GOES-R SERIES PRODUCT DEFINITION AND USERS' GUIDE

(PUG)

VOLUME 1: MAIN

VOLUME 2: L0 PRODUCTS

VOLUME 3: LEVEL 1B PRODUCTS

VOLUME 4: GOES-R REBROADCAST (GRB)

VOLUME 5: LEVEL 2+ PRODUCTS

APPENDIX X: ISO SERIES METADATA

27 October 2017

REVISION 1.1

U.S. Department of Commerce (DOC)
National Oceanic and Atmospheric Administration (NOAA)
NOAA Satellite and Information Service (NESDIS)
National Aeronautics and Space Administration (NASA)

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CHANGE RECORD

ISSUE	CCR #	DATE	PAGES AFFECTED	DESCRIPTION
Rev. 1.0	03240	03/02/2017	All	CDRL SE-16 under Government Control. Harris DCN 7035538 PUG L2+ Vol 5 Rev E has been placed under Gov. GS control as GOES-R Series 416-R-PUG-L2 Plus-0349 Vol 5 Rev 1.0.
Rev. 1.1	03332	10/27/2017	All	CDRL SE-16 under Government Control. Harris DCN 7035538 PUG L2+ Vol 5 Rev F has been placed under Gov. GS control as GOES-R Series 416-R-PUG-L2 Plus-0349 Vol 5 Rev 1.1.

PRODUCT DEFINITION AND USER'S GUIDE (PUG)

VOLUME 5: LEVEL 2+ PRODUCTS

FOR

GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE
R SERIES (GOES-R) CORE GROUND SEGMENT
CONTRACT NO: DG133E-09-CN-0094
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PRODUCT DEFINITION AND USER'S GUIDE (PUG)

VOLUME 5: LEVEL 2+ PRODUCTS

FOR
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE R SERIES (GOES-R) CORE GROUND SEGMENT

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RECORD OF CHANGE

REVISION	DATE	DESCRIPTION
-	08 February 2011	Initial Release Pre-ECP5
-.1	25 August 2011	Interim Release including ECP5 PTR-2871 Incorporate GSP comments & organize document structure into volumes PTR-2872 Update content for TBDs/Action Items PTR-2874 Incorporate monthly work-in-progress comments
A	06 February 2012	Pre-CDR Release PTR 3226 Update per BCN_046 ATP for BCR 049 Metadata Delivery PTR-3525 Incorporate GSP Comments (from Interim Release) PTR-3525 Incorporate GSP Comments (CDR Release) PTR-3526 Update Content for TBDs/Action Items (CDR Release)
B	26 July 2012	CDR+90 Release PTR-3239 SE-16 PUG – Update External File Naming Convention for New Static Metadata Files from Metadata BCR PTR-4138 Remove ITAR from Volume 4, GRB PTR-3576 Remove Reference to AWG Ancillary Data PTR-3409 Update Content for TBD-11, TBD-17 and TBD-20 PTR-4039 Update Content for TBDs/Action Items PTR-4203 PUG Update for SUVI Image Refresh and Snow Ice Metadata PTR-4298 GSP Comments Rev A PTR-4204 SE-16 PUG Feedback on PUG for L1b Volume 3 PTR-4845 SE-16 PUG Incorporate Peer Review Comments Deferred from Rev A (Note: Updated NcML files are from 6/12 for CMI and 6/11 for all others)
B.1	17 December 2012	Post-CDR Interim Release PTR-4841 SE-16 PUG - Deferred Comments from Release A

REVISION	DATE	DESCRIPTION
		PTR-4946 SE-16 PUG - Deferred Comments from PostCDR+90 Peer Review PTR-5318 SE-16 PUG: BCN_067 ATP for ECP007 RFP Amend 4 PTR-5373 SE-16 PUG - Update PUG Vol 5 Product Algorithm Output Tables PTR-5403 Incorporate customer comments against Rev. B
B.2	20 May 2013	Post-CDR Interim Release PTR-6419 SE-16_Product Definition and User's Guide (PUG) Release Update Rev B.2 Update due to BCR75 PTR-6158 UMB_Delivery_SE-16_Product Definition and User's Guide (PUG) Release Update Rev B.2 PTR-6159 SE-16 PUG - Deferred Comments from Rev. B.1 Peer Review PTR-6837 SE-16 PUG Incorporate Customer Comments Against Rev B.1 PTR-6877 SE-16 Product Definition and User's Guide (PUG) - BCN_085 ATP for MAG SEISS L1b Changes
C	6 December 2013	Post-CDR Interim Release PTR-9218 Delivery_SE-16_Product Definition and User's Guide (PUG) Release Update Rev C 1) Other than the ABI Fixed Grid paragraph, paragraphs 1 through the end of paragraph 5.1.6 have been completely revised with new and updated content. A Standard Coordinate data paragraph has been added to the ABI Fixed Grid paragraph. 2) Paragraphs 5.2 through the end of paragraph 5.14.7 have not been revised for this version of the PUG. 3) New appendices for the filename conventions, and product refresh rates and latencies have been included. 4) The subsequent version is identified where new content will be inserted into paragraphs that currently have headings and no content. PTR-7556 SE-16 PUG - Deferred GSP Comments from Rev. B.2 Review A subset of the deferred comments addressed related to the Cloud and Moisture Imagery product, filename conventions, and several miscellaneous topics.

REVISION	DATE	DESCRIPTION
		PTR-9027 A subset of the deferred comments addressed related to the Cloud and Moisture Imagery product, filename conventions, and several miscellaneous topics.
C.1	05 December 2014	Post-CDR Interim Release Vol 1, Main: • Added FITS format section (SUVI) Vol 2, L0: • Minor editorial changes Vol 3, L1b: • Revised Space Weather and Solar instrument sections • Co-located Instrument Calibration Data with instrument section Vol 4, GRB: • Revised Space Weather and Solar instrument sections • Corrected APID list Vol 5, L2+: • Combined Volumes 5A and 5B • Added section for Latitude/Longitude grid (Radiation products) • Added Appendix for dynamic source data • Miscellaneous changes to CMI product Appendix X, ISO Series Metadata: • Revised L1b, L2+, Instrument Calibration Data sections PTR-12388 UMB_Delivery_SE-16_ Product Definition and User's Guide (PUG) Release Update Rev C.1 • Incorporates PTR-7028, PTR-7556, PTR-7557, PTR-7553, PTR-8055, PTR-8742, PTR-9027, PTR-9518, PTR-11701 • Combined Vol 5A and Vol 5B into a single volume • Rearranged major sections of the document (consolidated File Naming conventions, consolidated APID lists, etc.), for usability PTR-7028 Update Cumulative ERB/PCRB Changes in Next Rev of Document • ERB: delete the Rainfall Rate Coefficient Algorithm • PCRB: change GLM Lightning Event Peak L1b/GRB update • PCRB: change Radiation Grid from ABI Grid to Latitude/Longitude

REVISION	DATE	DESCRIPTION
		PTR-7556 Deferred Comments from Rev. B.2 Peer Review • Incorporate comments deferred from Revision B.2 Peer Review PTR-7753 SE-16: Updates to PUG Rev C for next Release • Fixed MAG L1b OMAS/GRB/PD periodicity PTR-8055 SE-16 PUG BCR # 127 + BCR #129 + BCR 124 + BCN_120 ATP for NcML/Product Definition for non-ABI Sensors + BCN_149, BCR 115 Update GLM L2 NcML + BCR 119 + BCR #127 and 129 (IPS and Product Set 1 NcML Corrections) • BCR#127: incorporated IPS Product NcML corrections • BCR#129: incorporated IPS and Product Set 1 NcML corrections • BCR#124: changed SUVI, SEISS, MAG NcML • BCN_120: NcML/product definition for non-ABI instruments • BCN_149 / BCR#115: updated GLM L2+ NcML definition • BCR#119: changed SUVI GLM INR report design • ECP-9a: added aggregation criteria for Geomagnetic Field, Solar Flux: X-Ray products • BCR#212: incorporated Product Set 2 NcML corrections PTR-8742 SE-16 PUG - Scheduled Science Instrument Products definitions • Updated SUVI, EXIS, SEISS, MAG, GLM product definitions PTR-9027 SE-16 PUG - Evaluate Customer Comments Against Rev B.2 • Incorporated customer comments not previously addressed in PUG Rev C PTR-9518 SE-16 PUG, Evaluate Customer Comments from Rev C • Incorporated customer comments against PUG Rev C PTR-11701 SE-16 PUG - Update for BCR # 227, Non-ABI product Corrections Incorporated non-ABI Product NcML corrections
D	13 May 2015	PTR-7557 UMB_Delivery_SE-16_Product Definition and User's Guide (PUG) Release Update Rev D • Incorporate customer comments against PUG Rev C.1 PTR-13600 • SE-16 PUG - Miscellaneous Corrections

REVISION	DATE	DESCRIPTION
		Appendix X • New content – L0 and GRB Info ISO Series Metadata Vol 2, L0 • Restructured to be consistent with other volumes Vol 3, L1b • New content – dynamic and semi-static processing parameters Vol 4, GRB • New content – GRB Information Vol 5, L2+ • New content – dynamic and semi-static processing parameters
D.1	11 August 2015	PTR-14093 • Change 132.8 Angstroms wavelength to 131.2 Angstroms in SUVI documentation PTR-14107 • Update various L2 product lineage issues PTR-13638 • Update document for ECP-023 new CONUS center points PTR-14388 • WR 757: SE-16: CMI - Update PUG to change scaling of band 7 to a max brightness temp of 400K
D.2	24 March 2016	PUG release aligned with PC DO.03.00.00 software baseline. PTR-14663 • SE-16 PUG, Evaluate Customer Comments from Rev D PTR-15294 • SE-16 PUG, Add GRB-INFO-STATIC description PTR-15324 • SE-16 PUG - Misc. Updates to Sync with GS File Naming Conventions
E	15 June 2016	PUG release aligned with PC DO.04.00.00 software baseline. PTR-16585 • SE-16 PUG - Miscellaneous Corrections PTR-16442

REVISION	DATE	DESCRIPTION
		• WR 1949: GLM appears to have Timing Artifacts (PUG Update) PTR-15605 • WR 813: Space Weather products' enhancements requested by NCEI (SE-16 PUG) • Add SEISS MPS-LO energy bounds/levels to differential_flux_energy_band_label variable value PTR-15580 • WR 1697: SE-16 PUG - Rainfall Rate Product DQF Valid Range is Incorrect PTR-15194 • WR 1177: SE-16 Modify Product Definition User's Guide for expanded ABI L1b Radiance Limits
E.1	4 November 2016	PUG release aligned with PC DO.04.02.00 software baseline, except where otherwise noted. PTRDOC-15878 DO.05.00.00 • WR 1552: SE-16 PUG - ABI L1b Instrument Calibration Data - Number of detector rows discrepancy PTRDOC-16363 • WR 2261: SE-16 PUG - Provide documentation for CAL INR data file structures PTRDOC-16387 DO.05.00.00 • WR 2218: SE-16 PUG - There are no ABI CCR results in the PM Generated ABI INR Report PTRDOC-16397 DO.05.00.00 • WR 1937: SE-16 PUG - GLM L2+ product metadata errors PTRDOC-16639 DO.05.00.00 • WR 1698: SE-16 PUG - Sea Surface Temperature Fill Value incorrect PTRDOC-16911 DO.05.00.00 • WR 2961: SE-16 Update PUG to clarify Rainfall Rate metadata PTRDOC-16936 • WR 2566: SE-16 PUG - Add Derived Motion Winds PQI and Diagnostic Intermediate Products to the PUG PTRDOC-17008 • WR 2749: SE-16 PUG - Update PUG to reflect 2 minute EXIS L0 LZSS file aggregation time

REVISION	DATE	DESCRIPTION
		PTRDOC-17088 • WR 2874: SE-16 PUG - Correct File Names of Instrument Calibration Files Produced PTRDOC-17123 • WR 1739: SE-16 PUG - SUVI Instrument Calibration File Names PTRDOC-17254 • WR 2962: SE-16 PUG - CMI Coefficients update-ADR 143 PTRDOC-17416 • WR 3058: SE-16 PUG - SUVI scale factors in products do not match scale factors in the PUG PTRDOC-17661 • WR 3274: SE-16 PUG - Update to Align with XTCE Database v6.3.005A PTRDOC-17818 DO.06.00.00 • WR 2260: SE-16 PUG - Derived Motion Winds (DMW) Wind Direction: Incorrect Direction
E.2	30 March 2017	PUG release aligned with GOES-R Ground Segment Product Capabilities (PG, PD, PM) software baselines, as follows: DO.04.04.00: April 2017 DO.05.00.00: July 2017 DO.06.00.00: September 2017 (TBR) PTRDOC-17880 DO.05.00.00 Vol 5, Table 5.1.6.4-1. • WR 3383: SE-16 PUG - Changes for Expansion of CMI range to match DO.04 Rad-ADR 154 PTRDOC-17887 DO.04.04.00 Vol 3, Section 5.0.1; Vol 4, Section 7.0.1; Vol 5, Section 5.0.1 • WR 3483: SE-16 PUG - add explanation/instructions for converting 'seconds since epoch' to standard date/time PTRDOC-17995 DO.06.00.00 Vol 3, Table 5.3.2.5.1-11; Vol 4, Table 7.4.2.5.1-11. • WR 3438: SE-16 PUG - Fix Incorrect Flag Definition in EXIS Files - ADR 159 PTRDOC-18023 DO.06.00.00 Vol 5, Table 4.3.7-2. • WR 2291: SE-16 PUG - GRIP is not showing full SRB image on GOES WEST

REVISION	DATE	DESCRIPTION
		PTRDOC-18057 DO.05.00.00 Vol 3, Sections D.7, D.8 and D.9. • WR 3554: SE-16 PUG - Provide documentation for [CAL] INR data file structures (ABI, GLM, SUVI) PTRDOC-18090 DO.06.00.00 Vol 3, Section 5.1.4.1. • WR 3433: SE-16 PUG - Include pixels with under-saturated sample contributors in ABI Sample Outlier files PTRDOC-18144 DO.06.00.00 Vol 5, Table 5.1.7.6-2. • WR 3076: SE-16 PUG: DMW Output File is not CF Compliant-ADR 139 (PUG Changes) PTRDOC-18158 DO.06.00.00 Vol 3, Table 5.3.1.5-2; Vol 4, Table 7.4.1.5.2. • WR 3078: SE-16 PUG: EXIS - Add total number of valid SPS measurements used - ADR 148 PTRDOC-18191 DO.05.00.00 Vol 3, Table 5.3.1.5-2; Vol 4, Tables 7.4.1.5.1 and 7.4.1.5.2. • WR 3568: SE-16 PUG: Revise EXIS EUVS-C Cadence - ADR 183 (PUG Updates) PTRDOC-18225 DO.05.00.00 Vol 3, Sections D.4 and D.5. • WR 3324, 2989: SE-16 PUG - Update Documentation for MAG, SEISS CAL INR data file structures PTRDOC-18228 DO.06.00.00 Vol 3, Table 5.3.2.5-2; Vol 4, Table 7.4.2.5.2. • WR 3571: SE-16 PUG: Add SUVI roll angle to EXIS XRS - ADR 147 (PUG Changes) PTRDOC-18259 DO.06.00.00 Vol 5, Table 5.21.6-2. • WR 3222: SE-16 PUG - Land L2: FSC Metadata Issues-ADR 167 PTRDOC-18406 DO.06.00.00 Vol 3, Table 5.5.1.5-2; Vol 4, Tables 7.6.1.5.1 and 7.6.1.5.2. • WR 3429: SE-16 PUG - MAG Add IB and OB measurements in 4 coord frames-ADR 145 PTRDOC-18441 DO.04.04.00 Vol 3, Table 5.1.3.6.3-2; Vol 4, Table 7.1.3.6.1.1-2. • WR 3804: SE-16 PUG: Bad Radiance-to-Brightness-Temp Conversion Coeffs

REVISION	DATE	DESCRIPTION
		PTRDOC-18608 DO.04.04.00 Vol 5, Table A.2-1, Section E.1. • WR 1264: SE-16 PUG: Change DMW Intermediate Product Filename (Data Short Name) PTRDOC-18646 DO.05.00.00 Vol 3, Tables 5.3.1.5-2, 5.4.4.5-1, 5.4.4.5-2, 5.4.4.5.2-4 and 5.4.6.2-1; Vol 4, Tables 7.4.1.5.1, 7.4.1.5.2, 7.5.4.5.1, 7.5.4.5.1.2-4 and 7.5.4.5.2. • WR 3918: SE-16 PUG: Removing Hyphens in EXIS and SEIS Vars and Attrs-ADR 207
F	16 June 2017	PTRDOC-18154 DO.06.00.00 Vol 3, section 5.0.2; Vol 4, section 7.0.2; Vol 5, section 5.0.2 • WR 3725: SE-16 PUG - Add description of unsigned integer processing PTRDOC-18519 DO.06.00.00 Vol 3, Table 5.3.1.5-2, Table 5.4.4.5-2; Vol 5, Table 5.10.6-2 • WR 3897: SE-16 PUG: Variable missing from XRS and SGPS files- ADR 211 PTRDOC-18813 DO.06.00.00 Vol 3, Table 5.2.1.5.1-2, section 5.2.1.5.2, Table 5.2.1.5.4-5, Table 5.3.1.5-2, Table 5.3.1.5.2-7, Table 5.3.2.5-2, Table 5.3.2.5.1-15, Table 5.4.1.5-2, Table 5.4.1.5.2-9, Table 5.4.2.5-2, Table 5.4.2.5.2-5, Table 5.4.3.5-2, Table 5.4.3.5.2-6, Table 5.4.4.5-2, Table 5.4.4.5.2-6, Table 5.5.1.5-2, Table 5.5.1.5.2-3; Vol 4, Table 7.3.1.5.1.2-8, Table 7.3.1.5.2, Table 7.4.1.5.1.2-7, Table 7.4.1.5.2, Table 7.4.2.5.1.1-15, Table 7.4.2.5.2, Table 7.5.1.5.1.2-9, Table 7.5.1.5.2, Table 7.5.2.5.1.2-5, Table 7.5.2.5.2, Table 7.5.3.5.1.2-6, Table 7.5.3.5.2, Table 7.5.4.5.1.2-6, Table 7.5.4.5.2, Table 7.6.1.5.1.2-3, Table 7.6.1.5.2 • WR 4164: SE-16 PUG: Space weather eclipse_flag flags do not capture all possible states PTRDOC-18819 DO.06.00.00 Vol 4, section 4.1, section 4.3 • WR 4139: SE-16 PUG: GRB Default Modem Configuration - QPSK PTRDOC-18879 DO.06.00.00 Vol 4, section 2.0, section 5.0, section 6.0, section 6.2.6.3, section 7.1.3.6, section 7.3.1.5 • WR 4179: SE-16 PUG: ABI L1b metadata sent prior to end of scene in GRB PTRDOC-18890 DO.06.00.00 Vol 4, Table A • WR 3511: SE-16 PUG: Add statement on CCSDS reserved APIDs to the PUG

REVISION	DATE	DESCRIPTION
		PTRDOC-18907 DO.06.00.00 Vol 3, section 5.3.1.1; Vol 4, section 7.4.1.1 • WR 3257: SE-16 PUG: Resolve Time Stamp Error in EXIS Files-ADR 158 PTRDOC-18910 DO.06.00.00 Vol 3, Table 5.3.1.5-2; Vol 4, Table 7.4.1.5.1, Table 7.4.1.5.2 • WR 4205: SE-16 PUG: EXIS EUVS long name corrections-ADR278 PTRDOC-18951 DO.06.00.00 Vol 3, Table 5.6.2.2-1 • WR 3407: SE-16 PUG: GLM Background Image Metadata Differences from PUG PTRDOC-18955 DO.06.00.00 Vol 1 – 5, Appendix X, several sections and tables • WR 4263: BCR_591 ATP for ECP-029, SE-16: ECP-029 - Update Product Users Guide (PUG) for Mode 6 functionality PTRDOC-19131 DO.07.00.00 Vol 3, Table 5.2.1.1-1, Table 5.2.1.5.3-1, Table 5.2.1.5.4-2, Table A.1; Vol 4, Table 7.3.1.1-1, Table 7.3.1.5.1.1-1, Table 7.3.1.5.1.2-2 • WR 4023: SE-16 PUG: SUVI short exposure time - Long term fix - ADR 199 PTRDOC-19350 DO.06.00.00 Vol 3, Table 5.3.1.5.2-3, Table 5.3.2.5.1-3; Vol 4, Table 7.4.1.5.1.2-3, Table 7.4.2.5.1.1-3 • WR 4540: SE-16 PUG: EUVS and EXIS Processing and Data Quality Flag Meanings

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LIST OF FIGURES

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1.0 SCOPE

The Product Definition and User's Guide (PUG) document provides product descriptions and formats for all data and products produced and made available to users by the Geostationary Operational Environmental Satellite R Series (GOES-R) Core Ground Segment (GS), developed under contract DG133E-09-CN-0094. This includes the Level 0 products, Level 1b products, GOES-R Rebroadcast (GRB), and Level 2+ products. This also includes ISO series metadata, instrument calibration data, and semi-static source data and algorithm packages.

The PUG is divided into five volumes. This volume, Volume 5: Level 2+ Products, contains Level 2+ product and data descriptions, and content and format information. Note that there is a separate standalone Appendix X containing detailed descriptions of the ISO series metadata associated with Level 2+ products.

1.1 Document Overview

The purpose of this volume is to describe the functional characteristics, and content and format of GOES-R Level 2+ products and data made available to users. The intent of providing this information is to allow users to exploit the products and data. This document also supports Government remote tele-training and public outreach requirements.

This Level 2+ PUG volume includes the following sections:

- ABI Modes and Coverage Regions
- Level 2+ Algorithm Precedence Network
- Common Level 2+ Product and Data Characteristics
- Level 2+ Filename Conventions
- Level 2+ Product Refresh Rates and Latencies

2.0 ABI MODES AND LEVEL 2+ PRODUCT COVERAGE REGIONS

There are three standard scanning modes for the ABI instrument: Mode 3, Mode 6 and Mode 4. Mode 4 consists of the observation of the full disk scene every five minutes. Mode 3 consists of one observation of the full disk scene of the earth, three observations of the continental United States (CONUS) scene, and thirty observations for each of two distinct mesoscale scenes every fifteen minutes, during nominal operations. Mode 6 consists of one observation of the full disk scene of the earth, two observations of the continental United States (CONUS) scene, and twenty observations for each of two distinct mesoscale scenes every ten minutes, during nominal operations. The CONUS scene coverage area is approximately 5000 km in the east-west direction by 3000 km in the north-south direction. The coverage area of a mesoscale scene is approximately 1000 km by 1000 km. In all of these modes, there are interleaved space, blackbody, and star looks to support radiometric and navigation accuracy requirements.

The detailed sensing timelines for the ABI in Mode 3, 4, and 6 are defined in Figure 2-1, Figure 2-2 and Figure 2-3, respectively. Space Looks needed for data calibration may occur after a Full Disk swath rather than before it depending on whether the Space Look occurs on the East or West side of the earth. Observations of the Full Disk (pink), CONUS (blue), and mesoscale (green) scenes, and the calibration looks (yellow: visible stars, red: infrared stars) are shown.

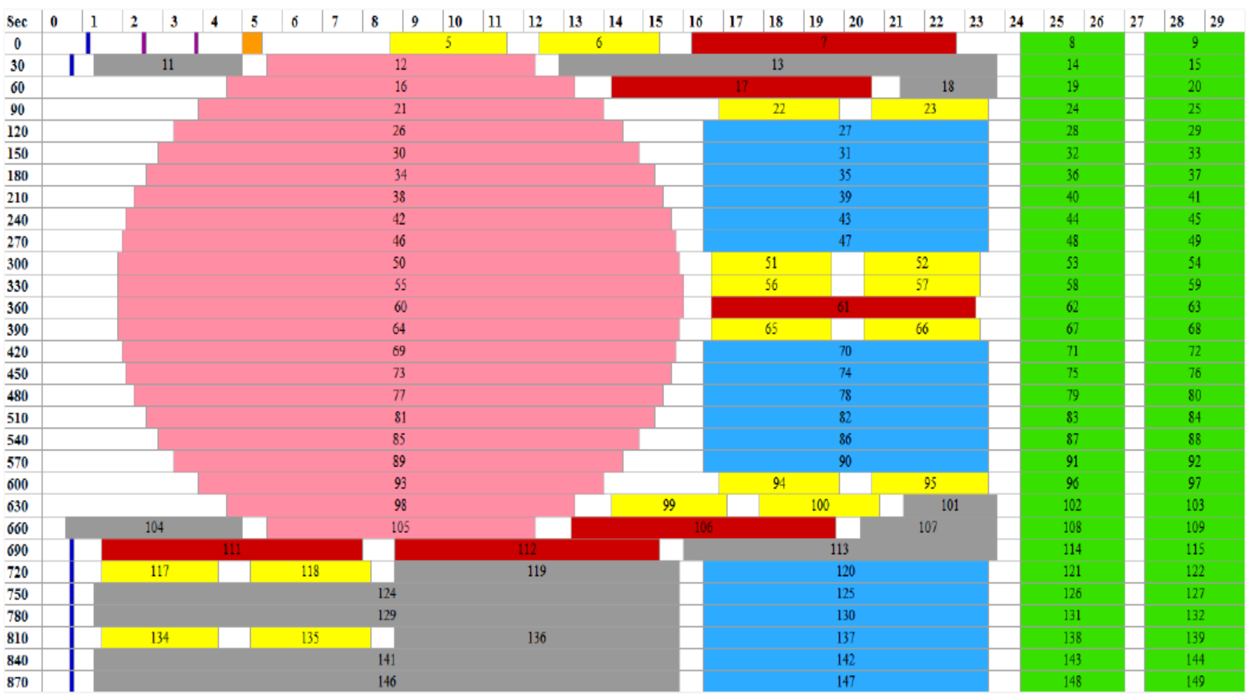


Figure 2-1 ABI Mode 3 Timeline

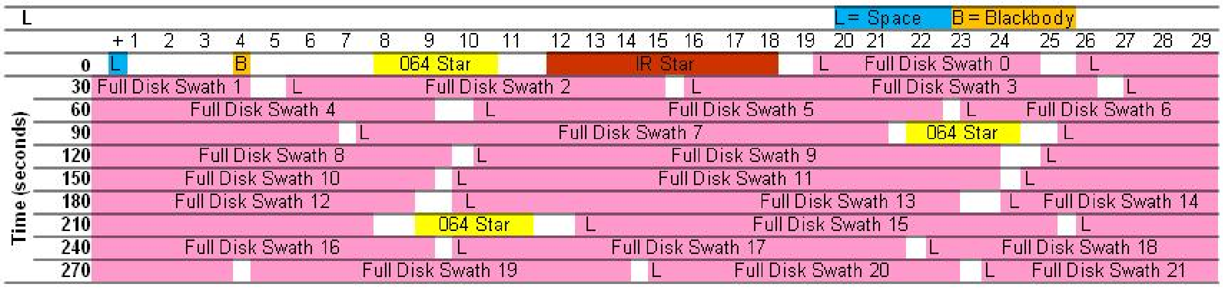


Figure 2-2 ABI Mode 4 Timeline

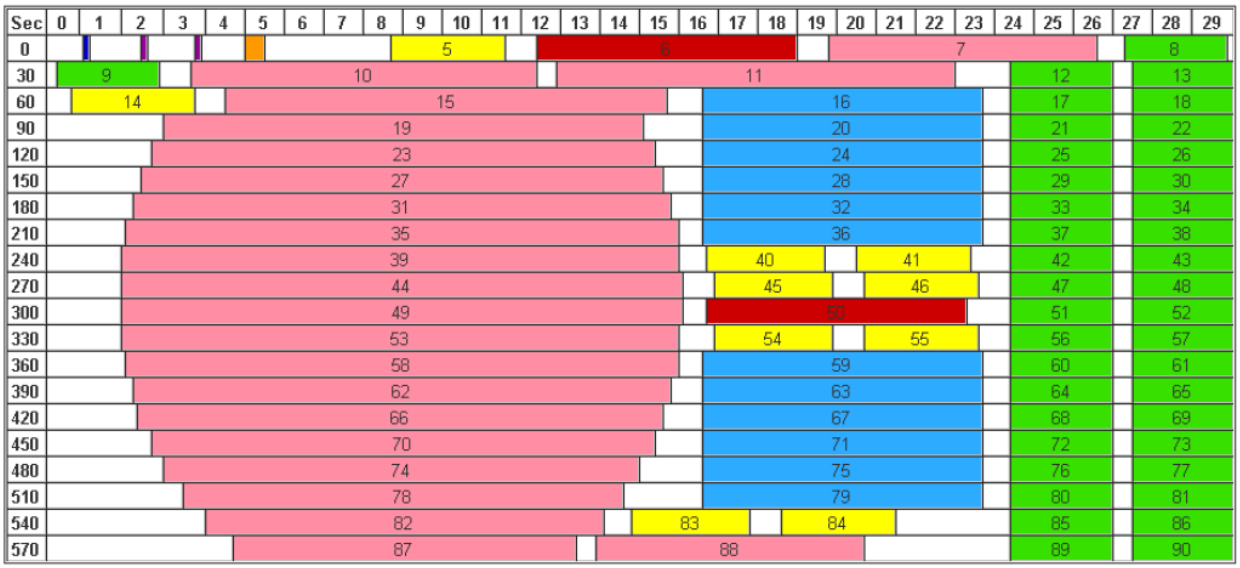


Figure 2-3 ABI Mode 6 Timeline

Table 2.0 summarizes the standard coverage regions associated with ABI Level 2+ products.

Table 2.0 ABI Level 2+ Products Standard Coverage Regions

Coverage Region	Description
Full Disk	Near hemispheric earth region centered at the longitude of the sensing satellite.
CONUS	An approximately 3000 km x 5000 km region intended to cover the continental United States within the constraints of viewing angle from the sensing satellite.
Mesoscale	An approximately 1000 km x 1000 km dynamically centered region in the instrument's field of regard. The particular coverage region associated with a mesoscale product is operator- selected to support high-rate temporal analysis of environmental conditions in regions of interest.

For many Level 2+ products, product files for CONUS coverage regions are provided in Mode 4 by extracting the CONUS region from the full disk image. In addition, the required refresh rates for many Level 2+ products do not require the use of all available observations. Furthermore, there are cases when the generation of a Level 2+ product requires the use of a set of observations over time, such as the case with the Derived Motion Winds product. Refer to Appendix B for detailed Level 2+ product refresh rate and latency information.

3.0 LEVEL 2+ ALGORITHM PRECEDENCE NETWORK

The GOES-R Level 2+ algorithm precedence network defines the chain of processing and data required to produce ABI Level 2+ products. The use of an algorithm precedence network ensures consistency of product data by identifying, implementing, and using software components that perform common functions. It also reduces the amount of computational resources required by performing common functions once, and distributing the data output by these common functions to the product algorithm unique functions.

The Level 2+ algorithm precedence network is important to users of GOES-R products because it explains the source of product data, specifically the algorithms and data dependencies associated with the product data. In addition, the algorithm precedence network provides a valuable tool to diagnose and resolve anomalies in products.

The nodes in the algorithm precedence network, some of which provide common functions as alluded to above, are algorithms and the lines connecting the nodes are the final and intermediate product data. The algorithm precedence network nodes and lines define the dependencies among the algorithms and data.

The types and descriptions of the types of nodes in the Level 2+ algorithm precedence network are defined in Table 3.0-1, Level 2+ Algorithm Precedence Network Types of Nodes.

Table 3.0-1 Level 2+ Algorithm Precedence Network Types of Nodes

Node Type	Description
Dynamic ancillary data processing algorithm	Temporally and spatially interpolates National Weather Prediction (NWP) model output data for use by the product and augmented CRTM algorithms. Also prepares Near Real-Time Global Ice Concentration and Snow Extent, Ice Mapping System (IMS) Snow/Ice Analysis, Reynolds Sea Surface Temperature (SST) Analysis and Official Tropical Cyclone Forecast data for use by several product algorithms. This type of node exists to optimize Level 2+ product generation performance.
Radiative transfer model algorithm based on the Community Radiative Transfer Model (CRTM)	Generates predicted radiance and transmittance estimates from atmospheric and surface state information for selected wavelengths corresponding to the central wavelengths of ABI emissive bands. These algorithms are composed of off-the-shelf CRTM and custom radiative transfer processing software components.
Dynamic auxiliary data generation algorithm	Generates sun geometry related information for product data points. This type of node exists to optimize Level 2+ product generation performance.
Product algorithm	Generates the ABI Level 1b Radiances or a Level 2+ final product.

Many of the ABI Level 2+ product and the augmented CRTM-based forward radiative transfer algorithms make use of temporally and spatially interpolated NWP model output data. Temporal and spatial interpolation is required to align the NWP model output data so it coincides with the time and spatial characteristics of the ABI observation data. The NWP model output data provides predictions of atmospheric state information that can not be derived solely from the ABI observation data. This data is used to initiate, constrain, or verify product algorithm and augmented CRTM algorithm outputs. For example, the Legacy Atmospheric Profiles algorithm uses the processed NWP model output data as a first guess of the atmospheric conditions at each location in the product coverage region.

In addition to the processed dynamic ancillary data derived from NWP model output data, Near Real-Time Global Ice Concentration and Snow Extent, Ice Mapping System (IMS) Snow/Ice Analysis, the product algorithms use Reynolds Sea Surface Temperature (SST) Analysis and Official Tropical Cyclone Forecast data. The processed snow/ice dynamic ancillary data is used as either the primary source for snow and ice or as the backup for those product algorithms that adopt the Snow Cover algorithm product data output over land as the primary input. The identification of snow cover is important to the ABI Level 2+ product algorithms that rely on reflective bands and are sensitive to the contrast with the background in the field of view. The processed Reynolds SST Analysis data is used exclusively by the SST hybrid regression algorithm. The arrival of a new Official Tropical Cyclone Forecast data is used to activate the Hurricane Intensity algorithm.

The CRTM forms the core of the radiative transfer calculations used for physical retrievals. The ground system radiative transfer algorithm use CRTM output to generate radiance and transmittance profile data, and simulated TOA measurement data that are used by several ABI Level 2+ product algorithms. This data is used by several product algorithms to identify signals from clouds relative to the background in the field of view. For example, the Cloud Mask algorithm uses an estimate of the clear sky conditions generated by the ground system radiative transfer algorithm when determining the clear or cloudy conditions at each location in the product coverage region.

The dynamic auxiliary data generation algorithm generates several solar dependent types of data needed by several of the ABI Level 2+ product algorithms. The algorithms use this data when making decisions related to determination of the utility of ABI observation data at specific bands for each location in the product coverage region, and dealing with its sensitivities related to glint or atmospheric scattering relative to the satellite viewing geometry. The dynamic auxiliary data is generated such that it is temporally coincident with the start of each ABI observation.

The ABI Level 2+ product algorithms generate one or more final and intermediate products. Two of these algorithms are of particular importance in the context of the algorithm precedence network, the Cloud and Moisture Imagery and Cloud Mask algorithms. Many of the product algorithm operate in the physical regime based on where the signal in the emissive bands can be related to the thermal characteristics of the field of view. In addition, the signal in the reflective bands is relative to the amount of reflected and scattered solar radiation. The Cloud and Moisture Imagery algorithm converts the Radiances product data to brightness temperature and reflectance and makes these quantities available to other product algorithms in support of their processing.

Similarly, the Cloud Mask algorithm data output is used by several other ABI Level 2+ algorithms that are sensitive to cloud cover. It is important to note that some product algorithms generate tailored cloud masks based on the Cloud Mask algorithm intermediate product data consisting of a 4-level cloud mask or test results rather than using the Cloud Mask product data.

The production of Level 2+ products also relies on semi-static data that does not change often. This is data such as surface masks, land surface emissivity, climatologies, regression parameters, lookup tables, satellite look angles to specific locations on the ABI Full Disk, and configurable algorithm thresholds. Several of these types of semi-static data are used by several ABI Level 2+ product algorithms. Several of these types of semi-static data, such as land surface emissivity and water/ice cloud, aerosol, total precipitable water, and ozone climatologies, vary based on time of year. This type of data is referred to as Level 2+ Semi-Static Source Data, and is not represented in the algorithm precedence network.

Each Level 2+ product algorithm produces one or more final products that are made available to end users. Refer to Table 3.0-2, Level 2+ Algorithm Products for a mapping between the algorithms and their products.

Table 3.0-2 Level 2+ Algorithm Products

Algorithm	Product
Cloud and Moisture Imagery	Cloud and Moisture Imagery
Cloud Mask	Clear Sky Mask
Cloud Type	Cloud Top Phase
Cloud Top Height	Cloud Top Height Cloud Top Pressure Cloud Top Temperature
Cloud Microphysical and Optical Properties	Cloud Optical Depth Cloud Particle Size
Aerosol Detection	Aerosol Detection
Aerosol Optical Depth	Aerosol Optical Depth
Volcanic Ash: Detection and Height	Volcanic Ash: Detection and Height
Legacy Atmospheric Profiles	Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
Rainfall Rate (Quantitative Prediction Estimate)	Rainfall Rate (Quantitative Prediction Estimate)
Derived Motion Winds	Derived Motion Winds
Hurricane Intensity	Hurricane Intensity
Land Fire (Hot Spot Characterization)	Fire (Hot Spot Characterization)
Land Surface (Skin) Temperature	Land Surface (Skin) Temperature
Snow Cover	Snow Cover
Sea Surface (Skin) Temperature	Sea Surface (Skin) Temperature
Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: Top-of-Atmosphere	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: Top-of-Atmosphere

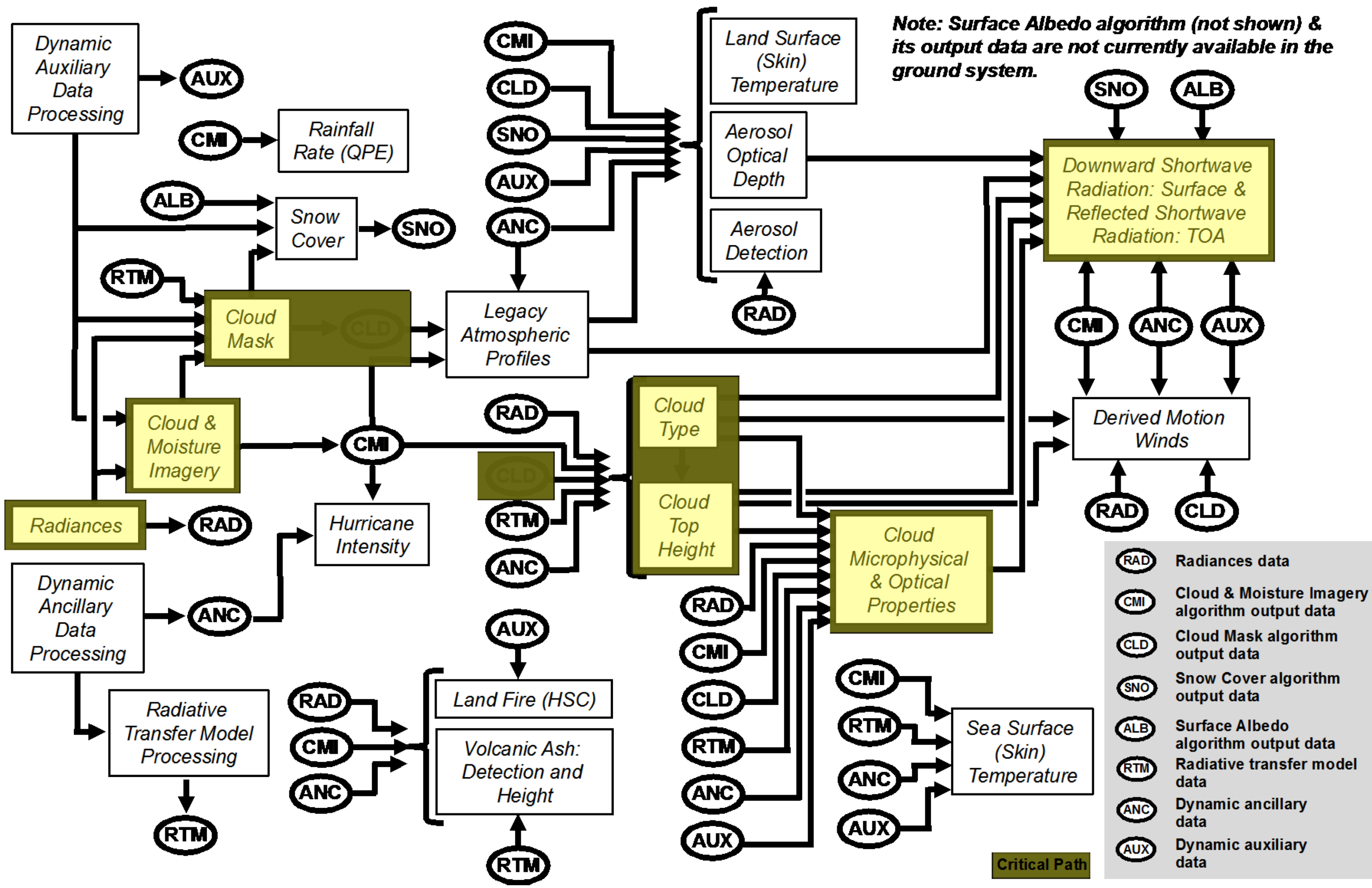


Figure 3.0 Level 2+ Algorithm Precedence Network

The ground system implementation of the Level 2+ algorithm precedence network is tuned for performance to minimize the latency between when the ABI observation occurs and when the products are available to users. Product refresh rate and latency information are located Appendix B, Product Refresh Rates and Latencies.

Low latency is achieved using a data block processing approach, which supports a high degree of data processing concurrency, coupled with a substantial number of computing resources. Data is processed through the algorithm precedence network in blocks. Note that Level 1b and Level 2+ data processing are completely decoupled.

Dynamic ancillary data interpolation and augmented CRTM algorithm processing occur periodically at fifteen minute intervals. A single instance of this processing occurs for each satellite slot. The output data generated covers the on-earth portion of the ABI Field of Regard (FOR), which corresponds to the ABI Full Disk coverage region. Separate instances of the dynamic auxiliary data generation algorithm processing node execute and generate output data for each ABI Full Disk, CONUS, and mesoscale image. Separate instances of the product algorithm processing nodes in the algorithm precedence network execute for the ABI Full Disk, CONUS, and mesoscale images required to satisfy product refresh rate requirements.

The details of the specific types of data flowing among the nodes in the algorithm precedence network are located in Appendix C, Dynamic Source Data, and each Level 2+ product's dynamic source data subparagraph in Section 5.0.

4.0 COMMON LEVEL 2+ PRODUCT AND DATA CHARACTERISTICS

The Level 2+ products and data other than the related ISO series metadata and semi-static source data are delivered using the Network Common Data Format version 4 (netCDF-4) file format.

The Level 2+ products contain processed observation data of the earth's surface and atmosphere. Many of the ABI Level 2+ products are provided for one or more of the full disk, continental United States, and mesoscale regions.

The ABI Level 2+ gridded product data is either on the native ABI fixed grid or global latitude/longitude grid. The Level 2+ non-gridded products, which include the Lightning Detection, Derived Motion Winds, and Hurricane Intensity, are composed of data located to specific latitude and longitude coordinates.

The Level 2+ products conform to the prevailing standards and conventions applicable to netCDF-4 product files. The Level 2+ product data have coordinates, many of which are common to multiple Level 2+ products. The Level 2+ products have an indicator of quality for each primary product data value. Additionally, the Level 2+ products have common product statistics. The ABI Level 2+ gridded product data is scaled and compressed to reduce file size.

The typical ABI Level 2+ gridded product file contains a single image whose pixels are associated with an environmental physical quantity, such as cloud top height, per-pixel data quality flags, and product-level summary statistics that provide indications of the quality of the image.

Subordinate paragraphs follow that discuss in more detail:

- Applicable standards and conventions
- ABI fixed grid
- Global latitude/longitude grid
- Common Level 2+ product coordinates
- Common Level 2+ product data quality variables
- Common Level 2+ product statistics

- Level 2+ gridded product data scaling and compression

The detailed descriptions of the ISO series metadata for GOES-R Level 2+ products are located in the standalone Appendix X, ISO Series Metadata. This is a special standalone appendix to the PUG. This appendix includes a table of contents with a paragraph reference to each ISO series metadata file.

4.1 Standards and Conventions

The Level 2+ products and data conform to the netCDF User's Guide (NUG) recommended attributes where applicable. The NUG recommended attributes are identified and described in the main volume of the PUG.

The Level 2+ products and data conform to Unidata's Attribute Conventions for Data Discovery (ACDD) recommended where applicable. Unidata's ACDD are identified and described in the main PUG volume. Conforming to this set of conventions enables cataloguing product files with information contained in the product files.

The ABI Level 2+ products conform to the Climate and Forecast (CF) Metadata Conventions. The CF Metadata Conventions, and how these conventions are applied to these products are described in the main volume of the PUG. Conforming to the CF Metadata Conventions enable the Level 2+ product files to be self-describing.

4.2 ABI Fixed Grid

The ABI fixed grid is the projection associated with the data in the ABI Level 1b Radiances products, and all the ABI Level 2+ products except for the Derived Motion Winds, Hurricane Intensity, Downward Shortwave Radiation: Surface, and Reflected Shortwave Radiation: Top-Of-Atmosphere products.

This paragraph includes the following subordinate paragraphs:

- Description
- Coordinate System
- Coverage Area Associated with the Full Disk, CONUS, and Mesoscale Images
- Horizontal Spatial Resolutions
- Data Point Coordinates
- Product Data Structures
- Standard Coordinate Data
- Navigation of Image Data
- Overlaying Data from Different Image Types

4.2.1 Description

The data points in the GOES-R ABI Level 1b and the ABI Level 2+ imagery products are on the ABI fixed grid. The ABI fixed grid is a projection based on the viewing perspective of the idealized location of a satellite in geosynchronous orbit. This allows the same data points in every product to be at the same location on the earth. All of the dynamics associated with an orbiting satellite are removed from the data to accomplish this. GOES-R ground system product processing functionality receives raw data from the ABI instrument and performs the processing required to place the data points on the ABI fixed grid.

The fixed grid is rectified to a GRS80 ellipsoid viewed from the idealized geostationary position. This defines the ellipsoid parameters to use when geo-referencing data points on the fixed grid. Data points are defined out to the edge of the earth's limb as defined by the GRS80 ellipsoid.

Data points at a particular horizontal spatial resolution on the fixed grid have the same angular separation from the satellite's viewing perspective in both east to west and north to south directions. Refer to Figure 4.2.1.

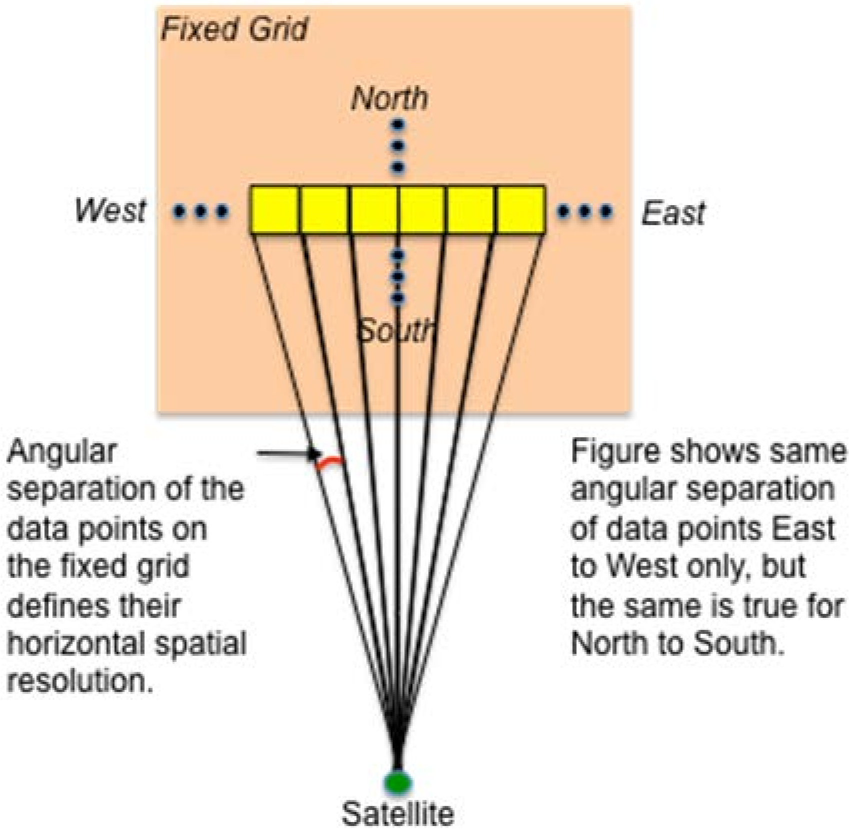


Figure 4.2.1 Data Points Have the Same Angular Separation on the Fixed Grid

The angular separation of the data points on the fixed grid provides the basis for the spatial resolution of the imagery data points, and is used to determine their coordinates. From the viewpoint of a right-hand coordinate system of the idealized geostationary satellite with the x-axis in the direction of the satellite velocity and the z-axis pointed at nadir, the north to south angle (i.e., N/S elevation angle) is determined by a rotation about the x-axis. The east to west angle (i.e., E/W scanning angle) is determined by a rotation about the rotated y-axis. Note that the earth surface area covered by a data point at a specific horizontal spatial resolution increases as the distance from the satellite's nadir increases.

4.2.2 Coordinate System

The ABI fixed grid is expressed in terms of the Cartesian coordinate system. The x axis represents the ABI E/W scan angle, i.e., the east-to-west direction. The y axis represents the ABI N/S scan angle, i.e., the north-to-south direction. The origin of the fixed grid represents the satellite sub-point which, by definition, is at the coordinate, (y = 0, x = 0). Refer to Figure 4.2.2-1, ABI Fixed Grid Coordinate System.

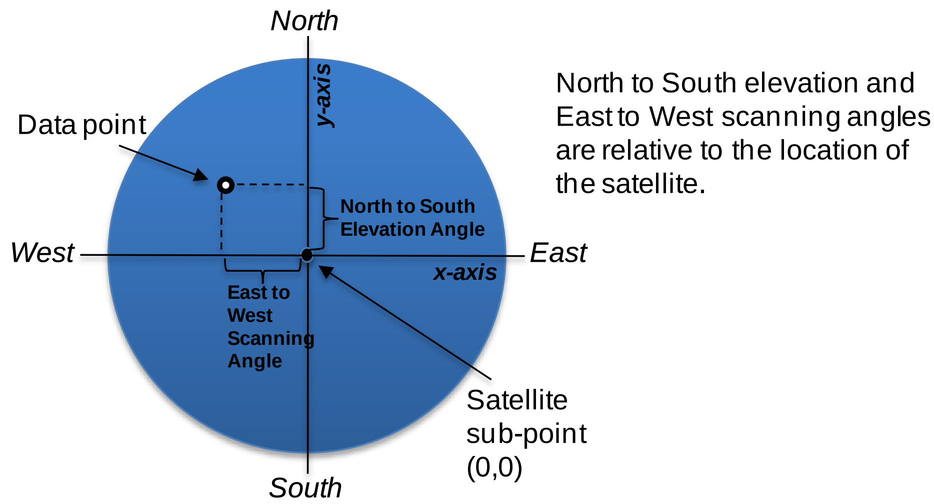


Figure 4.2.2-1 ABI Fixed Grid Coordinate System

The ABI native spatial resolutions are 0.5, 1.0, and 2.0 km at nadir. The radian is the standard unit of measure of the fixed grid. It is used to express the angular separation between imagery data points, which are 14, 28, and 56 microradians, respectively. For the ABI L2+ products that have reduced resolution (i.e., coarser distance between data points), the analogous spatial resolutions and angular separations apply. For example, ABI L2+ products with a spatial resolution of 10 km at nadir have data points with an angular separation of 280 microradians.

The ABI fixed grid coordinate system dictates that the ideal satellite sub-point is located at the corner of four imagery data points for the ABI native resolutions. Refer to Figure 4.2.2-2.

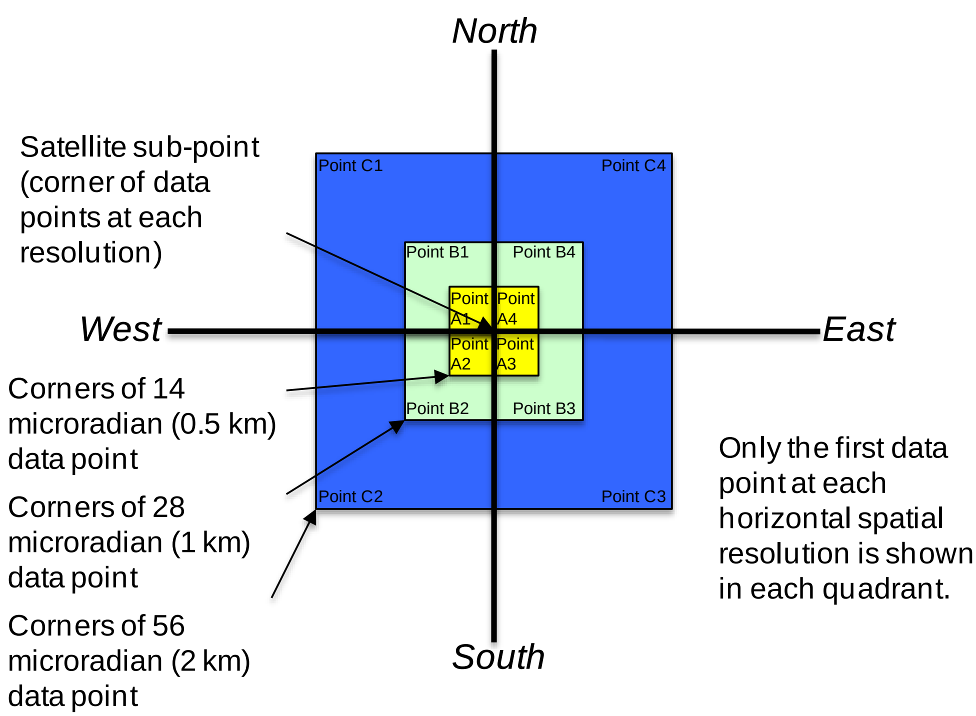


Figure 4.2.2-2 Fixed Grid Data Point Locations Relative to the Satellite Sub-Point

A 2 km data point subsumes four 1 km data points exactly. A 1 km data point subsumes four 0.5 km data points exactly. Refer to Figure 4.2.2-3. Note that for each of the full disk, CONUS, and mesoscale products, this relationship holds true when the lower resolution data is a multiple of the higher resolution data.

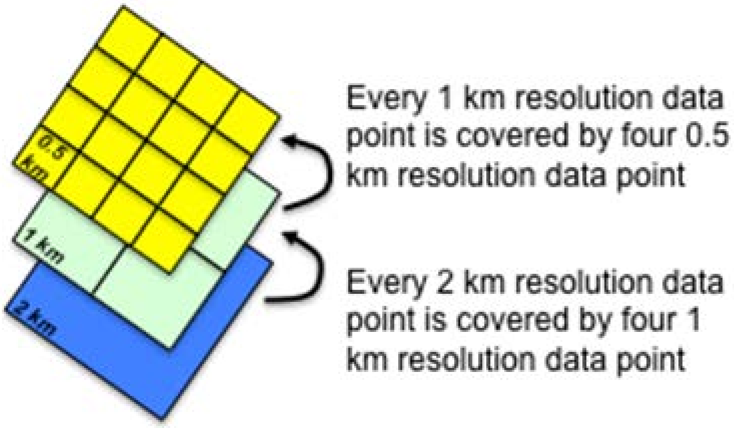


Figure 4.2.2-3 Relationship Between Data Points at Different Resolutions

ABI fixed grid imagery data points can be located on the earth. Knowing the (1) satellite sub-point longitude, (2) horizontal spatial resolution of the imagery data, (3) distance of the ideal geostationary satellite location from the earth, and (4) the selected earth model (GRS80) allows the location on the earth of each data point on the fixed grid to be determined.

4.2.3 Coverage Regions Associated with the Full Disk, CONUS, and Mesoscale Images

The coverage associated with the ABI images is defined in terms of the viewing angle of the earth from the satellite perspective. Note that the term "scene" is used to communicate what the ABI instrument observes. The term, "image," is used to communicate the product data resulting from the scene. Refer to Figure 4.2.3.

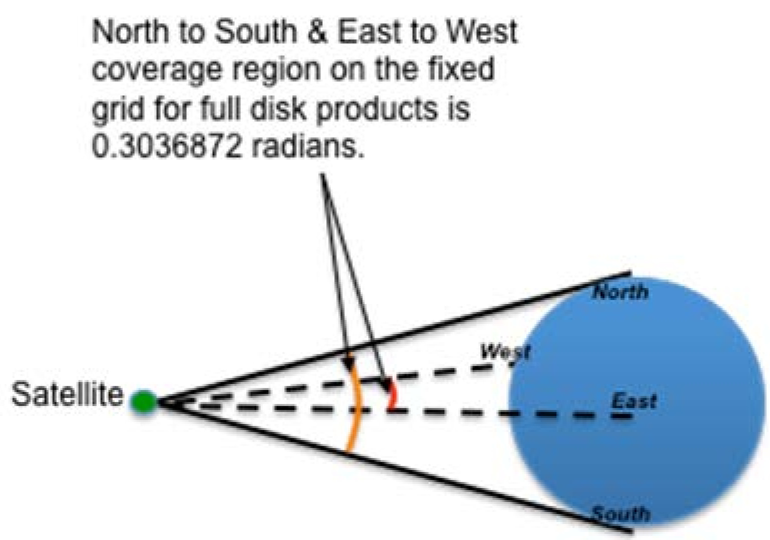


Figure 4.2.3 ABI Coverage Regions are Defined In Terms of Viewing Angle from the Satellite's Perspective

The coverage of the Full Disk L1b product consists of those pixels whose centers fall within the GRS80 Earth Ellipse. The maximum East to West and North to South extent of the GRS80 ellipse is shown in Table 4.1.2.3-1. Note that the center of the full disk image is the satellite sub-point.

Table 4.2.3-1 Full Disk Image Coverage Region

East to West Coverage Extent	0.303704160 radians
North to South Coverage Extent	0.302701402 radians

Table 4.2.3-2 defines the coverage region for a CONUS image.

Table 4.2.3-2 CONUS Image Coverage Region

East to West Coverage Extent	0.14 radians
North to South Coverage Extent	0.084 radians

Table 4.2.3-3, Table 4.2.3-4 and Table 4.2.3-5 define the precise location of the center of the CONUS regions sensed by the ABI for the GOES-R East, West and Test satellite orbital slots at 75 degrees, 137 degrees and 89.5 degrees west longitude. Note that a negative fixed grid coordinate indicates a data point that is either west or south of the satellite sub-point.

Table 4.2.3-3 GOES-R East CONUS Image Center

East to West Image Offset from Satellite Sub-point	-0.031360 radians
North to South Image Offset from Satellite Sub-point	0.086240 radians

Table 4.2.3-4 GOES-R West CONUS Image Center

East to West Image Offset from Satellite Sub-point	0.000000 radians
North to South Image Offset from Satellite Sub-point	0.086240 radians

Table 4.2.3-5 GOES-R Test CONUS Image Center

East to West Image Offset from Satellite Sub-point	-0.005040 radians
North to South Image Offset from Satellite Sub-point	0.084560 radians

Table 4.2.3-6 defines the coverage region for a mesoscale image. The mesoscale coverage region extents are relative to the center of the mesoscale image. The center of a mesoscale image is selected during operations based on weather conditions in the ABI's field of regard.

Table 4.2.3-6 Mesoscale Image Coverage Region

East to West Coverage Extent	0.028 radians
North to South Coverage Extent	0.028 radians

Note that the center of each CONUS image and mesoscale image is adjusted to the image corner that is nearest to the fixed grid data point.

4.2.4 Horizontal Spatial Resolutions

The GOES-R ground system outputs ABI Level 1b and ABI Level 2+ imagery products on the ABI fixed grid at several horizontal spatial resolutions. Table 4.2.4 identifies the set of horizontal spatial resolutions associated with the different types of products. Note that the horizontal spatial resolutions are specified in terms of resolution in kilometers at nadir, and angular resolution as defined above.

Table 4.2.4 Horizontal Spatial Resolution

ABI L1b/GRB	ABI L2+	Horizontal Spatial Resolution	
		At Nadir	Angular
applicable	*applicable*	0.5 km	14 µrad
		1.0 km	28 µrad
		2.0 km	56 µrad
not applicable		4.0 km	112 µrad
		10.0 km	280 µrad

4.2.5 Data Point Coordinates

An imagery data point on the ABI fixed grid is associated with an area on or above the surface of the earth. For example, a data point with a horizontal spatial resolution of 2 km at nadir is associated with a 4 square kilometer area. By convention, a data point is located at the center of this area with its coordinates expressed in terms of its angular resolution. For example, the center of a 2 km data point, which has an angular resolution of 56 microradians in both N/S elevation angle and E/W scanning angle, is 28 microradians from its edges. Refer to Figure 4.2.5.

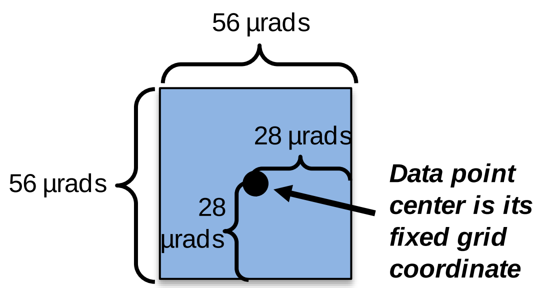


Figure 4.2.5 Example: Center of 2 km Data Point

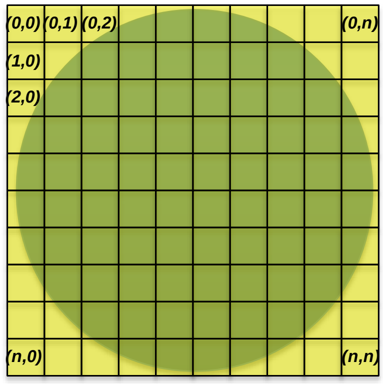
A data point is populated with observed data if its center is on-earth and in the ABI's field of regard. In the case of the lower resolution, non-native resolutions, 4 and 10 km, a data point is populated with observed data if the center of at least one constituent 2 km pixel is on-earth and in the ABI's field of regard.

4.2.6 Product Data Structures

In the preceding paragraphs that discussed the ABI fixed grid, the specification of its coordinate system, and the size and location of its data points have been defined. This paragraph defines how this information is captured in the ABI Level 1b and ABI Level 2+ imagery products.

The ABI Level 1b and ABI Level 2+ products are stored in netCDF version 4 product files. netCDF includes constructs to define scalar and multi-dimensional data, along with the associated metadata. netCDF variables are used to store scalar and multi-dimensional data. Metadata can be stored using either netCDF variables or attributes. The Climate and Forecast (CF) Metadata Conventions are applied to make the ABI Level 1b and ABI Level 2+ products self-describing. This standard includes requirements that allow the data to be located in space and time, as well as the semantics of the data to be captured in the product file.

For full disk products, the netCDF variables used to house the values for data points on the fixed grid define a rectangular region that encompasses the elliptical earth. Note that fill values are used for off-earth and missing data points. Refer to Figure 4.2.6-1.



- NetCDF variables provide storage for data point values on the fixed grid.
- Array element (0,0) of variable contains the data value for the most northwest data point.
- Array element (n, n) of variable contains the data value for the most southeast data point.

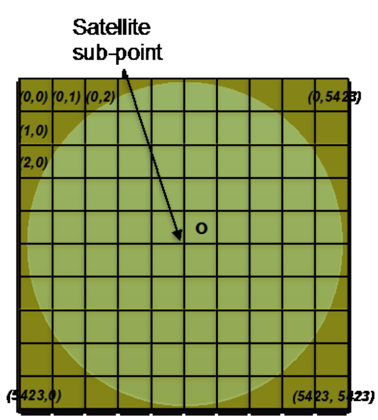
Figure 4.2.6-1 Storing Data Point Values For Full Disk Image in a Variable

CONUS and mesoscale images are stored in a similar manner.

When netCDF values for data points are reported for single levels in the atmosphere, the variable has two dimensions, with array element value (0, 0) being the most northwest data point and array element value (n,n) being the most southeast data point. Note that the first element of an array element represents the fixed grid y-axis, while the second element represents the fixed grid x-axis, i.e., (n_y,n_x).

When netCDF data values are reported for multiple levels in the atmosphere, the data variable has three dimensions. The data variable subscripting is in the form (y, x, z) where z provides the dimension to store multiple values at the same location on the fixed grid.

In addition to the netCDF variables containing the data, there are coordinate variables in the product file. Coordinate variables, which are a CF Metadata Convention construct, provide the means to locate the data in space and time. Coordinate variables are required for the time, and the location along the y and x axes. The CF Metadata Conventions dictate that the coordinate variable names be the same as the corresponding dimension names. The values of data elements in the y and x coordinate variables are the ABI fixed grid coordinates, the N/S elevation angle and the E/W scanning elevation angle, respectively. Note that scaled integers as defined in the netCDF Users Guide are used for the y and x axis coordinate variables. The coordinate variable value in the product file is multiplied by the attached attribute scale_factor and then summed with the add_offset to obtain the ABI fixed grid coordinate in radians. The y and x coordinate variables are one-dimensional. The dimension of the y coordinate variable is the same as the y dimension in the data variable. The same is true for the x coordinate variable. This allows specific data points in the data variable to be associated with their ABI fixed grid coordinates. Refer to Figure 4.2.6-2.



Full disk 2 km data variable is dimensioned 5424 x 5424.

The data variable array element for the data point marked with an "o" is (2711, 2712).

The x coordinate variable value for array element (2712) = 0.000028 radians.

The y coordinate variable value for array element (2711) =0.000028 radians.

The East to West scanning and North to South elevation angles of (0.000028, 0.000028) in the 2 km fixed grid coordinate system are used to determine the latitude and longitude of data point "o".

Figure 4.2.6-2 Relating a Data Point to its ABI Fixed Grid Coordinates

In the GRB form of the ABI Level 1b Radiances product, the y- and x-coordinate variables, which are included in the Generic Payload containing the product metadata, are not populated. In this case, the y- and x-coordinate variables can be determined using the upper left y- and x-coordinates of the data points in the image, along with the image block height field and the image block width field contained in the Image Payload Header.

Determining the latitude and longitude of data points using their ABI fixed grid coordinates is defined in paragraph 4.2.8, Navigation of Image Data, which follows.

The dimensions of the data variables for ABI Level 1b and 2+ full disk, CONUS, and mesoscale products are defined in Table 4.2.6.

Table 4.2.6 ABI Product Data Variable Dimensions

Horizontal Spatial Resolution		Full Disk		CONUS Extraction from Full Disk		CONUS		Mesoscale	
km (nadir)	micro-radians	N/S (y-axis)	E/W (x-axis)	N/S (y-axis)	E/W (x-axis)	N/S (y-axis)	E/W (x-axis)	N/S (y-axis)	E/W (x-axis)
0.5	14	21696	21696	6000	10000	6000	10000	2000	2000
1.0	28	10848	10848	3000	5000	3000	5000	1000	1000
2.0	56	5424	5424	1500	2500	1500	2500	500	500
4.0	112	2712	2712	*not applicable*				250	250
10.0	280	1086	1086	300	500	300	500	100	100

There are two conventions associated with the dimensioning of variables for image data on the fixed grid. The first convention requires the dimensioning of the lowest native resolution data variables (2 km at nadir) completely covers the Full Disk, CONUS, and mesoscale images defined above. The second convention requires the higher native resolution data variables (i.e., 0.5, 1, and 2 km at nadir) and the lower non-native resolution data variables (i.e., 4 and 10 km at nadir) fully cover the region included in the native 2 km at nadir resolution data variables.

The selection of CONUS and mesoscale center points has an effect on the location of these region's pixels on the ABI fixed grid. For example, if the center point of a native CONUS image is not on the corner of a Full Disk 10 km pixel, the locations of its 10 km pixels are not the same as that in a CONUS image extracted from a mode 4 Full Disk image. It is advantageous to end users and their applications to select CONUS and mesoscale center points where pixels at the provided resolutions are at the same locations regardless of image type. This is accomplished by selecting CONUS and mesoscale center points using the least common denominator among the horizontal spatial resolutions (0.5, 1.0, 2.0. 4.0, and 10.0 km) for ABI fixed grid products. This constraint requires CONUS and mesoscale center points to be on the corner of full disk 20 km (i.e., 0.00056 radian) pixels.

4.2.7 Standard Coordinate Data

There are several netCDF variables and attributes in the ABI Level 1b and ABI Level 2+ products on the fixed grid that contain coordinate related information required to geo-locate data points and geo-reference metadata in the product, and provide support for data discovery. The standard coverage areas associated with full disk and CONUS products result in coordinate data values that do not change for a satellite operating at a particular slot. These standard and fixed coordinate data are identified and described in this paragraph.

Table 4.2.7-1 defines the variables and attributes that contain standard coordinate data.

Table 4.2.7-1 Variables and Attributes Containing Standard Coordinate Data

Variable / Attribute	Description
y -> add_offset x -> add_offset	Attribute add_offset of coordinate variables "y" and "x" contains the N/S elevation and E/W scanning angles for center, respectively, of the upper left (i.e., most northwest) data point in the image. This value varies with the location of the image for mesoscale.
y -> scale_factor x -> scale_factor	Attribute scale_factor of coordinate variables "x" and "y" contains the horizontal spatial resolution of the image.
y_image_center x_image_center	The y_image_center and x_image_center coordinate variables contain the N/S elevation and E/W scanning angles, respectively, of the center the image. These values vary with the location of the image for mesoscale.
y_image_bounds x_image_bounds	The y_image_bounds and x_image_bounds boundary variables contain the N/S elevation and E/W scanning angles of the north and south, and west and east, extents, respectively, of the image. These values vary with the location of the image for mesoscale.
geospatial_lat_lon_extent -> geospatial_lat_nadir geospatial_lat_lon_extent -> geospatial_lon_nadir geospatial_lat_lon_extent -> geospatial_lat_center geospatial_lat_lon_extent -> geospatial_lon_center geospatial_lat_lon_extent -> geospatial_northbound_latitude geospatial_lat_lon_extent -> geospatial_southbound_latitude geospatial_lat_lon_extent -> geospatial_westbound_longitude geospatial_lat_lon_extent -> geospatial_eastbound_longitude	This variable and its attributes contain the latitude and longitude of the satellite's nadir, center of the image, and north, south, west, and east extents of the image. Except for the satellite's nadir, these values vary with the location of the image for mesoscale.

Table 4.2.7-2 identifies the N/S elevation and E/W scanning angles of the center of the most northwest pixel in full disk and CONUS images (i.e., y and x coordinate variables' add_offsets), and the y and x coordinate variables' scale_factors.

Table 4.2.7-2 ABI Image Standard Upper Left Coordinates

		Horizontal Spatial Resolution				
		0.5 km (0.000014 radians)	**1.0 km (0.000028 radians)**	**2.0 km (0.000056 radians)**	**4.0 km (0.000112 radians)**	**10.0 km (0.000280 radians)**
Full Disk (all slots)	**add offset for y**	0.151865	0.151858	0.151844	0.151816	0.151900
	add offset for x	-0.151865	-0.151858	-0.151844	-0.151816	-0.151900
CONUS (GOES-R East at -75 degrees east longitude)	**add offset for y**	0.128233	0.128226	0.128212	*not applicable*	0.128100
	add offset for x	-0.101353	-0.101346	-0.101332		-0.101220
CONUS (GOES-R West at -137 degrees east longitude)	**add offset for y**	0.128233	0.128226	0.128212		0.128100
	add offset for x	-0.069993	-0.069986	-0.069972		-0.069860
CONUS (Test Slot at -89.5 degrees east longitude)	**add offset for y**	0.126553	0.126546	0.126532		0.126420
	add offset for x	-0.075033	-0.075026	-0.075012		-0.074900
Scale Factors for All Image Types	**scale factor for y**	-0.000014	-0.000028	-0.000056	-0.000112	-0.000280
	scale factor for x	0.000014	0.000028	0.000056	0.000112	0.000280

Table 4.2.7-3 ABI Image Center (Fixed Grid Coordinates) identifies the N/S elevation and E/W scanning angles of the center of full disk and CONUS images (i.e., y_image_center and x_image_center coordinate variables).

Table 4.2.7-3 ABI Image Center (Fixed Grid Coordinates)

	y image center (N/S)	**x image center (E/W)**
Full Disk (all slots)	0.0	0.0
CONUS (GOES-R East at -75 degrees east longitude)	0.086240	-0.031360
CONUS	0.086240	0.000000

	y image center (N/S)	x image center (E/W)
(GOES-R West at -137 degrees east longitude)		
CONUS (Test Slot at -89.5 degrees east longitude)	0.084560	-0.005040

Table 4.2.7-4 identifies the N/S elevation angles of the N/S extents and E/W scanning angles of the E/W extents of full disk and CONUS images (i.e., y_image_bounds and x_image_bounds boundary variables).

Table 4.2.7-4 ABI Image N/S and E/W Extents (Fixed Grid Coordinates)

	y image bounds		x image bounds	
	North	South	West	East
Full Disk (all slots)	0.151872	-0.151872	-0.151872	0.151872
CONUS (GOES-R East at -75 degrees east longitude)	0.128240	0.044240	-0.101360	0.038640
CONUS (GOES-R West at -137 degrees east longitude)	0.128240	0.044240	-0.070000	0.070000
CONUS (Test Slot at -89.5 degrees east longitude)	0.126560	0.042560	-0.075040	0.064960

Table 4.2.7-5 identifies the latitude and longitude of the center and extents of full disk and CONUS images (i.e., geospatial_lat_lon_extent variable attributes).

Table 4.2.7-5 ABI Image Center and Extents (Lat/Lon Coordinates)

Latitude is degrees north Longitude is degrees east	**Full Disk (GOES-R East at -75 degrees east longitude)**	**Full Disk (GOES-R West at -137 degrees east longitude)**	**Full Disk (GOES-R Test Slot at -89.5 degrees east longitude)**	**CONUS (GOES-R East at -75 degrees east longitude)**	**CONUS (GOES-R West at -137 degrees east longitude)**	**CONUS (GOES-R Test Slot at -89.5 degrees east longitude)**
geospatial_lat_nadir	0.0	0.0	0.0	0.0	0.0	0.0
geospatial_lon_nadir	-75.0	-137.0	-89.5	-75.0	-137.0	-89.5
geospatial_lat_center	0.0	0.0	0.0	30.083003	29.967	29.294
geospatial_lon_center	-75.0	-137.0	-89.5	-87.096958	-137.000	-91.406
geospatial_northbound_latitude	81.3282	81.3282	81.3282	56.761450	53.500062	52.767707
geospatial_southbound_latitude	-81.3282	-81.3282	-81.3282	14.571340	14.571340	14.000162
geospatial_westbound_longitude	-156.2995	141.7005	-170.7995	-152.109282	175.623576	-140.616268
geospatial_eastbound_longitude	6.2995	-55.7005	-8.2005	-52.946879	-89.623576	-49.179291

4.2.8 Navigation of Image Data

This paragraph provides the equations needed to navigate data points on the ABI fixed grid to and from latitude and longitude. ABI fixed grid coordinates, N/S elevation angle and E/W scanning angle, coupled with the location of the satellite and the parameters associated with the selected earth model (GRS80) are used to determine the geodetic latitude/longitude coordinates. This paragraph also provides equations to determine the ABI fixed grid coordinates from the geodetic latitude/longitude coordinates.

All of the equations are based on the International System of Units (SI). These equations assume data points are lying on the GRS80 ellipsoid, and the location of data points on the ABI fixed grid is based on a geostationary satellite at the equator in an idealized orbit.

Table 4.2.8 defines the parameters required to navigate data points on the ABI fixed grid. The parameters are used in the equations in the following sections.

Table 4.2.8 Parameters Required to Navigate Data Points on ABI Fixed Grid

Parameter	netCDF Product File Attributes for the "goes_imager_projection" Variable	Attribute Value	Definition
r_{eq}	semi_major_axis	6378137 m	GRS80 semi-major axis of earth
$1/f$	inverse_flattening	298.257222096	Reciprocal of GRS80 flattening factor
r_{pol}	semi_minor_axis	6356752.31414 m	GRS80 semi-minor axis of earth = $(1-f)r_{eq}$
e	n/a	0.0818191910435	1st eccentricity = sqrt(f(2-f)) =sqrt((r_{eq}^2-r_{pol}^2)/r_{eq}^2)
n/a	perspective_point_height	35786023 m	Satellite height above ellipsoid
H	perspective_point_height + semi_major_axis	42164160 m	Satellite height from center of earth (m)
x	x	Input or Output Value rad	Fixed Grid E/W scanning angle (rad)
y	y	Input or Output Value rad	Fixed Grid N/S elevation angle (rad)
ϕ		Input or Output Value deg/rad	GRS80 geodetic latitude (deg/rad)
λ		Input or Output Value deg/rad	GRS80 longitude (deg/rad)
n/a	latitude_of_projection_origin	0 deg 0 rad	Satellite East latitude North
		0 deg 0 rad	Satellite West latitude North
		0 deg 0 rad	Satellite Test latitude North
λ_0	longitude_of_projection_origin	-75 deg -1.308996939 rad	Satellite East longitude East
		-137 deg -2.39110107523 rad	Satellite West longitude East
		-89.5 deg -1.56206968053 rad	Satellite Test longitude East

Figure 4.2.8 provides an illustration of the coordinate frames and their relationships required for navigation. The equations in the following paragraphs are based on this figure.

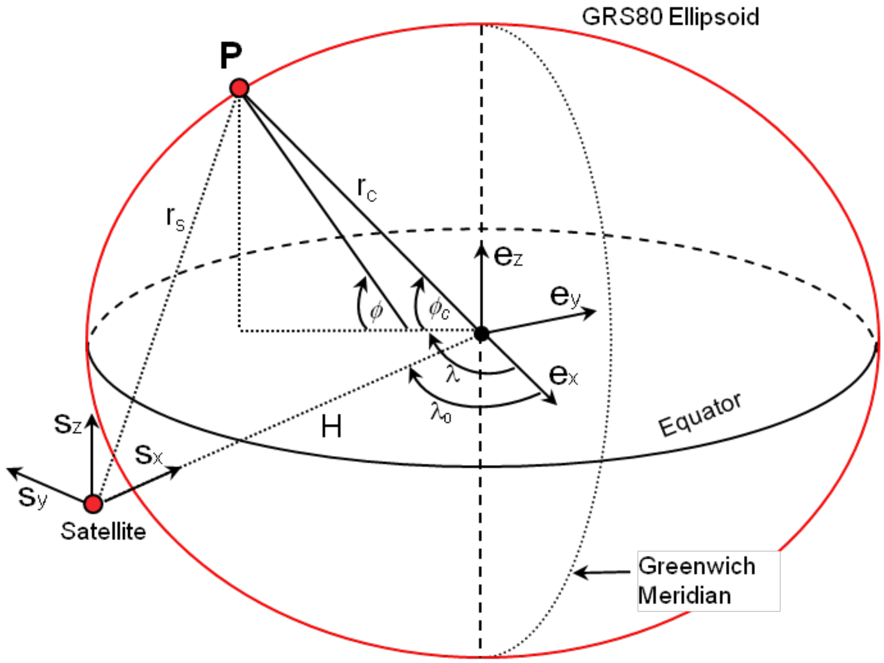


Figure 4.2.8 Coordinate Frames for ABI Fixed Grid Navigation

Two coordinate frames are described. The Earth Centered Fixed (ECF) coordinate frame rotates with the Earth. The origin is located at the center of the earth. The x-axis (e_x) passes through the Greenwich Meridian and the equator. The z-axis (e_z) passes through the North Pole. The y-axis (e_y) is defined as the cross product of the z-axis (e_z) with the x-axis (e_x) completing the right-handed coordinate system. The satellite coordinate frame has its origin located at the center of mass of the satellite. Its x-axis (s_x) is defined along the line from the satellite to the center of the earth and the z-axis (s_z) is parallel to the ECF z-axis (e_z) and points up. Again the y-axis (s_y) completes the right-handed coordinate system and is aligned with the equatorial axis. Two representations are shown for the latitude. The ϕ represents the geodetic latitude, and ϕ_C represents the geocentric latitude. Note that the geodetic latitude is measured at the equator, where the line is perpendicular or normal to the GRS80 ellipsoid at point P. The geodetic and geocentric longitudes λ are the same. Longitude is measured from the Greenwich meridian and is positive East and negative West. Note that the geostationary positions of the GOES-R satellites are both west of the Greenwich Meridian and therefore have negative longitudes as shown in the table immediately above.

Note that the open-source Unidata Geolocation Projection and Proj.4 Cartographic Projections software to perform these navigation functions will be available on the web at:

- **http://www.unidata.ucar.edu/software/thredds/v4.3/netcdf-java/v4.2/javadoc/ucar/unidata/geoloc/Projection.html**
- **http://trac.osgeo.org/proj/wiki/proj%3Dgeos**

4.2.8.1 Navigating from N/S Elevation Angle (*y*) and E/W Scanning Angle (*x*) to Geodetic Latitude (ϕ) and Longitude (λ)

Given a point P on the GRS80 ellipsoid with fixed grid coordinates (y,x) find the geodetic coordinates, (ϕ, λ).

The geodetic latitude (ϕ) and longitude (λ) are computed by the following equations

$$\begin{pmatrix} \phi \\ \lambda \end{pmatrix} = \begin{pmatrix} \arctan\left(\dfrac{r_{eq}^2}{r_{pol}^2} \dfrac{s_z}{\sqrt{(H - s_x)^2 + s_y^2}} \right) \\ \lambda_0 - \arctan\left(\dfrac{s_y}{H - s_x} \right) \end{pmatrix}$$

For:

$x =$ Fixed Grid E/W scan angle in radians

$y =$ Fixed Grid N/S scan angle in radians

One computes S_x, S_y, S_z as follows:

$$a = \sin^2(x) + \cos^2(x)\left(\cos^2(y) + \frac{r_{eq}^2}{r_{pol}^2} \sin^2(y) \right)$$

$$b = -2H \cos(x)\cos(y)$$

$$c = H^2 - r_{eq}^2$$

$$r_s = \frac{-b - \sqrt{b^2 - 4ac}}{2a} \text{ distance from the satellite to point P}$$

$$s_x = r_s \cos(x)\cos(y)$$

$$s_y = -r_s \sin(x)$$

$$s_z = r_s \cos(x)\sin(y)$$

Example

This example is based on the GOES-R east satellite for a point, P, in a 2 km CONUS product with fixed grid coordinates given by

$y(558) = 0.095340$ rad

$x(1539) = -0.024052$ rad

Note the variables and their subscripts used here are as defined in paragraph 4.2.6, Product Data Structures, above.

Values for the parameters used in the equations and their netCDF Product File Attribute Names described in the table immediately above are as follows:

r_{eq} = goes_imagery_projection:semi_major_axis = *6378137 (meters)*

1/f= goes_imagery_projection:inverse_flattening = *298.257222096*

r_{pol} = goes_imagery_projection:semi_minor_axis = *6356752.31414 (meters)*

e = 0.0818191910435

goes_imagery_projection:perspective_point_height = *35786023 (meters)*

H = goes_imagery_projection:perspective_point_height +
goes_imagery_projection:semi_major_axis = *42164160 (meters)*

$x = x(1539) = -0.024052$

$y = y(558) = 0.095340$

λ_0 = goes_imagery_projection: longitude_of_projection_origin
= -1.308996939

Based on these input values, the intermediate calculations in the above equations yield the following:

$a = 1.000061039$

$b = -83921070.03$

$c = 1.73714E+15$

$r_s = 37116295.87$

$s_x = 36937048.73$

$s_y = 892635.0779$

$s_z = 3532287.213$

Now using the values specified above and substituting into the equations for ϕ and λ, we obtain the following for the geodetic latitude and longitude,

ϕ = 0.590726971 rad = 33.846162 deg

λ = -1.478135612 rad = -84.690932 deg

corresponding to the GOES-R east satellite fixed grid coordinates of:

$y(558)$ = 0.095340 rad

$x(1539)$ = -0.024052 rad

4.2.8.2 Navigating from Geodetic Latitude (ϕ) and Longitude (λ) to N/S Elevation Angle (*y*) and E/W Scanning Angle (*x*)

Given a point P on the GRS80 ellipsoid with geodetic (ϕ , λ) coordinates find the fixed grid (*y*, *x*) coordinates.

Note that if the following inequality is true, then the (ϕ , λ) location is not visible from the satellite and the elevation and scanning angles should not be computed.

$$H(H - s_x) < s_y^2 + \frac{r_{eq}^2}{r_{pol}^2} s_z^2$$

The N/S Elevation Angle (*y*) and E/W Scanning Angle (*x*) are computed by the following equations:

$$\begin{pmatrix} y \\ x \end{pmatrix} = \begin{pmatrix} \arctan\left(\dfrac{s_z}{s_x}\right) \\ \arcsin\left(\dfrac{-s_y}{\sqrt{s_x^2 + s_y^2 + s_z^2}}\right) \end{pmatrix}$$

Where,

$$\phi = \text{GRS80 geodetic latitude in radians}$$

$$\lambda = \text{GRS80 longitude in radians}$$

$$\phi_C = \arctan\left(\frac{r_{pol}^2}{r_{eq}^2}\tan(\phi)\right) \quad \text{geocentric latitude}$$

$$r_C = \frac{r_{pol}}{\sqrt{1 - e^2\cos^2(\phi_C)}} \quad \text{geocentric distance to the point on the ellipsoid}$$

$$\begin{pmatrix} s_x \\ s_y \\ s_z \end{pmatrix} = \begin{pmatrix} H - r_C\cos(\phi_C)\cdot\cos(\lambda - \lambda_0) \\ -r_C\cos(\phi_C)\cdot\sin(\lambda - \lambda_0) \\ r_C\sin(\phi_C) \end{pmatrix}$$

<u>Example</u>

This example verifies that the algorithm defined in paragraph 4.1.2.8.1 has an inverse. This example is based on the GOES-R east satellite for a point, P, in a 2 km CONUS product with geodetic latitude and longitude given by

ϕ = 33.846162 deg = 0.590726966 rad

λ = -84.690932 deg = -1.47813561 rad

Values for the parameters used in the equations and their netCDF Product File Attribute Names described in the table immediately above are as follows:

r_{eq} = goes_imagery_projection:semi_major_axis = *6378137 (meters)*

1/f = goes_imagery_projection:inverse_flattening = *298.257222096*

r_{pol} = goes_imagery_projection:semi_minor_axis = *6356752.31414 (meters)*

e = 0.0818191910435

goes_imagery_projection:perspective_point_height = *35786023 (meters)*

H = goes_imagery_projection:perspective_point_height +
goes_imagery_projection:semi_major_axis = *42164160 (meters)*

ϕ = 0.590726966

λ = -1.47813561

λ_0 = goes_imagery_projection: longitude_of_projection_origin
= -1.308996939

Based on these input values, the intermediate calculations in the above equations yield the following:

ϕ_C = 0.587623849

r_c = 6371541.614

s_x = 36937048.71

s_y = 892635.07

s_z = 3532287.186

Now using the values specified above and substituting into the equations for y and x, we obtain the following for the fixed grid coordinates,

y = 0.095340 rad

x = -0.024052 rad

corresponding to the GOES-R east satellite geodetic latitude and longitude of:

ϕ = 33.846162 deg

λ = -84.690932 deg

4.2.9 Overlaying Data from Different Image Types

GOES-R ABI Level 1b and ABI Level 2+ product data users will need to overlay full disk, CONUS, and mesoscale products for data processing and display purposes.

The netCDF coordinate variables contain the ABI fixed grid coordinates, E/W scanning angle and N/S elevation angle that correspond to each point in the data variable. The ABI fixed grid coordinate values are relative to the origin of the fixed grid, which is the satellite sub-point. However, the array subscripts for a netCDF product image data variable are relative to the most northwest data point in the image.

When the resolutions of the products are the same, the following equation allows one to map the data variable array subscripts from the product containing the geographically smaller region to the product containing the geographically larger region. Note that the data variable array element (0,0) corresponds to the most northwest data point in the image data.

$^{\wedge}Y_L = (^{FG}Y_L - {}^{FG}Y_S) / \alpha$

$^{\wedge}X_L = (^{FG}X_S - {}^{FG}X_L) / \alpha$

Where:

$^{FG}Y_S$ *fixed grid N/S elevation angle in radians for smaller region's northwest data point*

$^{FG}X_S$ *fixed grid E/W scanning angle in radians for smaller region's northwest data point*

$^{FG}Y_L$ *fixed grid N/S elevation angle in radians for larger region's northwest data point*

$^{FG}X_L$ *fixed grid E/W scanning angle in radians for larger region's northwest data point*

α *horizontal spatial resolution of the data in radians*

$^{\wedge}X_L$ *larger region's data variable x-axis subscript for smaller region's northwest data point*

$^{\wedge}Y_L$ *larger region's data variable y-axis subscript for smaller region's northwest data point*

In the case where the resolution of the products being overlaid is not the same, the same general thinking applies, except "α" needs to be the horizontal spatial resolution of the data in radians for the geographically larger product, and the application will need to deal with incongruities caused by the differing resolutions of the products.

Example

This example shows how a 2 km CONUS product can be overlaid on a 2 km Full Disk product from the GOES-R East satellite at -75 degrees east longitude.

Table 4.2.9 captures the parameters required.

Table 4.2.9 Parameters for 2 km CONUS Product Overlay on 2 km Full Disk Product

Parameter Name	netCDF Product Variable / Attribute Name	Value (radians)
${}^{FG}Y_{CONUS}$	CONUS coordinate variable y(0)	0.126588
${}^{FG}X_{CONUS}$	CONUS coordinate variable x(0)	-0.110236
${}^{FG}Y_{FullDisk}$	Full Disk coordinate variable y(0)	0.151844
${}^{FG}X_{FullDisk}$	Full Disk coordinate variable x(0)	-0.151844
α	CONUS product file <*primary data variable*>:resolution	0.000056

Using the equations defined above:

$$ {}^{\wedge}Y_{FullDisk} = ({}^{FG}Y_{FullDisk} - {}^{FG}Y_{CONUS}) / \alpha = (0.151844 - 0.126588) / 0.000056 = 451 $$

$$ {}^{\wedge}X_{FullDisk} = ({}^{FG}X_{CONUS} - {}^{FG}X_{FullDisk}) / \alpha = (-0.110236 - -0.151844) / 0.000056 = 743 $$

Therefore:

(1) Full Disk location for coordinate variable y(451) and x(743) is same location as CONUS coordinate variable y(0) and x(0)

(2) <DataVariable> Full Disk (451,743) is same location as <DataVariable> CONUS (0,0)

4.3 Global Latitude/Longitude Grid

A global latitude/longitude grid is the projection associated with the data in the ABI Level 2+ Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: Top Of Atmosphere (TOA) products.

This paragraph includes the following subordinate paragraphs:

- Description
- Coordinate System
- Coverage Area Associated with the Full Disk, CONUS, and Mesoscale Images
- Horizontal Spatial Resolutions
- Data Point Coordinates
- Product Data Structures
- Standard Coordinate Data
- Overlaying Data from Different Image Types and Satellites

4.3.1 Description

The data points in the GOES-R ABI Level 2+ shortwave radiation products are on a global latitude/longitude grid. Data point edges are on integer (i.e., whole) degree latitudes and longitudes for all horizontal spatial resolutions associated with the shortwave radiation products.

Data points populated in these global latitude/longitude products are limited by the availability of data in the source ABI Level 1b Radiances products, which are on the ABI fixed grid. As a result, the data points populated do not form a rectangular region in the projected latitude/longitude space. In fact, the shape of the region formed by the populated data points in the global latitude/longitude grid varies as a function of the ABI's viewing angle for the CONUS and mesoscale image types. Even the full disk image type, which is near hemispheric, populated data points in the shortwave radiation products do not form a perfect rectangular region in the projected latitude/longitude space due to the characteristics of the ABI's field of regard along its edge. Refer to Figure 4.3.1, Populated Region in GOES-R CONUS Shortwave Radiation Product, for an illustration of where valid data exists.

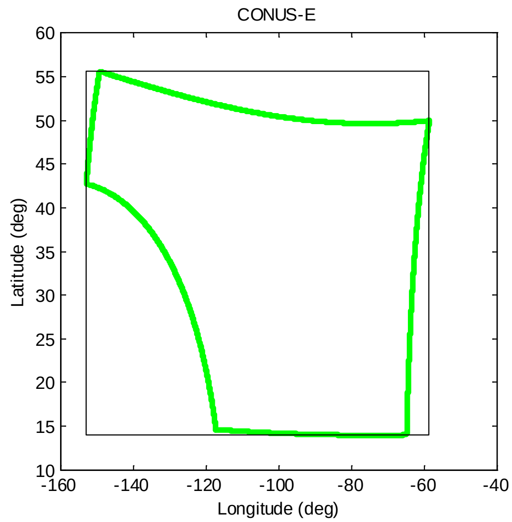


Figure 4.3.1 Populated Region in GOES-R CONUS Shortwave Radiation Product

As is the case with the ABI fixed grid ABI Level 1b and 2+ products, the GRS80 ellipsoid is the earth model employed.

4.3.2 Coordinate System

The coordinates for the global latitude/longitude grid are latitude and longitude. In two-dimensional map space, the x-axis is at the equator, and the y-axis is at the prime (Greenwich) meridian. Unlike the ABI fixed grid, this coordinate system is independent of the satellite's location. By convention, degrees north and degrees east are used for latitude and longitude, respectively. Refer to Figure 4.3.2, Projecting Latitude and Longitude on a Two Dimensional Map.

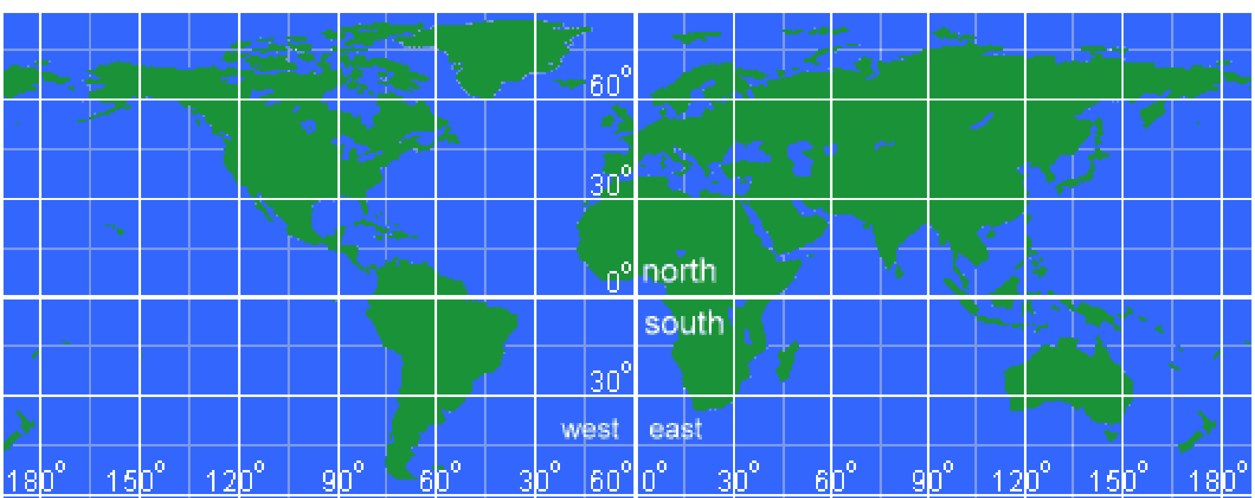


Figure 4.3.2 Projecting Latitude and Longitude on a Two Dimensional Map

Latitude coordinates north of the x-axis (i.e., equator) are positive when using degrees north. Longitude coordinates east of the y-axis (i.e., prime meridian) are positive when using degrees east. Note that 180 degrees east longitude equals -180 degrees east longitude.

4.3.3 Coverage Regions Associated with the Full Disk, CONUS, and Mesoscale Images

The coverage regions associated with full disk, CONUS, and mesoscale shortwave radiation products are nearly identical to those associated with the source ABI fixed grid product data. The one difference being the geographic extents of the images are multiples of the horizontal spatial resolution of shortwave radiation product data points. A data point is populated with shortwave radiation product data if its center is on-earth, and it is in the ABI's field of regard. Table 4.3.3 defines the coverage region for a full disk shortwave radiation product image in degrees of latitude and longitude. Note that the center of this image is the satellite sub-point.

Table 4.3.3 Shortwave Radiation Product Full Disk Image Coverage Region

East to West Coverage Extent	163.0 degrees of longitude
North to South Coverage Extent	163.0 degrees of latitude

The CONUS and mesoscale image type coverage regions in terms of degrees of latitude and longitude vary as a function of the ABI's viewing angle as discussed above in Paragraph 4.3.1, Description, and illustrated in Figure 4.3.1, Populated Region in GOES-R CONUS Shortwave Radiation Product. By convention, the center of these CONUS and mesoscale shortwave radiation product images are the centers of source ABI fixed grid images.

4.3.4 Horizontal Spatial Resolutions

The GOES-R ground system outputs ABI Level 2+ shortwave radiation products on the global latitude/longitude grid at three horizontal spatial resolutions. Table 4.3.4-1 identifies the set of horizontal spatial resolutions associated with the different shortwave radiation product image types.

Table 4.3.4-1 Horizontal Spatial Resolution of Shortwave Radiation Products

	Horizontal Spatial Resolution (in degrees)		
	Full Disk	**CONUS**	**Mesoscale**
Downward Shortwave Radiation: Surface (DSR:S)	0.5	0.25	0.05
Reflected Shortwave Radiation: TOA (RSR:T)	0.25	0.25	*not applicable*

The horizontal spatial resolutions for the shortwave radiation products are 0.05, 0.25, and 0.5 degrees in both latitude and longitude. The edge of the areas covered by data points for all three horizontal spatial resolutions align to integer (i.e., whole) degrees of latitude and longitude. A 0.5 degree data point subsumes four 0.25 degree data points exactly. A 0.25 degree data point subsumes twenty-five 0.05 degree data points exactly. Refer to Figure 4.3.4, Relationship Between Latitude/Longitude Data Points at Different Resolutions.

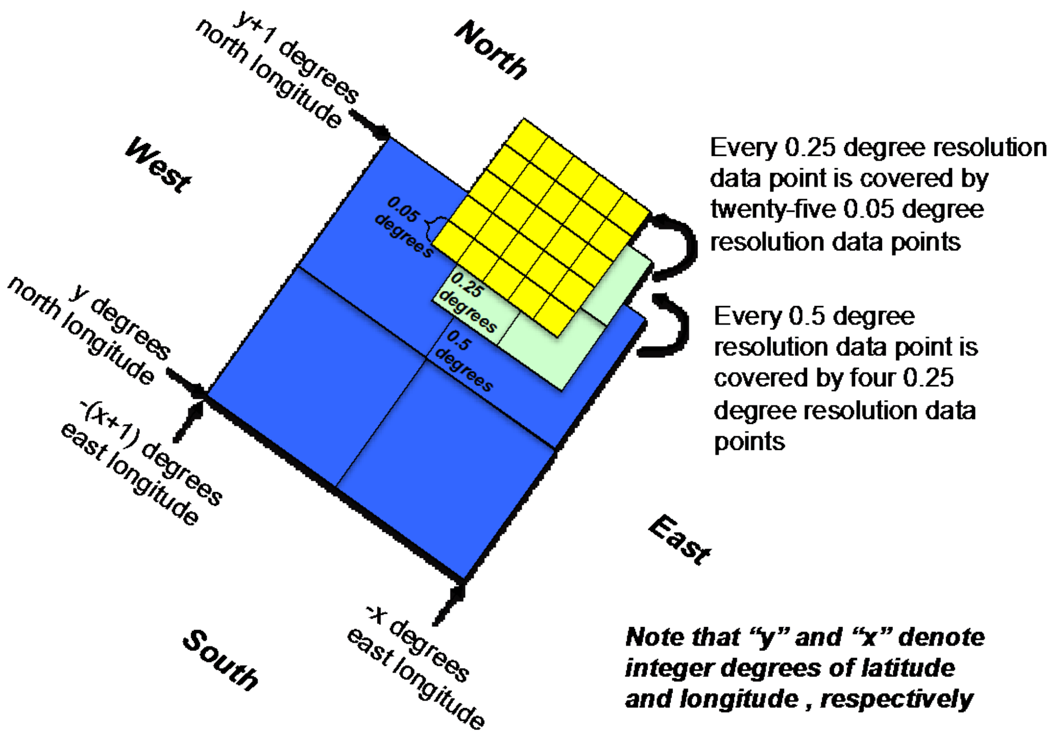


Figure 4.3.4 Relationship Between Latitude/Longitude Data Points at Different Resolutions

The latitude and longitude labeling in this figure illustrates an example north and west of the equator and prime meridian, respectively.

The location of shortwave radiation product data points is relative to global latitude/longitude grids defined for each of the horizontal spatial resolutions. Table 4.3.4-2 defines the global grid dimensions for each of the horizontal spatial resolutions.

Table 4.3.4-2 Shortwave Radiation Product Global Grid Dimensions

Degrees per data point	0.5	0.25	0.05
Global grid dimensions	720 x 360	1440 x 720	7200 x 3600

Each of the full disk, CONUS, and mesoscale shortwave radiation products reside on a subset of one of these global grids.

4.3.5 Data Point Coordinates

A shortwave radiation product data point on the global latitude/longitude grid is associated with an area on or above the surface of the earth. By convention, a data point is located at the center of this area with its coordinates expressed in terms of degrees latitude and longitude. For example, the center of a 0.25 degree data point is 0.125 degrees from its edges. Refer to Figure 4.3.5.

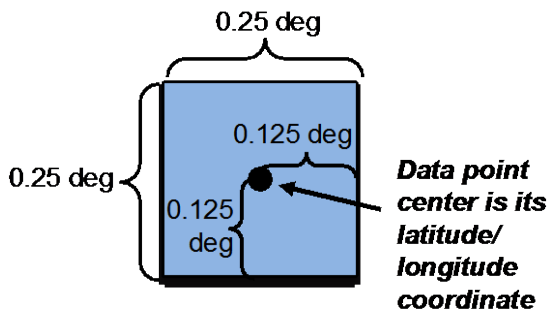


Figure 4.3.5 Example: Center of 0.25 Degree Data Point

4.3.6 Product Data Structures

In the preceding paragraphs, the specification of the global latitude/longitude grid coordinates system and the size and locations of its data points have been defined. This paragraph defines how this information is captured in the ABI Level 2+ shortwave radiation products.

In addition to the netCDF variables containing the data, there are coordinate variables in the product file. Coordinate variables, which are a CF metadata convention construct, provide the means to locate the data in space and time. Coordinate variables are required for the time, and the location along the latitude and longitude axes. The CF metadata conventions dictate that the coordinate variable names be the same as the corresponding dimension names. The values of data elements in the lat and lon coordinate variables are the latitude and longitude coordinates, respectively. Note that scaled integers as defined in the netCDF Users Guide are used for the lat and lon axis coordinate variables. The coordinate variable value in the product file is multiplied by the attached attribute scale_factor and then the add_offset to obtain the latitude or longitude coordinate in degrees. The lat and lon coordinate variables are one-dimensional. This allows specific data points in the data variable to be associated with their latitude and longitude coordinates.

Data points populated in these global latitude/longitude products are limited by the availability of data in the source ABI Level 1b Radiances product data. As a result, the data points populated do not form a rectangular region in the projected latitude/longitude space. In fact, the shape of the region formed by the populated data points in the global latitude/longitude grid varies as a function of the ABI's viewing angle for the CONUS and mesoscale image types. Even the full disk image type, which is near hemispheric, populated data points in the shortwave radiation products do not form a perfect rectangular region in the projected latitude/longitude space due to the characteristics of the ABI's field of regard along its edge. Refer to Figure 4.3.1, Populated Region in GOES-R CONUS Shortwave Radiation Product, for an illustration of where valid data exists.

The dimensions associated with the bounding rectangle on the global latitude/longitude grid for shortwave radiation product data points populated from the source ABI Level 1b Radiances product data vary as a function of the ABI's viewing angle to the CONUS or mesoscale region. In the case of CONUS images, whose geographic location do not change often, the dimensions of the data variable precisely align to the bounding rectangle.

In the case of mesoscale image type, where their earth locations vary with changing weather conditions, the dimensions are selected based on a worst case scenario, which is a maximum northern or southern off-nadir mesoscale center point. The dimensions of the data variables for ABI Level 2+ shortwave radiation full disk, CONUS, and mesoscale products are defined in Table 4.3.6.

Table 4.3.6 ABI Level 2+ Shortwave Radiation Product Data Variable Dimensions

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="3">Horizontal Spatial Resolution</th></tr>
<tr><th>0.05 degrees (approximately 5 km at nadir)</th><th>0.25 degrees (approximately 25 km at nadir)</th><th>0.5 degrees (approximately 50 km at nadir)</th></tr>
<tr><td rowspan="2">Full Disk</td><td>N/S (latitude axis)</td><td rowspan="8">not applicable</td><td>652</td><td>326</td></tr>
<tr><td>E/W (longitude axis)</td><td>652</td><td>326</td></tr>
<tr><td rowspan="2">CONUS East</td><td>N/S (latitude axis)</td><td>169</td><td rowspan="6">not applicable</td></tr>
<tr><td>E/W (longitude axis)</td><td>397</td></tr>
<tr><td rowspan="2">CONUS West</td><td>N/S (latitude axis)</td><td>156</td></tr>
<tr><td>E/W (longitude axis)</td><td>378</td></tr>
<tr><td rowspan="2">CONUS Test</td><td>N/S (latitude axis)</td><td>155</td></tr>
<tr><td>E/W (longitude axis)</td><td>364</td></tr>
<tr><td rowspan="2">Mesoscale</td><td>N/S (latitude axis)</td><td>888</td><td colspan="2" rowspan="2">not applicable</td></tr>
<tr><td>E/W (longitude axis)</td><td>565</td></tr>
</table>

The design to position the mesoscale shortwave product data into a data variable sized for the worst case maps the northwest corner of the bounding rectangle in global latitude/longitude space to (0,0) of the data variable. By design, the first row and column each have one or more valid shortwave radiation data points. Unused elements in the data variable are loaded with the fill value. Refer to Figure 4.3.6-2, Population of Mesoscale Shortwave Radiation Product Data Variable (Conceptual).

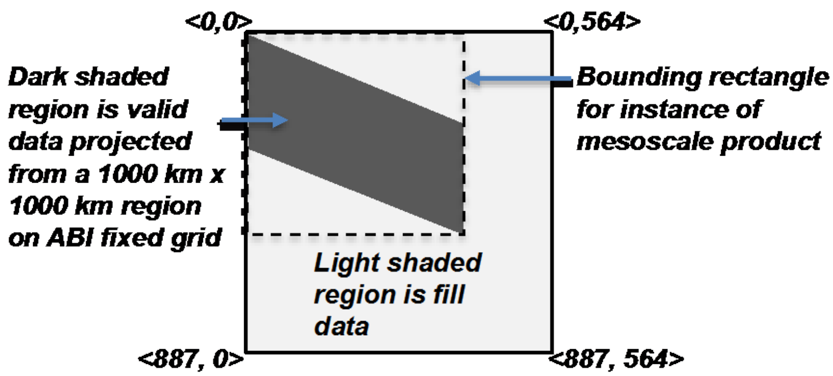


Figure 4.3.6-2 Population of Mesoscale Shortwave Radiation Product Data Variable (Conceptual)

4.3.7 Standard Coordinate Data

There are several netCDF variables and attributes in the ABI Level 2+ shortwave radiation products on the global latitude/longitude grid that contain coordinate related information required to geo-locate data points, geo-reference metadata in the product, and provide support for data discovery. The standard coverage areas associated with full disk and CONUS products result in coordinate data values that do not change for a satellite operating at a particular slot. These standard and fixed coordinate data are identified and described in this paragraph.

Table 4.3.7-1 defines the variables and attributes that contain standard coordinate data.

Table 4.3.7-1 Variables and Attributes Containing Standard Coordinate Data

Variable / Attribute	Description
lat -> add_offset lon -> add_offset	Attribute add_offset of coordinate variables "lat" and "lon" contains the latitude and longitude for center, respectively, of the upper left (i.e., most northwest) data point in the image. This value varies with the location of the image for mesoscale.
lat -> scale_factor lon -> scale_factor	Attribute add_offset of coordinate variables "lat" and "lon" contains the horizontal spatial resolution of the image.
lat_image_center lon_image_center	These coordinate variables contain the latitude and longitude of the center the image. These values vary with the location of the image for mesoscale. Note that this center location is the ABI fixed grid center of the source ABI level 1b Radiances image data.
lat_image_bounds lon_image_bounds	These boundary variables contain the latitude and longitude of the west and east, and north and south extents, respectively, of the image. These values vary with the location of the image for mesoscale.
geospatial_lat_lon_extent -> geospatial_lat_nadir geospatial_lat_lon_extent -> geospatial_lon_nadir geospatial_lat_lon_extent -> geospatial_lat_center geospatial_lat_lon_extent -> geospatial_lon_center geospatial_lat_lon_extent -> geospatial_northbound_latitude geospatial_lat_lon_extent ->	This variable and its attributes contain the latitude and longitude of the satellite's nadir, center of the image, and north, south, west, and east extents of the image. Except for the satellite's nadir, these values vary with the location of the image for mesoscale.

Variable / Attribute	Description
geospatial_southbound_latitude geospatial_lat_lon_extent -> geospatial_westbound_longitude geospatial_lat_lon_extent -> geospatial_eastbound_longitude	

Table 4.3.7-2 identifies the latitude and longitude of the center of the most northwest pixel in full disk and CONUS images (i.e., lat and lon coordinate variables' add_offsets), and the lat and lon coordinate variables' scale_factors.

Table 4.3.7-2 Shortwave Radiation Product Image Standard Upper Left Coordinates

		Horizontal Spatial Resolution	
		0.25 degrees (approximately 25 km at nadir)	**0.5 degrees (approximately 50 km at nadir)**
Full Disk All (East, West, & Test)	**add offset for lat**	81.375	81.25
	scale factor for lat	-0.25	-0.5
	scale factor for lon	0.25	0.5
Full Disk East	**add offset for lon**	-156.375	-156.25
Full Disk West	**add offset for lon**	141.625	141.75
Full Disk Test	**add offset for lon**	-170.875	-170.75
CONUS All (East, West, & Test)	**scale factor for lat**	-0.25	*not applicable*
	scale factor for lon	0.25	
CONUS East	**add offset for lat**	56.375	
	add offset for lon	-151.875	
CONUS West	**add offset for lat**	53.125	
	add offset for lon	-183.125	
CONUS Test	**add offset for lat**	53.0	
	add offset for lon	-140.75	

Table 4.3.7-3 identifies the latitude and longitude of the center and extents of the full disk and CONUS shortwave radiation product images. Note that these coordinates exist in two forms in the product files. One form is the coordinate variables required to conform to the CF metadata conventions. The other form is attributes used for data discovery.

Table 4.3.7-3 Shortwave Radiation Product Image Center and Extents

coordinate variable / attribute for data discovery *latitude is degrees north longitude is degrees east*	**Full Disk East**	**Full Disk West**	**Full Disk Test**	**CONUS East**	**CONUS West**	**CONUS Test**
lat_image_center / geospatial_lat_center	0.0	0.0	0.0	30.083003	29.8659	29.294
lon_image_center / geospatial_lon_center	-75.0	-137.0	-89.5	-87.096958	-137.0	-91.406
lat_image_bounds (1) / geospatial_northbound_latitude	81.5	81.5	81.5	56.5	53.25	53.0
lat_image_bounds (2) / geospatial_southbound_latitude	-81.5	-81.5	-81.5	14.5	14.50	14.0

coordinate variable / ***attribute for data discovery*** ***latitude is degrees north*** ***longitude is degrees east***	**Full Disk East**	**Full Disk West**	**Full Disk Test**	**CONUS East**	**CONUS West**	**CONUS Test**
lon_image_bounds (1) / geospatial_westbound_longitude	-156.5	141.5	-171.0	-152.0	176.875	-140.625
lon_image_bounds (2) / geospatial_eastbound_longitude	6.5	-55.5	-8.0	-53.25	-90.5	-49.0

4.3.8 Overlaying Data from Different Image Types and Satellites

GOES-R ABI Level 2+ shortwave radiation product data users may need to overlay full disk, CONUS, and mesoscale shortwave radiation products for data processing and display purposes.

The netCDF coordinate variables contain the latitude and longitude coordinates that correspond to each point in the data variable. However, the array subscripts for a netCDF data variable are relative to the most northwest data point in the particular product file.

When the resolutions of the products are the same, the following equation allows one to map the data variable array subscripts from the product containing the geographically smaller region to the product containing the geographically larger region. Note that the data variable array element (0,0) corresponds to the most northwest data point in the image data.

$^{\wedge}LAT_L = (LAT_L - LAT_S) / \alpha$

$^{\wedge}LON_L = (LON_S - LON_L) / \alpha$

where,

LAT_S *latitude for smaller region's northwest data point*

LON_S *longitude for smaller region's northwest data point*

LAT_L *latitude for larger region's northwest data point*

LON_L *longitude for larger region's northwest data point*

α *horizontal spatial resolution of the data in degrees*

$^{\wedge}LAT_L$ *larger region's data variable latitude axis subscript for smaller region's northwest data point*

$^{\wedge}LON_L$ *larger region's data variable longitude axis subscript for smaller region's northwest data point*

The use of a global latitude/longitude grid for shortwave radiation product data allows for overlaying and merging data from GOES-R satellites operating at different orbital slots. The same equation is used to support this except the terms for the larger region are generalized to become the anchor region from a data processing and display standpoint.

In the case where the resolution of the products being overlaid is not the same, the same general thinking applies, except "α" needs to be the horizontal spatial resolution of the data in degrees for the geographically larger or anchor product, and the application will need to deal with incongruities caused by the differing resolutions of the products.

Example

This example shows how a 0.25 degree CONUS product can be overlaid on a 0.25 degree Full Disk product from the GOES-R East satellite at -75 degrees east longitude.

Table 4.3.8 captures the parameters required.

Table 4.3.8 Parameters for 0.25 Degree CONUS Product Overlay on 0.25 Degree Full Disk Product

Parameter Name	netCDF Product Variable / Attribute Name	Value (degrees north for latitude, degrees east for longitude)
LAT_{CONUS}	CONUS coordinate variable y(0)	56.5
LON_{CONUS}	CONUS coordinate variable x(0)	-152.0
$LAT_{FullDisk}$	Full Disk coordinate variable y(0)	81.5
$LON_{FullDisk}$	Full Disk coordinate variable x(0)	-156.5
α	CONUS product file <*primary data variable*>:resolution	0.25

Using the equations defined above:

$^{\wedge}LAT_{FullDisk} = (LAT_{FullDisk} - LAT_{CONUS}) / \alpha = (81.5 - 56.5) / 0.25 = 100$

$^{\wedge}LON_{FullDisk} = (LON_{CONUS} - LON_{FullDisk}) / \alpha = (-152.0 - -156.5) / 0.25 = 18$

Therefore:

(1) Full Disk location for coordinate variable lat (100) and lon (18) is same location as CONUS coordinate variable lat(0) and lon(0)

(2) <DataVariable> Full Disk (100,18) is same location as <DataVariable> CONUS (0,0)

4.4 Common Level 2+ Product Coordinates

Coordinates are included in the product files, and provide the capability to locate individual product data values in space and time. Space not only refers to physical location but can refer to wavelength within the electromagnetic spectrum, atmospheric pressure levels, location relative to sun or the sensing platform, and other points of reference meaningful to the particular data quantity. Coordinates are described in detail in the CF Metadata Conventions section in the main volume of the PUG.

Table 4.4, Common Level 2+ Product Coordinates identifies and describes coordinates common to multiple ABI Level 2+ products.

Table 4.4 Common Level 2+ Product Coordinates

Coordinate	Description
Geo-location coordinates	The geo-location coordinates for product data points on the ABI fixed grid are the N/S elevation and E/W scanning angles stored in variables "y" and "x", respectively. A mapping to latitude and longitude coordinates is required. Refer to the paragraph 4.1.2 ABI Fixed Grid, for additional details. The geo-location coordinates for product-level metadata on the ABI fixed grid, such as the roll-up statistics associated with the gridded data, are the N/S elevation and E/W scanning angles for the center of the product and its bounding rectangle. These coordinate values are stored in variables "y_image", "x_image", "y_image_bounds", and "x_image bounds".

Coordinate	Description
	The geo-location coordinates for product data points not on the ABI fixed grid are latitude and longitude coordinates. These coordinate values are stored in variables "y" and "x", respectively. The geo-location coordinates for product-level metadata not on the ABI fixed grid, such as the roll-up statistics associated with the Derived Motion Winds product, are the latitude and longitude for the center of the product and its bounding rectangle. These coordinate values are stored in variables "y_image", "x_image", "y_image_bounds", and "x_image bounds".
Observation time period	The time coordinates for the product data and metadata are the mid-point, and start and end time of the sensing period for the product. These coordinate values are stored in variables "t" and "time_bounds".
Band central wavelength and identifier	The band central wavelength and corresponding band identifier where applicable for wavelength dependent data quantities. These coordinate values are stored in variables "band_wavelength" and "band_id", respectively.
Local zenith angle	There are many ABI Level 2+ products where the angle between the line of sight to the satellite and the zenith at the observation target has an adverse effect on the quality of product data or precludes its generation. The local zenith angle coordinates identify the specific angular constraints. These coordinate values are stored in variables whose names have the string "local_zenith_angle" and "local_zenith_angle_bounds". Additional details on the use of local zenith angle coordinate variables are discussed in paragraph 4.4.1 Local and Solar Zenith Angle Coordinate Variable Usage.
Solar zenith angle	There are many Level 2+ products where the angle between the line of sight to the sun and the zenith at the observation target has an adverse effect on the quality of product data or precludes its generation. This coordinate is also used to indicate day-only product data. These coordinate values are stored in variables whose names have the string "solar_zenith_angle" and "solar_zenith_angle_bounds". Additional details on the use of solar zenith angle coordinate variables are discussed in paragraph 4.4.1 Local and Solar Zenith Angle Coordinate Variable Usage.

4.4.1 Local and Solar Zenith Angle Coordinate Variable Usage

The vast majority of ABI Level 2+ products have one or both local and solar zenith angle constraints. In fact, many of these products have one or both two local and two solar zenith angle constraints. Typically, the reason a product has two local or solar zenith angle constraints is that there is one angular constraint for good and degraded quality data production, and another more restrictive angular constraint for good quality data production. It is important to note that there are products that have a zenith angle constraint for data production, and that the same constraint is also associated with good quality data production. That is, there is no degraded quality data production. It is also important to note that there are cases where different local and solar zenith angle constraints apply to the variables in a product.

A key design objective for the ABI Level 2+ detailed product specifications is that they result in a product that is self-describing and clear. The use of local and solar zenith angle coordinate variables where they may be associated with good, or good or degraded quality product data, coupled with the need for multiple zenith angle coordinate variables of each type introduce complexity, and have the potential to cause confusion. As a result, a set of zenith angle coordinate variable product specification conventions have been developed and applied across all the ABI Level 2+ products to minimize confusion. The conventions are as follows:

- When both local and solar zenith angle constraints do not apply to an ABI Level 2+ product, local and solar zenith angle coordinate variables are not specified.

- When a product has a local or solar zenith angle constraint, both local and solar zenith angle coordinate variables are specified.
- When a product has only one local zenith angle constraint, the name of the coordinate variable is "local_zenith_angle". When a product has only one solar zenith angle constraint, the name of the coordinate variable is "solar_zenith_angle".
- When a product has more than one local zenith angle constraint, the name of the coordinate variable associated with data production is "retrieval_local_zenith_angle". When a product has more than one solar zenith angle constraint, the name of the coordinate variable associated with data production is "retrieval_solar_zenith_angle".
- When a product has one local zenith angle constraint for good and degraded quality data production, and another for good quality data production, the name of the coordinate variable for the latter is "quantitative_local_zenith_angle". When a product has one solar zenith angle constraint for good and degraded quality data production, and another for good quality data production, the name of the coordinate variable for the latter is "quantitative_solar_zenith_angle".

The value of the long_name attribute for these zenith angle coordinate variables capture the quality of the product data for which they are associated.

These zenith angle coordinate variables are associated with the product primary data, data quality flag, and statistic variables as applicable. In the case of product primary data variables, all zenith angles coordinate variables defined for the product are associated with these variables because the fidelity of the values of the primary data variable elements are dependent on the angular constraints defined by zenith angle coordinate variables.

In the case of the data quality flag variables, these zenith angle coordinate variables indicate whether the values of data quality flag variable elements are dependent on the specific zenith angle coordinate variable. For example, should the value of a data quality flag variable provide an indication for the angular constraint where product data is produced, only the zenith coordinate variable for data production is associated with the data quality flag variable. However, should the value of a data quality flag variable provide an indication for the angular constraints where good and degraded quality data is produced, and where good quality data is produced, the zenith coordinate variables for both good and degraded quality, and good quality data production are associated with the data quality flag variable.

For the product statistic variables, only one local and one solar zenith coordinate variable are associated with the product statistic variables because the calculations used to generate the statistical values uses one local and one solar zenith angle angular constraint.

4.5 Common Level 2+ Product Data Quality Flag Variables

A data quality flag provides one or more indicators of quality. It is associated with:

- each data point in the case of an ABI Level 2+ gridded product
- each wind vector or hurricane intensity estimate in the case of the Derived Motion Winds and Hurricane Intensity Estimate products, respectively
- each Lightning Detection product flash and constituent group

The dimensions of the variable containing the data quality flags mirror that of the variable containing the data. The relationship between the data variable and the data quality flag variable is expressed by attaching the attribute ancillary_variables to the data variable in accordance with the CF Metadata Conventions. The value of this attribute is the name of the variable containing the data quality flags, usually DQF unless the product file contains multiple DQF variables.

The possible values assigned to a data quality flag vary for each Level 2+ product. This is a result of the different science and boundary conditions, and design approaches associated with each Level 2+ algorithm. Some products provide the quality of the product data elements, while others provide the quality of the algorithm execution (i.e., retrieval) for the product data elements. Some products include a binary indication of quality while others include many indications of quality. The CF Metadata Convention attributes flag_values, flag_mask, and flag_meanings are used to express the data quality flag values and their meaning. Refer to the CF Metadata Conventions paragraph in the main volume of the PUG for additional details.

4.6 Common Level 2+ Product Statistics

The Level 2+ products contain data transmission error statistics that provide a summary level indication of the availability of error-free source data required for the generation of the product.

The Level 2+ products contain the percentage of data elements (e.g., gridded data points, etc.) associated with each data quality flag value. In the case of gridded data products on the ABI fixed grid, the value of the denominator used in calculating this percentage is the number of data points where the source data for the data points can be geolocated (i.e., on-earth). In the case of Derived Motion Winds, the value of the denominator is the number of wind vectors. In the case of Lightning Detection, the value of the denominators for the flag and group quality flags are the number of flashes and groups, respectively, in the product file.

The ABI Level 2+ products whose data quantities are continuous other than the Legacy Vertical Moisture and Temperature Profile products contain minimum, maximum, mean, and standard deviation values associated with their primary data, which is a gridded data set in all cases except the Derived Motion Winds product. The specific product data elements used in the determination of these statistics varies among the different products. What specific data elements are used is expressed in description paragraph for each product and the attribute cell_methods attached to the statistic data variables in the product metadata.

The ABI Level 2+ gridded products whose data quantities are continuous, and not categorical, or report at multiple levels in the atmosphere, include outlier counts, which are processed pixels who values are outside the valid measurement range.

The minimum, maximum, mean, and standard deviation values for mode 4 CONUS products are slightly skewed because of the design used in extracting CONUS products from the Full Disk product.

4.7 Level 2+ Gridded Product Data Scaling and Compression

Level 2+ gridded product data, specifically the one or more gridded environmental physical quantities, are unsigned 16 bit integers whose values are the result of a scaling operation. The conventions used to specify the scaling information, specifically the data variable attributes scale_factor and add_offset, conform to the netCDF User's Guide (NUG) recommendations defined in the main volume of the PUG. In the event, the algorithm generates a data value less or greater than the valid range, the scaled value is assigned to be the minimum or maximum value in the valid range, respectively.

Level 2+ gridded product data, specifically the one or more gridded environmental physical quantities, and the data quality flags are losslessly compressed using a built-in netCDF API compression feature. Applications that make use of these Level 2+ product files, which make use of the netCDF API, do not have to do anything special to read the compressed data.

5.0 LEVEL 2+ PRODUCT AND DATA DESCRIPTIONS

This section of the document describes and defines the detailed content and format of the GOES-R Level 2+ product files.

The Level 2+ products include a metadata field identifying the percentage of product data lost due to uncorrectable Level 0 data errors. The Level 2+ products other than Lightning Detection include a metadata field identifying the percentage of product data lost due to uncorrectable GRB data errors. These metadata fields are not specifically discussed in the product description paragraphs.

There are two variable attributes that denote versions – product_version and algorithm_version. These attributes are independent of each other. Algorithm version will always increment when a new algorithm version is installed. Product version will also increment for a new algorithm, but may also increment due to a change to a product that is not an algorithm update.

Tables are used to communicate the detailed content. For each type of netCDF product file, one table defines their global attributes in the file. Another table defines their variables and their variables' attributes. By default, in the product tables included in the volume, the values of the variables are dynamic and the values of the attributes are static. However, there are situations when an attribute value is selected from a list of valid values, has a fixed format, or is a dynamic value. Furthermore, there are situations where a variable or attribute value contains geospatial coordinates, dimensioning information related to coverage areas and resolution, band dependent values, or flag values. For all these cases, ***bold italic text*** is used to convey how to properly interpret what the value of the variable or attribute should be.

5.0.1 Time Representation and Conversion

Products and data files described in this volume contain time and time-related variables that represent the seconds since J2000 (J2K) epoch (2000-01-01 12:00:00 UTC). Below are three methods that can be used to convert the "seconds since J2000 epoch" value into a standard calendar date and time. The following URL contains numerous other methods that are used in various computer languages (e.g., C, Perl, Python):

http://www.epochconverter.com.

Let "SSE" represent the value of "seconds since J2000 epoch".

Microsoft Excel conversion:

1. Enter into cell A1: =DATE(2000,1,1) + TIME(12,0,0)
2. Enter into cell A2: =SSE/24/3600
3. Enter into cell A3: =A2+A1
4. Change the format of cell A3 as desired (e.g., Format Cells > Number > Category:Date, Type:choose format)

IDL conversion:

1. epoch = julday(1,1,2000,12,0,0)
2. CALDAT, epcoh + SSE, month, day, year, hour, minute, second
3. time_format = '(I04,"-",I02,"-",I02,"T",I02,":",I02,":",I02,"Z")'
4. print, year, month, day, hour, minute, second, FORMAT=time_format

Linux workstation conversion:

1. Add 946,728,000 to SSE (946,728,000 is the difference in seconds between J2000 epoch and the UNIX epoch (1/1/1970):
    a. SUM=$((946728000 + SSE))
2. Enter on the command line:

a. date -u -d @${SUM}

Note: this method may not work after January 19, 2038, which is the largest date the linux "date" command can support on some machines.

5.0.2 Unsigned Integer Processing

The classic model for netCDF (used by the GS) does not support unsigned integers larger than 8 bits. Many of the variables in GOES-R netCDF files are unsigned integers of 16-bit or 32-bit length. The following process is recommended to convert these unsigned integers:

1. Retrieve the variable data from the netCDF file.
2. For this variable, retrieve the attribute "_Unsigned".
3. If the "_Unsigned" attribute is set to "true" or "True", then cast the variable data to be unsigned.

The steps above must be completed before applying the scale_factor and add_offset values to convert from scaled integer to science units. Also, the valid_range and _FillValue attribute values are to be governed by the "_Unsigned" attribute.

5.1 Cloud and Moisture Imagery Product

5.1.1 Description

The Cloud and Moisture Imagery product contains one or more Earth-view images with pixel values identifying "brightness values" that are scaled to support visual analysis. The product includes data quality information that provides an assessment of the cloud and moisture imagery data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

Cloud and Moisture Imagery product files are generated for each of the sixteen ABI reflective and emissive bands. In addition, there is a multi-band product file where the imagery at all bands is included.

The brightness value bit depth for all sixteen bands is 12 bits with the exception of band 7, which is 14 bits. This brightness value is stored as a scaled 16 bit integer. A user of the imagery product can apply enhancements to convert the product for display. For example, a square-root function or bi-linear stretch can be included in the transformation of the brightness values from the product image bit depth to a depth of 8 bits.

The imagery value for the reflective bands, ABI bands 1 through 6, is a dimensionless "reflectance factor" quantity that is normalized by the solar zenith angle. These bands support the characterization of clouds, vegetation, snow/ice, and aerosols. The imagery value for the emissive bands, ABI bands 7 through 16, is the brightness temperature at the Top-Of-Atmosphere (TOA) in Kelvin. These bands support the characterization of the surface, clouds, water vapor, ozone, volcanic ash and dust based on emissive properties. Table 5.1.1, Applications of the Cloud and Moisture Imagery Product, identifies the ABI bands and their central wavelength, native horizontal spatial resolution, and applications for the product. The pixels' brightness values may be used individually with custom color tables or combined as red/green/blue color composites resulting in enhanced imagery intended to highlight environmental features of interest.

Table 5.1.1 Applications of the Cloud and Moisture Imagery Product

ABI Band	Central Wavelength (um)	Native Resolution (km at nadir)	Applications
1	0.47	1	Daytime aerosol over land, coastal water mapping.
2	0.64	0.5	Daytime clouds, fog, insolation, winds.
3	0.865	1	Daytime vegetation, burn scar, aerosol over water, winds.

ABI Band	Central Wavelength (um)	Native Resolution (km at nadir)	Applications
4	1.378	2	Daytime cirrus cloud.
5	1.61	1	Daytime cloud-top phase and particle size, snow.
6	2.25	2	Daytime land, cloud properties, particle size, vegetation, snow.
7	3.9	2	Surface and cloud, fog at night, fire, winds.
8	6.185	2	High-level atmospheric water vapor, winds, rainfall.
9	6.95	2	Midlevel atmospheric water vapor, winds, rainfall.
10	7.34	2	Lower-level water vapor, winds, and silicon dioxide.
11	8.5	2	Total water for stability, cloud phase, dust, silicon dioxide, rainfall.
12	9.61	2	Total ozone, turbulence, winds.
13	10.35	2	Surface and clouds.
14	11.2	2	Imagery, sea surface temperature, clouds, rainfall.
15	12.3	2	Total water, volcanic ash, sea surface temperature.
16	13.3	2	Air temperature, cloud heights.

The Cloud and Moisture Imagery product image is produced on the ABI fixed grid for Full Disk, CONUS, and Mesoscale coverage regions. The resolution of the sixteen single-band images in the multi-band product file is 2 km.

There are no measurement performance requirements associated with the Cloud and Moisture Imagery product. The mapping accuracy requirement is 1 km for all sixteen ABI bands.

Metadata in the Cloud and Moisture Imagery product provides statistical and other properties of the product image(s) and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Solar radiance and irradiance values that vary as a function of the Earth-Sun distance and Planck constants used for cloud and moisture imagery correction.
- Number of geolocated pixels.
- Number of good and conditionally usable pixels.
- Number of cloud and moisture imagery pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the cloud and moisture imagery values in the product image.

The cloud and moisture imagery outlier count and minimum, maximum, mean, and standard deviation values are calculated using good and conditionally usable quality pixels. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Cloud and Moisture Imagery product is located in the standalone Appendix X, ISO Series Metadata.

5.1.2 Dynamic Source Data

The Cloud and Moisture Imagery product is derived using unprocessed ABI Level 1b reflective and emissive band images from the current observation. In addition, the algorithm uses dynamic auxiliary data, specifically solar zenith angle data.

The primary sensor data used by the Cloud and Moisture Imagery algorithm is identified in 5.1.2-1 Primary Sensor Data.

Table 5.1.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_1_1km_data

Dynamic Data Category	Dynamic Data Type
	input_ABI_L1b_radiance_band_2_half_km_data input_ABI_L1b_radiance_band_3_1km_data input_ABI_L1b_radiance_band_4_2km_data input_ABI_L1b_radiance_band_5_1km_data input_ABI_L1b_radiance_band_6_2km_data input_ABI_L1b_radiance_band_7_2km_data input_ABI_L1b_radiance_band_8_2km_data input_ABI_L1b_radiance_band_9_2km_data input_ABI_L1b_radiance_band_10_2km_data input_ABI_L1b_radiance_band_11_2km_data input_ABI_L1b_radiance_band_12_2km_data input_ABI_L1b_radiance_band_13_2km_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L1b_radiance_band_15_2km_data input_ABI_L1b_radiance_band_16_2km_data

The other dynamic source data inputs are summarized in Table 5.1.2-2, Other Dynamic Source Data.

Table 5.1.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.1.3 Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Cloud and Moisture Imagery ground-processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm specific parameters represent parameters that are unique to Cloud and Moisture Imagery algorithm. These include:

- Flag indicating the method for downscaling to 2 km (0 = subsampled; 1 = averaged).
- Maximum solar zenith angle limit for calculations of the intermediate reflectance used in Level 2 ground processing.
- Minimum/maximum valid range /outlier limits on bands 1 to 6 reflectance factor.
- Minimum/maximum valid range /outlier limits on bands 7 to 16 brightness temperature.

Common library parameters shared across multiple algorithms are used by the Cloud and Moisture Imagery algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These parameters include:

- Band wavelength map associating each of 16 ABI bands with the corresponding center wavelength.

- Solar irradiance in bands 1 to 6 used in the computation of the kappa factor conversion for the reflectance factor calculation.
- Spectral bandpass correction constants bc1 and bc2 used in the calculation of brightness temperature.
- Scale factors to convert L1b input pixel radiance values from scaled integers to floating point values.

The category of gridded parameters used in the generation of the Cloud and Moisture Imagery product is projection and mapping. The specific type of gridded semi-static source data in the categories used in the generation of the Cloud and Moisture Imagery product are identified in Table 5.1.3 Gridded Semi-Static Source Data.

Table 5.1.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-ImagerySemiStaticParams.bin
- LibraryServices_DMI_ABI_Parameters.bin
- parms.tar

5.1.4 Coordinates

The coordinates associated with data variables in the Cloud and Moisture Imagery product are identified in Table 5.1.4, Cloud and Moisture Imagery Product Coordinates.

Table 5.1.4 Cloud and Moisture Imagery Product Coordinates

Cloud and Moisture Imagery Product Data Quantity	Coordinates
cloud and moisture imagery data cloud and moisture imagery data quality flags	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Central wavelength and identifier of the ABI band
cloud and moisture imagery pixel counts cloud and moisture imagery minimum, maximum, mean, and standard deviation values	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Central wavelength and identifier of the ABI band
solar irradiance (esun) inverse of the incoming top of atmosphere radiance (kappa0)	• Observation time period • Central wavelength and identifier of the ABI band
planck constants	• Central wavelength and identifier of the ABI band
Earth – sun distance anomaly	• Observation time period
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.1.5 Production Notes

The Cloud and Moisture product is generated by the GOES-R ABI Cloud and Moisture Imagery ground processing algorithm. Production of the reflective bands depends on the solar radiance at the Earth-Sun distance at the time of observation, and the solar zenith angle. The inverse of the solar radiance is represented by the "kappa0" variable in the product file. The dynamic range of the reflectance factor and brightness temperature output is not constrained by the algorithm but it is compared to the expected measurement range for each band based on the ABI's dynamic range.

The bit depth of the source Level 1b Radiances product for the Cloud and Moisture Imagery product, 10 to 14 bits, is band dependent, and is based on the bit depth of the down-linked samples from the ABI coupled with optimization considerations for GRB transmission. The bit depth for each of the sixteen bands is identified in Table 5.1.6.4-1, Cloud and Moisture Imagery Product Quantity Characteristics.

A conditionally usable pixel means less than the full complement of sixteen radiometrically corrected data samples but at least twelve data samples are used in the formulation of the pixel value. Pixels can be either under-saturated or over-saturated. The valid range of pixel values is identified in Table 5.1.6.4-1, Cloud and Moisture Imagery Product Quantity Characteristics. Under-saturated and over-saturated pixels are assigned the minimum and maximum value in the valid range, respectively.

The Cloud and Moisture Imagery algorithm also generates intermediate reflectance and brightness temperature products used in the generation of other ABI Level 2+ products. The Cloud and Moisture Imagery algorithm final and intermediate data product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

The Cloud and Moisture Imagery product is generated for each observation performed by the instrument. For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Cloud and Moisture Imagery ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Cloud and Moisture Imagery. This document is located at
http://www.goes-r.gov/products/ATBDs/baseline/Imagery_v2.0_no_color.pdf.

5.1.6 Data Fields

The Cloud and Moisture Imagery product is delivered using the netCDF-4 file format. The specifications for the reflective and emissive bands are different, and, as a result, separate tables are used to convey their content. In addition, there are metadata fields in the Cloud and Moisture Imagery product related to the physical quantity that varies as a function of the band. Following the product specification tables are subordinate paragraphs containing tables that clearly communicate the physical quantity characteristics that vary as a function of the bands, and values and meanings for the flag variables in the product.

The filename conventions for the Cloud and Moisture Imagery product are located in Appendix A.

5.1.6.1 Reflective Bands Data Fields

Table 5.1.6.1-1 Cloud and Moisture Imagery for Reflective Bands: Global Attributes

Global Attribute Name	Value	Type
id	***universally unique identifier (UUID) for the instance of the product.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	8c9e8150-3692-11e3-aa6e-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud and Moisture Imagery	string
summary	Single reflective band Cloud and Moisture Imagery Products are digital maps of clouds, moisture, and atmospheric windows at visible and near-IR bands.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > ATMOSPHERIC RADIATION > REFLECTANCE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string

Global Attribute Name	Value	Type
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	***possible values are 0.5km at nadir, 1km at nadir, and 2km at nadir.***	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	

Table 5.1.6.1-2 Cloud and Moisture Imagery for Reflective Bands: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string

Variable			**Attribute**		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_ time_bounds = 2	long_name	Scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
band_wavelength ***value = see note [2]***	float	band = 1	long_name	ABI band central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_id ***value = see note [2]***	byte	band = 1	long_name	ABI channel number	string
			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_ image_ bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds	float		long_name		string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
value = ***see note [1]***		number_of_ image_ bounds = 2		GOES-R fixed grid projection x-coordinate west/east extent of image	
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
CMI	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	***see note [2]***	byte
			valid_range	***see note [2]***	short
			scale_factor	***see note [2]***	float
			add_offset	***see note [2]***	float
			units	1	string
			resolution	y: see note [2] rad x: see note [2] rad	string
			coordinates	band_id band_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id band_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***1.2 see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
total_number_of_points	int	n/a	long_name	number of geolocated/not missing pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: see note [2] rad comment: geolocated/not missing pixels only)	string
valid_pixel_count	int	n/a	long_name	number of good and conditionally usable pixels	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count	int	n/a	long_name	number of cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: see note [2] rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_reflectance_factor	float	n/a	long_name	minimum reflectance factor value of pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
max_reflectance_factor	float	n/a	long_name	maximum reflectance factor value of pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
mean_reflectance_factor	float	n/a	long_name	mean reflectance factor value of pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
std_dev_reflectance_factor	float	n/a	long_name	standard deviation of reflectance factor values of pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
esun	float	n/a	long_name	bandpass-weighted solar irradiance at the mean Earth-Sun distance	string
			standard_name	toa_shortwave_irradiance_per_unit_wavelength	string
			_FillValue	-999.0	float
			units	W m-2 um-1	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id band_wavelength t	string
			cell_methods	t: mean	string
kappa0	float	n/a	long_name	Inverse of the incoming top of atmosphere radiance at current earth-sun distance (PI d2 esun-1)-1, where d is the ratio of instantaneous Earth-Sun distance divided by the mean Earth-Sun distance, esun is the bandpass-weighted solar irradiance and PI is a standard constant used to convert ABI L1b radiance to reflectance	string
			_FillValue	-999.0	float
			units	(W m-2 um-1)-1	string
			coordinates	band_id band_wavelength t	string
			cell_methods	t: mean	string
planck_fk1	float	n/a	long_name	wavenumber-dependent coefficient (2 h c2/ nu3) used in the ABI emissive band monochromatic brightness temperature computation, where nu =central wavenumber and h and c are standard constants	string
			_FillValue	-999.0	float
			units	W m-1	string
			coordinates	band_id band_wavelength	string
planck_fk2	float	n/a	long_name	wavenumber-dependent coefficient (h c nu/b) used in the ABI emissive band monochromatic brightness temperature computation, where nu = central wavenumber and h, c, and b are standard constants	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id band_wavelength	string
planck_bc1	float	n/a	long_name	spectral bandpass correction offset for brightness temperature (B(nu) – bc_1)/bc_2 where B()=planck_function() and nu=wavenumber	string
			_FillValue	-999.0	float
			units	K	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id band_wavelength	string
planck_bc2	float	n/a	long_name	spectral bandpass correction scale factor for brightness temperature (B(nu) – bc_1)/bc_2 where B()=planck_function() and nu=wavenumber	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id band_wavelength	string
earth_sun_distance_anomaly_in_AU	float	n/a	long_name	earth sun distance anomaly in astronomical units	string
			_FillValue	-999.0	float
			units	ua	string
			coordinates	t	string
			cell_methods	t: mean	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999.0	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999.0	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
value = 0.00			standard_name	latitude	string
			_FillValue	-999.0	float
			units	degrees_north	string
nominal_satellite_subpoint_ lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999.0	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999.0	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_ longitude	***see note [1]***	float
			geospatial_northbound_ latitude	***see note [1]***	float
			geospatial_eastbound_ longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0.0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_dat a_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_auxiliary_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L1b_radiance_ band_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
processing_parm_version_con tainer	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_co ntainer	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note 2: Cloud and Moisture Imagery product quantity characteristics are located in paragraph 5.1.6.4, Cloud and Moisture Imagery Product Quantity Characteristics.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.1.6.5, Cloud and Moisture Imagery Product Data Quality Flag Values and Meanings.

5.1.6.2 Emissive Bands Data Fields

Table 5.1.6.2-1 Cloud and Moisture Imagery for Emissive Bands: Global Attributes

Global Attribute Name	Value	Type
id	***universally unique identifier (UUID) for the instance of the product.***	string
dataset_name	***refer to filename conventions for ABI L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	8c9e8150-3692-11e3-aa6e-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string

Global Attribute Name	Value	Type
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud and Moisture Imagery	string
summary	Single emissive band Cloud and Moisture Imagery Products are digital maps of clouds, moisture, and atmospheric windows at IR bands.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > BRIGHTNESS TEMPERATURE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	***possible values are 0.5km at nadir, 1km at nadir, and 2km at nadir.***	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.1.6.2-2 Cloud and Moisture Imagery for Emissive Bands: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	Scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
band_wavelength ***value = see note [2]***	float	band = 1	long_name	ABI band central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_id ***value = see note [2]***	byte	band = 1	long_name	ABI band number	string
			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
CMI	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	***see note [2]***	byte
			valid_range	***see note [2]***	short
			scale_factor	***see note [2]***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			add_offset	***see note [2]***	float
			units	K	string
			resolution	y: see note [2] rad x: see note [2] rad	string
			coordinates	band_id band_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id band_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
total_number_of_points	int	n/a	long_name	number of geolocated/not missing pixels	string
			_FillValue	-1	int

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	count	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: see note [2] rad comment: geolocated/not missing pixels only)	string
valid_pixel_count	int	n/a	long_name	number of good and conditionally usable pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count	int	n/a	long_name	number of cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: see note [2] rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature	float	n/a	long_name	minimum top of atmosphere brightness temperature value of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id band_wavelength t y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature	float	n/a	long_name	maximum top of atmosphere brightness temperature value of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature	float	n/a	long_name	mean top of atmosphere brightness temperature value of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature	float	n/a	long_name	standard deviation of top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id band_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: see note [2] rad comment: good and conditionally usable quality pixels only)	string
esun	float	n/a	long_name	bandpass-weighted solar irradiance at the mean Earth-Sun distance	string
			standard_name	toa_shortwave_irradiance_per_unit_ wavelength	string
			_FillValue	-999.0	float
			units	W m-2 um-1	string
			coordinates	band_id band_wavelength t	string
			cell_methods	t: mean	string
kappa0	float	n/a	long_name	Inverse of the incoming top of atmosphere radiance at current earth-sun distance (PI d2 esun-1)-1, where d is the ratio of instantaneous Earth-Sun distance divided by the mean Earth-Sun distance, esun is the bandpass-weighted solar irradiance and PI is a standard constant used to convert ABI L1b radiance to reflectance	string
			_FillValue	-999.0	float
			units	(W m-2 um-1)-1	string
			coordinates	band_id band_wavelength t	string
			cell_methods	t: mean	string
planck_fk1 *value* = ***see note [2]***	float	n/a	long_name	wavenumber-dependent coefficient (2 h c2/ nu3) used in the ABI emissive band monochromatic brightness temperature computation, where nu =central wavenumber and h and c are standard constants	string
			_FillValue	-999.0	float
			units	W m-1	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id band_wavelength	string
planck_fk2 *value* = ***see note [2]***	float	n/a	long_name	wavenumber-dependent coefficient (h c nu/b) used in the ABI emissive band monochromatic brightness temperature computation, where nu = central wavenumber and h, c, and b are standard constants	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id band_wavelength	string
planck_bc1 *value* = ***see note [2]***	float	n/a	long_name	spectral bandpass correction offset for brightness temperature (B(nu) – bc_1)/bc_2 where B()=planck_function() and nu=wavenumber	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id band_wavelength	string
planck_bc2 *value* = ***see note [2]***	float	n/a	long_name	spectral bandpass correction scale factor for brightness temperature (B(nu) – bc_1)/bc_2 where B()=planck_function() and nu=wavenumber	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id band_wavelength	string
earth_sun_distance_anomaly_in_AU	float	n/a	long_name	earth sun distance anomaly in astronomical units	string
			_FillValue	-999.0	float
			units	ua	string
			coordinates	t	string
			cell_methods	t: mean	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999.0	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_ errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999.0	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999.0	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999.0	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999.0	float
			units	km	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_ longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_ longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0.0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_ container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L1b_radiance_ band_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
processing_parm_version_contai ner	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_cont ainer	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note 2: Cloud and Moisture Imagery Product quantity characteristics are located in paragraph 5.1.6.4, Cloud and Moisture Imagery Product Quantity Characteristics.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.1.6.5, Cloud and Moisture Imagery Product Data Quality Flag Values and Meanings.

5.1.6.3 Multi-Band Data Fields

Table 5.1.6.3-1 Cloud and Moisture Imagery for Multi-band: Global Attributes

Global Attribute Name	Value	Type
id	***universally unique identifier (UUID) for the instance of the product.***	string
dataset_name	***refer to filename conventions for ABI L2+ products.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	8c9e8150-3692-11e3-aa6e-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud and Moisture Imagery	string
summary	Multiple reflectance and emissive band Cloud and Moisture Imagery Products are digital maps of clouds, moisture, and atmospheric windows at visible, near-IR, and IR bands.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > ATMOSPHERIC RADIATION > REFLECTANCE, SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > BRIGHTNESS TEMPERATURE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.1.6.3-2 Cloud and Moisture Imagery for Multi-band: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_ bounds = 2	long_name	Scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
band_wavelength_C01 ***value = 0.47***	float	band01 = 1	long_name	ABI band 1 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C02 ***value = 0.64***	float	band02 = 1	long_name	ABI band 2 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C03 ***value = 0.865***	float	band03 = 1	long_name	ABI band 3 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
band_wavelength_C04 ***value = 1.378***	float	band04 = 1	long_name	ABI band 4 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C05 ***value = 1.61***	float	band05 = 1	long_name	ABI band 5 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C06 ***value = 2.25***	float	band06 = 1	long_name	ABI band 6 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C07 ***value = 3.9***	float	band07 = 1	long_name	ABI band 7 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C08 ***value = 6.185***	float	band08 = 1	long_name	ABI band 8 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C09 ***value = 6.95***	float	band09 = 1	long_name	ABI band 9 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C10 ***value = 7.34***	float	band10 = 1	long_name	ABI band 10 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C11 ***value = 8.5***	float	band11 = 1	long_name	ABI band 11 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C12 ***value = 9.61***	float	band12 = 1	long_name	ABI band 12 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C13 ***value = 10.35***	float	band13 = 1	long_name	ABI band 13 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
band_wavelength_C14 ***value = 11.2***	float	band14 = 1	long_name	ABI band 14 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C15 ***value = 12.3***	float	band15 = 1	long_name	ABI band 15 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_wavelength_C16 ***value = 13.3***	float	band16 = 1	long_name	ABI band 16 central wavelength	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_id_C01 ***value = 1***	byte	band01 = 1	long_name	ABI band 1	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C02 ***value = 2***	byte	band02 = 1	long_name	ABI band 2	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C03 ***value = 3***	byte	band03 = 1	long_name	ABI band 3	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C04 ***value = 4***	byte	band04 = 1	long_name	ABI band 4	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C05 ***value = 5***	byte	band05 = 1	long_name	ABI band 5	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C06 ***value = 6***	byte	band06 = 1	long_name	ABI band 6	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C07 ***value = 7***	byte	band07 = 1	long_name	ABI band 7	string
			standard_name	sensor_band_identifier	string
			units	1	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
band_id_C08 ***value = 8***	byte	band08 = 1	long_name	ABI band 8	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C09 ***value = 9***	byte	band09 = 1	long_name	ABI band 9	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C10 ***value = 10***	byte	band10 = 1	long_name	ABI band 10	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C11 ***value = 11***	byte	band11 = 1	long_name	ABI band 11	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C12 ***value = 12***	byte	band12 = 1	long_name	ABI band 12	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C13 ***value = 13***	byte	band13 = 1	long_name	ABI band 13	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C14 ***value = 14***	byte	band14 = 1	long_name	ABI band 14	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C15 ***value = 15***	byte	band15 = 1	long_name	ABI band 15	string
			standard_name	sensor_band_identifier	string
			units	1	string
band_id_C16 ***value = 16***	byte	band16 = 1	long_name	ABI band 16	string
			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_ bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_ bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_ origin	0	double
			longitude_of_projection_ origin	***see note [1]***	double
			sweep_angle_axis	x	string
CMI_C01	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_ solar_zenith_angle	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			sensor_band_bit_depth	10	byte
			valid_range	0 4095	short
			scale_factor	0.0002442	float
			add_offset	0	float
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C01 band_wavelength_C01 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: sum (interval: 0.000028 rad)	string
			ancillary_variables	DQF_C01	string
CMI_C02	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	12	byte
			valid_range	0 4095	short
			scale_factor	0.0002442	float
			add_offset	0	float
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C02 band_wavelength_C02 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: sum (interval: 0.000014 rad)	string
			ancillary_variables	DQF_C02	string
CMI_C03	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			sensor_band_bit_depth	10	byte
			valid_range	0 4095	short
			scale_factor	0.0002442	float
			add_offset	0	float
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C03 band_wavelength_C03 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: sum (interval: 0.000028 rad)	string
			ancillary_variables	DQF_C03	string
CMI_C04	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_ solar_zenith_angle	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	11	byte
			valid_range	0 4095	short
			scale_factor	0.0002442	float
			add_offset	0	float
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C04 band_wavelength_C04 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C04	string
CMI_C05	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_ solar_zenith_angle	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			sensor_band_bit_depth	10	byte
			valid_range	0 4095	short
			scale_factor	0.0002442	float
			add_offset	0	float
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C05 band_wavelength_C05 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: sum (interval: 0.000028 rad)	string
			ancillary_variables	DQF_C05	string
CMI_C06	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_ solar_zenith_angle	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	10	byte
			valid_range	0 4095	short
			scale_factor	0.0002442	float
			add_offset	0	float
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C06 band_wavelength_C06 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C06	string
CMI_C07	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			sensor_band_bit_depth	14	byte
			valid_range	0 16383	short
			scale_factor	0.01384667	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C07 band_wavelength_C07 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C07	string
CMI_C08	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	12	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C08 band_wavelength_C08 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C08	string
CMI_C09	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			sensor_band_bit_depth	11	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C09 band_wavelength_C09 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C09	string
CMI_C10	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	12	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C10 band_wavelength_C10 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C10	string
CMI_C11	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			sensor_band_bit_depth	12	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C11 band_wavelength_C11 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C11	string
CMI_C12	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	11	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C12 band_wavelength_C12 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C12	string
CMI_C13	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			sensor_band_bit_depth	12	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C13 band_wavelength_C13 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C13	string
CMI_C14	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	12	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C14 band_wavelength_C14 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C14	string
CMI_C15	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			sensor_band_bit_depth	12	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C15 band_wavelength_C15 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C15	string
CMI_C16	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere	string
			standard_name	toa_brightness_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			sensor_band_bit_depth	10	byte
			valid_range	0 4095	short
			scale_factor	0.03931624	float
			add_offset	173.15	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	band_id_C16 band_wavelength_C16 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			ancillary_variables	DQF_C16	string
DQF_C01	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C01 band_wavelength_C01 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_ usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_ pixel_qf	***dynamic value***	float
			percent_no_value_pixel_ qf	***dynamic value***	float
DQF_C02	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C02 band_wavelength_C02 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_ usable_pixel_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C03	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C03 band_wavelength_C03 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C04	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0, 3	byte
			units	1	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id_C04 band_wavelength_C04 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C05	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C05 band_wavelength_C05 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C06	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery reflectance factor data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C06 band_wavelength_C06 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C07	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C07 band_wavelength_C07 t y x	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_ usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_ pixel_qf	***dynamic value***	float
			percent_no_value_pixel_ qf	***dynamic value***	float
DQF_C08	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C08 band_wavelength_C08 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_us able_pixel_qf	***dynamic value***	float
			percent_out_of_range_pi xel_qf	***dynamic value***	float
			percent_no_value_pixel_ qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
DQF_C09	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C09 band_wavelength_C09 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C10	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C10 band_wavelength_C10 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_value_qf	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C11	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C11 band_wavelength_C11 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
DQF_C12	byte	***y = see note[1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
		x = see note [1]	standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C12 band_wavelength_C12 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_ usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_ pixel_qf	***dynamic value***	float
			percent_no_value_pixel_ qf	***dynamic value***	float
DQF_C13	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C13 band_wavelength_C13 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_ usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_ pixel_qf	***dynamic value***	float
			percent_no_value_pixel_ qf	***dynamic value***	float
DQF_C14	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C14 band_wavelength_C14 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_ usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_ pixel_qf	***dynamic value***	float
			percent_no_value_pixel_ qf	***dynamic value***	float
DQF_C15	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C15 band_wavelength_C15 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float
			percent_conditionally_ usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_ pixel_qf	***dynamic value***	float
			percent_no_value_pixel_ qf	***dynamic value***	float
DQF_C16	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud and Moisture Imagery brightness temperature at top of atmosphere data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	short
			valid_range	0 3	byte
			units	1	string
			coordinates	band_id_C16 band_wavelength_C16 t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_pixel_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_conditionally_usable_pixel_qf	***dynamic value***	float
			percent_out_of_range_pixel_qf	***dynamic value***	float
			percent_no_value_pixel_qf	***dynamic value***	float
outlier_pixel_count_C01	int	n/a	long_name	number of band 1 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C01 band_wavelength_C01 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000028 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_reflectance_factor_C01	float	n/a	long_name	minimum reflectance factor value of band 1 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C01 band_wavelength_C01 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
max_reflectance_factor_C01	float	n/a	long_name	maximum reflectance factor value of band 1 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C01 band_wavelength_C01 t y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
mean_reflectance_factor_C01	float	n/a	long_name	mean reflectance factor value of band 1 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C01 band_wavelength_C01 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
std_dev_reflectance_factor_C01	float	n/a	long_name	standard deviation of reflectance factor values of band 1 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id_C01 band_wavelength_C01 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C02	int	n/a	long_name	number of band 2 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C02 band_wavelength_C02 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: sum area: sum (interval: 0.000014 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_reflectance_factor_C02	float	n/a	long_name	minimum reflectance factor value of band 2 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C02 band_wavelength_C02 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000014 rad comment: good and conditionally usable quality pixels only)	string
max_reflectance_factor_C02	float	n/a	long_name	maximum reflectance factor value of band 2 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C02 band_wavelength_C02 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000014 rad comment: good and conditionally usable quality pixels only)	string
mean_reflectance_factor_C02	float	n/a	long_name	mean reflectance factor value of band 2 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C02 band_wavelength_C02 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	t: sum area: mean (interval: 0.000014C01 rad comment: good and conditionally usable quality pixels only)	string
std_dev_reflectance_factor_C02	float	n/a	long_name	standard deviation of reflectance factor values of band 2 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id_C02 band_wavelength_C02 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000014 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C03	int	n/a	long_name	number of band 3 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C03 band_wavelength_C03 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000028 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_reflectance_factor_C03	float	n/a	long_name	minimum reflectance factor value of band 3 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C03 band_wavelength_C03 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	t: sum area: minimum (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
max_reflectance_factor_C03	float	n/a	long_name	maximum reflectance factor value of band 3 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C03 band_wavelength_C03 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
mean_reflectance_factor_C03	float	n/a	long_name	mean reflectance factor value of band 3 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C03 band_wavelength_C03 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
std_dev_reflectance_factor_C03	float	n/a	long_name	standard deviation of reflectance factor values of band 3 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id_C03 band_wavelength_C03 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: sum area: standard_deviation (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C04	int	n/a	long_name	number of band 4 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C04 band_wavelength_C04 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_reflectance_factor_C04	float	n/a	long_name	minimum reflectance factor value of band 4 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C04 band_wavelength_C04 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_reflectance_factor_C04	float	n/a	long_name	maximum reflectance factor value of band 4 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C04 band_wavelength_C04 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
mean_reflectance_factor_C04	float	n/a	long_name	mean reflectance factor value of band 4 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C04 band_wavelength_C04 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_reflectance_factor_C04	float	n/a	long_name	standard deviation of reflectance factor values of band 4 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id_C04 band_wavelength_C04 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C05	int	n/a	long_name	number of band 5 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C05 band_wavelength_C05 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000028 rad comment: good quality pixels whose values are outside valid measurement range only)	string
	float	n/a	long_name	minimum reflectance factor value of band 5 pixels	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
min_reflectance_factor_C05			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C05 band_wavelength_C05 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
max_reflectance_factor_C05	float	n/a	long_name	maximum reflectance factor value of band 5 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C05 band_wavelength_C05 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
mean_reflectance_factor_C05	float	n/a	long_name	mean reflectance factor value of band 5 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C05 band_wavelength_C05 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
std_dev_reflectance_factor_C05	float	n/a	long_name	standard deviation of reflectance factor values of band 5 pixels	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_ solar_zenith_angle	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id_C05 band_wavelength_C05 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000028 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C06	int	n/a	long_name	number of band 6 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C06 band_wavelength_C06 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_reflectance_factor_ C06	float	n/a	long_name	minimum reflectance factor value of band 6 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_ solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C06 band_wavelength_C06 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_reflectance_factor_ C06	float	n/a	long_name	maximum reflectance factor value of band 6 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_ solar_zenith_angle	string
			_FillValue	-999.0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C06 band_wavelength_C06 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_reflectance_factor_C06	float	n/a	long_name	mean reflectance factor value of band 6 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	1	string
			coordinates	band_id_C06 band_wavelength_C06 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_reflectance_factor_C06	float	n/a	long_name	standard deviation of reflectance factor values of band 6 pixels	string
			standard_name	toa_lambertian_equivalent_albdeo_multiplied_by_cosine_solar_zenith_angle	string
			_FillValue	-999.0	float
			units	1	string
			coordinates	band_id_C06 band_wavelength_C06 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C07	int	n/a	long_name	number of band 7 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id_C07 band_wavelength_C07 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C07	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 7 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C07 band_wavelength_C07 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C07	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 7 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C07 band_wavelength_C07 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C07	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 7 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	band_id_C07 band_wavelength_C07 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C07	float	n/a	long_name	standard deviation of band 7 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C07 band_wavelength_C07 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C08	int	n/a	long_name	number of band 8 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C08 band_wavelength_C08 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C08	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 8 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C08 band_wavelength_C08 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C08	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 8 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C08 band_wavelength_C08 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C08	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 8 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C08 band_wavelength_C08 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C08	float	n/a	long_name	standard deviation of band 8 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C08 band_wavelength_C08 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C09	int	n/a	long_name	number of band 9 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C09 band_wavelength_C09 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C09	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 9 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C09 band_wavelength_C09 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C09	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 9 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C09 band_wavelength_C09 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
mean_brightness_temperature_C09	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 9 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C09 band_wavelength_C09 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C09	float	n/a	long_name	standard deviation of band 9 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C09 band_wavelength_C09 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C10	int	n/a	long_name	number of band 10 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C10 band_wavelength_C10 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C10	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 10 pixels	string
			standard_name	toa_brightness_temperature	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C10 band_wavelength_C10 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C10	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 10 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C10 band_wavelength_C10 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C10	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 10 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C10 band_wavelength_C10 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C10	float	n/a	long_name	standard deviation of band 10 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	K	string
			coordinates	band_id_C10 band_wavelength_C10 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C11	int	n/a	long_name	number of band 11 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C11 band_wavelength_C11 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C11	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 11 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C11 band_wavelength_C11 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C11	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 11 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id_C11 band_wavelength_C11 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C11	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 11 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C11 band_wavelength_C11 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C11	float	n/a	long_name	standard deviation of band 11 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C11 band_wavelength_C11 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C12	int	n/a	long_name	number of band 12 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C12 band_wavelength_C12 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C12	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 12 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C12 band_wavelength_C12 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C12	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 12 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C12 band_wavelength_C12 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C12	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 12 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C12 band_wavelength_C12 t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C12	float	n/a	long_name	standard deviation of band 8 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C12 band_wavelength_C12 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C13	int	n/a	long_name	number of band 13 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C13 band_wavelength_C13 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C13	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 13 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C13 band_wavelength_C13 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
max_brightness_temperature_C13	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 13 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C13 band_wavelength_C13 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C13	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 13 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C13 band_wavelength_C13 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C13	float	n/a	long_name	standard deviation of band 13 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C13 band_wavelength_C13 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
outlier_pixel_count_C14	int	n/a	long_name	number of band 14 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C14 band_wavelength_C14 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C14	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 14 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C14 band_wavelength_C14 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C14	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 14 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C14 band_wavelength_C14 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C14	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 14 pixels	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C14 band_wavelength_C14 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C14	float	n/a	long_name	standard deviation of band 14 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C14 band_wavelength_C14 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C15	int	n/a	long_name	number of band 15 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C15 band_wavelength_C15 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C15	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 15 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C15 band_wavelength_C15 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C15	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 15 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C15 band_wavelength_C15 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C15	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 15 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C15 band_wavelength_C15 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C15	float	n/a	long_name	standard deviation of band 15 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	band_id_C15 band_wavelength_C15 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
outlier_pixel_count_C16	int	n/a	long_name	number of band 16 cloud and moisture imagery pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	band_id_C16 band_wavelength_C16 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only)	string
min_brightness_temperature_C16	float	n/a	long_name	minimum top of atmosphere brightness temperature value of band 16 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C16 band_wavelength_C16 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: minimum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
max_brightness_temperature_C16	float	n/a	long_name	maximum top of atmosphere brightness temperature value of band 16 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C16 band_wavelength_C16 t y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: maximum (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
mean_brightness_temperature_C16	float	n/a	long_name	mean top of atmosphere brightness temperature value of band 16 pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			valid_range	***see note [2]***	float
			units	K	string
			coordinates	band_id_C16 band_wavelength_C16 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: mean (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
std_dev_brightness_temperature_C16	float	n/a	long_name	standard deviation of band 16 top of atmosphere brightness temperature values of pixels	string
			standard_name	toa_brightness_temperature	string
			_FillValue	-999.0	float
			units	K	string
			coordinates	band_id_C16 band_wavelength_C16 t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: standard_deviation (interval: 0.000056 rad comment: good and conditionally usable quality pixels only)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999.0	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
percent_uncorrectable_ L0_errors			_FillValue	-999.0	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_ subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999.0	float
			units	degrees_north	string
nominal_satellite_ subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999.0	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999.0	float
			units	km	string
geospatial_lat_lon_ extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_ longitude	***see note [1]***	float
			geospatial_northbound_ latitude	***see note [1]***	float
			geospatial_eastbound_ longitude	***see note [1]***	float
			geospatial_southbound_ latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			geospatial_lat_nadir	0.0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L1b_radiance_band_1_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_2_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_3_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_4_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_5_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_6_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_7_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_8_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_9_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_10_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_11_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_12_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_13_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L1b_radiance_band_14_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_15_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_16_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note 2: Cloud and Moisture Imagery Product quantity characteristics are located in paragraph 5.1.6.4, Cloud and Moisture Imagery Product Quantity Characteristics.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.1.6.5, Cloud and Moisture Imagery Product Data Quality Flag Values and Meanings.

5.1.6.4 Cloud and Moisture Imagery Product Quantity Characteristics

Table 5.1.6.4-1 Cloud and Moisture Imagery Product Quantity Characteristics

						Scaled Integer to Physical Quantity Conversion		Valid Range (packed - scaled integer form)		Valid Range (in units of physical quantity)	
ABI Band	**Central wavelength (in µm)**	**Horizontal Spatial Resolution (in km at nadir)**	**Horizontal Spatial Resolution (in radians)**	**Fill Value (packed - scaled integer form)**	**L1b (Radiance) Bit Depth**	**Scale Factor**	**Add Offset**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
1	0.47	1.0	0.000028	65535	10	0.00024420	0.0	0	4095	0.0	1.0
2	0.64	0.5	0.000014	65535	12	0.00024420	0.0	0	4095	0.0	1.0

						Scaled Integer to Physical Quantity Conversion		Valid Range (packed - scaled integer form)		Valid Range (in units of physical quantity)	
ABI Band	Central wavelength (in µm)	Horizontal Spatial Resolution (in km at nadir)	Horizontal Spatial Resolution (in radians)	Fill Value (packed - scaled integer form)	L1b (Radiance) Bit Depth	Scale Factor	Add Offset	Minimum	Maximum	Minimum	Maximum
3	0.865	1.0	0.000028	65535	10	0.00024420	0.0	0	4095	0.0	1.0
4	1.378	2.0	0.000056	65535	11	0.00024420	0.0	0	4095	0.0	1.0
5	1.61	1.0	0.000028	65535	10	0.00024420	0.0	0	4095	0.0	1.0
6	2.25	2.0	0.000056	65535	10	0.00024420	0.0	0	4095	0.0	1.0
7	3.9	2.0	0.000056	65535	14	0.01309618	197.31	0	16383	197.31	411.86
8	6.185	2.0	0.000056	65535	12	0.04224986	138.05	0	4095	138.05	311.06
9	6.95	2.0	0.000056	65535	11	0.04233911	137.70	0	4095	137.70	311.08
10	7.34	2.0	0.000056	65535	12	0.04988919	126.91	0	4095	126.91	331.20
11	8.5	2.0	0.000056	65535	12	0.05216432	127.69	0	4095	127.69	341.30
12	9.61	2.0	0.000056	65535	11	0.04727034	117.49	0	4095	117.49	311.06
13	10.35	2.0	0.000056	65535	12	0.06145332	89.62	0	4095	89.62	341.27
14	11.2	2.0	0.000056	65535	12	0.05985075	96.19	0	4095	96.19	341.28
15	12.3	2.0	0.000056	65535	12	0.05956082	97.38	0	4095	97.38	341.28
16	13.3	2.0	0.000056	65535	10	0.05508153	92.70	0	4095	92.70	318.26

For the emissive channel Cloud and Moisture Imagery products, the planck constants used to convert the radiances to brightness temperature (*T*) are defined in Table 5.1.6.4-2, Radiances to Brightness Temperature Planck Constants.

Table 5.1.6.4-2 Radiances to Brightness Temperature Planck Constants[1]

	Variable Names			
ABI Channel (Band)	planck_fk1	planck_fk2	planck_bc1	planck_bc2
7	2.02263e+05	3.69819e+03	0.43361	0.99939
8	5.06871e+04	2.33158e+03	1.55228	0.99667
9	3.58283e+04	2.07695e+03	0.34427	0.99918
10	3.01740e+04	1.96138e+03	0.05651	0.99986
11	1.97799e+04	1.70383e+03	0.18733	0.99948
12	1.34321e+04	1.49761e+03	0.09102	0.99971
13	1.08033e+04	1.39274e+03	0.07550	0.99975
14	8.51022e+03	1.28627e+03	0.22516	0.99920
15	6.45462e+03	1.17303e+03	0.21702	0.99916
16	5.10127e+03	1.08453e+03	0.06266	0.99974

[1] The Planck constants in this table are example values, based on the ABI FM-1 instrument (on GOES-16). User applications should use the values in the product files because these values vary with each instance of the ABI instrument.

5.1.6.5 Cloud and Moisture Imagery Data Quality Flag Values and Meanings

Table 5.1.6.5 Cloud and Moisture Imagery Product Data Quality Flag Values and Meanings

Data Quality Flags	
Flag Value	**Flag Meaning**
0	good_pixels_qf
1	conditionally_usable_pixels_qf
2	out_of_range_pixels_qf
3	no_value_pixels_qf

5.2 Clear Sky Mask Product

5.2.1 Description

The Clear Sky Mask product contains an image in the form of a binary cloud mask that identifies pixels within a coverage region as "clear" or "cloudy". The production of the clear sky mask is an important step in the processing of many other GOES-R Level 2+ products that use the information generated in the production of the clear sky mask to determine the presence of cloud. The product includes data quality information for the binary cloud mask data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The binary cloud mask value is a dimensionless quantity.

The Clear Sky Mask product image is provided at 2 km resolution on the ABI fixed grid for Full Disk, CONUS, and Mesoscale coverage regions. Product data is produced for geolocated source data to local zenith angles of 90 degrees for both daytime and nighttime conditions.

The Clear Sky Mask performance requirements are summarized in Table 5.2.1, Clear Sky Mask Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement range and performance conditions identified therein.

Table 5.2.1 Clear Sky Mask Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk, CONUS, & Mesoscale	0 or 1	87% correct detection	N/A	LZA $\leq$ 70 degrees	1 km

Metadata in the Clear Sky Mask product provides statistical and other information about the final and intermediate product image, and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of pixels and percentages of the intermediate 4-level cloud mask image having clear, probably clear, cloudy, and probably cloudy classifications.
- Applicable ABI emissive band-specific brightness temperature differences minimum, maximum, mean, and standard deviation values between those observed and modeled for all and clear sky conditions.

These statistics are calculated using good quality pixels to a local zenith angle of 70 degrees. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Clear Sky Mask product is located in the standalone Appendix X, ISO Series Metadata.

5.2.2 Dynamic Source Data

The Clear Sky Mask product is derived using unprocessed and processed ABI Level 1b reflective and emissive band images from the current and previous observations. The algorithm uses the National Centers for Environmental Predictions (NCEP) Global Forecast System GFS Numerical Weather Prediction (NWP) model forecast ancillary data. Processed snow cover data derived from the GFS model or from the National Snow and Ice Data Center (NSIDC) ancillary data are also used. In addition, the algorithm uses clear and cloudy sky radiances and brightness temperature, clear sky transmittance profile, and cloudy sky radiances profile data derived from the ground system deployment of the Community Radiative Transfer Model (CRTM). Dynamic auxiliary data, specifically temporally coincident solar zenith angle, sunglint angle, and scattering angle data, are also used. Furthermore, the algorithm uses intermediate output from the Cloud Mask algorithm from a previous observation.

The primary sensor data used by the Cloud Mask algorithm is identified in Table 5.2.2-1 Primary Sensor Data.

Table 5.2.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_7_2km_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L2_brightness_temperature_band_9_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_11_2km_data [1] input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data [1] input_ABI_L2_brightness_temperature_band_16_2km_data [1]
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_reflectance_band_2_2km_data [2] input_ABI_L2_intermediate_product_reflectance_band_4_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data [2]

[1] Inputs required for band 11, 15, and 16 from previous 60-minute and for band 15 from previous 15-minute refresh periods, in addition to current refresh period.
[2] Reflectance for ABI bands 2 and 5 aggregated to 2 km resolution is an intermediate product of the Level 2+ Cloud and Moisture Imagery algorithm.

The other dynamic source data inputs are summarized in Table 5.2.2-2, Other Dynamic Source Data.

Table 5.2.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data [1]
CRTM Intermediate Products	input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_profile_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_profile_band_7_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data
Processed Dynamic Source Ancillary	input_dynamic_ancillary_NWP_surface_level_index_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_tropopause_level_index_data input_dynamic_ancillary_NWP_total_precipitable_water_data input_dynamic_ancillary_NWP_total_ozone_data input_dynamic_ancillary_global_snow_mask_data input_dynamic_ancillary_NWP_snow_mask_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_scattering_angle_data input_ABI_L2_auxiliary_sunglint_angle_data

[1] Intermediate 4-level cloud mask data generated by the Cloud Mask algorithm from the previous 60-minute refresh period is used.

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.2.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Clear Sky Mask ground-processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Clear Sky Mask algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Cloud detection and uniformity pass/fail thresholds corresponding to algorithm binary cloud detection tests and uniformity tests specified as a function of background (e.g., land, ocean, snow/ice, cold surface, desert).
- Pixel padding parameters defining the neighborhood window for internal calculations.
- Solar irradiance for band 7 used in calculation of band 7 reflectance.
- Default physical quantities (e.g., for aerosol optical depth).
- Minimum/maximum thresholds for quantities used in cloud detection and uniformity tests.
- Scaling factors and regression coefficients.
- Default missing values.

The common library parameters shared across multiple algorithms are used by the Clear Sky Mask algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These parameters include:

- Band wavelength map associating each of 16 ABI bands with the corresponding central wavelength.
- Fast Planck Look Up Table (LUT) used to convert between Radiance and Brightness Temperature for bands 7 to 16.
- Maximum allowed pixel displacement for cloud local radiative center determination.
- Scale factors to convert L1b input pixel radiance values from scaled integers to floating point values.

The categories of gridded parameters used in the generation of the Clear Sky Mask product are projection and mapping, earth surface classifications and characteristics, and seasonal. The specific types of gridded semi-static source data in the category used in the generation of the Clear Sky Mask product are identified in Table 5.2.3 Gridded Semi-Static Source Data.

Table 5.2.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_local_zenith_angle_bin_index_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_surface_elevation_data input_ABI_L2_slot_specific_semi_static_land_sea_mask_data input_ABI_L2_slot_specific_semi_static_coast_mask_data input_ABI_L2_slot_specific_semi_static_desert_mask_data
Seasonal	input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_7_data

	input_ABI_L2_slot_specific_semi_static_16_day_white_sky_albedo_band_2_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-ACMSemiStaticParams.bin

5.2.4 Coordinates

The coordinates associated with data variables in the Clear Sky Mask product are identified in Table 5.2.4, Clear Sky Mask Product Coordinates.

Table 5.2.4 Clear Sky Mask Product Coordinates

<table>
<tr><th>Clear Sky Mask Product Data Quantity</th><th>Coordinates</th></tr>
<tr><td>clear sky mask data</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Local zenith angle ranges for good, and good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>clear sky mask data quality flags</td></tr>
<tr><td>clear and cloud pixel counts</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>clear and cloud pixel percentages</td></tr>
<tr><td>terminator (twilight) pixel percentage</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good quality data production</td></tr>
</table>

	• Solar zenith angle range associated with twilight
minimum, maximum, mean, and standard deviation values associated with the difference between observed and modeled brightness temperature at specific ABI emissive band central wavelengths for all and clear sky conditions	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Central wavelength and identifier of the applicable ABI bands • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.2.5 Production Notes

The Clear Sky Mask product is generated by the GOES-R ABI Cloud Mask ground processing algorithm. The Cloud Mask algorithm is an important component of the GOES-R Level 2+ Algorithm Precedence Network, as the output of the algorithm is used in the generation of the GOES-R Cloud, Aerosol, Sounding, Land, Ocean, Radiation, and Wind products.

The Clear Sky Mask product algorithm identifies clear, probably clear, cloudy, and probably cloudy conditions based on spectral, spatial, and temporal tests. The algorithm compares ABI emissive band data with processed clear sky and cloudy sky model data derived from the CRTM. In addition to the binary cloud mask and DQF, the algorithm generates an intermediate 4-level cloud mask that classifies pixels as "clear", "probably clear", "probably cloudy", and "cloudy". It is used by several downstream algorithms in the Level 2+ algorithm precedence network. Also, diagnostic information generated by the Cloud Mask algorithm is captured in an intermediate data information flag product that indicates the outcome of individual cloud tests and includes additional diagnostic information. The intermediate data information flag product data is used by downstream Aerosol and Ocean algorithms that require custom cloud masks. The final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Cloud Mask ground processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for the ABI Cloud Mask. This document is located at http://www.goes-r.gov/products/ATBDs/baseline/Cloud_CldMask_v2.0_no_color.pdf.

5.2.6 Data Fields

The Clear Sky Mask product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Clear Sky Mask product are located in Appendix A.

Table 5.2.6-1 Clear Sky Mask: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	b015d6f0-b002-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Clear Sky Mask	string
summary	The Clear Sky Mask product consists of a binary cloud mask identifying pixels as 'clear or probably clear' or 'cloudy or probably cloudy'. The binary cloud mask is generated through a series of cloud detection threshold tests that key on the spatial, spectral, and temporal characteristics associated with the cloud and clear-sky states. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > CLOUDS > CLOUD AMOUNT/FREQUENCY	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string

production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.2.6-2 Clear Sky Masks: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_ bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality clear sky mask data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality clear sky mask data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality clear sky mask data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality clear sky mask data is produced	string
retrieval_solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality clear sky mask data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	retrieval_solar_zenith_angle_bounds	string
twilight_solar_zenith_angle ***value = 90.0***	float	n/a	long_name	midpoint of the twilight region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	twilight_solar_zenith_angle_bounds	string
retrieval_solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality clear sky mask data is produced	string
twilight_solar_zenith_angle_bounds ***value = 87.0 93.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the twilight region	string
RTM_BT_comparison_wavelengths ***value = 11.2 12.3***	float	RTM_BT_comparison_bands = 2	long_name	ABI center wavelengths associated with radiative transfer model's brightness temperature comparison outputs	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
RTM_BT_comparison_band_ids	byte	RTM_BT_comparison_bands = 2	long_name	ABI band identifiers associated with radiative transfer model's brightness temperature comparison outputs	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
value = 14 15			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_ bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_ bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projec tion	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_heigh t	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_o rigin	0	double
			longitude_of_projection _origin	***see note [1]***	double
			sweep_angle_axis	x	string
BCM	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Clear Sky Mask	string
			standard_name	cloud_binary_mask	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 1	byte
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string

Variable			**Attribute**		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	DQF	string
			clear_pixel_definition	no cloud detected and failed a test for high values of spatial heterogeneity	string
			probably_clear_pixel_definition	no cloud detected but passed a test for high values of spatial heterogeneity and one or more neighboring pixels identified as cloudy. pixel is possibly cloud-contaminated	string
			probably_cloudy_pixel_definition	cloud detected but likely contains a cloud edge, since one or more neighboring pixels are clear. pixel is probably cloud-contaminated	string
			cloudy_pixel_definition	cloud detected and failed a test for cloud edges	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Clear Sky Mask data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 6	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point retrieval_solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	7	byte

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_or_algorithm_non-execution_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_input_11um_brightness_temperature_qf	***dynamic value***	float
			percent_degraded_due_to_bad_input_3.9um_pixel_qf	***dynamic value***	float
			percent_degraded_due_to_failed_0.64_um_tests_qf	***dynamic value***	float
			percent_degraded_due_to_other_bad_bands_qf	***dynamic value***	float
total_number_of_cloud_mask_points	int	n/a	long_name	total number of clear sky mask pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only)	string
number_of_clear_pixels	int	n/a	long_name	number of clear pixels that do not exceed local zenith angle threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky	string
number_of_probably_clear_pixels	int	n/a	long_name	number of probably clear pixels (surrounding NxN pixels centered on pixel have high degree of spatial heterogeneity, and one or more adjacent pixels are identified as cloudy) that do not exceed local zenith angle threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky	string
number_of_probably_cloudy_pixels	int	n/a	long_name	number of probably cloudy pixels (cloud detected in pixel, likely contains a cloud edge, and one or more adjacent pixels are clear) that do not exceed local zenith angle threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
number_of_cloudy_pixels	int	n/a	long_name	number of cloudy pixels that do not exceed local zenith angle threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
percent_clear_pixels	float	n/a	long_name	percent of clear pixels that do not exceed local zenith angle threshold	string
			standard_name	clear_sky_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky	string
percent_probably_clear_pixels	float	n/a	long_name	percent of probably clear pixels (surrounding NxN pixels centered on pixel have high degree of spatial heterogeneity, and one or more adjacent pixels are identified as cloudy) that do not exceed local zenith angle threshold	string
			standard_name	clear_sky_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky	string
percent_probably_cloudy_pixels	float	n/a	long_name	percent of probably cloudy pixels (cloud detected in pixel, likely contains a cloud edge, and one or more adjacent pixels are clear) that do not exceed local zenith angle threshold	string
			standard_name	cloud_area_fraction	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle : sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
percent_cloudy_pixels	float	n/a	long_name	percent of cloudy pixels that do not exceed local zenith angle threshold	string
			standard_name	cloud_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
percent_terminator_pixels	float	n/a	long_name	percent of pixels that are associated with the twilight solar zenith angle range	string
			standard_name	area_fraction_of_twilight_defined_by_twilight_solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	retrieval_local_zenith_angle twilight_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum twilight_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
min_obs_modeled_diff_RTM_BT_comparison_bands_all_sky	float	RTM_BT_comparison_bands = 2	long_name	minimum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only)	string
max_obs_modeled_diff_RTM_BT_comparison_bands_all_sky	float	RTM_BT_comparison_bands = 2	long_name	maximum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only)	string
mean_obs_modeled_diff_RTM_BT_comparison_bands_all_sky	float	RTM_BT_comparison_bands = 2	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only)	string
std_dev_obs_modeled_diff_RTM_BT_comparison_bands_all_sky	float	RTM_BT_ comparison_bands = 2	long_name	standard deviation of the difference of the observed and modeled brightness temperature values (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only)	string
min_obs_modeled_diff_RTM_BT_comparison_bands_clear_sky	float	RTM_BT_ comparison_bands = 2	long_name	minimum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths for the clear sky portion of image	string
			_FillValue	-999	float
			units	K	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only) where clear_sky	string
max_obs_modeled_diff_RTM_BT_comparison_bands_clear_sky	float	RTM_BT_comparison_bands = 2	long_name	maximum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths for the clear sky portion of image	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only) where clear_sky	string
mean_obs_modeled_diff_RTM_BT_comparison_bands_clear_sky	float	RTM_BT_comparison_bands = 2	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths for the clear sky portion of image	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only) where clear_sky	string
std_dev_obs_modeled_diff_RTM_BT_comparison_bands_clear_sky	float	RTM_BT_ comparison_bands = 2	long_name	standard deviation of the differences of the observed and modeled brightness temperature values (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) at 11.2 and 12.3 um ABI central wavelengths for the clear sky portion of image	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle RTM_BT_comparison_band_ids RTM_BT_comparison_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: corresponding good quality cloud mask pixels only) where clear_sky	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_scattering_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_sunglint_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L1b_radiance_band_7_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_14_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L2_brightness_temperature_band_9_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_10_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_11_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_4_2km_data	***refer to filename conventions for L2 products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_5_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_7_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_global_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_snow_mask_data		string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_column_ozone_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_dynamic_ancillary_NWP_tropopause_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.2.6.1, Clear Sky Mask Product Flag Values and Meanings.

5.2.6.1 Clear Sky Mask Product Flag Values and Meanings

Table 5.2.6.1-1 Clear Sky Mask Product Binary Cloud Mask Flag Values and Meanings

Binary Cloud Mask (BCM)	
Flag Value	**Flag Meaning**
0	clear_or_probably_clear
1	cloudy_or_probably_cloudy

Table 5.2.6.1-2 Clear Sky Mask Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_or_algorithm_non-execution_qf
2	degraded_due_to_LZA_threshold_exceeded_qf
3	invalid_due_to_bad_or_missing_input_11um_brightness_temperature_qf
4	degraded_due_to_bad_input_3.9um_pixel_qf

5	degraded_due_to_failed_0.64um_tests_qf
6	degraded_due_to_other_bad_bands_qf

5.3 Cloud Top Phase Product

5.3.1 Description

The Cloud Top Phase product contains an image with pixel values identifying the presence of cloud in four phase categories. The categories, which are consistent with heritage NOAA and NASA cloud products, include:

- ***Warm liquid water***: liquid water cloud with an opaque cloud temperature greater than 273 degrees K.
- ***Supercooled liquid water***: liquid water topped cloud with an opaque cloud temperature less than 273 degrees K.
- ***Mixed phase clouds***: high probability of containing both liquid water and ice near cloud top.
- ***Ice phase clouds***: all ice topped clouds.

The Cloud Top Phase product image data variable also has categories for clear sky and unknown phases. A pixel is classified as having an unknown phase when the retrieval has failed because of missing or bad input data. The product includes data quality information that provides an assessment of the cloud top phase data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The cloud top phase value is a dimensionless quantity.

The Cloud Top Phase product image is provided at 2 km resolution on the ABI fixed grid for Full Disk, CONUS, and Mesoscale coverage regions. Product data is produced for geolocated source data to local zenith angles of 90 degrees for both daytime and nighttime conditions. The Cloud Top Phase performance requirements are summarized in Table 5.3.1, Cloud Top Phase Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement range and performance conditions identified therein except as noted.

Table 5.3.1 Cloud Top Phase Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk, CONUS, & Mesoscale	Liquid, Supercooled, Mixed, or Ice	80%	1.5 categories	LZA $\leq$ 65 degrees [1] COD > 1	1 km

[1] Conditions for good quality prescribed by the algorithm are for LZA ≤ 82 degrees.

Metadata in the Cloud Top Phase product provides statistical and other properties of the final and intermediate product image, and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Percentages of pixels in each of the phase category.
- Number of cloudy pixels in the image.

These statistics are calculated using geolocated pixels. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Cloud Top Phase product is located in the standalone Appendix X, ISO Series Metadata.

5.3.2 Dynamic Source Data

The Cloud Top Phase product is derived using unprocessed and processed ABI Level 1b emissive band images from the current observation. The algorithm uses intermediate product data generated by the Cloud

Mask algorithm. In addition, processed surface and tropopause level, and temperature and pressure profile data derived from the NWP model ancillary data are used. Furthermore, the algorithm uses clear sky radiance and cloudy sky radiance profile data in selected emissive bands derived from the ground system deployment of the CRTM.

The primary sensor data used by the Cloud Top Phase algorithm is identified in Table 5.3.2-1, Primary Sensor Data.

Table 5.3.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_10_2km_data input_ABI_L1b_radiance_band_11_2km_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L1b_radiance_band_15_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data

The other dynamic source data inputs are summarized in Table 5.3.2-2, Other Dynamic Source Data.

Table 5.3.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data
CRTM Intermediate Products	input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_profile_band_10_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_profile_band_11_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_profile_band_14_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_profile_band_15_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_NWP_surface_level_index_data input_dynamic_ancillary_NWP_tropopause_level_index_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_pressure_profile_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.3.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Cloud Phase ground-processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Cloud Top Phase algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Constants and limits used in the calculation of cloud emissivity.
- Spectral and spatial test thresholds used in the classification of the cloud type category.
- Median filter size parameters.
- Thresholds for assignment of quality flags and quality information.

The common library parameters shared across multiple algorithms are used by the Cloud Top Phase algorithm. These parameters include:

- Maximum allowed pixel displacement for cloud local radiative center determination.

The categories of gridded parameter used in the generation of the Cloud Top Phase product are projection and mapping, and atmospheric climatology. The specific types of gridded semi-static source data in the category used in the generation of the Cloud Top Phase product are identified in Table 5.3.3 Gridded Semi-Static Source Data.

Table 5.3.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_local_zenith_angle_bin_index_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Atmospheric Climatology	input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_11_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin

- AI_ABI-L2-ACTSemiStaticParams.bin

5.3.4 Coordinates

The coordinates associated with data variables in the Cloud Top Phase product are identified in Table 5.3.4, Cloud Top Phase Product Coordinates.

Table 5.3.4 Cloud Top Phase Product Coordinates

<table>
<tr><th>Cloud Top Phase Product Data Quantity</th><th>Coordinates</th></tr>
<tr><td>cloud top phase data</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Local zenith angle ranges for good, and good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>cloud top phase data quality flags</td></tr>
<tr><td>cloud pixel count</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>data transmission error percentages</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location</td></tr>
</table>

5.3.5 Production Notes

The Cloud Top Phase product is generated by the GOES-R ABI Cloud Type ground processing algorithm. The Cloud Type algorithm is an important component of the GOES-R ground processing precedence chain, as the output of the algorithm is used in the generation of other cloud products. The algorithm determines the cloud top phase for pixels identified as cloudy, probably cloudy, and probably clear in the intermediate 4-level cloud mask generated by the Cloud Mask algorithm. Clear sky is determined using clear pixels indicated in the temporally coincident intermediate 4-level cloud mask generated by the Cloud Mask algorithm.

In addition to the Cloud Top Phase primary data variable and DQF, the algorithm generates an intermediate cloud type product that contains the classifications of the same cloud phase categories of liquid water, super-cooled liquid water, and mixed phase, but divides the ice phase clouds into optically thin ice, optically thick ice, and multilayered ice categories. Both the final cloud top phase product primary data variable and the intermediate cloud type product data are used as inputs to downstream processing. The algorithm also generates a 22-bit product quality information flag that provides diagnostic information including intermediate quantities and algorithm tests results about the cloud top phase retrieval. The final, and intermediate data and diagnostics information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Cloud Type ground processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for Cloud Type and Cloud Phase. This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/Cloud_CldType_v2.0_no_color.pdf

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5.3.6 Data Fields

The Cloud Top Phase product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Cloud Top Phase product are located in Appendix A.

Table 5.3.6-1 Cloud Top Phase: Global Attributes

Global Attribute	Name	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	1f205b40-afd3-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud Top Phase	string
summary	The Cloud Top Phase product consists of cloud classification identification information for each pixel. The cloud phase categories are clear sky, liquid water, super cooled liquid water, mixed phase, ice, and unknown. The cloud phase is determined using a physical retrieval of emissivity utilizing a radiative transfer model, followed by a series of threshold tests applied to a cloud microphysical parameter derived from the calculated emissivity. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > CLOUDS > CLOUD LIQUID WATER/ICE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string

production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.3.6-2 Cloud Top Phase: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality cloud top phase data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 82.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality cloud top phase data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality cloud top phase data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 82.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality cloud top phase data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud top phase data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality cloud top phase data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float		long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
		number_of_image_bounds = 2			
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
Phase	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Phase	string
			standard_name	cloud_phase_category	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 5	byte
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	DQF	string
			number_of_cloud_top_phase_category_values	6	byte
			percent_clear_sky	***dynamic value***	float
			percent_liquid_water	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_super_cooled_liquid_water	***dynamic value***	float
			percent_mixed_phase	***dynamic value***	float
			percent_ice	***dynamic value***	float
			percent_unknown	***dynamic value***	float
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Phase data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 63	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	byte
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_overall_qf_values	2	byte
			percent_overall_good_quality_qf	***dynamic value***	float
			percent_overall_degraded_quality_qf	***dynamic value***	float
			number_of_L1b_qf_values	2	byte
			percent_good_quality_L1b_data_qf	***dynamic value***	float
			percent_degraded_quality_L1b_data_qf	***dynamic value***	float
			number_of_beta_ratio_qf_values	2	byte
			percent_good_quality_beta_ratio_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_degraded_quality_beta_ratio_qf	***dynamic value***	float
			number_of_ice_cloud_qf_values	2	byte
			percent_ice_cloud_determination_based_on_strong_radiative_signal_qf	***dynamic value***	float
			percent_ice_cloud_determination_based_on_weak_radiative_signal_qf	***dynamic value***	float
			number_of_surface_emissivity_qf_values	2	byte
			percent_good_quality_surface_emissivity_qf	***dynamic value***	float
			percent_degraded_quality_surface_emissivity_qf	***dynamic value***	float
			number_of_LZA_qf_values	2	byte
			percent_good_within_LZA_threshold_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
total_number_cloudy_pixels	int	n/a	long_name	number of cloudy pixels with cloud phase category of liquid_water, super_cooled_liquid_water, mixed_phase, or ice	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: pixels with cloud phase category of liquid_water, super_cooled_liquid_water, mixed_phase, or ice only) where cloud	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L1b_radiance_band_10_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_11_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_14_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_15_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_10_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_11_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_pressure_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.3.6.1, Cloud Top Phase Product Flag Values and Meanings.

5.3.6.1 Cloud Top Phase Product Flag Values and Meanings

Table 5.3.6.1-1 Cloud Top Phase Product Primary Data Variable Values and Meanings

Cloud Top Phase (Phase)	
Flag Value	**Flag Meaning**
0	clear_sky
1	liquid_water
2	super_cooled_liquid_water
3	mixed_phase
4	Ice
5	Unknown

Table 5.3.6.1-2 Cloud Top Phase Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
1	0	overall_good_quality_qf
1	1	overall_degraded_quality_qf
2	0	good_quality_L1b_data_qf
2	2	degraded_quality_L1b_data_qf
4	0	good_quality_beta_ratio_qf
4	4	degraded_quality_beta_ratio_qf
8	0	ice_cloud_determination_based_on_strong_radiative_signal_qf
8	8	ice_cloud_determination_based_on_weak_radiative_signal_qf
16	0	good_quality_surface_emissivity_qf
16	16	degraded_quality_surface_emissivity_qf
32	0	good_within_LZA_threshold_qf
32	32	degraded_due_to_LZA_threshold_exceeded_qf

5.4 Cloud Top Height Product

5.4.1 Description

The Cloud Top Height product contains an image with pixel values identifying the geopotential height at the top of a cloud layer. The product is generated in combination with the Cloud Top Temperature and Cloud Top Pressure products by the same algorithm. The product includes data quality information that provides an assessment of the cloud top height data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the cloud top height value are "meters".

The Cloud Top Height product image is produced on the ABI fixed grid at 10 km resolution for Full Disk and CONUS, and 4 km resolution for Mesoscale coverage regions. Product data is produced under the following conditions:

- cloudy
- geolocated source data to local zenith angles of 70 degrees for both daytime and nighttime conditions

The Cloud Top Height performance requirements are summarized in Table 5.4.1, Cloud Top Height Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.4.1 Cloud Top Height Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk, CONUS, & Mesoscale	0 to 20,000 m	cloud emissivity > 0.8: 500 m	cloud emissivity > 0.8: 1500 m	LZA $\leq$ 62 degrees [1]	Full Disk: 5 km CONUS: 5 km Mesoscale: 2 km

[1] Conditions for good quality prescribed by the algorithm are for LZA ≤ 70 degrees.

Metadata in the Cloud Top Height product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of cloudy or probably cloud pixels that qualify for the algorithm retrieval.
- Number of cloud top height pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the cloud top height values in the product image.

These statistics are calculated using good quality pixels. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Cloud Top Height product is located in the standalone Appendix X, ISO Series Metadata.

5.4.2 Dynamic Source Data

The Cloud Top Height product is derived using unprocessed and processed ABI Level 1b emissive band images from the current observation. The algorithm uses intermediate product data generated by the Cloud

Mask and Cloud Top Phase algorithms. In addition, processed surface pressure and temperature, and atmospheric temperature and height profile data derived from the NWP model ancillary data are used. Furthermore, the algorithm uses clear sky Top-Of-Atmosphere (TOA) radiance, and radiance and transmittance profile data in selected emissive bands derived from the ground system deployment of the CRTM.

The primary sensor data used by the Cloud Top Height algorithm is identified in Table 5.4.2-1, Primary Sensor Data.

Table 5.4.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_14_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_brightness_temperature_band_16_2km_data

The other dynamic source data inputs are summarized in Table 5.4.2-2, Other Dynamic Source Data.

Table 5.4.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_cloud_type_data
CRTM Intermediate Products	input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_tropopause_temperature_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_temperature_inversion_layer_data input_dynamic_ancillary_NWP_geopotential_height_profile_data input_dynamic_ancillary_NWP_pressure_profile_data input_dynamic_ancillary_NWP_surface_level_index_data input_dynamic_ancillary_NWP_tropopause_level_index_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.4.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Cloud Top Height ground-processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Cloud Top Height algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- A priori (first guess) values for retrieval state vector and uncertainties as a function of cloud type.
- Beta ratio scaling parameters for water and ice clouds.
- Forward model uncertainties.
- Retrieval limits and convergence criteria.
- Local radiative center convergence criteria.
- Median filter size parameters.
- Aggregation factors for 4km and 10km products.
- Thresholds for assignment of quality flags and quality information.
- Minimum/maximum valid range / outlier limits for cloud temperature, pressure, and height products.

The common library parameters shared across multiple algorithms are used by the Cloud Top Height algorithm. These parameters include:

- Band wavelength map associating each of 16 ABI bands with the corresponding central wavelength.
- Fast Planck Look Up Table (LUT) used to convert between Radiance and Brightness Temperature for bands 7 to 16.
- Maximum allowed pixel displacement for cloud local radiative center determination.
- Scale factors to convert L1b input pixel radiance values from scaled integers to floating point values.

The categories of gridded parameters used in the generation of the Cloud Top Height product are projection and mapping, earth surface classifications and characteristics, and atmospheric climatology. The specific types of gridded semi-static source data in the categories used in the generation of the Cloud Top Height product are identified in Table 5.4.3 Gridded Semi-Static Source Data.

Table 5.4.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_local_zenith_angle_bin_index_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_surface_elevation_data input_ABI_L2_slot_specific_semi_static_surface_type_mask_data
Atmospheric Climatology	input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_11_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-ACHSemiStaticParams.bin

5.4.4 Coordinates

The coordinates associated with data variables in the Cloud Top Height product are identified in Table 5.4.4, Cloud Top Height, Cloud Top Pressure, and Cloud Top Temperature Product Coordinates.

Table 5.4.4 Cloud Top Height, Cloud Top Pressure, and Cloud Top Temperature Product Coordinates

Cloud Top Height, Cloud Top Pressure, and Cloud Top Temperature Product Data Quantity	Coordinates
cloud top height, cloud top pressure, and cloud top temperature data	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
cloud top height, cloud top pressure, and cloud top temperature data quality flags	
cloud pixel count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location
cloud top height, cloud top pressure, and cloud top temperature outlier pixel count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
cloud top height, cloud top pressure, and cloud top temperature minimum, maximum, mean, and standard deviation values	
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.4.5 Production Notes

The Cloud Top Temperature, Cloud Top Pressure, and Cloud Top Height products are generated by the GOES-R ABI Cloud Top Height ground processing algorithm. The Cloud Top Height algorithm is an important component of the GOES-R ground processing precedence chain as the output of the algorithm is used in the generation of other ABI Level 2+ products. The algorithm retrieves a state vector composed of cloud top temperature, channel 14 emissivity, and band 15/14 beta ratio. It is retrieved using an optimal estimation technique. Cloud top pressure and height are then derived from cloud top temperature. The channel 14 emissivity and band 15/14 beta ratio are output as intermediate products. Pixels in the product image with out of range values are assigned the minimum or maximum value in the valid range.

Cloudy conditions are determined using cloudy and probably cloudy pixels indicated in the temporally coincident intermediate 4-level cloud mask generated by the Cloud Mask algorithm. The Cloud Top Height algorithm operates on 2 km resolution pixels, generating intermediate temperature, pressure, and height products at this resolution, but the delivered Cloud Top Height and Pressure products are aggregated to 4 km or 10 km as needed to satisfy end user product resolution requirements.

Other diagnostic outputs include a processing information flag, an error estimate for the state vector parameters, and a cloud height quality indicator flag. The Cloud Top Height algorithm final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Cloud Top Height ground processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Cloud Height. This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/Cloud_CldHeight_v2.0_no_color.pdf

5.4.6 Data Fields

The Cloud Top Height product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Cloud Top Height product are located in Appendix A.

Table 5.4.6-1 Cloud Top Height: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	4571d650-b00c-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud Top Height	string
summary	The Cloud Top Height product consists of the height at the top of clouds. The product is derived using a physical retrieval composed of a radiative transfer model that calculates clear sky radiances, which is then used to compute the air temperature at cloud top. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > CLOUDS > CLOUD HEIGHT	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	***possible values are 10km at nadir for Full Disk and CONUS, and 4km at nadir for Mesoscale.***	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.4.6-2 Cloud Top Height: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality cloud top height data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	local_zenith_angle_bounds	string
local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality cloud top height data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud top height data production	string
			standard_name	solar_zenith_angle	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle _bounds ***value = 0.0 180.0***	float	number_of_SZA_ bounds = 2	long_name	solar zenith angle degree range where good quality cloud top height data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image _bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image _bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_proje ction	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_he ight	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projectio n_origin	0	double
			longitude_of_project ion_origin	***see note [1]***	double
			sweep_angle_axis	x	string
HT	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Height	string
			standard_name	geopotential_height_at_cloud_top	string
			_Unsigned	TRUE	string
			_FillValue	65535	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	0 65530	short
			scale_factor	0.30520372	float
			add_offset	0	float
			units	m	string
			resolution	y: ***see note [2]*** rad x: ***see note [2]*** rad	string
			coordinates	local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Height data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 6	byte
			units	1	string
			coordinates	local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	7	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_qf	***dynamic value***	float
			percent_invalid_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_brightness_temp_data_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_invalid_due_to_clear_or_probably_clear_sky_qf	***dynamic value***	float
			percent_invalid_due_to_unknown_cloud_type_qf	***dynamic value***	float
			percent_invalid_due_to_nonconvergent_retrieval_qf	***dynamic value***	float
cloud_pixels	int	n/a	long_name	number of cloudy or probably cloudy pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: based on temporally coincident intermediate 4-level cloud mask produced by clear sky mask algorithm) where cloud	string
outlier_pixels	int	n/a	long_name	number of cloud top height pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: ***see note [2]*** rad comment: good quality pixels whose values are outside valid measurement range only) where cloud	string
minimum_cloud_top_height	float	n/a	long_name	minimum cloud top height	string
			standard_name	geopotential_height_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 20000.0	float
			units	m	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: ***see note [2]*** rad comment: good quality pixels only) where cloud	string
	float	n/a	long_name	maximum cloud top height	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
maximum_cloud_top_height			standard_name	geopotential_height_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 20000.0	float
			units	m	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: ***see note [2]*** rad comment: good quality pixels only) where cloud	string
mean_cloud_top_height	float	n/a	long_name	mean cloud top height	string
			standard_name	geopotential_height_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 20000.0	float
			units	m	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: ***see note [2]*** rad comment: good quality pixels only) where cloud	string
std_dev_cloud_top_height	float	n/a	long_name	standard deviation of cloud top height values	string
			standard_name	geopotential_height_at_cloud_top	string
			_FillValue	-999	float
			units	m	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: ***see note [2]*** rad comment: good quality pixels only) where cloud	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L1b_radiance_band_14_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_type_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_inversion_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_pressure_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.
Note 2: Possible values for y, x, and interval are 0.000280 for Full Disk and CONUS, and 0.000112 for Mesoscale.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.4.6.1, Cloud Top Height Product Flag Values and Meanings.

5.4.6.1 Cloud Top Height Product Flag Values and Meanings

Table 5.4.6.1 Cloud Top Height Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_qf
2	invalid_due_to_LZA_threshold_exceeded_qf
3	invalid_due_to_bad_or_missing_brightness_temp_data_qf
4	invalid_due_to_clear_or_probably_clear_sky_qf
5	invalid_due_to_unknown_cloud_type_qf
6	invalid_due_to_nonconvergent_retrieval_qf

5.5 Cloud Top Pressure Product

5.5.1 Description

The Cloud Top Pressure product contains an image with pixel values identifying the atmospheric pressure at the top of a cloud layer. The product is generated in combination with the Cloud Top Height and Cloud Top Temperature products by the same algorithm. The product includes data quality information that provides an assessment of the cloud top height data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the cloud top pressure value are "hectopascals".

The Cloud Top Pressure product image is produced on the ABI fixed grid at 10 km for Full Disk and CONUS coverage regions. Product data is produced under the following conditions:

- cloudy
- geolocated source data to local zenith angles of 70 degrees for both daytime and nighttime conditions

The Cloud Top Pressure performance requirements are summarized in Table 5.5.1, Cloud Top Pressure Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.5.1 Cloud Top Pressure Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk & CONUS	100 to 1000 hPa	cloud emissivity > 0.8: 50 hPa	cloud emissivity > 0.8: 150 hPa	LZA $\leq$ 62 degrees [2]	5 km

[1] Valid measurement range prescribed by the algorithm is 0 to 1100 hPa.
[2] Conditions for good quality prescribed by the algorithm are for LZA $\leq$ 70 degrees.

Metadata in the Cloud Top Pressure product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of cloudy or probably cloud pixels that qualify for the algorithm retrieval.
- Number of cloud top pressure pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the cloud top pressure values in the product image.

These statistics are calculated using good quality pixels. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Cloud Top Pressure product is located in the standalone Appendix X, ISO Series Metadata.

5.5.2 Dynamic Source Data

Refer to the Dynamic Source Data subparagraph in paragraph 5.4, Cloud Top Height Product, as this product is generated by the same algorithm.

5.5.3 Level 2+ Semi-Static Source Data

Refer to the Level 2+ Semi-Static Source Data subparagraph in paragraph 5.4, Cloud Top Height Product, as this product is generated by the same algorithm.

5.5.4 Coordinates

Refer to the Coordinates subparagraph in paragraph 5.4 Cloud Top Height Product, as this product is generated by the same algorithm.

5.5.5 Production Notes

Refer to the Production Notes subparagraph in paragraph 5.4, Cloud Top Height Product, as this product is generated by the same algorithm.

5.5.6 Data Fields

The Cloud Top Pressure product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Cloud Top Pressure product are located in Appendix A.

Table 5.5.6-1 Cloud Top Pressure: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	aa36b140-b00d-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud Top Pressure	string
summary	The Cloud Top Pressure product consists of the pressure at the top of clouds. The product is derived using a physical retrieval composed of a radiative transfer model that calculates clear sky radiances, which is then used to compute the air temperature at cloud top. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > CLOUDS > CLOUD TOP PRESSURE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk and CONUS.***	string

Global Attribute Name	Value	Type
spatial_resolution	10km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.5.6-2 Cloud Top Pressure: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality cloud top pressure data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	local_zenith_angle_bounds	string
local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality cloud top pressure data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud top pressure data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality cloud top pressure data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
PRES	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Pressure	string
			standard_name	air_pressure_at_cloud_top	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.01678621	float
			add_offset	0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	hPa	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string
			coordinates	local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Pressure data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 6	byte
			units	1	string
			coordinates	local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	7	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_qf	***dynamic value***	float
			percent_invalid_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_brightness_temp_data_qf	***dynamic value***	float
			percent_invalid_due_to_clear_or_probably_clear_sky_qf	***dynamic value***	float
			percent_invalid_due_to_unknown_cloud_type_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_invalid_due_to_nonconvergent_retrieval_qf	***dynamic value***	float
cloud_pixels	int	n/a	long_name	number of cloudy or probably cloudy pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: based on temporally coincident intermediate 4-level cloud mask produced by clear sky mask algorithm) where cloud	string
outlier_pixels	int	n/a	long_name	number of cloud top pressure pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good quality pixels whose values are outside valid measurement range only) where cloud	string
minimum_cloud_top_pressure	float	n/a	long_name	minimum cloud top pressure	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 1100.0	float
			units	hPa	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000280 rad comment: good quality pixels only) where cloud	string
maximum_cloud_top_pressure	float	n/a	long_name	maximum cloud top pressure	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 1100.0	float
			units	hPa	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000280 rad comment: good quality pixels only) where cloud	string
mean_cloud_top_pressure	float	n/a	long_name	mean cloud top pressure	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 1100.0	float
			units	hPa	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: good quality pixels only) where cloud	string
std_dev_cloud_top_pressure	float	n/a	long_name	standard deviation of cloud top pressure values	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			units	hPa	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: good quality pixels only) where cloud	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L1b_radiance_band_14_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_type_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_inversion_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_dynamic_ancillary_NWP_pressure_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.5.6.1, Cloud Top Pressure Product Flag Values and Meanings.

5.5.6.1 Cloud Top Pressure Product Flag Values and Meanings

Table 5.5.6.1 Cloud Top Pressure Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_qf
2	invalid_due_to_LZA_threshold_exceeded_qf
3	invalid_due_to_bad_or_missing_brightness_temp_data_qf
4	invalid_due_to_clear_or_probably_clear_sky_qf
5	invalid_due_to_unknown_cloud_type_qf
6	invalid_due_to_nonconvergent_retrieval_qf

5.6 Cloud Top Temperature Product

5.6.1 Description

The Cloud Top Temperature product contains an image with pixel values identifying the atmospheric temperature at the top of a cloud layer. The product is generated in combination with the Cloud Top Height and Cloud Top Pressure products by the same algorithm. The product includes data quality information that provides an assessment of the cloud top height data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the cloud top temperature value are "kelvin".

The Cloud Top Temperature product image is produced on the ABI fixed grid at 2 km resolution for Full Disk and Mesoscale coverage regions. Product data is produced under the following conditions:

- cloudy
- geolocated source data to local zenith angles of 70 degrees for both daytime and nighttime conditions

The Cloud Top Temperature performance requirements are summarized in Table 5.6.1, Cloud Top Temperature Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.6.1 Cloud Top Temperature Performance Requirements

	Measurement				Mapping
Region	Range [1]	Accuracy	Precision	Performance Conditions	Accuracy
Full Disk & Mesoscale	180 to 300 K	cloud emissivity > 0.8: 3 K	cloud emissivity > 0.8: 5 K	LZA ≤ 65 degrees [2] COD > 1	1 km

[1] Valid measurement range prescribed by the algorithm is 180 to 340 K.
[2] Conditions for good quality prescribed by the algorithm are for LZA ≤ 70 degrees.

Metadata in the Cloud Top Temperature product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of cloudy or probably cloud pixels that qualify for the algorithm retrieval.
- Number of cloud top temperature pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the cloud top temperature values in the product image.

These statistics are calculated using good quality pixels. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Cloud Top Temperature product is located in the standalone Appendix X, ISO Series Metadata.

5.6.2 Dynamic Source Data

Refer to the Dynamic Source Data subparagraph in paragraph 5.4, Cloud Top Height Product, as this product is generated by the same algorithm.

5.6.3 Level 2+ Semi-Static Source Data

Refer to the Level 2+ Semi-Static Source Data subparagraph in paragraph 5.4, Cloud Top Height Product, as this product is generated by the same algorithm.

5.6.4 Coordinates

Refer to the Coordinates subparagraph in paragraph 5.4 Cloud Top Height Product, as this product is generated by the same algorithm.

5.6.5 5.6.5 Production Notes

Refer to the Production Notes subparagraph in paragraph 5.4, Cloud Top Height Product, as this product is generated by the same algorithm.

5.6.6 Data Fields

The Cloud Top Temperature product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Cloud Top Temperature product are located in Appendix A.

Table 5.6.6-1 Cloud Top Temperature: Global Attributes

Global Attribute Name	Value
id	***attribute is added dynamically when the file is created.***
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***
naming_authority	gov.nesdis.noaa
Institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services
Project	GOES
iso_series_metadata_id	8c98eff0-afda-11e1-afa6-0800200c9a66
Conventions	CF-1.7
Metadata_Conventions	Unidata Dataset Discovery v1.0
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)
Title	ABI L2 Cloud Top Temperature
Summary	The Cloud Top Temperature product consists of the temperature at the top of clouds. The product is derived using a physical retrieval composed of a radiative transfer model that calculates clear sky radiances, which is then used to compute the air temperature at cloud top. Product data is generated both day and night.
license	Unclassified data. Access is restricted to approved users only.
keywords	ATMOSPHERE > CLOUDS > CLOUD TOP TEMPERATURE
cdm_data_type	Image
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***
platform_ID	***possible values are G16 and G17.***
instrument_type	GOES R Series Advanced Baseline Imager
instrument_ID	***serial number of the instrument.***
processing_level	National Aeronautics and Space Administration (NASA) L2
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***
production_site	NSOF
production_environment	***possible values are OE, ITE, and DE.***
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***
scene_id	***possible values are Full Disk and Mesoscale.***
spatial_resolution	2km at nadir
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***

Table 5.6.6-2 Cloud Top Temperature: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality cloud top temperature data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	local_zenith_angle_bounds	string
local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality cloud top temperature data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud top temperature data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality cloud top temperature data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
TEMP	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Temperature	string
			standard_name	air_temperature_at_cloud_top	string
			_Unsigned	TRUE	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00244163	float
			add_offset	180	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Top Temperature data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 6	byte
			units	1	string
			coordinates	local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	7	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_qf	***dynamic value***	float
			percent_invalid_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_invalid_due_to_bad_or_missing_brightness_temp_data_qf	***dynamic value***	float
			percent_invalid_due_to_clear_or_probably_clear_sky_qf	***dynamic value***	float
			percent_invalid_due_to_unknown_cloud_type_qf	***dynamic value***	float
			percent_invalid_due_to_nonconvergent_retrieval_qf	***dynamic value***	float
cloud_pixels	int	n/a	long_name	number of cloudy or probably cloudy pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (interval: 0.000056 rad comment: based on temporally coincident intermediate 4-level cloud mask produced by clear sky mask algorithm) where cloud	string
outlier_pixels	int	n/a	long_name	number of cloud top temperature pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only) where cloud	string
minimum_cloud_top_temperature	float	n/a	long_name	minimum cloud top temperature	string
			standard_name	air_temperature_at_cloud_top	string
			_FillValue	-999	float
			valid_range	180.0 340.0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	K	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
maximum_cloud_top_temperature	float	n/a	long_name	maximum cloud top temperature	string
			standard_name	air_temperature_at_cloud_top	string
			_FillValue	-999	float
			valid_range	180.0 340.0	float
			units	K	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
mean_cloud_top_temperature	float	n/a	long_name	mean cloud top temperature	string
			standard_name	air_temperature_at_cloud_top	string
			_FillValue	-999	float
			valid_range	180.0 340.0	float
			units	K	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
std_dev_cloud_top_temperature	float	n/a	long_name	standard deviation of cloud top temperature values	string
			standard_name	air_temperature_at_cloud_top	string
			_FillValue	-999	float
			units	K	string
			coordinates	local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where cloud	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L1b_radiance_band_14_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_type_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmitt	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			ance_band_15_profile_data		
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_inversion_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_pressure_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.6.6.1, Cloud Top Temperature Product Flag Values and Meanings.

5.6.6.1 Cloud Top Temperature Product Flag Values and Meanings

Table 5.6.6.1 Cloud Top Temperature Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_qf
2	invalid_due_to_LZA_threshold_exceeded_qf
3	invalid_due_to_bad_or_missing_brightness_temp_data_qf
4	invalid_due_to_clear_or_probably_clear_sky_qf
5	invalid_due_to_unknown_cloud_type_qf
6	invalid_due_to_nonconvergent_retrieval_qf

5.7 Cloud Optical Depth Product

5.7.1 Description

The Cloud Optical Depth product contains an image with pixel values identifying the measure of the extinction due to condensed water or ice clouds at a wavelength of 0.64 um. Separate algorithms are used for daytime, solar zenith angle to 82 degrees, and nighttime, solar zenith angle greater than 82 degrees, conditions. The product is generated in combination with the Cloud Particle Size product by the same algorithms. The product includes data quality information that identifies whether the daytime or nighttime algorithm generated the pixel, and provides an assessment of the cloud optical depth data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The cloud optical depth value is a dimensionless quantity.

The Cloud Optical Depth product image is produced on the ABI fixed grid at 4 km resolution for Full Disk and 2 km resolution for CONUS coverage regions. Product data is produced under the following conditions for the daytime algorithm:

- cloudy
- geolocated source data to local zenith angles of 65 degrees and to solar zenith angles of 82 degrees

Product data generated by the nighttime algorithm is produced under the following conditions:

- cloudy
- geolocated source data to local zenith angles of 70 degrees and solar zenith angles between 82 and 180 degrees

The cloud optical depth values reported range from 0 to 160. The sensitivity of the product to high optical depths is limited for nighttime conditions to the nighttime maximum threshold, which is an optical depth value of 16.

Cloud Optical Depth product data is identified as degraded in the terminator region, which is a solar zenith angle between 65 and 82 degrees for the daytime algorithm, and 82 and 90 degrees for the nighttime algorithm.

The Cloud Optical Depth performance requirements are summarized in Table 5.7.1, Cloud Optical Depth Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein.

Table 5.7.1 Cloud Optical Depth Performance Requirements

		Measurement				Mapping
Algorithm	**Region**	**Range [1]**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Daytime	Full Disk & CONUS	1 to 50	liquid phase : 20% ice phase : 20%	maximum of 4.5 or 30%	LZA $\leq$ 65 degrees COD > 1	Full Disk: 2 km CONUS: 1 km
Nighttime	Full Disk & CONUS	1 to 8	liquid phase : 20% ice phase : 30%	maximum of 0.8 or 35%	LZA $\leq$ 65 degrees COD > 1	Full Disk: 2 km CONUS: 1 km

[1] Valid measurement range prescribed by the algorithm is 0 to 160.

The measurement range for Cloud Optical Depth is determined by the model parameterization used in the algorithm retrieval. For daytime retrievals, the cloud optical depth is determined by the lookup table bounds, $10^{-0.6}$ to 102.2 for both liquid and ice clouds. For nighttime retrievals, the cloud optical depth is constrained by the range of models considered, 0.25 to 32, as well as by the minimum and maximum data threshold parameters, 0.01 and 16, respectively.

Metadata in the Cloud Optical Depth product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of good or degraded cloud optical depth pixels for both day and night.
- Percentage of daytime, nighttime, and twilight pixels in the product image (solar zenith angles 0 to 65, 90 to 180, and 65 to 90 degrees, respectively).
- Number of cloud optical depth pixels whose values are outside the required measurement range for both the daytime (1 to 50) and nighttime (1 to 8) algorithms.
- Minimum, maximum, mean, and standard deviation of the cloud optical depth values in the product image for both the daytime and nighttime algorithms.

The daytime and nighttime statistics are calculated using pixels to a daytime solar zenith angle of 82 degrees, except for the percent day, night, and twilight statistics that are based on more restrictive day, night, and twilight solar zenith angle ranges. Percentage of daytime, nighttime, and twilight pixels in the image are calculated using geolocated pixels. The other statistics are calculated using good and degraded pixels to a local zenith angle of 65 degrees. The statistics for the image are not restricted to the measurement range specified in the performance requirements. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Cloud Optical Depth product is located in the standalone Appendix X, ISO Series Metadata.

5.7.2 Dynamic Source Data

The Cloud Optical Depth product is derived using unprocessed and processed ABI Level 1b reflective and emissive band images from the current observation. The algorithm uses final and intermediate product data generated by the Cloud Mask and Cloud Top Phase algorithms. Processed global snow and ice cover data derived from the NSIDC ancillary data is used. In addition, processed surface pressure and temperature, total precipitable water, total column ozone, atmospheric temperature and moisture profile, and other data derived from the NWP model ancillary data are used. Furthermore, the algorithm uses clear sky TOA radiance, and radiance and transmittance profile data in selected emissive bands derived from a ground system deployment of the CRTM. Dynamic auxiliary data, specifically solar zenith angle, and sun-satellite relative azimuth angle data, are also used.

The primary sensor data used by the Cloud Optical and Microphysical Properties algorithm is identified in Table 5.7.2-1, Primary Sensor Data.

Table 5.7.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_4_2km_data input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_data

The other dynamic source data inputs are summarized in Table 5.7.2-2, Other Dynamic Source Data.

Table 5.7.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Products	input_ABI_L2_cloud_top_phase_data input_ABI_L2_cloud_top_temperature_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_cloud_top_height_data input_ABI_L2_intermediate_product_cloud_top_pressure_data input_ABI_L2_intermediate_product_cloud_type_data
CRTM Intermediate Products	input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_7_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_global_snow_mask_data input_dynamic_ancillary_NWP_geopotential_height_profile_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_precipitable_water_profile_data input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_total_precipitable_water_data input_dynamic_ancillary_NWP_total_column_ozone_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.7.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Cloud Microphysical and Optical Properties (COMP) ground-processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Cloud Optical Properties algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Algorithm qualification thresholds based on solar zenith angle and satellite zenith angle.
- Spatial uniformity scale parameter.
- Parameters adopted in daytime atmospheric correction calculations.
- A priori values, error covariance, and convergence criteria for daytime optimal estimation retrieval.

- Cloud optical depth LUTs and fiducials for reflectance bands representing cloud reflectance, cloud transmission, cloud spherical albedo, and cloud albedo for water and ice-phase clouds used in daytime forward model calculations.
- Default surface albedo for snow and ice for daytime forward model calculations.
- Band 7 calibration correction.
- Initial conditions, step sizes, convergence parameters, and limits for nighttime retrievals.
- Cloud emissivity parameterization coefficients and fiducials for water and ice clouds used in nighttime retrievals.
- Coefficients to convert ice particle size diameter to effective radius.
- Interpolation parameters.
- Thresholds used in setting product quality.
- Aggregation factors for 4 km products.
- Minimum/maximum valid range / outlier limits for cloud optical depth.

The common library parameters shared across multiple algorithms are used by the Cloud Optical Properties algorithm. These parameters include:

- Band wavelength map associating each of 16 ABI bands with the corresponding central wavelength.
- Fast Planck Look Up Table (LUT) used to convert between Radiance and Brightness Temperature for bands 7 to 16.

The categories of gridded parameters used in the generation of the Cloud Optical Depth product are projection and mapping, earth surface classifications and characteristics, and seasonal. The specific types of gridded semi-static source data used in the generation of the Cloud Optical Depth product are identified in Table 5.7.3 Gridded Semi-Static Source Data.

Table 5.7.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_local_zenith_angle_bin_index_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_land_sea_mask_data
Seasonal	input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_7_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_14_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_15_data input_ABI_L2_slot_specific_semi_static_16_day_white_sky_albedo_band_2_data input_ABI_L2_slot_specific_semi_static_16_day_white_sky_albedo_band_6_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-COMPSemiStaticParams.bin

5.7.4 Coordinates

The coordinates associated with data variables in the Cloud Optical Depth product are identified in Table 5.7.4, Cloud Optical Depth and Cloud Particle Size Product Coordinates.

Table 5.7.4 Cloud Optical Depth and Cloud Particle Size Product Coordinates

<table>
<tr><th>Cloud Optical Depth and Cloud Particle Size Product Data Quantity</th><th>Coordinates</th></tr>
<tr><td>cloud optical depth and cloud particle size data</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Wavelength associated with data (cloud optical depth product only)
• Local zenith angle ranges for good quality data production, and day and night area good or degraded quality data production
• Solar zenith angle ranges for day and night area good quality data production, and twilight's degraded quality data production</td></tr>
<tr><td>cloud optical depth and cloud particle size data quality flags</td></tr>
<tr><td>day algorithm cloud pixel count</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good quality data production
• Solar zenith angle range for day algorithm good or degraded quality data production</td></tr>
<tr><td>day algorithm cloud optical depth and cloud particle size outlier pixel count</td></tr>
<tr><td>night algorithm cloud pixel count</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good quality data production
• Solar zenith angle range for night algorithm good or degraded quality data production</td></tr>
<tr><td>night algorithm cloud optical depth and cloud particle size outlier pixel count</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for night algorithm data production</td></tr>
<tr><td>day area pixel percentage</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Solar zenith angle range for day area good quality data production</td></tr>
<tr><td>night area pixel percentage</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Solar zenith angle range for night area good quality data production</td></tr>
<tr><td>terminator (twilight) pixel percentage</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Solar zenith angle range for twilight degraded quality data production</td></tr>
<tr><td>day algorithm cloud optical depth and cloud particle size minimum, maximum, mean, and standard deviation values</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Wavelength associated with data (cloud optical depth product only)
• Local zenith angle range for good quality data production
• Solar zenith angle range for day algorithm good or degraded quality data production</td></tr>
<tr><td>night algorithm cloud optical depth and cloud particle size minimum, maximum, mean, and standard deviation values</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Wavelength associated with data (cloud optical depth product only)
• Local zenith angle range for good quality data production</td></tr>
</table>

	• Solar zenith angle range for night algorithm good or degraded quality data production
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.7.5 Production Notes

The Cloud Optical Depth and Cloud Particle Size products are generated by the GOES-R ABI Cloud Microphysical and Optical Properties (COMP) ground processing algorithms for daytime and nighttime. The daytime algorithm employs a physical retrieval based on theoretically computed lookup tables while the nighttime retrieval employs CRTM calculations in an iterative physical retrieval that seeks to minimize the difference between the computed TOA brightness temperature and the observations.

The algorithm processes the data pixel-by-pixel, choosing to use the daytime or nighttime approach based on the solar zenith angle threshold value of 82 degrees. The two approaches use different criteria to identify candidate cloudy pixels. The daytime algorithm processes pixels that are identified as cloudy or probably cloudy in the intermediate 4-level cloud mask. In addition to the intermediate 4-level cloud mask, the nighttime algorithm processes pixels based on the intermediate cloud type product data that is generated by the Cloud Type algorithm. The nighttime processing occurs for any pixel that is identified as cloudy, probably cloudy, or probably clear in the intermediate 4-level cloud mask. However, because the nighttime retrieval requires cloud top temperature product data as input, which is generated only for cloudy, and probably cloud pixels, the nighttime cloud optical depth and particle size are flagged as invalid for pixels identified anywhere the cloud top temperature is invalid. Pixels in the product image with out of range values are assigned the minimum or maximum value in the valid range.

The daytime algorithm is limited to local zenith angles below a threshold of 65 degrees. The nighttime algorithm produces degraded quality product data beyond the local zenith angle limit. However, because of the dependency on cloud top temperature, a valid product is restricted to the local zenith angle range for the Cloud Top Temperature product of 70 degrees. The product is generated for all solar zenith angles but is flagged as degraded in the twilight region where the solar zenith angle is between 65 and 82 degrees for the daytime algorithm, and between 82 and 90 degrees for the nighttime algorithm.

The Cloud Optical and Microphysical Properties algorithm operates on 2 km pixels, generating an intermediate product at this resolution, but the delivered Cloud Optical Depth product is aggregated to 4 km for the Full Disk coverage region.

The Cloud Optical and Microphysical Properties algorithm outputs diagnostic daytime and nighttime processing information flags. The final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Cloud Optical and Microphysical Properties ground processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for Daytime Cloud Optical and Microphysical Properties and the GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for Nighttime Cloud Optical Depth, Cloud Particle Size, Cloud Ice Water Path, and Cloud Liquid Water Path. These documents are located at http://www.goes-r.gov/products/ATBDs/baseline/Cloud_DCOMP_v2.0_no_color.pdf and http://www.goes-r.gov/products/ATBDs/baseline/Cloud_NCOMP_2%200_no_color.pdf.

5.7.6 Data Fields

The Cloud Optical Depth product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Cloud Optical Depth product are located in Appendix A.

Table 5.7.6-1 Cloud Optical Depth: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	49b3d350-afec-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud Optical Depth at 640 nm	string
summary	The Cloud Optical Depth product consists of pixels containing the optical thickness along an atmospheric column, which is the integral along the path of radiation of a volume scattering/absorption/attenuation coefficient, due to cloud. The product is generated using different algorithms for day and night conditions. The day algorithm treats the cloud as a single, thin homogeneous atmospheric layer inserted between two cloud-free layers, makes atmospheric corrections for the cloud-free layers, and iteratively refines a state vector by searching cloud reflectivity, cloud transmission, cloud spherical albedo, and cloud albedo look-up-tables generated by a radiative transfer model. The night algorithm relies on the dependence of spectral absorption differences, and corresponding brightness temperature differences on cloud optical properties.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > CLOUDS > CLOUD OPTICAL DEPTH/THICKNESS	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk and CONUS.***	string
spatial_resolution	***possible values are 4km at nadir for Full Disk and 2km at nadir for CONUS.***	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.7.6-2 Cloud Optical Depth: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
day_retrieval_local_zenith_angle ***value = 65.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality cloud optical depth data production by the day algorithm	string
			standard_name	platform_zenith_angle	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	degree	string
			bounds	day_retrieval_local_zenith_angle_bounds	string
night_retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality cloud optical depth data production by the night algorithm	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	night_retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 65.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality cloud optical depth data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
day_retrieval_local_zenith_angle_bounds ***value = 0.0 65.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality cloud optical depth data is produced by the day algorithm	string
night_retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality cloud optical depth data is produced by the night algorithm	string
quantitative_local_zenith_angle_bounds ***value = 0.0 65.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality cloud optical depth data is produced	string
day_solar_zenith_angle ***value = 65.0***	float	n/a	long_name	threshold angle of the day region for the angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud optical depth data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	day_solar_zenith_angle_bounds	string
night_solar_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle of the night region for the angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud optical depth data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	night_solar_zenith_angle_bounds	string
twilight_solar_zenith_angle ***value = 77.5***	float	n/a	long_name	midpoint of the twilight region for the angle between the line of sight to the sun and the local zenith at the observation target for degraded quality cloud optical depth data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	twilight_solar_zenith_angle_bounds	string
day_algorithm_solar_zenith_angle ***value = 82.0***	float	n/a	long_name	threshold angle of the day algorithm region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	day_algorithm_solar_zenith_angle_bounds	string
night_algorithm_solar_zenith_angle ***value = 82.0***	float	n/a	long_name	threshold angle of the night algorithm region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	night_algorithm_solar_zenith_angle_bounds	string
day_solar_zenith_angle_bounds ***value = 0.0 65.0***	float	number_of_SZA_bounds = 2	long_name	day region solar zenith angle degree range where good quality cloud optical depth data is produced	string
night_solar_zenith_angle_bounds ***value = 90.0 180.0***	float	number_of_SZA_bounds = 2	long_name	night region solar zenith angle degree range where good quality cloud optical depth data is produced	string
twilight_solar_zenith_angle_bounds ***value = 65.0 90.0***	float	number_of_SZA_bounds = 2	long_name	twilight region solar zenith angle degree range where degraded quality cloud optical depth data is produced	string
day_algorithm_solar_zenith_angle_bounds ***value = 0.0 82.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the day algorithm region	string
night_algorithm_solar_zenith_angle_bounds ***value = 82.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the night algorithm region	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
cod_product_wavelength ***value = 0.64***	float	n/a	long_name	cloud optical depth product data wavelength	string
			standard_name	radiation_wavelength	string
			units	um	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
COD	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Optical Depth at 640 nm	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00244163	float
			add_offset	0	float
			units	1	string
			resolution	y: ***see note [2]*** rad x: ***see note [2]*** rad	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	day_retrieval_local_zenith_angle night_retrieval_local_zenith_angle quantitative_local_zenith_angle day_solar_zenith_angle night_solar_zenith_angle twilight_solar_zenith_angle cod_product_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	day_retrieval_local_zenith_angle: point (good or degraded quality pixel produced, day algorithm only) night_retrieval_local_zenith_angle: point (good or degraded quality pixel produced, night algorithm only) quantitative_local_zenith_angle: point (good quality pixel produced) day_solar_zenith_angle: point (good quality pixel produced) night_solar_zenith_angle: point (good quality pixel produced) twilight_solar_zenith_angle: point (degraded quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Optical Depth at 640 nm data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 16	byte
			units	1	string
			coordinates	day_retrieval_local_zenith_angle night_retrieval_local_zenith_angle quantitative_local_zenith_angle day_solar_zenith_angle night_solar_zenith_angle twilight_solar_zenith_angle cod_product_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	day_retrieval_local_zenith_angle: point night_retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point day_solar_zenith_angle: point night_solar_zenith_angle: point twilight_solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	byte
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	11	byte

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_day_algorithm_pixel_qf	***dynamic value***	float
			percent_night_algorithm_pixel_qf	***dynamic value***	float
			percent_good_quality_qf	***dynamic value***	float
			percent_degraded_quality_due_to_snow_or_sea_ice_qf	***dynamic value***	float
			percent_degraded_quality_due_to_twilight_qf	***dynamic value***	float
			percent_invalid_due_to_clear_conditions_qf	***dynamic value***	float
			percent_invalid_due_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_qf	***dynamic value***	float
			percent_invalid_due_to_missing_or_bad_input_data_qf	***dynamic value***	float
			percent_degraded_due_to_nonconvergence_qf	***dynamic value***	float
daytime_cloud_pixels	int	n/a	long_name	number of pixels identified as cloudy in the day portion of the image	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
nighttime_cloud_pixels	int	n/a	long_name	number of pixels identified as cloudy in the night portion of the image	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
percent_daytime_pixels	float	n/a	long_name	percent of pixels that are associated with the day solar zenith angle range	string
			standard_name	area_fraction_of_day_defined_by_solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	day_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	day_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string
percent_nighttime_pixels	float	n/a	long_name	percent of pixels that are associated with the night solar zenith angle range	string
			standard_name	area_fraction_of_night_defined_by_solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	night_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	night_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string
percent_terminator_pixels	float	n/a	long_name	percent of pixels that are associated with the twilight solar zenith angle range	string
			standard_name	area_fraction_of_twilight_defined_by_solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	twilight_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	twilight_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
outlier_COD_day	int	n/a	long_name	number of cloud optical depth at 640 nm pixels whose value is outside valid measurement range in day portion of image	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: ***see note [2]*** rad comment: good and degraded quality pixels whose values are outside valid measurement range only) where cloud	string
outlier_COD_night	int	n/a	long_name	number of cloud optical depth at 640 nm pixels whose value is outside valid measurement range in night portion of image	string
			_FillValue	-1	int
			units	count	string
			coordinates	night_retrieval_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	night_retrieval_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: ***see note [2]*** rad comment: good and degraded quality pixels whose values are outside valid measurement range only) where cloud	string
minimum_COD_da y	float	n/a	long_name	minimum cloud optical depth at 640 nm pixels in day portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			valid_range	0.0 160.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: minimum (interval: ***see note [2]*** rad comment: good and degraded quality pixels only) where cloud	string
maximum_COD_day	float	n/a	long_name	maximum cloud optical depth at 640 nm pixels in day portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			valid_range	0.0 160.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: maximum (interval: ***see note [2]*** rad comment: good and degraded quality pixels only) where cloud	string
mean_COD_day	float	n/a	long_name	mean cloud optical depth at 640 nm pixels in day portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			valid_range	0.0 160.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: mean (interval: ***see note [2]*** rad comment: good and degraded quality pixels only) where cloud	string
std_dev_COD_day	float	n/a	long_name	standard deviation of cloud optical depth at 640 nm values of pixels in day portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			units	1	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: standard_deviation (interval: ***see note [2]*** rad comment: good and degraded quality pixels only) where cloud	string
minimum_COD_night	float	n/a	long_name	minimum cloud optical depth at 640 nm pixels in night portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			valid_range	0.0 160.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: minimum (interval: ***see note [2]*** rad comment: good and degraded quality pixels only) where cloud	string
maximum_COD_night	float	n/a	long_name	maximum cloud optical depth at 640 nm pixels in night portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			valid_range	0.0 160.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: maximum (interval: ***see note [2]*** rad comment: good and degraded quality pixels only) where cloud	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
mean_COD_night	float	n/a	long_name	mean cloud optical depth at 640 nm pixels in night portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			valid_range	0.0 160.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: mean (interval: ***see note [2]*** rad comment: good and degraded quality pixels only) where cloud	string
std_dev_COD_night	float	n/a	long_name	standard deviation of cloud optical depth at 640 nm values of pixels in night portion of image	string
			standard_name	atmosphere_optical_thickness_due_to_cloud	string
			_FillValue	-999	float
			units	1	string
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle cod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: standard_deviation (interval: see ***note [2]*** rad comment: good and degraded quality pixels only) where cloud	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L1b_radiance_band_4_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_cloud_top_phase_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_cloud_top_temperature_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_reflectance_band_6_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_top_height_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_top_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_type_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_7_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_global_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_column_ozone_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_precipitable_water_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.
Note 2: Possible values for y, x, and interval are 0.000112 for Full Disk and 0.000056 for CONUS.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.7.6.1, Cloud Optical Depth Product Flag Values and Meanings.

5.7.6.1 Cloud Optical Depth Product Flag Values and Meanings

Table 5.7.6.1 Cloud Optical Depth Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
1	0	day_algorithm_pixel_qf
1	1	night_algorithm_pixel_qf

30	0	good_quality_qf
30	2	degraded_quality_due_to_snow_or_sea_ice_qf
30	4	degraded_quality_due_to_twilight_qf
30	6	invalid_due_to_clear_conditions_qf
30	8	invalid_due_LZA_threshold_exceeded_qf
30	10	degraded_due_to_LZA_threshold_exceeded_qf
30	12	invalid_due_to_not_geolocated_qf
30	14	invalid_due_to_missing_or_bad_input_data_qf
30	16	degraded_due_to_nonconvergence_qf

5.8 Cloud Particle Size Product

5.8.1 Description

The Cloud Particle Size product contains an image with pixel values identifying a measure of the effective radius of the particles in a single cloud layer. It is defined by the ratio of the third and second moment of the particle size distribution. Separate algorithms are used for daytime, solar zenith angle to 82 degrees, and nighttime, solar zenith angle greater than 82 degrees, conditions. The product is generated in combination with the Cloud Optical Depth product by the same algorithms. The product includes data quality information that identifies whether the daytime or nighttime algorithm generated the pixel, and provides an assessment of the cloud particle size data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the cloud particle size value are "microns".

The Cloud Particle Size product image is produced on the ABI fixed grid at 2 km resolution for Full Disk, CONUS, and Mesoscale coverage regions. Product data is produced under the following conditions for the daytime algorithm:

- cloudy
- geolocated source data to local zenith angles of 65 degrees and to solar zenith angles of 82 degrees

Product data generated by the nighttime algorithm is produced under the following conditions:

- cloudy
- geolocated source data to local zenith angles of 70 degrees and solar zenith angles between 82 and 180 degrees

The cloud particle size values reported range from 0 to 100 um. However, the size range depends on day/night conditions and the liquid/ice water phase.

Cloud Particle Size product data is identified as degraded in the terminator region, which is a solar zenith angle between 65 and 82 degrees for the daytime algorithm, and 82 and 90 degrees for the nighttime algorithm.

The Cloud Particle Size performance requirements are summarized in Table 5.8.1, Cloud Particle Size Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein.

Table 5.8.1 Cloud Particle Size Performance Requirements

		Measurement				Mapping
Algorithm	**Region**	**Range [1]**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Daytime	Full Disk, CONUS, & Mesoscale	liquid phase: 2 to 32 um ice phase: 2 to 50 um	liquid phase : 4 um ice phase : 10 um	liquid phase: 2 um ice phase: 4 um	LZA ≤ 65 degrees 2 < Cloud Optical Depth < 60	1 km
Nighttime	Full Disk, CONUS, & Mesoscale	liquid phase: 2 to 32 um ice phase: 2 to 50 um	liquid phase : 4 um ice phase : 10 um	liquid phase: 100% ice phase: 45%	LZA ≤ 65 degrees 2 < Cloud Optical Depth < 60	1 km

[1] Valid measurement range prescribed by the algorithm is 0 to 100 um.

The measurement range for Cloud Particle Size is determined by the model parameterization used in the algorithm retrieval. For daytime retrievals, the effective radius is determined by the lookup table bounds, $10^{0.4}$ to 102.0, corresponding to 2.51 to 100 um, for both liquid and ice clouds. For nighttime retrievals, the effective radiance is determined by the range of particle size models considered: 2 to 32 um for water clouds, and; 2.62 to 78.15 um for ice clouds where the retrieval of particle size diameter is related to the effective radius by a quadratic equation.

Metadata in the Cloud Particle Size product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of good or degraded cloud particle size pixels for both day and night.
- Percentage of daytime, nighttime, and twilight pixels in the product image (solar zenith angles 0 to 65, 90 to 180, and 65 to 90 degrees, respectively).
- Number of cloud particle size pixels whose values are outside the required measurement range for both the daytime and nighttime algorithms (liquid: 2 to 32 um; ice 2 to 50 um).
- Minimum, maximum, mean, and standard deviation of the cloud particle size values in the product image for both the daytime and nighttime algorithms.

The daytime and nighttime statistics are calculated using pixels to a daytime solar zenith angle of 82 degrees, except for the percent day, night, and twilight statistics that are based on more restrictive day, night, and twilight solar zenith angle ranges. Percentage of daytime, nighttime, and twilight pixels in the image are calculated using geolocated pixels. The other statistics are calculated using good and degraded pixels to a local zenith angle of 65 degrees. The statistics for the image are not restricted to the measurement range specified in the performance requirements. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Cloud Particle Size product is located in the standalone Appendix X, ISO Series Metadata

5.8.2 Dynamic Source Data

Refer to the Dynamic Source Data subparagraph in paragraph 5.7, Cloud Optical Depth Product, as this product is generated by the same algorithm.

5.8.3 Level 2+ Semi-Static Source Data

Refer to the Level 2+ Semi-Static Source Data subparagraph in paragraph 5.7, Cloud Optical Depth Product, as this product is generated by the same algorithm.

5.8.4 Coordinates

Refer to the Coordinates subparagraph in paragraph 5.7 Cloud Optical Depth Product, as this product is generated by the same algorithm.

5.8.5 Production Notes

Refer to the Production Notes subparagraph in paragraph 5.7, Cloud Optical Depth Product, as this product is generated by the same algorithm.

5.8.6 Data Fields

The Cloud Particle Size product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Cloud Particle Size product are located in Appendix A.

Table 5.8.6-1 Cloud Particle Size: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	964f0910-afe1-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Cloud Particle Size	string
summary	The Cloud Particle Size product consists of pixels containing the effective radius of cloud liquid and ice water particles at cloud top. The product is generated using different algorithms for day and night conditions. The day algorithm treats the cloud as a single, thin homogeneous atmospheric layer inserted between two cloud-free layers, makes atmospheric corrections for the cloud-free layers, and iteratively refines a state vector by searching cloud reflectivity, cloud transmission, cloud spherical albedo, and cloud albedo look-up-tables generated by a radiative transfer model. The night algorithm relies on the dependence of spectral absorption differences, and corresponding brightness temperature differences on cloud optical properties.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > CLOUDS > DROPLET CONCENTRATION/SIZE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.8.6-2 Cloud Particle Size: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
day_retrieval_local_zenith_angle ***value = 65.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality cloud particle size data production by the day algorithm	string
			standard_name	platform_zenith_angle	string
			units	degree	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	day_retrieval_local_zenith_angle_bounds	string
night_retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality cloud particle size data production by the night algorithm	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	night_retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 65.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality cloud particle size data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
day_retrieval_local_zenith_angle_bounds ***value = 0.0 65.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality cloud particle size data is produced by the day algorithm	string
night_retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality cloud particle size data is produced by the night algorithm	string
quantitative_local_zenith_angle_bounds ***value = 0.0 65.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality cloud particle size data is produced	string
day_solar_zenith_angle ***value = 65.0***	float	n/a	long_name	threshold angle of the day region for the angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud particle size data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	day_solar_zenith_angle_bounds	string
night_solar_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle of the night region for the angle between the line of sight to the sun and the local zenith at the observation target for good quality cloud particle size data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	night_solar_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
twilight_solar_zenith_angle ***value = 77.5***	float	n/a	long_name	midpoint of the twilight region for the angle between the line of sight to the sun and the local zenith at the observation target for degraded quality cloud particle size data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	twilight_solar_zenith_angle_bounds	string
day_algorithm_solar_zenith_angle ***value = 82.0***	float	n/a	long_name	threshold angle of the day algorithm region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	day_algorithm_solar_zenith_angle_bounds	string
night_algorithm_solar_zenith_angle ***value = 82.0***	float	n/a	long_name	threshold angle of the night algorithm region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	night_algorithm_solar_zenith_angle_bounds	string
day_solar_zenith_angle_bounds ***value = 0.0 65.0***	float	number_of_SZA_bounds = 2	long_name	day region solar zenith angle degree range where good quality cloud particle size data is produced	string
night_solar_zenith_angle_bounds ***value = 90.0 180.0***	float	number_of_SZA_bounds = 2	long_name	night region solar zenith angle degree range where good quality cloud particle size data is produced	string
twilight_solar_zenith_angle_bounds ***value = 65.0 90.0***	float	number_of_SZA_bounds = 2	long_name	twilight region solar zenith angle degree range where degraded quality cloud particle size data is produced	string
day_algorithm_solar_zenith_angle_bounds ***value = 0.0 82.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the day algorithm region	string
night_algorithm_solar_zenith_angle_bounds ***value = 82.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the night algorithm region	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
PSD	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Particle Size	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00152602	float
			add_offset	0	float
			units	um	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	day_retrieval_local_zenith_angle night_retrieval_local_zenith_angle quantitative_local_zenith_angle day_solar_zenith_angle night_solar_zenith_angle twilight_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	day_retrieval_local_zenith_angle: point (good or degraded quality pixel produced, day algorithm only) night_retrieval_local_zenith_angle: point (good or degraded quality pixel produced, night algorithm only) quantitative_local_zenith_angle: point (good quality pixel produced) day_solar_zenith_angle: point (good quality pixel produced) night_solar_zenith_angle: point (good quality pixel produced) twilight_solar_zenith_angle: point (degraded quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Cloud Particle Size data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 16	byte
			units	1	string
			coordinates	day_retrieval_local_zenith_angle night_retrieval_local_zenith_angle quantitative_local_zenith_angle day_solar_zenith_angle night_solar_zenith_angle twilight_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	day_retrieval_local_zenith_angle: point night_retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point day_solar_zenith_angle: point night_solar_zenith_angle: point twilight_solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	byte
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	11	byte
			percent_day_algorithm_pixel_qf	***dynamic value***	float
			percent_night_algorithm_pixel_qf	***dynamic value***	float
			percent_good_quality_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_degraded_quality_due_to_snow_or_sea_ice_qf	***dynamic value***	float
			percent_degraded_quality_due_to_twilight_qf	***dynamic value***	float
			percent_invalid_due_to_clear_conditions_qf	***dynamic value***	float
			percent_invalid_due_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_qf	***dynamic value***	float
			percent_invalid_due_to_missing_or_bad_input_data_qf	***dynamic value***	float
			percent_degraded_due_to_nonconvergence_qf	***dynamic value***	float
daytime_cloud_pixels	int	n/a	long_name	number of pixels identified as cloudy in the day portion of the image	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
nighttime_cloud_pixels	int	n/a	long_name	number of pixels identified as cloudy in the night portion of the image	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
percent_daytime_pixels	float	n/a	long_name	percent of pixels that are associated with the day solar zenith angle range	string
			standard_name	area_fraction_of_day_defined_by_solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	day_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	day_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string
percent_nighttime_pixels	float	n/a	long_name	percent of pixels that are associated with the night solar zenith angle range	string
			standard_name	area_fraction_of_night_defined_by_solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	night_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	night_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string
percent_terminator_pixels	float	n/a	long_name	percent of pixels that are associated with the twilight solar zenith angle range	string
			standard_name	area_fraction_of_twilight_defined_by_solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	twilight_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	twilight_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
outlier_PSD_day	int	n/a	long_name	number of cloud particle size pixels whose value is outside valid measurement range in day portion of image	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good and degraded quality pixels whose values are outside valid measurement range only) where cloud	string
outlier_PSD_night	int	n/a	long_name	number of cloud particle size pixels whose value is outside valid measurement range in night portion of image	string
			_FillValue	-1	int
			units	count	string
			coordinates	night_retrieval_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	night_retrieval_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: sum (interval: see note [2] rad comment: good and degraded quality pixels whose values are outside valid measurement range only) where cloud	string
minimum_PSD_day	float	n/a	long_name	minimum cloud particle size of pixels in day portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float
			units	um	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
maximum_PSD_day	float	n/a	long_name	maximum cloud particle size of pixels in day portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			valid_range	0.0 100.0	float
			units	um	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
mean_PSD_day	float	n/a	long_name	mean cloud particle size of pixels in day portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float
			units	um	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
std_dev_PSD_day	float	n/a	long_name	standard deviation of cloud particle size values of pixels in day portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float
			units	um	string
			coordinates	quantitative_local_zenith_angle day_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_algorithm_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
minimum_PSD_night	float	n/a	long_name	minimum cloud particle size of pixels in night portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	um	string
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
maximum_PSD_night	float	n/a	long_name	maximum cloud particle size of pixels in night portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float
			units	um	string
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
mean_PSD_night	float	n/a	long_name	mean cloud particle size of pixels in night portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float
			units	um	string
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
std_dev_PSD_night	float	n/a	long_name	standard deviation of cloud particle size values of pixels in night portion of image	string
			standard_name	effective_radius_of_cloud_condensed_water_particles_at_cloud_top	string
			_FillValue	-999	float
			units	um	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	quantitative_local_zenith_angle night_algorithm_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_algorithm_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good and degraded quality pixels only) where cloud	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L1b_radiance_band_4_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_cloud_top_phase_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_cloud_top_temperature_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_reflectance_band_6_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_top_height_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_top_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_type_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_7_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_global_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_column_ozone_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_precipitable_water_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.8.6.1, Cloud Particle Size Product Flag Values and Meanings.

5.8.6.1 Cloud Particle Size Product Flag Values and Meanings

Table 5.8.6.1 Cloud Particle Size Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
1	0	day_algorithm_pixel_qf
1	1	night_algorithm_pixel_qf
30	0	good_quality_qf
30	2	degraded_quality_due_to_snow_or_sea_ice_qf
30	4	degraded_quality_due_to_twilight_qf
30	6	invalid_due_to_clear_conditions_qf
30	8	invalid_due_LZA_threshold_exceeded_qf
30	10	degraded_due_to_LZA_threshold_exceeded_qf
30	12	invalid_due_to_not_geolocated_qf
30	14	invalid_due_to_missing_or_bad_input_data_qf
30	16	degraded_due_to_nonconvergence_qf

5.9 Aerosol Detection Product

5.9.1 Description

The Aerosol Detection product contains three images in the form of binary masks that identify the presence of aerosols, dust, and smoke. The aerosol mask indicates the presence of either smoke or dust. The dust and smoke masks indicate the presence of dust and smoke, respectively. Because the presence of smoke and dust are independently derived, a given pixel can be identified with both dust and smoke. The product includes data quality information for on-earth pixels, including an assessment of the validity of the smoke and dust detections, and a confidence level.

The binary aerosol, dust, and smoke mask values are dimensionless quantities.

The Aerosol Detection product images are produced on the ABI fixed grid at 2 km resolution for Full Disk, CONUS and Mesoscale coverage regions. Product data is produced under the following conditions:

- clear sky
- snow-free
- geolocated source data to local zenith angles of 90 degrees and to solar zenith angles of 87 degrees

The Aerosol Detection performance requirements are summarized in Table 5.9.1, Aerosol Detection Performance Requirements. Good quality retrievals as prescribed by the algorithm are those that satisfy the measurement range and performance conditions identified therein except as noted.

Table 5.9.1 Aerosol Detection Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions [1]**	**Accuracy**
Full Disk, CONUS, & Mesoscale	0 or 1	Dust over land: 80% Dust over ocean: 80% Smoke over land: 80% Smoke over ocean: 70%	N/A	LZA ≤ 60 degrees daytime [2] clear sky AOD > 0.2	1 km

[1] Conditions for data production prescribed by the algorithm also include snow/ice-free.
[2] Conditions for good quality prescribed by the algorithm are for SZA ≤ 60 degrees.

Metadata in the Aerosol Detection product provides statistical and other properties of the product images and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of pixels where geolocated source data is available to a local zenith angle of 60 degrees.
- Number of pixels where geolocated source data is available to a solar zenith angle of 60 degrees.
- Number of pixels that qualified for the smoke and dust retrievals.
- Number of pixels where each of smoke and dust are detected.

The first statistic in the list is calculated using geolocated pixels to a solar zenith angle of 87 degrees. The second statistic in the list is calculated using geolocated pixels to a local zenith angle of 90 degrees. The last two statistics in the list are calculated using good retrieved detection pixels to a local zenith angle of 90 degrees and a solar zenith angle of 87 degrees. The percentages of pixels assigned to each retrieval quality value are also included in the product.

The detailed description of the ISO series metadata for the Aerosol Detection product is located in the standalone Appendix X, ISO Series Metadata.

5.9.2 Dynamic Source Data

The Aerosol Detection product is derived using processed ABI Level 1b reflective and emissive band images from the current observation. The algorithm uses intermediate product data generated by the Cloud Mask and Snow Cover algorithms. In addition, the algorithm uses dynamic auxiliary data, specifically solar zenith angle, sunglint angle, and sun-satellite relative azimuth angle. Processed global snow and ice cover data derived from the NSIDC ancillary data is a secondary input to the algorithm.

The primary sensor data used by the Aerosol Detection algorithm is identified in Table 5.9.2-1, Primary Sensor Data.

Table 5.9.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_reflectance_band_1_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_3_2km_data input_ABI_L2_intermediate_product_reflectance_band_4_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_2km_data

The other dynamic source data inputs are summarized in Table 5.9.2-2, Other Dynamic Source Data.

Table 5.9.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_info_flag_data input_ABI_L2_intermediate_product_binary_snow_mask_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_global_snow_mask_data [1]
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sunglint_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data [2]

[1] Processed global snow mask ancillary data is used when the ABI intermediate binary snow mask product data is not available.
[2] Sun-satellite relative azimuth angle is used to compute the sunglint angle in the event that the sunglint angle is not available.

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.9.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Aerosol Detection ground-processing algorithm:

- Algorithm-specific parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Aerosol Detection algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Qualification thresholds based on latitude, longitude, solar zenith angle, satellite zenith angle, and sunglint.
- Thresholds for retrieval over snow/ice.
- Aerosol detection test thresholds for smoke and dust over land and water backgrounds.
- Confidence values and thresholds for confidence tests.
- Thresholds for assignment of quality flags.

The categories of gridded parameters used in the generation of the Aerosol Detection product are projection and mapping, and earth surface classifications and characteristics. The specific types of gridded semi-static source data in the categories used in the generation of the Aerosol Detection product are identified in Table 5.9.3 Gridded Semi-Static Source Data.

Table 5.9.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_land_sea_mask_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-ADPSemiStaticParams.bin

5.9.4 Coordinates

The coordinates associated with data variables in the Aerosol Detection product are identified in Table 5.9.4, Aerosol Detection Product Coordinates.

Table 5.9.4 Aerosol Detection Product Coordinates

Aerosol Detection Product Data Quantity	Coordinates
aerosol detection data (including smoke and dust)	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle ranges for good, and good or degraded quality data production • Solar zenith angle ranges for good, and good or degraded quality data production
aerosol detection retrieval quality flags	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good or degraded quality data production
good local zenith angle pixel count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for good or degraded quality data production
good solar zenith angle pixel count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production
good smoke and dust retrieval counts	• Observation time period • NN/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good or degraded quality data production
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.9.5 Production Notes

The Aerosol Detection product is generated by the GOES-R ABI Aerosol Detection ground processing algorithm. The algorithm applies threshold tests to ABI reflectance bands and thermal bands over land and ocean backgrounds to obtain results. Clear sky is determined using clear and probably clear pixels indicated in the temporally coincident intermediate 4-level cloud mask generated by the Cloud Mask algorithm. Snow-free is determined using snow-free pixels indicated in the most recent intermediate binary snow mask generated by the Snow Cover algorithm.

In addition to the aerosol, dust, and smoke binary mask images, the algorithm produces a data information flag bit mask that captures the outcome of individual tests and other diagnostic information. The final and intermediate diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Aerosol Detection ground processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for the ABI Aerosol Detection Product. This document is located at
http://www.goes-r.gov/products/ATBDs/baseline/AAA_AIP_v2.0_no_color.pdf

5.9.6 Data Fields

The Aerosol Detection product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Aerosol Detection product are located in Appendix A.

Table 5.9.6-1 Aerosol Detection: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	258cad90-af4b-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Aerosol Detection	string
summary	The Aerosol Detection product consists of three flags for each pixel in the image indicating the presence of aerosol and whether the type of aerosol is dust or smoke. The three flags are generated based on the results of threshold tests applied to reflectances at ABI reflective bands with central wavelengths 0.47, 0.64, 0.865, 1.378, 1.61, and 2.25 um, and brightness temperatures at ABI emissive bands with central wavelengths 3.9, 11.2, and 12.3 um. Product data is generated during the day.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > AEROSOLS > DUST/ASH/SMOKE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string

production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.9.6-2 Aerosol Detection: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality aerosol detection data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_local_zenith_angle ***value = 60.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality aerosol detection data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality aerosol detection data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 60.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality aerosol detection data is produced	string
retrieval_solar_zenith_angle ***value = 87.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good or degraded quality aerosol detection data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	retrieval_solar_zenith_angle_bounds	string
quantitative_solar_zenith_angle ***value = 60.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality aerosol detection data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	quantitative_solar_zenith_angle_bounds	string
retrieval_solar_zenith_angle_bounds ***value = 0.0 87.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good or degraded quality aerosol detection data is produced	string
	float		long_name		string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_solar_zenith_angle_bounds ***value = 0.0 60.0***		number_of_SZA_bounds = 2		solar zenith angle degree range where good quality aerosol detection data is produced	
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
Aerosol	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Aerosol Detection: Aerosol	string
			standard_name	aerosol_binary_mask	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 1	byte
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good or degraded quality pixel produced) quantitative_solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	DQF	string
Smoke	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Aerosol Detection: Smoke	string
			standard_name	smoke_binary_mask	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 1	byte
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good or degraded quality pixel produced) quantitative_solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	DQF	string
Dust	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Aerosol Detection: Dust	string
			standard_name	dust_binary_mask	string
			_Unsigned	TRUE	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			_FillValue	255	byte
			valid_range	0 1	byte
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good or degraded quality pixel produced) quantitative_solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Aerosol Detection data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 60	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point retrieval_solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	byte
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_smoke_detection_qf_values	2	byte
			percent_good_smoke_detection_retrieval_qf	***dynamic value***	float
			percent_invalid_smoke_detection_due_to_snow_ice_clouds_or_bad_source_data_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			number_of_dust_detection_qf_values	2	byte
			percent_good_dust_detection_retrieval_qf	***dynamic value***	float
			percent_invalid_dust_detection_due_to_snow_ice_clouds_or_bad_source_data_qf	***dynamic value***	float
			number_of_smoke_confidence_qf_values	3	byte
			percent_low_confidence_smoke_detection_qf	***dynamic value***	float
			percent_medium_confidence_smoke_detection_qf	***dynamic value***	float
			percent_high_confidence_smoke_detection_qf	***dynamic value***	float
			number_of_dust_confidence_qf_values	3	byte
			percent_low_confidence_dust_detection_qf	***dynamic value***	float
			percent_medium_confidence_dust_detection_qf	***dynamic value***	float
			percent_high_confidence_dust_detection_qf	***dynamic value***	float
number_good_LZA_pixels	int	n/a	long_name	number of pixels that do not exceed LZA threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
number_good_SZA_pixels	int	n/a	long_name	number of pixels that do not exceed SZA threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only)	string
number_of_good_smoke_retrievals	int	n/a	long_name	number of smoke retrievals where smoke may or may not exist	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good smoke detection retrieval pixels only)	string
number_of_good_dust_retrievals	int	n/a	long_name	number of dust retrievals where dust may or may not exist	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good dust detection retrieval pixels only)	string
number_of_good_retrievals_where_smoke_detected	int	n/a	long_name	number of retrievals where smoke is detected	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good smoke detection retrieval pixels only) where smoke	string
	int	n/a	long_name	number of retrievals where dust is detected	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
number_of_good_retrievals_where_dust_detected			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good dust detection retrieval pixels only) where dust_aerosol	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_sunglint_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_1_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_3_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_4_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_5_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_6_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_cloud_mask_info_flag_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_binary_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_global_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.9.6.1, Aerosol Detection Product Flag Values and Meanings.

5.9.6.1 Aerosol Detection Product Flag Values and Meanings

Table 5.9.6.1-1 Aerosol Detection Product Binary Aerosol Mask Flag Values and Meanings

Aerosol (aerosol)	
Flag Value	**Flag Meaning**
0	aerosols_absent
1	aerosols_present

Table 5.9.6.1-2 Aerosol Detection Product Binary Smoke Mask Flag Values and Meanings

Smoke (smoke)	
Flag Value	**Flag Meaning**
0	smoke_absent
1	smoke_present

Table 5.9.6.1-3 Aerosol Detection Product Binary Dust Mask Flag Values and Meanings

Dust (dust)	
Flag Value	**Flag Meaning**
0	dust_absent
1	dust_present

Table 5.9.6.1-4 Aerosol Detection Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
1	0	good_smoke_detection_retrieval_qf
1	1	invalid_smoke_detection_due_to_snow_ice_clouds_or_bad_source_data_qf
2	0	good_dust_detection_retrieval_qf
2	2	invalid_dust_detection_due_to_snow_ice_clouds_or_bad_source_data_qf

12	0	low_confidence_smoke_detection_qf
12	4	medium_confidence_smoke_detection_qf
12	12	high_confidence_smoke_detection_qf
48	0	low_confidence_dust_detection_qf
48	16	medium_confidence_dust_detection_qf
48	48	high_confidence_dust_detection_qf

5.10 Aerosol Optical Depth Product

5.10.1 Description

The Aerosol Optical Depth product contains an image with pixel values identifying a measure of the extinction due to atmospheric aerosols at a wavelength of 550 nm over land and ocean. The product includes data quality information that provides an assessment of the quality of the algorithm retrievals for on-earth pixels.

The aerosol optical depth value is a dimensionless quantity.

The Aerosol Optical Depth product image is produced on the ABI fixed grid at 2 km resolution for Full Disk and CONUS coverage regions. Product data is produced under the following conditions:

- clear sky
- snow-free
- geolocated source data to local zenith angles of 90 degrees, to solar zenith angles of 90 degrees, and sunglint angles greater than 40 degrees when over the ocean
- surface with reflectance not greater than 0.25 at ABI band with ABI band 6 central wavelength of 2.25 um when over the land

The Aerosol Optical Depth performance requirements are summarized in Table 5.10.1, Aerosol Optical Depth Performance Requirements. Good quality retrievals as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.10.1 Aerosol Optical Depth Performance Requirements

		Measurement				Mapping
Region	**Surface Type**	**Range**	**Accuracy**	**Precision**	**Performance Conditions [1]**	**Accuracy**
Full Disk & CONUS	Over Land	-1 to 5	(1) AOD < 0.04: 0.06 (2) 0.04 ≤ AOD ≤ 0.80: 0.04 (3) AOD > 0.80: 0.12	(1) AOD < 0.04: 0.13 (2) 0.04 ≤ AOD ≤ 0.80: 0.25 (3) AOD > 0.80: 0.35	LZA ≤ 60 degrees daytime [2] clear sky	1 km
Full Disk & CONUS	Over Ocean	-1 to 5	(1) AOD < 0.40: 0.02 (2) AOD > 0.40: 0.10	(1) AOD < 0.40: 0.15 (2) AOD > 0.40: 0.23	LZA ≤ 60 degrees daytime [2] clear sky	1 km

[1] Conditions for data production prescribed by the algorithm also include snow/ice-free and, when over ocean, sunglint angle > 40 degrees.
[2] Conditions for good quality prescribed by the algorithm are for SZA ≤ 80 degrees.

Metadata in the Aerosol Optical Depth product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Percentages of each of good and bad aerosol optical depth pixels over land and over ocean for the eighteen, 10 degree latitude bands in the product image.
- Number of aerosol optical depth pixels whose values are outside the required measurement range over land and Over Ocean.
- Minimum, maximum, mean, and standard deviation of the aerosol optical depth values in the 550 nm image over land and over ocean for the eighteen, 10 degree latitude bands in the product image.
- Minimum, maximum, mean, and standard deviation of the aerosol optical depth values in the images at ABI reflective band wavelengths associated with source level 1b data used by the algorithm over land and over ocean for the eighteen, 10 degree latitude bands in the product image.

- Minimum, maximum, mean, and standard deviation of the surface reflectivity values at the ABI reflective band wavelengths associated with source level 1b data used by the algorithm over land for the eighteen, 10 degree latitude bands in the product image.
- Number of attempted retrievals over land and over ocean for the eighteen, 10 degree latitude bands.
- Number of attempted retrievals over land and over ocean within the local zenith angle performance specification limit of 60 degrees for the eighteen, 10 degree latitude bands.

These statistics are calculated using geolocated pixels to a solar zenith angle of 80 degrees, which is associated with good quality pixels. These statistics are calculated using geolocated pixels to a local zenith angle of 90 degrees, except for the number of attempted retrievals over land and over ocean within the local zenith angle performance specification limit of 60 degrees. The percentages of pixels assigned to each retrieval quality value are also included in the product.

The detailed description of the ISO series metadata for the Aerosol Optical Depth product is located in the standalone Appendix X, ISO Series Metadata.

5.10.2 Dynamic Source Data

The Aerosol Optical Depth product is derived using processed ABI L1b reflective band images from the current observation. The algorithm uses final and intermediate product data generated by the Cloud Mask, Legacy Atmospheric Profiles, and Snow Cover algorithms. In addition, processed surface wind, total column ozone, and surface pressure data derived from the NWP model ancillary data are used. Furthermore, the algorithm uses dynamic auxiliary data, specifically solar zenith angle, solar azimuth angles, and sun-satellite relative azimuth angle data. Processed global snow and ice cover data derived from the NSIDC ancillary data and processed total precipitable water derived from the NWP model ancillary data are secondary inputs to the algorithm.

The primary sensor data used by the Aerosol Optical Depth algorithm is identified in Table 5.10.2-1, Primary Sensor Data.

Table 5.10.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_reflectance_band_1_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_3_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_data

The other dynamic source data inputs are summarized in Table 5.10.2-2, Other Dynamic Source Data.

Table 5.10.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L2_total_precipitable_water_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_snow_mask_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_global_snow_mask_data [1] input_dynamic_ancillary_NWP_total_precipitable_water_data [2] input_dynamic_ancillary_NWP_total_column_ozone_data input_dynamic_ancillary_NWP_surface_wind_vector_data input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_surface_geopotential_height_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_solar_azimuth_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data

[1] Processed global snow mask ancillary data is used when the ABI intermediate binary snow mask product data is not available.
[2] Processed NWP total precipitable water ancillary data is used when the ABI total precipitable water product data is not available.

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.10.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Aerosol Optical Depth ground-processing algorithm:

- Algorithm-specific parameters.
- Gridded parameters.

The algorithm-specific parameters represent parameters that are unique to the Aerosol Optical Depth algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Qualification thresholds based on sunglint, surface reflectance, solar and satellite zenith angles, etc.
- Default physical values for missing inputs (for graceful degradation).
- Aerosol optical depth LUT and fiducials for normalized atmospheric extinction coefficients, atmospheric spherical albedo, atmospheric transmittance, and atmospheric reflectance over land.
- Aerosol optical depth LUT and fiducials for normalized atmospheric extinction coefficients, atmospheric spherical albedo, atmospheric transmittance, and atmospheric reflectance over ocean.
- Mass extinction coefficient LUTs and fiducials for land and for ocean.
- Real and imaginary components of the water vapor refractive index.
- Coefficients used in the correction for extinction by atmospheric gases and for determination of water vapor transmittance.
- Coefficients used in computation of Rayleigh multiple scattering reflectance.
- In-water reflectance and whitecap reflectance parameters for ocean.
- Ocean sunglint surface reflectance LUT and fiducials for diffuse reflectance and spherical albedo.
- Coefficients in Cox Munk ocean directional reflectance model.
- Coefficients used in the NDVI-based association between VIS and SWIR band reflectance.
- Thresholds used in setting product quality.
- Minimum/maximum valid range / outlier limits on aerosol optical depth.

The categories of gridded parameters used in the generation of the Aerosol Optical Depth product are projection and mapping, earth surface classifications and characteristics, and atmospheric climatology. The specific types of gridded semi-static source data in the categories used in the generation of the Aerosol Optical Depth product are identified in Table 5.10.3 Gridded Semi-Static Source Data.

Table 5.10.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_semi_static_local_azimuth_angle_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data

Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_surface_elevation_data input_ABI_L2_slot_specific_semi_static_land_sea_mask_data
Atmospheric Climatology	input_ABI_L2_slot_specific_semi_static_monthly_aerosol_climatology_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-SMAODSemiStaticParams.bin

5.10.4 Coordinates

The coordinates associated with data variables in the Aerosol Optical Depth product are identified in Table 5.10.4, Aerosol Optical Depth Product Coordinates.

Table 5.10.4 Aerosol Optical Depth Product Coordinates

Aerosol Optical Depth Product Data Quantity	Coordinates
aerosol optical depth at wavelength of 550 nm data	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Wavelength associated with data • Local zenith angle ranges for good, and good or degraded quality data production • Solar zenith angle ranges for good, and good or degraded quality data production • Sunglint angle range for no data production over sea
aerosol optical depth at wavelength of 550 nm retrieval quality flags	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Wavelength associated with data

Aerosol Optical Depth Product Data Quantity	Coordinates
	• Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good or degraded quality data production • Sunglint angle range for no data production over sea
aerosol optical depth at wavelength of 550 nm retrievals attempted over land	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Wavelength associated with data • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production
aerosol optical depth at wavelength of 550 nm retrievals attempted over sea	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Wavelength associated with data • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production • Sunglint angle range for no data production over sea
aerosol optical depth at wavelength of 550 nm outlier pixel count	
aerosol optical depth at wavelength of 550 nm good local zenith angle retrievals attempted	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Wavelength associated with data • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production • Sunglint angle range for no data production over sea
latitude band aerosol optical depth at wavelength of 550 nm retrievals attempted over land	• Observation time period • Latitude band (10 degree) statistics geo-location • N/S elevation and E/W scanning angle extents for image perimeter associated with band statistics geo-location • Wavelength associated with data • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production
latitude band aerosol optical depth at wavelength of 550 nm percent good and bad retrievals over land	
latitude band aerosol optical depth at wavelength of 550 nm minimum, maximum, mean, and standard deviation values over land	
latitude band aerosol optical depth at wavelength of 550 nm retrievals attempted over sea	• Observation time period • Latitude band (10 degree) statistics geo-location • N/S elevation and E/W scanning angle extents for image perimeter associated with band statistics geo-location • Wavelength associated with data • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production • Sunglint angle range for no data production over sea
latitude band aerosol optical depth at wavelength of 550 nm percent good and bad retrievals over sea	
latitude band aerosol optical depth at wavelength of 550 nm minimum, maximum, mean, and standard deviation values over sea	
latitude band aerosol optical depth at wavelength of 550 nm good local zenith angle retrievals attempted over land	• Observation time period • Latitude band (10 degree) statistics geo-location • Wavelength associated with data

<table>
<tr><th>Aerosol Optical Depth Product Data Quantity</th><th>Coordinates</th></tr>
<tr><td></td><td>• N/S elevation and E/W scanning angle extents for image perimeter associated with band statistics geo-location
• Local zenith angle range for good quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>latitude band AOD at wavelength of 550 nm good local zenith angle retrievals attempted over sea</td><td>• Observation time period
• Latitude band (10 degree) statistics geo-location
• N/S elevation and E/W scanning angle extents for image perimeter associated with band statistics geo-location
• Wavelength associated with data
• Local zenith angle range for good quality data production
• Solar zenith angle range for good quality data production
• Sunglint angle range for no data production over sea</td></tr>
<tr><td>AOD at wavelength of 550 nm minimum, maximum, mean, and standard deviation values over land</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Wavelength associated with data
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>AOD at wavelength of 550 nm minimum, maximum, mean, and standard deviation values over sea</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Wavelength associated with data
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production
• Sunglint angle range for no data production over sea</td></tr>
<tr><td>latitude band AOD at specific ABI sensor band central wavelengths minimum, maximum, mean, and standard deviation values over land</td><td rowspan="2">• Observation time period
• Latitude band (10 degree) statistics geo-location
• N/S elevation and E/W scanning angle extents for image perimeter associated with band statistics geo-location
• Central wavelength and identifier of the applicable ABI bands
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>latitude band surface reflectivity at specific ABI sensor band central wavelengths minimum, maximum, mean, and standard deviation values over land</td></tr>
<tr><td>latitude band AOD at specific ABI sensor band central wavelengths minimum, maximum, mean, and standard deviation values over sea</td><td rowspan="2">• Observation time period
• Latitude band (10 degree) statistics geo-location
• N/S elevation and E/W scanning angle extents for image perimeter associated with band statistics geo-location
• Central wavelength and identifier of the applicable ABI bands
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production
• Sunglint angle range for no data production over sea</td></tr>
<tr><td>latitude band surface reflectivity at specific ABI sensor band central wavelengths minimum, maximum, mean, and standard deviation values over sea</td></tr>
<tr><td>AOD at specific ABI sensor band central wavelengths minimum, maximum, mean, and standard deviation values over land</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image perimeter associated with image geo-location
• Central wavelength and identifier of the applicable ABI bands
• Local zenith angle range for good or degraded quality data production</td></tr>
</table>

Aerosol Optical Depth Product Data Quantity	Coordinates
	• Solar zenith angle range for good quality data production
AOD at specific ABI sensor band central wavelengths minimum, maximum, mean, and standard deviation values over sea	• Observation time period • N/S elevation and E/W scanning angle extents for image perimeter associated with image geo-location • Central wavelength and identifier of the applicable ABI bands • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production • Sunglint angle range for no data production over sea
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.10.5 Production Notes

The Aerosol Optical Depth product is generated by the GOES-R ABI Aerosol Optical Depth ground processing algorithm. The algorithm determines ABI reflectance measurements using physical retrievals that utilize a lookup table of TOA reflectance that is pre-calculated from a radiative transfer model. The physical retrievals are performed separately over land and ocean. The algorithm computes the optical thickness of aerosols at wavelengths that depend on the surface type. ABI bands 1, 2, and 6 with central wavelengths of 0.47, 0.64, and 2.25 um are used for land retrievals over dark vegetated surfaces. ABI bands 2, 3, 5, and 6 with central wavelengths of 0.64, 0.865, 1.61, and 2.25 um are used for ocean retrievals. The aerosol type is evaluated based on the selection of an aerosol model from four prescribed land aerosol models, generic, dust, smoke, and urban, or for a pair of fine and coarse marine aerosol modes selected from four prescribed fine modes and five prescribed coarse modes. The suspended matter is derived from the computed aerosol optical depth. Pixels in the product image with out of range values are assigned the minimum or maximum value in the valid range.

Clear sky is determined using clear and probably clear pixels indicated in the temporally coincident intermediate 4-level cloud mask generated by the Cloud Mask algorithm. Snow-free is determined using snow-free pixels indicated in the most recent intermediate binary snow mask generated by the Snow Cover algorithm.

The latitude band statistics, whose extents are a function of the ABI's fixed grid field of regard and latitude, use the CF metadata conventions hybrid grid mapping that includes both the grid_mapping for the "geostationary" and "latitude_longitude" projections.

Intermediate output and diagnostic information data are output by the algorithm, including:

- Quality information
- Aerosol optical depth in ABI bands 1, 2, 3, 5, and 6
- Land surface reflectance in ABI bands 1, 2, and 6
- Aerosol model index over land
- Coarse-mode aerosol index over ocean
- Fine-mode aerosol index over ocean
- Fine-mode weight over ocean
- Suspended matter

The fine-mode aerosol index over ocean is an intermediate product that supports the generation of the GOES-R Level 2+ shortwave radiation products. The Aerosol Optical Depth algorithm final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Aerosol Optical Depth ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for Suspended Matter / Aerosol Optical Depth and Aerosol Size Parameter. This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/AAA_AODASP_v2.0_no_color.pdf.

5.10.6 Data Fields

The Aerosol Optical Depth product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Aerosol Optical Depth product are located in Appendix A.

Table 5.10.6-1 Aerosol Optical Depth: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	6aae4020-af4e-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Aerosol Optical Depth	string
summary	The Aerosol Optical Depth at 550 nm product consists of pixels containing a dimensionless quantity representing the atmospheric absorption optical thickness due to ambient aerosol. The product is derived from ABI reflectance measurements through physical retrievals that utilize a lookup table of top of the atmosphere reflectance that is calculated from a radiative transfer model. The product is reported at 0.55 um, and 10 degree latitude band statistics are included for aerosol optical depth at 0.55 um, and ABI bands with central wavelengths 0.47, 0.64, and 2.25 um, respectively, over land, and ABI bands with central wavelengths 0.64, 0.865, 1.61, and 2.25 um, respectively, over sea. Product data is generated during the day.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > AEROSOLS > AEROSOL OPTICAL DEPTH/THICKNESS	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk and CONUS.***	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.10.6-2 Aerosol Optical Depth: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
sunglint_angle ***value = 40.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the direction of the beam of incident solar radiation for aerosol optical depth data production	string
			standard_name	sunglint_angle	string
			units	degree	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	sunglint_angle_bounds	string
sunglint_angle_bounds ***value = 0.0 40.0***	float	number_of_sunglint_angle_bounds = 2	long_name	sunglint angle degree range where aerosol optical depth data is not produced	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality aerosol optical depth data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 60.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality aerosol optical depth data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality aerosol optical depth data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 60.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality aerosol optical depth data is produced	string
retrieval_solar_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good or degraded quality aerosol optical depth data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	retrieval_solar_zenith_angle_bounds	string
quantitative_solar_zenith_angle ***value = 80.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality aerosol optical depth data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	quantitative_solar_zenith_angle_bounds	string
retrieval_solar_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good or degraded quality aerosol optical depth data is produced	string
	float		long_name		string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_solar_zenith_angle_bounds ***value = 0.0 80.0***		number_of_SZA_bounds = 2		solar zenith angle degree range where good quality aerosol optical depth data is produced	
aod_product_wavelength ***value = 0.55***	float	n/a	long_name	aerosol optical depth product data wavelength	string
			standard_name	radiation_wavelength	string
			units	um	string
land_sensor_band_wavelengths ***value = 0.47 0.64 2.25***	float	land_sensor_bands = 3	long_name	ABI band central wavelengths for aerosol optical depth statistics over land	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
sea_sensor_band_wavelengths ***value = 0.64 0.865 1.61 2.25***	float	sea_sensor_bands = 4	long_name	ABI band central wavelengths for aerosol optical depth statistics over sea	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
land_sensor_band_ids ***value = 1 2 6***	byte	land_sensor_bands = 3	long_name	ABI band identifiers for aerosol optical depth statistics over land	string
			standard_name	sensor_band_identifier	string
			units	1	string
sea_sensor_band_ids ***value = 2 3 5 6***	byte	sea_sensor_bands = 4	long_name	ABI band identifiers for aerosol optical depth statistics over sea	string
			standard_name	sensor_band_identifier	string
			units	1	string
latitude_bands ***value = 85.0 75.0 65.0 55.0 45.0 35.0 25.0 15.0 5.0 -5.0 -15.0 -25.0 -35.0 -45.0 -55.0 -65.0 -75.0 -85.0***	float	latitude_bands = 18	long_name	midpoint of 10 degree latitude bands	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
			bounds	latitude_band_bounds	string
latitude_band_bounds	float	n/a	long_name	latitude band degree ranges	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
value = 90.0 80.0 80.0 70.0 70.0 60.0 60.0 50.0 50.0 40.0 40.0 30.0 30.0 20.0 20.0 10.0 10.0 0.0 0.0 -10.0 -10.0 -20.0 -20.0 -30.0 -30.0 -40.0 -40.0 -50.0 -50.0 -60.0 -60.0 -70.0 -70.0 -80.0 -80.0 -90.0					
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
snow_free_land_and_ice_free_sea ***value = snow_free_land ice_free_sea***	char	n/a	long_name	CF area_types where AOD retrievals occur	string
			standard_name	area_type	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
goes_lat_lon_projection	int	n/a	long_name	GOES-R latitude / longitude projection	string
			grid_mapping_name	***see note [1]***	string
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			longitude_of_prime_meridian	0	double
AOD	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Aerosol Optical Depth at 550 nm	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00009156	float
			add_offset	-1	float
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: point (no pixel produced over sea only) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good or degraded quality pixel produced) quantitative_solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Aerosol Optical Depth at 550 nm data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	255	byte
			valid_range	0 1	byte
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle retrieval_solar_zenith_angle aod_product_wavelength t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: point (no retrieval over sea only) retrieval_local_zenith_angle: point retrieval_solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	2	byte
			percent_good_retrieval_qf	***dynamic value***	float
			percent_bad_retrieval_qf	***dynamic value***	float
aod550_retrievals_attempted_land	int	n/a	long_name	number of ABI L2+ Aerosol Optical Depth at 550 nm over land retrievals attempted	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only) where clear_sky over snow_free_land	string
aod550_retrievals_attempted_sea	int	n/a	long_name	number of ABI L2+ Aerosol Optical Depth at 550 nm over sea retrievals attempted	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	sunglint_angle: sum (no data retrievals attempted for pixels) retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only) where clear_sky over ice_free_sea	string
aod550_good_LZA_retrievals_attempted	int	n/a	long_name	number of ABI L2+ Aerosol Optical Depth at 550 nm retrievals attempted that do not exceed LZA threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle quantitative_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no data retrievals attempted for pixels over sea only) quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only) where clear_sky over snow_free_land_and_ice_free_sea	string
aod550_outlier_pixel_count	int	n/a	long_name	number of aerosol optical depth at 550 nm pixels over land whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no data retrievals attempted for pixels over sea only) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good retrieval pixels whose values are outside valid measurement range only) where clear_sky over snow_free_land_and_ice_free_sea	string
lat_band_aod550_retrievals_attempted_land	int	latitude_bands = 18	long_name	number of ABI L2+ Aerosol Optical Depth at 550 nm over land retrievals attempted in latitude band	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only) where clear_sky over snow_free_land	string
lat_band_aod550_retrievals_attempted_sea	int	latitude_bands = 18	long_name	number of ABI L2+ Aerosol Optical Depth at 550 nm over sea retrievals attempted in latitude band	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no data retrievals attempted for pixels) retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only) where clear_sky over ice_free_sea	string
lat_band_aod550_good_LZA_retrievals_attempted_land	int	latitude_bands = 18	long_name	number of ABI L2+ Aerosol Optical Depth at 550 nm over land retrievals attempted that do not exceed LZA threshold in latitude band	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only) where clear_sky over snow_free_land	string
lat_band_aod550_good_LZA_retrievals_attempted_sea	int	latitude_bands = 18	long_name	number of ABI L2+ Aerosol Optical Depth at 550 nm over sea retrievals attempted that do not exceed LZA threshold in latitude band	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle quantitative_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no data retrievals attempted for pixels) quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: geolocated/not missing pixels only) where clear_sky over ice_free_sea	string
lat_band_aod550_percent_good_retrievals_land	float	latitude_bands = 18	long_name	percent good retrievals of ABI L2+ Aerosol Optical Depth at 550 nm over land in latitude band	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_aod550_percent_bad_retrievals_land	float	latitude_bands = 18	long_name	percent bad retrievals of ABI L2+ Aerosol Optical Depth at 550 nm over land in latitude band	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: bad retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_aod550_percent_ good_retrievals_sea	float	latitude_bands = 18	long_name	percent good retrievals of ABI L2+ Aerosol Optical Depth at 550 nm over sea in latitude band	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_aod550_percent_ bad_retrievals_sea	float	latitude_bands = 18	long_name	percent bad retrievals of ABI L2+ Aerosol Optical Depth at 550 nm over sea in latitude band	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: sum (interval: 0.000056 rad comment: bad retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_min_aod550_lan d	float	latitude_bands = 18	long_name	minimum ABI L2+ Aerosol Optical Depth at 550 nm over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_a erosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_max_aod550_lan d	float	latitude_bands = 18	long_name	maximum ABI L2+ Aerosol Optical Depth at 550 nm over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_a erosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_mean_aod550_land	float	latitude_bands = 18	long_name	mean ABI L2+ Aerosol Optical Depth at 550 nm over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_std_dev_aod550_land	float	latitude_bands = 18	long_name	standard_deviation of the ABI L2+ Aerosol Optical Depth at 550 nm values over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
lat_band_min_aod550_sea	float	latitude_bands = 18	long_name	minimum ABI L2+ Aerosol Optical Depth at 550 nm over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_max_aod550_sea	float	latitude_bands = 18	long_name	maximum ABI L2+ Aerosol Optical Depth at 550 nm over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
lat_band_mean_aod550_sea	float	latitude_bands = 18	long_name	mean ABI L2+ Aerosol Optical Depth at 550 nm over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_std_dev_aod550_sea	float	latitude_bands = 18	long_name	standard_deviation of the ABI L2+ Aerosol Optical Depth at 550 nm values over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle : sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
min_aod550_land	float	n/a	long_name	minimum ABI L2+ Aerosol Optical Depth at 550 nm over land	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
max_aod550_land	float	n/a	long_name	maximum ABI L2+ Aerosol Optical Depth at 550 nm over land	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
mean_aod550_land	float	n/a	long_name	mean ABI L2+ Aerosol Optical Depth at 550 nm over land	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
std_dev_aod550_land	float	n/a	long_name	standard deviation of ABI L2+ Aerosol Optical Depth values at 550 nm over land	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
min_aod550_sea	float	n/a	long_name	minimum ABI L2+ Aerosol Optical Depth at 550 nm over sea	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
max_aod550_sea	float	n/a	long_name	maximum ABI L2+ Aerosol Optical Depth at 550 nm over sea	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
mean_aod550_sea	float	n/a	long_name	mean ABI L2+ Aerosol Optical Depth at 550 nm over sea	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
std_dev_aod550_sea	float	n/a	long_name	standard deviation of ABI L2+ Aerosol Optical Depth values at 550 nm over sea	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle aod_product_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_min_aod_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	minimum aerosol optical depth for ABI sensor band over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_sensor_band_max_aod_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	maximum aerosol optical depth for ABI sensor band over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_sensor_band_mean_aod_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	mean aerosol optical depth for ABI sensor band over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: mean (interval: 0.000056 rad comment: good retrieval pixels only) where where clear_sky over snow_free_land	string
lat_band_sensor_band_std_dev_aod_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	standard_deviation of the aerosol optical depth values for ABI sensor band over land in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where where clear_sky over snow_free_land	string
lat_band_sensor_band_min_aod_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	minimum aerosol optical depth for ABI sensor band over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_max_aod_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	maximum aerosol optical depth for ABI sensor band over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_mean_aod_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	mean aerosol optical depth for ABI sensor band over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_std_dev_aod_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	standard_deviation of the aerosol optical depth values for ABI sensor band over sea in latitude band	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
sensor_band_min_aod_land	float	land_sensor_bands = 3	long_name	minimum aerosol optical depth for ABI sensor band over land	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
sensor_band_max_aod_land	float	land_sensor_bands = 3	long_name	maximum aerosol optical depth for ABI sensor band over land	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
sensor_band_mean_aod_land	float	land_sensor_bands = 3	long_name	mean aerosol optical depth for ABI sensor band over land	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
sensor_band_std_dev_aod_land	float	land_sensor_bands = 3	long_name	standard deviation of aerosol optical depth values for ABI sensor band over land	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
sensor_band_min_aod_sea	float	sea_sensor_bands = 4	long_name	minimum aerosol optical depth for ABI sensor band over sea	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
sensor_band_max_aod_sea	float	sea_sensor_bands = 4	long_name	maximum aerosol optical depth for ABI sensor band over sea	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
sensor_band_mean_aod_sea	float	sea_sensor_bands = 4	long_name	mean aerosol optical depth for ABI sensor band over sea	string
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			valid_range	-1.0 5.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
sensor_band_std_dev_aod_sea	float	sea_sensor_bands = 4	long_name	standard deviation of aerosol optical depth values for ABI sensor band over sea	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			standard_name	atmosphere_absorption_optical_thickness_due_to_ambient_aerosol	string
			_FillValue	-999	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_min_surface_reflectivity_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	minimum surface reflectivity for ABI sensor band over land in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_sensor_band_max_surface_reflectivity_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	maximum surface reflectivity for ABI sensor band over land in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	1	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_sensor_band_mean_surface_reflectivity_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	mean surface reflectivity for ABI sensor band over land in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_sensor_band_std_dev_surface_reflectivity_land	float	latitude_bands = 18 land_sensor_bands = 3	long_name	standard deviation of the surface reflectivity values for ABI sensor band over land in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_solar_zenith_angle land_sensor_band_ids land_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over snow_free_land	string
lat_band_sensor_band_min_surface_reflectivity_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	minimum surface reflectivity for ABI sensor band over sea in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: minimum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_max_surface_reflectivity_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	maximum surface reflectivity for ABI sensor band over sea in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: maximum (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_mean_surface_reflectivity_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	mean surface reflectivity for ABI sensor band over sea in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: mean (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
lat_band_sensor_band_std_dev_surface_reflectivity_sea	float	latitude_bands = 18 sea_sensor_bands = 4	long_name	standard deviation of the surface reflectivity values for ABI sensor band over sea in latitude band	string
			standard_name	surface_bidirectional_reflectance	string
			_FillValue	-999	float
			units	1	string
			coordinates	sunglint_angle retrieval_local_zenith_angle quantitative_solar_zenith_angle sea_sensor_band_ids sea_sensor_band_wavelengths t latitude_bands y_image x_image	string
			grid_mapping	goes_lat_lon_projection: latitude_bands goes_imager_projection: y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixels produced) retrieval_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum y_image: x_image: sum latitude bands: standard_deviation (interval: 0.000056 rad comment: good retrieval pixels only) where clear_sky over ice_free_sea	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_solar_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_1_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_3_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_5_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_reflectance_band_6_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_binary_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_global_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_total_column_ozone_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_dynamic_ancillary_NWP_surface_wind_vector_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_geopotential_height_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.10.6.1, Aerosol Optical Depth Product Flag Values and Meanings.

5.10.6.1 Aerosol Optical Depth Product Flag Values and Meanings

Table 5.10.6.1 Aerosol Optical Depth Product Retrieval Quality Flag Values and Meanings

Retrieval Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_retrieval_qf
1	bad_retrieval_qf

5.11 Volcanic Ash: Detection and Height Product

5.11.1 Description

The Volcanic Ash: Detection and Height product contains two images with pixel values identifying volcanic ash cloud height and volcanic ash mass loading. The ash cloud top height is the geopotential height of the ash cloud top. The ash mass loading in the mass of volcanic ash per unit of area.

The product includes two types of data quality information. One type of data quality indicator describes the quality of the volcanic ash detection, providing an assessment of the presence of volcanic ash for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale, and the confidence in the detection of volcanic ash existing in single and multiple layers. The second type of data quality indicator provides information about the quality and ash characteristics of the retrieval for on-earth pixels, identifying failure conditions, cloud top temperature, cloud emissivity, and absorbed optical depth ratio retrieval quality, and the volcanic ash particle size.

The units of measure for the ash cloud top height value are "meters". The units of measure for the ash mass loading value are "metric tons (tonnes) per square kilometer".

The Volcanic Ash: Detection and Height product images are produced on the ABI fixed grid at 2 km resolution for the Full Disk coverage region. Product data is produced for geolocated source data to local zenith angles of 90 degrees for both daytime and nighttime conditions. The Volcanic Ash: Detection and Height performance requirements are summarized in Table 5.11.1, Volcanic Ash: Detection and Height Performance Requirements. Good quality pixels and retrievals as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.11.1 Volcanic Ash: Detection and Height Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy**	**Precision [2]**	**Performance Conditions**	**Accuracy**
Full Disk	(1) Volcanic ash cloud top height: 0 to 30,000 m (2) Volcanic ash mass loading: 0 to 50 metric tons/km^2	(1) Volcanic ash cloud top height: 3 km (top height) (2) Volcanic ash mass loading: 2 metric tons/km^2	(2) Volcanic ash mass loading: 2.5 metric tons/km^2	LZA ≤ 60 degrees [3]	1 km

[1] Valid measurement range for volcanic ash mass loading prescribed by the algorithm is 0 to 260 metric tons/km^2.
[2] Precision requirement for volcanic ash cloud top height has not been specified.
[3] Conditions for good quality prescribed by the algorithm are for LZA ≤ 80 degrees.

Metadata in the Volcanic Ash: Detection and Height product provides statistical and other properties of the product images and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period
- Number of attempted retrievals
- Total volcanic ash mass loading in image
- Number of volcanic ash cloud top height and volcanic ash mass loading pixels whose values are outside the required measurement range
- Minimum, maximum, mean, and standard deviation of the values in the volcanic ash cloud top height and volcanic ash mass loading product images

Number of attempted retrievals is calculated using geolocated pixels where the retrieval is successful or failed. The other statistics are calculated using geolocated pixels where the retrieval is successful to a local zenith angle of 80 degrees. The percentages of pixels assigned to each flag value for the data detection and retrieval quality information are also included in the product.

The detailed description of the ISO series metadata for the Volcanic Ash: Detection and Height product is located in the standalone Appendix X, ISO Series Metadata.

5.11.2 Dynamic Source Data

The Volcanic Ash: Detection and Height product is derived using unprocessed and processed ABI Level 1b emissive band images from the current observation. The algorithm uses processed surface pressure, and pressure, height, and temperature profile data derived from the NWP model ancillary data. In addition, the algorithm uses clear sky radiance, clear sky radiance and transmittance profile, and cloudy sky radiance profile data in selected emissive bands derived from the ground system deployment of the CRTM.

The primary sensor data used by the Volcanic Ash: Detection and Height algorithm is identified in Table 5.11.2-1, Primary Sensor Data.

Table 5.11.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_10_2km_data input_ABI_L1b_radiance_band_11_2km_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L1b_radiance_band_15_2km_data input_ABI_L1b_radiance_band_16_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_brightness_temperature_band_16_2km_data

The other dynamic source data inputs are summarized in Table 5.11.2-2, Other Dynamic Source Data.

Table 5.11.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_10_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_11_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_10_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_11_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_geopotential_height_profile_data

	input_dynamic_ancillary_NWP_pressure_profile_data input_dynamic_ancillary_NWP_tropopause_level_index_data input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.11.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Volcanic Ash: Detection and Height ground processing algorithm:

- Algorithm-specific parameters.
- Common library parameters.
- Gridded parameters.

The algorithm-specific parameters represent parameters that are unique to the Volcanic Ash algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Constants used to define black and opaque cloud properties.
- Parameters and thresholds initialization and refinement of ash confidence assignment.
- Thresholds for defining ash confidence quality.
- A priori values and constraints for the retrieval state vector components and their uncertainties.
- Beta ratio scaling parameters.
- Forward model uncertainties.
- Retrieval convergence criteria parameters.
- Physical constants (e.g., ash density).
- Regression coefficients used to determine effective ash cloud particle size and extinction cross section.
- Thresholds for assignment of ash quality flags and quality information.
- Minimum/maximum valid range / outlier limits on volcanic ash mass loading and height.

The common library parameters shared across multiple algorithms are used by the Volcanic Ash algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These parameters include:

- Band wavelength map associating each of 16 ABI bands with the corresponding central wavelength.
- Fast Planck Look Up Table (LUT) used to convert between Radiance and Brightness Temperature for bands 7 to 16
- Maximum allowed pixel displacement for cloud local radiative center determination.
- Scale factors to convert L1b input pixel radiance values from scaled integers to floating point values.

The categories of gridded parameters used in the generation of the Volcanic Ash: Detection and Height product are projection and mapping, earth surface classifications and characteristics, and seasonal. The specific types of gridded semi-static source data in the categories used in the generation of the Volcanic Ash: Detection and Height product are identified in Table 5.11.3 Gridded Semi-Static Source Data.

Table 5.11.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_local_zenith_angle_bin_index_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_surface_type_mask_data
Seasonal	input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_14_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_15_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- VolcanicAsh_Parameters.bin

5.11.4 Coordinates

The coordinates associated with data variables in the Volcanic Ash: Detection and Height product are identified in Table 5.11.4, Volcanic Ash: Detection and Height Product Coordinates.

Table 5.11.4 Volcanic Ash: Detection and Height Product Coordinates

Volcanic Ash Product Data Quantity	Coordinates
volcanic ash cloud top height data	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle ranges for good, and good or degraded quality data production
volcanic ash mass loading data	

volcanic ash retrieval data quality flags	• Solar zenith angle range for good quality data production
volcanic ash detection data quality flags	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle ranges for good, and good or degraded quality data production • Local zenith angle range for nominal confidence level • Solar zenith angle range for good quality data production
attempted retrieval count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production
total volcanic ash mass loading	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
volcanic ash cloud top height outlier pixel count	
volcanic ash mass loading outlier pixel count	
volcanic ash cloud top height minimum, maximum, mean, and standard deviation values	
volcanic ash mass loading minimum, maximum, mean, and standard deviation values	
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.11.5 Production Notes

The Volcanic Ash: Detection and Height product is generated by the GOES-R ABI Volcanic Ash: Detection and Height ground processing algorithm. Volcanic ash cloud top height and mass loading are determined by retrieving ash cloud effective temperature, 11 micron cloud emissivity, and the 12/11 micron effective absorption optical depth ratio (β-ratio). The algorithm uses a physical retrieval utilizing an in-line radiative transfer model to compute clear sky TOA radiances, clear sky transmittance and radiance profiles, and black cloud radiance profiles. The algorithm is optimized by first detecting volcanic ash, and then performing the volcanic ash cloud top height and mass loading retrievals satisfying an ash confidence level threshold. The algorithm identifies volcanic ash confidence levels for both single and multiple layer cloud conditions. Pixels in the product images with out of range values are assigned the minimum or maximum value in the valid range.

The algorithm generates product quality indicator flags for ash detection, and ash height and mass loading that identify the conditions associated with the retrievals. The Volcanic Ash: Detection and Height algorithm final and diagnostic information files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Volcanic Ash: Detection and Height ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Volcanic Ash (Detection and Height). This document is located at http://www.goes-r.gov/products/ATBDs/baseline/Aviation_VolAsh_v2.0_no_color.pdf.

5.11.6 Data Fields

The Volcanic Ash: Detection and Height product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Volcanic Ash: Detection and Height product are located in Appendix A.

Table 5.11.6-1 Volcanic Ash: Detection and Height: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	0c7acd60-b012-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Volcanic Ash: Detection and Height	string
summary	The Volcanic Ash: Detection and Height product consists of pixels containing the geopotential height at the top of volcanic ash clouds and the atmospheric mass content of the volcanic ash. The product is generated by leveraging that volcanic ash clouds are more absorptive than meteorological clouds in emissive bands with wavelengths 8.5, 9.61, 10.35, and 11.2 um, while meteorological clouds absorb strongly in emissive bands with wavelengths 11.2 and 12.3 um. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > AEROSOLS > DUST/ASH/SMOKE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string

production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	Full Disk	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.11.6-1 Volcanic Ash: Detection and Height: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for overall good or degraded quality volcanic ash data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_local_zenith_angle ***value = 80.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for overall good quality volcanic ash data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
ash_existence_confidence_threshold_local_zenith_angle ***value = 75.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for nominal assignment of confidence level to overall good quality volcanic ash data	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	ash_existence_confidence_threshold_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where overall good or degraded quality volcanic ash data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 80.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where overall good quality volcanic ash data is produced	string
ash_existence_confidence_threshold_local_zenith_angle_bounds ***value = 0.0 75.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where nominal assignment of confidence level to overall good quality volcanic ash data occurs	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for overall good quality volcanic ash data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where overall good quality volcanic ash data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
VAH	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Volcanic Ash: Ash Cloud Height	string
			standard_name	geopotential_height_at_volcanic_ash_cloud_top	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.45780559	float
			add_offset	0	float
			units	m	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: point (overall good or degraded quality pixel produced) quantitative_local_zenith_angle: point (overall good quality pixel produced) solar_zenith_angle: point (overall good quality pixel produced) t: point area: point	string
			ancillary_variables	DET_DQF RET_DQF	string
VAML	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Volcanic Ash: Ash Mass Loading	string
			standard_name	atmosphere_mass_content_of_volcanic_ash	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00396765	float
			add_offset	0	float
			units	t km-2	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (overall good or degraded quality pixel produced) quantitative_local_zenith_angle: point (overall good quality pixel produced) solar_zenith_angle: point (overall good quality pixel produced) t: point area: point	string
			ancillary_variables	DET_DQF RET_DQF	string
DET_DQF	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Volcanic Ash data detection quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 1059	short
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle ash_existence_confidence_threshold_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point ash_existence_confidence_threshold_local_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	short

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			flag_values	***see note [flags and meanings]***	short
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	2	byte
			percent_overall_good_quality_qf	***dynamic value***	float
			percent_overall_bad_quality_qf	***dynamic value***	float
			number_of_L1b_qf_values	2	byte
			percent_good_source_L1b_data_qf	***dynamic value***	float
			percent_invalid_source_L1b_data_qf	***dynamic value***	float
			number_of_LZA_qf_values	2	byte
			percent_good_within_LZA_threshold_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			number_of_confidence_levels_single_layer_ash	5	byte
			percent_high_confidence_single_layer_ash_qf	***dynamic value***	float
			percent_moderate_confidence_single_layer_ash_qf	***dynamic value***	float
			percent_low_confidence_single_layer_ash_qf	***dynamic value***	float
			percent_very_low_confidence_single_layer_ash_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_single_layer_not_ash_qf	***dynamic value***	float
			number_of_confidence_levels_multiple_layer_ash	5	byte
			percent_high_confidence_multiple_layer_ash_qf	***dynamic value***	float
			percent_moderate_confidence_multiple_layer_ash_qf	***dynamic value***	float
			percent_low_confidence_multiple_layer_ash_qf	***dynamic value***	float
			percent_very_low_confidence_multiple_layer_ash_qf	***dynamic value***	float
			percent_multiple_layer_not_ash_qf	***dynamic value***	float
RET_DQF	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Volcanic Ash data retrieval quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 2730	short
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	short
			flag_values	***see note [flags and meanings]***	short
			flag_meanings	***see note [flags and meanings]***	string
			number_of_retrieval_status_qf_values	3	byte

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_good_retrieval_qf	***dynamic value***	float
			percent_failed_retrieval_qf	***dynamic value***	float
			percent_not_attempted_retrieval_qf	***dynamic value***	float
			number_of_retrieved_cloud_top_temperature_qf_values	3	byte
			percent_high_quality_retrieved_cloud_top_temperature_qf	***dynamic value***	float
			percent_medium_quality_retrieved_cloud_top_temperature_qf	***dynamic value***	float
			percent_low_quality_retrieved_cloud_top_temperature_qf	***dynamic value***	float
			number_of_retrieved_cloud_emissivity_qf_values	3	byte
			percent_high_quality_retrieved_cloud_emissivity_qf	***dynamic value***	float
			percent_medium_quality_retrieved_cloud_emissivity_qf	***dynamic value***	float
			percent_low_quality_retrieved_cloud_emissivity_qf	***dynamic value***	float
			number_of_retrieved_absorption_optical_depth_ratio_qf_values	3	byte

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_high_quality_retrieved_absorption_optical_depth_ratio_qf	***dynamic value***	float
			percent_medium_quality_retrieved_absorption_optical_depth_ratio_qf	***dynamic value***	float
			percent_low_quality_retrieved_absorption_optical_depth_ratio_qf	***dynamic value***	float
			number_of_ash_particle_size_classifications	11	byte
			percent_ash_particle_size_lt_2um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_2um_lt_3um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_3um_lt_4um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_4um_lt_5um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_5um_lt_6um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_6um_lt_7um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_7um_lt_8um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_8um_lt_9um_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_ash_particle_size_ge_9um_lt_10um_qf	***dynamic value***	float
			percent_ash_particle_size_ge_10um_qf	***dynamic value***	float
			percent_ash_particle_size_invalid_qf	***dynamic value***	float
count_attempted_ash_retrievals	int	n/a	long_name	number of attempted ash retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good and failed retrievals only)	string
ash_mass_loading_total_mass	float	n/a	long_name	total volcanic ash mass loading	string
			standard_name	atmosphere_mass_content_of_volcanic_ash	string
			_FillValue	-999	float
			units	t km-2	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_cloud_height_outlier_pixel_count	int	n/a	long_name	number of volcanic ash cloud height pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good retrievals whose values are outside valid measurement range only) where volcanic_ash_cloud	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
ash_mass_loading_outlier_pixel_count	int	n/a	long_name	number of volcanic ash mass loading pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good retrievals whose values are outside valid measurement range only) where volcanic_ash_cloud	string
ash_cloud_height_minimum	float	n/a	long_name	minimum volcanic ash cloud height	string
			standard_name	geopotential_height_at_volcanic_ash_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 30000.0	float
			units	m	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_cloud_height_maximum	float	n/a	long_name	maximum volcanic ash cloud height	string
			standard_name	geopotential_height_at_volcanic_ash_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 30000.0	float
			units	m	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_cloud_height_mean	float	n/a	long_name	mean volcanic ash cloud height	string
			standard_name	geopotential_height_at_volcanic_ash_cloud_top	string
			_FillValue	-999	float
			valid_range	0.0 30000.0	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	m	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_cloud_height_standard_deviation	float	n/a	long_name	standard deviation of volcanic ash cloud height values	string
			standard_name	geopotential_height_at_volcanic_ash_cloud_top	string
			_FillValue	-999	float
			units	m	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_mass_loading_minimum	float	n/a	long_name	minimum volcanic ash mass loading	string
			standard_name	atmosphere_mass_content_of_volcanic_ash	string
			_FillValue	-999	float
			valid_range	0.0 260.0	float
			units	t km-2	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_mass_loading_maximum	float	n/a	long_name	maximum volcanic ash mass loading	string
			standard_name	atmosphere_mass_content_of_volcanic_ash	string
			_FillValue	-999	float
			valid_range	0.0 260.0	float
			units	t km-2	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_mass_loading_mean	float	n/a	long_name	mean volcanic ash mass loading	string
			standard_name	atmosphere_mass_content_of_volcanic_ash	string
			_FillValue	-999	float
			valid_range	0.0 260.0	float
			units	t km-2	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
ash_mass_loading_standard_deviation	float	n/a	long_name	standard_deviation of volcanic ash mass loading values	string
			standard_name	atmosphere_mass_content_of_volcanic_ash	string
			_FillValue	-999	float
			units	t km-2	string
			coordinates	quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good retrievals only) where volcanic_ash_cloud	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L1b_radiance_band_10_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L1b_radiance_band_11_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_14_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_15_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L1b_radiance_band_16_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_10_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_11_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_10_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_11_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_pressure_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_tropopause_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.11.6.1, Volcanic Ash: Detection and Height Product Flag Values and Meanings.

5.11.6.1 Volcanic Ash: Detection and Height Product Flag Values and Meanings

Table 5.11.6.1-1 Volcanic Ash: Detection and Height Product Detection Data Quality Flag Values and Meanings

Detection Data Quality Flags (DET_DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
1	0	overall_good_quality_qf
1	1	overall_bad_quality_qf
2	0	good_source_L1b_data_qf
2	2	invalid_source_L1b_data_qf
4	0	good_within_LZA_threshold_qf
4	4	degraded_due_to_LZA_threshold_exceeded_qf
56	0	high_confidence_single_layer_ash_qf
56	8	moderate_confidence_single_layer_ash_qf
56	16	low_confidence_single_layer_ash_qf
56	24	very_low_confidence_single_layer_ash_qf
56	32	single_layer_not_ash_qf
1792	0	high_confidence_multiple_layer_ash_qf
1792	256	moderate_confidence_multiple_layer_ash_qf
1792	512	low_confidence_multiple_layer_ash_qf
1792	768	very_low_confidence_multiple_layer_ash_qf
1792	1024	multiple_layer_not_ash_qf

Table 5.11.6.1-2 Volcanic Ash: Detection and Height Product Retrieval Data Quality Flag Values and Meanings

Retrieval Quality Flags (RET_DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
3	0	good_retrieval_qf
3	1	failed_retrieval_qf
3	2	not_attempted_retrieval_qf
12	0	high_quality_retrieved_cloud_top_temperature_qf
12	4	medium_quality_retrieved_cloud_top_temperature_qf
12	8	low_quality_retrieved_cloud_top_temperature_qf
48	0	high_quality_retrieved_cloud_emissivity_qf
48	16	medium_quality_retrieved_cloud_emissivity_qf
48	32	low_quality_retrieved_cloud_emissivity_qf
192	0	high_quality_retrieved_absorption_optical_depth_ratio_qf
192	64	medium_quality_retrieved_absorption_optical_depth_ratio_qf
192	128	low_quality_retrieved_absorption_optical_depth_ratio_qf
3840	0	ash_particle_size_lt_2um_qf
3840	256	ash_particle_size_ge_2um_lt_3um_qf
3840	512	ash_particle_size_ge_3um_lt_4um_qf
3840	768	ash_particle_size_ge_4um_lt_5um_qf
3840	1024	ash_particle_size_ge_5um_lt_6um_qf
3840	1280	ash_particle_size_ge_6um_lt_7um_qf
3840	1536	ash_particle_size_ge_7um_lt_8um_qf
3840	1792	ash_particle_size_ge_8um_lt_9um_qf
3840	2048	ash_particle_size_ge_9um_lt_10um_qf
3840	2304	ash_particle_size_ge_10um_qf
3840	2560	ash_particle_size_invalid_qf

5.12 Legacy Vertical Temperature Product

5.12.1 Description

The Legacy Vertical Temperature Profile product contains a three-dimensional image with pixel values identifying the air temperature at 101 standard pressure levels. This product is generated by the same algorithm that produces the Legacy Vertical Moisture Profile, Total Precipitable Water, and Derived Stability Indices products.

The product includes three types of data quality information. One describes the overall quality of the data pixels, providing an assessment of the legacy vertical temperature profile data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale. The second provides information about the quality of the physical retrieval for on-earth pixels, identifying failure conditions. The third provides information about the quality of the first guess skin temperature for on-earth pixels, identifying temperature threshold failure conditions for on-earth pixels.

The units of measure for the vertical temperature value are "kelvin".

The Legacy Vertical Temperature Profile product image is generated on the ABI fixed grid at 10 km resolution for Full Disk, CONUS, and Mesoscale coverage regions. Product data is produced under the following conditions:

- clear sky
- geolocated source data to local zenith angles of 80 degrees for both daytime and nighttime conditions

The Legacy Vertical Temperature Profile performance requirements are summarized in Table 5.12.1, Legacy Vertical Temperature Profile Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.12.1 Legacy Vertical Temperature Profile Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy**	**Precision**	**Performance Conditions [2]**	**Accuracy**
Full Disk, CONUS, & Mesoscale	180 to 320 K	1 K below 400 hPa and above boundary layer	2 K below 400 hPa and above boundary layer	LZA ≤ 62 degrees [3]	5 km

[1] Valid measurement range prescribed by the algorithm is 165 to 320 K.
[2] Conditions for good quality prescribed by the algorithm also include latitude ≤ +/- 70 degrees.
[3] Conditions for good quality prescribed by the algorithm are for LZA ≤ 70 degrees.

Metadata in the Legacy Vertical Temperature Profile product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of attempted retrievals.
- Number of legacy vertical temperature profile data values outside the required measurement range. Note that the count is constrained to no more than one per horizontal grid point.
- Applicable ABI emissive band-specific brightness temperature differences mean and standard deviation values between those observed and modeled.

These statistics are calculated using valid pixels based on the local zenith angle threshold of 80 degrees and the latitude threshold of 70 degrees north and south. The percentage of pixels assigned to each flag value for the three types of data quality information are also included in the product.

The detailed description of the ISO series metadata for the Legacy Vertical Temperature Profile product is located in the standalone Appendix X, ISO Series Metadata.

5.12.2 Dynamic Source Data

The Legacy Vertical Temperature Profile product is derived using processed ABI Level 1b emissive band images from the current observation. The algorithm uses intermediate product data generated by the Cloud Mask algorithm. Processed surface level index, surface pressure, surface skin temperature or sea surface temperature, sea surface wind speed, and atmospheric temperature and moisture profile data derived from the NWP model ancillary data are used.

The primary sensor data used by the Legacy Atmospheric Profiles algorithm is identified in Table 5.12.2-1, Primary Sensor Data.

Table 5.12.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_8_2km_data input_ABI_L2_brightness_temperature_band_9_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_11_2km_data input_ABI_L2_brightness_temperature_band_12_2km_data input_ABI_L2_brightness_temperature_band_13_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_brightness_temperature_band_16_2km_data

The other dynamic source data inputs are summarized in Table 5.12.2-2, Other Dynamic Source Data.

Table 5.12.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_moisture_profile_data input_dynamic_ancillary_NWP_wind_vector_profile_data input_dynamic_ancillary_NWP_surface_level_index_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.12.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Legacy Atmospheric Profiles (Sounding) ground processing algorithm:

- Algorithm-specific parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Sounding algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Qualification thresholds for computation based on regression and physical retrievals
- Band specification for regression and physical retrievals
- Field of regard size in pixels
- Minimum percentage of clear pixels in field of regard
- Field of regard brightness temperature calculation method
- Brightness temperature bias correction slope and offsets for thermal bands
- Regression coefficients for temperature, moisture, and ozone profiles, surface temperature, and surface emissivity
- Pressure profile
- Sensor noise specification for thermal bands
- The inverse background error covariance (and scaling factors)
- Matrices used to map temperature and water vapor profiles to empirical orthogonal functions
- Algorithm convergence parameters
- Ocean surface emissivity look-up table as a function of local zenith angle and wind speed
- Coefficients and physical parameters used in computation of total precipitable water and stability indices
- Thresholds for assignment of quality flags and quality information
- Minimum/maximum valid range/ outlier threshold for temperature/ moisture profiles, total precipitable water, and stability indices

The categories of gridded parameters used in the generation of the Legacy Vertical Temperature Profile product are projection and mapping, earth surface classifications and characteristics, and seasonal. The specific types of gridded semi-static source data in the categories used in the generation of the Legacy Vertical Temperature Profile product are identified in Table 5.12.3 Gridded Semi-Static Source Data.

Table 5.12.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_land_sea_mask_data
Seasonal	input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_7_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_8_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_9_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_10_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_11_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_12_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_13_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_14_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_15_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_16_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- SoundingParameters_ABI_GOESR.bin

5.12.4 Coordinates

The coordinates associated with data variables in the Legacy Vertical Temperature Profile product are identified in Table 5.12.4, Legacy Vertical Temperature Profile and Legacy Vertical Moisture Profile Product Coordinates.

Table 5.12.4 Legacy Vertical Temperature Profile and Legacy Vertical Moisture Profile Product Coordinates

Legacy Vertical Temperature Profile and Legacy Vertical Moisture Profile Product Data Quantity	Coordinates
legacy vertical temperature profile and legacy vertical moisture profile data	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Air pressure for pixel • Local zenith angle ranges for good, and good or degraded quality data production • Solar zenith angle range for good quality data production • Latitude range for good quality data production
legacy vertical temperature profile and legacy vertical moisture profile overall data quality flags	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle ranges for good, and good or degraded quality data production • Solar zenith angle range for good quality data production • Latitude range for good quality data production
legacy vertical temperature profile and legacy vertical moisture profile retrieval data quality flags	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle range for good or degraded quality data production

Legacy Vertical Temperature Profile and Legacy Vertical Moisture Profile Product Data Quantity	Coordinates
legacy vertical temperature profile and legacy vertical moisture profile skin temperature data quality flags	• Solar zenith angle range for good quality data production
attempted retrieval count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production
legacy vertical temperature profile and legacy vertical moisture profile outlier pixel counts	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production • Latitude range for good quality data production
mean and standard deviation values associated with the difference between observed and modeled brightness temperature at specific ABI emissive band central wavelengths	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Central wavelength and identifier of the applicable ABI bands • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.12.5 Production Notes

The Legacy Vertical Temperature Profile, Legacy Vertical Moisture Profile, Total Precipitable Water, and Derived Stability Indices products are generated by the GOES-R ABI Legacy Atmospheric Profiles ground processing algorithm.

The algorithm uses processed NWP model profile data as the first guess and employs a regression retrieval followed by an iterative physical retrieval that utilizes an algorithm-specific internal deployment of the CRTM to derive the final product data. The temperature and moisture profiles contain values at 101 standard pressure levels, of which only 54 temperature and 35 moisture pressure levels are actually populated in the retrieval. The 54 temperature levels are from approximately 103 hPa to approximately 1014 hPa. The 35 moisture levels are from 300 hPa to approximately 1014 hPa. The regression retrieval is applied for coverage regions corresponding to local zenith angles to 80 degrees but the physical retrieval is limited to local zenith angles to 67 degrees. The product is generated for 5 x 5 fields of regard from 2 km pixel inputs where the percentage of clear pixels satisfies a 20 percent threshold. Clear sky is determined using clear and probably clear pixels indicated in the temporally coincident intermediate 4-level cloud mask generated by the Cloud Mask algorithm.

Total precipitable water from the surface to 300 hPa is derived from the retrieved moisture profile. In addition, the five atmospheric stability indices, CAPE, K-index, Lifted Index, Showalter Index, and Total Totals Index, are derived from the retrieved moisture and temperature profiles. Pixels in the product images with out of range values are assigned the minimum or maximum value in the valid range.

Furthermore, in addition to the two profiles, five atmospheric stability indices, and three DQFs, the algorithm generates diagnostic data including the surface skin temperature, precipitable water in three atmospheric layers, field of regard latitude, longitude coordinates, number of clear pixels in the fields of regard, land/sea flag, number of physical retrieval iterations, and root mean squared error brightness temperature difference for each band used in this the physical retrieval. The three atmospheric layers are from:

- A lower layer from the surface to the level of 0.9 in sigma coordinate (approximately 900 hPa).
- A middle layer from 0.9 (approximately) 900 hPa to 0.7 (approximately 700 hPa).
- An upper layer from 0.7 (approximately 700 hPa) to 0.3 (approximately 300 hPa).

The Legacy Atmospheric Profile algorithm final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and legacy information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Legacy Atmospheric Profile ground-processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for Legacy Atmospheric Moisture Profile, Legacy Atmospheric Temperature Profile, Total Precipitable Water, and Derived Atmospheric Stability Indices. This document is located at
http://www.goes-r.gov/products/ATBDs/baseline/Sounding_LAP_v2.0_no_color.pdf

5.12.6 Data Fields

The Legacy Vertical Temperature Profile product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Legacy Vertical Temperature Profile product are located in Appendix A.

Table 5.12.6-1 Legacy Vertical Temperature Profile: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	52291390-afe9-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Legacy Vertical Temperature Profile	string
summary	The Legacy Vertical Temperature product consists of the air temperature at 101 standard pressure levels in the atmosphere between 0.005 and 1100.0 hPa. The product is generated using a regression retrieval followed by an iterative physical retrieval that makes use of a radiative transfer model. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > ATMOSPHERIC TEMPERATURE > TEMPERATURE PROFILES	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string

timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	10km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.12.6-2 Legacy Vertical Temperature Profile: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
pressure ***value = 0.005 0.0161 0.0384 0.0769 0.137 0.2244 0.3454 0.5064 0.714 0.9753 1.2972 1.6872 2.1526 2.7009 3.3398 4.077 4.9204 5.8776 6.9567 8.1655 9.5119 11.0038 12.6492 14.4559 16.4318 18.5847 20.9224 23.4526 26.1829 29.121 32.2744 35.6505 39.2566 43.1001 47.1882 51.5278 56.126 60.9895 66.1253 71.5398 77.2396 83.231 89.5204 96.1138 103.0172 110.2366 117.7775 125.6456 133.8462 142.3848 151.2664 160.4959 170.0784 180.0183 190.3203 200.9887***	float	pressure = 101	long_name	pressure levels in the atmosphere reported for legacy vertical temperature profile	string
			standard_name	air_pressure	string
			units	hPa	string
			axis	Z	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
212.0277 223.4415 235.2338 247.4085 259.9691 272.9191 286.2617 300.0 314.1369 328.6753 343.6176 358.9665 374.7241 390.8926 407.4738 424.4698 441.8819 459.7118 477.9607 496.6298 515.72 535.2322 555.1669 575.5248 596.3062 617.5112 639.1398 661.192 683.6673 706.5654 729.8857 753.6275 777.7897 802.3714 827.3713 852.788 878.6201 904.8659 931.5236 958.5911 986.0666 1013.9476 1042.2319 1070.917 1100.0					
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 80.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality legacy vertical temperature profile data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality legacy vertical temperature profile data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 80.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality legacy vertical temperature profile is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality legacy vertical temperature profile data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality legacy vertical temperature profile data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality legacy vertical temperature profile data is produced	string
latitude ***value = 70.0***	float	n/a	long_name	threshold latitude for assigning overall quality flag of good to product data	string
			standard_name	latitude	string
			units	degrees_north	string
			bounds	latitude_bounds	string
latitude_bounds ***value = -70.0 70.0***	float	number_of_lat_bounds = 2	long_name	latitude range for assigning overall quality flag of good to product data	string
sounding_emissive_wavelengths ***value = 6.185 6.95 7.34 10.35 11.2 12.3 13.3***	float	sounding_emissive_bands = 7	long_name	ABI band central emissive wavelengths used to generate Legacy Vertical Temperature Profile product	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
sounding_emissive_band_ids ***value = 8 9 10 13 14 15 16***	byte	sounding_emissive_bands = 7	long_name	ABI band identifiers used to generate Legacy Vertical Temperature Profile product	string
			standard_name	sensor_band_identifier	string
			units	1	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
pressure_image ***value = 0.005***	float	n/a	long_name	upper atmospheric pressure level threshold reported for Legacy Vertical Temperature Profile product	string
			standard_name	air_pressure	string
			units	hPa	string
			axis	Z	string
			bounds	pressure_image_bounds	string
pressure_image_bounds ***value = 0.005 1100.0***	float	number_of_image_bounds = 2	long_name	reported upper/lower atmospheric pressure level extent of image for Legacy Temperature Moisture Profile product	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
LVT	short	***y = see note[1]*** ***x = see note [1]*** pressure = 101	long_name	ABI L2+ Legacy Vertical Temperature Profile provides air temperature at 101 pressure levels in the atmosphere	string
			standard_name	air_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00236533	float
			add_offset	165	float
			units	K	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x pressure	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point pressure: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
DQF_Overall	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Legacy Vertical Temperature Profile data overall quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 10	byte
			units	1	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	11	byte

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_latitude_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_quantitative_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf	***dynamic value***	float
			percent_invalid_due_to_missing_NWP_data_qf	***dynamic value***	float
			percent_invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf	***dynamic value***	float
			percent_invalid_due_to_bad_NWP_surface_pressure_index_qf	***dynamic value***	float
			percent_invalid_due_to_indeterminate_land_surface_emissivity_qf	***dynamic value***	float
			percent_invalid_due_to_bad_TPW_sigma_pressure_level_index_qf	***dynamic value***	float
			percent_invalid_due_to_occurrence_of_not_a_number_qf	***dynamic value***	float
DQF_Retrieval	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Legacy Vertical Temperature Profile algorithm atmospheric temperature and water vapor profile physical retrieval quality flags	string
			standard_name	status_flag	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 5	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	6	byte
			percent_good_retrieval_qf	***dynamic value***	float
			percent_nonconvergent_retrieval_qf	***dynamic value***	float
			percent_brightness_temp_residual_exceeds_threshold_qf	***dynamic value***	float
			percent_incomplete_convergence_of_retrieval_qf	***dynamic value***	float
			percent_unrealistic_retrieved_value_qf	***dynamic value***	float
			percent_invalid_radiative_transfer_model_brightness_temp_value_qf	***dynamic value***	float
DQF_SkinTemp	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Legacy Vertical Temperature Profile algorithm first guess skin temperature quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 2	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	3	byte
			percent_good_first_guess_skin_temp_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_upper_threshold_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_lower_threshold_qf	***dynamic value***	float
total_attempted_retrievals	int	n/a	long_name	number of attempted sounding algorithm retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: geolocated/not missing pixels only	string
outlier_pixel_count	int	n/a	long_name	number of legacy vertical temperature profile pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image pressure_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only) pressure_image: sum (no more than one outlier counted per x, y location)	string
mean_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
				interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Legacy Vertical Temperature Profile product	
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
std_dev_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	standard deviation of the difference of the observed and modeled brightness temperature values (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Legacy Vertical Temperature Profile product	string
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_brightness_temperature_band_8_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_9_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_10_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_11_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_12_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_13_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_moisture_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_wind_vector_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.12.6.1, Legacy Vertical Temperature Profile Product Flag Values and Meanings.

5.12.6.1 Legacy Vertical Temperature Profile Product Flag Values and Meanings

Table 5.12.6.1-1 Legacy Vertical Temperature Product Overall Data Quality Flag Values and Meanings

Overall Data Quality Flags (DQF_Overall)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf
2	degraded_due_to_latitude_threshold_exceeded_qf
3	degraded_due_to_quantitative_LZA_threshold_exceeded_qf
4	invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf
5	invalid_due_to_missing_NWP_data_qf
6	invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf
7	invalid_due_to_bad_NWP_surface_pressure_index_qf
8	invalid_due_to_indeterminate_land_surface_emissivity_qf
9	invalid_due_to_bad_TPW_sigma_pressure_level_index_qf
10	invalid_due_to_occurrence_of_not_a_number_qf

Table 5.12.6.1-2 Legacy Vertical Temperature Product Retrieval Quality Flag Values and Meanings

Retrieval Quality Flags (DQF_Retrieval)	
Flag Value	**Flag Meaning**
0	good_retrieval_qf
1	nonconvergent_retrieval_qf
2	brightness_temp_residual_exceeds_threshold_qf
3	incomplete_convergence_of_retrieval_qf
4	unrealistic_retrieved_value_qf
5	invalid_radiative_transfer_model_brightness_temp_value_qf

Table 5.12.6.1-3 Legacy Vertical Temperature Product Skin Temperature Data Quality Flag Values and Meanings

Skin Temperature Data Quality Flags (DQF_SkinTemp)	
Flag Value	**Flag Meaning**
0	good_first_guess_skin_temp_qf
1	first_guess_skin_temp_exceeds_upper_threshold_qf
2	first_guess_skin_temp_exceeds_lower_threshold_qf

5.13 Legacy Vertical Moisture Profile Product

5.13.1 Description

The Legacy Vertical Moisture Profile product contains a three-dimensional image with pixel values identifying the water vapor at 101 standard pressure levels. This product is generated by the same algorithm that produces the Legacy Vertical Temperature Profile, Total Precipitable Water, and Derived Stability Indices products.

The product includes three types of data quality information. One describes the overall quality of the data pixels, providing an assessment of the legacy vertical moisture profile data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale. The second provides information about the quality of the physical retrieval for on-earth pixels, identifying failure conditions. The third provides information about the quality of the first guess skin temperature for on-earth pixels, identifying temperature threshold failure conditions for on-earth pixels.

The units of measure for the vertical moisture value are "percent".

The Legacy Vertical Moisture Profile product image is generated on the ABI fixed grid at 10 km resolution for Full Disk, CONUS, and Mesoscale coverage regions. Product data is produced under the following conditions:

- clear sky
- geolocated source data to local zenith angles of 80 degrees for both daytime and nighttime conditions

The Legacy Vertical Moisture Profile performance requirements are summarized in Table 5.13.1, Legacy Vertical Moisture Profile Performance Requirements. Note that accuracy and precision requirements are expressed in terms of relative humidity. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.13.1 Legacy Vertical Moisture Profile Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions [1]**	**Accuracy**
Full Disk, CONUS, & Mesoscale	0 to 100%	Surface to 500 hPa: 18% 500 to 300 hPa: 18% 300 to 100 hPa: 20%	Surface to 500 hPa: 18% 500 to 300 hPa: 18% 300 to 100 hPa: 20%	LZA $\leq$ 62 degrees [2]	5 km

[1] Conditions for good quality prescribed by the algorithm also include latitude ≤ +/- 70 degrees.
[2] Conditions for good quality prescribed by the algorithm are for LZA ≤ 70 degrees.

Metadata in the Legacy Vertical Moisture Profile product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of attempted retrievals.
- Number of legacy vertical moisture profile data values outside the required measurement range. Note that the count is constrained to no more than one per horizontal grid point.
- Applicable ABI emissive band-specific brightness temperature differences mean and standard deviation values between those observed and modeled.

These statistics are calculated using valid pixels based on the local zenith angle threshold of 80 degrees and the latitude threshold of 70 degrees north and south. The percentages of pixels assigned to each flag value for the three types of data quality information are also included in the product.

The detailed description of the ISO series metadata for the Legacy Vertical Moisture Profile product is located in the standalone Appendix X, ISO Series Metadata.

5.13.2 Dynamic Source Data

Refer to the Dynamic Source Data subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product, as this product is generated by the same algorithm.

5.13.3 Level 2+ Semi-Static Source Data

Refer to the Level 2+ Semi-Static Source Data subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product, as this product is generated by the same algorithm.

5.13.4 Coordinates

Refer to the Coordinates subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product.

5.13.5 Production Notes

Refer to the Production Notes subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product , as this product is generated by the same algorithm.

5.13.6 Data Fields

The Legacy Vertical Moisture Profile product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Legacy Vertical Moisture Profile product are located in Appendix A.

Table 5.13.6-1 Legacy Vertical Moisture Profile: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	d5ed67b0-afe6-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Legacy Vertical Moisture Profile	string
summary	The Legacy Vertical Moisture product consists of the relative humidity at 101 standard pressure levels in the atmosphere between 0.005 and 1100.0 hPa. The product is generated using a regression retrieval followed by an iterative physical retrieval that makes use of a radiative transfer model. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > ATMOSPHERIC WATER VAPOR > WATER VAPOR PROFILES	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string

timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	10km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.13.6-2 Legacy Vertical Moisture Profile: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
pressure ***value = 0.005 0.0161 0.0384 0.0769 0.137 0.2244 0.3454 0.5064 0.714 0.9753 1.2972 1.6872 2.1526 2.7009 3.3398 4.077 4.9204 5.8776 6.9567 8.1655 9.5119 11.0038 12.6492 14.4559 16.4318 18.5847 20.9224 23.4526 26.1829 29.121 32.2744 35.6505 39.2566 43.1001 47.1882 51.5278 56.126 60.9895 66.1253 71.5398 77.2396 83.231 89.5204 96.1138 103.0172 110.2366 117.7775 125.6456 133.8462***	float	pressure = 101	long_name	pressure levels in the atmosphere reported for legacy vertical moisture profile	string
			standard_name	air_pressure	string
			units	hPa	string
			axis	Z	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
142.3848 151.2664 160.4959 170.0784 180.0183 190.3203 200.9887 212.0277 223.4415 235.2338 247.4085 259.9691 272.9191 286.2617 300.0 314.1369 328.6753 343.6176 358.9665 374.7241 390.8926 407.4738 424.4698 441.8819 459.7118 477.9607 496.6298 515.72 535.2322 555.1669 575.5248 596.3062 617.5112 639.1398 661.192 683.6673 706.5654 729.8857 753.6275 777.7897 802.3714 827.3713 852.788 878.6201 904.8659 931.5236 958.5911 986.0666 1013.9476 1042.2319 1070.917 1100.0					
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
value = 80.0				degraded quality legacy vertical moisture profile data production	
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality legacy vertical moisture profile data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 80.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality legacy vertical moisture profile data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality legacy vertical moisture profile data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality legacy vertical moisture profile data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality legacy vertical moisture profile data is produced	string
latitude ***value = 70.0***	float	n/a	long_name	threshold latitude for assigning overall quality flag of good to product data	string
			standard_name	latitude	string
			units	degrees_north	string
			bounds	latitude_bounds	string
latitude_bounds ***value = -70.0 70.0***	float	number_of_lat_bounds = 2	long_name	latitude range for assigning overall quality flag of good to product data	string
sounding_emissive_wavelengths	float	sounding_emissive_bands = 7	long_name	ABI band central emissive wavelengths used to generate Legacy Vertical Moisture Profile product	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
value = 6.185 6.95 7.34 10.35 11.2 12.3 13.3					
sounding_emissive_band_ids ***value = 8 9 10 13 14 15 16***	byte	sounding_emissive_bands = 7	long_name	ABI band identifiers used to generate Legacy Vertical Moisture Profile product	string
			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
pressure_image ***value = 0.005***	float	n/a	long_name	upper atmospheric pressure level threshold reported for Legacy Vertical Moisture Profile product	string
			standard_name	air_pressure	string
			units	hPa	string
			axis	Z	string
			bounds	pressure_image_bounds	string
pressure_image_bounds ***value = 0.005 1100.0***	float	number_of_image_bounds = 2	long_name	reported upper/lower atmospheric pressure level extent of image for Legacy Vertical Moisture Profile product	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
LVM	short	***y = see note[1]*** ***x = see note [1]*** pressure = 101	long_name	ABI L2+ Legacy Vertical Moisture Profile provides relative humidity at 101 pressure levels in the atmosphere	string
			standard_name	relative_humidity	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00001526	float
			add_offset	0	float
			units	percent	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x pressure	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point pressure: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
DQF_Overall	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Legacy Vertical Moisture Profile data overall quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 10	byte
			units	1	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	11	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_latitude_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_quantitative_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf	***dynamic value***	float
			percent_invalid_due_to_missing_NWP_data_qf	***dynamic value***	float
			percent_invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf	***dynamic value***	float
			percent_invalid_due_to_bad_NWP_surface_pressure_index_qf	***dynamic value***	float
			percent_invalid_due_to_indeterminate_land_surface_emissivity_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_invalid_due_to_bad_TPW_sigma_pressure_level_index_qf	***dynamic value***	float
			percent_invalid_due_to_occurrence_of_not_a_number_qf	***dynamic value***	float
DQF_Retrieval	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Legacy Vertical Moisture Profile algorithm atmospheric temperature and water vapor profile physical retrieval quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 5	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	6	byte
			percent_good_retrieval_qf	***dynamic value***	float
			percent_nonconvergent_retrieval_qf	***dynamic value***	float
			percent_brightness_temp_residual_exceeds_threshold_qf	***dynamic value***	float
			percent_incomplete_convergence_of_retrieval_qf	***dynamic value***	float
			percent_unrealistic_retrieved_value_qf	***dynamic value***	float
			percent_invalid_radiative_transfer_model_brightness_temp_value_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
DQF_SkinTemp	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Legacy Vertical Moisture Profile algorithm first guess skin temperature quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 2	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	3	byte
			percent_good_first_guess_skin_temp_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_upper_threshold_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_lower_threshold_qf	***dynamic value***	float
total_attempted_retrievals	int	n/a	long_name	number of attempted sounding algorithm retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: geolocated/not missing pixels only	string
outlier_pixel_count	int	n/a	long_name	number of legacy vertical moisture profile pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image pressure_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only) pressure_image: sum (no more than one outlier counted per x, y location)	string
mean_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Legacy Vertical Moisture Profile product	string
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
std_dev_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	standard deviation of the difference of the observed and modeled brightness temperature values (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Legacy Vertical Moisture Profile product	string
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_8_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_9_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_10_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_11_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_12_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_13_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_moisture_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_wind_vector_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.13.6.1, Legacy Vertical Moisture Profile Product Flag Values and Meanings.

5.13.6.1 Legacy Vertical Moisture Profile Product Flag Values and Meanings

Table 5.13.6.1-1 Legacy Vertical Moisture Product Overall Data Quality Flag Values and Meanings

Overall Data Quality Flags (DQF_Overall)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf
2	degraded_due_to_latitude_threshold_exceeded_qf
3	degraded_due_to_quantitative_LZA_threshold_exceeded_qf
4	invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf
5	invalid_due_to_missing_NWP_data_qf
6	invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf
7	invalid_due_to_bad_NWP_surface_pressure_index_qf
8	invalid_due_to_indeterminate_land_surface_emissivity_qf
9	invalid_due_to_bad_TPW_sigma_pressure_level_index_qf
10	invalid_due_to_occurrence_of_not_a_number_qf

Table 5.13.6.1-2 Legacy Vertical Moisture Product Retrieval Quality Flag Values and Meanings

Retrieval Quality Flags (DQF_Retrieval)	
Flag Value	**Flag Meaning**
0	good_retrieval_qf
1	nonconvergent_retrieval_qf
2	brightness_temp_residual_exceeds_threshold_qf
3	incomplete_convergence_of_retrieval_qf
4	unrealistic_retrieved_value_qf
5	invalid_radiative_transfer_model_brightness_temp_value_qf

Table 5.13.6.1-3 Legacy Vertical Moisture Product Skin Temperature Data Quality Flag Values and Meanings

Skin Temperature Data Quality Flags (DQF_SkinTemp)	
Flag Value	**Flag Meaning**
0	good_first_guess_skin_temp_qf
1	first_guess_skin_temp_exceeds_upper_threshold_qf
2	first_guess_skin_temp_exceeds_lower_threshold_qf

5.14 Total Precipitable Water Product

5.14.1 Description

The Total Precipitable Water product contains an image with pixel values identifying the integrated column water vapor amount from the surface to a height corresponding to an atmospheric pressure of 300 hPa. This product is generated by the same algorithm that produces the Legacy Vertical Temperature Profile, Legacy Vertical Moisture Profile, and Derived Stability Indices products.

The product includes three types of data quality information. One describes the overall quality of the data pixels, providing an assessment of the total precipitable water data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale. The second provides information about the quality of the physical retrieval for on-earth pixels, identifying failure conditions. The third provides information about the quality of the first guess skin temperature for on-earth pixels, identifying temperature threshold failure conditions for on-earth pixels.

The units of measure for the total precipitable water value are "millimeters".

The Total Precipitable Water product image is generated on the ABI fixed grid at 10 km resolution for Full Disk, CONUS, and Mesoscale coverage regions. Product data is produced under the following conditions:

- clear sky
- geolocated source data to local zenith angles of 80 degrees for both daytime and nighttime conditions

The Total Precipitable Water performance requirements are summarized in Table 5.14.1, Total Precipitable Water Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.14.1 Total Precipitable Water Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions [1]**	**Accuracy**
Full Disk, CONUS, & Mesoscale	0 to 100 mm	1 mm	3 mm	LZA $\leq$ 62 degree [2]	2 km

[1] Conditions for good quality prescribed by the algorithm also include latitude ≤ +/- 70 degrees.
[2] Conditions for good quality prescribed by the algorithm are for LZA ≤ 70 degrees.

Metadata in the Total Precipitable Water product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of attempted retrievals.
- Number of total precipitable water pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the total precipitable water values in the product image.
- Applicable ABI emissive band-specific brightness temperature differences mean and standard deviation values between those observed and modeled.

These statistics are calculated using valid pixels based on the local zenith angle threshold of 80 degrees and the latitude threshold of 70 degrees north and south. The percentages of pixels assigned to each flag value for the three types of data quality information are also included in the product.

The detailed description of the ISO series metadata for the Total Precipitable Water product is located in the standalone Appendix X, ISO Series Metadata.

5.14.2 Dynamic Source Data

Refer to the Dynamic Source Data subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product, as this product is generated by the same algorithm.

5.14.3 Level 2+ Semi-Static Source Data

Refer to the Level 2+ Semi-Static Source Data subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product, as this product is generated by the same algorithm.

5.14.4 Coordinates

The coordinates associated with data variables in the Total Precipitable Water product are identified in Table 5.14.4, Total Precipitable Water Product and Derived Stability Indices Product Coordinates.

Table 5.14.4 Total Precipitable Water and Derived Stability Indices Product Coordinates

<table>
<tr><th>Total Precipitable Water and Derived Stability Indices Data Quantity</th><th>Coordinates</th></tr>
<tr><td>total precipitable water, and CAPE, lifted index, k-index, Showalter Index, and total totals index data</td><td>• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Ending air pressure (lifted index only)
• Local zenith angle ranges for good, and good or degraded quality data production
• Solar zenith angle range for good quality data production
• Latitude range for good quality data production</td></tr>
<tr><td>total precipitable water, and CAPE, lifted index, k-index, Showalter Index, and total totals index overall data quality flags</td><td>• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Local zenith angle ranges for good, and good or degraded quality data production
• Solar zenith angle range for good quality data production
• Latitude range for good quality data production</td></tr>
<tr><td>total precipitable water, and CAPE, lifted index, k-index, Showalter Index, and total totals index retrieval data quality flags</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>total precipitable water, and CAPE, lifted index, k-index, Showalter Index, and total totals index skin temperature data quality flags</td></tr>
<tr><td>attempted retrieval count</td><td>• Observation time period
• N/S elevation and E/W scanning angles for image geo-location
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>total precipitable water, and CAPE, lifted index, k-index, Showalter Index, and total totals index outlier pixel counts</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angles for image geo-location
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production
• Latitude range for good quality data production</td></tr>
<tr><td>total precipitable water, and CAPE, lifted index, k-index, Showalter Index, and total totals index minimum, maximum, mean, and standard deviation values</td></tr>
</table>

Total Precipitable Water and Derived Stability Indices Data Quantity	Coordinates
mean and standard deviation values associated with the difference between observed and modeled brightness temperature at specific ABI emissive band central wavelengths	• Observation time period • N/S elevation and E/W scanning angles for image geo-location • Central wavelength and identifier of the applicable ABI bands • Local zenith angle range for good or degraded quality data production • Solar zenith angle range for good quality data production
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angles for image geo-location

5.14.5 Production Notes

Refer to the Production Notes subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product, as this product is generated by the same algorithm.

5.14.6 Data Fields

The Total Precipitable Water product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Total Precipitable Water product are located in Appendix A.

Table 5.14.6-1 Total Precipitable Water: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce National Oceanic and Atmospheric Administration National Environmental Satellite Data and Information Services	string
project	GOES	string
iso_series_metadata_id	42511480-afef-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25 05 July 2013)	string
title	ABI L2 Total Precipitable Water	string
summary	The Total Precipitable Water product consists of the water depth if it were condensed in the atmospheric column between approximately 300 hPa and the surface. The product is generated using a regression retrieval followed by an iterative physical retrieval that makes use of a radiative transfer model. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > ATMOSPHERIC WATER VAPOR > PRECIPITABLE WATER	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East GOES-West GOES-Test and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE ITE and DE.***	string
production_data_source	***possible values are Realtime Simulated Playback and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string

scene_id	***possible values are Full Disk CONUS and Mesoscale.***	string
spatial_resolution	10km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.14.6-2 Total Precipitable Water: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time _bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 80.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality total precipitable water data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_a ngle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality total precipitable water data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle _bounds ***value = 0.0 80.0***	float	number_of_LZA _bounds = 2	long_name	local zenith angle degree range where good or degraded quality total precipitable water data is produced	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality total precipitable water data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality total precipitable water data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality total precipitable water data is produced	string
latitude ***value = 70.0***	float	n/a	long_name	threshold latitude for assigning overall quality flag of good to product data	string
			standard_name	latitude	string
			units	degrees_north	string
			bounds	latitude_bounds	string
latitude_bounds ***value = -70.0 70.0***	float	number_of_lat_bounds = 2	long_name	latitude range for assigning overall quality flag of good to product data	string
sounding_emissive_wavelengths ***value = 6.185 6.95 7.34 10.35 11.2 12.3 13.3***	float	sounding_emissive_bands = 7	long_name	ABI band central emissive wavelengths used to generate Total Precipitable Water product	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
sounding_emissive_band_ids ***value = 8 9 10 13 14 15 16***	byte	sounding_emissive_bands = 7	long_name	ABI band identifiers used to generate Total Precipitable Water product	string
			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
TPW	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Total Precipitable Water	string
			standard_name	lwe_thickness_of_atmosphere_mass_content_of_water_vapor	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00152602	float
			add_offset	0	float
			units	mm	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
DQF_Overall	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Total Precipitable Water data overall quality flags	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 10	byte
			units	1	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	11	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_latitude_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_quantitative_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf	***dynamic value***	float
			percent_invalid_due_to_missing_NWP_data_qf	***dynamic value***	float
			percent_invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf	***dynamic value***	float
			percent_invalid_due_to_bad_NWP_surface_pressure_index_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_invalid_due_to_indeterminate_land_surface_emissivity_qf	***dynamic value***	float
			percent_invalid_due_to_bad_TPW_sigma_pressure_level_index_qf	***dynamic value***	float
			percent_invalid_due_to_occurrence_of_not_a_number_qf	***dynamic value***	float
DQF_Retrieval	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Total Precipitable Water algorithm atmospheric temperature and water vapor profile physical retrieval quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 5	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	6	byte
			percent_good_retrieval_qf	***dynamic value***	float
			percent_nonconvergent_retrieval_qf	***dynamic value***	float
			percent_brightness_temp_residual_exceeds_threshold_qf	***dynamic value***	float
			percent_incomplete_convergence_of_retrieval_qf	***dynamic value***	float
			percent_unrealistic_retrieved_value_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_invalid_radiative_transfer_model_brightness_temp_value_qf	***dynamic value***	float
DQF_SkinTemp	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Total Precipitable Water algorithm first guess skin temperature quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 2	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	3	byte
			percent_good_first_guess_skin_temp_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_upper_threshold_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_lower_threshold_qf	***dynamic value***	float
total_attempted_retrievals	int	n/a	long_name	number of attempted sounding algorithm retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: geolocated/not missing pixels only	string
outlier_pixel_count	int	n/a	long_name	number of total precipitable water pixels whose value is outside valid measurement range	string
			_FillValue	-1	int

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only)	string
minimum_total_precipitable_water	float	n/a	long_name	minimum total precipitable water	string
			standard_name	lwe_thickness_of_atmosphere_mass_content_of_water_vapor	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float
			units	mm	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
maximum_total_precipitable_water	float	n/a	long_name	maximum total precipitable water	string
			standard_name	lwe_thickness_of_atmosphere_mass_content_of_water_vapor	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float
			units	mm	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
	float	n/a	long_name	mean total precipitable water	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
mean_total_precipitable_water			standard_name	lwe_thickness_of_atmosphere_mass_content_of_water_vapor	string
			_FillValue	-999	float
			valid_range	0.0 100.0	float
			units	mm	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
standard_deviation_total_precipitable_water	float	n/a	long_name	standard deviation of total precipitable water values	string
			standard_name	lwe_thickness_of_atmosphere_mass_content_of_water_vapor	string
			_FillValue	-999	float
			units	mm	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
mean_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Total Precipitable Water product	string
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
std_dev_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	standard deviation of the difference of the observed and modeled brightness temperature values (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Total Precipitable Water product	string
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
nominal_satellite_subpoint_lon value = ***see note [1]***			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_8_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_9_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_10_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_brightness_temperature_band_11_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_12_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_13_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_moisture_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_wind_vector_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.14.6.1, Total Precipitable Water Product Flag Values and Meanings.

5.14.6.1 Total Precipitable Water Product Flag Values and Meanings

Table 5.14.6.1-1 Total Precipitable Water Product Overall Data Quality Flag Values and Meanings

Overall Data Quality Flags (DQF_Overall)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf
2	degraded_due_to_latitude_threshold_exceeded_qf
3	degraded_due_to_quantitative_LZA_threshold_exceeded_qf
4	invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf
5	invalid_due_to_missing_NWP_data_qf
6	invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf
7	invalid_due_to_bad_NWP_surface_pressure_index_qf
8	invalid_due_to_indeterminate_land_surface_emissivity_qf
9	invalid_due_to_bad_TPW_sigma_pressure_level_index_qf
10	invalid_due_to_occurrence_of_not_a_number_qf

Table 5.14.6.1-2 Total Precipitable Water Product Retrieval Quality Flag Values and Meanings

Retrieval Quality Flags (DQF_Retrieval)	
Flag Value	**Flag Meaning**
0	good_retrieval_qf
1	nonconvergent_retrieval_qf
2	brightness_temp_residual_exceeds_threshold_qf
3	incomplete_convergence_of_retrieval_qf
4	unrealistic_retrieved_value_qf
5	invalid_radiative_transfer_model_brightness_temp_value_qf

Table 5.14.6.1-3 Total Precipitable Water Product Skin Temperature Data Quality Flag Values and Meanings

Skin Temperature Data Quality Flags (DQF_SkinTemp)	
Flag Value	**Flag Meaning**
0	good_first_guess_skin_temp_qf
1	first_guess_skin_temp_exceeds_upper_threshold_qf
2	first_guess_skin_temp_exceeds_lower_threshold_qf

5.15 Derived Stability Indices Product

5.15.1 Description

The Derived Stability Indices product contains images for five stability indices with pixel values that are indicators of atmospheric instability associated with convection and potential thunderstorm activity. Refer to Table 5.15.1-1, Derived Stability Indices for descriptions of each of the five stability indices.

Table 5.15.1-1 Derived Stability Indices

Derived Stability Index Type	Description
Convective(ly) Available Potential Energy (CAPE)	A measure of atmospheric stability calculated by integrating the positive temperature difference between the surrounding atmosphere and a parcel of air lifted adiabatically from the surface to its equilibrium level. It exists under conditions of potential instability, and measures the potential energy per unit mass that would be released by the unstable parcel if it were able to convect upwards to equilibrium.
Lifted Index	The temperature difference between a parcel of air lifted adiabatically from the surface to a finishing air pressure of 500 hPa in the troposphere and the ambient air temperature at the finishing air pressure in the troposphere. The air parcel is "lifted" by moving the air parcel from the surface to the Lifting Condensation Level (dry adiabatically) and then from the Lifting Condensation Level to the finishing air pressure (wet adiabatically).
K-index	A measure of atmospheric stability indicating the potential of severe convection. The index is the difference in air temperature between 850 and 500 hPa, the dew point temperature at 850 hPa, and the difference between the air temperature and the dew point temperature at 700 hPa.
Showalter Index	A measure of atmospheric stability indicating the convective and thunderstorm potential. The index is the temperature difference between a parcel of air lifted from 850 to 500 hPa (wet adiabatically) and the ambient air temperature at 500 hPa.
Total Totals Index	A measure of atmospheric stability indicating the likelihood of severe convection. The index is derived from the difference in air temperature between 850 and 500 hPa (the vertical totals) and the difference between the dew point temperature at 850 hPa and the air temperature at 500 hPa (the cross totals). The index is the sum of the vertical and cross totals.

This product is generated by the same algorithm that produces the Legacy Vertical Temperature Profile, Legacy Vertical Moisture Profile, and Total Precipitable Water products.

The product includes three types of data quality information. One describes the overall quality of the data pixels, providing an assessment of the derived stability indices data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale. The second provides information about the quality of the physical retrieval for on-earth pixels, identifying failure conditions. The third provides information about the quality of the first guess skin temperature for on-earth pixels, identifying temperature threshold failure conditions for on-earth pixels.

The units of measure for the five stability indices are identified in Table 5.15.1-2 Derived Stability Indices Units of Measure.

Table 5.15.1-2 Derived Stability Indices Units of Measure

Derived Stability Index Type	Units of Measure
Convective(ly) Available Potential Energy (CAPE)	joules per kilogram

Lifted Index	kelvin
K-index	kelvin
Showalter Index	kelvin
Total Totals Index	kelvin

The Derived Stability Indices product images are produced on the ABI fixed grid at 10 km resolution for Full Disk, CONUS, and Mesoscale coverage regions. Product data is produced under the following conditions:

- clear sky
- geolocated source data to local zenith angles of 80 degrees for both daytime and nighttime conditions

The Derived Stability Indices performance requirements are summarized in Table 5.15.1-3, Derived Stability Indices Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.15.1-3 Derived Stability Indices Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy**	**Precision**	**Performance Conditions [2]**	**Accuracy**
Full Disk, CONUS, & Mesoscale	(1) CAPE: 0 to 5000 J/kg (2) Lifted Index: -10 to 40 K (3) K-index: 0 to 40 K (4) Showalter-Index: -10 to > 4 K (5) Total Totals Index: -43 to > 56 K	(1) CAPE: 1000 J/kg (2) Lifted Index: 2K (3) K-index: 2 K (4) Showalter Index: 2 K (5) Total Totals Index: 1 K	(1) CAPE: 2500 J/kg (2) Lifted Index: 6.5 K (3) K-index: 6.5 K (4) Showalter Index: 6.5 K (5) Total Totals Index: 4 K	LZA ≤ 62 degrees [3]	2 km

[1] Valid measurement range for K-index prescribed by the algorithm is -70 to 50 K. Valid measurement range for Total Totals Index prescribed by the algorithm is -43 to 60 K. Valid measurement range for Showalter Index prescribed by the algorithm is -10 to 25 K.
[2] Conditions for good quality prescribed by the algorithm also include latitude ≤ +/- 70 degrees.
[3] Conditions for good quality prescribed by the algorithm are for LZA ≤ 70 degrees.

Metadata in the Derived Stability Indices product provides statistical and other properties of the product images and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of attempted retrievals.
- Number of CAPE, lifted index, k-index, Showalter index, and total totals index pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the values in the CAPE, lifted index, k-index, Showalter index, and total totals index product images.
- Applicable ABI emissive band-specific brightness temperature differences mean and standard deviation values between those observed and modeled.

These statistics are calculated using valid pixels based on the local zenith angle threshold of 80 degrees and the latitude threshold of 70 degrees north and south. The percentages of pixels assigned to each flag value for the three types of data quality information are also included in the product.

The detailed description of the ISO series metadata for the Derived Stability Indices product is located in the standalone Appendix X, ISO Series Metadata.

5.15.2 Dynamic Source Data

Refer to the Dynamic Source Data subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product, as this product is generated by the same algorithm.

5.15.3 Level 2+ Semi-Static Source Data

Refer to the Level 2+ Semi-Static Source Data subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product, as this product is generated by the same algorithm.

5.15.4 Coordinates

Refer to the Coordinates subparagraph in paragraph 5.14, Total Precipitable Water Product.

5.15.5 Production Notes

Refer to the Production Notes subparagraph in paragraph 5.12, Legacy Vertical Temperature Profile Product , as this product is generated by the same algorithm.

5.15.6 Data Fields

The Derived Stability Indices product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Derived Stability Indices product are located in Appendix A.

Table 5.15.6-1 Derived Stability Indices: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	158fae30-affd-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Derived Stability Indices	string
summary	The Derived Stability Indices product consists of the atmosphere convective available potential energy (CAPE) with respect to the surface, the lifted index between the surface and 500 hPa, k index, showalter index, and the total totals index. The product is generated using a regression retrieval followed by an iterative physical retrieval that makes use of a radiative transfer model. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > ATMOSPHERIC TEMPERATURE > ATMOSPHERIC STABILITY	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string

timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	string
spatial_resolution	10km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.15.6-2 Derived Stability Indices: Variables

Name	Type	Shape	Name	Value	Type
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
final_air_pressure ***value = 500.0***	float	n/a	long_name	Ending height pressure level in the atmosphere associated with the lifted index	string
			standard_name	final_air_pressure_of_lifted_parcel	string
			units	hPa	string
			axis	Z	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 80.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality derived stability indices data production	string

Name	Type	Shape	Name	Value	Type
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality derived stability indices data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 80.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality derived stability indices data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality derived stability indices data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality derived stability indices data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality derived stability indices data is produced	string
latitude ***value = 70.0***	float	n/a	long_name	threshold latitude for assigning overall quality flag of good to product data	string
			standard_name	latitude	string
			units	degrees_north	string
			bounds	latitude_bounds	string
latitude_bounds ***value = -70.0 70.0***	float	number_of_lat_bounds = 2	long_name	latitude range for assigning overall quality flag of good to product data	string
sounding_emissive_wavelengths ***value = 6.185 6.95 7.34 10.35 11.2 12.3 13.3***	float	sounding_emissive_bands = 7	long_name	ABI band central emissive wavelengths used to generate Derived Stability Indices product	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
sounding_emissive_band_ids	byte	sounding_emissive_bands = 7	long_name	ABI band identifiers used to generate Derived Stability Indices product	string

Name	Type	Shape	Name	Value	Type
value = 8 9 10 13 14 15 16			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
CAPE	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices: CAPE	string
			standard_name	atmosphere_convective_available_potential_energy_wrt_surface	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.07630093	float
			add_offset	0	float
			units	J kg-1	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string

Name	Type	Shape	Name	Value	Type
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
LI	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices: Lifted Index	string
			standard_name	temperature_difference_between_ambient_air_and_air_lifted_ adiabatically_from_the_surface	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00076301	float
			add_offset	-10	float
			units	K	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x final_air_pressure	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
KI	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices: K-Index	string
			standard_name	atmosphere_stability_k_index	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00183122	float
			add_offset	-70	float
			units	K	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string

Name	Type	Shape	Name	Value	Type
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
SI	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices: Showalter Index	string
			standard_name	atmosphere_stability_showalter_index	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00053411	float
			add_offset	-10	float
			units	K	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
TT	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices: Total Totals Index	string
			standard_name	atmosphere_stability_total_totals_index	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.0015718	float
			add_offset	-43	float
			units	K	string
			resolution	y: 0.000280 rad x: 0.000280 rad	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string

Name	Type	Shape	Name	Value	Type
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF_Overall DQF_Retrieval DQF_SkinTemp	string
DQF_Overall	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices data overall quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 10	byte
			units	1	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	11	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_latitude_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_quantitative_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf	***dynamic value***	float
			percent_invalid_due_to_missing_NWP_data_qf	***dynamic value***	float

Name	Type	Shape	Name	Value	Type
			percent_invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf	***dynamic value***	float
			percent_invalid_due_to_bad_NWP_surface_pressure_index_qf	***dynamic value***	float
			percent_invalid_due_to_indeterminate_land_surface_emissivity_qf	***dynamic value***	float
			percent_invalid_due_to_bad_TPW_sigma_pressure_level_index_qf	***dynamic value***	float
			percent_invalid_due_to_occurrence_of_not_a_number_qf	***dynamic value***	float
DQF_Retrieval	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices algorithm atmospheric temperature and water vapor profile physical retrieval quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 5	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	6	byte
			percent_good_retrieval_qf	***dynamic value***	float
			percent_nonconvergent_retrieval_qf	***dynamic value***	float
			percent_brightness_temp_residual_exceeds_threshold_qf	***dynamic value***	float

Name	Type	Shape	Name	Value	Type
			percent_incomplete_convergence_of_retrieval_qf	***dynamic value***	float
			percent_unrealistic_retrieved_value_qf	***dynamic value***	float
			percent_invalid_radiative_transfer_model_brightness_temp_value_qf	***dynamic value***	float
DQF_SkinTemp	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Derived Stability Indices algorithm first guess skin temperature quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 2	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	3	byte
			percent_good_first_guess_skin_temp_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_upper_threshold_qf	***dynamic value***	float
			percent_first_guess_skin_temp_exceeds_lower_threshold_qf	***dynamic value***	float
total_attempted_retrievals	int	n/a	long_name	number of attempted sounding algorithm retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: geolocated/not missing pixels only	string

Name	Type	Shape	Name	Value	Type
CAPE_outlier_pixel_count	int	n/a	long_name	number of CAPE pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only)	string
lifted_index_outlier_pixel_count	int	n/a	long_name	number of lifted index pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only)	string
k_index_outlier_pixel_count	int	n/a	long_name	number of k index pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only)	string
showalter_index_outlier_pixel_count	int	n/a	long_name	number of showalter index pixels whose value is outside valid measurement range	string

Name	Type	Shape	Name	Value	Type
			_FillValue	-1	int
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only)	string
total_totals_index_outlier_pixel_count	int	n/a	long_name	number of total totals index pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels whose values are outside valid measurement range only)	string
minimum_CAPE	float	n/a	long_name	minimum CAPE	string
			standard_name	atmosphere_convective_available_potential_energy_wrt_surface	string
			_FillValue	-999	float
			valid_range	0.0 5000.0	float
			units	J kg-1	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
maximum_CAPE	float	n/a	long_name	maximum CAPE	string
			standard_name	atmosphere_convective_available_potential_energy_wrt_surface	string

Name	Type	Shape	Name	Value	Type
			_FillValue	-999	float
			valid_range	0.0 5000.0	float
			units	J kg-1	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
mean_CAPE	float	n/a	long_name	mean CAPE	string
			standard_name	atmosphere_convective_available_potential_energy_wrt_surface	string
			_FillValue	-999	float
			valid_range	0.0 5000.0	float
			units	J kg-1	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
standard_deviation_CAPE	float	n/a	long_name	standard deviation of CAPE values	string
			standard_name	atmosphere_convective_available_potential_energy_wrt_surface	string
			_FillValue	-999	float
			units	J kg-1	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
minimum_lifted_index	float	n/a	long_name	minimum lifted index	string
			standard_name	temperature_difference_between_ambient_air_and_air_lifted_adiabatically_from_the_surface	string

Name	Type	Shape	Name	Value	Type
			_FillValue	-999	float
			valid_range	-10.0 40.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image final_air_pressure	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only) final_air_pressure: point	string
maximum_lifted_index	float	n/a	long_name	maximum lifted index	string
			standard_name	temperature_difference_between_ambient_air_and_air_lifted_adiabatically_from_the_surface	string
			_FillValue	-999	float
			valid_range	-10.0 40.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image final_air_pressure	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only) final_air_pressure: point	string
mean_lifted_index	float	n/a	long_name	mean lifted index	string
			standard_name	temperature_difference_between_ambient_air_and_air_lifted_adiabatically_from_the_surface	string
			_FillValue	-999	float
			valid_range	-10.0 40.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image final_air_pressure	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only) final_air_pressure: point	string
standard_deviation_lifted_index	float	n/a	long_name	standard deviation of lifted index values	string
			standard_name	temperature_difference_between_ambient_air_and_air_lifted_adiabatically_from_the_surface	string
			_FillValue	-999	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image final_air_pressure	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only) final_air_pressure: point	string
minimum_k_index	float	n/a	long_name	minimum k index	string
			standard_name	atmosphere_stability_k_index	string
			_FillValue	-999	float
			valid_range	-70.0 50.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
maximum_k_index	float	n/a	long_name	maximum k index	string
			standard_name	atmosphere_stability_k_index	string
			_FillValue	-999	float
			valid_range	-70.0 50.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
mean_k_index	float	n/a	long_name	mean k index	string
			standard_name	atmosphere_stability_k_index	string
			_FillValue	-999	float
			valid_range	-70.0 50.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
standard_deviation_k_index	float	n/a	long_name	standard deviation of k index values	string
			standard_name	atmosphere_stability_k_index	string
			_FillValue	-999	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
minimum_showalter_index	float	n/a	long_name	minimum showalter index	string
			standard_name	atmosphere_stability_showalter_index	string
			_FillValue	-999	float
			valid_range	-10.0 25.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
maximum_showalter_index	float	n/a	long_name	maximum showalter index	string
			standard_name	atmosphere_stability_showalter_index	string
			_FillValue	-999	float
			valid_range	-10.0 25.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
mean_showalter_index	float	n/a	long_name	mean showalter index	string
			standard_name	atmosphere_stability_showalter_index	string
			_FillValue	-999	float
			valid_range	-10.0 25.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
standard_deviation_showalter_index	float	n/a	long_name	standard deviation of showalter index values	string
			standard_name	atmosphere_stability_showalter_index	string
			_FillValue	-999	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
minimum_total_totals_index	float	n/a	long_name	minimum total totals index	string
			standard_name	atmosphere_stability_total_totals_index	string
			_FillValue	-999	float
			valid_range	-43.0 60.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
maximum_total_totals_index	float	n/a	long_name	maximum total totals index	string
			standard_name	atmosphere_stability_total_totals_index	string
			_FillValue	-999	float
			valid_range	-43.0 60.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
mean_total_totals_index	float	n/a	long_name	mean total totals index	string
			standard_name	atmosphere_stability_total_totals_index	string
			_FillValue	-999	float
			valid_range	-43.0 60.0	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
standard_deviation_total_totals_index	float	n/a	long_name	standard deviation of total totals index values	string
			standard_name	atmosphere_stability_total_totals_index	string
			_FillValue	-999	float
			units	K	string
			coordinates	latitude retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: good and degraded due to quantitative LZA threshold exceeded quality pixels only)	string
mean_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Derived Stability Indices product	string
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
std_dev_obs_modeled_diff_sounding_emissive_bands	float	sounding_emissive_bands = 7	long_name	standard deviation of the difference of the observed and modeled brightness temperature values (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the emissive band central wavelengths used in the generation of the Derived Stability Indices product	string
			_FillValue	-999	float
			units	K	string

Name	Type	Shape	Name	Value	Type
			coordinates	retrieval_local_zenith_angle solar_zenith_angle sounding_emissive_band_ids sounding_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000280 rad comment: geolocated/not missing pixels only)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float

Name	Type	Shape	Name	Value	Type
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_8_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_9_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_10_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_11_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_12_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_13_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Name	Type	Shape	Name	Value	Type
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_16_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_pressure_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_moisture_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_wind_vector_profile_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_dynamic_ancillary_NWP_surface_level_index_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.15.6.1, Derived Stability Indices Product Flag Values and Meanings.

5.15.6.1 Derived Stability Indices Product Flag Values and Meanings

Table 5.15.6.1-1 Derived Stability Indices Product Overall Data Quality Flag Values and Meanings

Overall Data Quality Flags (DQF_Overall)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	invalid_due_to_not_geolocated_or_retrieval_LZA_threshold_exceeded_qf
2	degraded_due_to_latitude_threshold_exceeded_qf
3	degraded_due_to_quantitative_LZA_threshold_exceeded_qf
4	invalid_due_to_insufficient_clear_pixels_in_field_of_regard_qf
5	invalid_due_to_missing_NWP_data_qf
6	invalid_due_to_missing_L1b_data_or_fatal_processing_error_qf
7	invalid_due_to_bad_NWP_surface_pressure_index_qf
8	invalid_due_to_indeterminate_land_surface_emissivity_qf
9	invalid_due_to_bad_TPW_sigma_pressure_level_index_qf
10	invalid_due_to_occurrence_of_not_a_number_qf

Table 5.15.6.1-2 Derived Stability Indices Product Retrieval Quality Flag Values and Meanings

Retrieval Quality Flags (DQF_Retrieval)	
Flag Value	**Flag Meaning**
0	good_retrieval_qf
1	nonconvergent_retrieval_qf
2	brightness_temp_residual_exceeds_threshold_qf
3	incomplete_convergence_of_retrieval_qf
4	unrealistic_retrieved_value_qf
5	invalid_radiative_transfer_model_brightness_temp_value_qf

Table 5.15.6.1-3 Derived Stability Indices Product Skin Temperature Data Quality Flag Values and Meanings

Skin Temperature Data Quality Flags (DQF_SkinTemp)	
Flag Value	**Flag Meaning**
0	good_first_guess_skin_temp_qf
1	first_guess_skin_temp_exceeds_upper_threshold_qf
2	first_guess_skin_temp_exceeds_lower_threshold_qf

5.16 Rainfall Rate (Quantitative Precipitation Estimate) Product

5.16.1 Description

The Rainfall Rate Quantitative Precipitation Estimate (QPE) product contains an image with pixel values identifying the rainfall rate. The product includes data quality information that provides an assessment of the rainfall rate data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the rainfall rate value are "millimeters per hour".

The Rainfall Rate (QPE) product image is produced on the ABI fixed grid at 2 km resolution for the Full Disk coverage region. Product data is produced for geolocated source data to local zenith angles of 90 degrees for both daytime and nighttime conditions. The Rainfall Rate (QPE) performance requirements are summarized in Table 5.16.1, Rainfall Rate (QPE) Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.16.1 Rainfall Rate (QPE) Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions [1]**	**Accuracy**
Full Disk	0 to 100 mm/hour	6 mm/hour at 10 mm/hr rate, with higher values at higher rates	9 mm/hour at 10 mm/hour rate, with higher values at higher rates	LZA ≤ 70 degrees	2 km

[1] Conditions for good quality prescribed by the algorithm also include latitude ≤ +/-60 degrees.

Metadata in the Rainfall Rate (QPE) product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of pixels where retrieval is successful.
- Number of pixels with rain.
- Total rainfall rate in product image.
- Number of rainfall rate pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the rainfall rate values in the product image.

Note that the total rain area (total_pixels_with_rain variable) and total rain volume (total_rain_volume) variables are based on good quality pixels and rain rate being greater than 1 mm/h; the remaining rain statistics are based on good quality pixels and rain rate (RRQPE variable) being between 0 and 100 mm/h (exclusive).

These statistics are calculated using good quality pixels. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Rainfall Rate (QPE) product is located in the standalone Appendix X, ISO Series Metadata.

5.16.2 Dynamic Source Data

The Rainfall Rate (QPE) product is derived using processed ABI Level 1b emissive band images from the current observation.

The primary sensor data used by the Rainfall Rate (QPE) algorithm is identified in Table 5.16.2, Primary Sensor Data.

Table 5.16.2 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Products	input_ABI_L2_brightness_temperature_band_8_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_11_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.16.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Rainfall Rate (QPE) ground-processing algorithm:

- Algorithm-specific parameters
- Gridded parameters

The algorithm-specific parameters represent parameters unique to the ABI Rainfall Rate (Quantitative Precipitation Estimate) algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. The algorithm parameters include:

- Spatial uniformity parameters
- Rainfall detection and rate predictor offsets
- Rain class brightness temperature difference and latitude regime thresholds
- Coefficient and predictor validity thresholds
- Upper bound for rainfall rate bias adjustment
- Thresholds for assignment of quality flags
- Minimum/maximum valid range/outlier thresholds for rainfall rate

The retrieval coefficient table is a distinct set of parameters that may be updated more frequently during operations. It includes:

- Rain detection IDs, regression coefficients, and thresholds for each rain class
- Rainfall rate IDs and regression coefficient for each rain class
- Rainfall rate bias correction look-up table as a function of rain rate and rain class

The category of gridded parameters used in the generation of the Rainfall Rate (QPE) product is projection and mapping. The specific types of gridded semi-static source data in the category used in the generation of the Rainfall Rate (QPE) product are identified in Table 5.16.3 Gridded Semi-Static Source Data.

Table 5.16.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- RRCE_CoefficientTable.bin
- RRPE_SemiStaticParameters.bin

5.16.4 Coordinates

The coordinates associated with data variables in the Rainfall Rate (QPE) product are identified in Table 5.16.4, Rainfall Rate (QPE) Product Coordinates.

Table 5.16.4 Rainfall Rate (QPE) Product Coordinates

<table>
<tr><th>Rainfall Rate (QPE) Product Data Quantity</th><th>Coordinates</th></tr>
<tr><td>rainfall rate data</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Local zenith angle ranges for good, and good or degraded quality data production
• Latitude range for good quality data production</td></tr>
<tr><td>rainfall rate data quality flags</td></tr>
<tr><td>good retrieval count</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Latitude range for good quality data production
• Local zenith angle range for good quality data production</td></tr>
<tr><td>rain pixel count</td><td rowspan="4">• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Accounted rainfall rate range
• Local zenith angle range for good quality data production
• Latitude range for good quality data production</td></tr>
<tr><td>rain volume</td></tr>
<tr><td>rainfall rate outlier pixel count</td></tr>
<tr><td>rainfall rate minimum, maximum, mean, and standard deviation values</td></tr>
<tr><td>data transmission error percentages</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location</td></tr>
</table>

5.16.5 Production Notes

The Rainfall Rate (QPE) product is generated by the GOES-R ABI Rainfall Rate (QPE) ground processing algorithm. Rainfall rate is obtained using a two-step process that involves the detection of pixels where rain is occurring and the retrieval of rainfall rate for those pixels. The algorithm includes eight linear and eight non-linear predictors based on brightness temperatures measured in five emissive ABI bands 8, 10, 11, 14, and 15 with central wavelengths of 6.185, 7.34. 8.5, 11.2, and 12.3 um, respectively. As a result of the spectral range of the ABI instrument not being capable of penetrating optically thick clouds where precipitation is occurring, the algorithm uses retrieval coefficients that are established based on a statistical correlation of the observed cloud top brightness temperatures with rainfall occurrence and rate as detected by sources capable of penetrating optically thick clouds, such as microwave observations. The retrieval coefficients used by the algorithm are managed as Level 2+ semi-static source data in the ground system. Pixels in the product image with out-of -range values are assigned the minimum or maximum value in the valid range. The ABI Level 1b source data is not parallax corrected.

The algorithm generates product quality information that flags conditions resulting in out-of-range rain rate retrievals, and classifies the conditions associated with the retrievals based on water, ice, or overshooting top cloud, and latitude. The Rainfall Rate (QPE) algorithm final and intermediate diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Rainfall Rate (QPE) ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Rainfall Rate. This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/Hydro_RRQPE_v2.0_no_color.pdf.

5.16.6 Data Fields

The Rainfall Rate (QPE) product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Rainfall Rate (QPE) product are located in Appendix A.

Table 5.16.6-1 Rainfall Rate (QPE): Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	3a3268a0-b006-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Rainfall Rate - Quantitative Precipitation Estimate	string
summary	The Rainfall Rate - Quantitative Precipitation Estimate product consists of pixels containing the rainfall rate. This product is generated by establishing statistical relationships from matching the observed cloud top brightness temperatures with rainfall occurrence and rate as derived by microwave sensors using rainfall predictors based on brightness temperatures measured in ABI emissive bands at wavelengths of 6.185, 7.34, 8.5, 11.2, and 12.3 um. Product data is generated both day and night.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > PRECIPITATION > PRECIPITATION RATE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	string

production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	string
scene_id	Full Disk	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.16.6-2 Rainfall Rate (QPE): Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality rainfall rate QPE data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality rainfall rate QPE data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality rainfall rate QPE data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality rainfall rate QPE data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality rainfall rate QPE data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality rainfall rate QPE data is produced	string
latitude ***value = 60.0***	float	n/a	long_name	threshold latitude for good quality rainfall rate QPE data production	string
			standard_name	latitude	string
			units	degrees_north	string
			bounds	latitude_bounds	string
latitude_bounds ***value = -60.0 60.0***	float	number_of_lat_bounds = 2	long_name	latitude range where good quality rainfall rate QPE data is produced	string
accounted_rainfall_rate ***value = 1.0***	float	n/a	long_name	threshold rainfall rate for including pixel in image statistics	string
			standard_name	rainfall_rate	string
			units	mm h-1	string
			bounds	accounted_rainfall_rate_bounds	string
accounted_rainfall_rate_bounds ***value = 1.0 100.0***	float	number_of_rainfall_rate_bounds = 2	long_name	rainfall rate range for including pixel in image statistics	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
RRQPE	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Rainfall Rate - Quantitative Prediction Estimate	string
			standard_name	rainfall_rate	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00152602	float
			add_offset	0	float
			units	mm h-1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	latitude: point (good quality pixel produced) retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: sum (good quality pixel produced) solar_zenith_angle: sum (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Rainfall Rate - Quantitative Prediction Estimate data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 127	byte
			units	1	string
			coordinates	latitude retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: point retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	byte
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	8	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_bad_quality_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_or_latitude_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_brightness_temp_data_or_1st_rain_pre	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			dictor_fails_validation_qf		
			percent_invalid_due_to_bad_or_missing_brightness_temp_data_or_2nd_rain_predictor_fails_validation_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_brightness_temp_data_or_1st_rain_rate_predictor_fails_validation_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_brightness_temp_data_or_2nd_rain_rate_predictor_fails_validation_qf	***dynamic value***	float
			percent_invalid_due_to_missing_retrieval_coefficients_qf	***dynamic value***	float
total_pixels_with_successful_retrieval	int	n/a	long_name	number of good rainfall rate algorithm retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only)	string
total_pixels_with_rain	int	n/a	long_name	number of good quality pixels where it is raining (i.e., where rainfall_rate is > 1 mm h-1)	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	accounted_rainfall_rate latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	accounted_rainfall_rate: sum latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where rain	string
total_rain_volume	float	n/a	long_name	sum of rainfall rate for good quality pixels where it is raining (i.e., where rainfall_rate is > 1 mm h-1)	string
			_FillValue	-999	float
			units	mm h-1	string
			coordinates	accounted_rainfall_rate latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	accounted_rainfall_rate: sum latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where rain	string
rainfall_rate_outlier_pixel_count	int	n/a	long_name	number of rainfall rate pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	accounted_rainfall_rate latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	accounted_rainfall_rate: sum latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only) where rain	string
minimum_rainfall_rate	float	n/a	long_name	minimum rainfall rate	string
			standard_name	rainfall_rate	string
			_FillValue	-999	float
			valid_range	1.0 100.0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	mm h-1	string
			coordinates	accounted_rainfall_rate latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	accounted_rainfall_rate: sum latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where rain	string
maximum_rainfall_rate	float	n/a	long_name	maximum rainfall rate	string
			standard_name	rainfall_rate	string
			_FillValue	-999	float
			valid_range	1.0 100.0	float
			units	mm h-1	string
			coordinates	accounted_rainfall_rate latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	accounted_rainfall_rate: sum latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where rain	string
mean_rainfall_rate	float	n/a	long_name	mean rainfall rate	string
			standard_name	rainfall_rate	string
			_FillValue	-999	float
			valid_range	1.0 100.0	float
			units	mm h-1	string
			coordinates	accounted_rainfall_rate latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	accounted_rainfall_rate: sum latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where rain	string
standard_deviation_rainfall_rate	float	n/a	long_name	standard deviation of rainfall rate values	string
			standard_name	rainfall_rate	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999	float
			units	mm h-1	string
			coordinates	accounted_rainfall_rate latitude quantitative_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	accounted_rainfall_rate: sum latitude: sum quantitative_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where rain	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_brightness_temperature_band_8_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_10_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_11_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string
			input_ABI_L2_brightness_temperature	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_band_15_2km_data		
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.16.6.1, Rainfall Rate (QPE) Product Flag Values and Meanings.

5.16.6.1 Rainfall Rate (QPE) Product Flag Values and Meanings

Table 5.16.6.1 Rainfall Rate (QPE) Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
1	0	good_quality_qf
1	1	bad_quality_qf
2	2	degraded_due_to_LZA_or_latitude_threshold_exceeded_qf
4	4	invalid_due_to_bad_or_missing_brightness_temp_data_or_1st_rain_predictor_fails_validation_qf
8	8	invalid_due_to_bad_or_missing_brightness_temp_data_or_2nd_rain_predictor_fails_validation_qf
16	16	invalid_due_to_bad_or_missing_brightness_temp_data_or_1st_rain_rate_predictor_fails_validation_qf
32	32	invalid_due_to_bad_or_missing_brightness_temp_data_or_2nd_rain_rate_predictor_fails_validation_qf
64	64	invalid_due_to_missing_retrieval_coefficients_qf

5.17 Derived Motion Winds Product

5.17.1 Description

The Derived Motion Winds product contains a list of wind vectors identifying their location, wind speed, wind direction, air pressure and temperature, and local zenith angle. The product includes data quality information for each wind vector, including an indication of good quality or invalid, and the rationale.

The product name includes the word "derived" because the wind vectors are derived by tracking environmental features, specifically clouds and clear sky water vapor over multiple ABI observations. The type of feature tracked varies as a function of the ABI band. Derived Motion Wind product files are generated for the ABI reflective and emissive band that are used to track features

The units of measure for the wind vector quantities are identified in Table 5.17.1-1 Wind Vector Quantities Units of Measure.

Table 5.17.1-1 Wind Vector Quantities Units of Measure

Wind Vector Quantity	Units of Measure
Speed	meters per second
Direction	degrees
Pressure	hectopascals
Air temperature	kelvin

Product data is produced for geolocated source data to local zenith angles of 90 degrees. However, product data production varies as a function of the solar zenith angle. Refer to Table 5.17.1-2, Band-Specific Derived Motion Wind Product Files.

Table 5.17.1-2 Band-Specific Derived Motion Wind Product Files

		Feature Tracked		
ABI Band	Central Wavelength (um)	Cloud	Clear Sky Water Vapor	Solar Zenith Angle Range
2	0.64	X		0 to 80 degrees
7	3.9	X		90 to 180 degrees
8[1]	6.185	X	X	0 to 180 degrees
9	6.95		X	0 to 180 degrees
10	7.34		X	0 to 180 degrees
14	11.2	X		0 to 180 degrees

[1] Both a cloud and clear sky water vapor based product file are generated for ABI band 8.

The Derived Motion Winds product is produced using ABI Full Disk, CONUS, and Mesoscale coverage region observations. The Derived Motion Winds performance requirements are summarized in Table 5.17.1-3, Derived Motion Winds Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement range and performance conditions identified therein except as noted.

Table 5.17.1-3 Derived Motion Winds Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy [2]**	**Precision [2]**	**Performance Conditions**	**Accuracy**
Full Disk, CONUS, & Mesoscale	(1) Wind speed: 0 to 155 m/s (2) Wind direction: 0 to 360 degrees	(1) Mean vector distance: 7.5 m/s	(1) Mean vector distance standard deviation: 4.2 m/s	LZA ≤ 62 degrees [3]	5 km

[1] Valid measurement range for wind speed prescribed by the algorithm is 3 to 155 m/s.
[2] Mean vector distance accounts for.both wind speed and direction. Vector distance is the root sum square of the difference between the calculated and reference u and v wind components.
[3] Conditions for good quality prescribed by the algorithm are for LZA ≤ 90.

Metadata in the Derived Motion Winds product provides algorithm configuration information and statistical and other properties of the wind vectors, and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Time between successive ABI images used to derive wind vectors, and ABI band-specific geospatial criteria for finding and tracking features.
- Start, midpoint, and end time of the wind vectors in the product, which corresponds to the middle Level 1b product image observation period.
- Number of vectors' wind speeds whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the vector's wind speed values in the product file.
- Number of wind vectors in each of three atmospheric layers, and the minimum, maximum, mean, and standard deviation of the constituent wind vectors' cloud top pressure values.

These statistics are calculated using good quality wind vectors. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Derived Motion Wind product is located in the standalone Appendix X, ISO Series Metadata.

5.17.2 Dynamic Source Data

The Derived Motion Winds product is derived using a triplet of ABI Level 1b reflective and emissive band images from the current and two previous observations equidistant in time. The algorithm uses final and intermediate product data generated by the Cloud Mask, Cloud Top Phase, and Cloud Top Height algorithms. In addition, processed temperature and wind vector profile data derived from the NWP model ancillary data are used. Furthermore, solar zenith angle dynamic auxiliary data is used.

The primary sensor data used by the Derived Motion Winds algorithm is identified in Table 5.17.2-1, Primary Sensor Data.

Table 5.17.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_14_2km_data [1] input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_8_2km_data input_ABI_L2_brightness_temperature_band_9_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_reflectance_band_2_half_km_data

[1] Band 14 level 1b radiances data is used in the generation of bands 2, 7, and 14 product files.

The other dynamic source data inputs are summarized in Table 5.17.2-2, Other Dynamic Source Data.

Table 5.17.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Products	input_ABI_L2_cloud_top_phase_data input_ABI_L2_cloud_top_temperature_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_cloud_top_height_data input_ABI_L2_intermediate_product_cloud_top_pressure_data input_ABI_L2_intermediate_product_cloud_type_data input_ABI_L2_intermediate_product_low_level_temperature_inversion_flag_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_NWP_raw_temperature_profile_data input_dynamic_ancillary_NWP_wind_vector_profile_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.17.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Derived Motion Winds ground-processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Derived Motion Winds ground algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Nominal target and nested-target box sizes.
- Band-specific algorithm configuration parameters including: time interval between images, target box size, band resolution, nested tracking flag setting, and clear/cloud target type flag setting. (Algorithm configuration parameters are also recorded as product metadata.)
- Band-specific target selection test thresholds, including solar zenith angle thresholds for Band 2 and Band 7.
- Band-specific test thresholds.
- Band-specific height assignment quality check thresholds.
- Band-specific and generic quality control test coefficients, weights, and thresholds.
- Parameterization of atmospheric layers.

The common library parameters shared across multiple algorithms are used by the Derived Motion Winds algorithm. These parameters include:

- Pressure profile for the native NWP grid

The category of gridded parameters used in the generation of the Derived Motion Winds product is projection and mapping. The specific types of gridded semi-static source data in the category used in the generation of the Derived Motion Winds product are identified in Table 5.17.3 Gridded Semi-Static Source Data.

Table 5.17.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data input_ABI_L2_semi_static_E_W_to_N_S_distance_ratio_for_fixed_grid_half_km_data input_ABI_L2_semi_static_E_W_to_N_S_distance_ratio_for_fixed_grid_2km_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-DMWSemiStaticParams.bin
- AI_ABI-L2-DMWSemiStaticParams_15m.bin
- AI_ABI-L2-DMWSemiStaticParams_5m.bin
- ANC_ABI-L2-DMW-PixelFactor_modified.bin
- ANC_ABI-L2-RawPressGrid.bin
- GM-ANC_ABI-L2-DMW-PixelFactor.bin

5.17.4 Coordinates

The coordinates associated with data variables in the Derived Motion Winds product are identified in Table 5.17.4, Derived Motion Winds Product Coordinates.

Table 5.17.4 Derived Motion Winds Product Coordinates

Derived Motion Winds Product Data Quantity	Coordinates
wind speed	• Observation time period • Latitude and longitude for wind vector • Central wavelength and identifier of the applicable ABI band
wind direction	

	• Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
air pressure (associated with wind vector)	• Observation time period • Latitude and longitude for wind vector • Central wavelength and identifier of the applicable ABI band
air temperature (associated with wind vector)	
data quality flags (associated with wind vector)	• Observation time period • Latitude and longitude for wind vector • Central wavelength and identifier of the applicable ABI band • Air pressure for wind vector • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
wind speed outlier count	• Observation time period • Latitude and longitude extents for source image geo-location • Central wavelength and identifier of the applicable ABI band • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
wind speed minimum, maximum, mean, and standard deviation values	
wind vectors in atmospheric layer count cloud top pressure in atmospheric layer minimum, maximum, mean, and standard deviation values	• Observation time period • Latitude and longitude extents for source image geo-location • Central wavelength and identifier of the applicable ABI band • Air pressure extent for atmospheric layer • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
data transmission error percentages	• Observation time period • Latitude and longitude extents for source image geo-location

5.17.5 Production Notes

The Derived Motion Winds product is generated by the GOES-R ABI Derived Motion Winds ground processing algorithm. Wind speed and direction are determined by tracking environmental features, specifically cloud edges and clear sky moisture gradients, over a time series composed of three ABI observations. Two displacement vectors are produced for the two time adjacent observation pairs, and then averaged. The time associated with wind vectors in a Derived Motion Winds product file is the acquisition time associated with the middle observation. The algorithm performs several consistency checks on the derived wind information including a comparison with the NWP wind forecast to establish a confidence level for the wind vector and an estimate of its wind speed error.

Refer to Table 5.17.1-2, Band-Specific Derived Motion Wind Product Files. For each ABI band, algorithm processing occurs independently and separate product files are generated. The configuration of each retrieval is band dependent and is determined by the target type (clear sky water vapor or cloud), target box size, search window size (i.e., lag size), temporal spacing between image pairs, and the application of nested tracking of target sub-regions. This configuration information is included in the product metadata. Product files include data for each attempted wind retrieval. It is possible that one or more wind vectors in a product file have one or more null values in its data elements, which is indicated with the applicable variables' fill values.

The algorithm generates diagnostic data including the characteristics of the West/East and South/North components of the two displacement wind vectors, target identification and tracking statistics, cloud and atmospheric properties, and the NWP wind forecast. Details of these diagnostic datasets are contained in Appendix E, Selected Intermediate Products.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Derived Motion Winds ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Derived Motion Winds. This document is located at:
http://www.goes-r.gov/products/ATBDs/baseline/Winds_DMW_v2.0_no_color.pdf

5.17.6 Data Fields

The Derived Motion Winds product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Derived Motion Winds product are located in Appendix A.

Table 5.17.6-1 Derived Motion Winds: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
featureType	point	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	aee58cd0-f85a-11e1-a21f-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Derived Motion Winds	string
summary	The Derived Motion Winds product consists of wind vectors containing wind speed, wind direction, pressure, and brightness temperature. The product is generated by tracking features (i.e., clouds edges for the cloudy target scenes and, in the case of clear-sky conditions, the moisture gradients) from three time sequential ABI images at bands with central wavelengths 0.64, 3.9, 6.185, 6.95, 7.34, and 11.2 um. Reflective band product data is generated during the day. Emissive band product data is generated both day and night except for the 3.9 um band, where product data is generated during night only.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	ATMOSPHERE > ATMOSPHERIC WINDS	string
cdm_data_type	Point	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string

Global Attribute Name	Value	Type
production_environment	***possible values are OE, ITE, and DE.***	String
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	String
spatial_resolution	10km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.17.6-2 Derived Motion Winds: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
lat	double	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds: wind vector's latitude coordinate	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
lon	double	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds: wind vector's longitude coordinate	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
time	double	***nMeasures = unlimited***	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
local_zenith_angle	float	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds: wind vector's local zenith angle	string
			standard_name	platform_zenith_angle	string
			units	degree	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality derived motion winds data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality derived motion winds data is produced	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
solar_zenith_angle ***value = see note [2]***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality derived motion winds data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle _bounds ***value = see note [2] see note [2]***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality derived motion winds data is produced	string
band_wavelength ***value = see note [2]***	float	dmw_band = 1	long_name	ABI band central wavelength for this derived motion winds product file's data	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
band_id ***value = see note [2]***	byte	dmw_band = 1	long_name	ABI band identifier for this derived motion winds product file's data	string
			standard_name	sensor_band_identifier	string
			units	1	string
atmospheric_layer _pressure ***value = 250.0 550.0 850.0***	float	atmospheric_layer = 3	long_name	central pressure level in atmospheric layer for related reported derived motion wind statistics	string
			standard_name	air_pressure	string
			units	hPa	string
			axis	Z	string
			bounds	atmospheric_layer_pressure_bounds	string
atmospheric_layer _pressure_bounds ***value = 100.0 399.9 400.0 699.9 700.0 1000.0***	float	n/a	long_name	pressure range for each atmospheric layer for related reported derived motion wind statistics	string
lat_image value = ***see note [1]***	float	n/a	long_name	latitude coordinate for center of image	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	lat_image_bounds	string
lat_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	latitude coordinates for north/south extent of image	string
lon_image value = ***see note [1]***	float	n/a	long_name	longitude coordinate for center of image	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
			bounds	lon_image_bounds	string
lon_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	longitude coordinates for west/east extent of image	string
goes_lat_lon_projection	int	n/a	long_name	GOES-R latitude / longitude projection	string
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			longitude_of_prime_meridian	0	double
wind_speed	float	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds: wind vector's wind speed	string
			standard_name	wind_speed	string
			_FillValue	-999	float
			valid_range	3.0 155.0	float
			units	m s-1	string
			coordinates	retrieval_local_zenith_angle local_zenith_angle solar_zenith_angle band_id band_wavelength time lat lon	string
			cell_methods	retrieval_local_zenith_angle: point (good quality wind vector produced) local_zenith_angle: point solar_zenith_angle: point (good quality wind vector produced) time: point area: mean (interval: see note [2] km comment: geolocated/not missing pixels from tracked feature's dominant cluster)	string
			ancillary_variables	pressure temperature DQF	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
wind_direction	float	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds: wind vector's wind from direction measured positive clockwise from due north	string
			standard_name	wind_from_direction	string
			_FillValue	-999	float
			valid_range	0.0 359.99999	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle local_zenith_angle solar_zenith_angle band_id band_wavelength time lat lon	string
			cell_methods	retrieval_local_zenith_angle: point (good quality wind vector produced) local_zenith_angle: point solar_zenith_angle: point (good quality wind vector produced) time: point area: mean (interval: see note [2] km comment: geolocated/not missing pixels from tracked feature's dominant cluster)	string
			ancillary_variables	pressure temperature DQF	string
pressure	float	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds: wind vector's air pressure	string
			standard_name	air_pressure	string
			_FillValue	-999	float
			valid_range	0.0 1100.0	float
			units	hPa	string
			coordinates	band_id band_wavelength time lat lon	string
			cell_methods	time: point area: median (interval: see note [2] km comment: geolocated/not missing pixels from tracked feature's dominant cluster)	string
temperature	float	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds: wind vector's air temperature	string
			standard_name	air_temperature	string
			_FillValue	-999	float
			valid_range	180.0 340.0	float
			units	K	string
			coordinates	band_id band_wavelength time lat lon	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	time: point area: median (interval: 2 km comment: geolocated/not missing pixels)	string
DQF	byte	***nMeasures = unlimited***	long_name	ABI L2+ Derived Motion Winds data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 22	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time pressure lat lon	string
			cell_methods	retrieval_local_zenith_angle: point solar_zenith_angle: point time: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	23	byte
			percent_good_wind_qf	***dynamic value***	float
			percent_invalid_due_to_max_gradient_below_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_location_on_earth_limb_qf	***dynamic value***	float
			percent_invalid_due_to_cloud_amount_below_or_exceeds_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_median_pressure_retrieval_failure_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_brightness_temp_or_reflectance_qf	***dynamic value***	float
			percent_invalid_due_to_multiple_cloud_layers_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_invalid_due_to_insufficient_structure_for_reliable_tracking_qf	***dynamic value***	float
			percent_invalid_due_to_cloud_tracking_correlation_below_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_u_component_acceleration_exceeds_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_v_component_acceleration_exceeds_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_u_and_v_components_acceleration_exceeds_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_wind_speed_below_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_day_night_terminator_proximity_below_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_cloud_height_median_pressure_below_or_exceeds_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_feature_match_at_search_region_boundary_qf	***dynamic value***	float
			percent_invalid_due_to_difference_with_forecast_wind_exceeds_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_difference_in_image_pairs_cloud_height_median_pressure_exceeds_threshold_qf	***dynamic value***	float
			percent_invalid_due_to_data_needed_for_search_region_unavailable_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_invalid_due_to_falure_of_quality_indicator_and_expected_error_method_checks_qf	***dynamic value***	float
			percent_invalid_due_to_missing_data_in_search_region_qf	***dynamic value***	float
			percent_invalid_due_to_winds_not_found_qf	***dynamic value***	float
			percent_invalid_due_to_feature_cluster_not_found_qf	***dynamic value***	float
wind_speed_outlier_count	int	n/a	long_name	number of wind vector's wind speed whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum area: sum (good quality wind vectors whose values are outside valid measurement range only)	string
minimum_wind_speed	float	n/a	long_name	minimum wind speed	string
			standard_name	wind_speed	string
			_FillValue	-999	float
			valid_range	3.0 155.0	float
			units	m s-1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum area: minimum (good quality wind vectors only)	string
maximum_wind_speed	float	n/a	long_name	maximum wind speed	string
			standard_name	wind_speed	string
			_FillValue	-999	float
			valid_range	3.0 155.0	float
			units	m s-1	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum area: maximum (good quality wind vectors only)	string
mean_wind_speed	float	n/a	long_name	mean wind speed	string
			standard_name	wind_speed	string
			_FillValue	-999	float
			valid_range	3.0 155.0	float
			units	m s-1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum area: mean (good quality wind vectors only)	string
standard_deviation_wind_speed	float	n/a	long_name	standard deviation of wind speed values	string
			standard_name	wind_speed	string
			_FillValue	-999	float
			units	m s-1	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum area: standard_deviation (good quality wind vectors only)	string
number_of_wind_vectors_in_atmospheric_layer	int	atmospheric_layer = 3	long_name	number of good quality wind vectors in atmospheric layer	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time atmospheric_layer_pressure lat_image lon_image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum atmospheric_layer_pressure: sum area: sum (good quality wind vectors only)	string
min_cloud_top_pressure_in_atmospheric_layer	float	atmospheric_layer = 3	long_name	minimum cloud top pressure in atmospheric layer associated with the derivation of wind vectors	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			valid_range	100.0 1000.0	float
			units	hPa	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time atmospheric_layer_pressure lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum atmospheric_layer_pressure: sum area: minimum (good quality wind vectors only)	string
max_cloud_top_pressure_in_atmospheric_layer	float	atmospheric_layer = 3	long_name	maximum cloud top pressure in atmospheric layer associated with the derivation of wind vectors	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			valid_range	100.0 1000.0	float
			units	hPa	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time atmospheric_layer_pressure lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum atmospheric_layer_pressure: sum area: maximum (good quality wind vectors only)	string
mean_cloud_top_pressure_in_atmospheric_layer	float	atmospheric_layer = 3	long_name	mean cloud top pressure in atmospheric layer associated with the derivation of wind vectors	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			valid_range	100.0 1000.0	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	hPa	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time atmospheric_layer_pressure lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum atmospheric_layer_pressure: sum area: mean (good quality wind vectors only)	string
standard_deviation_cloud_top_pressure_in_atmospheric_layer	float	atmospheric_layer = 3	long_name	standard deviation of cloud top pressure values in atmospheric layer associated with the derivation of wind vectors	string
			standard_name	air_pressure_at_cloud_top	string
			_FillValue	-999	float
			units	hPa	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle band_id band_wavelength time atmospheric_layer_pressure lat_image lon_image	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum time: sum atmospheric_layer_pressure: sum area: standard_deviation (good quality wind vectors only)	string
seconds_between_images	int	n/a	long_name	number of seconds between successive images used to derive wind vectors	string
			_Unsigned	TRUE	string
			_FillValue	4294967295	int
			units	s	string
			coordinates	time	string
			cell_methods	time: sum	string
target_box_size	int	n/a	long_name	row and column dimension in pixels of the target box scene used to locate targets in image	string
			_FillValue	-1	int
			valid_range	5 30	int
			units	count	string
			coordinates	band_id band_wavelength time	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	time: sum	string
lag_size	int	n/a	long_name	maximum displacement in pixels of target box scene used to locate targets in image within search area. Numerically, absolute value of lag_size-1 is maximum displacement in pixels for a target at center of search box	string
			_FillValue	-1	int
			valid_range	3 219	int
			units	count	string
			coordinates	band_id band_wavelength time	string
			cell_methods	time: sum	string
nested_tracking_flag	int	n/a	long_name	binary flag indicating the enabling of nested tracking of sub-scenes within the target box scene, which is used to determine the dominant motion of features in image	string
			_FillValue	-1	int
			valid_range	0 1	int
			units	1	string
			coordinates	band_id band_wavelength time	string
			cell_methods	time: sum	string
			flag_values	***see note [flags and meanings]***	int
			flag_meanings	***see note [flags and meanings]***	string
target_type	int	n/a	long_name	binary flag indicating whether wind vectors are derived from clear-sky (i.e water vapor) or cloud targets	string
			_FillValue	-1	int
			valid_range	0 1	int
			units	1	string
			coordinates	band_id band_wavelength time	string
			cell_methods	time: sum	string
			flag_values	***see note [flags and meanings]***	int
			flag_meanings	***see note [flags and meanings]***	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	time lat_image lon_image	string
			cell_methods	time: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	time lat_image lon_image	string
			cell_methods	time: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L1b_radiance_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_brightness_temperature_band_8_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_brightness_temperature_band_9_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_brightness_temperature_band_10_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_cloud_top_phase_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_cloud_top_temperature_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_reflectance_band_2_half_km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_cloud_top_height_data	***refer to filename conventions for L2+ products in Appendix A.***	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_cloud_top_pressure_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_cloud_type_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_intermediate_product_low_level_temperature_inversion_flag_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_dynamic_ancillary_NWP_raw_temperature_profile_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_dynamic_ancillary_NWP_wind_vector_profile_data	***refer to filename conventions for L2+ products in Appendix A.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region extent variable and attribute values are located in paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.
Note 2: Solar zenith angle constraints are defined in Table 5.17.1-1, Band-Specific Derived Motion Wind Product Files.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.17.6.1, Derived Motion Winds Product Flag Values and Meanings.

5.17.6.1 Derived Motion Winds Product Flag Values and Meanings

Table 5.17.6.1-1 Derived Motion Winds Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_wind_qf
1	invalid_due_to_max_gradient_below_threshold_qf
2	invalid_due_to_location_on_earth_limb_qf
3	invalid_due_to_cloud_amount_below_or_exceeds_threshold_qf
4	invalid_due_to_median_pressure_retrieval_failure_qf
5	invalid_due_to_bad_or_missing_brightness_temp_or_reflectance_qf
6	invalid_due_to_multiple_cloud_layers_qf
7	invalid_due_to_insufficient_structure_for_reliable_tracking_qf

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
8	invalid_due_to_cloud_tracking_correlation_below_threshold_qf
9	invalid_due_to_u_component_acceleration_exceeds_threshold_qf
10	invalid_due_to_v_component_acceleration_exceeds_threshold_qf
11	invalid_due_to_u_and_v_components_acceleration_exceeds_threshold_qf
12	invalid_due_to_wind_speed_below_threshold_qf
13	invalid_due_to_day_night_terminator_proximity_below_threshold_qf
14	invalid_due_to_cloud_height_median_pressure_below_or_exceeds_threshold_qf
15	invalid_due_to_feature_match_at_search_region_boundary_qf
16	invalid_due_to_difference_with_forecast_wind_exceeds_threshold_qf
17	invalid_due_to_difference_in_image_pairs_cloud_height_median_pressure_exceeds_threshold_qf
18	invalid_due_to_data_needed_for_search_region_unavailable_qf
19	invalid_due_to_falure_of_quality_indicator_and_expected_error_method_checks_qf
20	invalid_due_to_missing_data_in_search_region_qf
21	invalid_due_to_winds_not_found_qf
22	invalid_due_to_feature_cluster_not_found_qf

Table 5.17.6.1-2 Derived Motion Winds Product Nested Tracking Flag Values and Meanings

Nested Tracking Flags (nested_tracking_flag)	
Flag Value	**Flag Meaning**
0	nested_tracking_disabled
1	nested_tracking_enabled

Table 5.17.6.1-3 Derived Motion Winds Product Target Type Flag Values and Meanings

Target Types (target_type)	
Flag Value	**Flag Meaning**
0	clear_sky_targets
1	cloud_targets

5.18 Hurricane Intensity Product

5.18.1 Description

The Hurricane Intensity product contains information about tropical cyclones along their trajectories from the time they are identified to the current time. Tropical cyclone information provided in the product includes its identity, location, maximum wind speed, Dvorak tropical cyclone current intensity number, detailed wind shear, cloud, and eye characteristics, strengthening and weakening state information, and the start, midpoint, and end observation time of the source ABI product image. Data quality information is not included in the product. A hurricane intensity product file is produced for each tropical cyclone.

The units of measure for the maximum sustained wind speed value are "meters per second". The advanced Dvorak technique tropical cyclone current and tropical intensity numbers are dimensionless quantities.

The Hurricane Intensity product is produced using ABI Full Disk coverage region observations. Product data is produced when a tropical cyclone is in the ABI's field of regard for both daytime and nighttime conditions. The Hurricane Intensity performance requirements are summarized in Table 5.18.1, Hurricane Intensity Performance Requirements.

Table 5.18.1 Hurricane Intensity Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy [1]**	**Precision [1]**	**Performance [2]**	**Accuracy**
Full Disk	(1) Wind speed: 12.8 m/s to 87.5 m/s (2) Dvorak hurricane intensity scale value: 1.0 to 9.0	(1) Wind speed: 5 m/s over ocean	(2) Wind speed: 5 m/s over ocean	LZA ≤ 65 degrees	1 km

[1] Accuracy and precision requirements for Dvorak hurricane intensity scale value have not been specified.
[2] Conditions for good quality are not prescribed by the algorithm.

The detailed description of the ISO series metadata for the Hurricane Intensity product is located in the standalone Appendix X, ISO Series Metadata.

5.18.2 Dynamic Source Data

The Hurricane Intensity product is derived using a processed ABI Level 1b emissive band image from the current observation. The algorithm uses tropical cyclone forecast file ancillary data made available by the National Hurricane Center. The algorithm is designed to use passive microwave eye score ancillary data, which improves the accuracy of the hurricane intensity, but this information is not being made available to the ground system at the present time. Note that the algorithm uses historical records in the product file to support the generation of the current record.

The primary sensor data used by the Hurricane Intensity algorithm is identified in Table 5.18.2-1, Primary Sensor Data.

Table 5.18.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Products	input_ABI_L2_brightness_temperature_band_13_2km_data

The other dynamic source data inputs are summarized in Table 5.18.2-2, Other Dynamic Source Data.

Table 5.8.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type

Processed Dynamic Ancillary Data	input_dynamic_ancillary_tropical_cyclone_forecast_file_data input_dynamic_ancillary_passive_microwave_eye_score_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.18.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Hurricane Intensity ground processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Hurricane Intensity algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Hurricane intensity initialization.
- Default values for hurricane outputs.
- Time and space thresholds and extents applied in automated storm center determination.
- Physical constants for angular separation to distance conversions.
- Parameters applied in the scene and eye characterization, the determination of eye score and classification of eye scene type, and the determination of the cloud score and classification of cloud scene type.
- Characterization of basic Dvorak enhancement categories.
- Characterization of curved band scenarios.
- Thresholds, parameters, and regression coefficients applied in the determination of the initial intensity estimate based on scene type and in microwave eye-score adjustment.
- Thresholds applied in determination of adjusted intensity estimate.
- Latitude and longitude coordinates specifying the boundary of the Atlantic Basin.
- Wind speed from current intensity look-up table.

This algorithm also requires the following input on its native projection (i.e., not mapped to the ABI fixed grid as with other gridded parameters):

- Digital elevation model (GTOPO30) on latitude/longitude grid projection

Common library parameters are shared across multiple algorithms and are used by the Hurricane Intensity algorithm.

The category of gridded parameters used in the generation of the Hurricane Intensity product is projection and mapping. The specific types of gridded semi-static source data in the category used in the generation of the Hurricane Intensity product are identified in Table 5.18.3 Gridded Semi-Static Source Data.

Table 5.18.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- AI_ABI-L2-HIESemiStaticParams.bin

5.18.4 Coordinates

The coordinates associated with data variables in the Hurricane Intensity product are identified in Table 5.18.4, Hurricane Intensity Product Coordinates.

Table 5.18.4 Hurricane Intensity Product Coordinates

Hurricane Intensity Product Data Quantity	Coordinates
cyclone center land / ocean flag	• Cyclone identifier • Observation time period • Latitude and longitude for cyclone center • Central wavelength and identifier of the source ABI band
current intensity number	
current intensity number difference from previous estimate	
maximum sustained wind speed	
final T number	
adjusted raw tropical number	
raw tropical number	
eye region scene type	
eye region size	
eye region temperature	
eye region temperature standard deviation	
cloud region scene type	
average annular cloud temperature	
average sector cloud temperature	
coldest warmest cloud temperature	
coldest warmest distance to cyclone center	
average symmetrical temperature difference	
eye region brightness temperature FFT harmonic count	
cloud region brightness temperature FFT harmonic count	

curved band gray scale enhancement category	
curved band curvature amount	
cyclone central dense overcast scene region size	• Cyclone identifier • Observation time period • Latitude and longitude for cyclone center • Central wavelength and identifier of the applicable ABI band • Central dense overcast scene sizing brightness temperature threshold
cyclone shear distance	• Cyclone identifier • Observation time period • Latitude and longitude for cyclone center • Central wavelength and identifier of the applicable ABI band • Shear scene sizing brightness temperature threshold
passive microwave eye score	• Cyclone identifier • Observation time period • Latitude and longitude for cyclone center
rule 8 flag	• Cyclone identifier • Observation time period
rule 9 flag	
rapid dissipation flag	
cyclone center location method	
data transmission error percentages	• Observation time period for source image • Latitude and longitude extents for source image geo-location

5.18.5 Production Notes

The Hurricane Intensity product is generated by the GOES-R ABI Hurricane Intensity ground processing algorithm. The algorithm, which is the Advanced Dvorak Technique, is used to derive a set of Dvorak Tropical numbers and a Current Intensity number that map directly to a maximum sustained one minute wind speed using a set of pre-determined statistical relationships. The algorithm determines the intensity of a tropical cyclone by matching observed brightness temperature patterns in the current processed ABI Full Disk Level 1b band 13 image with a central wavelength of 10.35 um to a set of pre-defined tropical cyclone structures. From this correlation, the center and scene type of the tropical cyclone are determined.

The Tropical and Current Intensity numbers are determined based on the recent trend of strengthening or weakening, and pre-defined intensity variation thresholds that vary as a function of time. The recent trend of strengthening or weakening can cause the algorithm to revise previous records in the product. The algorithm supports receiving and using passive microwave eye score data, but this data is not currently made available to the ground system.

The algorithm is activated as a result of the ground system receiving an Official Tropical Cyclone Forecast file, and executes as a result of the product's refresh rate criteria being satisfied and the ground system receiving an ABI Full Disk observation. The algorithm continues to monitor the cyclone and update the product data until the cyclone can no longer be tracked or official tropical cyclone warnings are discontinued. The GOES-R ground system implementation of the algorithm is fully automated.

Separate product files are generated for each tropical cyclone. The final and intermediate diagnostic information product files are available in the GOES-R system two-day store to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Hurricane Intensity Estimation ground-processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Hurricane Intensity. This document is located at
http://www.goes-r.gov/products/ATBDs/baseline/Winds_HIE_v2.0_no_color.pdf

5.18.6 Data Fields

The Hurricane Intensity product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Hurricane Intensity product are located in Appendix A.

Table 5.18.6-1 Hurricane Intensity: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	String
featureType	trajectory	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	a70be540-c38b-11e0-962b-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Hurricane Intensity	string
summary	The Hurricane Intensity product consists of records containing previous and current characteristics of a tropical cyclone over its history including its maximum sustained wind speed, intensity designation, location, and key spatial features and brightness temperatures. The product is generated using the Advanced Dvorak Technique, which uses pattern recognition in the ABI image at a band with a central wavelength of 10.35 um, microwave data received from an external source, and logic and accompanying state machine derived empirically. Product data is generated both day and night.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	ATMOSPHERE > ATMOSPHERIC PHENOMENA > HURRICANES	string
cdm_data_type	Trajectory	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	String
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	Full Disk	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.18.6-2 Hurricane Intensity: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
storm_center_lat	double	***num_structures = unlimited***	long_name	latitude longitude projection lat-coordinate	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
storm_center_lon	double	***num_structures = unlimited***	long_name	latitude longitude projection lon-coordinate	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
observation_time	double	***num_structures = unlimited***	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00, associated with tropical cyclone intensity estimate	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	observation_time_bounds	string
observation_time_bounds	double	n/a	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00) for each tropical cyclone intensity estimate	string
CDO_size_brightness_temp_threshold ***value = -30.0***	float	n/a	long_name	threshold brightness temperature at top of atmosphere limit for defining the radius of a central dense overcast or embedded center scene type tropical cyclone	string
			standard_name	toa_brightness_temperature	string
			units	degrees_C	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
shear_distance_brightness_temp_threshold ***value = -36.0***	float	n/a	long_name	threshold brightness temperature at top of atmosphere limit for defining the distance from tropical cyclone center to leading edge of displaced convection for a shear scene type tropical cyclone	string
			standard_name	toa_brightness_temperature	string
			units	degrees_C	string
hi_band_wavelength ***value = 10.35***	float	hi_band = 1	long_name	central wavelength associated with the ABI band used for estimating tropical cyclone characteristics	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
hi_band_id ***value = 13***	byte	hi_band = 1	long_name	identifier associated with the ABI band used for estimating tropical cyclone characteristics	string
			standard_name	sensor_band_identifier	string
			units	1	string
lat_image value = ***see note [1]***	float	n/a	long_name	latitude coordinate for center of image	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
			bounds	lat_image_bounds	string
lat_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	latitude coordinates for north/south extent of image	string
lon_image value = ***see note [1]***	float	n/a	long_name	longitude coordinate for center of image	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
			bounds	lon_image_bounds	string
lon_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	longitude coordinates for west/east extent of image	string
goes_lat_lon_projection	int	n/a	long_name	GOES-R latitude / longitude projection	string
			grid_mapping_name	***see note [1]***	string
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			longitude_of_prime_meridian	0	double
cyclone_identifier	char	cyclone_id_string_length = 8	long_name	ABI L2+ Hurricane Intensity: tropical cyclone identifier	string
			standard_name	automated_tropical_cyclone_forecasting_system_storm_identifier	string
			units	1	string
			cf_role	trajectory_id	string
image_analysis_time	double	***num_structures* = *unlimited***	long_name	J2000 epoch time when forecast associated with tropical cyclone intensity estimate was made, in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			_FillValue	-999	douible
			units	seconds since 2000-01-01 12:00:00	string
			coordinates	cyclone_identifier observation_time	string
			cell_methods	observation_time: point	string
land_ocean_flag	int	***num_structures* = *unlimited***	long_name	flag indicating whether tropical cyclone center position is over land or ocean	string
			_FillValue	0	int
			valid_range	1 2	int
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: point (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
CI_number	float	***num_structures* = *unlimited***	long_name	ABI L2+ Hurricane Intensity: advanced Dvorak technique tropical cyclone current intensity number (CI#)	string
			standard_name	dvorak_tropical_cyclone_current_intensity_number	string
			_FillValue	0	float
			valid_range	1.0 9.0	float
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
			ancillary_variables	wind_speed ci_difference final_T_number	string
ci_difference	float	***num_structures* = *unlimited***	long_name	difference between previous and current estimate of advanced Dvorak technique tropical cyclone current intensity number (CI#)	string
			_FillValue	-999	float
			valid_range	0.0 3.0	float
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
wind_speed	float	***num_structures* = *unlimited***	long_name	ABI L2+ Hurricane Intensity: tropical cyclone's maximum sustained wind speed	string
			standard_name	tropical_cyclone_maximum_sustained_wind_speed	string
			_FillValue	-999	float
			valid_range	12.8 87.5	float
			units	m s-1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: maximum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
			ancillary_variables	radius_of_maximum_wind	string
radius_of_maximum_wind	float	***num_structures* = *unlimited***	long_name	radius of tropical cyclone's maximum winds	string
			standard_name	radius_of_tropical_cyclone_defined_by_maximum_sustained_wind_speed	string
			_FillValue	-99.5	float
			valid_range	0.0 136.0	float
			units	km	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
final_T_number	float	***num_structures* = *unlimited***	long_name	ABI L2+ Hurricane Intensity: advanced Dvorak technique final tropical number (T#)	string
			standard_name	dvorak_tropical_number	string
			_FillValue	0	float
			valid_range	1.0 9.0	float
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
			ancillary_variables	adjusted_raw_T_number	string
adjusted_raw_T_number	float	***num_structures* = *unlimited***	long_name	ABI L2+ Hurricane Intensity: advanced Dvorak technique adjusted raw tropical number (T#)	string
			standard_name	dvorak_tropical_number	string
			_FillValue	0	float
			valid_range	1.0 9.0	float
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
			ancillary_variables	raw_T_number	string
raw_T_number	float	***num_structures* = *unlimited***	long_name	ABI L2+ Hurricane Intensity: advanced Dvorak technique raw tropical number (T#)	string
			standard_name	dvorak_tropical_number	string
			_FillValue	0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	1.0 9.0	float
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
eye_scene_type	int	***num_structures = unlimited***	long_name	ABI L2+ Hurricane Intensity: tropical cyclone eye type, when present	string
			standard_name	scene_type_of_dvorak_tropical_cyclone_eye_region	string
			_FillValue	-999	int
			valid_range	0 3	int
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels 0 – 160 km from tropical cyclone center)	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	eye_size eye_temperature eye_temperature_std_dev	string
eye_size	float	***num_structures = unlimited***	long_name	radius of tropical cyclone eye (all eye types)	string
			standard_name	radius_of_tropical_cyclone_eye	string
			_FillValue	-99.5	float
			valid_range	0.0 60.0	float
			units	km	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: mean (interval: 2 km comment: geolocated/not missing pixels 0 – 160 km from tropical cyclone center)	string
eye_temperature	float	***num_structures = unlimited***	long_name	warmest brightness temperature value in eye region	string
			standard_name	tropical_cyclone_eye_brightness_temperature	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			_FillValue	99.99	float
			valid_range	-100.0 40.0	float
			units	degrees_C	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: maximum (interval: 2 km comment: geolocated/not missing pixels 0 – 24 km from tropical cyclone center)	string
eye_temperature_std_dev	float	***num_structures* = *unlimited***	long_name	standard deviation of brightness temperature values in eye region	string
			standard_name	tropical_cyclone_eye_brightness_temperature	string
			_FillValue	0	float
			units	degrees_C	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: standard_deviation (interval: 2 km comment: geolocated/not missing pixels 0 – 24 km from tropical cyclone center with Bessel's correction applied in standard deviation calculation)	string
cloud_scene_type	int	***num_structures* = *unlimited***	long_name	ABI L2+ Hurricane Intensity: tropical cyclone cloud region scene type when no eye present	string
			standard_name	scene_type_of_dvorak_tropical_cyclone_cloud_region	string
			_FillValue	-999	int
			valid_range	0 4	int
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	CDO_size shear_distance	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
CDO_size	float	***num_structures*** = ***unlimited***	long_name	radius of tropical cyclone central dense overcast region (CDO, irregular CDO, and embedded center scene types only)	string
			standard_name	radius_of_tropical_cyclone_central_dense_overcast_region	string
			_FillValue	-99.5	float
			valid_range	0.0 300.0	float
			units	km	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength CDO_size_brightness_temp_threshold observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: mean (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
shear_distance	float	***num_structures*** = ***unlimited***	long_name	distance from tropical cyclone center to leading edge of displaced convection (shear scene type only)	string
			standard_name	distance_from_tropical_cyclone_center_to_leading_edge_of_ displaced_convection	string
			_FillValue	-99.5	float
			valid_range	0.0 300.0	float
			units	km	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength shear_distance_brightness_temp_threshold observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: mean (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
cloud_temperature _annular_average	float	***num_structures*** = ***unlimited***	long_name	cloud top temperature in cloud region annulus centered at storm center	string
			standard_name	brightness_temperature_at_cloud_top	string
			_FillValue	99.99	float
			valid_range	-100.0 40.0	float
			units	degrees_C	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	observation_time: point area: mean (interval: 2 km comment: geolocated/not missing pixels from 80 km wide cloud region annulus centered somewhere between 24 and 136 km at a concentric ring's coldest, warmest brightness temperature relative to tropical cyclone center)	string
cloud_temperature_sector_average	float	***num_structures*** = ***unlimited***	long_name	cloud top temperature 15 degree arc sector average	string
			standard_name	brightness_temperature_at_cloud_top	string
			_FillValue	99.99	float
			valid_range	-100.0 40.0	float
			units	degrees_C	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: mean (interval: 2 km comment: geolocated/not missing pixels from 24 15-degree arc sectors between 24 and 136 km from center in tropical cyclone's cloud region – mean of each arc sector calculated and then used to calculate arc sector average)	string
coldest_warmest_cloud_temperature	float	***num_structures*** = ***unlimited***	long_name	coldest cloud top temperature among warmest cloud top temperatures in 2 km wide cyclone centered concentric rings	string
			standard_name	brightness_temperature_at_cloud_top	string
			_FillValue	99.99	float
			valid_range	-100.0 40.0	float
			units	degrees_C	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: minimum (interval: 2 km comment: geolocated/not missing pixels between 24 and 136 km at a concentric ring's coldest, warmest brightness temperature relative to tropical cyclone center)	string
			ancillary_variables	coldest_warmest_distance_to_storm_center	string
coldest_warmest_distance_to_storm_center	float	***num_structures*** = ***unlimited***	long_name	distance between cyclone center and coldest cloud top temperature among warmest cloud top temperatures in 2 km wide cyclone centered concentric rings	string
			_FillValue	0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			valid_range	24.0 136.0	float
			units	km	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: mean (interval: 2 km comment: distance somewhere between 24 and 136 km defined by a 2 km wide concentric ring's coldest, warmest brightness temperature and tropical cyclone center)	string
cloud_symmetry_temperature	float	***num_structures* = *unlimited***	long_name	average temperature difference between opposing 15 degree arc sectors in cloud region annulus centered at tropical cyclone center	string
			_FillValue	0	float
			units	degrees_C	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: mean (interval: 2 km comment: difference of geolocated/not missing pixels from opposing 15-degree arc sectors between 24 and 136 km from center in tropical cyclone's cloud region – mean of each arc sector calculated and then used to calculate mean difference of 12 opposing arc sectors)	string
dvorak_EIR_rule_8_flag	int	***num_structures* = *unlimited***	long_name	advanced Dvorak technique rule 8 flag constrains intensity change as a function of type of cyclone, time since last intensity estimate occurred, and its most recently calculated intensity and age	string
			_FillValue	-999	int
			valid_range	0 34	int
			units	1	string
			coordinates	cyclone_identifier observation_time	string
			cell_methods	observation_time: point	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
dvorak_EIR_rule_9_flag	int	***num_structures* = *unlimited***	long_name	advanced Dvorak technique rule 9 flag indicates whether Dvorak weakening rules are applied to dampen unrealistic	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
				fluctuations in intensity for cyclones that have reached maximum strength and are beginning to dissipate	
			_FillValue	-999	int
			valid_range	0 2	int
			units	1	string
			coordinates	cyclone_identifier observation_time	string
			cell_methods	observation_time: point	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
rapid_dissipation_flag	int	***num_structures = unlimited***	long_name	advanced Dvorak technique rapid dissipation flag, whose value is assigned based on variations in intensity of tropical cyclone over the previous 6 hours, governs application of Dvorak weakening rules	string
			_FillValue	-999	int
			valid_range	0 3	int
			units	1	string
			coordinates	cyclone_identifier observation_time	string
			cell_methods	observation_time: point	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
eye_fft	int	***num_structures = unlimited***	long_name	number of harmonics detected by Fast Fourier Transform (FFT) operating on brightness temperature of pixels in tropical cyclone's eye region. Each harmonic corresponds to a single cosine wave at a different frequency. FFT used to approximate brightness temperature histogram for eye region. Larger value indicate more harmonics and less uniform temperature scene in eye region	string
			_FillValue	-999	int
			valid_range	0 15	int
			units	count	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels 0 – 24 km from tropical cyclone center)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
cloud_fft	int	***num_structures*** = ***unlimited***	long_name	number of harmonics detected by Fast Fourier Transform (FFT) operating on brightness temperature of pixels in tropical cyclone's cloud region. Each harmonic corresponds to a single cosine wave at a different frequency. FFT used to approximate brightness temperature histogram for eye region. Larger value indicate more harmonics and less uniform temperature scene in cloud region	string
			_FillValue	-999	int
			valid_range	0 15	int
			units	count	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels between 24 and 136 km from cyclone center in tropical cyclone's cloud region)	string
curved_band_gray_scale	int	***num_structures*** = ***unlimited***	long_name	Basic Dvorak (BD) gray scale enhancement category for tropical cyclone curved band cloud region scene type, which is used to determine curvature extent of convective cloud region around tropical cyclone's center	string
			_FillValue	-999	int
			valid_range	0 8	int
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	curved_band_curvature	string
curved_band_curvature	int	***num_structures*** = ***unlimited***	long_name	amount of curvature in Curved Band Gray Scale analysis region, which is used to determine intensity based on premise that greater curvature corresponds to more intense tropical cyclones	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999	int
			valid_range	0 25	int
			units	1	string
			coordinates	cyclone_identifier hi_band_id hi_band_wavelength observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (interval: 2 km comment: geolocated/not missing pixels associated with tropical cyclone)	string
fix_method	int	***num_structures* = *unlimited***	long_name	automated method used to locate tropical cyclone center	string
			_FillValue	-999	int
			valid_range	1 6	int
			units	1	string
			coordinates	cyclone_identifier observation_time	string
			cell_methods	observation_time: point	string
			flag_values	***see note [flags and meanings]***	string
			flag_meanings	***see note [flags and meanings]***	string
passive_microwave_eye_score	float	***num_structures* = *unlimited***	long_name	passive microwave eye score with zero indicating no eye wall and larger values indicating increasingly stronger eye wall	string
			_FillValue	-99	float
			valid_range	0.0 100.0	float
			units	1	string
			coordinates	cyclone_identifier observation_time storm_center_lat storm_center_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: point area: sum (1 – 160 km from tropical cyclone center)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	observation_time lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: sum area: sum (uncorrectable GRB errors only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	observation_time lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	observation_time: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_brightness_temperature_band_13_2km_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_dynamic_ancillary_tropical_cyclone_forecast_file_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			Input_dynamic_ancillary_passive_microwave_eye_score_data	***refer to filename conventions for L2+ products in Appendix A.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region extent variable and attribute values are located in paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.18.6.1, Hurricane Intensity Product Flag Values and Meanings.

5.18.6.1 Hurricane Intensity Product Flag Values and Meanings

Table 5.18.6.1-1 Hurricane Intensity Product Land Ocean Flag Values and Meanings

Land Ocean Flags (land_ocean_flag)	
Flag Value	**Flag Meaning**
1	cyclone_over_land
2	cyclone_over_ocean

Table 5.18.6.1-2 Hurricane Intensity Product Eye Scene Type Flag Values and Meanings

Eye Scene Type Flags (eye_scene_type)

flag_values	flag_meanings
0	clear_ragged_or_obscured_eye
1	pinhole_eye
2	large_eye
3	no_eye

Table 5.18.6.1-3 Hurricane Intensity Product Cloud Scene Type Flag Values and Meanings

Cloud Scene Type Flags (cloud_scene_type)	
Flag Value	**Flag Meaning**
0	uniform_central_dense_overcast
1	embedded_center
2	irregular_central_dense_overcast
3	curved_band
4	shear

Table 5.18.6.1-4 Hurricane Intensity Product Dvorak EIR Rule 8 Flag Values and Meanings

Dvorak EIR Rule 8 Flags (dvorak_EIR_rule_8_flag)	
Flag Value	**Flag Meaning**
0	shear_scene_no_t_number_rate_of_change_constraint_with_6_hr_condition_window
1	shear_scene_t_number_rate_of_change_0.5_per_hr_when_prev_final_t_number_lt_4.0_with_6_hr_condition_window
2	shear_scene_t_number_rate_of_change_1.5_per_hr_with_6_hr_condition_window
3	shear_scene_t_number_rate_of_change_2.0_per_hr_when_prev_final_t_number_ge_4.0_with_12_hr_condition_window
4	shear_scene_t_number_rate_of_change_2.5_per_hr_when_prev_final_t_number_ge_4.0_with_18_hr_condition_window
5	shear_scene_t_number_rate_of_change_3.0_per_hr_when_prev_final_t_number_ge_4.0_with_24_hr_condition_window
8	shear_scene_t_number_rate_of_change_0.2_per_hr_when_prev_final_t_number_lt_4.0_with_6_hr_condition_window
9	shear_scene_t_number_rate_of_change_0.5_per_hr_with_6_hr_condition_window_and_1_hr_ocean_condition_window
10	eye_scene_no_t_number_rate_of_change_constraint_with_6_hr_condition_window
11	eye_scene_t_number_rate_of_change_0.5_per_hr_when_prev_final_t_number_lt_4.0_with_6_hr_condition_window
12	eye_scene_t_number_rate_of_change_1.5_per_hr_with_6_hr_condition_window
13	eye_scene_t_number_rate_of_change_2.0_per_hr_when_prev_final_t_number_ge_4.0_with_12_hr_condition_window
14	eye_scene_t_number_rate_of_change_2.5_per_hr_when_prev_final_t_number_ge_4.0_with_18_hr_condition_window
15	eye_scene_t_number_rate_of_change_3.0_per_hr_when_prev_final_t_number_ge_4.0_with_24_hr_condition_window
18	eye_scene_t_number_rate_of_change_0.2_per_hr_when_prev_final_t_number_lt_4.0_with_6_hr_condition_window
19	eye_scene_t_number_rate_of_change_0.5_per_hr_with_6_hr_condition_window_and_1_hr_ocean_condition_window
20	curved_band_or_CDO_or_embedded_ctr_scene_no_t_number_rate_of_change_constraint_with_6_hr_condition_window
21	curved_band_or_CDO_or_embedded_ctr_scene_t_number_rate_of_change_0.5_per_hr_when_prev_final_t_number_lt_4.0_with_6_hr_condition_window
22	curved_band_or_CDO_or_embedded_ctr_scene_t_number_rate_of_change_1.5_per_hr_with_6_hr_condition_window
23	curved_band_or_CDO_or_embedded_ctr_scene_t_number_rate_of_change_2.0_per_hr_when_prev_final_t_number_ge_4.0_with_12_hr_condition_window
24	curved_band_or_CDO_or_embedded_ctr_scene_t_number_rate_of_change_2.5_per_hr_when_prev_final_t_number_ge_4.0_with_18_hr_condition_window
25	curved_band_or_CDO_or_embedded_ctr_scene_t_number_rate_of_change_3.0_per_hr_when_prev_final_t_number_ge_4.0_with_24_hr_condition_window
28	curved_band_or_CDO_or_embedded_ctr_scene_t_number_rate_of_change_0.2_per_hr_when_prev_final_t_number_lt_4.0_with_6_hr_condition_window
29	curved_band_or_CDO_or_embedded_ctr_scene_t_number_rate_of_change_0.5_per_hr_with_6_hr_condition_window_and_1_hr_ocean_condition_window
30	microwave_adjustment_12_hr_interpolation
31	microwave_adjustment_initial
32	microwave_adjustment_on
33	microwave_adjustment_12_hr_holding_period

34	microwave_adjustment_off

Table 5.18.6.1-5 Hurricane Intensity Product Dvorak EIR Rule 9 Flag Values and Meanings

Dvorak EIR Rule 9 Flags (dvorak_EIR_rule_9_flag)	
Flag Value	**Flag Meaning**
0	dvorak_weakening_rules_apply
1	dvorak_weakening_rules_dont_apply
2	cyclone_initial_t_number_ge_6.0

Table 5.18.6.1-6 Hurricane Intensity Product Rapid Dissipation Flag Values and Meanings

Rapid Dissipation Flags (rapid_dissipation_flag)	
Flag Value	**Flag Meaning**
0	off_dont_apply_dvorak_weakening_rules
1	tripped_on_dont_apply_dvorak_weakening_rules
2	on_apply_dvorak_weakening_rules
3	tripped_off_apply_dvorak_weakening_rules

Table 5.18.6.1-7 Hurricane Intensity Product Curved Band Gray Scale Flag Values and Meanings

Curved Band Gray Scale Flags (curved_band_gray_scale)	
Flag Value	**Flag Meaning**
0	no_enhancement_low_clouds_brightness_temp_gt_9_degreesC
1	off_white_cirrus_outflow_pattern_brightness_temp_le_9_and_ge_-30_degreesC
2	dark_gray_brightness_temp_lt_-30_and_ge_-42_degreesC
3	medium_gray_brightness_temp_lt_-42_and_ge_-54_degreesC
4	light_gray_brightness_temp_lt_-54_and_ge_-64_degreesC
5	black_brightness_temp_lt_-64_and_ge_-70_degreesC
6	white_brightness_temp_lt_-70_and_ge_-76_degreesC
7	top_medium_gray_brightness_temp_lt_-76_and_ge_-80_degreesC
8	top_dark_gray_brightness_temp_lt_-80_degreesC

Table 5.18.6.1-8 Hurricane Intensity Product Fix Method Flag Values and Meanings

Fix Method Flags (fix_method)	
flag_values	**flag_meanings**
1	forecast_interpolation
4	spiral_analysis
5	ring_spiral_combination
6	extrapolation_using_cyclone_history

5.19 Fire (Hot Spot Characterization) Product

5.19.1 Description

The Fire (HSC) product contains four images, one in the form of a fire mask, and the other three with pixel values identifying fire temperature, fire area, and fire radiative power. Pixel values in the fire mask image identify a fire category and diagnostic information associated with algorithm execution. The six fire categories include:

- Good quality or temporally filtered good quality fire pixel
- Saturated fire pixel or temporally filtered saturated fire pixel
- Cloud contaminated or temporally filtered cloud contaminated fire pixel
- High probability or temporally filtered high probability fire pixel
- Medium probability or temporally filtered high probability fire pixel
- Low probability or temporally filtered high probability fire pixel

Temporally filtered fire pixels are those resulting from fire pixels that are in close proximity in both space and time.

The product includes data quality information that provides an assessment of fire detection for on-earth pixels, including an indication of good quality or invalid, and the rationale.

The units of measure for the Fire (HSC) product quantities are identified in Table 5.19.1-1 Fire (HSC) Product Quantities Units of Measure.

Table 5.19.1-1 Fire (HSC) Product Quantities Units of Measure

Fire Product Quantity	Units of Measure
Mask	dimensionless
Temperature	kelvin
Area	square kilometers
Radiative power	megawatts

The Fire (HSC) product image is produced on the ABI fixed grid at 2 km resolution for Full Disk and CONUS coverage regions. Product data is produced under the following conditions:

- existence of land
- geolocated source data to local zenith angles of 80 degrees, solar zenith angles between 10 and 180 degrees, and sunglint angles greater than 10 degrees

The Fire (HSC) performance requirements are summarized in Table 5.19.1-2, Fire (HSC) Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.19.1-2 Fire (HSC) Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy [2]**	**Precision [2]**	**Performance Conditions [3] [4]**	**Accuracy**
Full Disk & CONUS	(1) Fire 3.9 um brightness temperature: 275 to 400 K	(1) Fire 3.9 um brightness temperature: 2	(1) Fire 3.9 um brightness temperature: 2 degrees K	LZA ≤ 65 degrees [5]	1 km

	(2) Fire temperature: 600 to 1,200 degrees K (3) Fire area: 0.004 to 4 km^2 (4) Fire radiative power: 75 to 50,000 MW	degrees K within dynamic range			

[1] Requirements specify the measurement range for 3.9 um brightness temperature, which is not included in the product.
[2] Accuracy and precision requirements for fire area, temperature, and radiative power have not been specified. Instead the performance conditions are specified in terms of the 3.9 um brightness temperature.
[3] Conditions for good quality prescribed by the algorithm also include 10 ≤ SZA ≤ 180 degrees and sunglint angle > 10 degrees constraints.
[4] Thick cloud conditions preclude satisfaction of the performance requirements.
[5] Conditions for good quality prescribed by the algorithm are for LZA ≤ 80 degrees.

Metadata in the Fire (HSC) product provides statistical and other properties of the product images and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of pixels with fire detected, but fire temperature, area and radiative power not reported.
- Number of pixels with fire temperature and area reported, but radiative power not reported.
- Number of pixels with fire temperature, area, and radiative power reported.
- Number of fire temperature, fire area, and fire radiative power pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the values in the fire temperature, fire area, and fire radiative power product images.

The fire pixel count statistics are calculated using good quality fire pixels where the fire mask for these pixels indicate at least medium probability of fire. The fire temperature, fire area, and fire radiative power minimum, maximum, mean and standard deviation statistics are calculated using good quality fire pixels where the fire mask for these pixels indicate definite fire. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Fire (HSC) product is located in the standalone Appendix X, ISO Series Metadata.

5.19.2 Dynamic Source Data

The Fire (HSC) product is derived using unprocessed and processed ABI Level 1b reflective and emissive band images from the current observation. The algorithm uses intermediate product data from the previous execution of the Land Fire (HSC) algorithm. In addition, processed total precipitable water derived from the NWP model ancillary data is used. Furthermore, the algorithm uses dynamic auxiliary data, specifically solar zenith angle and solar azimuth angle data.

The primary sensor data used by the Land Fire (HSC) algorithm is identified in Table 5.19.2-1, Primary Sensor Data.

Table 5.19.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type

ABI L1b/L2+ Final Products	input_ABI_L1b_radiance_band_7_2km_data input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_reflectance_band_2_2km_data

The other dynamic source data inputs are summarized in Table 5.19.2-2, Other Dynamic Source Data.

Table 5.19.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_time_of_last_fire_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_NWP_total_precipitable_water_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sunglint_angle_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.19.3 Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GOES-R ABI Land Fire (HSC) ground processing algorithm:

- Algorithm-specific parameters
- Common library parameters
- Gridded parameters

The algorithm-specific parameters represent parameters unique to the Fire/Hot Spot Characterization algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These parameters include:

- Initialization parameters.
- Qualification thresholds based on local zenith angle, solar zenith angle, solar glint, and input brightness temperatures.
- Parameters and thresholds associated with cloud tests, background statistics and contextual tests.
- Parameters and thresholds applied in atmospheric correction (e.g., atmospheric transmission, semi-transparent clouds and smoke, etc.) and post-correction tests.
- Look-up table for bands 7 and 14 transmittance and absorption, including total precipitable water and satellite zenith angle dependencies, used in the correction radiances for water vapor attenuation.
- Parameters for computation of fire area and temperature, and fire power including minimum valid pixel proportion and convergence threshold and maximum iterations.
- Additional test thresholds, false alarm thresholds, confidence test thresholds, and parameters applied in temporal filtering.
- Minimum/maximum valid range / outlier limits for fire temperature, area, and power.

The common library parameters shared across multiple algorithms are used by the Fire/Hot Spot Characterization algorithm. These parameters include:

- Physical constants used in brightness temperature computations.
- Scale factors to convert L1b input pixel radiance values from scaled integers to floating point values.

The categories of gridded parameters used in the generation of the Fire (HSC) product are projection and mapping, and earth surface classifications and characteristics. The specific types of gridded semi-static source data in the categories used in the generation of the Fire (HSC) product are identified in Table 5.19.3 Gridded Semi-Static Source Data.

Table 5.19.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_land_sea_mask_data input_ABI_L2_slot_specific_semi_static_desert_mask_data input_ABI_L2_slot_specific_semi_static_ecosystem_mask_data input_ABI_L2_slot_specific_semi_static_surface_type_mask_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- Fire_Parameters.bin

5.19.4 Coordinates

The coordinates associated with data variables in the Fire (HSC) product are identified in Table 5.19.4 Fire (HSC) Product Coordinates.

Table 5.19.4 Fire (HSC) Characterization Product Coordinates

Fire (HSC) Product Data Quantity	Coordinates
fire mask data	• Observation time period
fire temperature data	
fire radiative power data	

fire area data	• N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production • Sunglint angle range for no data production
fire data quality flags	
fire pixels detected count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production • Sunglint angle range for no data production
fire pixels with temperature and area reported count	
fire pixels with radiative power reported count	
fire temperature outlier pixel count	
fire area outlier pixel count	
fire radiative power outlier pixel count	
fire temperature minimum, maximum, mean, and standard deviation values	
fire area minimum, maximum, mean, and standard deviation values	
fire radiative power minimum, maximum, mean, and standard deviation values	
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.19.5 Production Notes

The Fire (HSC) product is generated by the GOES-R ABI Land Fire (HSC) ground processing algorithm. The Fire algorithm is a dynamic multispectral thresholding algorithm that uses the differences in sensitivity to high temperature sub pixel anomalies of ABI bands 7 and 14, with central wavelengths of 3.9 and 11.2 um, respectively. The algorithm consists of a series of screening tests, threshold tests, and calculations that are applied to each pixel. Estimates of sub pixel fire area, temperature, and power are computed based on a screening. Additionally, subsequent analysis can introduce additional fire pixels in the fire mask for which fire properties are not derived from the source ABI data. Pixels in the product images with out of range values are assigned the minimum or maximum value in the valid range. Reflectance for band 2 and brightness temperature for band 15 are used in cloud tests but are not required to detect fires. The algorithm maintains "time of last fire" intermediate data for each pixel that is used and updated for each execution of the algorithm.

The algorithm makes use of resampled ABI Level 1b product data. This potentially has implications to product quality. The ABI Sample Outlier Data described in the Level 1b volume of the PUG provides the capability to evaluate these product quality implications during operations.

The Land Fire (HSC) algorithm final and intermediate product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Land Fire (HSC) ground processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Land Fire (HSC). This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/baseline-fire-hot-spot-v2.0.pdf

5.19.6 Data Fields

The Fire (HSC) product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Fire (HSC) product are located in Appendix A.

Table 5.19.6-1 Fire (HSC): Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	String
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	b015d6f0-b002-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Fire – Hot Spot Characterization	string
summary	The Fire – Hot Spot Characterization product consists of a fire mask identifying pixels as one of many fire, non-fire, and obstructed view categories. In addition, the product consists of fire temperature,radiative power, and area for valid fire pixels that satisfy specific criteria. This product is generated by utilizing differences in emissive bands with wavelengths 3.9 and 11.2 um to high temperature sub pixel anomalies. Product data is generated both day and night.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	HUMAN DIMENSIONS > NATURAL HAZARDS > FIRES	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	String
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String

timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	***possible values are Full Disk and CONUS.***	String
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.19.6-2 Fire (HSC): Variables

Name	Type	Shape	Name	Value	Type
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
sunglint_angle ***value = 10.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the direction of the beam of incident solar radiation for good quality fire-hot spot characterization data production	string
			standard_name	sunglint_angle	string
			units	degree	string
			bounds	sunglint_angle_bounds	string
sunglint_angle_bounds ***value = 0.0 10.0***	float	number_of_sunglint_angle_bounds = 2	long_name	sunglint angle degree range where fire-hot spot characterization data is not produced	string

Name	Type	Shape	Name	Value	Type
local_zenith_angle ***value = 80.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality fire-hot spot characterization data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	local_zenith_angle_bounds	string
local_zenith_angle _bounds ***value = 0.0 80.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality fire-hot spot characterization data is produced	string
solar_zenith_angle ***value = 10.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality fire-hot spot characterization data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle _bounds ***value = 10.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality fire-hot spot characterization data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double

Name	Type	Shape	Name	Value	Type
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
Mask	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Fire – Hot Spot Characterization: Fire Mask	string
			_FillValue	-99	short
			valid_range	10 245	short
			units	1	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: point (no pixel produced) local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			flag_values	***see note [flags and meanings]***	short
			flag_meanings	***see note [flags and meanings]***	string
			ancillary_variables	DQF Temp Power	string
			number_of_fire_categories	6	byte
			percent_good_fire_pixel_or_temporally_filtered_good_fire_pixel	***dynamic value***	float
			percent_saturated_fire_pixel_or_temporally_filtered_saturated_fire_pixel	***dynamic value***	float
			percent_cloud_contaminated_fire_pixel_or_temporally_filtered_cloud_contaminated_fire_pixel	***dynamic value***	float
			percent_high_probability_fire_pixel_or_temporally_filtered_high_probability_fire_pixel	***dynamic value***	float

Name	Type	Shape	Name	Value	Type
			percent_medium_probability_fire_pixel_or_temporally_filtered_medium_probability_fire_pixel	***dynamic value***	float
			percent_low_probability_fire_pixel_or_temporally_filtered_low_probability_fire_pixel	***dynamic value***	float
			invalid_fire_MODIS_land_mask_types_definition	shallow ocean, ocean coastlines and lake shorelines, deep or shallow inland water, or moderate, continental, or deep ocean	string
Temp	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Fire-Hot Spot Characterization: Fire Temperature	string
			standard_name	fire_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00915611	float
			add_offset	600	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_measures	area: Area	string
			cell_methods	sunglint_angle: point (no pixel produced) local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point	string
			ancillary_variables	DQF	string
Power	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Fire-Hot Spot Characterization: Fire Radiative Power	string
			standard_name	fire_radiative_power	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.7618648	float
			add_offset	75	float
			units	MW	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y x	string

Name	Type	Shape	Name	Value	Type
			grid_mapping	goes_imager_projection	string
			cell_measures	area: Area	string
			cell_methods	sunglint_angle: point (no pixel produced) local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point	string
			ancillary_variables	DQF	string
Area	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Fire-Hot Spot Characterization: Fire Area	string
			standard_name	fire_area	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00006098	float
			add_offset	0.004	float
			units	km2	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: point (no pixel produced) local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Fire – Hot Spot Characterization data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 5	byte
			units	1	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: point (no retrieval) local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	6	byte
			percent_good_quality_ fire_pixel_qf	***dynamic value***	float
			percent_good_fire_free _land_pixel_qf	***dynamic value***	float

Name	Type	Shape	Name	Value	Type
			percent_invalid_due_to_opaque_cloud_pixel_qf	***dynamic value***	float
			percent_invalid_due_to_surface_type_or_sunglint_or_LZA_threshold_exceeded_or_off_earth_or_missing_input_data_qf	***dynamic value***	float
			percent_invalid_due_to_bad_input_data_qf	***dynamic value***	float
			percent_invalid_due_to_algorithm_failure_qf	***dynamic value***	float
total_number_of_pixels_with_fires_detected	int	n/a	long_name	total number of pixels with fires detected	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality fire pixels only) where fire over land	string
total_number_of_pixels_with_fire_temperature_and_area	int	n/a	long_name	total number of pixels with fire temperature and area reported	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
total_number_of_pixels_with_fire_radiative_power	int	n/a	long_name	total number of pixels with fire radiative power reported	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string

Name	Type	Shape	Name	Value	Type
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel, high_probability_fire_pixel, medium_probability_fire_pixel, temporally_filtered_good_fire_pixel, temporally_filtered_high_probability_fire_pixel, or temporally_filtered_medium_probability_fire_pixel where adjacent region has sufficient non-fire, clear pixels only) where fire over land	string
fire_temperature_outlier_pixel_count	int	n/a	long_name	number of pixels with fire temperature reported whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel whose values are outside valid measurement range only) where fire over land	string
fire_area_outlier_pixel_count	int	n/a	long_name	number of pixels with fire area reported whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel whose values are outside valid measurement range only) where fire over land	string

Name	Type	Shape	Name	Value	Type
fire_radiative_power_outlier_pixel_count	int	n/a	long_name	number of pixels with fire radiative power reported whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel, high_probability_fire_pixel, medium_probability_fire_pixel, temporally_filtered_good_fire_pixel, temporally_filtered_high_probability_fire_pixel, or temporally_filtered_medium_probability_fire_pixel where adjacent region has sufficient non-fire, clear pixels whose values are outside valid measurement range only) where fire over land	string
minimum_fire_temperature	float	n/a	long_name	minimum fire temperature	string
			standard_name	fire_temperature	string
			_FillValue	-999	float
			valid_range	600.0 1200.0	float
			units	K	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
maximum_fire_temperature	float	n/a	long_name	maximum fire temperature	string
			standard_name	fire_temperature	string
			_FillValue	-999	float
			valid_range	600.0 1200.0	float
			units	K	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
mean_fire_temperature	float	n/a	long_name	mean fire temperature	string
			standard_name	fire_temperature	string
			_FillValue	-999	float
			valid_range	600.0 1200.0	float
			units	K	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
standard_deviation_fire_temperature	float	n/a	long_name	standard deviation of fire temperature values	string
			standard_name	fire_temperature	string
			_FillValue	-999	float
			units	K	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
minimum_fire_area	float	n/a	long_name	minimum fire area	string
			standard_name	fire_area	string
			_FillValue	-999	float
			valid_range	0.004 4.0	float
			units	km2	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
maximum_fire_area	float	n/a	long_name	maximum fire area	string
			standard_name	fire_area	string
			_FillValue	-999	float
			valid_range	0.004 4.0	float
			units	km2	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
mean_fire_area	float	n/a	long_name	mean fire area	string
			standard_name	fire_area	string
			_FillValue	-999	float
			valid_range	0.004 4.0	float
			units	km2	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
standard_deviation_fire_area	float	n/a	long_name	standard deviation of fire area values	string
			standard_name	fire_area	string
			_FillValue	-999	float
			units	km2	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Name	Type	Shape	Name	Value	Type
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel or temporally_filtered_good_fire_pixel only) where fire over land	string
minimum_fire_radiative_power	float	n/a	long_name	minimum fire radiative power	string
			standard_name	fire_radiative_power	string
			_FillValue	-999	float
			valid_range	75.0 50000.0	float
			units	MW	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel, high_probability_fire_pixel, medium_probability_fire_pixel, temporally_filtered_good_fire_pixel, temporally_filtered_high_probability_fire_pixel, or temporally_filtered_medium_probability_fire_pixel where adjacent region has sufficient non-fire, clear pixels only) where fire over land	string
maximum_fire_radiative_power	float	n/a	long_name	maximum fire radiative power	string
			standard_name	fire_radiative_power	string
			_FillValue	-999	float
			valid_range	75.0 50000.0	float
			units	MW	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel, high_probability_fire_pixel, medium_probability_fire_pixel, temporally_filtered_good_fire_pixel, temporally_filtered_high_probability_fire_pixel, or fire	string

Name	Type	Shape	Name	Value	Type
				temporally_filtered_medium_probability_fire_pixel where adjacent region has sufficient non-fire, clear pixels only) where fire over land	
mean_fire_radiative_power	float	n/a	long_name	mean fire radiative power	string
			standard_name	fire_radiative_power	string
			_FillValue	-999	float
			valid_range	75.0 50000.0	float
			units	MW	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel, high_probability_fire_pixel, medium_probability_fire_pixel, temporally_filtered_good_fire_pixel, temporally_filtered_high_probability_fire_pixel, or temporally_filtered_medium_probability_fire_pixel where adjacent region has sufficient non-fire, clear pixels only) where fire over land	string
standard_deviation_fire_radiative_power	float	n/a	long_name	standard deviation of fire radiative power values	string
			standard_name	fire_radiative_power	string
			_FillValue	-999	float
			units	MW	string
			coordinates	sunglint_angle local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	sunglint_angle: sum (no pixel produced) local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality fire pixels with fire mask values of good_fire_pixel, high_probability_fire_pixel, medium_probability_fire_pixel, temporally_filtered_good_fire_pixel, temporally_filtered_high_probability_fire_pixel, or temporally_filtered_medium_probability_fire_pixel where adjacent region has sufficient non-fire, clear pixels only) where fire over land	string

Name	Type	Shape	Name	Value	Type
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float

Name	Type	Shape	Name	Value	Type
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_auxiliary_sunglint_angle_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L1b_radiance_band_7_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_time_of_last_fire_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.19.6.1, Fire (HSC) Product Flag Values and Meanings.

5.19.6.1 Fire (HSC) Product Flag Values and Meanings

Table 5.19.6.1-1 Fire (HSC) Product Fire Mask Flag Values and Meanings

Fire Mask (Mask)	
Flag Value	**Flag Meaning**
10	good_fire_pixel
11	saturated_fire_pixel
12	cloud_contaminated_fire_pixel
13	high_probability_fire_pixel
14	medium_probability_fire_pixel
15	low_probability_fire_pixel
30	temporally_filtered_good_fire_pixel
31	temporally_filtered_saturated_fire_pixel
32	temporally_filtered_cloud_contaminated_fire_pixel
33	temporally_filtered_high_probability_fire_pixel
34	temporally_filtered_medium_probability_fire_pixel
35	temporally_filtered_low_probability_fire_pixel
40	off_earth_pixel
50	LZA_block_out_zone
60	SZA_or_glint_angle_block_out_zone
100	processed_no_fire_pixel
120	missing_input_3.9um_pixel
121	missing_input_11.2um_pixel
123	saturated_input_3.9um_pixel
124	saturated_input_11.2um_pixel
125	invalid_input_radiance_value
126	below_threshold_input_3.9um_pixel
127	below_threshold_input_11.2um_pixel
150	invalid_ecosystem_UMD_land_cover_type_sea_water_or_MODIS_land_mask_types_or_framework_desert_mask_type_bright_desert
151	invalid_ecosystem_USGS_type_sea_water
152	invalid_ecosystem_USGS_types_coastline_fringe_or_compound_coastlines
153	invalid_ecosystem_USGS_types_inland_water_or_water_and_island_fringe_or_land_and_water_shore_or_land_and_water_rivers
170	no_background_value_could_be_computed
180	conversion_error_between_BT_and_radiance
182	conversion_error_radiance_to_adjusted_BT
185	modified_Dozier_technique_bisection_method_invalid_computed_BT
186	524urfaces_Dozier_technique_Newton_method_invalid_computed_radiance
187	524urfaces_Dozier_technique_Newton_method_invalid_computed_fire_brighness_temp

Fire Mask (Mask)	
Flag Value	**Flag Meaning**
188	525urfaces_Dozier_technique_Newton_method_invalid_computed_fire_area
200	cloud_pixel_detected_by_11.2um_threshold_test
205	cloud_pixel_detected_by_negative_difference_3.9um_minus_11.2um_threshold_test
210	cloud_pixel_detected_by_positive_difference_3.9um_minus_11.2um_threshold_test
215	cloud_pixel_detected_by_albedo_threshold_test
220	cloud_pixel_detected_by_12.3um_threshold_test
225	cloud_pixel_detected_by_negative_difference_11.2um_minus_12.3um_threshold_test
230	cloud_pixel_detected_by_positive_difference_11.2um_minus_12.3um_threshold_test
240	cloud_edge_pixel_detected_by_along_scan_reflectivity_and_3.9um_threshold_test
245	cloud_edge_pixel_detected_by_along_scan_reflectivity_and_albedo_threshold_test

Table 5.19.6.1-2 Fire (HSC) Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_quality_fire_pixel_qf
1	good_quality_fire_free_land_pixel_qf
2	invalid_due_to_opaque_cloud_pixel_qf
3	invalid_due_to_surface_type_or_sunglint_or_LZA_threshold_exceeded_or_off_earth_or_missing_input_data_qf
4	invalid_due_to_bad_input_data_qf
5	invalid_due_to_algorithm_failure_qf

5.20 Land Surface (Skin) Temperature Product

5.20.1 Description

The Land Surface (Skin) Temperature product contains an image with pixel values identifying the instantaneous land surface skin temperature or surface "radiometric" temperature. Measured from the perspective of the satellite, the product is limited to clear conditions over land and represents the effective land temperature over an isothermal mixed pixel. The product includes data quality information that provides an assessment of the quality of the algorithm retrievals for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the land surface (skin) temperature value are "kelvin".

The Land Surface (Skin) Temperature product image is produced on the ABI fixed grid at 10 km resolution for Full Disk and 2 km resolution for CONUS and Mesoscale coverage regions. Product data is produced under the following conditions:

- existence of land
- clear sky
- geolocated source data to local zenith angles of 85 degrees for both daytime and nighttime conditions

The Land Surface (Skin) Temperature performance requirements are summarized in Table 5.20.1, Land Surface (Skin) Temperature Performance Requirements. Good quality retrievals as prescribed by the algorithm are those that satisfy the measurement range and performance conditions identified therein except as noted.

Table 5.20.1 Land Surface Temperature Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk, CONUS, & Mesoscale	213 to 330 K	2.5 K with known surface emissivity, known atmospheric correction, and 80% band correlation; 5 K otherwise	2.3 K	LZA ≤ 70 degrees clear sky	Full Disk: 5 km CONUS: 1 km Mesoscale: 1 km

[1] Valid measurement range prescribed by the algorithm is 213 to 330 K.

Metadata in the Land Surface (Skin) Temperature product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of good retrievals.
- Number of good retrievals where valid land surface (skin) temperature data is determined.
- Number of land surface (skin) temperature pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the land surface (skin) temperature values in the product image.

These statistics are calculated using pixels with good retrievals and a local zenith angle to 85 degrees. The percentages of pixels assigned to each retrieval quality value are also included in the product.

The detailed description of the ISO series metadata for the Land Surface (Skin) Temperature product is located in the standalone Appendix X, ISO Series Metadata.

5.20.2 Dynamic Source Data

The Land Surface (Skin) Temperature product is derived using processed ABI Level 1b emissive band images from the current observation. The algorithm uses final and intermediate product data generated by the Legacy Atmospheric Profiles, Cloud Mask, and Snow Cover algorithms. Processed global snow and ice cover data derived from the NSIDC ancillary data is used. In addition, processed total precipitable water data derived from the NWP model ancillary data is used. Furthermore, the algorithm uses dynamic auxiliary data, specifically solar zenith angle data.

The primary sensor data used by the Land Surface (Skin) Temperature algorithm is identified in Table 5.20.2-1, Primary Sensor Data.

Table 5.20.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Product	input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data

The other dynamic source data inputs are summarized in Table 5.20.2-2, Other Dynamic Source Data.

Table 5.20.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Products	input_ABI_L2_total_precipitable_water_data
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_binary_snow_mask_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_global_snow_mask_data input_dynamic_ancillary_NWP_total_precipitable_water_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.20.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Land Surface (Skin) Temperature ground-processing algorithm:

- Algorithm-specific parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Land Surface Temperature algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Qualification thresholds based on local zenith angle
- Thresholds and limits for day/night and water vapor characterization
- Regression coefficient look-up table
- Total precipitable water conversion factor
- Thresholds on land surface temperature and local zenith angle used in setting product quality
- Spatial aggregation parameters
- Minimum/maximum valid range / outlier limits on land surface temperature

The categories of gridded parameters used in the generation of the Land Surface Temperature product are projection and mapping, earth surface classifications and characteristics, and seasonal. The specific types of gridded semi-static source data in the categories used in the generation of the Land Surface Temperature product are identified in Table 5.20.3 Gridded Semi-Static Source Data.

Table 5.20.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_land_sea_mask_data
Seasonal	input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_14_data input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_15_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- LST_ABI_Parameters.bin

5.20.4 Coordinates

The coordinates associated with data variables in the Land Surface (Skin) Temperature product are identified in Table 5.20.4, Land Surface (Skin) Temperature Product Coordinates.

Table 5.20.4 Land Surface (Skin) Temperature Product Coordinates

Land Surface (Skin) Product Data Quantity	Coordinates
land surface (skin) temperature data	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location
land surface (skin) temperature retrieval quality flags	

Land Surface (Skin) Product Data Quantity	Coordinates
	• Local zenith angle ranges for good, and good or degraded quality data production • Solar zenith angle range for good quality data production
attempted retrieval count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle ranges for good or degraded quality data production • Solar zenith angle range for good quality data production
good retrieval count	
land surface (skin) temperature outlier pixel count	
land surface (skin) temperature minimum, maximum, mean, and standard deviation values	
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.20.5 Production Notes

The Land Surface (Skin) Temperature product is generated by the GOES-R ABI Land Surface (Skin) Temperature ground processing algorithm. This product is generated using a regression algorithm based on ABI brightness temperatures and brightness temperature differences for ABI thermal infrared bands 14 and 15 with central wavelengths of 11.2 and 12.3 um, respectively and on semi-static surface emissivity data. The algorithm applies different regression coefficients for dry or moist atmospheric conditions as determined from the Total Precipitable Water product or the NWP total precipitable water dynamic processed ancillary data. The 10 km resolution Total Precipitable Water product is up scaled to 2 km using nearest neighbor to support the retrieval.

Clear sky is determined using clear and probably clear pixels indicated in the temporally coincident intermediate 4-level cloud mask generated by the Cloud Mask algorithm. The Land Surface (Skin) Temperature algorithm operates on 2 km resolution pixels and generates products at this resolution for CONUS and Mesoscale coverage regions, and aggregates the retrieved land surface temperatures to 10 km resolution for the Full Disk coverage region. Pixels in the product image with out-of-range values are assigned the minimum or maximum value in the valid range.

The algorithm generates product quality information flags that identify the conditions associated with the retrievals, including time of day and earth surface type. The Land Surface (Skin) Temperature algorithm final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Land Surface (Skin) Temperature ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Land Surface Temperature. This document is located at http://www.goes-r.gov/products/ATBDs/baseline/baseline-LST-v2.0.pdf.

5.20.6 Data Fields

The Land Surface (Skin) Temperature product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Land Surface (Skin) Temperature product are located in Appendix A.

Table 5.20.6-1 Land Surface (Skin) Temperature: Global Attributes

Global AttributeName	Value	Type
id	***attribute is added dynamically when the file is created.***	String
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	f22c3310-b00a-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Land Surface (Skin) Temperature	string
summary	The Land Surface (Skin) Temperature product consists of pixels containing the skin temperatures for each 'clear' or 'probably clear' land surface pixel. This product is generated from a regression algorithm that linearly combines ABI surface emissivity data, brightness temperature, and brightness temperature differences derived from top of atmosphere radiances from ABI bands with wavelengths 11.2 and 12.3 um. Product data is generated both day and night.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	LAND SURFACE > LAND TEMPERATURE > LAND SURFACE TEMPERATURE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	String

production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	String
spatial_resolution	***possible values are 10km at nadir for Full Disk, and 2km at nadir for CONUS and Mesoscale.***	String
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.20.6-2 Land Surface (Skin) Temperature: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 85.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality land surface (skin) temperature data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality land surface (skin) temperature data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 85.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality land surface (skin) temperature data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality land surface (skin) temperature data is produced	string
solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality land surface (skin) temperature data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	solar_zenith_angle_bounds	string
solar_zenith_angle_bounds ***value = 0.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality land surface (skin) temperature data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
LST	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Land Surface (Skin) Temperature	string
			standard_name	surface_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	6310 63103	short
			scale_factor	0.00206013	float
			add_offset	200	float
			units	K	string
			resolution	y: ***see note [2]*** rad x: ***see note [2]*** rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) solar_zenith_angle: point (good quality pixel produced) t: point area: point where land	string
			ancillary_variables	DQF	string
DQF	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Land Surface (Skin) Temperature data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 40	short

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	short
			flag_values	***see note [flags and meanings]***	short
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	11	byte
			percent_good_retrieval_qf	***dynamic value***	float
			percent_valid_input_data_qf	***dynamic value***	float
			percent_invalid_due_to_bad_or_missing_input_data_qf	***dynamic value***	float
			percent_valid_clear_conditions_qf	***dynamic value***	float
			percent_invalid_due_to_cloudy_conditions_qf	***dynamic value***	float
			percent_valid_LZA_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_valid_land_or_inland_water_surface_type_qf	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			percent_invalid_due_to_water_surface_type_qf	***dynamic value***	float
			percent_valid_land_surface_temperature_qf	***dynamic value***	float
			percent_invalid_due_to_out_of_range_land_surface_temperature_qf	***dynamic value***	float
			good_retrieval_qf_definition	clear sky land or inland water surface type pixel with valid input data	string
total_pixels_where_lst_is_retrieved	int	n/a	long_name	number of pixels where land surface temperature is retrieved	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: ***see note [2]*** rad comment: good retrieval pixels only) where clear_sky over land	string
number_good_retrievals	int	n/a	long_name	number of good retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: ***see note [2]*** rad comment: good retrieval pixels with land surface temperature in valid range only) where clear_sky over land	string
outlier_pixel_count	int	n/a	long_name	number of land surface temperature pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: sum (interval: ***see note [2]*** rad comment: number of good retrieval pixels whose values are outside valid measurement range only) where clear_sky over land	string
min_lst	float	n/a	long_name	minimum land surface temperature	string
			standard_name	surface_temperature	string
			_FillValue	-999	float
			valid_range	213.0 330.0	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: minimum (interval: ***see note [2]*** rad comment: good retrieval pixels only) where clear_sky over land	string
max_lst	float	n/a	long_name	maximum land surface temperature	string
			standard_name	surface_temperature	string
			_FillValue	-999	float
			valid_range	213.0 330.0	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: maximum (interval: ***see note [2]*** rad comment: good retrieval pixels only) where clear_sky over land	string
mean_lst	float	n/a	long_name	mean land surface temperature	string
			standard_name	surface_temperature	string
			_FillValue	-999	float
			valid_range	213.0 330.0	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: mean (interval: ***see note [2]*** rad comment: good retrieval pixels only) where clear_sky over land	string
standard_deviation_lst	float	n/a	long_name	standard deviation of land surface temperature values	string
			standard_name	surface_temperature	string
			_FillValue	-999	float
			units	K	string
			coordinates	retrieval_local_zenith_angle solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum solar_zenith_angle: sum t: sum area: standard_deviation (interval: ***see note [2]*** rad comment: good retrieval pixels only) where clear_sky over land	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_binary_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.
Note 2: Possible values for y, x, and interval are 0.000280 for Full Disk and 0.000056 for CONUS and Mesoscale.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.20.6.1, Land Surface (Skin) Temperature Product Flag Values and Meanings.

5.20.6.1 Land Surface (Skin) Temperature Product Flag Values and Meanings

Table 5.20.6.1 Land Surface (Skin) Temperature Product Retrieval Quality Flag Values and Meanings

Retrieval Quality Flags (DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
22	0	good_retrieval_qf
2	0	valid_input_data_qf
2	2	invalid_due_to_bad_or_missing_input_data_qf
4	0	valid_clear_conditions_qf

4	4	invalid_due_to_cloudy_conditions_qf
8	0	valid_LZA_qf
8	8	degraded_due_to_LZA_threshold_exceeded_qf
16	0	valid_land_or_inland_water_surface_type_qf
16	16	invalid_due_to_water_surface_type_qf
32	0	valid_land_surface_temperature_qf
32	32	invalid_due_to_out_of_range_land_surface_temperature_qf

5.21 Snow Cover Product

5.21.1 Description

The Snow Cover product contains an image with pixel values identifying the fraction of their areas covered by snow. The product includes data quality information that provides an assessment of the snow cover data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the snow cover value are "percent".

The Snow Cover product image is produced on the ABI fixed grid at 2 km resolution for Full Disk, CONUS and Mesoscale coverage regions. Product data is produced under the following conditions:

- existence of land
- clear sky
- geolocated source data to local zenith angles of 90 degrees and solar zenith angles of 90 degrees

The Snow Cover performance requirements are summarized in Table 5.21.1, Snow Cover Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.21.1 Snow Cover Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk, CONUS, & Mesoscale	0 to 1 (0 to 100%)	0.30 (30%)	0.15 (15%)	LZA ≤ 55 degrees [1] SZA ≤ 67 degrees [2] clear sky	1 km

[1] Conditions for good quality prescribed by the algorithm are for LZA ≤ 67.5 degrees.
[2] Conditions for good quality prescribed by the algorithm are for SZA ≤ 67.5 degrees.

Metadata in the Snow Cover product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of snow cover pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the snow cover values in the product image.
- Minimum, maximum, mean, and standard deviation of the root mean square difference between the observed surface bidirectional reflectance values in ABI reflective bands 1, 2, 3, 5 and 6 with central wavelengths of 0.47, 0.64, 0.865, 1.61, and 2.25 um, and the corresponding modeled values derived from a multiple endmember mixing model values in the product image.

These statistics are calculated using good quality pixels. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Snow Cover product is located in the standalone Appendix X, ISO Series Metadata.

5.21.2 Dynamic Source Data

The Snow Cover product is currently derived using processed ABI Level 1b reflective band images from the current observation. The proper primary sensor source data is an intermediate product generated by the surface albedo algorithm, which is not available in the current GOES-R ground system's baseline. The algorithm uses intermediate product data generated by the Cloud Mask algorithm. In addition, the algorithm uses dynamic auxiliary data, specifically solar zenith angle data and solar azimuth angle data.

The primary sensor data used by the Snow Cover algorithm is identified in Table 5.21.2-1, Primary Sensor Data.

Table 5.21.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_1_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_2_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_3_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_5_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_6_data

The other dynamic source data inputs are summarized in Table 5.21.2-2, Other Dynamic Source Data.

Table 5.21.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_4_level_cloud_mask_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_solar_azimuth_angle_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.21.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Snow Cover ground-processing algorithm:

- Algorithm-specific parameters.
- Gridded parameters.

The algorithm-specific parameters represent parameters that are unique to the Snow Cover algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Qualification thresholds based on solar and local zenith angles
- Endmember types mapping from endmember spectrum to endmember type
- Endmember spectral look-up tables
- Endmember mixture model containing all possible combinations of endmember types
- Constraints on model goodness of fit for endmember model types
- Snow grain size associated with the endmembers types
- Model type parameterization
- Spectral library parameterization
- Thresholds and limits that apply to grain size, snow mask, solar zenith angle, local zenith angle, reflectance, latitude, and longitude used in setting product quality
- Minimum/maximum valid range/ outlier limits on fractional snow cover

The categories of gridded parameters used in the generation of the Snow Cover product are projection and mapping, and earth surface classifications and characteristics. The specific types of gridded semi-static source data in the categories used in the generation of the Snow Cover product are identified in Table 5.21.3 Gridded Semi-Static Source Data.

Table 5.21.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_land_sea_mask_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- FSC_Parameters.bin

5.21.4 Coordinates

The coordinates associated with data variables in the Snow Cover product are identified in Table 5.21.4, Snow Cover Product Coordinates.

Table 5.21.4 Snow Cover Product Coordinates

Snow Cover Product Data Quantity	Coordinates
snow cover data	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle ranges for good, and good or degraded quality data production • Solar zenith angle ranges for good, and good or degraded quality data production
snow cover data quality flags	• Observation time period • N/S elevation and E/W scanning angles for pixel geo-location • Local zenith angle ranges for good, and good or degraded quality data production • Solar zenith angle range for good, and good or degraded quality data production

Snow Cover Product Data Quantity	Coordinates
snow cover outlier pixel count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for good quality data production
snow cover minimum, maximum, mean, and standard deviation values	
snow cover pixel root mean square difference minimum, maximum, mean, and standard deviation values	
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.21.5 Production Notes

The Snow Cover product is generated by the GOES-R ABI Snow Cover ground processing algorithm. The algorithm relies on atmospherically-corrected surface reflectance derived as part of the determination of the surface albedo and does not use ABI Level 1b data inputs directly. The product is generated using spectral mixture analysis with a look-up table containing spectral reflectance of individual surfaces calculated from a radiative transfer model, and also a physical retrieval utilizing a spectral library lookup table to account for the dependency of reflectance on snow grain size, and local and solar zenith angles. The algorithm maintains an endmember memory file that contains two values per pixel indicating the endmember identifiers of the last modeled endmembers. Types of endmembers are land surface materials such as snow, vegetation, and rock, and are characterized using unique reflectance spectra based on modeled and field measurements. The endmemory memory file is re-initialized daily.

Clear sky is determined using clear and probably clear pixels indicated in the temporally coincident intermediate 4-level cloud mask generated by the Cloud Mask algorithm. Pixels in the product image with out of range values are assigned the minimum or maximum value in the valid range.

The Snow Cover algorithm generates an intermediate snow mask product that is used in the production of other ABI Level 2+ products. In addition, the algorithm generates diagnostic product images including estimates of snow grain size, snow mask, and the fractional abundance of soil, rock, vegetation, and lake ice. Furthermore, the algorithm generates product quality information flags that identify the conditions associated with the retrievals, and the root mean squared difference between the modeled surface reflectance and the input values.

The Snow Cover algorithm final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the FSC ground-processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Fractional Snow Cover. This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/Cryosphere_SnowCover_v2.0_no_color.pdf.

5.21.6 Data Fields

The Snow Cover product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for Snow Cover product are located in Appendix A.

Table 5.21.6-1 Snow Cover: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	String
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	e7ce8b20-b00a-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Snow Cover	string
summary	The Snow Cover product consists of pixels containing the fractional amount of snow therein. The product is generated using spectral mixture analysis with a look-up table containing spectral reflectances of individual surfaces calculated from a radiative transfer model, and also a physical retrieval utilizing a spectral library lookup table to take into account the dependency of reflectance on snow grain size, and local and solar zenith angles. Product data is generated during the day.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	CRYOSPHERE > SNOW/ICE > SNOW COVER	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	String

production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	String
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.21.6-2 Snow Cover: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality snow cover data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
quantitative_local_zenith_angle ***value = 67.5***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality snow cover data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality snow cover data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 67.5***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality snow cover data is produced	string
retrieval_solar_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good or degraded quality snow cover data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	retrieval_solar_zenith_angle_bounds	string
quantitative_solar_zenith_angle ***value = 67.5***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality snow cover data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	quantitative_solar_zenith_angle_bounds	string
retrieval_solar_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good or degraded quality snow cover data is produced	string
quantitative_solar_zenith_angle_bounds ***value = 0.0 67.5***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality snow cover data is produced	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
FSC	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Snow Cover, which contains fraction of pixel covered by snow	string
			standard_name	surface_snow_area_fraction	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00001526	float
			add_offset	0	float
			units	percent	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good or degraded quality pixel produced) quantitative_solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Snow Cover data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 128	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point retrieval_solar_zenith_angle: point quantitative_solar_zenith_angle: point t: point area: point	string
			flag_masks	***see note [flags and meanings]***	byte
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	9	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_invalid_due_to_missing_input_data_qf	***dynamic value***	float
			percent_invalid_due_to_bad_input_data_qf	***dynamic value***	float
			percent_invalid_due_to_cloudy_conditions_qf	***dynamic value***	float
			percent_invalid_due_to_water_surface_type_qf	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			percent_invalid_due_to_SZA_threshold_exceeded_qf	***dynamic value***	float
			percent_degraded_due_to_LZA_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_lat_or_lon_threshold_exceeded_qf	***dynamic value***	float
			percent_invalid_due_to_algorithm_failure_qf	***dynamic value***	float
outlier_pixel_count	int	n/a	long_name	number of snow cover pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only) where clear_sky over land	string
minimum_snow_fraction	float	n/a	long_name	minimum fraction of pixel covered by snow	string
			standard_name	surface_snow_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
	float	n/a	long_name	maximum fraction of pixel covered by snow	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
maximum_snow_fraction			standard_name	surface_snow_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
mean_snow_fraction	float	n/a	long_name	mean fraction of pixel covered by snow	string
			standard_name	surface_snow_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
standard_deviations_of_snow_fractions	float	n/a	long_name	standard deviation of fraction of pixel covered by snow values	string
			standard_name	surface_snow_area_fraction	string
			_FillValue	-999	float
			units	percent	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
snow_pixel_minimum_RMS_retrieval_error	float	n/a	long_name	minimum value of the root mean square difference between the observed surface bidirectional reflectance in five of the ABI reflective bands (1, 2, 3, 5 and 6 with central wavelengths of 0.47,	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
				0.64, 0.865, 1.61, and 2.25 um) and the corresponding modeled values derived from a multiple endmember mixing model	
			_FillValue	-999	float
			valid_range	0.0 50.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
snow_pixel_maximum_RMS_retrieval_error	float	n/a	long_name	maximum value of the root mean square difference between the observed surface bidirectional reflectance in five of the ABI reflective bands (1, 2, 3, 5 and 6 with central wavelengths of 0.47, 0.64, 0.865, 1.61, and 2.25 um) and the corresponding modeled values derived from a multiple endmember mixing model	string
			_FillValue	-999	float
			valid_range	0.0 50.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
snow_pixel_mean_RMS_retrieval_error	float	n/a	long_name	mean value of the root mean square difference between the observed surface bidirectional reflectance in five of the ABI reflective bands (1, 2, 3, 5 and 6 with central wavelengths of 0.47, 0.64, 0.865, 1.61, and 2.25 um) and the corresponding modeled values derived from a multiple endmember mixing model	string
			_FillValue	-999	float
			valid_range	0.0 50.0	float
			units	1	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
snow_pixel_standard_deviation_RMS_retrieval_error	float	n/a	long_name	standard deviation of the root mean square difference between the observed surface bidirectional reflectance in five of the ABI reflective bands (1, 2, 3, 5 and 6 with central wavelengths of 0.47, 0.64, 0.865, 1.61, and 2.25 um) values and the corresponding modeled values derived from a multiple endmember mixing model	string
			_FillValue	-999	float
			units	1	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where clear_sky over land	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_solar_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_1_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_2_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_3_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_5_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_6_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_4_level_cloud_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.21.6.1, Snow Cover Product Flag Values and Meanings.

5.21.6.1 Snow Cover Product Flag Values and Meanings

Table 5.21.6.1 Snow Cover Data Quality Flag Values and Meanings

Data Quality Flags (DQF)		
Flag Mask	**Flag Value**	**Flag Meaning**
255	0	good_quality_qf
1	1	invalid_due_to_missing_input_data_qf
2	2	invalid_due_to_bad_input_data_qf
4	4	invalid_due_to_cloudy_conditions_qf
8	8	invalid_due_to_water_surface_type_qf
16	16	invalid_due_to_SZA_threshold_exceeded_qf
32	32	degraded_due_to_LZA_threshold_exceeded_qf
64	64	invalid_due_to_lat_or_lon_threshold_exceeded_qf
128	128	invalid_due_to_algorithm_failure_qf

5.22 Surface Albedo Product

The current ground system baseline does not produce the Surface Albedo product.

5.23 Sea Surface (Skin) Temperature Product

5.23.1 Description

The Sea Surface (Skin) Temperature product contains an image with pixel values identifying the variations in temperature of the top 10 um of the sea surface. These values are calibrated to the bulk temperature at a depth of 1 m associated with in situ temperature measurements. On average, the pixel values represent the bulk sea surface temperature, but horizontal spatial variations in the product image reveal features associated with the sea surface skin temperature. The product includes data quality information that provides an assessment of the sea surface (skin) temperature data values for on-earth pixels, including an indication of good or degraded quality, or invalid, and the rationale.

The units of measure for the sea surface (skin) temperature value are "kelvin".

The Sea Surface (Skin) Temperature product image is produced on the ABI fixed grid at 2 km resolution for the Full Disk coverage region. Product data is produced under the following conditions:

- existence of sea
- geolocated source data to local zenith angles of 90 degrees for both daytime and nighttime conditions

The Sea Surface (Skin) Temperature performance requirements are summarized in Table 5.23.1, Sea Surface (Skin) Temperature Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement performance conditions identified therein except as noted.

Table 5.23.1 Sea Surface (Skin) Temperature Performance Requirements

	Measurement				Mapping
Region	**Range [1]**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk	271 to 313 K	2.1 K with known surface emissivity, known atmospheric correction, and 80% band correlation; 3.1 K otherwise	1.0 K	LZA ≤ 67 degrees	1 km

[1] Valid measurement range prescribed by the algorithm is 180 to 340 K.

Metadata in the Sea Surface (Skin) Temperature product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the ABI source images collection period.
- Number of good quality sea surface (skin) temperature pixels.
- Number of degraded and severely degraded quality sea surface (skin) temperature pixels.
- Number of unprocessed on-earth pixels in the sea surface (skin) temperature image.
- Number of day, night, and twilight sea surface (skin) temperature pixels.
- Number of sea surface (skin) temperature pixels whose values are outside the required measurement range.
- Minimum, maximum, mean, and standard deviation of the sea surface (skin) temperature values in the product image.
- Minimum, maximum, mean, and standard deviation of the difference in the observed and modeled brightness temperature for ABI band 7 with central wavelength of 3.9 um used during the nighttime only generation of the sea surface (skin) temperature data.

- Minimum, maximum, mean, and standard deviation of the difference in the observed and modeled brightness temperature for ABI bands 14 and 15 with central wavelengths of 11.2 and 12.3 um used during the daytime and nighttime generation of the sea surface (skin) temperature data.

The number of good quality, day, night, twilight, and outlier statistics are calculated using geolocated sea pixels to a local zenith angle of 67 degrees. The degraded count statistics are calculated using geolocated sea pixels to a local zenith angle of 90 degrees. The sea surface (skin) temperature and brightness temperature difference statistics are calculated using good quality pixels to a local zenith angle of 67 degrees. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Sea Surface (Skin) Temperature product is located in the standalone Appendix X, ISO Series Metadata.

5.23.2 Dynamic Source Data

The Sea Surface (Skin) Temperature product is derived using processed ABI Level 1b emissive band images from current and previous observations from the last hour collected at fifteen minute intervals. The algorithm uses intermediate product data generated by itself in previous activations, and the Cloud Mask algorithm. In addition, the algorithm uses Reynolds sea surface temperature dynamic ancillary data, and clear sky brightness temperature, and skin temperature and water vapor derivative data in selected emissive bands derived from the ground system deployment of the CRTM. Furthermore, the algorithm uses dynamic auxiliary data, specifically solar zenith angle and sunglint angle data.

The primary sensor data used by the Sea Surface (Skin) Temperature algorithm is identified in Table 5.23.2-1, Primary Sensor Data.

Table 5.23.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Products	input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data

The other dynamic source data inputs are summarized in Table 5.23.2-2, Other Dynamic Source Data.

Table 5.23.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_cloud_mask_info_flag_data input_ABI_L2_intermediate_product_instantaneous_sea_surface_temperature_data input_ABI_L2_intermediate_product_SST_historical_bias_estimate_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_7_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_7_data input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_14_data input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_15_data input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_7_data input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_14_data input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_15_data
Processed Dynamic Ancillary Data	input_dynamic_ancillary_Reynolds_SST_data input_dynamic_ancillary_Reynolds_SST_uncertainty_data

Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sunglint_angle_data

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.23.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Sea Surface (Skin) Temperature ground-processing algorithm:

- Algorithm-specific parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Sea Surface Temperature algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Coefficients for the non-linear SST and multi-channel SST algorithms.
- Coefficients for the daytime and nighttime hybrid algorithms.
- Flag indicating the algorithm to be used.
- Thresholds on solar zenith angle, glint angle, and local zenith angle.
- Thresholds for the SST quality control tests.
- Flag specifying source of cloud screening.
- Covariance matrix of measurement error and a priori covariance matrix of retrieved variables.
- Constraints for calculation of SST biases.
- Minimum/maximum valid range/ outlier thresholds for the sea surface temperature product.

The categories of gridded parameters used in the generation of the Sea Surface (Skin) Temperature product are projection and mapping, and earth surface classifications and characteristics. The specific types of gridded semi-static source data in the categories used in the generation of the Sea Surface (Skin) Temperature product are identified in Table 5.23.3 Gridded Semi-Static Source Data.

Table 5.23.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_land_sea_mask_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the two categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin

- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- SST_ABI_Parameters.bin
- SST_Empty_Historical_Bias.bin

5.23.4 Coordinates

The coordinates associated with data variables in the Sea Surface (Skin) Temperature product are identified in Table 5.23.4, Sea Surface (Skin) Temperature Product Coordinates.

Table 5.23.4 Sea Surface (Skin) Temperature Product Coordinates

<table>
<tr><th>Sea Surface (Skin) Temperature Product Data Quantity</th><th>Coordinates</th></tr>
<tr><td>sea surface (skin) temperature data</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angles for pixel geo-location
• Local zenith angle ranges for good, and good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>sea surface (skin) temperature data quality flags</td></tr>
<tr><td>good sea surface (skin) temperature pixel count</td><td rowspan="4">• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>sea surface (skin) temperature outlier pixel count</td></tr>
<tr><td>sea surface (skin) temperature minimum, maximum, mean, and standard deviation values</td></tr>
<tr><td>minimum, maximum, mean, and standard deviation values associated with the difference between the retrieved and Reynolds real-time global analysis sea surface (skin) temperature</td></tr>
<tr><td>degraded and severely degraded sea surface (skin) temperature pixel counts</td><td rowspan="2">• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>unprocessed pixel count</td></tr>
<tr><td>day area sea surface (skin) temperature pixel count</td><td>• Observation time period
• N/S elevation and E/W scanning angle extents for image geo-location
• Local zenith angle range for good quality data production
• Solar zenith angle range for day area data production</td></tr>
</table>

Sea Surface (Skin) Temperature Product Data Quantity	Coordinates
night area sea surface (skin) temperature pixel count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for night area data production
twilight area sea surface (skin) temperature pixel count	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Local zenith angle range for good quality data production • Solar zenith angle range for twilight area data production
minimum, maximum, mean, and standard deviation values associated with the difference between observed and modeled brightness temperature at specific ABI emissive band central wavelengths used in the night area only	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Central wavelength and identifier of the applicable ABI bands • Local zenith angle range for good quality data production • Solar zenith angle range for night area data production
minimum, maximum, mean, and standard deviation values associated with the difference between observed and modeled brightness temperature at specific ABI emissive band central wavelengths used in the day and night area only	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location • Central wavelength and identifier of the applicable ABI bands • Local zenith angle range for good quality data production • Solar zenith angle range for day area data production
data transmission error percentages	• Observation time period • N/S elevation and E/W scanning angle extents for image geo-location

5.23.5 Production Notes

The Sea Surface (Skin) Temperature product is generated by the GOES-R ABI Sea Surface (Skin) Temperature ground processing algorithm. This product is retrieved using a hybrid regression algorithm that incorporates observed brightness temperatures, clear sky brightness temperatures computed based on the CRTM, and the Reynolds sea surface temperature. Regression coefficients are defined for daytime and for nighttime conditions. This algorithm can also be configured to execute in a standard regression configuration that does not rely on the CRTM inputs. An attribute of the primary data variable in the product file, "algorithm_type", indicates the specific algorithm used. Both algorithms employ a multi-band approach, relying on brightness temperature in ABI bands 7, 14, and 15 with central wavelengths 3.9, 11.2, and 12.3 um for nighttime, and ABI bands 14 and 15 for daytime. Pixels in the product image with out-of-range values are assigned the minimum or maximum value in the valid range.

The product is a composite, making use of multiple ABI Full Disk images collected over a one hour period. The algorithm applies the hybrid regression for all ocean pixels regardless of cloud cover.

The sea surface temperature algorithm employs extensive quality control checks on the product image that are reflected in the product quality information flags. These quality control checks include the calculation of brightness temperature derivatives with respect to surface temperature and water vapor scaling factors. Tests based on the bias estimates for certain physical parameters are also performed. The algorithm generates an intermediate product containing these biases for each execution of the algorithm. The instantaneous outputs that contribute to the generation of the final product, the observed sea surface (skin) temperature, and product quality information flags containing quality control test results and observation conditions, are also intermediate products generated by the algorithm.

The Sea Surface (Skin) Temperature algorithm final, and intermediate data and diagnostic information product files are available in the GOES-R ground system's two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Sea Surface (Skin) Temperature ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Sea Surface Temperature. This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/baseline-SST-v2.0.pdf.

5.23.6 Data Fields

The Sea Surface (Skin) Temperature product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Sea Surface (Skin) Temperature product are located in Appendix A.

Table 5.23.6-1 Sea Surface (Skin) Temperature: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	String
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	d70be540-c38a-11e0-962b-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Sea Surface (Skin) Temperature	string
summary	The Sea Surface (Skin) Temperature product consists of pixels containing the temperature of the sea at the surface capturing variations in the skin, but, on average, is equivalent to the bulk SST since the SST retrievals are calibrated to in situ bulk SSTs and bias corrected to the Reynolds SST field. This product is generated using either a regression algorithm or hybrid algorithm that combines regression and model approaches. Both algorithms employ a multi-band approach, relying on brightness temperature in ABI bands with wavelengths 11.2 and 12.3 during the day, and 3.9, 11.2, and 12.3 um at night. Product data is generated both day and night.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	OCEANS > OCEAN TEMPERATURE > SEA SURFACE TEMPERATURE	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string

production_environment	***possible values are OE, ITE, and DE.***	String
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	Full Disk	string
spatial_resolution	2km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.23.6-2 Sea Surface (Skin) Temperature: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
y	short	***y = see note[1]***	long_name	GOES-R fixed grid projection y-coordinate	string
			standard_name	projection_y_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	Y	string
x	short	***x = see note [1]***	long_name	GOES-R fixed grid projection x-coordinate	string
			standard_name	projection_x_coordinate	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	rad	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point of the ABI source observation collection interval associated with the composite product image in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	start and end times of the ABI source observation collection interval associated with the composite product image in seconds since J2000 epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality sea surface (skin) temperature data production	string
			standard_name	platform_zenith_angle	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 67.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality sea surface (skin) temperature data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality sea surface (skin) temperature data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 67.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality sea surface (skin) temperature data is produced	string
retrieval_solar_zenith_angle ***value = 180.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality sea surface (skin) temperature data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	retrieval_solar_zenith_angle_bounds	string
day_solar_zenith_angle ***value = 85.0***	float	n/a	long_name	threshold angle of the day region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	day_solar_zenith_angle_bounds	string
night_solar_zenith_angle ***value = 95.0***	float	n/a	long_name	threshold angle of the night region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	night_solar_zenith_angle_bounds	string
twilight_solar_zenith_angle ***value = 85.0***	float	n/a	long_name	midpoint of the twilight region for the angle between the line of sight to the sun and the local zenith at the observation target	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	twilight_solar_zenith_angle_bounds	string
	float		long_name		string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
retrieval_solar_zenith_angle_bounds ***value = 0.0 180.0***		number_of_SZA_bounds = 2		solar zenith angle degree range where good quality sea surface (skin) temperature data is produced	
day_solar_zenith_angle_bounds ***value = 0.0 85.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the day region	string
night_solar_zenith_angle_bounds ***value = 95.0 180.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the twilight region	string
twilight_solar_zenith_angle_bounds ***value = 85.0 95.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range for the twilight region	string
SST_night_only_emissive_wavelength ***value = 3.9***	float	SST_night_only_emissive_band = 1	long_name	ABI band central emissive wavelength used to generate Sea Surface (Skin) Temperature product (night pixels only)	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
SST_day_night_emissive_wavelengths ***value = 11.2 12.3***	float	SST_day_night_emissive_bands = 2	long_name	ABI band central emissive wavelengths used to generate Sea Surface (Skin) Temperature product (day and night pixels)	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	um	string
SST_night_only_emissive_band_id ***value = 7***	byte	SST_night_only_emissive_band = 1	long_name	ABI band identifier used to generate Sea Surface (Skin) Temperature product (night pixels only)	string
			standard_name	sensor_band_identifier	string
			units	1	string
SST_day_night_emissive_band_ids ***value = 14 15***	byte	SST_day_night_emissive_bands = 2	long_name	ABI band identifiers used to generate Sea Surface (Skin) Temperature product (day and night pixels)	string
			standard_name	sensor_band_identifier	string
			units	1	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
			bounds	y_image_bounds	string
y_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection y-coordinate north/south extent of image	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	rad	string
			axis	X	string
			bounds	x_image_bounds	string
x_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	GOES-R fixed grid projection x-coordinate west/east extent of image	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023	double
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
SST	short	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Sea Surface (Skin) Temperature	string
			standard_name	sea_surface_skin_temperature	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.00244163	float
			add_offset	180	float
			units	K	string
			resolution	y: 0.000056 rad x: 0.000056 rad	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good quality pixel produced) t: point area: point	string
			ancillary_variables	DQF	string
			algorithm_type	***possible values are hybrid and regression***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
DQF	byte	***y = see note[1]*** ***x = see note [1]***	long_name	ABI L2+ Sea Surface (Skin) Temperature data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 3	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle t y x	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point retrieval_solar_zenith_angle: point t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_degraded_quality_qf	***dynamic value***	float
			percent_severely_degraded_quality_qf	***dynamic value***	float
			percent_invalid_due_to_unprocessed_qf	***dynamic value***	float
total_number_of_good_quality_ocean_pixels	int	n/a	long_name	number of good quality sea surface temperature pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
total_number_of_degraded_quality_ocean_pixels	int	n/a	long_name	number of degraded quality sea surface temperature pixels	string
			_FillValue	-1	int

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: degraded quality pixels only) where sea	string
total_number_of_severely_degraded_quality_ocean_pixels	int	n/a	long_name	number of severely degraded quality sea surface temperature pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: severely degraded quality pixels only) where sea	string
total_number_of_unprocessed_pixels	int	n/a	long_name	number of unprocessed pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: invalid due to unprocessed pixels only)	string
number_of_day_SST_pixels	int	n/a	long_name	number of day sea surface temperature pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle day_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum day_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where sea	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
number_of_night_SST_pixels	int	n/a	long_name	number of night sea surface temperature pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle night_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
number_of_twilight_SST_pixels	int	n/a	long_name	number of twilight sea surface temperature pixels	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle night_twilight_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum twilight_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
sea_surface_temp_outlier_pixel_count	int	n/a	long_name	number of sea surface temperature pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.000056 rad comment: good quality pixels whose values are outside valid measurement range only) where sea	string
minimum_sea_surface_temp	float	n/a	long_name	minimum sea surface temperature	string
			standard_name	sea_surface_temperature	string
			_FillValue	-999	float
			valid_range	180.0 340.0	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
maximum_sea_surface_temp	float	n/a	long_name	maximum sea surface temperature	string
			standard_name	sea_surface_temperature	string
			_FillValue	-999	float
			valid_range	180.0 340.0	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
mean_sea_surface_temp	float	n/a	long_name	mean sea surface temperature	string
			standard_name	sea_surface_temperature	string
			_FillValue	-999	float
			valid_range	180.0 340.0	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where sea	string
standard_deviation_sea_surface_temp	float	n/a	long_name	standard deviation of sea surface temperature values	string
			standard_name	sea_surface_temperature	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area:	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
				standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where sea	
min_obs_modeled_diff_SST_night_only_emissive_band	float	n/a	long_name	minimum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the night only emissive band central wavelength used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle night_solar_zenith_angle SST_night_only_emissive_band_id SST_night_only_emissive_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
max_obs_modeled_diff_SST_night_only_emissive_band	float	n/a	long_name	maximum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the night only emissive band central wavelength used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle night_solar_zenith_angle SST_night_only_emissive_band_id SST_night_only_emissive_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
mean_obs_modeled_diff_SST_night_only_emissive_band	float	n/a	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the night only emissive	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
				band central wavelength used in the generation of the sea surface temperature product	
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle night_solar_zenith_angle SST_night_only_emissive_band_id SST_night_only_emissive_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where sea	string
std_dev_obs_modeled_diff_SST_night_only_emissive_band	float	n/a	long_name	standard deviation of the difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) values for the night only emissive band central wavelength used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle night_solar_zenith_angle SST_night_only_emissive_band_id SST_night_only_emissive_wavelength t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum night_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where sea	string
min_obs_modeled_diff_SST_day_night_emissive_bands	float	SST_day_night_emissive_bands = 2	long_name	minimum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the day and night emissive band central wavelengths used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle SST_day_night_emissive_band_ids SST_day_night_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
max_obs_modeled_diff_SST_day_night_emissive_bands	float	SST_day_night_emissive_bands = 2	long_name	maximum difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the day and night emissive band central wavelengths used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle SST_day_night_emissive_band_ids SST_day_night_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
mean_obs_modeled_diff_SST_day_night_emissive_bands	float	SST_day_night_emissive_bands = 2	long_name	mean difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) for the day and night emissive band central wavelengths used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle SST_day_night_emissive_band_ids SST_day_night_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where sea	string
std_dev_obs_modeled_diff_SST_day_night_emissive_bands	float	SST_day_night_emissive_bands = 2	long_name	standard deviation of the difference of the observed and modeled brightness temperature (Joint Center for Satellite Data Assimilation Community Radiative Transfer Model using temporally interpolated NWP data as input) values for the day and night emissive band central wavelengths used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle SST_day_night_emissive_band_ids SST_day_night_emissive_wavelengths t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where sea	string
min_retrieved_Reynolds_SST_diff	float	n/a	long_name	minimum difference of the retrieved SST and Reynolds real-time global SST analysis used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: minimum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
max_retrieved_Reynolds_SST_diff	float	n/a	long_name	maximum difference of the retrieved SST and Reynolds real-time global SST analysis used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: maximum (interval: 0.000056 rad comment: good quality pixels only) where sea	string
mean_retrieved_Reynolds_SST_diff	float	n/a	long_name	mean difference of the retrieved SST and Reynolds real-time global SST analysis used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: mean (interval: 0.000056 rad comment: good quality pixels only) where sea	string
std_dev_retrieved_Reynolds_SST_diff	float	n/a	long_name	standard_deviation of the difference of the retrieved SST and Reynolds real-time global SST analysis values used in the generation of the sea surface temperature product	string
			_FillValue	-999	float
			units	K	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.000056 rad comment: good quality pixels only) where sea	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t y_image x_image	string
			grid_mapping	goes_imager_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_auxiliary_sunglint_angle_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_brightness_temperature_band_7_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_brightness_temperature_band_14_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_brightness_temperature_band_15_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_cloud_mask_info_flag_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_instantaneous_sea_surface_temperature_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_SST_historical_bias_estimate_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_7_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_7_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_produ	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			ct_CRTM_water_vapor_derivative_band_7_data		
			input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_14_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_15_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_Reynolds_SST_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_Reynolds_SST_uncertainty_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.2.6, Product Data Structures, and paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Note "flags and meanings": Flag values and meanings are located in paragraph 5.23.6.1, Sea Surface (Skin) Temperature Product Flag Values and Meanings.

5.23.6.1 Sea Surface (Skin) Temperature Product Flag Values and Meanings

Table 5.23.6.1 Sea Surface (Skin) Temperature Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	degraded_quality_qf
2	severely_degraded_quality_qf
3	invalid_due_to_unprocessed_qf

5.24 Downward Shortwave Radiation: Surface Product

5.24.1 Description

The Downward Shortwave Radiation: Surface product contains an image with pixel values identifying the instantaneous total shortwave irradiance (flux) received at the Earth's surface integrated over the 0.2 to 4.0 um wavelength band pass. It includes contributions from direct solar radiation attenuated by the atmosphere and from diffuse radiation associated with scattering within the atmosphere. The product includes data quality information that provides an assessment of the downward shortwave radiation: surface data values for on-earth pixels, including an indication of good quality, or degraded quality or invalid.

The units of measure for the downward shortwave radiation: surface value are "watts per square meter".

The Downward Shortwave Radiation: Surface product image is produced on a global latitude/longitude grid at 0.5 degree resolution for Full Disk, 0.25 degree resolution for CONUS, and 0.05 degree resolution for Mesoscale coverage regions. Product data is produced for geolocated source data to local zenith angles of 90 degrees and solar zenith angles to 90 degrees.

The Downward Shortwave Radiation: Surface performance requirements are summarized in Table 5.24.1, Downward Shortwave Radiation: Surface Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement range and performance conditions identified therein except as noted.

Table 5.24.1 Downward Shortwave Radiation: Surface Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk, CONUS, & Mesoscale	0 to 1500 W/m^2	85 W/m^2 at high end of range (1000 W/m^2) 65 W/m^2 at middle of range (350 W/m^2) 110 W/m^2 at low end of range (100 W/m^2)	100 W/m^2 for high end of range (1000 W/m^2) 130 W/m^2 for middle of range (350 W/m^2) 100 W/m^2 for low end of range (100 W/m^2)	LZA ≤ 70 degrees daytime, solar elevation angle > 25 degrees [1]	Full Disk: 4 km CONUS: 2 km Mesoscale: 1 km

[1] Conditions for good quality prescribed by the algorithm are for SZA ≤ 70 degrees.

Metadata in the Downward Shortwave Radiation: Surface product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of attempted retrievals.
- Number of attempted retrievals to local zenith angle of 70 degrees.
- Number of downward shortwave radiation: surface pixels whose values are outside the required measurement range.
- Cloud fraction in product image.
- Minimum, maximum, mean, and standard deviation of the solar zenith angle values for the product image's pixels.
- Minimum, maximum, mean, and standard deviation of the downward shortwave radiation: surface values in the product image.

The attempted retrieval count, cloud fraction, and solar zenith angle statistics are calculated using geolocated pixels to a solar zenith angle of 90 degrees. The downward shortwave radiation: surface outlier count and other statistics are calculated using good quality pixels to a local zenith angle to 70 degrees and solar zenith angle to 70 degrees. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Downward Shortwave Radiation: Surface product is located in the standalone Appendix X, ISO Series Metadata.

5.24.2 Dynamic Source Data

The dynamic source data used to produce the Downward Shortwave Radiation: Surface product is dependent on the availability of dynamic source data, and the conditions, cloudy or clear, in the coverage region. The algorithm has two retrieval paths, primary and secondary. The primary path is the "direct" retrieval path where the product is derived using temporally coincident final and intermediate product data produced by the Cloud Mask, Cloud Type, Cloud Top Height, Cloud Microphysical and Optical Properties, Aerosol Optical Depth, Legacy Atmospheric Profiles, Snow Cover, and Surface Albedo algorithms. Primary sensor data is not directly used by the algorithm in this case. Note that the current ground system baseline does not produce the Surface Albedo product.

In the event that cloudy conditions exist and cloud top height, cloud optical depth, cloud particle size, or surface albedo product data is not available, or in the event clear conditions exist and aerosol optical depth and fine aerosol model index, or surface albedo data are not available, a secondary "indirect" retrieval path is invoked where the algorithm uses processed ABI Level 1b reflective band images.

The algorithm uses processed total column ozone data derived from the NWP model ancillary data, and dynamic auxiliary data, specifically solar zenith angle and sun-satellite relative azimuth angle data for both retrieval paths. Processed global snow and ice cover data derived from the NSIDC ancillary data and processed total precipitable water derived from the NWP model ancillary data are secondary inputs to the algorithm.

The primary sensor data used by the Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA algorithm is identified in Table 5.24.2-1, Primary Sensor Data.

Table 5.24.2-1 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type [1]
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_reflectance_band_1_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_3_2km_data input_ABI_L2_intermediate_product_reflectance_band_4_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_2km_data

[1] Processed reflectance product data are required inputs for the secondary "indirect" retrieval path only.

The other dynamic source data inputs are summarized in Table 5.24.2-2, Other Dynamic Source Data.

Table 5.24.2-2 Other Dynamic Source Data

Dynamic Data Category	Dynamic Data Type
ABI L2+ Final Products	input_ABI_L2_aerosol_optical_depth_550nm_data [1] input_ABI_L2_cloud_top_phase_data input_ABI_L2_cloud_effective_particle_size_data [2] input_ABI_L2_total_precipitable_water_data input_ABI_L2_surface_albedo_data [1]
ABI L2+ Intermediate Products	input_ABI_L2_intermediate_product_binary_snow_mask

	input_ABI_L2_intermediate_product_fine_aerosol_data [1] input_ABI_L2_intermediate_product_cloud_optical_depth_data [2] input_ABI_L2_intermediate_product_cloud_top_height_data [2]
Processed Dynamic Ancillary Data	input_dynamic_ancillary_global_snow_mask_data [3] input_dynamic_ancillary_NWP_total_precipitable_water_data [4] input_dynamic_ancillary_NWP_total_column_ozone_data
Dynamic Auxiliary Data	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data

[1] Aerosol optical depth, fine aerosol model index, and surface albedo data are required inputs for the primary "direct" retrieval path only.
[2] Cloud top height, cloud optical depth, and cloud particle size data are required inputs for the primary "direct" retrieval path but are used in the secondary "indirect" path, if available.
[3] Processed global snow mask ancillary data is used when the ABI intermediate binary snow mask product data is not available.
[4] Processed NWP total precipitable water ancillary data is used when the ABI total precipitable water product data is not available.

Refer to Appendix C, Dynamic Source Data, for a description of each of the individual types of dynamic source data used to generate this product.

5.24.3 Level 2+ Semi-Static Source Data

There are two categories of semi-static source data employed in the GOES-R ABI Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA ground processing algorithm:

- Algorithm-specific parameters
- Gridded parameters

The algorithm-specific parameters represent parameters that are unique to the Downward Shortwave Radiation Surface algorithm. Some of these parameters may be tuned for the specific characteristics of the ABI instrument. These include:

- Qualification thresholds based on local zenith angle, solar zenith angle, relative azimuth angle, latitude, and longitude and other dynamic inputs.
- Default climatological values.
- Narrow to broad band conversion factor look-up tables for clear sky, water cloud and ice cloud and associated dependencies
- Look-up table mappings between surface types.
- Angular distribution model look-up table for conversion of TOA broadband reflectance to TOA broadband albedo for clear and cloudy sky conditions over land, ocean and snow/ice, and associated dependencies.
- Solar constants for ABI spectral bands.
- Coefficients in earth-sun distance correction of solar irradiance.
- Coefficients in solar declination calculation used to identify polar night.
- Reference surface spectral albedo by surface type.
- Scattering parameters for determination of surface albedo over snow.
- Look-up tables of atmospheric reflectance, direct transmittance, diffuse transmittance, spherical reflectivity, and spherical transmittance under clear-sky, water cloud, and ice cloud conditions, and associated dependencies.
- Threshold values for assignment of data quality flags.
- Minimum/maximum valid range /outlier thresholds for shortwave radiation products.

The categories of gridded parameters used in the generation of the Downward Shortwave Radiation: Surface product are projection and mapping, earth surface classifications and characteristics, and atmospheric climatology. The specific types of gridded semi-static source data in the categories used in the generation of the Downward Shortwave Radiation: Surface product are identified in Table 5.24.3 Gridded Semi-Static Source Data.

Table 5.24.3 Gridded Semi-Static Source Data

Gridded Semi-Static Source Data Category	Gridded Semi-Static Data Type
Projection and Mapping	input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data input_ABI_L2_semi_static_local_zenith_angle_data input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data input_ABI_L2_slot_specific_0.05_degree_lat_lon_grid_mapping_for_fixed_grid_data input_ABI_L2_slot_specific_0.25_degree_lat_lon_grid_mapping_for_fixed_grid_data input_ABI_L2_slot_specific_0.50_degree_lat_lon_grid_mapping_for_fixed_grid_data input_ABI_L2_slot_specific_0.05_degree_lat_lon_cells_nearest_neighbor_data input_ABI_L2_slot_specific_0.25_degree_lat_lon_cells_nearest_neighbor_data input_ABI_L2_slot_specific_0.50_degree_lat_lon_cells_nearest_neighbor_data
Earth Surface Classification and Characteristics	input_ABI_L2_slot_specific_semi_static_surface_elevation_data input_ABI_L2_slot_specific_semi_static_land_sea_mask_data input_ABI_L2_slot_specific_semi_static_IGBP_surface_type_mask_data
Atmospheric Climatology	input_ABI_L2_slot_specific_semi_static_monthly_cloud_climatology_data input_ABI_L2_slot_specific_semi_static_monthly_aerosol_climatology_data input_ABI_L2_slot_specific_semi_static_monthly_total_precipitable_water_climatology_data input_ABI_L2_slot_specific_semi_static_monthly_total_column_ozone_climatology_data

Refer to Appendix D, Gridded Semi-Static Source Data, for a description of each of the individual types of gridded semi-static source data used to generate this product.

Semi-static source data files from the three categories above are contained in a single zip file. The filename conventions for the ABI Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Following are the file names of coverage parameters within the ABI semi-static source data zip file. In this case the file names describe the content.

- ABI_CONUS_2km_LatLonPosition.bin
- ABI_CONUS_2km_LocalAzimuth.bin
- ABI_CONUS_2km_LocalZenith.bin
- ABI_CONUS_2km_SemiStaticMasks_GM.bin
- ABI_FD_2km_LatLonPosition.bin
- ABI_FD_2km_LocalAzimuth.bin
- ABI_FD_2km_LocalZenith.bin
- ABI_FD_2km_SemiStaticMasks_GM.bin
- Auxiliary_Params.bin
- DMI_ABI_Params.bin
- Imagery_Params.bin
- L2ServicesSharedLibrary_Params.bin
- NWP_StaticMasks_GM_AllOnes.bin
- NWP_StaticMasks_GM_OnesLt80.bin
- SRB_Semistatic.bin

5.24.4 Coordinates

The coordinates associated with data variables in the Downward Shortwave Radiation: Surface product are identified in Table 5.24.4, Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA Product Coordinates.

Table 5.24.4 Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA Product Coordinates

<table>
<tr><th>Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA Product Data Quantity</th><th>Coordinates</th></tr>
<tr><td>downward shortwave radiation: surface and reflected shortwave radiation:TOA data</td><td rowspan="2">• Observation time period
• Latitude and longitude for pixel geo-location
• Wavelength range associated with data
• Local zenith angle ranges for good, and good or degraded quality data production
• Solar zenith angle ranges for good, and good or degraded quality data production</td></tr>
<tr><td>downward shortwave radiation: surface and reflected shortwave radiation:TOA data quality flags</td></tr>
<tr><td>attempted retrieval count</td><td>• Observation time period
• Latitude and longitude extents for image geo-location
• Wavelength range associated with data
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good or degraded quality data production</td></tr>
<tr><td>attempted retrieval count within local zenith angle required for good quality data production</td><td rowspan="2">• Observation time period
• Latitude and longitude extents for image geo-location
• Wavelength range associated with data
• Local zenith angle range for good quality data production
• Solar zenith angle range for good or degraded quality data production</td></tr>
<tr><td></td></tr>
<tr><td>image cloud fraction</td><td rowspan="2">• Observation time period
• Latitude and longitude extents for image geo-location
• Local zenith angle range for good or degraded quality data production
• Solar zenith angle range for good or degraded quality data production</td></tr>
<tr><td>solar zenith angle minimum, maximum, mean, and standard deviation values</td></tr>
<tr><td>downward shortwave radiation: surface and reflected shortwave radiation:TOA minimum, maximum, mean, and standard deviation values</td><td rowspan="2">• Observation time period
• Latitude and longitude extents for image geo-location
• Wavelength range associated with data
• Local zenith angle range for good quality data production
• Solar zenith angle range for good quality data production</td></tr>
<tr><td>downward shortwave radiation: surface and reflected shortwave radiation:TOA outlier pixel count</td></tr>
<tr><td>data transmission error percentages</td><td>• Observation time period
• Latitude and longitude extents for image geo-location</td></tr>
</table>

5.24.5 Production Notes

The Downward Shortwave Radiation: Surface product is generated by the GOES-R ABI Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA ground processing algorithm. Depending on the availability of inputs, the algorithm performs either a “direct” or “indirect” retrieval of broadband transmittance and reflectance over four scene types: clear sky over no snow/ice; clear sky over snow/ice; water cloud, and; ice cloud. The “direct” retrieval is primary method. Computed atmospheric transmittance and reflectance are used to derive the shortwave fluxes at the surface and TOA.

The “direct” retrieval path uses ABI products to estimate fluxes from semi-static lookup tables whose values are based on a forward radiative transfer model. When inputs needed for the “direct” retrieval path are not available, the algorithm uses the “indirect” retrieval path, invoking a multi-step inversion scheme. The “indirect” retrieval path includes the calculation of a clear-sky snow/ice-free composite TOA albedo derived from the ABI reflectance observations over the previous 29 days. The ground system currently uses the “indirect” retrieval path because the surface albedo product data is not available in the ground system.

Both retrieval paths rely on primary inputs at 2 km resolution that are averaged over each scene type on the output global latitude/longitude grid. Grid cells within the product extent not represented by a direct mapping between the ABI fixed grid and the global latitude/longitude grid are assigned values based on the nearest neighbor. The coverage region included in the Full Disk and CONUS radiation products is the minimum bounding rectangle within the global latitude/longitude grid. In the case of the mesoscale coverage region, the radiation product data structure dimensions are fixed and based on its maximum latitude/longitude extent on the ABI Full Disk. Pixels in the product image with out of range values are assigned the minimum or maximum value in the valid range.

The algorithm generates diagnostic outputs, including the clear sky 29 day composite albedo, internally derived aerosol and cloud optical depths, shortwave flux components for each individual scene type, and product quality information for each output grid cell. The product quality information includes the retrieval path used, source and quality of inputs, success or failure of the retrieval, and possible reasons for degraded retrieval quality.

The Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA algorithm final and intermediate diagnostic information product files are available in the GOES-R ground system’s two-day revolving storage to support anomaly resolution and algorithm analysis.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Downward Shortwave Radiation (Surface) ground-processing algorithm and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for ABI Downward Shortwave Radiation (Surface). This document is located at

http://www.goes-r.gov/products/ATBDs/baseline/baseline-DSR-v2.0.pdf.

5.24.6 Data Fields

The Downward Shortwave Radiation: Surface product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Downward Shortwave Radiation: Surface product are located in Appendix A.

Table 5.24.6-1 Downward Shortwave Radiation: Surface: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	String
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	de00d810-b013-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Downward Shortwave Radiation: Surface	string
summary	The Downward Shortwave Radiation: Surface product consists of pixels containing the instantaneous total shortwave irradiance (flux) received at the Earth's surface integrated over the 0.2 to 4.0 µm wavelength interval. The product is generated by retrieving broadband transmittance and reflectance over four scene types (clear sky over no snow/ice, clear sky over snow/ice, water cloud, and ice cloud). Other derived GOES-R products, aerosol optical depth, cloud top phase, cloud optical depth, cloud effective particle size, and total precipitable water, or reflectances from ABI bands with central wavelengths of 0.47, 0.64, 0.865, 1.378, 1.61, and 2.25 um are used to directly or indirectly, respectively, generate this product. Product data is generated during the day.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	ATMOSPHERE > ATMOSPHERIC RADIATION > SHORTWAVE RADIATION	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

production_site	NSOF	string
production_environment	***possible values are OE, ITE, and DE.***	String
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	***possible values are Full Disk, CONUS, and Mesoscale.***	String
spatial_resolution	***possible values are 50km at nadir for Full Disk, 25km at nadir for CONUS, and 5km at nadir for Mesoscale.***	String
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.24.6-2 Downward Shortwave Radiation: Surface: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
lat	short	***lat = see note[1]***	long_name	latitude longitude projection lat-coordinate	string
			standard_name	latitude	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	degrees_north	string
			axis	Y	string
lon	short	***lon = see note[1]***	long_name	latitude longitude projection lon-coordinate	string
			standard_name	longitude	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	degrees_east	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality downward shortwave radiation: surface data production	string
			standard_name	platform_zenith_angle	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	degree	string
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality downward shortwave radiation: surface data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality downward shortwave radiation: surface data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality downward shortwave radiation: surface data is produced	string
retrieval_solar_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good or degraded quality downward shortwave radiation: surface data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	retrieval_solar_zenith_angle_bounds	string
quantitative_solar_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality downward shortwave radiation: surface data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	quantitative_solar_zenith_angle_bounds	string
retrieval_solar_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good or degraded quality downward shortwave radiation: surface data is produced	string
quantitative_solar_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality downward shortwave radiation: surface data is produced	string
dsr_product_wavelength ***value = 2.1***	float	n/a	long_name	central wavelength for downward shortwave radiation: surface product data	string
			standard_name	radiation_wavelength	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	um	string
			bounds	dsr_product_wavelength_bounds	string
dsr_product_wavelength_bounds ***value = 0.2 4.0***	float	number_of_wavelength_bounds = 2	long_name	wavelength range for downward shortwave radiation: surface data	string
lat_image value = ***see note [1]***	float	n/a	long_name	latitude longitude projection lat-coordinate center of image	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
			bounds	lat_image_bounds	string
lat_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	latitude longitude projection lat-coordinate north/south extent of image	string
lon_image value = ***see note [1]***	float	n/a	long_name	latitude longitude projection lon-coordinate center of image	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
			bounds	lon_image_bounds	string
lon_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	latitude longitude projection lon-coordinate west/east extent of image	string
goes_lat_lon_projection	int	n/a	long_name	GOES-R latitude / longitude projection	string
			grid_mapping_name	***see note [1]***	string
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			longitude_of_prime_meridian	0	double
DSR	short	***lat = see note[1] lon = see note [1]***	long_name	ABI L2+ Downward Shortwave Radiation: Surface	string
			standard_name	surface_downwelling_shortwave_flux_in_air	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.02289028	float
			add_offset	0	float
			units	W m-2	string
			resolution	lon: ***see note [2]*** degree lat: ***see note [2]*** degree	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle dsr_product_wavelength t lat lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good or degraded quality pixel produced) quantitative_solar_zenith_angle: point (good quality pixel produced) dsr_product_wavelength: sum t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***lat = see note[1]*** ***lon = see note [1]***	long_name	ABI L2+ Downward Shortwave Radiation: Surface data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 1	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle dsr_product_wavelength t lat lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point retrieval_solar_zenith_angle: point quantitative_solar_zenith_angle: point dsr_product_wavelength: sum t: point area: point	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	2	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_degraded_quality_or_invalid_qf	***dynamic value***	float
retrieval_pixel_count	int	n/a	long_name	number of attempted shortwave radiation algorithm retrievals	string
			_FillValue	-1	int
			units	count	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle dsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum dsr_product_wavelength: sum t: sum area: sum (interval: ***see note [2]*** degree comment: geolocated/not missing pixels only)	string
lza_pixel_count	int	n/a	long_name	number of attempted shortwave radiation algorithm retrievals that do not exceed LZA threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle dsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum dsr_product_wavelength: sum t: sum area: sum (interval: ***see note [2]*** degree comment: geolocated/not missing pixels only)	string
outlier_pixel_count	int	n/a	long_name	number of downward shortwave radiation: surface pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle dsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum dsr_product_wavelength: sum t: sum area: sum (interval: ***see note [2]*** degree comment: outside valid measurement range, otherwise good quality pixels only)	string
image_cloud_fraction	float	n/a	long_name	total cloud fraction in downward shortwave radiation: surface image	string
			standard_name	cloud_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: ***see note [2]*** degree comment: good quality pixels only)	string
minimum_sza	float	n/a	long_name	minimum solar zenith angle in downward shortwave radiation: surface image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 70.0	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: minimum (interval: ***see note [2]*** degree comment: geolocated/not missing pixels only)	string
maximum_sza	float	n/a	long_name	maximum solar zenith angle in downward shortwave radiation: surface image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 70.0	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: maximum (interval: ***see note [2]*** degree comment: geolocated/not missing pixels only)	string
mean_sza	float	n/a	long_name	mean solar zenith angle in downward shortwave radiation: surface image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 70.0	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: mean (interval: ***see note [2]*** degree comment: geolocated/not missing pixels only)	string
std_dev_sza	float	n/a	long_name	standard deviation of solar zenith angle values in downward shortwave radiation: surface image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: standard_deviation (interval: ***see note [2]*** degree comment: geolocated/not missing pixels only)	string
minimum_dsr	float	n/a	long_name	minimum downward shortwave radiation: surface	string
			standard_name	surface_downwelling_shortwave_flux_in_air	string
			_FillValue	-999	float
			valid_range	0.0 1500.0	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle dsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitativl_local_zenith_angle: sum quantitative_solar_zenith_angle: sum dsr_product_wavelength: sum t: sum area: minimum (interval: ***see note [2]*** degree comment: good quality pixels only)	string
maximum_dsr	float	n/a	long_name	maximum downward shortwave radiation: surface	string
			standard_name	surface_downwelling_shortwave_flux_in_air	string
			_FillValue	-999	float
			valid_range	0.0 1500.0	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle dsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum dsr_product_wavelength:	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
				sum t: sum area: maximum (interval: ***see note [2]*** degree comment: good quality pixels only)	
mean_dsr	float	n/a	long_name	mean downward shortwave radiation: surface	string
			standard_name	surface_downwelling_shortwave_flux_in_air	string
			_FillValue	-999	float
			valid_range	0.0 1500.0	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle retrieval_quantitative_zenith_angle dsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum dsr_product_wavelength: sum t: sum area: mean (interval: ***see note [2]*** degree comment: good quality pixels only)	string
std_dev_dsr	float	n/a	long_name	standard deviation of downward shortwave radiation: surface values	string
			standard_name	surface_downwelling_shortwave_flux_in_air	string
			_FillValue	-999	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle dsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum dsr_product_wavelength: sum t: sum area: standard_deviation (interval: ***see note [2]*** degree comment: good quality pixels only)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			units	percent	string
			coordinates	t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_aerosol_optical_depth_550nm_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_cloud_top_phase_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_cloud_effective_particle_size_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_total_precipitable_water_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_surface_albedo_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_1_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_3_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_4_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_5_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_6_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_binary_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			input_ABI_L2_intermediate_product_fine_aerosol_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_cloud_optical_depth_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_cloud_top_height_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_global_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_NWP_total_column_ozone_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.3.6, Product Data Structures, and paragraph 4.3.7, Standard Coordinate Data, in the Global Latitude/Longitude Grid section.
Note 2: Possible values for lon, lat, and interval are 0.5 for Full Disk, 0.25 for CONUS, and 0.05 for Mesoscale.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.24.6.1, Downward Shortwave Radiation: Surface Product Flag Values and Meanings.

5.24.6.1 Downward Shortwave Radiation: Surface Product Flag Values and Meanings

Table 5.24.6.1 Downward Shortwave Radiation: Surface Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	Flag Meaning

0	good_quality_qf
1	degraded_quality_or_invalid_qf

5.25 Reflected Shortwave Radiation: Top-Of-Atmosphere Product

5.25.1 Description

The Reflected Shortwave Radiation: TOA product contains an image with pixel values identifying the instantaneous total shortwave irradiance (flux) emerging at the Earth's TOA integrated over the 0.2 to 4.0 um wavelength band pass. It includes contributions from the solar radiation reflected upward by the Earth's surface and that scattered by the atmosphere. The product includes data quality information that provides an assessment of the reflected shortwave radiation: TOA data values for on-earth pixels, including an indication of good quality, or degraded quality or invalid.

The units of measure for the reflected shortwave radiation: TOA value are "watts per square meter".

The Reflected Shortwave Radiation: TOA product image is produced on a global latitude/longitude grid at 0.25 degree resolution for Full Disk and CONUS coverage regions. Product data is produced for geolocated source data to local zenith angles of 90 degrees and solar zenith angles to 90 degrees.

The Reflected Shortwave Radiation: TOA performance requirements are summarized in Table 5.25.1, Reflected Shortwave Radiation: TOA Performance Requirements. Good quality pixels as prescribed by the algorithm are those that satisfy the measurement range and performance conditions identified therein except as noted.

Table 5.25.1 Reflected Shortwave Radiation: TOA Performance Requirements

	Measurement				Mapping
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions**	**Accuracy**
Full Disk & CONUS	0 to 1300 W/m^2	85 W/m^2 at high end of range (1000 W/m^2) 65 W/m^2 at middle of range (350 W/m^2)	100 W/m^2 for high end of range (1000 W/m^2) 130 W/m^2 for middle of range (350 W/m^2)	LZA ≤ 70 degrees daytime [1]	Full Disk: 4 km CONUS: 2 km

[1] Conditions for good quality prescribed by the algorithm are for SZA ≤ 70 degrees.

Metadata in the Reflected Shortwave Radiation: TOA product provides statistical and other properties of the product image and supports diagnosis of algorithm anomalies. Specific metadata includes:

- Start, midpoint, and end time of the product image observation period.
- Number of attempted retrievals.
- Number of attempted retrievals to local zenith angle of 70 degrees.
- Number of reflected shortwave radiation: TOA pixels whose values are outside the required measurement range.
- Cloud fraction in product image.
- Minimum, maximum, mean, and standard deviation of the solar zenith angle values for the product image's pixels.
- Minimum, maximum, mean, and standard deviation of the reflected shortwave radiation: TOA values in the product image.

The attempted retrieval count, cloud fraction, and solar zenith angle statistics are calculated using geolocated pixels to a solar zenith angle of 90 degrees. The reflected shortwave radiation: surface outlier count and other statistics are calculated using good quality pixels to a local zenith angle to 70 degrees and solar zenith angle to 70 degrees. The percentages of pixels assigned to each DQF value are also included in the product.

The detailed description of the ISO series metadata for the Reflected Shortwave Radiation: TOA product is located in the standalone Appendix X, ISO Series Metadata.

5.25.2 Dynamic Source Data

Refer to the Level 2+ Dynamic Source Data subparagraph in paragraph 5.24, Downward Shortwave Radiation: Surface Product, as this product is generated by the same algorithm.

5.25.3 Level 2+ Semi-Static Source Data

Refer to the Level 2+ Semi-Static Source Data subparagraph in paragraph 5.24, Downward Shortwave Radiation: Surface Product, as this product is generated by the same algorithm.

5.25.4 Coordinates

Refer to the Coordinates subparagraph in paragraph 5.24, Downward Shortwave Radiation: Surface Product.

5.25.5 Production Notes

Refer to the Production Notes subparagraph in paragraph 5.24, Downward Shortwave Radiation: Surface Product, as this product is generated by the same algorithm.

5.25.6 Data Fields

The Reflected Shortwave Radiation: TOA product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing a table that describes the values and meanings for the flag variable in the product.

The filename conventions for the Reflected Shortwave Radiation: TOA product are located in Appendix A.

Table 5.25.6-1 Reflected Shortwave Radiation: TOA: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	String
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	02f5ddc0-b008-11e1-afa6-0800200c9a66	string
Conventions	CF-1.7	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	ABI L2 Reflected Shortwave Radiation: Top Of Atmosphere (TOA)	string
summary	The Reflected Shortwave Radiation: TOA product consists of pixels containing the instantaneous total shortwave irradiance (flux) reflected at the Earth's top of atmosphere integrated over the 0.2 to 4.0 µm wavelength interval. The product is generated by retrieving broadband transmittance and reflectance over four scene types (clear sky over no snow/ice, clear sky over snow/ice, water cloud, and ice cloud). Other derived GOES-R products, aerosol optical depth, cloud top phase, cloud optical depth, cloud effective particle size, and total precipitable water, or reflectances from ABI bands with central wavelengths of 0.47, 0.64, 0.865, 1.378, 1.61, and 2.25 um are used to directly or indirectly, respectively, generate this product. Product data is generated during the day.	String
license	Unclassified data. Access is restricted to approved users only.	String
keywords	ATMOSPHERE > ATMOSPHERIC RADIATION > SHORTWAVE RADIATION	string
cdm_data_type	Image	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	String
platform_ID	***possible values are G16 and G17.***	String
instrument_type	GOES R Series Advanced Baseline Imager	string
instrument_ID	***serial number of the instrument.***	String
processing_level	National Aeronautics and Space Administration (NASA) L2	string
date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	NSOF	string

production_environment	***possible values are OE, ITE, and DE.***	String
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	String
timeline_id	***possible values are ABI Mode 3, ABI Mode 4 and ABI Mode 6.***	String
scene_id	***possible values are Full Disk and CONUS.***	String
spatial_resolution	***possible values are 50km at nadir for Full Disk and 25km at nadir for CONUS.***	String
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.25.6-2 Reflected Shortwave Radiation: TOA: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
lat	short	***lat = see note[1]***	long_name	latitude longitude projection lat-coordinate	string
			standard_name	latitude	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	degrees_north	string
			axis	Y	string
lon	short	***lon = see note[1]***	long_name	latitude longitude projection lon-coordinate	string
			standard_name	longitude	string
			scale_factor	***see note [1]***	float
			add_offset	***see note [1]***	float
			units	degrees_east	string
			axis	X	string
t	double	n/a	long_name	J2000 epoch mid-point between the start and end image scan in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	time_bounds	string
time_bounds	double	number_of_time_bounds = 2	long_name	scan start and end times in seconds since epoch (2000-01-01 12:00:00)	string
retrieval_local_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good or degraded quality reflected shortwave radiation: TOA data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			bounds	retrieval_local_zenith_angle_bounds	string
quantitative_local_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the satellite and the local zenith at the observation target for good quality reflected shortwave radiation: TOA data production	string
			standard_name	platform_zenith_angle	string
			units	degree	string
			bounds	quantitative_local_zenith_angle_bounds	string
retrieval_local_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good or degraded quality reflected shortwave radiation: TOA data is produced	string
quantitative_local_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_LZA_bounds = 2	long_name	local zenith angle degree range where good quality reflected shortwave radiation: TOA data is produced	string
retrieval_solar_zenith_angle ***value = 90.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good or degraded quality reflected shortwave radiation: TOA data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	retrieval_solar_zenith_angle_bounds	string
quantitative_solar_zenith_angle ***value = 70.0***	float	n/a	long_name	threshold angle between the line of sight to the sun and the local zenith at the observation target for good quality reflected shortwave radiation: TOA data production	string
			standard_name	solar_zenith_angle	string
			units	degree	string
			bounds	quantitative_solar_zenith_angle_bounds	string
retrieval_solar_zenith_angle_bounds ***value = 0.0 90.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good or degraded quality reflected shortwave radiation: TOA data is produced	string
quantitative_solar_zenith_angle_bounds ***value = 0.0 70.0***	float	number_of_SZA_bounds = 2	long_name	solar zenith angle degree range where good quality reflected shortwave radiation: TOA data is produced	string
rsr_product_wavelength ***value = 2.1***	float	n/a	long_name	central wavelength for reflected shortwave radiation: TOA product data	string
			standard_name	radiation_wavelength	string
			units	um	string
			bounds	rsr_product_wavelength_bounds	string
	float		long_name	wavelength range for reflected shortwave radiation: TOA data	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
rsr_product_wavelength_bounds ***value = 0.2 4.0***		number_of_wavelength_bounds = 2			
lat_image value = ***see note [1]***	float	n/a	long_name	latitude longitude projection lat-coordinate center of image	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
			bounds	lat_image_bounds	string
lat_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	latitude longitude projection lat-coordinate north/south extent of image	string
lon_image value = ***see note [1]***	float	n/a	long_name	latitude longitude projection lon-coordinate center of image	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
			bounds	lon_image_bounds	string
lon_image_bounds value = ***see note [1]***	float	number_of_image_bounds = 2	long_name	latitude longitude projection lon-coordinate west/east extent of image	string
goes_lat_lon_projection	int	n/a	long_name	GOES-R latitude / longitude projection	string
			grid_mapping_name	***see note [1]***	string
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			longitude_of_prime_meridian	0	double
RSR	short	***lat = see note[1]*** ***lon = see note [1]***	long_name	ABI L2+ Reflected Shortwave Radiation: TOA	string
			standard_name	toa_outgoing_shortwave_flux	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.01983824	float
			add_offset	0	float
			units	W m-2	string
			resolution	lon: 0.25 degree lat: 0.25 degree	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle rsr_product_wavelength t lat lon	string
			grid_mapping	goes_lat_lon_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: point (good or degraded quality pixel produced) quantitative_local_zenith_angle: point (good quality pixel produced) retrieval_solar_zenith_angle: point (good or degraded quality pixel produced) quantitative_solar_zenith_angle: point (good quality pixel produced) rsr_product_wavelength: sum t: point area: point	string
			ancillary_variables	DQF	string
DQF	byte	***lat = see note[1]*** ***lon = see note [1]***	long_name	ABI L2+ Reflected Shortwave Radiation: TOA data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 1	byte
			units	1	string
			coordinates	retrieval_local_zenith_angle quantitative_local_zenith_angle retrieval_solar_zenith_angle quantitative_solar_zenith_angle dsr_product_wavelength t lat lon	string
			cell_methods	retrieval_local_zenith_angle: point quantitative_local_zenith_angle: point retrieval_solar_zenith_angle: point quantitative_solar_zenith_angle: point rsr_product_wavelength: sum t: point area: point	string
			grid_mapping	goes_lat_lon_projection	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	2	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_degraded_quality_or_invalid_qf	***dynamic value***	float
retrieval_pixel_count	int	n/a	long_name	number of attempted shortwave radiation algorithm retrievals	string
			_FillValue	-1	int
			units	count	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle rsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum rsr_product_wavelength: sum t: sum area: sum (interval: 0.25 degree comment: geolocated/not missing pixels only)	string
lza_pixel_count	int	n/a	long_name	number of attempted shortwave radiation algorithm retrievals that do not exceed LZA threshold	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle retrieval_solar_zenith_angle rsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum retrieval_solar_zenith_angle: sum rsr_product_wavelength: sum t: sum area: sum (interval: 0.25 degree comment: geolocated/not missing pixels only)	string
outlier_pixel_count	int	n/a	long_name	number of reflected shortwave radiation: TOA pixels whose value is outside valid measurement range	string
			_FillValue	-1	int
			units	count	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle rsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum rsr_product_wavelength: sum t: sum area: sum (interval: 0.25 degree comment: outside valid measurement range, otherwise good quality pixels only)	string
image_cloud_fraction	float	n/a	long_name	total cloud fraction in reflected shortwave radiation: TOA image	string
			standard_name	cloud_area_fraction	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: sum (interval: 0.25 degree comment: good quality pixels only)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
minimum_sza	float	n/a	long_name	minimum solar zenith angle in reflected shortwave radiation: TOA image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 70.0	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: minimum (interval: 0.25 degree comment: geolocated/not missing pixels only)	string
maximum_sza	float	n/a	long_name	maximum solar zenith angle in reflected shortwave radiation: TOA image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 70.0	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: maximum (interval: 0.25 degree comment: geolocated/not missing pixels only)	string
mean_sza	float	n/a	long_name	mean solar zenith angle in reflected shortwave radiation: TOA image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			valid_range	0.0 70.0	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: mean (interval: 0.25 degree comment: geolocated/not missing pixels only)	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
std_dev_sza	float	n/a	long_name	standard deviation of solar zenith angle values in reflected shortwave radiation: TOA image	string
			standard_name	solar_zenith_angle	string
			_FillValue	-999	float
			units	degree	string
			coordinates	retrieval_local_zenith_angle retrieval_solar_zenith_angle t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	retrieval_local_zenith_angle: sum retrieval_solar_zenith_angle: sum t: sum area: standard_deviation (interval: 0.25 degree comment: geolocated/not missing pixels only)	string
minimum_rsr	float	n/a	long_name	minimum reflected shortwave radiation: TOA	string
			standard_name	toa_outgoing_shortwave_flux	string
			_FillValue	-999	float
			valid_range	0.0 1300.0	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle rsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum rsr_product_wavelength: sum t: sum area: minimum (interval: 0.25 degree comment: good quality pixels only)	string
maximum_rsr	float	n/a	long_name	maximum reflected shortwave radiation: TOA	string
			standard_name	toa_outgoing_shortwave_flux	string
			_FillValue	-999	float
			valid_range	0.0 1300.0	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle rsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum rsr_product_wavelength: sum t: sum area: maximum (interval: 0.25 degree comment: good quality pixels only)	string
mean_rsr	float	n/a	long_name	mean reflected shortwave radiation: TOA	string
			standard_name	toa_outgoing_shortwave_flux	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999	float
			valid_range	0.0 1300.0	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle rsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum rsr_product_wavelength: sum t: sum area: mean (interval: 0.25 degree comment: good quality pixels only)	string
std_dev_rsr	float	n/a	long_name	standard deviation of reflected shortwave radiation: TOA values	string
			standard_name	toa_outgoing_shortwave_flux	string
			_FillValue	-999	float
			units	W m-2	string
			coordinates	quantitative_local_zenith_angle quantitative_solar_zenith_angle rsr_product_wavelength t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	quantitative_local_zenith_angle: sum quantitative_solar_zenith_angle: sum rsr_product_wavelength: sum t: sum area: standard_deviation (interval: 0.25 degree comment: good quality pixels only)	string
percent_uncorrectable_GRB_errors	float	n/a	long_name	percent data lost due to uncorrectable GRB errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	t: sum area: sum (uncorrectable GRB errors only)	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	t lat_image lon_image	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	t: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
value = 0.00			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_ABI_L2_auxiliary_solar_zenith_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data	***refer to filename conventions for L2+ products in Appendix A.***	string
			input_ABI_L2_aerosol_optical_depth_550nm_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_cloud_top_phase_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_cloud_effective_particle_size_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_total_precipitable_water_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_surface_albedo_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_1_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	***refer to filename conventions for L1b products in Appendix A of PUG L1b volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_3_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_4_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_5_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_reflectance_band_6_2km_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_binary_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			input_ABI_L2_intermediate_product_fine_aerosol_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_cloud_optical_depth_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_ABI_L2_intermediate_product_cloud_top_height_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_global_snow_mask_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_NWP_total_precipitable_water_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
			input_dynamic_ancillary_NWP_total_column_ozone_data	***refer to filename conventions for L2+ products in Appendix A of PUG L2+ volume.***	String
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L2_processing_parm_version	***refer to filename conventions for L2+ Semi-Static parameter filenames in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	String

Note 1: Coverage region and horizontal spatial resolution related sizing and extent variable and attribute values are located in paragraph 4.3.6, Product Data Structures, and paragraph 4.3.7, Standard Coordinate Data, in the Global Latitude/Longitude Grid section.
Note "flags and meanings": Flag values and meanings are located in paragraph 5.25.6.1, Reflected Shortwave Radiation: TOA Product Flag Values and Meanings.

5.25.6.1 Reflected Shortwave Radiation: TOA Product Flag Values and Meanings

Table 5.25.6.1 Reflected Shortwave Radiation: TOA Product Data Quality Flag Values and Meanings

Data Quality Flags (DQF)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	degraded_quality_or_invalid_qf

5.26 Lightning Detection Product

5.26.1 Description

The Lightning Detection product contains a list of lightning flashes, and their constituent groups and events. Refer to Figure 5.26.1-1, Lightning Detection Product Data Relationships.

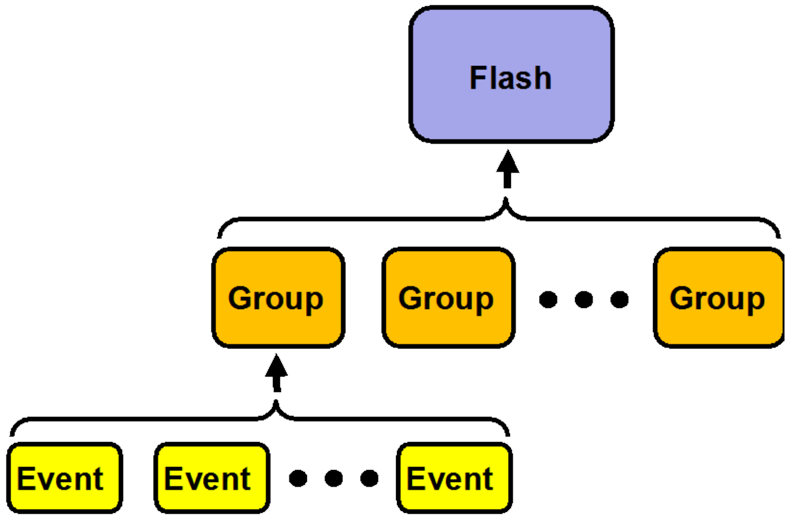

Figure 5.26.1-1 Lightning Detection Product Data Relationships

The definition of and relationship among flashes, groups, and events are governed by the following spatial and temporal characteristics:

- An event represents the signal detected from the cloud top associated with a lightning emission in an individual sensor pixel for a 2 ms integration period.
- A group represents the events detected in adjacent sensor pixels for the same integration period as an event.
- A flash represents a series of measurements constrained by temporal and spatial extent thresholds that are associated with one or more groups.

The parent, child relationship among specific flashes, groups, and events is stored in the product. Data for each flash includes an energy-weighted centroid latitude, longitude location, time span of occurrence, amount of radiant energy, and coverage area. Data for each group includes an energy-weighted centroid latitude, longitude location, mean time of occurrence, amount of radiant energy, and coverage area. Data for each event includes a latitude, longitude location, time of occurrence, and amount of radiant energy. The product includes data quality information for each flash and group, including an indication of good or degraded quality, and the rationale.

A Lightning Detection product contains a set of flashes, and its constituent groups and events for a nominally 20.5 second period, corresponding to a nominal twenty 1.024 second blocks.

The units of measure for the flash, group, and event radiant energy values are "joules". The units of measure for the flash and group coverage areas are "square kilometers".

The coverage area for the lightning detection product is defined in Table 5.26.1-1 Lighting Detection Product Field of View Center and Extents.

Table 5.26.1-1 Lightning Detection Product Field of View Center and Extents

latitude is degrees north longitude is degrees east	**GOES-R East**	**GOES-R West**	**GOES-R Test**
nominal_satellite_subpoint_lat / lat_field_of view (center)	0.0	0.0	0.0
nominal_satellite_subpoint_lon / lon_field_of view (center)	-75.0	-137.0	-89.5
lat_field_of view_bounds (1) (north)	66.56	66.56	66.56
lat_field_of view_bounds (2) (south)	-66.56	-66.56	-66.56
lon_field_of view_bounds (1) (west)	-141.56	-203.56	-156.06
lon_field_of view_bounds (2) (east)	-8.44	-70.44	-22.94

Note that the field of view is not a rectangle in latitude, longitude space as implied with the field-of-view values in the table. The corners of the instrument field of view are rounded. See Figure 5.26.1-2.

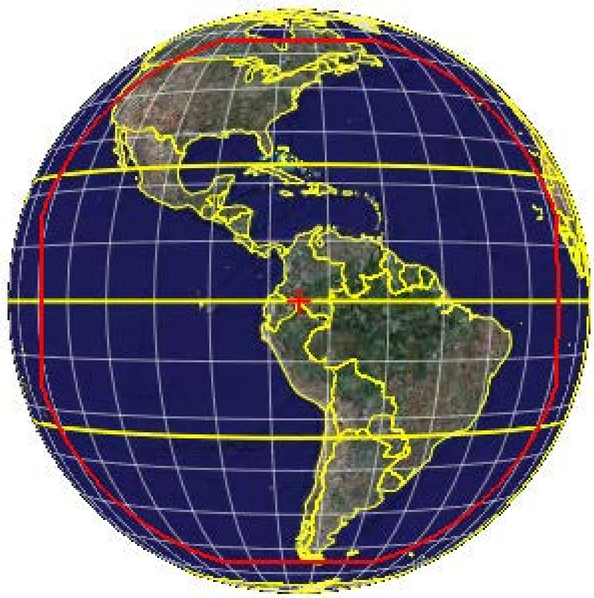

Figure 5.26.1-2 GLM Field of View

The Lightning Detection performance requirements are summarized in Table 5.26.1-2, Lightning Detection Performance Requirements.

Table 5.26.1-2 Lightning Detection Performance Requirements

	Measurement				**Mapping**	
Region	**Range**	**Accuracy**	**Precision**	**Performance Conditions**	**Resolution**	**Accuracy**
GLM Instrument Field of View	Not specified	Flash probability of detection: 70% [1]	Flash false alarm rate: 5% [1]	LZA $\leq$ 65 degrees [2]	10 km (average)[3]	5 km

[1] Flash probability of detection and false alarm rate are computed as averages with equal weight given to all sensor pixels (i.e., potential events).
[2] Conditions for good quality prescribed by the algorithm do not include LZA ≤ 65 degrees.
[3] Actual event horizontal spatial resolution is 8 km at nadir, 14 km at the edge of the field of view. Requirement is 10 km (average across the field of view).

Metadata in the Lightning Detection product provides observation period, lightning detection statistics, and satellite state information. Specific metadata includes:

- Approximate start and end time of the observation period
- Number of flashes, groups, and events
- Satellite yaw flip configuration

The percentages of pixels assigned to each flash and group DQF value are also included in the product.

The detailed description of the ISO series metadata for the Lightning Detection product is located in the standalone Appendix X, ISO Series Metadata.

5.26.2 Dynamic Source Data

The Lightning Detection product is derived using the GLM Level 0 raw science and engineering telemetry over an approximate 20.5 second period.

The primary sensor data used by the Lightning Detection algorithm is identified in Table 5.26.2, Primary Sensor Data.

Table 5.26.2 Primary Sensor Data

Dynamic Data Category	Dynamic Data Type
L0 Products	input_GLM_L0_data

5.26.3 Level 1b and Level 2+ Semi-Static Source Data

There are three categories of semi-static source data employed in the GLM Level 1b ground processing algorithm:

- Radiometric calibration parameters
- Geometric calibration parameters
- Algorithm processing parameters

Semi-static source data files from the three categories above are contained in a single zip file, rolled up to the instrument level - all GLM semi-static parameter files are in one zip file. Some files fit into more than one category. The filename conventions for the Level 2 semi-static source data files are located in Appendix A, Table A.3-1.

Radiometric calibration parameters are those associated with the instrument's radiometric observing characteristics, or its raw outputs. Specific types include:

- CCD sizing parameters
- Background sizing parameters
- Data formatter and RTEP to CCD subarray mapping table
- 32 possible background levels of the five most significant bits of the 14-bit event background, which is used to index into the event energy calibration lookup table
- CCD constants used to determine event pixel coordinates
- GLM event real time event processor and data formatter to detector focal plane mapping.
- Masked region lookup table
- Minimum count for valid lightning event cluster
- Radiometric calibration lookup table as function of event RTEP count, background energy level, and pixel location in RTEP
- Event pixel amplitude thresholds

Following are the file names of radiometric calibration parameters within the zip file. HDF5 files are internally self-describing. Date qualifiers and other version-specific information have been removed from the file names.

- GLM_CALINR_AllFilters.h5
- AI_GLM-L2-GLMSemiStaticParams.bin

Geometric calibration parameters are those associated with the precise look angle and size of the instrument's field of view. Specific types include:

- CCD temperature, lens assembly, and bipod calibration coefficients
- Lens assembly reference/nominal temperature and thermal coefficient
- Reference and nominal effective focal length
- Optical distortion and thermal expansion coefficients
- CCD distortion coefficient matrix
- Bipod reference locations, and temperature correction constants
- FPGA configuration bias angles.
- Nominal lightning elevation above the geoid
- Pixel size parameters
- Maximum x, y, and radius of CCD field of view
- Location, attitude, and attitude rate parameters
- Satellite sub-point longitude
- Earth reference ellipsoid parameters

Following are the file names of geometric calibration parameters within the zip file. XML files are internally self-describing. Date qualifiers and other version-specific information have been removed from the file names.

- GLMNavigationParams.xml
- GLMNavigationParams.bin
- GLM_LSRLUT.bin
- AI_GLM-L2-GLMSemiStaticParams.bin

Algorithm processing parameters are those associated with configurable decision-making logic in the algorithm related to numerous filter behaviors, coherency filter factors and tuning parameters. Specific types include:

- Pixel padding, and time and probability factors used in the coherency filter
- Event filter activation control switch
- Contrast leakage, radiation track, and CCD frame transfer noise filter factors
- Probability event is false as function of its amplitude and background

There is one category of semi-static source data employed in the GOES-R GLM Lightning Cluster-Filter ground-processing algorithm:

- Algorithm-specific parameters

The algorithm-specific parameters represent parameters that are unique to the GLM Lightning Cluster-Filter algorithm. Some of these parameters may be tuned for the specific characteristics of the GLM instrument. These include:

- Spatial and temporal thresholds for the identification of groups and flashes.
- Maximum thresholds on group and flash durations and on group and flash child limits.
- Look-up table for pixel solid angle.
- Look-up table for pixel area.
- Scales and offsets applied to output group/flash energies and areas, to the event latitude and longitude, and to the event/group/flash times.

Following are the file names of algorithm parameters within the zip file. XML files are internally self-describing. Date qualifiers and other version-specific information have been removed from the file names.

- GLM_L0_NcML_Metadata_Template.xml
- glm_metadata_config.xml
- GLM_LSRLUT.bin
- AI_GLM-L2-GLMSemiStaticParams.bin

The filename conventions for the GLM Level 1b and Level 2+ semi-static source data file are located in Appendix A.

5.26.4 Coordinates

The coordinates associated with data variables in the Lightning Detection product are identified in Table 5.26.4, Lightning Detection Product Coordinates.

Table 5.26.4 Lightning Detection Product Coordinates

Lightning Detection Product Data Quantity	Coordinates
event energy data	• Event identifier • Observation time • Latitude and longitude for event • Wavelength range of data • Event to parent group mapping
group area data group energy data group data quality flags	• Group identifier • Observation time • Latitude and longitude for group centroid • Wavelength range of data • Group time threshold • Group to parent flash mapping (group area and group energy only) • Event to parent group mapping (group area and group energy only)
flash area data flash energy data flash data quality flags	• Flash identifier • Observation time period • Latitude and longitude for flash centroid • Wavelength range of data • Flash time threshold • Group to parent flash mapping (flash area and flash energy only)
event count group count flash count percent_navigated_L1b_events	• Observation time period for product data • Latitude and longitude extents for field of view geo-location • Wavelength range of data
data transmission error percentages	• Observation time period

	• Latitude and longitude extents for field of view geo-location

5.26.5 Production Notes

The Lightning Detection product is generated by the sequential execution of Level 0, Level 1b and Level 2+ ground processing algorithms. The Level 2+ algorithm is the GOES-R GLM Lightning Cluster-Filter algorithm. The Level 0 algorithm decompresses and extracts events and GLM background image data from the CCSDS packets.

The GLM instrument detects areas of potential lightning by capturing optical images of the Earth in its field of view, and identifying potential lightning events based on transient emissions from the tops of cloud. GLM Level 1b algorithm ground processing filters false lightning events using spatial and temporal thresholds and tracking tests. Each event remaining after filtering is radiometrically corrected, navigated to latitude, longitude coordinates, and time-tagged. The time-tag is corrected for light propagation time from cloud to satellite.

The Level 2+ Lightning Detection algorithm clusters the events into groups and flashes based on spatial and temporal threshold parameters. Events, groups, and flashes are related in a tree-like structure with each flash made up of a unique set of groups and each group made up of a unique set of events. Refer to Figure 5.26.1, Lightning Detection Product Data Relationships. For each group and flash, the centroid location is its optically-weighted position, the energy is the sum of its events' energies, and its area is the sum of the areas covered by its events' pixels. Flashes from cloud-to-ground lightning and intra-cloud lightning are not distinguished. The wavelength of the radiant energy sensed by the instrument is from 776.87 to 777.87 nm at half the maximum of the spectral response function.

The Level 1b and Level 2+ processing algorithms are executed at a cadence of once per second. The flashes for which processing has completed are included in the nominally 20.5 second products. This means that event, group, time stamp values may be prior to the nominally 20.5 second period associated with the particular product instance. These algorithms are designed subject to requirements for the maximum event, group, and flash rates to ensure that ground system processing operates at the data rate for lightning in the sensor's field of view.

For product refresh rate and latency information, refer to Appendix B, Product Refresh Rates and Latencies.

For additional details on the Level 2+ Lightning Detection ground processing algorithm, and the expected performance, refer to the NOAA NESDIS Center for Satellite Applications and Research GOES-R Advanced Baseline Imager Algorithm Theoretical Basis Document for the GLM Lightning Cluster-Filter Algorithm. This document is located at
http://www.goes-r.gov/products/ATBDs/baseline/Lightning_v2.0_no_color.pdf

5.26.6 Data Fields

The Lightning Detection product is delivered using the netCDF-4 file format. This product does not conform to the netCDF classic data model because it makes use of multiple unlimited dimensions. Its global attributes and the variables are defined in the tables that follow. Following the product specification tables is a subordinate paragraph containing tables that describe the values and meanings for the flag variables in the product.

The filename conventions for the Lightning Detection product are located in Appendix A.

Table 5.26.6-1 Lightning Detection: Global Attributes

Global Attribute Name	Value	Type
id	***attribute is added dynamically when the file is created.***	string
featureType	point	string
dataset_name	***refer to filename conventions for L2+ products in Appendix A.***	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	f5816f53-fd6d-11e3-a3ac-0800200c9a66	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
standard_name_vocabulary	CF Standard Name Table (v25, 05 July 2013)	string
title	GLM L2 Lightning Detections: Events, Groups, and Flashes	string
summary	The Lightning Detections: Events, Groups, and Flashes product consists of a hierarchy of earth-located lightning radiant energy measures including events, groups, and flashes. Lightning events are detected by the instrument. Lightning groups are a collection of one or more lightning events that satisfy temporal and spatial coincidence thresholds. Similarly, lightning flashes are a collection of one or more lightning groups that satisfy temporal and spatial coincidence thresholds. The product includes the relationship among lightning events, groups, and flashes, and the area coverage of lightning groups and flashes. The product also includes processing and data quality metadata, and satellite state and location information.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	ATMOSPHERE > ATMOSPHERIC ELECTRICITY > LIGHTNING, ATMOSPHERE > ATMOSPHERIC PHENOMENA > LIGHTNING	string
cdm_data_type	Point	string
orbital_slot	***possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.***	string
platform_ID	***possible values are G16 and G17.***	string
instrument_type	GOES-R Series Geostationary Lightning Mapper	string
instrument_ID	***serial number of the instrument (sensor).***	string
processing_level	National Aeronautics and Space Administration (NASA) L2	string

date_created	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
production_site	***possible values are WCDAS and RBU.***	string
production_environment	***possible values are OE, ITE, and DE.***	string
production_data_source	***possible values are Realtime, Simulated, Playback, and Test.***	string
spatial_resolution	8km at nadir	string
time_coverage_start	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string
time_coverage_end	***format is YYYY-MM-DD"T"HH:MM:SS.s"Z".***	string

Table 5.26.6-2 Lightning Detection: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
event_lat	short	***number_of_events* = *unlimited***	long_name	GLM L2+ Lightning Detection: event latitude coordinate	string
			standard_name	latitude	string
			_Unsigned	TRUE	string
			scale_factor	0.00203128	float
			add_offset	-66.56	float
			units	degrees_north	string
			axis	Y	string
event_lon	short	***number_of_events* = *unlimited***	long_name	GLM L2+ Lightning Detection: event longitude coordinate	string
			standard_name	longitude	string
			_Unsigned	TRUE	string
			scale_factor	0.00203128	float
			add_offset	***see note [1]***	float
			units	degrees_east	string
			axis	X	string
group_lat	float	***number_of_groups* = *unlimited***	long_name	GLM L2+ Lightning Detection: group centroid (mean constituent event latitude weighted by their energies) latitude coordinate	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
group_lon	float	***number_of_groups* = *unlimited***	long_name	GLM L2+ Lightning Detection: group centroid (mean constituent event latitude weighted by their energies) longitude coordinate	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
flash_lat	float	***number_of_flashes* = *unlimited***	long_name	GLM L2+ Lightning Detection: flash centroid (mean constituent event latitude weighted by their energies) latitude coordinate	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
flash_lon	float	***number_of_flashes* = *unlimited***	long_name	GLM L2+ Lightning Detection: flash centroid (mean constituent event latitude weighted by their energies) longitude coordinate	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
product_time	double	n/a	long_name	start time of observations associated with product, in seconds since 2000-01-01 12:00:00	string
			standard_name	time	string
			units	seconds since 2000-01-01 12:00:00	string
			axis	T	string
			bounds	product_time_bounds	string
product_time_bounds	double	number_of_time_bounds = 2	long_name	start and end time of observations associated with product in seconds since J2000 epoch (2000-01-01 12:00:00)	string
event_time_offset	short	***number_of_events* = *unlimited***	long_name	GLM L2+ Lightning Detection: event's time of occurrence	string
			standard_name	time	string
			scale_factor	1	float
			add_offset	0	float
			units	milliseconds since ***see note [2***]	string
group_time_offset	short	***number_of_groups* = *unlimited***	long_name	GLM L2+ Lightning Detection: mean time of group's constituent events' times of occurrence	string
			standard_name	time	string
			scale_factor	2	float
			add_offset	0	float
			units	milliseconds since ***see note [2]***	string
flash_time_offset_of_first_event	short	***number_of_flashes* = *unlimited***	long_name	GLM L2+ Lightning Detection: time of occurrence of first constituent event in flash	string
			standard_name	time	string
			scale_factor	2	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			add_offset	0	float
			units	milliseconds since ***see note [2]***	string
flash_time_offset_of_last_event	short	***number_of_flashes = unlimited***	long_name	GLM L2+ Lightning Detection: time of occurrence of last constituent event in flash	string
			standard_name	time	string
			scale_factor	2	float
			add_offset	0	float
			units	milliseconds since ***see note [2]***	string
lightning_wavelength ***value = 777.37***	float	n/a	long_name	central wavelength for lightning data	string
			standard_name	sensor_band_central_radiation_wavelength	string
			units	nm	string
			bounds	lightning_wavelength_bounds	string
lightning_wavelength_bounds ***value = 776.87 777.87***	float	number_of_wavelength_bounds = 2	long_name	wavelength range lightning data (full width at half the maximum of the response function)	string
group_time_threshold ***value = 0.0***	float	n/a	long_name	lightning group maximum time difference among lightning events in a group	string
			units	s	string
flash_time_threshold ***value = 3.33***	float	n/a	long_name	lightning flash maximum time difference among lightning events in a flash	string
			units	s	string
lat_field_of_view ***value = 0.0***	float	n/a	long_name	latitude coordinate for center of field of view	string
			standard_name	latitude	string
			units	degrees_north	string
			axis	Y	string
			bounds	lat_field_of_view_bounds	string
lat_field_of_view_bounds ***value = 66.56 -66.56***	float	number_of_field_of_view_bounds = 2	long_name	latitude coordinates for north/south extent of field of view	string
lon_field_of_view value = ***see note [1]***	float	n/a	long_name	longitude coordinate for center of field of view	string
			standard_name	longitude	string
			units	degrees_east	string
			axis	X	string
			bounds	lon_field_of_view_bounds	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
lon_field_of_view_bounds value = ***see note [1]***	float	number_of_field_of_view_bounds = 2	long_name	longitude coordinates for west/east extent of field of view	string
event_id	int	***number_of_events*** = ***unlimited***	long_name	product-unique lightning event identifier	string
			_Unsigned	TRUE	string
			units	1	string
group_id	int	***number_of_groups*** = ***unlimited***	long_name	product-unique lightning group identifier	string
			_Unsigned	TRUE	string
			units	1	string
flash_id	short	***number_of_flashes*** = ***unlimited***	long_name	product-unique lightning flash identifier	string
			_Unsigned	TRUE	string
			units	1	string
event_parent_group_id	int	***number_of_events*** = ***unlimited***	long_name	product-unique lightning group identifier for one or more events	string
			_Unsigned	TRUE	string
			units	1	string
group_parent_flash_id	short	***number_of_groups*** = ***unlimited***	long_name	product-unique lightning flash identifier for one or more groups	string
			_Unsigned	TRUE	string
			units	1	string
goes_lat_lon_projection	int	n/a	long_name	GOES-R latitude / longitude projection	string
			grid_mapping_name	goes_lat_lon_projection	string
			semi_major_axis	6378137	double
			semi_minor_axis	6356752.314	double
			inverse_flattening	298.2572221	double
			longitude_of_prime_meridian	0	double
event_energy	short	***number_of_events*** = ***unlimited***	long_name	GLM L2+ Lightning Detection: event radiant energy	string
			standard_name	lightning_radiant_energy	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			scale_factor	1.52597E-15	float
			add_offset	3.0E-15	float
			units	J	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			coordinates	event_parent_group_id event_id lightning_wavelength event_time_offset event_lat event_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum event_time_offset: point (sensor pixels have 2 ms integration time) area: sum (interval: 8 km comment: resolution of sensor data at nadir, filtered events only) where cloud	string
group_area	short	***number_of_groups = unlimited***	long_name	GLM L2+ Lightning Detection: group area coverage (pixels containing at least one constituent event only)	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.15163901	float
			add_offset	63.09573445	float
			units	km2	string
			coordinates	group_parent_flash_id event_parent_group_id group_id lightning_wavelength group_time_threshold group_time_offset group_lat group_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum group_time_offset: mean (times of occurrence of group's constituent events defined by variable event_parent_group_id) area: sum (interval: 8 km comment: resolution of sensor data at nadir, adjacent pixels only, including the diagonal, in sensor focal plane array) where cloud	string
group_energy	short	***number_of_groups = unlimited***	long_name	GLM L2+ Lightning Detection: group radiant energy	string
			standard_name	lightning_radiant_energy	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	1.52597E-15	float
			add_offset	3.0E-15	float
			units	J	string
			coordinates	group_parent_flash_id event_parent_group_id group_id lightning_wavelength group_time_threshold group_time_offset group_lat group_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_measures	area: group_area	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			cell_methods	lightning_wavelength: sum group_time_offset: mean (times of occurrence of group's constituent events defined by variable event_parent_group_id) area: mean (centroid location of constituent events defined by variable event_parent_group_id weighted by their radiant energies) where cloud	string
			ancillary_variables	group_quality_flag	string
group_quality_flag	short	***number_of_groups = unlimited***	long_name	GLM L2+ Lightning Detection: group data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 5	short
			units	1	string
			coordinates	group_id lightning_wavelength group_time_threshold group_time_offset group_lat group_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum group_time_offset: mean (times of occurrence of group's constituent events defined by variable event_parent_group_id) area: mean (centroid location of constituent events defined by variable event_parent_group_id weighted by their radiant energies) where cloud	string
			flag_values	***see note [flags and meanings]***	short
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_degraded_due_to_group_constituent_events_out_of_time_order_or_parent_flash_abnormal_qf	***dynamic value***	float
			percent_degraded_due_to_group	***dynamic value***	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_constituent_event_count_exceeds_threshold_qf		
			percent_degraded_due_to_group_duration_exceeds_threshold_qf	***dynamic value***	float
flash_area	short	***number_of_flashes = unlimited***	long_name	GLM L2+ Lightning Detection: flash area coverage (pixels containing at least one constituent event only)	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	0.15163901	float
			add_offset	63.09573445	float
			units	km2	string
			coordinates	group_parent_flash_id flash_id lightning_wavelength flash_time_threshold flash_time_offset_of_first_event flash_time_offset_of_last_event flash_lat flash_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum flash_time_offset_of_first_event: flash_time_offset_of_last_event: sum area: sum (interval: 8 km comment: resolution of sensor data at nadir, area of constituent groups' areas defined by variable group_parent_flash_id) where cloud	string
flash_energy	short	***number_of_flashes = unlimited***	long_name	GLM L2+ Lightning Detection: flash radiant energy	string
			standard_name	lightning_radiant_energy	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 65530	short
			scale_factor	1.52597E-15	float
			add_offset	3.0E-15	float
			units	J	string
			coordinates	group_parent_flash_id flash_id lightning_wavelength flash_time_threshold flash_time_offset_of_first_event flash_time_offset_of_last_event flash_lat flash_lon	string
			grid_mapping	goes_lat_lon_projection	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			cell_measures	area: flash_area	string
			cell_methods	lightning_wavelength: sum flash_time_offset_of_first_event: flash_time_offset_of_last_event: sum area: mean (centroid location of constituent events defined by variables group_parent_flash_id and event_parent_group_id weighted by their radiant energies) where cloud	string
			ancillary_variables	flash_quality_flag	string
flash_quality_flag	short	***number_of_flashes = unlimited***	long_name	GLM L2+ Lightning Detection: flash data quality flags	string
			standard_name	status_flag	string
			_Unsigned	TRUE	string
			_FillValue	65535	short
			valid_range	0 5	short
			units	1	string
			coordinates	flash_id lightning_wavelength flash_time_threshold flash_time_offset_of_first_event flash_time_offset_of_last_event flash_lat flash_lon	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum flash_time_offset_of_first_event: flash_time_offset_of_last_event: sum area: mean (centroid location of constituent events defined by variables group_parent_flash_id and event_parent_group_id weighted by their radiant energies) where cloud	string
			flag_values	***see note [flags and meanings]***	short
			flag_meanings	***see note [flags and meanings]***	string
			number_of_qf_values	4	byte
			percent_good_quality_qf	***dynamic value***	float
			percent_degraded_due_to_flash_constituent_events_out_of_time_order_qf	***dynamic value***	float
			percent_degraded_due_to_flash_	***dynamic value***	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			constituent_event_count_exceeds_threshold_qf		
			percent_degraded_due_to_flash_duration_exceeds_threshold_qf	***dynamic value***	float
event_count	int	n/a	long_name	number of lightning events in product	string
			_FillValue	-1	int
			valid_range	1 630000	int
			units	count	string
			coordinates	lightning_wavelength product_time lat_field_of_view lon_field_of_view	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum product_time: sum area: sum (filtered events only) where cloud	string
group_count	int	n/a	long_name	number of lightning groups in product	string
			_FillValue	-1	int
			valid_range	1 630000	int
			units	count	string
			coordinates	lightning_wavelength product_time lat_field_of_view lon_field_of_view	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum product_time: sum area: sum where cloud	string
flash_count	int	n/a	long_name	number of lightning flashes in product	string
			_FillValue	-1	int
			valid_range	1 630000	int
			units	count	string
			coordinates	lightning_wavelength product_time lat_field_of_view lon_field_of_view	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum product_time: sum area: sum where cloud	string
percent_navigated_L1b_events	float	n/a	long_name	after false event filtering, percent of lightning events navigated by instrument	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			_FillValue	-999.0	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	lightning_wavelength product_time lat_field_of_view lon_field_of_view	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	lightning_wavelength: sum product_time: sum area: sum (filtered, and filtered and navigated lightning events only) where cloud	string
yaw_flip_flag	byte	n/a	long_name	Flag indicating spacecraft is operating in yaw flip configuration	string
			_Unsigned	TRUE	string
			_FillValue	255	byte
			valid_range	0 2	byte
			units	1	string
			coordinates	product_time	string
			cell_methods	product_time: sum	string
			flag_values	***see note [flags and meanings]***	byte
			flag_meanings	***see note [flags and meanings]***	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
			coordinates	product_time lat_field_of_view lon_field_of_view	string
			grid_mapping	goes_lat_lon_projection	string
			cell_methods	product_time: sum area: sum (uncorrectable L0 errors only)	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999	float
			units	degrees_east	string
nominal_satellite_height	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
value = 35786.023			_FillValue	-999	float
			units	km	string
algorithm_dynamic_input_data_container	int	n/a	long_name	container for filenames of dynamic algorithm input data	string
			input_GLM_L0_data	***refer to filename conventions for L0 products in Appendix A.***	string
			input_GLM_L1b_data	***refer to filename conventions for L1b products in Appendix A.***	string
processing_parm_version_container	int	n/a	long_name	container for processing parameter filenames	string
			L1b_processing_parm_version	***refer to filename conventions for L1b processing parameters in Appendix A.***	string
algorithm_product_version_container	int	n/a	long_name	container for algorithm package filename and product version	string
			algorithm_version	***refer to filename conventions for L2+ algorithm packages in Appendix A.***	string
			product_version	***format is vVVrRR where VV is major release # and RR is minor revision #.***	string

Note 1: Coverage region extent variable and attribute values are located in Table 5.26.1-1, Lightning Detection Product Field of View Center and Extents. Note that the value of add_offset attribute for event_lon variable is the same as lon_field_of view_bounds (1) in Table 5.26.1-1.
Note 2: Time value is product_time in format YYYY-MM-DD HH:MM:SS.sss (e.g., "milliseconds since 2016-10-05 13:12:44.839").
Note "flags and meanings": Flag values and meanings are located in paragraph 5.26.6.1, Lightning Detection Product Flag Values and Meanings.

5.26.6.1 Lightning Detection Product Flag Values and Meanings

Table 5.26.6.1-1 Lightning Detection Product Group Data Quality Flag Values and Meanings

Group Data Quality Flags (group_quality_flag)	
Flag Value	**Flag Meaning**
0	good_quality_qf
1	degraded_due_to_group_constituent_events_out_of_time_order_or_parent_flash_abnormal_qf
3	degraded_due_to_group_constituent_event_count_exceeds_threshold_qf
5	degraded_due_to_group_duration_exceeds_threshold_qf

Table 5.26.6.1-2 Lightning Detection Product Flash Data Quality Flag Values and Meanings

Flash Data Quality Flags (flash_quality_flag)	
Flag Value	**Flag Meaning**

0	good_quality_qf
1	degraded_due_to_flash_constituent_events_out_of_time_order_qf
3	degraded_due_to_flash_constituent_event_count_exceeds_threshold_qf
5	degraded_due_to_flash_duration_exceeds_threshold_qf

Table 5.26.6.1-3 Lightning Detection Product Satellite Yaw Flip Flag Values and Meanings

Satellite Yaw Flip Flags (yaw_flip_flag)	
Flag Value	**Flag Meaning**
0	UPRIGHT
1	NEITHER
2	INVERTED

APPENDIX A L2+ PRODUCT, DATA, METADATA AND ALGORITHM PACKAGE FILENAME CONVENTION

The main volume of the PUG contains a summary level description of the filename conventions used for all GOES-R product and data files. This appendix contains the detailed filename conventions for Level 2+ products and data files defined in this volume of the PUG.

As discussed in the main volume of the PUG, filenames consist of a set of string fields delimited by underscores or a period that are concatenated together. The content and format of several of the filename string fields are common across more than one of the Level 1b product and data filenames. Refer to Table A-1, Common Filename String Fields.

Table A-1 Common Filename String Fields

Common String Field	Description	Values and Meanings
System Environment	Defines whether the file is created by the operational system or a test system. Also defines whether the data in the file is real-time, test, playback, or simulated data.	"OR" = operational system real-time data "OT" = operational system test data "IR" = test system real-time data "IT" = test system test data "IP" = test system playback data "IS" = test system simulated data Note: Real-time data created by the operational system (i.e., "OR") support the operational mission.
Platform Identifier	Identifies the applicable GOES-R series satellite.	"G16" = GOES-16 (R) "G17" = GOES-17 (S)
Observation Period Date & Time	Start & end date & time of the raw or processed observation data in the file.	"sYYYYDDDHHMMSSs" = start date & time "eYYYYDDDHHMMSSs" = end date & time Notes: ➢ YYYY = year: e.g., 2015 ➢ DDD = day of year: 001-366 ➢ HH = UTC hour of day: 00-23 ➢ SSs = second of minute: 00-60 (60 indicates leap second and third "s" is tenth of second)
Creation Date & Time	Date & time the file is created.	"cYYYYDDDHHMMSSs" Notes: ➢ YYYY = year: e.g., 2015 ➢ DDD = day of year: 001-366 ➢ HH = UTC hour of day: 00-23 ➢ MM = minute of hour: 00-59 ➢ SSs = second of minute: 00-59 (60 indicates leap second and third "s" is tenth of second)
Version	Version associated with the data file. Composed of a major version & minor revision number.	"vVVrRR" Notes: ➢ VV = major version number: 01-99 ➢ RR = minor revision number: 00-Z9

Table A-2, Appendix A Filename Convention Paragraphs for Specific Level 2+ Product or Data Types, identifies the subordinate paragraph where Level 2+ product and data unique Data Set Names (DSNs), and product and data specific file extensions are defined. In addition, example filenames are included in the subordinate paragraphs.

Table A-2 Appendix A Filename Convention Paragraphs

Level 2+ Product or Source Data	Appendix A Paragraph
Level 2+ Products	Paragraph A.1
Level 2+ Intermediate Products	Paragraph A.2
Level 2+ Semi-Static Source Data	Paragraph A.3
Level 2+ Algorithm Packages	Paragraph A.4
Level 2+ ISO Series Metadata	Paragraph A.5

A.1 Level 2+ Product Filenames

Level 2+ product filenames are assembled using filename string fields as follows:

<System Environment>_<DSN>_<Platform ID>_<Observation Period Start Date & Time> _<Observation Period End Date & Time> _<Creation Date & Time>.<File Extension>

The string fields other than DSN and file extension are defined above in Table A-1, Common Filename String Fields. The DSN for Level 2+ products include the following sub-fields:

- Instrument and processing level
- Product acronym
- ABI image type
- ABI mesoscale image number
- ABI mode
- ABI channel

The DSNs for the Lightning Detection product is composed of one string fields. The DSN for the Lighting Detection product is "GLM-L2-LCFA".

The DSN for the ABI Level 2+ products is composed of four or five sub-fields except for the Cloud and Moisture Imagery and Derived Motion Winds products. The fourth sub-field is needed to distinguish between the two different mesoscale regions observed during ABI mode 3 or ABI mode 6. The Cloud and Moisture Imagery and Derived Motion Winds products are composed of five or six sub-fields. The sixth sub-field is needed to identify the ABI channel (i.e., band) associated with these products. Refer to Table A.1 for an understanding of the DSN sub-fields used in Level 2+ product filenames.

Table A.1 Level 2+ Product Filename DSN Sub-Fields

Level 2+ Product DSN Sub-Field	Values and Meanings
Instrument & Processing Level	"ABI-L2" = Advanced Baseline Imager Level 2+
Product Acronym	"-ACHA" = Cloud Top Height "-ACHT" = Cloud Top Temperature "-ACM" = Clear Sky Masks "-ACTP" = Cloud Top Phase "-ADP" = Aerosol Detection "-AOD" = Aerosol Optical Depth "-CMIP" = Cloud & Moisture Imagery "-MCMIP" = Cloud & Moisture Imagery Multiband

Level 2+ Product DSN Sub-Field	Values and Meanings
	"-COD" = Cloud Optical Depth "-CPS" = Cloud Particle Size Distribution "-CTP" = Cloud Top Pressure "-DMW" = *Derived Motion Winds for ABI bands 2, 7, 8, 9, 10 & 14 "-DMWV" = *Derived Motion Winds for ABI bands 8 "-DSI" = Derived Stability Indices "-DSR" = Downward Shortwave Radiation: Surface "-FDC" = Fire / Hot Spot Characterization "-FSC" = Snow Cover "-HIE" = Hurricane Intensity "-LST" = Land Surface (Skin) Temperature "-LVMP" = Legacy Vertical Moisture Profile "-LVTP" = Legacy Vertical Temperature Profile "-RRQPE" = Rainfall Rate/QPE "-RSR" = Reflected Shortwave Radiation: TOA "-SST" = Sea Surface (Skin) Temperature "-TPW" = Total Precipitable Water "-VAA" = Volcanic Ash: Detection & Height
ABI Image Type	"F" = Full Disk "C" = CONUS "M" = Mesoscale
ABI Mesoscale Image Number	"1" = Region 1 "2" = Region 2
ABI Mode	"-M3" = ABI Scanning Mode 3 "-M4" = ABI Scanning Mode 4 "-M6" = ABI Scanning Mode 6
ABI Channel	"CXX" Note: ➢ XX = band number: 01-16 (For Single band CMI and DMW products only)
Cyclone Identifier	"_<BBCCYYYY>" The subfield format for the HIE product includes: BB = Ocean Basin (AL, SL, EP, CP, WP, IO, SH) CC = Cyclone Identifier (01-49 are reserved for tropical and subtropical cyclones, 50-79 are reserved for forecast center internal use, 80-89 are reserved for training/excercises and testing, 90's are assigned sequentially and reused throughout the year) YYYY = 4 digit year (For HIE product only)

* The Derived Motion Winds product file containing wind vectors derived from cloud tops and water vapor use the product acronyms "DMW" and "DMWV", respectively. Note that two unique product files are generated for ABI band 8.

The file extension for Level 2+ product files is ".nc", indicating the netCDF file format.

The filename for a GOES R satellite operational mesoscale region #2 band 7 Cloud and Moisture Imagery product for February 2, 2016 with an observation start time of noon UTC with a file creation time of 20 seconds past noon is:

"OR_ABI-L2-CMIPM2-M3C07_G16_s20160331200000_e20160331200299_c20160331200200.nc"

A.2 Level 2+ Intermediate Product Filenames

Level 2+ intermediate products are created by the ABI Level 2+ algorithms. Some are used as inputs to produce downstream products. The remaining intermediate products are used for anomaly resolution and algorithm and data analysis. These intermediate products are only available in the internal GOES-R system two-day revolving storage.

Level 2+ intermediate product filenames are assembled using filename string fields as follows:

<System Environment>_<DSN>_<Platform ID>_<Observation Period Start Date & Time> _<Observation Period End Date & Time> _<Creation Date & Time>.<File Extension>

The string fields other than DSN and file extension are defined above in Table A-1, Common Filename String Fields. There are four categories associated with the Level 2+ intermediate product files. The four Level 2+ intermediate product file categories are as follows:

- Generated by the ABI Level 2+ product algorithms.
- Derived from the periodic execution of the Community Radiative Transfer Model (CRTM) software component and additional pre-processing components.
- Generated by the periodic processing of dynamic ancillary data received from the Ancillary Data Relay System (ADRS).
- Generated by Level 2+ auxiliary data processing components upon receipt of each ABI Level 1b Radiances product image.

The DSNs for each category of Level 2+ intermediate product are identified in the four tables that follow. In all four tables, the first column contains a string that identifies the type of Level 2 intermediate product data. This same string is used in the Level 2 product metadata and in Appendix C, Dynamic Source Data to identify the type of Level 2 intermediate product data.

The DSNs for intermediate product files created during the execution of Level 2+ product algorithms are identified in Table A.2-1, ABI Level 2+ Intermediate Product File DSNs. The producing algorithms are named in the shaded rows followed by their intermediate products. Intermediate files that are used as inputs to downstream processing contain the prefix "input_" in the leftmost column which is the attribute name within the variable named "algorithm_dynamic_input_data_container"in the netCDF product. Files that are used solely for analysis are so indicated. In the vast majority of cases, as is the case with the Level 2+ final products, there are separate files generated for the following ABI mode, image type combinations with each having a unique DSN:

- Mode 4 Full Disk
- Mode 3 Full Disk
- Mode 3 CONUS
- Mode 3 Mesoscale #1
- Mode 3 Mesoscale #2
- Mode 6 Full Disk
- Mode 6 CONUS
- Mode 6 Mesoscale #1
- Mode 6 Mesoscale #2

Table A.2-1 ABI Level 2+ Intermediate Product File DSNs

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
Clear Sky Mask algorithm	input_ABI_L2_intermediate_product_4_level_cloud_mask_data	4	Full Disk	I_ABI-L2-ACMF1-M4
		3	Full Disk	I_ABI-L2-ACMF1-M3
		3	CONUS	I_ABI-L2-ACMC1-M3
		3	Mesoscale #1	I_ABI-L2-ACMM11-M3
		3	Mesoscale #2	I_ABI-L2-ACMM21-M3
		6	Full Disk	I_ABI-L2-ACMF1-M6
		6	CONUS	I_ABI-L2-ACMC1-M6
		6	Mesoscale #1	I_ABI-L2-ACMM11-M6
		6	Mesoscale #2	I_ABI-L2-ACMM21-M6
	input_ABI_L2_intermediate_product_cloud_mask_info_flag_data	4	Full Disk	I_ABI-L2-ACMF2-M4
		3	Full Disk	I_ABI-L2-ACMF2-M3
		3	CONUS	I_ABI-L2-ACMC2-M3
		3	Mesoscale #1	I_ABI-L2-ACMM12-M3
		3	Mesoscale #2	I_ABI-L2-ACMM22-M3
		6	Full Disk	I_ABI-L2-ACMF2-M6
		6	CONUS	I_ABI-L2-ACMC2-M6
		6	Mesoscale #1	I_ABI-L2-ACMM12-M6
		6	Mesoscale #2	I_ABI-L2-ACMM22-M6
Aerosol Detection algorithm	Aerosol Detection intermediate product (IP) for analysis	4	Full Disk	I_ABI-L2-ADPF-M4
		3	Full Disk	I_ABI-L2-ADPF-M3
		3	CONUS	I_ABI-L2-ADPC-M3
		3	Mesoscale #1	I_ABI-L2-ADPM1-M3
		3	Mesoscale #2	I_ABI-L2-ADPM2-M3
		6	Full Disk	I_ABI-L2-ADPF-M6

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		6	CONUS	I_ABI-L2-ADPC-M6
		6	Mesoscale #1	I_ABI-L2-ADPM1-M6
		6	Mesoscale #2	I_ABI-L2-ADPM2-M6
Aerosol Optical Depth algorithm	Aerosol Optical Depth IP for analysis	4	Full Disk	I_ABI-L2-AODF-M4
		3	Full Disk	I_ABI-L2-AODF-M3
		3	CONUS	I_ABI-L2-AODC-M3
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	I_ABI-L2-AODF-M6
		6	CONUS	I_ABI-L2-AODC-M6
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
Aviation algorithm (Volcanic Ash)	Volcanic Ash IP for analysis	4	Full Disk	I_ABI-L2-VAAF-M4
		3	Full Disk	I_ABI-L2-VAAF-M3
		3	CONUS	Not applicable
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	I_ABI-L2-VAAF-M6
		6	CONUS	Not applicable
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
Cloud Top Temperature / Pressure / Height algorithm	Cloud Top algorithm IP for analysis	4	Full Disk	I_ABI-L2-ACHF-M4
		3	Full Disk	I_ABI-L2-ACHF-M3
		3	CONUS	I_ABI-L2-ACHC-M3
		3	Mesoscale #1	I_ABI-L2-ACHM1-M3
		3	Mesoscale #2	I_ABI-L2-ACHM2-M3

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		6	Full Disk	I_ABI-L2-ACHF-M6
		6	CONUS	I_ABI-L2-ACHC-M6
		6	Mesoscale #1	I_ABI-L2-ACHM1-M6
		6	Mesoscale #2	I_ABI-L2-ACHM2-M6
	Cloud Top Temperature CONUS IP	4	Full Disk	Not applicable
		3	Full Disk	Not applicable
		3	CONUS	I_ABI-L2-ACHTC-M3
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	Not applicable
		6	CONUS	I_ABI-L2-ACHTC-M6
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
	Cloud Top Pressure Mesoscale IP	4	Full Disk	Not applicable
		3	Full Disk	Not applicable
		3	CONUS	Not applicable
		3	Mesoscale #1	I_ABI-L2-CTPM1-M3
		3	Mesoscale #2	I_ABI-L2-CTPM2-M3
		6	Full Disk	Not applicable
		6	CONUS	Not applicable
		6	Mesoscale #1	I_ABI-L2-CTPM1-M6
		6	Mesoscale #2	I_ABI-L2-CTPM2-M6
Cloud Top Type and Phase algorithm	input_ABI_L2_intermediate_product_cloud_type_data	4	Full Disk	I_ABI-L2-ACTPF1-M4
		3	Full Disk	I_ABI-L2-ACTPF1-M3
		3	CONUS	I_ABI-L2-ACTPC1-M3
		3	Mesoscale #1	I_ABI-L2-ACTPM11-M3
		3	Mesoscale #2	I_ABI-L2-ACTPM21-M3
		6	Full Disk	I_ABI-L2-ACTPF1-M6

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		6	CONUS	I_ABI-L2-ACTPC1-M6
		6	Mesoscale #1	I_ABI-L2-ACTPM11-M6
		6	Mesoscale #2	I_ABI-L2-ACTPM21-M6
	Cloud Top Phase IP for analysis	4	Full Disk	I_ABI-L2-ACTPF2-M4
		3	Full Disk	I_ABI-L2-ACTPF2-M3
		3	CONUS	I_ABI-L2-ACTPC2-M3
		3	Mesoscale #1	I_ABI-L2-ACTPM12-M3
		3	Mesoscale #2	I_ABI-L2-ACTPM22-M3
		6	Full Disk	I_ABI-L2-ACTPF2-M6
		6	CONUS	I_ABI-L2-ACTPC2-M6
		6	Mesoscale #1	I_ABI-L2-ACTPM12-M6
		6	Mesoscale #2	I_ABI-L2-ACTPM22-M6
Cloud Optical and Microphysical Properties (COMP) algorithm (Cloud Optical Depth, Cloud Particle Size products)	COMP IP for analysis	4	Full Disk	I_ABI-L2-CODF-M4
		3	Full Disk	I_ABI-L2-CODF-M3
		3	CONUS	I_ABI-L2-CODC-M3
		3	Mesoscale #1	I_ABI-L2-CODM1-M3
		3	Mesoscale #2	I_ABI-L2-CODM2-M3
		6	Full Disk	I_ABI-L2-CODF-M6
		6	CONUS	I_ABI-L2-CODC-M6
		6	Mesoscale #1	I_ABI-L2-CODM1-M6
		6	Mesoscale #2	I_ABI-L2-CODM2-M6
Sounding algorithm (Legacy Vertical Moisture and Temperature Profiles, Total Precipitable Water, Derived Stability Indices products)	Sounding IP for analysis	4	Full Disk	I_ABI-L2-LSPF-M4

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		3	Full Disk	I_ABI-L2-LSPF-M3
		3	CONUS	I_ABI-L2-LSPC-M3
		3	Mesoscale #1	I_ABI-L2-LSPM1-M3
		3	Mesoscale #2	I_ABI-L2-LSPM2-M3
		6	Full Disk	I_ABI-L2-LSPF-M6
		6	CONUS	I_ABI-L2-LSPC-M6
		6	Mesoscale #1	I_ABI-L2-LSPM1-M6
		6	Mesoscale #2	I_ABI-L2-LSPM2-M6
Cloud and Moisture Imagery algorithm	input_ABI_L2_intermediate_product_reflectance_band_1_2km_data	4	Full Disk	I_ABI-L2-CMIPF-M4C01
		3	Full Disk	I_ABI-L2-CMIPF-M3C01
		3	CONUS	I_ABI-L2-CMIPC-M3C01
		3	Mesoscale #1	I_ABI-L2-CMIPM1-M3C01
		3	Mesoscale #2	I_ABI-L2-CMIPM2-M3C01
		6	Full Disk	I_ABI-L2-CMIPF-M6C01
		6	CONUS	I_ABI-L2-CMIPC-M6C01
		6	Mesoscale #1	I_ABI-L2-CMIPM1-M6C01
		6	Mesoscale #2	I_ABI-L2-CMIPM2-M6C01
	input_ABI_L2_intermediate_product_reflectance_band_2_2km_data	4	Full Disk	I_ABI-L2-CMIPF-M4C02
		3	Full Disk	I_ABI-L2-CMIPF-M3C02
		3	CONUS	I_ABI-L2-CMIPC-M3C02
		3	Mesoscale #1	I_ABI-L2-CMIPM1-M3C02
		3	Mesoscale #2	I_ABI-L2-CMIPM2-M3C02
		6	Full Disk	I_ABI-L2-CMIPF-M6C02

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		6	CONUS	I_ABI-L2-CMIPC-M6C02
		6	Mesoscale #1	I_ABI-L2-CMIPM1-M6C02
		6	Mesoscale #2	I_ABI-L2-CMIPM2-M6C02
	input_ABI_L2_intermediate_product_reflectance_band_3_2km_data	4	Full Disk	I_ABI-L2-CMIPF-M4C03
		3	Full Disk	I_ABI-L2-CMIPF-M3C03
		3	CONUS	I_ABI-L2-CMIPC-M3C03
		3	Mesoscale #1	I_ABI-L2-CMIPM1-M3C03
		3	Mesoscale #2	I_ABI-L2-CMIPM2-M3C03
		6	Full Disk	I_ABI-L2-CMIPF-M6C03
		6	CONUS	I_ABI-L2-CMIPC-M6C03
		6	Mesoscale #1	I_ABI-L2-CMIPM1-M6C03
		6	Mesoscale #2	I_ABI-L2-CMIPM2-M6C03
	input_ABI_L2_intermediate_product_reflectance_band_4_2km_data	4	Full Disk	I_ABI-L2-CMIPF-M4C04
		3	Full Disk	I_ABI-L2-CMIPF-M3C04
		3	CONUS	I_ABI-L2-CMIPC-M3C04
		3	Mesoscale #1	I_ABI-L2-CMIPM1-M3C04
		3	Mesoscale #2	I_ABI-L2-CMIPM2-M3C04
		6	Full Disk	I_ABI-L2-CMIPF-M6C04
		6	CONUS	I_ABI-L2-CMIPC-M6C04
		6	Mesoscale #1	I_ABI-L2-CMIPM1-M6C04

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		6	Mesoscale #2	I_ABI-L2-CMIPM2-M6C04
	input_ABI_L2_intermediate_product_reflectance_band_5_2km_data	4	Full Disk	I_ABI-L2-CMIPF-M4C05
		3	Full Disk	I_ABI-L2-CMIPF-M3C05
		3	CONUS	I_ABI-L2-CMIPC-M3C05
		3	Mesoscale #1	I_ABI-L2-CMIPM1-M3C05
		3	Mesoscale #2	I_ABI-L2-CMIPM2-M3C05
		6	Full Disk	I_ABI-L2-CMIPF-M6C05
		6	CONUS	I_ABI-L2-CMIPC-M6C05
		6	Mesoscale #1	I_ABI-L2-CMIPM1-M6C05
		6	Mesoscale #2	I_ABI-L2-CMIPM2-M6C05
	input_ABI_L2_intermediate_product_reflectance_band_6_2km_data	4	Full Disk	I_ABI-L2-CMIPF-M4C06
		3	Full Disk	I_ABI-L2-CMIPF-M3C06
		3	CONUS	I_ABI-L2-CMIPC-M3C06
		3	Mesoscale #1	I_ABI-L2-CMIPM1-M3C06
		3	Mesoscale #2	I_ABI-L2-CMIPM2-M3C06
		6	Full Disk	I_ABI-L2-CMIPF-M6C06
		6	CONUS	I_ABI-L2-CMIPC-M6C06
		6	Mesoscale #1	I_ABI-L2-CMIPM1-M6C06
		6	Mesoscale #2	I_ABI-L2-CMIPM2-M6C06
Fractional Snow Cover algorithm	input_ABI_L2_intermediate_product_binary_snow_mask_data	4	Full Disk	I_ABI-L2-FSCF1-M4

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		3	Full Disk	I_ABI-L2-FSCF1-M3
		3	CONUS	I_ABI-L2-FSCC1-M3
		3	Mesoscale #1	I_ABI-L2-FSCM11-M3
		3	Mesoscale #2	I_ABI-L2-FSCM12-M3
		6	Full Disk	I_ABI-L2-FSCF1-M6
		6	CONUS	I_ABI-L2-FSCC1-M6
		6	Mesoscale #1	I_ABI-L2-FSCM11-M6
		6	Mesoscale #2	I_ABI-L2-FSCM12-M6
	Snow Cover IP for analysis	4	Full Disk	I_ABI-L2-FSCF2-M4
		3	Full Disk	I_ABI-L2-FSCF2-M3
		3	CONUS	I_ABI-L2-FSCC2-M3
		3	Mesoscale #1	I_ABI-L2-FSCM21-M3
		3	Mesoscale #2	I_ABI-L2-FSCM22-M3
		6	Full Disk	I_ABI-L2-FSCF2-M6
		6	CONUS	I_ABI-L2-FSCC2-M6
		6	Mesoscale #1	I_ABI-L2-FSCM21-M6
		6	Mesoscale #2	I_ABI-L2-FSCM22-M6
Rainfall Rate algorithm	Rainfall Rate IP for analysis	4	Full Disk	I_ABI-L2-RRQPEF-M4
		3	Full Disk	I_ABI-L2-RRQPEF-M3
		3	CONUS	Not applicable
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	I_ABI-L2-RRQPEF-M6
		6	CONUS	Not applicable
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
Fire Hot Spot algorithm	input_ABI_L2_intermediate_product_time_of_last_fire_data	4	Full Disk	I_ABI-L2-FDCF-M4
		3	Full Disk	I_ABI-L2-FDCF-M3

Producing Algorithm	**Level 2+ Intermediate Product Type**	**ABI Mode**	**Scene Type**	**Data Short Name (DSN)**
		3	CONUS	I_ABI-L2-FDCC-M3
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	I_ABI-L2-FDCF-M6
		6	CONUS	I_ABI-L2-FDCC-M6
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
Land Surface Temperature algorithm	Land Surface Temperature 2km IP for analysis	4	Full Disk	I_ABI-L2-LSTF-M4
		3	Full Disk	I_ABI-L2-LSTF-M3
		3	CONUS	I_ABI-L2-LSTC-M3
		3	Mesoscale #1	I_ABI-L2-LSTM1-M3
		3	Mesoscale #2	I_ABI-L2-LSTM2-M3
		6	Full Disk	I_ABI-L2-LSTF-M6
		6	CONUS	I_ABI-L2-LSTC-M6
		6	Mesoscale #1	I_ABI-L2-LSTM1-M6
		6	Mesoscale #2	I_ABI-L2-LSTM2-M6
Shortwave Radiation algorithm	Shortwave Radiation 50km IP for analysis	4	Full Disk	I_ABI-L2-SWRF50-M4
		3	Full Disk	I_ABI-L2-SWRF50-M3
		3	CONUS	Not applicable
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	I_ABI-L2-SWRF50-M6
		6	CONUS	Not applicable
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
	Shortwave Radiation 25km FD IP for analysis	4	Full Disk	I_ABI-L2-SWRF25-M4
		3	Full Disk	I_ABI-L2-SWRF25-M3

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		3	CONUS	Not applicable
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	I_ABI-L2-SWRF25-M6
		6	CONUS	Not applicable
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
	Shortwave Radiation CONUS IP for analysis	4	Full Disk	Not applicable
		3	Full Disk	Not applicable
		3	CONUS	I_ABI-L2-SWRC-M3
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	Not applicable
		6	CONUS	I_ABI-L2-SWRC-M6
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
	Reflected Shortwave Radiation IP for analysis	4	Full Disk	Not applicable
		3	Full Disk	Not applicable
		3	CONUS	Not applicable
		3	Mesoscale #1	I_ABI-L2-RSRM1-M3
		3	Mesoscale #2	I_ABI-L2-RSRM2-M3
		6	Full Disk	Not applicable
		6	CONUS	Not applicable
		6	Mesoscale #1	I_ABI-L2-RSRM1-M6
		6	Mesoscale #2	I_ABI-L2-RSRM2-M6
	Shortwave Radiation Mesoscale IP for analysis	4	Full Disk	Not applicable
		3	Full Disk	Not applicable
		3	CONUS	Not applicable

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		3	Mesoscale #1	I_ABI-L2-SWRM1-M3
		3	Mesoscale #2	I_ABI-L2-SWRM2-M3
		6	Full Disk	Not applicable
		6	CONUS	Not applicable
		6	Mesoscale #1	I_ABI-L2-SWRM1-M6
		6	Mesoscale #2	I_ABI-L2-SWRM2-M6
Sea Surface Temperature algorithm	input_ABI_L2_intermediate_product_instantaneous_sea_surface_temperature_data	4	Full Disk	I_ABI-L2-SSTQF-M4
		3	Full Disk	I_ABI-L2-SSTQF-M3
		3	CONUS	Not applicable
		3	Mesoscale #1	Not applicable
		3	Mesoscale #2	Not applicable
		6	Full Disk	I_ABI-L2-SSTQF-M6
		6	CONUS	Not applicable
		6	Mesoscale #1	Not applicable
		6	Mesoscale #2	Not applicable
Derived Motion Winds algorithm	Derived Motion Winds Diagnostic IP for analysis (separate products for each channel 02, 07, 08, 09, 10, 14)	4	Full Disk	ABI-L2-DMWDIAGF-M4C<02, 07, 08, 09, 10, 14>
		3	Full Disk	ABI-L2-DMWDIAGF-M3C<02, 07, 08, 09, 10, 14>
		3	CONUS	ABI-L2-DMWDIAGC-M3C<02, 07, 08, 09, 10, 14>
		3	Mesoscale #1	ABI-L2-DMWDIAGM1-M3C<02, 07, 08, 09, 10, 14>

Producing Algorithm	**Level 2+ Intermediate Product Type**	**ABI Mode**	**Scene Type**	**Data Short Name (DSN)**
		3	Mesoscale #2	ABI-L2-DMWDIAGM2-M3C<02, 07, 08, 09, 10, 14>
		6	Full Disk	ABI-L2-DMWDIAGF-M6C<02, 07, 08, 09, 10, 14>
		6	CONUS	ABI-L2-DMWDIAGC-M6C<02, 07, 08, 09, 10, 14>
		6	Mesoscale #1	ABI-L2-DMWDIAGM1-M6C<02, 07, 08, 09, 10, 14>
		6	Mesoscale #2	ABI-L2-DMWDIAGM2-M6C<02, 07, 08, 09, 10, 14>
	Derived Motion Winds Product Quality Indicator IP for analysis (separate products for each channel 02, 07, 08, 09, 10, 14)	4	Full Disk	ABI-L2-DMWPQIF-M4C<02, 07, 08, 09, 10, 14>
		3	Full Disk	ABI-L2-DMWPQIF-M3C<02, 07, 08, 09, 10, 14>
		3	CONUS	ABI-L2-DMWPQIC-M3C<02, 07, 08, 09, 10, 14>
		3	Mesoscale #1	ABI-L2-DMWPQIM1-M3C<02, 07, 08, 09, 10, 14>
		3	Mesoscale #2	ABI-L2-DMWPQIM2-M3C<02, 07, 08, 09, 10, 14>
		6	Full Disk	ABI-L2-DMWPQIF-M6C<02, 07, 08, 09, 10, 14>

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		6	CONUS	ABI-L2-DMWPQIC-M6C<02, 07, 08, 09, 10, 14>
		6	Mesoscale #1	ABI-L2-DMWPQIM1-M6C<02, 07, 08, 09, 10, 14>
		6	Mesoscale #2	ABI-L2-DMWPQIM2-M6C<02, 07, 08, 09, 10, 14>
	Derived Motion Winds (using Water Vapor Tracers) Diagnostic IP for analysis	4	Full Disk	ABI-L2-DMWVDIAGF-M4C08
		3	Full Disk	ABI-L2-DMWVDIAGF-M3C08
		3	CONUS	ABI-L2-DMWVDIAGC-M3C08
		3	Mesoscale #1	ABI-L2-DMWVDIAGM1-M3C08
		3	Mesoscale #2	ABI-L2-DMWVDIAGM2-M3C08
		6	Full Disk	ABI-L2-DMWVDIAGF-M6C08
		6	CONUS	ABI-L2-DMWVDIAGC-M6C08
		6	Mesoscale #1	ABI-L2-DMWVDIAGM1-M6C08
		6	Mesoscale #2	ABI-L2-DMWVDIAGM2-M6C08
	Derived Motion Winds (using Water Vapor Tracers) Product Quality Indicator IP for analysis	4	Full Disk	ABI-L2-DMWVPQIF-M4C08
		3	Full Disk	ABI-L2-DMWVPQIF-M3C08

Producing Algorithm	Level 2+ Intermediate Product Type	ABI Mode	Scene Type	Data Short Name (DSN)
		3	CONUS	ABI-L2-DMWVPQIC-M3C08
		3	Mesoscale #1	ABI-L2-DMWVPQIM1-M3C08
		3	Mesoscale #2	ABI-L2-DMWVPQIM2-M3C08
		6	Full Disk	ABI-L2-DMWVPQIF-M6C08
		6	CONUS	ABI-L2-DMWVPQIC-M6C08
		6	Mesoscale #1	ABI-L2-DMWVPQIM1-M6C08
		6	Mesoscale #2	ABI-L2-DMWVPQIM2-M6C08

The DSNs for intermediate product files whose contents are derived from the execution of the Community Radiative Transfer Model (CRTM) software component and additional pre-processing components running in the GOES-R ground system are identified in Table A.2-2, DSNs for Intermediate Product Files Derived from CRTM. These files are generated periodically and cover the ABI's entire field of regard, as a minimum. Note that there are cases when multiple Level 2+ intermediate product types are stored in the same file.

Table A.2-2 DSNs for Intermediate Product Files Derived From CRTM

Level 2+ Intermediate Product Type	Data Short Name (DSN)
input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_<7, 14, 15>_data	I_ABI-L2-TARPEF-C<07, 14, 15>
input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_<7, 10, 11, 14, 15, 16>_data	I_ABI-L2-TARPEF-C<07, 10, 11, 14, 15, 16>
input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_<7, 10, 11, 14, 15, 16>_profile_data	I_ABI-L2-TARPPF-C<07, 10, 11, 14, 15, 16>
input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_<7, 10, 11, 14, 15, 16>_profile_data	I_ABI-L2-TARPPF-C<07, 10, 11, 14, 15, 16>
input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_<10, 11, 14, 15, 16>_profile_data	I_ABI-L2-TARPPF-C<10, 11, 14, 15, 16>
input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_<7, 14, 15>_data	I_ABI-L2-TARPEF-C<07, 14, 15>
input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_<7, 14, 15>_data	I_ABI-L2-TARPEF-C<07, 14, 15>

The DSNs for intermediate product files whose contents come from the processing of dynamic ancillary data received from ADRS are identified in Table A.2-3, Processed Dynamic Ancillary Data Intermediate Product File DSNs. These files are generated periodically and cover the ABI's entire field of regard, as a minimum, or coverage area is irrelevant.

Table A.2-3 Processed Dynamic Ancillary Data Intermediate Product File DSNs

Level 2+ Intermediate Product Type	Data Short Name (DSN)
input_dynamic_ancillary_NWP_geopotential_height_profile_data	I_ANC-GeoHgt-101-TI
input_dynamic_ancillary_NWP_snow_mask_data	I_ANC-SnowMask-Der
input_dynamic_ancillary_NWP_surface_geopotential_height_data	I_ANC-SurGeoHgt-TI
input_dynamic_ancillary_NWP_surface_level_index_data	I_ANC-SurIdx-Der
input_dynamic_ancillary_NWP_surface_pressure_data	I_ANC-SurPress-TI
input_dynamic_ancillary_NWP_surface_temperature_data	I_ANC-SurTemp-TI
input_dynamic_ancillary_NWP_surface_wind_vector_data	I_ANC-SurUVWind-TI
input_dynamic_ancillary_NWP_temperature_profile_data	I_ANC-TempPro-101
input_dynamic_ancillary_NWP_temperature_inversion_layer_data	I_ANC-InvLayPro-Der
input_dynamic_ancillary_NWP_total_column_ozone_data	I_ANC-TotalOzone-TI
input_dynamic_ancillary_NWP_total_precipitable_water_data	I_ANC-TPW-TI
input_dynamic_ancillary_NWP_tropopause_level_index_data	I_ANC-TroIdx-Der
input_dynamic_ancillary_NWP_wind_vector_profile_data	I_ANC-UVWndPro-26-TI
input_dynamic_ancillary_Reynolds_SST_data	I_ANC-ReyDailySST
input_dynamic_ancillary_Reynolds_SST_uncertainty_data	I_ANC-ReyDailySSTUnc
input_dynamic_ancillary_NWP_raw_temperature_profile_data	I_ANC-TempPro-26-TI
input_dynamic_ancillary_global_snow_mask_data	I_ANC-GlobalSnowMask

The DSNs for intermediate product files whose contents come from the execution of Level 2+ auxiliary data processing components are identified in Table A.4-1, ABI Level 2+ Product Generation Algorithm Intermediate Product File DSNs. There are separate files generated for the following received image types with each having a unique DSN:

- Mode 3, 4 or 6 Full Disk
- Mode 3 or 6 CONUS
- Mode 3 or 6 Mesoscale #1
- Mode 3 or 6 Mesoscale #2

Note that for a specific ABI Level 1b Radiances product image, all types of dynamic auxiliary data are stored in the same file.

Table A.2-4 Dynamic Auxiliary Data Intermediate Product File DSNs

	Data Short Name (DSN)			
Level 2+ Intermediate Product Type	**Full Disk**	**CONUS**	**Mesoscale #1**	**Mesoscale #2**
input_ABI_L2_auxiliary_scattering_angle_data	I_ABI-L2-AUXF2	I_ABI-L2-AUXC2	I_ABI-L2-AUXM12	I_ABI-L2-AUXM22
input_ABI_L2_auxiliary_solar_azimuth_angle_data				
input_ABI_L2_auxiliary_solar_zenith_angle_data				
input_ABI_L2_auxiliary_sunglint_angle_data				
input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data				

The file extension for Level 2+ intermediate product files is ".nc", indicating the netCDF file format.

The filename for a GOES-R satellite (GOES-16) operational mesoscale region #2 ABI Level 2+ intermediate product containing cloud mask info flag data for January 29, 2017 with an observation start time of one minute after midnight UTC with a file creation time of 90.5 seconds after midnight UTC is:

"OR_I_ABI-L2-ACMM22-M3_G16_s20170290001000_e20170290000299_c20170290001305.nc"

A.3 Level 2+ Semi-Static Source Data Filenames

There is a single aggregate non-gridded semi-static source data file for each Level 2+ algorithm. Refer to Tables A.4-1 and A.4-2 for non-gridded and gridded data, respectively.

Table A.3-1 Level 2+ Semi-Static Source Data Filenames

Level 2+ Algorithm	Filename
Cloud and Moisture Imagery	OR_ABI-L2-PARM-CMI_<PlatformID>_**<*Version*>.**zip
Clear Sky Mask	OR_ABI-L2-PARM-ACM_<PlatformID>_**<*Version*>**.zip
Cloud Top Phase	OR_ABI-L2-PARM-ACT_<PlatformID>_**<*Version*>**.zip
Cloud Top Height	OR_ABI-L2-PARM-ACH_<PlatformID>_**<*Version*>**.zip
Cloud Microphysical and Optical Properties (COMP)	OR_ABI-L2-PARM-COMP_<PlatformID>_**<*Version*>**.zip
Aerosol Detection	OR_ABI-L2-PARM-ADP_<PlatformID>_**<*Version*>**.zip
Aerosol Optical Depth	OR_ABI-L2-PARM-SMAOD_<PlatformID>_**<*Version*>**.zip
Volcanic Ash: Detection and Height	OR_ABI-L2-PARM-AVA_<PlatformID>_**<*Version*>**.zip
ABI Legacy Atmospheric Profiles	OR_ABI-L2-PARM-SOUNDINGS_<PlatformID>_**<*Version*>**.zip
Rainfall Rate (QPE)	OR_ABI-L2-PARM-RRPE_<PlatformID>_**<*Version*>**.zip
Derived Motion Winds	OR_ABI-L2-PARM-DMW_<PlatformID>_**<*Version*>**.zip
Hurricane Intensity	OR_ABI-L2-PARM-HIE_<PlatformID>_**<*Version*>**.zip
Land Fire (HSC)	OR_ABI-L2-PARM-FHS_<PlatformID>_**<*Version*>**.zip
Land Surface (Skin) Temperature	OR_ABI-L2-PARM-LST_<PlatformID>_**<*Version*>**.zip
Snow Cover	OR_ABI-L2-PARM-FSC_<PlatformID>_**<*Version*>**.zip
Sea Surface (Skin) Temperature	OR_ABI-L2-PARM-SST_<PlatformID>_**<*Version*>**.zip
Downward Shortwave Radiation: Surface and Reflected Shortwave Radiation: TOA	OR_ABI-L2-PARM-SRB_<PlatformID>_**<*Version*>**.zip
GLM Level 1b and Lightning Cluster-Filter algorithms	OR_GLM-L1b-PARM_<PlatformID>_**<*Version*>**.zip
Common Library Services	OR_ABI-L2-PARM-AUXILIARY_<PlatformID>_**<*Version*>**.zip

<*Version*> details are defined in Table A-1, Common Filename String Fields.

The types of Level 2+ gridded semi-static are defined in Appendix D. These types are grouped into aggregate files when they are sent to the PDA system. The grouping of these files is based on their functional similarity and the frequency in which they change. The aggregate dataset name is shown in Table D.1.

Table A.3-2 Level 2+ Gridded Semi-Static Data

Level 2+ Gridded Semi-Static DataType	Filename
input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data	

Level 2+ Gridded Semi-Static DataType	Filename
input_ABI_L2_semi_static_local_zenith_angle_data	OR_ABI-L2-PARM-SEMISTATIC_FG_LAT_LON_<***Version***>.zip
input_ABI_L2_slot_specific_semi_static_local_azimuth_angle_data	
input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data	
input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data	
input_ABI_L2_slot_specific_semi_static_local_zenith_angle_bin_index_data	
input_ABI_L2_semi_static_E_W_to_N_S_distance_ratio_for_fixed_grid_half_km_data	
input_ABI_L2_semi_static_E_W_to_N_S_distance_ratio_for_fixed_grid_2km_data	
input_ABI_L2_slot_specific_0.05_degree_lat_lon_grid_mapping_for_fixed_grid_data	
input_ABI_L2_slot_specific_0.25_degree_lat_lon_grid_mapping_for_fixed_grid_data	
input_ABI_L2_slot_specific_0.50_degree_lat_lon_grid_mapping_for_fixed_grid_data	
input_ABI_L2_slot_specific_0.05_degree_lat_lon_cells_nearest_neighbor_data	
input_ABI_L2_slot_specific_0.25_degree_lat_lon_cells_nearest_neighbor_data	
input_ABI_L2_slot_specific_0.50_degree_lat_lon_cells_nearest_neighbor_data	
input_ABI_L2_slot_specific_semi_static_surface_elevation_data	OR_ABI-L2-PARM-ANCILLARY_ELEVATION_<***Version***>.zip
input_ABI_L2_slot_specific_semi_static_land_sea_mask_data	OR_ABI-L2-PARM-ANCILLARY_MASK_<***Version***>.zip
input_ABI_L2_slot_specific_semi_static_coast_mask_data	
input_ABI_L2_slot_specific_semi_static_desert_mask_data	
input_ABI_L2_slot_specific_semi_static_ecosystem_mask_data	
input_ABI_L2_slot_specific_semi_static_surface_type_mask_data	
input_ABI_L2_slot_specific_semi_static_IGBP_surface_type_mask_data	

Level 2+ Gridded Semi-Static DataType	Filename
input_ABI_L2_slot_specific_semi_static_monthly_cloud_climatology_data	OR_ABI-L2-PARM-ANCILLARY_CLIMATOLOGY_<***Version***>.zip
input_ABI_L2_slot_specific_semi_static_monthly_aerosol_climatology_data	
input_ABI_L2_slot_specific_semi_static_monthly_total_precipitable_water_climatology_data	
input_ABI_L2_slot_specific_semi_static_monthly_total_column_ozone_climatology_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_7_data	OR_ABI-L2-PARM-ANCILLARY_EMISSIVITY_<***Version***>.zip
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_8_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_9_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_10_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_11_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_12_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_13_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_14_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_15_data	
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_16_data	
input_ABI_L2_slot_specific_semi_static_16_day_white_sky_albedo_band_2_data	OR_ABI-L2-PARM-ANCILLARY_ALBEDO_<***Version***>.zip
input_ABI_L2_slot_specific_semi_static_16_day_white_sky_albedo_band_2_data	

<***Version***> details are defined in Table A-1, Common Filename String Fields

A.4 Algorithm Package Filenames

Table A.4 Algorithm Package Names

Algorithm Package Data Short Names		
Data Short Name	**Description**	**Example Filenames**
ABI-L2-ALG	ABI L2+ Algorithm Package	OR_ABI-L2-ALG_<***Version***>.zip
GLM-L2-ALG	GLM L2+ Algorithm Package	OR_GLM-L2-ALG_<***Version***>.zip

<*Version*> details are defined in Table A-1, Common Filename String Fields

A.5 ISO Series Metadata Filenames

The string fields that make up the full file name are defined above in Table A-1, Common Filename String Fields.

Table A.5 L2+ ISO Series Metadata Data Short Names

Data Short Name	Description
ABI-L2-ACHA-ISO-SERIES	L2+ Cloud Top Height
ABI-L2-ACHT-ISO-SERIES	L2+ Cloud Top Temperature
ABI-L2-ACM-ISO-SERIES	L2+ Clear Sky Masks
ABI-L2-ACTP-ISO-SERIES	L2+ Cloud Top Phase
ABI-L2-ADP-ISO-SERIES	L2+ Aerosol Detection
ABI-L2-AOD-ISO-SERIES	L2+ Aerosol Optical Depth
ABI-L2-CMIP-ISO-SERIES	L2+ Cloud & Moisture Imagery
ABI-L2-COD-ISO-SERIES	L2+ Cloud Optical Depth
ABI-L2-CPS-ISO-SERIES	L2+ Cloud Particle Size Distribution
ABI-L2-CTP-ISO-SERIES	L2+ Cloud Top Pressure
ABI-L2-DMW-ISO-SERIES	L2+ Derived Motion Winds

Data Short Name	Description
ABI-L2-DSI-ISO-SERIES	L2+ Derived Stability Indices
ABI-L2-DSR-ISO-SERIES	L2+ Downward Shortwave Radiation: Surface
ABI-L2-FDC-ISO-SERIES	L2+ Fire / Hot Spot Characterization
ABI-L2-FSC-ISO-SERIES	L2+ Snow Cover
ABI-L2-HIE-ISO-SERIES	L2+ Hurricane Intensity
ABI-L2-LST-ISO-SERIES	L2+ Land Surface (Skin) Temperature
ABI-L2-LVMP-ISO-SERIES	L2+ Legacy Vertical Moisture Profile
ABI-L2-LVTP-ISO-SERIES	L2+ Legacy Vertical Temperature Profile
ABI-L2-RRQPE-ISO-SERIES	L2+ Rainfall Rate/QPE
ABI-L2-RSR-ISO-SERIES	L2+ Reflected Shortwave Radiation: TOA
ABI-L2-SST-ISO-SERIES	L2+ Sea Surface Temperature
ABI-L2-TPW-ISO-SERIES	L2+ Total Precipitable Water
ABI-L2-VAA-ISO-SERIES	L2+ Volcanic Ash: Detection and Height
GLM-L2-LCFA-ISO-SERIES	L2+ Lighning Detection

APPENDIX B PRODUCT REFRESH RATES AND LATENCIES

This appendix contains the refresh rates and latencies associated with Level 2+ products available from the NOAA Product Distribution and Access (PDA) system.

The product refresh rate is defined as the time between the completion of the nth update of the product and the completion of the (n+1)th update of the same product for the user.

Latency for Level 2+ products is defined as the interval between the end of an observation by an instrument on the satellite to the availability of the observation at the PDA system.

Refer to Table B, Product Refresh Rates and Latencies.

Table B Product Refresh Rates and Latencies

		Product Refresh Rate			
	Image Type	**ABI Mode 3**	**ABI Mode 4**	**ABI Mode 6**	**Product Latency**
Cloud & Moisture Imagery	Full Disk	15 min	5 min	10 min	55 sec
	CONUS	5 min	5 min	5 min	55 sec
	Mesoscale	0.5 min ***see note [1]***		0.5 min ***see note [1]***	28 sec
Aerosol Detection	Full Disk	15 min	15 min	10 min	542 sec
	CONUS	15 min	15 min	15 min	811 sec
	Mesoscale	5 min		5 min	271 sec
Aerosol Optical Depth	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
Volcanic Ash: Detection & Height	Full Disk	15 min	15 min	10 min	435 sec
Cloud Optical Depth	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
Cloud Particle Size Distribution	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Cloud Top Phase	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Cloud Top Height	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Cloud Top Pressure	Full Disk	15 min	15 min	10 min	542 sec
	CONUS	5 min	5 min	5 min	271 sec
Cloud Top Temperature	Full Disk	15 min	5 min	10 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Hurricane Intensity	Full Disk	30 min	30 min	30 min	811 sec
Rainfall Rate/QPE	Full Disk	15 min	15 min	10 min	271 sec
Legacy Vertical Moisture Profile	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec

		Product Refresh Rate			
	Image Type	**ABI Mode 3**	**ABI Mode 4**	**ABI Mode 6**	**Product Latency**
Legacy Vertical Temperature Profile	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Derived Stability Indices	Full Disk	15 min	5 min	10 min	164 sec
	CONUS	5 min	5 min	5 min	164 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Total Precipitable Water	Full Disk	15 min	5 min	10 min	811 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Clear Sky Masks	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Downward Shortwave Radiation: Surface	Full Disk	60 min	60 min	60 min	3241 sec
	CONUS	60 min	60 min	60 min	3241 sec
	Mesoscale	60 min		60 min	3241 sec
Reflected Shortwave Radiation: TOA	Full Disk	60 min	60 min	60 min	3241 sec
	CONUS	60 min	60 min	60 min	3241 sec
Derived Motion Winds	Full Disk	60 min	15 min	60 min	537 sec
	CONUS	15 min	15 min	15 min	811 sec
	Mesoscale	5 min		5 min	271 sec
Fire / Hot Spot Characterization	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
Land Surface (Skin) Temperature	Full Disk	60 min	60 min	60 min	542 sec
	CONUS	60 min	60 min	60 min	3241 sec
	Mesoscale	60 min		60 min	164 sec
Snow Cover	Full Disk	15 min	5 min	10 min	271 sec
	CONUS	5 min	5 min	5 min	271 sec
	Mesoscale	0.5 min		0.5 min	28 sec
Sea Surface (Skin) Temperature	Full Disk	60 min	60 min	60 min	811 sec
Lightning Detection	Full Disk	20.5 sec (nominally)			16 sec

Note 1: The refresh rate for mesoscale products applies to each of the two mesoscale scenes in the ABI mode 3 or mode 6 epoch. A 30 second refresh rate is provided if the two mesoscale scenes are geographically coincident.

The refresh rates and latency values presented in this table are based on required performance. For latency, five seconds are associated with the combination of sensing and data processing on the satellite, downlink from the satellite, receipt by the ground antenna, transmission of the GRB data stream by the ground antenna, uplink and downlink of the GRB data stream, and cataloguing by the PDA system. The remainder of the latency value is associated with data processing by the ground system.

The latency values presented in this table are minimum performance requirements necessary to achieve end-product refresh rates.

APPENDIX C DYNAMIC SOURCE DATA

This appendix identifies the dynamic source data used as inputs to ABI Level 2+ algorithms.

The following types of dynamic source data categories are used to support production of ABI Level 2+ products:

End products output by the ABI Level 1b and 2+ product generation algorithm software executing in the GOES-R ground system which are distributed to external systems/archives.

Intermediate products output by the ABI Level 2+ product generation algorithm software executing in the GOES-R ground system which are not distributed to external systems/archives.

Intermediate product data output from the GOES-R ground system implementation of the Joint Center for Satellite Data Assimilation (JCSDA) implementation of the Community Radiative Transfer Model (CRTM) augmented with custom radiative transfer processing software components.

Dynamic ancillary data received from the Ancillary Data Relay System (ADRS), which is a subsystem of the Product Distribution and Access (PDA) system.

Dynamic auxiliary data generated by product generation software executing in the GOES-R ground system.

C.1 ABI L2+ End Product Dependencies

Several ABI Level 2+ product algorithms make use of ABI Level 1b and 2+ intermediate and end products as inputs to generate other ABI Level 2+ final products. End products are those distributed externally by the GOES-R ground system. Intermediate products are available only from the ground system revolving storage.

Table C.1 ABI Level 2+ End Product Dependencies

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Clear Sky Mask algorithm produces Clear Sky Mask end product	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_input_ABI_L2_auxiliary_sunglint_angle_data L2_auxiliary_scattering_angle_data input_ABI_L2_auxiliary_sunglint_angle_data input_ABI_L1b_radiance_band_7_2km_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L2_brightness_temperature_band_9_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_11_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_brightness_temperature_band_16_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_4_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_7_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data input_dynamic_ancillary_global_snow_mask_data input_dynamic_ancillary_NWP_snow_mask_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_total_precipitable_water_data input_dynamic_ancillary_NWP_total_column_ozone_data input_dynamic_ancillary_NWP_surface_level_index_data input_dynamic_ancillary_NWP_tropopause_level_index_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Aerosol Detection algorithm produces Aerosol Detection end product	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sunglint_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data input_ABI_L1b_radiance_band_4_2km_data input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_intermediate_product_reflectance_band_1_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_3_2km_data input_ABI_L2_intermediate_product_reflectance_band_4_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_2km_data input_ABI_L2_intermediate_product_cloud_mask_info_flag_data input_ABI_L2_intermediate_product_binary_snow_mask_data input_dynamic_ancillary_global_snow_mask_data
Aerosol Optical Depth algorithm produces Aerosol Optical Depth end product	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_solar_azimuth_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data input_ABI_L2_total_precipitable_water_data input_ABI_L2_intermediate_product_reflectance_band_1_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_3_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_2km_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_binary_snow_mask_data input_dynamic_ancillary_global_snow_mask_data input_dynamic_ancillary_NWP_total_precipitable_water_data input_dynamic_ancillary_NWP_total_column_ozone_data input_dynamic_ancillary_NWP_surface_wind_vector_data input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_surface_geopotential_height_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Aviation algorithm produces Volcanic Ash end product	input_ABI_L1b_radiance_band_10_2km_data input_ABI_L1b_radiance_band_11_2km_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L1b_radiance_band_15_2km_data input_ABI_L1b_radiance_band_16_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_brightness_temperature_band_16_2km_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_10_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_11_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_10_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_11_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_geopotential_height_profile_data input_dynamic_ancillary_NWP_pressure_profile_data input_dynamic_ancillary_NWP_tropopause_level_index_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
	input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Cloud Top Temperature algorithm produces Cloud Top Temperature, Cloud Top Pressure and Cloud Top Height end products	input_ABI_L1b_radiance_band_14_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_brightness_temperature_band_16_2km_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_cloud_type_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_tropopause_temperature_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_temperature_inversion_profile_data input_dynamic_ancillary_NWP_geopotential_height_profile_data input_dynamic_ancillary_NWP_pressure_profile_data input_dynamic_ancillary_NWP_surface_level_index_data input_dynamic_ancillary_NWP_tropopause_level_index_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Cloud Top Type and Phase algorithm produces Cloud Top Phase end product	input_ABI_L1b_radiance_band_4_2km_data input_ABI_L1b_radiance_band_10_2km_data input_ABI_L1b_radiance_band_11_2km_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L1b_radiance_band_15_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_10_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_11_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_pressure_profile_data input_dynamic_ancillary_NWP_tropopause_level_index_data input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Cloud Optical and Microphysical Properties (COMP) algorithm produces Cloud Optical Depth and Cloud Particle Size end products	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data input_ABI_L1b_radiance_band_4_2km_data input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_cloud_top_phase_data input_ABI_L2_cloud_top_temperature_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_2km_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_cloud_top_height_data input_ABI_L2_intermediate_product_cloud_top_pressure_data input_ABI_L2_intermediate_product_cloud_type_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_7_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data input_dynamic_ancillary_global_snow_mask_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_total_precipitable_water_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_total_column_ozone_data input_dynamic_ancillary_NWP_geopotential_height_profile_data input_dynamic_ancillary_NWP_precipitable_water_profile_data input_dynamic_ancillary_NWP_geopotential_height_derived_surface_index_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Sounding algorithm produces Legacy Vertical Temperature Profile, Legacey Vertical Moisture Profile, Derived Stabilityindices and Total Precipitable Water end products	input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_8_2km_data input_ABI_L2_brightness_temperature_band_9_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_11_2km_data input_ABI_L2_brightness_temperature_band_12_2km_data input_ABI_L2_brightness_temperature_band_13_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_brightness_temperature_band_16_2km_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_dynamic_ancillary_NWP_surface_pressure_data input_dynamic_ancillary_NWP_surface_temperature_data input_dynamic_ancillary_NWP_temperature_profile_data input_dynamic_ancillary_NWP_moisture_profile_data input_dynamic_ancillary_NWP_wind_vector_profile_data input_dynamic_ancillary_NWP_surface_level_index_data
Cloud and Moisture Imagery algorithm produces 16 band-specific CMI end products	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L1b_radiance_band_data (band-specific input for each band-specific output CMI product)
Snow Cover algorithm produces Fractional Snow Cover end product	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_solar_azimuth_angle_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_1_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_2_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_3_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_5_data input_ABI_L2_intermediate_product_bidirectional_reflectance_factor_band_6_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data
Rainfall Rate algorithm produces Rainfall Rate Quantitative Precipitation Estimate end product	input_ABI_L2_brightness_temperature_band_8_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_11_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data
Fire algorithm produces Fire/Hot Spot end product	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sunglint_angle_data input_ABI_radiance_band_7 input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_time_of_last_fire_data input_dynamic_ancillary_NWP_total_precipitable_water_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
Land Surface Temperature algorithm produces Land Surface Temperature end product	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_total_precipitable_water_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_binary_snow_mask_data input_dynamic_ancillary_NWP_total_precipitable_water_data
Shortwave Radiation algorithm produces Downward Shortwave Radiation and Reflected Shortwave Radiation end products	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data input_ABI_L2_aerosol_optical_depth_550nm_data input_ABI_L2_cloud_top_phase_data input_ABI_L2_cloud_effective_particle_size_data input_ABI_L2_total_precipitable_water_data input_ABI_L2_surface_albedo_data input_ABI_L2_intermediate_product_reflectance_band_1_2km_data input_ABI_L2_intermediate_product_reflectance_band_2_2km_data input_ABI_L2_intermediate_product_reflectance_band_3_2km_data input_ABI_L2_intermediate_product_reflectance_band_4_2km_data input_ABI_L2_intermediate_product_reflectance_band_5_2km_data input_ABI_L2_intermediate_product_reflectance_band_6_2km_data input_ABI_L2_intermediate_product_binary_snow_mask_data input_ABI_L2_intermediate_product_fine_aerosol_data input_ABI_L2_intermediate_product_cloud_optical_depth_data input_ABI_L2_intermediate_product_cloud_top_height_data input_dynamic_ancillary_global_snow_mask_data input_dynamic_ancillary_NWP_total_precipitable_water_data input_dynamic_ancillary_NWP_total_column_ozone_data
Sea Surface Temperature algorithm produces Sea Surface Temperature end product	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L2_auxiliary_sunglint_angle_data input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_brightness_temperature_band_15_2km_data input_ABI_L2_intermediate_product_cloud_mask_info_flag_data input_ABI_L2_intermediate_product_instantaneous_sea_surface_temperature_data input_ABI_L2_intermediate_product_SST_historical_bias_estimate_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_7_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_14_data input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_7_data input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_14_data input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_15_data input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_7_data

ABI Level 2+ Algorithm / Output end product(s)	ABI level 1b or 2+ Inputs
	input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_14_data input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_15_data input_dynamic_ancillary_Reynolds_SST_data input_dynamic_ancillary_Reynolds_SST_uncertainty_data
Derived Motion Winds algorithm produces Derived Motion Winds end products (per channel for channels 02, 07, 08, 09, 10 and 14)	input_ABI_L2_auxiliary_solar_zenith_angle_data input_ABI_L1b_radiance_band_14_2km_data input_ABI_L2_brightness_temperature_band_7_2km_data input_ABI_L2_brightness_temperature_band_8_2km_data input_ABI_L2_brightness_temperature_band_9_2km_data input_ABI_L2_brightness_temperature_band_10_2km_data input_ABI_L2_brightness_temperature_band_14_2km_data input_ABI_L2_cloud_top_phase_data input_ABI_L2_cloud_top_temperature_data input_ABI_L2_intermediate_product_reflectance_band_2_half_km_data input_ABI_L2_intermediate_product_4_level_cloud_mask_data input_ABI_L2_intermediate_product_cloud_top_height_data input_ABI_L2_intermediate_product_cloud_top_pressure_data input_ABI_L2_intermediate_product_cloud_type_data input_ABI_L2_intermediate_product_low_level_temperature_inversion_flag_data input_dynamic_ancillary_NWP_raw_temperature_profile_data input_dynamic_ancillary_NWP_wind_vector_profile_data
Hurricane Intensity Estimate algorithm produces Hurricane Intensity Estimate end product	input_ABI_L2_brightness_temperature_band_13_2km_data input_dynamic_ancillary_tropical_cyclone_forecast_file_data input_dynamic_ancillary_passive_microwave_eye_score_data
Lightning Cluster Filter algorithm produces Ligthning end product	input_GLM_L1b_data

C.2 Joint Center for Satellite Data Assimilation (JCSDA) Community Radiative Transfer Model (CRTM) Based Radiative Transfer Output Data

Several ABI Level 2+ product algorithms make use of radiative transfer model output data computed for specific ABI emissive bands generated based on time interpolated National Weather Prediction (NWP) model output from the Global Forecast System (GFS) and Reynolds Sea Surface Temperature (SST) Analysis dynamic ancillary data. This dynamic ancillary data is described in paragraph C.4, Dynamic Ancillary Data. Level 2+ semi-static source data, including land surface height and land surface emissivity data are also required inputs.

The off-the-shelf JCSDA implementation of the CRTM provides the core for these calculations. The CRTM is applied to the NWP model output data to generate layer optical depth profiles and ocean surface emissivity. Custom ground system software components use the CRTM output data to compute transmittance profile, and clear and cloudy radiance profile data on the NWP 0.5 degree grid. This profile data is combined with NWP model output and Reynolds SST surface temperature, for land and sea, respectively, semi-static land emissivity data, and CRTM computed ocean emissivity to generate Top-Of-Atmosphere (TOA) radiance and brightness temperature data, which are projected to the ABI fixed grid. Additional CRTM runs are executed based on this calculated data to generate the input data required by the ABI Sea Surface Temperature algorithm. The CRTM runs at each NWP 0.5 degree grid point for a range of viewing angles corresponding to the viewing geometry of geospatially coincident higher resolution data points on the ABI fixed grid.

The ground system radiative transfer model calculations are executed at fifteen minute intervals (:00, :15, :30 :45 of each wall clock hour). Conservatively, the CRTM software execution requires ten minutes. This means that updated CRTM output data is available at :10, :25, :40, and :55 of each wall clock hour. Once the most recent version of the CRTM output data is available, it is used for the next five minute ABI mode 4, ten minute ABI mode 6 or fifteen minute ABI mode 3 epoch.

The CRTM output data files are available internally in the GOES-R ground system revolving storage for a minimum of 48 hours. Refer to Table C.3-1, CRTM Intermediate Product Data, for the a description of each CRTM output data type, its horizontal spatial resolution, coverage area, dependent ABI Level 2+ products, and Data Short Name (DSN). The DSN is the identifying portion of the processed CRTM data filename. Note that "band" references correspond to the sensor band central wavelengths associated with the ABI.

Table C.2-1 CRTM Intermediate Product Data

CRTM Intermediate Product Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Names
input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_7_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_14_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_brightness_temperature_band_15_data: Brightness temperature for the specific band at the top of atmosphere computed for clear sky conditions. Units of measure are Kelvin.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask (bands 14, 15) Sea Surface Temperature (bands 7, 14, 15)	I_ABI-L2-TARPEF-C<07, 14, 15>
input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_data: Radiance for the specific band at the top of atmosphere computed for clear sky conditions. Units of measure are milliwatt per square meter per steradian per wavenumber [mW m-2 sr-1 (cm-1)-1].	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask (bands 7, 14) Cloud Optical Depth (band 14) Cloud Particle Size (band 14) Cloud Top Height (bands 14, 15, 16) Cloud Top Phase (bands 10, 11, 14, 15, 16) Cloud Top Pressure (bands 14, 15, 16) Cloud Top Temperature (bands 14, 15, 16) Volcanic Ash (bands 10, 11, 14, 15, 16)	I_ABI-L2-TARPEF-C<07, 10, 11, 14, 15, 16>
input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_7_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_10_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_11_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_14_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_15_profile_data:	0.5 degrees	Global with data tailored for satellite slot-specific processing	Cloud Optical Depth (bands 7, 14, 15) Cloud Particle Size (bands 7, 14, 15) Cloud Top Height (bands 14, 15, 16) Cloud Top Pressure (bands 14, 15, 16) Cloud Top Temperature (bands 14, 15, 16)	I_ABI-L2-TARPPF-C<07, 10, 11, 14, 15, 16>

CRTM Intermediate Product Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Names
input_ABI_L2_intermediate_product_CRTM_clear_sky_radiance_band_16_profile_data: Cumulative emission from each level to the TOA for the specific band, provided as a radiance value, computed for clear sky conditions evaluated at 101 pressure levels as defined in Table C.3-2, and for the set of local zenith angles from the satellite to ABI fixed grid data points in the 0.5 degree cell. The atmosphere above each level absorbs some of the radiation and thus the radiance at TOA is reduced. Units of measure are milliwatt per square meter per steradian per wavenumber [mW m-2 sr-1 (cm-1)-1].			Volcanic Ash (bands 10, 11, 14, 15, 16)	
input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_7_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_10_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_11_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_14_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_15_profile_data: input_ABI_L2_intermediate_product_CRTM_clear_sky_transmittance_band_16_profile_data: Transmittance from the TOA to each level computed for clear sky conditions for the specific band evaluated at 101 pressure levels as defined in Table C.3-2, and for the set of local zenith angles from the satellite to ABI fixed grid data points in the 0.5 degree cell. This is a dimensionless quantity (fractional value).	0.5 degrees	Global with data tailored for satellite slot-specific processing	Clear Sky Mask (band 7) Cloud Optical Depth (bands 7, 14, 15) Cloud Particle Size (band 7, 14, 15) Cloud Top Height (bands 14, 15, 16) Cloud Top Pressure (bands 14, 15, 16) Cloud Top Temperature (bands 14, 15, 16) Volcanic Ash (bands 10, 11, 14, 15, 16)	I_ABI-L2-TARPPF-C<07, 10, 11, 14, 15, 16>
input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_10_profile_data: input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_11_profile_data: input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_14_profile_data: input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_15_profile_data:	0.5 degrees	Global with data tailored for satellite slot-specific processing	Clear Sky Mask (band 14) Cloud Top Height (bands 14, 15, 16) Cloud Top Phase (bands 10, 11, 14, 15, 16) Cloud Top Pressure (bands 14, 15, 16)	I_ABI-L2-TARPPF-C<10, 11, 14, 15, 16>

CRTM Intermediate Product Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Names
input_ABI_L2_intermediate_product_CRTM_cloudy_sky_radiance_band_16_profile_data: Cumulative emission from each level to the TOA for the specific band provided as a radiance value, which represent conditions with a blackbody cloud at the given level, evaluated at 101 pressure levels as defined in Table C.3-2, and for the set of local zenith angles from the satellite to ABI fixed grid data points in the 0.5 degree cell. The atmosphere above each level absorbs some of the radiation and thus the radiance at TOA is reduced. Units of measure are milliwatt per square meter per steradian per wavenumber [mW m-2 sr-1 (cm-1)-1].			Cloud Top Temperature (bands 14, 15, 16) Volcanic Ash (bands 10, 11, 14, 15, 16)	
input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_7_data: input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_14_data: input_ABI_L2_intermediate_product_CRTM_skin_temperature_derivative_band_15_data: Derivative of brightness temperature at the top of atmosphere with respect to surface skin temperature for the specific band. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Sea Surface Temperature (bands 7, 14, 15)	I_ABI-L2-TARPEF-C<07, 14, 15>
input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_7_data: input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_14_data: input_ABI_L2_intermediate_product_CRTM_water_vapor_derivative_band_15_data: Derivative of brightness temperature at the top of atmosphere with respect to water vapor amount for the specific band. Units of measure are Kelvin per kilogram per square meter.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Sea Surface Temperature (bands 7, 14, 15)	I_ABI-L2-TARPEF-C<07, 14, 15>

Table C.2-2 101 Pressure Levels

Level	Pressure (hPa)	Level	Pressure (hPa)	Level	Pressure (hPa)
1	0.005	36	51.5278	71	407.4738
2	0.0161	37	56.126	72	424.4698
3	0.0384	38	60.9895	73	441.8819
4	0.0769	39	66.1253	74	459.7118
5	0.137	40	71.5398	75	477.9607
6	0.2244	41	77.2396	76	496.6298
7	0.3454	42	83.231	77	515.72
8	0.5064	43	89.5204	78	535.2322
9	0.714	44	96.1138	79	555.1669
10	0.9753	45	103.0172	80	575.5248
11	1.2972	46	110.2366	81	596.3062
12	1.6872	47	117.7775	82	617.5112
13	2.1526	48	125.6456	83	639.1398
14	2.7009	49	133.8462	84	661.192
15	3.3398	50	142.3848	85	683.6673
16	4.077	51	151.2664	86	706.5654
17	4.9204	52	160.4959	87	729.8857
18	5.8776	53	170.0784	88	753.6275
19	6.9567	54	180.0183	89	777.7897
20	8.1655	55	190.3203	90	802.3714
21	9.5119	56	200.9887	91	827.3713
22	11.0038	57	212.0277	92	852.788
23	12.6492	58	223.4415	93	878.6201
24	14.4559	59	235.2338	94	904.8659
25	16.4318	60	247.4085	95	931.5236
26	18.5847	61	259.9691	96	958.5911
27	20.9224	62	272.9191	97	986.0666
28	23.4526	63	286.2617	98	1013.948
29	26.1829	64	300	99	1042.232
30	29.121	65	314.1369	100	1070.917
31	32.2744	66	328.6753	101	1100
32	35.6505	67	343.6176		
33	39.2566	68	358.9665		
34	43.1001	69	374.7241		
35	47.1882	70	390.8926		

C.3 Dynamic Ancillary Data

The dynamic ancillary data files received from ADRS are available from CLASS. The identity and description of these files are defined in Table C.4-1, Source Dynamic Ancillary Data.

Table C.3-1 Source Dynamic Ancillary Data

Source Ancillary Data File Type	Description	Horizontal Spatial Resolution / Projection	Update Frequency	File Format	Source
Numerical Weather Prediction (NWP) model output from Global Forecast System (GFS)	Defines the state of the atmosphere. The model output data is of two types: (1) analysis data describes the initial state of the atmosphere (i.e., time 00:) (2) forecast data predicts the state of the atmosphere at a future time in three hour intervals. The GOES-R ground system may use forecast data out to 12 hour in the future (i.e., time 03:, 06:, 09, and 12:). There is a separate NWP output model data file for the initial state and each forecast time. The model executes on a 6 hour cycle (i.e., 00:, 06:, 12:, and 18:). The nominal latency associated with the availability of model data is approximately 3.5 hours. The data includes a variety of data variables, such as surface temperature, surface geopotential height, and temperature and moisture profiles. For specific data variables and descriptions thereof used by GOES-R ground system ABI Level 2 product generation algorithm software, refer to Table C.4-2 Processed Dynamic Ancillary Data. Note that the model output data includes 26 pressure levels at 10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 925, 950, 975, and 1000 millibars. Not all levels exist for each data variable in the model output data.	0.5 degree (Mercator projection)	6 hours	GRIB2	National Centers for Environmental Predictions (NCEP)
Ice Mapping System (IMS) Snow/Ice Analysis (snow mask)	The file contains a 6144 x 6144 image capturing snow and ice extent over the northern hemisphere. Pixel values range from 0 to 4 where 0 (outside Northern Hemisphere), 1 (sea), 2 (land), 3 (sea ice), and 4 (snow).	4 km (polar stereographic)	24 hours	GeoTIFF	National Snow and Ice Data Center

Source Ancillary Data File Type	Description	Horizontal Spatial Resolution / Projection	Update Frequency	File Format	Source
Near Real-Time Global Ice Concentration and Snow Extent	The file contains four grid objects: one data grid and one age grid each for both the Northern and Southern hemispheres. Data variables include snow extent, sea ice concentration, coastal pixels, and age of input data. The definition of grid element values is located on the web at http://nsidc.org/data/docs/daac/nise1_nise.gd.html. The information required to convert grid cell locations to latitude and longitude values is located on the web at http://nsidc.org/data/hdfeos/geolocate.html.	25 km (azimuthal, equal-area projection, north/south pole is center of grid)	24 hours	Hierarchical Data Format Earth Observing System (HDF-EOS)	National Snow and Ice Data Center
Reynolds Sea Surface Temperature (SST) Analysis	The file contains the following data elements: SST, SST anomaly, estimated error standard deviation of analyzed SST, sea ice concentration, and sea surface height.	0.25 degree (global latitude / longitude grid)	24 hours	netCDF	National Climatic Data Center (NCDC)
Official Tropical Cyclone Forecast	Official Tropical Cyclone Forecast files are in one of two formats: (1) Automated Tropical Cyclone Forecasting system (ATCF) data file format and (2) National Hurricane Center (NHC) discussion files. The ATCF file contains the forecast issue time, and a set of records containing the basin ID (e.g., north Atlantic, south Atlantic, etc.), storm identifier, and forecast time, latitude and longitude of cyclone center, and maximum sustained winds. The NHC discussion file contains the cyclone name, forecast issue time, and a set of records containing the forecast time, latitude and longitude of cyclone center, and maximum sustained winds.	not applicable	6 hours	ASCII	National Hurricane Center (NHC)

The dynamic ancillary data in the form received from ADRS is not directly used by the ABI Level 2+ product generation algorithm software. Rather, the dynamic ancillary data received from ADRS is pre-processed. Specific pre-processing functions include:

Data type partitioning the one NWP model output data file into files containing individual environmental data variables.

Temporally interpolating NWP model output data four times an hour at fifteen minute intervals (:00, :15, :30 :45 of each wall clock hour) from bounding NWP forecast fields to correspond to the time associated with the source observation data.

Changing the horizontal spatial resolution and/or projection of the data to simplify product generation algorithm software design and satisfy product latency requirements, while ensuring product accuracy requirements are satisfied and hardware utilization levels are within acceptable limits. For some types of dynamic ancillary data, the data is projected to the ABI fixed grid. Note that a nearest neighbor algorithm is used as required in dynamic ancillary data pre-processing, and the ABI Level 2 product algorithms.

Changing the vertical spatial resolution of the NWP model output data (26 levels) to 101 levels as required to conform to the needs of many of the Level 2 product algorithms and the off-the-shelf Community Radiative Transfer model (CRTM) software, and simplify product generation algorithm software design and satisfy product latency requirements, while ensuring product accuracy requirements are satisfied and hardware utilization levels are within acceptable limits. For levels on the 101 level grid that fall between levels existing in the NWP model output data, an interpolation in log pressure is used. For pressures below (i.e., higher pressure) that available in the NWP data, extrapolate to the lowest level in the 101 level grid from the lowest 2 levels in the NWP data. For pressure levels above the highest (i.e., lowest pressure), set the water vapor equal to 0.003 grams per kilogram, compute coefficients for the 3-point parabolic fit from temperature-extrapolation coefficients, establish temperature predictions for different latitudes, and perform a regression.

Upon receiving updated dynamic ancillary data from ADRS, it is used as input for dynamic ancillary data pre-processing at the next fifteen minute offset in a wall clock hour. The NWP output model data files temporally interpolated are one of the following pairs: analysis (current conditions and 3 hour forecast data sets; 3 and 6 hour forecast data sets; 6 and 9 hour forecast data sets, or; 9 and 12 hour forecast data sets. The decision as to which pair of the NWP output model data files to use is based on what is available in the ground system when the pre-processing starts, and the current time. Note that the analysis data sets are never used because of the time required for the ground system to receive the data. Conservatively, the pre-processing of the dynamic ancillary data received from ADRS requires ten minutes. This means that updated processed dynamic ancillary data is available at :10, :25, :40, and :55 of each wall clock hour. Once the most recent version of the processed dynamic ancillary data is available, it is used for the next five minute ABI mode 4, ten minute ABI mode 6 or fifteen minute ABI mode 3 epoch.

The processed form of these dynamic ancillary data files are available internally in the GOES-R ground system revolving storage for a minimum of 48 hours. Refer to Table C.4-2, Processed Dynamic Ancillary Data, for the a description of each processed dynamic ancillary data type, its horizontal spatial resolution, coverage area, dependent ABI Level 2+ products, and Data Short Name (DSN). The DSN is the identifying portion of the processed dynamic ancillary data filename.

Table C.3-2 Processed Dynamic Ancillary Data

Processed Dynamic Ancillary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Name
input_dynamic_ancillary_NWP_geopotential_height_profile_data: Geopotential heights derived from the source NWP model geopotential height profile data received from ADRS at 101 pressure levels as defined in Table C.3-2, 101 Pressure Levels. Geopotential height is the gravity adjusted vertical elevation above mean sea level. Units of measure are meters.	0.5 degrees	Global	Cloud Optical Depth Cloud Particle Size Cloud Top Height Cloud Top Pressure Cloud Top Temperature Volcanic Ash	I_ANC-GeoHgt-101-TI
input_dynamic_ancillary_NWP_moisture_profile_data:	0.5 degrees	Global	Derived Stability Indices	I_ANC-MoisturePro

Processed Dynamic Ancillary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Name
Moisture (i.e., relative humidity) derived from the source NWP model moisture profile data received from ADRS at 101 pressure levels as defined in Table C.3-2, 101 Pressure Levels. Units of measure are grams per kilogram.			Legacy Vertical Moisture Profile Legacy Vertical Temperature Profile Total Precipitable Water	
input_dynamic_ancillary_NWP_precipitable_water_profile_data: Total amount of water vapor contained in a vertical column in the atmosphere derived from the source NWP model moisture profile data received from ADRS at 101 pressure levels as defined in Table C.3-2, 101 Pressure Levels. This is a cumulative value. Units of measure are centimeters.	0.5 degrees	Global	Cloud Optical Depth Cloud Particle Size	I_ANC-DerTPWPro
input_dynamic_ancillary_NWP_pressure_profile_data: 101 pressure levels as defined in Table C.3-2, 101 Pressure Levels. Units of measure are millibar.	0.5 degrees	Global	Cloud Top Height Cloud Top Phase Cloud Top Pressure Cloud Top Temperature Volcanic Ash	I_ANC-DynPressGrids
input_dynamic_ancillary_NWP_raw_temperature_profile_data: Temperature at 26 pressure levels obtained from the source NWP model output data received from ADRS. The 26 pressure levels are 10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 925, 950, 975, and 1000 millibars. Units of measure are Kelvin.	0.5 degrees	Global	Derived Motion Winds	I_ANC-TempPro-26-TI
input_dynamic_ancillary_NWP_snow_mask_data: Snow existence mask derived from the source NWP model snow depth data received from ADRS. This is a dimensionless quantity (Boolean / logical data type value).	0.5 degrees	Global	Clear Sky Mask	I_ANC-SnowMask-Der
input_dynamic_ancillary_NWP_surface_geopotential_height_data: Geopotential heights at the surface obtained from the corresponding source NWP model output data received from ADRS. Geopotential height is the gravity adjusted vertical elevation above mean sea level. Units of measure are meters.	0.5 degrees	Global	Aerosol Optical Depth	I_ANC-SurGeoHgt-TI
input_dynamic_ancillary_NWP_surface_level_index_data:	0.5 degrees	Global	Clear Sky Mask	I_ANC-SurIdx-Der

Processed Dynamic Ancillary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Name
The "surface level index", which is a derived value, indicates the first level of the 26 pressure levels in the source NWP model output data received from ADRS with a value larger than the NWP model output surface pressure (i.e., first level below the surface). The 26 pressure levels are 10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 925, 950, 975, and 1000 millibars. This is a dimensionless quantity (an index into 101 level grid).			Cloud Top Height Cloud Top Pressure Cloud Top Temperature Derived Stability Indices Legacy Vertical Moisture Profile Legacy Vertical Temperature Profile Total Precipitable Water	
input_dynamic_ancillary_NWP_surface_pressure_data: Pressure at the surface obtained from the corresponding source NWP model output surface pressure data received from ADRS. Units of measure are millibars.	0.5 degrees	Global	Aerosol Optical Depth Cloud Optical Depth Cloud Particle Size Cloud Top Height Cloud Top Pressure Cloud Top Temperature Derived Stability Indices Legacy Vertical Moisture Profile Legacy Vertical Temperature Profile Total Precipitable Water	I_ANC-SurPress-TI
input_dynamic_ancillary_NWP_surface_temperature_data: Temperature at the surface obtained from the corresponding source NWP model output data received from ADRS. Units of measure are Kelvin.	0.5 degrees	Global	Clear Sky Mask Cloud Optical Depth Cloud Particle Size Cloud Top Height Cloud Top Pressure Cloud Top Temperature Derived Stability Indices Legacy Vertical Moisture Profile Legacy Vertical Temperature Profile Total Precipitable Water Volcanic Ash	I_ANC-SurTemp-TI
input_dynamic_ancillary_NWP_surface_wind_vector_data: Wind speed and direction, which is provided with U and V components, at the surface obtained from the corresponding	0.5 degrees	Global	Aerosol Optical Depth	I_ANC-SurUVWind-TI

Processed Dynamic Ancillary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Name
source NWP model output data received from ADRS. Units of measure are meters per second. The horizontal component (U) is referenced positive to the East, the vertical component (V) is positive North.				
input_dynamic_ancillary_NWP_temperature_profile_data: Temperature derived from the source NWP model temperature profile data received from ADRS at 101 pressure levels as defined in Table C.3-2, 101 Pressure Levels. Units of measure are Kelvin.	0.5 degrees	Global	Cloud Optical Depth Cloud Particle Size Cloud Top Height Cloud Top Phase Cloud Top Pressure Cloud Top Temperature Derived Stability Indices Legacy Vertical Moisture Profile Legacy Vertical Temperature Profile Total Precipitable Water Volcanic Ash	I_ANC-TempPro-101
input_dynamic_ancillary_NWP_temperature_inversion_layer_data: Temperature inversion indication derived from the source NWP model temperature profile data received from ADRS at 101 pressure levels as defined in Table C.3-2, 101 Pressure Levels. This is a dimensionless quantity (Boolean / logical data type value).	0.5 degrees	Global	Cloud Top Height Cloud Top Pressure Cloud Top Temperature	I_ANC-InvLayPro-Der
input_dynamic_ancillary_NWP_total_column_ozone_data: Total amount of ozone contained in a vertical column in the atmosphere obtained from the corresponding source NWP model output data. Units of measure are Dobson (i.e., milli-atmo-centimeter).	0.5 degrees	Global	Aerosol Optical Depth Clear Sky Mask Cloud Optical Depth Cloud Particle Size Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA	I_ANC-TotalOzone-TI
input_dynamic_ancillary_NWP_total_precipitable_water_data:	0.5 degrees	Global	Aerosol Optical Depth Clear Sky Mask Cloud Optical Depth	I_ANC-TPW-TI

Processed Dynamic Ancillary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Name
Total amount of water vapor contained in a vertical column in the atmosphere. Units of measure are kilograms per square meter.			Cloud Particle Size Downward Shortwave Radiation: Surface Fire / Hot Spot Characterization Land Surface Temperature Reflected Shortwave Radiation: TOA	
input_dynamic_ancillary_NWP_tropopause_level_index_data: The "tropopause level index", which is a derived value, indicates the nearest neighbor where the tropopause begins of the 26 pressure levels extrapolated from the source NWP model output data received from ADRS. The 26 pressure levels are 10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 925, 950, 975, and 1000 millibars. This is a dimensionless quantity (an index into 101 level grid).	0.5 degrees	Global	Clear Sky Mask Cloud Top Height Cloud Top Phase Cloud Top Pressure Cloud Top Temperature Volcanic Ash	I_ANC-TroIdx-Der
input_dynamic_ancillary_NWP_tropopause_temperature_data: Temperature at the tropopause obtained from the corresponding source NWP model output data received from ADRS. Units of measure are Kelvin.	0.5 degrees	Global	Cloud Top Height Cloud Top Pressure Cloud Top Temperature	I_ANC-TropTemp
input_dynamic_ancillary_NWP_wind_vector_profile_data: Wind speed and direction, which is provided with U and V components, at 26 pressure levels extrapolated from the source NWP model output data received from ADRS. The 26 pressure levels are 10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 925, 950, 975, and 1000 millibars. Units of measure are meters per second. The horizontal component (U) is referenced positive to the East, the vertical component (V) is positive North.	0.5 degrees	Global	Derived Stability Indices Derived Motion Winds Legacy Vertical Moisture Profile Legacy Vertical Temperature Profile Total Precipitable Water	I_ANC-UVWndPro-26-TI

Processed Dynamic Ancillary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Name
input_dynamic_ancillary_Reynolds_SST_data: Daily sea surface temperature derived from the source Reynolds SST analysis data received from ADRS. Units of measure are degrees Celsius.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Sea Surface Temperature	I_ANC-ReyDailySST
input_dynamic_ancillary_Reynolds_SST_uncertainty_data: Estimated error provided from the source Reynolds SST analysis data received from ADRS. Units of measure are degrees Celsius.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Sea Surface Temperature	I_ANC-ReyDailySST-Unc
input_dynamic_ancillary_tropical_cyclone_forecast_file_data: The forecast issue time, and a set of records containing the cyclone identifier and forecast time, latitude and longitude of cyclone center, and maximum sustained winds. There is one file for each cyclone.	not applicable	not applicable	Hurricane Intensity	I_ANC-OffTropCycFor_<automated_tropical_cyclone_forecasting_system_storm_identifier>
input_dynamic_ancillary_passive_microwave_eye_score_data: The Level 2 hurricane intensity product algorithm software has been designed to receive this data, but ADRS does not currently provide this data.	not applicable	not applicable	Hurricane Intensity	I_ANC-PassMWEyeSco

C.4 Dynamic Auxiliary Data

Several ABI Level 2+ product algorithms make use of auxiliary data to generate the ABI Level 2+ products. Dynamic auxiliary data is composed of several types of angles between the sun, satellite, and data point locations on the ABI fixed grid.

Auxiliary data processing software executes in the GOES-R ground system upon receipt of each Full Disk, CONUS, or mesoscale scene, and is used in the generation of products associated with the scene. Current wall clock time is a key parameter used in the generation the auxiliary data set.

The dynamic auxiliary output data files are available internally in the GOES-R ground system revolving storage for a minimum of 48 hours. Refer to Table C.5, Dynamic Auxiliary Output Data, for the a description of each output data type, its horizontal spatial resolution, coverage area, dependent ABI Level 2+ products, and Data Short Name (DSN). The DSN is the identifying portion of the dynamic auxiliary data filename.

Table C.4 Dynamic Auxiliary Data

Dynamic Auxiliary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Names
input_ABI_L2_auxiliary_scattering_angle_data: Angle between the forward direction of the incident beam from the sun and a straight line connecting the scattering point (i.e., earth surface location on the ABI fixed grid) and the imaging detector. Units of measure are radians (positive values only, 0 to PI).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask	I_ABI-L2-AUXF2 I_ABI-L2-AUXC2 I_ABI-L2-AUXM12 I_ABI-L2-AUXM22
input_ABI_L2_auxiliary_solar_azimuth_angle_data: Angle between two vectors projected onto a plane, one pointed to the line of sight to the sun (sub-solar point), and due north (north pointing vector) measured clockwise. Units of measure are radians (0 o 2 PI).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Aerosol Optical Depth Snow Cover	
input_ABI_L2_auxiliary_solar_zenith_angle_data: Angle between the line of sight to the sun and the local vertical, a point on the earth (i.e., earth surface location on the ABI fixed grid). Units of measure are radians (positive values only, 0 to PI).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Aerosol Detection Aerosol Optical Depth Clear Sky Mask Cloud and Moisture Imagery (reflective bands 1-6 only) Cloud Optical Depth Cloud Particle Size Derived Motion Winds Downward Shortwave Radiation: Surface	I_ABI-L2-AUXF2 I_ABI-L2-AUXC2 I_ABI-L2-AUXM12 I_ABI-L2-AUXM22

Dynamic Auxiliary Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)	Data Short Names
			Fire / Hot Spot Characterization Land Surface Temperature Reflected Shortwave Radiation: TOA Sea Surface Temperature Snow Cover	
input_ABI_L2_auxiliary_sunglint_angle_data: Angle between the direction of the beam of incident solar radiation and the direction into which it is reflected from a point on the earth (i.e., earth surface location on the ABI fixed grid). Units of measure are radians (positive values only).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Aerosol Detection Clear Sky Mask Fire / Hot Spot Characterization Sea Surface Temperature	I_ABI-L2-AUXF2 I_ABI-L2-AUXC2 I_ABI-L2-AUXM12 I_ABI-L2-AUXM22
input_ABI_L2_auxiliary_sun_satellite_relative_azimuth_angle_data: Angle between two vectors projected onto a plane, one pointed towards the line of sight to the satellite (sub-satellite point), and the line of sight to the sun (sub-solar point). Units of measure are radians (positive values only, 0 to PI radians).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Aerosol Detection Aerosol Optical Depth Cloud Optical Depth Cloud Particle Size Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA	I_ABI-L2-AUXF2 I_ABI-L2-AUXC2 I_ABI-L2-AUXM12 I_ABI-L2-AUXM22

APPENDIX D GRIDDED SEMI-STATIC SOURCE DATA

This appendix identifies and describes gridded semi-static source data used to support the generation of ABI Level 2+ products. The gridded semi-static source data is maintained for specific orbital slots (e.g., GOES-R East, GOES_R West, etc.). Each of these data sets have dependencies to the ABI fixed grid. This gridded data includes climatological data, seasonal and infrequently changing earth surface characteristics data, and mapping data that relates the ABI fixed grid to other projection grids (e.g., NWP lat/lon based grid). These datasets are defined for Full Disk coverage for quantities specified on the fixed grid and for global coverage for quantities specified on other grids.

The following categories of gridded Level 2+ semi-static source data are used to support production of ABI Level 2+ products:

- Projection and mapping.
- Earth surface classifications and characteristics.
- Atmospheric climatology.
- Seasonal.

This appendix describes semi-static source data used as a direct input to the ABI Level 2+ ground processing algorithms. Product generation support functions of the ground system that process dynamic ancillary data received from ADRS, compute dynamic auxiliary data (e.g., solar angles), and perform numerical radiative transfer calculations in support of the Level 2+ algorithms also use semi-static source data in support of these functions. However, a description of the semi-static source data used by these product generation support functions is not currently included in this document.

Projection and mapping.

The projection and mapping category of semi-static source data includes auxiliary coordinate data referenced to the fixed grid (e.g., latitude, longitude, satellite zenith angle) and captures information used by Level 2+ algorithm to map data from one grid to another (e.g., from the NWP grid to the ABI fixed grid). Defining this information as semi-static source data ensures consistency between algorithm components and removes the need for the Level 2+ algorithms to perform mapping calculations that can be represented as pre-computed semi-static source data. These data sets contain pre-calculated values allowing lookups of latitude and longitudes, local zenith angles data mappings between the ABI fixed grid and the NWP 0.5 degree grid, distances between data points, and other geometry related information. These data sets are subject to change only if the characteristics of the source NWP ancillary data changes or modifications are introduced to the CRTM-based radiative transfer calculations (e.g., to change the angle bin resolution) that use some of the same data sets.

Earth surface classification and characteristics.

The earth surface classifications and characteristics category of gridded semi-static source data represents data that is used directly by the Level 2+ algorithms where the algorithm functionality depends on the type for surface, background, or other surface characteristics such as elevation. These gridded semi-static source data are derived from global datasets and are subject to change in the event changes are made to the source datasets.

Atmospheric climatology.

The atmospheric climatology category of gridded semi-static source data is used by the Level 2+ algorithms. Atmospheric climatology semi-static source data is derived from global datasets, compiled over multi-year periods, and provides "truth" data to the algorithms to initialize, moderate, or bound their behavior or validate their output. Atmospheric climatologies are also used as default information to support non-nominal scenarios when sources for dynamic inputs are unavailable. This category of gridded semi-static source data may be subject to change in the event changes are made to the global datasets.

Seasonal.

The seasonal category of gridded semi-static source data is used by the Level 2+ algorithms. The GOES-R Level 2+ algorithms make use of both seasonal surface emissivity and white sky albedo data sets. This data provides information about the radiative properties of surface backgrounds throughout the year, such as that resulting from changes in vegetation. The seasonal semi-static source data is typically defined for a full season with datasets specified monthly for emissivity and based on 16-day clear sky reflectance averages for the white-sky albedo. The seasonal semi-static source data may be updated on an annual basis to account for longer-term changes in land surface characteristics.

Table D.1, Gridded Semi-Static Source Data Details, identifies and describes the types of Level 2+ gridded semi-static source data categories in each type. All ABI L2 processing parameter data are included in one zip file per satellite.

Table D.1 Gridded Semi-Static Source Data Details

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
			Data Short Name
Projection and Mapping Category			OR_ABI-L2-PARM-SEMISTATIC
			Aggregate Dataset Name
			OR_ABI-L2-PARM-SEMISTATIC_Gnn_vVVrRR.zip
input_ABI_L2_slot_specific_semi_static_lat_lon_position_2km_data: Latitude is the earth coordinate at each ABI fixed grid data point specifying the angular position north or south of the equator; defined for -90 degrees (South) to +90 degree (North). Units of measure are degrees. Longitude is the earth coordinate at each ABI fixed grid data point specifying the angular east-west location; defined for -	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region for latitude and longitude Satellite slot-independent Full Disk region for space mask	Clear Sky Mask Cloud Top Phase Cloud Top Height Cloud Top Pressure Could Top Temperature Cloud Optical Depth Cloud Particle Size Aerosol Detection Aerosol Optical Depth

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
180 degrees (West) to +180 degrees (East). Units of measure are degrees. Space mask identifies ABI fixed grid points that are earth-geolocated (value = 1) or not earth-geolocated (value = 0). The space mask for the ABI fixed grid projection is slot independent.			Volcanic Ash Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices Rainfall Rate Derived Motion Winds Hurricane Intensity Fire / Hot Spot Characterization Snow Cover Sea Surface Temperature Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_semi_static_local_zenith_angle_data: Local zenith angle (i.e., satellite zenith angle) at each ABI fixed grid data point. It is the angle between the straight line from a point on the earth surface to the satellite and the line from the same point on the earth surface that is perpendicular to the earth's horizontal surface at that point. It is defined for 0 to 90 degrees. Units of measure are degrees.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-independent Full Disk region	Clear Sky Mask Cloud Top Phase Cloud Optical Depth Cloud Particle Size Cloud Top Height Cloud Top Pressure Could Top Temperature Aerosol Detection Aerosol Optical Depth Volcanic Ash Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices Rainfall Rate Derived Motion Winds Hurricane Intensity Fire / Hot Spot Characterization Land Surface Temperature Snow Cover Sea Surface Temperature Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
input_ABI_L2_semi_static_local_azimuth_angle_data: Local azimuth angle at each ABI fixed grid data point is the angle between the straight line, which is projected perpendicularly by the straight line from a point on the earth surface to the satellite onto the horizontal surface at the same earth point, and the straight line from the same earth point to true south. It is defined for 0 to 360 degrees clockwise relative to the south-pointing vector. Units of measure are degrees.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-independent Full Disk region	Aerosol Optical Depth
input_ABI_L2_slot_specific_semi_static_NWP_grid_mapping_for_fixed_grid_data: NWP grid point indices (defined for a global 0.5 degree NWP grid with valid range: 0 to 719 columns and 0 to 360 rows) identified with each ABI fixed grid data point. This is a dimensionless quantity (indices).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask Cloud Top Phase Cloud Top Height Cloud Top Pressure Cloud Top Temperature Cloud Optical Depth Cloud Particle Size Aerosol Optical Depth Volcanic Ash Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices Derived Motion Winds Fire / Hot Spot Characterization Land Surface Temperature Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_semi_static_local_zenith_angle_bin_index_data: The subset of local zenith angle bin indices identified with each NWP grid point defined to support calculations of CRTM-based dynamic ancillary data and specified for the ranges of angles represented by corresponding ABI fixed grid points. One to six angles may be defined for NWP grid points	0.5 degrees	Global	Clear Sky Mask Cloud Top Phase Cloud Optical Depth Cloud Particle Size Cloud Top Height Cloud Top Pressure Coud Top Temperature

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
corresponding to fixed grid geolocated pixels. Bin angle indices (0 to 100) are defined for local zenith angles equally spaced in log space.			Volcanic Ash
input_ABI_L2_semi_static_E_W_to_N_S_distance_ratio_for_fixed_grid_half_km_data: Ratio of the east-west geometric distance between a reference ABI fixed 0.5 km grid data point and the first neighboring data point in the east direction to the north-south geometric distance between a reference ABI 0.5 km grid data point and the first neighboring data point in the south direction. These values are independent of the satellite slot. This is a dimensionless quantity (ratio).	0.00014 radians (0.5 km at satellite's nadir)	Satellite slot-independent Full Disk region	Derived Motion Winds
input_ABI_L2_semi_static_E_W_to_N_S_distance_ratio_for_fixed_grid_2km_data: Ratio of the east-west distance between a reference ABI fixed 2 km grid data point and the first neighboring data point in the east direction to the north-south geometric distance between a reference ABI 2 km grid data point and the first neighboring data point in the south direction.. These values are independent of the satellite's orbital slot. This is a dimensionless quantity (ratio).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-independent Full Disk region	Derived Motion Winds
input_ABI_L2_slot_specific_0.05_degree_lat_lon_grid_mapping_for_fixed_grid_data: Global 0.05 degree lat/lon grid indices identified with each ABI fixed grid data point. 0 to 7199 columns, West to East, relative to -180 degrees longitude and 0 to 3599 rows, North to South, relative to +90 degree latitude. This is a dimensionless quantity (indices).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_0.25_degree_lat_lon_grid_mapping_for_fixed_grid_data: Global 0.25 degree lat/lon grid indices identified with each ABI fixed grid data point. 0 to 1439 columns, West to East,	0.00056 radians (2 km at	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
relative to -180 degrees longitude and 0 to 719 rows, North to South, relative to +90 degree latitude. This is a dimensionless quantity (indices).	satellite's nadir)		
input_ABI_L2_slot_specific_0.50_degree_lat_lon_grid_mapping_for_fixed_grid_data: Global 0.5 degree lat/lon grid indices identified with each ABI fixed grid data point. 0 to 719 columns, West to East, relative to -180 degrees longitude and 0 to 359 rows, North to South, relative to +90 degree latitude. This is a dimensionless quantity (indices).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_0.05_degree_lat_lon_cells_nearest_neighbor_data: Global 0.05 degree lat/lon grid indices specifying the nearest lat/lon grid point that is represented in the corresponding lat/lon to fixed grid index mapping data. 0 to 7199 columns, West to East, relative to -180 degrees longitude, and 0 to 3600 rows, North to South, relative to +90 degree latitude. Because of the relative sampling of the fixed grid and lat/lon grid not all lat/lon grid points are directly associated with fixed grid point data. This mapping between lat/lon grid points addresses the gaps associated with the ABI fixed grid mapping. This is a dimensionless quantity (indices).	0.05 degrees	Global slot-specific	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_0.25_degree_lat_lon_cells_nearest_neighbor_data: Global 0.05 degree lat/lon grid indices specifying the nearest lat/lon grid point that is represented in the corresponding lat/lon to fixed grid index mapping data. 0 to 1439 columns, West to East, relative to -180 degrees longitude, and 0 to 719 rows, North to South, relative to +90 degree latitude. Because of the relative sampling of the fixed grid and lat/lon grid not all lat/lon grid points are directly associated with fixed grid point data. This mapping between lat/lon grid points addresses the gaps associated with the ABI fixed grid mapping. This is a dimensionless quantity (indices).	0.25 degrees	Global slot-specific	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_0.50_degree_lat_lon_cells_nearest_neighbor_data:	0.50 degrees	Global slot-specific	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
Global 0.05 degree lat/lon grid indices specifying the nearest lat/lon grid point that is represented in the corresponding lat/lon to fixed grid index mapping data. 0 to 719 columns, West to East, relative to -180 degrees longitude, and 0 to 359 rows, North to South, relative to +90 degree latitude. Because of the relative sampling of the fixed grid and lat/lon grid not all lat/lon grid points are directly associated with fixed grid point data. This mapping between lat/lon grid points addresses the gaps associated with the ABI fixed grid mapping. This is a dimensionless quantity (indices).			
Earth Surface Classifications and Characteristics Category			
input_ABI_L2_slot_specific_semi_static_surface_elevation_data: Surface elevation at each ABI fixed grid data point. Units of measure are meters.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask Cloud Top Height Cloud Top Pressure Cloud Top Temperature Aerosol Optical Depth Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_semi_static_land_sea_mask_data: Existence of land or sea at each ABI fixed grid data point. This is a dimensionless quantity (enumeration type: shallow ocean; all land; ocean coastlines and lake shorelines; shallow inland water; ephemeral water; deep inland water, moderate or continental ocean, and deep ocean).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask Cloud Optical Depth Cloud Particle Size Aerosol Detection Aerosol Optical Depth Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices Fire / Hot Spot Characterization Land Surface Temperature Snow Cover Sea Surface Temperature Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
input_ABI_L2_slot_specific_semi_static_coast_mask_data: Indicates near or at a water/land transition. This is a dimensionless quantity (enumeration type: not coast; coast within 1 km; coast within 2 km; coast within 3 km; coast within 4 km; coast within 5 km; coast within 6 km; coast within 7 km; coast within 8 km; coast within 9 km; coast within 10 km).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask
input_ABI_L2_slot_specific_semi_static_desert_mask_data: Indicates the presence of desert. This is a dimensionless quantity (enumeration type: no desert; Near Infrared (NIR) desert, identified with open shrubland, woody savannas, savannas, grasslands, and permanent wetlands; and bright desert, identified with urban areas)	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask Fire / Hot Spot Characterization
input_ABI_L2_slot_specific_semi_static_ecosystem_mask_data: Indicates the land cover characteristics. 98 types of land cover characteristics are defined but only 7 characteristics used. This is a dimensionless quantity (enumeration types: inland water; sea water; water and island fringe; land, water, and shore; land and water, rivers, coastline fringe, and compound coastlines).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Fire / Hot Spot Characterization
input_ABI_L2_slot_specific_semi_static_surface_type_mask_data: Indicates land cover classification. This is a dimensionless quantity (enumeration type: water; evergreen needle leaf forest; evergreen broadleaf forest; deciduous needle leaf forest; deciduous broadleaf forest; mixed forests; woodland; wooded grassland; closed shrubland; open shrubland; grasslands; croplands; bare ground; urban and built-up).	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Cloud Top Height Cloud Top Pressure Could Top Temperature Volcanic Ash Fire / Hot Spot Characterization
input_ABI_L2_slot_specific_semi_static_IGBP_surface_type_mask_data: Indicates the International Geosphere-Biosphere Programme (IGBP) surface type classification. This is a dimensionless quantity (enumeration type: evergreen needle leaf forest; evergreen broadleaf forest; deciduous needle leaf forest; deciduous broadleaf forest; mixed forests; closed shrublands; open shrublands; woody savannas; savannas; grasslands;	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
permanent wetlands; croplands; urban and built-up; cropland mosaics; snow and ice (permanent); bare soil and rocks; water bodies; tundra)			
Atmospheric Climatology Category			
input_ABI_L2_slot_specific_semi_static_monthly_cloud_climatology_data: Monthly mean cloud top height, optical depth and particle size for both ice and water clouds at each ABI fixed grid data point. Units of measure for cloud top heights are meters. Cloud optical depth is a dimensionless quantity. Units of measure for cloud particle size are micrometers.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_semi_static_monthly_aerosol_climatology_data: Monthly mean aerosol optical depth and single scatter albedo at 0.55 microns at each ABI fixed grid data point. Aerosol optical depth and single scattering albedo are dimensionless quantities.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_semi_static_monthly_total_precipitable_water_climatology_data: Thickness of atmospheric mass content of water vapor at each ABI fixed grid data point. Units of measure are centimeters.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
input_ABI_L2_slot_specific_semi_static_monthly_total_column_ozone_climatology_data: Total column ozone at each ABI fixed grid data point. Units of measure are Dobson units.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Downward Shortwave Radiation: Surface Reflected Shortwave Radiation: TOA
Seasonal Category			
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_7_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at	Satellite slot-specific Full Disk region	Clear Sky Mask Cloud Optical Depth Cloud Particle Size Legacy Vertical Temperature Profile

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
	satellite's nadir)		Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_8_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_9_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_10_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_11_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Cloud Top Phase Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_12_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_13_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity..	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices

Gridded Semi-Static Source Data Type: Description	Horizontal Spatial Resolution	Coverage Area	Dependent ABI Level 2+ Product(s)
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_14_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Cloud Optical Depth Cloud Particle Size Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices Volcanic Ash Land Surface Temperature
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_15_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Cloud Optical Depth Cloud Particle Size Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices Volcanic Ash Land Surface Temperature
input_ABI_L2_slot_specific_semi_static_surface_monthly_emissivity_band_16_data: Monthly surface emissivity for the specific band at each ABI fixed grid point. This is a dimensionless quantity.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Legacy Vertical Temperature Profile Legacy Vertical Moisture Profile Total Precipitable Water Derived Stability Indices
input_ABI_L2_slot_specific_semi_static_16_day_white_sky_albedo_band_2_data: Estimate of the 16 day cloud-cleared white-sky reflectance for the specific band at each ABI fixed grid data point. The units of measure are percent.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Clear Sky Mask Cloud Optical Depth Cloud Particle Size
input_ABI_L2_slot_specific_semi_static_16_day_white_sky_albedo_band_6_data: Estimate of the cloud-cleared white-sky reflectance for the specific band at each ABI fixed grid data point. The units of measure are percent.	0.00056 radians (2 km at satellite's nadir)	Satellite slot-specific Full Disk region	Cloud Optical Depth Cloud Particle Size

APPENDIX E SELECTED NON-STANDARD PRODUCTS

This appendix identifies and describes selected non-standard products that are produced in the generation of some Level 2+ products. The non-standard products preserve key information from an execution of an algorithm that may be used by subsequent execution of that algorithm.

These non-standard products are produced in the generation of the following Level 2+ products:

- Derived Motion Winds Product.

E.1 Derived Motion Winds Non-Standard Products

There are two categories of Derived Motion Winds non-standard products that are needed by specific users (e.g., the National Weather Service (NWS)):

- Derived Motion Winds Diagnostic Non-Standard Product
- Derived Motion Winds Product Quality Information Non-Standard Product.

Notes:

- These Derived Motion Winds non-standard products are distributed to the PDA archive, when the Ground Segment is configured for distribution of Derived Motion Winds Diagnostic and Product Quality Information non-standard products.
- These Derived Motion Winds non-standard products do not necessarily conform to the Climate and Forecast (CF) conventions that are used for the end product files.
- These Derived Motion Winds non-standard products do not necessarily contain the level of metadata and variable attributes that is present in the end product files.

The file naming convention follows the same format as the Derived Motion Winds L2+ product, with the exception of the Data Short Name.

The Data Short Names of the files for the Derived Motion Winds Diagnostic Non-Standard Product are as follows:

- ABI-L2-DMWDIAGx-M3Cyy L2+ Derived Motion Winds: ABI Mode 3 Scene Type x (F, C, M1, M2) Channel yy 02, 07, 08, 09, 10, 14) Diagnostic Information
- ABI-L2-DMWVDIAGx-M3C08 L2+ Derived Motion Winds – Vapor: ABI Mode 3Scene Type x (F, C, M1, M2) Channel 8 Diagnostic Information
- ABI-L2-DMWDIAGx-M6Cyy L2+ Derived Motion Winds: ABI Mode 6 Scene Type x (F, C, M1, M2) Channel yy 02, 07, 08, 09, 10, 14) Diagnostic Information
- ABI-L2-DMWVDIAGx-M6C08 L2+ Derived Motion Winds – Vapor: ABI Mode 6 Scene Type x (F, C, M1, M2) Channel 8 Diagnostic Information
- ABI-L2-DMWDIAGx-M4Cyy L2+ Derived Motion Winds: ABI Mode 4 Scene Type x (F) Channel yy 02, 07, 08, 09, 10, 14) Diagnostic Information
- ABI-L2-DMWVDIAGx-M4C08 L2+ Derived Motion Winds – Vapor: ABI Mode 4 Scene Type x (F) Channel 8 Diagnostic Information

The Data Short Names of the files for the Derived Motion Winds Product Quality Information Non-Standard Product are as follows:

- ABI-L2-DMWPQIx-M3Cyy L2+ Derived Motion Winds: ABI Mode 3 Scene Type x (F, C, M1, M2) Channel yy (02, 07, 08, 09, 10, 14) Product Quality Information
- ABI-L2-DMWVPQIx-M3C08 L2+ Derived Motion Winds – Vapor: ABI Mode 3 Scene Type x (F, C, M1, M2) Channel 8 Product Quality Information
- ABI-L2-DMWPQIx-M6Cyy L2+ Derived Motion Winds: ABI Mode 6 Scene Type x (F, C, M1, M2) Channel yy (02, 07, 08, 09, 10, 14) Product Quality Information
- ABI-L2-DMWVPQIx-M6C08 L2+ Derived Motion Winds – Vapor: ABI Mode 6 Scene Type x (F, C, M1, M2) Channel 8 Product Quality Information
- ABI-L2-DMWPQIx-M4Cyy L2+ Derived Motion Winds: ABI Mode 4 Scene Type x (F) Channel yy (02, 07, 08, 09, 10, 14) Product Quality Information
- ABI-L2-DMWVPQIx-M4C08 L2+ Derived Motion Winds – Vapor: ABI Mode 4 Scene Type x (F) Channel 8 Product Quality Information

E.1.1 Derived Motion Winds Diagnostic Non-Standard Product

Table E.1.1-1 describes the Derived Motion Winds Diagnostic Non-Standard Product.

Table E.1.1-1 Derived Motion Winds Diagnostic Non-Standard Product: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
latitude_of_vector1	double	nMeasures = unlimited	long_name	Latitude of vector 1 (degrees north) (backward in time)	string
			_FillValue	0.0	double
			units	degrees_north	string
longitude_of_vector1	double	nMeasures = unlimited	long_name	Longitude of vector 1 (degrees east) (backward in time)	string
			_FillValue	0.0	double
			units	degrees_east	string
u_component_of_vector1	float	nMeasures = unlimited	long_name	u-component of vector 1 (m/s) (backward in time)	string
			_FillValue	-999.0	float
			units	m/s	string
v_component_of_vector1	float	nMeasures = unlimited	long_name	v-component of vector 1 (m/s) (backward in time)	string
			_FillValue	-999.0	float
			units	m/s	string
latitude_of_vector2	double	nMeasures = unlimited	long_name	Latitude of vector 2 (degrees north) (forward in time)	string
			_FillValue	0.0	double
			units	degrees_north	string
longitude_of_vector2	double	nMeasures = unlimited	long_name	Longitude of vector 2 (degrees east) (forward in time)	string
			_FillValue	0.0	double
			units	degrees_east	string
u_component_of_vector2	float	nMeasures = unlimited	long_name	u-component of vector 2 (m/s) (forward in time)	string
			_FillValue	-999.0	float
			units	m/s	string
v_component_of_vector2	float	nMeasures = unlimited	long_name	v-component of vector 2 (m/s) (forward in time)	string
			_FillValue	-999.0	float
			units	m/s	string
forecast_wind_speed	float	nMeasures = unlimited	long_name	Speed of forecast wind (m/s) at pressure assigned to satellite wind	string
			_FillValue	0.0	float
			units	m/s	string
forecast_wind_direction	float	nMeasures = unlimited	long_name	Direction of wind vector	string
			_FillValue	0.0	float
			units	radians	string
tracking_correlation_of_vector1	float	nMeasures = unlimited	long_name	Tracking correlation of vector 1 (backward in time	string
			_FillValue	-999.0	float

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	unitless	string
tracking_correlation_of_vector2	float	nMeasures = unlimited	long_name	Tracking correlation of vector 2 (forward in time	string
			_FillValue	-999.0	float
			units	unitless	string
std_dev_cloud_top_pressure	float	nMeasures = unlimited	long_name	Standard deviation of cloud top pressure values in target scene (hPa)	string
			_FillValue	-999.0	float
			units	hPa	string
cold_sample_counter	short	nMeasures = unlimited	long_name	Cold sample counter in brightness temperature histogram	string
			_FillValue	0	short
			units	unitless	string
std_dev_of_largest_sample1_cluster	float	nMeasures = unlimited	long_name	Standard deviation of largest 5x5 cluster (sample 1 reverse vector)	string
			_FillValue	-999.0	float
			units	unitless	string
percent_of_average_sample1	float	nMeasures = unlimited	long_name	Standard deviation of sample 1 divided by magnitude of average displacement	string
			_FillValue	-999.0	float
			units	unitless	string
std_dev_of_largest_sample2_cluster	float	nMeasures = unlimited	long_name	Standard deviation of largest 5x5 cluster (sample 2 forward vector)	string
			_FillValue	-999.0	float
			units	unitless	string
percent_of_average_sample2	float	nMeasures = unlimited	long_name	Standard deviation of sample 2 divided by magnitude of average displacement	string
			_FillValue	-999.0	float
			units	unitless	string
number_of_motion_clusters_sample1	short	nMeasures = unlimited	long_name	Number of distinct motion clusters from DBSCAN analysis (sample 1 reverse vector)	string
			_FillValue	-999	short
			units	unitless	string
size_of_largest_dbscan_cluster_sample1	short	nMeasures = unlimited	long_name	Size of largest DBSCAN cluster (sample 1 reverse vector)	string
			_FillValue	-999	short
			units	unitless	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
number_of_motion_clusters_sample2	short	nMeasures = unlimited	long_name	Number of distinct motion clusters from DBSCAN analysis (sample 2 forward vector)	string
			_FillValue	-999	short
			units	unitless	string
size_of_largest_dbscan_cluster_sample2	short	nMeasures = unlimited	long_name	Size of largest DBSCAN cluster (sample 2 forward vector)	string
			_FillValue	-999	short
			units	unitless	string
median_cloud_top_height	float	nMeasures = unlimited	long_name	Median cloud-top height (m)	string
			_FillValue	-999.0	float
			units	m	string
minimum_cloud_top_pressure	float	nMeasures = unlimited	long_name	Minimum cloud-top pressure (hPa) in largest cluster	string
			_FillValue	-999.0	float
			units	hPa	string
maximum_cloud_top_pressure	float	nMeasures = unlimited	long_name	Maximum cloud-top pressure (hPa) in largest cluster	string
			_FillValue	-999.0	float
			units	hPa	string
minimum_cloud_top_temperature	float	nMeasures = unlimited	long_name	Minimum cloud-top temperature (K) in largest cluster	string
			_FillValue	-999.0	float
			units	Kelvin	string
maximum_cloud_top_temperature	float	nMeasures = unlimited	long_name	Maximum cloud-top temperature (K) in largest cluster	string
			_FillValue	-999.0	float
			units	Kelvin	string
dominant_cloud_phase	byte	nMeasures = unlimited	long_name	Dominant cloud phase of target scene	string
			_FillValue	-1	byte
			units	unitless	string
			flag_values	***see [flag values and meanings] table below***	byte
			flag_meanings	***see [flag values and meanings] table below***	string
dominant_cloud_type	byte	nMeasures = unlimited	long_name	Dominant cloud type of target scene	string
			_FillValue	-1	byte
			units	unitless	string
			flag_values	***see [flag values and meanings] table below***	byte
			flag_meanings	***see [flag values and meanings] table below***	string
vertical_temperature_gradient	float	nMeasures = unlimited	long_name	NWP vertical temperature gradient (K) (+/- 200 hPa about pressure assignment of tracer)	string
			_FillValue	-999.0	float
			units	Kelvin	string

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
vertical_wind_shear	float	nMeasures = unlimited	long_name	NWP vertical wind shear (m/s) (+/- 200 hPa about pressure assignment of tracer)	string
			_FillValue	-999.0	float
			units	m/s	string
land_mask	byte	nMeasures = unlimited	long_name	Land mask	string
			_FillValue	-1	byte
			units	unitless	string
			flag_values	***see [flag values and meanings] table below***	byte
			flag_meanings	***see [flag values and meanings] table below***	string
low_level_inversion_flag	byte	nMeasures = unlimited	long_name	Low-level inversion flag	string
			_FillValue	-1	byte
			units	unitless	string
			flag_values	***see [flag values and meanings] table below***	byte
			flag_meanings	***see [flag values and meanings] table below***	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023.0	double
			semi_major_axis	6378137.0	double
			semi_minor_axis	6356752.31414	double
			inverse_flattening	298.2572221	double
			latitude_of_projection_origin	0.0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	X	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999.0	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999.0	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999.0	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_longitude	***see note [1]***	float
			geospatial_northbound_latitude	***see note [1]***	float
			geospatial_eastbound_longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0.0	float

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string
first_image_time	int	time = 2	long_name	Time of the first image in seconds since epoch (2000-01-01 12:00:00)	string
			_FillValue	-2147483648	int
			units	seconds since 2000-01-01 12:00:00	string
last_image_time	int	time = 2	long_name	Time of the last image in seconds since epoch (2000-01-01 12:00:00)	string
			_FillValue	-2147483648	int
			units	seconds since 2000-01-01 12:00:00	string

Note 1: Coverage region extent variable and attribute values are located in paragraph 4.2.7, Standard Coordinate Data, in the ABI Fixed Grid section.

Table E.1.1-2 Derived Motion Winds Diagnostic Non-Standard Product Dominant Cloud Phase Flag Values and Meanings

Dominant Cloud Phase Flags (dominant_cloud_phase)	
Flag Value	**Flag Meaning**
0	Clear
1	liquid_water
2	super_cooled_water
3	Mixed
4	Ice
5	unknown

Table E.1.1-3 Derived Motion Winds Diagnostic Non-Standard Product Dominant Cloud Type Flag Values and Meanings

Dominant Cloud Type Flags (dominant_cloud_type)	
Flag Value	**Flag Meaning**
0	clear_type
1	fog_type
2	water_type
3	supercooled_type
4	mixed_type

Dominant Cloud Type Flags (dominant_cloud_type)	
Flag Value	**Flag Meaning**
5	thick_ice_type (thick, opaque ice clouds)
6	cirrus_type
7	overlap_type
8	overshooting_type
9	unknown_type

Table E.1.1-4 Derived Motion Winds Diagnostic Non-Standard Product Land Mask Flag Values and Meanings

Land Mask Flags (land_mask)	
Flag Value	**Flag Meaning**
0	shallow_ocean
1	land
2	ocean_coastlines_and_lake_shorelines
3	shallow_inland_water
4	ephemeral_water
5	deep_inland_water
6	moderate_or_continental_ocean
7	deep_ocean

Table E.1.1-5 Derived Motion Winds Diagnostic Non-Standard Product Low Level Inversion Flag Values and Meanings

Low Level Inversion Flags (low_level_inversion_flag)	
Flag Value	**Flag Meaning**
0	false
1	true

E.1.2 Derived Motion Winds Product Quality Information Non-Standard Product

Table E.1.2-1 describes the Derived Motion Winds Product Quality Information (PQI) Non-Standard Product.

Table E.1.2-1 Derived Motion Winds Product Quality Information Non-Standard Product: Variables

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
product_quality_flag	byte	nMeasures = unlimited	long_name	RFF Flag Value	string
			_FillValue	-1	byte
			valid_range	-1 22	Byte
			units	unitless	string
			flag_values	***see [flag values and meanings] table below***	Byte
			flag_meanings	***see [flag values and meanings] table below***	string
expected_error_estimate	float	nMeasures = unlimited	long_name	Expected Error estimate of derived wind (m/s)	string
			_FillValue	-999.0	float
			units	m/s	string
quality_indicator	byte	nMeasures = unlimited	long_name	Quality Indicator (QI) of derived wind (0-100 with 100 being the best)	string
			_FillValue	-1	byte
			units	unitless	string
speed_consistency_test	byte	nMeasures = unlimited	long_name	QI Test 1 value (Speed Consistency) (0-100 with 100 being the best)	string
			_FillValue	-1	byte
			units	unitless	string
direction_consistency_test	byte	nMeasures = unlimited	long_name	QI Test 2 value –(Direction Consistency) (0-100 with 100 being the best)	string
			_FillValue	-1	byte
			units	unitless	string
vector_consistency_test	byte	nMeasures = unlimited	long_name	QI Test 3 value –(Vector Consistency) (0-100 with 100 being the best)	string
			_FillValue	-1	byte
			units	unitless	string
local_consistency_test	byte	nMeasures = unlimited	long_name	QI Test 4 value (Local Consistency) (0-100 with 100 being the best)	string
			_FillValue	-1	byte
			units	unitless	string
forecast_consistency_test	byte	nMeasures = unlimited	long_name	QI Test 5 value –(Forecast Consistency)_ (0-100 with 100 being the best)	string
			_FillValue	-1	byte
			units	unitless	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
representative_height_error	float	nMeasures = unlimited	long_name	Representative height error (hPa)	string
			_FillValue	-999.0	float
			units	hPa	string
representative_temperature_error	float	nMeasures = unlimited	long_name	Representative temperature error (K)	string
			_FillValue	-999.0	float
			units	Kelvin	string
goes_imager_projection	int	n/a	long_name	GOES-R ABI fixed grid projection	string
			grid_mapping_name	geostationary	string
			perspective_point_height	35786023.0	double
			semi_major_axis	6378137.0	double
			semi_minor_axis	6356752.31414	double
			inverse_flattening	298.2572221.0	double
			latitude_of_projection_origin	0.0	double
			longitude_of_projection_origin	***see note [1]***	double
			sweep_angle_axis	x	string
y_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection y-coordinate center of image	string
			standard_name	projection_y_coordinate	string
			units	rad	string
			axis	Y	string
x_image value = ***see note [1]***	float	n/a	long_name	GOES-R fixed grid projection x-coordinate center of image	string
			standard_name	projection_x_coordinate	string
			units	rad	string
			axis	X	string
nominal_satellite_subpoint_lat ***value = 0.00***	float	n/a	long_name	nominal satellite subpoint latitude (platform latitude)	string
			standard_name	latitude	string
			_FillValue	-999.0	float
			units	degrees_north	string
nominal_satellite_subpoint_lon value = ***see note [1]***	float	n/a	long_name	nominal satellite subpoint longitude (platform longitude)	string
			standard_name	longitude	string
			_FillValue	-999.0	float
			units	degrees_east	string
nominal_satellite_height ***value = 35786.023***	float	n/a	long_name	nominal satellite height above GRS 80 ellipsoid (platform altitude)	string

Variable			Attribute		
Name	**Type**	**Shape**	**Name**	**Value**	**Type**
			standard_name	height_above_reference_ellipsoid	string
			_FillValue	-999.0	float
			units	km	string
geospatial_lat_lon_extent	float	n/a	long_name	geospatial latitude and longitude references	string
			geospatial_westbound_ longitude	***see note [1]***	float
			geospatial_northbound_ latitude	***see note [1]***	float
			geospatial_eastbound_ longitude	***see note [1]***	float
			geospatial_southbound_latitude	***see note [1]***	float
			geospatial_lat_center	***see note [1]***	float
			geospatial_lon_center	***see note [1]***	float
			geospatial_lat_nadir	0.0	float
			geospatial_lon_nadir	***see note [1]***	float
			geospatial_lat_units	degrees_north	string
			geospatial_lon_units	degrees_east	string

Table E.1.2-2 Derived Motion Winds Product Quality Information Non-Standard Product Quality Flag Values and Meanings

Product Quality Flags (product_quality_flag)	
Flag Value	**Flag Meaning**
0	good_wind_qf
1	invalid_due_to_max_gradient_below_threshold_qf
2	invalid_due_to_location_on_earth_limb_qf
3	invalid_due_to_cloud_amount_below_or_exceeds_threshold_qf
4	invalid_due_to_median_pressure_retrieval_failure_qf

Product Quality Flags (product_quality_flag)	
Flag Value	**Flag Meaning**
5	invalid_due_to_bad_or_missing_brightness_temp_or_reflectance_qf
6	invalid_due_to_multiple_cloud_layers_qf
7	invalid_due_to_insufficient_structure_for_reliable_tracking_qf
8	invalid_due_to_cloud_tracking_correlation_below_threshold_qf
9	invalid_due_to_u_component_acceleration_exceeds_threshold_qf
10	invalid_due_to_v_component_acceleration_exceeds_threshold_qf
11	invalid_due_to_u_and_v_components_acceleration_exceeds_threshold_qf
12	invalid_due_to_wind_speed_below_threshold_qf
13	invalid_due_to_day_night_terminator_proximity_below_threshold_qf
14	invalid_due_to_cloud_height_median_pressure_below_or_exceeds_threshold_qf
15	invalid_due_to_feature_match_at_search_region_boundary_qf
16	invalid_due_to_difference_with_forecast_wind_exceeds_threshold_qf
17	invalid_due_to_difference_in_image_pairs_cloud_height_median_pressure_exceeds_threshold_qf
18	invalid_due_to_data_needed_for_search_region_unavailable_qf
19	invalid_due_to_falure_of_quality_indicator_and_expected_error_method_checks_qf
20	invalid_due_to_missing_data_in_search_region_qf
21	invalid_due_to_winds_not_found_qf
22	invalid_due_to_feature_cluster_not_found_qf