Geophysical Research Abstracts
Vol. 12, EGU2010-15421, 2010
EGU General Assembly 2010

Climatology and Dynamics of Water Vapor: Three Years of Sounding with the Differential Absorption Lidar on Mt. Zugspitze

Hannes Vogelmann and Thomas Trickl
Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany

Water vapor is the the most important greenhouse gas and its vertical distribution plays a major role for the radiative balance. In particular in the upper troposphere the radiative transfer is very sensitive to small changes of the water-vapor concentration. At the same time the water-vapor distribution strongly depends on atmospheric dynamics and, thus, can serve as a good tracer for airmass histories. In order to access water-vapor profiles with a high resolution in time (typically 15 min) and a high vertical resolution (50 m to 300 m) throughout the free troposphere (3 km to 12 km a.s.l.) a differential absorption lidar (DIAL) system with excellent daytime capability has been developed and installed at the Schneefernerhaus research station (UFS) on Mt. Zugspitze (Germany) at an altitude of 2675 m a.s.l. (Vogelmann and Trickl 2008). The DIAL system is in routine operation since January 2007 and recording water-vapor profiles on one or two days a week. We present results from the first three years of operation. A climatology is derived and different water-vapor profile-types are assigned to typical large-scale atmospheric circulation patterns as well as to local-scale circulation patterns for the lower altitudes, in particular in the summer season, when the orographic convection reaches altitudes higher than 3 km a.s.l.. Particular attention is spent on stratospheric air intrusion events, which exhibit a maximum at the Alpine summit levels during the winter season (Trickl et al., 2010). Based on daily intrusion forecast-model by ETH Zürich simultaneousmeasurements with the water-vapor DIAL and the ozone-lidar at Garmisch-Partenkirchen have been carried out.
In combination also with the in-situ measurements at the Zugspitze summit several intrusions have been very well characterized. In one exciting case a large-scale stratospheric intrusion took place during a lidar intercomparison campaign (LUAMI 2008) with an airborne DIAL. The intrusion layer was mapped by the airborne system over a major part of Central Europe as well as by the H2O profiles obtained at the four lidar stations overpassed during that cruise. Another atmospheric pattern type of special interest is the advection from the Mediterranean Sea and the Sahara, which are often accompanied by orographic ”Föhn” events.

References:

H. Vogelmann and T. Trickl: Wide Range Sounding of Free Tropospheric Water Vapor with a Differential Absorption Lidar (DIAL) at a High Altitude Station, Appl. Opt., 47, 2116-2132, 2008.

T. Trickl, H. Feldmann, H.-J. Kanter, H. E. Scheel, M. Sprenger, A. Stohl, and H.Wernli: Deep Stratospheric Intrusions over Central Europe: Case Studies and Climatological Aspects, Atmos. Chem. Phys. 10, 499-524, 2010.