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Atmos. Chem. Phys., 8, 309-320, 2008
www.atmos-chem-phys.net/8/309/2008/
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Comparison of satellite limb-sounding humidity climatologies of the uppermost tropical troposphere

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Abstract. Humidity climatologies of the tropical uppermost troposphere from satellite limb emission measurements have been compared. Four instruments are considered; UARS-MLS, Odin-SMR, and Aura-MLS operating in the microwave region, and MIPAS in the infrared region. A reference for the comparison is obtained by MOZAIC in-situ measurements.

The upper tropospheric humidity products were compared on basis of their empirical probability density functions and seasonally averaged horizontal fields at two altitude layers, 12 and 15 km. The probability density functions of the microwave datasets were found to be in very good agreement with each other, and were also consistent with MOZAIC. The average seasonal humidities differ with less than 10%RH_i between the instruments, indicating that stated measurement accuracies of 20–30% are conservative estimates. The systematic uncertainty in Odin-SMR data due to cloud correction was also independently estimated to be 10%RH_i. MIPAS humidity profiles were found to suffer from cloud contamination, with only 30% of the measurements reaching into the upper troposphere, but under clear-sky conditions there is a good agreement between MIPAS, Odin-SMR and Aura-MLS.

Odin-SMR and the two MLS datasets can be treated as independent, being based on different underlying spectroscopy and technology. The good agreement between the microwave limb-sounders, and MOZAIC, is therefore an important step towards understanding the upper tropospheric humidity. The found accuracy of 10%RH_i is approaching the level required to validate climate modelling of the upper troposphere humidity. The comparison of microwave and infrared also stresses that microwave limb-sounding is necessary for a complete view of the upper troposphere.

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Citation: Ekström, M., Eriksson, P., Read, W. G., Milz, M., and Murtagh, D. P.: Comparison of satellite limb-sounding humidity climatologies of the uppermost tropical troposphere, Atmos. Chem. Phys.,

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