DYNAMO Atmospheric Sounding Data and Products

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1. Data Set Overview:

Atmospheric sounding data during DYNAMO consisted of routine soundings (generally twice daily) and intensive field campaign soundings (2-8X/day). Five sounding data products are included in the DYNAMO legacy data.

(1) **Level 3 high resolution station data**. There are 32 sounding sites in this product and a single netCDF file for each site.

(2) **Level 4 5 hPa interpolated station data**. There are the same 32 sounding sites in this product as in the L3 product, but there are 33 netCDF files (not just 32) for this L4 product: a single netCDF file for each site containing the "standard" version of the data for that site and one additional netCDF file containing a special "merged" version of the data for Colombo (43466) in which the sounding data was merged with ECMWF reanalysis at low levels to mitigate island effects.

(3) **L4 Global Telecommunication System (GTS) Sounding Product**. This product contains sounding data obtained from the GTS (or from GTS archives) for 40 additional sounding sites beyond the 32 high-resolution sounding sites of the above L3 and L4 products. These additional 40 sounding sites include 24 priority sounding sites and 16 non-priority sounding sites (we have grouped them all together as one product with each site having the same netCDF file format).

(4) **Gridded (1 deg) Sounding Based Products**. The first netCDF file (DYNAMO_Gridded_Analyses_from_Obs.nc) contains gridded analyses based only on observations (no supplemental model data was used). The second netCDF file (DYNAMO_Gridded_Analyses_from_Obs_and_Model.nc) is similar, but model data from the ECMWF operational analyses were used to supplement data in data sparse regions. This product is more reliable in data sparse regions.

(5) **Array Averaged Sounding Products**. Averages for quite a number of fields were computed over 2 different arrays: NSA = Northern Sounding Array (bounded by Male, Colombo, Gan, and the Revelle); and SSA = Southern Sounding Array (bounded by the Mirai, Gan, Diego Garcia, and the Revelle). These averages were computed using the 2 gridded analyses products (4).

Time period: 1 June 2011 – 31 March 2012. Array time series data are Every 3 hours from 2011-10-01 00Z to 2011-12-31 21Z (Oct - Dec; 736 times).

Physical location: The priority sounding sites were centered around the DYNANO arrays, but data are included from throughout the Indo-Pacific region. See Fig. 1 below. The gridded products are 1 deg x 1 deg horizontal grid over the region 35 E to 155 E and 20 S to 20 N at 40 vertical levels: surface, 1000, 975, 950, ... , 50 hPa.

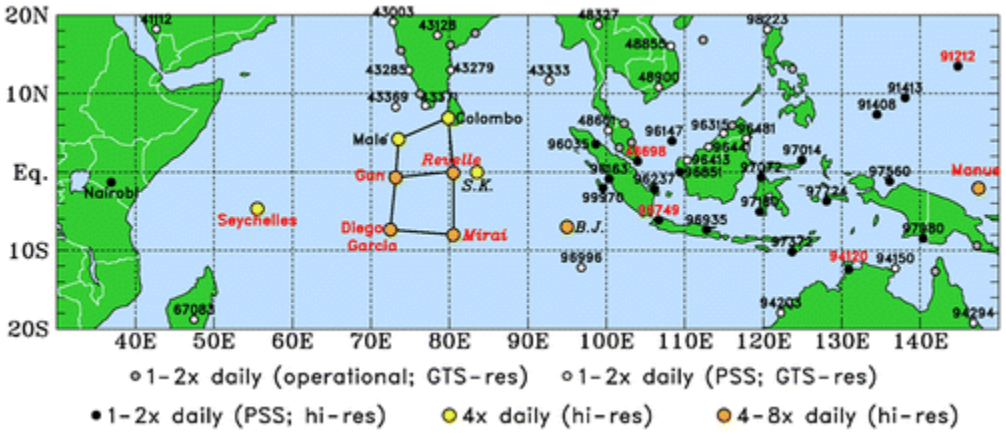

Figure 1 Upper-air sounding network for DYNAMO where color coding of dots indicates the type of site, including typical launch frequency. Enhanced sounding sites are labeled with station name, while PSS are labeled with WMO number. Red labels indicate sites with collocated GPS and/or MWR PW data. High-resolution sonde data were collected at 11 enhanced sites and 21 PSS (black dots). After Ciesielski et al. (2014a).

Data source: Data were collected using standard in situ radiosondes. ECMWF operational analysis was used for the merged gridded and array averaged time series products.

2. Instrument Description

The data were collected using several types of radiosondes (Table 1). Sounding operations at 11 sites in the DYNAMO domain (including the six core sites) were enhanced either by increasing the sounding frequency above normal operational frequency or establishing operations where none previously existed. Hi-res data were collected for these 11 sites, which are labeled with their station names in Fig. 1

Diego Garcia and R/V Revelle deployed a National Center for Atmospheric Research (NCAR) Integrated Sounding System (ISS) that included a surface meteorological (SMET) station, a 915-MHz wind profiler, a GPS Advanced Upper-Air Sounding System (GAUS), and a ground-based GPS receiver for computation of total-column precipitable water (PW).

The types of sounding used at each site is summarized in the table below reproduced from Ciesielski et al. (2014a).

Table 1. DYNAMO site information for stations for which hi-res sonde data were collected. Enhanced sites are in boldface. Native resolution refers to the vertical time resolution of the data received at NCAR EOL. After Ciesielski et al. (2014a).

Site	Station ID	Sonde type	Native resolution (s)	No. of soundings	Dates of retrieved data
Ambon	97724	Meisei RS06G	1	363	1 Oct 2011–31 Mar 2012
R/V *Baruna Jaya*	**YEAU**	**Vaisala RS92-SGP**	**2**	**58**	**5 Dec 2011–18 Dec 2011**
Biak	97560	Meisei RS06G	1	347	1 Oct 2011–31 Mar 2012
Colombo	**43466**	**Meisei RS06G**	**1**	**258**	**1 Oct 2011–28 Dec 2011**
Darwin	94120	Vaisala RS92-15	2	397	1 Oct 2011–31 Mar 2012
Diego Garcia	**DRG**	**Vaisala RS92-SGP**	**1**	**679**	**30 Sep 2011–15 Jan 2012**
P3 dropsondes	NOAA3	Vaisala RS92-SGP	0.25	469	9 Nov 2011–13 Dec 2011
Gan	**43599**	**Vaisala RS92-SGP**	**2**	**1250**	**15 Jun 2011–8 Apr 2012**
Guam	91212	VIZ B2	6	297	1 Oct 2011–31 Mar 2012
Jakarata	96749	Meisei RS06G	1	356	1 Oct 2011–31 Mar 2012
Koror	91408	Sippican Mark IIA	1	339	1 Oct 2011–31 Mar 2012
Kupang	97372	Meisei RS06G	1	349	1 Oct 2011–31 Mar 2012
Makassar	97180	Meisei RS06G	1	337	1 Oct 2011–31 Mar 2012
Malé	**43555**	**Vaisala RS92-SGP**	**2**	**323**	**29 Sep 2011–15 Dec 2011**
Manado	97014	Meisei RS06G	1	361	1 Oct 2011–31 Mar 2012
Manus	**92044**	**Vaisala RS92-SGP**	**2**	**1411**	**25 Sep 2011–31 Mar 2012**
Medan	96035	Meisei RS06G	1	364	1 Oct 2011–31 Mar 2012
Merauke	97980	Meisei RS06G	1	364	1 Oct 2011–31 Mar 2012
R/V *Mirai*	**JNSR**	**Vaisala RS92-SGP**	**2**	**518**	**26 Sep 2011–10 Dec 2011**
Nairobi	**63741**	**Vaisala RS92-SGP**	**2**	**198**	**1 Sep 2011–5 Mar 12**
Nauru	91532	Vaisala RS92-SGP	2	337	1 Oct 2011–31 Mar 2012
Padang	96163	Meisei RS06G	1	421	1 Oct 2011–31 Mar 2012
Palu	97072	Meisei RS06G	1	365	1 Oct 2011–31 Mar 2012
Pangkal	96237	Meisei RS06G	1	297	5 Oct 2011–31 Mar 2012
Pontianak	96851	Vaisala RS92-SGP	2	57	3 Dec 2011–1 Jan 2012
Ranai	96147	Modem M2K2DC	1	321	8 Sep 2011–29 Feb 2012
R/V *Revelle*	**KAOU**	**Vaisala RS92-SGP**	**1**	**635**	**30 Aug 2011–10 Feb 2012**
R/V *Sagar Kanya*	**VTJR**	**Vaisala RS92-SGP**	**2**	**71**	**25 Nov 2011–19 Oct 2011**
Seychelles	**63985**	**Vaisala RS92-SGP**	**2**	**320**	**28 Oct 2011–31 Mar 2012**
Singapore	48698	Vaisala RS92-SGP	2	163	1 Oct 2011–21 Dec 2011
		Graw DMF-09	1	202	21 Dec 2011–31 Mar 2012
Sipora		Vaisala RS92-SGP	2	215	29 Nov 2011–1 Jan 12
Surabaya	96935	Meisei RS06G	1	365	1 Oct 2011–31 Mar 2012
Yap	91413	Sippican Mark IIA	1	267	30 Sep 2011–31 Mar 2012

3. Data Collection and Processing

This dataset includes 72 rawinsonde stations. Sounding operations at 11 sites in the DYNAMO domain (including the six core sites) were enhanced either by increasing the sounding frequency above normal operational frequency or establishing operations where none previously existed. Hi-res data were collected for these 11 sites, which are labeled with their station names in Fig. 1. The GTS resolution data for the 21 non priority sites were from the University of Wyoming sounding data archive. The gridded products were generated using optimum interpolation (OI), and gridded products were spatially averaged to obtain the array averaged products.

In DYNAMO the hi-res sonde data came from six different sonde types (see Table 2) and 12 unique data formats. Data were first converted to a common format (L1). L2 quality control was carried out using Aspen. Due to the science objectives of DYNAMO, special attention was paid to the relative humidity. L3 processing mainly involved removing the influence of the ships, for those stations on board ships. For Sri Lanka, the island influence was removed as described in Ciesielski et al. (2014b). For L4 data, vertical interpolation was performed and suspect data were noted using both objective and subjective metrics. Quality control and processing of the sounding data is described in more detail in Ciesielski et al. (2014a) and references therein.

For the Dynamo Legacy Data Products, the data were formatted in to NetCDF by the CSU group.

4. Data Format

The data are in CF compliant NetCDF format. All of the netCDF files have been compressed using the `nccopy` command. Below is a list of the parameters with units and attributes from ncdump, for each of the five products.

Level 3 High Resolution data

```
dimensions:
        str12 = 12 ;
        str80 = 80 ;
        info_line = 3 ;
        level = 7985 ;
        sounding = UNLIMITED ; // (634 currently)
variables:
        int n_soundings ;
                n_soundings:long_name = "number of soundings" ;
        double release_time(sounding) ;
                release_time:long_name = "UTC release time" ;
                release_time:units = "seconds since 2011-01-01 00:00:00 UTC" ;
                release_time:comment = "release time reported to nearest second for L3
sounding data" ;
        int release_date_enc(sounding) ;
                release_date_enc:long_name = "UTC release date (encoded)" ;
                release_date_enc:format = "8-digit integer: yyyymmdd" ;
        int release_time_enc(sounding) ;
                release_time_enc:long_name = "UTC release time (encoded)" ;
                release_time_enc:format = "6-digit integer: hhmmss" ;
        float site_lon(sounding) ;
                site_lon:long_name = "site longitude" ;
                site_lon:units = "degree_E" ;
                site_lon:valid_range = -180.f, 180.f ;
        float site_lat(sounding) ;
                site_lat:long_name = "site latitude" ;
                site_lat:units = "degree_N" ;
                site_lat:valid_range = -90.f, 90.f ;
        float site_alt(sounding) ;
                site_alt:long_name = "site altitude above MSL" ;
                site_alt:units = "m" ;
        int n_levels(sounding) ;
                n_levels:long_name = "number of levels" ;
        float time(sounding, level) ;
                time:long_name = "time since release time" ;
                time:units = "s" ;
                time:missing_value = -999.f ;
                time:_FillValue = -9999.f ;
        float p(sounding, level) ;
                p:long_name = "pressure" ;
                p:units = "hPa" ;
                p:missing_value = -999.f ;
                p:_FillValue = -9999.f ;
        float T(sounding, level) ;
                T:long_name = "dry bulb temperature" ;
                T:units = "degree_C" ;
                T:missing_value = -999.f ;
                T:_FillValue = -9999.f ;
        float Td(sounding, level) ;
                Td:long_name = "dew point temperature" ;
                Td:units = "degree_C" ;
                Td:missing_value = -999.f ;
                Td:_FillValue = -9999.f ;
```

```
float rh(sounding, level) ;
        rh:long_name = "relative humidity" ;
        rh:units = "percent" ;
        rh:missing_value = -999.f ;
        rh:_FillValue = -9999.f ;
float u(sounding, level) ;
        u:long_name = "eastward wind component" ;
        u:units = "m/s" ;
        u:missing_value = -999.f ;
        u:_FillValue = -9999.f ;
float v(sounding, level) ;
        v:long_name = "northward wind component" ;
        v:units = "m/s" ;
        v:missing_value = -999.f ;
        v:_FillValue = -9999.f ;
float wind_spd(sounding, level) ;
        wind_spd:long_name = "wind speed" ;
        wind_spd:units = "m/s" ;
        wind_spd:missing_value = -999.f ;
        wind_spd:_FillValue = -9999.f ;
float wind_dir(sounding, level) ;
        wind_dir:long_name = "wind direction" ;
        wind_dir:units = "degree" ;
        wind_dir:valid_range = 0.f, 360.f ;
        wind_dir:missing_value = -999.f ;
        wind_dir:_FillValue = -9999.f ;
float dzdt(sounding, level) ;
        dzdt:long_name = "ascent rate" ;
        dzdt:units = "m/s" ;
        dzdt:missing_value = -999.f ;
        dzdt:_FillValue = -9999.f ;
float lon(sounding, level) ;
        lon:long_name = "longitude" ;
        lon:units = "degree_E" ;
        lon:valid_range = -180.f, 180.f ;
        lon:missing_value = -999.f ;
        lon:_FillValue = -9999.f ;
float lat(sounding, level) ;
        lat:long_name = "latitude" ;
        lat:units = "degree_N" ;
        lat:valid_range = -90.f, 90.f ;
        lat:missing_value = -999.f ;
        lat:_FillValue = -9999.f ;
float alt(sounding, level) ;
        alt:long_name = "altitude above MSL" ;
        alt:units = "m" ;
        alt:missing_value = -999.f ;
        alt:_FillValue = -9999.f ;
byte qc_p(sounding, level) ;
        qc_p:long_name = "NCAR/EOL QC flag for pressure" ;
        qc_p:value_1 = "GOOD (value is physically reasonable)" ;
        qc_p:value_2 = "QUESTIONABLE (value is physically questionable)" ;
        qc_p:value_3 = "BAD (value seems to be in error)" ;
        qc_p:value_4 = "ESTIMATED (value is interpolated)" ;
        qc_p:value_9 = "NO VALUE (value is missing)" ;
        qc_p:value_99 = "UNCHECKED (value is unchecked)" ;
        qc_p:_FillValue = -1b ;
byte qc_t(sounding, level) ;
        qc_t:long_name = "NCAR/EOL QC flag for dry bulb temperature" ;
        qc_t:comment = "see qc_p attributes for info about QC flag values" ;
        qc_t:_FillValue = -1b ;
byte qc_rh(sounding, level) ;
        qc_rh:long_name = "NCAR/EOL QC flag for humidity" ;
```

```
                qc_rh:comment = "see qc_p attributes for info about QC flag values" ;
                qc_rh:_FillValue = -1b ;
        byte qc_u(sounding, level) ;
                qc_u:long_name = "NCAR/EOL QC flag for u wind component" ;
                qc_u:comment = "see qc_p attributes for info about QC flag values" ;
                qc_u:_FillValue = -1b ;
        byte qc_v(sounding, level) ;
                qc_v:long_name = "NCAR/EOL QC flag for v wind component" ;
                qc_v:comment = "see qc_p attributes for info about QC flag values" ;
                qc_v:_FillValue = -1b ;
        char sonde_id(sounding, str12) ;
                sonde_id:long_name = "sonde ID or serial number" ;
                sonde_id:string_length = "12 characters" ;
                sonde_id:string_padding = "null character" ;
        char aux_info(sounding, info_line, str80) ;
                aux_info:long_name = "auxiliary info about sounding" ;
                aux_info:comment = "3 info lines per sounding for this site" ;
                aux_info:string_length = "80 characters per info line" ;
                aux_info:string_padding = "null character" ;

// global attributes:
                :Experiment = "Dynamics of the Madden-Julian Oscillation (DYNAMO)" ;
                :Project = "DYNAMO Legacy Data Project" ;
                :Data_Set = "DYNAMO Level 3 High Resolution Sounding Data" ;
                :Data_File = "DYNAMO Level 3 HiRes Sounding Data for the Revelle" ;
                :Data_Type = "Upper Air/Radiosonde/High Resolution" ;
                :Data_Level = "L3.1 (best corrected data for this site)" ;
                :Site_Name = "R/V Roger Revelle" ;
                :Site_Short_Name = "Revelle" ;
                :Site_ID = "99991" ;
                :Site_Code = "KAOU" ;
                :Site_Note = "US research vessel (Scripps); managed by NCAR/EOL during
DYNAMO" ;
                :Time_Period = "2011-08-29 23:59:40 UTC to 2012-02-10 23:15:54 UTC" ;
                :Sonde_Type = "Vaisala RS92-SGP (ccGPS)" ;
                :Ground_Station_Info = "N/A" ;
                :Original_Data = "GAUS Sounding Data/Ascending (provided by NCAR/EOL)"
;
                :L1_to_L2_Process = "Automated QC process performed by NCAR/EOL" ;
                :L1_to_L2_QC1 = "Gross limit and vertical consistency checks" ;
                :L1_to_L2_QC2 = "Visual quality checks" ;
                :L1_to_L2_QC3 = "N/A" ;
                :L1_to_L2_QC_Ref = "Loehrer et al. (1996), Loehrer et al. (1998)" ;
                :L2_to_L3_Process = "Special corrections applied by NCAR/EOL" ;
                :L2_to_L3_Corr1 = "Correction to surface pressure and geopotential
height" ;
                :L2_to_L3_Corr1_Ref = "Young et al. (2013)" ;
                :L2_to_L3_Corr2 = "N/A" ;
                :L2_to_L3_Corr2_Ref = "N/A" ;
                :L2_to_L3_Corr3 = "N/A" ;
                :L2_to_L3_Corr3_Ref = "N/A" ;
                :L2_to_L3_Corr4 = "N/A" ;
                :L2_to_L3_Corr4_Ref = "N/A" ;
                :L2_to_L3_Corr5 = "N/A" ;
                :L2_to_L3_Corr5_Ref = "N/A" ;
                :Reference = "Ciesielski et al. (2014), J. Atmos. Ocean. Tech., 31,
741-764." ;
                :More_Info = "See https://data.eol.ucar.edu/dataset/347.158/" ;
                :File_Creator = "Johnson Research Group, Dept. of Atmos. Science,
Colorado State University" ;
                :File_Version = "1.1 (correction to initial official release)" ;
                :Last_Modified = "Thu May 25 15:33:42 MDT 2017" ;
```

Level 4 5 hPa Data

```
dimensions:
        level = 198 ;
        sounding = UNLIMITED ; // (215 currently)
variables:
        int n_soundings ;
                n_soundings:long_name = "number of soundings" ;
        double release_time(sounding) ;
                release_time:long_name = "UTC release time" ;
                release_time:units = "seconds since 2011-01-01 00:00:00 UTC" ;
                release_time:comment = "release time truncated to nearest minute for
L4 sounding data" ;
        int release_date_enc(sounding) ;
                release_date_enc:long_name = "UTC release date (encoded)" ;
                release_date_enc:format = "8-digit integer: yyyymmdd" ;
        int release_time_enc(sounding) ;
                release_time_enc:long_name = "UTC release time (encoded)" ;
                release_time_enc:format = "6-digit integer: hhmmss" ;
        float site_lon(sounding) ;
                site_lon:long_name = "site longitude" ;
                site_lon:units = "degree_E" ;
                site_lon:valid_range = -180.f, 180.f ;
        float site_lat(sounding) ;
                site_lat:long_name = "site latitude" ;
                site_lat:units = "degree_N" ;
                site_lat:valid_range = -90.f, 90.f ;
        float site_alt(sounding) ;
                site_alt:long_name = "site altitude above MSL" ;
                site_alt:units = "m" ;
        int n_levels(sounding) ;
                n_levels:long_name = "number of levels" ;
        float p(sounding, level) ;
                p:long_name = "pressure" ;
                p:units = "hPa" ;
                p:_FillValue = -9999.f ;
        float T(sounding, level) ;
                T:long_name = "dry bulb temperature" ;
                T:units = "degree_C" ;
                T:missing_value = -999.f ;
                T:_FillValue = -9999.f ;
        float Td(sounding, level) ;
                Td:long_name = "dew point temperature" ;
                Td:units = "degree_C" ;
                Td:missing_value = -999.f ;
                Td:_FillValue = -9999.f ;
        float wind_spd(sounding, level) ;
                wind_spd:long_name = "wind speed" ;
                wind_spd:units = "m/s" ;
                wind_spd:missing_value = -999.f ;
                wind_spd:_FillValue = -9999.f ;
        float wind_dir(sounding, level) ;
                wind_dir:long_name = "wind direction" ;
                wind_dir:units = "degree" ;
                wind_dir:valid_range = 0.f, 360.f ;
                wind_dir:missing_value = -999.f ;
                wind_dir:_FillValue = -9999.f ;
        float lon(sounding, level) ;
                lon:long_name = "longitude" ;
                lon:units = "degree_E" ;
                lon:valid_range = -180.f, 180.f ;
```

```
                lon:missing_value = -999.f ;
                lon:_FillValue = -9999.f ;
        float lat(sounding, level) ;
                lat:long_name = "latitude" ;
                lat:units = "degree_N" ;
                lat:valid_range = -90.f, 90.f ;
                lat:missing_value = -999.f ;
                lat:_FillValue = -9999.f ;
        float alt(sounding, level) ;
                alt:long_name = "altitude above MSL" ;
                alt:units = "m" ;
                alt:missing_value = -999.f ;
                alt:_FillValue = -9999.f ;
        byte qcf_p(sounding, level) ;
                qcf_p:long_name = "CSU QC flag for pressure" ;
                qcf_p:value_1 = "data value appears to be good" ;
                qcf_p:value_2 = "data value is objectively questionable" ;
                qcf_p:value_3 = "data value is visually questionable" ;
                qcf_p:value_4 = "data value is objectively bad" ;
                qcf_p:value_5 = "data value is visually bad" ;
                qcf_p:value_6 = "data value is interpolated" ;
                qcf_p:value_7 = "data value is estimated" ;
                qcf_p:value_8 = "data value is unchecked" ;
                qcf_p:value_9 = "data value is missing" ;
                qcf_p:_FillValue = -1b ;
        byte qcf_alt(sounding, level) ;
                qcf_alt:long_name = "CSU QC flag for altitude" ;
                qcf_alt:comment = "See qcf_p attributes for info about QC flag values"
;
                qcf_alt:_FillValue = -1b ;
        byte qcf_t(sounding, level) ;
                qcf_t:long_name = "CSU QC flag for dry bulb temperature" ;
                qcf_t:comment = "See qcf_p attributes for info about QC flag values" ;
                qcf_t:_FillValue = -1b ;
        byte qcf_td(sounding, level) ;
                qcf_td:long_name = "CSU QC flag for dew point temperature" ;
                qcf_td:comment = "See qcf_p attributes for info about QC flag values"
;
                qcf_td:_FillValue = -1b ;
        byte qcf_winds(sounding, level) ;
                qcf_winds:long_name = "CSU QC flag for wind values" ;
                qcf_winds:comment = "See qcf_p attributes for info about QC flag
values" ;
                qcf_winds:_FillValue = -1b ;
        float CAPE(sounding) ;
                CAPE:long_name = "convective available potential energy" ;
                CAPE:units = "J/kg" ;
                CAPE:comment = "computed when sufficient data available" ;
                CAPE:missing_value = -999.f ;
        float CIN(sounding) ;
                CIN:long_name = "convective inhibition" ;
                CIN:units = "J/kg" ;
                CIN:comment = "computed when sufficient data available" ;
                CIN:missing_value = -999.f ;
        float TPW(sounding) ;
                TPW:long_name = "total precipitable water" ;
                TPW:units = "mm" ;
                TPW:comment = "computed when sufficient data available" ;
                TPW:missing_value = -999.f ;
        float LCL(sounding) ;
                LCL:long_name = "lifting condensation level" ;
                LCL:units = "hPa" ;
                LCL:comment = "computed when sufficient data available" ;
```

```
                LCL:missing_value = -999.f ;
        float LFC(sounding) ;
                LFC:long_name = "level of free convection" ;
                LFC:units = "hPa" ;
                LFC:comment = "computed when sufficient data available" ;
                LFC:missing_value = -999.f ;
        float EL(sounding) ;
                EL:long_name = "equilibrium level" ;
                EL:units = "hPa" ;
                EL:comment = "computed when sufficient data available" ;
                EL:missing_value = -999.f ;

// global attributes:
                :Experiment = "Dynamics of the Madden-Julian Oscillation (DYNAMO)" ;
                :Project = "DYNAMO Legacy Data Project" ;
                :Data_Set = "DYNAMO Level 4 5-hPa Resolution Sounding Data" ;
                :Data_File = "DYNAMO Level 4 5-hPa Sounding Data for Sipora" ;
                :Data_Type = "Upper Air/Radiosonde/5-hPa Resolution" ;
                :Data_Level = "L4.0 (based on L3.0 data for this site)" ;
                :Data_Note = "Standard edition" ;
                :Site_Name = "Sipora, Indonesia" ;
                :Site_Short_Name = "Sipora" ;
                :Site_ID = "99970" ;
                :Site_Code = "N/A" ;
                :Site_Note = "N/A" ;
                :Time_Period = "2011-11-29 09:00 UTC to 2012-01-01 12:00 UTC" ;
                :HiRes_L4_Process = "Performed by Colorado State University (CSU)" ;
                :HiRes_L4_Step1 = "Interpolation of L3.0 data to 5-hPa levels" ;
                :HiRes_L4_Step2 = "Setting of QC flags via objective and visual QC" ;
                :HiRes_L4_Note = "Missing lat/lon data values in L3 data were
interpolated when possible" ;
                :Special_Process = "N/A" ;
                :Special_Process_Ref = "N/A" ;
                :L3_Data_Info_1 = "See DYNAMO Level 3 HiRes Sounding Data for this
site" ;
                :L3_Data_Info_2 = "See https://data.eol.ucar.edu/dataset/347.045/" ;
                :Convective_Parameters = "Computed by CSU (see details in reference
below)" ;
                :Reference = "Ciesielski et al. (2014), J. Atmos. Ocean. Tech., 31,
741-764." ;
                :File_Creator = "Johnson Research Group, Dept. of Atmos. Science,
Colorado State University" ;
                :File_Version = "1.0 (initial official release)" ;
                :Last_Modified = "Wed May 24 23:00:10 MDT 2017" ;
}
```

Level 4 GTS Resolution Data

```
dimensions:
        level = 19 ;
        sounding = UNLIMITED ; // (363 currently)
variables:
        int n_soundings ;
                n_soundings:long_name = "number of soundings" ;
        double nom_rel_time(sounding) ;
                nom_rel_time:long_name = "UTC nominal release time" ;
                nom_rel_time:units = "seconds since 2011-01-01 00:00:00 UTC" ;
        int nom_rel_date_enc(sounding) ;
                nom_rel_date_enc:long_name = "UTC nominal release date (encoded)" ;
                nom_rel_date_enc:format = "8-digit integer: yyyymmdd" ;
```

```
        int nom_rel_time_enc(sounding) ;
                nom_rel_time_enc:long_name = "UTC nominal release time (encoded)" ;
                nom_rel_time_enc:format = "6-digit integer: hhmmss" ;
        float site_lon(sounding) ;
                site_lon:long_name = "site longitude" ;
                site_lon:units = "degree_E" ;
                site_lon:valid_range = -180.f, 180.f ;
        float site_lat(sounding) ;
                site_lat:long_name = "site latitude" ;
                site_lat:units = "degree_N" ;
                site_lat:valid_range = -90.f, 90.f ;
        float site_alt(sounding) ;
                site_alt:long_name = "site altitude above MSL" ;
                site_alt:units = "m" ;
        int n_levels(sounding) ;
                n_levels:long_name = "number of levels" ;
        float p(sounding, level) ;
                p:long_name = "pressure" ;
                p:units = "hPa" ;
                p:missing_value = -999.f ;
                p:_FillValue = -9999.f ;
        float T(sounding, level) ;
                T:long_name = "dry bulb temperature" ;
                T:units = "degree_C" ;
                T:missing_value = -999.f ;
                T:_FillValue = -9999.f ;
        float Td(sounding, level) ;
                Td:long_name = "dew point temperature" ;
                Td:units = "degree_C" ;
                Td:missing_value = -999.f ;
                Td:_FillValue = -9999.f ;
        float wind_spd(sounding, level) ;
                wind_spd:long_name = "wind speed" ;
                wind_spd:units = "m/s" ;
                wind_spd:missing_value = -999.f ;
                wind_spd:_FillValue = -9999.f ;
        float wind_dir(sounding, level) ;
                wind_dir:long_name = "wind direction" ;
                wind_dir:units = "degree" ;
                wind_dir:valid_range = 0.f, 360.f ;
                wind_dir:missing_value = -999.f ;
                wind_dir:_FillValue = -9999.f ;
        float alt(sounding, level) ;
                alt:long_name = "altitude above MSL" ;
                alt:units = "m" ;
                alt:missing_value = -999.f ;
                alt:_FillValue = -9999.f ;
        byte qcf_p(sounding, level) ;
                qcf_p:long_name = "CSU QC flag for pressure" ;
                qcf_p:value_1 = "data value appears to be good" ;
                qcf_p:value_2 = "data value is objectively questionable" ;
                qcf_p:value_3 = "data value is visually questionable" ;
                qcf_p:value_4 = "data value is objectively bad" ;
                qcf_p:value_5 = "data value is visually bad" ;
                qcf_p:value_6 = "data value is interpolated" ;
                qcf_p:value_7 = "data value is estimated" ;
                qcf_p:value_8 = "data value is unchecked" ;
                qcf_p:value_9 = "data value is missing" ;
                qcf_p:_FillValue = -1b ;
        byte qcf_alt(sounding, level) ;
                qcf_alt:long_name = "CSU QC flag for altitude" ;
                qcf_alt:comment = "See qcf_p attributes for info about QC flag values"
;
```

```
                qcf_alt:_FillValue = -1b ;
        byte qcf_t(sounding, level) ;
                qcf_t:long_name = "CSU QC flag for dry bulb temperature" ;
                qcf_t:comment = "See qcf_p attributes for info about QC flag values" ;
                qcf_t:_FillValue = -1b ;
        byte qcf_td(sounding, level) ;
                qcf_td:long_name = "CSU QC flag for dew point temperature" ;
                qcf_td:comment = "See qcf_p attributes for info about QC flag values"
;
                qcf_td:_FillValue = -1b ;
        byte qcf_winds(sounding, level) ;
                qcf_winds:long_name = "CSU QC flag for wind values" ;
                qcf_winds:comment = "See qcf_p attributes for info about QC flag
values" ;
                qcf_winds:_FillValue = -1b ;

// global attributes:
                :Experiment = "Dynamics of the Madden-Julian Oscillation (DYNAMO)" ;
                :Project = "DYNAMO Legacy Data Project" ;
                :Data_Set = "DYNAMO Level 4 GTS Resolution Sounding Data" ;
                :Data_File = "DYNAMO Level 4 GTS Sounding Data for Xisha Island" ;
                :Data_Type = "Upper Air/Radiosonde/GTS Resolution" ;
                :Data_Level = "L4" ;
                :Site_Name = "Xisha Island, China" ;
                :Site_Short_Name = "Xisha Island" ;
                :Site_ID = "59981" ;
                :Site_Code = "N/A" ;
                :Site_Note = "DYNAMO non-priority sounding site (non-PSS)" ;
                :Time_Period = "2011-10-01 00:00 UTC to 2012-03-31 12:00 UTC" ;
                :GTS_L4_Process = "Performed by Colorado State University (CSU)" ;
                :GTS_L4_Step1 = "Collection of GTS data" ;
                :GTS_L4_Step2 = "Decoding and processing of GTS data" ;
                :GTS_L4_Step3 = "Setting of QC flags via objective and visual QC" ;
                :Reference = "Ciesielski et al. (2014), J. Atmos. Ocean. Tech., 31,
741-764." ;
                :File_Creator = "Johnson Research Group, Dept. of Atmos. Science,
Colorado State University" ;
                :File_Version = "1.0 (initial official release)" ;
                :Last_Modified = "Thu Aug  3 18:04:00 MDT 2017" ;
```

Gridded data product

```
dimensions:
        lon = 121 ;
        lat = 41 ;
        level = 40 ;
        time = UNLIMITED ; // (736 currently)
variables:
        float lon(lon) ;
                lon:long_name = "longitude" ;
                lon:units = "degree_E" ;
                lon:resolution = 1.f ;
                lon:actual_range = 35.f, 155.f ;
        float lat(lat) ;
                lat:long_name = "latitude" ;
                lat:units = "degree_N" ;
                lat:resolution = 1.f ;
                lat:actual_range = -20.f, 20.f ;
        float level(level) ;
                level:long_name = "pressure level" ;
                level:units = "hPa" ;
```

```
                level:resolution = 25.f ;
                level:actual_range = 1025.f, 50.f ;
                level:comment = "first level (labeled 1025) represents the surface" ;
        double time(time) ;
                time:long_name = "UTC time" ;
                time:units = "seconds since 2011-01-01 00:00:00 UTC" ;
                time:resolution = "0000-00-00 03:00:00" ;
                time:actual_range = 23587200., 31525200. ;
                time:first_time = "2011-10-01 00:00:00 UTC" ;
                time:last_time = "2011-12-31 21:00:00 UTC" ;
        int date_enc(time) ;
                date_enc:long_name = "UTC date (encoded)" ;
                date_enc:format = "8-digit integer: yyyymmdd" ;
                date_enc:actual_range = 20111001, 20111231 ;
        int time_enc(time) ;
                time_enc:long_name = "UTC time (encoded)" ;
                time_enc:format = "6-digit integer: hhmmss" ;
                time_enc:actual_range = 0, 210000 ;
        float ps(time, lat, lon) ;
                ps:long_name = "surface pressure" ;
                ps:units = "hPa" ;
                ps:comment = "pressure levels greater than surface pressure are
underground" ;
                ps:actual_range = 834.1594f, 1024.34f ;
        float z(time, level, lat, lon) ;
                z:long_name = "geopotential height" ;
                z:units = "m" ;
                z:missing_value = -999.f ;
                z:actual_range = 4.59137f, 20884.37f ;
        float T(time, level, lat, lon) ;
                T:long_name = "temperature" ;
                T:units = "degree_C" ;
                T:missing_value = -999.f ;
                T:actual_range = -91.29752f, 41.9425f ;
        float q(time, level, lat, lon) ;
                q:long_name = "water vapor mixing ratio" ;
                q:units = "g/kg" ;
                q:missing_value = -999.f ;
                q:actual_range = 0.f, 23.7812f ;
        float u(time, level, lat, lon) ;
                u:long_name = "zonal wind" ;
                u:units = "m/s" ;
                u:missing_value = -999.f ;
                u:actual_range = -49.33657f, 53.43981f ;
        float v(time, level, lat, lon) ;
                v:long_name = "meridional wind" ;
                v:units = "m/s" ;
                v:missing_value = -999.f ;
                v:actual_range = -58.05911f, 40.03307f ;
        float omega(time, level, lat, lon) ;
                omega:long_name = "vertical p-velocity" ;
                omega:units = "hPa/s" ;
                omega:missing_value = -999.f ;
                omega:actual_range = -0.04108636f, 0.03547803f ;
        float div(time, level, lat, lon) ;
                div:long_name = "horizontal divergence" ;
                div:units = "1/s" ;
                div:missing_value = -999.f ;
                div:actual_range = -0.0001933768f, 0.0001686717f ;
        float vor(time, level, lat, lon) ;
                vor:long_name = "horizontal relative vorticity" ;
                vor:units = "1/s" ;
                vor:missing_value = -999.f ;
```

```
                vor:actual_range = -0.000139203f, 0.0001569367f ;
        float Q1(time, level, lat, lon) ;
                Q1:long_name = "apparent heating" ;
                Q1:units = "K/day" ;
                Q1:missing_value = -999.f ;
                Q1:actual_range = -165.2442f, 158.9377f ;
        float Q2(time, level, lat, lon) ;
                Q2:long_name = "apparent drying" ;
                Q2:units = "K/day" ;
                Q2:missing_value = -999.f ;
                Q2:actual_range = -413.991f, 417.4117f ;

// global attributes:
                :Experiment = "Dynamics of the Madden-Julian Oscillation (DYNAMO)" ;
                :Project = "DYNAMO Legacy Data Project" ;
                :Data_Set = "DYNAMO Gridded Analyses" ;
                :Data_File = "DYNAMO Gridded Analyses from Observations and Model
Data" ;
                :Data_Type = "Upper Air and Surface/Gridded Analyses" ;
                :Data_Version = "CSU version 3b (observations supplemented with ECMWF
OA)" ;
                :Time_Period = "2011-10-01 00:00:00 UTC to 2011-12-31 21:00:00 UTC" ;
                :Time_Resolution = "every 3 h" ;
                :Vertical_Levels = "surface, 1000, 975, 950, 925, ... , 50 hPa" ;
                :Vertical_Resolution = "25 hPa" ;
                :Horizontal_Region = "20S to 20N and 35E to 155E" ;
                :Horizontal_Resolution = "1 deg x 1 deg" ;
                :Gridding_Process = "Performed by Colorado State University (CSU)" ;
                :Gridding_Method = "Multiquadric interpolation scheme of Nuss and
Titley (1994)" ;
                :Observations_Used = "DYNAMO L4 sounding data, satellite wind data,
and COSMIC profiles" ;
                :Model_Data_Used = "ECMWF operational analyses (OA) used in data
sparse regions" ;
                :Note_1 = "Analyzed values set to missing at grid points that are
underground (level > ps)" ;
                :Note_2 = "Use of supplemental model data in this version (vs. the obs
only version) ..." ;
                :Note_2a = "(a) makes these analyses more reliable in data sparse
regions" ;
                :Note_2b = "(b) may introduce some model influence to the analyses" ;
                :Note_3 = "If needed, consider using the obs only version of this
product, but ..." ;
                :Note_3a = "make sure to read the notes and cautions contained within
it" ;
                :Note_4 = "N/A" ;
                :Note_4a = "N/A" ;
                :Note_5 = "N/A" ;
                :Note_5a = "N/A" ;
                :Note_5b = "N/A" ;
                :Note_6 = "N/A" ;
                :Caution_1 = "N/A" ;
                :Caution_1a = "N/A" ;
                :Caution_1b = "N/A" ;
                :Caution_1c = "N/A" ;
                :Reference_1 = "Johnson and Ciesielski (2013), J. Atmos. Sci., 70,
3157-3179." ;
                :Reference_2 = "Johnson et al. (2015), J. Atmos. Sci., 72, 598-622." ;
                :File_Creator = "Johnson Research Group, Dept. of Atmos. Science,
Colorado State University" ;
                :File_Version = "1.0 (initial official release)" ;
                :Last_Modified = "Thu Aug 10 17:23:41 MDT 2017" ;
```

Array average products

```
dimensions:
        level = 40 ;
        time = UNLIMITED ; // (736 currently)
variables:
        float level(level) ;
                level:long_name = "pressure level" ;
                level:units = "hPa" ;
                level:resolution = 25.f ;
                level:actual_range = 1025.f, 50.f ;
                level:comment = "first level (labeled 1025) represents the surface" ;
        double time(time) ;
                time:long_name = "UTC time" ;
                time:units = "seconds since 2011-01-01 00:00:00 UTC" ;
                time:resolution = "0000-00-00 03:00:00" ;
                time:actual_range = 23587200., 31525200. ;
                time:first_time = "2011-10-01 00:00:00 UTC" ;
                time:last_time = "2011-12-31 21:00:00 UTC" ;
        int date_enc(time) ;
                date_enc:long_name = "UTC date (encoded)" ;
                date_enc:format = "8-digit integer: yyyymmdd" ;
                date_enc:actual_range = 20111001, 20111231 ;
        int time_enc(time) ;
                time_enc:long_name = "UTC time (encoded)" ;
                time_enc:format = "6-digit integer: hhmmss" ;
                time_enc:actual_range = 0, 210000 ;
        int npts(time, level) ;
                npts:long_name = "number of points used in array averages" ;
                npts:actual_range = 43, 43 ;
        float ps(time) ;
                ps:long_name = "array-averaged surface pressure" ;
                ps:units = "hPa" ;
                ps:actual_range = 1003.79f, 1012.63f ;
        float z(time, level) ;
                z:long_name = "array-averaged geopotential height" ;
                z:units = "m" ;
                z:actual_range = 0.f, 20707.33f ;
        float u(time, level) ;
                u:long_name = "array-averaged zonal wind" ;
                u:units = "m/s" ;
                u:actual_range = -38.25f, 18.18f ;
        float v(time, level) ;
                v:long_name = "array-averaged meridional wind" ;
                v:units = "m/s" ;
                v:actual_range = -11.6f, 14.f ;
        float omega(time, level) ;
                omega:long_name = "array-averaged vertical p-velocity" ;
                omega:units = "hPa/s" ;
                omega:actual_range = -0.006261111f, 0.001469444f ;
        float T(time, level) ;
                T:long_name = "array-averaged temperature" ;
                T:units = "degree_C" ;
                T:actual_range = -84.73f, 30.29f ;
        float theta(time, level) ;
                theta:long_name = "array-averaged potential temperature" ;
                theta:units = "K" ;
                theta:actual_range = 297.54f, 497.68f ;
        float q(time, level) ;
                q:long_name = "array-averaged water vapor mixing ratio" ;
                q:units = "g/kg" ;
                q:actual_range = 0.f, 19.95f ;
```

```
float rh(time, level) ;
        rh:long_name = "array-averaged relative humidity" ;
        rh:units = "%" ;
        rh:comment = "wrt to ice for T < 0 C" ;
        rh:actual_range = 1.95f, 150.f ;
float div(time, level) ;
        div:long_name = "array-averaged horizontal divergence" ;
        div:units = "1/s" ;
        div:actual_range = -3.053e-05f, 4.996e-05f ;
float vor(time, level) ;
        vor:long_name = "array-averaged horizontal relative vorticity" ;
        vor:units = "1/s" ;
        vor:actual_range = -2.73e-05f, 4.53e-05f ;
float Q1(time, level) ;
        Q1:long_name = "array-averaged apparent heating" ;
        Q1:units = "K/day" ;
        Q1:actual_range = -15.51f, 34.74f ;
float Q2(time, level) ;
        Q2:long_name = "array-averaged apparent drying" ;
        Q2:units = "K/day" ;
        Q2:actual_range = -39.38f, 40.76f ;
float hT(time, level) ;
        hT:long_name = "array-averaged horizontal advection of T" ;
        hT:units = "degree_C/s" ;
        hT:comment = "computed using centered differences" ;
        hT:actual_range = -9.916e-05f, 0.0002655f ;
float vT(time, level) ;
        vT:long_name = "array-averaged vertical advection of T" ;
        vT:units = "degree_C/s" ;
        vT:comment = "computed using centered differences" ;
        vT:actual_range = -0.001117f, 0.0002826f ;
float hq(time, level) ;
        hq:long_name = "array-averaged horizontal advection of q" ;
        hq:units = "g/(kg*s)" ;
        hq:comment = "computed using centered differences" ;
        hq:actual_range = -5.026e-05f, 7.44e-05f ;
float vq(time, level) ;
        vq:long_name = "array-averaged vertical advection of q" ;
        vq:units = "g/(kg*s)" ;
        vq:comment = "computed using centered differences" ;
        vq:actual_range = -0.0001504f, 8.426e-05f ;
float s(time, level) ;
        s:long_name = "array-averaged dry static energy" ;
        s:units = "m^2/s^2" ;
        s:comment = "s = (cp*T + g*z)" ;
        s:actual_range = 299600.f, 414800.f ;
float st(time, level) ;
        st:long_name = "array-averaged local time tendency of s" ;
        st:units = "m^2/s^3" ;
        st:comment = "computed using centered differences" ;
        st:actual_range = -0.161f, 0.1904f ;
float usx(time, level) ;
        usx:long_name = "array-averaged zonal advection of s" ;
        usx:units = "m^2/s^3" ;
        usx:comment = "computed using centered differences" ;
        usx:actual_range = -0.1034f, 0.2096f ;
float vsy(time, level) ;
        vsy:long_name = "array-averaged meridional advection of s" ;
        vsy:units = "m^2/s^3" ;
        vsy:comment = "computed using centered differences" ;
        vsy:actual_range = -0.02579f, 0.05539f ;
float omegasp(time, level) ;
        omegasp:long_name = "array-averaged vertical advection of s" ;
```

```
                omegasp:units = "m^2/s^3" ;
                omegasp:comment = "computed using centered differences" ;
                omegasp:actual_range = -0.3785f, 0.4137f ;
        float h(time, level) ;
                h:long_name = "array-averaged moist static energy" ;
                h:units = "m^2/s^2" ;
                h:comment = "h = (cp*T + Lv*q + g*z)" ;
                h:actual_range = 317400.f, 414800.f ;
        float ht(time, level) ;
                ht:long_name = "array-averaged local time tendency of h" ;
                ht:units = "m^2/s^3" ;
                ht:comment = "computed using centered differences" ;
                ht:actual_range = -0.3532f, 0.3128f ;
        float uhx(time, level) ;
                uhx:long_name = "array-averaged zonal advection of h" ;
                uhx:units = "m^2/s^3" ;
                uhx:comment = "computed using centered differences" ;
                uhx:actual_range = -0.1104f, 0.2096f ;
        float vhy(time, level) ;
                vhy:long_name = "array-averaged meridional advection of h" ;
                vhy:units = "m^2/s^3" ;
                vhy:comment = "computed using centered differences" ;
                vhy:actual_range = -0.065f, 0.07942f ;
        float omegahp(time, level) ;
                omegahp:long_name = "array-averaged vertical advection of h" ;
                omegahp:units = "m^2/s^3" ;
                omegahp:comment = "computed using centered differences" ;
                omegahp:actual_range = -0.3785f, 0.2441f ;
        float LH(time) ;
                LH:long_name = "array-averaged surface latent heat flux" ;
                LH:units = "W/m^2" ;
                LH:comment = "computed using TropFlux product; daily resolution" ;
                LH:actual_range = 57.19355f, 179.7097f ;
        float SH(time) ;
                SH:long_name = "array-averaged surface sensible heat flux" ;
                SH:units = "W/m^2" ;
                SH:comment = "computed using TropFlux product; daily resolution" ;
                SH:actual_range = 1.16129f, 28.16129f ;
        float Qrnet(time) ;
                Qrnet:long_name = "array-averaged column net radiation" ;
                Qrnet:units = "W/m^2" ;
                Qrnet:comment = "computed from combined Q1/Q2-budget residual using LH
and SH" ;
                Qrnet:actual_range = -696.1935f, 780.387f ;
        float Qrnet_CERES(time) ;
                Qrnet_CERES:long_name = "array-averaged column net radiation from
CERES" ;
                Qrnet_CERES:units = "W/m^2" ;
                Qrnet_CERES:comment = "computed from CERES product" ;
                Qrnet_CERES:actual_range = -215.7097f, 188.7097f ;
        float P0_1(time) ;
                P0_1:long_name = "array-averaged Q1-budget derived surface rainfall" ;
                P0_1:units = "mm/day" ;
                P0_1:comment = "computed using SH and Qrnet_CERES estimates" ;
                P0_1:actual_range = -10.25f, 59.22f ;
        float P0_2(time) ;
                P0_2:long_name = "array-averaged Q2-budget derived surface rainfall" ;
                P0_2:units = "mm/day" ;
                P0_2:comment = "computed using LH estimate" ;
                P0_2:actual_range = -16.81f, 56.17f ;
        float P_TRMM(time) ;
                P_TRMM:long_name = "array-averaged rainfall from TRMM" ;
                P_TRMM:units = "mm/day" ;
```

```
                P_TRMM:comment = "computed using TRMM 3B42v7 product" ;
                P_TRMM:actual_range = 0.f, 113.1596f ;
        int npts_TRMM(time) ;
                npts_TRMM:long_name = "number of 0.25 deg points used in TRMM array
averages" ;
                npts_TRMM:actual_range = 645, 645 ;

// global attributes:
                :Experiment = "Dynamics of the Madden-Julian Oscillation (DYNAMO)" ;
                :Project = "DYNAMO Legacy Data Project" ;
                :Data_Set = "DYNAMO Array Averages" ;
                :Data_File = "DYNAMO NSA Array Averages from Observations and Model
Data" ;
                :Data_Type = "Upper Air and Surface/Array Averages" ;
                :Data_Version = "CSU version 3b (based on gridded analyses from obs
plus ECMWF OA data)" ;
                :Time_Period = "2011-10-01 00:00:00 UTC to 2011-12-31 21:00:00 UTC" ;
                :Time_Resolution = "every 3 h" ;
                :Vertical_Levels = "surface, 1000, 975, 950, 925, ... , 50 hPa" ;
                :Vertical_Resolution = "25 hPa" ;
                :Averaging_Array = "Northern Sounding Array (NSA) bounded by
Male/Colombo/Gan/Revelle" ;
                :Averaging_Process = "Performed by Colorado State University (CSU)" ;
                :Gridded_Data_Used = "DYNAMO Gridded Analyses from Observations and
Model Data (CSU version 3b)" ;
                :Gridded_Data_Note_1 = "Constructed from observations and supplemental
model data in data sparse regions" ;
                :Gridded_Data_Note_2 = "Use of supplemental model data in this version
(vs. the obs only version) ..." ;
                :Gridded_Data_Note_2a = "(a) makes these analyses more reliable in
data sparse regions" ;
                :Gridded_Data_Note_2b = "(b) may introduce some model influence to the
analyses" ;
                :Gridded_Data_Note_3 = "N/A" ;
                :Gridded_Data_Note_3a = "N/A" ;
                :Gridded_Data_Note_4 = "N/A" ;
                :Gridded_Data_Note_4a = "N/A" ;
                :Gridded_Data_Note_5 = "N/A" ;
                :Gridded_Data_Note_5a = "N/A" ;
                :Gridded_Data_Note_5b = "N/A" ;
                :Caution_1 = "N/A" ;
                :Caution_1a = "N/A" ;
                :Caution_1b = "N/A" ;
                :Note_1 = "If needed, consider using version 3a of this product (based
on obs only), ..." ;
                :Note_1a = "but make sure to read the notes and cautions contained
within it" ;
                :Reference_1 = "Johnson and Ciesielski (2013), J. Atmos. Sci., 70,
3157-3179." ;
                :Reference_2 = "Johnson et al. (2015), J. Atmos. Sci., 72, 598-622." ;
                :File_Creator = "Johnson Research Group, Dept. of Atmos. Science,
Colorado State University" ;
                :File_Version = "1.0 (initial official release)" ;
                :Last_Modified = "Thu Aug 24 11:49:20 MDT 2017" ;
```

5. Data Remarks

The data can be accessed using the myriad of software that is able to interact with NetCDF format files, including ncdump, ncview, Matlab, Python, IDL, and NCL.

The gridded and array averaged time series products are most reliable within the enhanced sounding arrays when both ships (R/V *Revelle* and R/V *Mirai*) were on-site and should be used with caution in data sparse regions and for most of December.

6. References

Ciesielski, P.E., H. Yu, R.H. Johnson, K. Yoneyama, M. Katsumata, C.N. Long, J. Wang, S.M. Loehrer, K. Young, S.F. Williams, W. Brown, J. Braun, and T. Van Hove, 2014a: Quality-Controlled Upper-Air Sounding Dataset for DYNAMO/CINDY/AMIE: Development and Corrections. *J. Atmos. Oceanic Technol.*, **31,** 741–764, https://doi.org/10.1175/JTECH-D-13-00165.1

Ciesielski, P. E. , R. H. Johnson, K. Yoneyama, and R. K. Taft, 2014b: Mitigation of Sri Lanka Island Effects in Colombo Sounding Data and Its Impact on DYNAMO Analyses. *Journal of the Meteorological Society of Japan,* **92,** 385-405. https://doi.org/10.2151/jmsj.2014-407

Johnson, R.H., P.E. Ciesielski, J.H. Ruppert, and M. Katsumata, 2015: Sounding-Based Thermodynamic Budgets for DYNAMO. *J. Atmos. Sci.,* **72,** 598–622, https://doi.org/10.1175/JAS-D-14-0202.1