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California Institute of Technology
Pasadena, California

AIRS Version 6

Validation Report, ATBD, and Science Results

Eric J. Fetzer

Jet Propulsion Laboratory / California Institute of Technology

AIRS Science Team Meeting, Greenbelt, MD

November 13, 2012



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Validation Reports and ATBD

- ***V5 Validation Report: We will deliver a list of publications and a summary.***
- ***V6 Validation Report will contain recent results.***
 - ***Some of the analyses are based on V6 testing studies.***
 - ***Please start thinking about V6 validation papers***
- **We will begin regular telecons to plan the ATBD**
 - ***Note: there was not V5 ATBD.***
 - ***V6 first step: decide what needs to be included***
 - Perhaps an overview with appropriate citations.

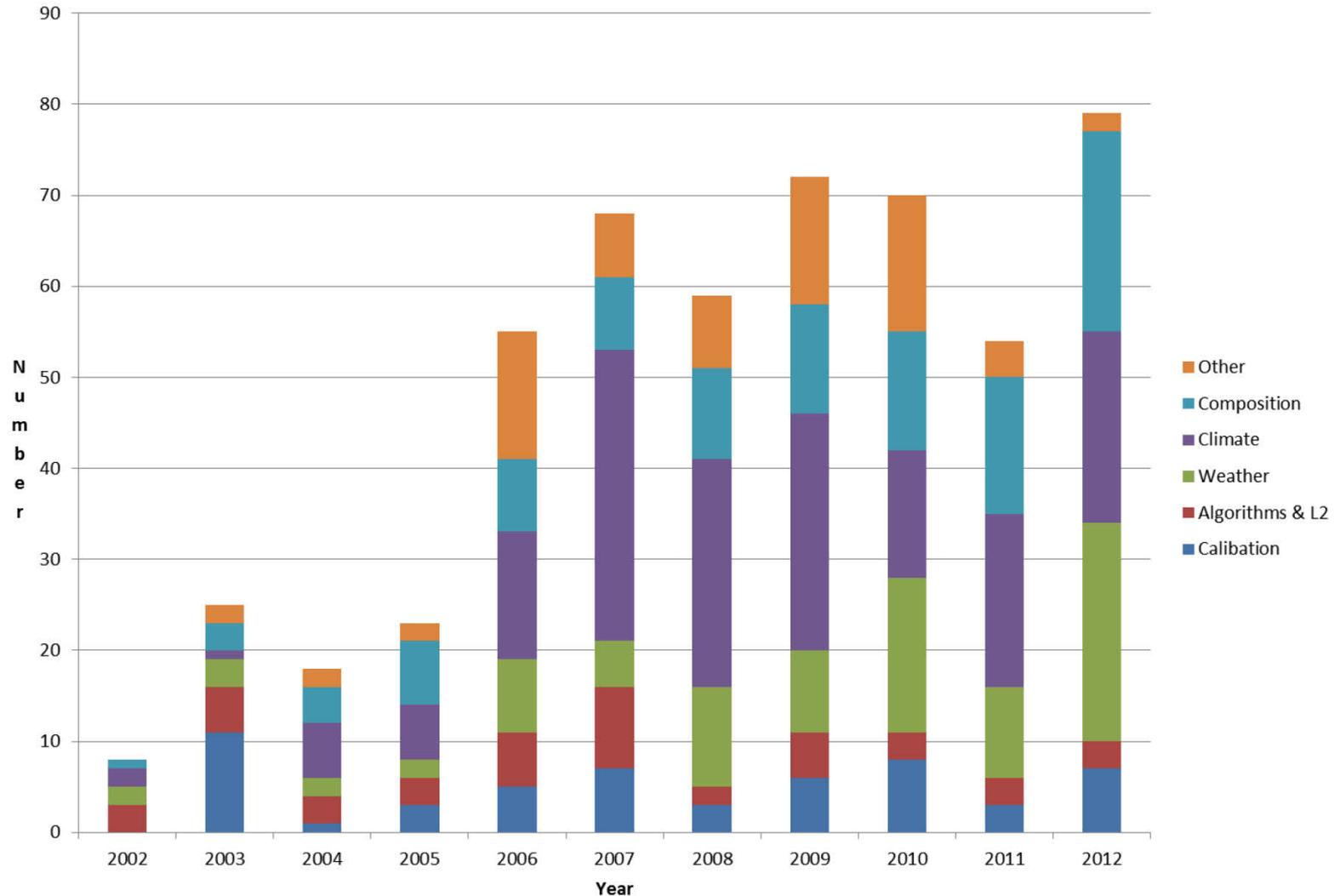


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A Record Year for AIRS Publications

Over 531 AIRS Peer Reviewed Publications Through October 2012





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Selected Studies

Published During First Quarter of 2012

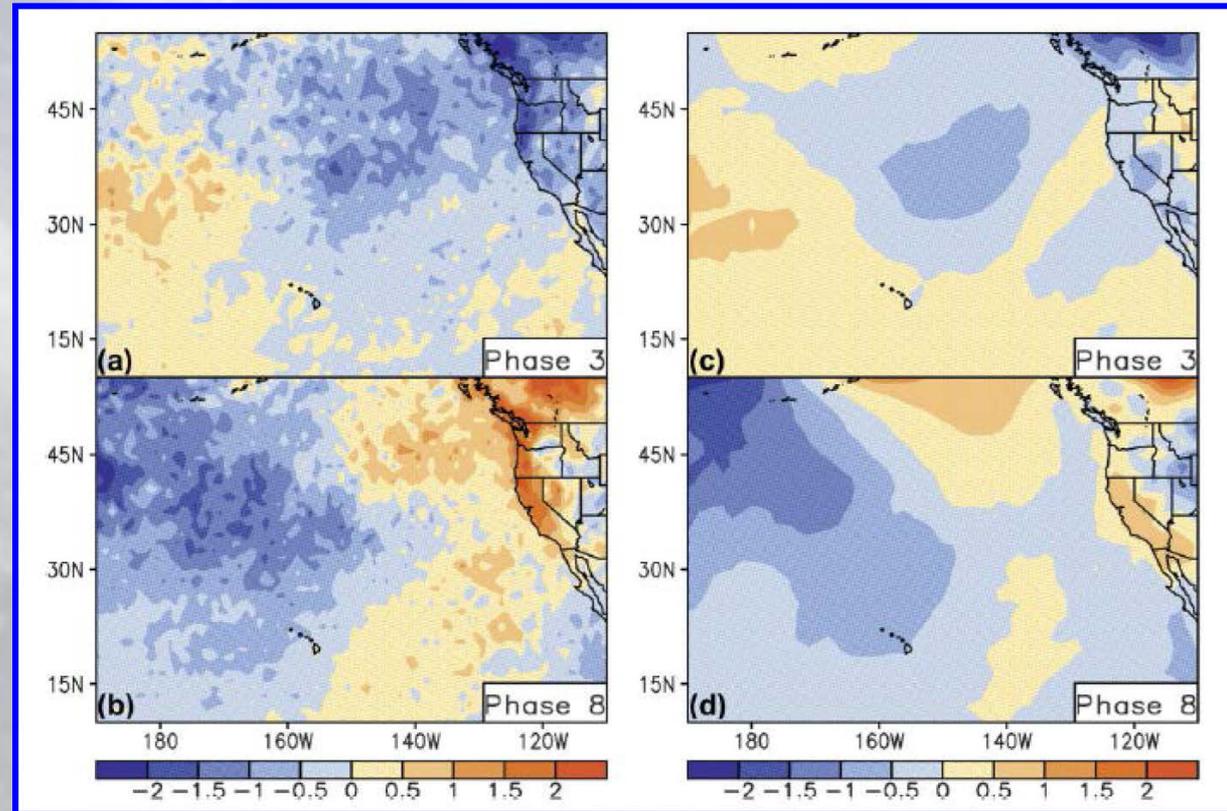


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Influence of MJO on Sierra Snowfall

“The contrasting SAT [surface air temperature] patterns associated with MJO phases 3 and 8, revealed by the in situ observations, are more realistically represented in AIRS satellite retrievals than in the ECMWF Interim reanalysis.”



Guan, B., D. E. Waliser, N. P. Molotch, E. J. Fetzer and P. J. Neiman (2012), Does the Madden-Julian Oscillation influence wintertime atmospheric rivers and snowpack in the Sierra Nevada?, *Mon. Wea. Rev.*, 140, 325-342, DOI: 10.1175/MWR-D-11-00087.1



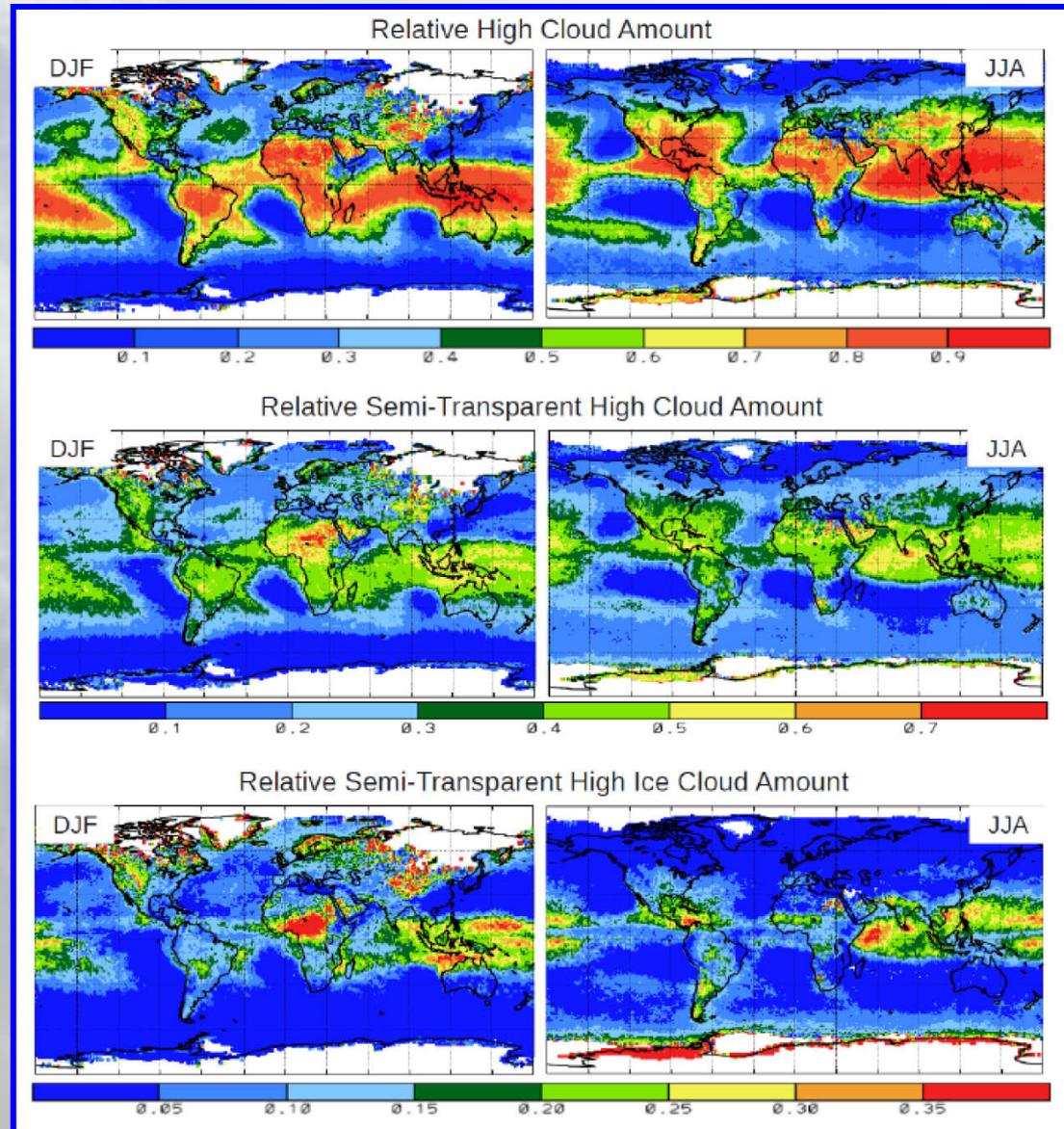
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Cirrus Cloud Climatologies

Six Years of Thin Clouds from AIRS and CloudSat/CALI PSO

Guignard, A., C. J. Stubenrauch, A. J. Baran, and R. Armante (2012), Bulk microphysical properties of semi-transparent cirrus from AIRS: a six year global climatology and statistical analysis in synergy with geometrical profiling data from CloudSat-CALIPSO, *Atmos. Chem. Phys.*, 12(1), 503-525.

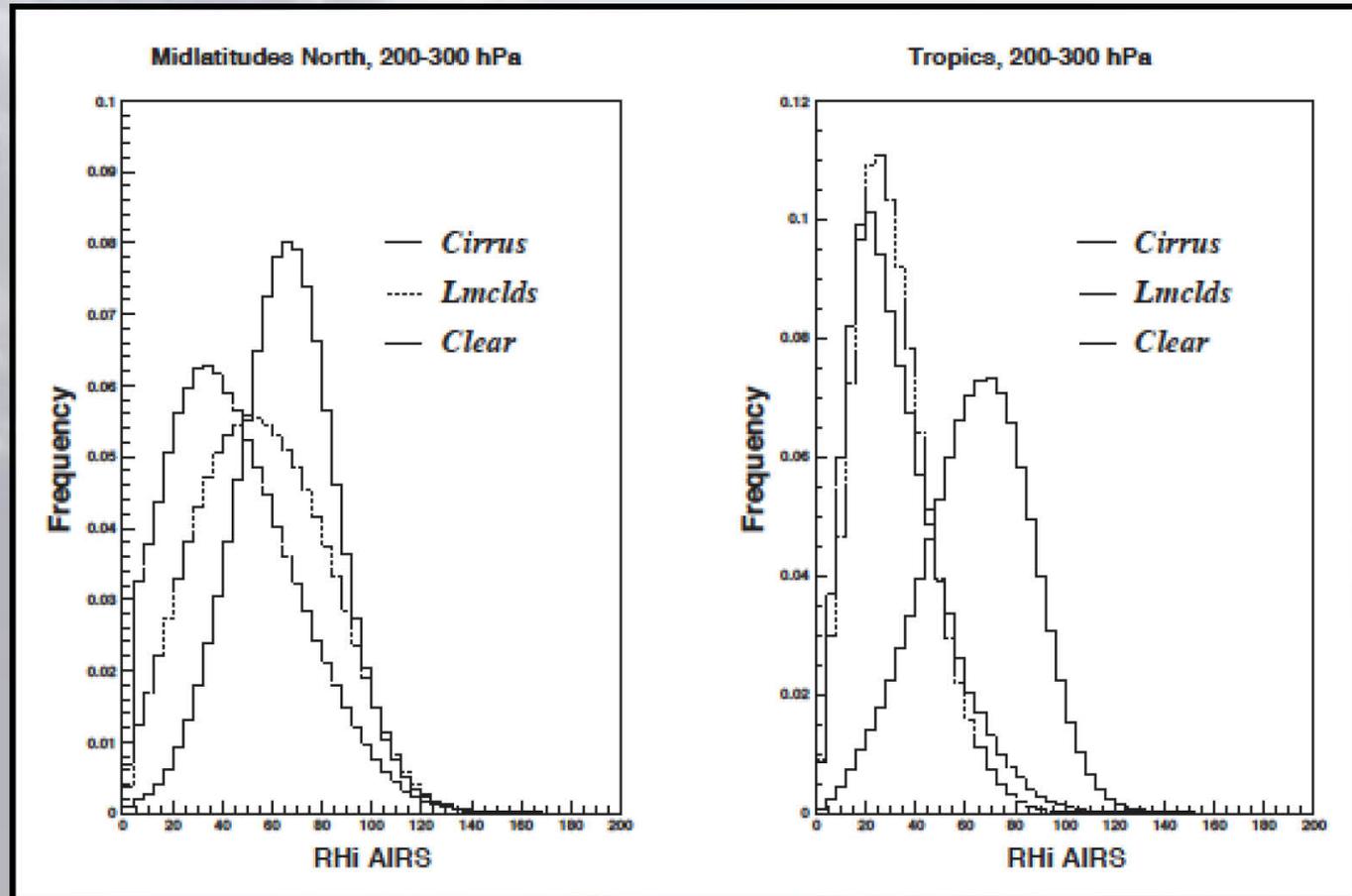




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A Climatology of Supersaturation by Cloud Type



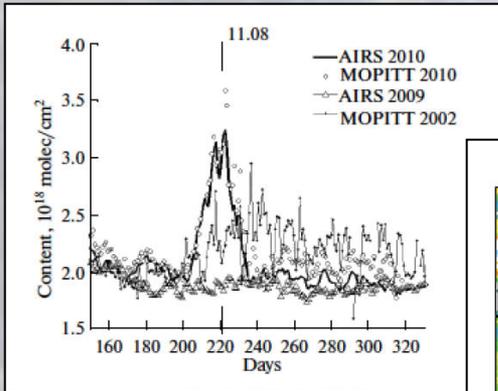
Lamquin, N., C. J. Stubenrauch, K. Gierens, U. Burkhardt, and H. Smit (2012), A global climatology of upper-tropospheric ice supersaturation occurrence inferred from the Atmospheric Infrared Sounder calibrated by MOZAIC, *Atmos. Chem. Phys.*, 12(1), 381-405.



AIRS Carbon Monoxide

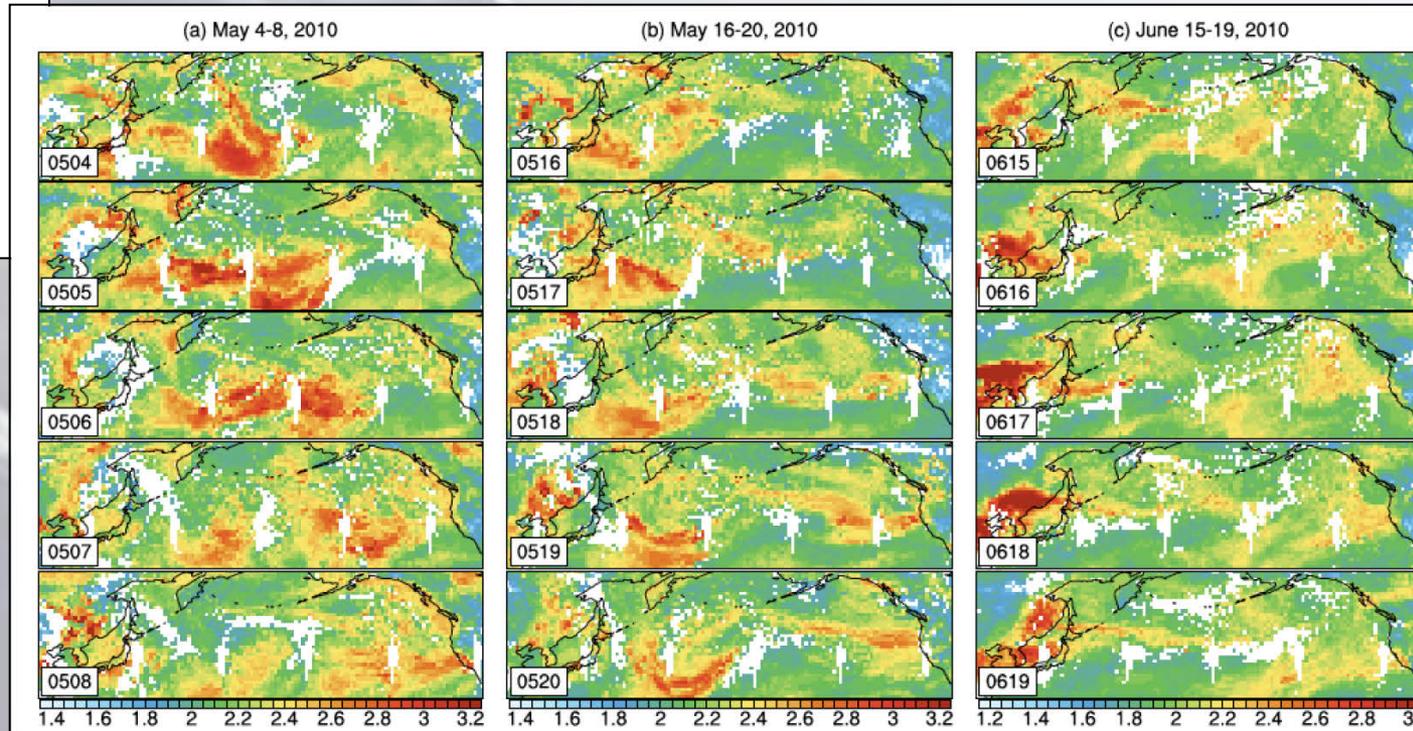
CO from Asia to North America

Lin et al.



CO over Moscow

Fokeeva et al.



Fokeeva, E., A. Safronov, V. Rakitin, L. Yurganov, E. Grechko, and R. Shumskii (2011), Investigation of the 2010 July–August fires impact on carbon monoxide atmospheric pollution in Moscow and its outskirts, estimating of emissions, *Izvestiya Atmospheric and Oceanic Physics*, 47(6), 682-698.

Lin, M., et al. (2012), Transport of Asian ozone pollution into surface air over the western United States in spring, *J. Geophys. Res.*, 117, D00V07, doi:10.1029/2011JD016961.

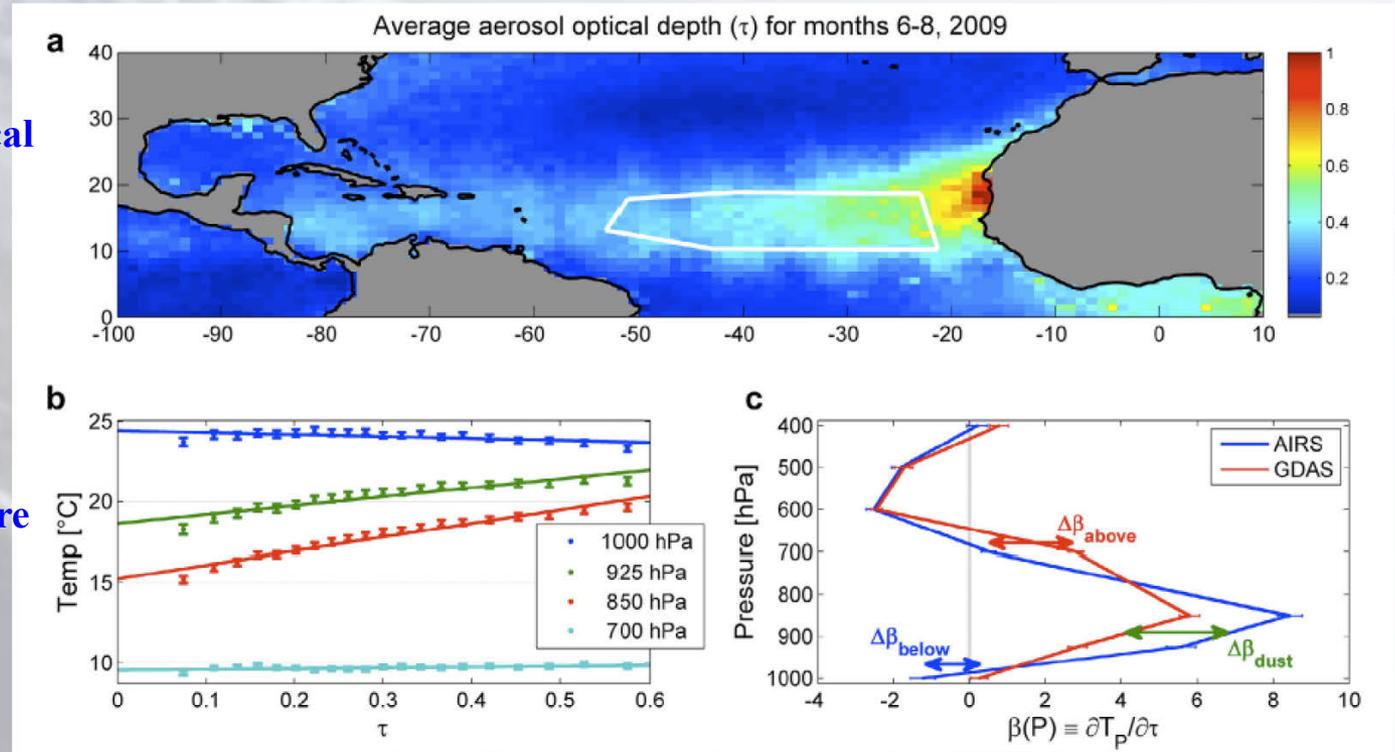


Two Studies on Aerosols

Top: MODIS optical
depth

Bottom: AIRS
temperature and
vertical temperature
gradient.

From Davidi et al.



Davidi, A., A. B. Kostinski, I. Koren, and Y. Lehahn (2012), Observational bounds on atmospheric heating by aerosol absorption: Radiative signature of transatlantic dust, *Geophys. Res. Lett.*, 39, L04803, doi 10.1029/2011GL050358.

Miller, D. J., K. Sun, M. A. Zondlo, D. Kanter, O. Dubovik, E. J. Welton, D. M. Winker, and P. Ginoux (2011), Assessing boreal forest fire smoke aerosol impacts on U.S. air quality: A case study using multiple data sets, *J. Geophys. Res.*, 116, D22209, doi:10.1029/2011JD016170.



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New Studies of Gravity Waves

AIRS Gravity Wave Structure from Alexander and Tietelbaum

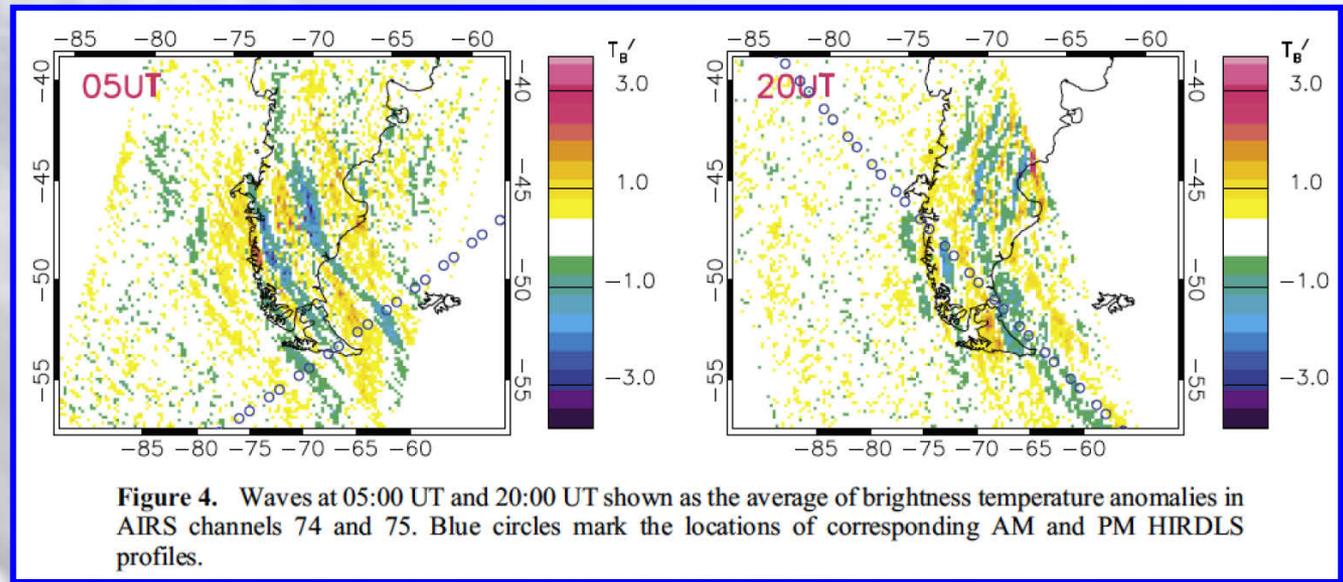


Figure 4. Waves at 05:00 UT and 20:00 UT shown as the average of brightness temperature anomalies in AIRS channels 74 and 75. Blue circles mark the locations of corresponding AM and PM HIRDLS profiles.

Alexander, M. J., and H. Teitelbaum (2011) Three-dimensional properties of Andes mountain waves observed by satellite: A case study, *J. Geophys. Res.*, *116*, D23110, doi:10.1029/2011JD016151.

Choi, H.-J., H.-Y. Chun, J. Gong, and D. L. Wu (2012), Comparison of gravity wave temperature variances from ray-based spectral parameterization of convective gravity wave drag with AIRS observations, *J. Geophys. Res.*, *117*, D05115, doi:10.1029/2011JD016900.1.

Gong, J., D. L. Wu, and S. D. Eckermann (2011), Gravity wave variances and propagation derived from AIRS radiances, *Atmos. Chem. Phys.*, *12*(4), 1701-1720.



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Selected Studies

Published During Second Quarter of 2012



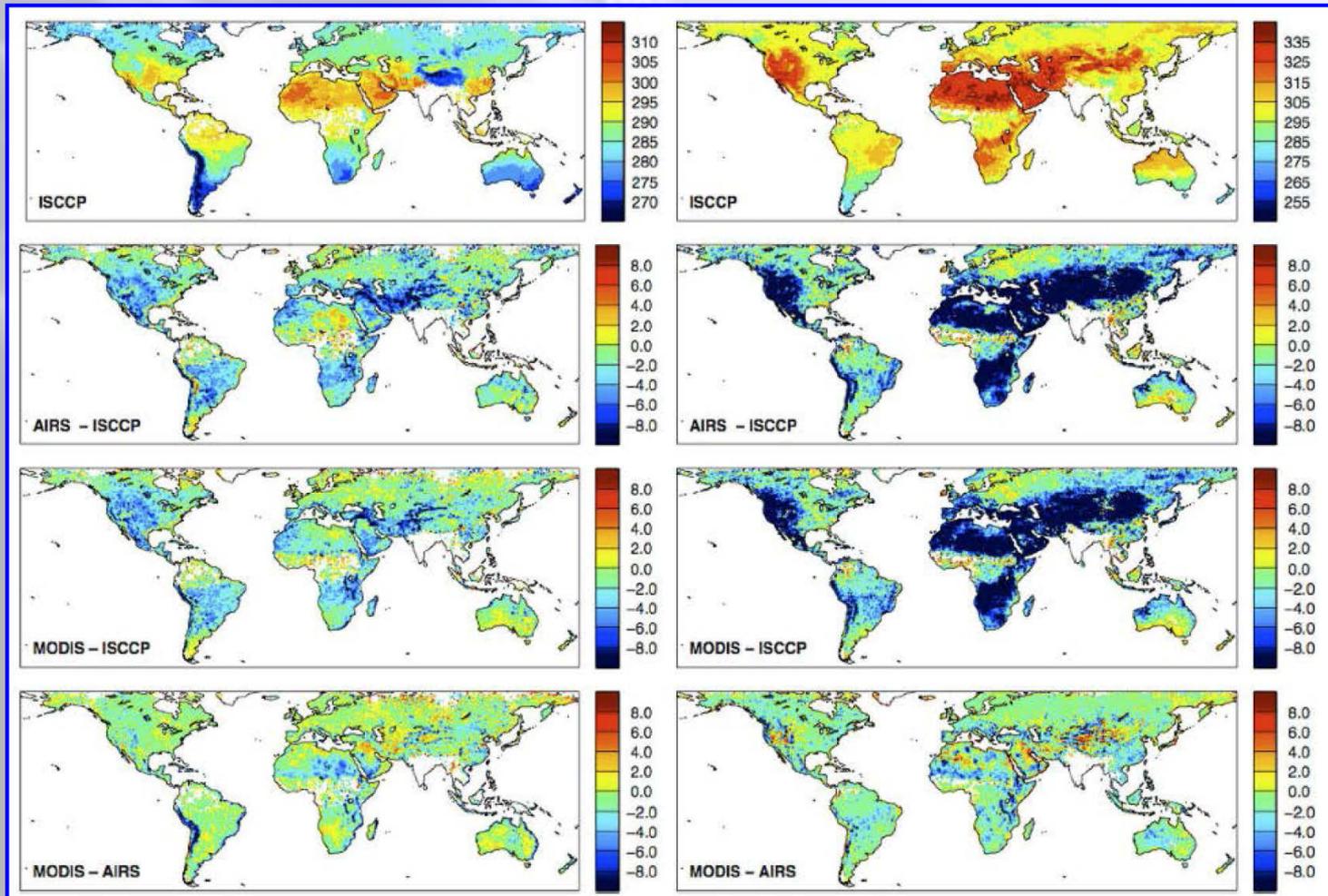
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Land Surface Temperature from Several Satellites

Night

Day



Jiménez, C., C. Prigent, J. Catherinot, W. Rossow, P. Liang, and J.-L. Moncet (2012), A comparison of ISCCP land surface temperature with other satellite and in situ observations, *J. Geophys. Res.*, *117*, D08111, doi:10.1029/2011JD017058

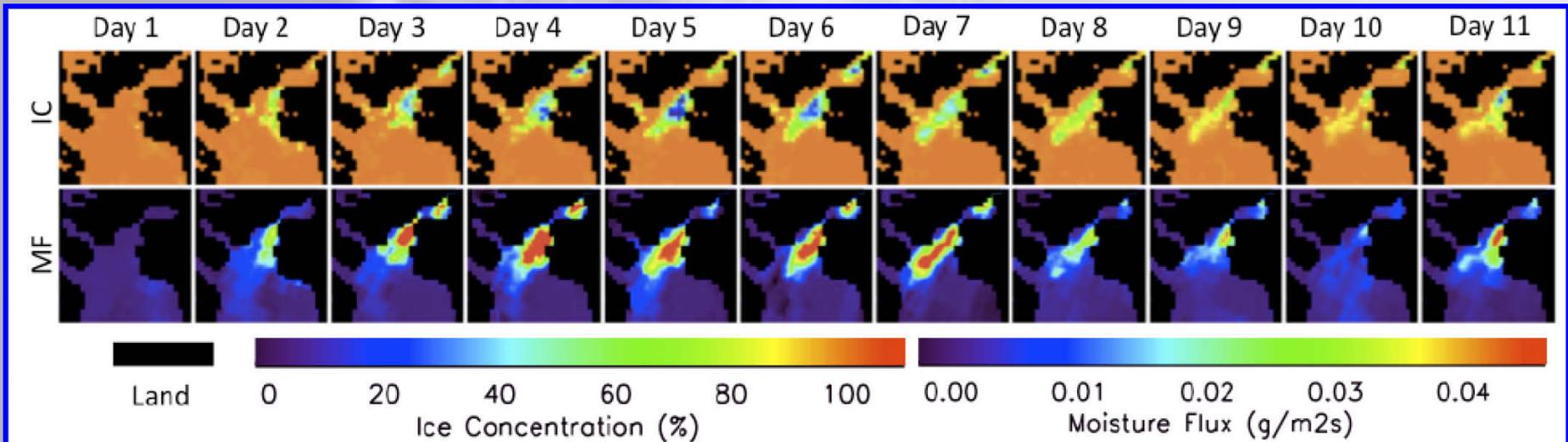
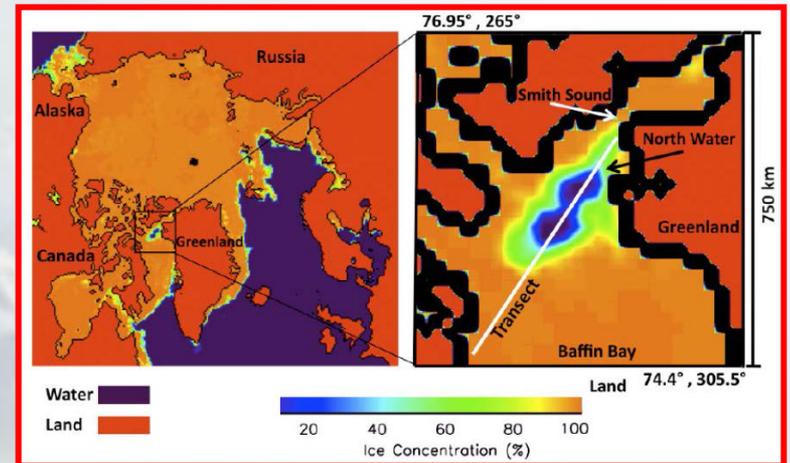


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Estimating Water Flux from a Greenland Polynya with AIRS

Boisvert, L. N., T. Markus, C. L. Parkinson, and T. Vihma (2012), Moisture fluxes derived from EOS aqua satellite data for the north water polynya over 2003–2009, *J. Geophys. Res.*, 117, D06119, doi:10.1029/2011JD016949.



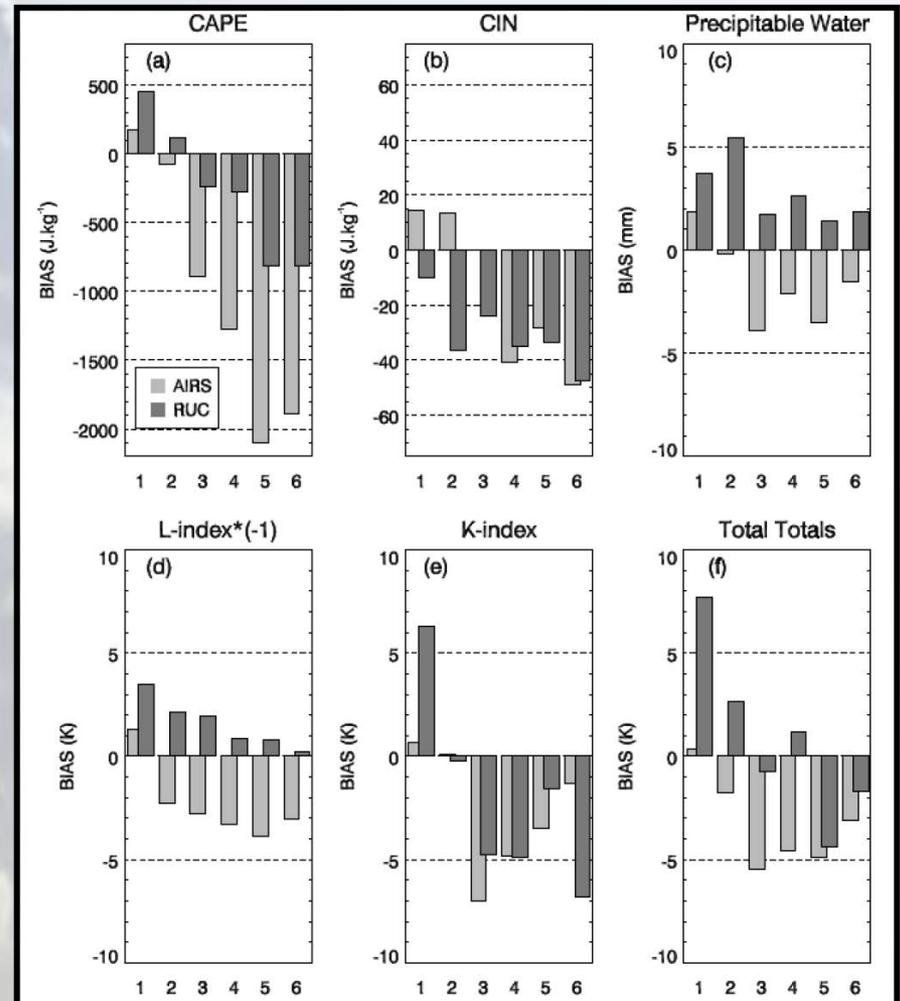
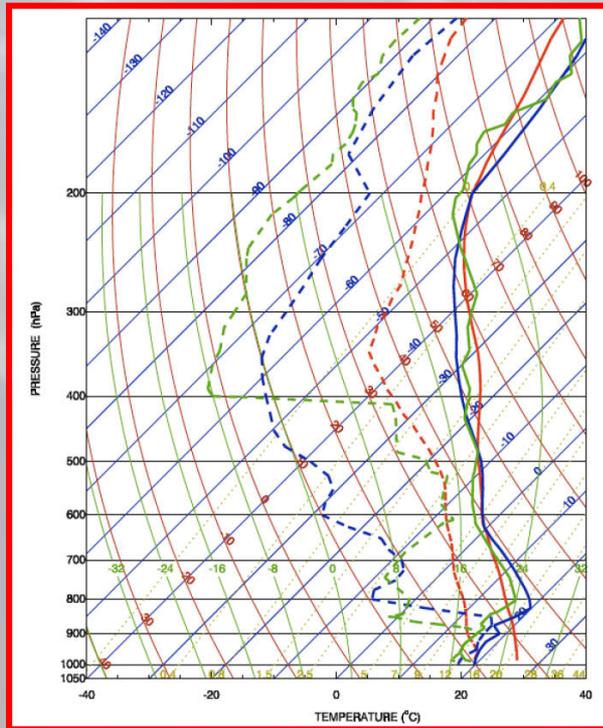


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Evaluating Pre-convective Conditions with AIRS and In Situ Data

Synoptic Comparisons



Botes, D., J. R. Mecikalski, and G. J. Jedlovec (2012),
Atmospheric Infrared Sounder (AIRS) sounding evaluation
and analysis of the pre-convective environment, *J. Geophys.
Res.*, 117, D09205, doi:10.1029/2011JD016996.



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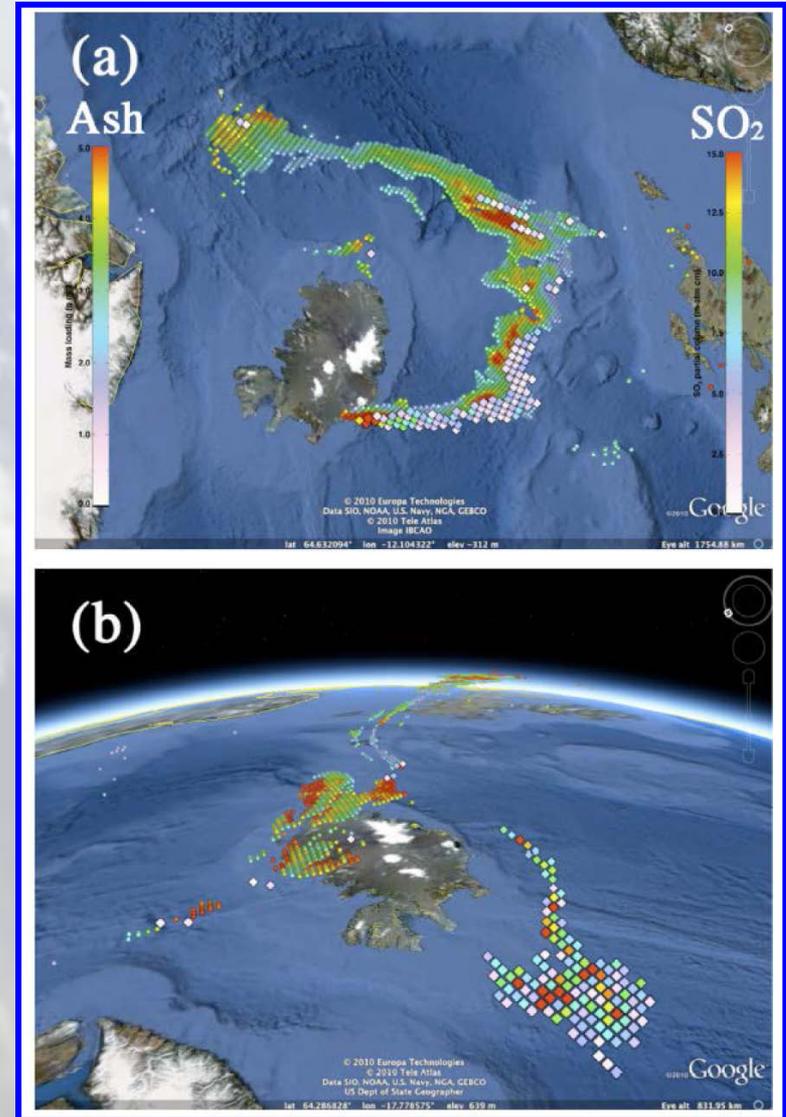
Eyjafjallajökull: AIRS SO₂ and SEVIRI Dust

Diamonds: SO₂

Dots: Dust

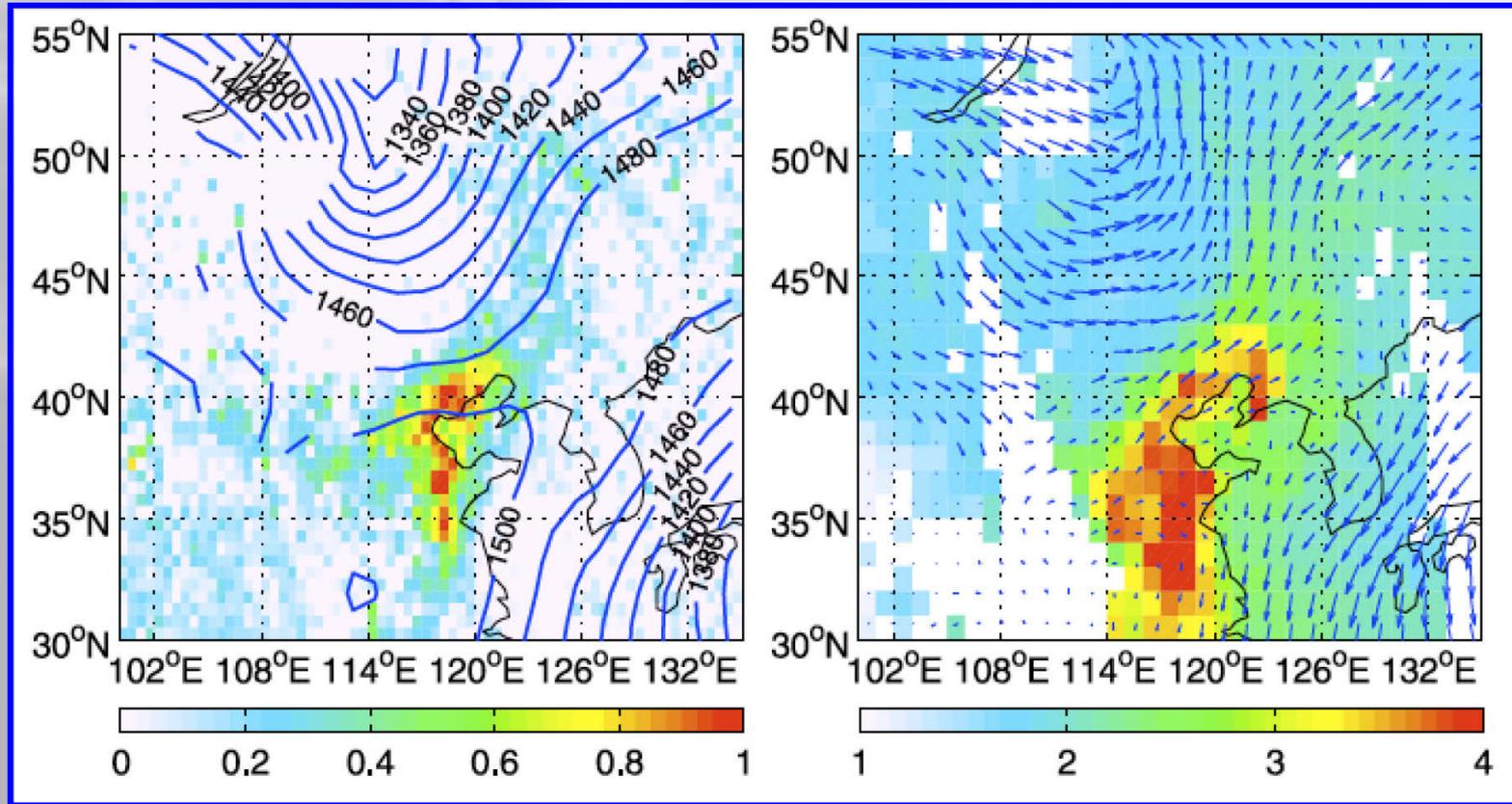
“The ash and SO₂ are not necessarily
collocated in the vertical.

Prata, A. J., and A. T. Prata (2012), Eyjafjallajökull volcanic
ash concentrations determined using Spin Enhanced Visible
and Infrared Imager measurements, *J. Geophys. Res.*, 117,
D00U23, doi:10.1029/2011JD016800.





Transport Study Combining AIRS CO and OMI SO₂



OMI SO₂

AIRS CO and MERRA Winds

Hsu, N. C., C. Li, N. A. Krotkov, Q. Liang, K. Yang, and S.-C. Tsay (2012), Rapid transpacific transport in autumn observed by the A-train satellites, *J. Geophys. Res.*, *117*, D06312, doi:10.1029/2011JD016626.



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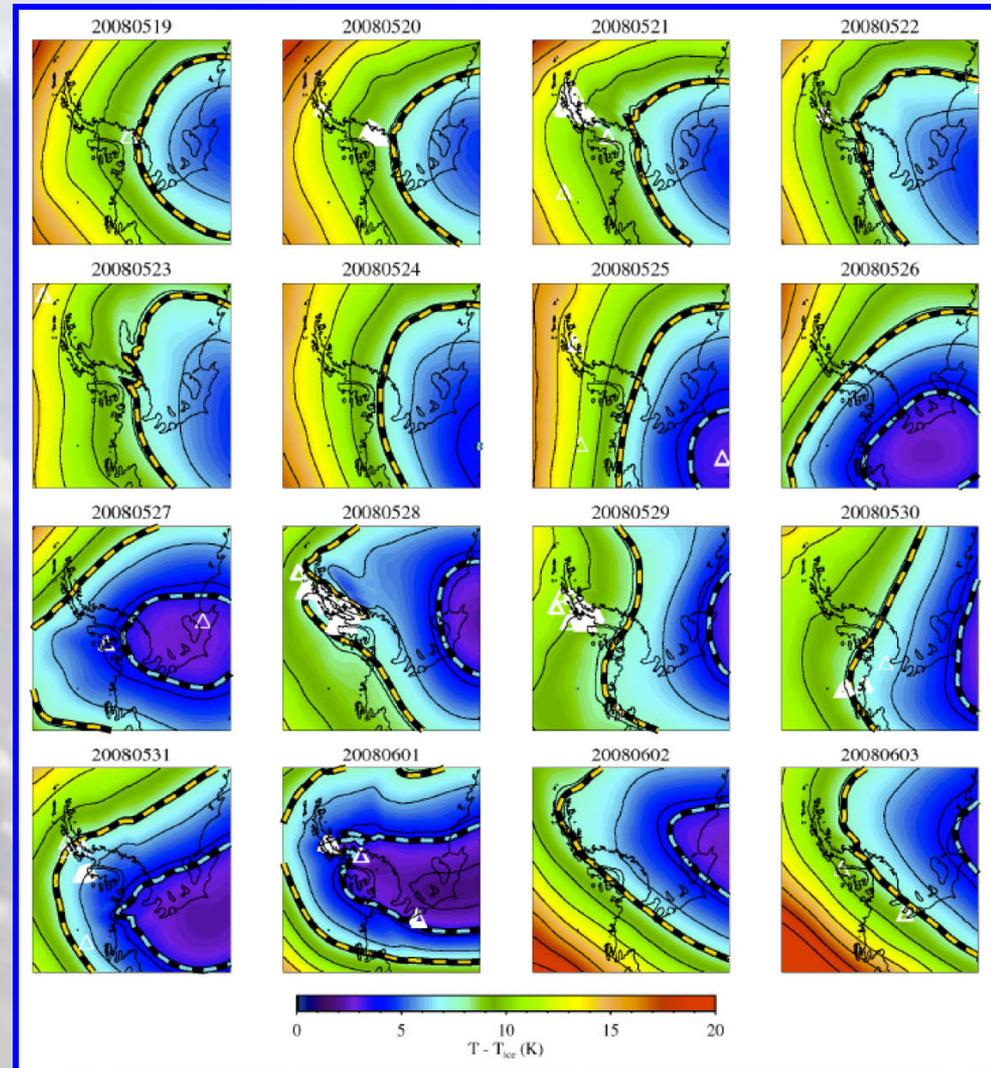
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Polar Stratospheric Clouds from MLS, CALIPSO and AIRS

White Triangles: AIRS detections of gravity waves at 40 hPa from 19 May–3 June 2008 over the Antarctic Peninsula region.

Colored shading: the GEOS-5 temperatures relative to the the frost point. Highlighted contours show the existence threshold temperature of nitric acid trihydrate (NAT).

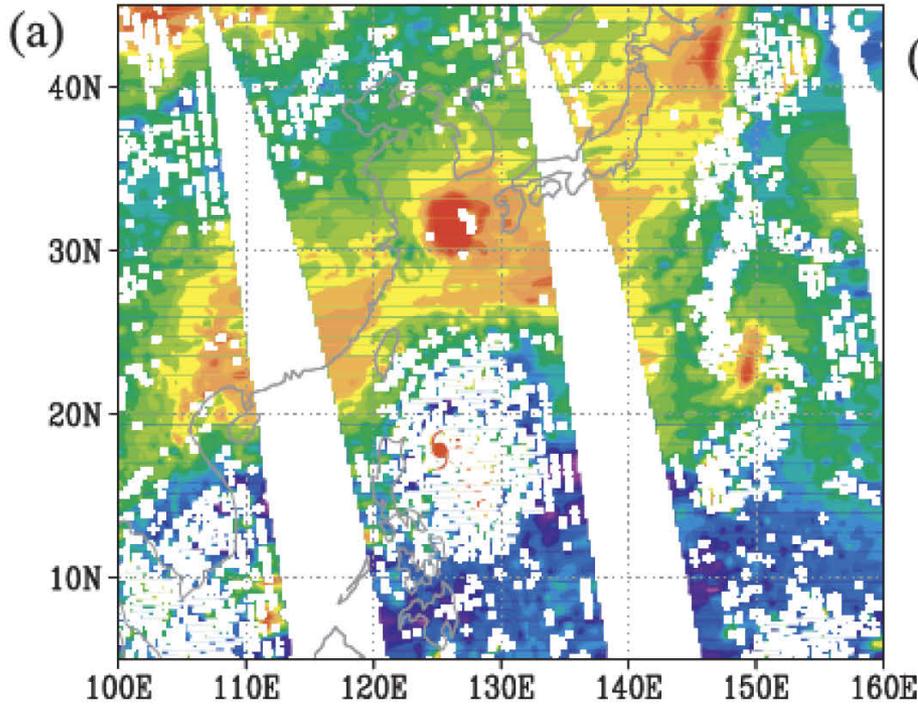
Lambert, A., Santee, M. L., Wu, D. L., and Chae, J. H.:
A-train CALIOP and MLS observations of early winter
Antarctic polar stratospheric clouds and nitric acid in
2008, *Atmos. Chem. Phys.*, 12, 2899-2931,
doi:10.5194/acp-12-2899-2012, 2012.



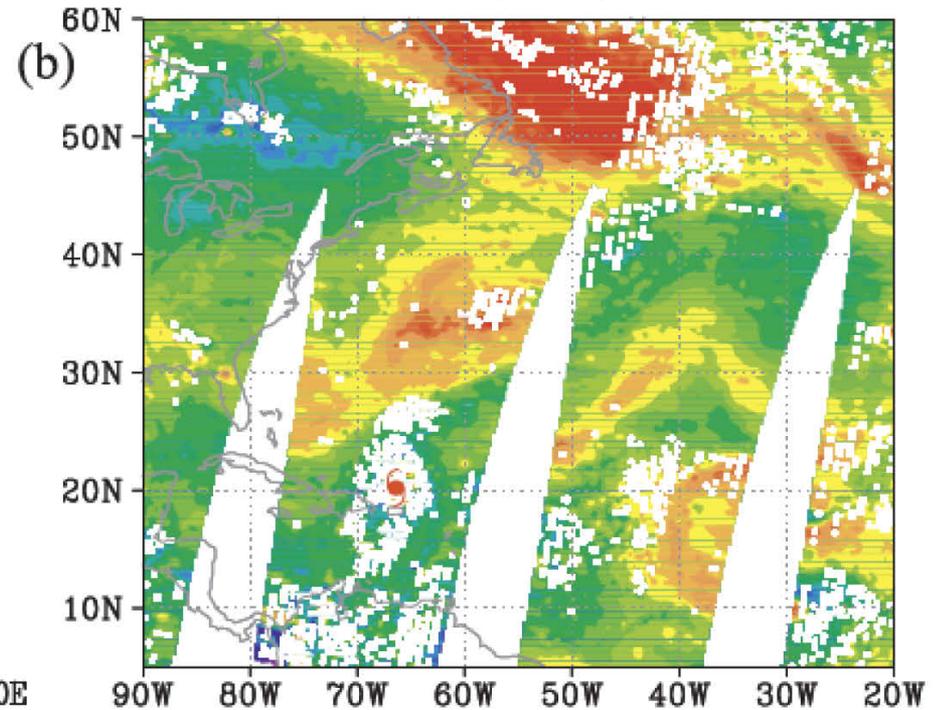


AIRS Total Ozone Around Tropical Cyclones

Sinlaku (2008)



Earl (2010)



Wang, H., X. Zou, and G. Li (2012), An Improved Quality Control for AIRS Total Column Ozone Observations within and around Hurricanes, *J. Atmospheric and Oceanic Tech.*, 29(3), 417-432.



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Selected Studies

Published During Third Quarter of 2012

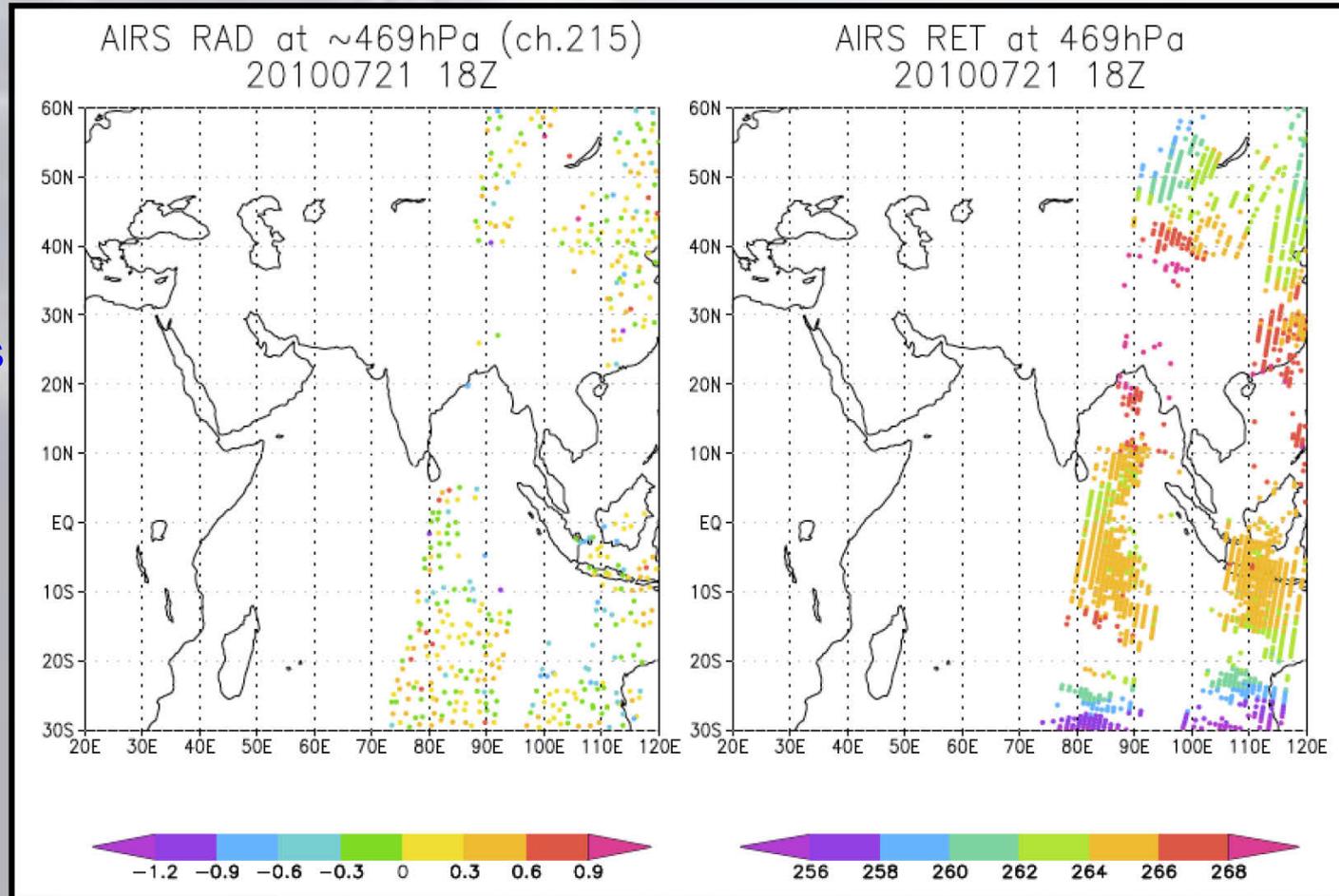


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Assimilation of AIRS Retrievals Improves Hindcast of Pakistan Floods

Clear
Radiances



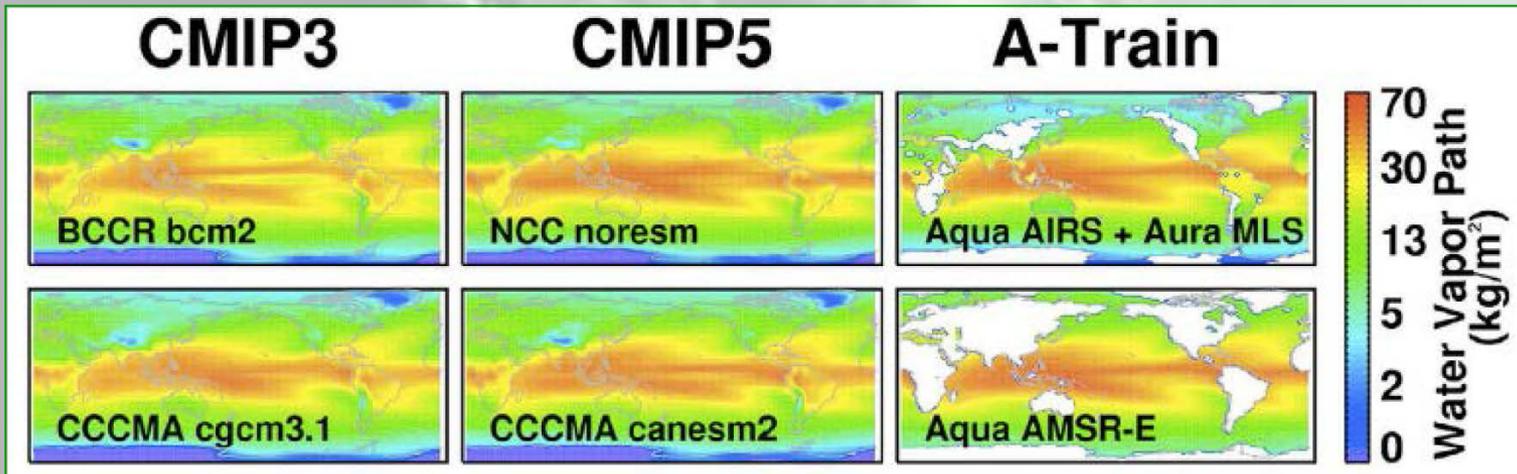
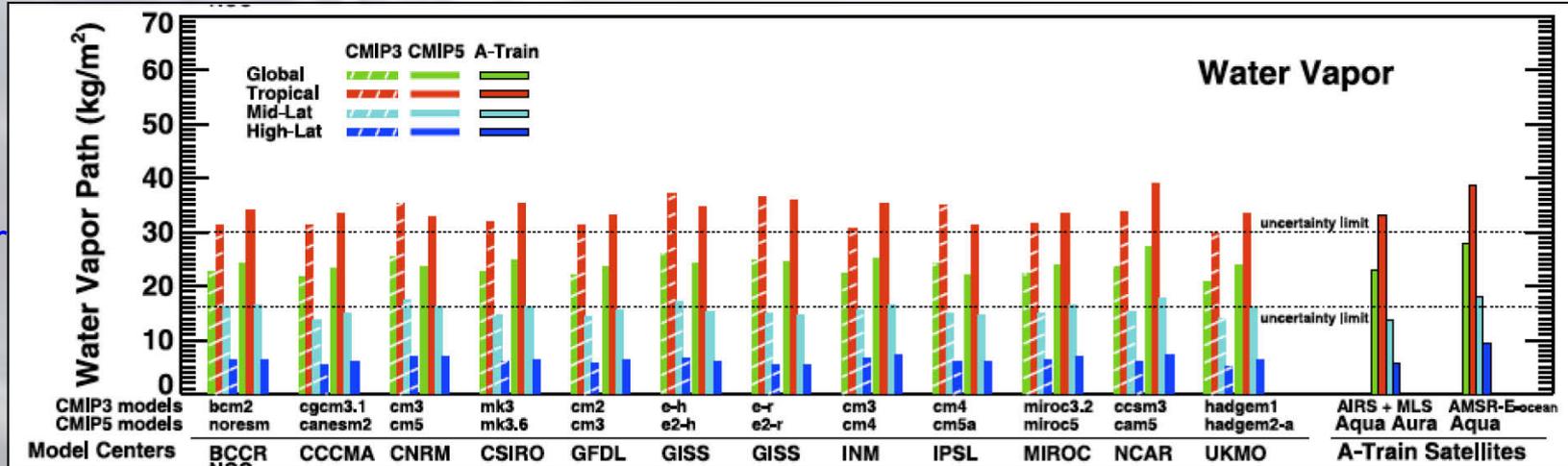
Retrieved
Temperatures

Reale, O., K. M. Lau, J. Susskind, and R. Rosenberg (2012), AIRS impact on analysis and forecast of an extreme rainfall event (Indus River Valley, Pakistan, 2010) with a global data assimilation and forecast system, *J. Geophys. Res.*, *117*, D08103, doi:10.1029/2011JD017093.



Evaluating CMIP5 Models with the A-Train

Excellent agreement for global mean water vapor...



...but large regional differences.



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Published in *Science* on Friday
with Commentary

A Less Cloudy Future: The Role of Subtropical Subsidence in Climate Sensitivity

John T. Fasullo* and Kevin E. Trenberth

An observable constraint on climate sensitivity, based on variations in mid-tropospheric relative humidity (RH) and their impact on clouds, is proposed. We show that the tropics and subtropics are linked by teleconnections that induce seasonal RH variations that relate strongly to albedo (via clouds), and that this covariability is mimicked in a warming climate. A present-day analog for future trends is thus identified whereby the intensity of subtropical dry zones in models associated with the boreal monsoon is strongly linked to projected cloud trends, reflected solar radiation, and model sensitivity. Many models, particularly those with low climate sensitivity, fail to adequately resolve these teleconnections and hence are identifiably biased. Improving model fidelity in matching observed variations provides a viable path forward for better predicting future climate.

CLIMATE CHANGE

Constraining Cloud Feedbacks

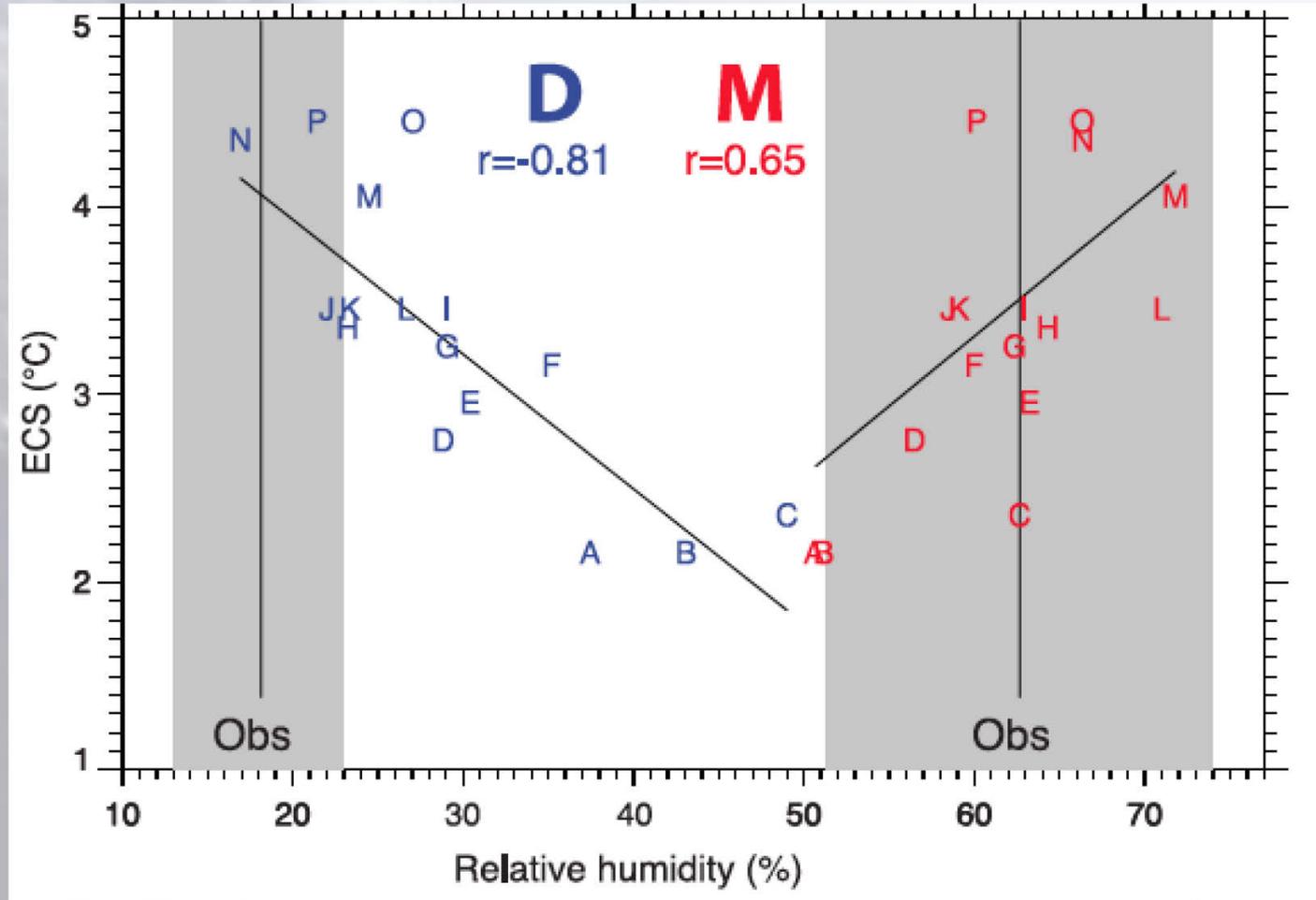
Karen M. Shell

A simple diagnostic circumvents the need for measuring cloud properties, helping to improve climate sensitivity estimates.



Models with More Realistic Subtropical RH Predict Greatest Warming (Fasullo & Trenberth, 2012)

Response to
 $2 \times \text{CO}_2$



Mean subtropical relative humidity



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Wrapping Up

- **AIRS continues to advance our understanding of the natural world.**
- **Thanks everyone for your contribution.**

– BUT –

- **We still have much to learn from the full, decadal AIRS record.**