

AIRS/AMSU/HSB Version 5 CalVal Status Summary

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Introduction

AIRS V5 product validation will be completed via publications in the open literature. The summary presented here reflects studies performed on V4 released data products and the pre-release V5 product studies.

Data Validation States

AIRS product validation states are “**Beta**”, “**Provisional**” and “**Validated**”. The state of product validation depends upon surface type, latitude and product type

Beta -- Early release product, minimally validated and may still contain significant errors. Available to allow users to gain familiarity with data formats and parameters but not appropriate as the basis for quantitative scientific publications.

Provisional -- Product quality may not be optimal and incremental product improvements are still occurring. General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing. Users are urged to contact science team representatives prior to use of the data in publications. Provisional products may be replaced in the archive when the validated product becomes available.

Validated -- Formally validated product, although validation is still ongoing. Uncertainties are well defined, and products are ready for use in scientific publications, and by other agencies. There may be later improved versions of these products.

The validation states for Level 1B and Level 2 Data Products in release V5 are:

Level 1B Product	RMS Requirement	Uncertainty Estimate	Vertical Coverage	Val Status
AIRS IR Radiance	3%*	<0.2% 0.1K Antarctica	N/A	Val5
AIRS VIS/NIR Radiance	20%	15-20%	N/A	Prov
AMSU Radiance	0.25-1.2 K	1-3 K	N/A	Val3
HSB Radiance	1.0-1.2 K	N/A	N/A	Val1

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Standard Geophysical Product	RMS Req	Uncertainty Estimate	Vertical Coverage	Val Status
Cloud Cleared IR Radiance	1.0 K	Accuracy ~1 K precision 0.3-8 K	N/A	Val3
Sea Surface Temperature	0.5 K	1.0 K	N/A	Val1
Land Surface Temperature	1.0 K	2-3 K	N/A	Prov
Surface Emissivity	N/A		N/A	Beta
Temperature Profile	1 K / km	Tropo: 1-2 K/km above: 2-3 K/km	Surface to 1 hPa	Val4
Water Vapor Profile	15% /2km	low trop: 20%/2km hi trop: 20-60%/2km sensitivity thresh: ~30 ppmv	Surface to 200 hPa or tropopause	Val4
Total Precipitable Water	5%	5-20% 0.1 mm wet bias in Antarctic	N/A	Val5
Fractional Cloud Cover	5%	5-30% cloud type dependent	900 to 100 hPa	Val2
Cloud Top Height	0.5 km	0.5-2 km cloud type dependent	900 to 100 hPa	Val3
Cloud Top Temperature	1.0 K	1-2 K	900 to 100 hPa	Val1
Total Ozone Column	-	tropics: 5% poles: 5-40%	N/A	Val3
Ozone Profile	-	20%	200 to 70 hPa	Val4
Carbon Monoxide	-	10-50% at 500 mb	800-200 hPa layer	Val3
Methane	-	1.5% monthly in mid-trop (alt & lat dependent)	700-200 hPa layer	Prov

Beta = Not suitable for scientific investigations.

Prov = Provisionally validated.

suitable for scientific investigations with caution.

Validated for nonpolar ($|\text{lat}| \leq 50^\circ$) night ocean only

Val1 = non-polar ($|\text{lat}| \leq 50^\circ$) day/night ocean.

Val2 = Val1 + non-polar ($|\text{lat}| \leq 50^\circ$) night land.

Val3 = Val2+nonpolar day land Val4 = Val3+polar night Val5 = Val4+polar day

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The validation state for the Level 3 Gridded Data Product matches that of the corresponding Level 1B or Level 2 Data Product from which it is generated.

Data Validation Summary

Radiance (Level 1) Products

AIRS IR Radiance *Validation Status:* Val5. Validated for all conditions except high latitude polar winter.

Conditions Validated	RMS Requirement	Uncertainty Estimate	References
Ocean, $T_{\text{surf}} > 273 \text{ K}$.	3%	0.2%	Aumann et al. [2006], Tobin et al. [2006a]
Snow/Ice, $T_{\text{surf}} < 273 \text{ K}$.	3%	0.1 K	Walden et al. [2006]

Further analyses: None anticipated.

AIRS VIS/NIR Radiance *Validation Status:* Prov. No quantitative comparisons have been reported.

Conditions Validated	RMS Requirement	Uncertainty Estimate	References
Low latitude ocean, qualitative only.	20%	15-20%	Meeting presentations of images and cloud detection.

Futher analyses: Need quantitative comparisons with MODIS and in situ observations.

AMSU Radiance *Validation Status:* Val3. Comparisons for low and middle latitude land and ocean.

Conditions Validated	RMS Requirement	Uncertainty Estimate	References
Non-polar land and ocean.	0.25-1.2 K	1-3 K	Rosenkranz and Barnet [2006]

Futher analyses: Extend analyses to ARM NSA and non-ARM sites.

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Geophysical (Level 2) Products

Cloud Cleared IR Radiance *Validation Status:* Val3. Global comparisons at nonpolar latitudes against models.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
All non-polar	1.0 K	Accuracy ~1 K, precision 0.3-8 K.	Meeting presentations comparing ECMWF and NCAR CAM3.

Futher analyses: Need published comparison against sondes.

Sea Surface Temperature *Validation Status:* Val1. Characterized for all conditions except polar oceans.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
All non-polar	0.5 K	1 K	Aumann et al. [2006]

Futher analyses: Need comparisons at very high latitudes.

Land Surface Temperature *Validation Status:* Prov. Compared against MODIS L3, ECMWF and Dome C.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
Global using MODIS, ECMWF and Dome C data.	1.0 K	3 K	R. Knuteson, March 2007 Science Team Meeting

Futher analyses: Need more complete L2 analysis.

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Temperature Profile *Validation Status:* Val4. Validated for all but polar winter conditions

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
Ocean, surface to lower stratosphere.	1 K / km	1 K / km	Divakarla et al. [2006], Fetzer et al. [2003, 2004, 2005], Nalli et al. [2006], Tobin et al. [2006]
Non-polar land, 1-2 km to lower stratosphere	1 K / km	1 K / km	Divakarla et al. [2006], Fetzer et al. [2003], Tobin et al. [2006]
Non-polar land, surface to 1-2 km.	1 K / km	1-2 K / km	Divakarla et al. [2006], Fetzer et al. [2003], Tobin et al. [2006]
Polar land.	1 K / km	1-2 K / km	D. Tobin, March 2006 Science Team Meeting ARM NSA results.
Middle stratosphere and above.	3 K / km	<5 K / km*	Froidevaux et al. [2006], Schwartz et al. [2007]

*Error likely dominated by MLS.

Futher analyses: Complete ARM best comparisons, all dedicated cold-season sondes; GPS or other sensor in middle atmosphere.

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Water Vapor Profile *Validation Status:* Val3. Validated for all non-polar conditions.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
Ocean, surface to 300 hPa	15% / 2 km	15-25% / 2 km	Divakarla et al. [2006], Fetzer et al. [2003, 2004, 2005], Livingston et al. [2007], Nalli et al. [2006], Pierce et al. [2006], Tobin et al. [2006]
Non-polar land 2 km to 300 hPa.	15% / 2 km	15-25% / 2 km	Divakarla et al. [2006], Fetzer et al. [2003], Tobin et al. [2006]
Non-polar land, surface to 1-2 km	15% / 2 km	30-40% / 2 km	"
Polar land.	15% / 2 km	30-40% / 2 km	Gottelman et al. [2006a]
Tropical upper troposphere.	15% / 2 km	25% / 2 km*+	Fetzer et al. [2007], Gottelman et al. [2004], Hagan et al. [2004], Read et al. [2007]
Middle and high latitude upper troposphere.	15% / 2 km	30-50% / 2 km*+	Fetzer et al. [2007], Read et al. [2007]

*Sensitivity threshold is ~30 ppmv; no sensitivity above tropopause.

+Upper bound; includes MLS uncertainties.

Futher analyses: Complete ARM NSA comparison, all dedicated sondes, including over European winter; examine averaging kernels to understand low-end sensitivity.

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Total Precipitable Water *Validation Status:* Val5. Validated for all conditions except sea ice and high latitude polar winter.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
Ocean, $\pm 50^\circ$ latitude	5%	5%	Divakarla et al. [2006], Fetzer et al. [2003, 2005, 2006], Tobin et al. [2006]
Non-polar land	5%	5-20%	Divakarla et al. [2006], Fetzer et al. [2003], Tobin et al. [2006]
Polar land	5%	10%; 0.1 mm wet bias.	Ye et al. [2007]

Futher analyses: Complete ARM NSA comparison, all dedicated sondes, including over European winter.

Fractional Cloud Cover *Validation Status:* Val2. Compared against radar/lidar and CloudSat/CALIPSO; consistency check with MLS and MODIS.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
Tropical ocean	5%	5-20%	Kahn et al. [2007; 2007a]
Global	5%	5-30%, type-dependent.	Kahn presentations of comparisons against CloudSat/CALIPSO.

Futher analyses: Manuscript in preparation describing extensive comparisons with CloudSat/CALIPSO by Kahn.

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Cloud Top Height *Validation Status:* Val3. Compared against CloudSat/CALIPSO; consistency check with MLS.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
Tropical ocean	0.5 km	<1 km	Kahn et al. [2007, 2007a]
Global	0.5 km	0.5-2 km, type dependent.	Kahn presentations of comparisons against CloudSat/CALIPSO.

Futher analyses: Manuscript in preparation describing extensive comparisons with CloudSat/CALIPSO by Kahn.

Cloud Top Temperature *Validation Status:* Val1. Consistency check against MODIS brightness temperatures and in situ cloud height.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References
Tropical ocean	1.0 K	1-2 K	Kahn et al. [2007a]

Futher analyses: None planned.

Total Ozone Column *Validation Status:* Val3. Validated for all conditions except polar.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Non-polar	N/A	5%	Fetzer et al. [2003, 2005], Presentations by Divakarla and Irion.
High latitude	N/A	5-40%	Presentations by Divakarla and Irion.

Futher analyses: Complete comparison of Version 5 against TOMS/OMI and ozonesondes.

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Ozone Profile (250 mb – 70 mb) *Validation Status:* Val4. Validated for all conditions except sea ice and high latitude polar winter.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Mid-latitude land and ocean.	N/A	0-100% bias near tropopause; <20% above.	Bian et al. [2007], presentations by Divakarla and Irion.

Futher analyses: Complete comparison of Version 5 against TOMS/OMI and ozonesondes.

Carbon Monoxide *Validation Status:* Val3. Comparison against aircraft observations.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Global non-polar, mid-tropospheric total.	N/A	15-20% at 500mb	McMillan et al. [2005]; McMillan meeting presentations.

Further analyses: INTEx comparisons in progress.

Methane *Validation Status:* Prov. Some aircraft comparisons.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Low, mid latitude land and ocean.	N/A	1.5% monthly in mid-trop. (alt. & lat. dependent)	Divakarla [2006], Fetzer [2006], Tobin [2006a], Barnet meeting presentation.

Further analyses: Aircraft comparisons in progress.

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Other Geophysical (Level 2) Products

Relative Humidity *Validation Status:* Val5. Validated for all conditions except sea ice and high latitude polar winter.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Subtropical ocean	N/A	15%	Nalli et al. [2006]
Polar land	N/A	15-25%	Gettelman et al. [2006a]

Further analyses: Should be folded into other sonde comparisons.

Tropopause Pressure *Validation Status:* Prov. Compared against GPS profiles and ECMWF.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Global	N/A	~0.5 km log P	Fetzer meeting presentations.

Further analyses: Formal comparison is planned.

Air-Ocean Temperature Difference *Validation Status:* Prov. Compared against radiosondes and NCEP reanalyses.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Cold air outbreaks in Northeast Pacific	N/A	T _{air} high	Fetzer [2004a]
Southern Ocean and Tropics	N/A	Varies	S. Dong March 07 Science Team Presentation

Further analyses: S. Dong is planning a formal comparison with ships of opportunity.

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Boundary Layer Depth *Validation Status:* Val3. Compared against radiosondes and NCEP reanalyses.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
Subtropical Northeast Pacific	N/A	<1 K / 1 km	Fetzer et al. [2004]
ARM SGP site	N/A	<1 K / 1 km	J. Santanello March 07 Science Team Presentation

Further analyses: J. Santanello publishing dissertation results.

Cloud Liquid Water *Validation Status:* Prov.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
ARM sites	N/A	>50%	Rosenkranz [2006]

Further analyses: None planned.

Carbon Dioxide *Validation Status:* Prov.

Geophysical Conditions Studied	RMS Requirement	Uncertainty Estimate	References / Further analyses
xxx	N/A	~3 ppmv	Chahine et al. [2005]

Further analyses: Ongoing.

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