

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

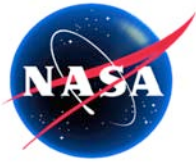
AIRS Project Status

T. Pagano

NASA AIRS Project Office

California Institute of Technology
Jet Propulsion Laboratory

April 15, 2008

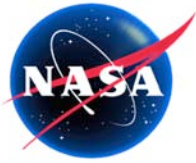


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Agenda

- Introduction
- Instrument Operations and Calibration
- Version 5 Product Generation
- Version 5 Validation
- Science Highlights
- Version 6 Status
- Preparing for the Future



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

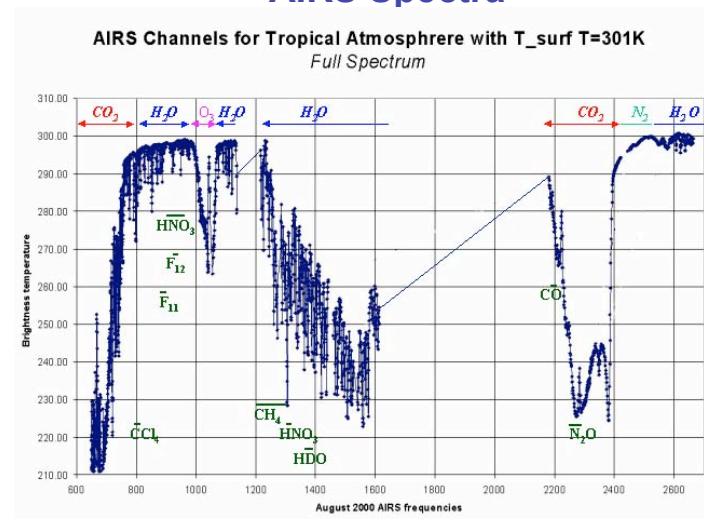
The Atmospheric Infrared Sounder on NASA's EOS Aqua Spacecraft

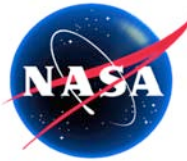
AIRS

- AIRS Characteristics
- Launched: May 4, 2002
- Orbit: 705 km, 1:30pm, Sun Synch
- IFOV : $1.1^\circ \times 0.6^\circ$
(13.5 km x 7.4 km)
- Scan Range: $\pm 49.5^\circ$
- Full Aperture OBC Blackbody, $\epsilon > 0.998$
- Full Aperture Space View
- Solid State Grating Spectrometer
 - IR Spectral Range:
3.74-4.61 μm , 6.2-8.22 μm ,
8.8-15.4 μm
 - IR Spectral Resolution:
 $\approx 1200 (\lambda/\Delta\lambda)$
 - # IR Channels: 2378 IR
- VIS Channels: 4
- Mass: 177Kg,
Power: 256 Watts,
Life: 5 years (7 years goal)



AIRS Spectra



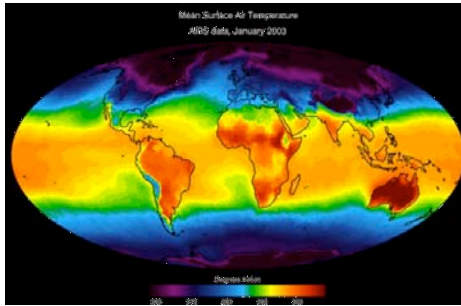


National Aeronautics and Space Administration

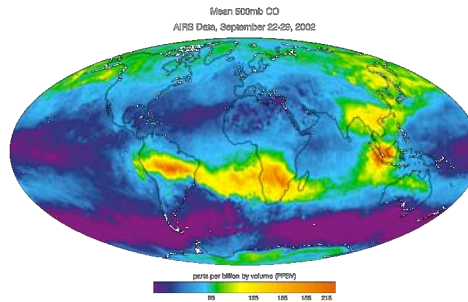
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

AIRS Science Products

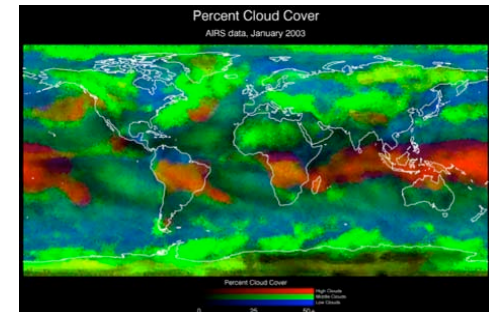
Atmospheric Temperature



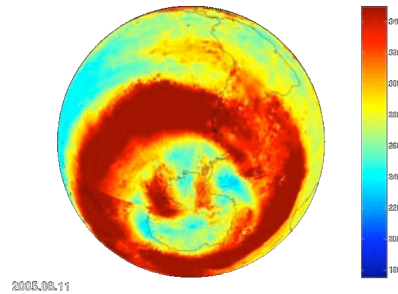
CO



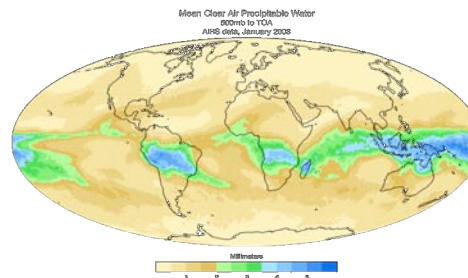
Cloud Properties



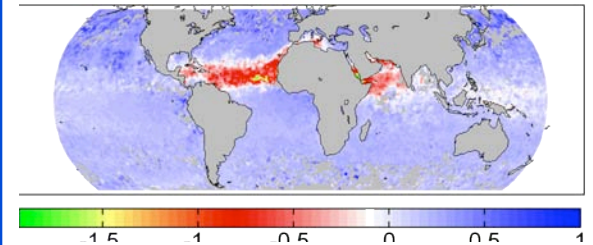
Ozone



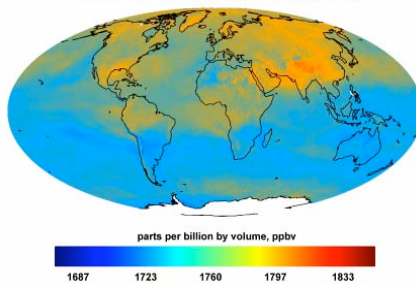
Atmospheric Water Vapor



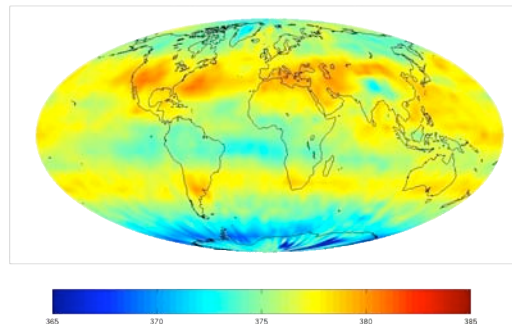
Dust



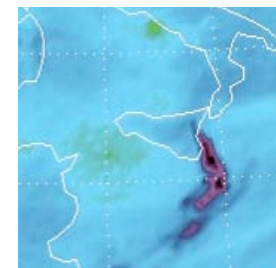
Methane



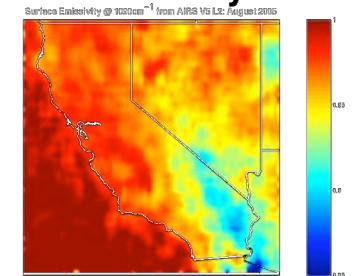
CO2

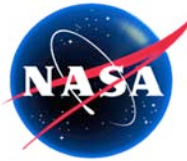


SO2



Emissivity

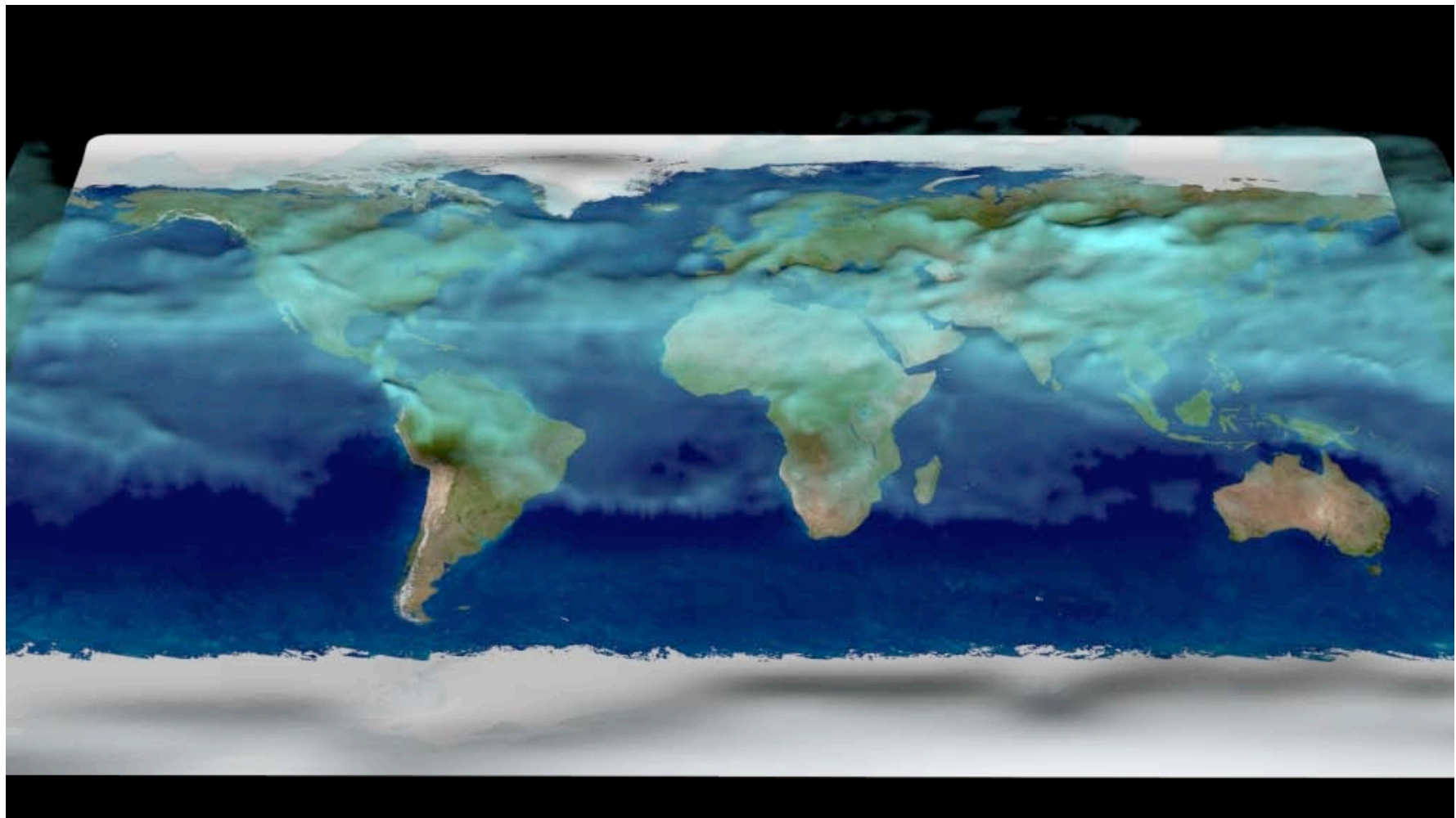




National Aeronautics and
Space Administration

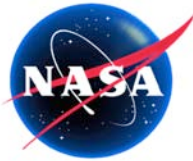
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

AIRS Water Vapor in 3 Dimensions



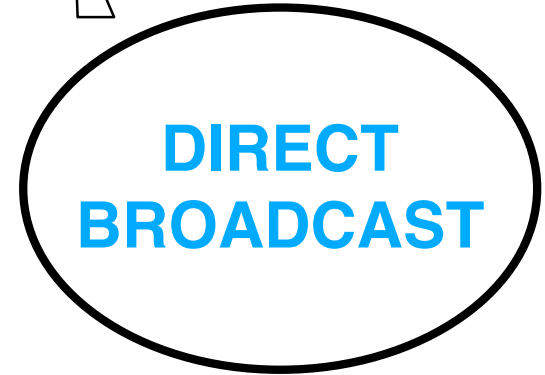
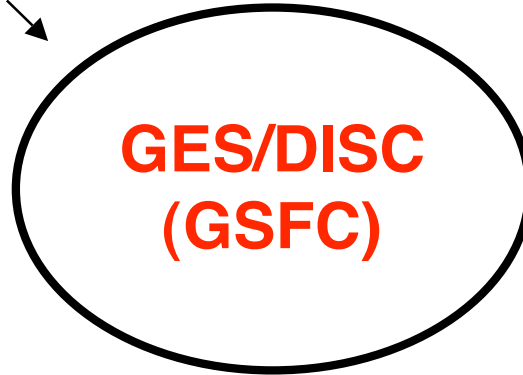
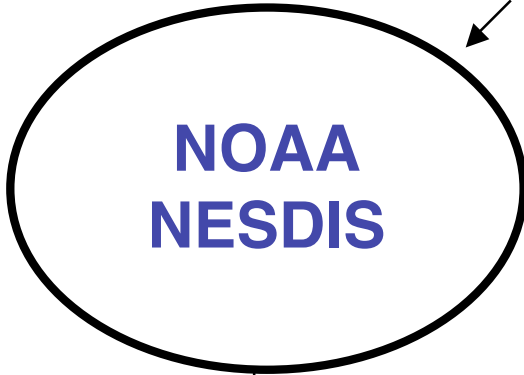
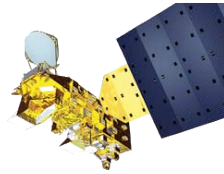
Vince Realmuto, Charles Thompson





National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

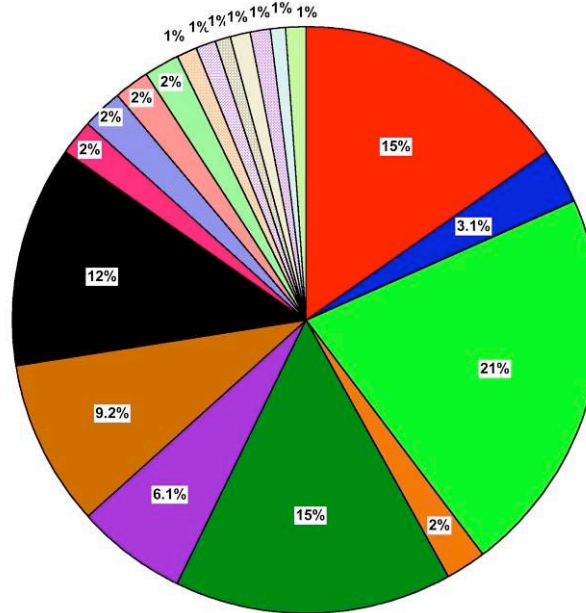


NWP Centers

- NCEP
- CMC (Canada)
- JMA (Japan)
- FNMOG (US Navy)
- BMRC (Australia)
- UK Met Office
- ECMWF (Europe)
- Meteo-France
- DWD (Germany)
- CPC

star.nesdis.noaa.gov

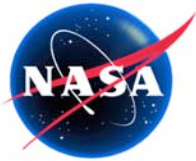
AIRS Registered Users by Country



daac.gsfc.nasa.gov

- Universities
- SPoRT (Regional)
- Brazil (INPE)
- China
- Korea
- DoD
- Other International

cimss.ssec.wisc.edu/imapp

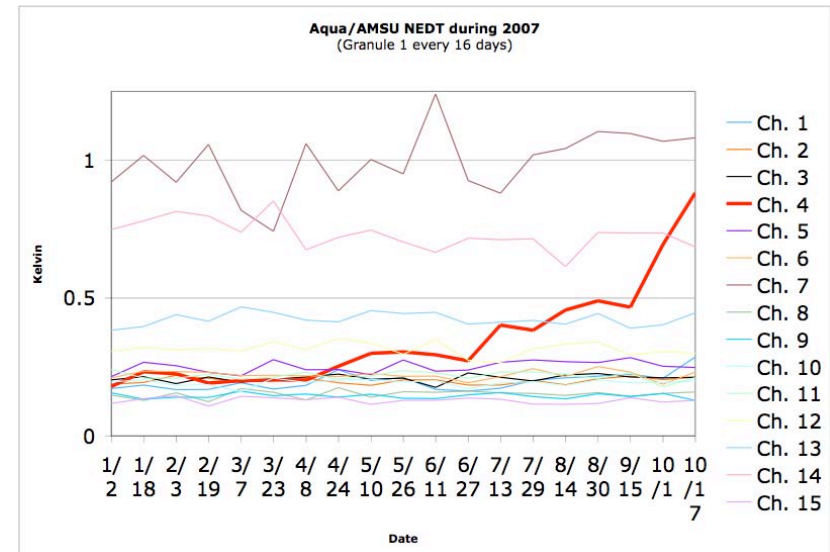


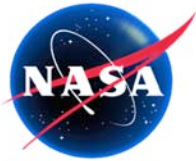
National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

AIRS and AMSU Instruments Operating Well

- AIRS
 - Hardware in excellent shape
 - Slow trends exist for some parameters but none are cause for concern
 - The most rapidly changing parameter is the Cooler B drive level, which is increasing by 0.6% per year and is now at 66.4% (yellow alarm level is 80%)
- AMSU-A
 - No alarming trends in temperatures or voltages
 - Channel 4 cannot be calibrated using existing algorithms—looks at warm target are contaminated by radiation leaking from a bad diode
 - Channel 5 Ne Δ T is slowly rising (has been doing so since November 2003) but is still only 0.3 K
 - Other channels are relatively stable



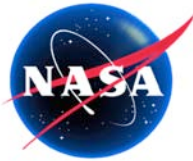


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

New Anomaly-Handling Documentation

- AIRS/AMSU Anomaly Resolution Plan has been written, reviewed, and approved
 - Specifies organizational responsibilities when an anomaly has occurred
 - Specifies organizational interfaces
 - Provides high-level procedures for anomaly resolution
- AIRS/AMSU Fault Trees (separate) now being developed
 - Intended to be “Owners Manuals” for reference when an anomaly occurs
 - Categorize all potential anomalies we can think of
 - Will provide pointers to existing documentation describing the relevant hardware, software, and or operational procedures for each category

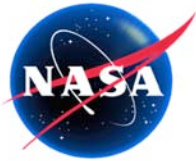


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Version 5 Product Generation

- **Version 5 Released to the Public: 07/25/07**
 - Verification Report and User Documentation Complete
- **AMSU Channel 4 Anomaly Resolution Complete**
- **GES/DISC Reprocessing for AIRS Complete**
 - Processing with Version 5.0 Prior to October 1, 2007
 - Processing with Version 5.2 October 1, 2007 to Present
- **All AIRS Data Available at**
 - http://disc.sci.gsfc.nasa.gov/news/airs_v5_072507.shtml



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

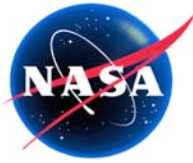
Validation of Version 5 Core Products is Project Priority

Senior Review
Requested
Peer-Review of
Validation
Status of
Standard
Products
By end of 2008

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
Necessary 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

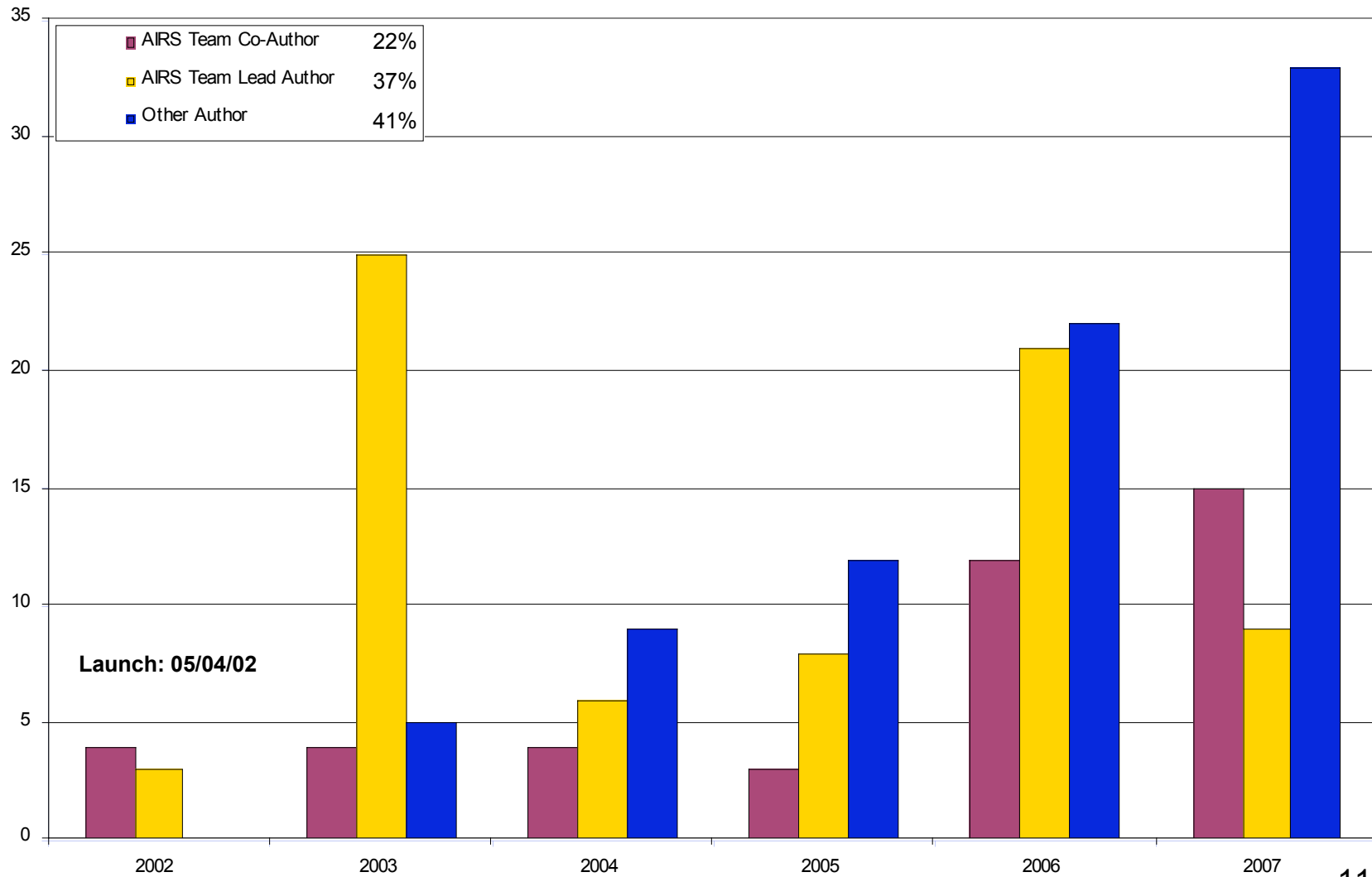
**Product not yet available in AIRS Level 2 Files. Products will be available in Version 6

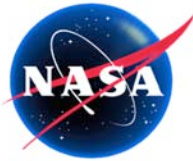


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Over 200 AIRS Peer Reviewed Science Publications

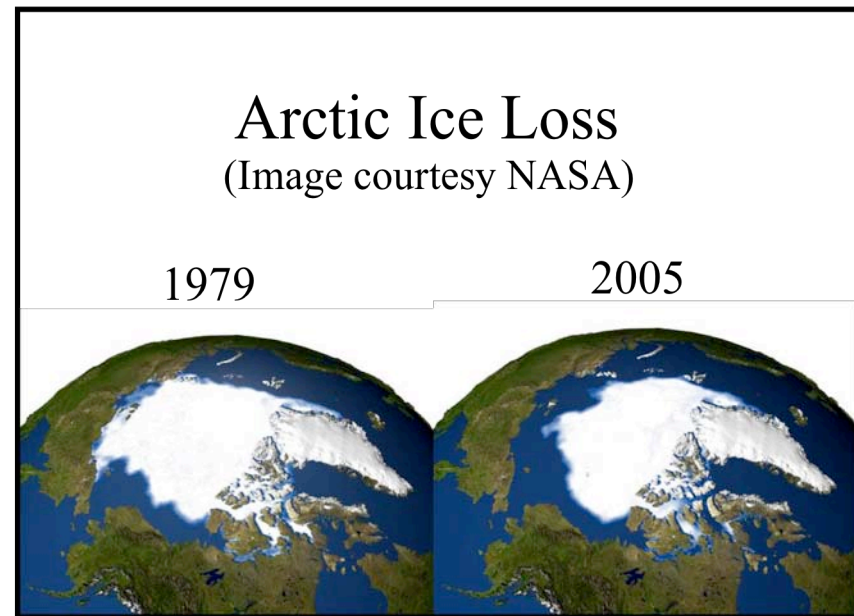
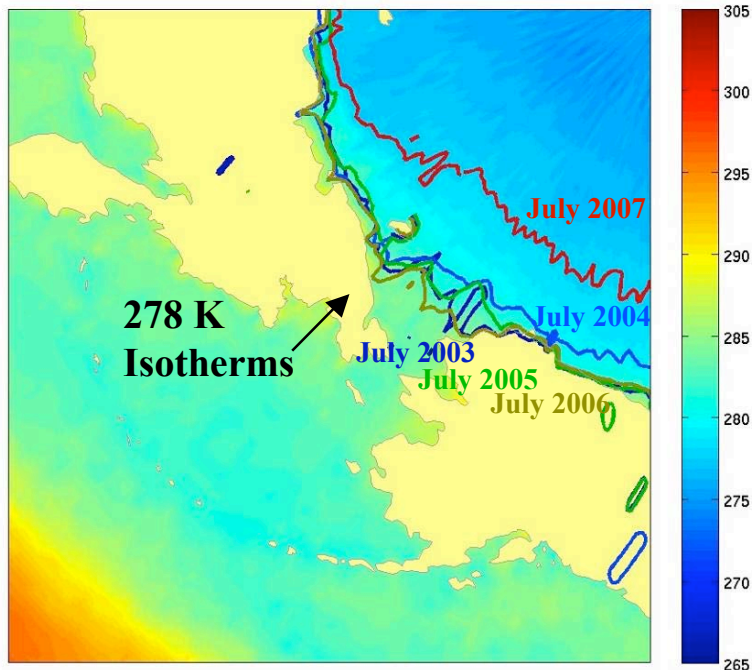
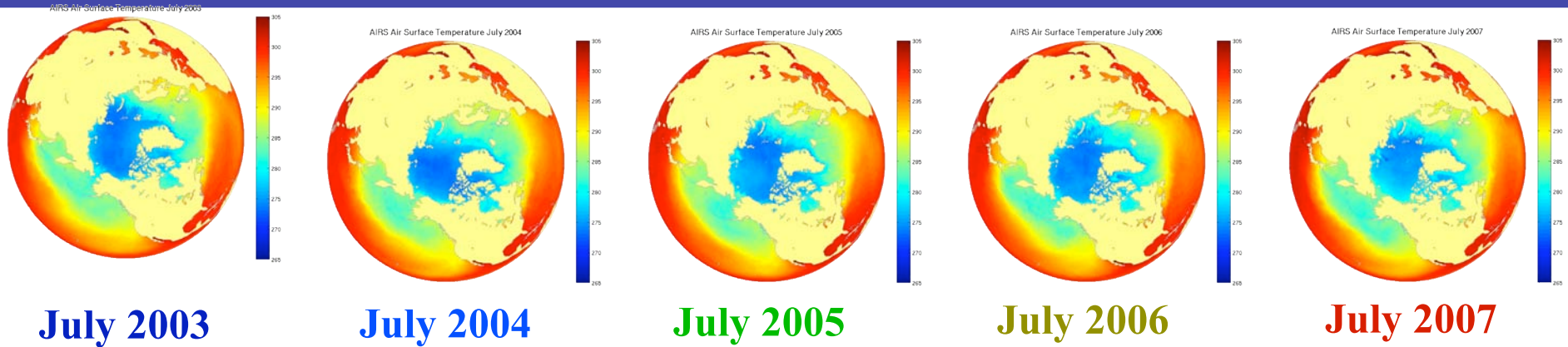




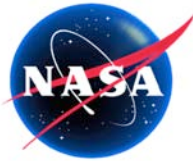
National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

5 Years of AIRS Data Aid in Trending Global Climate Change



T. Pagano

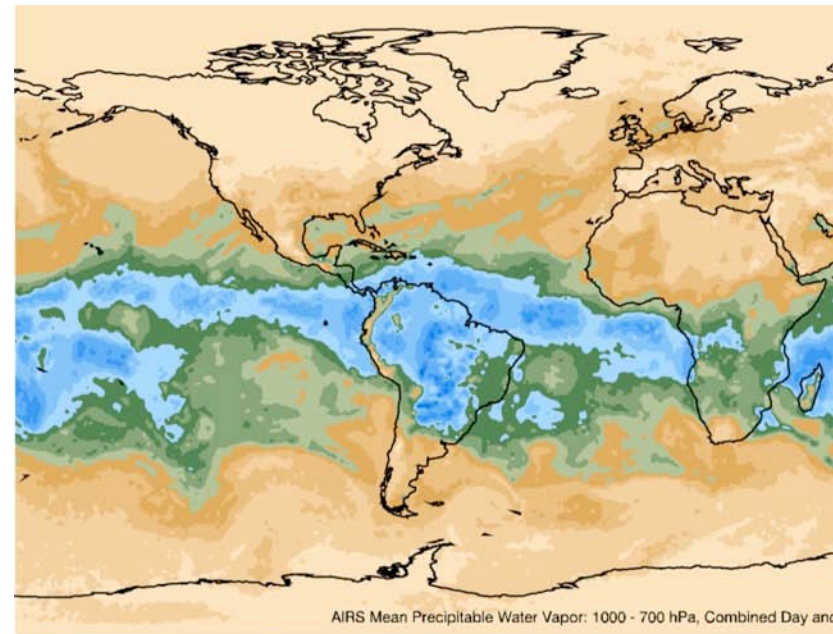


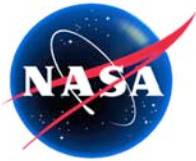
National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

JPL Participating in Facilitating use of GIS for Weather Science Applications

- Multi-sensor, multi-parameter, multi-dimensional analysis through Geographic Information Systems (GIS)
 - JPL, Univ. Redlands, ESRI collaboration
- Case study focus on Pacific Basin “warm conveyor belt”
 - Jan 2005 CA severe weather event
 - 40 inches of rain
 - La Conchita landslide
- Incorporate AIRS H₂O Profiles, QuikSCAT Winds, GHRSSST L4 SST (AMSR-E and AVHRR) and ground-based GPS (SCIGN)
 - Relate height resolved water vapor and surface winds to coastal rainfall



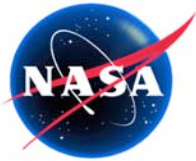


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Science and Validation Papers Since Last Science Team Meeting (1 of 3)

- Bhattacharjee, P.S., Prasad, A.K., Kafatos, M., Singh, R.P., Influence of a dust storm on carbon monoxide and water vapor over the Indo-Gangetic Plains, *Journal of Geophysical Research - Atmospheres*, 2007, 112, D18, D18203
- Wang, L.; Cao, C; Ciren, P, Assessing NOAA-16 HIRS radiance accuracy using simultaneous nadir overpass observations from AIRS, *Assessing NOAA-16 HIRS radiance accuracy using simultaneous nadir overpass observations from AIRS*, *J. Atmos.Ocean.Technol.*, 2007, 24, 9, 1546-1561
- John, V.O. and Soden, B. J., Temperature and humidity biases in global climate models and their impact on climate feedbacks, *Geophys.Res. Lett.*, 34, L18704, doi:10.1029/2007GL030429
- Monahan, K.P.; Pan, L.L.; McDonald, A. J.; Bodeker, G. E.; Wei, J.; George, S.E.; Barnett, C.D.; Maddy, E., Validation of AIRS v4 ozone profiles in the UTLS using ozonesondes from lauder, NZ and Boulder, USA, *Journal of Geophysical Research - Atmospheres*, 2007, 112, D17, D17304
- Weisz, E.; Li, J.; Menzel, W.P.; Heidinger, A.K.; Kahn, B. H.; Liu, C.Y., Comparison of AIRS, MODIS, CloudSat and CALIPSO cloud top height retrievals *Geophys.Res.Lett.*, 2007, 34, 17, L17811
- Ho., S.P., Kuo, Y.H., Sokolovskiy, S, Improvement of the temperature and moisture retrievals in the lower troposphere using AIRS and GPS radio occultation measurements, *J.Atmos.Ocean.Techol.*, 2007, 24, 10, 1726-1739
- Alexander, M.J., Teitelbaum, H., Observation and analysis of a large amplitude mountain wave event over the Antarctic peninsula, *J. Geophys. Res.*, 112, D121103, doi: 10.1029/2006JD008368
- Andersson, E., Holm, E., Bauer, P, Beljaars, A., Kelly, G.A., McNally, A.P., Simmons. A.J., Thepaut, J.N., Tompkins, A.M., Analysis and forecast of the main humidity observing systems, *Quarterly journal of the royal meteorological Society (Q.J.R. Meteorol.Soc.)* 2007, 133, 627, 1473-1485

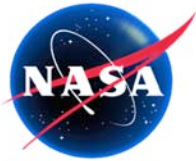


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Science and Validation Papers Since Last Science Team Meeting (2 of 3)

- Yue, Q., Liou, K. N., Ou, S.C., Kahn, B., Yang, P., Mace, G.G., Interpretation of AIRS data in thin cirrus atmospheres based on a fast radiative transfer model, *J.Atmos.Sci.* 64, 3831-3846
- Li, Jun, Li, Jinlong, Weisz, Elizabeth, Zhou, Daniel K., Physical retrieval of surface emissivity spectrum from hyperspectral infrared radiances, *Geophys.Res.Lett.*, 2007, 34, 16, 16812
- Prata, A.J., Bernardo, C., Retrieval of volcanic SO₂ column abundance from atmospheric infrared sounder data, *Journal of Geophysical Research Atmospheres*, 2007, 112, D20, D20204
- Liu, W.T., Xie, X., Ocean Atmosphere interaction over Agulhas Extension Meanders, *Journal of Climate*, Volume 20, 2007, DOI:10.1175/2007JCL1732.1
- Singh, D., Performance of the AQUA and NOAA-16 soundings over India, *Current Science* 93 (9): 1281-1287 Nov. 10, 2007
- Auligne, T., An objective approach to modelling biases in satellite radiances: Application to AIRS and AMSU-A, *Q.J.R.Meteorol.Soc.*, 2007, 133, 628, 1789-1801
- Gettelman, A., Kinnison, D.E., The global impact of supersaturation in a coupled chemistry climate model, *Atmospheric Chemistry & Physics*, 2007, 7, 6, 1629-1643
- Shavrina, A.V., Pavlenko, Y.V., Veles, A., Syniavskyi, I., Kroon, M., Ozone Columns Obtained by Ground Based Remote Sensing in Kiev for Air Ozone Measurement Instrument Validation, *Journal of Geophysical Research - Atmospheres*, 2007, 112, D24, D24S45
- Huang, Y., Ramaswamy, V., Huang, X.L., Fu, Q., Bardeen, C., A strict test in climate modeling with spectrally resolved radiances: GCM simulation versus AIRS observations, *Geophys.Res.Lett.*, 2007, 34, 24, L24707

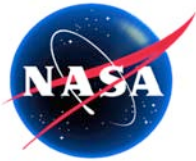


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Science and Validation Papers Since Last Science Team Meeting (3 of 3)

- Read., W.G., Lambert, A., Bacmeister, J., etal, Aura Microwave Limb Sounder upper tropospheric and lower stratospheric H₂O and relative humidity with respect to ice validation, *Journal of Geophysical Research - Atmospheres*, 2007, 112, D24, D24S35
- Zhou, Lihang, Goldberg, Mitchel, Barnet, Chris, Cheng, Zhahui, Sun, Fengying Wolf, Walter, King, Thomas, Liu, Xingpin, Sun, Haibing, Divarkala, Murty, Regression of surface spectral emissivity from hyperspectral instruments, *IEEE Trans.Geosci.Remote.Sens.*, 2008, 46, 2, 328-333
- Eckerman, Stephen D., Ma, Jun, Wu, Dong, L., Broutman, Dave, A three dimensional mountain wave imaged in satellite radiance throughout the stratosphere: Evidence of the effects of directional wind shear, *Q.J.R.Meteorol.Soc.*2007, 133, 629, 1959-1975
- Heilliette, S., Garand, L., A practical approach for the assimilation of cloudy infrared radiances and its evaluation using AIRS simulated observations, *Atmosphere-Ocean*, 2007, 45, 4, 211-255
- Liu, X., Zhou, D.K., Lara, A., Smith, W. L., Mango, S.A., Case study of a principal component based radiative transfer forward model and retrieval algorithm using EAQUATE data, *Q.J.R.Meteorol.Soc.*2007, 133, 243-256
- Zhou, D.K., Smith, W.L., Cuomo, V., Taylor, J.P., Barnet, C.D., Di Girolamo, P., Pappalardo, G., Larar, A.M., Liu, X., Newman S.M., Lee, C., Mango, S.A., Retrieval validation during the European aqua thermodynamic experiment, *Q.J.R.Meteorol.Soc.*, 2007, 133, 203-215
- Kahn, B.H., Liang, C.K., Eldering. A., Getteman, A., Yue, Q., Liou, K.N., Tropical thin cirrus and relative humidity observed by the Atmospheric Infrared Sounder, *Atmos.Chem.Phys.*, 8, 1501-1518, 2008

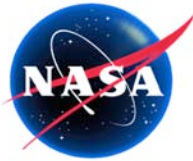


National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

On-Track for Version 6

<u>Task</u>	<u>Person</u>
<ul style="list-style-type: none">• Level 1C Climate Product (New)<ul style="list-style-type: none">– Resampled to constant spectral grid to remove very small instrument artifacts with age	Aumann /Elliott
<ul style="list-style-type: none">• Level 2<ul style="list-style-type: none">– Retrieve Surface Emissivity– Improve Boundary Layer Sensitivity– Yield Improvement in Critical Areas– Initialization State and Error Estimation– RTA Improvement– Improve OLR computation– Cloud Retrieval Improvement– Retrieve Mid Tropospheric CO₂	Susskind/Hook Susskind Strow Susskind Kahn Chahine
<ul style="list-style-type: none">• Level 3<ul style="list-style-type: none">– Reduce Sampling Bias Effects	Granger/Fetzer
<ul style="list-style-type: none">• Validation Priorities<ul style="list-style-type: none">– Validate all Version 5 Products	Fetzer



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

JPL Participating in CrIS and IASI Evaluation

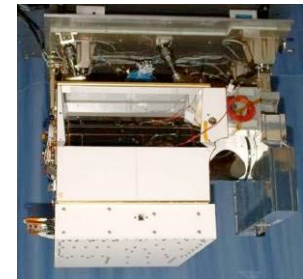
- AIRS Successor is NPOESS CrIS and MetOp IASI
- NASA Sounder Product Evaluation and Test Element (PEATE) at JPL (NASA Science Processing)
- Goal is to continue climate products started on AIRS with CrIS and IASI
- AIRS Project hosted NASA NPP Sounder Science Team at October 2007 AIRS Science Team Meeting
- Several AIRS Science Team Members also on NPP Sounder Science Team
- Sounder Team actively comparing IASI and AIRS data
- Sounder Team Participating in CrIS TVAC Data Evaluation
- Next Meeting to also Host NPP Sounder Science Team (October 2008)

IASI

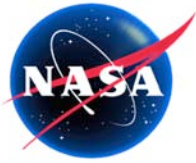


IASI on MetOp
9:30 AM Orbit
12 km GSD, $\pm 49^\circ$
236 kg, 210 W
1.72 m³, 1.5 Mbps

CrIS



CrIS on NPOESS
1:30 PM Orbit
14 km GSD, $\pm 48.3^\circ$
3.9-15.4 μm
165 kg, 135 W,
0.5 m³, 1.5 Mbps



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Summary

- Instrument operations and calibration running smoothly
- Recovery from loss of AMSU channel 4 complete
- All AIRS Version 5 Data Available at the DAAC
- Validation of Version 5 a major priority for the next few months
- Over 25 science papers released since last science team meeting
- On-track for Version 6
- Preparing for Data Product Continuation with CrIS and IASI