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1.0 Data Set Description

NSF NCAR Trace Organic Gas Analyzer with TOFWERK (Thun, Switzerland) high-resolution Time-of-Flight Mass Spectrometer (TOGA-TOF) data collected during the Greater New York Oxidant Trace Gas Halogen and Aerosol Airborne Mission (GOTHAAM) study. The data files are in ICARTT V2.0 format.

- Data version: R1 as of 21 May 2026
- Data Status: FINAL
- Time period covered by the data: 11 July 2025 through 28 August 2025 (UTC)
- Physical location: NSF NCAR C-130 flights based out of Broomfield, Colorado, USA and Ronkonkoma, New York, USA.
- Additional Information:

- GOTHAAM campaign information: https://www.eol.ucar.edu/field_projects/gothaam
- TOGA-TOF instrument: https://www2.acom.ucar.edu/facility/toga-tof

2.0 Instrument Description

The airborne TOGA-TOF instrument was developed at NSF NCAR ACOM to provide measurements of a large suite of C_1-C_{10} VOCs, including non-methane hydrocarbons (NMHC; including alkanes, alkenes, and aromatic hydrocarbons), oxygenated VOCs (OVOCs) including aldehydes, ketones, alcohols, esters, and ethers, sulfur species including dimethyl sulfide (DMS), carbon disulfide (CS_2), and methanethiol (CH_3SH), nitrogen species including nitriles (HCN, CH_3CN, propanenitrile, acrylonitrile, and methylacrylonitrile) and alkyl nitrates, and a large number of chlorine-, bromine-, iodine-, and fluorine-containing halocarbons. VOCs are generally sampled for 35 seconds every 2 minutes continuously from take-off to landing. The TOGA-TOF instrument has been successfully deployed on FIREX-AQ (NASA/NOAA, 2019), TI3GER (NSF, 2022), and ACCLIP (NSF/NASA, 2022), ASIA-AQ (NASA, 2024), and GOTHAAM (NSF, 2025). Apart from the Time-of-Flight detector, TOGA-TOF instrument is very similar to the TOGA-Quad instrument with an Agilent quadrupole mass spectrometer detector, which has an excellent record of performance on the WE-CAN (NSF, 2018), ATom (NASA, 2016-2018), ORCAS (NSF, 2016), FRAPPÉ (NSF, 2014), CONTRAST (NSF, 2014), NOMADSS (NSF, 2013), DC3 (NSF/NASA, 2012), and TORERO (NSF, 2012) campaigns.

- Data Frequency: 35-s samples every 2 minutes.
- Data Precision and Accuracy: VOC specific, reported in the ICARTT file header.
- Detection limits: low ppt to sub-ppt and VOC specific, reported in the ICARTT file header.

3.0 Data Collection and Processing

- Data collection computer-controlled and monitored in flight by a TOGA-TOF operator
- TOGA sampling, pre-concentration and gas chromatography processes are monitored and recorded in a 1-Hz housekeeping file.
- TOF data files are saved in HDF5 format. High-resolution mass calibration and ion trace batch fitting are performed using Tofware (Aerodyne Research, Inc.). Chromatographic peak fitting is performed using TERN in Igor (Aerodyne Research, Inc.)

4.0 Data Format

- *In situ* gas-phase VOC observations are reported as dry volume mixing ratios (DVMR) in units of ppt (parts per trillion), or “arbppt” (arbitrary ppt) for species that have not been fully calibrated, as specified in the header for each species.
- Data file structure is ASCII following the ICARTT V2.0 specifications outlined in https://www.earthdata.nasa.gov/esdis/esco/standards-and-practices/icartt-file-format
- Detection limits are species specific and reported in species order in the header as LLOD_VALUE.
- Data below detection limits (LLOD_FLAG) are represented by -888.
- Missing/unavailable data are represented by -999.

5.0 Data Remarks

- Data are available for two test flights based out of Broomfield (2025-07-11 and 2025-07-12), the ferry flight from Colorado to New York (2025-07-16), and all but two research flights due to

an instrument computer malfunction during RF04 (2025-07-25) and a sample trap malfunction during RF06 (2025-07-30).

- Following RF06, a new sample trap was installed resulting in several species requiring a background correction for the next several flights, and a change in calibration parameters for many TOGA-TOF VOCs. Due to a necessary sample trap temperature tuning procedure at the start of RF07, data are missing for several VOC species for up to the first two hours of that flight. Other short periods of missing data during the campaign are due to in-flight calibrations and zeros, and several brief TOGA-TOF computer issues.
- VOCs not of importance to GOTHAAM science goals that were below detection limits for the majority of the campaign are not reported in the R1 FINAL data, including very short-lived fire tracers.