AIRS/AMSU/HSB Version 6
Level 3 Product User Guide

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August 2013
Version 1.1

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1. Introduction

The purpose of this document is to give users of AIRS Version 6 (V6) Level 3 (L3) products a brief guide how to use the AIRS V6 L3 products in their research.

The AIRS L3 files contain geophysical parameters that have been averaged into latitude/longitude grid cells. Grid maps coordinates range from -180.0° to +180.0° in longitude and from -90.0° to +90.0° in latitude.

Most AIRS L3 files contain simple statistics for 1°x1° grid cells. These include the standard, support, and research products. A second set of “quantized” products contain more sophisticated statistics for 5°x5° grid cells.

1.1. 1°x1° L3 products (standard, support, research)

These L3 gridded products are derived from the V6 Level 2 (L2) swath products. The L2 quality indicators determine which of the L2 products are combined to create these L3 products. As a general rule, L2 retrieved quantities whose quality indicators are “best” (=0) or “good” (=1) are included in the sums that generate the L3 gridded products. These L3 files contain geophysical and quality parameters that have been averaged and binned into **1°x1° grid cells**. For each grid map of mean values there are corresponding maps of standard deviation, counts, minimum, maximum, and in some cases error estimate. The counts map provides the user with the number of points per bin that were included in the statistics and can be used to generate custom multi-day maps from the daily gridded products. The complete description of the contents of the AIRS L3 product is available in Appendix A5, A6, A7 and A8 of **V6_Released_Proc_FileDesc.pdf.** Values of -9999 or a count of 0 indicate invalid or missing data.

The L3 **standard** products contain retrieved parameters on standard pressure levels roughly matching instrument vertical resolution and are designed for use by the general public in their research. Temperature and water vapor profiles are reported on 24 (**TempPresLvls**) or 12 (**H2OPresLvls)** pressure levels. The values (in hPa) are listed in **Table 1** and also provided for convenient reference in the document **V6_L3_Standard_Pressure_Levels.pdf.**

L3 **support** products contain interim and experimental portions intended for use by the AIRS team and others willing to make a significant investment of time in understanding the product and are reported at higher internal vertical resolution at 100 pressure levels similar to the L2 products. The pressure levels (in hPa) are listed in **Table 2** and also provided for convenient reference in the document **V6_L2_Support_Pressure_Levels.pdf**.

L3 **research** products include more detailed internal and quality control information and are not generally distributed for the public.

Table 1. L3 Standard Pressure Levels.

Index of Temperature & H2OVapMMR Levels & Layers	Values of Temperature Levels (TempPresLvls) (hPa)	Values of H2OVapMMR Levels (H2OPresLvls) (hPa)	Values of H2OVapMMR Layers (midlayer pressure) (hPa)
1	1000.0	1000.0	961.8
2	925.0	925.0	886.7
3	850.0	850.0	771.4
4	700.0	700.0	648.1
5	600.0	600.0	547.7
6	500.0	500.0	447.2
7	400.0	400.0	346.4
8	300.0	300.0	273.9
9	250.0	250.0	223.6
10	200.0	200.0	173.2
11	150.0	150.0	122.5
12	100.0	100.0	83.7
13	70.0		
14	50.0		
15	30.0		
16	20.0		
17	15.0		
18	10.0		
19	7.0		
20	5.0		
21	3.0		
22	2.0		
23	1.5		
24	1.0		

Table 2. L3 Support Pressure Levels.

Index	pressSup, mb	Index	pressSup, mb	Index	pressSup, mb
1	0.0161	34	47.1882	67	358.966
2	0.0384	35	51.5278	68	374.724
3	0.0769	36	56.1260	69	390.893
4	0.1370	37	60.9895	70	407.474
5	0.2244	38	66.1253	71	424.47
6	0.3454	39	71.5398	72	441.882
7	0.5064	40	77.2396	73	459.712
8	0.714	41	83.2310	74	477.961
9	0.9753	42	89.5204	75	496.63
10	1.2972	43	96.1138	76	515.72
11	1.6872	44	103.017	77	535.232
12	2.1526	45	110.237	78	555.167
13	2.7009	46	117.777	79	575.525
14	3.3398	47	125.646	80	596.306
15	4.077	48	133.846	81	617.511
16	4.9204	49	142.385	82	639.14
17	5.8776	50	151.266	83	661.192
18	6.9567	51	160.496	84	683.667
19	8.1655	52	170.078	85	706.565
20	9.5119	53	180.018	86	729.886
21	11.0038	54	190.32	87	753.628
22	12.6492	55	200.989	88	777.79
23	14.4559	56	212.028	89	802.371
24	16.4318	57	223.441	90	827.371
25	18.5847	58	235.234	91	852.788
26	20.9224	59	247.408	92	878.62
27	23.4526	60	259.969	93	904.866
28	26.1829	61	272.919	94	931.524
29	29.121	62	286.262	95	958.591
30	32.2744	63	300	96	986.067
31	35.6505	64	314.137	97	1013.95
32	39.2566	65	328.675	98	1042.23
33	43.1001	66	343.618	99	1070.92
				100	1100.0

These L3 products are separated into **ascending and descending** portion of the orbit, where "ascending or descending" refers to the direction of movement of the sub-satellite point in the satellite track. The ascending direction of movement is from Southern Hemisphere to Northern Hemisphere, with an equatorial crossing time of 1:30 PM local time; the descending direction of movement is from Northern Hemisphere to Southern Hemisphere, with an equatorial crossing time of 1:30 AM local time. Outside of the polar zones, these correspond respectively to daytime and nighttime.

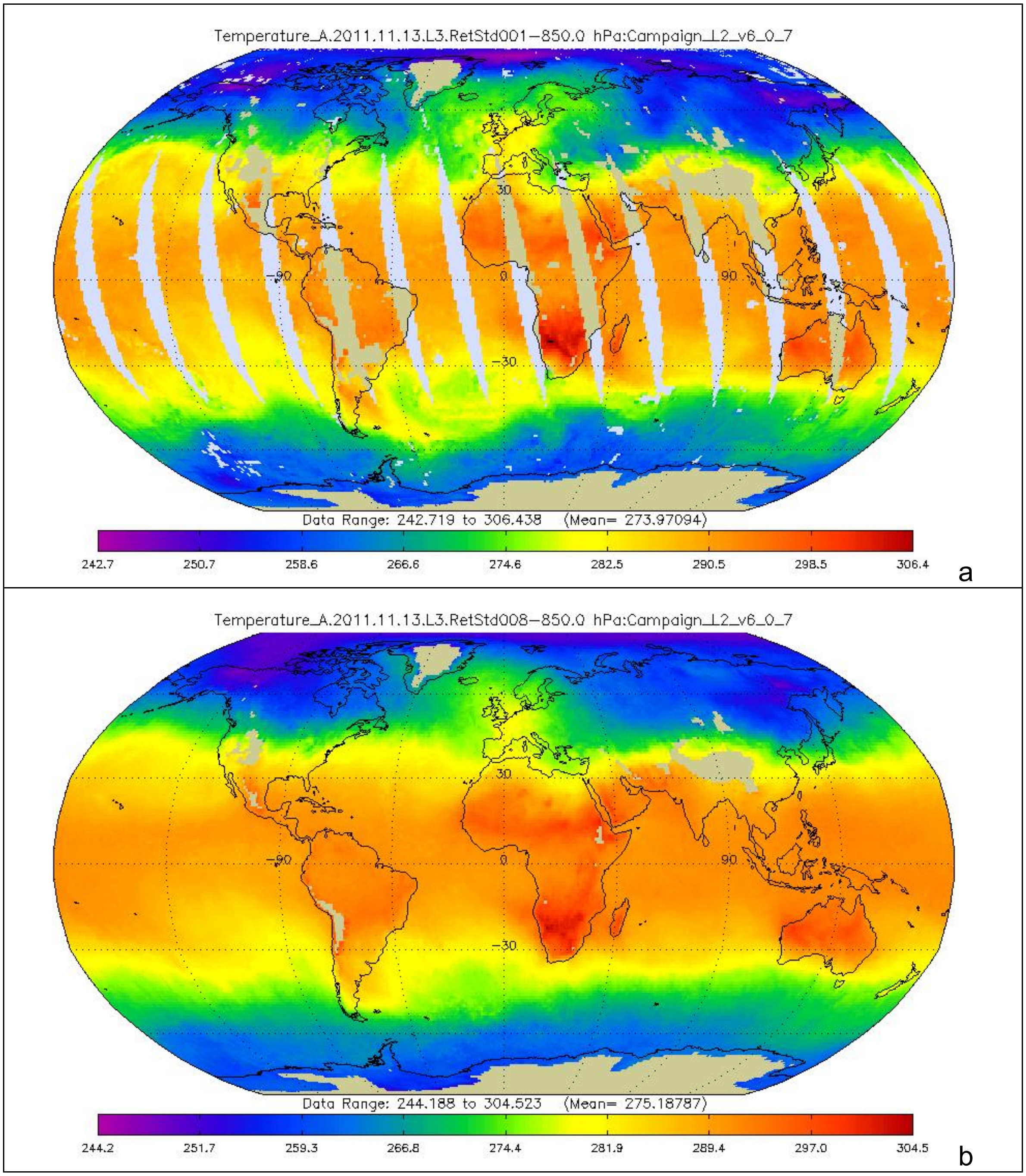
The temporal resolution of these AIRS L3 products is **daily**, **8-day** (half of the 16 day Aqua orbit repeat cycle) and **monthly** (calendar). The multi-day product means are simply the arithmetic mean weighted by the counts of the daily data combined in each grid box, with the standard deviation, counts, minimum, maximum, and error estimate similarly aggregated. Daily L3 products can be used to address the high frequency climate variability, such as synoptic weather and intraseasonal variability. In addition, individual users can easily aggregate daily L3 products into custom multi-day global products based on their specific needs. These data are also used as input to the 8-day and monthly L3 products. The monthly L3 products address the interests of those involved in climate trend analysis and low-frequency climate variability. They are typically interested in monthly means over long timescales and prefer data products with the lowest possible systematic errors. The temporal characteristics of these three data types are summarized in **Table 3**.

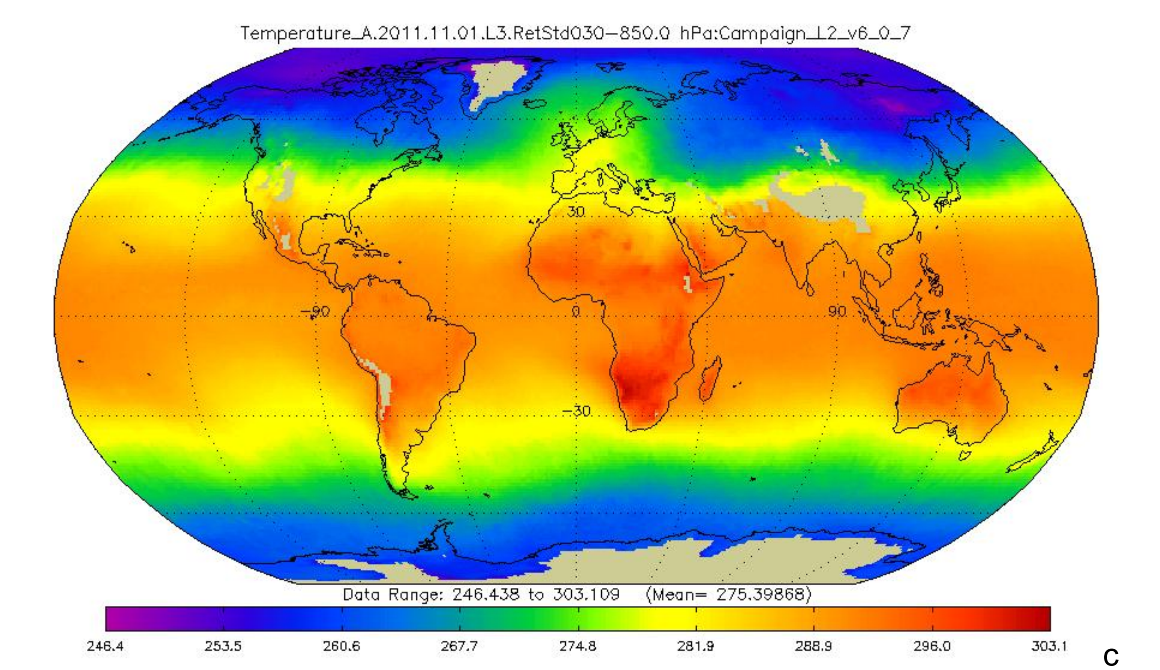
Table 3. L3 Standard Product Temporal Characteristics.

Daily	*8-Day*	*Monthly*
"Complex" data, leaves in gores between satellite tracks (missing)	"Moderate" data, no gores, and some data dropouts.	"Simple" data, no gores, complete coverage
1°x1° spatial resolution	1°x1° spatial resolution	1°x1° spatial resolution
1-day temporal resolution.	8-day temporal resolution based on Aqua 16-day repeat cycle.	Monthly (calendar)

The daily L3 products will have gores (cells with no data) between the satellite paths where there is no coverage for that day (**Figure 1a**). The 8-day and monthly L3 products will likely contain complete global coverage without gores and with missing data only in locations in which the retrieval algorithm found to be problematical or where topography intrudes into the lower altitude regime of profiles (**Figures 1b and 1c**).

Figure 1. The V6 L3 Temperature maps at 850 hPa for November 2011: (a) daily, 11/13/2011; (b) 8-day; 11/13-20/2011; (c) Monthly





c

Each L3 daily product contains information for a nominal temporal period of 24 hours for either the descending or ascending orbit rather than midnight-to-midnight. The nominal period for the descending orbit is 1:30PM-to-1:30PM UTC (centered at the equator crossing time of 1:30AM); for the ascending orbit it is 1:30AM-to-1:30AM. The data included in the gridding on a particular day start at the international dateline and progress westward (as do the subsequent orbits of the satellite) so that neighboring gridded cells of data are no more than a swath of time apart (about 100 minutes). The two parts of a scan line that crosses the dateline are included in separate data sets, according to the appropriate date. This ensures that data points in a grid box are always coincident in time. If the data were gridded using the midnight-to-midnight time-span, the start of the day and the end of the day could be in the same grid cell, producing an artificial time discontinuity. The edge of the AIRS L3 gridded cells is at the date line (the 180E/W longitude boundary). When plotted, this produces a map with 0 degrees longitude in the center of the image unless the bins are reordered. This method is preferred because the left (West) side of the image and the right (East) side of the image contain data farthest apart in time. Similar contiguous daily L3 maps centered at other longitudes may be created by combining the appropriate parts of two daily L3 files. The gridding scheme used by AIRS is the same as used by TOVS Pathfinder to create L3 products.

Three different combinations of instrument data can be used and these result in different sets of L3 products. The main processing combination uses data from AIRS and AMSU-A. A second set uses only AIRS. This set is somewhat less accurate and has lower yield, especially in cloudy regions, but will have greater continuity if the AMSU-A instrument degrades further. The final set uses AIRS, AMSU-A and HSB (a variant of AMSU-B). Because HSB failed less than a year into the mission, this set is available only for a few months. But it has higher-quality water vapor and has precipitation parameters that are not present in the other variants.

The shortnames used to identify AIRS L3 products according to instrument mix, temporal duration, and product type are listed in **Table 4**.

Table 4. Shortnames for AIRS L3 products

AIRS + AMSU			
	Daily	8-day	Monthly
Standard L3	AIRX3STD	AIRX3ST8	AIRX3STM
Support L3	AIRX3SPD	AIRX3SP8	AIRX3SPM
Research L3	AIRX3RED	AIRX3RE8	AIRX3REM
Quantized L3	AIRX3QP5 (5-day)		AIRX3QPM
AIRS Only			
	Daily	8-day	Monthly
Standard L3	AIRS3STD	AIRS3ST8	AIRS3STM
Support L3	AIRS3SPD	AIRS3SP8	AIRS3SPM
Research L3	AIRS3RED	AIRS3RE8	AIRS3REM
Quantized L3	AIRS3QP5 (5-day)		AIRS3QPM
AIRS + AMSU + HSB			
	Daily	8-day	Monthly
Standard L3	AIRH3STD	AIRH3ST8	AIRH3STM
Support L3	AIRH3SPD	AIRH3SP8	AIRH3SPM
Research L3	AIRH3RED	AIRH3RE8	AIRH3REM
Quantized L3	AIRH3QP5 (5-day)		AIRH3QPM

1.2. 5°x5° L3 quantized products

L3 quantized products summarize mean, standard deviation and number of observations on a 5x5 degree grid per pentad (5 days) and calendar month for up to 100 clusters at 10 pressure levels. Day and night data is mixed together.

2. Major New Improvements for V6 in Comparison to V5

There are three major improvements for V6 L3 products in comparison to Version 5 (V5) L3 products.

2.1. New ‘L3 research’ products

First, in addition to the existing standard, support and quant L3 products in V5, new “L3 research” products are added in V6. L3 standard products are the primary public L3 products that contain only well-validated fields at roughly instrument vertical resolution reported at 24 or 12 levels. L3 support products are an additional public L3 product for more sophisticated users and contain fields that are at higher internal vertical resolution at 100 levels and fields that are verified but not fully validated. L3 research products are for internal science team and project use and include outputs of intermediate retrieval steps and residuals also reported at 100 levels.

2.2. New ‘TqJoint’ grid products

Second, in addition to the existing four grids “ascending_MW_only”, “descending_MW_only”, “ascending”, and “descending” in V5 L3 standard products, two new “ascending_TqJoint”, and “descending_TqJoint” grids are added in V6 L3 standard products. **These two new “TqJoint” grids in V6 L3 standard products contain data for a common set of observations across water vapor and temperature at all atmospheric levels. These will be suitable for climate process studies.** Other fields, such as clouds, OLR, are also present but must also pass their own QC restrictions. The original “ascending” and “descending” grids are also preserved. For the ascending and descending grids (and ascending_MW_Only and descending_MW_Ony), L2 quality control per field is used (*_QC) collecting all observations where quality level is 0 (best) or 1 (good). This ensures that these grids have the most complete set of data available for each field and level, but the use of different ensembles for different data fields can complicate comparisons across fields or levels.

2.3. The L3 standard water vapor and trace gas products are reported on pressure levels in addition to pressure layers as in Version 5

Third, the L3 standard water vapor and trace gas products (H2OVapMMR and RelHum) are placed on **pressure levels** in addition to **pressure layers** as in Version 5. These will be consistent with the L3 temperature profiles, suitable for climate process studies and easier to compare with other observational and model water vapor data sets. As a result, the TQJoint V6 L3 products can be used directly for CMIP5 model comparison and evaluation. For the pressure level and layer differences, the readers can refer to **V6_L2_Levels_Layers_Trapezoids.pdf** for more details.

In addition the above three major improvements, there are some minor improvements in V6 L3 products as well:

a) Erroneous sub-surface values are deleted. V5 L2 products included some values that were extrapolated below the surface. When theses values were averaged into L3 products the extrapolated values were mixed with real retrieved values, sometimes giving very hot or cold values for the lowest levels. For V6, L2 standard has changed so no values are included below the surface, and L3 support excludes values below the surface.
b) Added additional fields _min and _max which provide the minimum and maximum values for each parameter
a) Retrievals are spread from a single AMSU FOV to all nine AIRS FOVs for a smoother, more complete map.
b) Coastal logic is eliminated. Previously each grid square was classified as either land or ocean, and any observations that were not mostly of the specified surface type were discarded. This left low yields in coastal areas.
c) OLR is calculated from the L2 OLR at 3X3 AIRS footprints, which leads to a more detailed map.
d) Trace gasses are provided on standard levels instead of the trapezoids used internally in retrieval.
e) Fields are grouped more logically.

The V6 L3 quant (L3Q) product is an existing product in V5 and has only minor updates from V5 to V6.

a) V6 L3Q uses WV on levels, instead of layers.
b) V6 L3Q uses T and WV only on standard levels 925-150 hPa, not 1000-150 as in V5. Because V6 L2 does not provide values below the surface, so there are often not values for 1000 hPa, even for ocean.
c) V6 uses PGood > 500 hPa instead of PGood > 300 hPa as a quality flag because V6 PGood is almost always > 300 hPa. Note: L3Q clusters all retrievals that have values for all variables. The quality flag is included as a variable so users know how many good retrievals are in each cluster.
d) Because of improvements in L2 yield and outliership, and because V6 L3Q eliminates the 1000 hPa level, V6 L3Q is more globally

representative than V5 L3Q. V6 L3Q includes 86% of all possible observations, up from 81%. Most of the missing observations are because of surface elevation above 925 hPa, not because of retrieval failure.

3. L3 Standard Product

ESDT ShortNames= “AIRX3STD”, “AIRX3ST8”, “AIRX3STM”, “AIRH3STD”, “AIRH3ST8”, “AIRH3STM”, “AIRS3STD”. “AIRS3ST8”, “AIRS3STM”

Grid Names = “location”, “ascending”, “descending”, “ascending_TqJoint”, “descending_TqJoint”, “ascending_MW_only”, “descending_MW_only”

Horizontal resolution= 1°x1° degree (360x180)

Upper Left Point= -180.0, 90.0

Lower Right Point= 180.0, -90.0

Projection= GCTP_GEO (Global image)

3.1. L3 Standard Product Example File Names

The following examples are L3 standard daily, 8-day and monthly product files for January 2011.

Daily Product Jan 1, 2011 processed using AIRS and AMSU radiances:
Name: AIRS.2011.01.01.L3.RetStd001.v6.0.9.0.G13010201044.hdf
Shortname: **AIRX3STD**

Daily Product Dec 3, 2009 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2009.12.03.L3.RetStd_H001.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRH3STD**

Daily Product Jan 1, 2011 processed using only AIRS radiances:
Name: AIRS.2011.01.01.L3.RetStd_IR001.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRS3STD**

8-Day Product Dec 3-10, 2009 processed using AIRS and AMSU radiances:
Name: AIRS.2009.12.03.L3.RetStd008.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRX3ST8**

8-Day Product Dec 3-10, 2009 processed using AIRS, AMSU, HSB radiances:

Name: AIRS.2009.12.03.L3.RetStd_H008.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRH3ST8**

8-Day Product Dec 3-10, 2009 processed using only AIRS radiances:
Name: AIRS.2009.12.03.L3.RetStd_IR008.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRS3ST8**

Monthly Product Dec, 2009 processed using AIRS and AMSU radiances:
Name: AIRS.2009.12.01.L3.RetStd031.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRX3STM**

Monthly Product Dec, 2009 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2009.12.01.L3.RetStd_H031.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRH3STM**

Monthly Product Dec, 2009 processed using only AIRS radiances:
Name: AIRS.2009.12.01.L3.RetStd_IR031.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRS3STM**

3.2. L3 Standard Product Grids

The data in the L3 standard product is contained in 7 HDF-EOS Grids. Each grid includes data for the entire globe in 360 x 180 grid cells each 1 x 1 degree of latitude/longitude. Most fields appear in the 4 main grids: ascending, descending, ascending_TqJoint, and descending_TqJoint. The ascending grids collect data taken while the spacecraft is in the ascending part of its orbit. This is generally daytime, except near the poles. For the ascending and descending grids (and ascending_MW_Only and descending_MW_Ony), L2 quality control per field is used (*_QC) collecting all observations where quality level is 0 (best) or 1 (good). This ensures that these grids have the most complete set of data available for each field and level, but the use of different ensembles for different data fields can complicate comparisons across fields or levels, so the TqJoint fields apply a single, unified quality control criterion for all fields: TSurfAir_QC must be 0 or 1.

Each L3 standard product (daily, 8-day and monthly) contains six grids containing fields created using the appropriate L2 products whose quality indicators are “best” or “good. The grids are named “ascending_MW_only”, “descending_MW_only”, “ascending”, “descending”, “ascending_TqJoint”, and "descending_TqJoint". The first pair are created from the MW-Only L2 products; the second pair are created from the L2 Standard Product arising from IR-Only or combined IR/MW retrievals using independent quality controls for temperature and water vapor per level similar to V5; the third pair are created from the L2 Standard Product arising from IR-Only or combined IR/MW retrievals using the same quality control for both temperature and water vapor different with V5.

The separation into ascending and descending portions of the orbit mitigates the suppression of the diurnal signal in the data. Ascending field names have "_A" appended. Descending field names have "_D" appended.

Each grid provides a 360x180xn array of standard retrieval **mean** (without any appendix), **standard deviation** (with an appendix of _sdev), **minimum** (with an appendix of _min), **maximum** (with an appendix of _max), **input count** (with an appendix of _ct). Some also contain **standard error** (with an appendix of _err). The "extra dimension" n=24 for temperature and n=12 for water vapor and n=1 if the product is not a profile. The inclusion of counts allows the user to create custom L3 products over any desired time span via a simple combination of the published products.

Each grid also provides a 360x180 array of total count of observations, whether included in the calculation of the L3 product or not. This can be used with a field's input counts to provide a measure of the sampling of a reported L3 product, but not of the sampling bias.

Grid name	Tag	Description
location	None	Location information which is valid for all grids
ascending	_A	Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) Each field and level is individually quality controlled.
descending	_D	Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) Each field and level is individually quality controlled.
ascending_TqJoint	_TqJ_A	Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) Collective quality control is used across all fields and levels.
descending_TqJoint	_TqJ_D	Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) Collective quality control is used across all fields and levels.
ascending_MW_Only	_MW_A	Microwave information collected while the spacecraft is in the ascending part of its orbit.

		(Daytime data except near the poles.)
descending_MW_Only	_MW_D	Microwave information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.)

These dimensions appear in selected grids as needed.

Name	**Grids**	**Size: Values**	**Explanation**
StdPressureLev	ascending, descending, ascending_TqJoint, descending_TqJoint, ascending_MW_Only, descending_MW_Only	24: 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 15, 10, 7, 5, 3, 2, 1.5, 1 hPa	Pressure levels of temperature and trace gas profiles and geopotential height. The array order is from the surface upward, in conformance with WMO standard. Note that the L3 pressure levels are a subset of the 28 L2 pressure levels, restricted to the range of [1.0, 1000.0] hPa.
H2OPressureLev	ascending, descending, ascending_TqJoint, descending_TqJoint	12: 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100 hPa	Pressure levels of water vapor level profiles.
H2OPressureLay	ascending, descending, ascending_TqJoint, descending_TqJoint	12: 961.8, 886.7 771.4, 648.1, 547.7, 447.2, 346.4, 273.9, 223.6, 173.2, 122.5, 83.7 hPa	Midpoints of pressure layers of water vapor layer profiles. Layer boundaries are at StdPressureLev.
EmisFreqIR	ascending, descending,	4:	Frequencies corresponding to each

	ascending_TqJoint, descending_TqJoint	832, 961, 1203, 2616 cm^{-1}	of the 4 IR emissivity values reported in the AIRS L3 Standard Product.
EmisFreqMW	ascending_MW_Only, descending_MW_Only	3: 23.0, 50.3, 89.0 GHz	Frequencies corresponding to each of the 3 microwave emissivity values reported in the AIRS L3 Standard Product.
CoarseCloudLayer	ascending, descending, ascending_TqJoint, descending_TqJoint	3: 865, 547, 66 hPa	Midlayer pressures of the 3 coarse cloud layers. Layer boundaries are at {1100., 680., 440., 10.} hPa
FineCloudLayer	ascending, descending, ascending_TqJoint, descending_TqJoint	12: 1018, 887, 771, 648, 548, 447, 346, 274, 224, 173, 122, 32 hPa	Midlayer pressures of the 24 fine cloud layers. Layer boundaries are at {1100., 925., 850., 700., 600, 500, 400, 300, 250, 200, 150, 100, 10} hPa
XDim	location, ascending, descending, ascending_TqJoint, descending_TqJoint, ascending_MW_Only, descending_MW_Only	360: -179.5, -178.5, … 178.5, 179.5	West to East dimension for all grids. Long_name “Longitude”. Values are mid-cell longitude.
YDim	location, ascending, descending, ascending_TqJoint, descending_TqJoint, ascending_MW_Only, descending_MW_Only	180: -89.5, -88.5, … 88.5, 89.5	South to North dimension for all grids. Long_name “Latitude”. Values are mid-cell latitude.

3.3. L3 Standard Product Location Grid

The location grid contains 4 geolocation fields each of which is a 360x180 element array. The elements provide the location and characteristics of the grid cells:

Name	**Type**	**Extra Dimensions**	**Explanation**
Latitude	32-bit floating-point	None	Array of 360 x 180 latitude values at the center of the grid box (Degrees).
Longitude	32-bit floating-point	None	Array of 360 x 180 longitude values at the center of the grid box (Degrees).
LandSeaMask	16-bit integer	None	Land sea mask. 1 = land, 0 = ocean. (Unitless). (Up through V5 this data was used to exclude land profiles from grid squares marked sea and vice versa. As of v6 this is not done, but the field is retained for user convenience.)
Topography	32-bit floating-point	None	Topography of the Earth in meters above the geoid. Original data source: PGS Toolkit

3.4. L3 Standard Product Attributes

These fields appear once per L3 file as HDF-EOS grid attributes in the location grid. They apply to the entire file.

The attributes with extra dimensions are provided in this format for backwards compatibility, but the same information is provided in identically named dimensions with associated dimension scales in the grids where these dimensions are used.

Name	**Type**	**Extra Dimensions**	**Explanation**
Year	32-bit integer	None	Year at start of nominal data period
Month	32-bit integer	None	Month at start of nominal data period [1,12]
Day	2-bit integer	None	Day of month at start of nominal data period [1,31]
NumOfDays	32-bit	None	Total number of days of

	integer		input L2 data included in gridded maps.
AscendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), ascending.
AscendingGridEndTimeUTC	String of 8-bit characters	None	End time of mapped fields (UTC), ascending.
DescendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), descending.
DescendingGridEndTimeUTC	String of 8-bit characters	None	End time of mapped fields (UTC), descending.
StdPressureLev	32-bit floating point	StdPressureLev (24)	Pressure levels of temperature profiles and geopotential height. The array order is from the surface upward, in conformance with WMO standard. Note that the L3 pressure levels are a subset of L2 pressure levels and are constrained to begin at 1000.0 mb and end at 1.0 mb.
H2OPressureLev	32-bit floating point	H2OPressureLev (12)	Pressure levels of water vapor level profiles.
H2OPressureLay	32-bit floating point	H2OPressureLay (12)	Midpoints of pressure layers of water vapor layer profiles.
EmisFreqIR	32-bit floating point	EmisFreqIR (4)	Frequencies corresponding to each of the 4 IR emissivity values reported in the AIRS L3 Standard Product. (832.0, 961.0, 1203.0, 2616.0 cm-1)
EmisFreqMW	32-bit floating point	EmisFreqMW (3)	Frequencies corresponding to each of the 3 microwave emissivity values reported in the AIRS L3 Standard Product. (23.0, 50.3, and 89.0

			GHz)
CoarseCloudLayer	32-bit floating point	CoarseCloudLayer (3)	Midlayer pressures of the 3 coarse cloud layers
FineCloudLayer	32-bit floating point	FineCloudLayer (12)	Midlayer pressures of the 12 fine cloud layers

3.5. L3 Standard Product Grid Fields

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example the field with the basename "Temperature" will appear as "Temperature_A" in the ascending grid and "Temperature_TqJ_D" in the descending_TqJoint grid. Quantities for which L2 provides one retrieved value per FOR (3x3 AIRS FOVs) are recorded for each of the associated 9 AIRS FOV latitudes and longitudes. The value in the field is the mean over all observations that fell in the grid cell and passed quality control.

There are also up to 5 ancillary fields for each field:

1. _ct is a 16-bit count of the number of observations used in the calculation. It can be ratioed with TotalCounts to give a yield. It is present for all floating-point fields.
2. _sdev is a 32-bit standard deviation over the observations in this grid cell. It is present for all floating-point fields.
3. _min is the 32-bit floating-point minimum of the observations in this grid cell. It is present for all floating-point fields.
4. _max is the 32-bit floating-point maximum of the observations in this grid cell. It is present for all floating-point fields.
5. _err is the 32-bit floating-point mean of the L2 error estimates of the observations in this grid cell. It is present for all fields where the L2 product provides an error estimate.

So for example in the ascending grid the main (mean) Temperature field is "Temperature_A" and it has ancillary fields "Temperature_A_ct", "Temperature_A_sdev", "Temperature_A_min", "Temperature_A_max", and "Temperature_A_err".

3.5.1. Standard and TqJoint Grid Fields

Basename	Type	Extra Dimensions	Explanation
TotalCounts	16-bit integer	None	Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations.
SurfPres_Forecast	32-bit floating point	None	Surface pressure from forecast. (hPa)
SurfSkinTemp	32-bit floating point	None	Surface skin temperature. (Kelvin)
EmisIR	32-bit floating point	EmisFreqIR (4)	IR surface emissivity at frequencies {832, 961, 1203, 2616} cm^{-1}
Temperature	32-bit floating point	StdPressureLev (24)	Atmospheric temperature (Kelvin)
SurfAirTemp	32-bit floating point	None	Temperature of the atmosphere at the Earth's surface. (Kelvin)
TropPres	32-bit floating point	None	Pressure of the tropopause. (hPa)
TropTemp	32-bit floating point	None	Temperature of the tropopause. (Kelvin)
TotH2OVap	32-bit floating point	None	Total integrated column water vapor burden. (kg/m^2)
H2O_MMR_Lyr	32-bit floating point	H2OPressureLay (12)	Water vapor mass mixing ratio averaged over each of standard pressure layers (gm/kg dry air)
H2O_MMR	32-bit floating point	H2OPressureLev (12)	Water vapor mass mixing ratio at standard pressure levels (gm/kg dry air)
H2O_MMR_Surf	32-bit floating point	None	Water vapor mass mixing ratio at the surface (gm/kg dry air)
RelHum	32-bit floating point	H2OPressureLev (12)	Relative humidity over equilibrium phase (Percent)
RelHumSurf	32-bit floating point	None	Relative humidity at the surface over equilibrium phase (Percent)

RelHum_liquid	32-bit floating point	H2OPressureLev (12)	Relative humidity over liquid phase (Percent)
RelHumSurf_liquid	32-bit floating point	None	Relative humidity at the surface over liquid phase (Percent)
TropHeight	32-bit floating point	None	Height of the tropopause. (meters)
GPHeight	32-bit floating point	StdPressureLev (24)	Geopotential height. (Meters)
CloudFrc	32-bit floating point	None	Combined layer cloud fraction. (0-1). (Unitless)
CloudTopPres	32-bit floating point	None	Combined cloud top pressure (weighted by cloud fraction). (hPa)
CloudTopTemp	32-bit floating point	None	Combined cloud top temperature (weighted by cloud fraction). (Kelvin)
FineCloudFrc	32-bit floating point	FineCloudLayer (12)	Cloud fraction at fine cloud resolution (Unitless)
CoarseCloudFrc	32-bit floating point	CoarseCloudLayer (3)	Cloud fraction at coarse cloud resolution. 3 layers: low, middle, high. (Unitless)
CoarseCloudPres	32-bit floating point	CoarseCloudLayer (3)	Cloud layer pressure at coarse cloud resolution. 3 layers: low, middle, high. (hPa)
CoarseCloudTemp	32-bit floating point	CoarseCloudLayer (3)	Cloud layer cloud top temperature at coarse cloud resolution. 3 layers: low, middle, high. (Kelvin)
TotO3	32-bit floating point	None	Total integrated column ozone burden. (Dobson units)
O3_VMR	32-bit floating point	StdPressureLev (24)	Ozone volume mixing ratio (ppmv)
TotCO	32-bit floating point	None	Retrieved total column CO. (molecules/cm^2)
CO_VMR	32-bit floating point	StdPressureLev (24)	CO volume mixing ratio. (ppmv)
TotCH4	32-bit floating point	None	Retrieved total column CH4. (molecules/cm^2)
CH4_VMR	32-bit floating point	StdPressureLev (24)	CH4 volume mixing ratio. (ppmv)
OLR	32-bit floating point	None	Outgoing long-wave radiation flux. (watts/m^2)

ClrOLR	32-bit floating point	None	Clear-sky outgoing long-wave radiation flux. (watts/m^2)

3.5.2. MW-Only Grids

The Microwave-Only (MW-Only) grid products are retrieved by the MW retrieval stage of the AIRS algorithm. No IR data are used to retrieve these products. All other products described later in this document are retrieved employing the combined IR/MW retrieval stages of the AIRS algorithm, providing greater vertical resolution of temperature and water vapor fields, improved surface emissivity and retrievals of atmospheric constituents.

Basename	Type	Extra Dimensions	Explanation
TotalCounts	16-bit integer	None	Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations.
Emis	32-bit floating point	EmisFreqMW (3)	Microwave spectral emissivity at frequencies {23.8, 50.3 and 89.0} GHz.
Temperature	32-bit floating point	StdPressureLev (24)	Microwave-only atmospheric temperature (Kelvin)
TotH2OVap	32-bit floating point	None	Total integrated column water vapor burden. (kg/m^2)
GPHeight	32-bit floating point	2 StdPressureLev (24)4	Microwave-only geopotential height (Meters)
TotCldLiqH2O	32-bit floating point	None	Total integrated column cloud liquid water. (kg/m^2)

4. L3 Support Product

ESDT ShortNames= “AIRX3SPD”, “AIRX3SP8”, “AIRX3SPM”, “AIRH3SPD”, “AIRH3SP8”, “AIRH3SPM”, “AIRS3SPD”. “AIRS3SP8”, “AIRS3SPM”
Grid Names = “location”, “ascending”, “descending”
Horizontal resolution= 1°x1° degree (360x180)
Upper Left Point= -180.0, 90.0
Lower Right Point= 180.0, -90.0
Projection= GCTP_GEO (Global image)

The L3 support products are similar to the L3 standard products but contain fields that are either the full 100 levels; not fully validated; or are inputs or intermediary values. Because no quality control information is available for some of these fields, values from failed retrievals may be included.

The temporal resolution of the AIRS L3 support products is same as that for the L3 standard products: **daily**, **8-day** (half of the 16 day Aqua orbit repeat cycle) and **monthly** (calendar).

4.1. L3 Support Product Example File Names

The following examples are L3 support daily, 8-day and monthly product files for January 2011.

Daily Product Jan 1, 2011 processed using AIRS and AMSU radiances:
Name: AIRS.2011.01.01.L3.RetSup001.v6.0.9.0.T13010201044.hdf
Shortname: **AIRX3SPD**

Daily Product Dec 3, 2009 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2009.12.03.L3.RetSup_H001.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRH3SPD**

Daily Product Jan 1, 2011 processed using only AIRS radiances:
Name: AIRS.2011.01.01.L3.RetSup_IR001.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRS3SPD**

8-Day Product Dec 3-10, 2009 processed using AIRS and AMSU radiances:
Name: AIRS.2009.12.03.L3.RetSup008.v6.0.9.0.G2002123120634.hdf

Shortname: **AIRX3SP8**

8-Day Product Dec 3-10, 2009 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2009.12.03.L3.RetSup_H008.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRH3SP8**

8-Day Product Dec 3-10, 2009 processed using only AIRS radiances:
Name: AIRS.2009.12.03.L3.RetSup_IR008.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRS3SP8**

Monthly Product Dec, 2009 processed using AIRS and AMSU radiances:
Name: AIRS.2009.12.01.L3.RetSup031.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRX3SPM**

Monthly Product Dec, 2009 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2009.12.01.L3.RetSup_H031.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRH3SPM**

Monthly Product Dec, 2009 processed using only AIRS radiances:
Name: AIRS.2009.12.01.L3.RetSup_IR031.v6.0.9.0.G2002123120634.hdf
Shortname: **AIRS3SPM**

4.2. L3 Support Product Grids

The data in the L3 support product is contained in 3 HDF-EOS Grids. Each grid includes data for the entire globe in 360 x 180 grid cells each 1 x 1 degree of latitude/longitude. Most fields appear in the two main grids: ascending and descending. The ascending grids collect data taken while the spacecraft is in the ascending part of its orbit. This is generally daytime, except near the poles.

Grid name	Tag	Description
location	None	Location information which is valid for all grids
ascending	_A	Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.)
descending	_D	Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.)

These dimensions appear in selected grids as needed.

Name	Grids	Size: Values	Explanation
XtraPressureLev	ascending, descending	100	Pressure levels of internal 100-level temperature profiles. hPa.
XtraPressureLay	ascending, descending	100	Pressure layers of internal 100-layer gas profiles. hPa.
SurfClass	ascending, descending	8: 0="coastline (Liquid water covers 50-99% of area)", 1= "land (Liquid water covers < 50% of area)", 2="ocean (Liquid water covers > 99% of area)", 3="sea ice (High MW emissivity)", 4="sea ice (Low MW emissivity)", 5="snow (Higher-frequency MW scattering)", 6="glacier/snow (Very low-frequency MW scattering)", 7= "snow (Lower-frequency MW scattering)"	Surface Classes counted in SurfClass_Count
DustTest	ascending, descending	9: 1, 2, 4, 8, 16, 32, 64, 128, 256	Dust Tests counted in Dust_Score. Least significant to most significant.
MODISEmis10Hinge	ascending, descending	10: 699.30, 826.45, 925.93, 1075.27 1204.82, 1315.79, 1724.14, 2000.00, 2325.58, 2777.78	MODIS emissivity hinge points
SpectralOlr	ascending, descending	16: **Band Spectral Interval (cm^{-1})** 1 100 – 350 2 350 – 500 3 500 – 630 4 630 – 700 5 700 – 820	Frequency bands on which spectralolr and spectralclrolr are reported

		6 820 – 980 7 980 – 1080 8 1080–1180 9 1180–1390 10 1390–1480 11 1480–1800 12 1800–2080 13 2080–2250 14 2250–2380 15 2380–2600 16 2600–3260	
CloudPhase	ascending, descending	7: liquid (high confidence), liquid (low confidence), unknown, ice (low confidence), ice (medium confidence), ice (high confidence), ice (very high confidence)	Cloud phases used in cloud_phase_3x3
SpectralClr	ascending, descending	5: "Ocean test applied and scene identified as clear", "Ocean test applied and scene not identified as clear", "Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule", "Unvalidated land test applied and scene not identified as clear", "Unvalidated land test applied and scene identified as clear"	Categories used in Spectral_Clear_Counts
XDim	location,	360:	West to East dimension for

	ascending, descending	-179.5, -178.5, … 178.5, 179.5	all grids. Long_name “Longitude”. Values are mid-cell longitude.
YDim	location, ascending, descending	180: -89.5, -88.5, … 88.5, 89.5	South to North dimension for all grids. Long_name “Latitude”. Values are mid-cell latitude.

4.3. L3 Support Product Location Grid

These fields are within the location grid and document pertinent information for determining the location and characteristics of a given grid cell for all grids.

Name	Type	Extra Dimensions	Explanation
Latitude	32-bit floating-point	None	Array of 360 x 180 latitude values at the center of the grid box (Degrees).
Longitude	32-bit floating-point	None	Array of 360 x 180 longitude values at the center of the grid box (Degrees).
LandSeaMask	16-bit integer	None	Land sea mask. 1 = land, 0 = ocean. (Unitless). (Up through V5 this data was used to exclude land profiles from grid squares marked sean and vice versa. As of v6 this is not done, but the field is retained for user convenience.)
Topography	32-bit floating-point	None	Topography of the Earth in meters above the geoid. Original data source: PGS Toolkit

4.4. L3 Support Product Attributes

These fields appear once per L3 file as HDF-EOS grid attributes in the location grid. They apply to the entire file.

The attributes with extra dimensions are provided in this format for backwards compatibility, but the same information is provided in identically named dimensions with associated dimension scales in the grids where these dimensions are used.

Name	Type	Extra Dimensions	Explanation
Year	32-bit integer	None	Year at start of nominal data period
Month	32-bit integer	None	Month at start of nominal data period [1,12]
Day	2-bit integer	None	Day of month at start of nominal data period [1,31]
NumOfDays	32-bit integer	None	Total number of days of input L2 data included in gridded maps.
AscendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), ascending.
AscendingGridEndTimeUTC	String of 8-bit characters	None	End time of mapped fields (UTC), ascending.
DescendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), descending.
DescendingGridEndTimeUTC	String of 8-bit characters	None	End time of mapped fields (UTC), descending.
SurfClass	16-bit integer	SurfClass (8)	Surface Classes counted in SurfClass_Count
DustTest	16-bit integer	DustTest (9)	Dust Tests counted in Dust_Score
SpectralOlr	16-bit integer	SpectralOlr (16)	Frequency bands on which spectralolr and spectralclrolr are reported
CloudPhase	16-bit integer	CloudPhase (4)	Cloud phases used in cloud_phase_3x3
SpectralClr	16-bit integer	SpectralClr (5)	Categories used in Spectral_Clear_Counts
MODISEmis10Hinge	32-bit float	MODISEmis10Hinge (10)	10 MODIS emissivity hinge points
XtraPressureLev	32-bit float	XtraPressureLev (100)	100 pressure levels for internal temperature profiles

XtraPressureLay	32-bit float	XtraPressureLay (100)	100 pressure layer for internal gas profiles

4.5. L3 Support Product Grid Fields

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example the carbon monoxide molecule number density field with the basename “COCDSup” will appear as “COCDSup_A” in the ascending grid and “COCDSup_D” in the descending grid. The value in the main field is the mean over all observations which fell in the grid cell and passed quality control. Quantities for which L2 provides just one retrieved value per FOR (3x3 AIRS FOVs) are recorded for each of the 9 AIRS FOV center locations.

There are also up to 5 ancillary fields for each field:

1. _ct is a 16-bit count of the number of observations used in the calculation. It can be ratioed with TotalCounts to give a yield. It is present for all floating-point fields.
2. _sdev is a 32-bit standard deviation over the observations in this grid cell. It is present for all floating-point fields.
3. _min is the 32-bit floating-point minimum of the observations in this grid cell. It is present for all floating-point fields.
4. _max is the 32-bit floating-point maximum of the observations in this grid cell. It is present for all floating-point fields.
5. _err is the 32-bit floating-point mean of the L2 error estimates of the observations in this grid cell. It is present for all fields where the L2 product provides an error estimate.

So for example in the ascending grid the main (mean) COCDSup field is “COCDSup_A” and it has ancillary fields “COCDSup_A_ct”, “COCDSup_A_sdev”, “COCDSup_A_min”, “COCDSup_A_max”, and “COCDSup_A_err”.

Basename	**Type**	**Extra Dimensions**	**Explanation**
TotalCounts	16-bit integer	None	Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3

			product or not. Used for yield calculations.
Dust_Score	32-bit floating point	DustTest (9)	Fraction of obs with each dust test triggered. [0.0, 1.0]
SO2_Indicator	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. (L2 BT_diff_SO2) (Kelvins)
TAirSup	32-bit floating point	XtraPressureLev (100)	Atmospheric temperature (Kelvin)
Temp_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of temperature (unitless)
H2OCDSup	32-bit floating point	XtraPressureLay (100)	Water vapor layer column density (molecules/cm^2)
H2O_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of water vapor (unitless)
bndry_lyr_top	32-bit floating point	None	Pressure at top of planetary boundary layer (hPa)
cloud_phase_3x3	32-bit floating point	CloudPhase (7)	Counts of observations with each of the 7 possible cloud phase values. Use with TotalCounts to get fraction of obs with any given type.
ice_cld_opt_dpth	32-bit floating point	None	Ice cloud optical depth (unitless)
ice_cld_eff_diam	32-bit floating point	None	Ice cloud effective diameter (microns)
ice_cld_temp_eff	32-bit floating point	None	Ice cloud effective cloud top temperature (Kelvin)
ice_cld_fit_reduced_chisq	32-bit floating point	None	Normalized chi-square residual of the obs-calc radiance residual in the ice cloud optical properties calculation
O3CDSup	32-bit	XtraPressureLay	Ozone layer column density

	floating point	(100)	(molecules/cm^2)
O3_VMR_Surf	32-bit floating point	None	Ozone volume mixing ratio at the surface (ppmv)
O3_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of ozone (unitless)
COCDSup	32-bit floating point	XtraPressureLay (100)	Carbon monoxide layer column density (molecules/cm^2)
CO_VMR_Surf	32-bit floating point	None	Carbon monoxide volume mixing ratio at the surface (ppmv)
CO_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of carbon monoxide (unitless)
CH4CDSup	32-bit floating point	XtraPressureLay (100)	Methane layer column density (molecules/cm^2)
CH4_VMR_Surf	32-bit floating point	None	Methane volume mixing ratio at the surface (ppmv)
CH4_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of methane (unitless)
spectralolr	32-bit floating point	SpectralOLR (16)	Outgoing longwave radiation flux integrated over 16 frequency bands (Watts/meter^2)
spectralclrolr	32-bit floating point	SpectralOLR (16)	Clear-sky Outgoing longwave radiation flux integrated over 16 frequency bands (Watts/meter^2)
SurfClass_Count	16-bit integer	SurfClass (7)	Count of cases with each surface type.
IR_Precip_Est	32-bit floating point	None	Regression-based estimate of daily precipitation based on clouds and relative humidity from L2 IR/MW retrieval. Analogous to and forms a continuous record when used with TOVS precipitation index. (per 45 km AMSU-A FOV) (mm/day)
MWSST	32-bit	None	Effective surface skin

	floating point		temperature from MW-Only retrieval step. BT / emis @ 23.8 GHz. (Kelvin)
MW_Emis_24GHz	32-bit floating point	None	MW emissivity @ 23.8 GHz (unitless)
MW_Emis_31GHz	32-bit floating point	None	MW emissivity @ 31.4 GHz (unitless)
MW_Emis_50GHz	32-bit floating point	None	MW emissivity @ 50.3 GHz (unitless)
MW_Emis_89GHz	32-bit floating point	None	MW emissivity @ 89.0 GHz (unitless)
SurfSkinTemp_Forecast	32-bit floating point	None	Predicted surface temperature interpolated from NOAA NCEP GFS forecast (K)
MODIS_LST	32-bit floating point	None	Climatology land surface temperature from MODIS averaged over MYD11C3 0.05 degree (~5 km) pixels covering an area roughly corresponding to an AMSU FOV or 3x3 of AIRS FOVs. Not used in AIRS retrieval but provided for user convenience.
MODIS_emis_10_hinge	32-bit floating-point	MODISEmis10Hinge (= 10)	First guess emissivity from MODIS MYD11C3 at 10 hinge points
Strato_CCI	32-bit floating-point	None	A Stratospheric Coarse Climate Indicator representing the weighted average of retrieved temperatures over the lower stratosphere (maximum weight near 70 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU4 products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K)
Tropo_CCI	32-bit	None	A Tropospheric Coarse

	floating-point		Climate Indicator representing the weighted average of retrieved temperatures over the lower troposphere (maximum weight near 700 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU2R products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K)
Spectral_Clear_Counts	16-bit integer	SpectralClr (=5)	Counts of cases found for each value of spectral_clear_indicator

5. L3 Quant Product

ESDT ShortNames: “AIRX3QP5”, “AIRX3QPM8”, “AIRH3QP5”, “AIRH3QPM”, “AIRS3QP5”. “AIRS3QPM”

File Type: HDF-EOS Grid

Grid Name = “L3Quant”

Horizontal resolution= 5°x5° degree (72x36)

Upper Left Point= -180.0, 90.0

Lower Right Point= 180.0, -90.0

Projection= GCTP_GEO

5.1. L3 Quant Product Temporal Characteristics

The temporal resolution of the AIRS L3 Quant products is 5-day (pentad) and monthly (calendar). Pentads always start on the 1st, 6th, 11th, 16th, 21st, and 26th days of a month. The last pentad may contain as little as 3 days of data or as much as 6 days.

5.2. L3 Quant Product Dimensions

Dimensions		
Name	***Value***	***Description***

LonDim	72	Number of Longitude grid cells. 72 5-degree cells = 360 degrees. Cells are ordered West to East, from -180 to + 180.
LatDim	36	Number of Latitude grid cells. 36 5-degree cells = 180 degrees. Cells are ordered North to South. (???)
NumTrials	200	Number of different clustering attempts for each grid cell.
MaxNumClusters	100	Maximum number of clusters permitted in each grid cell. Actual number of clusters can be less. In this case, only the first NumClusters values are valid.
NumDimNorm	18	Dimensionality of clusters in normalized space.
NumDimPhysical	33	Dimensionality of clusters in physical space. (Need to list what the physical dims are here or refer to a table that does.)
NumPentad	6	Present in monthly files only – Number of pentads contributing to month. (6 5-day periods gives 30 days. For longer or shorter months the last pentad will be 3-6 Days. See TBD.)

5.3. L3 Quant Product Global Attributes

Global Attributes		
Name	***Additional Dimensions***	***Description***
Start_year	None	Year at start of data set
Start_month	None	Month at start of data set
Start_day	None	Day at start of data set. Data starts at the beginning of this day.
Start_TAI	None	TAI93 at start of data set
End_year	None	Year at end of data set
End_month	None	Month at end of data set
End_day	None	Day at end of data set. Data runs through the end of this day.
End_TAI	None	TAI93 at end of data set
Means	NumDimPhysical	Means of Physical Parameters (T, q…)
Covariance Matrix	NumDimPhysical, NumDimPhysical	
Eigenvectors	NumDimPhysical, NumDimPhysical	
PhysicalValuesDescriptor	NumDimPhysical strings	An array of string values describing the contents of PhysicalValues. (e.g., “Temperature at 350 mb (K)”)
Lambda	None	

5.4. L3 Quant Product Grid Fields

Name	***Type***	***Units***	***Additional Dimensions***	***Description***

LatCenter	Float32	Degrees North	None	Center Latitude of 5x5 grid cell (-90.0, 90.0)
LonCenter	Float32	Degrees East	None	Center Longitude of 5x5 grid cell (-180.0, 180.0)
SouthLatBound	Float32	Degrees North	None	Minimum bounding latitude in a 5x5 degree grid cell. (-90.0, 90.0)
NorthLatBound	Float32	Degrees North	None	Maximum bounding latitude in a 5x5 degree grid cell. (-90.0, 90.0)
WestLonBound	Float32	Degrees East	None	Minimum bounding longitude in a 5x5 degree grid cell. (-180.0, 180.0)
EastLonBound	Float32	Degrees East	None	Maximum bounding longitude in a 5x5 degree grid cell. (-180.0, 180.0)
NumClusters	Int16	Number	None	Number of clusters in a 5x5 degree grid cell. Cannot exceed MaxNumClusters
NormalizedValues	Float32	Unitless	MaxNumClusters, NumDimNorm	Normalized observations averaged over each cluster
PhysicalValues	Float32	Various physical units	NumClusters, NumDimPhysical	Raw physical observations averaged over each cluster. PhysicalValuesDescription in Global Attributes gives mapping of contents to physical values (e.g., T, H2O…)
NumObsInCluster	Int16	Number	MaxNumClusters,	Number of Observations represented by this cluster
ClusterMeanSquaredError	Float32	Unitless	MaxNumClusters	
Entropy	Float32	Unitless	NumTrials	

6. Disclaimer and Caveats for L3 Data Products

The user is advised to read the full disclaimer documentation for the V6 Data Products Release: **V6_Data_Disclaimer.pdf.**

6.1. Application of Quality Indicators Creates Unequal Numbers of Samples within Profiles and among Retrieved Parameters for L3 Standard Grid Products

Analyses which depend upon correlations between temperature and water vapor fields or correlations of temperature or water vapor between different pressure levels should always use TqJoint grids that contain data for a common set of observations across water vapor and temperature at all atmospheric levels.

For the ascending and descending grids (and ascending_MW_Only and descending_MW_Only grids), L2 quality control per field is used (*_QC) collecting all observations where quality level is 0 (best) or 1 (good). In all cases, a sample is included if the applied quality indicators are either “best” (quality indicator = 0) or “good” (quality indicator = 1). Please refer to the document **V6_L2_Quality_Control_and_Error_Estimation.pdf** for a complete description of the L2 quality indicators. Quality control is applied to each data point entering the gridding algorithm both for different parameters and at different levels in the atmosphere for a profile. This ensures that these grids have the most complete set of data available for each field and level. However, the ensemble of samples combined to create the averages varies between parameters and levels in the atmosphere and this can complicate comparisons across fields or levels. For example, there will be a greater number of samples (greater yield) included in the **TAirStd** profiles at higher altitudes than those at lower altitudes**.** Surface fields are filtered using their individual ***_QC**, which are generally the most restrictive of the quality indicators.

We provide the count of samples, but this does not characterize sampling biases, which result from the measuring system. For example, parameters that are correlated with cloudiness, e.g. cloud properties and water vapor mass mixing ratio, have sampling biases different from those of the air temperature profile or of the surface parameters. The problem is complicated because the bias is height and species dependent within a grid box. The loss of sensitivity from clouds is not only dependent upon cloud amount, but depends upon correlations between clouds at different levels that are not characterized by cloud amount alone. Thus you cannot use total cloudiness in a grid box to further quality control the products.

6.2. Topography Creates Unequal Numbers of Samples within Profiles

Binning vertical profile data over a spatial area containing topography is always problematical. Some samples in a bin may cover a footprint of low altitude topography while others in the same bin may cover a footprint of high altitude topography. This affects the number of samples as a function of altitude of the temperature profile. For example, the number samples falling within an ascending bin, **TotalCounts_A**, is the maximum number of entries which may be used in determining the average air temperature, **Temperature_A**, as some point in the vertical profile. Over topography, the count of samples actually included in the calculation at a particular level, **Temperature_A_ct**, may drop rapidly to zero as the profile approaches the 1000mb level due to intervening topography.

6.3. Digitization Effect due to Compression by Rounding

A user who combines data over a time interval to create a histogram of the number of occurrences of a given value of water vapor in the 500-600mb layer will see a high-frequency oscillation. This is a digitization effect due to the compression of the L3 data by rounding to shrink the product file size. The precision of H2OMMR is 11 bits in the mantissa. This is equivalent to 3 1/2 significant digits. The effective bin size is ~1/2048 of whatever the value is for the given cell. The user has two options to avoid creating a histogram that shows this beating. The first is to make the histogram bin size much larger than the effective bin size. The second is to make the histogram bin size much smaller, but then only display the non-empty bins.

6.4. Integrating the Layer Mixing Ratios in H2OVapMMR yields a value smaller than TotH2Ovap

The L3 layer profiles assume the atmosphere extends downward all the way to 1000mb. The L3 total water vapor values do not make this assumption. Profiles can extend below the surface, and the user can partially correct for this by using topography to remove from sums of H2OVapMMR layers and fractions of layers that are below the surface. Unfortunately, specific humidity is not constant throughout the vertical extent of a layer so the correction cannot be exact. The user might believe that he is safe over the ocean. However, if the surface pressure is less than 1000mb and the L3 bin is over the ocean, the bottom layer should appear to have more water vapor than is really there because it will extend below the surface.