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Information and Services Center (GES DISC)*

README Document for Sounder PEATE Level 3 Products

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Goddard Earth Sciences Data and Information Services Center (GES DISC)

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Table of Contents

Contents

1	Introduction	6
1.1	Mission Instrument Description	7
1.2	Sounder PEATE.....	7
1.3	Algorithm Background	10
1.3.1	Processing.....	11
1.4	Data Disclaimer	11
1.4.1	Acknowledgement.....	12
1.4.2	Contact Information.....	12
2	Data Organization.....	13
2.1	File Naming Convention.....	13
2.2	L3 Product Granules.....	14
2.2.1	CrIMSS Level 3	14
2.3	File Format and Structure	15
3	Data Contents	16
3.1	Dimensions.....	16
3.2	Global Attributes.....	16
3.3	Products/Parameters.....	17
3.3.1	Data Fields in Root Group	17
3.3.2	State/Ascending Group	17
3.3.3	Physical Parameters	17
4	Options for Reading the Data.....	19
4.1	Command Line Utilities/Tools/Programming	19
4.1.1	h5dump	19
4.1.2	ncdump.....	19
4.1.3	HDFView	19

5	Data Services.....	20
6	More Information	20
7	Acknowledgements	20
8	References	20

1 Introduction

This document provides basic information for using Version 10 Level 3 products produced by Sounder Product Evaluation and Test Element (PEATE)¹, based on from Suomi NPP CrIMSS data.

The Sounder PEATE Level 3 (L3) Product provides global cylindrical grids summarizing Level-2 (L2) data from a given instrument suite for one day, 8-consecutive days, or one month. Data on such a grid is easier to visualize and to compare to data from other instruments and from forecasts and climate models.

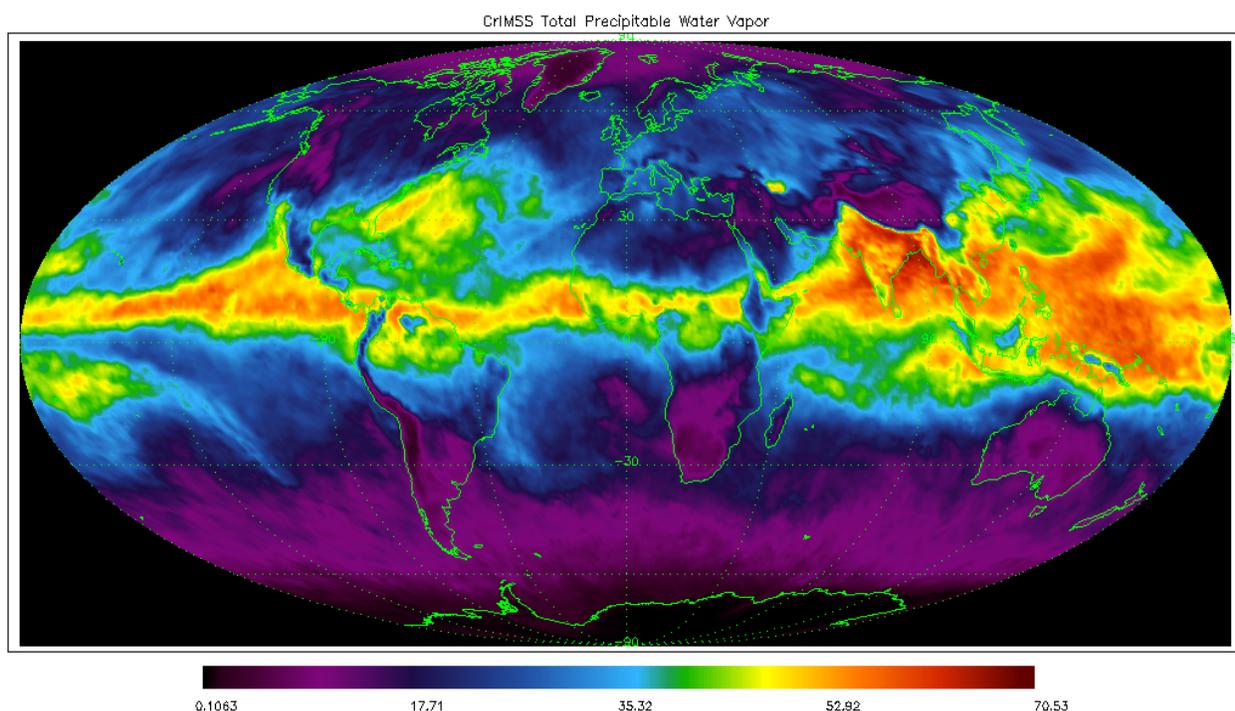


Figure 1-1. Level 3 Image. The mean total precipitable water vapor in mm for the descending (night) portion of S-NPP orbits for the 8-day period starting July 1 2013.

The PEATE Level 3 products contain retrieved L2 surface pressure, total water and ozone columns, and vertical profiles of temperature and water vapor averaged over a uniform set of latitude, longitude grid cells accumulated over daily, 8-day or monthly time scales. Separate Level 3 files are prepared based on the output of the microwave-only retrieval (MW), and the

¹ The Sounder PEATE, or SNPP Sounder PEATE, is one six PEATEs formed by NASA to support NASA Science Teams studying instrument data from the Soumi NPP (previously known as NPP) satellite. The Suomi NPP satellite is managed by the National Polar-orbiting Partnership (NPP) which includes elements from NASA, NOAA and DoD. Specific details about SNPP can be found at: <http://npp.gsfc.nasa.gov/index.html>.

combined microwave and infrared retrieval (IRMW). The IRMW file includes the infrared-retrieved ozone column.

1.1 Mission Instrument Description

Table 1.1-1 and Table 1.1-2 contain summaries of instrument and platform parameters.

Table 1.1-1 Instrument parameters. *CrIS additionally reports 12 unusable “guard” channels (2 on each band edge). First dimension of the above scan patterns reflects the field-of-regard (for) along the scan direction.

Platform	Instrument	Instrument Type	PEATE Id	Scan Rate (s)	Scan Range (°)	Scan Pattern	FOR Dia (km, nadir)	Spectral Channels
SNPP	CrIS	IR (FTS)	901	8	±50	30 x 3 x 3	14	1305*
	ATMS	MW	301	8/3	±53	96	16-75	22
			219					

Table 1.1-2 Approximate orbital parameters. *Orbital drift of NOAA satellites not tightly constrained.

Platform	NORAD Id	Alt	Orbit Incl. (°)	Equator X Time	Period	Repeat Orbits	Repeat Days	Launch
SNPP	37849	824	98.7	13:30*	101	228	16	28 Oct 2011

1.2 Sounder PEATE

With the launch of the Suomi NPP (SNPP, previously known as NPP) on October 28, 2011, NASA became a data customer for the next suite of Earth-observing platforms. This role is quite different when compared to previous Earth missions where NASA served additional roles as the primary data provider and curator of data products. Just how well SNPP data products would fit into the science and observation paradigm established over more than a decade of Earth missions was now known. Would these products support long-term climate studies that began utilizing data products that preceded SNPP? NASA commissioned SNPP science teams to analyze SNPP data products and determine whether those products would be “climate quality” and support ongoing climate studies. Six science teams were selected through a competitive proposal process to analyze data from SNPP’s five instruments. Six data processing systems and support teams were formed to support each of the six science teams. They are referred to as PEATEs for “Product Evaluation and Test Element.”

Table 1.1-1 PEATEs.

Science Team	PEATE	Instrument(s) Analyzed
Sounder	Sounder	CrIS and ATMS
Ozone	Ozone	OMPS
Ceres	CERES CARS	CERES
Land	Land	VIIRS
Atmospheres	Atmospheres	VIIRS
Ocean	Ocean	VIIRS

Collectively, each SNPP science team and associated PEATE has been charged with two fundamental tasks: First, they are to ascertain whether SNPP data products can be used to continue ongoing climate studies. Second, they are expected to improve the SNPP data production algorithms when possible in order to (1) produce climate quality products or (2) produce better climate quality products.

The PEATE's roles in supporting their science teams are extensive. PEATEs develop products that help the science teams evaluate the quality of SNPP products. If the science teams identify potential improvements to those products through enhancements to existing or new algorithms, the PEATEs provide a computational environment and software development staff to enable coding and testing these potential improvements. The PEATEs may also develop additional products that may help their science teams analyze how well SNPP products will be useful for continuing ongoing climate studies. Consequently, most PEATEs produce a variety of data products for their science teams. Since it is possible that many of these data products may have general utility to the science community beyond the SNPP science teams, NASA requests that PEATE products be made available to the public. This is consistent with NASA's Earth Science Data Policy (<http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/>).

The Sounder PEATE produces several such products including Simultaneous Nadir Observations, Calibration Subsets and Level 3 products. Level 3s are described in this document. Other Sounder PEATE products are described in other Readme documents.

Data are received from a variety of sources for the production of Level 3s. Our major source of data products is from the NOAA Comprehensive Large Array Data Stewardship Data System (CLASS). SNPP products, however, are obtained via an interface with the SNPP Science Data Segment's Data Depository Element (SD3E) at the GSFC.

The physical interface from NOAA through the SD3E is for the convenience of NOAA. But, should SD3E cease to exist, then the Sounder PEATE will obtain SNPP products directly from NOAA Class.

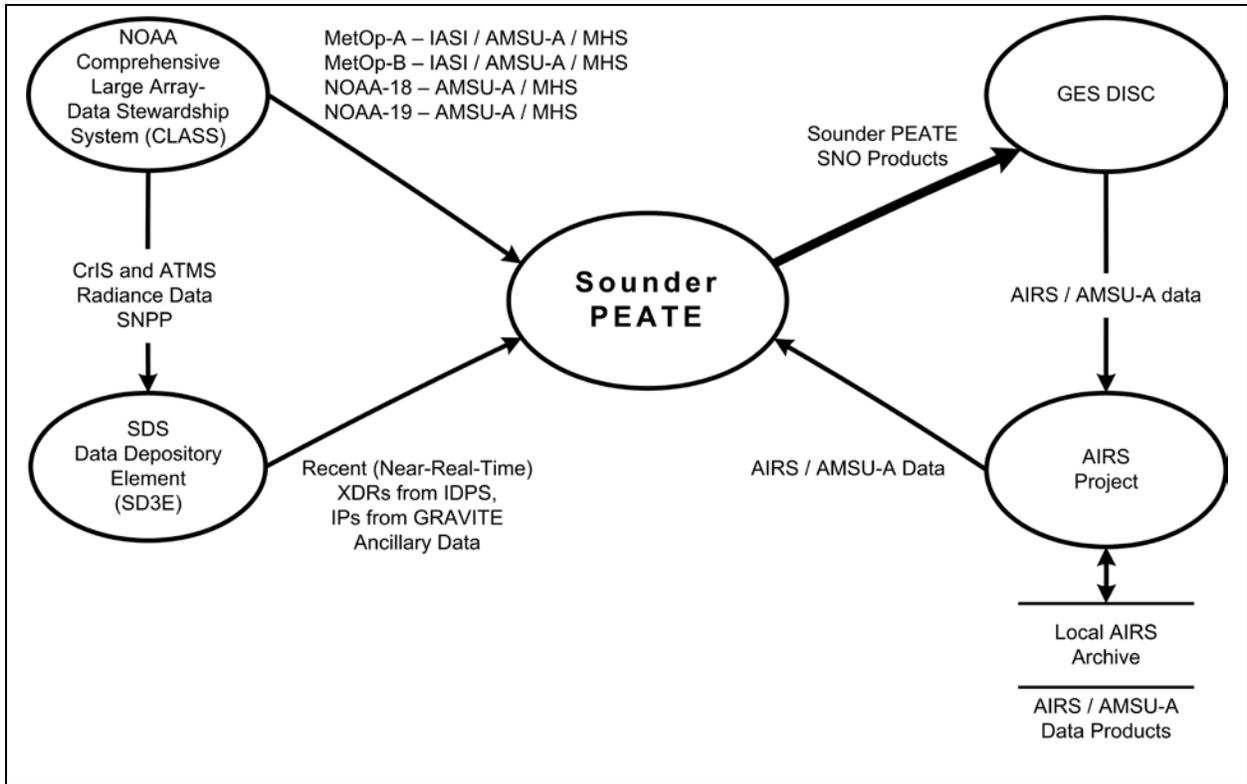


Figure 1-2. Sounder PEATE Data Flow. Data are received from a variety of sources for Level 3 processing.

1.3 Algorithm Background

Sounder PEATE Level 3 analyses are performed on CrIMSS Environmental Data Records (EDR), associated geolocation and Intermediate Products (IPs) obtained from the SD3E component of NASA's SNPP Science Data System (SDS). These are also publically available at the NOAA Comprehensive Large Array-data Stewardship System (CLASS). A list of input file types is given in Table 1.2-1.

Table 1.2-1 Input data types for Sounder PEATE SNPP CrIMSS Level 3.

Level 3 Input	Input Files	Input Granularity	Format	Data Source	Version ID
EDR	CrIMSS EDR (Environmental Data Record) (REDRO)	8 min, 15-granule aggregation	H5	SDS SD3E	Ops (see Table 1.2-1)
Geolocation	CrIMSS EDR Geolocation (GCRIO)	8 min, 15-granule aggregation	H5	SDS SD3E	
Additional Geolocation	MW RSDR (Remapped Sensor Data Record) (SATMR)	8 min, 15-granule aggregation	H5	SDS SD3E	
Additional Geolocation	MW RSDR Geolocation (GATRO)	8 min, 15-granule aggregation	H5	SDS SD3E	
O3	CrIMSS Ozone IP (IIROO)	8 min, 15-granule aggregation	H5	SDS SD3E	
MW H2O	CrIMSS MW Moisture Profile IP (ICALM)	32 sec granule	H5	SDS SD3E	
MW Temp	CrIMSS MW Temperature Profile IP (ICTLM)	32 sec granule	H5	SDS SD3E	
IR H2O	CrIMSS IR Moisture Profile IP (ICALI)	32 sec granule	H5	SDS SD3E	
IR Temp	CrIMSS IR Temperature Profile IP (ICTLI)	32 sec granule	H5	SDS SD3E	

Table 1.2-2 SNPP SD3E operational algorithm versions.

Version	Start Date	Orbit Number	Comments
Mx5.0	3-Nov-2011	88	Launch Version; Bad ATMS sidelobe correction
Mx5.1	9-Dec-2011	601	Zero ATMS sidelobe correction
Mx5.2	1-Feb-2012	1365	
Mx5.3	2-Apr-2012	2232	Emergency delivery to fix CrIS geolocation issue
Mx6.2	9-Aug-2012	4056	Mx5.3 merged with main CM tree
Mx6.3	15-Oct-2012	5010	
Mx6.4	16-Oct-2012	5025	Emergency delivery to fix OMPS related issue
Mx6.5	27-Nov-2012	5621	
Mx6.6	28-Feb-2013	6944	
Mx6.7	13-Mar-2013	7131	
Mx7.1	10-Jul-2013	8812	
	Nov 20, 2013		ATMS sidelobe correction started
Mx8.1	Jan 2014(?)	?	

1.3.1 Processing

Daily products are created from L2 input files. Multi-day and Monthly products are created using the summary statistics found in Daily products.

1.3.1.1 Ascending/Descending

In each product data from ascending and descending orbit segments are mapped to separate netCDF4 groups so that day vs. night differences can be isolated. The data associated with any given day are those whose local solar time are within ± 12 hours of 13:30 of the nominal date for ascending data, and within ± 12 hours of 01:30 for descending data.

1.3.1.2 Gridding and weighting

The surface of the Earth is divided into uniform grid cells with the specified number of longitude grid cells from -180.0 to +180.0 degrees, and the specified number of latitude grid cells from 90.0 degrees (South pole) to +90.0 degrees (North Pole).

To account for the finite FOV, the observational geometry and an assumed half scan angle of 1.65 degrees is used to compute the fraction of the signal from the FOV to assign to each grid cell. The sum of these fractions over the grid cell represents to total weight.

1.3.1.3 Column Integration

For CrIMSS, total water and ozone column are derived from integration of their respective vertical profiles.

1.3.1.4 QA Filtering

For temperature, only data in range [100-400k] are accepted. For water vapor, the valid range is. [0:100]. Data below the surface are excluded.

1.3.1.5 QA Filtering CrIMSS

Data are excluded for which QF5_CrIMSSDR is a fill value, or for which bit 2 and bit 3 are set. For MW Level 3, data are excluded for which ChiSquareMW1 is a fill value.

1.4 Data Disclaimer

Data contained in Sounder PEATE Level 3 products are derived from source files noted in Table 1.2-1.

For documentation of specific instrument data included in Sounder PEATE Level 3 products, see references in Section 8.

1.4.1 Acknowledgement

All data contained in Sounder PEATE Level 3 products are derived from the original sources of those data products. We freely acknowledge and attribute the source data to the following organizations:

- Acknowledgement for NOAA:

NOAA distributes all data for ATMS and CrIS via the Comprehensive Large Array-data Stewardship System (CLASS), <http://www.class.ngdc.noaa.gov>. The NOAA CLASS data disclaimer, listed below, can be found at <http://www.ncdc.noaa.gov/oa/pod-guide/ncdc/docs/podug/disclaim.htm>:

While every effort has been made to ensure that this documentation is accurate and reliable, NOAA cannot assume liability for any damages caused by inaccuracies in the NOAA polar orbiter data or documentation, or as a result of the failure of the data or software to function in a particular manner. The software (included in the appendices) was developed by the U.S. Government and is not intended for resale. The user should be aware that phone numbers, fax numbers, addresses and Internet Uniform Resource Locators (URLs) are subject to change and cannot be expected to remain constant. NOAA makes no warranty, expressed or implied, nor does the fact of distribution constitute a warranty.

All NOAA data used in SNPP Sounder PEATE Level 3 products is free for use and reuse in accordance with the “NOAA/National Climatic Data Center Open Access to Physical Climate Data Policy.” More information can be found at: <http://www.ncdc.noaa.gov/oa/about/open-access-climate-data-policy.pdf>.

1.4.2 Contact Information

For more information about Sounder PEATE data products including Level 3 products, please contact the Sounder PEATE System Engineer, Ruth Monarrez. Ms. Monarrez’ contact information is provided below:

Ruth Monarrez, (Ruth.Monarrez@jpl.nasa.gov)
Jet Propulsion Laboratory
MS 168-414
4800 Oak Grove Dr.
Pasadena CA, 91109

2 Data Organization

PEATE SNPP Level 3 files are provided at 1-day, 8-day, and monthly intervals, separately for MW and IRMW retrievals.

2.1 File Naming Convention

The Level 3 product naming convention is as follows:

SNDR.platform.instr.yyyymmdd.duration.L3.type.sampling.standard.vn_m_l.S.prodStamp.nc

- SNDR = Sounder PEATE product
- platform = satellite platform [NPP]
- instr = primary instrument of data in file:
 - NPP: CRIMMS

- yyyymmdd = nominal start date of data
 - yyyy: 4 digit year number [2002 -]
 - mm: 2 digit month number [01-12]
 - dd: 2 digit day of month [01-31]
- duration: D1 = daily, D8 = 8 day, M1 = monthly product
- L3 = Sounder PEATE L3 File Type

- type: MW or IRMW Retrieval

- sampling tag
 - EDR_CRIMSS

- standard = PEATE Collection Label identifying standard processing configuration
- *vn_m_l* = algorithm version identifier of major version, minor version, release version.
- S = file produced in Sounder PEATE Operational data stream

- prodStamp = datetime stamp of product generation, yymmddhhmmss:
 - yy: year number without century
 - mm: month number [01-12]
 - dd: day of month [01-31]
 - hhmmss: hours, minutes and seconds UTC time.

- nc = NetCDF 4 formatted file

2.2 L3 Product Granules

The orderable L3 subtypes, along with sample filenames and sizes are given below.

2.2.1 CrIMSS Level 3

2.2.1.1 SNPP CrIMSS MW Retrieval Level 3 Daily

Short Name	SPL3NP1D
Long Name	Sounder PEATE SNPP CrIMSS MW Retrieval Level 3 Daily
File Size	150 MB
Sample Filename	<i>SNDR.NPP.CRIMSS.20130801.D1.L3.MW.EDR_CRIMSS.standard.v10_0_0.S.130826164125.nc</i>

2.2.1.2 SNPP CrIMSS MW IR Retrieval Level 3 Daily

Short Name	SPL3NP2D
Long Name	Sounder PEATE SNPP CrIMSS IR MW Retrieval Level 3 Daily
File Size	150 MB
Sample Filename	<i>SNDR.NPP.CRIMSS.20130801.D1.L3.IRMW.EDR_CRIMSS.standard.v10_0_0.S.130822180700.nc</i>

2.2.1.3 SNPP CrIMSS MW Retrieval Level 3 8-Day

Short Name	SPL3NP1N
Long Name	Sounder PEATE SNPP CrIMSS MW Retrieval Level 3 8-Day
File Size	150 MB
Sample Filename	<i>SNDR.NPP.CRIMSS.20130801.D8.L3.MW.EDR_CRIMSS.standard.v10_0_0.S.130826164125.nc</i>

2.2.1.4 SNPP CrIMSS MW IR Retrieval L3 8-Day

Short Name	SPL3NP2N
Long Name	Sounder PEATE SNPP CrIMSS IR MW Retrieval Level 3 8-Day
File Size	150 MB
Sample Filename	<i>SNDR.NPP.CRIMSS.20130801.D8.L3.IRMW.EDR_CRIMSS.standard.v10_0_0.S.130822180700.nc</i>

2.2.1.5 SNPP CrIMSS MW Retrieval L3 Monthly

Short Name	SPL3NP1M
Long Name	Sounder PEATE SNPP CrIMSS MW Retrieval Level 3 Monthly
File Size	150 MB
Sample Filename	<i>SNDR.NPP.CRIMSS.20130801.M1.L3.MW.EDR_CRIMSS.standard.v10_0_0.S.130826164125.nc</i>

2.2.1.6 SNPP CrIMSS MW IR Retrieval L3 Monthly

Short Name	SPL3NP2M
Long Name	Sounder PEATE SNPP CrIMSS IR MW Retrieval Level 3 Monthly
File Size	150 MB
Sample Filename	<i>SNDR.NPP.CRIMSS.20130801.M1.L3.IRMW.EDR_CRIMSS.standard.v10_0_0.S.130822180700.nc</i>

2.3 File Format and Structure

Data files are in NetCDF-4 (Network Common Data Form) format; see <http://www.unidata.ucar.edu/software/netcdf/>. NetCDF-4 is an extension of the Hierarchical Data Format Version 5 (H5), developed at the National Center for Supercomputing Applications <http://www.hdfgroup.org>. Tools written to read H5 versions 1.8 or later will also operate on NetCDF-4 files. These data files in particular were created with NetCDF-4.1.2.

At the top level of each file, data fields are contained in the “State” group. This is then divided into 2 groups “Ascending” and “Descending”. Each of these has groups “Mean”, “Counts”, “SDev” and “TotalWeights”. Within each of these groups are the parameters relating to the physical variables of interest.

3 Data Contents

3.1 Dimensions

A description of Science Data Set (SDS) dimensions is given in Table 3.1-1.

Table 3.1-1 Dimensions used in product.

Dimensions	Description
nlat	Number of latitudes bins (180)
nlon	Number of longitude bins (360)
nlevs	Number of vertical levels (101)

3.2 Global Attributes

In addition to Data Set arrays containing variables and dimension scales, global metadata is also stored in the files. Some metadata are required by standard conventions, some are present to meet data provenance requirements and others as a convenience to users of **Level 3** products. Global attributes in a **Level 3** file can be viewed with *ncdump* software:

Global attributes in a **Level 3** file can be viewed with *ncdump* software:

ncdump -h -c <Product file>.

A summary of global attributes present in all files is shown in Table 3.2-1.

Table 3.2-1 Global metadata attributes associated with each product file.

Global Attribute	Type	Description
comments	string	Miscellaneous information about the data or methods used to produce it. Can be empty.
Conventions	string	CF standard used in file (= "CF-1.4")
enddatetime	string	Nominal end time of the file in UTC; for Level 3 this is the NomInalDay + nominal file duration in days, midnight UTC
epoch	string	UTC reference time for all time fields that are reported in seconds.
featureType	string	= "grid"
griddingversion		Version of PEATE gridding SW
history	string	Provides an audit trail for modifications to the original data – time ordered list of (PGE name, version, variant)
institution	string	Processing facility that produced this file (e.g., "JPL/Caltech Sounder PEATE Operations")
source	string	The method of production of the original data, e.g. ECMWF, radiosondes, surface observations
references	string	ATDB and design documents describing processing algorithms. Can be empty.
startdatetime	string	Nominal start time of the file in UTC; this corresponds to midnight of the day in the filename.
title	string	A succinct description of what is in the dataset.

Table 3.2-2 NetCDF attributes associated with each data set.

Name	Type	Description
_FillValue	Same as data set	Value used to identify missing data.
long_name	string	Ad hoc description of the variable.
units	string	The units of the variable.

3.3 Products/Parameters

3.3.1 Data Fields in Root Group

Table 3.3-1 Data Fields in Root Group.

Name	Type	Dimensions	Description	Units
lat	float	nlat	Latitude grid centers	degree
lon	float	nlon	Longitude grid centers	degree
plevs	float	nlevs	Vertical pressure levels	hPa

3.3.2 State/Ascending Group

The Ascending group contains variables calculated using data collected when the spacecraft was ascending. The Descending group contains variables calculated using data collected when the spacecraft was descending.

3.3.3 Physical Parameters

The structure of the Ascending and Descending groups are identical. Each has subgroups that contain values related to each tracked physical parameter.

Table 3.3-2 Level 3 data fields. Units apply to the values within the Mean and SDev groups. The tO3 fields occur in the IRMW products only.

Name	Type	Dimensions	Description	Units
pH2O	float	nlevs, nlat, nlon	Water vapor profile	mass mixing ratio relative to dry air in parts per thousand
ptemp	float	nlevs, nlat, nlon	Temperature profile	K
stemp	float	nlat, nlon	Surface temperature	K
tH2O	float	lat, lon	Water column total	kg/m ²
tO3	float	lat, lon	Ozone column total	Dobson (DU)

3.3.3.1 Mean Group

The group name as it appears in the SPG file is “Mean”. This group contains calculated averages of various variables. All values are single-precision floating-point.

3.3.3.2 Counts Group

This group contains identical fields as Mean group with identical variable names and dimensions. The group name as it appears in SPG file is “Counts”. This group contains variables that contain the number of Level-2 records that contribute to the corresponding value in the Mean group, but units are always “unitless”. All values are 4-byte integers.

3.3.3.3 SDev Group

This group contains identical fields as Mean group with identical variable names, dimensions, and units. This group contains variables that contain standard deviations of the data contained in Mean group. The group name as it appears in SPG file is “SDev”. All values are single-precision floating-point.

3.3.3.4 TotalWeights Group

In order to support the computation of Level 3 values spanning multiple days, the sum of weights are recorded for each variable. All values are single-precision floating-point.

4 Options for Reading the Data

4.1 Command Line Utilities/Tools/Programming

Files can be read using tools and libraries for either NetCDF -4 or H5.

4.1.1 h5dump

The h5dump tool can be used as a simple browser for H5 data files, and comes with the H5 distribution. Type h5dump -h for usage information.

4.1.2 ncdump

The ncdump tool can be used as a simple browser for netCDF data files, to display the dimension names and sizes; variable names, types, and shapes; attribute names and values; and optionally, the values of data for all variables or selected variables in a netCDF file. The most common use of ncdump is with the -h option, in which only the header information is displayed.

```
ncdump [-c|-h] [-v ...] [[-b|-f] [c|f]] [-l len] [-n name] [-d n[,n]] filename
```

Options/Arguments:

[-c] Coordinate variable data and header information

[-h] Header information only, no data

[-v var1[,...]] Data for variable(s) <var1>,... only data

[-f [c|f]] Full annotations for C or Fortran indices in data

[-l len] Line length maximum in data section (default 80)

[-n name] Name for netCDF (default derived from file name)

[-d n[,n]] Approximate floating-point values with less precision filename File name of input netCDF file

Note: the ncdump tool will only display variables whose ranks are great than 1. In other words, you will not see one dimensional vectors such as *satheight* using this tool.

The ncdump program can be found in bin directory of the HDF installation area. Consult your local computer system administrator for the specifics.

4.1.3 HDFView

HDFView is a Java based graphical user interface created by the HDF Group which can be used to browse TRMM VIRS HDF files. The utility allows users to view all objects in an HDF file hierarchy which is represented as a tree structure. HDFView can be downloaded at <ftp://ftp.hdfgroup.org/HDF5/hdf-java/>. Documentation for HDFView can be view at

<http://www.hdfgroup.org/products/java/hdf-java-html/hdfview/UsersGuide/index.html>.

5 Data Services

If you need assistance or wish to report a problem:

Email: gsfc-help-disc@lists.nasa.gov

Voice: 301-614-5224

Fax: 301-614-5268

Address:

Goddard Earth Sciences Data and Information Services Center NASA Goddard Space Flight Center Code 610.2 Greenbelt, MD 20771 USA

6 More Information

Documentation on input products used:

SNPP: <http://npp.gsfc.nasa.gov/documents.html>

7 Acknowledgements

This activity was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

8 References

- ATMS (SNPP):
http://npp.gsfc.nasa.gov/sciencedocuments/2013-12/474-00076_OAD-ATMS-SDR_C.pdf
- CrIS (SNPP):
http://npp.gsfc.nasa.gov/sciencedocuments/2014-02/474-00071_OAD-CrIS-SDR_D.pdf