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Odin-SMR observations of relative humidity and clouds the tropical upper troposphere

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Water vapour and clouds in the upper troposphere (UT) have a crucial impact on the radiative balance, but are today poorly treated in climate models due to a lack of relevant measurement data. Main considerations for satellite sounding of water vapour in UT are achievable vertical resolution and cloud penetration capability. These two considerations are probably best addressed by microwave limb sounding.

The sub-mm radiometer onboard the Odin satellite, Odin-SMR, performs limb sounding at frequencies around 500 GHz since the launch in 2001. The observations have sensitivity down to 10 km, but tangent altitudes inside the troposphere have up to now been ignored due to cloud scattering. This effect can now be rigorously simulated by a new radiative transfer software (ARTS) and first retrievals of tropospheric quantities have been performed.

A first retrieval scheme has been developed, using only spectra with tangent altitudes below 9 km. This way spectra can be inverted individually, uncertainties in sideband filter characteristics can be ignored, and the presence of clouds is comparably easily determined. This scheme gives the all weather mean relative humidity between 10-14 km, and column of cloud ice above 10 km. Main water vapour retrieval uncertainties are compensation for cloud scattering and spectroscopic information. The key retrieval issue for cloud ice is the necessary assumption on particle size distribution.

Odin covers the gap between the UARS and AURA missions and gives an independent view of the tropical UT. Odin-SMR cloud ice retrievals are an important complement to lidar and radar measurements, as the cloud signal is more directly related to the total ice mass.