

# MLS-Scientific Publication

Scientific Themes: Climate Research

## UARS Microwave Limb Sounder upper tropospheric humidity measurement: Method and Validation,

W. G. Read, J. W. Waters, D. L. Wu, E. M. Stone, Z. Shippony, A. C. Smedley, C. C. Smallcomb, S. Oltmans, D. Kley, H. G. J. Smit, J. L. Mergenthaler, and M. K. Karki, *J. Geophys. Res.*, **106**, 32,207–32,258, (Dec., 2001).

MLS contact: W. G. Read, bill@mls.jpl.nasa.gov, 818-354-6773.

### Summary

Humidity in the upper troposphere (UTH) affects weather and climate. Upper tropospheric relative humidity has a substantial effect on outgoing longwave radiation (OLR), which regulates the global greenhouse budget. For example, a change in relative humidity from 20% to 30% in a 100 hPa thick layer centered at 200 hPa altitude decreases OLR by  $2 \text{ Wm}^{-2}$ , which is equivalent to half the direct forcing of doubling the  $\text{CO}_2$  concentration in the atmosphere. Despite its importance, few reliable UTH measurements exist because of difficulty in detecting its low absolute abundances. Although the Microwave Limb Sounder (MLS) was not designed to measure UTH, it has been successfully extracted from MLS data using a novel analysis method described in this publication. The measured MLS UTH is validated by comparisons with the Vaisala radiosonde network, frostpoint hygrometers, MOZAIC (an airborne humidity sensor mounted on commercial aircraft), potential vorticity, and the Goddard Earth Observing System data assimilation humidity. As an example, Figure 1 shows a scatterplot of coincident MLS UTH and Vaisala radiosonde measurements. Comparing the thick solid line, which is a running average of the scatter, to the one-to-one thin line demonstrates that the MLS UTH compares favorably with the Vaisala humidity within the expected 20–25% MLS UTH accuracy. The large scatter results from comparing a volume averaged measurement (MLS) to an in-situ measurement (Vaisala) for UTH, which has large short-term temporal and spatial variability. As an example of new science, Figure 2 shows for the first time a height resolved UTH global climatology measured in the presence of cirrus. Note in particular, the transition from a relatively dry tropics at 464 and 316 hPa to a relatively moist tropics at 215 and 147 hPa.

This work benefits society by providing global measurements of UTH that can be used to test climate models.

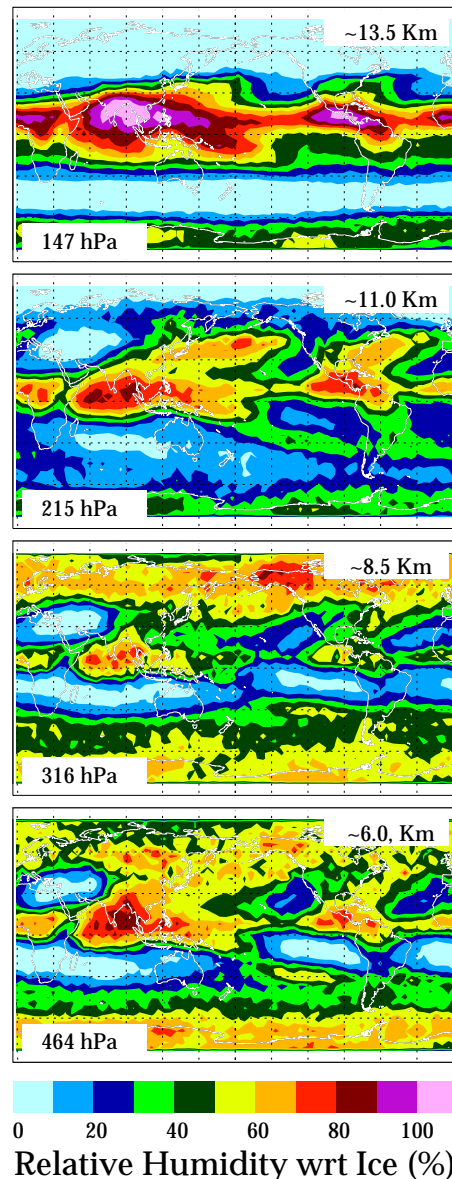
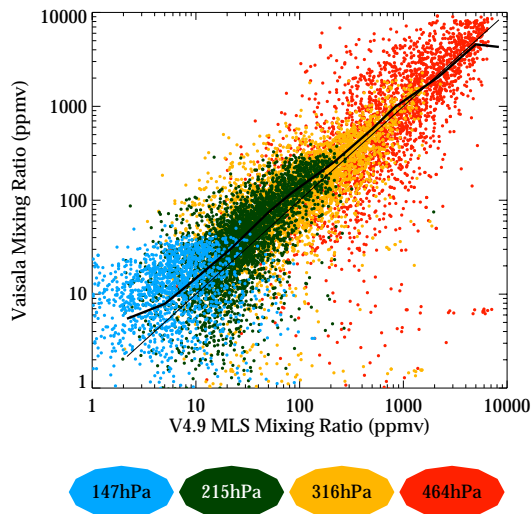


Figure 1: Scatter between Vaisala radiosonde and MLS V4.9 UTH measurements. Pressure level of the measurements is color coded. One to one (thin) and averaged (thick) lines are shown.

Figure 2: Height resolved UTH climatology from v4.9 MLS for June, July, and August.