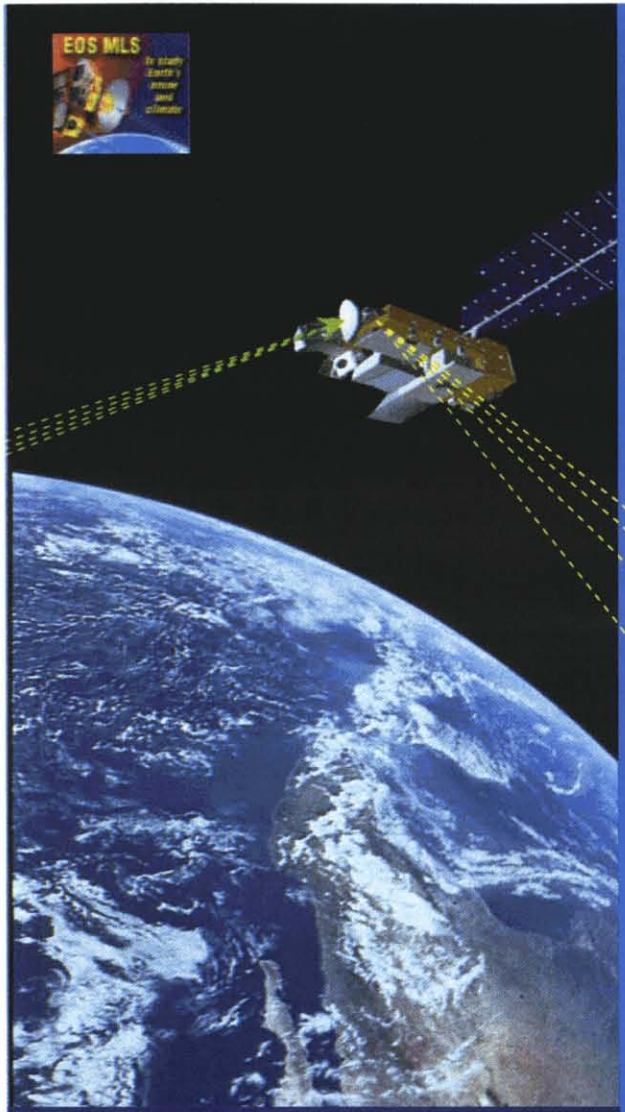


Aura MLS Cloud Measurements:

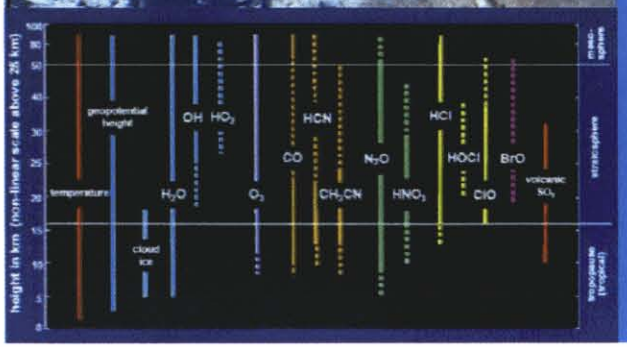
— First-Year Results —

Jonathan H. Jiang and Dong L. Wu

Representing

Microwave Atmospheric Science Team

PI: Dr. Joe W. Waters

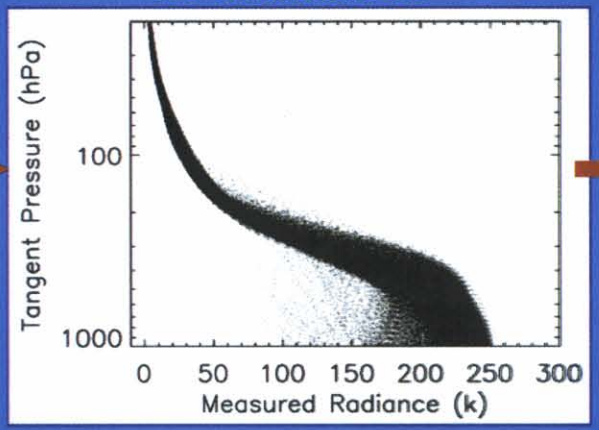


http://mls.jpl.nasa.gov

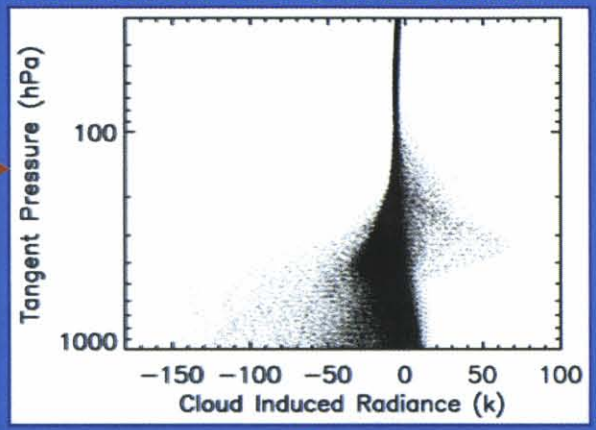
Aura MLS Cloud Measurements (V1.51)

Launched on July 15 2004

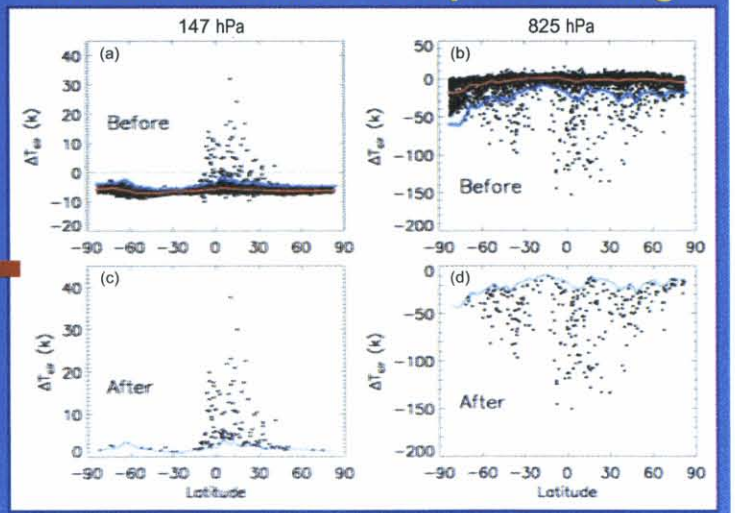
L1 Radiances



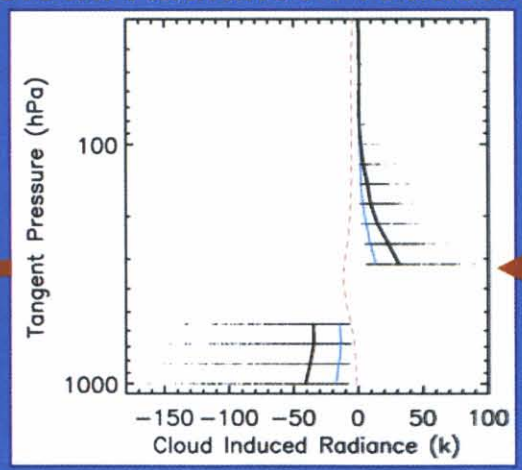
Retrieved Cloud Radiances



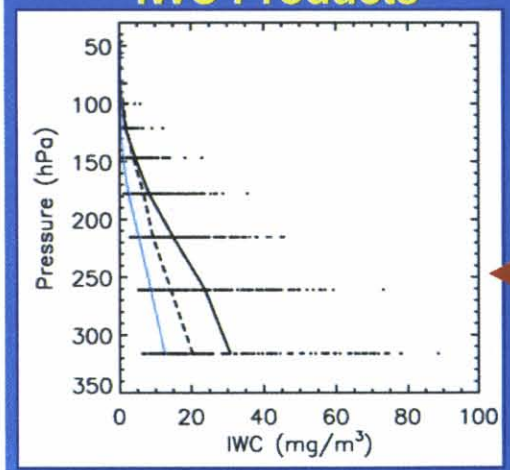
Cloud Radiance Re-processing



Cloud Radiance Products

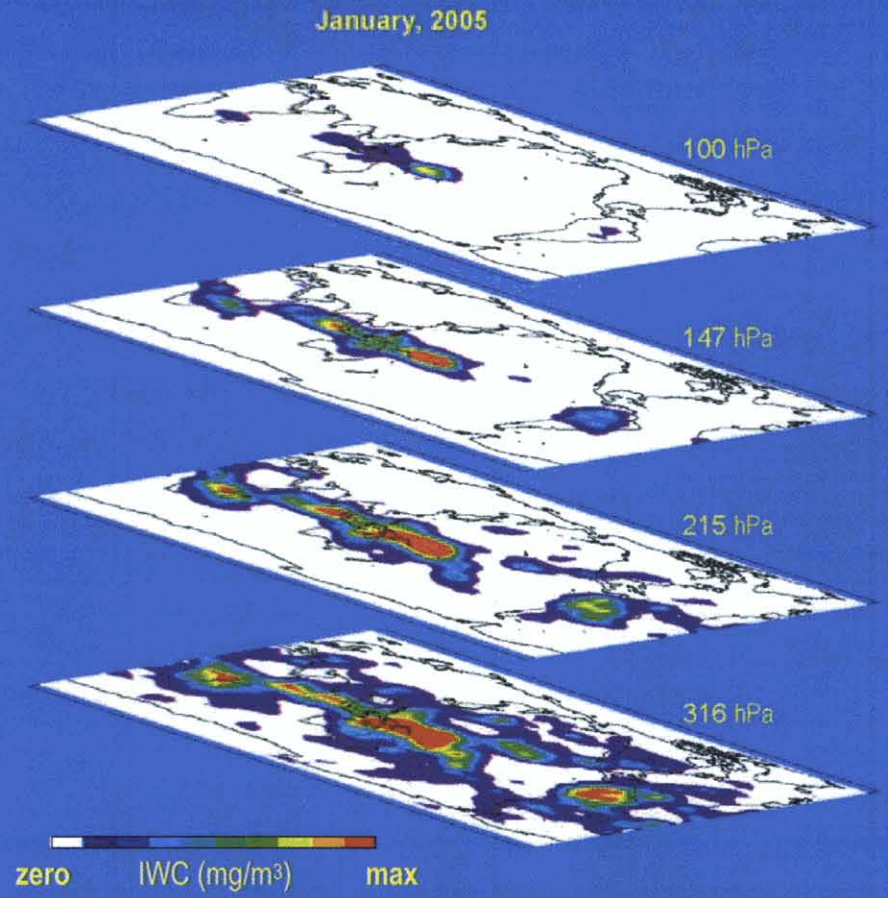


IWC Products



Vertical Cloud Profiling From Space

Aura MLS global cloud ice survey



Cloud ice water content (IWC) in four upper tropospheric layers measured from Aura MLS. The values are series of 5-day mean averages. Colors give IWC in mg/m^3: max is 1.2 at 100 hPa, 4.5 at 147 hPa and 9 at 215, 316 hPa.

- **Aura MLS provides the *first* vertical upper tropospheric cloud profiling from space, enabling global survey of the vertical structure of cloud systems, with seasonal and geographical variations, needed to evaluate the way clouds are parameterized in global models, thereby contributing to the understanding of cloud-climate feedbacks, and improved weather and climate predictions**

Data pressure levels:

- **Standard Products:**
  - **68 hPa**
  - **83 hPa**
  - **100 hPa**
  - **121 hPa**
  - **147 hPa**
  - **178 hPa**
  - **215 hPa**
- Research Products:
  - 261 hPa
  - 316 hPa

MLS V1.5-CLD01

Wu, Jiang & Davis, 2005

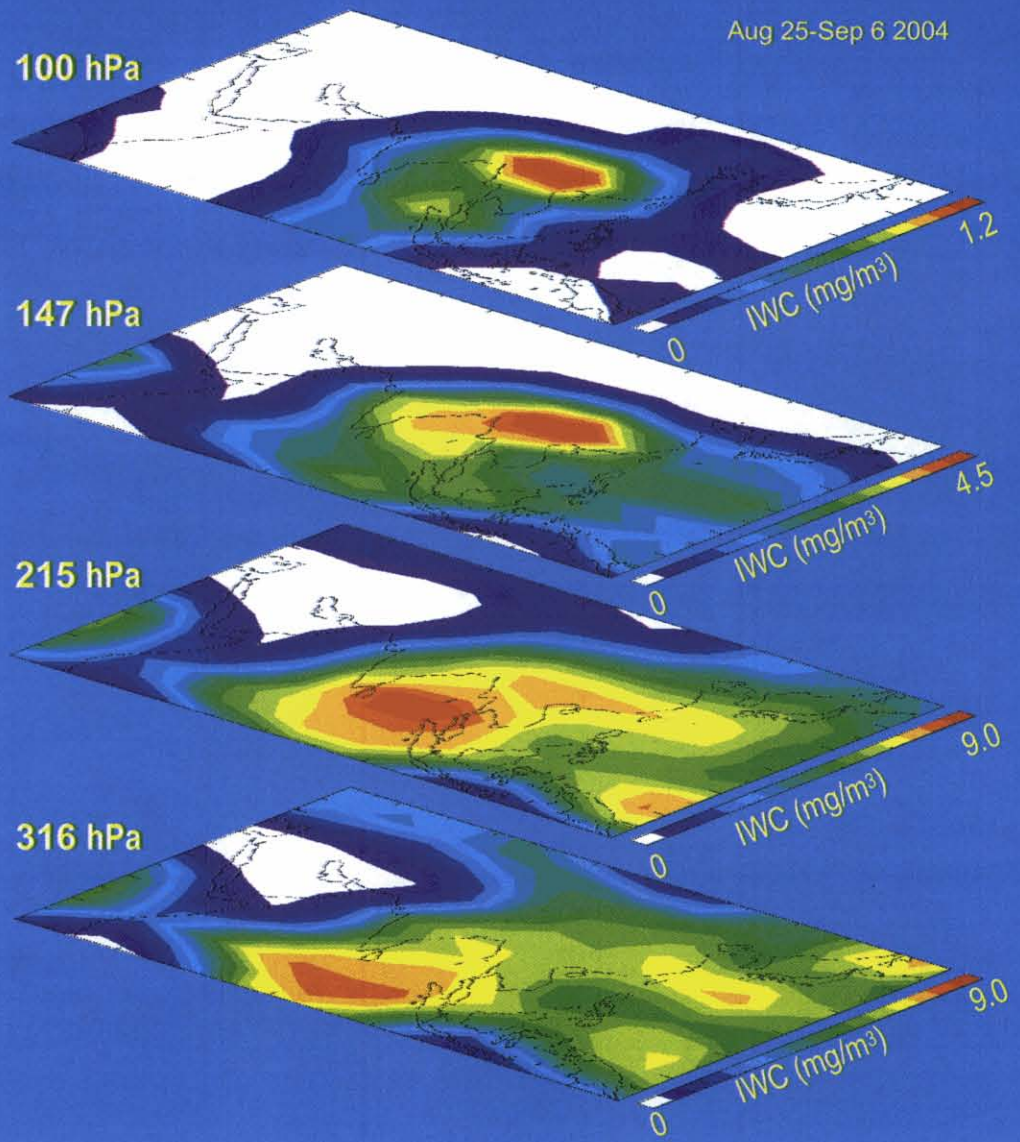
Livesry et al. V1.5 quality document, 2005

Data resolution:

~3.5 km vertical

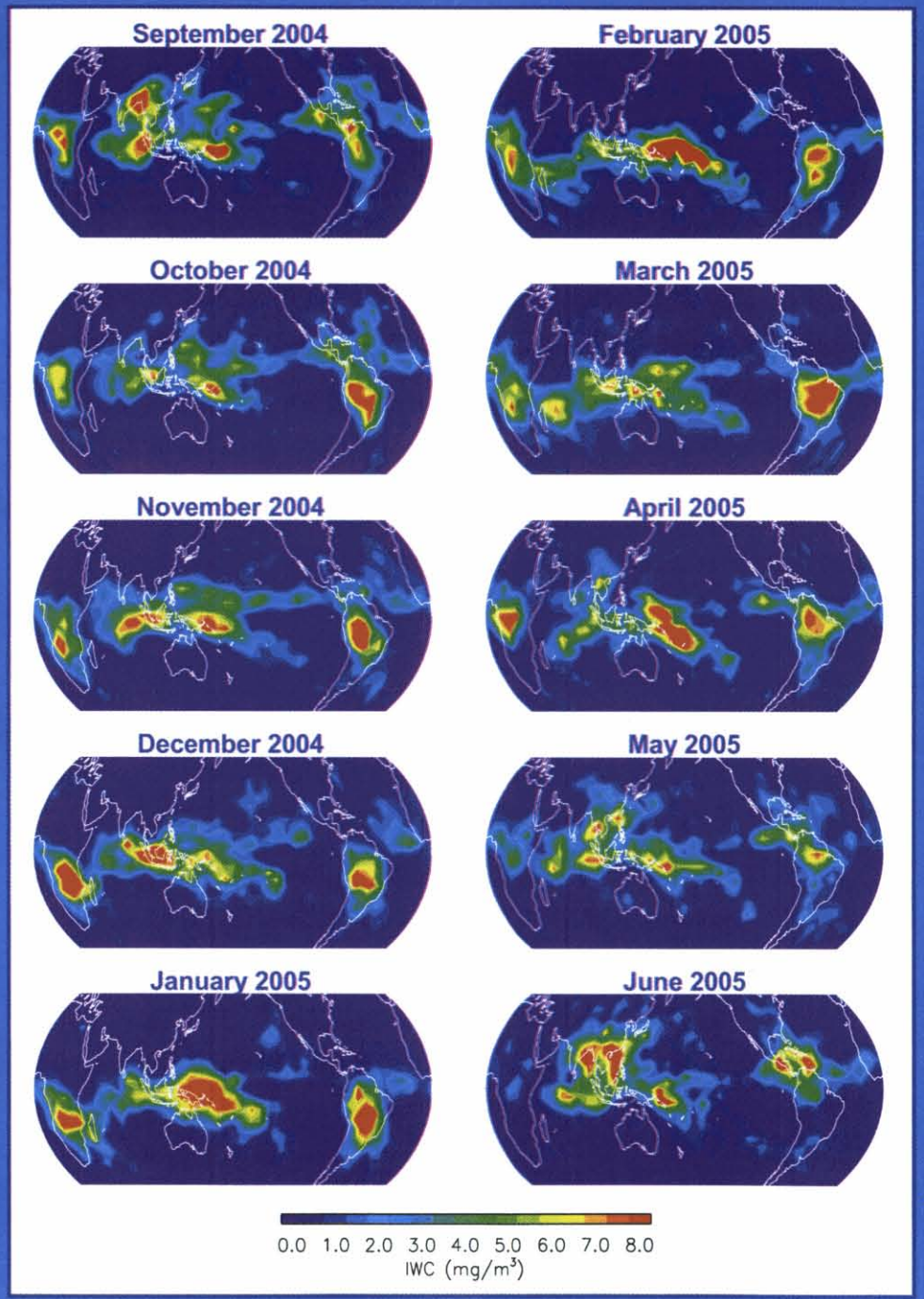
~160 km horizontal

Aura MLS's regional survey of cloud systems vertical structure



- **The vertical structure of cloud systems is fundamentally important for understanding how clouds affect both their regional and large-scale atmospheric and radiative environments. The regional cloud profiles provide a critical tests of important parameterizations that enable the calculation of radiative flux profiles and heating rates throughout the atmospheric column, which in turn also regulates the water and energy cycles in the upper troposphere.**

Variation of vertical structure of cloud ice observed by Aura MLS during Aug 25 Aug - Sep 6 2004 above the South Asia suggests a summer Asian monsoon deep convection coupled by an strong upper level anticyclone dynamics.



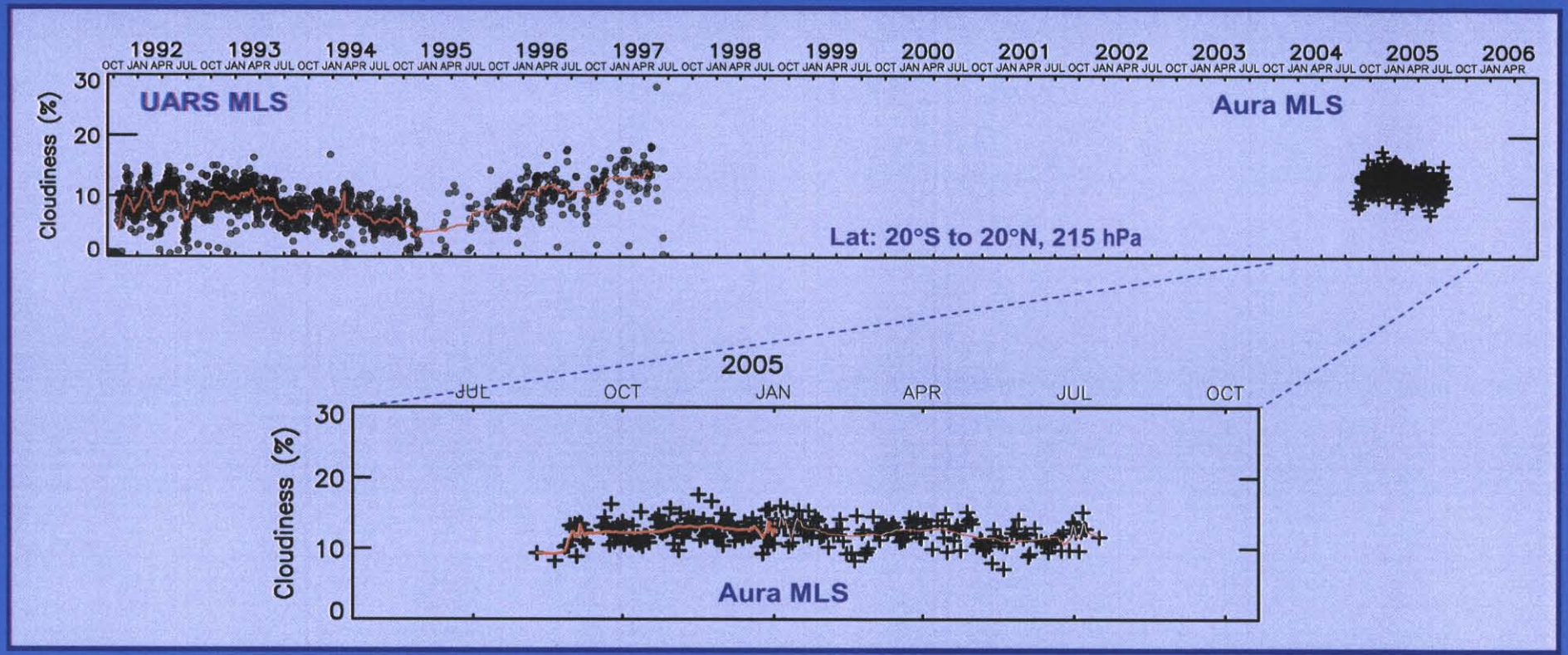
Monitoring the Seasonal Variation of Global Cloud Systems

This set of figures shows the evolution of monthly-mean IWC at 215 hPa measured from Aura MLS during Sep-2004 to Jun-2005.

We can see the transition between the northern-summer convective pattern of monsoon activity over Asia, Central, and the southern-summer pattern of continental convection over the central Africa, south America, and intense convection over the western Pacific.

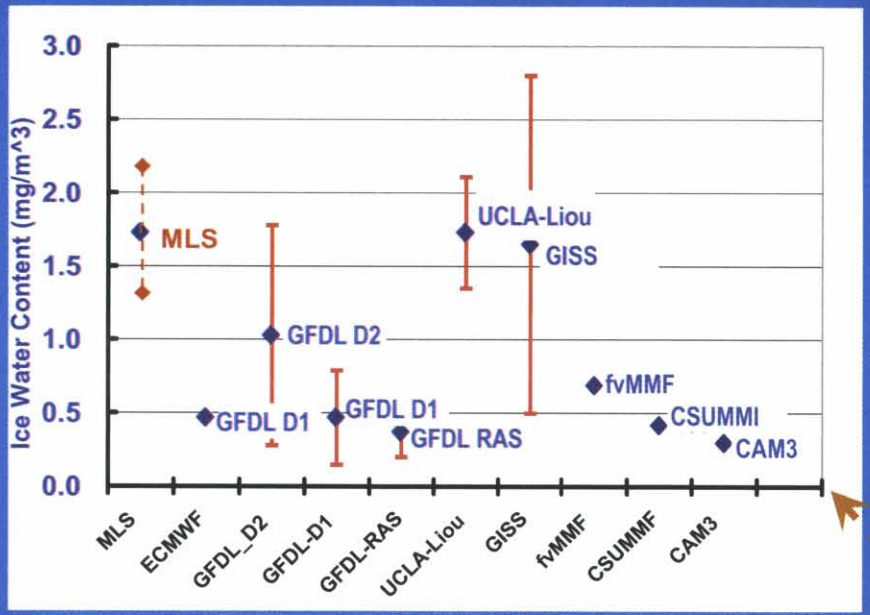
First Year Climatology from Aura MLS on

Long-Term Data Records

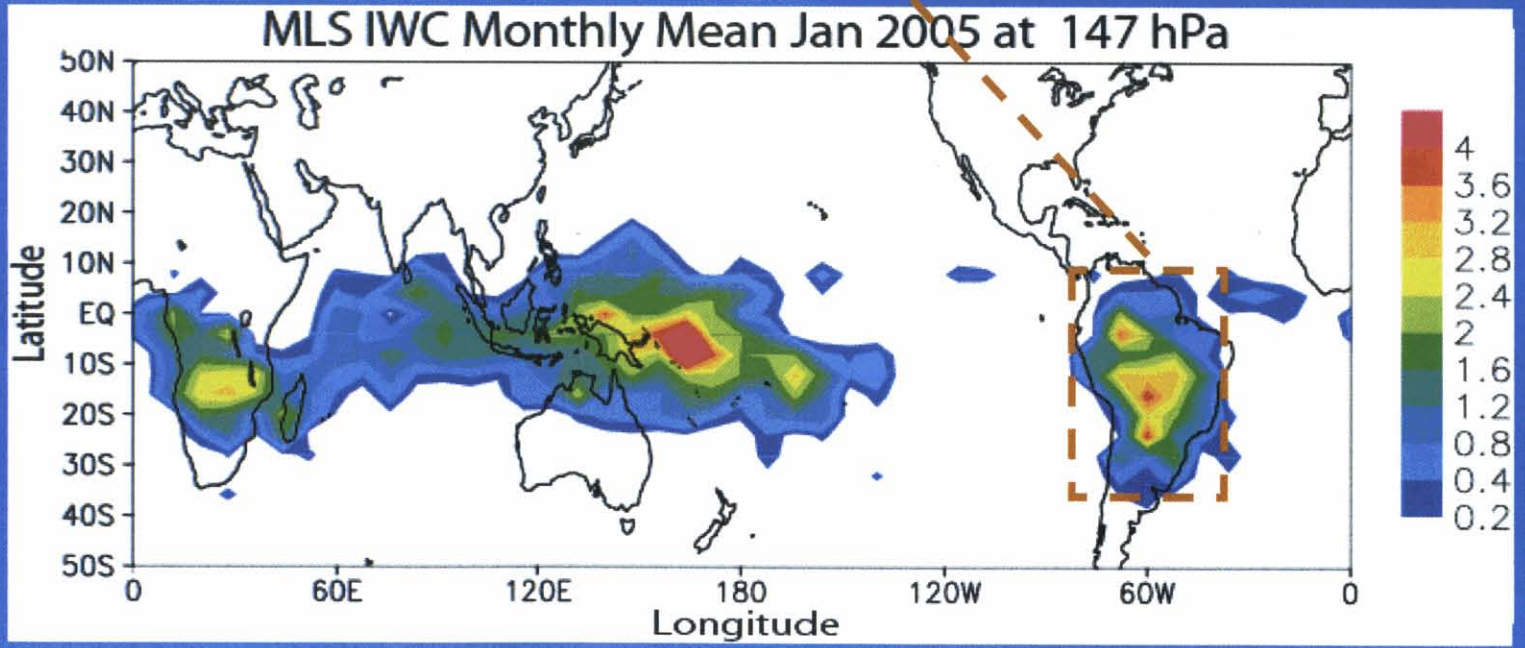


Time series of cloud occurrence in the tropics at 215 hPa, measured by UARS MLS 203 GHz radiometer during 1991-1997 and by Aura-MLS 240 GHz radiometer between Aug 2004 and Jul 2005. Dots are daily measurements, red-line is 30-day running window mean.

Evaluate the representation of clouds in global models



- Cloud ice measured by MLS is one of the key quantities predicted by global circulation models and affects practically all important hydrological & radiative processes essential for predicting climate change.
- Great efforts are now being made to evaluate and eventually to improve models representation of upper trop clouds using the MLS data.



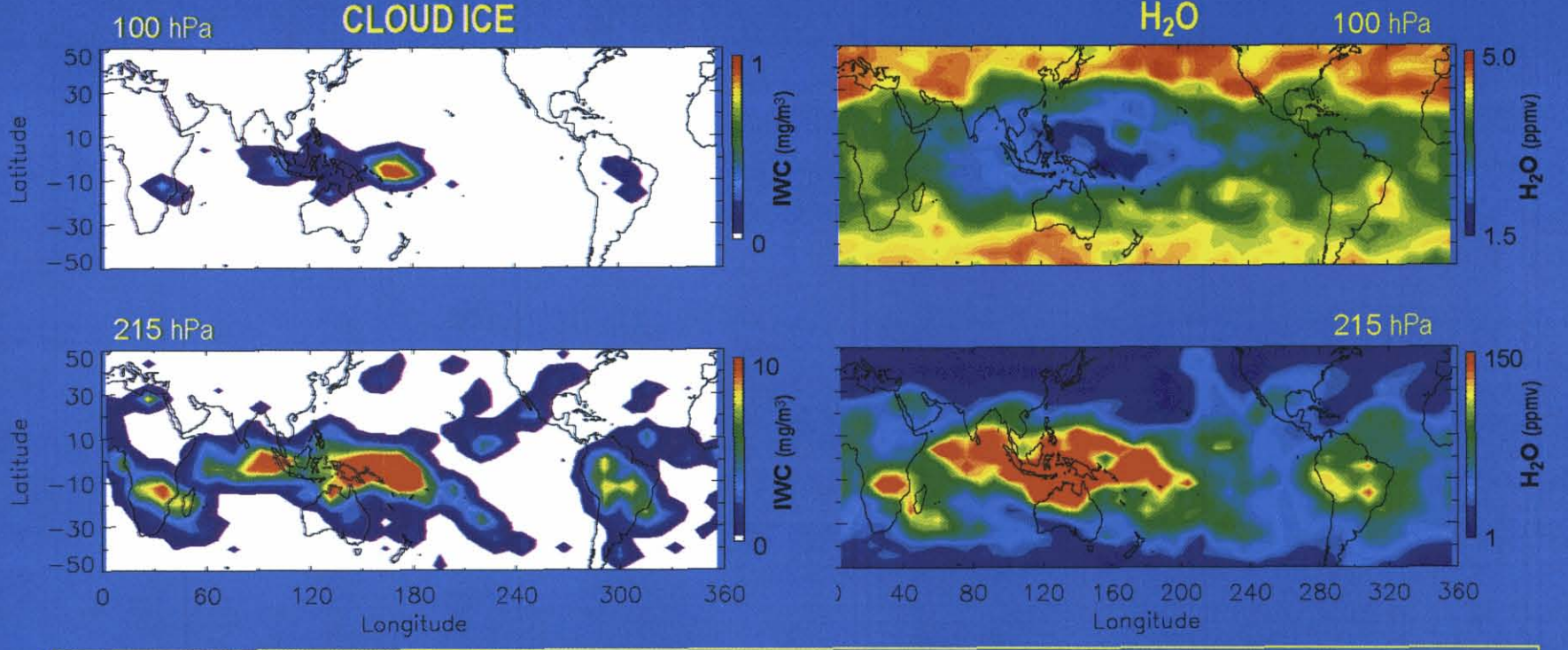
Li et al. 2005

A demonstration of global models-MLS measurement comparison efforts

MLS Simultaneous Measurements

JPL

January, 2005

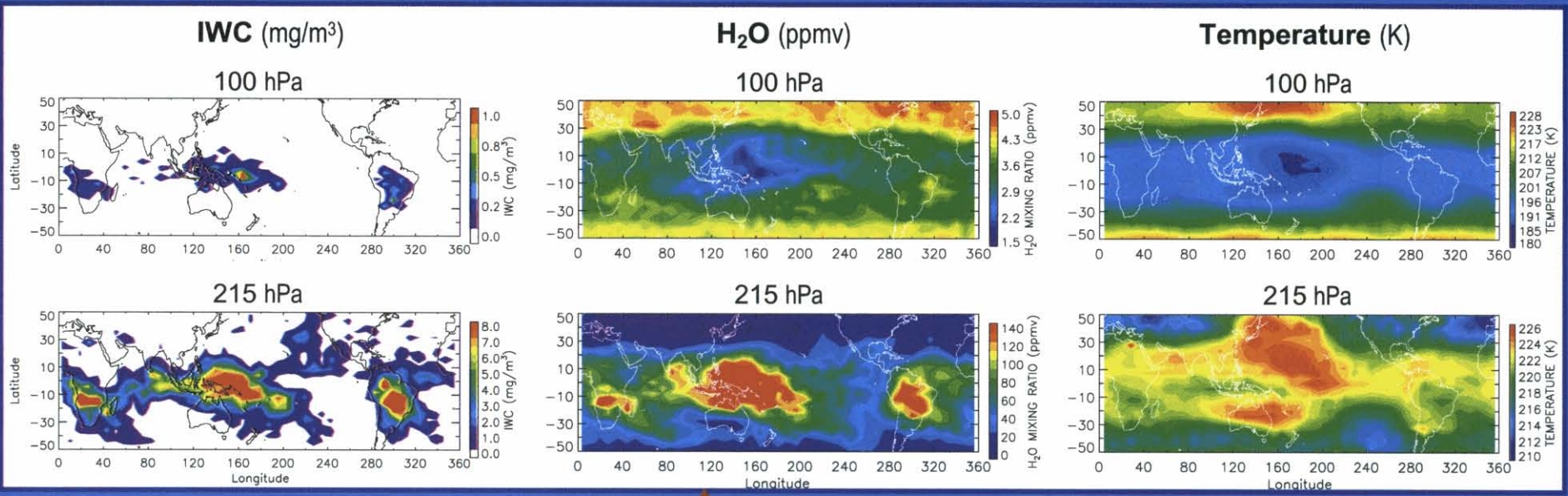


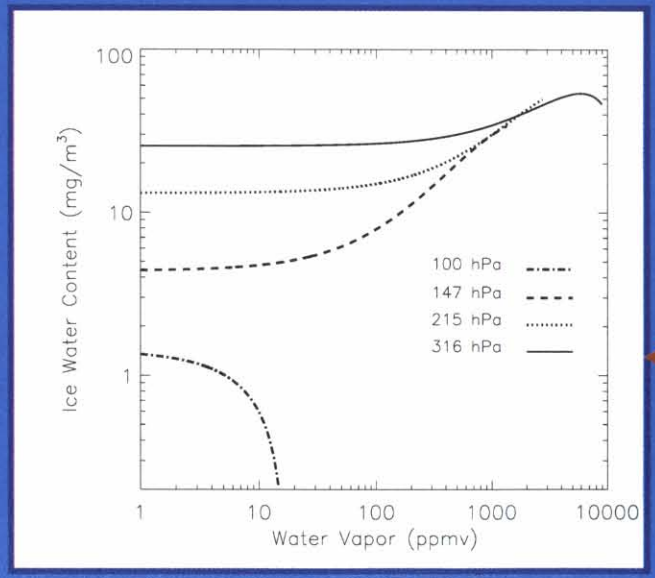
Aura MLS simultaneous measurements of cloud ice and water vapor concentrations at 100 and 215 hPa.

- **The interplay between hydrological quantities** (e.g. cloud ice, H_2O, T, relatively humidity) **in the upper troposphere is complex, reflecting the present debate in the field whether air entering the stratosphere is dehydrated during vertical transport in convection or during horizontal transport through cold regions, or some combination of the two.** (e.g. Sherwood & Dessler, 200; Holton & Gettelman, 2001)

- **Aura MLS, with its unique ability to provide information on clouds, water vapor, and temperature simultaneously, could help us to identify the important hydrological and dynamical processes occurring in the upper troposphere, especially around the tropopause.**

MLS Simultaneous Measurements





Top: January 2005 mean cloud IWC, water vapor (H_2O) and Temperature measured by Aura MLS at 100 hPa and 215 pressure levels

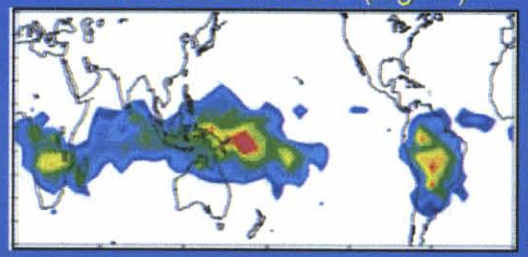
Bottom: Correlations between IWC and H_2O mixing ratio at four pressure levels (316, 215, 147, 100 hPa). The curves are polynomial fits to all January 2005 Aura MLS measurements.

Evaluation of hydrological processes in global models

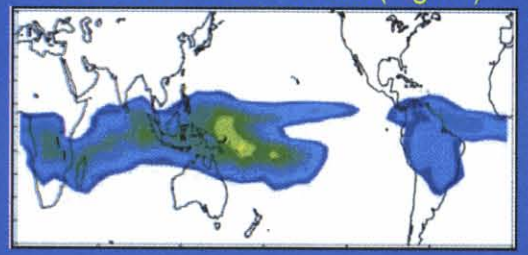
JPL

Aura MLS Measurements	Forecast Model Analyses	Climate Model Simulations
Jan 2005, 150 hPa	*Jan 2005, 150 hPa*	*10-yr Jan Climatology, 150 hPa*

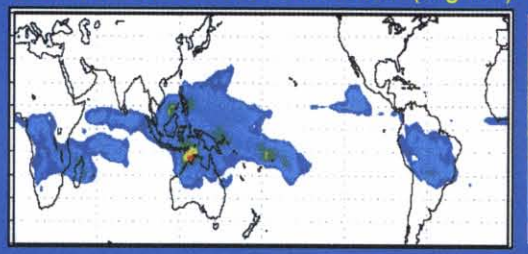
MLS Cloud Ice (mg/m^3)



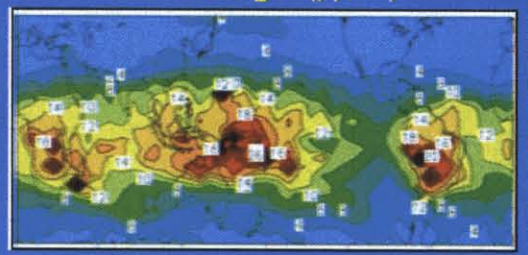
ECMWF Cloud Ice (mg/m^3)



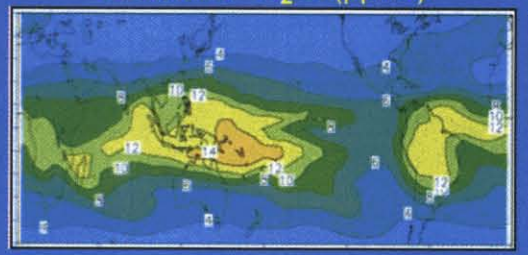
NCAR CAM3 Cloud Ice (mg/m^3)



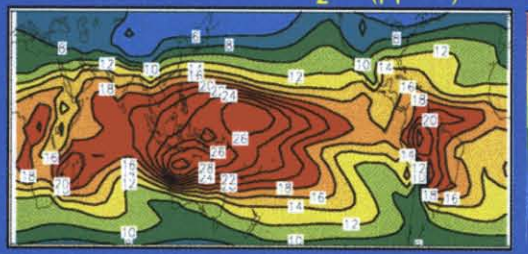
MLS H_2O (ppmv)



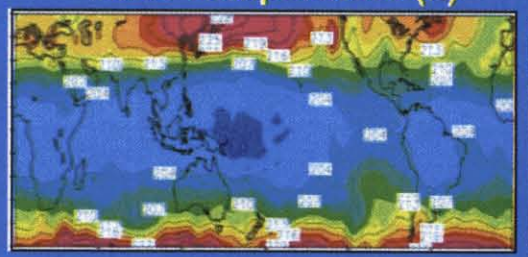
ECMWF H_2O (ppmv)



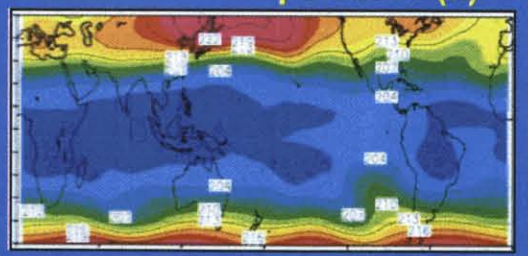
NCAR CAM3 H_2O (ppmv)



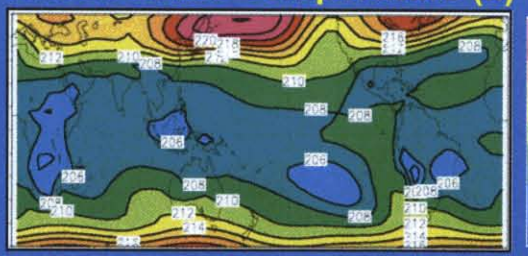
MLS Temperature (k)



ECMWF Temperature (k)

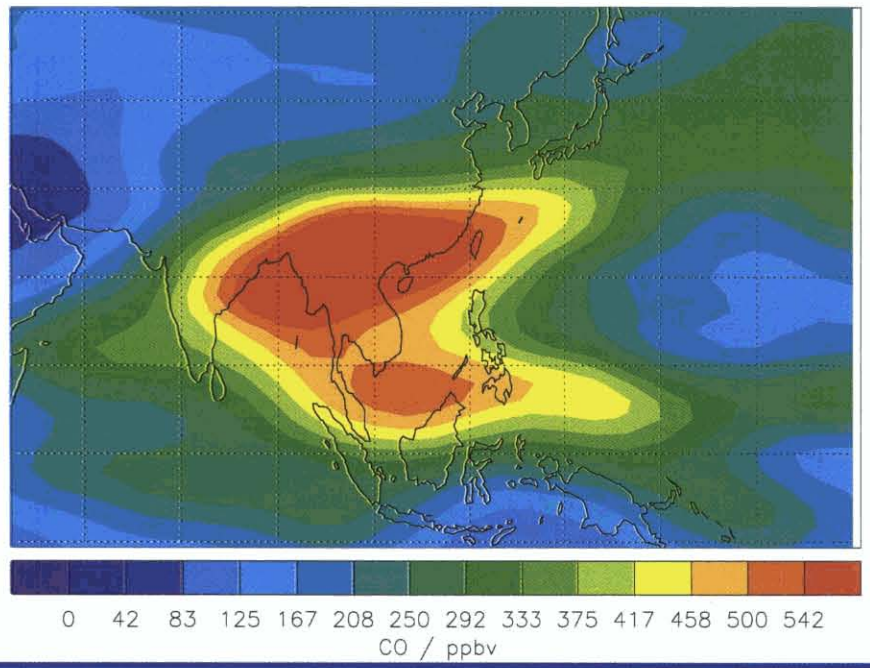


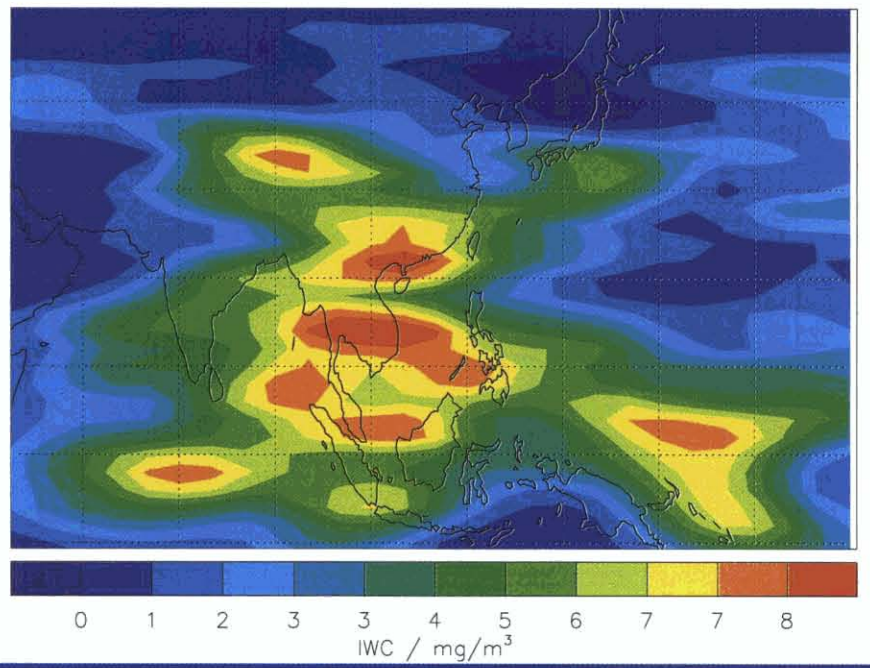
NCAR CAM3 Temperature (k)



- **Great uncertainties exist in our model representation of clouds and the related phase changes and water cycle in the upper troposphere. Aura MLS, for the first time, is providing new , and simultaneous global data that can set constraints on the uncertainties within the weather and climate forecasts.**

Studying the effect of pollution on high altitude clouds

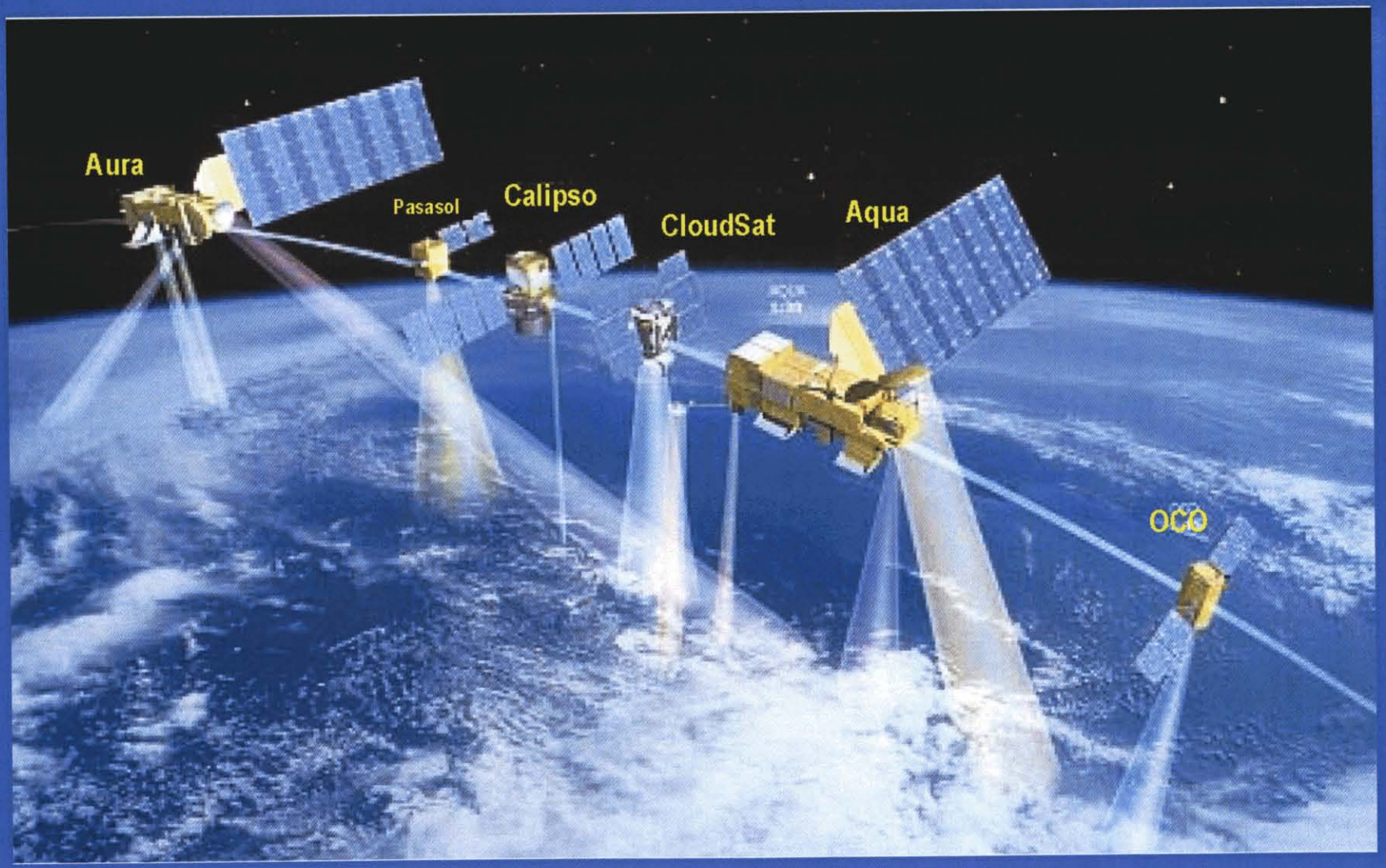




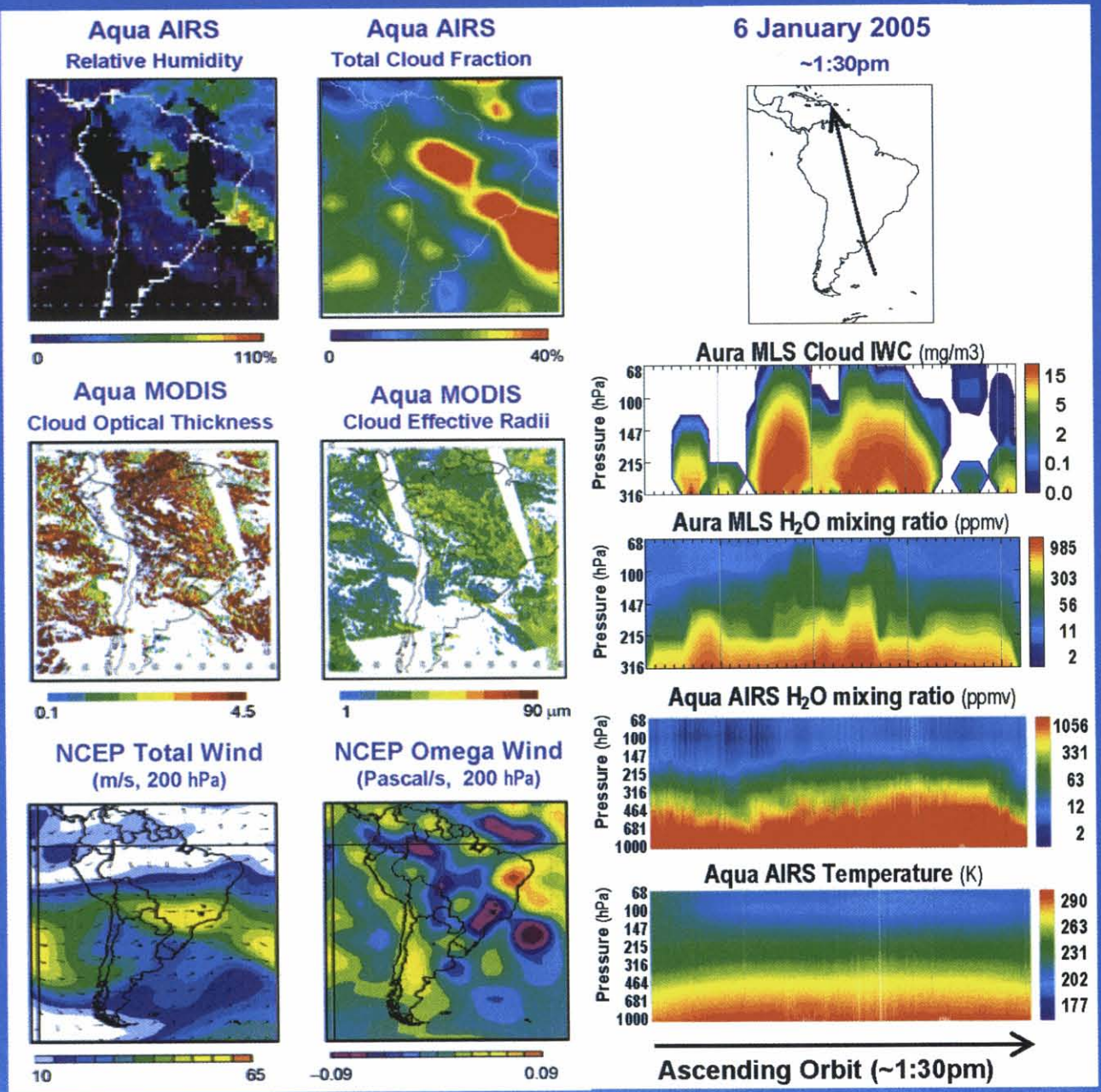
Aura MLS measured June 2005 mean CO mixing ratio (ppbv) and IWC (mg/m^3) at 350 K potential temperature surface. MLS's ability to measure clouds and CO simultaneously can help locate pollutant contaminated clouds and help study the potential influence of aerosols on high altitude clouds, since CO can be used as a proxy for aerosol in some cases [*Filipiak et al.* 2005; *Li et al.* 2005].

Exploiting 'A-Train' satellite datasets to support climate model development and validation:

Applications to clouds and chemistry/composition



A-Train analysis example I



Top-left:

On 1/6/2005, Aqua AIRS detected enhanced 200 hPa relative humidity and total cloud fraction over South America;

Mid-left:

Aqua MODIS reported coincident cloud optical thickness and effective radii, indicating larger radii were somewhat coincident with higher humidity and cloud fraction;

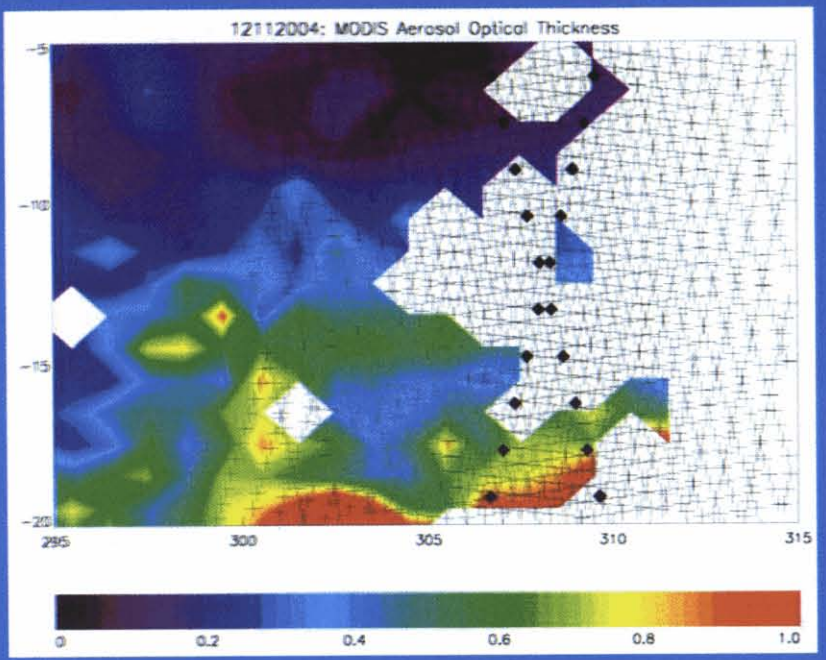
Lower-left:

NCEP analyses suggest an upper-level frontal system mov-ing across the continent;

Right:

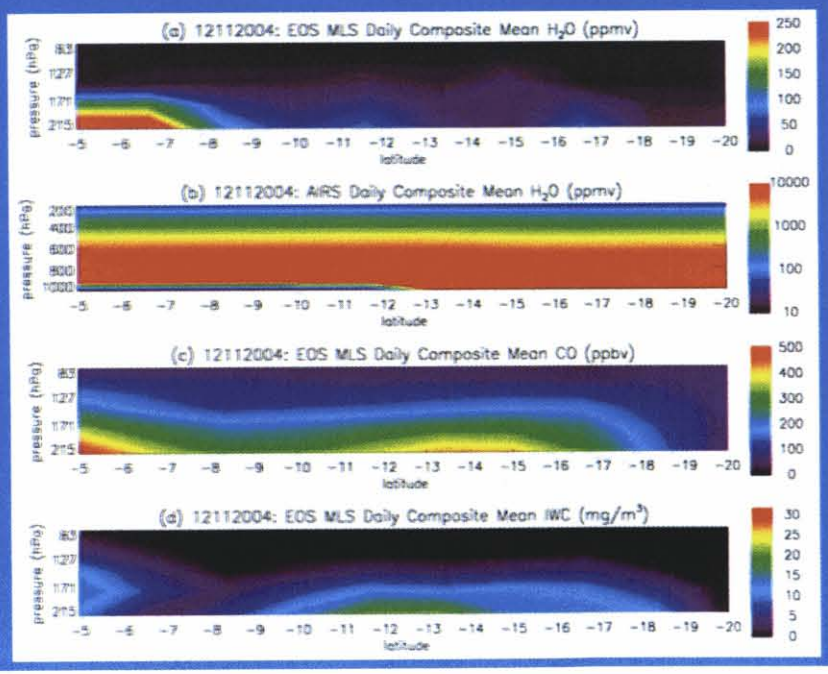
At same time, the MLS provided vertical profiles of IWC and H_2O mixing ratio in the upper trop - above 300 hPa. Complimenting this are profiles of H_2O mixing ratio and temperature from AIRS, where the former is expected to be good in the mid- and lower troposphere, with sensitivity loss at about 200 ppmv and less (< ~200 hPa). The horizontal line in the AIRS plot roughly indicates the lower level reached by MLS retrievals.

A-Train analysis example II



Aerosol optical depth observed by Aqua MODIS on 11-12-2004 over Amazonia. Aqua AIRS swath are marked by "+" and Aura MLS tracks are marked by "•".

Note missing data (white area) are due to the presence of thick clouds.



Curtain plots (11 December 2004)

Aura MLS H_2O mixing ratio (ppmv)

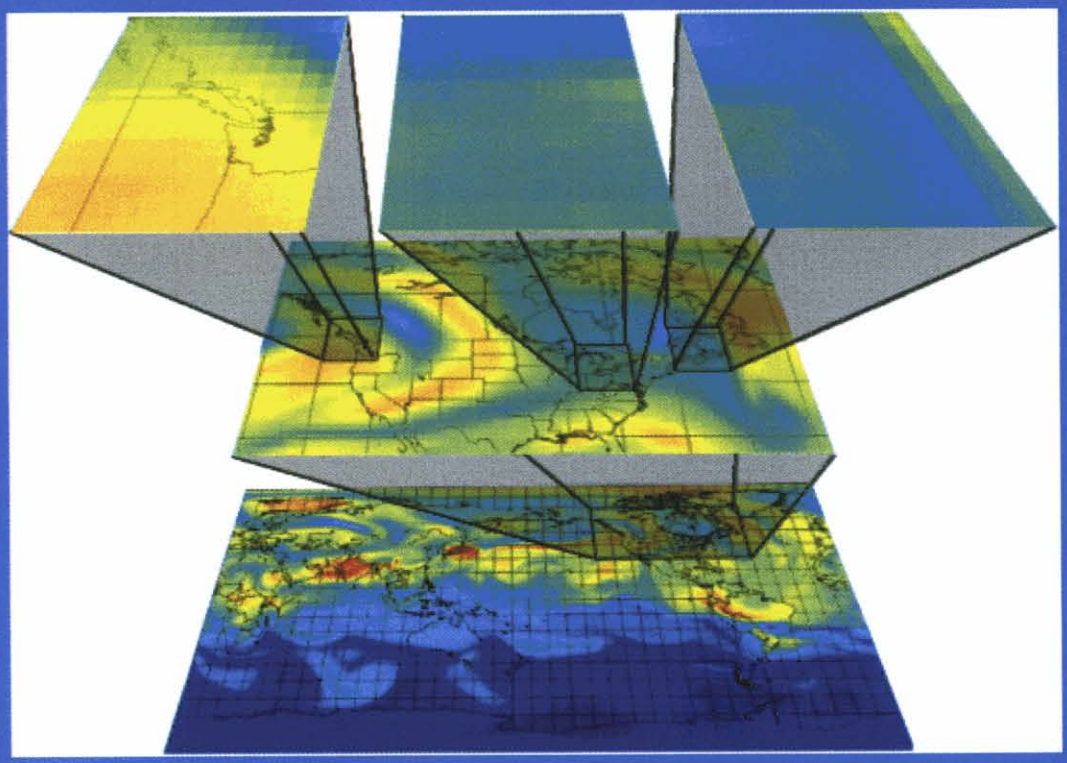
Aqua AIRS H_2O mixing ratio (ppmv)

Aura MLS CO mixing ratio (ppbv)

Aura MLS cloud IWC (mg/m^3)

JPL

Thank You !



http://mls.jpl.nasa.gov