Geophysical Research Abstracts,
Vol. 11, EGU2009-11520, 2009
EGU General Assembly 2009

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Tropical Stratospheric Water Vapour Observed by Microwave Spectrometry

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Abstract

Water vapour plays a key role in middle atmospheric processes. Because of its large infrared resonance, it contributes to radiative cooling. It is a source gas for the highly reactive hydroxyl radical, and exerts further indirect effects on ozone destruction in the formation of polar stratospheric clouds. It also serves as a dynamical tracer. The processes governing water vapour distribution, variability, and trends are still not sufficiently understood. Continuous long-term monitoring of stratospheric water vapour is of particular importance in the separation of trend signals from the large seasonal and annual variations in water vapour entering the stratosphere.

The authors observe tropical stratospheric water vapour with a ground-based microwave spectrometer at Mérida Atmospheric Research Station, Pico Espejo, Venezuela ($8°32'\,\mathrm{N}, 71°03'\,\mathrm{W}$, $4765\,\mathrm{m}$ above sea level). The $22\,\mathrm{GHz}$ receiver WaRAM2 is the only such sensor that continuously operates at tropical latitudes. A time series of stratospheric water vapour in 2007 demonstrates the sensor's utility for mitigating the current observational shortcomings. A numerical experiment supports its capacity to study the seasonal modulation of stratospheric water vapour entry levels, and the observation technique in principle allows detecting diurnal variations in $\mathrm{H_2O}$. The retrieval is currently limited to $30 - 50\,\mathrm{km}$ at roughly $10\,\mathrm{km}$ vertical resolution, but could be extended downwards by refinements to the retrieval set-up that are currently being investigated. WaRAM2 results are compared to correlative data from Aura/MLS, yielding good agreement at $33\,\mathrm{km}$. At $44\,\mathrm{km}$, WaRAM2 is $0.7\,\mathrm{ppmv}$ (10%) lower than MLS on average.

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