MLS-Related Scientific Publication

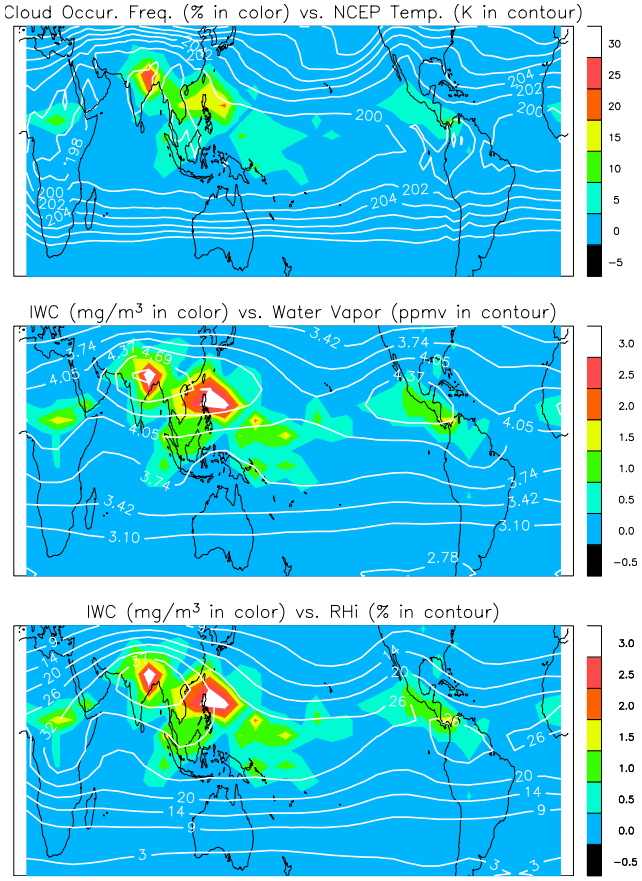
Scientific Themes: Atmospheric Dynamics.

UARS MLS Cloud Ice Measurements and Implications for H_2O Transport near the Tropopause, D. L. Wu, W. G. Read, A. E. Dessler, S. C. Sherwood, and J. H. Jiang, *J. Atmos. Sci.*, **62** (2): 518-530 FEB 2005.

MLS contact: D. L. Wu, dwu@mls.jpl.nasa.gov, 818-393-1954.

Summary

A technique for cloud detection and Ice Water Content (*IWC*) retrieval is described here and applied to UARS MLS (Upper Atmosphere Research Satellite Microwave Limb Sounder) 203-GHz radiance measurements at tangent pressures between 300 and 46 hPa. At these tangent pressures the radiances remain optically thin and cloudy-sky radiances are brighter than normal clear-sky cases. Unlike infrared/visible cloud observations, the 203-GHz radiances are sensitive mostly to large ice crystals that are often of convective origin rather than thin cirrus. The initial MLS *IWC* results and comparisons with MLS water vapor measurements reveal many interesting features in the tropical tropopause layer (TTL) region. The 100-hPa *IWC* averaged between 30°S-30°N is approximately constant at ~0.07 mg/m^3, or 0.7 ppmv for equivalent water vapor at this pressure, but large *IWC*s are concentrated over convective centers where seasonal mean ice content can exceed 20 ppmv vapor equivalent. The correlation between *IWC* and water vapor at 100 hPa is relatively poor over oceans compared to one over land masses. However, there exists good correlation between tropical *IWC* and RH_i (relative humidity with respect to ice) at 100 hPa during both the dry (January-March) and moist (July-September) periods.



Measuring cloud ice at the tropopause altitudes has been one of the most difficult challenges for remote sensing from space. Millimeter and sub-millimeter limb techniques offer a new opportunity for cloud observations in the upper troposphere and are complementary to IR/visible sensors in many aspects.

This figure shows cloud ice, water vapor and temperature maps at 100 hPa for June-August 1992. Top: MLS cloud occurrence frequency (colors) and NCEP temperature (contours). Middle: MLS IWC (colors) and H_2O vmr (contours). Bottom: MLS IWC (colors) and RH_i (contours). Profiles contaminated by clouds are excluded in the water vapor and RH_i maps.

The patterns of MLS *IWC* generally correlate positively with the water vapor *vmr* at 100 hPa except near the southern Pacific during the dry period (e.g., January-March 1992), where the *vmr* peak is located 5-10° south of the *IWC*. Better agreement is found when comparing the 100-hPa *IWC* to the 147-hPa H_2O *vmr*.