National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Plans for Version 5 and 6 Validation

and

The V6 Algorithm Theoretical Basis Document

Eric J. Fetzer

Jet Propulsion Laboratory / California Institute of Technology

AIRS Science Team Meeting, Caltech

April 26, 2012

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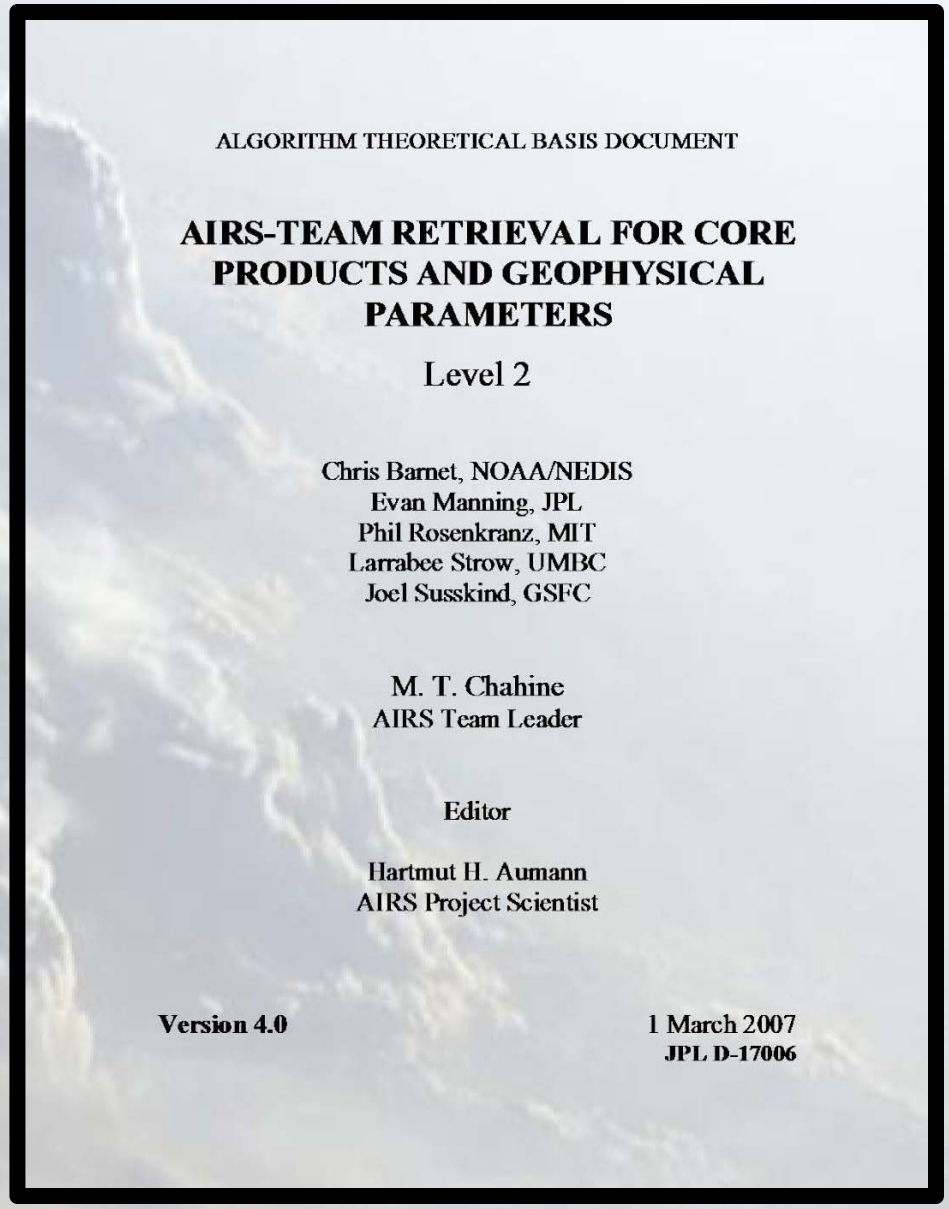
Pasadena, California

Algorithm Theoretical Basis Document
Most recent history

- **Last update 1 March 2007**
  - ***Described the Version 4 Algorithm***
- **What do we do about Version 5?**



ALGORITHM THEORETICAL BASIS DOCUMENT

AIRS-TEAM RETRIEVAL FOR CORE PRODUCTS AND GEOPHYSICAL PARAMETERS

Level 2

Chris Barnet, NOAA/NEDIS
Evan Manning, JPL
Phil Rosenkranz, MIT
Larrabee Strow, UMBC
Joel Susskind, GSFC

M. T. Chahine
AIRS Team Leader

Editor

Hartmut H. Aumann
AIRS Project Scientist

Version 4.0

1 March 2007
JPL D-17006

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Algorithm Theoretical Basis Document
Version 6

- **Some significant changes have been made since V4/5**
  - ***A neural net first guess.***
  - ***MODIS emissivity model.***
  - ***Changes in trace gas first guess.***
  - ***Cloud formations on 3 x 3 AIRS FOVs (formerly 1 AMSU).***

- **These changes must to be documented.**

- **WE ARE PREPARING A MATURE DRAFT BY THE FALL 2012 SCIENCE TEAM MEETING.**

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Validation Report: A Recap of Documentation with Version Deliveries

We have three levels of reporting with AIRS L2 data releases:

1. **Quick-look documentation**
   - ***Lead: Ed Olsen***
2. **A Test Report**
   - ***Lead: Van Dang)***
3. **Validation Report**
   - ***Lead: Eric Fetzer***

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Groups of Data Products for Testing in V6
From Van's talk this morning

1. Water Vapor in layer/level quantities for AIRS/AMSU and AIRS-ONLY by Sun Wong
2. Air Temperature profile in level quantities for AIRS/AMSU and AIRS-ONLY by Bill Irion
3. Surface Air Temperature by H. Van Dang
4. Land Surface Temperature for AIRS/AMSU and AIRS-ONLY and IR-emissivity by Glynn Hulley
5. Sea Surface Temperature for AIRS/AMSU and AIRS-ONLY and IR-emissivity by Joel Susskind
6. Microwave Surface Products by Bjorn Lambrigtsen
7. Ice Phase and Ice Cloud Properties of Cirrus Clouds by Brian Kahn
8. Cloud Top Properties by H. Van Dang
9. Outgoing Longwave Radiation by Joel Susskind
10. Methane by Xiaozhen (Shawn) Xiong
11. Carbon Monoxide by Juying Warner
12. Ozone by Bill Irion
13. Cloud Cleared Radiances by Larrabee Strow and Dong Wu
14. Stability Parameters by Qing Yue
15. Boundary Layer Top by Joao Teixeira

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Validation Table

From 2008 Senior Review

AIRS Product	Uncertainty Estimate (Version 5)	Val Status (Version 5)	Source
Radiances			
AIRS IR Radiance	<0.2%	Stage 3	Project
AIRS VIS/NIR Radiance	15-20%	Stage 1	Project
AMSU Radiance	1-3 K	Stage 3	Project
HSB Radiance	1-3 K	Stage 3	Project
Core Products			
Cloud Cleared IR Radiance	1.0 K	Stage 2	Project
Sea Surface Temperature	1.0 K	Stage 2	Project
Land Surface Temperature	2-3 K	Stage 1	Project
Temperature Profile	1 K / km	Stage 2	Project
Water Vapor Profile	15% / 2km	Stage 2	Project
Total Precipitable Water	5%	Stage 2	Project
Fractional Cloud Cover	20%	Stage 2	Project
Cloud Top Height	1 km	Stage 2	Project
Cloud Top Temperature	2.0 K	Stage 2	Project
Neccesary Products*			
Total Ozone Column	5%	Stage 2	Project
Ozone Profile	20%	Stage 2	Project
Land Surface Emissivity	10%	Stage 1	Project
IR Dust**	0.5 K	Stage 1	Project
Research Products			
Carbon Monoxide	15%	Stage 2	NOAA/UMBC
Methane	2%	Stage 1	NOAA
Carbon Dioxide**	1-2 ppm	Stage 1	NASA/NOAA
OLR	5 W/m2	Stage 1	GSFC
HNO3**	0.2 DU	Stage 1	NOAA/UMBC
Sulfur Dioxide**	1 DU	Stage 1	NOAA/UMBC

*Necessary Products are required to retrieve accurate temperature profiles (1K/km) in all conditions

**Product not yet available in AIRS Level 2 Files. Products will be available in Version 6

Validation Status Definitions (Common to all Aqua Instruments)

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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Validation:
A reminder of V6 goals

Improvements since V5 include:

- **Reduced spurious cooling trend in the free troposphere.**
- **Smaller temperature biases.**
- **Higher yield**
  - ***No trend in yield.***
- **Improved surface properties.**
- **Improved cloud properties.**
- **Improved trace gases.**

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Version 5 Validation Report

- **No V5 validation report has been published.**
- **The report will be a summary of *published* literature.**
  - ***Everyone's input is needed here.***
- ***We are not planning a compilation of results, as was done with Versions 3 and 4.***

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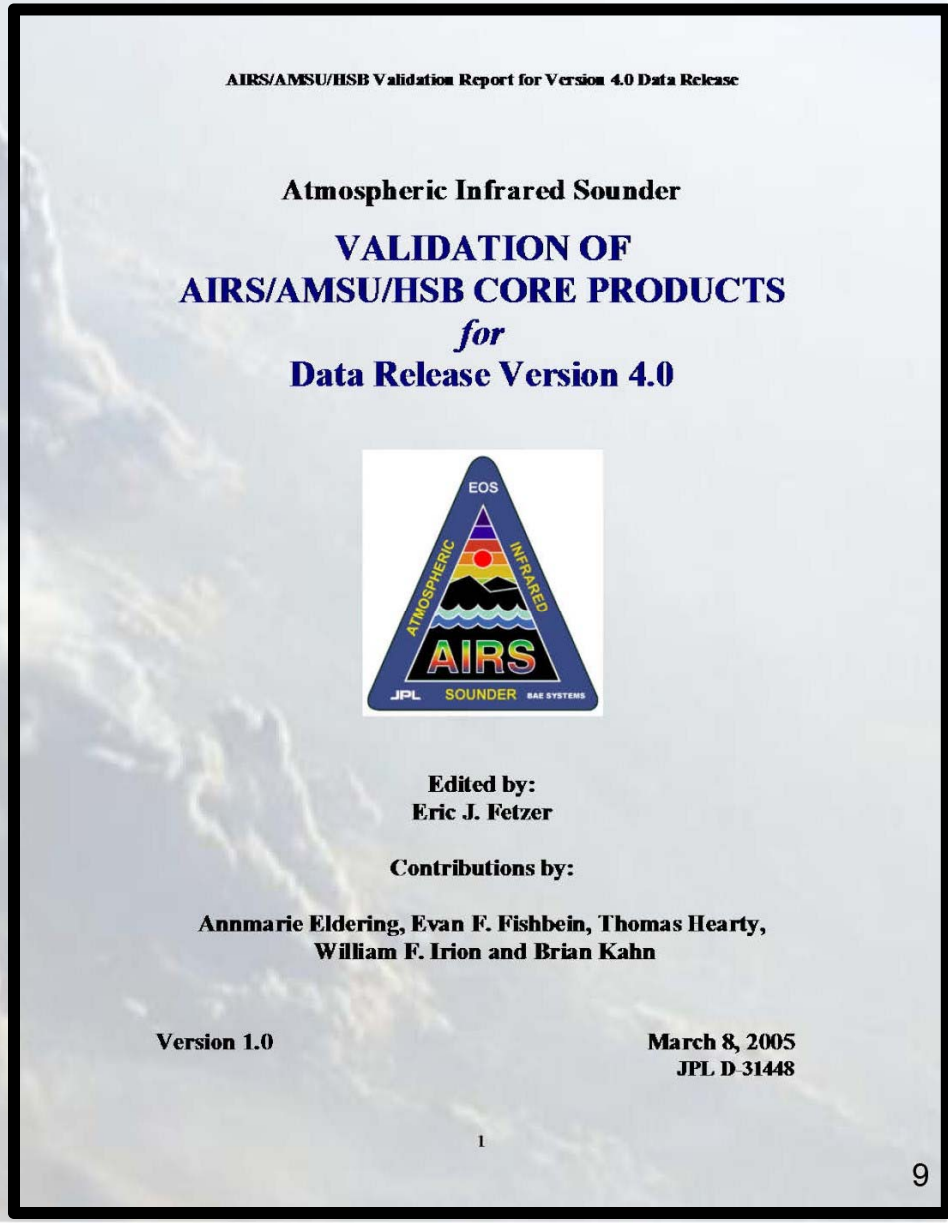
Version 6 Validation Report

- **We are planning a compilation of results, as was done with Versions 3 and 4.**

- **This will be a natural extension of the Version 6 testing**
  - ***Many current test involve correlative data.***
  - ***Refine these for more rigorous error constraints.***



AIRS/AMSU/HSB Validation Report for Version 4.0 Data Release

Atmospheric Infrared Sounder

VALIDATION OF
AIRS/AMSU/HSB CORE PRODUCTS
for
Data Release Version 4.0

Edited by:
Eric J. Fetzer

Contributions by:

Annmarie Eldering, Evan F. Fishbein, Thomas Hearty,
William F. Irion and Brian Kahn

Version 1.0

March 8, 2005
JPL D-31448

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V6 products to be tested
From April 2010 Science Team Meeting!

- Temperature profile
- Water vapor
- Cloud fraction, cloud-top pressure
- Total ozone
- Carbon monoxide
- Methane
- Sea surface temperature
- Land surface emissivity
- Error bars
- Bias trends

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Four Year Old Table of Status and Planned Analyses for Version 5

	Validation Status by Geophysical Conditions					
	Ocean		*Land*			*Polar*
	Low lat	*High lat*	*Desert*	*Temperate*	*Frozen*	
Radiances						
IR Rad	Stage 3	Stage 3	-----	Stage 3		Stage 3
Vis/NIR	Stage 1	-----	-----	-----	-----	-----
AMSU	Stage 3(?)	-----	-----	Stage (3)	-----	-----
HSB	Stage 3(?)			Stage 3(?)		
Core Products						
CC Rad	Stage 2	-----	Stage 2	Stage 2	-----	-----
SST	Stage 2	Stage 2	N/A	N/A	N/A	N/A
LST	N/A	N/A	Stage 1	Stage 1	Stage 1	Stage 1
T(all)	Stage 3	-----	-----	Stage 2	-----	Stage 3
Microwave-only T, q??????						
T (p<700 hPa)						
T (300<p<700 hPa)						
T (100<p<300 hPa)						
T (p<100 hPa)						
q(all)	Stage 3	-----	-----	Stage 2	-----	Stage 3