Measurements with the IPM UHOH scanning rotational Raman lidar at Hornisgrinde during COPS

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Temperature and Aerosol Measurements on Hornisgrinde

Scanning temperature and aerosol measurements on 25 August 2007 at Supersite Hornisgrinde (1161 m ASL)

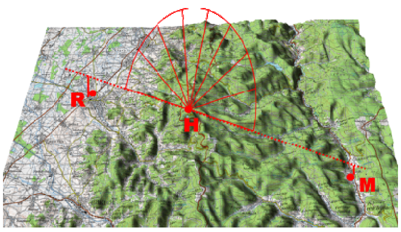

Fig. 1. The supersite transect in the northern Black Forest region at a glance. R, H and M are the three supersites Rhine Valley, Hornisgrinde and Murg Valley. Respectively.

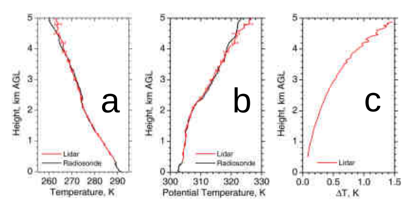

Fig. 3. a,b: Temperature and potential temperature measured by lidar and radiosonde (launched at 17 UTC) on 25 August 2007, respectively. The data below 1 km is corrected for overlap effects. The lidar profile is the vertical data measured between 16-17 UTC of Fig.2. Error bars show the statistical uncertainties of the lidar data; c: Statistical temperature uncertainty of the lidar profile.

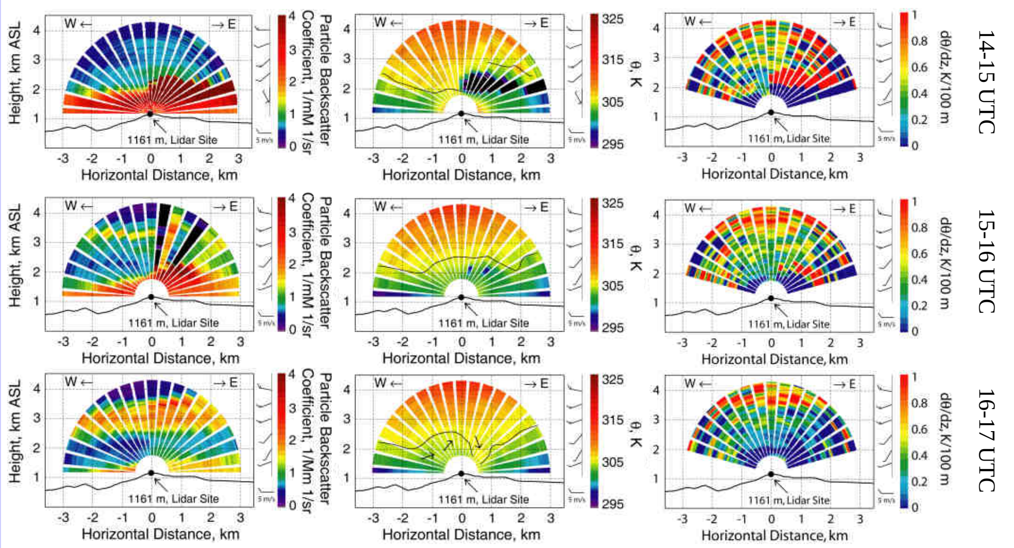

Fig. 2. Particle backscatter coefficient at 355 nm (left), potential temperature (middle) and gradient of the potential temperature (right) measured at 21 elevation angles at Hornisgrinde on 25 August 2007. The plane in which the RHI-scan (Range-Height-Indicator) was performed was orientated towards the neighboring COPS Supersites R and M (azimuth = 291°). For these fields 13 consecutive raw-data scans were averaged giving an averaging time of 3 minutes for each profile. The range resolution is 37.5 m. For the temperature plots a gliding average of 300 m was applied. The statistical temperature uncertainties are smaller than 1 K for all the data. Wind was measured by the radiosonde launched at 14 UTC (upper row) and 17 UTC (middle and lower row). The particle backscatter coefficient is calculated with the Raman technique for scanning lidar. In the first hour there were observed some clouds to the east of Hornisgrinde which developed at the boundary layer top. Towards the evening the convective boundary layer broke down and accordingly the clouds dissolved. Between 2.5 and 3.5 km a layer with enhanced aerosol load is visible that became more pronounced with time. This layer was capped by a stable layer as can be seen by the gradient of potential temperature. The black line marks the 305 K isentrope.

High resolved vertical temperature and aerosol measurements on 19 June 2007 at Supersite Hornisgrinde (1161 m ASL)

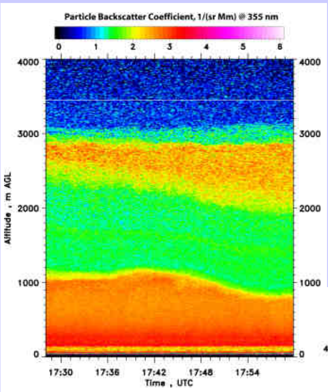

Fig. 4. Particle backscatter coefficient at 355 nm measured on 19 June 2007 at Hornisgrinde between 17:30-18:00 UTC. A stable stratified aerosol layer was observed at heights below 1000 m which is linked to the boundary layer. Another layer is present at around 2-3 km AGL. The descent in the lowest 3 km AGL is showing the transition towards a nocturnal boundary layer caused by the absence of insolation. The time resolution is 10 s and the range resolution 3.75 m.

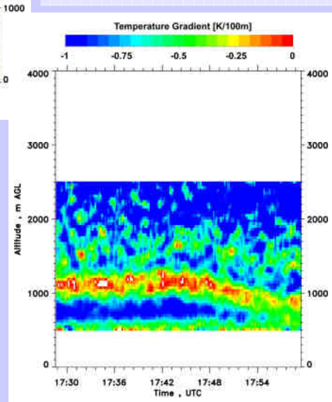

Fig. 5. Temperature gradient measured by the lidar on 19 June 2007 at Hornisgrinde in the same time frame as Fig. 4. An stable layer exists at a height of around 1 km AGL that is coming downward towards the end of the measurement periode. The vertical temperature gradient within this stable layer was measured with values of around 0 K/100 m. This inversion is situated atop the aerosol layer seen in Fig. 4 and thus marks the boundary layer top. The range resolution is 37.5 m and the time resolution 10 s. A gliding average of 300 m and 60 s was applied.

System Setup

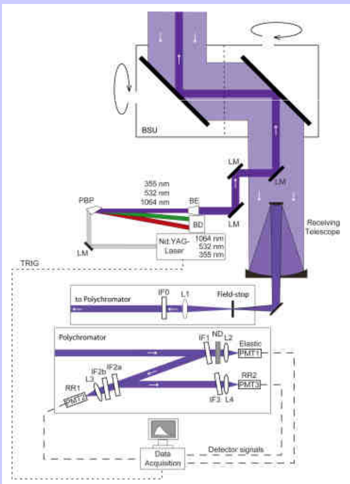

Fig. 6. UHOH scanning rotational Raman lidar.

Fig. 7. Scheme of the UHOH Scanning Lidar: BD: Beam dump, BE: Beam expander, BSU: Scanner (Beam steering unit), IF0-IF3: Interference filter, L1-L4: Lenses, LM: Laser mirrors, ND: Neutral density filter, PBP: Pellin-Broca-Prism, PMT1-PMT3: Photomultiplier tube, TRIG: Trigger signal

TRANSMITTER
Type: Flash-lamp-pumped frequency-tripled Nd:YAG laser, Spectra-Physics 290-50
Pulse energy: ~200 mJ at 355 nm
Repetition rate: 50 Hz
Pulse duration: 5-6 ns (355 nm)
Beam diameter: 9 mm (approx. 65 mm after beam expansion)

RECEIVER
Telescope: Ritchey-Chretien
Focal length ratio: f/10
Diameter of primary mirror: 40 cm
Coating: Aluminum with quartz protection layer

SCANNER
Manufactured by the NCAR in Boulder, CO, USA
Mirror Coating: Protected silver enhanced at 355 nm
Scan speed: up to 10°/s

DETECTOR (PMT)
Type: Hamamatsu R7400- U02 (Elastic) and R1924P (RR1 and RR2)

DATA ACQUISITION SYSTEM
3-channel transient-recorder by LICEL GmbH, Germany
Parallel data acquisition in analog and photon-counting mode with 3.75 m range resolution up to 30 km range and in photon-counting mode with 37.5 m range resolution up to 75 km range

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