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Combined Raman Lidar and DIAL Sounding of Water Vapour and Temperature at the NDACC Station Zugspitze

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The primary greenhouse gas water vapour has moved into the focus of lidar sounding within the Network for the Detection of Atmosperhic Compostion Change (NDACC). Lidar systems with an operating range reaching at least the tropopause region are asked for, with some future extension into the stratosphere. As a first step, we installed in 2003 a powerful differential-absorption lidar (DIAL) at the Schneefernerhaus high-altitude station next to the Zugspitze summit (Germany) [Vogelmann and Trickl, 2008]. This lidar system, located at 2675 m a.s.l., provides water-vapour profiles in the entire free troposphere above 3 km with high vertical resolution and an accuracy of about 5 % up to 8 km without observable bias. Most importantly, due to the high sensitivity of the DIAL technique this wide operating range is also achieved during daytime and under dry conditions. In a parallel contribution we present examples from the routine measurements of this lidar system during the past three years. The results reflect the extreme variability of the free-tropospheric water-vapour concentration, caused by the rich tropospheric dynamics. The system is capable of quantititatively detecting relative humidities of 0 to 2 % in layers of stratospheric origin even just 300 m wide.

Due to the very low stratospheric water-vapour mixing ratio of about 5 ppm an extension of the lidar sounding of H_2O into the stratosphere is a highly demanding task. Our solution is a particularly big Raman lidar system, which is currently under development at the Schneefernerhaus. By using a 350-W xenon-chloride laser system and a 1.5-m-diameter receiver we hope to extend for the first time the humidity measurements to almost 30 km during nighttime (as extrapolated from results by Leblanc et al. [2004], Whiteman et al. [2008]). We expect that this system is going to fill the existing gap for accurate vertically resolved ground-based routine measurements of water vapour in the lower stratosphere. At the same time the sensitivity for water vapour around the tropopause will be enhanced.One important feature is the calibration of the Raman lidar with the DIAL measurements in the same laboratory, which will result in a good long-term stability. Our first, quite ambitious goal is to achieve narrow-band and polarized operation of the powerful excimer laser that is normally used for industrial production. At the meeting, we will present the system layout and first results on the laser development.

In addition, the new lidar will provide temperature profiles up to more than 80 km, based on Raman and Rayleigh methods. The measurements of both quantities are seen as an important step towards an experimental approach to climate research, which will be complemented by recording the spectrally resolved thermal radiation of the sky in the near future.

References:

H. Vogelmann, T. Trickl, Wide-range sounding of free-tropospheric water vapor with a differential-absorption lidar (DIAL) at a high-altitude station, Appl. Opt. 47 (2008), 2116-2132

T. Leblanc, I. S. McDermid, D. A. Haner, T. D. Walsh, A High-capability Raman Lidar for Upper Tropospheric and Lower Stratospheric Water Vapor Measurements, p. 447-450 in: Reviewed and Revised Papers Presented at the 22nd International Laser Radar Conference, G. Pappalardo, A. Amodeo, Eds., ESA Publications Division (Noordwijk, The Netherlands, 2004), ISBN 92-9092-872-7

D. N. Whiteman, et al., Airborne and Ground-Based Measurements of Water Vapor and Aerosols Using a High-Performance Raman Lidar, pp. 87-90 in: Reviewed and Revised Papers Presented at the 24th International Laser Radar Conference, M. Hardesty, S. Mayor, Eds., NOAA (Boulder, U.S.A., 2008), ISBN 978-0-615-21489-4