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NASA Aqua AIRS and SNPP CrIS Calibration Subset Level 1 Data Product User Guide: File Format and Definition

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1 Introduction

This document provides basic information for using Calibration Subset (CalSub) products produced by the Aqua Atmospheric InfraRed Spectrometer (AIRS) project and the Suomi-National Polar-orbiting Partnership (S-NPP) Sounder Science Investigator-led Processing System (SIPS).

1.1 Mission Instrument Description

The tables below present summaries of select instrument and platform parameters. Calibration subset products are produced for S-NPP and Aqua-AIRS.

Platform	Instrument	Instrument Type	Scan Rate (sec)	Scan Range (deg)	Scan Pattern	Spectral Channels
S-NPP	CrIS	IR (FTS)	8	+/- 50	30 x 3 x 3	1305*
	ATMS	MW	8/3	+/- 53	96	22
Aqua	AIRS	IR (Grating)	8/3	+/- 50	90	2378
	AMSU-A	MW	8	+/- 50	30	15

Table 1.1-1. Instrument parameters; First dimension of the above scan patterns reflects the field-of-regard (for) along the scan direction. *This is for CrIS NSR. A future FSR product will be produced. CrIS NSR additionally reports 12 unusable “guard” channels (2 on each band edge).

Platform	NORAD Id	Alt (km)	Orbit Incl. (deg)	Over Flight Time	Period (min)	Repeat Orbits	Repeat Days	Launch
S-NPP	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

Table 1.1-2. Approximate orbital parameters.

CalSub Input	Input Files	Input Granularity	Format	Data Source	Version ID
S-NPP IR	CrIS L1B NSR	6 min	netCDF	GES DISC	Collection 2
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
	AIRS HSB L1B*				
CMC GHR_SST	1-deg	daily	netCDF	PODAAC	n/a

Table 1.2-1. *AIRS HSB ceased operations in February 2003.

1.2 Algorithm Background

1.2.1 Overview

Infrared temperature sounders generate a large amount of data. For example, the AIRS instrument with 2378 channels, its visible light component and AMSU with 15 channels create 3x240 files of calibrated radiances (Level-1B) each day, for a total of over 500 MB of data. The data volume per day from CrIS SNPP is similar to that of AIRS, but the calibrated radiances have already been subject to various corrections based on upwelling radiances. For AIRS there is a separate Level-1C product which makes corrections based on upwelling radiances.

The purpose of the Calibration Data Subsets is extract key information from these data into a few daily files to:

1. Facilitate a quick evaluation of the absolute calibration of the instruments.
2. Facilitate an assessment of the instrument performance under clear, cloudy, and extreme hot and cold conditions.
3. Facilitate the evaluation of instrument trends and their significance relative to potential climate trends.
4. Facilitate the comparison of AIRS with CrIS using their equivalent data subsets.

The output files are constructed from Level-1B or Level-1C IR and MW brightness or antenna temperatures. Each file contains selected observations taken from a nominal 24-hour period. The reduction in the number of files provides for much faster processing of years of data.

For each platform two daily files are produced, supporting different classes of analyses.

- 1) The “summary” product includes a large set of cases of interest, including all identified spectra that match selection criteria detailed below for clear, special cloud classes, etc. These amount to about 10% of all spectra. But for each selected case only brightness temperatures (BTs) for ~150 selected key channels are saved.
- 2) The “random” product includes only a random subset of cases, but includes full spectra in radiance units for each selected spectrum. This product flags the included cases that meet the other selection criteria but does not include them unless they also are chosen randomly. These spectra amount to ~1.5% of all observed spectra and are selected to be globally representative.

The key algorithms select which observed spectra to include. They are:

- Clear
- Special Calibration sites
- Cold clouds
- Random nadir
- Hottest in granule
- Uniform clouds
- Random full-swath
- Fire
- Hotter than 335 K

The reasons for collecting each type and the general approach are listed in the subsections below. See the Algorithm Theoretical Basis Document (ATBD), Ref(1), for technical details of each algorithm.

Version 2.52 of the Calsub products use *algorithm_version* 5c6 for AIRS and 5c8 for CrIS.

The “*reason*” and “*site_id*” variables in the “*select*” group specify which criteria each included observation matches.

Reason is a bit flag giving all the conditions a spectrum matches. Table 1.2.1-1 lists the meaning of each bit. Because *reason* is a bitflag it can show all applicable reason codes, but *site_id* only has a single value and so shouldn’t be depended on except for calibration sites.

Table 1.2.1-1: reason bit values

<i>reason</i> Bit Value	Meaning	Section	<i>calsite_id</i>
1	Clear	1.2.2	0, -1, -2, 98
2	Calibration site	1.2.3	1-30
4	Cold cloud	1.2.4	99
8	Random nadir	1.2.5	88
16	Hottest in granule	1.2.6	97
32	(Not used)		
64	Uniform Cloud (ocean only)	1.2.7	96
128	Random Full-swath	1.2.5	88
256	Fire	1.2.8	79
512	Hotter than 335 K	1.2.9	78

See ATBD, Ref(1), for details of the random selection algorithm.

1.2.2 Clear Selection

Clear footprint subsets are used to compare and trend surface conditions and instrument performance under warm conditions.

There are different kinds of clear tests, which can be distinguished using the *calsite_id* field. These include spatial coherence test (SCT, *calsite_id*=0), forecast clear, and pseudo-lapse rate (PLR). PLR clear sets *calsite_id* to 98, -1, or -2 for ocean, non-frozen land, and frozen surfaces respectively.

ATBD, Ref(1), section 4.1. discusses the details and limitations of the algorithms used to identify clear footprints.

1.2.3 Special Calibration Sites

Spectra near a variety of special calibration sites are saved in the summary product. These are locations for which correlative data is available or places that are of particular interest for their extreme conditions.

Table 1.2.3-1 contains key information about these sites. Each site has a central latitude and longitude and also a max difference in latitude and longitude to be considered a match. The sites at Lake Qinghai and Lake Titicaca are also constrained to exclude very high elevations. The information in this table is also available in the “*select*” group of each file.

Table 1.2.3-1. Calibration site specification.

<i>calsite_id</i>	<i>calsite_name</i>	<i>calsite_lat</i>	<i>calsite_lon</i>	<i>calsite_dlat</i>	<i>calsite_dlon</i>	<i>calsite_addl_cond</i>	<i>calsite_notes</i>
1	Egypt-1 test site	27.12	26.1	0.5	0.56	NA	NA
2	Simpson Desert	-24.5	137	0.5	0.55	NA	NA
3	Dome Concordia	-75.12	123.37	0.5	1.95	NA	3200 meter elevaton
4	Mitu	1.5	290.5	1	1	NA	Colombia/Brazil Tropical Forest
5	Boumba	3.5	14.5	1	1	NA	S.E. Cameroon Tropical Forest
6	Sonoran Desert	32.25	245.35	0.5	0.59	NA	NA
7	ARM SGP	36.62	262.5	1	1.25	NA	NA
8	ARM TWP Manus	-2.006	147.425	0.5	0.5	NA	NA
9	ARM TWP Nauru	-0.521	166.916	0.5	0.5	NA	NA
10	N.Pole	89	173	0.5	28.65	NA	NA
11	S.Pole	-89	183	0.5	28.65	NA	NA
12	Surgut	61.15	73.37	1	2.07	NA	Siberian tundra
13	Hunan	23.9	100.5	0.5	0.55	NA	Rainforest
14	ARM NSA Barrow	71.32	203.34	0.5	1.56	NA	Alaska
15	ARM NSA Atqasuk	70.32	203.33	0.5	1.48	NA	NA
16	ARM TWP Darwin	-12.425	130.891	0.5	0.51	NA	TWP Darwin

17	Lake Qinhai	36.75	100.33	2	2.5	elev < 3300	3196 meter elevation (water)
18	Dunhuang	40.17	94.33	0.5	0.65	NA	Gobi Desert 3176 meter elevation
19	Lake Titicaca	-15.88	290.67	2	2.08	elev < 3900	3800 meter elevation (water)
20	Lake Tahoe	39.1	240	0.5	0.64	NA	NA
21	Toolik Alaska	68.6	210.4	0.5	1.37	NA	NA
22	Park Falls, WI Tower	45.94	269.73	0.5	0.72	NA	Tower
23	Brenham, TX	30.1592	263.6079	0.5	0.58	NA	NA
24	Crosbyton, TX	33.6571	258.75495	0.5	0.6	NA	NA
25	Beltsville, MD	39.05	283.13	0.5	0.64	NA	NA
26	Pacific Missile Range	22.02	200.21	0.5	0.54	NA	W. Kauai
27	Railroad Valley	38.5011	244.3084	0.5	0.6	NA	NA
28	Edwards AFB	34.9	242.1	0.5	0.6	NA	NA
29	Channel Islands	33	242	0.5	0.6	NA	NA
30	ARM Eastern North Atlantic	39.1	332	0.5	0.64	NA	NA

Some other types of observations are also tagged with special values in the variable “calsite_id”. These are listed in Table 1.2.4-2.

Table 1.2.4-2 Other calsite_ids

calsite_id	calsite_name
-2	frozen surfaces clear spectra
-1	clear non-frozen land spectra
0	clear non-frozen ocean spectra
78	BT900 or BT1231 over 335K
79	Fire or extreme desert
88	randomly selected spectra
96	uniform cloud
97	hottest spectrum in each granule
98	pseudo lapse rate clear non-frozen ocean spectra
99	cold cloud spectra

1.2.4 Cold Clouds

Cold clouds are useful for probing instrument performance at cold scene temperatures. Deep Convective Clouds (DCCs) and overshooting DCCs can be selected from among these by various additional filters. Appendix C has sample code in Matlab for AIRS using cold clouds.

See ATBD, Ref(1), section 4.2.4 for details of the cold cloud selection algorithm.

1.2.5 Random Selection

The random spectra selection supports climate applications of IR data. Each day AIRS and CrIS each produce three million spectra which are saved in 240 6-minute granule files. Due to the nature of the polar orbits, the high latitudes are oversampled. The CalSub Random data sets create a much smaller daily samples, which sample the globe uniformly by selecting a smaller proportion of polar observations.

There are two variations of the random selection. The Random Nadir Spectra (RNS) selects only footprints within 3.3 degrees of nadir, while Random Full-Swath Spectra (RFS) samples all scan angles.

The summary product file type contains only spectra which meet the RFS criterion, while the summary product contains key BTs for all observations meeting all criteria.

1.2.6 Hot scenes

The hottest scenes in each granule were initially selected for engineering analysis, but also have potential climate applications.

See ATBD, Ref(1), section 4.4 for details of the hot scene selection algorithm.

1.2.7 Uniform Clouds

Uniform clouds which are probably stratus between 1 and 2 km altitude are flagged.

See ATBD, Ref(1), section 4.2.3 for details of the uniform cloud selection algorithm.

1.2.8 Fires

Fires as seen by AIRS and CrIS present the opportunity to evaluate spatial response differences. Only very large night land fires are detected with a 15 km footprint. This is not to be confused with a MODIS or VIIRS type fire detection, but may facilitate the examination of spectra for minor gases and aromatics.

See ATBD, Ref(1), section 4.5 for details of the fire scene selection algorithm.

1.2.9 Over 335 K

Scenes where the brightness temperature at 1231 or 901 cm^{-1} exceeds 335 K are saved. They are of interest from an engineering viewpoint, and possibly for climate change evaluations.

1.3 Data Disclaimer

Version 2 CalSub AIRS and CrIS Level-1 data are released to the public as is. Every effort has been made to properly represent the data which this document describes.

All users are encouraged to read the appropriate documentation listed in the references related to these data products to further understand the contents.

1.3.1 Contact Information

For information, questions or concerns with any of the CalSub Level-1 products, please send to: sounder.sips@jpl.nasa.gov or submit questions to: <https://airs.jpl.nasa.gov/data/support/ask-airs>

For information, questions or concerns with dataset completeness or downloading issues, please send to: gsfc-dl-help-disc@mail.nasa.gov

2 Data Organization

Each CalSub file contains data subsetted for one or more “reasons” for one day. Each file consists of a sequence of spectra, with each profile describing a single observation.

File contents differ depending on the type of data in the file. This is described in more detail in Section 3.0.

2.1 File Naming Convention

File naming for Sounder SIPS products will be unique and include the following tokens separated by the delimiter ‘.’

Each token that makes up the filename is also in the global attributes of the data file.

```
<product_name_project>
<product_name_platform>
<product_name_instr>
<gran_id>
<product_name_duration>
<product_type_name_id>
<product_name_variant>
<product_name_version>
<product_name_producer>
<product_name_timestamp>
<extension>
```

Where:

- product_name_project = SNDR
- product_name_platform = SNPP, AQUA
- product_name_instr = CrIS, AIRS
- gran_id nominal start time where:
 - yyyy = year
 - mm = month of year (01-12)
 - dd = day of month (01-31)
- product_name_duration = D01 or M01 (1 day or 1 month)
- product_type_name_id =
 - L1B_CALSUB_SUM_NSR for CalSub summary products derived from S-NPP CrIS normal spectral resolution (NSR)
 - L1B_CALSUB_NSR for CalSub products derived from S-NPP CrIS normal spectral resolution (NSR)
 - L1B_CALSUB_SUM for CalSub summary products derived from Aqua AIRS
 - L1C_CALSUB for CalSub products derived from Aqua AIRS
- product_name_variant = std
- product_name_version (vmm_mm) - eg. v02_52
 - Versioning will be synchronized across Sounder SIPS products
- product_name_producer = G: Operations
- product_name_timestamp (yymmddhhmmss) - 210428082042
- Extension (.nc)

Example Filename: CalSub S-NPP and Aqua AIRS products:

```
SNDR.AQUA.AIRS.20190302.D01.L1B_CALSUB_SUM.std.v02_52.G.210428073320.nc
SNDR.AQUA.AIRS.20190302.D01.L1C_CALSUB.std.v02_52.G.210428073320.nc
SNDR.SNPP.CRIS.20190302.D01.L1B_CALSUB_SUM_NSR.std.v02_52.G.210428082042.nc
SNDR.SNPP.CRIS.20190302.D01.L1B_CALSUB_NSR.std.v02_52.G.210428082042.nc
```

3.2 Time Representation

Observation times are provided in both UTC (*obs_time_utc*) and TAI93 (*obs_time_tai93*) representations as a convenience to users.

Coordinated Universal Time (UTC) is the international standard for representation of time. UTC times are expressed in human-readable form, as a set of values indicating year, month, day, hour and so on. In the data stream received from the satellite, observation times are represented as UTC.

Timestamps in product filenames and attributes are represented as UTC and formatted according to the “ISO 8601:2004” standard. For example, the time January 25, 2016 at 13:00 may be represented as either of the following:

2016-01-25T13:00Z
20160125T1300

The longer form is used in attributes, and the more compact form is used in filenames. The character “Z” indicates “Zulu time”, or UTC.

International Atomic Time (TAI) is expressed as number of seconds elapsed on the surface of the Earth since some reference UTC time. The term “TAI93” indicates that the reference time is the beginning of the year 1993, or 1993-01-01T00:00:00Z. This reference time was chosen to be consistent with data products from other instruments, and to allow for precise representation of times spanning the expected mission length.

Each Calsub product file nominally covers 24 hours of one day UTC, but the details will vary. They actually cover granules 1-240 of a given platform’s Level-1 files, which can extend outside of the nominal day. There might also not be observations from the very beginning or end of the nominal interval. For more precise time info look at the *obs_time_** variables for per-obs info or the global attributes *time_of_first_valid_obs* and *time_of_last_valid_obs*.

2.3 CalSub Product Files

CalSub subtypes and example filenames are given below.

2.3.1 Aqua CalSub

The Aqua AIRS summary subset contains Level-1B BTs for all selection types but only for selected channels, while the Aqua AIRS random calibration subset contains full Level-1C spectra for only the randomly selected observations. Level-1B is less processed and so supports investigation of instrument artifacts, while Level-1C is more suitable for wider use.

2.3.1.1 Aqua AIRS Random Calibration Subset

Short Name	SNDRAQIML1CCALSUBRND
Long Name	Sounder SIPS: Aqua AIRS Level-1C Calibration Subset: Random Full Spectra
Sample Filename	SNDR.AQUA.AIRS.20160114.D01.L1C_CALSUB.std.v02_52_01.G.211111085949.nc

2.3.1.2 Aqua AIRS Summary Calibration Subset

Short Name	SNDRAQIML1BCALSUBSUM
Long Name	Sounder SIPS: Aqua AIRS Level-1B Calibration Subset: Summary
Sample Filename	SNDR.AQUA.AIRS.20160114.D01.L1B_CALSUB_SUM.std.v02_52_01.G.211111085949.nc

2.3.2 S-NPP CalSub

The S-NPP CrIS summary subset contains Level-1B BTs for all selection types but only for selected channels, while the S-NPP CrIS random calibration subset contains full Level-1B spectra for only the randomly selected observations.

2.3.2.1 S-NPP CrIS Random Calibration Subset

Short Name	SNDRSNIL1BCALSUBRND
Long Name	Sounder SIPS: Suomi NPP CrIS Level-1B Calibration Subset NSR: Random Full Spectra
Sample Filename	SNDR.SNPP.CRIS.20160114.D01.L1B_CALSUB_NSR.std.v02_52_01.G.211111090637.nc

2.3.2.2 S-NPP CrIS Summary Calibration Subset

Short Name	SNDRSNIL1BCALSUBSUMN
Long Name	Sounder SIPS: Suomi NPP CrIS Level-1B Calibration Subset: Summary
Sample Filename	SNDR.SNPP.CRIS.20160114.D01.L1B_CALSUB_SUM_NSR.std.v02_52_01.G.211111090637.nc

2.4 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 will also operate on NetCDF files.

2.4.1 Group Structure

CalSub files are organized using netCDF4 groups with no data included in the root group. There are three classes of groups: select, instrument observations, and input granule info.

Each CalSub file has one “*select*” group giving information about the selection of each observation. “*reason*” and “*site_id*” tell which algorithm or algorithms caused the selection, while other fields give lat/lon/time, distance from cal site, and external info about the surface temperature. In addition, the “*calsite_**” info shown in tables 1.2.4-* is contained here.

Instrument observation groups contain parallel per-observation info from the IR and MW instruments. For S-NPP “*Ulb_cris*” is the only instrument observation group, but for Aqua there is “*Ulb_amsua*” and “*Ulb_airs*” for the summary file or “*Ulc_airs*” for the random file. In the instrument groups there are the actual observations with a variety of geolocation info and quality and indexing info.

Input granule groups have per-granule info for each instrument. For S-NPP “*Ulb_cris_ingran*” is the only instrument observation group, but for Aqua there is “*Ulb_amsua_ingran*” and “*Ulb_airs_ingran*” for the summary file or “*Ulc_airs_ingran*” for the random file. These groups always include identifying information like the file names and locations, and for the IR instruments also contain a number of per-granule statistics.

2.5 Key Dimensions

The most important dimension is *obs*. This is the key observation dimension guaranteed to be common across the groups that contain it in a given file. It counts the observations collected in time order.

The *ingran* groups have a primary dimension *gran*, counting granules. It will be 240 for complete days but can be smaller when Level-1 data was not available for the entire day for some reason.

2.6 Key Science Data Fields

2.6.1 Time and Geolocation

Observation times, latitudes and longitudes for each spectrum are provided for each instrument group in the fields, *obs_time_tai93/obs_time_utc*, *lat* and *lon*. Many additional geolocation-related quantities are present, including FOV boundary polygons, solar and spacecraft view angles, etc.

2.6.2 CrIS full-spectrum observations

For the CrIS SNPP random CalSub product the IR obs are provided in the *l1b_cris* group in variables *rad_lw*, *rad_mw*, and *rad_sw* similarly to how they are in CrIS L1B granule files. There are parallel *rad_*w_qc* variables in the *l1b_cris* group and the *l1b_cris_ingran* group contains the wavenumbers in *wnum_*w* arrays and noise levels per granule and FOV number in *nedn_*w*.

2.6.3 CrIS summary observations

For the SNPP summary CalSub product IR BT observations are provided in the *l1b_cris* group in variable *brightness_temp* for 115 select channels. Per-band QC is provided in *brightness_temp_*w_qc* arrays. The channels are listed in the *wnum* variable.

The *l1b_cris_ingran* group contains the full-spectrum set of wavenumbers in *wnum_*w* arrays and noise levels per granule and FOV number in *nedn_*w*.

2.6.4 Aqua AIRS full-spectrum observations

For the Aqua random CalSub product the IR obs are provided in the *l1c_airs* group in variable *rad*. The parallel *rad_qc*, *nedn*, and *wnum* variables in the *l1c_airs* group provide quality, noise, and wavenumber information per channel. In addition, the variables *rad_vis_mean*, *rad_vis_max*, and *rad_vis_sdev* provide statistical information about the 8x9 Visible/near IR pixels associated with the spectrum.

2.6.5 Aqua AIRS summary observations

For the Aqua summary CalSub product IR BT observations are provided in the *l1b_airs* group in variable *brightness_temp* for 136 select channels. QC is provided in *brightness_temp_qc* array. The channels are listed in the *wnum* variable, and *wnum_index_1b* cross-references back to the full AIRS Level-1B channel list.

The *l1b_airs_ingran* group contains the full-spectrum set of wavenumbers in *wnum* and noise levels per granule in *nedn* and *nedt250*.

2.6.6 Aqua AMSU-A observations

For both the Aqua summary and full-spectrum CalSub products MW observations are provided in the *l1b_amsua* group in variables *brightness_temp* and *antenna_temp*. Per-granule QC is provided in *warm_nedt* array in the *l1b_amsua_ingran* group.

3 Options for Reading the Data

The product files are written in netCDF4/HDF5. Because netCDF4 builds upon the classic netCDF data model using HDF5 as the storage layer, a user of the data product can take full advantage of tools and libraries readily available to access the data.

Every netCDF4 file is considered an HDF5 file, however, not every HDF5 file is necessarily a netCDF4 file. A limited subset of the HDF5 data model and file format features are used in netCDF4 files. Conformance to the earlier mentioned CF & ACDD standards allows for users to take advantage of most netCDF interfaces.

Tools and libraries for reading netCDF4 as well as a netCDF Users' Guide are written and maintained by Unidata and can be found online at:

<http://www.unidata.ucar.edu/software/netcdf/>

Panoply is a good netCDF data viewer tool for visualizing these files.

<https://www.giss.nasa.gov/tools/panoply/>

There are a number of interfaces available for reading netCDF for different programming languages including: C/C++, Fortran, Matlab, IDL, Python and Perl.

The files can also be accessed with HDF5 tools and libraries available at: <https://portal.hdfgroup.org/display/HDF5/HDF5>

4 Data Services

The product is available to the user community via the Goddard Earth Sciences Data and Information Services Center (GES DISC). <https://disc.gsfc.nasa.gov/>
Data at the GES DISC is organized by unique shortnames and version numbers.

shortname_version	Description
Products described in this document	
SNDRAQIML1BCALSUBSUM_2	Sounder SIPS: Aqua AIRS Calibration Subset Level-1B Summary
SNDRAQIML1CCALSUBRND_2	Sounder SIPS: Aqua AIRS Calibration Subset Level-1C Random Full Spectra
SNDRSNIL1BCALSUBSUMN_2	Sounder SIPS: Suomi NPP CrIS Calibration Subset Level-1B NSR Summary
SNDRSNIL1BCALSUBRNDN_2	Sounder SIPS: Suomi NPP CrIS Calibration Subset Level-1B NSR Random Full Spectra
Input datasets at GES DISC	
AIRIBRAD_005	AIRS/Aqua L1B Infrared (IR) geolocated and calibrated radiances
AIRICRAD_6.7	AIRS/Aqua L1C Infrared (IR) resampled and corrected radiances
AIRVBRAD_005	AIRS/Aqua L1B Visible/Near Infrared (VIS/NIR) geolocated and calibrated radiances
AIRABRAD_005	AIRS/Aqua L1B AMSU (A1/A2) geolocated and calibrated brightness temperatures
SNPPCrISL1BNSR_2	Suomi NPP CrIS Level 1B Normal Spectral Resolution

5 References

1. Aumann, H. H., E.M. Manning, A. Goodman (2022) "Algorithm Theoretical Basis Document Level 1B AIRS and CrIS SNPP Calibration Data Subset", Version 2
2. Aumann, H. H., D. Elliot, S. Gaiser, D. Gregorich, T. Hearty, T. Pagano (2006) "AIRS Algorithm Theoretical Basis Document Level 1B Part 1: Infrared Spectrometer", Version 5
3. Northrop Grumman Space Technology (2019) "Cross Track Infrared Sounder (CrIS) Sensor Data Records (SDR) Algorithm theoretical Basis Document ATBD", Revision C, Doc: 474-00032
4. Revercomb, H., L. Strow (2018) "NASA SNPP Cross Track Infrared Sounder (CrIS) Level 1B Delta Algorithm Theoretical Basis Document (ATBD)", Version 2
5. Taylor, J. (2018) "Cross-track Infrared Sounder (CrIS) Level 1B Quality Flags Description Document", Version 2.0

Appendix A: Sample images

These images were generated with Panoply. See Section 3 for the link for obtaining and installing Panoply.

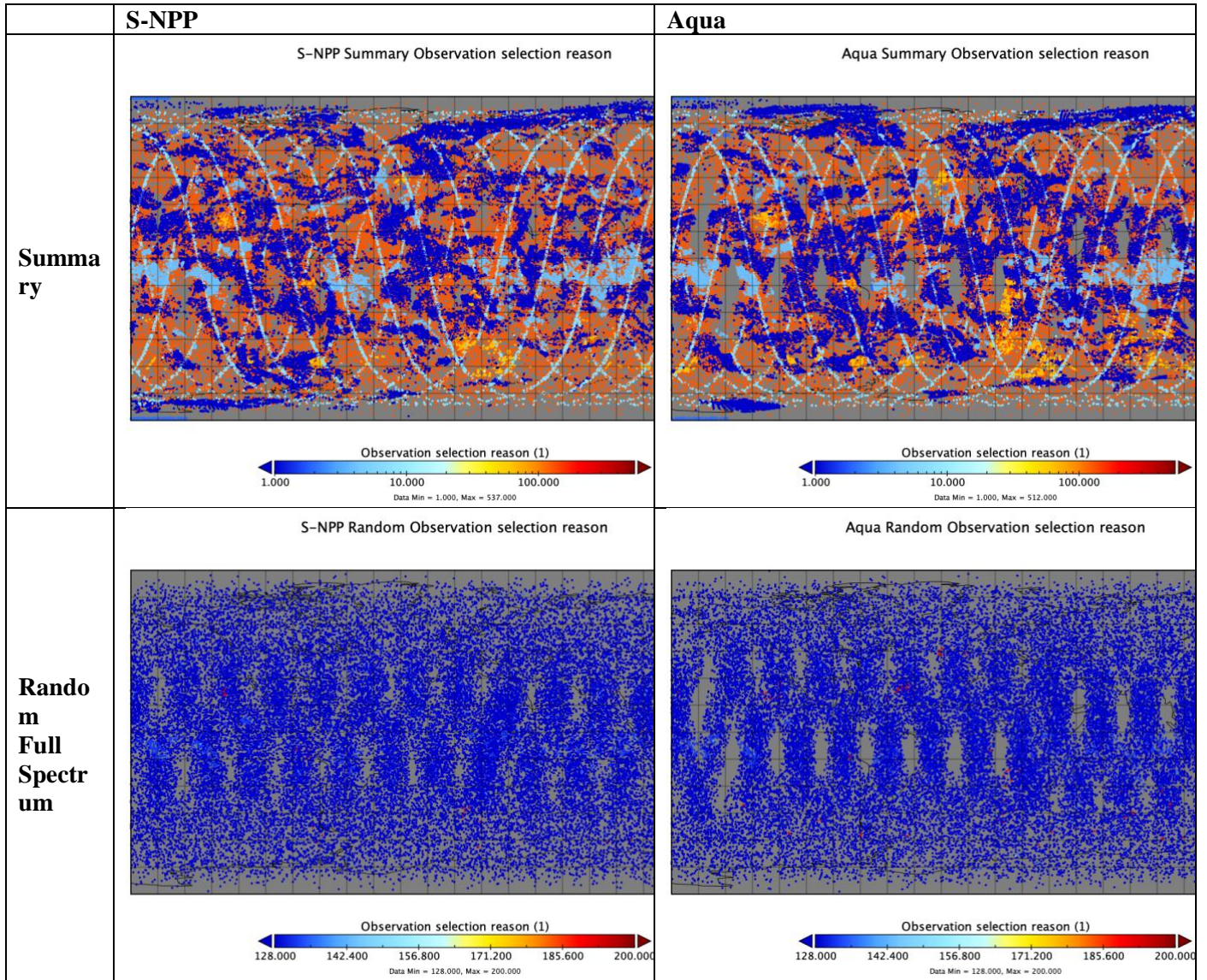
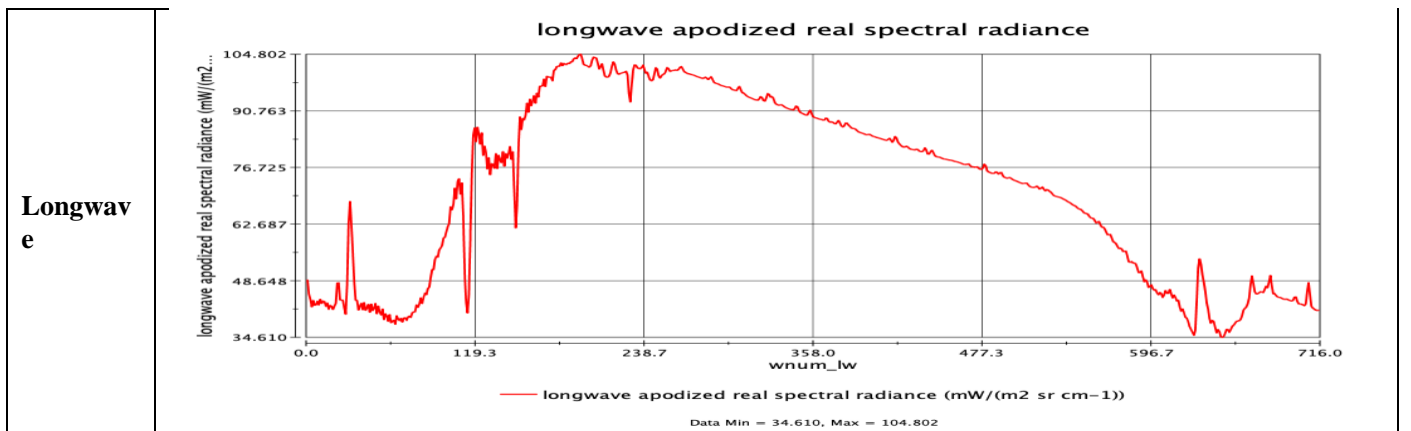
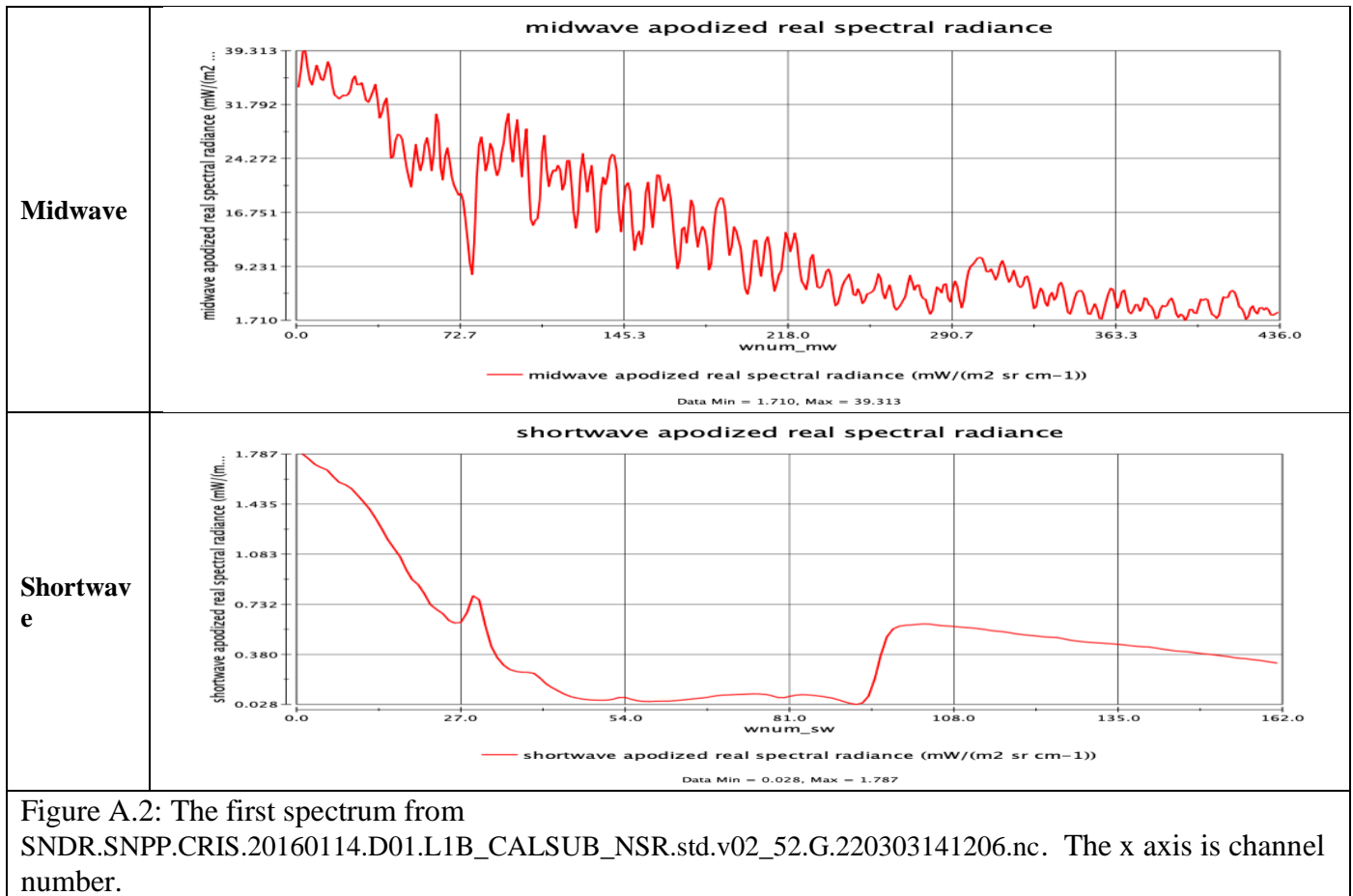


Figure A.1: *reason* for 2016-01-14. See Table 1.2.1-1 for the meanings of the values. The random files mostly have code 128 “random” but sometimes also have other bits set.





Appendix B: Interface Specification

The tables in this appendix show the interface specification for all of the dimensions, global attributes, and variables in the CalSub product types.

For clarity, some variable attributes are omitted, including long_name, standard_name, coverage_content_type, axis, valid_range, coordinates, and _FillValue.

To get a complete listing including all variable attributes, apply “ncdump -h” to any netCDF4 product file.

B1. SNPP Summary

B1 CALSUB CrIS SUM SNPP NSR Interface Specification

Interface Specification Version v02.02.20

09-03-2021

Groups

Path	Description
/	
/select	Info about the selection of the matches
/11b_cris	Level-1B CrIS
/11b_cris_ingran	Per-granule L1B CrIS info

Global Dimensions

Name	Size	Description
obs	-1	Trajectory dimension counting number of observations matching criteria

fov_poly	8	lat_bnds, lon_bnds points defining the polygon bounding an FOV (anticlockwise as viewed from above)
utc_tuple	8	parts of UTC time: year, month, day, hour, minute, second, millisecc, microsec

Global Variables

Name	Type	Dimensions	Description	Units
utc_tuple_lbl	string	utc_tuple	names of the elements of UTC when it is expressed as an array of integers year,month,day,hour,minute,second,millisecond,microsecond	

Global Attributes

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
Conventions	string	1	CF-1.6, ACDD-1.3	A comma-separated list of the conventions that are followed by the dataset.
history	string	1		Provides an audit trail for modifications to the original data. This attribute is also in the NetCDF Users Guide: 'This is a character array with a line for each invocation of a program that has modified the dataset. Well-behaved generic netCDF applications should append a line containing: date, time of day, user name, program name and command arguments.' To include a more complete description you can append a reference to an ISO Lineage entity; see NOAA EDM ISO Lineage guidance.
source	string	1	CrIS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1B	A textual description of the processing (or quality control) level of the data.
product_name_type_id	string	1	L1B_CALSUB_SUM_NSR	Product name as it appears in product_name (L1A, L1B, L2, CalSub_Fixed)
comment	string	1		Miscellaneous information about the data or methods used to produce it. Can be empty.
acknowledgment	string	1	Support for this research was provided by NASA.	A place to acknowledge various types of support for the project that produced this data.
license	string	1	Limited to Sounder SIPS affiliates	Provide the URL to a standard or specific license, enter "Freely Distributed" or "None", or describe any restrictions to data access and distribution in free text.
standard_name_vocabulary	string	1	CF Standard Name Table v28	The name and version of the controlled vocabulary from which variable standard names are taken. (Values for any standard_name attribute must come from the CF Standard Names vocabulary for the data file or product to comply with CF.) Example: 'CF Standard Name Table v27'.
date_created	string	1	Unassigned	The date on which this version of the data was created. (Modification of values implies a new version, hence this would be assigned the date of the most recent values modification.) Metadata changes are not considered when assigning the date_created. The ISO 8601:2004 extended date format is recommended, as described in the Attribute Content Guidance section.
creator_name	string	1	Unassigned	The name of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_email	string	1	Unassigned	The email address of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_url	string	1	Unassigned	The URL of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
institution	string	1	Unassigned	Processing facility that produced this file

project	string	1	Sounder SIPS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	SNDR	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
publisher_name	string	1	Unassigned	The name of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_email	string	1	Unassigned	The email address of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_url	string	1	Unassigned	The URL of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
geospatial_bounds	string	1	POLYGON ((-180.0 -90.0, 180.0 -90.0, 180.0 90.0, -180.0 90.0, -180.0 -90.0))	Describes the data's 2D or 3D geospatial extent in OGC's Well-Known Text (WKT) Geometry format (reference the OGC Simple Feature Access (SFA) specification). The meaning and order of values for each point's coordinates depends on the coordinate reference system (CRS). The ACDD default is 2D geometry in the EPSG:4326 coordinate reference system. The default may be overridden with geospatial_bounds_crs and geospatial_bounds_vertical_crs (see those attributes). EPSG:4326 coordinate values are latitude (decimal degrees_north) and longitude (decimal degrees_east), in that order. Longitude values in the default case are limited to the [-180, 180) range. Example: 'POLYGON ((-111.29 40.26, -111.29 41.26, -110.29 41.26, -110.29 40.26, -111.29 40.26))'.
geospatial_bounds_crs	string	1	EPSG:4326	The coordinate reference system (CRS) of the point coordinates in the geospatial_bounds attribute. This CRS may be 2-dimensional or 3-dimensional, but together with geospatial_bounds_vertical_crs, if that attribute is supplied, must match the dimensionality, order, and meaning of point coordinate values in the geospatial_bounds attribute. If geospatial_bounds_vertical_crs is also present then this attribute must only specify a 2D CRS. EPSG CRSs are strongly recommended. If this attribute is not specified, the CRS is assumed to be EPSG:4326. Examples: 'EPSG:4979' (the 3D WGS84 CRS), 'EPSG:4047'.
geospatial_lat_min	float	1		Describes a simple lower latitude limit; may be part of a 2- or 3-dimensional bounding region. Geospatial_lat_min specifies the southernmost latitude covered by the dataset.
geospatial_lat_max	float	1		Describes a simple upper latitude limit; may be part of a 2- or 3-dimensional bounding region. Geospatial_lat_max specifies the northernmost latitude covered by the dataset.
geospatial_lon_min	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. geospatial_lon_min specifies the westernmost longitude covered by the dataset. See also geospatial_lon_max.
geospatial_lon_max	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. geospatial_lon_max specifies the easternmost longitude covered by the dataset. Cases where geospatial_lon_min is greater than

				geospatial_lon_max indicate the bounding box extends from geospatial_lon_max, through the longitude range discontinuity meridian (either the antimeridian for -180:180 values, or Prime Meridian for 0:360 values), to geospatial_lon_min; for example, geospatial_lon_min=170 and geospatial_lon_max=-175 incorporates 15 degrees of longitude (ranges 170 to 180 and -180 to -175).
time_coverage_start	string	1		Nominal start time. Describes the time of the first data point in the data set. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_of_first_valid_obs	string	1		Describes the time of the first valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_mid	string	1		Describes the midpoint between the nominal start and end times. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_coverage_end	string	1		Nominal end time. Describes the time of the last data point in the data set. Use ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_of_last_valid_obs	string	1		Describes the time of the last valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_duration	string	1	P0000-00-01T00:00:00	Describes the duration of the data set. Use ISO 8601:2004 duration format, preferably the extended format as recommended in the Attribute Content Guidance section.
product_name_duration	string	1	D01	Product duration as it appears in product_name (D01 means full day)
creator_type	string	1	institution	Specifies type of creator with one of the following: 'person', 'group', 'institution', or 'position'. If this attribute is not specified, the creator is assumed to be a person.
creator_institution	string	1	Jet Propulsion Laboratory -- California Institute of Technology	The institution of the creator; should uniquely identify the creator's institution. This attribute's value should be specified even if it matches the value of publisher_institution, or if creator_type is institution.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
keywords_vocabulary	string	1	GCMD:GCMD Keywords	If you are using a controlled vocabulary for the words/phrases in your "keywords" attribute, this is the unique name or identifier of the vocabulary from which keywords are taken. If more than one keyword vocabulary is used, each may be presented with a prefix and a following comma, so that keywords may optionally be prefixed with the controlled vocabulary key. Example: 'GCMD:GCMD Keywords, CF:NetCDF COARDS Climate and Forecast Standard Names'.
platform	string	1	SUOMI-NPP > Suomi National Polar-orbiting Partnership	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
platform_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "platform" attribute.
product_name_platform	string	1	SNPP	Platform name as it appears in product_name
instrument	string	1	CrIS > Cross-track Infrared Sounder	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate

				controlled vocabulary used in instrument_vocabulary.
instrument_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "instrument" attribute.
product_name_instr	string	1	CRIS	Instrument name as it appears in product_name
product_name	string	1		Canonical fully qualified product name (official file name)
product_name_variant	string	1	std	Processing variant identifier as it appears in product_name. 'std' (shorthand for 'standard') is to be the default and should be what is seen in all public products.
product_name_version	string	1	vxx_xx_xx	Version number as it appears in product_name (v01_00_00)
product_name_producer	string	1	T	Production facility as it appears in product_name (single character) 'T' is the default, for unofficial local test products
product_name_timestamp	string	1	yymmddhhmmss	Processing timestamp as it appears in product_name (yymmddhhmmss)
product_name_extension	string	1	nc	File extension as it appears in product_name (typically nc)
gran_id	string	1	yyyymmdd	Unique granule identifier yyyymmdd of granule start day, including year, month, and day of granule start time
featureType	string	1	trajectory	structure of data in file
data_structure	string	1	trajectory	a character string indicating the internal organization of the data with currently allowed values of 'grid', 'station', 'trajectory', or 'swath'. The 'structure' here generally describes the horizontal structure and in all cases data may also be functions, for example, of a vertical coordinate and/or time. (If using CMOR pass this in a call to cmor_set_cur_dataset_attribute.)
cdm_data_type	string	1	Trajectory	The data type, as derived from Unidata's Common Data Model Scientific Data types and understood by THREDDS. (This is a THREDDS "dataType", and is different from the CF NetCDF attribute 'featureType', which indicates a Discrete Sampling Geometry file in CF.)
id	string	1	Unassigned	An identifier for the data set, provided by and unique within its naming authority. The combination of the "naming authority" and the "id" should be globally unique, but the id can be globally unique by itself also. IDs can be URLs, URNs, DOIs, meaningful text strings, a local key, or any other unique string of characters. The id should not include white space characters.
naming_authority	string	1	Unassigned	The organization that provides the initial id (see above) for the dataset. The naming authority should be uniquely specified by this attribute. We recommend using reverse-DNS naming for the naming authority; URIs are also acceptable. Example: 'edu.ucar.unidata'.
identifier_product_doi	string	1	Unassigned	digital signature
identifier_product_doi_authority	string	1	Unassigned	digital signature source
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.
production_host	string	1		Identifying information about the host computer for this run. (Output of linux "uname -a" command.)
format_version	string	1	v02.02.20	Format version.
input_file_names	string	1		Semicolon-separated list of names or unique identifiers of files that were used to make this product. There will always be one space after each semicolon. There is no final semicolon.

input_file_types	string	1		Semicolon-separated list of tags giving the role of each input file in input_file_names. There will always be one space after each semicolon. There is no final semicolon.
input_file_dates	string	1		Semicolon-separated list of creation dates for each input file in input_file_names. There will always be one space after each semicolon. There is no final semicolon.
AutomaticQualityFlag	string	1	Missing	"Passed": the granule contains a non-degraded calibrated brightness temperature, radiance, or retrieved value for at least one value in a geolocated FOV; "Suspect": the granule does not qualify as "Passed" but contains a (possibly degraded) calibrated or retrieved value (possibly without associated geolocation); "Failed": the granule contains no calibrated or retrieved values.
qa_no_data	string	1	TRUE	A simple indicator of whether this is an "empty" granule with no data from the instrument. "TRUE" or "FALSE".
title	string	1	Suomi NPP CrIS Calibration Subset Level-1B NSR Summary	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The SNPP CrIS NSR calibration subset summary product contains key Level-1B CrIS channels selected to support investigation of instrument properties and comparisons with other similar instruments. Cases include cold clouds, clear cases, a random subset, and locations with correlative data.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	SNDRSNIL1BCALSUBSUMN	ECS Short Name
metadata_link	string	1	Unassigned	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1		ATDB and design documents describing processing algorithms. Can be empty.

11b_cris group

Dimensions for the 11b_cris group

Name	Size	Description
wnum	115	wavenumber

Variables for the 11b_cris group

Name	Type	Dimensions	Description	Units	Ancillary Variables
obs_id	string	obs	unique earth view observation identifier.		
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00	
obs_time_utc	uint16	obs, utc_tuple	UTC earth view observation time as an array of integers: year, month, day, hour, minute, second, millisec, microsec		
lat	float	obs	latitude of FOV center	degrees_north	bnds
lon	float	obs	longitude of FOV center	degrees_east	bnds
land_frac	float	obs	land fraction over the FOV	unitless	
surf_alt	float	obs	mean surface altitude wrt earth model over the FOV	m	sdev
sol_zen	float	obs	solar zenith angle at the center of the FOV	degree	
sun_glint_dist	float	obs	Distance from the center of the calculated sun glint spot to the center of the spot. Note that there may not be a glint for cloudy or land cases and in ocean cases the glint can move based on wind conditions. Fill for night observations.	m	
view_ang	float	obs	off nadir pointing angle	degree	
sat_zen	float	obs	satellite zenith angle at the center of the FOV	degree	
asc_flag	ubyte	obs	ascending orbit flag: 1 if ascending, 0 descending		
sat_alt	float	obs	satellite altitude with respect to earth model at scan_mid_time	m	
ingran_index	unsigned short int	obs	1-based index into granules in the corresponding *_ingran group. This is not always the granule number.	unitless	

ingran_atrack	unsigned short int	obs	1-based 'atrack' dimension index of observation in original granule	unitless	
ingran_xtrack	unsigned short int	obs	1-based 'xtrack' dimension index of observation in source granule	unitless	
ingran_fov	unsigned short int	obs	1-based 'FOV' dimension index of observation in source granule	unitless	
brightness_temp	float32	obs, wnum	Brightness Temperature, Hanning apodized	Kelvin	lw_qc, mw_qc, sw_qc
wnum	float64	wnum	wavenumber	cm-1	
ce1232	float32	obs	ce1232 - 4-neighbor uniformity at 1232.5 cm-1, mixing scene inhomogeneity and FOV detector calibration differences	Kelvin	
ce2508	float32	obs	ce2508 - 4-neighbor uniformity at 2508 cm-1, mixing scene inhomogeneity and FOV detector calibration differences	Kelvin	
ce900	float32	obs	ce900 - 4-neighbor uniformity at 900 cm-1, mixing scene inhomogeneity and FOV detector calibration differences	Kelvin	
sst1232h5	float32	obs	Simple surface temperature derived from the Hanning apodized 1232.5 radiance assuming clear conditions, corrected for water vapor absorption using the split1232.5/1227.75 channel pair trained using SARTA from 2002. A rough estimate of cloud impact can be made by comparing it to stemp_cmc for ocean or stemp_clim for land.	Kelvin	

Attributes for the 11b_cris group

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
source	string	1	CrIS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1B	A textual description of the processing (or quality control) level of the data.
project	string	1	Sounder SIPS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	SNDR	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
platform	string	1	SUOMI-NPP > Suomi National Polar-orbiting Partnership	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
instrument	string	1	CrIS > Cross-track Infrared Sounder	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2;

				BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.
title	string	1	SNPP CrIS Level-1B NSR	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The NSR CrIS Level 1B product consists of calibrated radiance spectra at Normal Spectral Resolution, as well as geolocation information, metadata and derived parameters related to the observations.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	SNPPCrISL1BNSR	ECS Short Name
product_group	string	1	l1b_cris	The group name to be used for this product when it is collected in a multi-group file type, like SNO or calsub
metadata_link	string	1	http://disc.sci.gsfc.nasa.gov/	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1	NASA Cross-track Infrared Sounder (CrIS) Level 1B Algorithm Theoretical Basis Document (ATBD) Version 3.0; NASA Cross-track Infrared Sounder (CrIS) Level 1B Product Users' Guide Version 3.0; NASA Cross-track Infrared Sounder (CrIS) Level 1B Quality Flags Description Document Version 3.0	ATDB and design documents describing processing algorithms. Can be empty.
contributor_name	string	1	UW-Madison Space Science and Engineering Center: Joe K Taylor; UMBC Atmospheric Spectroscopy Laboratory: Larrabee Strow	The names of any individuals or institutions that contributed to the creation of this data.
contributor_role	string	1	CrIS L1B Scientist; CrIS L1B Scientist	The roles of any individuals or institutions that contributed to the creation of this data.

l1b_cris_ingran group

Dimensions for the l1b_cris_ingran group

Name	Size	Description
fov	9	Field-of-view dimension
wnum_lw	717	longwave IR channel number
wnum_mw	437	midwave IR channel number
wnum_sw	163	shortwave IR channel number
gran	-1	granules contributing

Variables for the l1b_cris_ingran group

Name	Type	Dimensions	Description	Units
ingran_file_name	string	gran	Input file name	
ingran_granule_number	unsigned short int	gran	granule number of day (1-240)	
ingran_gran_id	string	gran	Unique granule identifier yyyyymmddThhmm of granule start	
ingran_orbitDirection	string	gran	Orbit is ascending and/or descending. Values are 'Ascending' or 'Descending' if the entire granule fits that description. 'NorthPole' and 'SouthPole' are used for polar-crossing granules. 'NA' is used when a determination cannot be made.	
ingran_day_night_flag	string	gran	Data is day or night. 'Day' means subsatellite point for all valid scans has solar zenith angle less than 90 degrees. 'Night' means subsatellite point for all valid scans has solar zentih angle greater than 90 degrees. 'Both' means the dataset contains valid observations with solar zenith angle above and below 90 degrees. 'NA' means a value could not be determined.	
ingran_geospatial_lat_mid	float	gran	granule center latitude	degrees_north
ingran_geospatial_lon_mid	float	gran	granule center longitude	degrees_east
ingran_geospatial_bounds	string	gran	Describes the horizontal geospatial extent in OGCs Well-Known Text (WKT) Geometry format.	
nedn_lw	float32	gran, fov, wnum_lw	longwave noise equivalent differential radiance	mW/(m2 sr cm-1)
nedn_mw	float32	gran, fov, wnum_mw	midwave noise equivalent differential radiance	mW/(m2 sr cm-1)
nedn_sw	float32	gran, fov, wnum_sw	shortwave noise equivalent differential radiance	mW/(m2 sr cm-1)
wnum_lw	float64	wnum_lw	longwave wavenumber	cm-1

wnum_mw	float64	wnum_mw	midwave wavenumber	cm-1
wnum_sw	float64	wnum_sw	shortwave wavenumber	cm-1
i_LandPixel_count	float32	gran	Count of spectra considered land.	unitless
i_OceanPixel_count	float32	gran	Count of spectra considered ocean.	unitless
i_found_PLR_clear_land	float32	gran	Count of land spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_frozen	float32	gran	Count of frozen spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_SCT_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the SCT Spatial Coherence test.	unitless
i_found_forecast_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the Forecast Clear test.	unitless
i_found_sct_low_stratus_ocean	float32	gran	Count of ocean spectra that pass the cx1231 < 0.5 K test but have abs(d1231) < -4 K	unitless
i_max900	float32	gran	The hottest value of BT at 900 cm-1 in the granule.	Kelvin
i_max_bt900_lat	float32	gran	Latitude of i_max900	degrees_north
i_max_bt900_lon	float32	gran	Longitude of i_max900	degrees_east
i_mean_lat	float32	gran	Granule mean latitude	degrees_north
i_mean_lon	float32	gran	Granule mean longitude	degrees_east
i_mean_solzen	float32	gran	Granule mean solar zenith angle	degrees

select group

Dimensions for the select group

Name	Size	Description
calsite	40	calibration sites

Variables for the select group

Name	Type	Dimensions	Description	Units
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00
lat	float	obs	latitude of FOV center	degrees_north
lon	float	obs	longitude of FOV center	degrees_east
reason	unsigned short int	obs	Bitcode giving reason(s) why this observation was selected for inclusion in calibration subset products.	
site_id	short int	obs	Validation site ID if reason is validation site. Special codes identify other reasons as well. If a case satisfies multiple criteria then this will contain the code for the last one set -- see the bits in reason.	
distance	float	obs	Distance between validation site and observation	m
stemp_cmc	float	obs	Surface temperature from Canadian Meteorological Center	Kelvin
stemp_clim	float	obs	Surface temperature from AIRS L3 climatology for 2003-2006	Kelvin
calsite_id	short int	calsite	calibration site ID number. Numbers outside of [1, 50] tag observations which were selected for reasons other than proximity to calibration sites.	
calsite_name	string	calsite	Calibration site name	
calsite_lat	float	calsite	calibration site latitude	degrees_north
calsite_lon	float	calsite	calibration site longitude	degrees_east
calsite_dlat	float	calsite	maximum delta latitude miss distance for this calibration site	degree
calsite_dlon	float	calsite	maximum delta longitude miss distance for this calibration site	degree
calsite_addl_cond	string	calsite	additional conditions when collecting data for this calibration site	
calsite_notes	string	calsite	notes for this calibration site	

Attributes for the select group

Name	Type	Size	Value	Description
primary_product_group	string	1	11b_cris	group name for the observations that are the primary product type. Observations will be ordered by time of observations in this group. Distances and times are measured from this group.
match_product_group	string	1	TBD	group name for the observations that are matched the primary product type. Distances and times are measured from primary_product_group to this group.

B2. SNPP Random

CALSUB CrIS SNPP NSR Interface Specification

Interface Specification Version v02.02.20

09-03-2021

Groups

Path	Description
/	
/select	Info about the selection of the matches
/lib_cris	Level-1B CrIS
/lib_cris_ingran	Per-granule L1B CrIS info

Global Dimensions

Name	Size	Description
obs	-1	Trajectory dimension counting number of observations matching criteria
fov_poly	8	lat_bnds, lon_bnds points defining the polygon bounding an FOV (anticlockwise as viewed from above)
utc_tuple	8	parts of UTC time: year, month, day, hour, minute, second, millisecond, microsecond

Global Variables

Name	Type	Dimensions	Description	Units
utc_tuple_lbl	string	utc_tuple	names of the elements of UTC when it is expressed as an array of integers year,month,day,hour,minute,second,millisecond,microsecond	

Global Attributes

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
Conventions	string	1	CF-1.6, ACDD-1.3	A comma-separated list of the conventions that are followed by the dataset.
history	string	1		Provides an audit trail for modifications to the original data. This attribute is also in the NetCDF Users Guide: 'This is a character array with a line for each invocation of a program that has modified the dataset. Well-behaved generic netCDF applications should append a line containing: date, time of day, user name, program name and command arguments.' To include a more complete description you can append a reference to an ISO Lineage entity; see NOAA EDM ISO Lineage guidance.
source	string	1	CrIS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1B	A textual description of the processing (or quality control) level of the data.
product_name_type_id	string	1	L1B_CALSUB_NSUR	Product name as it appears in product_name (L1A, L1B, L2, CalSub_Fixed)
comment	string	1		Miscellaneous information about the data or methods used to produce it. Can be empty.
acknowledgment	string	1	Support for this research was provided by NASA.	A place to acknowledge various types of support for the project that produced this data.
license	string	1	Limited to Sounder SIPS affiliates	Provide the URL to a standard or specific license, enter "Freely Distributed" or "None", or describe any restrictions to data access and distribution in free text.
standard_name_vocabulary	string	1	CF Standard Name Table v28	The name and version of the controlled vocabulary from which variable standard names are taken. (Values for any standard_name attribute must come from the CF Standard Names vocabulary for the data file or product to comply with CF.) Example: 'CF Standard Name Table v27'.
date_created	string	1	Unassigned	The date on which this version of the data was created. (Modification of values implies a new version, hence

				this would be assigned the date of the most recent values modification.) Metadata changes are not considered when assigning the date_created. The ISO 8601:2004 extended date format is recommended, as described in the Attribute Content Guidance section.
creator_name	string	1	Unassigned	The name of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_email	string	1	Unassigned	The email address of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_url	string	1	Unassigned	The URL of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
institution	string	1	Unassigned	Processing facility that produced this file
project	string	1	Sounder SIPS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	SNDR	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
publisher_name	string	1	Unassigned	The name of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_email	string	1	Unassigned	The email address of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_url	string	1	Unassigned	The URL of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
geospatial_bounds	string	1	POLYGON ((-180.0 -90.0, 180.0 -90.0, 180.0 90.0, -180.0 90.0, -180.0 -90.0))	Describes the data's 2D or 3D geospatial extent in OGC's Well-Known Text (WKT) Geometry format (reference the OGC Simple Feature Access (SFA) specification). The meaning and order of values for each point's coordinates depends on the coordinate reference system (CRS). The ACDD default is 2D geometry in the EPSG:4326 coordinate reference system. The default may be overridden with geospatial_bounds_crs and geospatial_bounds_vertical_crs (see those attributes). EPSG:4326 coordinate values are latitude (decimal degrees_north) and longitude (decimal degrees_east), in that order. Longitude values in the default case are limited to the [-180, 180] range. Example: 'POLYGON ((-111.29 40.26, -111.29 41.26, -110.29 41.26, -110.29 40.26, -111.29 40.26))'.
geospatial_bounds_crs	string	1	EPSG:4326	The coordinate reference system (CRS) of the point coordinates in the geospatial_bounds attribute. This CRS may be 2-dimensional or 3-dimensional, but together with geospatial_bounds_vertical_crs, if that attribute is supplied, must match the dimensionality, order, and meaning of point coordinate values in the geospatial_bounds attribute. If geospatial_bounds_vertical_crs is also present then this attribute must only specify a 2D CRS. EPSG CRSs are strongly recommended. If this attribute is not specified, the CRS is assumed to be EPSG:4326. Examples: 'EPSG:4979' (the 3D WGS84 CRS), 'EPSG:4047'.
geospatial_lat_min	float	1		Describes a simple lower latitude limit; may be part of a 2- or 3-dimensional bounding region. Geospatial_lat_min specifies the southernmost latitude covered by the dataset.
geospatial_lat_max	float	1		Describes a simple upper latitude limit; may be part of a 2- or 3-dimensional bounding region.

				Geospatial_lat_max specifies the northernmost latitude covered by the dataset.
geospatial_lon_min	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. geospatial_lon_min specifies the westernmost longitude covered by the dataset. See also geospatial_lon_max.
geospatial_lon_max	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. geospatial_lon_max specifies the easternmost longitude covered by the dataset. Cases where geospatial_lon_min is greater than geospatial_lon_max indicate the bounding box extends from geospatial_lon_max, through the longitude range discontinuity meridian (either the antimeridian for -180:180 values, or Prime Meridian for 0:360 values), to geospatial_lon_min; for example, geospatial_lon_min=170 and geospatial_lon_max=-175 incorporates 15 degrees of longitude (ranges 170 to 180 and -180 to -175).
time_coverage_start	string	1		Nominal start time. Describes the time of the first data point in the data set. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_of_first_valid_obs	string	1		Describes the time of the first valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_mid	string	1		Describes the midpoint between the nominal start and end times. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_coverage_end	string	1		Nominal end time. Describes the time of the last data point in the data set. Use ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_of_last_valid_obs	string	1		Describes the time of the last valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_duration	string	1	P0000-00-01T00:00:00	Describes the duration of the data set. Use ISO 8601:2004 duration format, preferably the extended format as recommended in the Attribute Content Guidance section.
product_name_duration	string	1	D01	Product duration as it appears in product_name (D01 means full day)
creator_type	string	1	institution	Specifies type of creator with one of the following: 'person', 'group', 'institution', or 'position'. If this attribute is not specified, the creator is assumed to be a person.
creator_institution	string	1	Jet Propulsion Laboratory -- California Institute of Technology	The institution of the creator; should uniquely identify the creator's institution. This attribute's value should be specified even if it matches the value of publisher_institution, or if creator_type is institution.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
keywords_vocabulary	string	1	GCMD:GCMD Keywords	If you are using a controlled vocabulary for the words/phrases in your "keywords" attribute, this is the unique name or identifier of the vocabulary from which keywords are taken. If more than one keyword vocabulary is used, each may be presented with a prefix and a following comma, so that keywords may optionally be prefixed with the controlled vocabulary key. Example: 'GCMD:GCMD Keywords, CF:NetCDF COARDS Climate and Forecast Standard Names'.
platform	string	1	SUOMI-NPP > Suomi National Polar-orbiting Partnership	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
platform_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "platform" attribute.
product_name_platform	string	1	SNPP	Platform name as it appears in product_name

instrument	string	1	CrIS > Cross-track Infrared Sounder	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in <code>instrument_vocabulary</code> .
instrument_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "instrument" attribute.
product_name_instr	string	1	CRIS	Instrument name as it appears in <code>product_name</code>
product_name	string	1		Canonical fully qualified product name (official file name)
product_name_variant	string	1	std	Processing variant identifier as it appears in <code>product_name</code> . 'std' (shorthand for 'standard') is to be the default and should be what is seen in all public products.
product_name_version	string	1	vxx_xx_xx	Version number as it appears in <code>product_name</code> (v01_00_00)
product_name_producer	string	1	T	Production facility as it appears in <code>product_name</code> (single character) 'T' is the default, for unofficial local test products
product_name_timestamp	string	1	yymmddhhmmss	Processing timestamp as it appears in <code>product_name</code> (yymmddhhmmss)
product_name_extension	string	1	nc	File extension as it appears in <code>product_name</code> (typically nc)
gran_id	string	1	yyyymmdd	Unique granule identifier yyyymmdd of granule start day, including year, month, and day of granule start time
featureType	string	1	trajectory	structure of data in file
data_structure	string	1	trajectory	a character string indicating the internal organization of the data with currently allowed values of 'grid', 'station', 'trajectory', or 'swath'. The 'structure' here generally describes the horizontal structure and in all cases data may also be functions, for example, of a vertical coordinate and/or time. (If using CMOR pass this in a call to <code>cmor_set_cur_dataset_attribute</code> .)
cdm_data_type	string	1	Trajectory	The data type, as derived from Unidata's Common Data Model Scientific Data types and understood by THREDDS. (This is a THREDDS "dataType", and is different from the CF NetCDF attribute 'featureType', which indicates a Discrete Sampling Geometry file in CF.)
id	string	1	Unassigned	An identifier for the data set, provided by and unique within its naming authority. The combination of the "naming authority" and the "id" should be globally unique, but the id can be globally unique by itself also. IDs can be URLs, URNs, DOIs, meaningful text strings, a local key, or any other unique string of characters. The id should not include white space characters.
naming_authority	string	1	Unassigned	The organization that provides the initial id (see above) for the dataset. The naming authority should be uniquely specified by this attribute. We recommend using reverse-DNS naming for the naming authority; URIs are also acceptable. Example: 'edu.ucar.unidata'.
identifier_product_doi	string	1	Unassigned	digital signature
identifier_product_doi_authority	string	1	Unassigned	digital signature source
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.
production_host	string	1		Identifying information about the host computer for this run. (Output of linux "uname -a" command.)
format_version	string	1	v02.02.20	Format version.
input_file_names	string	1		Semicolon-separated list of names or unique identifiers of files that were used to make this product. There will always be one space after each semicolon. There is no final semicolon.
input_file_types	string	1		Semicolon-separated list of tags giving the role of each input file in <code>input_file_names</code> . There will always be one space after each semicolon. There is no final semicolon.

input_file_dates	string	1		Semicolon-separated list of creation dates for each input file in input_file_names. There will always be one space after each semicolon. There is no final semicolon.
AutomaticQualityFlag	string	1	Missing	"Passed": the granule contains a non-degraded calibrated brightness temperature, radiance, or retrieved value for at least one value in a geolocated FOV; "Suspect": the granule does not qualify as "Passed" but contains a (possibly degraded) calibrated or retrieved value (possibly without associated geolocation); "Failed": the granule contains no calibrated or retrieved values.
qa_no_data	string	1	TRUE	A simple indicator of whether this is an "empty" granule with no data from the instrument. "TRUE" or "FALSE".
title	string	1	Suomi NPP CrIS Calibration Subset Level-1B NSR Random Full Spectra	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The SNPP CrIS NSR calibration subset product contains full Level-1B CrIS spectra randomly selected to support investigation of instrument properties and comparisons with other similar instruments.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	SNDRSNL1BCALSUBRNDN	ECS Short Name
metadata_link	string	1	Unassigned	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1		ATDB and design documents describing processing algorithms. Can be empty.

11b_cris group

Dimensions for the 11b_cris group

Name	Size	Description
wnum_lw	717	longwave IR channel number
wnum_mw	437	midwave IR channel number
wnum_sw	163	shortwave IR channel number

Variables for the 11b_cris group

Name	Type	Dimensions	Description	Units	Ancillary Variables
obs_id	string	obs	unique earth view observation identifier.		
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00	
obs_time_utc	uint16	obs, utc_tuple	UTC earth view observation time as an array of integers: year, month, day, hour, minute, second, millisec, microsec		
lat	float	obs	latitude of FOV center	degrees_north	bnds
lon	float	obs	longitude of FOV center	degrees_east	bnds
land_frac	float	obs	land fraction over the FOV	unitless	
surf_alt	float	obs	mean surface altitude wrt earth model over the FOV	m	sdev
sol_zen	float	obs	solar zenith angle at the center of the FOV	degree	
sun_glint_dist	float	obs	Distance from the center of the calculated sun glint spot to the center of the spot. Note that there may not be a glint for cloudy or land cases and in ocean cases the glint can move based on wind conditions. Fill for night observations.	m	
view_ang	float	obs	off nadir pointing angle	degree	
sat_zen	float	obs	satellite zenith angle at the center of the FOV	degree	
asc_flag	ubyte	obs	ascending orbit flag: 1 if ascending, 0 descending		
sat_alt	float	obs	satellite altitude with respect to earth model at scan_mid_time	m	
ingran_index	unsigned short int	obs	1-based index into granules in the corresponding *_ingran group. This is not always the granule number.	unitless	
ingran_atrack	unsigned short int	obs	1-based 'atrack' dimension index of observation in original granule	unitless	
ingran_xtrack	unsigned short int	obs	1-based 'xtrack' dimension index of observation in source granule	unitless	

ingran_fov	unsigned short int	obs	1-based 'FOV' dimension index of observation in source granule	unitless	
rad_lw	float32	obs, wnum_lw	longwave apodized real spectral radiance	mW/(m ² sr cm ⁻¹)	qc
rad_mw	float32	obs, wnum_mw	midwave apodized real spectral radiance	mW/(m ² sr cm ⁻¹)	qc
rad_sw	float32	obs, wnum_sw	shortwave apodized real spectral radiance	mW/(m ² sr cm ⁻¹)	qc
ce1232	float32	obs	ce1232 - 4-neighbor uniformity at 1232.5 cm ⁻¹ , mixing scene inhomogeneity and FOV detector calibration differences	Kelvin	
ce2508	float32	obs	ce2508 - 4-neighbor uniformity at 2508 cm ⁻¹ , mixing scene inhomogeneity and FOV detector calibration differences	Kelvin	
ce900	float32	obs	ce900 - 4-neighbor uniformity at 900 cm ⁻¹ , mixing scene inhomogeneity and FOV detector calibration differences	Kelvin	
sst1232h5	float32	obs	Simple surface temperature derived from the Hanning apodized 1232.5 radiance assuming clear conditions, corrected for water vapor absorption using the split1232.5/1227.75 channel pair trained using SARTA from 2002. A rough estimate of cloud impact can be made by comparing it to stemp_cmc for ocean or stemp_clim for land.	Kelvin	

Attributes for the 11b_cris group

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
source	string	1	CrIS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1B	A textual description of the processing (or quality control) level of the data.
project	string	1	Sounder SIPS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	SNDR	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
platform	string	1	SUOMI-NPP > Suomi National Polar-orbiting Partnership	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
instrument	string	1	CrIS > Cross-track Infrared Sounder	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be

				updated with every delivery that changes numerical results.
title	string	1	SNPP CrIS Level-1B NSR	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The NSR CrIS Level 1B product consists of calibrated radiance spectra at Normal Spectral Resolution, as well as geolocation information, metadata and derived parameters related to the observations.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	SNPPCrISL1BNSR	ECS Short Name
product_group	string	1	l1b_cris	The group name to be used for this product when it is collected in a multi-group file type, like SNO or calsub
metadata_link	string	1	http://disc.sci.gsfc.nasa.gov/	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1	NASA Cross-track Infrared Sounder (CrIS) Level 1B Algorithm Theoretical Basis Document (ATBD) Version 3.0; NASA Cross-track Infrared Sounder (CrIS) Level 1B Product Users' Guide Version 3.0; NASA Cross-track Infrared Sounder (CrIS) Level 1B Quality Flags Description Document Version 3.0	ATDB and design documents describing processing algorithms. Can be empty.
contributor_name	string	1	UW-Madison Space Science and Engineering Center: Joe K Taylor; UMBC Atmospheric Spectroscopy Laboratory: Larrabee Strow	The names of any individuals or institutions that contributed to the creation of this data.
contributor_role	string	1	CrIS L1B Scientist; CrIS L1B Scientist	The roles of any individuals or institutions that contributed to the creation of this data.

l1b_cris_ingran group

Dimensions for the l1b_cris_ingran group

Name	Size	Description
fov	9	Field-of-view dimension
wnum_lw	717	longwave IR channel number
wnum_mw	437	midwave IR channel number
wnum_sw	163	shortwave IR channel number
gran	-1	granules contributing

Variables for the l1b_cris_ingran group

Name	Type	Dimensions	Description	Units
ingran_file_name	string	gran	Input file name	
ingran_granule_number	unsigned short int	gran	granule number of day (1-240)	
ingran_gran_id	string	gran	Unique granule identifier yyyyymmddThhmm of granule start	
ingran_orbitDirection	string	gran	Orbit is ascending and/or descending. Values are 'Ascending' or 'Descending' if the entire granule fits that description. 'NorthPole' and 'SouthPole' are used for polar-crossing granules. 'NA' is used when a determination cannot be made.	
ingran_day_night_flag	string	gran	Data is day or night. 'Day' means subsatellite point for all valid scans has solar zenith angle less than 90 degrees. 'Night' means subsatellite point for all valid scans has solar zenith angle greater than 90 degrees. 'Both' means the dataset contains valid observations with solar zenith angle above and below 90 degrees. 'NA' means a value could not be determined.	
ingran_geospatial_lat_mid	float	gran	granule center latitude	degrees_north
ingran_geospatial_lon_mid	float	gran	granule center longitude	degrees_east
ingran_geospatial_bounds	string	gran	Describes the horizontal geospatial extent in OGCs Well-Known Text (WKT) Geometry format.	
nedn_lw	float32	gran, fov, wnum_lw	longwave noise equivalent differential radiance	mW/(m2 sr cm-1)
nedn_mw	float32	gran, fov, wnum_mw	midwave noise equivalent differential radiance	mW/(m2 sr cm-1)
nedn_sw	float32	gran, fov, wnum_sw	shortwave noise equivalent differential radiance	mW/(m2 sr cm-1)
wnum_lw	float64	wnum_lw	longwave wavenumber	cm-1
wnum_mw	float64	wnum_mw	midwave wavenumber	cm-1

wnum_sw	float64	wnum_sw	shortwave wavenumber	cm-1
i_LandPixel_count	float32	gran	Count of spectra considered land.	unitless
i_OceanPixel_count	float32	gran	Count of spectra considered ocean.	unitless
i_found_PLR_clear_land	float32	gran	Count of land spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_frozen	float32	gran	Count of frozen spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_SCT_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the SCT Spatial Coherence test.	unitless
i_found_forecast_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the Forecast Clear test.	unitless
i_found_sct_low_stratus_ocean	float32	gran	Count of ocean spectra that pass the cx1231 < 0.5 K test but have abs(d1231) < -4 K	unitless
i_max900	float32	gran	The hottest value of BT at 900 cm-1 in the granule.	Kelvin
i_max_bt900_lat	float32	gran	Latitude of i_max900	degrees_north
i_max_bt900_lon	float32	gran	Longitude of i_max900	degrees_east
i_mean_lat	float32	gran	Granule mean latitude	degrees_north
i_mean_lon	float32	gran	Granule mean longitude	degrees_east
i_mean_solzen	float32	gran	Granule mean solar zenith angle	degrees

select group

Dimensions for the select group

Name	Size	Description
calsite	40	calibration sites

Variables for the select group

Name	Type	Dimensions	Description	Units
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00
lat	float	obs	latitude of FOV center	degrees_north
lon	float	obs	longitude of FOV center	degrees_east
reason	unsigned short int	obs	Bitcode giving reason(s) why this observation was selected for inclusion in calibration subset products.	
site_id	short int	obs	Validation site ID if reason is validation site. Special codes identify other reasons as well. If a case satisfies multiple criteria then this will contain the code for the last one set -- see the bits in reason.	
distance	float	obs	Distance between validation site and observation	m
stemp_cmc	float	obs	Surface temperature from Canadian Meteorological Center	Kelvin
stemp_clim	float	obs	Surface temperature from AIRS L3 climatology for 2003-2006	Kelvin
calsite_id	short int	calsite	calibration site ID number. Numbers outside of [1, 50] tag observations which were selected for reasons other than proximity to calibration sites.	
calsite_name	string	calsite	Calibration site name	
calsite_lat	float	calsite	calibration site latitude	degrees_north
calsite_lon	float	calsite	calibration site longitude	degrees_east
calsite_dlat	float	calsite	maximum delta latitude miss distance for this calibration site	degree
calsite_dlon	float	calsite	maximum delta longitude miss distance for this calibration site	degree
calsite_addl_cond	string	calsite	additional conditions when collecting data for this calibration site	
calsite_notes	string	calsite	notes for this calibration site	

Attributes for the select group

Name	Type	Size	Value	Description
primary_product_group	string	1	11b_cris	group name for the observations that are the primary product type. Observations will be ordered by time of observations in this group. Distances and times are measured from this group.
match_product_group	string	1	TBD	group name for the observations that are matched the primary product type. Distances and times are measured from primary_product_group to this group.

B3. Aqua Summary

CALSUB AIRS SUM 1B Interface Specification

Groups

Path	Description
/	
/select	Info about the selection of the matches
/11b_airs	Level-1B AIRS
/11b_amsua	Level-1B AMSU-A
/11b_airs_ingran	Per-granule L1B AIRS info
/11b_amsua_ingran	Per-granule L1B AMSU-A info

Global Dimensions

Name	Size	Description
obs	-1	Trajectory dimension counting number of observations matching criteria
fov_poly	8	lat_bnds, lon_bnds points defining the polygon bounding an FOV (anticlockwise as viewed from above)
utc_tuple	8	parts of UTC time: year, month, day, hour, minute, second, millisec, microsec

Global Variables

Name	Type	Dimensions	Description	Units
utc_tuple_lbl	string	utc_tuple	names of the elements of UTC when it is expressed as an array of integers year,month,day,hour,minute,second,millisecond,microsecond	

Global Attributes

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > MICROWAVE > ANTENNA TEMPERATURE, EARTH SCIENCE > SPECTRAL/ENGINEERING > MICROWAVE > BRIGHTNESS TEMPERATURE, EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
Conventions	string	1	CF-1.6, ACDD-1.3	A comma-separated list of the conventions that are followed by the dataset.
history	string	1		Provides an audit trail for modifications to the original data. This attribute is also in the NetCDF Users Guide: 'This is a character array with a line for each invocation of a program that has modified the dataset. Well-behaved generic netCDF applications should append a line containing: date, time of day, user name, program name and command arguments.' To include a more complete description you can append a reference to an ISO Lineage entity; see NOAA EDM ISO Lineage guidance.
source	string	1	AIRS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1	A textual description of the processing (or quality control) level of the data.
product_name_type_id	string	1	L1B_CALSUB_SUM	Product name as it appears in product_name (L1A, L1B, L2, CalSub_Fixed)
comment	string	1		Miscellaneous information about the data or methods used to produce it. Can be empty.
acknowledgment	string	1	Support for this research was provided by NASA.	A place to acknowledge various types of support for the project that produced this data.
license	string	1	Limited to Sounder SIPS affiliates	Provide the URL to a standard or specific license, enter "Freely Distributed" or "None", or describe any restrictions to data access and distribution in free text.

standard_name_vocabulary	string	1	CF Standard Name Table v28	The name and version of the controlled vocabulary from which variable standard names are taken. (Values for any standard_name attribute must come from the CF Standard Names vocabulary for the data file or product to comply with CF.) Example: 'CF Standard Name Table v27'.
date_created	string	1	Unassigned	The date on which this version of the data was created. (Modification of values implies a new version, hence this would be assigned the date of the most recent values modification.) Metadata changes are not considered when assigning the date_created. The ISO 8601:2004 extended date format is recommended, as described in the Attribute Content Guidance section.
creator_name	string	1	Unassigned	The name of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_email	string	1	Unassigned	The email address of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_url	string	1	Unassigned	The URL of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
institution	string	1	Unassigned	Processing facility that produced this file
project	string	1	Sounder SIPS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	SNDR	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
publisher_name	string	1	Unassigned	The name of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_email	string	1	Unassigned	The email address of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_url	string	1	Unassigned	The URL of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
geospatial_bounds	string	1	POLYGON ((-180.0 -90.0, 180.0 -90.0, 180.0 90.0, -180.0 90.0, -180.0 -90.0))	Describes the data's 2D or 3D geospatial extent in OGC's Well-Known Text (WKT) Geometry format (reference the OGC Simple Feature Access (SFA) specification). The meaning and order of values for each point's coordinates depends on the coordinate reference system (CRS). The ACDD default is 2D geometry in the EPSG:4326 coordinate reference system. The default may be overridden with geospatial_bounds_crs and geospatial_bounds_vertical_crs (see those attributes). EPSG:4326 coordinate values are latitude (decimal degrees_north) and longitude (decimal degrees_east), in that order. Longitude values in the default case are limited to the [-180, 180) range. Example: 'POLYGON ((-111.29 40.26, -111.29 41.26, -110.29 41.26, -110.29 40.26, -111.29 40.26))'.
geospatial_bounds_crs	string	1	EPSG:4326	The coordinate reference system (CRS) of the point coordinates in the geospatial_bounds attribute. This CRS may be 2-dimensional or 3-dimensional, but together with geospatial_bounds_vertical_crs, if that attribute is

				<p>supplied, must match the dimensionality, order, and meaning of point coordinate values in the <code>geospatial_bounds</code> attribute. If <code>geospatial_bounds_vertical_crs</code> is also present then this attribute must only specify a 2D CRS. EPSG CRSs are strongly recommended. If this attribute is not specified, the CRS is assumed to be EPSG:4326. Examples: 'EPSG:4979' (the 3D WGS84 CRS), 'EPSG:4047'.</p>
geospatial_lat_min	float	1		Describes a simple lower latitude limit; may be part of a 2- or 3-dimensional bounding region. <code>geospatial_lat_min</code> specifies the southernmost latitude covered by the dataset.
geospatial_lat_max	float	1		Describes a simple upper latitude limit; may be part of a 2- or 3-dimensional bounding region. <code>geospatial_lat_max</code> specifies the northernmost latitude covered by the dataset.
geospatial_lon_min	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. <code>geospatial_lon_min</code> specifies the westernmost longitude covered by the dataset. See also <code>geospatial_lon_max</code> .
geospatial_lon_max	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. <code>geospatial_lon_max</code> specifies the easternmost longitude covered by the dataset. Cases where <code>geospatial_lon_min</code> is greater than <code>geospatial_lon_max</code> indicate the bounding box extends from <code>geospatial_lon_max</code> , through the longitude range discontinuity meridian (either the antimeridian for -180:180 values, or Prime Meridian for 0:360 values), to <code>geospatial_lon_min</code> ; for example, <code>geospatial_lon_min=170</code> and <code>geospatial_lon_max=-175</code> incorporates 15 degrees of longitude (ranges 170 to 180 and -180 to -175).
time_coverage_start	string	1		Nominal start time. Describes the time of the first data point in the data set. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_of_first_valid_obs	string	1		Describes the time of the first valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_mid	string	1		Describes the midpoint between the nominal start and end times. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_coverage_end	string	1		Nominal end time. Describes the time of the last data point in the data set. Use ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_of_last_valid_obs	string	1		Describes the time of the last valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_duration	string	1	P0000-00-01T00:00:00	Describes the duration of the data set. Use ISO 8601:2004 duration format, preferably the extended format as recommended in the Attribute Content Guidance section.
product_name_duration	string	1	D01	Product duration as it appears in <code>product_name</code> (D01 means full day)
creator_type	string	1	institution	Specifies type of creator with one of the following: 'person', 'group', 'institution', or 'position'. If this attribute is not specified, the creator is assumed to be a person.

creator_institution	string	1	Jet Propulsion Laboratory -- California Institute of Technology	The institution of the creator; should uniquely identify the creator's institution. This attribute's value should be specified even if it matches the value of publisher_institution, or if creator_type is institution.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
keywords_vocabulary	string	1	GCMD:GCMD Keywords	If you are using a controlled vocabulary for the words/phrases in your "keywords" attribute, this is the unique name or identifier of the vocabulary from which keywords are taken. If more than one keyword vocabulary is used, each may be presented with a prefix and a following comma, so that keywords may optionally be prefixed with the controlled vocabulary key. Example: 'GCMD:GCMD Keywords, CF:NetCDF COARDS Climate and Forecast Standard Names'.
platform	string	1	AQUA > Earth Observing System	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
platform_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "platform" attribute.
product_name_platform	string	1	AQUA	Platform name as it appears in product_name
instrument	string	1	AIRS > Atmospheric Infrared Sounder, AMSU-A > Advanced Microwave Sounding Unit-A	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
instrument_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "instrument" attribute.
product_name_instr	string	1	AIRS	Instrument name as it appears in product_name
product_name	string	1		Canonical fully qualified product name (official file name)
product_name_variant	string	1	std	Processing variant identifier as it appears in product_name. 'std' (shorthand for 'standard') is to be the default and should be what is seen in all public products.
product_name_version	string	1	vxx_xx_xx	Version number as it appears in product_name (v01_00_00)
product_name_producer	string	1	T	Production facility as it appears in product_name (single character) 'T' is the default, for unofficial local test products
product_name_timestamp	string	1	yymmddhhmmss	Processing timestamp as it appears in product_name (yymmddhhmmss)
product_name_extension	string	1	nc	File extension as it appears in product_name (typically nc)
gran_id	string	1	yyyymmdd	Unique granule identifier yyyymmdd of granule start day, including year, month, and day of granule start time
featureType	string	1	trajectory	structure of data in file
data_structure	string	1	trajectory	a character string indicating the internal organization of the data with currently allowed values of 'grid', 'station', 'trajectory', or 'swath'. The 'structure' here generally describes the horizontal structure and in all cases data may also be functions, for example, of a vertical coordinate and/or time. (If using CMOR pass this in a call to cmor_set_cur_dataset_attribute.)
cdm_data_type	string	1	Trajectory	The data type, as derived from Unidata's Common Data Model Scientific Data types and understood by THREDDS. (This is a THREDDS "dataType", and is different from the CF NetCDF attribute 'featureType', which indicates a Discrete Sampling Geometry file in CF.)

id	string	1	Unassigned	An identifier for the data set, provided by and unique within its naming authority. The combination of the "naming authority" and the "id" should be globally unique, but the id can be globally unique by itself also. IDs can be URLs, URNs, DOIs, meaningful text strings, a local key, or any other unique string of characters. The id should not include white space characters.
naming_authority	string	1	Unassigned	The organization that provides the initial id (see above) for the dataset. The naming authority should be uniquely specified by this attribute. We recommend using reverse-DNS naming for the naming authority; URIs are also acceptable. Example: 'edu.ucar.unidata'.
identifier_product_doi	string	1	Unassigned	digital signature
identifier_product_doi_authority	string	1	Unassigned	digital signature source
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.
production_host	string	1		Identifying information about the host computer for this run. (Output of linux "uname -a" command.)
format_version	string	1	v02.02.20	Format version.
input_file_names	string	1		Semicolon-separated list of names or unique identifiers of files that were used to make this product. There will always be one space after each semicolon. There is no final semicolon.
input_file_types	string	1		Semicolon-separated list of tags giving the role of each input file in input_file_names. There will always be one space after each semicolon. There is no final semicolon.
input_file_dates	string	1		Semicolon-separated list of creation dates for each input file in input_file_names. There will always be one space after each semicolon. There is no final semicolon.
AutomaticQualityFlag	string	1	Missing	"Passed": the granule contains a non-degraded calibrated brightness temperature, radiance, or retrieved value for at least one value in a geolocated FOV; "Suspect": the granule does not qualify as "Passed" but contains a (possibly degraded) calibrated or retrieved value (possibly without associated geolocation); "Failed": the granule contains no calibrated or retrieved values.
qa_no_data	string	1	TRUE	A simple indicator of whether this is an "empty" granule with no data from the instrument. "TRUE" or "FALSE".
title	string	1	Aqua AIRS Calibration Subset Level-1B Summary	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The AIRS calibration subset summary product contains key Level-1B AIRS channels with colocated AMSU-A selected to support investigation of instrument properties and comparisons with other similar instruments. Cases include cold clouds, clear cases, a random subset, and locations with correlative data.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	SNDRQIMLIBCALSUBSUM	ECS Short Name
metadata_link	string	1	Unassigned	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1		ATDB and design documents describing processing algorithms. Can be empty.

11b_airs group

Dimensions for the 11b_airs group

Name	Size	Description
channel	136	wavenumber
band_vnir	4	V/NIR bands

Variables for the 11b_airs group

Name	Type	Dimensions	Description	Units	Ancillary Variables
obs_id	string	obs	unique earth view observation identifier.		
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00	
obs_time_utc	uint16	obs, utc_tuple	UTC earth view observation time as an array of integers: year, month, day, hour, minute, second, millisec, microsec		
lat	float	obs	latitude of FOV center	degrees_north	bnds
lon	float	obs	longitude of FOV center	degrees_east	bnds
land_frac	float	obs	land fraction over the FOV	unitless	
surf_alt	float	obs	mean surface altitude wrt earth model over the FOV	m	sdev
sol_zen	float	obs	solar zenith angle at the center of the FOV	degree	
sun_glint_dist	float	obs	Distance from the center of the calculated sun glint spot to the center of the spot. Note that there may not be a glint for cloudy or land cases and in ocean cases the glint can move based on wind conditions. Fill for night observations.	m	
view_ang	float	obs	off nadir pointing angle	degree	
sat_zen	float	obs	satellite zenith angle at the center of the FOV	degree	
asc_flag	ubyte	obs	ascending orbit flag: 1 if ascending, 0 descending		
sat_alt	float	obs	satellite altitude with respect to earth model at scan_mid_time	m	
ingran_index	unsigned short int	obs	1-based index into granules in the corresponding *_ingran group. This is not always the granule number.	unitless	
ingran_atrack	unsigned short int	obs	1-based 'atrack' dimension index of observation in original granule	unitless	
ingran_xtrack	unsigned short int	obs	1-based 'xtrack' dimension index of observation in source granule	unitless	
brightness_temp	float32	obs, channel	Brightness temperature	Kelvin	qc
rad_vis_mean	float32	obs, band_vnir	The mean of the 72 pixels for Visible/Near Infrared channels	W/(m2 sr um)	rad_vis_sdev
rad_vis_sdev	float32	obs, band_vnir	The standard deviation of the 72 pixels for Visible/Near Infrared channels	W/(m2 sr um)	
rad_vis_max	float32	obs, band_vnir	The maximum of the 72 pixels for Visible/Near Infrared channels	W/(m2 sr um)	
baseline_nedn	float32	channel	baseline reference level for noise equivalent differential radiance at a scene BT of 250 K	mW/(m2 sr cm-1)	
wnum_index_1b	int32	channel	Index linking to the AIRS LIB 2378-channel wavenumber list. (1-based)	unitless	
wnum	float64	channel	wavenumber	cm-1	
cx1231	float32	obs	cx1231 - 4-neighbor uniformity at 1231 cm-1	Kelvin	
cx2616	float32	obs	cx2616 - 4-neighbor uniformity at 2616 cm-1	Kelvin	
cx900	float32	obs	cx900 - 4-neighbor uniformity at 900 cm-1	Kelvin	
sst1231r5	float32	obs	Simple surface temperature derived from the 1231.3 radiance assuming clear conditions, corrected for water vapor absorption using the split1231.3/1227.7 channel pair trained using SARTA from 2002. A rough estimate of cloud impact can be made by comparing it to stemp_cmc for ocean or stemp_clim for land.	Kelvin	

Attributes for the 11b_airs group

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).

source	string	1	AIRS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1B	A textual description of the processing (or quality control) level of the data.
project	string	1	AIRS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	AIRS	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
platform	string	1	AQUA > Earth Observing System	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
instrument	string	1	AIRS > Atmospheric Infrared Sounder	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.
title	string	1	Aqua AIRS Level-1B	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The Level-1B AIRS product includes data from the AIRS instrument for one six-minute interval. Data is geolocated and calibrated.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	AIRSAQAIRSL1B	ECS Short Name
product_group	string	1	l1b_airs	The group name to be used for this product when it is collected in a multi-group file type, like SNO or calsub
metadata_link	string	1	http://disc.sci.gsfc.nasa.gov/	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1		ATDB and design documents describing processing algorithms. Can be empty.

l1b_airs_ingran group

Dimensions for the l1b_airs_ingran group

Name	Size	Description
channel	2,378	wavenumber
gran	-1	granules contributing

Variables for the l1b_airs_ingran group

Name	Type	Dimensions	Description	Units
ingran_file_name	string	gran	Input file name	
ingran_granule_number	unsigned short int	gran	granule number of day (1-240)	
ingran_gran_id	string	gran	Unique granule identifier yyyyymmddThhmm of granule start	
ingran_orbitDirection	string	gran	Orbit is ascending and/or descending. Values are 'Ascending' or 'Descending' if the entire granule fits that description. 'NorthPole' and 'SouthPole' are used for polar-crossing granules. 'NA' is used when a determination cannot be made.	
ingran_day_night_flag	string	gran	Data is day or night. 'Day' means subsatellite point for all valid scans has solar zenith angle less than 90 degrees. 'Night' means subsatellite point for all valid scans has solar zenth angle greater	

			than 90 degrees. 'Both' means the dataset contains valid observations with solar zenith angle above and below 90 degrees. 'NA' means a value could not be determined.	
ingran_geospatial_lat_mid	float	gran	granule center latitude	degrees_north
ingran_geospatial_lon_mid	float	gran	granule center longitude	degrees_east
ingran_geospatial_bounds	string	gran	Describes the horizontal geospatial extent in OGCs Well-Known Text (WKT) Geometry format.	
nedn	float32	gran, channel	noise equivalent differential radiance at a scene BT of 250 K	mW/(m2 sr cm-1)
nedt250	float32	gran, channel	noise equivalent delta temperature for a 250 K scene	Kelvin
spec_shift_y0	float32	gran	Focal plane shift calculated in grating model fit to upwelling radiances In these units the spectral response function width is 100 um.	um
wnum	float64	channel	Nominal wavenumbers at the centroid of the spectral response. Actual wavenumbers can vary slightly, but under 1% of spectral response function width.	cm-1
ab_weight	int8	gran, channel	Which of the A/B redundant detectors were used: 0: A weight = B weight; 1: A side only; 2: B side only	
static_qual	int8	gran, channel	static channel quality flagging	
gain	float32	gran, channel	Gain	mW/(m2 sr cm-1)/Count
scan_mirror_temp	float32	gran	scan mirror temperature	Kelvin
entr_filter_temp	float32	gran	entrance filter temperature	Kelvin
grating_temp_2	float32	gran	grating temperature 2	Kelvin
nedt250_ref	float32	channel	ratio of NEDT250 to a reference from 2002-09-01	unitless
i_ref_relative_noise	float32	gran	granule mean of nedt250_ref to find granules with bad noise overall like partial granules	unitless
std_sv3_signal	float32	gran, channel	Standard deviation of spaceview 3 signals	Count
std_bb_signal	float32	gran, channel	Standard deviation of blackbody signals	Count
mean_bb_signal	float32	gran, channel	Mean of blackbody signals	Count
svdratio	uint8	gran, channel	Range of spaceviews in noise units	unitless
i_1p1128	float32	gran	1st percentile of BT at 1128 cm-1 over all spectra in the granule.	Kelvin
i_1p1231	float32	gran	1st percentile of BT at 1231 cm-1 over all spectra in the granule.	Kelvin
i_1p2616	float32	gran	1st percentile of BT at 2616 cm-1 over all spectra in the granule.	Kelvin
i_1p901	float32	gran	1st percentile of BT at 901 cm-1 over all spectra in the granule.	Kelvin
i_99p1128	float32	gran	99th percentile of BT at 1128 cm-1 over all spectra in the granule.	Kelvin
i_99p1231	float32	gran	99th percentile of BT at 1231 cm-1 over all spectra in the granule.	Kelvin
i_99p2616	float32	gran	99th percentile of BT at 2616 cm-1 over all spectra in the granule.	Kelvin
i_99p901	float32	gran	99th percentile of BT at 901 cm-1 over all spectra in the granule.	Kelvin
i_pixel_count	float32	gran	Count of valid spectra in the granule. Nominally 12150.	unitless
i_LandPixel_count	float32	gran	Count of spectra considered land.	unitless
i_OceanPixel_count	float32	gran	Count of spectra considered ocean.	unitless
i_PLR_clear_land_d1231c	float32	gran	The mean value of d1231c over land spectra identified as clear according to the PLR Pseudo-Lapse Rate test. d1231c = sst1231r5 - stemp_clim	Kelvin
i_PLR_frozen_d1231c	float32	gran	The mean value of d1231c over frozen spectra identified as clear according to the PLR Pseudo-Lapse Rate test. d1231c = sst1231r5 - stemp_clim	Kelvin
i_count_land_fire	float32	gran	Count of spectra where fire is detected	unitless
i_count901_210	float32	gran	Count of spectra where BT at 901 cm-1 is < 210 K	unitless
i_count901_225	float32	gran	Count of spectra where BT at 901 cm-1 is < 225 K	unitless
i_count901_235	float32	gran	Count of spectra where BT at 901 cm-1 is < 235 K	unitless
i_count1231_210	float32	gran	Count of spectra where BT at 1231 cm-1 is < 210 K	unitless
i_count1231_225	float32	gran	Count of spectra where BT at 1231 cm-1 is < 225 K	unitless
i_count1231_235	float32	gran	Count of spectra where BT at 1231 cm-1 is < 235 K	unitless
i_count1231gt320	float32	gran	Count of spectra where BT at 1231 cm-1 is > 320 K	unitless
i_count1231gt325	float32	gran	Count of spectra where BT at 1231 cm-1 is > 325 K	unitless
i_count1231gt330	float32	gran	Count of spectra where BT at 1231 cm-1 is > 330 K	unitless
i_count1231gt335	float32	gran	Count of spectra where BT at 1231 cm-1 is > 335 K	unitless

i_count1231gt340	float32	gran	Count of spectra where BT at 1231 cm-1 is > 340 K	unitless
i_countbt900gt340	float32		Count of spectra where BT at 900 cm-1 is > 340 K	unitless
i_forecast_clear_ocean_d1231	float32	gran	Mean of d1231 over ocean spectra identified as forecast clear because $\text{abs}(d1231) < 1 \text{ K}$. $d1231 = \text{sst}1231r5 - \text{stemp_cmc}$	Kelvin
i_found5_so2	float32	gran	Count of spectra with a SO2-indicator value of at least 5 K. SO2 indicator $\text{so2} = \text{bt}1433.0 - \text{bt}1361.4$; The two channels are located near an so2 absorption band, and appear to be related to volcano activities. A count of more then 10 colocated spectra with $\text{so2} > 5$ is significant.	unitless
i_found6_so2	float32	gran	Count of spectra with a SO2-indicator value of at least 6 K. SO2 indicator $\text{so2} = \text{bt}1433.0 - \text{bt}1361.4$; The two channels are located near an so2 absorption band, and appear to be related to volcano activities. A count of more then 10 colocated spectra with $\text{so2} > 5$ is significant.	unitless
i_found7_so2	float32	gran	Count of spectra with a SO2-indicator value of at least 7 K. SO2 indicator $\text{so2} = \text{bt}1433.0 - \text{bt}1361.4$; The two channels are located near an so2 absorption band, and appear to be related to volcano activities. A count of more then 10 colocated spectra with $\text{so2} > 5$ is significant.	unitless
i_found_PLR_clear_land	float32	gran	Count of land spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_frozen	float32	gran	Count of frozen spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_SCT_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the SCT Spatial Coherence test.	unitless
i_found_forecast_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the Forecast Clear test.	unitless
i_found_sct_low_stratus_ocean	float32	gran	Count of ocean spectra that pass the $\text{cx}1231 < 0.5 \text{ K}$ test but have $\text{abs}(d1231) < -4 \text{ K}$	unitless
i_max1231	float32	gran	The hottest value of BT at 1231 cm-1 in the granule.	Kelvin
i_max_bt1231_lat	float32	gran	Latitude of i_max1231	degrees_north
i_max_bt1231_lon	float32	gran	Longitude of i_max1231	degrees_east
i_mean_lat	float32	gran	Granule mean latitude	degrees_north
i_mean_lon	float32	gran	Granule mean longitude	degrees_east
i_mean_solzen	float32	gran	Granule mean solar zenith angle	degrees
i_mean901	float32	gran	Granule mean BT at 901 cm-1	Kelvin
i_mean1128	float32	gran	Granule mean BT at 1128 cm-1	Kelvin
i_mean1231	float32	gran	Granule mean BT at 1231 cm-1	Kelvin
i_mean2616	float32	gran	Granule mean BT at 2616 cm-1	Kelvin
i_min901	float32	gran	Granule minimum BT at 901 cm-1	Kelvin
i_min1128	float32	gran	Granule minimum BT at 1128 cm-1	Kelvin
i_min1231	float32	gran	Granule minimum BT at 1231 cm-1	Kelvin
i_min2616	float32	gran	Granule minimum BT at 2616 cm-1	Kelvin
i_std901	float32	gran	Granule standard deviation of BT at 901 cm-1	Kelvin
i_std1128	float32	gran	Granule standard deviation of BT at 1128 cm-1	Kelvin
i_std1231	float32	gran	Granule standard deviation of BT at 1231 cm-1	Kelvin
i_std2616	float32	gran	Granule standard deviation of BT at 2616 cm-1	Kelvin
i_mean_d1231	float32	gran	Granule mean of d1231. $d1231 = \text{sst}1231r5 - \text{stemp_cmc}$	Kelvin
i_std_d1231	float32	gran	Granule standard deviation of d1231. $d1231 = \text{sst}1231r5 - \text{stemp_cmc}$	Kelvin
i_plr_clear_ocean_d1231	float32	gran	The mean value of d1231 over land spectra identified as clear according to the PLR Pseudo-Lapse Rate test. $d1231 = \text{sst}1231r5 - \text{stemp_cmc}$	
i_so2_mean	float32	gran	Granule mean of SO2-indicator $\text{so2} = \text{bt}1433.0 - \text{bt}1361.4$; The two channels are located near an SO2 absorption band, and appear to be related to volcano activities.	Kelvin
i_so2_std	float32	gran	Granule standard deviation of SO2-indicator $\text{so2} = \text{bt}1433.0 - \text{bt}1361.4$; The two channels are located near an SO2 absorption band, and appear to be related to volcano activities.	Kelvin
i_start_tia	float32	gran	Granule start time	seconds since 1993-01-01 00:00

Dimensions for the 11b_amsua group

Name	Size	Description
channel	15	channel number
band	3	Microwave bands
spaceextract	2	space view

Variables for the 11b_amsua group

Name	Type	Dimensions	Description	Units	Ancillary Variables
obs_id	string	obs	unique earth view observation identifier.		
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00	
obs_time_utc	uint16	obs, utc_tuple	UTC earth view observation time as an array of integers: year, month, day, hour, minute, second, millisec, microsec		
lat	float	obs	latitude of FOV center	degrees_north	bnds
lon	float	obs	longitude of FOV center	degrees_east	bnds
land_frac	float	obs	land fraction over the FOV	unitless	
surf_alt	float	obs	mean surface altitude wrt earth model over the FOV	m	sdev
sol_zen	float	obs	solar zenith angle at the center of the FOV	degree	
sun_glint_dist	float	obs	Distance from the center of the calculated sun glint spot to the center of the spot. Note that there may not be a glint for cloudy or land cases and in ocean cases the glint can move based on wind conditions. Fill for night observations.	m	
view_ang	float	obs	off nadir pointing angle	degree	
sat_zen	float	obs	satellite zenith angle at the center of the FOV	degree	
asc_flag	ubyte	obs	ascending orbit flag: 1 if ascending, 0 descending		
sat_alt	float	obs	satellite altitude with respect to earth model at scan_mid_time	m	
ingran_index	unsigned short int	obs	1-based index into granules in the corresponding *_ingran group. This is not always the granule number.	unitless	
ingran_atrack	unsigned short int	obs	1-based 'atrack' dimension index of observation in original granule	unitless	
ingran_xtrack	unsigned short int	obs	1-based 'xtrack' dimension index of observation in source granule	unitless	
antenna_temp	float	obs, channel	Raw antenna temperature	Kelvin	
brightness_temp	float	obs, channel	Antenna temperatures, with an empirically derived correction applied to compensate for scan-position dependent bias. This correction is derived from AIRS retrievals.	Kelvin	
calib_degraded	int	obs, channel	Channel bitmap for AMSU-A: Bit 0: (LSB, value 1) All space view counts were bad for this channel and scanline; Bit 1: (value 2) Space view counts were marginal for this channel and scanline; Bit 2: (value 4) Space view counts could not be smoothed; Bit 3: (value 8) All blackbody counts were bad for this channel and scanline; Bit 4: (value 16) Blackbody counts were marginal for this channel and scanline; Bit 5: (value 32) Blackbody counts could not be smoothed; Bit 6: (value 64) Unable to calculate calibration coefficients for this scanline, most recent valid coefficients used instead; Bit 7: (value 128) Excessive NeDT estimated		
band_lbl	string	band	List of Microwave bands (A11, A12, A2)		
channel	unsigned short int	channel	Number for each channel (1-22)	unitless	
chan_band	string	channel	Name of band for each channel		
antenna	string	channel	Name of antenna for each channel		
center_freq	float	channel	Channel center frequency	MHz	
if_offset_1	float	channel	Offset of first intermediate frequency stage (zero for no mixing)	MHz	
if_offset_2	float	channel	Offset of second intermediate frequency stage (zero for no mixing)	MHz	
bandwidth	float	channel	bandwidth of sum of 1, 2, or 4 channels	MHz	
polarization	char	channel	Nominal polarization: Vertical or Horizontal		
beam_width	float	channel	Nominal beam width	degree	

Attributes for the 11b_amsua group

Name	Type	Size	Value	Description
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source	string	1	AMSU-A instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1B	A textual description of the processing (or quality control) level of the data.
project	string	1	AIRS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	AIRS	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
platform	string	1	AQUA > Earth Observing System	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
instrument	string	1	AMSU-A > Advanced Microwave Sounding Unit-A	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.

11b_amsua_ingran group

Dimensions for the 11b_amsua_ingran group

Name	Size	Description
channel	15	channel number
gran	-1	granules contributing

Variables for the 11b_amsua_ingran group

Name	Type	Dimensions	Description	Units
ingran_file_name	string	gran	Input file name	
ingran_granule_number	unsigned short int	gran	granule number of day (1-240)	
ingran_gran_id	string	gran	Unique granule identifier yyymmddThhmm of granule start	
ingran_orbitDirection	string	gran	Orbit is ascending and/or descending. Values are 'Ascending' or 'Descending' if the entire granule fits that description. 'NorthPole' and 'SouthPole' are used for polar-crossing granules. 'NA' is used when a determination cannot be made.	
ingran_day_night_flag	string	gran	Data is day or night. 'Day' means subsatellite point for all valid scans has solar zenith angle less than 90 degrees. 'Night' means subsatellite point for all valid scans has solar zentih angle greater than 90 degrees. 'Both' means the dataset contains valid observations with solar zenith angle above and below 90 degrees. 'NA' means a value could not be determined.	
ingran_geospatial_lat_mid	float	gran	granule center latitude	degrees_north
ingran_geospatial_lon_mid	float	gran	granule center longitude	degrees_east
ingran_geospatial_bounds	string	gran	Describes the horizontal geospatial extent in OGCs Well-Known Text (WKT) Geometry format.	
warm_nedt	float	gran, channel	Noise equivalent delta temperature derived from observations of the warm calibration target	Kelvin

select group

Dimensions for the select group

Name	Size	Description
calsite	40	calibration sites

Variables for the select group

Name	Type	Dimensions	Description	Units
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obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00
lat	float	obs	latitude of FOV center	degrees_north
lon	float	obs	longitude of FOV center	degrees_east
reason	unsigned short int	obs	Bitcode giving reason(s) why this observation was selected for inclusion in calibration subset products.	
site_id	short int	obs	Validation site ID if reason is validation site. Special codes identify other reasons as well. If a case satisfies multiple criteria then this will contain the code for the last one set -- see the bits in reason.	
distance	float	obs	Distance between validation site and observation	m
stemp_cmc	float	obs	Surface temperature from Canadian Meteorological Center	Kelvin
stemp_clim	float	obs	Surface temperature from AIRS L3 climatology for 2003-2006	Kelvin
calsite_id	short int	calsite	calibration site ID number. Numbers outside of [1, 50] tag observations which were selected for reasons other than proximity to calibration sites.	
calsite_name	string	calsite	Calibration site name	
calsite_lat	float	calsite	calibration site latitude	degrees_north
calsite_lon	float	calsite	calibration site longitude	degrees_east
calsite_dlat	float	calsite	maximum delta latitude miss distance for this calibration site	degree
calsite_dlon	float	calsite	maximum delta longitude miss distance for this calibration site	degree
calsite_addl_cond	string	calsite	additional conditions when collecting data for this calibration site	
calsite_notes	string	calsite	notes for this calibration site	

Attributes for the select group

Name	Type	Size	Value	Description
primary_product_group	string	1	11b_airs	group name for the observations that are the primary product type. Observations will be ordered by time of observations in this group. Distances and times are measured from this group.
match_product_group	string	1	TBD	group name for the observations that are matched the primary product type. Distances and times are measured from primary_product_group to this group.

B4 Aqua Random

CALSUB AIRS 1C Interface Specification

Interface Specification Version v02.02.20
09-03-2021

Groups

Path	Description
/	
/select	Info about the selection of the matches
/11c_airs	Level-1C AIRS
/11b_amsua	Level-1B AMSU-A
/11c_airs_ingran	Per-granule L1C AIRS info
/11b_amsua_ingran	Per-granule L1B AMSU-A info

Global Dimensions

Name	Size	Description
obs	-1	Trajectory dimension counting number of observations matching criteria
fov_poly	8	lat_bnds, lon_bnds points defining the polygon bounding an FOV (anticlockwise as viewed from above)
utc_tuple	8	parts of UTC time: year, month, day, hour, minute, second, millisecond, microsecond

Global Variables

Name	Type	Dimensions	Description
utc_tuple_lbl	string	utc_tuple	names of the elements of UTC when it is expressed as an array of integers year,month,day,hour,minute,second,millisecond,microsecond

Global Attributes

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > MICROWAVE > ANTENNA TEMPERATURE, EARTH SCIENCE > SPECTRAL/ENGINEERING > MICROWAVE > BRIGHTNESS TEMPERATURE, EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
Conventions	string	1	CF-1.6, ACDD-1.3	A comma-separated list of the conventions that are followed by the dataset.
history	string	1		Provides an audit trail for modifications to the original data. This attribute is also in the NetCDF Users Guide: 'This is a character array with a line for each invocation of a program that has modified the dataset. Well-behaved generic netCDF applications should append a line containing: date, time of day, user name, program name and command arguments.' To include a more complete description you can append a reference to an ISO Lineage entity; see NOAA EDM ISO Lineage guidance.
source	string	1	AIRS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1	A textual description of the processing (or quality control) level of the data.
product_name_type_id	string	1	L1C_CALSUB	Product name as it appears in product_name (L1A, L1B, L2, CalSub_Fixed)
comment	string	1		Miscellaneous information about the data or methods used to produce it. Can be empty.
acknowledgment	string	1	Support for this research was provided by NASA.	A place to acknowledge various types of support for the project that produced this data.

license	string	1	Limited to Sounder SIPS affiliates	Provide the URL to a standard or specific license, enter "Freely Distributed" or "None", or describe any restrictions to data access and distribution in free text.
standard_name_vocabulary	string	1	CF Standard Name Table v28	The name and version of the controlled vocabulary from which variable standard names are taken. (Values for any standard_name attribute must come from the CF Standard Names vocabulary for the data file or product to comply with CF.) Example: 'CF Standard Name Table v27'.
date_created	string	1	Unassigned	The date on which this version of the data was created. (Modification of values implies a new version, hence this would be assigned the date of the most recent values modification.) Metadata changes are not considered when assigning the date_created. The ISO 8601:2004 extended date format is recommended, as described in the Attribute Content Guidance section.
creator_name	string	1	Unassigned	The name of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_email	string	1	Unassigned	The email address of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
creator_url	string	1	Unassigned	The URL of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.
institution	string	1	Unassigned	Processing facility that produced this file
project	string	1	Sounder SIPS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	SNDR	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
publisher_name	string	1	Unassigned	The name of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_email	string	1	Unassigned	The email address of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
publisher_url	string	1	Unassigned	The URL of the person (or other entity specified by the publisher_type attribute) responsible for publishing the data file or product to users, with its current metadata and format.
geospatial_bounds	string	1	POLYGON ((-180.0 -90.0, 180.0 -90.0, 180.0 90.0, -180.0 90.0, -180.0 -90.0))	Describes the data's 2D or 3D geospatial extent in OGC's Well-Known Text (WKT) Geometry format (reference the OGC Simple Feature Access (SFA) specification). The meaning and order of values for each point's coordinates depends on the coordinate reference system (CRS). The ACDD default is 2D geometry in the EPSG:4326 coordinate reference system. The default may be overridden with geospatial_bounds_crs and geospatial_bounds_vertical_crs (see those attributes). EPSG:4326 coordinate values are latitude (decimal degrees_north) and

				longitude (decimal degrees_east), in that order. Longitude values in the default case are limited to the [-180, 180) range. Example: 'POLYGON ((-111.29 40.26, -111.29 41.26, -110.29 41.26, -110.29 40.26, -111.29 40.26))'.
geospatial_bounds_crs	string	1	EPSG:4326	The coordinate reference system (CRS) of the point coordinates in the geospatial_bounds attribute. This CRS may be 2-dimensional or 3-dimensional, but together with geospatial_bounds_vertical_crs, if that attribute is supplied, must match the dimensionality, order, and meaning of point coordinate values in the geospatial_bounds attribute. If geospatial_bounds_vertical_crs is also present then this attribute must only specify a 2D CRS. EPSG CRSs are strongly recommended. If this attribute is not specified, the CRS is assumed to be EPSG:4326. Examples: 'EPSG:4979' (the 3D WGS84 CRS), 'EPSG:4047'.
geospatial_lat_min	float	1		Describes a simple lower latitude limit; may be part of a 2- or 3-dimensional bounding region. Geospatial_lat_min specifies the southernmost latitude covered by the dataset.
geospatial_lat_max	float	1		Describes a simple upper latitude limit; may be part of a 2- or 3-dimensional bounding region. Geospatial_lat_max specifies the northernmost latitude covered by the dataset.
geospatial_lon_min	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. geospatial_lon_min specifies the westernmost longitude covered by the dataset. See also geospatial_lon_max.
geospatial_lon_max	float	1		Describes a simple longitude limit; may be part of a 2- or 3-dimensional bounding region. geospatial_lon_max specifies the easternmost longitude covered by the dataset. Cases where geospatial_lon_min is greater than geospatial_lon_max indicate the bounding box extends from geospatial_lon_max, through the longitude range discontinuity meridian (either the antimeridian for -180:180 values, or Prime Meridian for 0:360 values), to geospatial_lon_min; for example, geospatial_lon_min=170 and geospatial_lon_max=-175 incorporates 15 degrees of longitude (ranges 170 to 180 and -180 to -175).
time_coverage_start	string	1		Nominal start time. Describes the time of the first data point in the data set. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_of_first_valid_obs	string	1		Describes the time of the first valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_mid	string	1		Describes the midpoint between the nominal start and end times. Use the ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.
time_coverage_end	string	1		Nominal end time. Describes the time of the last data point in the data set. Use ISO 8601:2004 date format, preferably the extended format as recommended in the Attribute Content Guidance section.

time_of_last_valid_obs	string	1		Describes the time of the last valid data point in the data set. Use the ISO 8601:2004 date extended format.
time_coverage_duration	string	1	P0000-00-01T00:00:00	Describes the duration of the data set. Use ISO 8601:2004 duration format, preferably the extended format as recommended in the Attribute Content Guidance section.
product_name_duration	string	1	D01	Product duration as it appears in product_name (D01 means full day)
creator_type	string	1	institution	Specifies type of creator with one of the following: 'person', 'group', 'institution', or 'position'. If this attribute is not specified, the creator is assumed to be a person.
creator_institution	string	1	Jet Propulsion Laboratory -- California Institute of Technology	The institution of the creator; should uniquely identify the creator's institution. This attribute's value should be specified even if it matches the value of publisher_institution, or if creator_type is institution.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
keywords_vocabulary	string	1	GCMD:GCMD Keywords	If you are using a controlled vocabulary for the words/phrases in your "keywords" attribute, this is the unique name or identifier of the vocabulary from which keywords are taken. If more than one keyword vocabulary is used, each may be presented with a prefix and a following comma, so that keywords may optionally be prefixed with the controlled vocabulary key. Example: 'GCMD:GCMD Keywords, CF:NetCDF COARDS Climate and Forecast Standard Names'.
platform	string	1	AQUA > Earth Observing System	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
platform_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "platform" attribute.
product_name_platform	string	1	AQUA	Platform name as it appears in product_name
instrument	string	1	AIRS > Atmospheric Infrared Sounder, AMSU-A > Advanced Microwave Sounding Unit-A	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
instrument_vocabulary	string	1	GCMD:GCMD Keywords	Controlled vocabulary for the names used in the "instrument" attribute.
product_name_instr	string	1	AIRS	Instrument name as it appears in product_name
product_name	string	1		Canonical fully qualified product name (official file name)
product_name_variant	string	1	std	Processing variant identifier as it appears in product_name. 'std' (shorthand for 'standard') is to be the default and should be what is seen in all public products.
product_name_version	string	1	vxx_xx_xx	Version number as it appears in product_name (v01_00_00)
product_name_producer	string	1	T	Production facility as it appears in product_name (single character) 'T' is the default, for unofficial local test products
product_name_timestamp	string	1	yymmddhhmmss	Processing timestamp as it appears in product_name (yymmddhhmmss)
product_name_extension	string	1	nc	File extension as it appears in product_name (typically nc)

gran_id	string	1	yyyymmdd	Unique granule identifier yyyymmdd of granule start day, including year, month, and day of granule start time
featureType	string	1	trajectory	structure of data in file
data_structure	string	1	trajectory	a character string indicating the internal organization of the data with currently allowed values of 'grid', 'station', 'trajectory', or 'swath'. The 'structure' here generally describes the horizontal structure and in all cases data may also be functions, for example, of a vertical coordinate and/or time. (If using CMOR pass this in a call to cmor_set_cur_dataset_attribute.)
cdm_data_type	string	1	Trajectory	The data type, as derived from Unidata's Common Data Model Scientific Data types and understood by THREDDS. (This is a THREDDS "dataType", and is different from the CF NetCDF attribute 'featureType', which indicates a Discrete Sampling Geometry file in CF.)
id	string	1	Unassigned	An identifier for the data set, provided by and unique within its naming authority. The combination of the "naming authority" and the "id" should be globally unique, but the id can be globally unique by itself also. IDs can be URLs, URNs, DOIs, meaningful text strings, a local key, or any other unique string of characters. The id should not include white space characters.
naming_authority	string	1	Unassigned	The organization that provides the initial id (see above) for the dataset. The naming authority should be uniquely specified by this attribute. We recommend using reverse-DNS naming for the naming authority; URIs are also acceptable. Example: 'edu.ucar.unidata'.
identifier_product_doi	string	1	Unassigned	digital signature
identifier_product_doi_authority	string	1	Unassigned	digital signature source
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.
production_host	string	1		Identifying information about the host computer for this run. (Output of linux "uname -a" command.)
format_version	string	1	v02.02.20	Format version.
input_file_names	string	1		Semicolon-separated list of names or unique identifiers of files that were used to make this product. There will always be one space after each semicolon. There is no final semicolon.
input_file_types	string	1		Semicolon-separated list of tags giving the role of each input file in input_file_names. There will always be one space after each semicolon. There is no final semicolon.
input_file_dates	string	1		Semicolon-separated list of creation dates for each input file in input_file_names. There will always be one space after each semicolon. There is no final semicolon.
AutomaticQualityFlag	string	1	Missing	"Passed": the granule contains a non-degraded calibrated brightness temperature, radiance, or retrieved value for at least one value in a geolocated FOV; "Suspect": the granule does not qualify as "Passed" but contains a (possibly degraded) calibrated or retrieved value (possibly without associated

				geolocation); "Failed": the granule contains no calibrated or retrieved values.
qa_no_data	string	1	TRUE	A simple indicator of whether this is an "empty" granule with no data from the instrument. "TRUE" or "FALSE".
title	string	1	Aqua AIRS Calibration Subset Level-1C Random Full Spectra	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The Level-1C AIRS calibration subset product contains randomly sampled full Level-1C spectra from AIRS and AMSU-A selected to support investigation of instrument properties and comparisons with other similar instruments.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	SNDRAQIML1CCALSUBRND	ECS Short Name
metadata_link	string	1	Unassigned	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1		ATDB and design documents describing processing algorithms. Can be empty.

11b_amsua group

Dimensions for the 11b_amsua group

Name	Size	Description
channel	15	channel number
band	3	Microwave bands
spacetrack	2	space view

Variables for the 11b_amsua group

Name	Type	Dimensions	Description	Units	Ancillary Variables
obs_id	string	obs	unique earth view observation identifier.		
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00	
obs_time_utc	uint16	obs, utc_tuple	UTC earth view observation time as an array of integers: year, month, day, hour, minute, second, millisec, microsec		
lat	float	obs	latitude of FOV center	degrees_north	bnds
lon	float	obs	longitude of FOV center	degrees_east	bnds
land_frac	float	obs	land fraction over the FOV	unitless	
surf_alt	float	obs	mean surface altitude wrt earth model over the FOV	m	sdev
sol_zen	float	obs	solar zenith angle at the center of the FOV	degree	
sun_glint_dist	float	obs	Distance from the center of the calculated sun glint spot to the center of the spot. Note that there may not be a glint for cloudy or land cases and in ocean cases the glint can move based on wind conditions. Fill for night observations.	m	
view_ang	float	obs	off nadir pointing angle	degree	
sat_zen	float	obs	satellite zenith angle at the center of the FOV	degree	
asc_flag	ubyte	obs	ascending orbit flag: 1 if ascending, 0 descending		
sat_alt	float	obs	satellite altitude with respect to earth model at scan_mid_time	m	
ingran_index	unsigned short int	obs	1-based index into granules in the corresponding *_ingran group. This is not always the granule number.	unitless	
ingran_atrack	unsigned short int	obs	1-based 'atrack' dimension index of observation in original granule	unitless	
ingran_xtrack	unsigned short int	obs	1-based 'xtrack' dimension index of observation in source granule	unitless	
antenna_temp	float	obs, channel	Raw antenna temperature	Kelvin	
brightness_temp	float	obs, channel	Antenna temperatures, with an empirically derived correction applied to compensate for scan-position dependent bias. This correction is derived from AIRS retrievals.	Kelvin	
calib_degraded	int	obs, channel	Channel bitmap for AMSU-A: Bit 0: (LSB, value 1) All space view counts were bad for this channel and scanline; Bit 1: (value 2) Space view counts were marginal for this channel and scanline; Bit 2: (value 4) Space view counts could not be smoothed; Bit 3: (value 8) All blackbody counts were bad for this channel and scanline; Bit 4: (value 16) Blackbody counts were marginal for this channel and scanline; Bit 5: (value 32)		

			Blackbody counts could not be smoothed; Bit 6: (value 64) Unable to calculate calibration coefficients for this scanline, most recent valid coefficients used instead; Bit 7: (value 128) Excessive NeDT estimated		
band_lbl	string	band	List of Microwave bands (A11, A12, A2)		
channel	unsigned short int	channel	Number for each channel (1-22)	unitless	
chan_band	string	channel	Name of band for each channel		
antenna	string	channel	Name of antenna for each channel		
center_freq	float	channel	Channel center frequency	MHz	
if_offset_1	float	channel	Offset of first intermediate frequency stage (zero for no mixing)	MHz	
if_offset_2	float	channel	Offset of second intermediate frequency stage (zero for no mixing)	MHz	
bandwidth	float	channel	bandwidth of sum of 1, 2, or 4 channels	MHz	
polarization	char	channel	Nominal polarization: Vertical or Horizontal		
beam_width	float	channel	Nominal beam width	degree	

Attributes for the 11b_amsua group

Name	Type	Size	Value	Description
source	string	1	AMSU-A instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1B	A textual description of the processing (or quality control) level of the data.
project	string	1	AIRS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	AIRS	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
platform	string	1	AQUA > Earth Observing System	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
instrument	string	1	AMSU-A > Advanced Microwave Sounding Unit-A	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.

11b_amsua_ingran group

Dimensions for the 11b_amsua_ingran group

Name	Size	Description
channel	15	channel number
gran	-1	granules contributing

Variables for the 11b_amsua_ingran group

Name	Type	Dimensions	Description	Units
ingran_file_name	string	gran	Input file name	
ingran_granule_number	unsigned short int	gran	granule number of day (1-240)	
ingran_gran_id	string	gran	Unique granule identifier yyyyymmddThhmm of granule start	
ingran_orbitDirection	string	gran	Orbit is ascending and/or descending. Values are 'Ascending' or 'Descending' if the entire granule fits that description. 'NorthPole' and 'SouthPole' are used for polar-crossing granules. 'NA' is used when a determination cannot be made.	
ingran_day_night_flag	string	gran	Data is day or night. 'Day' means subsatellite point for all valid scans has solar zenith angle less than 90 degrees. 'Night' means subsatellite point for all valid scans has solar zentih angle greater than 90 degrees. 'Both' means the dataset contains valid observations with solar zenith angle above and below 90 degrees. 'NA' means a value could not be determined.	

ingran_geospatial_lat_mid	float	gran	granule center latitude	degrees_north
ingran_geospatial_lon_mid	float	gran	granule center longitude	degrees_east
ingran_geospatial_bounds	string	gran	Describes the horizontal geospatial extent in OGCs Well-Known Text (WKT) Geometry format.	
warm_nedt	float	gran, channel	Noise equivalent delta temperature derived from observations of the warm calibration target	Kelvin

11c_airs group

Dimensions for the 11c_airs group

Name	Size	Description
wnum	2,645	wavenumber
band_vnir	4	V/NIR bands

Variables for the 11c_airs group

Name	Type	Dimensions	Description	Units	Ancillary Variables
obs_id	string	obs	unique earth view observation identifier.		
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00	
obs_time_utc	uint16	obs, utc_tuple	UTC earth view observation time as an array of integers: year, month, day, hour, minute, second, millisecond, microsecond		
lat	float	obs	latitude of FOV center	degrees_north	bnds
lon	float	obs	longitude of FOV center	degrees_east	bnds
land_frac	float	obs	land fraction over the FOV	unitless	
surf_alt	float	obs	mean surface altitude wrt earth model over the FOV	m	sdev
sol_zen	float	obs	solar zenith angle at the center of the FOV	degree	
sun_glint_dist	float	obs	Distance from the center of the calculated sun glint spot to the center of the spot. Note that there may not be a glint for cloudy or land cases and in ocean cases the glint can move based on wind conditions. Fill for night observations.	m	
view_ang	float	obs	off nadir pointing angle	degree	
sat_zen	float	obs	satellite zenith angle at the center of the FOV	degree	
asc_flag	ubyte	obs	ascending orbit flag: 1 if ascending, 0 descending		
sat_alt	float	obs	satellite altitude with respect to earth model at scan_mid_time	m	
ingran_index	unsigned short int	obs	1-based index into granules in the corresponding *_ingran group. This is not always the granule number.	unitless	
ingran_atrack	unsigned short int	obs	1-based 'atrack' dimension index of observation in original granule	unitless	
ingran_xtrack	unsigned short int	obs	1-based 'xtrack' dimension index of observation in source granule	unitless	
rad	float32	obs, wnum	spectral radiance	mW/(m ² sr cm ⁻¹)	qc
nedn	float32	obs, wnum	noise equivalent differential radiance at a scene BT of 250 K	mW/(m ² sr cm ⁻¹)	
rad_vis_mean	float32	obs, band_vnir	The mean of the 72 pixels for Visible/Near Infrared channels	W/(m ² sr um)	rad_vis_sdev
rad_vis_sdev	float32	obs, band_vnir	The standard deviation of the 72 pixels for Visible/Near Infrared channels	W/(m ² sr um)	
rad_vis_max	float32	obs, band_vnir	The maximum of the 72 pixels for Visible/Near Infrared channels	W/(m ² sr um)	
wnum	float64	wnum	Wavenumbers at the centroid of the spectral response.	cm ⁻¹	
11c_proc	uint8	obs, wnum	Bit field, by channel, for the current spectrum. Zero means the channel was unchanged in Level-1C. Bit 7 (MSB, value 128): This is a synthesized fill channel where the AIRS instrument does not have a detector. Bit 6: (value 64) Synthesized. See 11c_synth_reason for the cause. Bit 5: (value 32) Shifted frequency. Bit 4: (value 16) radiometric correction applied (not used). Bit 3: (value 8) unused/reserved (set to 0). Bit 2: (value 4) unused/reserved (set to 0). Bit 1: (value 2) unused/reserved (set to 0). Bit 0: (LSB, value 1) Output value is a dummy/filler value because data is missing or otherwise could not be processed.		
cx1231	float32	obs	cx1231 - 4-neighbor uniformity at 1231 cm ⁻¹	Kelvin	
cx2616	float32	obs	cx2616 - 4-neighbor uniformity at 2616 cm ⁻¹	Kelvin	
cx900	float32	obs	cx900 - 4-neighbor uniformity at 900 cm ⁻¹	Kelvin	

sst1231r5	float32	obs	Simple surface temperature derived from the 1231.3 radiance assuming clear conditions, corrected for water vapor absorption using the split1231.3/1227.7 channel pair trained using SARTA from 2002. A rough estimate of cloud impact can be made by comparing it to stemp_cmc for ocean or stemp_clim for land.	Kelvin	
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Attributes for the l1c_airs group

Name	Type	Size	Value	Description
keywords	string	1	EARTH SCIENCE > SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > INFRARED RADIANCE	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
source	string	1	AIRS instrument telemetry	The method of production of the original data. If it was model-generated, source should name the model and its version. If it is observational, source should characterize it. This attribute is defined in the CF Conventions. Examples: 'temperature from CTD #1234'; 'world model v.0.1'.
processing_level	string	1	1C	A textual description of the processing (or quality control) level of the data.
project	string	1	AIRS	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas, as described under Attribute Content Guidelines. Examples: 'PATMOS-X', 'Extended Continental Shelf Project'.
product_name_project	string	1	AIRS	The name of the project as it appears in the file name. 'SNDR' for all Sounder SIPS products, even AIRS products.
product_version	string	1	vxx.xx.xx	Version identifier of the data file or product as assigned by the data creator. For example, a new algorithm or methodology could result in a new product_version.
platform	string	1	AQUA > Earth Observing System	Name of the platform(s) that supported the sensor data used to create this data set or product. Platforms can be of any type, including satellite, ship, station, aircraft or other. Indicate controlled vocabulary used in platform_vocabulary.
instrument	string	1	AIRS > Atmospheric Infrared Sounder	Name of the contributing instrument(s) or sensor(s) used to create this data set or product. Indicate controlled vocabulary used in instrument_vocabulary.
algorithm_version	string	1		The version of the algorithm in whatever format is selected by the developers. After the main algorithm name and version, versions from multiple sub-algorithms may be concatenated with semicolon separators. (ex: 'CCAST 4.2; BB emis from MIT 2016-04-01') Must be updated with every delivery that changes numerical results.
title	string	1	Aqua AIRS Level-1C	a succinct description of what is in the dataset. (= ECS long name)
summary	string	1	The Level-1C AIRS product includes data from the AIRS instrument for one six-minute interval. Data is geolocated, calibrated, and corrected for instrument artifacts.	A paragraph describing the dataset, analogous to an abstract for a paper.
shortname	string	1	AIRSAQAIRSL1C	ECS Short Name
product_group	string	1	l1c_airs	The group name to be used for this product when it is collected in a multi-group file type, like SNO or calsub
metadata_link	string	1	http://disc.sci.gsfc.nasa.gov/	A URL that gives the location of more complete metadata. A persistent URL is recommended for this attribute.
references	string	1		ATDB and design documents describing processing algorithms. Can be empty.

l1c_airs_ingran group

Dimensions for the l1c_airs_ingran group

Name	Size	Description
wnum	2,645	wavenumber

gran	-1	granules contributing
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Variables for the llc_airs_ingran group

Name	Type	Dimensions	Description	Units
ingran_file_name	string	gran	Input file name	
ingran_granule_number	unsigned short int	gran	granule number of day (1-240)	
ingran_gran_id	string	gran	Unique granule identifier yyyyymmddThhmm of granule start	
ingran_orbitDirection	string	gran	Orbit is ascending and/or descending. Values are 'Ascending' or 'Descending' if the entire granule fits that description. 'NorthPole' and 'SouthPole' are used for polar-crossing granules. 'NA' is used when a determination cannot be made.	
ingran_day_night_flag	string	gran	Data is day or night. 'Day' means subsatellite point for all valid scans has solar zenith angle less than 90 degrees. 'Night' means subsatellite point for all valid scans has solar zentih angle greater than 90 degrees. 'Both' means the dataset contains valid observations with solar zenith angle above and below 90 degrees. 'NA' means a value could not be determined.	
ingran_geospatial_lat_mid	float	gran	granule center latitude	degrees_north
ingran_geospatial_lon_mid	float	gran	granule center longitude	degrees_east
ingran_geospatial_bounds	string	gran	Describes the horizontal geospatial extent in OGCs Well-Known Text (WKT) Geometry format.	
spec_shift_y0	float32	gran	Focal plane shift calculated in grating model fit to upwelling radiances	um
wnum	float64	wnum	wavenumber	cm-1
scan_mirror_temp	float32	gran	scan mirror temperature	Kelvin
entr_filter_temp	float32	gran	entrance filter temperature	Kelvin
grating_temp_2	float32	gran	grating temperature 2	Kelvin
i_ref_relative_noise	float32	gran	granule mean of nedt250_ref to find granules with bad noise overall like partial granules	unitless
i_1p1128	float32	gran	1st percentile of BT at 1128 cm-1 over all spectra in the granule.	Kelvin
i_1p1231	float32	gran	1st percentile of BT at 1231 cm-1 over all spectra in the granule.	Kelvin
i_1p2616	float32	gran	1st percentile of BT at 2616 cm-1 over all spectra in the granule.	Kelvin
i_1p901	float32	gran	1st percentile of BT at 901 cm-1 over all spectra in the granule.	Kelvin
i_99p1128	float32	gran	99th percentile of BT at 1128 cm-1 over all spectra in the granule.	Kelvin
i_99p1231	float32	gran	99th percentile of BT at 1231 cm-1 over all spectra in the granule.	Kelvin
i_99p2616	float32	gran	99th percentile of BT at 2616 cm-1 over all spectra in the granule.	Kelvin
i_99p901	float32	gran	99th percentile of BT at 901 cm-1 over all spectra in the granule.	Kelvin
i_pixel_count	float32	gran	Count of valid spectra in the granule. Nominally 12150.	unitless
i_LandPixel_count	float32	gran	Count of spectra considered land.	unitless
i_OceanPixel_count	float32	gran	Count of spectra considered ocean.	unitless
i_PLR_clear_land_d1231c	float32	gran	The mean value of d1231c over land spectra identified as clear according to the PLR Pseudo-Lapse Rate test. d1231c = sst1231r5 - stemp_clim	Kelvin
i_PLR_frozen_d1231c	float32	gran	The mean value of d1231c over frozen spectra identified as clear according to the PLR Pseudo-Lapse Rate test. d1231c = sst1231r5 - stemp_clim	Kelvin
i_count_land_fire	float32	gran	Count of spectra where fire is detected	unitless
i_count901_210	float32	gran	Count of spectra where BT at 901 cm-1 is < 210 K	unitless
i_count901_225	float32	gran	Count of spectra where BT at 901 cm-1 is < 225 K	unitless
i_count901_235	float32	gran	Count of spectra where BT at 901 cm-1 is < 235 K	unitless
i_count1231_210	float32	gran	Count of spectra where BT at 1231 cm-1 is < 210 K	unitless
i_count1231_225	float32	gran	Count of spectra where BT at 1231 cm-1 is < 225 K	unitless
i_count1231_235	float32	gran	Count of spectra where BT at 1231 cm-1 is < 235 K	unitless
i_count1231gt320	float32	gran	Count of spectra where BT at 1231 cm-1 is > 320 K	unitless
i_count1231gt325	float32	gran	Count of spectra where BT at 1231 cm-1 is > 325 K	unitless
i_count1231gt330	float32	gran	Count of spectra where BT at 1231 cm-1 is > 330 K	unitless
i_count1231gt335	float32	gran	Count of spectra where BT at 1231 cm-1 is > 335 K	unitless
i_count1231gt340	float32	gran	Count of spectra where BT at 1231 cm-1 is > 340 K	unitless
i_countbt900gt340	float32	gran	Count of spectra where BT at 900 cm-1 is > 340 K	unitless
i_forecast_clear_ocean_d1231	float32	gran	Mean of d1231 over ocean spectra identified as forecast clear because abs(d1231) < 1 K. d1231 = sst1231r5 - stemp_cmc	Kelvin
i_found5_so2	float32	gran	Count of spectra with a SO2-indicator value of at least 5 K. SO2 indicator so2 = bt1433.0-bt1361.4; The two channels are located near an so2 absorption band, and appear to be related to volcano activities. A count of more then 10 collocated spectra with so2>5 is significant.	unitless

i_found6_so2	float32	gran	Count of spectra with a SO2-indicator value of at least 6 K. SO2 indicator so2 = bt1433.0-bt1361.4; The two channels are located near an so2 absorption band, and appear to be related to volcano activities. A count of more then 10 colocated spectra with so2>5 is significant.	unitless
i_found7_so2	float32	gran	Count of spectra with a SO2-indicator value of at least 7 K. SO2 indicator so2 = bt1433.0-bt1361.4; The two channels are located near an so2 absorption band, and appear to be related to volcano activities. A count of more then 10 colocated spectra with so2>5 is significant.	unitless
i_found_PLR_clear_land	float32	gran	Count of land spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_frozen	float32	gran	Count of frozen spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_plr_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the PLR Psuedo-Lapse Rate test.	unitless
i_found_SCT_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the SCT Spatial Coherence test.	unitless
i_found_forecast_clear_ocean	float32	gran	Count of ocean spectra which are clear according to the Forecast Clear test.	unitless
i_found_sct_low_stratus_ocean	float32	gran	Count of ocean spectra that pass the cx1231 < 0.5 K test but have abs(d1231) < -4 K	unitless
i_max1231	float32	gran	The hottest value of BT at 1231 cm-1 in the granule.	Kelvin
i_max_bt1231_lat	float32	gran	Latitude of i_max1231	degrees_north
i_max_bt1231_lon	float32	gran	Longitude of i_max1231	degrees_east
i_mean_lat	float32	gran	Granule mean latitude	degrees_north
i_mean_lon	float32	gran	Granule mean longitude	degrees_east
i_mean_solzen	float32	gran	Granule mean solar zenith angle	degrees
i_mean901	float32	gran	Granule mean BT at 901 cm-1	Kelvin
i_mean1128	float32	gran	Granule mean BT at 1128 cm-1	Kelvin
i_mean1231	float32	gran	Granule mean BT at 1231 cm-1	Kelvin
i_mean2616	float32	gran	Granule mean BT at 2616 cm-1	Kelvin
i_min901	float32	gran	Granule minimum BT at 901 cm-1	Kelvin
i_min1128	float32	gran	Granule minimum BT at 1128 cm-1	Kelvin
i_min1231	float32	gran	Granule minimum BT at 1231 cm-1	Kelvin
i_min2616	float32	gran	Granule minimum BT at 2616 cm-1	Kelvin
i_std901	float32	gran	Granule standard deviation of BT at 901 cm-1	Kelvin
i_std1128	float32	gran	Granule standard deviation of BT at 1128 cm-1	Kelvin
i_std1231	float32	gran	Granule standard deviation of BT at 1231 cm-1	Kelvin
i_std2616	float32	gran	Granule standard deviation of BT at 2616 cm-1	Kelvin
i_mean_d1231	float32	gran	Granule mean of d1231. d1231 = sst1231r5 - stemp_cmc	Kelvin
i_std_d1231	float32	gran	Granule standard deviation of d1231. d1231 = sst1231r5 - stemp_cmc	Kelvin
i_plr_clear_ocean_d1231	float32	gran	The mean value of d1231 over land spectra identified as clear according to the PLR Pseudo-Lapse Rate test. d1231 = sst1231r5 - stemp_cmc	
i_so2_mean	float32	gran	Granule mean of SO2-indicator so2 = bt1433.0-bt1361.4; The two channels are located near an SO2 absorption band, and appear to be related to volcano activities.	Kelvin
i_so2_std	float32	gran	Granule standard deviation of SO2-indicator so2 = bt1433.0-bt1361.4; The two channels are located near an SO2 absorption band, and appear to be related to volcano activities.	Kelvin
i_start_tia	float32	gran	Granule start time	seconds since 1993-01-01 00:00

select group

Dimensions for the select group

Name	Size	Description
calsite	40	calibration sites

Variables for the select group

Name	Type	Dimensions	Description	Units
obs_time_tai93	double	obs	earth view observation midtime for each FOV	seconds since 1993-01-01 00:00
lat	float	obs	latitude of FOV center	degrees_north

lon	float	obs	longitude of FOV center	degrees_east
reason	unsigned short int	obs	Bitcode giving reason(s) why this observation was selected for inclusion in calibration subset products.	
site_id	short int	obs	Validation site ID if reason is validation site. Special codes identify other reasons as well. If a case satisfies multiple criteria then this will contain the code for the last one set -- see the bits in reason.	
distance	float	obs	Distance between validation site and observation	m
stemp_cmc	float	obs	Surface temperature from Canadian Meteorological Center	Kelvin
stemp_clim	float	obs	Surface temperature from AIRS L3 climatology for 2003-2006	Kelvin
calsite_id	short int	calsite	calibration site ID number. Numbers outside of [1, 50] tag observations which were selected for reasons other than proximity to calibration sites.	
calsite_name	string	calsite	Calibration site name	
calsite_lat	float	calsite	calibration site latitude	degrees_north
calsite_lon	float	calsite	calibration site longitude	degrees_east
calsite_dlat	float	calsite	maximum delta latitude miss distance for this calibration site	degree
calsite_dlon	float	calsite	maximum delta longitude miss distance for this calibration site	degree
calsite_addl_cond	string	calsite	additional conditions when collecting data for this calibration site	
calsite_notes	string	calsite	notes for this calibration site	

Attributes for the select group

Name	Type	Size	Value	Description
primary_product_group	string	1	11b_airs	group name for the observations that are the primary product type. Observations will be ordered by time of observations in this group. Distances and times are measured from this group.
match_product_group	string	1	TBD	group name for the observations that are matched the primary product type. Distances and times are measured from primary_product_group to this group.

Appendix C: Code Examples

For most objectives only a small fraction of the available supporting information is needed.

Example 1. Reading the AIRS Summary CalSub files to evaluate the temperature trend on Dome C at 1231 cm-1

```
% read one day
fname='SNDR.AQUA.AIRS.20160114.D01.L1B_CALSUB_SUM.std.v02_52.G.220303141329.nc'
```

```
>> lon2s=ncread(fname,['11b_airs/lon']);%
>> lat2s=ncread(fname,['11b_airs/lat']);%
>> btemps=ncread(fname,['11b_airs/brightness_temp']);
% btemps    136x306364      333324032 double
>> solzens=ncread(fname,['11b_airs/sol_zen']);%
>> szas=ncread(fname,['11b_airs/sat_zen']);%
>> LandFrac=ncread(fname,['11b_airs/land_frac']);%
>> reasons=ncread(fname,['select/reason']);
>> wnum=ncread(fname,['11b_airs/wnum']);%
>> site_ids=ncread(fname,['select/site_id']);
>> sst1231r5s=ncread(fname,['11b_airs/sst1231r5']);% see ATBD
>> cmcs=ncread(fname,['select/stemp_cmc']);%
>> stemp_clims=ncread(fname,['select/stemp_clim']);
>> cx1231= ncread(fname,['11b_airs/cx1231']);% spatial coherence. See ATBD
```

```
% a quick check:
>> whos reasons
% reasons    306364x1
```

```
v1=find(abs(wnum-1231.3)<0.3);
bt1231=btemps(v1(1),:);
```

```
% quick check
>> mstats(bt1231); % mean= +276.6298 stdev=26.3313 [min=177.807 max=.333.947] N=306364
```

```
% Now select DomeC. This is special site_ids=3;
v=find(site_ids==3);
>> mstats(bt1231(v)); % mean= +240.0423 stdev= 5.0367 [min=231.369 max=.247.034] N= 249 cases
```

% now repeat this by reading all days in 20 years of ACDS data and save the daily mean.
The result is shown below. The temperature oscillates between 240K in the SH summer to 205K in the SH winter.

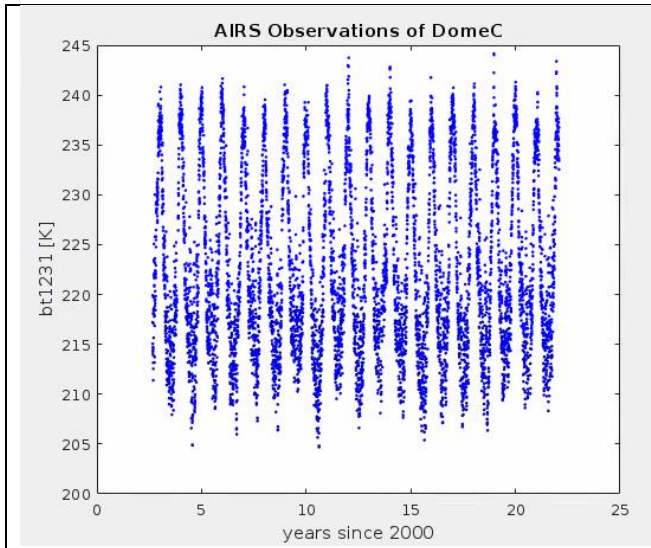
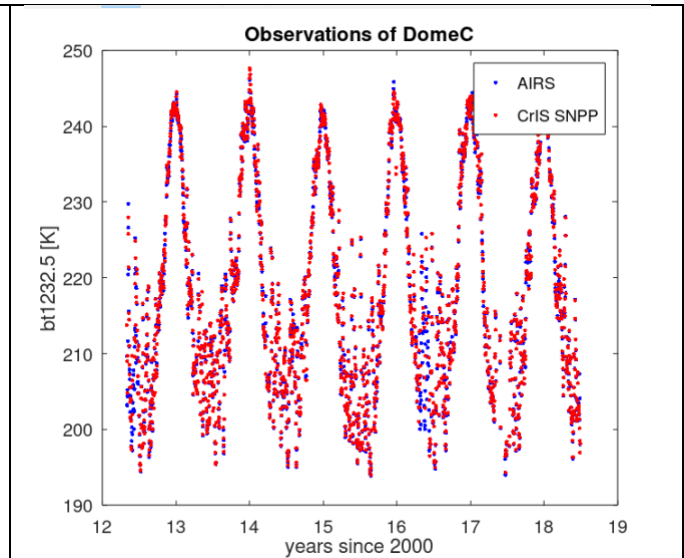


Figure C.1 a. Surface temperature at Dome C AIRS between 2002 and 2021



b) Surface temperature at Dome C between 2012 and 2018

A LSQ fit through the AIRS data can be used to evaluate if there is a trend. The trend is -6mK/yr but with a 16mK/yr uncertainty in the mean of 222K . The data period for the AIRS CrIS SNPP overlap period is too short to evaluate individual trends. The trend in AIRS-CrIS for the 6 year period is $+1.4\pm 2.5\text{mK/yr}$, with a mean of -125mK (CrIS is warmer than AIRS).

The code for CrIS is very similar, but the mid-wave band failed in 2018

Example 2. Assume you want to know if count the clouds colder than 210K for the night tropical land has changed

For each day proceed as above, but select the data using

```
>> v=find(bitget(reasons,3) & bt1231<210 & abs(lat2s)<30 & solzens>90 & LandFrac>0);
```

```
% for this day there were 2006 DCC at the tropopause.
```

```
% Save length(v) and repeat for all days in 20 years.
```

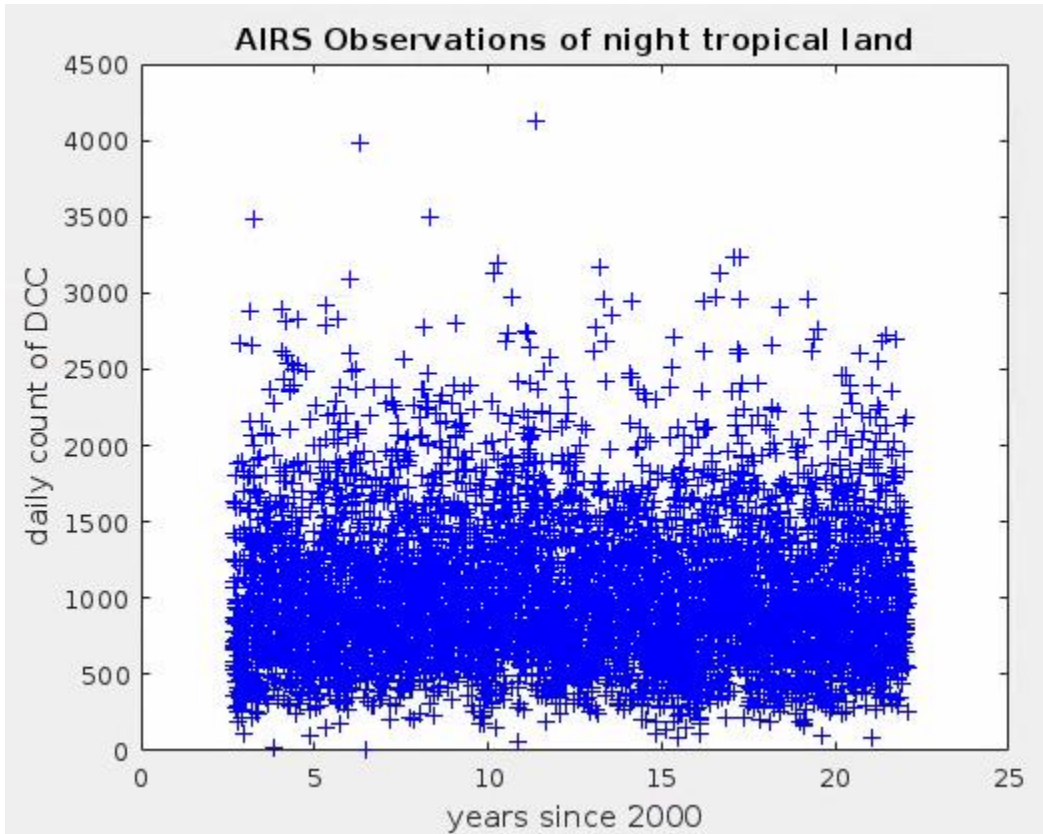


Figure C.2. Daily count of DCC for tropical land

The LSQ fit through the data can be used to test for a trend.

The trend is -1.5 counts/day with an uncertainty of 1.0/day in the mean of 1022/day in 20 years.