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Space Administration

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California Institute of Technology
Pasadena, California

AIRS Level 2 Validation: Status of Version 6 and Plans for Candidate Version 7

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AIRS Science Team Meeting, Caltech

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Lots of Mature Data Products

AIRS Product	Product	Accuracy (V5)	Val Status (V5)
Core: Radiances			
AIRS IR Radiance	L1B-AIRS	<0.2K	Stage 3
AIRS VIS/NIR Radiance	L1B-VIS	15-20%	Stage 2
AMSU Radiance	L1B-AMSU	1-3 K	Stage 3
HSB Radiance	L1B-HSB	1-3 K	Stage 3
Core: Thermodynamic			
Cloud Cleared IR Radiance	L2	1.0 K	Stage 2
Sea Surface Temperature	L2	1.0 K	Stage 3
Land Surface Temperature	L2	2-3 K	Stage 2
Land Surface Emissivity	L2	10%	Stage 2
Temperature Profile	L2	1 K / km	Stage 3
Water Vapor Profile	L2	15% / 2km	Stage 3
Total Precipitable Water	L2	5%	Stage 3
Fractional Cloud Cover	L2	20%	Stage 3
Cloud Top Height	L2	1 km	Stage 3
Cloud Top Temperature	L2	2.0 K	Stage 3
Core: Composition			
Carbon Monoxide	L2	15%	Stage 2
Carbon Dioxide	Post-Proc	1-2 ppm	Stage 2
Total Ozone Column	L2	5%	Stage 3
Ozone Profile	L2	20%	Stage 2
Dust	L1B	0.5 K	Stage 1
Methane	L2	2%	Stage 2
OLR	L2	5 W/m2	Stage 3
Sulfur Dioxide	L1B & L2	1 DU	Stage 1
Research Products			
Dust	L2	TBD	TBD
HNO3	L1B-Post	TBD	TBD
NH3	L2	TBD	TBD
N2O	L2	TBD	TBD

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 effort.

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.

Stage 3: Validation Product accuracy has been assessed, and the uncertainties in the product well-established **via independent measurements made in a systematic and statistically robust way that represents global conditions.**

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Over 300 papers based on AIRS Version 5 (compiled April 2015)

• Multiple quantities	106 papers
• IR Radiance	52
• Cloud Cleared Radiance	1
• Land Surface Temperature	6
• Land Surface Emissivity	1
• Temperature Profile	27
• Water Vapor Profile	16
• Clouds	14
• Carbon Dioxide	34
• Carbon Monoxide	18
• Ozone	4
• IR Dust	10
• Methane	7
• Sulfur Dioxide	7

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Version 7 and Beyond

- **Move toward merged AIRS/AMSU-CrIMSS (and -IASI?) data.**
- **Emphasize temperature and water vapor.**
- **We have several retrieval algorithms.**
- **AIRS project and Sounder SIPS developing:**
  - ***A common format (see Steve Friedman's Tuesday talk).***
  - ***A system to test and validate new data versions (for AIRS).***

Merged algorithm assessment should be a joint AIRS-SNPP Sounder Science Team process.

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Data Merger Challenges: *Hard to Easy*

1. **Providing *consistent information content* from different instrument suites on separate platforms.**
   - ***Not something our community has done in the past.***

2. **Organizing that information in a way that is useful to ALL users.**
   - ***Many lessons learned already.***

3. **Implementing a common data format.**
   - ***Very familiar.***

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Validation in V6 'Test' Report

Version 6 Performance and Test Report

AIRS/AMSU/HSB Version 6
Level 2 Performance and Test Report

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Version 1.2

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Submit Questions to:
http://airs.jpl.nasa.gov/AskAirs

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Level 2 and Mean State Validation in the V6 Test Report

- **Level 2 comparisons:**
  - ***Temperature bias and trends; operational sondes (Irion).***
  - ***Ocean SST; SST-RTG/ECMWF (Susskind).***
  - ***Methane; HIPPO campaign (Xiong).***
  - ***Ozone; OMI (Irion).***
  - ***Cloud-cleared radiance; SST-RTG/ECMWF (Strow).***
  - ***SO_2 flag; OMI (Warner).***

- **Means:**
  - ***Surface air temperature; operational sondes (Dang).***
  - ***Surface temperature and emissivity; MODIS (Hulley).***
  - ***Cloud properties; CloudSat/CALIPSO (Dang).***
  - ***OLR; CERES (Susskind).***

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Setting Priorities for V7 Testing/Validation

- **Priority variables:**
  1. ***Temperature, water vapor mixing ratio, relative humidity, surface properties.***
  2. ***Clouds***
  3. ***Trace gases***

- **Priority comparisons against:**
  - ***Surface stations and buoys, operational radiosondes, dedicated radiosondes.***
  - ***Other satellite and in situ observations.***

- **Complete a mix of short- and long-term comparisons, as in V6 test report.**

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V7 Test Data

1 = High priority for V7 testing
2 = Medium priority
3 = Low priority

* Not in V6 test report.
# V6 testing done outside JPL
-- Not testing in V7

	Limited space or time coverage	Long-term global analyses
Trend & yield tests		
Trends over all fields		1
Yield, bias trends of T and q	#	#
T, q accuracy vs. yield	#	#
Comparisons		
CC Radiances	2*	3*
Surface Properties	1	
SST vs ECMWF	1#	2*
LST and emissivity	1	--
Temperature		
Surface stations	1*	2*
PREPQC / IGRA sondes	1	1
Dedicated sondes	1*	2*
Tropopause height and pressure	1	--
TPW	1*	
GPS land	1*	2*
AMSR-E ocean	1*	2*
Water vapor profiles		
Surface stations	1*	2*
PREPQC / IGRA sondes	1*	2*
Dedicated sondes	1*	2*
Relative Humidity		
Surface stations	1*	2*
PREPQC / IGRA sondes	1*	2*
Dedicated sondes	1*	2*
Clouds and OLR		
Cloud top properties	2	3*
Cloud microphysics	2	3*
Trace gases		
Ozone	2	3*
CO	#	
Methane	#	
Dust	--	--
Layer to level transforms	--	--

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Updating Algorithm Selection Criteria

- **Traditional:**
  - ***Retrieval bias.***
  - ***Retrieval RMS.***
  - ***Yield.***
  - ***Sampling biases.***
  - ***Spurious trends***
  - ***Global performance.***

- **Additional proposed criteria:**
  - ***CC rad error estimates => other error estimates.***
  - ***Vertical resolution information (averaging kernels).***
  - ***Scene-dependent error estimation.***
  - ***Conditional performance relative to reanalyses***
    - Around clouds, in subsidence regions, etc…
    - Error estimates not in reanalyses.

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Summary of Test/Val Plans

- **Assessment criteria need to be revisited**
  - ***Move past mean, RMS independent of atmospheric state.***
  - ***Move to information content, conditional statistics, skill.***

- **We are creating a framework for rapidly ~~testing~~ validating prototype data sets for V7 and later.**

- **Merged AIRS/AMSU-CrIMSS data:**
  - ***High priority***
  - ***Inconsistent val responsibility***
    - AIRS TLSCF: yes; Sounder SIPS: no.
  - ***Choice of merged algorithm(s) is a community decision.***