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README Document for

AIRS Level-1B Version 5 AMSU-A Calibrated Brightness Temperature products:

AIRABRAD, AIRABRAD_NRT

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Last revised, March 7, 2008

Revision History

Revision Date	***Changes***	***Author***
12/31/2007	Initial version	Young-In Won
1/13/2008	Revised to include NRT	Young-In Won
2/15/2008	Minor revisions	Young-In Won
3/7/2008	Revised to add info on changes from version 4 to version 5	Young-In Won
7/21/2009	Removed reference to retired WHOM search engine	Randy Barth

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1. Introduction

1.1 Brief background

This document applies to the Atmospheric Infrared Sounder (AIRS) Version 5 Level 1B **Advanced Microwave Sounding Unit (AMSU)-A** Products (**AIRABRAD**) which contain calibrated and geolocated brightness temperatures in degrees Kelvin. **AIRABRAD_NRT (Near Real Time)** products are also available within ~3 hours of observations globally and stay for about 5 days from the time they are generated. A brief description on changes from Version 4 to version 5 products is given in the following section.

This data set is generated from AMSU-A level 1A digital numbers (DN) and contains 15 microwave channels in the 50-90 GHz and 23-32 GHz regions of the spectrum. A day's worth of data is divided into 240 scenes (granules), each of 6 minute duration. An AMSU-A scene contains 30 cross-track footprints in each of 45 along-track scanlines, for a total of 45 x 30 = 1350 footprints per scene. AMSU-A scans three times as slowly as AIRS (once per 8 seconds) and its footprints are approximately three times as large as those of AIRS (45 km at nadir). This results in three AIRS scans per AMSU-A scans and nine AIRS footprints per AMSU-A footprint.

AMSU-A is primarily a temperature sounder that provides atmospheric information in the presence of clouds, which can be used to correct the AIRS infrared measurements for the effects of clouds. This is possible because non-precipitating clouds are for the most part transparent to microwave radiation, in contrast to visible and infrared radiation which are strongly scattered and absorbed by clouds. Combined with simultaneous measurements from the AIRS and HSB instruments, the calibrated AMSU-A brightness temperatures will also be used to initialize the surface temperature and atmospheric temperature profile required for the retrieval of the final AIRS geophysical products. AMSU level 1B daily summary browse product is also available to provide users with a global quick look capability when searching for data of interest.

The data covers period from August 30, 2002 to current.

Table 1. Basic characteristics of the AIRABRAD data.

Latitude Range	-90° to 90°N
Longitude extent	-180° to 180°E
horizontal resolution	45 km (~3.3º) in diameter at nadir
Temporal resolution	6 minutes

1.2 Significant changes from V4 to V5

We strongly encourage users to use V5 products rather than V4 (GES DISC Collection 3 data products). A short description on changes from V4 to V5 that are most visible to the user is given below.

Improved Quality Indicators and Error Estimates
In the V5 release, an improved set of quality indicators has been provided to inform the user separately about the quality of the retrieval of various products. Please read the Level 2 Quality Control and Error Estimation documentation for a description of these indicators and how they are set.
V5_L2_Quality_Control_and_Error_Estimation.pdf

The V5 temperature profile yield is increased and the error estimate improved. The greatest yield increase is in the polar regions, and the greatest improvement in quality is over land. The yield in moisture retrievals has decreased slightly, but the quality of the accepted retrieval has increased, their error estimates improved and there are fewer outliers. In particular, there are no longer anomalously high moisture retrievals over warm scenes and the upper tropospheric dry bias and total water vapor wet bias have both improved over V4.

Correction to Saturation and Relative Humidity
The layer-average vapor pressure saturation relation for water vapor is provided over liquid and over liquid/ice dependent upon air temperature. The relative humidity calculation error present in V4 has been corrected.

Correction to Outgoing Longwave Radiation
The OLR calculation error present in V4 has been corrected. There was no error in the calculation for clear-sky OLR (clrolr) in V4.

Improved O3 Product
The V5 ozone retrieval channel set has been refined and an observationally based climatology is used for a first guess rather than a regression. The result is that the V5 ozone retrievals are less biased in the mid to low troposphere.

Addition of CO and CH4 Products
V5 L2 products now include total burden and profiles for carbon monoxide and methane. V5 L3 products contain profiles for both carbon monoxide and methane along with total column carbon monoxide. The methane product is an unvalidated research product that is still being refined.

Averaging Kernel, Verticality and Degrees of Freedom
V5 L2 products now provide averaging kernel (in support product), verticality and degrees of freedom for moisture, ozone, carbon monoxide and methane profiles.

AMSU-A Level 1B Sidelobe Correction Implemented

V5 AMSU-A L1B products now provide a sidelobe-correct brightness temperature in addition to the antenna temperature. The temperature error calculation is now fully implemented.

no HSB and including HSB
The HSB instrument ceased operation on February 5, 2003 due to a mirror motor failure. Released V5 of AIRS Data Products provide two versions of the L2 and L3 data products up to the date of HSB failure, and a single version thereafter.
See **V5_Released_Proc_FileDesc.pdf**
for a complete description of the AIRS Data Product file name and local granule ID (LGID) convention.

Removal of VIS/NIR Derived Cloud Fields
The Visible/Near Infrared derived cloud fields have been removed in V5.

Preparation of AIRS-Only Processing Option
We have prepared an AIRS-Only processing option whose products become visible to users due to a degrade of AMSU channel.

A complete listing of the noteworthy changes from V4 to V5 is provided in the document: **V5_Changes_from_V4.pdf**

1.3 AIRS Instrument Description

The Atmospheric Infrared Sounder (AIRS) instrument suite is designed to measure the Earth's atmospheric water vapor and temperature profiles on a global scale. It is comprised of a space-based hyperspectral infrared instrument (AIRS) and two multichannel microwave instruments, the Advanced Microwave Sounding Unit (AMSU-A) and the Humidity Sounder for Brazil (HSB). The AIRS instrument suite is one of several instruments onboard the Earth Observing System (EOS) Aqua spacecraft launched May 4, 2002. The HSB instrument ceased operation on February 5, 2003.

AMSU-A

AMSU-A primarily provides temperature soundings. It is a 15-channel microwave temperature sounder implemented as two independently operated modules. Module 1 (AMSU-A1) has 12 channels in the 50-58 GHz oxygen absorption band which provide the primary temperature sounding capabilities and 1 channel at 89 GHz which provides surface and moisture information. Module 2 (AMSU-A2) has 2 channels: one at 23.8 GHz and one at 31.4 GHz which provide surface and moisture information (total precipitable water and cloud liquid water). Like AIRS, AMSU-A is a cross-track scanner. The three receiving antennas, two for AMSU-A1 and one for AMSU-A2, are parabolic focusing reflectors that are mounted on a scan axis at a 45° Tilt angle, so that radiation is reflected from a direction along the scan axis (a 90° reflection). AMSU-A scans three times as slowly as AIRS (once per 8 seconds) and its footprints are approximately three times as large as those of AIRS (45 km at nadir). This result in three AIRS scans per AMSU-A scans and nine AIRS footprints per AMSU-A footprint.

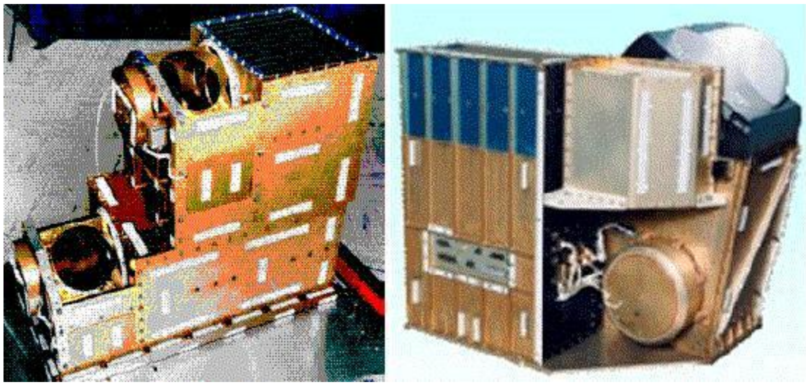


Figure 1. View of AMSU-A1 (left) and AMSU-A2 right.

Table 2. AMSU instrument characteristics

	AMSU-A1	AMSU-A2
Data Rate	1.3 kbits/s	0.4 kbits/s
Antenna Size	15 cm (2 units)	31 cm (1unit)
Instantaneous Field of View (IFOV)	3.3°	3.3°
Swath Width	100; 1650 km	100; 1650 km
Pointing Accuracy	±0.2°	±0.2°
Number of Channels	13	2

Sensor	Channel	Central Frequency (GHz)	Bandwidth (MHz)	Sensitivity NEDT (K)
AMSU-A2	1	23.8	280	0.3
	2	31.4	180	0.3
AMSU-A1	1	50.300	180	0.4
	2	52.800	400	0.25
	3	53.596±0.115	170	0.25
	4	54.400	400	0.25
	5	54.940	400	0.25
	6	55.500	330	0.25
	7	57.290344 = Flo	330	0.25
	8	Flo±0.217	78	0.4
	9	Flo±0.3222 (±0.048)	36	0.4
	10	Flo±0.3222 (±0.022)	16	0.6
	11	Flo±0.3222 (±0.010)	8	0.8
	12	Flo±0.3222 (±0.0045)	3	1.2

	13	89.000	6000	0.5

1.4 Brief background on algorithm

Level 1B Product Generation Executives (PGEs) receive 240 granules of AIRS IR Level 1A Engineering Units (EU) data and produce calibrated, geolocated radiance products. Calibration data and calibration control parameters are analyzed to develop processing specifications for Level 1B processing. Then, the Level 1A data are processed, yielding our Level 1B standard products. Each type of AIRS Level 1A data is processed by a specialized Level 1B PGE. Each Level 1B PGE generates 240 granules of Level 1B standard products.

Level 1B NRT products are produced by the same core science algorithms as in the regular science data production, but using predicted ephemeris in place of definitive ephemeris data and without one of optional dynamics inputs (next granule of AIRAACAL for the case of **AIRABRAD**). The advantage of NRT data is its fast turnaround time, generally available within 3 hours of observations globally. They can be utilized in regional weather forecast models as well as in support of field campaigns.

Level 1B PGEs produce 240 granules of four Level 1B standard products and two quality assessment (QA) subset products. Each granule is composed of 45 scansets. The Earth Science Data Type (ESDT) short names and normal granule sizes are:

Table 3. Shortname and Granule size (normal)

Data Set Granule Size	Short Name	Granule Size
L1B AMSU-A radiances	**AIRABRAD**	**0.5 MB**
L1B HSB radiances	AIRHBRAD	1.7 MB
L1B AIRS radiances	AIRIBRAD	56 MB
L1B VIS/NIR radiances	AIRVBRAD	21 MB
L1B AIRS QA	AIRIBQAP	5.6 MB
L1B VIS QA	AIRVBQAP	1.1 MB

The user is encouraged to read the documentation describing the Algorithm Theoretical Basis Document, Level 1b, Part 3: Microwave Instruments for further details. (http://eospso.gsfc.nasa.gov/eos_homepage/for_scientists/atbd/docs/AIRS/atbd-airs-L1B_microwave.pdf)

1.5 Data Disclaimer

AIRS science team provides AIRS/AMSU/HSB Version 5 Data Disclaimer (http://disc.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/V5_Data_Disclaimer.pdf) document as a part of Version 005 data release. Some of highlights related to L1B products are:

Invalid Values
Fields in Level 1B and Level 2 data products may contain an invalid value:
-9999 for floating-point and 16-bit and 32-bit integers
-1 or 255 for 8-bit fields.

The validation states for Level 1B Data Products in release V5

Level 1B Product	RMS Requirement	Uncertainty Estimate	Vertical Coverage	Val Status
AMSU Radiance	0.25-1.2 K	1-3 K	N/A	Val3*

***Val Status**:
Beta = Not suitable for scientific investigations.
Prov = Provisionally validated, suitable for scientific investigations with caution. Validated for nonpolar ($|lat| \leq 50°$) night ocean only
Val1 = non-polar ($|lat| \leq 50°$) day/night ocean.
Val2 = **Val1** + non-polar ($|lat| \leq 50°$) night land.
Val3 = **Val2**+nonpolar day land

Instrument States and Liens

Advanced Microwave Sounding Unit (AMSU)
AMSU data are unavailable for the period 29 October 2003-02:00:00 to 6 November 2003-06:00:00 due to the instrument being placed in safe mode following a very large solar flare and associated coronal mass ejection. The purpose was to guard against possible permanent damage caused by the expected large flux of high energy particles (including protons). The instrument was completely off except for its survival heaters.

AMSU Liens
• On 11/16/2004 at 13:21:19 UT all of the AMSU-A2 temperature read outs except the warm load temperatures showed a sudden and simultaneous increase in noise. Subsequent analyses indicate that failure of a compensation capacitor in the reference voltage amplifier is the most probable cause. This will have a negligible effect on science products because RF shelf temperature enters into the calibration in a small second-order term. At the same time, however, the warm load temperature appeared to undergo a decrease of 0.15 K. Analysis continues to determine whether the warm load temperature offset continued. If so, the DN to EU conversion in the calibration algorithm will require modification.

• AMSU channel 7 exhibits abnormal noise levels
  o Noise level is about 5x NEdT on the average, but varies substantially

  - o The added noise is not random; probable cause is spacecraft transmitter interference
  - o The underlying random noise (NEdT) is within specs
  - o Channel 7 should not be used until this systematic noise can be removed

- AMSU channel 6 exhibits some of the same noise characteristics as channel 7, however
  - o Added noise level is a fraction of NEdT; overall level still meets specs
  - o Use channel 6 with confidence

- AMSU channel 9 radiometer counts exhibit sudden, large change (~0.1%) recovering suddenly or gradually after 1-3 minutes; typically appears once or a few times per day, possibly clustered; no other channels affected
  - o The phenomenon is being characterized; cause as yet unknown
  - o Negligible effect in most cases; use channel 9 with confidence

2. Data Organization

2.1 File naming convention

The Level-1 B AMSU-A Radiance (AIRABRAD) files are named in accordance to the following convention:

AIRS.*yyyy***.***mm***.***dd***.***ggg***.L1B.AMSU_Rad.v***m***.***m***.***r***.***b***.***productionTimeStamp***.hdf**

For example:
AIRS.2007.04.28.044.L1B.AMSU_Rad.v5.0.0.0.G07233155454.hdf

Where:

- **yyyy** = 4 digit year number [2002 -].
- **mm** = 2 digit month number [01-12]
- **dd** = day of month [01-31]
- **ggg** = granule number [1-240]
- **L1B** = Level 1B
- **AMSU_Rad=** string defining the product file type (AMSU Radiation product)
- **vm.m.r.b** = algorithm version identifier is made up of major version, minor version, release version and build number respectively.
- **productionTimeStamp** = file creation time stamp. Starts off with a letter
  G for GES DISC processing facility,
  R for NRT product,
  followed by yydddhhmmss
  - yy: year number without century;
  - ddd: day of a year [1-366];
  - hhmmss: hours, minutes and seconds UTC time.
- **hdf** = format of the file.

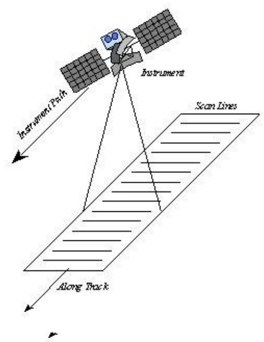
2.2 File Format

AIRS Level-1B files are stored in the Hierarchical Data Format-Earth Observing System (HDF-EOS4) Swath format. HDF-EOS4 format is an extension of the HDF4 format (developed by NCSA) to meet the needs of EOS data products

HDF: The following website contains detailed information on HDF file format, http://hdf.ncsa.uiuc.edu/. HDFView, one of visual tool for browsing and editing NCSA HDF4 and HDF5 files would be of great help in viewing, creating, or modifying the contents of a dataset.

HDF-EOS: In 1993 NASA chose NCSA's HDF format to be the standard file format for storing data from the Earth Observing System (EOS), which is the data gathering system of sensors (mainly satellites) supporting the Global Climate Change Research Program. Since NASA's selection of HDF, NCSA (and now THG) has been working with NASA to prepare for the enormous data management challenges that will come when the system is fully functional. This has included the development of a specialized form of HDF called HDF-EOS, which deals specifically with the kinds of data that EOS produces.

Swath: The swath concept for HDF-EOS is based on a typical satellite swath, where an instrument takes a series of scans perpendicular to the ground track of the satellite as it moves along that ground track (see Diagram on the right). As the AIRS is profiling instrument that scans across the ground track, the data would be a three dimensional array of measurements where two of the dimensions correspond to the standard scanning dimensions (along the ground track and across the ground track), and the third dimension represents a range from the sensor. The "horizontal" dimensions can be handled as normal geographic dimensions, while the third dimensions can be handled as a special "vertical" dimension.



2.3 Data Structure inside File

An AIRABRAD file is made of four major groups; “Dimensions”, “geolocation fields”, “Attributes”, and “Data fields” with data fields sub-divided into “Per-Granule Data Fields”, "Along-Track Data Fields, and “Full Swath Data Fields”.

Dimensions: These are HDF-EOS swath dimensions. The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "GeoTrack" is understood to be the dimension along the path of the spacecraft, and "GeoXTrack" is the dimension across the spacecraft track, starting on the left looking forward along the spacecraft track. There may also be a second across-track dimension "CalXTrack," equivalent to "GeoXTrack," except that "CalXTrack" refers to the number of calibration footprints per scanline. "GeoTrack" is 45 for large-spot products (**AMSU-A**, Level-2, cloud-cleared AIRS) and 135 for small-spot products (AIRS, Vis/NIR, HSB).

geolocation fields: These are all 64-bit floating-point fields that give the location of the data in space and time. If the note before the table specifies that these fields appear once per scanline then they have the single dimension "GeoTrack." Otherwise, they appear once per footprint per scanline and have dimensions "GeoTrack,GeoXTrack."

Attributes: These are scalar or string fields that appear only once per granule. They are attributes in the HDF-EOS Swath sense.

Per-Granule Data Fields: These are fields that are valid for the entire granule but that are not scalars because they have some additional dimension.

Along-Track Data Fields: These are fields that occur once for every scanline. These fields have dimension "GeoTrack" before any "Extra Dimensions." So an "Along-Track Data Field" with "Extra Dimensions" of "None" has dimensions "GeoTrack"; whereas, if the "Extra Dimensions" is "SpaceXTrack (= 4)," then it has dimensions “GeoTrack,SpaceXTrack."

2.4 Key data fields (see the following section for a complete list)

The data fields most likely to be used by users are as follows.

Location data Fields:

- **Latitude**
  AIRS spot boresight geodetic latitude
  (degrees North, -90->+90), dimension (90,135)
- **Longitude**
  AIRS spot boresight geodetic longitude
  (degrees East, -180->+180), dimension (90,135)
- **Time**
  Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993

The per-granule data fields

- **center_freq**
  channel center frequency (GHz), dimension (15)
- **IF_offset_1**
  offset of first intermediate frequency stage (MHz)
  (zero for no mixing), dimension (15)
- **IF_offset_2**
  offset of second intermediate frequency stage (MHz)
  (zero for no second mixing), dimension (15)
- **Bandwidth**
  bandwidth of sum of 1,2 or 4 channels (MHz), dimension (15)
- **NeDT**
  instrument noise level estimated from warm count scatter (15)

The along-track data fields

- **qa_scanline**
  Bit field for each scanline (bit 0 set if sun glint in scanline; bit 1 set if costal crossing in scanline, bit 2 set if some channels had excessive NeDT estimated), dimension (45)
- **qa_channel**

Bit field by channel for each scanline (bit 0 set if all space view counts bad; bit 1 set if space view counts marginal; bit 2 set if space view counts could not be smoothed; bit 3 set if all blackbody counts bad; bit 4 set if blackbody counts marginal; bit 5 set if blackbody counts could not be smoothed; bit 6 set if unable to calculate calibration coefficients; bit 7 set if excessive NeDT estimated), dimension (15,45)

The swath data fields

- **antenna_temp**
  calibrated, geolocated channel-by-channel AMSU observed raw antenna temperature (K), dimension (15,30,45)
- **brightness_temp**
  calibrated, geolocated channel-by-channel AMSU sidelobe-corrected antenna temperature (K), dimension (15,30,45)
- **brightness_temp_err**
  error estimate for brightness_temp (K), dimension (15,30,45)
- **landFrac**
  fraction of AMSU footprint that is land (0.0 -> 1.0), dimension (30,45)
- **landFrac_err**
  error estimate for landFrac, dimension (30,45)

3. Data Contents

Described below are all the parameters contained within an AIRS Version 5 Level-1B AMSU-A Product file.

3.1 Dimensions

Name	Value	Explanation
GeoXTrack	30	Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path
GeoTrack	# of scan lines in swath	Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering; 135 for AIRS/Vis and HSB high-rate quantities)
Channel	15	Dimension of channel array Channel 1: 23.8 GHz; Ch 2: 31.4 GHz; Ch 3: 50.3 GHz; Ch 4: 52.8 GHz; Ch 5: 53.596 +/- 0.115 GHz; Ch 6: 54.4 GHz; Ch 7: 54.94 GHz; Ch 8: 55.5 GHz; Ch 9: f0; Ch 10: f0 +/- 0.217 GHz Ch 11: f0 +/- df +/- 48 MHz; Ch 12: f0 +/- df +/- 22 MHz; Ch 13: f0 +/- df +/- 10 MHz; Ch 14: f0 +/- df +/- 4.5 MHz; Ch 15: 89 GHz (f0 = 57290.344 MHz; df = 322.4 MHz)
CalXTrack	4	Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_AMSU_CALIB) (Footprints are ordered: 1-2: spaceviews; 3-4: blackbody radiometric calibration source)
SpaceXTrack	2	Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AMSU_SPACE)
BBXTrack	2	Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AMSU_BB)
WarmPRTA11	5	Number of PRTs measuring AMSU-A1-1 warm target (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15)
WarmPRTA12	5	Number of PRTs measuring AMSU-A1-2 warm target (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8)
WarmPRTA2	7	Number of PRTs measuring AMSU-A2 warm target (AMSU-A2 is AMSU-A channels 1 & 2)

3.2 Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

Name	Explanation
Latitude	Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0)
Longitude	Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0)
Time	Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993

3.3 Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

Name	Type	Explanation
processing_level	string of 8-bit characters	Zero-terminated character string denoting processing level ("level1B")
instrument	string of 8-bit characters	Zero-terminated character string denoting instrument ("AMSU-A")
DayNightFlag	string of 8-bit characters	Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made.
AutomaticQAFlag	string of 8-bit characters	Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect")
NumTotalData	32-bit integer	Total number of expected channels * scene FOVs
NumProcessData	32-bit integer	Number of channels * scene FOVs which are present and can be processed routinely (state = 0)
NumSpecialData	32-bit integer	Number of channels * scene FOVs which are present and can be processed only as a special test (state = 1)
NumBadData	32-bit integer	Number of channels * scene FOVs which are present but cannot be processed (state = 2)
NumMissingData	32-bit integer	Number of expected channels * scene FOVs which are not present (state = 3)
NumLandSurface	32-bit integer	Number of scene footprints for which the surface is more than 90% land
NumOceanSurface	32-bit integer	Number of scene footprints for which the surface is less than 10% land
node_type	string of 8-bit characters	Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.)
start_year	32-bit integer	Year in which granule started, UTC (e.g. 1999)
start_month	32-bit integer	Month in which granule started, UTC (1 ... 12)
start_day	32-bit integer	Day of month in which granule started, UTC (1 ... 31)
start_hour	32-bit integer	Hour of day in which granule started, UTC (0 ... 23)
start_minute	32-bit integer	Minute of hour in which granule started, UTC (0 ... 59)
start_sec	32-bit floating-point	Second of minute in which granule started, UTC (0.0 ... 59.0)
start_orbit	32-bit integer	Orbit number of mission in which granule started
end_orbit	32-bit integer	Orbit number of mission in which granule ended
orbit_path	32-bit integer	Orbit path of start orbit (1 ... 233 as defined by EOS project)
start_orbit_row	32-bit integer	Orbit row at start of granule (1 ... 248 as defined by EOS project)
end_orbit_row	32-bit integer	Orbit row at end of granule (1 ... 248 as defined by EOS project)
granule_number	32-bit integer	Number of granule within day (1 ... 240)
num_scansets	32-bit integer	Number of scansets in granule (1 ... 45)
num_scanlines	32-bit integer	Number of scanlines in granule (1 * num_scansets)
start_Latitude	64-bit floating-point	Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0)
start_Longitude	64-bit floating-point	Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0)
start_Time	64-bit floating-point	TAI Time at start of granule (floating-point elapsed seconds since start of 1993)
end_Latitude	64-bit floating-point	Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0)
end_Longitude	64-bit	Geodetic Longitude of spacecraft at end of granule (subsatellite location at

	floating-point	midpoint of last scan) in degrees East (-180.0 ... 180.0)
end_Time	64-bit floating-point	TAI Time at end of granule (floating-point elapsed seconds since start of 1993)
eq_x_longitude	32-bit floating-point	Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0)
eq_x_tai	64-bit floating-point	Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993)
orbitgeoqa	32-bit unsigned integer	Orbit Geolocation QA:; Bit 0: (LSB, value 1) bad input value (last scanline); Bit 1: (value 2) bad input value (first scanline); Bit 2: (value 4) PGS_EPH_GetEphMet() gave PGSEPH_E_NO_SC_EPHEM_FILE; Bit 3: (value 8) PGS_EPH_GetEphMet() gave PGSEPH_E_BAD_ARRAY_SIZE; Bit 4: (value 16) PGS_EPH_GetEphMet() gave PGSTD_E_TIME_FMT_ERROR; Bit 5: (value 32) PGS_EPH_GetEphMet() gave PGSTD_E_TIME_VALUE_ERROR; Bit 6: (value 64) PGS_EPH_GetEphMet() gave PGSTD_E_SC_TAG_UNKNOWN; Bit 7: (value 128) PGS_EPH_GetEphMet() gave PGS_E_TOOLKIT; Bit 8: (value 256) PGS_TD_UTCtoTAI() gave PGSTD_E_NO_LEAP_SECS; Bit 9: (value 512) PGS_TD_UTCtoTAI() gave PGSTD_E_TIME_FMT_ERROR; Bit 10: (value 1024) PGS_TD_UTCtoTAI() gave PGSTD_E_TIME_VALUE_ERROR; Bit 11: (value 2048) PGS_TD_UTCtoTAI() gave PGS_E_TOOLKIT; Bit 12: (value 4096) PGS_CSC_DayNight() gave PGSTD_E_NO_LEAP_SECS; Bit 13: (value 8192) PGS_CSC_DayNight() gave PGSCSC_E_INVALID_LIMITTAG; Bit 14: (value 16384) PGS_CSC_DayNight() gave PGSCSC_E_BAD_ARRAY_SIZE; Bit 15: (value 32768) PGS_CSC_DayNight() gave PGSCSC_W_ERROR_IN_DAYNIGHT; Bit 16: (value 65536) PGS_CSC_DayNight() gave PGSCSC_W_BAD_TRANSFORM_VALUE; Bit 17: (value 131072) PGS_CSC_DayNight() gave PGSCSC_W_BELOW_HORIZON; Bit 18: (value 262144) PGS_CSC_DayNight() gave PGSCSC_W_PREDICTED_UT1 (This is expected except when reprocessing.); Bit 19: (value 524288) PGS_CSC_DayNight() gave PGSTD_E_NO_UT1_VALUE; Bit 20: (value 1048576) PGS_CSC_DayNight() gave PGSTD_E_BAD_INITIAL_TIME; Bit 21: (value 2097152) PGS_CSC_DayNight() gave PGSCBP_E_TIME_OUT_OF_RANGE; Bit 22: (value 4194304) PGS_CSC_DayNight() gave PGSCBP_E_UNABLE_TO_OPEN_FILE; Bit 23: (value 8388608) PGS_CSC_DayNight() gave PGSMEM_E_NO_MEMORY; Bit 24: (value 16777216) PGS_CSC_DayNight() gave PGS_E_TOOLKIT; Bit 25-31: not used
num_satgeoqa	16-bit integer	Number of scans with problems in satgeoqa
num_glintgeoqa	16-bit integer	Number of scans with problems in glintgeoqa
num_moongeoqa	16-bit integer	Number of scans with problems in moongeoqa
num_ftptgeoqa	16-bit integer	Number of footprints with problems in ftptgeoqa
num_zengeoqa	16-bit integer	Number of footprints with problems in zengeoqa
num_demgeoqa	16-bit integer	Number of footprints with problems in demgeoqa
num_fpe	16-bit integer	Number of floating point errors
LonGranuleCen	16-bit integer	Geodetic Longitude of the center of the granule in degrees East (-180 ... 180)
LatGranuleCen	16-bit integer	Geodetic Latitude of the center of the granule in degrees North (-90 ... 90)

LocTimeGranuleCen	16-bit integer	Local solar time at the center of the granule in minutes past midnight (0 ... 1439)
num_scanlines_not_norm_mode_a1	32-bit integer	Number of scanlines not in Process state (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15)
num_scanlines_not_norm_mode_a2	32-bit integer	Number of scanlines not in Process state (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2)
num_missing_scanlines_a1	32-bit integer	Number of scanlines with state = missing (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15)
num_missing_scanlines_a2	32-bit integer	Number of scanlines with state = missing (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2)
num_data_gaps_a1	32-bit integer	Number of blocks of scanlines where State is not Process (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15)
num_data_gaps_a2	32-bit integer	Number of blocks of scanlines where State is not Process (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2)
num_instr_mode_changes_a1	32-bit integer	Number of operational instrument mode changes (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15)
num_instr_mode_changes_a2	32-bit integer	Number of operational instrument mode changes (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2)
num_scanlines_rec_cal_prob_a11	32-bit integer	Number of scanlines with non-zero qa_receiver (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15)
num_scanlines_rec_cal_prob_a12	32-bit integer	Number of scanlines with non-zero qa_receiver (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8)
num_scanlines_rec_cal_prob_a2	32-bit integer	Number of scanlines with non-zero qa_receiver (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2)
num_scanlines_sig_coast_xing	32-bit integer	Number of scanlines with qa_scanline coast crossing bit set
num_scanlines_sig_sun_glint	32-bit integer	Number of scanlines with qa_scanline sun glint bit set
MoonInViewMWCount	32-bit integer	Number of scanlines in granule with the moon in the AMSU-A1 space view plus number of scanlines in granule with the moon in the AMSU-A2 space view (0-90)
QA_bb_PRT_a11	Limited Engineering Struct (see below)	Blackbody PRT temperature summary QA (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C)
QA_bb_PRT_a12	Limited Engineering Struct (see below)	Blackbody PRT temperature summary QA (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C)
QA_bb_PRT_a2	Limited Engineering Struct (see below)	Blackbody PRT temperature summary QA (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) (C)
QA_rec_PRT_a11	Limited Engineering Struct (see below)	Receiver PRT temperature summary QA (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C)
QA_rec_PRT_a12	Limited Engineering Struct (see below)	Receiver PRT temperature summary QA (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C)
QA_rec_PRT_a2	Limited Engineering Struct (see below)	Receiver PRT temperature summary QA (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) (C)
granules_present	string of 8-bit characters	Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next)

3.4 Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

Name	Type	Extra Dimensions	Explanation
center_freq	32-bit floating-point	Channel (= 15)	Channel Center frequency (GHz)
IF_offset_1	32-bit floating-point	Channel (= 15)	Offset of first intermediate frequency stage (MHz) (zero for no mixing)
IF_offset_2	32-bit floating-point	Channel (= 15)	Offset of second intermediate frequency stage (MHz) (zero for no second mixing)
bandwidth	32-bit floating-point	Channel (= 15)	bandwidth of sum of 1, 2, or 4 channels (MHz)
num_calibrated_scanlines	32-bit integer	Channel (= 15)	Number of scanlines that had calibration coefs applied
num_scanlines_ch_cal_problems	32-bit integer	Channel (= 15)	Number of scanlines with non-zero qa_channel
bb_signals	Unlimited Engineering Struct (see below)	BBXTrack (= 2) * Channel (= 15)	Statistics on blackbody calibration signals (data numbers with offset subtracted)
space_signals	Unlimited Engineering Struct (see below)	SpaceXTrack (= 2) * Channel (= 15)	Statistics on spaceview calibration signals (data numbers with offset subtracted)
gain_stats	Unlimited Engineering Struct (see below)	Channel (= 15)	Statistics on gains (count/K)
NeDT	32-bit floating-point	Channel (= 15)	Instrument noise level estimated from warm count scatter (K)
QA_unfiltered_scene_count	Unlimited Engineering Struct (see below)	GeoXTrack (= 30) * Channel (= 15)	Per footprint position raw scene count summary QA
QA_unfiltered_BB_count	Unlimited Engineering Struct (see below)	BBXTrack (= 2) * Channel (= 15)	Per BB footprint position raw warm count summary QA (unfiltered)
QA_unfiltered_space_count	Unlimited Engineering Struct (see below)	SpaceXTrack (= 2) * Channel (= 15)	Per space footprint position raw cold count summary QA (unfiltered)
QA_cal_coef_a0	Unlimited Engineering Struct (see below)	Channel (= 15)	Calibration coefficient a0 summary QA (K)
QA_cal_coef_a1	Unlimited Engineering Struct (see below)	Channel (= 15)	Calibration coefficient a1 summary QA (K/count)
QA_cal_coef_a2	Unlimited Engineering Struct (see below)	Channel (= 15)	Calibration coefficient a2 summary QA (K/count**2)
QA_bb_raw_noise_counts	Unlimited Engineering Struct (see below)	Channel (= 15)	Summary QA on differences between warm cal counts, DT=ABS(T1-T2)/SQRT(2)
QA_sv_raw_noise_counts	Unlimited Engineering Struct (see below)	Channel (= 15)	Summary QA on differences between cold cal counts, DT=ABS(T1-T2)/SQRT(2)

3.5 Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

Name	Type	Extra Dimensions	Explanation
satheight	32-bit floating-point	None	Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2)
satroll	32-bit floating-point	None	Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.)
satpitch	32-bit floating-point	None	Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.)

satyaw	32-bit floating-point	None	Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.)
satgeoqa	32-bit unsigned integer	None	Satellite Geolocation QA flags: Bit 0: (LSB, value 1) bad input value; Bit 1: (value 2) PGS_TD_TAItoUTC() gave PGSTD_E_NO_LEAP_SECS; Bit 2: (value 4) PGS_TD_TAItoUTC() gave PGS_E_TOOLKIT; Bit 3: (value 8) PGS_EPH_EphemAttit() gave PGSEPH_W_BAD_EPHEM_VALUE; Bit 4: (value 16) PGS_EPH_EphemAttit() gave PGSEPH_E_BAD_EPHEM_FILE_HDR; Bit 5: (value 32) PGS_EPH_EphemAttit() gave PGSEPH_E_NO_SC_EPHEM_FILE; Bit 6: (value 64) PGS_EPH_EphemAttit() gave PGSEPH_E_NO_DATA_REQUESTED; Bit 7: (value 128) PGS_EPH_EphemAttit() gave PGSTD_E_SC_TAG_UNKNOWN; Bit 8: (value 256) PGS_EPH_EphemAttit() gave PGSEPH_E_BAD_ARRAY_SIZE; Bit 9: (value 512) PGS_EPH_EphemAttit() gave PGSTD_E_TIME_FMT_ERROR; Bit 10: (value 1024) PGS_EPH_EphemAttit() gave PGSTD_E_TIME_VALUE_ERROR; Bit 11: (value 2048) PGS_EPH_EphemAttit() gave PGSTD_E_NO_LEAP_SECS; Bit 12: (value 4096) PGS_EPH_EphemAttit() gave PGS_E_TOOLKIT; Bit 13: (value 8192) PGS_CSC_ECItoECR() gave PGSCSC_W_BAD_TRANSFORM_VALUE; Bit 14: (value 16384) PGS_CSC_ECItoECR() gave PGSCSC_E_BAD_ARRAY_SIZE; Bit 15: (value 32768) PGS_CSC_ECItoECR() gave PGSTD_E_NO_LEAP_SECS; Bit 16: (value 65536) PGS_CSC_ECItoECR() gave PGSTD_E_TIME_FMT_ERROR; Bit 17: (value 131072) PGS_CSC_ECItoECR() gave PGSTD_E_TIME_VALUE_ERROR; Bit 18: unused (set to zero); Bit 19: (value 524288) PGS_CSC_ECItoECR() gave PGSTD_E_NO_UT1_VALUE; Bit 20: (value 1048576) PGS_CSC_ECItoECR() gave PGS_E_TOOLKIT; Bit 21: (value 2097152) PGS_CSC_ECRtoGEO() gave PGSCSC_W_TOO_MANY_ITERS; Bit 22: (value 4194304) PGS_CSC_ECRtoGEO() gave PGSCSC_W_INVALID_ALTITUDE; Bit 23: (value 8388608) PGS_CSC_ECRtoGEO() gave PGSCSC_W_SPHERE_BODY; Bit 24: (value 16777216) PGS_CSC_ECRtoGEO() gave PGSCSC_W_LARGE_FLATTENING; Bit 25: (value 33554432) PGS_CSC_ECRtoGEO() gave PGSCSC_W_DEFAULT_EARTH_MODEL; Bit 26: (value 67108864) PGS_CSC_ECRtoGEO() gave PGSCSC_E_BAD_EARTH_MODEL; Bit 27: (value 134217728) PGS_CSC_ECRtoGEO() gave PGS_E_TOOLKIT; Bit 28-31: not used
glintgeoqa	16-bit unsigned integer	None	Glint Geolocation QA flags: Bit 0: (LSB, value 1) bad input value; Bit 1: (value 2) glint location in Earth's shadow (Normal for night FOVs); Bit 2: (value 4) glint calculation not converging; Bit 3: (value 8) glint location sun vs. satellite zenith mismatch; Bit 4: (value 16) glint location sun vs. satellite azimuth mismatch; Bit 5: (value 32) bad glint location; Bit 6: (value 64) PGS_CSC_ZenithAzimuth() gave any 'W' class return code; Bit 7: (value 128) PGS_CSC_ZenithAzimuth() gave any 'E' class return code; Bit 8: (value 256) PGS_CBP_Earth_CB_Vector() gave any 'W' class return code; Bit 9: (value 512) PGS_CBP_Earth_CB_Vector() gave any 'E' class return code; Bit 10: (value 1024) PGS_CSC_ECItoECR() gave any 'W' class return code except PGSCSC_W_PREDICTED_UT1 (for Glint); Bit 11: (value 2048) PGS_CSC_ECItoECR() gave any 'E' class return code (for Glint); Bit 12: (value 4096) PGS_CSC_ECRtoGEO() gave any 'W' class return code (for

			Glint); Bit 13: (value 8192) PGS_CSC_ECRtoGEO() gave any 'E' class return code (for Glint); Bit 14: (value 16384) PGS_CSC_ECItoECR() gave any 'W' class return code except PGSCSC_W_PREDICTED_UT1 ; Bit 15: (value 32768) PGS_CSC_ECItoECR() gave any 'E' class return code
moongeoqa	16-bit unsigned integer	None	Moon Geolocation QA flags: Bit 0: (LSB, value 1) bad input value; Bit 1: (value 2) PGS_TD_TAItoUTC() gave PGSTD_E_NO_LEAP_SECS; Bit 2: (value 4) PGS_TD_TAItoUTC() gave PGS_E_TOOLKIT; Bit 3: (value 8) PGS_CBP_Sat_CB_Vector() gave PGSCSC_W_BELOW_SURFACE; Bit 4: (value 16) PGS_CBP_Sat_CB_Vector() gave PGSCBP_W_BAD_CB_VECTOR; Bit 5: (value 32) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_BAD_ARRAY_SIZE; Bit 6: (value 64) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_INVALID_CB_ID; Bit 7: (value 128) PGS_CBP_Sat_CB_Vector() gave PGSMEM_E_NO_MEMORY; Bit 8: (value 256) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_UNABLE_TO_OPEN_FILE; Bit 9: (value 512) PGS_CBP_Sat_CB_Vector() gave PGSTD_E_BAD_INITIAL_TIME; Bit 10: (value 1024) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_TIME_OUT_OF_RANGE; Bit 11: (value 2048) PGS_CBP_Sat_CB_Vector() gave PGSTD_E_SC_TAG_UNKNOWN; Bit 12: (value 4096) PGS_CBP_Sat_CB_Vector() gave PGSEPH_E_BAD_EPHEM_FILE_HDR; Bit 13: (value 8192) PGS_CBP_Sat_CB_Vector() gave PGSEPH_E_NO_SC_EPHEM_FILE; Bit 14: (value 16384) PGS_CBP_Sat_CB_Vector() gave PGS_E_TOOLKIT; Bit 15: not used
nadirTAI	64-bit floating-point	None	TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993)
sat_lat	64-bit floating-point	None	Satellite geodetic latitude in degrees North (-90.0 ... 90.0)
sat_lon	64-bit floating-point	None	Satellite geodetic longitude in degrees East (-180.0 ... 180.0)
scan_node_type	8-bit integer	None	'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value.
glintlat	32-bit floating-point	None	Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0)
glintlon	32-bit floating-point	None	Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0)
state1	32-bit integer	None	Data state for AMSU-A1: 0:Process, 1:Special, 2:Erroneous, 3:Missing
state2	32-bit integer	None	Data state for AMSU-A2: 0:Process, 1:Special, 2:Erroneous, 3:Missing (AMSU-A2 is AMSU-A channels 1 and 2)
cal_coef_a0	32-bit floating-point	Channel (= 15)	Calibration coefficients to convert raw counts to antenna temperature (K)
cal_coef_a0_err	32-bit floating-point	Channel (= 15)	Error estimate for cal_coef_a0 (K)
cal_coef_a1	32-bit floating-point	Channel (= 15)	Calibration coefficients to convert raw counts to antenna temperature (K/count)

cal_coef_a1_err	32-bit floating-point	Channel (= 15)	Error estimate for cal_coef_a1 (K/count)
cal_coef_a2	32-bit floating-point	Channel (= 15)	Calibration coefficients to convert raw counts to antenna temperature (K/count**2)
cal_coef_a2_err	32-bit floating-point	Channel (= 15)	Error estimate for cal_coef_a2 (K/count**2)
a1_ColdCalPstion	8-bit integer	None	AMSU-A1 Cold Calibration Position 1-4 (Binary 0-3)
a2_ColdCalPstion	8-bit integer	None	AMSU-A2 Cold Calibration Position 1-4 (Binary 0-3) (AMSU-A2 is AMSU-A channels 1 and 2)
a1_PLO_Redundncy	8-bit integer	None	AMSU-A1 PLO Redundancy, 1: default (PLO 2); 0: redundant (PLO 1)
a11_mux_temp_used	8-bit integer	None	AMSU-A1-1 MUX Temperature use flag. (1: used MUX temperature for AMSU-A1 receiver temperature; 0: used RF shelf temperature) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15)
a11_receiver_temp	32-bit floating-point	None	AMSU-A1-1 receiver temperature used in calibration (MUX temperature or RF shelf temperature as specified by a11_mux_temp_used) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C)
a11_target_temp	32-bit floating-point	None	AMSU-A1-1 target temperature used in calibration (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C)
a12_mux_temp_used	8-bit integer	None	AMSU-A1-2 MUX Temperature use flag. (1: used MUX temperature for AMSU-A1 receiver temperature; 0: used RF shelf temperature) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8)
a12_receiver_temp	32-bit floating-point	None	AMSU-A1-2 receiver temperature used in calibration (MUX temperature or RF shelf temperature as specified by a12_mux_temp_used) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C)
a12_target_temp	32-bit floating-point	None	AMSU-A1-2 target temperature used in calibration (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C)
a2_diplexer_temp_used	8-bit integer	None	AMSU-A2 diplexer Temperature use flag. (1: used diplexer temperature for AMSU-A2 receiver temperature; 0: used RF shelf temperature) (AMSU-A2 is AMSU-A channels 1 and 2)
a2_receiver_temp	32-bit floating-point	None	AMSU-A2 receiver temperature used in calibration (diplexer temperature or RF shelf temperature as specified by a2_diplexer_temp_used) (AMSU-A2 is AMSU-A channels 1 and 2) (C)
a2_target_temp	32-bit floating-point	None	AMSU-A2 target temperature used in calibration (AMSU-A2 is AMSU-A channels 1 and 2) (C)
qa_scanline	8-bit unsigned integer	None	Scanline bitmap for AMSU-A: Bit 0: (LSB, value 1) Sun glint in this scanline; Bit 1: (value 2) Coastal crossing in this scanline; Bit 2: (value 4) Some channels had excessive NeDT estimate; Bit 3: (value 8) Near sidelobe correction applied
qa_receiver_a11	8-bit unsigned integer	None	Receiver bitmap for AMSU-A1-1 (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15): Bit 0: (LSB, value 1) Calibration was not derived, due to the instrument mode; Bit 1: (value 2) Calibration was not derived, due to bad or missing PRT values; Bit 2: (value 4) This scanline was calibrated, but the moon was in the space view; Bit 3: (value 8) This scanline was calibrated, but there was a space view scan position err; Bit 4: (value 16) This scanline was calibrated, but there was a blackbody scan position error; Bit 5: (value 32) This scanline was calibrated, but some PRT values were bad or marginal; Bit 6: (value 64) This scanline was calibrated, but there was a data gap; Bit 7: (value 128) Some channels were not calibrated
qa_receiver_a12	8-bit unsigned	None	Receiver bitmap for AMSU-A1-2:Same fields as defined for qa_receiver_a11

	integer		
qa_receiver_a2	8-bit unsigned integer	None	Receiver bitmap for AMSU-A2:Same fields as defined for qa_receiver_a11
qa_channel	8-bit unsigned integer	Channel (= 15)	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

3.6 Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

Name	Type	Extra Dimensions	Explanation
scanang	32-bit floating-point	None	Scanning angle of AMSU-A instrument with respect to the AMSU-A Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir)
ftptgeoqa	32-bit unsigned integer	None	Footprint Geolocation QA flags: Bit 0: (LSB, value 1) bad input value; Bit 1: (value 2) PGS_TD_TAItoUTC() gave PGSTD_E_NO_LEAP_SECS; Bit 2: (value 4) PGS_TD_TAItoUTC() gave PGS_E_TOOLKIT; Bit 3: (value 8) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_MISS_EARTH; Bit 4: (value 16) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_SC_TAG_UNKNOWN; Bit 5: (value 32) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_ZERO_PIXEL_VECTOR; Bit 6: (value 64) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_BAD_EPH_FOR_PIXEL; Bit 7: (value 128) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_INSTRUMENT_OFF_BOARD; Bit 8: (value 256) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_BAD_ACCURACY_FLAG; Bit 9: (value 512) PGS_CSC_GetFOV_Pixel() gave PGSCSC_E_BAD_ARRAY_SIZE; Bit 10: (value 1024) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_DEFAULT_EARTH_MODEL; Bit 11: (value 2048) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_DATA_FILE_MISSING; Bit 12: (value 4096) PGS_CSC_GetFOV_Pixel() gave PGSCSC_E_NEG_OR_ZERO_RAD; Bit 13: (value 8192) PGS_CSC_GetFOV_Pixel() gave PGSMEM_E_NO_MEMORY; Bit 14: (value 16384) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_NO_LEAP_SECS; Bit 15: (value 32768) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_TIME_FMT_ERROR; Bit 16: (value 65536) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_TIME_VALUE_ERROR; Bit 17: (value 131072) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_PREDICTED_UT1; Bit 18: (value 262144) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_NO_UT1_VALUE; Bit 19: (value 524288) PGS_CSC_GetFOV_Pixel() gave PGS_E_TOOLKIT; Bit 20: (value 1048576) PGS_CSC_GetFOV_Pixel() gave PGSEPH_E_BAD_EPHEM_FILE_HDR; Bit 21: (value 2097152) PGS_CSC_GetFOV_Pixel() gave

			PGSEPH_E_NO_SC_EPHEM_FILE; Bit 22-31: not used
zengeoqa	16-bit unsigned integer	None	Satellite zenith Geolocation QA flags: Bit 0: (LSB, value 1) (Spacecraft) bad input value; Bit 1: (value 2) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_W_BELOW_HORIZON; Bit 2: (value 4) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_W_UNDEFINED_AZIMUTH; Bit 3: (value 8) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_W_NO_REFRACTION; Bit 4: (value 16) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_E_INVALID_VECTAG; Bit 5: (value 32) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_E_LOOK_PT_ALTIT_RANGE; Bit 6: (value 64) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_E_ZERO_INPUT_VECTOR; Bit 7: (value 128) PGS_CSC_ZenithAzimuth(S/C) gave PGS_E_TOOLKIT; Bit 8: (value 256) (Sun) bad input value; Bit 9: (value 512) (suppressed) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_W_BELOW_HORIZON (This is not an error condition - the sun is below the horizon at night); Bit 10: (value 1024) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_W_UNDEFINED_AZIMUTH; Bit 11: (value 2048) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_W_NO_REFRACTION; Bit 12: (value 4096) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_E_INVALID_VECTAG; Bit 13: (value 8192) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_E_LOOK_PT_ALTIT_RANGE; Bit 14: (value 16384) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_E_ZERO_INPUT_VECTOR; Bit 15: (value 32768) PGS_CSC_ZenithAzimuth(Sun) gave PGS_E_TOOLKIT
demgeoqa	16-bit unsigned integer	None	Digital Elevation Model (DEM) Geolocation QA flags: Bit 0: (LSB, value 1) bad input value; Bit 1: (value 2) Could not allocate memory; Bit 2: (value 4) Too close to North or South pole. Excluded. (This is not an error condition - a different model is used); Bit 3: (value 8) Layer resolution incompatibility. Excluded; Bit 4: (value 16) Any DEM Routine (elev) gave PGSDEM_E_IMPROPER_TAG; Bit 5: (value 32) Any DEM Routine (elev) gave PGSDEM_E_CANNOT_ACCESS_DATA; Bit 6: (value 64) Any DEM Routine (land/water) gave PGSDEM_E_IMPROPER_TAG; Bit 7: (value 128) Any DEM Routine (land/water) gave PGSDEM_E_CANNOT_ACCESS_DATA; Bit 8: (value 256) Reserved for future layers; Bit 9: (value 512) Reserved for future layers; Bit 10: (value 1024) PGS_DEM_GetRegion(elev) gave PGSDEM_M_FILLVALUE_INCLUDED; Bit 11: (value 2048) PGS_DEM_GetRegion(land/water) gave PGSDEM_M_FILLVALUE_INCLUDED; Bit 12: (value 4096) Reserved for future layers; Bit 13: (value 8192) PGS_DEM_GetRegion(all) gave PGSDEM_M_MULTIPLE_RESOLUTIONS; Bit 14: (value 16384) PGS_CSC_GetFOV_Pixel() gave any 'W' classreturn code except PGSCSC_W_PREDICTED_UT1; Bit 15: (value 32768) PGS_CSC_GetFOV_Pixel() gave any 'E' class return code
satzen	32-bit floating-point	None	Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.)
satazi	32-bit floating-point	None	Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO)
solzen	32-bit floating-point	None	Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.)

solazi	32-bit floating-point	None	Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO)
sun_glint_distance	16-bit integer	None	Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow)
topog	32-bit floating-point	None	Mean topography in meters above reference ellipsoid
topog_err	32-bit floating-point	None	Error estimate for topog
landFrac	32-bit floating-point	None	Fraction of spot that is land (0.0 ... 1.0)
landFrac_err	32-bit floating-point	None	Error estimate for landFrac
antenna_temp	32-bit floating-point	Channel (= 15)	Raw antenna temperature in Kelvins
brightness_temp	32-bit floating-point	Channel (= 15)	Antenna temperatures, with an empirically derived correction applied to compensate for scan-position dependent bias. This correction is derived from AIRS retrievals. (K)
brightness_temp_err	32-bit floating-point	Channel (= 15)	Uncertainty in empirically derived brightness_temp bias correction, excluding radiometer noise. (K)

3.7 Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "QA_bb_PRT_a11" involves reading HDF-EOS Swath field "QA_bb_PRT_a11.min". Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

Field Name	Type	Explanation
min	32-bit floating-point	Minimum value field takes on in granule (not valid when num_in = 0)
max	32-bit floating-point	Maximum value field takes on in granule (not valid when num_in = 0)
mean	32-bit floating-point	Mean of values field takes on in granule (not valid when num_in = 0)
dev	32-bit floating-point	Standard Deviation of values field takes on in granule (not valid when num_in < 2)
num_in	32-bit integer	Count of in-range values field takes on in granule
num_lo	32-bit integer	Count of out-of-range low values field takes on in granule
num_hi	32-bit integer	Count of out-of-range high values field takes on in granule
num_bad	32-bit integer	Count of occassions on which field takes on invalid flag value (-9999) in granule
range_min	32-bit floating-point	Minimum in-range value.
range_max	32-bit floating-point	Maximum in-range value.
missing	8-bit integer	Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing; Bit 1 is high when yellow high (range_max) limit is missing;

		other bits unused, set to 0.
max_track	32-bit integer	GeoTrack index (counting from 1) where max was found
max_xtrack	32-bit integer	GeoXTrack index (counting from 1) where max was found
min_track	32-bit integer	GeoTrack index (counting from 1) where min was found
min_xtrack	32-bit integer	GeoXTrack index (counting from 1) where min was found

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

Field Name	Type	Explanation
min	32-bit floating-point	Minimum value field takes on in granule (not valid when num_in = 0)
max	32-bit floating-point	Maximum value field takes on in granule (not valid when num_in = 0)
mean	32-bit floating-point	Mean of values field takes on in granule (not valid when num_in = 0)
dev	32-bit floating-point	Standard Deviation of values field takes on in granule (not valid when num_in < 2)
num	32-bit integer	Count of occurrences of field in granule (not including those counted in num_bad)
num_bad	32-bit integer	Count of occassions on which field takes on invalid flag value (-9999) in granule
max_track	32-bit integer	GeoTrack index (counting from 1) where max was found
max_xtrack	32-bit integer	GeoXTrack index (counting from 1) where max was found
min_track	32-bit integer	GeoTrack index (counting from 1) where min was found
min_xtrack	32-bit integer	GeoXTrack index (counting from 1) where min was found

4. Options for Reading Data

The HDF Group provides various utilities for viewing the contents of HDF files and extracting the raster, binary, or ASCII objects (see http://hdf.ncsa.uiuc.edu/products/index.html)

4.1 Command-line utilities

4.1.1 read_hdf

The read_hdf tool is a command-line utility developed by GES DISC. It allows user to browse the file structure and display data values if desired. The source code is written in C language and can be obtained from: ftp://disc1.gsfc.nasa.gov/software/aura/read_hdf

Command line syntax:

```
read_hdf [-l] | [[-i | -d] [-a <output> | -b <base>.*.bin ]]  filename

Options/Arguments:

   [-i] -- run in interactive mode (default), or
   [-l] -- list a tree of file objects, or
   [-d] -- dump all HDF object types (no filtering)
   [-a <output>] -- ASCII output file name (default is <filename>.txt)
   [-b <base>] -- base binary output file name (default is <filename>)
                  creates two files per HDF object:
                  <base>.*.met for metadata, and <base>.*.bin for binary data
                  (default output to stdout)
   filename -- name of the input HDF file
```

4.1.2 ncdump

The **ncdump** dumps HDF to ASCII format

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

Options/Arguments:
  [-c]                 Coordinate variable data and header information
  [-h]                 Header information only, no data
  [-v var1[,...]]      Data for variable(s) <var1>,... only
  [-b [c|f]]           Brief annotations for C or Fortran indices in data
  [-f [c|f]]           Full annotations for C or Fortran indices in data
  [-l len]             Line length maximum in data section (default 80)
  [-n name]            Name for netCDF (default derived from file name)
  [-d n[,n]]           Approximate floating-point values with less precision
  filename             File name of input netCDF file
e.g.
     ncdump <inputfilename.hdf>
            dumps the entire contents of an HDF file to ASCII format
     ncdump –v <variable name> <inputfilename.hdf>
```

```
        dump one data variable from the HDF file to ASCII format
ncdump -h <inputfilename.hdf> | more
        dump only the metadata information to the screen
ncdump -h <inputfilename.hdf> > ascii.out
        dump this metadata information to an output file named ascii.out
```

Note: the ncdump tool will only display variables whose ranks are great than 1.

The ncdump -H command provides instructions for using ncdump. Comprehensive yet simple instructions for extracting data and metadata from HDF files are given below. The following website (http://nsidc.org/data/hdfeos/hdf_to_ascii.html) provides step-by-step instructions on how to download, install and execute ncdump commands.

4.1.3 hdp

hdp is a command line utility designed for quick display of contents and data of HDF objects. It can list the contents of hdf files at various levels with different details. It can also dump the data of one or more specific objects in the file.

```
Usage: hdp [-H] command [command options] <filelist>
         -H  Display usage information about the specified command.
             If no command is specified, -H lists all commands.

         Commands:
             list        lists contents of files in <filelist>
             dumpsds     displays data of SDSs in <filelist>
             dumpvd      displays data of vdatas in <filelist>.
             dumpvg      displays data of vgroups in <filelist>.
             dumprig     displays data of RIs in <filelist>.
             dumpgr      displays data of RIs in <filelist>.
```

Detailed information on how to download, install and execute **hdp** command is found at http://nsidc.org/data/hdfeos/hdf_to_binary.html

4.2 GUI tools

The HDFView (http://hdf.ncsa.uiuc.edu/hdf-java-html/hdfview/) is a visual tool for browsing and editing NCSA HDF4 and HDF5 files and is available for various platforms (Windows 98/NT/2000/XP, Solaris, Linux, AIX, Irix 6.5, MacOSX). Using HDFView, you can:

(1) view a file hierarchy in a tree structure
(2) create new file, add or delete groups and datasets
(3) view and modify the content of a dataset
(4) add, delete and modify attributes
(5) replace I/O and GUI components such as table view, image view and metadata view

Users, especially **those who are not familiar with Unix/Linux environment** are strongly encouraged to use HDFView for a quick access to data contents.
There is also an add-on plug-in for handling HDFEOS data specifically, which you can download from: http://opensource.gsfc.nasa.gov/projects/hdf/hdf.php

4.3 Read software in C, Fortran, IDL and MATLAB

AIRS science team provides reader software in IDL, MATLAB, C and FORTRAN programming language. You can download them from GES DISC web site:

(1) IDL / MATLAB suite along with sample HDFEOS data files (http://disc.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/IDL_MATLAB_READERS.tar.gz)
(2) FORTRAN / C suite along with sample HDFEOS data files (http://disc.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/FORTRAN_C_READERS.tar.gz)

If you wish to program yourself, the HDFEOS programming model for accessing a swath data set through the swath (SW) interface is as follows:

(1) Open the file and obtain a file id from a file name.
(2) Open a swath data set by obtaining a swath id from a swath name.
(3) Perform desired operations on the data set.
(4) Close the swath data set by disposing of the swath id.
(5) Terminate swath access to the file by disposing of the file id.

A complete list of swath interface routines is summarized in the next two pages. To read an HDFEOS data file, access, basic I/O and inquiry routines are of particular interest.

Summary of HDF-EOS Swath Interface

Category	Routine Name		Description
	C	FORTRAN	
Access	SWopen	swopen	opens or creates HDF file in order to create, read, or write a swath
	SWcreate	swcreate	creates a swath within the file
	SWattach	swattach	attaches to an existing swath within the file
	SWdetach	swdetach	detaches from swath interface
	SWclose	swclose	closes file
Definition	SWdefdim	swdefdim	defines a new dimension within the swath
	SWdefdimmap	swdefmap	defines the mapping between the geolocation and data dimensions
	SWdefidxmap	swdefimap	defines a non-regular mapping between the geolocation and data dimension
	SWdefgeofield	swdefgfld	defines a new geolocation field within the swath
	SWdefdatafield	swdefdfld	defines a new data field within the swath
	SWdefprofile		defines the profile data structure within the swath
	SWdefcomp	swdefcomp	defines a field compression scheme
	SWwritegeometa	swwrgmeta	writes field metadata for an existing swath geolocation field
	SWwritedatameta	swwrdmeta	writes field metadata for an existing swath data field
Basic I/O	SWwritefield	swwrfld	writes data to a swath field
	SWreadfield	swrdfld	reads data from a swath field.
	SWwriteprofile		writes data to the profile
	SWreadprofile		reads data from the profile
	SWwriteattr	swwrattr	writes/updates attribute in a swath
	SWreadattr	swrdattr	reads attribute from a swath
	SWwritegrpattr	swwrgattr	writes/updates attribute as a swath
	SWreadgrpattr	swrdgattr	reads group attribute from a swath
	SWwritelocattr	swwrlattr	writes/updates local attribute in a swath
	SWreadlocattr	swrdlattr	reads local attribute from a swath
	SWsetfillvalue	swsetfill	sets fill value for the specified field
	SWgetfillvalue	swgetfill	retrieves fill value for the specified field
Inquiry	SWinqdims	swinqdims	retrieves information about dimensions defined in swath
	SWinqmaps	swinqmaps	retrieves information about the geolocation relations defined
	SWinqidxmaps	swinqimaps	retrieves information about the indexed geolocation/data mappings defined
	SWinqgeofields	swinqgflds	retrieves information about the geolocation fields defined
	SWinqdatafields	swinqdflds	retrieves information about the data fields defined
	SWinqattrs	swinqattrs	retrieves number and names of attributes defined
	SWinqgrpattrs	swinqgattrs	retrieves number and names of group attributes defined
	SWinqlocattrs	swinqlattrs	retrieves number and names of local attributes defined
	SWnentries	swnentries	returns number of entries and descriptive string buffer size for a specified entity
	SWdiminfo	swdiminfo	retrieve size of specified dimension
	SWgrpattrinfo	swgattrinfo	retrieves information about swath group attributes
	SWlocattrinfo	swlattrinfo	returns information about swath local attributes

Summary of HDF-EOS Swath Interface

Category	Routine Name		Description
	C	FORTRAN	
	SWmapinfo	swmapinfo	retrieve offset and increment of specified geolocation mapping
	SWidxmapinfo	swimapinfo	retrieve offset and increment of specified geolocation mapping
	SWattrinfo	swattrinfo	returns information about swath attributes
	SWfieldinfo	swfldinfo	retrieve information about a specific geolocation or data field
	SWcompinfo	swcompinfo	retrieve compression information about a field
	SWinqswath	swinqswath	retrieves number and names of swaths in file
	SWregionindex	swregidx	returns information about the swath region ID
	SWupdateidxmap	swupimap	update map index for a specified region
Subset	SWgeomapinfo	swgmapinfo	retrieves type of dimension mapping when first dimension is geodim
	SWdefboxregion	swdefboxreg	define region of interest by latitude/longitude
	SWregioninfo	swreginfo	returns information about defined region
	SWextractregion	swextreg	read a region of interest from a field
	SWdeftimeperiod	swdeftmeper	define a time period of interest
	SWperiodinfo	swperinfo	retuns information about a defined time period
	SWextractperiod	swextper	extract a defined time period
	SWdefvrtregion	swdefvrtreg	define a region of interest by vertical field
	SWdupregion	swdupreg	duplicate a region or time period
	SWdefscanregion		define region of interest based on range of scans

5. Data Services

AIRS File Subsetting Service

Users can limit number of files for download by specifying appropriate spatial and temporal constraints in search engines like Mirador (http://mirador.gsfc.nasa.gov). The total download size can be further reduced by choosing a subset of variables, channels within each file through the subsetting service. AIRS file subsetting service is provided as a part of the data ordering process through the Mirador search engine. The table below shows the available subsetting options for AIRS Level-1B and Level-2 products.
(http://disc.sci.gsfc.nasa.gov/AIRS/data_access.shtml)

Product Name	Variable	Channel	Spatial
AIRIBRAD		√	
AIRABRAD		**√**	
AIRVBRAD		√	
AIRXBCAL	√	√	√
AIRX2RET / AIRH2RET	√		
AIRI2CCF		√	
AIRX2SUP / AIRH2SUP	√		

Direct data access via FTP available at

server: airscal1u.ecs.nasa.gov (odd year), airscal2u.ecs.nasa.gov (even year)
directory: /data/s4pa/Aqua_AIRS_Level1

For NRT product,

server: airscal1u.ecs.nasa.gov
diretory: /data/s4pa/Aqua_AIRS_NearRealTime

6. Data Interpretation and Screening

Quality Assurance

AMSU channel 7 exhibits abnormal noise levels. Avoid using radiances from this channel unless averaging, smoothing or other noise reduction processing is part of your analysis. Please refer to the AMSU liens list in the Data Disclaimer documentation for details. (http://disc.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/V5_Data_Disclaimer.pdf)
Also, the radiometric noise, NeDT, in AMSU channel 4 has recently increased significantly. At launch it was 0.12 K and rapidly degraded since June, 2007, reaching 3K by the beginning of December, 2007. More details can be found at (http://disc.sci.gsfc.nasa.gov/AIRS/documentation/notices/AMSU-A_Channel_4_NeDT_Update_2007-12-20.pdf)

Per-Scan Quality Checks

Before using any AMSU-A1 or AMSU-A2 L1B brightness temperature, check the value of the corresponding "**state1**" or "**state2**" to ensure that it is equal to zero.

There is one "**state1**" value for all 30 fields-of-view of a scan, and it is valid for all AMSU-A1 channels (AMSU-A channels 3 through 15).

There is one "**state2**" value for all 30 fields-of-view of a scan, and it is valid for all AMSU-A2 channels (AMSU-A channels 1 and 2).

The "**state1**" and "**state2**" valids and their meaning are:

State Valid	State Value	Meaning
Process	0	normal data
Special	1	instrument in special calibration mode when these data were taken (e.g., staring at nadir)
Erroneous	2	data known bad (e.g., instrument in safe mode)
Missing	3	data are missing

Per-Channel Quality Checks
Individual channel readings ("**antenna_temp**" or "**brightness_temp**") must be checked for the flag bad value of **–9999.0**. A channel reading is set to this value by the PGE when no actual antenna temperature value can be calculated.

Advanced Quality Checks
Each scan contains a "**glintlat**" and "**glintlon**" giving the location of the solar glint center at the time in the middle of that scan. Users can use these or the perfield-of-view "**sun_glint_distance**" to check for possibility of solar glint contamination.

Serious glint contamination of AMSU window channels (channels 1,2,3, and 15) is seen when the scene contains substantial water (landFrac < 0.5) and “**sun_glint_distance**” is less than ~50km.

“**qa_receiver_a11**”, “**qa_receiver_a12**”, “**qa_receiver_a2**”, bits 2-6 and “**qa_channel**” bits 0-6 indicate conditions that can potentially, but not usually, impact data quality. Users who require pristine data should discard data when any of these bits are set.

Detailed information on algorithm, calibration, and error estimation is documented in “Algorithm Theoretical Bases Document” (http://eospso.gsfc.nasa.gov/eos_homepage/for_scientists/atbd/docs/AIRS/atbd-airs-L1B_microwave.pdf)

Also, please refer to the Advanced Theoretical Basis Document (ATBD) for AIRS Full Validation, AIRS Validation Plan (http://eospso.gsfc.nasa.gov/eos_homepage/for_scientists/atbd/docs/AIRS/AIRSValP2doc.pdf)

A report on the status of V5 calibration and validation is provided in the document: V5_CalVal_Status_Summary.pdf (http://disc.sci.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/V5_CalVal_Status_Summary.pdf)

The retrieval flow is also summarized in the AIRS/AMSU/HSB Version 5 Retrieval Flow (http://disc.sci.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/V5_Retrieval_Flow.pdf) document.

7. More Information

7.1 Web resources for AIRS data users:

NASA/JPL:

- AIRS Project Web Site: http://airs.jpl.nasa.gov/
- Ask AIRS Science Questions: http://airs.jpl.nasa.gov/AskAirs/
-

NASA/GSFC:

- AIRS Data Support Main Page: http://disc.sci.gsfc.nasa.gov/AIRS/
- AIRS Data Access: http://disc.sci.gsfc.nasa.gov/AIRS/data_access.shtml
- AIRS Documentation: http://disc.sci.gsfc.nasa.gov/AIRS/documentation.shtml
- AIRS Products: http://disc.sci.gsfc.nasa.gov/AIRS/data_products.shtml

Data can also be obtained from Giovanni (online visualization and analysis tool):
http://acdisc.sci.gsfc.nasa.gov/Giovanni/airs/

7.2 Point of Contact

URL	http://disc.gsfc.nasa.gov/	
Contact	Name	GES DISC HELP DESK SUPPORT GROUP
	Email	gsfc-help-disc@lists.nasa.gov
	Phone	301-614-5224
	Fax	301-614-5268
	Address	Goddard Earth Sciences Data and Information Services Center, Code 610.2 NASA Goddard Space Flight Center, Greenbelt, MD, 20771, USA

8. Acronyms

ADPUPA Automatic Data Processing Upper Air (radiosonde reports)
ADPUPA Automatic Data Processing Upper Air (radiosonde reports)
AIRS Atmospheric infraRed Sounder
AMSU Advanced Microwave Sounding Unit
DAAC Distributed Active Archive Center
DISC Data and Information Services Center
DN Data Number
ECMWF European Centre for Medium Range Weather Forecasts (UK)
ECS EOSDIS Core System
EDOS Earth Observing System Data and Operations System
EOS Earth Observing System
EOSDIS Earth Observing System Data and Information System
ESDT Earth Science Data Type
EU Engineering Unit
FOV Field of View
GDAAC Goddard Space Flight Center Distributed Active Archive Center
GES Goddard Earth Sciences
GSFC Goddard Space Flight Center
HDF Hierarchical Data Format
HSB Humidity Sounder for Brazil
L1A Level 1A Data
L1B Level 1B Data
L2 Level 2 Data
L3 Level 3 Data
LGID Local Granule IDentification
MW Microwave
NCEP National Centers for Environmental Prediction
NESDIS National Environmental Satellite, Data and Information Service
NIR Near Infrared
NOAA National Oceanic and Atmospheric Administration
PGE Product Generation Executive
PGS Product Generation System
PREPQC NCEP quality controlled final observation data
QA Quality Assessment
RTA Radiative Transfer Algorithm
SPS Science Processing System
URL Universal Reference Link
VIS Visible
WMO World Meteorological Organization