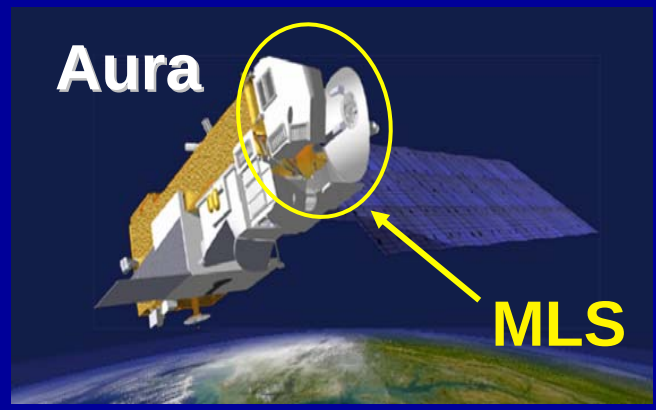
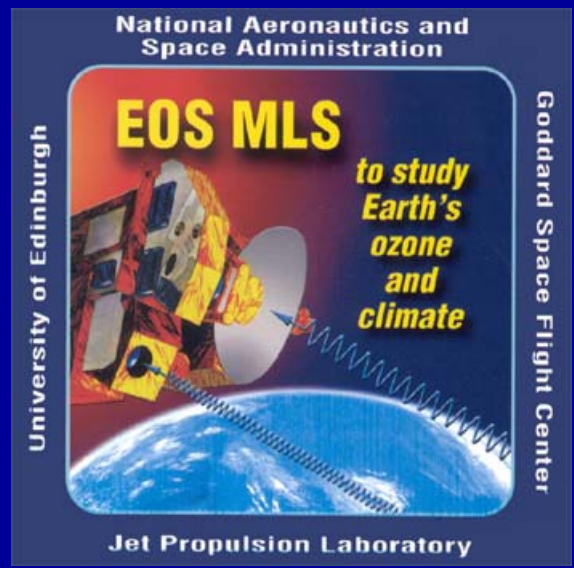
EOS MLS Overall Objectives

- Track recovery of the ozone layer
- Understand aspects of how composition affects climate
- Quantify aspects of pollution in the <u>upper</u> troposphere

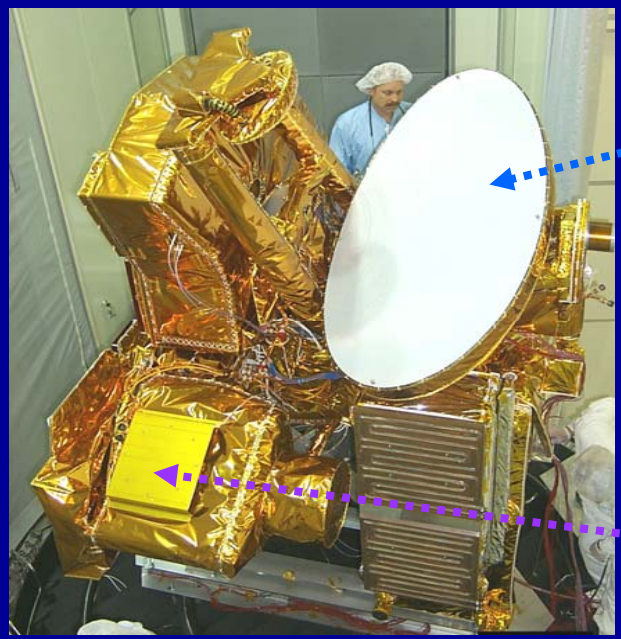




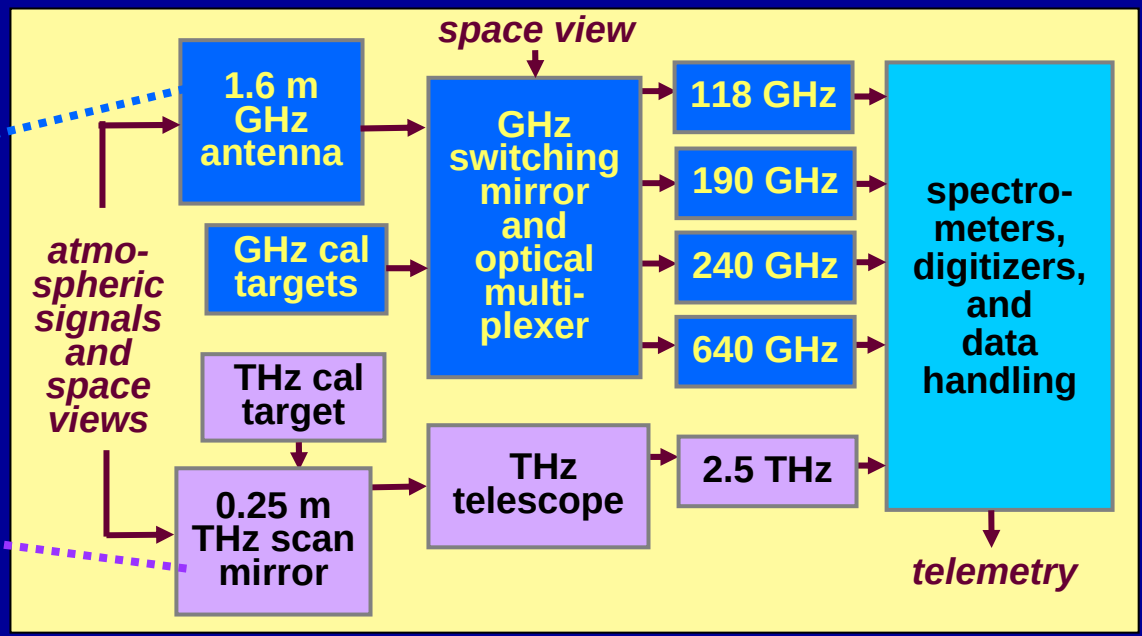
The EOS MLS Instrument

Jet Propulsion Laboratory
California Institute of Technology

- **Advanced follow-on to UARS MLS launched in 1991**
  - radiometers in 5 broad bands between 118 GHz, 2.5 THz
  - 455 kg, 535 W , 100 kb/s data, 28 spectrometers
- **Pioneers satellite measurements over full submillimeter wavelength region (0.1 - 3 mm)**
  - enabled by new technology, mostly developed by JPL



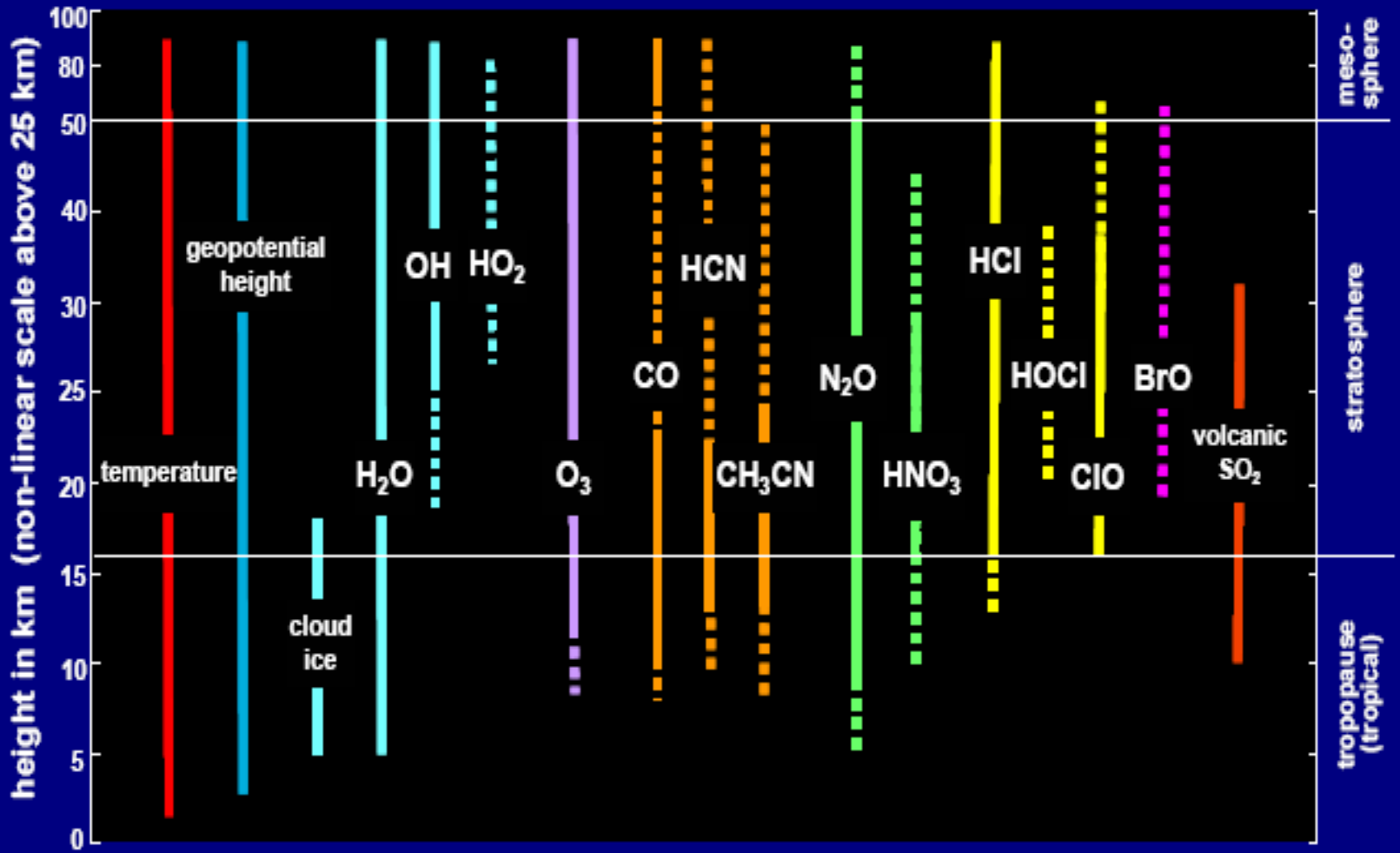
Flight instrument



Signal Flow Block Diagram

MLS Atmospheric Measurements

Jet Propulsion Laboratory
California Institute of Technology

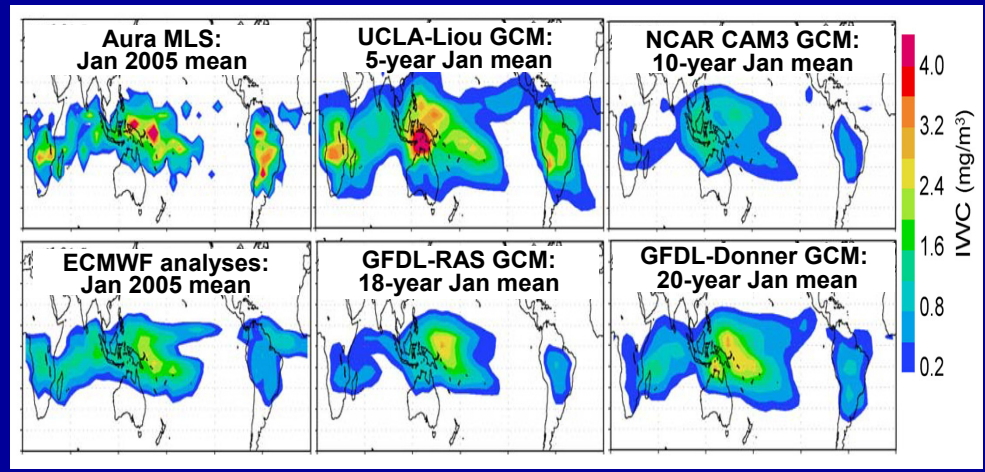


Solid lines indicate useful individual profile measurements are generally obtained.
Dashed lines indicate that averages are generally needed for useful precision.

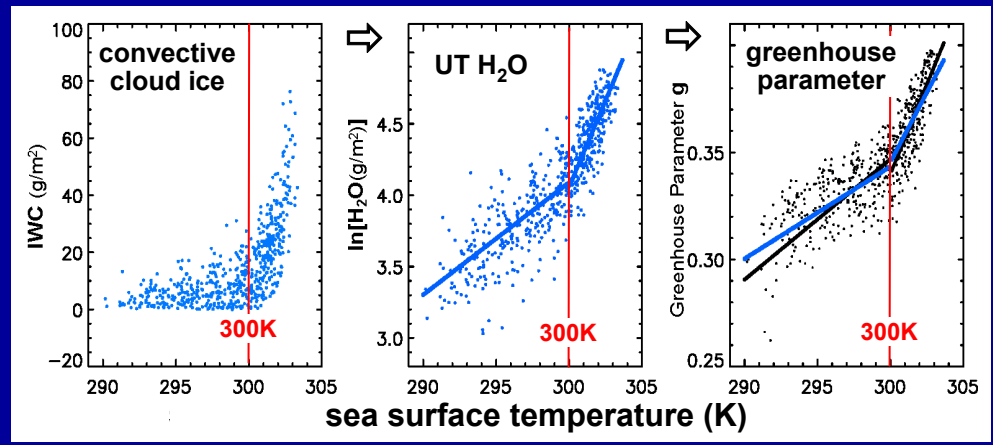
MLS Measurement of Cloud Ice in Upper Troposphere

Will improve global circulation models (GCMs) used for weather and climate forecasts and help quantify the upper tropospheric (UT) hydrological cycle, including water vapor feedbacks on climate change

- **UT cloud ice from MLS, ECMWF analyses, and various GCMs**
  - ➢ **Li et al., GRL 32, L14826, 2005**



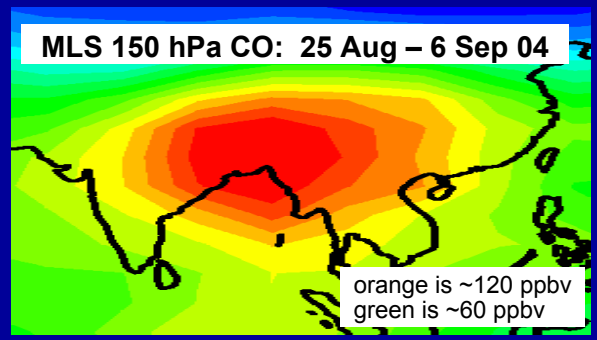
- **Cloud ice increase with sea surface temperature >300 K leads to convective moistening of UT, and H_2O feedback ~3x above that implied solely by thermodynamics**
  - ➢ **Su et al., GRL 33, L05709, 2006**



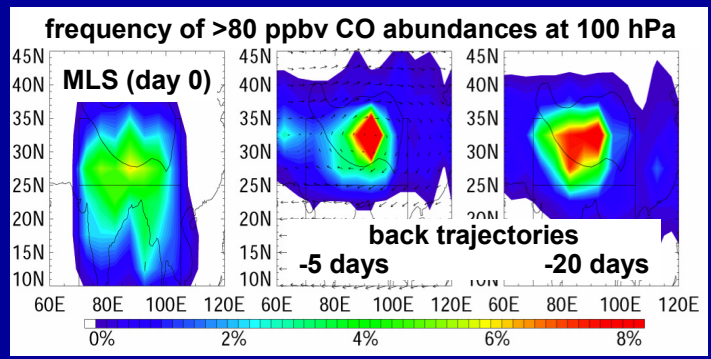
MLS Measurement of CO in Upper Troposphere

CO from biofuels and from biomass burning is lofted by convection, with a major pathway over Tibet into the stratosphere

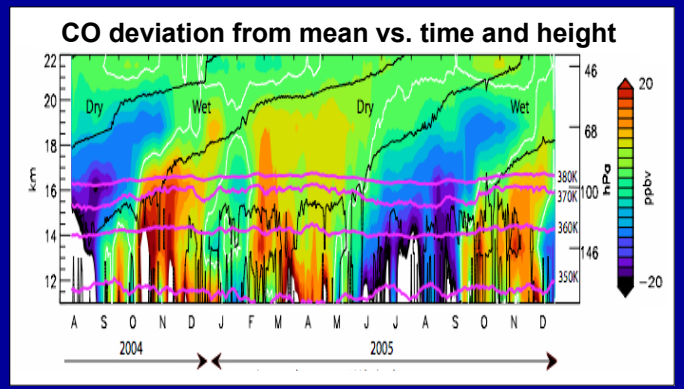
- **Detection of CO pollution lofted to the upper troposphere and temporarily 'trapped' in anticyclone over south Asia**
  - Filipiak et al., GRL 32, L14825, 2005
  - Li et al., GRL 32, L14826, 2005



- **Quantifying convective transport over the Tibetan plateau – and discovering it is a 'short circuit' to the global stratosphere**
  - Uses data primarily from MLS, but also from MODIS, AIRS and TRMM
  - Fu et al., Proc. Nat. Acad. Sci., April 2006



- **Detection of 'CO tape recorder' in lower stratosphere, and linking it to seasonal changes in biomass burning**
  - Reproduced by GMI chemical transport model
  - Schoeberl et al., GRL, in review

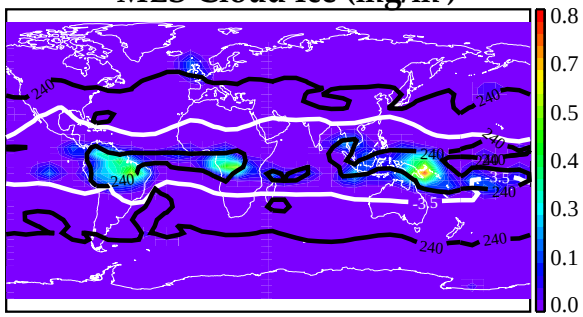


MLS Upper Troposphere Weekly Mean Maps for 9-15 Apr 2006 at 100 hPa

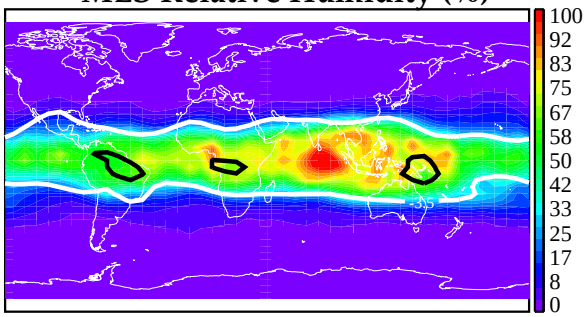
White contours: GMAO PV = 3.5 (10^{-6}Km^{2}kg^{-1}s^{-1}) indicative of dynamical tropopause

Black contours: GMAO OLR = 240 W/m^2 for IWC map and IWC = 0.3 mg/m^3 for other maps indicative of deep convection

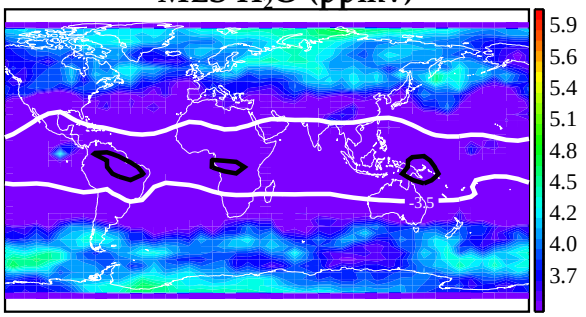
MLS Cloud Ice (mg/m^3)



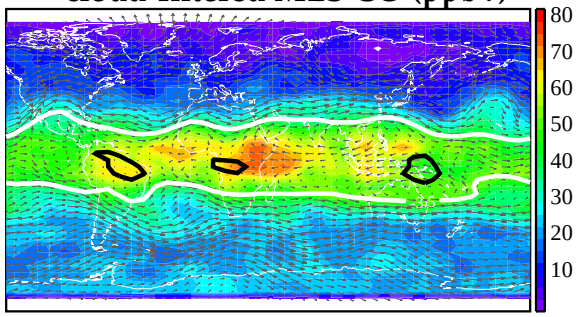
MLS Relative Humidity (%)



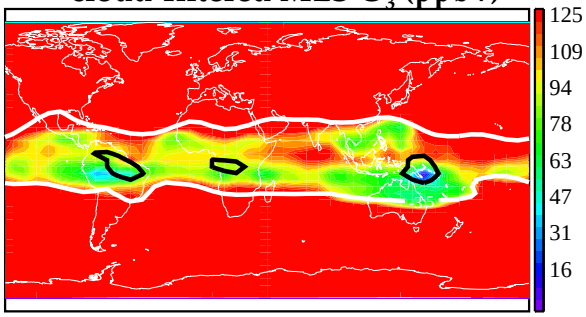
MLS H_2O (ppmv)



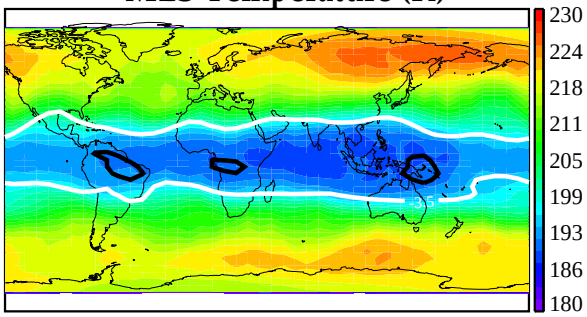
cloud-filtered MLS CO (ppbv)



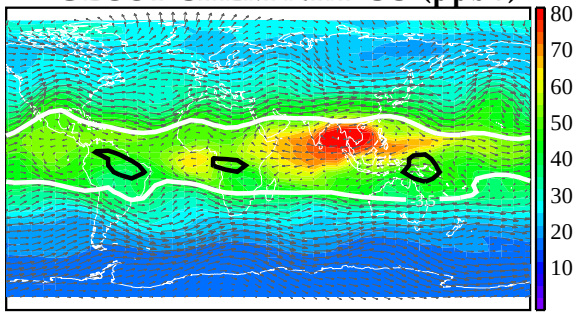
cloud-filtered MLS O_3 (ppbv)



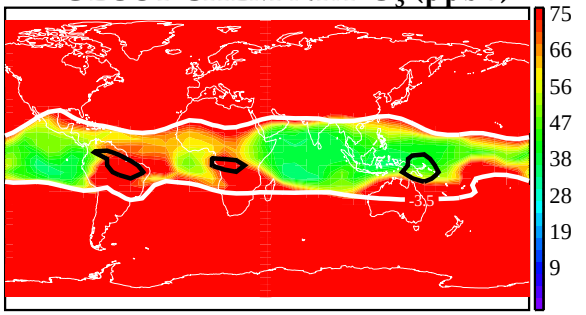
MLS Temperature (K)



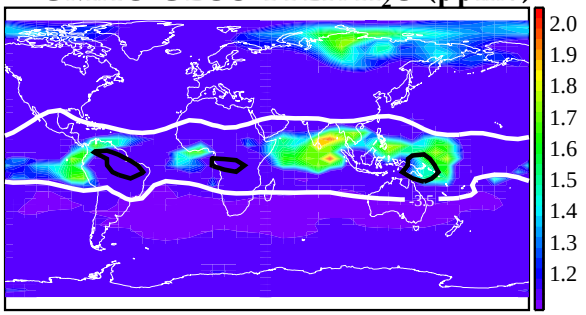
GEOS4-CHEM NRT CO (ppbv)



GEOS4-CHEM NRT O_3 (ppbv)



GMAO GEOS-4 FLK H_2O (ppmv)



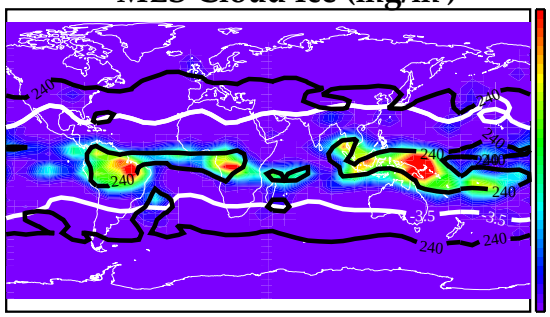
Produced by Jonathan Jiang of the MLS team at the Jet Propulsion Laboratory, California Institute of Technology, under contract with NASA, from EOS MLS, GEOS-CHEM and GMAO GEOS-4 data. JPL Clearance CL#05-3903

MLS Upper Troposphere Weekly Mean Maps for 9-15 Apr 2006 at 147 hPa

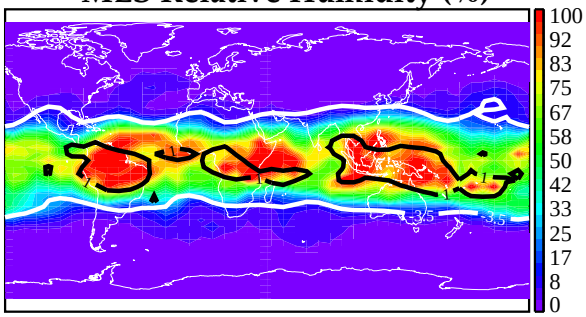
White contours: GMAO PV = 3.5 (10^{-6}Km^{2}kg^{-1}s^{-1}) indicative of dynamical tropopause

Black contours: GMAO OLR = 240 W/m^2 for IWC map and IWC = 1 mg/m^3 for other maps indicative of deep convection

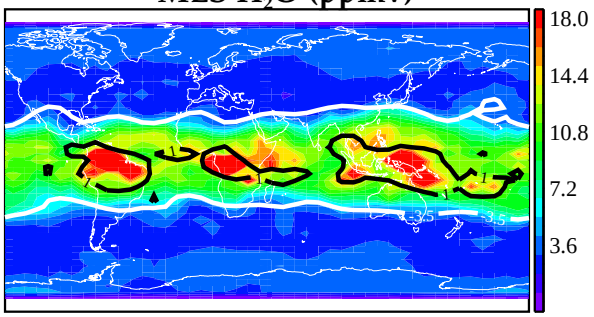
MLS Cloud Ice (mg/m^3)



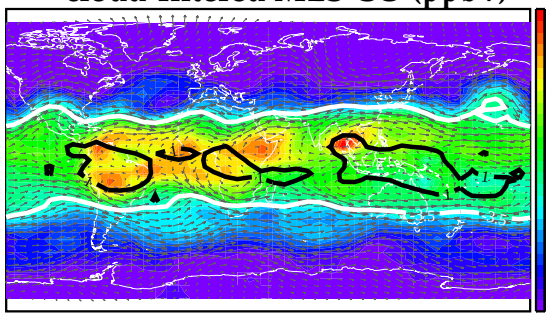
MLS Relative Humidity (%)



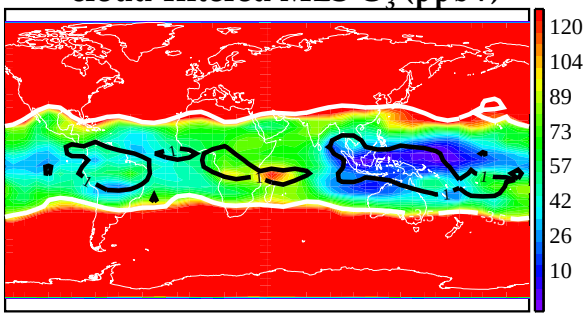
MLS H_2O (ppmv)



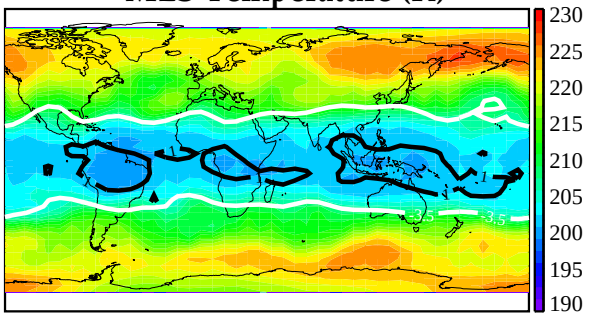
cloud-filtered MLS CO (ppbv)



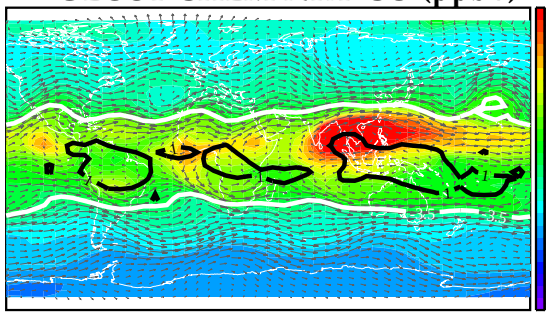
cloud-filtered MLS O_3 (ppbv)



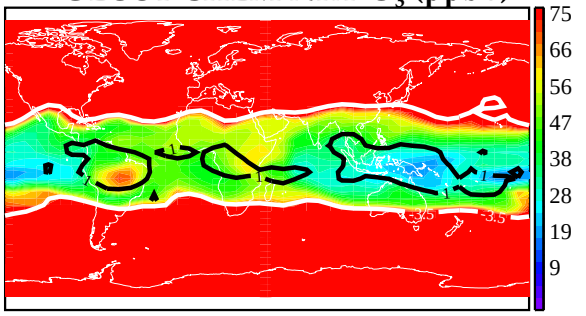
MLS Temperature (K)



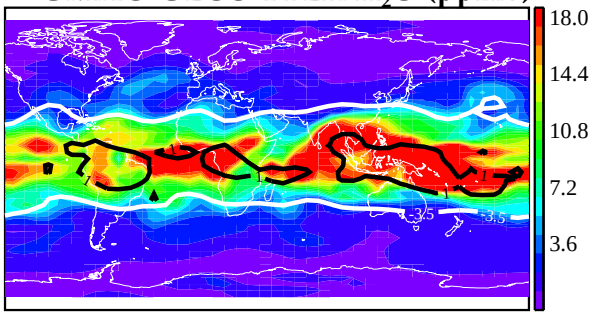
GEOS4-CHEM NRT CO (ppbv)



GEOS4-CHEM NRT O_3 (ppbv)



GMAO GEOS-4 FLK H_2O (ppmv)



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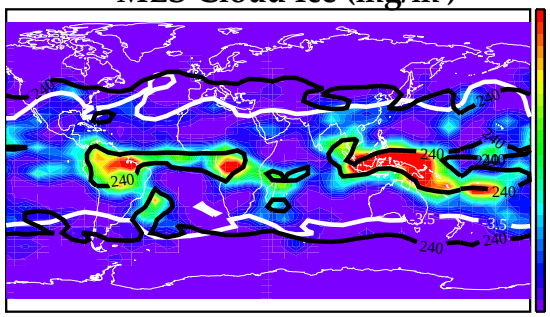
MLS Upper Troposphere Weekly Mean Maps for 9-15 Apr 2006 at 215 hPa

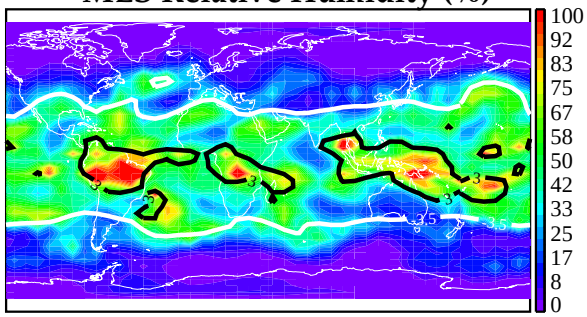
White contours: GMAO PV = 3.5 (10^{-6}Km^{2}kg^{-1}s^{-1}) indicative of dynamical tropopause

Black contours: GMAO OLR = 240 W/m^2 for IWC map and IWC = 3 mg/m^3 for other maps indicative of deep convection

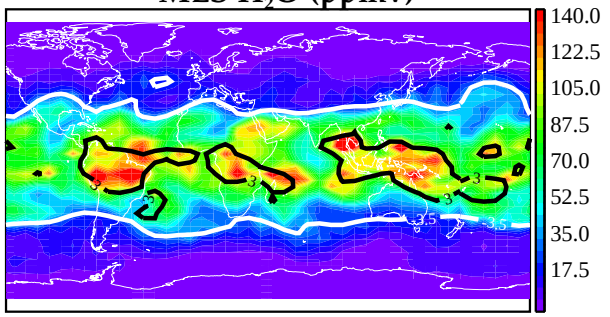
MLS Cloud Ice (mg/m^3)



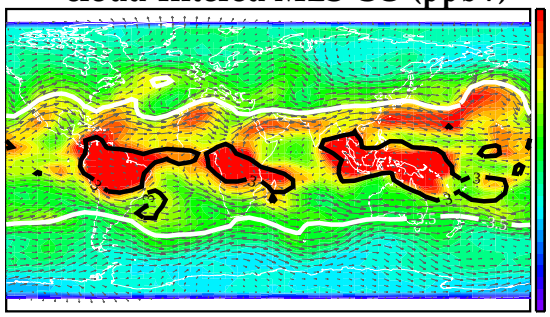
MLS Relative Humidity (%)



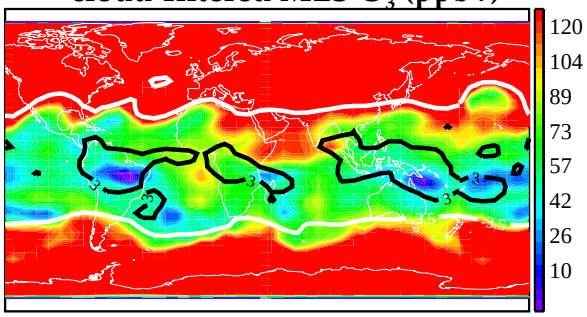
MLS H_2O (ppmv)



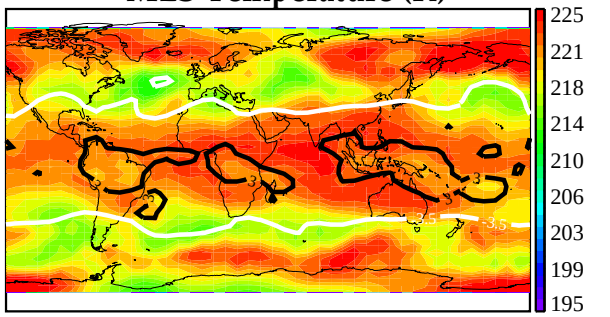
cloud-filtered MLS CO (ppbv)



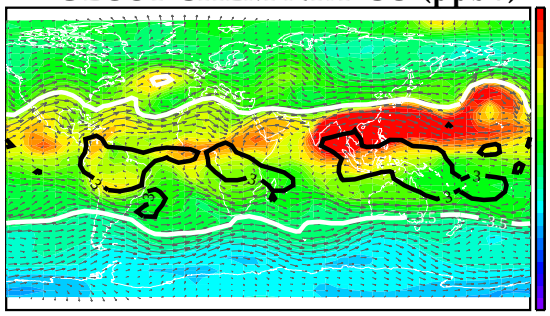
cloud-filtered MLS O_3 (ppbv)



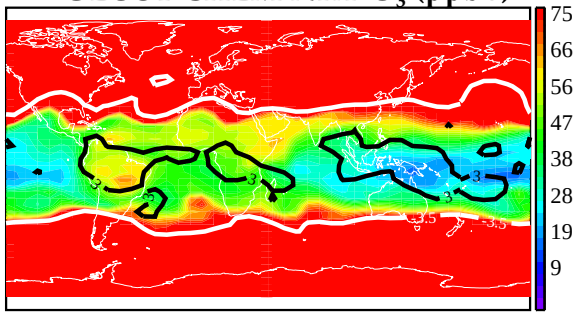
MLS Temperature (K)



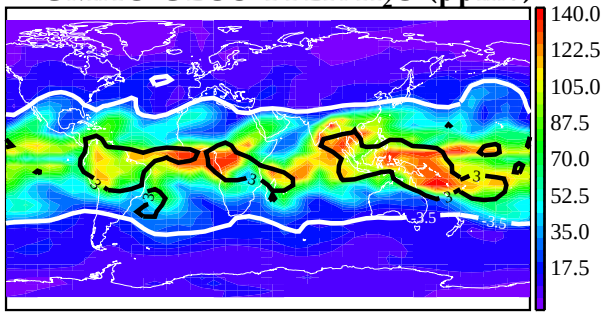
GEOS4-CHEM NRT CO (ppbv)



GEOS4-CHEM NRT O_3 (ppbv)



GMAO GEOS-4 FLK H_2O (ppmv)



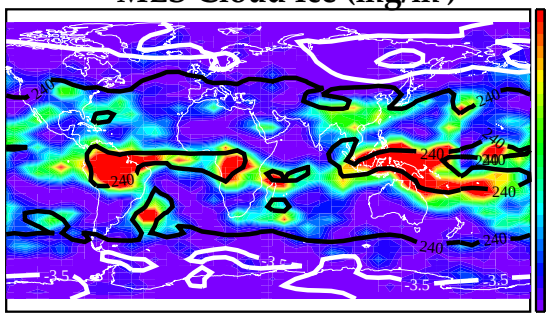
Produced by Jonathan Jiang of the MLS team at the Jet Propulsion Laboratory, California Institute of Technology, under contract with NASA, from EOS MLS, GEOS-CHEM and GMAO GEOS-4 data. JPL Clearance CL#05-3903

MLS Upper Troposphere Weekly Mean Maps for 9-15 Apr 2006 at 316 hPa

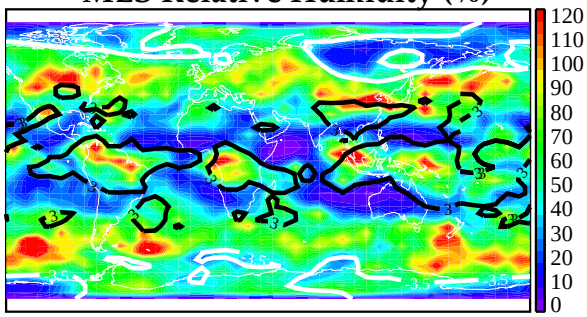
White contours: GMAO PV = 3.5 (10^{-6}Km^{2}kg^{-1}s^{-1}) indicative of dynamical tropopause

Black contours: GMAO OLR = 240 W/m^2 for IWC map and IWC = 3 mg/m^3 for other maps indicative of deep convection

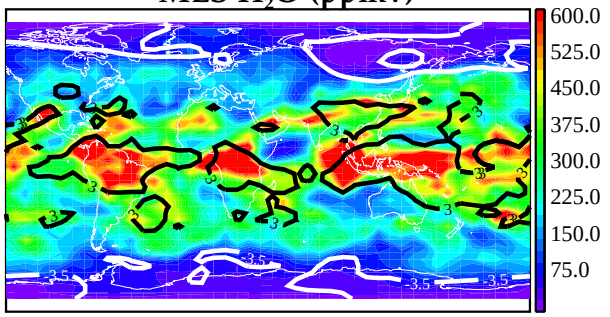
MLS Cloud Ice (mg/m^3)



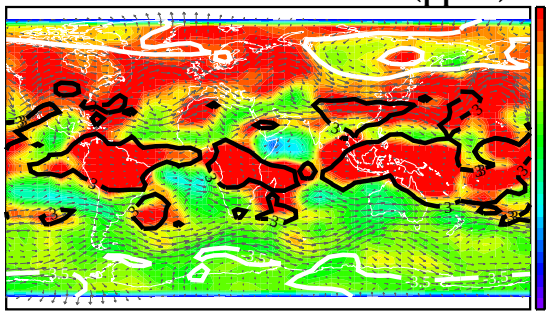
MLS Relative Humidity (%)



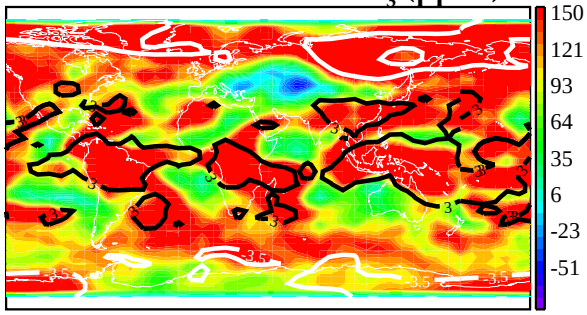
MLS H_2O (ppmv)



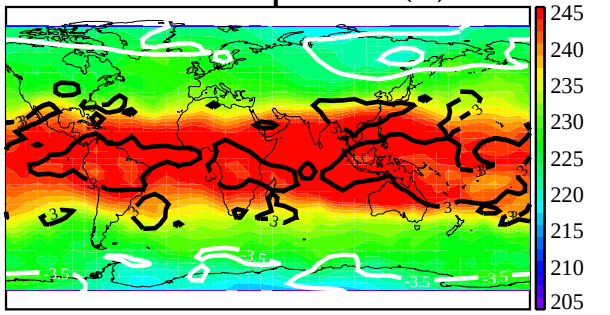
cloud-filtered MLS CO (ppbv)



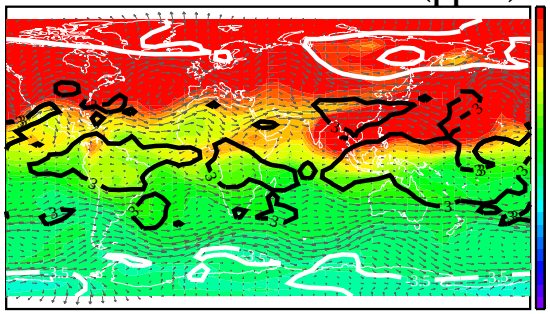
cloud-filtered MLS O_3 (ppbv)



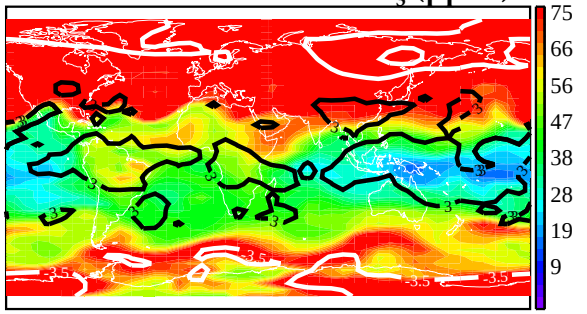
MLS Temperature (K)



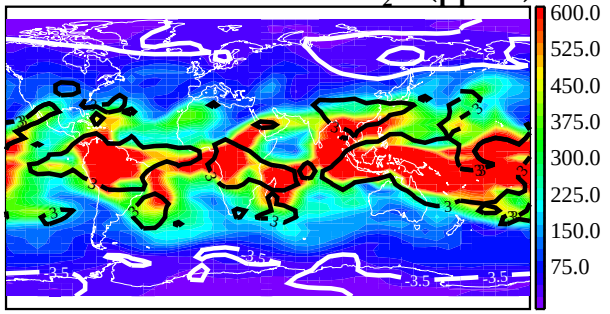
GEOS4-CHEM NRT CO (ppbv)



GEOS4-CHEM NRT O_3 (ppbv)



GMAO GEOS-4 FLK H_2O (ppmv)



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