National Aeronautics and Space Administration Goddard Earth Science Data Information and Services Center (GES DISC)

README Document for Sounder PEATE Simultaneous Nadir Observation (SNO) Products

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Revision History

Revision Date	*Changes*	*Author*
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Table of Contents

Contents

1 Introduction

This document provides basic information for using Version 10 Simultaneous Nadir Observation (SNO) products produced by Sounder Product Evaluation and Test Element (PEATE)[1].

Comparison of simultaneously observed data from similar instruments deployed on different satellites is a useful technique for assessing instruments calibration. SNO products contain simultaneous nadir radiance observations for the set of similar temperature-profiling instruments deployed on “AM satellites” (MetOp-A, MetOp-B) and “PM satellites“ (Aqua, SNPP, NOAA-18 and NOAA-19).

1.1 Mission Instrument Description

All instruments selected for SNO observations are either infrared or microwave sounders, and are often paired on orbital platforms such as Aqua (AIRS/ASMSU), MetOP (IASI/AMSU/MHS) and SNPP (CrIS/ATMS). Some instruments fly in a solo configuration and are typically microwave sounders (NOAA 18 and NOAA 19). All data products used in SNO observations are obtained from publically accessible data archives. Most products are obtained from the NOAA Comprehensive Large Array-data Stewardship System (CLASS). These data products include SNPP data products, MetOp A and B products, and NOAA 18 and 19 microwave products. The other remaining data products (AIRS and AMSU) are obtained from the Goddard Earth Sciences (GES) Data and Information Services Center (DISC) are from the Aqua platform. By prior arrangement, some of these products pass through intermediary destinations before they reach the Sounder PEATE. These include the AIRS Project for AIRS and AMSU data and the SD3E component of NASA’s SNPP Science Data System (SDS) for CrIS and ATMS products. These intermediary stops are identified only for completeness, as these sites do not alter the original data products in any form.

Table 1.1-1 and Table 1.1-2 contain summaries of selected instrument and platform parameters. The distribution of PEATE SNO products is limited to those providing comparison to the CrIS and ATMS instruments on SNPP.

[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.

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
Aqua	AIRS	IR (Grating)	801	8/3	±50	90	14	2378
	AMSU-A	MW	101	8	±50	30	41	15
MetOp-A/B	IASI	IR (FTS)	1001 1002	8	±48	30 x 2 x 2	12	8461
	AMSU-A	Primary MW	121 122	8	±50	30	47	15
	MHS	Secondary MW	221 222	8/3	±50	90	16	5
NOAA-18/19	AMSU-A	Primary MW	118 119	8	±50	30	50	15
	MHS	Secondary MW	218 219	8/3	±50	90	17	5

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
Aqua	27424	705	98.2	13:30	98.8	233	16	04 May 2002
MetOp-A	29499	817	98.7	09:30	101.3	412	29	19 Oct 2006
MetOp-B	38771	817	98.7	09:30	101.3	412	29	17 Sep 2012
NOAA-18	28654	854	98.7	14:00*	102	-	-	20 May 2006
NOAA-19	33591	870	98.7	14:00*	102	-	-	06 Feb 2009

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 not 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 1.2-1 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. SNOs 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 SNOs. Our major source of data products is from the NOAA Comprehensive Large Array Data Stewardship Data System (CLASS). In actuality, all input data with the exception of AIRS data products are obtained from CLASS. SNPP products, however, are obtained via an interface with the SNPP Science Data Segment’s Data Depository Element (SD3E) at the GSFC. All AIRS data products are obtained

from the AIRS Project at JPL. But, these products are actually produced at the Goddard Earth Sciences Data and Information Services Center (GES DISC) at 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.

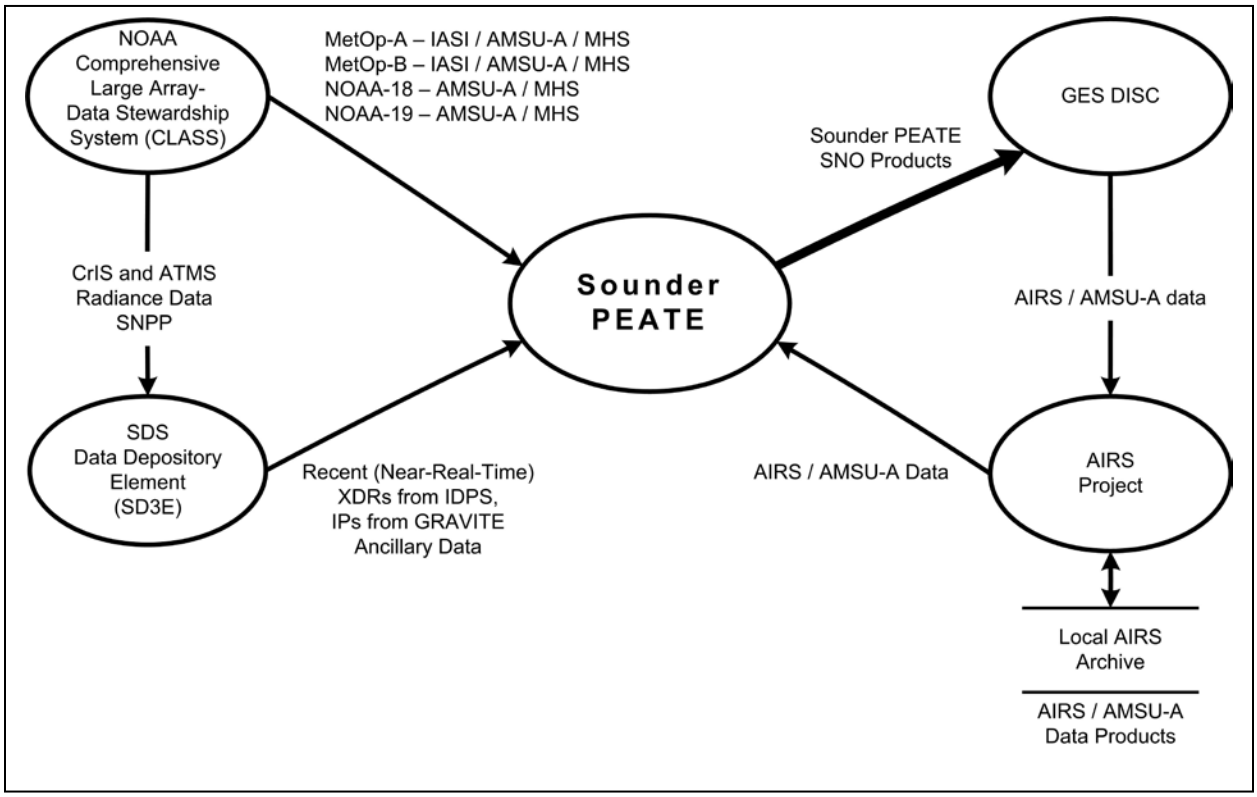

Figure 1.2-1 Sounder PEATE Data Flow. Data are received from a variety of sources for SNO processing.

1.3 Algorithm Background

SNO product files are created by matching instances of near-nadir simultaneous observations for instruments deployed on 2 different platforms. This analysis is performed for each data day, creating 2 matching data sets containing corresponding matching profiles. These daily data sets are then combined for each calendar month. The result is a pair of Monthly SNO files, one for each platform, that contain matching profiles for the entire calendar month.

Qualifying nadir observations are restricted to those having instrument scan angles of ± 3.5 °. Matching pairs are those that have differences in both time and space less than the maximums specified per PGE (see Section 2.2). Matches are written to each output file pairwise, so as to maintain a 1-1 relationship of profiles between the two files. If the same observation of one

platform matches to more than one observation of the other platform, the matching data is simply repeated to preserve this relationship.

1.3.1 Input Data

A list of input file types available to create SNOs is given in Table 1.3-1. Different SNO subtypes contain matches between different instruments and platforms. These combinations, along with their associated maximum matchup times and distances, is given in Section 2.2.

Table 1.3-1 Input data types for Sounder PEATE SNO Version 10.

SNO Input	Input Files	Input Granularity	Format	Data Source	Version ID
SNPP IR	CrIS SDR (Sensor Data Record) CrIS SDR Geolocation	8 min, 15-granule aggregation	H5	SDS SD3E	Ops (See Table 1.3-2)
SNPP MW TDR	ATMS TDR (Temperature Data Record) ATMS SDR Geolocation	8 min, 15-granule aggregation	H5	SDS SD3E	
Aqua IR	AIRS L1B	6 min	HDF-EOS	GES DISC	Collection 5
Aqua MW	AIRS AMSU L1B	6 min	HDF-EOS	GES DISC	Collection 5
MetOpA/B IR	IASI L1C	3 min	H5	NOAA CLASS	**Ops (See** Table 1.3-3)
MetOpA/B MW	NOAA AMSU-A L1B NOAA AMSU-B L1B	twice per orbit	NOAA KLM binary	NOAA CLASS	ops
NOAA-18/19 MW	NOAA AMSU-A L1B NOAA AMSU-B L1B	orbit	NOAA KLM binary	NOAA CLASS	ops

Table 1.3-2 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(?)	?	

Table 1.3-3 IASI operational L1C algorithm versions.

Version	Start Date
3.6	28-Feb-2007
4.0	4-Dec-2007
5.0	18-May-2010
5.1	1-Dec-2010
0.0	29-Sep-2011
6.2	22-Feb-2012
6.5	22-May-2013
7.0	8-Aug-2013

1.3.2 Coincident Observations

Due to the orbital geometries, coincidences occur mostly at high latitudes and on limited days. For some platform pairs, there are never any mid or low latitude coincidences. Some typical examples are shown in Figure 1.3-1 and Figure 1.3-2.

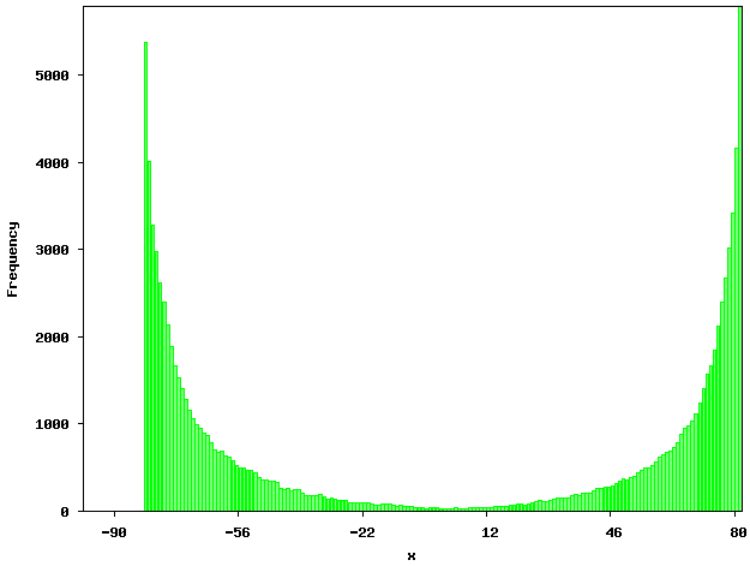

Figure 1.3-1 Latitudinal distribution of SNO observations for SNPP-Aqua IR (Oct 2012).

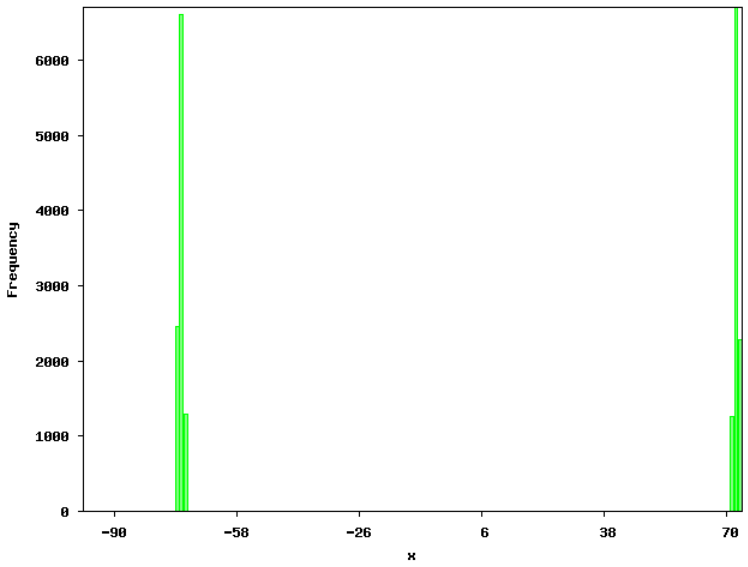

Figure 1.3-2 Latitudinal distribution of SNO observations for SNPP-MetOpA IR (Oct 2012).

1.4 Data Disclaimer

Most data contained in Sounder PEATE SNO products are derived from source files noted in Table 1.3-1. SNO primarily filters those data products according to an algorithm and writes out selected data fields. To foster better consistency between matched pairs between all instruments, a small subset of fields are calculated when the source does not contain them: *salt* (surface altitude), *landfrac* (land fraction), *scanang* (scan angle) and *ascflag* (ascending flag).

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

1.4.1 Acknowledgement

All data contained in Sounder PEATE SNO 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 AIRS and AMSU-A data:

  Distribution of GES DISC data sets is funded by NASA's Science Mission Directorate (SMD). The data are not copyrighted and are open to all for both commercial and non-commercial uses. If you used GES DISC data for a publication (research or otherwise), or for any other purpose, we request that you include the following acknowledgment:

"The data used in this effort were acquired as part of the activities of NASA's Science Mission Directorate, and are archived and distributed by the Goddard Earth Sciences (GES) Data and Information Services Center (DISC)."

We would appreciate receiving a copy of your publication, which can be forwarded to the following address:

Goddard Earth Sciences DISC Help Desk
Code 610.2
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

Or, you may email the publication reference gsfc-help-disc@lists.nasa.gov.

- Acknowledgement for NOAA instruments – ATMS, CrIS, and MHS and AMSU-A on NOAA-18 and NOAA-19:

  NOAA distributes all data for ATMS, CrIS and MHS 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:

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  All NOAA data used in SNPP Sounder PEATE SNO 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.

- Acknowledgement for IASI (MetOP-A/B):
  IASI data are obtained via CLASS from EUMETSAT via use agreement. The Level 1C data are considered free for use based on an international use agreement. References for acknowledgement should include the following statement:

  > *IASI data were obtained from CLASS via a special use agreement with EUMETSAT. The data are free for use based on their posting on NOAA CLASS in accordance with the* "NOAA/National Climatic Data Center Open Access to Physical Climate Data Policy" described above.

Specific reference information can be found at:
http://www.eumetsat.int/website/home/AboutUs/LegalInformation/index.html.

Within the above link, EUMETSAT's data use policy can be found at http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_LEG_DATA_POLICY&RevisionSelectionMethod=LatestReleased&Rendition=Web. It specifically states that a METOP data license "is granted to all users without charge, and against the signature of a license agreement. They may not be redistributed without transformation." NOAA maintains such a license agreement with EUMETSAT. As representation of METOP-A data as represented in SNO products is a subset of source product, they are considered to be *transformed*.

1.4.2 Contact Information

For more information about Sounder PEATE data products including SNO 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 SNO files are paired so that each orderable monthly SNO granule at GES DISC consists of a pair of matching files. Each SNO file contains data for 1 platform of the SNO pair. Each file consists of a sequence of profiles, with each profile describing a single observation. There is a 1-1 relationship between correspondingly indexed profiles in each file pair. Each file contains 1 month of data.

2.1 File Naming Convention

The SNO product naming convention is as follows:

SNDR.*platform.instr.yyyymm***01**.**M1.RTP3**.*mask.source.sampling*.**standard**.***v****n_m_l*.**S**.*prodStamp*.**nc**

- SNDR = Sounder PEATE product
- platform = satellite platform [NPP, AQUA, METOPA, METOPB, NOAA18, NOAA19]
- instr = primary instrument of data in file:
  - NPP: [CRIS, ATMS]
  - AQUA: [AIRS, AMSUA]
  - METOPA/B: [IASI, AMSUA]
  - NOAA18/19: [AMSUA]

- yyyymm01 = nominal start date of data
  - yyyy: 4 digit year number [2002 -].
  - mm: 2 digit month number [01-12]
  - 01: always first day of month
- M1 = monthly product
- RTP3 = Sounder PEATE RTP3 File Type

- (p) mask = 7 char string, for these products one of ['xxixxxx', 'xxxxmxx, 'xxxxmxb']
  from left to right, starting with position 0; possible non 'x' values:
  - position 2 = i indicates observed IR radiances are present in file
  - position 4 = m indicates observed primary MW-instrument radiances are present in file
  - position 6 = b indicates observed secondary MW-instrument radiances are present in file

- (content) source = sequence of 3 char mnemonics describing each non-x member of content mask, delimited by "_" , mnemonics are:
  - IR: [CRS, IAS, AIR]; CRIS, IASI, AIRS respectively
  - Primary MW: [ATT, AMA]; ATMS TDR, AMSU-A respectively
  - Secondary MW: [MHS]

- sampling = indicator of what the profiles in the file were matched to:

- [SNO_NPP, SNO_ATMS_TDR, SNO_AQUA, SNO_METOPA, SNO_METOPB, SNO_NOAA18, SNO_NOAA19]

- standard = PEATE Collection Label identifying standard processing configuration
- v*nn_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 SNO Product Granules

The orderable SNO subtypes, and mapping of granules to product files are given below, along with matching criteria and sample filenames and sizes. Note as monthly files are concatenated from daily files, the production date times of the matched files of each pair will differ. Also there can be large month-to-month variability in SNO file sizes; size ranges shown are only approximate.

2.2.1 IR SNOs (with MW)

2.2.1.1 Aqua vs. MetOp-A IR Monthly SNO

Short Name	**SPSNI01M**
Long Name	Sounder PEATE Aqua vs. MetOp-A IR Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	150 – 400 MB /pair
Sample Aqua Filename	*SNDR.AQUA.AIRS.20121001.M1.RTP3.xxixmxx.AIR_AMA.SNO_METOPA.standard.v10_0_0.S.131212182541.nc*
Sample MetOp-A Filename	*SNDR.METOPA.IASI.20121001.M1.RTP3.xxixmxb.IAS_AMA_MHS.SNO_AQUA.standard.v10_0_0.S.131212182533.nc*

2.2.1.2 Aqua vs. SNPP IR Monthly SNO

Short Name	**SPSNI02M**
Long Name	Sounder PEATE Aqua vs. SNPP IR Monthly Simultaneous Nadir Observations
Max Matchup Dist	8 km
Max Matchup Time	600 s
File Size (Range)	0.8 – 3 GB /pair
Sample Aqua Filename	*SNDR.AQUA.AIRS.20120901.M1.RTP3.xxixmxx.AIR_AMA.SNO_NPP.standard.v10_0_0.S.131212182519.nc*
Sample SNPP Filename	*SNDR.NPP.CRIS.20120901.M1.RTP3.xxixmxx.CRS_ATT.SNO_AQUA.standard.v10_0_0.S.131212182527.nc*

2.2.1.3 Aqua vs. MetOp-B IR Monthly SNO

Short Name	**SPSNI03M**
Long Name	Sounder PEATE Aqua vs. MetOp-B IR Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	150 – 500 MB /pair
Sample Aqua Filename	*SNDR.AQUA.AIRS.20120401.M1.RTP3.xxixmxx.AIR_AMA.SNO_METOPB.standard.v10_0_0.S.131212182609.nc*
Sample MetOp-B Filename	*SNDR.METOPB.IASI.20120401.M1.RTP3.xxixmxb.IAS_AMA_MHS.SNO_AQUA.standard.v10_0_0.S.131212182552.nc*

2.2.1.4 MetOp-A vs. SNPP IR Monthly SNO

Short Name	**SPSNI04M**
Long Name	Sounder PEATE MetOp-A vs. SNPP IR Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	1 – ? MB/pair
Sample MetOp-A FIlename	*SNDR.METOPA.IASI.20121001.M1.RTP3.xxixmxb.IAS_AMA_MHS.SNO_NPP.standard.v10_0_0.S.131212182533.nc*
Sample SNPP Filename	*SNDR.NPP.CRIS.20121001.M1.RTP3.xxixmxx.CRS_ATT.SNO_METOPA.standard.v10_0_0.S.131212182541.nc*

2.2.1.5 SNPP vs. MetOp-B IR Monthly SNO

Short Name	**SPSNI05M**
Long Name	Sounder PEATE SNPP vs. MetOp-B IR Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	250 – 800 MB /pair
Sample SNPP Filename	*SNDR.NPP.CRIS.20120401.M1.RTP3.xxixmxx.CRS_ATT.SNO_METOPB.standard.v10_0_0.S.131212182609.nc*
Sample MetOp-B Filename	*SNDR.METOPB.IASI.20120401.M1.RTP3.xxixmxb.IAS_AMA_MHS.SNO_NPP.standard.v10_0_0.S.131212182552.nc*

2.2.2 MW SNOs

2.2.2.1 Aqua vs. NOAA-18 MW Monthly SNO

ShortName	**SPSNM01M**
Description	Sounder PEATE Aqua vs. NOAA-18 MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	1.5 – 2.5 MB /pair
Sample Aqua Filename	*SNDR.AQUA.AMSUA.20120901.M1.RTP3.xxxxmxx.AMA.SNO_NOAA18.standard.v10_0_0.S.131212183055.nc*
Sample NOAA-18 Filename	*SNDR.NOAA18.AMSUA.20120901.M1.RTP3.xxxxmxb.AMA_MHS.SNO_AQUA.standard.v10_0_0.S.131212183054.nc*

2.2.2.2 Aqua vs. MetOp-A MW Monthly SNO

Short Name	SPSNM02M
Long Name	Sounder PEATE Aqua vs. MetOp-A MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	1 – 1.5 MB /pair
Sample Aqua Filename	*SNDR.AQUA.AMSUA.20120901.M1.RTP3.xxxxmxx.AMA.SNO_METOPA.standard.v10_0_0.S.131212182831.nc*
Sample MetOp-A Filename	*SNDR.METOPA.AMSUA.20120901.M1.RTP3.xxxxmxb.AMA_MHS.SNO_AQUA.standard.v10_0_0.S.131212182830.nc*

2.2.2.3 Aqua vs. NOAA-19 MW Monthly SNO

Short Name	**SPSNM03M**
Long Name	Sounder PEATE Aqua vs. NOAA-19 MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	25 – 50 MB /pair
Sample Aqua Filename	*SNDR.AQUA.AMSUA.20120901.M1.RTP3.xxxxmxx.AMA.SNO_NOAA19.standard.v10_0_0.S.131212183131.nc*
Sample NOAA-19 Filename	*SNDR.NOAA19.AMSUA.20120901.M1.RTP3.xxxxmxb.AMA_MHS.SNO_AQUA.standard.v10_0_0.S.131212183124.nc*

2.2.2.4 Aqua vs. SNPP TDR MW Monthly SNO

Short Name	**SPSNM04M**
Long Name	Sounder PEATE Aqua vs. SNPP TDR MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	80 – 250 MB /pair
Sample Aqua Filename	*SNDR.AQUA.AMSUA.20120901.M1.RTP3.xxxxmxx.AMA.SNO_ATMS_TDR.standard.v10_0_0.S.131212182740.nc*
Sample SNPP Filename	*SNDR.NPP.ATMS.20120901.M1.RTP3.xxxxmxx.ATT.SNO_AQUA.standard.v10_0_0.S.131212182747.nc*

2.2.2.5 Aqua vs. MetOp-B MW Monthly SNO

Short Name	**SPSNM05M**
Long Name	Sounder PEATE Aqua vs. MetOp-B MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	1 – 2 MB /pair
Sample Aqua FIlename	*SNDR.AQUA.AMSUA.20121101.M1.RTP3.xxxxmxx.AMA.SNO_METOPB.standard.v10_0_0.S.131212183016.nc*
Sample MetOp-B Filename	*SNDR.METOPB.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_AQUA.standard.v10_0_0.S.131212183014.nc*

2.2.2.6 NOAA-18 vs. MetOp-A MW Monthly SNO

Short Name	**SPSNM06M**
Long Name	Sounder PEATE NOAA-18 vs. MetOp-A MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size	1 – 2.5 MB /pair
Sample NOAA-18 Filename	*SNDR.NOAA18.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_METOPA.standard.v10_0_0.S.131212183016.nc*
Sample MetOp-A Filename	*SNDR.METOPA.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_NOAA18.standard.v10_0_0.S.131212183014.nc*

2.2.2.7 NOAA-18 vs. NOAA-19 MW Monthly SNO

Short Name	**SPSNM07M**
Long Name	Sounder PEATE NOAA-18 vs. NOAA-19 MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size	1 MB /pair
Sample NOAA-18 Filename	*SNDR.NOAA18.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_NOAA19.standard.v10_0_0.S.131212183016.nc*
Sample NOAA-19 Filename	*SNDR.NOAA19.AMSUA.20120901.M1.RTP3.xxxxmxb.AMA_MHS.SNO_NOAA18.standard.v10_0_0.S.131212183108.nc*

2.2.2.8 NOAA-18 vs. SNPP TDR MW Monthly SNO

ShortName	**SPSNM08M**
Description	Sounder PEATES NOAA-18 vs. SNPP TDR MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	15 – 20 MB /pair
Sample NOAA-18 Filename	*SNDR.NOAA18.AMSUA.20120901.M1.RTP3.xxxxmxb.AMA_MHS.SNO_ATMS_TDR.standard.v10_0_0.S.131212183054.nc*
Sample SNPP Filename	*SNDR.NPP.ATMS.20120901.M1.RTP3.xxxxmxx.ATT.SNO_NOAA18.standard.v10_0_0.S.131212183055.nc*

2.2.2.9 NOAA-18 vs. MetOp-B MW Monthly SNO

Short Name	**SPSNM09M**
Long Name	Sounder PEATE NOAA-18 vs. MetOp-B MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	1 – 2.5 MB /pair
Sample NOAA-18 Filename	*SNDR.NOAA18.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_METOPB.standard.v10_0_0.S.131212183016.nc*
Sample MetOp-B Filename	*SNDR.METOPB.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_NOAA18.standard.v10_0_0.S.131212183014.nc*

2.2.2.10 MetOp-A vs. NOAA-19 MW Monthly SNO

Short Name	**SPSNM10M**
Long Name	Sounder PEATE MetOp-A vs. NOAA-19 MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	1 – 2.5 MB /pair
Sample MetOp-A Filename	*SNDR.METOPA.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_NOAA19.standard.v10_0_0.S.131212183014.nc*
Sample NOAA-19 Filename	*SNDR.NOAA19.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_METOPA.standard.v10_0_0.S.131212183016.nc*

2.2.2.11 MetOp-A vs. SNPP TDR MW Monthly SNO

Short Name	**SPSNM11M**
Long Name	Sounder PEATE MetOp-A vs. SNPP TDR MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size	1 MB /pair
Sample MetOp-A Filename	*SNDR.METOPA.AMSUA.20120901.M1.RTP3.xxxxmxb.AMA_MHS.SNO_ATMS_TDR.standard.v10_0_0.S.131212182830.nc*
Sample SNPP Filename	*SNDR.NPP.ATMS.20120901.M1.RTP3.xxxxmxx.ATT.SNO_METOPA.standard.v10_0_0.S.131212182831.nc*

2.2.2.12 NOAA-19 vs. SNPP TDR MW Monthly SNO

Short Name	**SPSNM12M**
Long Name	Sounder PEATE NOAA-19 vs. SNPP TDR MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size (Range)	7 – 150 MB /pair
Sample NOAA-19 Filename	*SNDR.NOAA19.AMSUA.20120901.M1.RTP3.xxxxmxb.AMA_MHS.SNO_ATMS_TDR.standard.v10_0_0.S.131212183124.nc*
Sample SNPP Filename	*SNDR.NPP.ATMS.20120901.M1.RTP3.xxxxmxx.ATT.SNO_NOAA19.standard.v10_0_0.S.131212183131.nc*

2.2.2.13 NOAA-19 vs. MetOp-B MW Monthly SNO

Short Name	**SPSNM13M**
Long Name	Sounder PEATE NOAA-19 vs. MetOp-B MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size	1 – 3 MB /pair
Sample NOAA-19 Filename	*SNDR.NOAA19.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_METOPB.standard.v10_0_0.S.131212183016.nc*
Sample MetOp-B Filename	*SNDR.METOPB.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_NOAA19.standard.v10_0_0.S.131212183014.nc*

2.2.2.14 SNPP TDR vs. MetOp-B MW Monthly SNO

Short Name	**SPSNM14M**
Long Name	Sounder PEATE SNPP TDR vs. MetOp-B MW Monthly Simultaneous Nadir Observations
Max Matchup Dist	20 km
Max Matchup Time	600 s
File Size	7 – 20 MB /pair
Sample SNPP Filename	*SNDR.NPP.ATMS.20121101.M1.RTP3.xxxxmxx.ATT.SNO_METOPB.standard.v10_0_0.S.131212183016.nc*
Sample MetOp-B Filename	*SNDR.METOPB.AMSUA.20121101.M1.RTP3.xxxxmxb.AMA_MHS.SNO_ATMS_TDR.standard.v10_0_0.S.131212183014.nc*

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.

Most data fields are contained within the top-level H5 groups IRInst, MWInst, and MWBInst. Which groups are present depend on whether the file contains IR, and whether there is a secondary MW instrument on the platform.

2.4 Key Science Data Fields

2.4.1 Time and Geolocation

Observation times, latitudes and longitudes for each profile are provided for each instrument group in the fields, *time*, *lat* and *lon*. Time is expressed in seconds since an epoch, which is provided in ASCII UTC format in the global attribute, *epoch*. Additional geolocation-related quantities are present depending on the instrument and platform (see tables in Section 3.3).

The fields *matchuptime* and *matchupdistance* report the actual time and distance differences between matched profiles.

2.4.2 Radiance and Antenna Temperatures

IR radiances vs. channel are provided for each profile in the *IRInst* field, *robs*. Center channel wavenumbers are in the profile-independent *IRInst* field, *fchan*. For CrIS, the imaginary spectrum is provided in field *robsimag*.

Uncorrected raw MW antenna temperatures vs. channel are provided for each profile in the *MWInst* and *MWBInst* fields, *btobs*. Center channel frequencies are in profile-independent *MWInst* and *MWBInst* fields, *fchan*.

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
irnchan	Number of infrared channels; IRInst group only
mwba	Number of secondary MW (MWB) scanner footprints along track per primary mw scanner footprint, in MWBInstr group only
mwbnchan	Number of secondary MW (MWB) channel; MWBInstr group only
mwbx	Number of secondary mw scanner footprints cross-track per primary mw scanner footprint; MWBInstr group only
mwnchan	Number of primary MW channels; MWInstr group only
mwnif	Max number of intermediate frequency stages per MW channel
nprof	Number of profiles
nqc	Maximum number of possible quality indicators across all groups
utcMAX	Fixed size of UTC time strings (= 25 including null terminator)

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 **SNO** products. Global attributes in a **SNO** 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 monthly SNO products this corresponds to midnight after the last day of the month
epoch	string	UTC reference time for all time fields that are reported in seconds.
featureType	string	= “point”
geometry	string	A delimited list of dimensions (innermost to outermost) for interpreting nprof as a swath. SNO files are collections of single profiles and the geometry is “1, nprof”.
history	string	Provides an audit trail for modifications to the original data – time ordered list of (executable name, version, variant)
internalcrc	string	Currently not implemented (value is placeholder).
institution	string	Processing facility that produced this file (e.g., “JPL/Caltech Sounder

		PEATE Operations”)
matchupcrclist	string	Currently not implemented (value is placeholder).
platformmatchup	string	Comma delimited NORAD Ids of platforms in matchup
platform	string	= [“npp”, “aqua”, “metop_a”, “metop_b”]
references	string	ATDB and design documents describing processing algorithms. Can be empty.
rtpversion	string	RTP (Radiative Transfer Protocol) File Format Version
source	string	The method of production of the original data, e.g. ECMWF, radiosondes, surface observations; can be empty.
startdatetime	string	Nominal start time of the file in UTC; for monthly SNO products this corresponds to midnight of the first day of the month
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

Fields in Table 3.3-1 appear in all products.

Table 3.3-1 Data fields in root group.

Name	Type	Dimensions	Description	Units
filetype	bitfield	scalar	A bit-mapped summary of groups and subgroups in file. See Table 3.3-2. (Bits 0-6 correspond to fields in pmask in filename in LSB to HSB order).	1
maxmatch updist	float	scalar	Maximum difference in time between matchup footprints.	km
maxmatch uptime	float	scalar	Maximum difference in time between matchup footprints.	s

Table 3.3-2 Bitfield *filetype*.

Bit Offset	Description
0	Contains state data
1	Contains calculated IR radiances
2	Contains observed IR radiances
3	Contains calculated primary MW brightness temperatures
4	Contains observed primary MW brightness temperatures
5	Contains calculated secondary MW brightness temperatures
6	Contains observed secondary MW brightness temperatures
7	Unused
8	Unused
9	Member of matchup pair

3.3.2 Data Fields in IRInst Group

Table Table 3.3-3 describes the data fields in the IRInst group. This group is present in all IR SNOs.

Table 3.3-3 Data fields in IRInst group. Dimension order is outermost to innermost.

Name	Type	Dims	N	A	M	Description	Units
ascflag	int	nprof	y	y	y	Ascending orbit flag: 1 if ascending, 0 descending	1
atrack	int	nprof	y	y	y	1-based along-track index of field of regard from original input file	1
calflag	int	nprof, irnchan	y	y	y	Instrument-dependent per-channel calibration flag (see Sections 3.3.5.3, 3.3.6.2, 3.3.7.3)	1
fchan	float	irnchan	y	y	y	Channel center frequency	cm-1
fcmax	float	scalar	y	y	y	Channel set max frequency	cm-1
fcmin	float	scalar	y	y	y	Channel set min frequency	cm-1
findex	int	nprof	y	y	y	Input file reference: AIRS daily granule number (1-240) or HHMMSS start time of file for IASI/CrIS and NPP	1
ichan	int	irnchan	y	y	y	Channel numbers	1
ifov	int	nprof	y	y	y	1-based field of view index within field of regard	1
instid	int	scalar	y	y	y	Instrument ID of IR Instrument	1
iqcinfo	int	nprof, nqc	y	y	y	Instrument-dependent integer quality info (see Sections 3.3.8.1, 3.3.9.1, 3.3.7.1)	various
landfrac	float	nprof	y	y	y	land fraction; for IASI, approximated by averaging nearest 9 grid boxes of 30 arc sec DEM	1
lat	float	nprof	y	y	y	Observation latitude	degree north
lon	float	nprof	y	y	y	Observation longitude	degree east
matchup dist	float	nprof	y	y	y	Difference in distance between matched footprint pair	km
matchup time	float	nprof	y	y	y	Difference in time between matched footprint pair	s
qcinfo	int	nprof, nqc	y	y	n	Instrument-dependent floating point quality info (see Sections 3.3.5.2, 3.3.7.2)	various

qual	int	nprof	y	y	y	Instrument-dependent overall quality flag (see Sections 3.3.5.4, 3.3.6.3, 3.3.7.4)	1
robs	float	nprof, irnchan	y	y	y	Observed IR radiance	mW m-2 cm sr-1
robsimag	float	nprof, irnchan	y	n	n	Imaginary component of observed IR radiance	mW m-2 cm sr-1
salt	float	nprof	y	y	y	Surface height; for IASI, approximated by averaging nearest 9 grid boxes of 30 arc sec DEM	m
satalt	float	nprof	n	y	y	Satellite altitude	km
satazi	float	nprof	y	y	y	IR azimuth angle	degree
satzen	float	nprof	y	y	y	IR zenith angle	degree
scanang	float	nprof	y	y	y	IR scan angle (for non-Aqua, approximated from sat zen angle)	degree
solazi	float	nprof	y	y	y	Sun azimuth angle	degree
solzen	float	nprof	y	y	y	Sun zenith angle	degree
time	double	nprof	y	y	y	Observation time	s
upwell	int	nprof	y	y	y	Radiation direction (= 1)	1
xtrack	int	nprof	y	y	y	1-based cross-track index of field of regard	1
Column legend: N: Whether field present in SNPP IR SNO files A: Whether field present in Aqua IR SNO files M: Whether field present in MetOp IR SNO files							

Table 3.3-4 Attributes in IRInst group.

Name	Type	Dims	N	A	M	Description	Units
iqcinfo_info_descr	string	scalar	y	y	y	Comma delimited string describing non-fill fields of iqcinfo	1
qcinfo_info_descr	string	scalar	y	y	y	Comma delimited string describing non-fill fields of qcinfo	1
Column legend: N: Whether field present inSNPP IR SNO files A: Whether field present in Aqua IR SNO files M: Whether field present in MetOp IR SNO files							

3.3.3 Data Fields in MWInst Group

Table Table 3.3-5 describes the data fields in the MWInst group. This group contains the spatially nearest MW observation for each profile in IRInst. This group is present in all SNOs.

Table 3.3-5 Data fields in MWInst group. Dimension order is outermost to innermost.

Name	Type	Dims	N	A	M	Description	Units
ascflag	int	nprof	y	y	y	Ascending orbit flag, 1 if ascending, 0 descending	1
atrack	int	nprof	y	y	y	1-based along-track index of observation from original input file	1
btobs	float	nprof, mwnchan	y	y	y	Observed MW scene antenna temperatures	K
calflag	int	nprof, mwnchan	y	y	y	Instrument-dependent per-channel calibration flag (see Sections 3.3.8.3, 3.3.9.2, 3.3.10.2)	1

fchan	float	mwnchan	y	y	y	MW channel frequencies	GHz
findex	int	nprof	y	y	y	Input file reference: AIRS daily granule number (1-240) or HHMMSS start time of file for IASI/CrIS and NPP	1
ifchan	float	mwnchan, mwnif	y	y	y	Frequency offset of ith intermediate frequency stage	GHz
instid	int	scalar	y	y	y	Instrument ID of MW Instrument	1
iqcinfo	int	nprof, nqc	y	y	y	Instrument-dependent integer quality info (see Sections 3.3.8.1, 3.3.9.1, 3.3.10.2)	various
landfrac	float	nprof	y	y	y	land fraction; for IASI, approximated by averaging nearest 9 grid boxes of 30 arc sec DEM	1
lat	float	nprof	y	y	y	Observation latitude	degree north
lon	float	nprof	y	y	y	Observation longitude	degree east
matchup dist	float	nprof	y	y	y	Difference in distance between matched footprint pair (MW SNOs only)	km
matchup time	float	nprof	y	y	y	Difference in time between matched footprint pair (MW SNOs only)	s
qcinfo	int	nprof, nqc	n	y	n	Instrument-dependent floating point quality info (see Section 3.3.8.2)	various
qual	int	nprof	y	y	y	Instrument-dependent overall quality flag (see Sections 3.3.5.4, 3.3.9.3, 3.3.10.3)	1
salt	float	nprof	y	y	y	Surface height; for MetOp/NOAA, approximated by averaging nearest 9 grid boxes of 30 arc sec DEM	m
satalt	float	nprof	n	y	n	Satellite altitude	km
satazi	float	nprof	y	y	y	MW azimuth angle	degree
satzen	float	nprof	y	y	y	MW zenith angle	degree
scanang	float	nprof	y	y	y	MW scan angle (for non- Aqua, approximated from sat zen angle)	degree
solazi	float	nprof	y	y	n	Sun azimuth angle	degree
solzen	float	nprof	y	y	n	Sun zenith angle	degree
time	double	nprof	y	y	y	Observation time	s
upwell	int	nprof	y	y	y	Radiation direction (= 1)	1
xtrack	int	nprof	y	y	y	1-based cross-track index of field of regard	1
Column legend: N: Whether field present in SNPP MW SNO files A: Whether field present in Aqua MW SNO files M: Whether field present in MetOp/NOAA MW SNO files							

Table 3.3-6 Attributes in MWInst group.

Name	Type	Dims	N	A	M	Description	Units
iqcinfo_info_descr	string	scalar	y	y	y	Comma delimited string describing non-fill fields of iqcinfo	1
qcinfo_info_descr	string	scalar	y	y	y	Comma delimited string describing non-fill fields of qcinfo	1
Column legend: N: Whether field present inSNPP IR SNO files A: Whether field present in Aqua IR SNO files M: Whether field present in MetOp IR SNO files							

3.3.4 Data Fields in MWBInst Group

Table 3.3-7 describes the data fields in the MWBInst group. The center observation of each 3x3 spatial array is the MWBInst observation spatially nearest to the center of the corresponding MWInst profile. The other eight observations are the surrounding MWBInst observations (based on atrack, xtrack). This group is present in MetOp/NOAA SNOs only (it is omitted in Aqua files due to early mission HSB failure).

Table 3.3-7 Data fields in MWBInst group. Dimension order is outermost to innermost.

Name	Type	Dims	N	A	M	Description	Units
ascflag	int	nprof, mwba, mwbx	n	n	y	Ascending orbit flag, 1 if ascending, 0 descending	1
atrack	int	nprof, mwba, mwbx	n	n	y	1-based along-track index of observation from original input file	1
btobs	float	nprof, mwba, mwbx, mwbnchan	n	n	y	Observed MWB scene antenna temperatures	K
calflag	int	nprof, mwba, mwbx, mwbnchan	n	n	y	Instrument-dependent per-channel calibration flag (see Section 3.3.9.2)	1
fchan	float	mwbnchan	n	n	y	MWB channel frequencies	GHz
findex	int	nprof, mwba, mwbx	n	n	y	Input file reference: AIRS daily granule number (1-240) or HHMMSS start time of file for IASI/CrIS and NPP	1
ifchan	float	mwbnchan, mwnif	n	n	y	Frequency offset of ith intermediate frequency stage	GHz
instid	int	scalar	n	n	y	Instrument ID of MWB Instrument	1
iqcinfo	int	nprof, nqc	n	n	y	Instrument-dependent integer quality info (see Section 3.3.9.1)	various
landfrac	float	nprof, mwba, mwbx	n	n	y	Land fraction; for MetOp/NOAA, approximated by averaging nearest 9 grid boxes of 30 arc sec DEM	1
lat	float	nprof, mwba, mwbx	n	n	y	Observation latitude	degree north
lon	float	nprof, mwba, mwbx	n	n	y	Observation longitude	degree east
qual	int	nprof mwba, mwbx	n	n	y	Instrument-dependent overall quality flag (see Section 3.3.9.3)	1
salt	float	nprof, mwba, mwbx	n	n	y	Surface height; for MetOp/NOAA, approximated by averaging nearest 9 grid boxes of 30 arc sec DEM	m

satazi	float	nprof, mwba, mwbx	n	n	y	MWB azimuth angle	degree
satzen	float	nprof, mwba, mwbx	n	n	y	MWB zenith angle	degree
scanang	float	nprof, mwba, mwbx	n	n	y	MW scan angle (approximated from sat zen angle)	degree
time	double	nprof, mwba, mwbx	n	n	y	Observation time	s
upwell	int	nprof, mwba, mwbx	n	n	y	Radiation direction (= 1)	1
xtrack	int	nprof, mwba, mwbx	n	n	y	1-based cross-track index of field of regard	1
Column legend: N: Whether field present inSNPP MW SNO files A: Whether field present in Aqua MW SNO files M: Whether field present in MetOp/NOAA MW SNO files							

Table 3.3-8 Attributes in MWBInst group.

Name	Type	Dims	N	A	M	Description	Units
iqcinfo_info_descr	string	scalar	n	n	y	Comma delimited string describing non-fill fields of iqcinfo	1
qcinfo_info_descr	string	scalar	n	n	y	Comma delimited string describing non-fill fields of qcinfo	1
Column legend: N: Whether field present in SNPP MW SNO files A: Whether field present in Aqua MW SNO files M: Whether field present in MetOp MW SNO files							

3.3.5 Aqua AIRS IR Data Quality Assurance (QA) Indicators

All users of AIRS data are strongly encouraged to read the "AIRS/AMSU/HSB Version 5 Level L1B QA Quick Start" documentation.

3.3.5.1 AIRS iqcinfo Array

Inner Index	Description	Units
1	State [0:Process, 1:Special, 2:Erroneous, and 3: Missing]	1
2	SceneInhomogeneous	1
3	dust_flag	1
4	dust_score	1
5	spectral_clear_indicator	1
6-20	_FillValue	1

3.3.5.2 AIRS qcinfo Array

Inner Index	Description	Units
1	sun_glint_distance	km
2	Rdiff_swindow	mW m-2 cm sr-1
3	Rdiff_lwindow	mW m-2 cm sr-1
4	BT_diff_SO2	K
5-20	_FillValue	1

3.3.5.3 AIRS calflag Bitfield

Bit Offset	Description
0	cold scene noise
1	telemetry out of limit condition
2	n/a (zeroed out from AIRS calflag)
3	n/a (zeroed out from AIRS calflag)
4	pop detected
5	gain bad
6	offset bad
7	scene over/underflow
8	ExcludedChans > 2
9	ExcludedChans > 5

3.3.5.4 AIRS qual Bitfield

Bit Offset	Description
0	latitude is out of [-90, 90] or longitude is out of [-180, 360]
1	state is not ==0

3.3.6 MetOp IASI Data Quality Assurance (QA) Indicators

3.3.6.1 IASI iqcinfo Array

Inner Index	Description	Units
1	GQisFlagQual	1
2	GQisFlagQualDetailed (IASI Version 5 or later)	1
3	GEUMAvhrr1BCldFrac (IASI Version 5 or later)	%
4	GEUMAvhrr1BLandFrac (IASI Version 5 or later)	%
5-20	_FillValue	1

3.3.6.2 IASI calflag

Prior to IASI Version 5: always 0.

IASI Version 5 and later: calflag set from IASI GQisQualFlag[1:3] spread out over the band, i.e.,
calflag[1:2260] = GQisQualFlag[1]
calflag[2261:5740] = GQisQualFlag[2]
calflag[5741:8461] = GQisQualFlag[3]

3.3.6.3 IASI qual field

Bit Offset	Description
0	latitude is out of [-90, 90] or longitude is out of [-180, 360]
1	GQisFlagQual is not ==0

3.3.7 SNPP CrIS Data Quality Assurance (QA) Indicators

IR Quality fields are qcinfo and iqcinfo, calflag and qual.

3.3.7.1 CriS iqcinfo Array

Each RTP3 profile maps to 1 input [FOV, FOR, scanline].

Inner Index	Description	Units
1	QF1_SCAN_CRISSDR	1
2	QF2_CRISSDR[1]	1
3	QF2_CRISSDR[2]	1
4	QF2_CRISSDR[3]	1
5	QF3_CRISSDR[1]	1
6	QF3_CRISSDR[2]	1
7	QF3_CRISSDR[3]	1
8	QF4_CRISSDR[1]	1
9	QF4_CRISSDR[2]	1
10	QF4_CRISSDR[3]	1
11	QF1_CRISSDRGEO	1
12-20	_FillValue	1

3.3.7.2 CriS qcinfo Array

Inner Index	Description	Units
1	max(abs(ES_ImaginaryLW)) using only those elements of ES_Imaginary_LW with frequency in [800.0, 980.0] cm-1	mW m-2 cm sr-1
2	max(abs(ES_ImaginaryMW)) using only those elements of ES_Imaginary_MW with frequency in [1500.0, 1700.0] cm-1	mW m-2 cm sr-1
3	max(abs(ES_ImaginarySW)) using only those elements of ES_Imaginary_SW with frequency in [2250.0, 2350.0] cm-1	mW m-2 cm sr-1
4	stddev(ES_ImaginaryLW)	mW m-2 cm sr-1
5	stddev(ES_ImaginaryMW)	mW m-2 cm sr-1
6	stddev(ES_ImaginarySW)	mW m-2 cm sr-1
7	the element of ES_RealLW with frequency = 900.0 cm-1	mW m-2 cm sr-1
8	the element of ES_ImaginaryLW with frequency = 900.0 cm-1	mW m-2 cm sr-1
9	the element of ES_RealMW with frequency = 1232.5 cm-1	mW m-2 cm sr-1
10	the element of ES_ImaginaryMW with frequency = 1232.5 cm-1	mW m-2 cm sr-1
11	the element of ES_RealSW with frequency = 2507.5 cm-1	mW m-2 cm sr-1
12	the element of ES_ImaginarySW with frequency = 2507.5 cm-1	mW m-2 cm sr-1
13-20	_FillValue	1

3.3.7.3 CriS calflag

1 for all LW channels if qcinfo[1] > 1.5 mW m-2 cm sr-1

1 for all MW channels if qcinfo[2] > 0.5 mW m-2 cm sr-1

1 for all SW channels if qcinfo[3] > 0.05 mW m-2 cm sr-1

3.3.7.4 CriS qual Bitfield

Bit Offset	Description
0	latitude is out of [-90, 90] or longitude is out of [-180, 360]
1	if any of the following conditions are true. 1) ES_RealLW(900.0cm-1) is equal to exactly 0.0 2) ES_RealMW(1232.5cm-1) is equal to exactly 0.0 3) ES_RealSW(2507.5cm-1) is equal to exactly 0.0 4) ES_ImaginaryLW(900.0cm-1) is less than -100.0 5) ES_ImaginaryMW(1232.5cm-1) is less than -100.0 6) ES_ImaginarySW(2507.5cm-1) is less than -100.0

3.3.8 AIRS MW Data Quality Assurance (QA) Indicators

3.3.8.1 AIRS MW iqcinfo Array

Inner Index	Description	Units
1	qa_receiver_a11	1
2	qa_receiver_a12	1
3	qa_receiver_a2	1
4	qa_scanline	1
5-20	_FillValue	1

3.3.8.2 AIRS MW qcinfo Array

Inner Index	Description	Units
1	sun_glint_distance	km
2-20	_FillValue	1

3.3.8.3 AIRS MW calflag Bitfield

Bit Offset	Description
0	All space view counts were bad for this channel and scanline
1	Space view counts were marginal for this channel and scanline
2	Space view counts could not be smoothed
3	All blackbody counts were bad for this channel and scanline
4	Blackbody counts were marginal for this channel and scanline
5	Blackbody counts could not be smoothed
6	Most recent calibration coefficients used
7	n/a (zeroed out from AIRS MW calflag)

3.3.8.4 AIRS MW qual Bitfield

Bit Offset	Description
0	latitude is out of [-90, 90] or longitude is out of [-180, 360]
1	neither of {state1, state2} are zero

3.3.9 MetOp/NOAA MW Data Quality Assurance (QA) Indicators

3.3.9.1 MetOp/NOAA iqcinfo Array

Inner Index	Description	Units
1	Scan Line Quality Flags	1
2	Quality Indicator Bit Field	1
3	Instrument Status A1	1
4	Instrument Status A2	1
5-20	_FillValue	1

3.3.9.2 MetOp/NOAA calflag

Set to Calibration Quality Flag.

3.3.9.3 MetOp/NOAA qual Bitfield

Bit Offset	Description
0	latitude is out of [-90, 90] or longitude is out of [-180, 360]
1	Quality Indicator Bit Field is not == 0

3.3.10 SNPP ATMS Data Quality Assurance (QA) Indicators

3.3.10.1 ATMS TDR iqcinfo Array

Inner Index	Description	Units
1	InstrumentMode	1
2	QF19_SCAN_ATMSSDR	1
3-20	_FillValue	1

3.3.10.2 ATMS calflag

The ATMS calflag is zero unless BrightnessTemperature raw integer value >= 65528; then 1.

3.3.10.3 ATMS qual Bitfield

Bit Offset	Description
0	latitude is out of [-90, 90] or longitude is out of [-180, 360]
1	QF19_SCAN_ATMSSDR is not zero

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 viewed 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:

NPP: http://npp.gsfc.nasa.gov/documents.html

AIRS: http://disc.sci.gsfc.nasa.gov/AIRS/documentation/

IASI: http://oiswww.eumetsat.org/WEBOPS/eps-pg/IASI-L1/IASIL1-PG-0TOC.htm

NOAA KLM: http://www.ncdc.noaa.gov/oa/pod-guide/ncdc/docs/intro.htm

7 Acknowledgements

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8 References

- AIRS (Aqua):
  ftp://airsl1.gesdisc.eosdis.nasa.gov/ftp/data/s4pa/Aqua_AIRS_Level1/AIRIBRAD.005/doc/README.AIRIBRAD.pdf

- AMSU-A (including Aqua, NOAA-18, NOAA-19, and MetOP-A/B):
  http://airsl1.gesdisc.eosdis.nasa.gov/Aqua_AIRS_Level1/AIRABRAD.005/doc/README.AIRABRAD.pdf. Note: the referenced document pertains to AMSU-A on Aqua, but generally describes all AMSU-A data.)

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

- IASI (MetOP-A/B):
  IASI data are obtained via CLASS from EUMETSAT. The product guide can be found at:
  http://oiswww.eumetsat.org/WEBOPS/eps-pg/IASI-L1/IASIL1-PG-6ProdFormDis.htm

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

- MHS (NOAA-18, NOAA-19, and MetOP-A/B):
  http://www.ncdc.noaa.gov/oa/pod-guide/ncdc/docs/klm/html/c3/sec3-9.htm