Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 9, 9647-9660, 2009
www.atmos-chem-phys.net/9/9647/2009/

Hydration and dehydration at the tropical tropopause

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Abstract. High-resolution water measurements from three tropical airborne missions in Northern Australia, Southern Brazil and West Africa in different seasons are analysed to study the transport and transformation of water in the tropical tropopause layer (TTL) and its impact on the stratosphere. The mean profiles are quite different according to the season and location of the campaigns, with lowest mixing ratios below 2 ppmv at the cold point tropopause during the Australian mission in November/December and high TTL mixing ratios during the African measurements in August. We present backward trajectory calculations considering freeze-drying of the air to the minimum saturation mixing ratio and initialised with climatological satellite data. This trajectory-based reconstruction of water agrees well with the observed H_2O average profiles and therefore demonstrates that the water vapour set point in the TTL is primarily determined by the Lagrangian saturation history. Deep convection was found to moisten the TTL, in several events even above the cold point up to 420 K potential temperatures. However, our study does not provide evidence for a larger impact of these highly-localised events on global scales.

Final Revised Paper (PDF, 4152 KB) Discussion Paper (ACPD)

Citation: Schiller, C., Grooß, J.-U., Konopka, P., Plöger, F., Silva dos Santos, F. H., and Spelten, N.: Hydration and dehydration at the tropical tropopause, Atmos. Chem. Phys., 9, 9647-9660, 2009. Bibtex EndNote Reference Manager