AIRS/AMSU/HSB Version 5
Level 1B Product User Guide

Edited by:
Heidar Th. Thrastarson

Contributions by:
Steve Broberg, Evan Manning, Stephen Licata,
Edward T. Olsen, William Mathews
Jet Propulsion Laboratory, California Institute of Technology

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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA

Submit Questions to:
https://airs.jpl.nasa.gov/data/support/ask-airs

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1 Overview

At launch the AIRS suite of instruments on board the Aqua satellite included a hyperspectral infrared instrument (AIRS) and two multichannel microwave instruments, the Advanced Microwave Sounding Unit-A (AMSU-A or AMSU) and the Humidity Sounder for Brazil (HSB). AIRS and HSB have roughly 15 km horizontal resolution at nadir, and AMSU horizontal resolution is 45 km, and the AIRS instrument includes an imaging radiometer in four visible and near-infrared bands with 2.3 km resolution at nadir. HSB stopped operating on 5 February, 2003, but an AIRS/AMSU/HSB product has been available in all data releases.

AIRS/AMSU/HSB Level 1B (L1B) products contain calibrated and geolocated radiances measured by the AIRS suite of instruments. This document is a collection of useful information for L1B data users. The information applies to the Version 5 (V5) data release. Subsequent data releases apply to further processed data, as L1C data is released under Version 6.7, and L2 and L3 data under Version 7, but the algorithms that create L1B data products remain unchanged at Version 5.

Section 2 of this document contains a quick guide to the key contents of the L1B data products and lists of known issues that can affect the quality of the data from each of the instruments. Section 3 is a quick start guide to the most basic L1B quality assurance (QA) parameters that users of AIRS/AMSU/HSB data should access to judge L1B Radiance Product quality. Appendix A has a complete list of all fields provided in the L1B product data files, with short descriptions for each field.

An overview of the AIRS mission, including the AIRS suite of instruments, the data processing algorithms, data products and their organization, and the organization of the AIRS documentation, is given in

Overview_of_the_AIRS_Mission.pdf.

All AIRS documents, which are referred to throughout this document by file name, can be accessed through the Goddard Earth Sciences Data and Information Services Center (GES DISC) at the following webpage:

https://disc.gsfc.nasa.gov/information/documents?title=AIRS%20Documentation

AIRS products are archived at the Goddard Distributed Active Archive Center (GDAAC), located at the GES DISC. Each Level 1B science file type contains data from 6 minutes of observations in HDF-EOS Swath format. Thus, there are

240 granules of each L1B product produced every day. The product formats are defined in the product interface specifications, provided in Appendix A. The data can be accessed at the following webpage:

https://disc.gsfc.nasa.gov

Maps showing the location of each available granule can be accessed at the following URL:

https://airsl1.gesdisc.eosdis.nasa.gov/data/Aqua_AIRS_Level1/AIRXAMAP.005/

Level 1B science data is calibrated instrument measurements in physical units. Data from the AIRS instrument is divided into separate products, referred to by their Earth Science Data Type (ESDT) shortnames as follows: AIRIBRAD has infrared (IR) data, while AIRVBRAD has visible/near-infrared (Vis/NIR) data. The corresponding AIRIBQAP and AIRVBQAP Quality Assessment (QA) subset files exclude radiances and other large fields to deliver quality information in a compact format. The radiances are well calibrated; however, not all QA data have been validated.

AIRS IR and Vis/NIR radiances are in radiance units, while microwave (MW) instrument data AIRABRAD and AIRHBRAD are in brightness temperature units.

The basic L1B product and QA file types are shown in Table 1.1. For information about the additional L1B calibration subset files, please see:

V5_Cal_Subset_QuickStart.pdf.

Table 1.1: Level 1B Product and QA File Types

ESDT Shortname	Mnemonic Name
AIRIBRAD	L1B_AIRS_SCIENCE
AIRIBQAP	L1B_AIRS_QA
AIRVBRAD	L1B_VIS_SCIENCE
AIRVBQAP	L1B_VIS_QA
AIRABRAD	L1B_AMSU_SCIENCE
AIRABQAP	L1B_AMSU_QASup
AIRHBRAD	L1B_HSB_SCIENCE
AIRHBQAP	L1B_HSB_QASup

1.1 Data Validation States

AIRS product validation states are "**Provisional**" and "**Validated: Stages 1-3**". The state of product validation depends upon surface type, latitude and product type

Prov = Provisional: Product quality is sufficient for use by the general research community, but users are urged to contact the AIRS science team before using the data in publications

Val1 = Stage 1 Validation: Product accuracy has been estimated using a small number of independent measurements obtained from selected locations and time periods and ground-truth/field program efforts.

Val2 = Stage 2 Validation: Product accuracy has been assessed over a widely distributed set of locations and time periods via several ground-truth and validation efforts.

Val3 = Stage 3 Validation: Product accuracy has been assessed and the uncertainties in the product well established via independent measurements in a systematic and statistically robust way representing global conditions

The validation states and uncertainty estimates for Level 1B Data Products in release V5 are given in Table 1.2.

Table 2.2: L1B Product Validation States and Uncertainties

Level 1B Product	RMS Requirement	Uncertainty Estimate	Val Status
AIRS IR Radiance	3%	<0.2%	Val3
AIRS VIS/NIR Radiance	20%	10-15%	Val1
AMSU Brightness Temperature	0.25-1.2 K	1-2 K	Val3
HSB Brightness Temperature	1.0-1.2 K	1.5 K	Val3

Please see Pagano et al. (2020) for a detailed discussion of measurement uncertainties of AIRS L1B radiances:

Pagano, T. S., Aumann, H. H., Broberg, S. E., Canas, C., Manning, E. M., Overoye, K. O., & Wilson, R. C. (2020), SI-traceability and measurement uncertainty of the atmospheric infrared sounder version 5 level 1B radiances, Remote Sensing, 12(8). https://doi.org/10.3390/RS12081338

2 L1B Data Products

The following is a quick guide to the contents of the data products that we believe are of greatest interest to the user.

2.1 L1B AIRS Radiance Product

See Appendix A1 and A2 for a complete list of fields and their descriptions. Please note that values of -9999 (if integer) and -9999.0 (if floating) denote invalid data.

Users should consult the appropriate (by date) Calibration Properties File. The channel properties files are named

L1B.cal_prop.yyyy.mm.dd.v9.5.0.anc

Here, **yyyy.mm.dd** is the year, month and day of month (i.e., 2005.03.01) on which the calibration properties file supersedes the previous version. The file provides the quality indicators on a per-channel basis. Key indicators are the frequency centroids and widths, NEdT at 250 K and 300 K, spatial centroids, **AB-weight**, **Spec_qual**, **n3sigma** and **npops**. We recommend that users filter channels by requiring that **Spec_qual** = 1 (or both 1 and 2) and **npops** ≤ 1 and **NEdT250** ≤ 1 K. Users may work out an effective NEdT for any scene temperature from the values quoted at 250 K and 300 K. They may also choose to further filter channels by thresholding on **n3sigma**. Refer to Section 3, Appendix A2 and the following document for additional quality assurance information:

V7_L2_Quality_Control_and_Error_Estimation.pdf

The L1B AIRS Radiance Product files contain dynamic quality indicators, on-the-fly estimates of noise and indicators of abnormal behavior by the instrument or algorithms.

<u>SUGGESTION TO USERS FOR CHOOSING CHANNELS TO USE IN RESEARCH:</u>

Evaluate Candidate Channel Spectrally

- Check the **Spec_qual** field in appropriate (by date) calibration properties file and avoid using channels for which **Spec_qual** > 2. A more rigorous test is to require that **Spec_qual** = 1.

Evaluate Candidate Channel Radiometrically

- Check the **NEdT250** field in appropriate (by date) calibration properties file and avoid using channels for which **NedT250** > 1 K
- Check the **npops** field in the appropriate (by date) calibration properties file and avoid using channels for which **npops** > 1.
- Pick a noise limit and filter out channels exceeding it using dynamic **Min_NEdT250** and **Max_NEdT250**.
- Exclude channels having nonzero **CalChanSummary** (a 2378 element attribute in the L1B radiance granules. A zero means the channel was well calibrated for all scanlines in the granule.

Evaluate Candidate Channel Spatially

If sensitivity to channel co-registration is a concern:

- Check the X- and Y- centroid fields in the appropriate (by date) calibration properties and avoid using channels with absolute values greater than 0.25 degree, or
- Use the **Sceneinhomogeneous** flag, the **Rdiff_swindow** and **Rdiff_lwindow** flags and/or the radiances themselves to restrict data selection to uniform scenes where co-registration is not an issue. All flags are full swath fields, i.e. there is a value for each of the 90x135 AIRS footprints in the L1B radiance granule.

2.1.1 Selected fields

The geolocation data fields of immediate interest to the user are:

- **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)

The attribute of immediate interest to the user is:

- **CalGranSummary**
  Bit field that is a bitwise OR of **CalScanSummary**. Zero means that all channels with **ExcludedChans** < 3 were well calibrated in the entire granule, dimension (1)

The per-granule data fields of immediate interest to the user are:

- **CalChanSummary**
  Bit field that is a bitwise OR of CalFlag by channel over all scanlines. Zero means that channel was well calibrated in the entire granule, dimension (2378)
- **ExcludedChans**
  Bit field (**AB_state** from the channel properties file) that indicates A/B detector weights and radiometric quality assessment. Should require value to be less than 3, dimension (2378)
- **NeN**
  Noise equivalent radiance for each channel for an assumed 250 K scene (milliWatts/m^2/cm^{-1}/steradian), dimension (2378)
- **nominal_freq**
  nominal frequencies of each channel (cm^{-1}),
  USE THIS FOR FREQUENCIES, dimension (2378)
- **spectral_freq**
  calculated frequencies of each channel (cm^{-1}),
  noisy since determined using single granule, dimension (2378)
- **spectral_freq_unc**
  uncertainty in calculated frequencies(cm^{-1}),
  noisy since determined using single granule, dimension (2378)

The along-track data fields of immediate interest to the user are:

- **CalFlag**
  Bit field by channel for each scanline. Zero means the channel was well calibrated, dimension (2378,135)
- **CalScanSummary**
  Bit field that is a bitwise OR over the “good” channel list (i.e., channels with **ExcludedChans** < 2). Zero means that all such channels were well calibrated for a scanline, dimension (135)

The swath data fields of immediate interest to user are:

- **radiances**
  calibrated, geolocated channel-by-channel AIRS observed infrared spectra (milliWatts/m^2/cm^{-1}/steradian), dimension (2378,90,135)
- **landFrac**
  fraction of AIRS spot that is land (0.0 -> 1.0),
  dimension (90,135)

- **landFrac_err**
  error estimate for landFrac, dimension (90,135)
- **sun_glint_distance**
  distance from AIRS spot center to location of sun glint; -9999 if unknown and 30000 for no glint visible because
  platform is in the Earth's shadow (km), dimension (90,135)
- **solzen**
  solar zenith angle (degrees, 0->180; daytime if < 85),
  dimension (90,135)
- **Sceneinhomogeneous**
  flag using band-overlap detectors which is set non-zero if the scene is inhomogeneous as determined by Rdiff_swindow, Rdiff_lwindow or Rdiff_strat, dimension (90,135)
- **Rdiff_swindow**
  radiance difference in the 2560 cm^{-1} window region, used to warn of possible errors caused by scene non-uniformity and misalignment of the beams (milliWatts/m^2/cm^{-1}/steradian),
  dimension (90,135)
- **Rdiff_lwindow**
  radiance difference in the 850 cm^{-1} window region, used to warn of possible errors caused by scene non-uniformity and misalignment of the beams (milliWatts/m^2/cm^{-1}/steradian),
  dimension (90,135)

2.1.2 Known Issues

- The AIRS Level 1B is a "raw" or unpolished radiance product - it reports the measured radiances at a given point in time with no attempt to account for unusual noise events or frequency drift. The AIRS Level 1C product (also available at https://disc.gsfc.nasa.gov) is a "cleaned" version of the Level 1B - it accounts for excessive noise events and shifts the AIRS radiances to a fixed frequency grid. It is recommended for new users of the AIRS radiance products. Further information about the L1C data can be found in the following document:

L1C_Product_User_Guide.pdf.

2.2 L1B Visible/NIR Radiance Product

See Appendix A3 and A4 for a complete list of fields and their descriptions. Please note that values of -9999 (if integer) and -9999.0 (if floating) denote invalid data.

2.2.1 Selected Fields

The geolocation data fields of immediate interest to the user are:

- **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)

The attributes of immediate interest to the user are:

- **VISDarkAMSUFOVCount**
  number of AMSU-A footprints in the granule that are uniformly dark in the L1B VIS/NIR and are thus likely to be uniformly clear, dimension (1)
- **VISBrightAMSUFOVCount**
  number of AMSU-A footprints in the granule that are uniformly bright in the L1B VIS/NIR and are thus likely to be uniformly cloudy, dimension (1)

The per-granule data fields of immediate interest to the user are:

- **gain**
  number of radiance units per count, dimension (9,4)
- **gain_err**
  error estimate for number of radiance units per count caused by imperfect fit for gain, dimension (9,4)

The along-track data field of immediate interest to the user is:

- **NeN**
  noise equivalent radiance for each channel (Watts/m^2/micron/steradian), dimension (9,4,135)

The swath data fields of immediate interest to user are:

- **radiances**
  calibrated, geolocated channel-by-channel radiances for each channel (Watts/m^2/micron/steradian), dimension (8,9,4,90,135)
- **landFrac**
  fraction of AIRS spot that is land (0.0 -> 1.0),
  dimension (90,135)
- **landFrac_err**
  error estimate for landFrac, dimension (90,135)
- **sun_glint_distance**
  distance from AIRS spot center to location of sun glint; -9999 if unknown and 30000 for no glint visible because
  platform is in the Earth's shadow (km), dimension (90,135)
- **solzen**
  solar zenith angle (degrees, 0->180; daytime if < 85),
  dimension (90,135)

2.2.2 Known Issues

- In each scanline, at the left edge of the swath (first 3 IR footprints), the first few detectors of Channel 4 (the ones furthest South in ascending granules) have anomalously low values, less than 10% of their expected value. Since Channel 4 is primarily intended for use in a research product (energy balance studies) and the swath edges are of limited value, this problem is not considered critical.
- A decrease in responsivity has been observed in Visible/NIR Channel 1, and to a lesser extent in Channels 2 and 3. This has only been partially compensated for by an empirical correction, but additional data are required to validate the correction. The responses of Channels 2 and 3 erroneously decrease by about 0.4% per year.

2.3 L1B AMSU Radiance Product

See Appendix A5 and A6 for a complete list of fields and their descriptions. Please note that values of -9999 (if integer) and -9999.0 (if floating) denote invalid data.

2.3.1 Selected Fields

The geolocation data fields of immediate interest to the user are:

- **Latitude**
  AMSU footprint boresight geodetic latitude
  (degrees North, -90->+90), dimension (30,45)
- **Longitude**
  AMSU footprint boresight geodetic longitude
  (degrees East, -180->+180), dimension (30,45)

The per-granule data fields of immediate interest to the user are:

- **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 of immediate interest to the user are:

- **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 of immediate interest to user are:

- **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)

2.3.2 Known Issues

- 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 4 failed 1 October 2007
  - Radiances useful until mid-2007
- AMSU channel 5 progressively degraded beginning January 2010
  - Noise level of 0.5 K in January 2010

  - Noise level of 1.0 K in February 2011
  - Noise level of 2.0 K in February 2012 and sharply increased thereafter
- AMSU channel 7 exhibits abnormal noise levels
  - Noise level is about 5x NEdT on the average, but varies substantially
  - The added noise is not random; probable cause is spacecraft transmitter interference
  - The underlying random noise (NEdT) is within specs
  - 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
  - Added noise level is a fraction of NEdT; overall level still meets specs
  - 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
  - The phenomenon is being characterized; cause as yet unknown
  - Negligible effect in most cases; use channel 9 with confidence
- AMSU-A2 with its channels 1 and 2 has not been operational since 24 September 2016-19:46:58 UTC when a fuse in an Aqua quiet bus relay opened and shut off the AMSU-A2 quiet bus power.
- AMSU channel 14 scene temperature underwent a sudden drop of about 4 K on 21 June 2018-15:50 UTC. The channel recovered, with temperatures increasing by about 4 K on 19 June 2019.
  - The cause is not known. A faulty SAW filter is a possibility.

2.4 L1B HSB Radiance Product

See Appendix A7 and A8 for a complete list of fields and their description. Please note that values of -9999 (if integer) and -9999.0 (if floating) denote invalid data.

2.4.1 Selected Fields

The geolocation data fields of immediate interest to the user are:

- **Latitude**
  HSB spot boresight geodetic latitude
  (degrees North, -90->+90), dimension (90,135)
- **Longitude**
  HSB spot boresight geodetic longitude
  (degrees East, -180->+180), dimension (90,135)

The per-granule data fields of immediate interest to the user are:

- **center_freq**
  channel center frequency (GHz), dimension (5)
- **IF_offset_1**
  offset of first intermediate frequency stage (MHz)
  (zero for no mixing), dimension (5)
- **IF_offset_2**
  offset of second intermediate frequency stage (MHz)
  (zero for no second mixing), dimension (5)
- **Bandwidth**
  bandwidth of sum of 1,2 or 4 channels (MHz),
  dimension (5)
- **NeDT**
  instrument noise level estimated from warm count scatter (5)

The along-track data fields of immediate interest to the user are:

- **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; bit 3 set if near sidelobe correction applied),
  dimension (135)

- **qa_receiver**
  Receiver bit field for each scanline (bit 0 set if calibration was not derived due to instrument mode in scanline; bit 1 set if calibration was not derived due to bad or missing PRT values in scanline, bit 2 set if scanline was calibrated but the Moon was in the space view; bit 3 set if scanline was calibrated but there was a space view scan position error; bit 4 set if scanline was calibrated but there was a blackbody view scan position error; bit 5 set if scanline was calibrated but some PRT values were bad or marginal; bit 6 set if scanline calibrated but there was a data gap; bit 7 set if some channels were not calibrated), dimension (135)
- **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 most recent calibration coefficients used; bit 7 set if excessive NeDT estimated), dimension (15,135)

The swath data fields of immediate interest to user are:

- **antenna_temp**
  calibrated, geolocated channel-by-channel HSB observed raw antenna temperature (K), dimension (5,90,135)
- **brightness_temp**
  calibrated, geolocated channel-by-channel HSB sidelobe-corrected antenna temperature (K). No sidelobe correction applied in V6, so set equal to **antenna_temp**, dimension (5,90,135)
- **brightness_temp_err**
  error estimate for brightness_temp (K), do not use since no sidelobe correction applied in V6, dimension (5,90,135)
- **landFrac**
  fraction of HSB spot that is land (0.0 -> 1.0), dimension (90,135)
- **landFrac_err**
  error estimate for landFrac, dimension (90,135)

2.4.2 Known Issues

- HSB exhibits scan asymmetry which produces scan-dependent negative bias in scene brightness temperatures
    - A left-right asymmetry is present; the right swath edge exhibits a greater negative bias than the left edge
    - Probable cause is asymmetric space/spacecraft radiative environment
    - No scene sidelobe corrections have yet been applied
- L1B data contain fields named "**antenna_temp**" and "**brightness_temp**". Both are well calibrated and without sidelobe correction in this release. The **brightness_temp** data field will include sidelobe correction in a future release. In this release the two fields are identical.

3 L1B Quality Assurance Quick Start

This section is a guide to the most basic L1B AIRS/AMSU/HSB quality assurance (QA) parameters that a novice user of AIRS/AMSU/HSB data should access to judge L1B Radiance Product quality.

Please refer to the Level 2 Quality Control and Error Estimation Documentation for a description of the various quality indicators and how they are set:

V7_L2_Quality_Control_and_Error_Estimation.pdf

There are many Quality Assurance parameters that a user may use to filter AIRS/AMSU/HSB data to create a subset for analysis. A complete description of the AIRS L1B (infrared radiances) QA interface specification is provided in Appendix A2. Descriptions of the L1B QA interface specifications for visible/near-IR, and the AMSU and HSB microwave radiances are provided in other sections of Appendix A.

The novice user will find the plethora of QA parameters overwhelming; hence this document provides a quick start identification of the most basic QA parameters that a user should access before using any data for analysis. The QA parameters may be static or dynamic. If dynamic, their timescale and scope can range from global to all channels to per footprint to a single channel in a footprint.

3.1 Quick Start QA for AIRS Level-1B Data

AIRS's 2378 channels provide rich information on surface and atmospheric temperature and composition, but because each channel corresponds to an individual physical detector, not all channels will be of equal quality, and the quality of each channel can change over time. An application using AIRS Level-1B data will be using a set of channels over a range of time. Application success will require:

1. Selecting channels which meet static quality requirements
2. Monitoring channel health over time

Initial (static) channel selection must include consideration of channel Gaussian and non-Gaussian noise and possibly spectral and spatial quality in addition to sensitivity to the constituent of interest. Dynamic checking is mostly designed to filter for cases where noise increases, but must also check for various rare data drop-outs.

3.1.1 Semi-static channel selection

3.1.1.1 Files for Semi-Static Quality Checks

The properties of the 2378 AIRS instrument detectors are individually listed in two sets of self-documenting text files. Each set has a file for each calibration "epoch". The original set are the channel properties files, which are used by the Level-1B and Level-2 algorithms. The newer calibration properties files have much of the same information plus more, and should be used when selecting channels.

Some properties of the channels change slowly with time or discontinuously whenever the instrument is warmed by a spacecraft safety shutdown or in a defrost cycle. Whenever this occurs, a new calibration epoch is started. In addition, epochs are started about twice per year in order to give finer-grained temporal information on the health of each detector. For each epoch recalibration tests are performed and new channel properties and calibration properties files are created. The current file set used in V6 Level-2 and available for offline channel selection. A smaller set of epochs and older version of channel properties files were used in processing V5 Level-1B and Level-2. The Level-1B (and Level-2) algorithms use the proper channel properties file (chosen by date of properties file and date of data) for initial processing and reprocessing from the files available to them.

The names of these files all contain a date, which is the first date for which they are valid (and supersede a calibration properties file and channel properties file

containing an earlier date). As of this release, there are 26 files of each type covering the time period from 8/30/2002 to 3/23/2015. The smaller 8-file sets used by the V5 Level-1B processing are also provided for reference. Text versions are provided as ancillary files to this document:

Table 3.1: Calibration and Channel properties files used for semi-static channel selection (and in V6 Level-2 processing)

Calibration Properties Files	Channel Properties Files
L1B.cal_prop.2002.08.30.v9.5.0.anc	L2.chan_prop.2002.08.30.v9.5.3.anc
L1B.cal_prop.2002.09.17.v9.5.0.anc	L2.chan_prop.2002.09.17.v9.5.3.anc
L1B.cal_prop.2002.10.22.v9.5.0.anc	L2.chan_prop.2002.10.22.v9.5.3.anc
L1B.cal_prop.2003.01.10.v9.5.0.anc	L2.chan_prop.2003.01.10.v9.5.3.anc
L1B.cal_prop.2003.11.19.v9.5.0.anc	L2.chan_prop.2003.11.19.v9.5.3.anc
L1B.cal_prop.2004.07.01.v9.5.0.anc	L2.chan_prop.2004.07.01.v9.5.3.anc
L1B.cal_prop.2005.03.01.v9.5.0.anc	L2.chan_prop.2005.03.01.v9.5.3.anc
L1B.cal_prop.2005.07.01.v9.5.0.anc	L2.chan_prop.2005.07.01.v9.5.3.anc
L1B.cal_prop.2006.01.01.v9.5.0.anc	L2.chan_prop.2006.01.01.v9.5.3.anc
L1B.cal_prop.2006.07.01.v9.5.0.anc	L2.chan_prop.2006.07.01.v9.5.3.anc
L1B.cal_prop.2007.01.01.v9.5.0.anc	L2.chan_prop.2007.01.01.v9.5.3.anc
L1B.cal_prop.2007.07.01.v9.5.0.anc	L2.chan_prop.2007.07.01.v9.5.3.anc
L1B.cal_prop.2008.01.01.v9.5.0.anc	L2.chan_prop.2008.01.01.v9.5.3.anc
L1B.cal_prop.2008.07.01.v9.5.0.anc	L2.chan_prop.2008.07.01.v9.5.3.anc
L1B.cal_prop.2009.01.01.v9.5.0.anc	L2.chan_prop.2009.01.01.v9.5.3.anc
L1B.cal_prop.2009.07.01.v9.5.0.anc	L2.chan_prop.2009.07.01.v9.5.3.anc
L1B.cal_prop.2010.01.01.v9.5.0.anc	L2.chan_prop.2010.01.01.v9.5.3.anc
L1B.cal_prop.2010.07.01.v9.5.0.anc	L2.chan_prop.2010.07.01.v9.5.3.anc
L1B.cal_prop.2011.01.01.v9.5.0.anc	L2.chan_prop.2011.01.01.v9.5.3.anc
L1B.cal_prop.2011.07.01.v9.5.0.anc	L2.chan_prop.2011.07.01.v9.5.3.anc
L1B.cal_prop.2012.01.21.v9.5.0.anc	L2.chan_prop.2012.01.21.v9.5.3.anc
L1B.cal_prop.2012.07.01.v9.5.0.anc	L2.chan_prop.2012.07.01.v9.5.3.anc
L1B.cal_prop.2013.06.10.v9.5.0.anc	L2.chan_prop.2013.06.10.v9.5.3.anc
L1B.cal_prop.2015.03.23.v9.5.0.anc	L2.chan_prop.2015.03.23.v9.5.3.anc

Table 3.2: Calibration and Channel properties files used in V5 Level-1B (and V5 Level-2) processing

Calibration Properties Files	Channel Properties Files
L1B.cal_prop.2002.08.30.v9.5.0.anc	**L2.chan_prop.2002.08.30.v9.5.1.anc**
L1B.cal_prop.2002.09.17.v9.5.0.anc	**L2.chan_prop.2002.09.17.v9.5.1.anc**
L1B.cal_prop.2002.10.22.v9.5.0.anc	**L2.chan_prop.2002.10.22.v9.5.1.anc**
L1B.cal_prop.2003.01.10.v9.5.0.anc	**L2.chan_prop.2003.01.10.v9.5.1.anc**
L1B.cal_prop.2003.11.19.v9.5.0.anc	**L2.chan_prop.2003.11.19.v9.5.1.anc**
L1B.cal_prop.2005.03.01.v9.5.0.anc	**L2.chan_prop.2005.03.01.v9.5.1.anc**
L1B.cal_prop.2012.01.21.v9.5.0.anc	**L2.chan_prop.2012.01.21.v9.5.3.anc**
L1B.cal_prop.2012.07.01.v9.5.0.anc	**L2.chan_prop.2012.07.01.v9.5.3.anc**
L1B.cal_prop.2013.06.10.v9.5.0.anc	**L2.chan_prop.2013.06.10.v9.5.3.anc**
L1B.cal_prop.2015.03.23.v9.5.0.anc	**L2.chan_prop.2015.03.23.v9.5.3.anc**

We recommend that users choosing Level-1B (or Level-2 Cloud-Cleared) channels for their research refer to the calibration properties files rather than the channel properties files. The information contained in calibration properties files has been expanded with the user in mind and will be of greater utility. The channel properties files are provided for continuity and to support the Level 2 software. We are planning to phase out the channel properties files in later releases. Both sets of files include a documenting header describing their contents.

The calibration properties files provide the quality indicators on a per-channel basis. Key indicators are the frequency centroids and widths, NEdT at 250 K and 300 K, spatial centroids, **AB-weight**, **Spec_qual**, **n3sigma** and **npops.** Users may work out an effective NEdT for any scene temperature from the values quoted at 250 K and 300 K.

For analyses spanning multiple epochs, channels should be selected which have good behavior in all applicable epochs.

3.1.1.2 Evaluate Channel Static Radiometric Quality (Noise)

- Check the **NEdT250** field in appropriate (by date) calibration properties file and avoid using channels for which **NedT250** > 1 K
- Check the **npops** field in the appropriate (by date) calibration properties file and avoid using channels for which **npops** > 1. This can indicate non-Gaussian noise.

- Pick a noise limit and filter out channels exceeding it using **Max_NEdT250**. This will eliminate channels that sometimes exceeded this noise level during the test. Dynamic noise testing is still needed to eliminate other cases.

Users may also further filter channels by thresholding on **n3sigma**.

3.1.1.3 Evaluate Channel Static Spectral Quality

Channels with higher values of **Spec_Qual** are less well characterized in terms of SRF shape. They may still be useful as inputs to regression-like algorithms. If a well-characterized spectral response is required:

- Check the **Spec_qual** field in appropriate (by date) calibration properties file and avoid using channels for which **Spec_qual** > 2. A more rigorous test is to require that **Spec_qual** = 1.

3.1.1.4 (Advanced) Evaluate Channel Static Spatial Quality

If sensitivity to channel co-registration is a concern:

- Check the X- and Y- centroid fields in the appropriate (by date) calibration properties and avoid using channels with absolute values greater than 0.25 degree

Or all channels can be used but individual scenes eliminated using dynamic spatial quality checking.

3.1.2 Dynamic checking

Entire spectra can be unusable because of missing data or instrument tests. Individual channels may also become unusable at various timescales. When individual channels are eliminated, applications may continue using other channels if they are robust enough, or else they can create gaps in their products.

3.1.2.1 Dynamic Per-Field-of-View Quality Checks

These checks affect the usability of all channels in a Field-of-view (spectrum).

3.1.2.2 Dynamic Per-Field-of-View Instrument State Check

Before using any AIRS L1B radiance, check the value of the corresponding "**state**" to ensure that it is equal to zero. There is one "**state**" value per field-of-view (FOV), and it is valid for all 2378 channels in that FOV. The "**state**" 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

3.1.2.3 (Advanced) Dynamic Per-Field-of-View Scene Inhomogeneity Check

If sensitivity to channel coregistration is a concern then use the **Sceneinhomogeneous** flag, the **Rdiff_swindow** and **Rdiff_lwindow** flags and/or the radiances themselves to restrict data selection to uniform scenes where co-registration is not an issue. All flags are full swath fields, i.e. there is a value for each of the 90x135 AIRS footprints in the L1B radiance granule.

3.1.2.4 (Advanced) Glint 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 per-field-of-view "**sun_glint_distance**" to check for possibility of solar glint contamination.

Infrared glints can occur over clouds as well as water and can extend up to several hundred km.

3.1.3 Dynamic Per-Channel Quality Checks

These checks affect individual channels over various timescales.

3.1.3.1 Dynamic Noise Checking per Six-Minute Granule

Channels sometimes become noisier. Check **NeN** for each channel in each granule and discard channels that are too noisy or continue to use them but with lower weight because of the lower SNR. There is no indicator per granule of changes in non-Gaussian noise, but a sudden increase in **NeN** can be an indicator that non-Guassian component also increased. **NeN** is noise for a 250 K scene in radiance units. It can be converted to NEdT at 250 K using the Planck function.

3.1.3.2 Dynamic Per-Scan-Per-Channel Calibration Quality Check

The AIRS L1B product contains a per-scan field named "**CalFlag**". Users should avoid using any channel for any scan in which the "**offset problem**" or "**gain problem**", or "**pop detected**" bits are set (bits 6, 5, and 4 respectively where bit 0 is LSB). Bit 0, "**cold scene noise**", and bit 1, "**telemetry out of limit condition**", indicates conditions that can potentially impact data quality. Users who require pristine data should discard any data in which either of these bits is set.

3.1.3.3 Dynamic Per-Reading Quality Check

Individual channel readings ("**radiances**") must be checked for the fill value of **-9999.0**. A channel reading is set to this value only when no radiance can be calculated; QA fields indicate questionable or suspect (but non-fill) values.

Note that small negative radiances for shortwave channels (2000 to 2700 cm^{-1}) are rare, but valid. These negative radiances values are due to instrument noise, and occur when the scene temperatures drop below 190K, for example, over very high cloud or very cold surface.

3.1.3.4 (Advanced) Dynamic Spectral Frequency

Note that there are two spectral SRF centroids listed in AIRS Level-1B products: **nominal_freq** and **spectral_freq**. Ignore **spectral_freq**. **spectral_freq** is an instantaneous estimate and therefore noisy. It should not be relied upon as QA indicators. Frequency variations are generally small enough to safely be ignored, but where they are important users should get dynamic frequencies from V6 Level-1C products, which will provide a model of how frequencies are expected to vary with time.

3.2 Quick Start QA for AMSU-A L1B Data

3.2.1 Special Note for AMSU Channel 4

AMSU channel 4 worked well initially but then rapidly degraded. Radiances are useful until mid 2007.

3.2.2 Special Note for AMSU Channel 5

AMSU channel 5 worked well initially but then gradually degraded. Noise level had increased to 0.5 K in January 2010; 1.0 K February 2011; and by February 2012 was 2.0 K and increasing rapidly.

3.2.3 Special Note for AMSU Channel 7

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 subsection 2.3.2 in this document (L1B AMSU Radiance Products) for details.

3.2.4 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

3.2.5 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.

3.2.6 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 per-field-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.

3.3 Quick Start QA for HSB L1B Data

3.3.1 Per-Scan Quality Checks

Before using any HSB L1B brightness temperature, check the value of the corresponding "**state**" to ensure that it is equal to zero. There is one "**state**" value for all 90 fields-of-view of a scan, and it is valid for all four implemented channels. The "**state**" 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

3.3.2 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 it becomes suspect during processing.

HSB Channel 1 was never implemented, so will always be –9999.0.

HSB data are unavailable after February 5, 2003 due to failure of the scan system of that instrument.

3.3.3 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 per-field-of-view "**sun_glint_distance**" to check for possibility of solar glint contamination.

Some glint contamination is seen on HSB channel 2 when the scene contains substantial water (landFrac < 0.5) and "**sun_glint_distance**" is less than ~50km.

"**qa_receiver**" 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.

Appendix A. Level 1B Product Interface Specifications

In this appendix, all fields available in the Level 1B product files are listed with short descriptions. The fields are categorized into dimensions, geolocation, attributes, per-granule and along-track data fields, full swath data fields, and special AIRS types, as explained below.

Each file contains all observations of a given type made during a period of exactly 6 minutes. For each day there are 240 granules, numbered 1-240. Over the course of 6 minutes the EOS-Aqua platform travels approximately 1500 km, and the AIRS-suite instruments scan (whisk broom) a swath approximately 1500 km wide.

Start times of granules are keyed to the start of 1958. Because of leap seconds, they do not start at the same time as days do. For data from launch through 12-31-2005, granule 1 spans 00:05:26Z - 00:11:26Z and granule 240 starts at 23:59:26Z and ends at 00:05:26Z the next day. For data 12-31-2005 through the next leap second, granule 1 spans 00:05:25Z - 00:11:25Z and granule 240 starts at 23:59:25Z and ends at 00:05:25Z the next day.

These products have exactly one swath per file. The swath name is given in the interface specification.

The names of all dimensions, geolocation fields, fields and attributes are exactly as given in the "Name" column of the appropriate table, including underscores and capitalization.

The "Explanation" information, as provided in the product interface specifications, is a guide for users of the data and is not included the product files.

The contents of the "Type" column of the attribute and field tables can either specify a standard HDF type or a special AIRS type. The standard HDF types used by AIRS are:

String of 8-bit characters (Attributes only)
8-bit integer
8-bit unsigned integer
16-bit integer
16-bit unsigned integer
32-bit integer
32-bit unsigned integer

32-bit floating-point
64-bit floating-point

For all 16-bit or longer fields the value -9999 is used to flag bad or missing data. Special AIRS types are like structures, with the fields specified in tables as discussed below.

The first table of the interface specification lists "Dimensions" which are the 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. Some products also contain 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 (FOR) products (AMSU-A, Level-2, cloud-cleared AIRS) and 135 for small-spot (FOV) products (AIRS, Vis/NIR, HSB).

These files contain no geolocation mappings or indexed mappings.

The second table specifies "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."

The third table specifies "Attributes." These are scalar or string fields that appear only once per granule. They are attributes in the HDF-EOS Swath sense.

The fourth table specifies “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.

The fifth table specifies "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."

The sixth table specifies "Full Swath Data Fields." These are fields that occur once for every footprint of every scanline. These have dimensions

"GeoTrack,GeoXTrack" before any "Extra Dimensions." So a "Full Swath Data Field" with "Extra Dimensions" of "None" has dimensions "GeoTrack,GeoXTrack"; whereas, if the "Extra Dimensions" is "Channel (= 2378)," then it has dimensions "GeoTrack,GeoXTrack,Channel."

A1: L1B AIRS Science Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRIBRAD"

Swath Name = "L1B_AIRS_Science"

Level = "level1B"

Footprints = 90

scanlines per scanset = 3

Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

Name	Value	Explanation
GeoXTrack	90	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)
CalXTrack	6	Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_AIRS_CALIB) (Footprints are ordered: 1-4: spaceviews (ports 3, 4, 1, 2); 5: blackbody radiometric calibration source; 6: spectral/photometric calibration sources)
SpaceXTrack	4	Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_SPACE)
BBXTrack	1	Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_BB)
Channel	2378	Dimension of channel array (Channels are generally in order of increasing wavenumber, but because frequencies can vary and because all detectors from a physical array of detector elements (a "module") are always grouped together there are sometimes small reversals in frequency order where modules overlap.)
MaxRefChannel	100	Maximum number of radiometric reference channels. "RefChannels" lists the channels used.
MaxFeaturesUpwell	35	Maximum number of spectral features in upwelling radiances used for spectral calibration
MaxFeaturesPary	17	Maximum number of spectral features in parylene radiances used for spectral calibration

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

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 ("AIRS")
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 scene footprints
NumProcessData	32-bit integer	Number of scene footprints which are present and can be processed routinely (state = 0)
NumSpecialData	32-bit integer	Number of scene footprints which are present and can be processed only as a special test (state = 1)
NumBadData	32-bit integer	Number of scene footprints which are present but cannot be processed (state = 2)
NumMissingData	32-bit integer	Number of expected scene footprints 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 (3 * 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 floating-point	Geodetic Longitude of spacecraft at end of granule (subsatellite location at 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	See Appendix A7
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)
CalGranSummary	8-bit unsigned integer	Bit field. Bitwise OR of CalChanSummary, over all channels with ExcludedChans < 3. Zero means all good channels were well calibrated, for all scanlines. Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) noise out of bounds; Bit 2: (value 4) anomaly in spectral calibration; Bit 1: (value 2) Telemetry; Bit 0: (LSB, value 1) unused (reserved);
DCR_scan	16-bit integer	Scanline number following (first) DC-Restore. 0 for no DC-Restore
input_bb_temp	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature
input_bb_temp1	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature 1A (CaBbTempV1A or CaBbTempV1B, as active)
input_bb_temp2	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature 2 (CaBbTempV2A or CaBbTempV2B, as active)
input_bb_temp3	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature 3 (CaBbTemp3, active A or B)
input_bb_temp4	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature4 (CaBbTemp4, active A or B)
input_spec_temp	Limited Engineering Struct (see below)	Input statistics on Spectrometer temperature
input_ir_det_temp	Limited Engineering Struct (see below)	Input statistics on IR detector temperature
input_grating_temp_1	Limited Engineering Struct (see below)	Input statistics on Grating temperature 1 (SpGratngTemp1, active A or B)
input_grating_temp_2	Limited Engineering Struct (see below)	Input statistics on Grating temperature 2 (SpGratngTemp2, active A or B)
input_entr_filt_temp	Limited Engineering Struct (see below)	Input statistics on the entrance filter temperature (SpEntFiltTmp, active A or B)
input_opt_bench_temp_2	Limited Engineering Struct (see below)	Input statistics on optical bench temperature 2 (SpOptBnchTmp2, active A or B)
input_opt_bench_temp_3	Limited Engineering Struct (see below)	Input statistics on optical bench temperature 3 (SpOptBnchTmp3, active A or B)
input_scan_mirror_temp	Limited Engineering Struct (see below)	Input statistics on scan mirror housing temperature
input_chopper_phase_err	Limited Engineering Struct (see below)	Input statistics on chopper phase error voltage (ChPhaseErrVA or ChPhaseErrVB, as active)
PopCount	32-bit integer	Number of popcorn events within granule, i.e. number of times than an AIRS channel used in the Level 2 retrieval has suffered a sudden discontinuity in dark current
NumRefChannels	32-bit integer	The number of channels reported in MaxRefChannel arrays

Rdiff_swindow_M1a_chan	16-bit integer	Array M1a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378)
Rdiff_swindow_M2a_chan	16-bit integer	Array M2a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378)
Rdiff_lwindow_M8_chan	16-bit integer	Array M8 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378)
Rdiff_lwindow_M9_chan	16-bit integer	Array M9 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378)
CF_Version	string of 8-bit characters	Cloud Filter Version Identification. Identifies the set of thresholds used in determination of spectral_clear_indicator.
NumSaturatedFOVs	16-bit unsigned integer	Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts overflowed.
NumUnderflowFOVs	16-bit unsigned integer	Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts underflowed.
NumCalFOVsOutOfBounds	16-bit unsigned integer	Number of calibration fields-of-view (out of a nominal 810) in which the downlinked counts underflowed or overflowed.
NumSO2FOVs	16-bit unsigned integer	Number of fields-of-view (out of a nominal 1350) with a signifcant SO2 concentration based on the value of BT_diff_SO2.
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)
spectral_TAI	64-bit floating-point	TAI time of (first) Spectral calibration. (floating-point elapsed seconds since start of 1993) 0 for no Spectral calibration occurred in this granule.
spec_shift_upwell	32-bit floating-point	Focal plane shift calculated in grating model fit to upwelling radiances (microns)
spec_shift_unc_upwell	32-bit floating-point	Uncertainty of the focal plane shift calculated in the grating model fit to upwelling radiances (microns)
spec_fl_upwell	32-bit floating-point	Focal length calculated in grating model fit to upwelling radiances (microns)
spec_fl_unc_upwell	32-bit floating-point	Uncertainty of focal length calculated in grating model fit to upwelling radiances (microns)
SpectralFeaturesUpwell	32-bit integer	The actual number of upwelling features for MaxFeaturesUpwell-sized arrays
spec_iter_upwell	16-bit integer	Number of amoeba iterations to fit the grating model to upwelling radiance feature positions
spec_clim_select	16-bit integer	Number of the climatology to which the upwelling features were fitted
spec_shift_pary	32-bit floating-point	Focal plane shift calculated in grating model fit to parylene radiances (microns)
spec_shift_unc_pary	32-bit floating-point	Uncertainty of the focal plane shift calculated in grating model fit to parylene radiances (microns)
spec_fl_pary	32-bit floating-point	Focal length calculated in grating model fit to parylene radiances (microns)
spec_fl_unc_pary	32-bit floating-point	Uncertainty of focal length calculated in grating model fit to parylene radiances (microns)
SpectralFeaturesPary	32-bit integer	The actual number of parylene features for MaxFeaturesPary-sized arrays
spec_iter_pary	16-bit integer	Number of amoeba iterations in fit the grating model to parylene radiance feature positions
DCRCount	32-bit integer	Number of times a Direct Current Restore was executed for any module

Per-Granule Data Fields

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

Name	Type	Extra Dimensions	Explanation
CalChanSummary	8-bit unsigned integer	Channel (= 2378)	Bit field. Bitwise OR of CalFlag, by channel, over all scanlines. Noise threshold and spectral quality added. Zero means the channel was well calibrated for all scanlines Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) noise out of bounds; Bit 2: (value 4) anomaly in spectral calibration; Bit 1: (value 2) Telemetry; Bit 0: (LSB, value 1) unused (reserved);
ExcludedChans	8-bit unsigned integer	Channel (= 2378)	An integer 0-6, indicating A/B detector weights. Used in L1B processing. 0 - A weight = B weight. Probably better that channels with state > 2; 1 - A-side only. Probably better that channels with state > 2; 2 - B-side only. Probably better that channels with state > 2; 3 - A weight = B weight. Probably better than channels with state = 6; 4 - A-side only. Probably better than channels with state = 6; 5 - B-side only. Probably better than channels with state = 6; 6 - A weight = B weight.
NeN	32-bit floating-point	Channel (= 2378)	Noise-equivalent Radiance (radiance units) for an assumed 250K scene
input_scene_counts	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on scene data numbers
input_space_counts	Limited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 2378)	Input statistics on spaceview data numbers
input_space_signals	Limited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 2378)	Input statistics on spaceview signals (data numbers with offset subtracted)
input_space_diffs	Unlimited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 2378)	Statistics on differences between corresponding space views, for consecutive scanlines
input_bb_counts	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on blackbody calibration data numbers
input_bb_signals	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on blackbody calibration signals (data numbers with offset subtracted)
input_spec_counts	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on spectral calibration data numbers
offset_stats	Unlimited Engineering Struct (see below)	Channel (= 2378)	Statistics on offsets as of first spaceview of each scan
gain_stats	Unlimited Engineering Struct (see below)	Channel (= 2378)	Statistics on gains (radiance units / count)
rad_stats	Unlimited Engineering Struct (see below)	Channel (= 2378)	Statistics on radiances (radiance units)
Gain	32-bit floating-point	Channel (= 2378)	Number of radiance units per count
RefChannels	32-bit integer	MaxRefChannel (= 100)	The 1-based indexes of channels reported in MaxRefChannel arrays. Entries beyon NumRefChannels are set to -1.
rad_scan_stats	Unlimited Engineering Struct (see below)	GeoXTrack (= 90) * MaxRefChannel (= 100)	Statistics on scan angle dependence of radiances
nominal_freq	32-bit floating-point	Channel (= 2378)	Nominal frequencies (cm**-1) of each channel
spectral_freq	32-bit floating-point	Channel (= 2378)	Dynamic estimate of frequency associated with

			each channel (cm**-1). Note: This is a noisy estimate because there is very limited data in a single 6-minute granule. Designed for use only in aggregation to monitor instrument status. Use nominal_freq instead when analyzing data.
spectral_freq_unc	32-bit floating-point	Channel (= 2378)	a signed estimate of the spectral frequency uncertainty (positive means estimated frequencies are likely too high)
spec_feature_shifts_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Spectral shift seen for each upwelling feature, in microns at the focal plane
spec_feature_corr_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Maximum correlation seen for each upwelling feature (0.0 ... 1.0)
spec_feature_sharp_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Quadratic coefficient in fit to correlation for each upwelling feature
spec_feature_resid_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Fit residual for each upwelling feature (wavenumbers)
spec_feature_contrast_stats	Limited Engineering Struct (see below)	MaxFeaturesUpwell (= 35)	Statistics on the spectral contrasts for each of the upwelling features, for each of the scene footprints considered for spectral calibration
spec_feature_shifts_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Spectral shift seen for each parylene feature, in microns at the focal plane
spec_feature_corr_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Maximum correlation seen for each parylene feature (0.0 ... 1.0)
spec_feature_sharp_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Quadratic coefficient in fit to correlation for each parylene feature
spec_feature_resid_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Fit residual for each parylene feature (wavenumbers)
ave_pary_spectrum	32-bit floating-point	Channel (= 2378)	The average parylene spectrum (over good scanlines), in milliWatts/m**2/cm**-1/steradian

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	See Appendix A7
glintgeoqa	16-bit unsigned integer	None	See Appendix A7
moongeoqa	16-bit unsigned integer	None	See Appendix A7
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	None	Satellite geodetic latitude in degrees North (-90.0 ... 90.0)

	floating-point		
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)
CalScanSummary	8-bit unsigned integer	None	Bit field. Bitwise OR of CalFlag over the all channels with ExcludedChans < 3. Zero means all "good" channels were well calibrated for this scanline Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) DCR Occurred; Bit 2: (value 4) Moon in View; Bit 1: (value 2) telemetry out of limit condition; Bit 0: (LSB, value 1) cold scene noise
CalFlag	8-bit unsigned integer	Channel (= 2378)	Bit field, by channel, for the current scanline. Zero means the channel was well calibrated, for this scanline. Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) DCR Occurred; Bit 2: (value 4) Moon in View; Bit 1: (value 2) telemetry out of limit condition; Bit 0: (LSB, value 1) cold scene noise
SpaceViewDelta	32-bit floating-point	Channel (= 2378)	The median of the four spaceviews immediately following the Earth views in the scanline, minus the median of the spaceviews immediately preceding the Earth views in the scanline (also the magnitude of a "pop" in this scanline, when the "pop detected" bit is set in CalFlag.) (data numbers)
spaceview_selection	8-bit unsigned integer	None	Indicates which footprints were included for this scan. Each bit is high when the corresponding space view is used in the spaceview offset calculation. (See L1B Processing Requirements, section 6.2); LSB is first space view.
OpMode	16-bit unsigned integer	None	Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase; bits 3-6 Cal Func; Bit 7 quicklook (expedited) flag; bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival); bit 16 transition flag
EDCBOARD	16-bit unsigned integer	None	EDC A/B Powered on Indicator:; 0: Both sides off; 1: Side A; 2: Side B; 3: Invalid; 65534: No value downlinked

Full Swath Data Fields

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

Name	Type	Extra Dimensions	Explanation
radiances	32-bit floating-point	Channel (= 2378)	Radiances for each channel in milliWatts/m**2/cm**-1/steradian
scanang	32-bit floating-point	None	Scanning angle of AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir)
ftptgeoqa	32-bit unsigned integer	None	See Appendix A7
zengeoqa	16-bit unsigned	None	See Appendix A7

	integer		
demgeoqa	16-bit unsigned integer	None	See Appendix A7
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
state	32-bit integer	None	Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing
Rdiff_swindow	32-bit floating-point	None	Radiance difference in the 2560 cm**-1 window region used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_swindow_M1a_chan) - radiance(Rdiff_swindow_M2a_chan). (radiance units)
Rdiff_lwindow	32-bit floating-point	None	Radiance difference in the longwave window(850 cm**-1) used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_lwindow_M8_chan) - radiance(Rdiff_lwindow_M9_chan). (radiance units)
SceneInhomogeneous	8-bit unsigned integer	None	Threshold test for scene inhomogeneity, using band-overlap detectors (bit fields).; Bit 7 (MSB, value 128): scene is inhomogeneous, as determined by the Rdiff_swindow threshold. For v5.0 the test is abs(Rdiff_swindow) > 5 * sqrt(NeN(Rdiff_swindow_M1a_chan)^2 + NeN(Rdiff_swindow_M2a_chan)); Bit 6 (value 64): scene is inhomogeneous, as determined by the Rdiff_lwindow threshold. For v5.0 the test is abs(Rdiff_lwindow) > 5 * sqrt(NeN(Rdiff_lwindow_M8_chan)^2 + NeN(Rdiff_lwindow_M9_chan)); Bits 5-0: unused (reserved)
dust_flag	16-bit integer	None	Flag telling whether dust was detected in this scene; 1: Dust detected; 0: Dust not detected; -1: Dust test not valid because of land; -2: Dust test not valid because of high latitude; -3: Dust test not valid because of suspected cloud; -4: Dust test not valid because of bad input data
dust_score	16-bit integer	None	Dust score. Each bit results from a different test comparing radiances. Higher scores indicate more certainty of dust present. Dust probable when score is over 380. Not valid when dust_flag is negative.
spectral_clear_indicator	16-bit integer	None	Flag telling whether scene was flagged as clear by a spectral filter. Only ocean filter is validated; 2: Ocean test applied and scene identified as clear; 1: Ocean test applied and scene not identified as clear; 0: Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule; -1: Unvalidated land test applied and scene not identified as clear;

			-2: Unvalidated land test applied and scene identified as clear
BT_diff_SO2	32-bit floating-point	None	Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (Kelvins)

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 "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.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 = 0)
max	32-bit floating-point	Maximum value field takes on in granule (not valid when num = 0)
mean	32-bit floating-point	Mean of values field takes on in granule (not valid when num = 0)
dev	32-bit floating-point	Standard Deviation of values field takes on in granule (not valid when num < 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

A2: L1B AIRS QA Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRIBQAP"

Swath Name = "L1B_AIRS_QA"

Level = "level1B"

Footprints = 90

scanlines per scanset = 3

Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

Name	Value	Explanation
GeoXTrack	90	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)
CalXTrack	6	Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_AIRS_CALIB) (Footprints are ordered: 1-4: spaceviews (ports 3, 4, 1, 2); 5: blackbody radiometric calibration source; 6: spectral/photometric calibration sources)
SpaceXTrack	4	Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_SPACE)
BBXTrack	1	Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_BB)
Channel	2378	Dimension of channel array (Channels are generally in order of increasing wavenumber, but because frequencies can vary and because all detectors from a physical array of detector elements (a "module") are always grouped together there are sometimes small reversals in frequency order where modules overlap.)
MaxRefChannel	100	Maximum number of radiometric reference channels. "RefChannels" lists the channels used.
MaxFeaturesUpwell	35	Maximum number of spectral features in upwelling radiances used for spectral calibration
MaxFeaturesPary	17	Maximum number of spectral features in parylene radiances used for spectral calibration

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

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 ("AIRS")
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 scene footprints
NumProcessData	32-bit integer	Number of scene footprints which are present and can be processed routinely (state = 0)
NumSpecialData	32-bit integer	Number of scene footprints which are present and can be processed only as a special test (state = 1)
NumBadData	32-bit integer	Number of scene footprints which are present but cannot be processed (state = 2)
NumMissingData	32-bit integer	Number of expected scene footprints 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 (3 * 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 floating-point	Geodetic Longitude of spacecraft at end of granule (subsatellite location at 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	See Appendix A7
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)
CalGranSummary	8-bit unsigned integer	Bit field. Bitwise OR of CalChanSummary, over all channels with ExcludedChans < 3. Zero means all good channels were well calibrated, for all scanlines. Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) noise out of bounds; Bit 2: (value 4) anomaly in spectral calibration; Bit 1: (value 2) Telemetry; Bit 0: (LSB, value 1) unused (reserved);
DCR_scan	16-bit integer	Scanline number following (first) DC-Restore. 0 for no DC-Restore
input_bb_temp	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature
input_bb_temp1	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature 1A (CaBbTempV1A or CaBbTempV1B, as active)
input_bb_temp2	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature 2 (CaBbTempV2A or CaBbTempV2B, as active)
input_bb_temp3	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature 3 (CaBbTemp3, active A or B)
input_bb_temp4	Limited Engineering Struct (see below)	Input statistics on Blackbody temperature4 (CaBbTemp4, active A or B)
input_spec_temp	Limited Engineering Struct (see below)	Input statistics on Spectrometer temperature
input_ir_det_temp	Limited Engineering Struct (see below)	Input statistics on IR detector temperature
input_grating_temp_1	Limited Engineering Struct (see below)	Input statistics on Grating temperature 1 (SpGratngTemp1, active A or B)
input_grating_temp_2	Limited Engineering Struct (see below)	Input statistics on Grating temperature 2 (SpGratngTemp2, active A or B)
input_entr_filt_temp	Limited Engineering Struct (see below)	Input statistics on the entrance filter temperature (SpEntFiltTmp, active A or B)
input_opt_bench_temp_2	Limited Engineering Struct (see below)	Input statistics on optical bench temperature 2 (SpOptBnchTmp2, active A or B)

input_opt_bench_temp_3	Limited Engineering Struct (see below)	Input statistics on optical bench temperature 3 (SpOptBnchTmp3, active A or B)
input_scan_mirror_temp	Limited Engineering Struct (see below)	Input statistics on scan mirror housing temperature
input_chopper_phase_err	Limited Engineering Struct (see below)	Input statistics on chopper phase error voltage (ChPhaseErrVA or ChPhaseErrVB, as active)
PopCount	32-bit integer	Number of popcorn events within granule, i.e. number of times than an AIRS channel used in the Level 2 retrieval has suffered a sudden discontinuity in dark current
NumRefChannels	32-bit integer	The number of channels reported in MaxRefChannel arrays
Rdiff_swindow_M1a_chan	16-bit integer	Array M1a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378)
Rdiff_swindow_M2a_chan	16-bit integer	Array M2a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378)
Rdiff_lwindow_M8_chan	16-bit integer	Array M8 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378)
Rdiff_lwindow_M9_chan	16-bit integer	Array M9 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378)
CF_Version	string of 8-bit characters	Cloud Filter Version Identification. Identifies the set of thresholds used in determination of spectral_clear_indicator.
NumSaturatedFOVs	16-bit unsigned integer	Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts overflowed.
NumUnderflowFOVs	16-bit unsigned integer	Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts underflowed.
NumCalFOVsOutOfBounds	16-bit unsigned integer	Number of calibration fields-of-view (out of a nominal 810) in which the downlinked counts underflowed or overflowed.
NumSO2FOVs	16-bit unsigned integer	Number of fields-of-view (out of a nominal 1350) with a signifcant SO2 concentration based on the value of BT_diff_SO2.
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)
spectral_TAI	64-bit floating-point	TAI time of (first) Spectral calibration. (floating-point elapsed seconds since start of 1993) 0 for no Spectral calibration occurred in this granule.
spec_shift_upwell	32-bit floating-point	Focal plane shift calculated in grating model fit to upwelling radiances (microns)
spec_shift_unc_upwell	32-bit floating-point	Uncertainty of the focal plane shift calculated in the grating model fit to upwelling radiances (microns)
spec_fl_upwell	32-bit floating-point	Focal length calculated in grating model fit to upwelling radiances (microns)
spec_fl_unc_upwell	32-bit floating-point	Uncertainty of focal length calculated in grating model fit to upwelling radiances (microns)
SpectralFeaturesUpwell	32-bit integer	The actual number of upwelling features for MaxFeaturesUpwell-sized arrays
spec_iter_upwell	16-bit integer	Number of amoeba iterations to fit the grating model to upwelling radiance feature positions
spec_clim_select	16-bit integer	Number of the climatology to which the upwelling features were fitted
spec_shift_pary	32-bit floating-point	Focal plane shift calculated in grating model fit to parylene radiances (microns)
spec_shift_unc_pary	32-bit floating-point	Uncertainty of the focal plane shift calculated in grating model fit to parylene radiances (microns)
spec_fl_pary	32-bit floating-point	Focal length calculated in grating model fit to parylene radiances (microns)
spec_fl_unc_pary	32-bit floating-point	Uncertainty of focal length calculated in grating model fit to parylene radiances (microns)
SpectralFeaturesPary	32-bit integer	The actual number of parylene features for MaxFeaturesPary-sized arrays
spec_iter_pary	16-bit integer	Number of amoeba iterations in fit the grating model to parylene radiance feature positions

DCRCount	32-bit integer	Number of times a Direct Current Restore was executed for any module

Per-Granule Data Fields

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

Name	Type	Extra Dimensions	Explanation
CalChanSummary	8-bit unsigned integer	Channel (= 2378)	Bit field. Bitwise OR of CalFlag, by channel, over all scanlines. Noise threshold and spectral quality added. Zero means the channel was well calibrated for all scanlines Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) noise out of bounds; Bit 2: (value 4) anomaly in spectral calibration; Bit 1: (value 2) Telemetry; Bit 0: (LSB, value 1) unused (reserved);
ExcludedChans	8-bit unsigned integer	Channel (= 2378)	An integer 0-6, indicating A/B detector weights. Used in L1B processing. 0 - A weight = B weight. Probably better that channels with state > 2; 1 - A-side only. Probably better that channels with state > 2; 2 - B-side only. Probably better that channels with state > 2; 3 - A weight = B weight. Probably better than channels with state = 6; 4 - A-side only. Probably better than channels with state = 6; 5 - B-side only. Probably better than channels with state = 6; 6 - A weight = B weight.
NeN	32-bit floating-point	Channel (= 2378)	Noise-equivalent Radiance (radiance units) for an assumed 250K scene
input_scene_counts	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on scene data numbers
input_space_counts	Limited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 2378)	Input statistics on spaceview data numbers
input_space_signals	Limited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 2378)	Input statistics on spaceview signals (data numbers with offset subtracted)
input_space_diffs	Unlimited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 2378)	Statistics on differences between corresponding space views, for consecutive scanlines
input_bb_counts	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on blackbody calibration data numbers
input_bb_signals	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on blackbody calibration signals (data numbers with offset subtracted)
input_spec_counts	Limited Engineering Struct (see below)	Channel (= 2378)	Input statistics on spectral calibration data numbers
offset_stats	Unlimited Engineering Struct (see below)	Channel (= 2378)	Statistics on offsets as of first spaceview of each scan
gain_stats	Unlimited Engineering Struct (see below)	Channel (= 2378)	Statistics on gains (radiance units / count)
rad_stats	Unlimited Engineering Struct (see below)	Channel (= 2378)	Statistics on radiances (radiance units)
Gain	32-bit floating-point	Channel (= 2378)	Number of radiance units per count
RefChannels	32-bit integer	MaxRefChannel (= 100)	The 1-based indexes of channels reported in MaxRefChannel arrays. Entries beyon NumRefChannels are set to -1.
rad_scan_stats	Unlimited Engineering Struct (see below)	GeoXTrack (= 90) * MaxRefChannel (= 100)	Statistics on scan angle dependence of radiances

nominal_freq	32-bit floating-point	Channel (= 2378)	Nominal frequencies (cm**-1) of each channel
spectral_freq	32-bit floating-point	Channel (= 2378)	Dynamic estimate of frequency associated with each channel (cm**-1). Note: This is a noisy estimate because there is very limited data in a single 6-minute granule. Designed for use only in aggregation to monitor instrument status. Use nominal_freq instead when analyzing data.
spectral_freq_unc	32-bit floating-point	Channel (= 2378)	a signed estimate of the spectral frequency uncertainty (positive means estimated frequencies are likely too high)
spec_feature_shifts_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Spectral shift seen for each upwelling feature, in microns at the focal plane
spec_feature_corr_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Maximum correlation seen for each upwelling feature (0.0 ... 1.0)
spec_feature_sharp_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Quadratic coefficient in fit to correlation for each upwelling feature
spec_feature_resid_upwell	32-bit floating-point	MaxFeaturesUpwell (= 35)	Fit residual for each upwelling feature (wavenumbers)
spec_feature_contrast_stats	Limited Engineering Struct (see below)	MaxFeaturesUpwell (= 35)	Statistics on the spectral contrasts for each of the upwelling features, for each of the scene footprints considered for spectral calibration
spec_feature_shifts_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Spectral shift seen for each parylene feature, in microns at the focal plane
spec_feature_corr_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Maximum correlation seen for each parylene feature (0.0 ... 1.0)
spec_feature_sharp_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Quadratic coefficient in fit to correlation for each parylene feature
spec_feature_resid_pary	32-bit floating-point	MaxFeaturesPary (= 17)	Fit residual for each parylene feature (wavenumbers)
ave_pary_spectrum	32-bit floating-point	Channel (= 2378)	The average parylene spectrum (over good scanlines), in milliWatts/m**2/cm**-1/steradian

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	See Appendix A7
glintgeoqa	16-bit unsigned integer	None	See Appendix A7
moongeoqa	16-bit unsigned integer	None	See Appendix A7
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)
CalScanSummary	8-bit unsigned integer	None	Bit field. Bitwise OR of CalFlag over the all channels with ExcludedChans < 3. Zero means all "good" channels were well calibrated for this scanline Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) DCR Occurred; Bit 2: (value 4) Moon in View; Bit 1: (value 2) telemetry out of limit condition; Bit 0: (LSB, value 1) cold scene noise
CalFlag	8-bit unsigned integer	Channel (= 2378)	Bit field, by channel, for the current scanline. Zero means the channel was well calibrated, for this scanline. Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) DCR Occurred; Bit 2: (value 4) Moon in View; Bit 1: (value 2) telemetry out of limit condition; Bit 0: (LSB, value 1) cold scene noise
SpaceViewDelta	32-bit floating-point	Channel (= 2378)	The median of the four spaceviews immediately following the Earth views in the scanline, minus the median of the spaceviews immediately preceding the Earth views in the scanline (also the magnitude of a "pop" in this scanline, when the "pop detected" bit is set in CalFlag.) (data numbers)
spaceview_selection	8-bit unsigned integer	None	Indicates which footprints were included for this scan. Each bit is high when the corresponding space view is used in the spaceview offset calculation. (See L1B Processing Requirements, section 6.2); LSB is first space view.
OpMode	16-bit unsigned integer	None	Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase; bits 3-6 Cal Func; Bit 7 quicklook (expedited) flag; bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival); bit 16 transition flag
EDCBOARD	16-bit unsigned integer	None	EDC A/B Powered on Indicator:; 0: Both sides off; 1: Side A; 2: Side B; 3: Invalid; 65534: No value downlinked

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 AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir)
ftptgeoqa	32-bit unsigned integer	None	See Appendix A7
zengeoqa	16-bit unsigned integer	None	See Appendix A7

demgeoqa	16-bit unsigned integer	None	See Appendix A7
satzen	32-bit floating-point	None	See Appendix A7
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
state	32-bit integer	None	Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing
Rdiff_swindow	32-bit floating-point	None	Radiance difference in the 2560 cm**-1 window region used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_swindow_M1a_chan) - radiance(Rdiff_swindow_M2a_chan). (radiance units)
Rdiff_lwindow	32-bit floating-point	None	Radiance difference in the longwave window(850 cm**-1) used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_lwindow_M8_chan) - radiance(Rdiff_lwindow_M9_chan). (radiance units)
SceneInhomogeneous	8-bit unsigned integer	None	Threshold test for scene inhomogeneity, using band-overlap detectors (bit fields).; Bit 7 (MSB, value 128): scene is inhomogeneous, as determined by the Rdiff_swindow threshold. For v5.0 the test is abs(Rdiff_swindow) > 5 * sqrt(NeN(Rdiff_swindow_M1a_chan)^2 + NeN(Rdiff_swindow_M2a_chan)); Bit 6 (value 64): scene is inhomogeneous, as determined by the Rdiff_lwindow threshold. For v5.0 the test is abs(Rdiff_lwindow) > 5 * sqrt(NeN(Rdiff_lwindow_M8_chan)^2 + NeN(Rdiff_lwindow_M9_chan)); Bits 5-0: unused (reserved)
dust_flag	16-bit integer	None	Flag telling whether dust was detected in this scene; 1: Dust detected; 0: Dust not detected; -1: Dust test not valid because of land; -2: Dust test not valid because of high latitude; -3: Dust test not valid because of suspected cloud; -4: Dust test not valid because of bad input data
dust_score	16-bit integer	None	Dust score. Each bit results from a different test comparing radiances. Higher scores indicate more certainty of dust present. Dust probable when score is over 380. Not valid when dust_flag is negative.
spectral_clear_indicator	16-bit integer	None	Flag telling whether scene was flagged as clear by a spectral filter. Only ocean filter is validated; 2: Ocean test applied and scene identified as clear; 1: Ocean test applied and scene not identified as clear; 0: Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule; -1: Unvalidated land test applied and scene not identified as clear;

			-2: Unvalidated land test applied and scene identified as clear
BT_diff_SO2	32-bit floating-point	None	Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (Kelvins)

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 "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.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 = 0)
max	32-bit floating-point	Maximum value field takes on in granule (not valid when num = 0)
mean	32-bit floating-point	Mean of values field takes on in granule (not valid when num = 0)
dev	32-bit floating-point	Standard Deviation of values field takes on in granule (not valid when num < 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

A3: L1B Visible/NIR Science Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRVBRAD"

Swath Name = "L1B_VIS_Science"

Level = "level1B"

Footprints = 90

scanlines per scanset = 3

Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

Name	Value	Explanation
GeoXTrack	90	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)
SubTrack	9	VIS detector elements per AIRS footprint along track (9). Direction is the same as GeoTrack -- parallel to the satellite's path, increasing with time. (opposite order to detector ordering -- detector 0 is last)
SubXTrack	8	VIS samples per AIRS footprint across track (8). Direction is the same as GeoXTrack -- starting at the left and increasing towards the right as you look along the satellite's path
GeoLocationsPerSpot	4	Geolocations for the 4 corner pixels in the order: trailing first scanned; trailing last-scanned; leading first-scanned; leading last-scanned. Each footprint also has a central geolocation associated with the swath geolocation lat/lon/time of the footprint.
Channel	4	Dimension of channel array (Channel 1: ~0.40 micron; Ch 2: ~0.6 micron; Ch 3: ~0.8 micron; Ch 4: broadband)

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

Attributes

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

Name	Type	Explanation
VISDarkAMSUFOVCount	32-bit integer	Number of AMSU-A footprints that are uniformly dark in the level-1B VIS/NIR and are thus likely to be uniformly clear
VISBrightAMSUFOVCount	32-bit integer	Number of AMSU-A footprints that are uniformly bright in the level-1B VIS/NIR and are thus likely to be uniformly cloudy
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 ("VIS")
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 scene footprints
NumProcessData	32-bit integer	Number of scene footprints which are present and can be processed routinely (state = 0)
NumSpecialData	32-bit integer	Number of scene footprints which are present and can be processed only as a special test (state = 1)
NumBadData	32-bit integer	Number of scene footprints which are present but cannot be processed (state = 2)
NumMissingData	32-bit integer	Number of expected scene footprints 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 (3 * 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 atmidpoint 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 floating-point	Geodetic Longitude of spacecraft at end of granule (subsatellite location at 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	See Appendix A7
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)
VegMapFileName	string of 8-bit characters	Name of AVHRR input file used as Vegetation Map
limit_vis_det_temp	Color Counts (see below)	Input limit checking on Vis sensor array temperature
input_vis_det_temp	Limited Engineering Struct (see below)	Input statistics on Vis sensor array temperature
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)
align_1_2_nadir	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 1 & 2
align_2_3_nadir	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 3
align_2_4_nadir	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 4
align_1_2_maxang	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 1 & 2
align_2_3_maxang	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 3
align_2_4_maxang	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 4
align_vis_airs	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between the AIRS center and all VIS channels

Per-Granule Data Fields

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

Name	Type	Extra Dimensions	Explanation
limit_scene_counts	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Input limit checking on scene data numbers
limit_bb_counts	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Input limit checking on data numbers from the blackbody (dark target)
limit_phot_counts	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Input limit checking on data numbers from the photometric calibration source (bright target)
input_scene_counts	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Input statistics on scene data numbers

input_bb_counts	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Input statistics on data numbers from the blackbody (dark target)
input_phot_counts	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Input statistics on data numbers from the photometric calibration source (bright target)
limit_offsets	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Output limit checking on offsets
offset_stats	Unlimited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics on offsets
offset_unc_stats	Unlimited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics on offset uncertainties
gain	32-bit floating-point	Channel (= 4) * SubTrack (= 9)	Gain: number of radiance units per count.
gain_err	32-bit floating-point	Channel (= 4) * SubTrack (= 9)	Error caused by imperfect fit for gain (gain units).
rad_stats	Unlimited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics over the granule of radiances (radiance units)
NeN_stats	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics over the granule of Noise-equivalent Radiance (NeN)
xtrack_err	32-bit floating-point	Channel (= 4)	cross-track pixel location error estimate per channel (km)
track_err	32-bit floating-point	Channel (= 4)	Along-track pixel location error estimate per channel (km)

Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

Name	Type	Extra Dimensions	Explanation
offset	32-bit floating-point	Channel (= 4) * SubTrack (= 9)	Offset: number of counts expected for no radiance at time nadirTAI
offset_err	32-bit floating-point	Channel (= 4) * SubTrack (= 9)	Error caused by imperfect fit for offset (radiance units)
NeN	32-bit floating-point	Channel (= 4) * SubTrack (= 9)	Noise-equivalent Radiance (radiance units)
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	See Appendix A7
glintgeoqa	16-bit unsigned integer	None	See Appendix A7
moongeoqa	16-bit unsigned integer	None	See Appendix A7
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)
ViSnsrArrTemp	32-bit floating-point	None	Vis/NIR Sensor Array Temperature (Celcius)
ScHeadTemp1	32-bit floating-point	None	Scanner Head Housing Temperature 1 (active A or B) (Celcius)
OpMode	16-bit unsigned integer	None	Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase; bits 3-6 Cal Func; Bit 7 quicklook (expedited) flag; bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival); bit 16 transition flag

Full Swath Data Fields

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

Name	Type	Extra Dimensions	Explanation
radiances	32-bit floating-point	Channel (= 4) * SubTrack (= 9) * SubXTrack (= 8)	Radiances for each channel in Watts/m**2/micron/steradian
PrelimCldQA	8-bit integer	None	Cloud QA index (0-good or 1-bad) -1 for not calculated
PrelimCldFracVis	32-bit floating-point	None	Cloud Fraction (0.0-1.0) -9999.0 for not calculated
PrelimCldFracVisErr	32-bit floating-point	None	Cloud Fraction Error (0.0-1.0) -9999.0 for not calculated
PrelimClrFracVis	32-bit floating-point	None	Clear Fraction (0.0-1.0) -9999.0 for not calculated
PrelimClrFracVisErr	32-bit floating-point	None	Clear Fraction Error (0.0-1.0) -9999.0 for not calculated
PrelimCldMapVis	8-bit integer	SubTrack (= 9) * SubXTrack (= 8)	Cloud Map (0-clear, 1-cloudy) -1 for not calculated
PrelimNDVI	32-bit floating-point	SubTrack (= 9) * SubXTrack (= 8)	Vegetation Index (-1.0 to 1.0) -999.0 for not calculated
bright_index	16-bit integer	None	Brightness index (1...5, 5 is brightest. -1 for not calculated
inhomo_index	16-bit integer	None	Inhomgeneity index (0...64, 1st digit NDVI-Dev, 2nd digit Ch1-Dev, -9999 for not calculated
scanang	32-bit floating-point	None	Scanning angle of AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir)
ftptgeoqa	32-bit unsigned integer	None	See Appendix A7
zengeoqa	16-bit unsigned integer	None	See Appendix A7
demgeoqa	16-bit unsigned integer	None	See Appendix A7
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
state	32-bit integer	None	Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing
cornerlats	32-bit floating-point	GeoLocationsPerSpot (= 4) * Channel (= 4)	Geodetic Latitudes at the centers of the pixels at the corners of the IR footprint by channel in degrees North (-90.0 ... 90.0)
cornerlons	32-bit floating-point	GeoLocationsPerSpot (= 4) * Channel (= 4)	Geodetic Longitudes at the centers of the pixels at the corners of the IR footprint by channel in degrees East (-180.0 ... 180.0)

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 "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.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 = 0)
max	32-bit floating-point	Maximum value field takes on in granule (not valid when num = 0)
mean	32-bit floating-point	Mean of values field takes on in granule (not valid when num = 0)
dev	32-bit floating-point	Standard Deviation of values field takes on in granule (not valid when num < 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

Color Counts: This type tracks counts of values received during an interval by how they compare to corresponding "red" and "yellow" limits.

Field Name	Type	Explanation
red_lo_limit	32-bit floating-point	Value of the low "red" limit.
red_lo_cnt	32-bit integer	Count of values less than the low "red" limit. This is an "Alarm" condition.
to_red_lo	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "red_low".
yellow_lo_limit	32-bit floating-point	Value of the low "yellow" limit.
yellow_lo_cnt	32-bit integer	Count of values greater than the low "red" limit but less than the low "yellow" limit. This is a "Warning" condition.
to_yellow_lo	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "yellow_low".
green_cnt	32-bit integer	Count of values greater than the low "yellow" limit but less than the high "yellow" limit.
to_green	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "green".
yellow_hi_limit	32-bit floating-point	Value of the high "yellow" limit.
yellow_hi_cnt	32-bit integer	Count of values greater than the high "yellow" limit but less than the high "red" limit. This is a "Warning" condition.
to_yellow_hi	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "yellow_high".
red_hi_limit	32-bit floating-point	Value of the high "red" limit.
red_hi_cnt	32-bit integer	Count of values greater than the high "red" limit. This is an "Alarm" condition.
to_red_hi	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "red_high".
missing	8-bit integer	Missing limits flags. Bit 0 (LSB) is 1 when yellow low limit (yellow_lo_limit) is missing; Bit 1 is high when yellow high limit is missing; Bit 2 is 1 when red low limit is missing; Bit 3 is 1 when red high limit is missing; Other bits unused set to 0.

A4: L1B Visible/NIR QA Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRVBQAP"

Swath Name = "L1B_VIS_QA"

Level = "level1B"

Footprints = 90

scanlines per scanset = 3

Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

Name	Value	Explanation
GeoXTrack	90	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)
SubTrack	9	VIS detector elements per AIRS footprint along track (9). Direction is the same as GeoTrack -- parallel to the satellite's path, increasing with time. (opposite order to detector ordering -- detector 0 is last)
SubXTrack	8	VIS samples per AIRS footprint across track (8). Direction is the same as GeoXTrack -- starting at the left and increasing towards the right as you look along the satellite's path
GeoLocationsPerSpot	4	Geolocations for the 4 corner pixels in the order: trailing first scanned; trailing last-scanned; leading first-scanned; leading last-scanned. Each footprint also has a central geolocation associated with the swath geolocation lat/lon/time of the footprint.
Channel	4	Dimension of channel array (Channel 1: ~0.40 micron; Ch 2: ~0.6 micron; Ch 3: ~0.8 micron; Ch 4: broadband)

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

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 ("VIS")
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 scene footprints
NumProcessData	32-bit integer	Number of scene footprints which are present and can be processed routinely (state = 0)
NumSpecialData	32-bit integer	Number of scene footprints which are present and can be processed only as a special test (state = 1)
NumBadData	32-bit integer	Number of scene footprints which are present but cannot be processed (state = 2)
NumMissingData	32-bit integer	Number of expected scene footprints 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 (3 * 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 floating-point	Geodetic Longitude of spacecraft at end of granule (subsatellite location at 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	See Appendix A7
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)
VegMapFileName	string of 8-bit characters	Name of AVHRR input file used as Vegetation Map
limit_vis_det_temp	Color Counts (see below)	Input limit checking on Vis sensor array temperature
input_vis_det_temp	Limited Engineering Struct (see below)	Input statistics on Vis sensor array temperature
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)
align_1_2_nadir	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 1 & 2
align_2_3_nadir	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 3
align_2_4_nadir	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 4
align_1_2_maxang	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 1 & 2
align_2_3_maxang	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 3
align_2_4_maxang	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 4
align_vis_airs	32-bit floating-point	Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between the AIRS center and all VIS channels

Per-Granule Data Fields

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

Name	Type	Extra Dimensions	Explanation
limit_scene_counts	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Input limit checking on scene data numbers
limit_bb_counts	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Input limit checking on data numbers from the blackbody (dark target)
limit_phot_counts	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Input limit checking on data numbers from the photometric calibration source (bright target)
input_scene_counts	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Input statistics on scene data numbers
input_bb_counts	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Input statistics on data numbers from the blackbody (dark target)
input_phot_counts	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Input statistics on data numbers from the photometric calibration source (bright target)
limit_offsets	Color Counts (see below)	Channel (= 4) * SubTrack (= 9)	Output limit checking on offsets
offset_stats	Unlimited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics on offsets

offset_unc_stats	Unlimited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics on offset uncertainties
gain	32-bit floating-point	Channel (= 4) * SubTrack (= 9)	Gain: number of radiance units per count.
gain_err	32-bit floating-point	Channel (= 4) * SubTrack (= 9)	Error caused by imperfect fit for gain (gain units).
rad_stats	Unlimited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics over the granule of radiances (radiance units)
NeN_stats	Limited Engineering Struct (see below)	Channel (= 4) * SubTrack (= 9)	Statistics over the granule of Noise-equivalent Radiance (NeN)
xtrack_err	32-bit floating-point	Channel (= 4)	cross-track pixel location error estimate per channel (km)
track_err	32-bit floating-point	Channel (= 4)	Along-track pixel location error estimate per channel (km)

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	See Appendix A7
glintgeoqa	16-bit unsigned integer	None	See Appendix A7
moongeoqa	16-bit unsigned integer	None	See Appendix A7
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)
ViSnsrArrTemp	32-bit floating-point	None	Vis/NIR Sensor Array Temperature (Celcius)
ScHeadTemp1	32-bit floating-point	None	Scanner Head Housing Temperature 1 (active A or B) (Celcius)
OpMode	16-bit unsigned integer	None	Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase; bits 3-6 Cal Func; Bit 7 quicklook (expedited) flag; bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival); bit 16 transition flag

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 AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir)
ftptgeoqa	32-bit unsigned integer	None	See Appendix A7
zengeoqa	16-bit unsigned integer	None	See Appendix A7
demgeoqa	16-bit unsigned integer	None	See Appendix A7
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
state	32-bit integer	None	Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing

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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 "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.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 = 0)
max	32-bit floating-point	Maximum value field takes on in granule (not valid when num = 0)
mean	32-bit floating-point	Mean of values field takes on in granule (not valid when num = 0)
dev	32-bit floating-point	Standard Deviation of values field takes on in granule (not valid when num < 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

Color Counts: This type tracks counts of values received during an interval by how they compare to corresponding "red" and "yellow" limits.

Field Name	Type	Explanation
red_lo_limit	32-bit floating-point	Value of the low "red" limit.
red_lo_cnt	32-bit integer	Count of values less than the low "red" limit. This is an "Alarm" condition.
to_red_lo	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "red_low".
yellow_lo_limit	32-bit floating-point	Value of the low "yellow" limit.
yellow_lo_cnt	32-bit integer	Count of values greater than the low "red" limit but less than the low "yellow" limit. This is a "Warning" condition.
to_yellow_lo	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "yellow_low".
green_cnt	32-bit integer	Count of values greater than the low "yellow" limit but less than the high "yellow" limit.
to_green	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "green".
yellow_hi_limit	32-bit floating-point	Value of the high "yellow" limit.
yellow_hi_cnt	32-bit integer	Count of values greater than the high "yellow" limit but less than the high "red" limit. This is a "Warning" condition.
to_yellow_hi	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "yellow_high".
red_hi_limit	32-bit floating-point	Value of the high "red" limit.
red_hi_cnt	32-bit integer	Count of values greater than the high "red" limit. This is an "Alarm" condition.
to_red_hi	32-bit integer	Count of occasions on which the "color" of this field changed from some other value to "red_high".
missing	8-bit integer	Missing limits flags. Bit 0 (LSB) is 1 when yellow low limit (yellow_lo_limit) is missing; Bit 1 is high when yellow high limit is missing; Bit 2 is 1 when red low limit is missing; Bit 3 is 1 when red high limit is missing; Other bits unused set to 0.

A5: L1B AMSU Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRABRAD"

Swath Name = "L1B_AMSU"

Level = "level1B"

Footprints = 30

scanlines per scanset = 1

Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

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)

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

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 floating-point	Geodetic Longitude of spacecraft at end of granule (subsatellite location at 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	See Appendix A7
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)

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)

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	See Appendix A7
glintgeoqa	16-bit unsigned integer	None	See Appendix A7
moongeoqa	16-bit unsigned integer	None	See Appendix A7
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 integer	None	Receiver bitmap for AMSU-A1-2:Same fields as defined for qa_receiver_a11
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

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	See Appendix A7
zengeoqa	16-bit unsigned integer	None	See Appendix A7
demgeoqa	16-bit unsigned integer	None	See Appendix A7
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)

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

A6: L1B HSB Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRHBRAD"

Swath Name = "L1B_HSB"

Level = "level1B"

Footprints = 90

scanlines per scanset = 3

Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

Name	Value	Explanation
GeoXTrack	90	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	5	Dimension of channel array (Channel 1: Deleted 89.0 GHz channel: always invalid; Ch 2: 150.0 GHz; Ch 3: f0 +/- 1.0 GHz; Ch 4: f0 +/- 3.0 GHz; Ch 5: f0 +/- 7.0 GHz (f0 = 183.31 GHz))
CalXTrack	8	Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_HSB_CALIB) (Footprints are ordered: 1-4: spaceviews; 5-8: blackbody radiometric calibration source)
SpaceXTrack	4	Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_HSB_SPACE)
BBXTrack	4	Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_HSB_BB)
WarmPRT	7	Number of PRTs measuring warm target

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

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 ("HSB")
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 (3 * 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 floating-point	Geodetic Longitude of spacecraft at end of granule (subsatellite location at 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	See Appendix A7
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	32-bit integer	Number of scanlines not in Process state
num_missing_scanlines	32-bit integer	Number of scanlines with state = missing
num_data_gaps	32-bit integer	Number of blocks of scanlines where State is not Process
num_instr_mode_changes	32-bit integer	Number of operational instrument mode changes
num_scanlines_rec_cal_prob	32-bit integer	Number of scanlines with non-zero qa_receiver
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 HSB space view
QA_bb_PRT	Limited Engineering Struct (see below)	Blackbody PRT temperature summary QA (C)
QA_rec_PRT	Limited Engineering Struct (see below)	Receiver PRT temperature summary QA (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)

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 (= 5)	Channel Center frequency (GHz)
IF_offset_1	32-bit floating-point	Channel (= 5)	Offset of first intermediate frequency stage (MHz) (zero for no mixing)
IF_offset_2	32-bit floating-point	Channel (= 5)	Offset of second intermediate frequency stage (MHz) (zero for no second mixing)
bandwidth	32-bit floating-point	Channel (= 5)	Bandwidth of sum of 1, 2, or 4 channels (MHz)
num_calibrated_scanlines	32-bit integer	Channel (= 5)	Number of scanlines that had calibration coefs applied
num_scanlines_ch_cal_problems	32-bit integer	Channel (= 5)	Number of scanlines with non-zero qa_channel
bb_signals	Unlimited Engineering Struct (see below)	BBXTrack (= 4) * Channel (= 5)	Statistics on blackbody calibration signals (data numbers with offset subtracted)

space_signals	Unlimited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 5)	Statistics on spaceview calibration signals (data numbers with offset subtracted)
gain_stats	Unlimited Engineering Struct (see below)	Channel (= 5)	Statistics on gains (count/K)
NeDT	32-bit floating-point	Channel (= 5)	Instrument noise level estimated from warm count scatter (K)
QA_unfiltered_scene_count	Unlimited Engineering Struct (see below)	GeoXTrack (= 90) * Channel (= 5)	Per footprint position raw scene count summary QA
QA_unfiltered_BB_count	Unlimited Engineering Struct (see below)	BBXTrack (= 4) * Channel (= 5)	Per BB footprint position raw warm count summary QA (unfiltered)
QA_unfiltered_space_count	Unlimited Engineering Struct (see below)	SpaceXTrack (= 4) * Channel (= 5)	Per space footprint position raw cold count summary QA (unfiltered)
QA_cal_coef_a0	Unlimited Engineering Struct (see below)	Channel (= 5)	Calibration coefficient a0 summary QA (K)
QA_cal_coef_a1	Unlimited Engineering Struct (see below)	Channel (= 5)	Calibration coefficient a1 summary QA (K/count)
QA_cal_coef_a2	Unlimited Engineering Struct (see below)	Channel (= 5)	Calibration coefficient a2 summary QA (K/count**2)
QA_bb_raw_noise_counts	Unlimited Engineering Struct (see below)	Channel (= 5)	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 (= 5)	Summary QA on differences between cold cal counts, DT=ABS(T1-T2)/SQRT(2)

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	See Appendix A7
glintgeoqa	16-bit unsigned integer	None	See Appendix A7
moongeoqa	16-bit unsigned integer	None	See Appendix A7
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)
state	32-bit integer	None	Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing
cal_coef_a0	32-bit floating-point	Channel (= 5)	Calibration coefficients to convert raw counts to antenna temperature (K)
cal_coef_a0_err	32-bit floating-point	Channel (= 5)	Error estimate for cal_coef_a0 (K)
cal_coef_a1	32-bit floating-point	Channel (= 5)	Calibration coefficients to convert raw counts to antenna temperature (K/count)
cal_coef_a1_err	32-bit floating-point	Channel (= 5)	Error estimate for cal_coef_a1 (K/count)
cal_coef_a2	32-bit floating-point	Channel (= 5)	Calibration coefficients to convert raw counts to antenna temperature (K/count**2)
cal_coef_a2_err	32-bit floating-point	Channel (= 5)	Error estimate for cal_coef_a2 (K/count**2)
SpacViewSelct	8-bit integer	None	Space View Selected
mixer_17_temp_used	8-bit integer	None	Mixer 17 Temperature use flag. (1: used mixer 17 temperature for receiver temperature; 0: used mixer 18/19/20 temperature)
receiver_temp	32-bit floating-point	None	Receiver temperature used in calibration (mixer 17 temperature or mixer 18/19/20 temperature as specified by mixer_17_temp_used) (C)
target_temp	32-bit floating-point	None	HSB target temperature used in calibration (C)
qa_scanline	8-bit unsigned integer	None	Scanline bitmap for HSB: 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	8-bit unsigned integer	None	Receiver bitmap for HSB: 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_channel	8-bit unsigned integer	Channel (= 5)	Channel bitmap for HSB: 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) Most recent calibration coefficients used; Bit 7: (value 128) Excessive NeDT estimated

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 HSB instrument with respect to the HSB instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir)

ftptgeoqa	32-bit unsigned integer	None	See Appendix A7
zengeoqa	16-bit unsigned integer	None	See Appendix A7
demgeoqa	16-bit unsigned integer	None	See Appendix A7
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 (= 5)	Raw antenna temperature in Kelvins
brightness_temp	32-bit floating-point	Channel (= 5)	Brightness temperature. Same as antenna_temp because sidelobe correction is small and ground truth is less known for water vapor.(K)
brightness_temp_err	32-bit floating-point	Channel (= 5)	Uncertainty in empirically derived brightness_temp bias correction, excluding radiometer noise. (K)

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" involves reading HDF-EOS Swath field "QA_bb_PRT.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 = 0)
max	32-bit floating-point	Maximum value field takes on in granule (not valid when num = 0)
mean	32-bit floating-point	Mean of values field takes on in granule (not valid when num = 0)
dev	32-bit floating-point	Standard Deviation of values field takes on in granule (not valid when num < 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

A7: Geolocation QC Bit Definitions

These geolocation quality control fields are listed here for convenience only because the descriptions are long and would otherwise be repeated in all the other appendix subsections A1-A6.

Field name	Description
orbitgeoqa	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
satgeoqa	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	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	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
ftptgeoqa	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
satgeoqa	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	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 resolutionincompatibility. 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' class return code except PGSCSC_W_PREDICTED_UT1; Bit 15: (value 32768) PGS_CSC_GetFOV_Pixel() gave any 'E' class return code