Measurement highlights of temperature and aerosol fields with rotational Raman lidar at Hornisgrinde

Marcus Radlach, Andreas Behrendt, Sandip Pal and Volker Wulfmeyer

Institute of Physics and Meteorology, University of Hohenheim, 70599 Stuttgart, Germany

E-mail: radlach@uni-hohenheim.de

Measurement site

The scanning rotational Raman lidar (RRL) of University of Hohenheim (UHOH) was deployed on top of Hornisgrinde (Supersite (SuSi) H), the highest peak in the Northern Black Forest at an elevation of 1161 m above sea level (ASL).

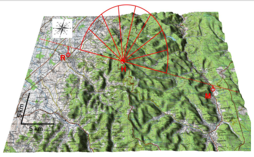


Fig. 1. The supersite transect in the Northern Black Forest region. R, H and M are the three COPS supersites Rhine Valley, Hornisgrinde and Murg Valley, respectively.

IOP 9c, 20 July 2007: Forced convection

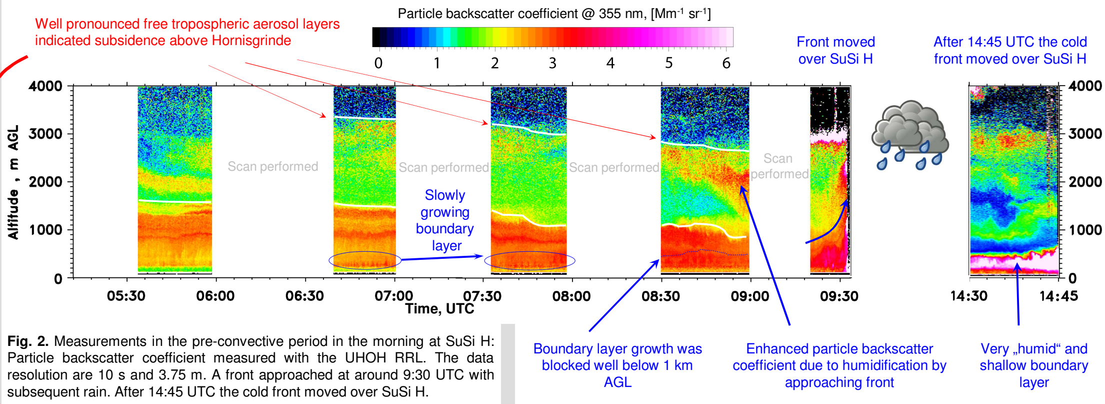


Fig. 2. Measurements in the pre-convective period in the morning at SuSi H: Particle backscatter coefficient measured with the UHOH RRL. The data resolution are 10 s and 3.75 m. A front approached at around 9:30 UTC with subsequent rain. After 14:45 UTC the cold front moved over SuSi H.

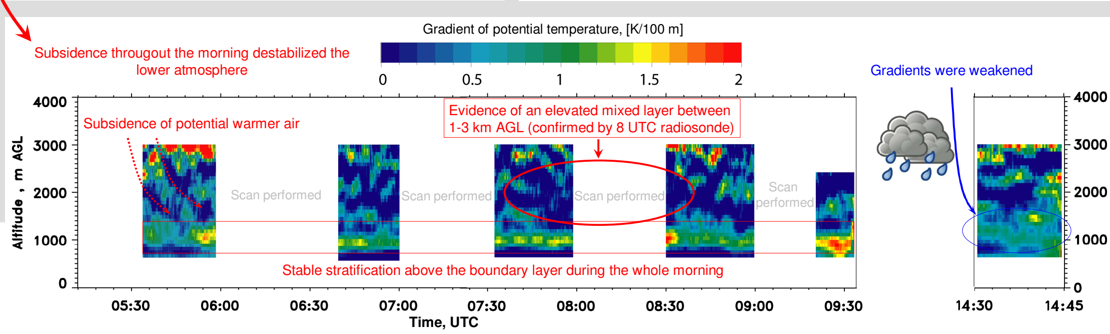


Fig. 3. Same period as Fig. 2 but gradient of potential temperature measured with the UHOH RRL. The temporal and spatial resolution are 10 s and 75 m, respectively. A gliding average of 3 minutes and 300 m were applied to the signals.

IOP 3a, 14 June 2007: Weakly forced diurnal convection

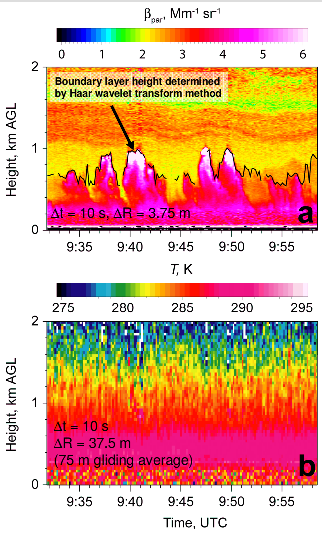


Fig. 4. a: Time-height cross section of particle backscatter coefficient at 355 nm on 14 June 2007, **b:** same as (a) but for temperature.

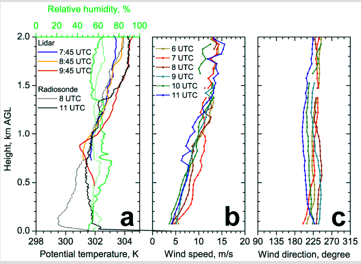


Fig. 5. a: Profiles of potential temperature measured by the UHOH RRL and radiosonde (launched at SuSi H) and relative humidity measured by radiosonde. The range resolution of the lidar data is 37.5 m. The lidar data were averaged for 30 minutes and 75 m in range.
b, c: Wind speed and wind direction measured by the Doppler lidar of IMK-FZK with a range resolution of 50 m (courtesy of A. Wieser and K. Träumner).

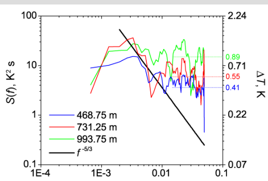


Fig. 6. Power spectra of temperature fluctuations at 3 different heights calculated with the data shown in Fig. 4b. The –5/3-slope of the inertial subrange is shown additionally.

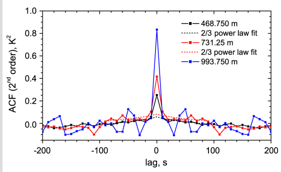


Fig. 7. Second order autocovariance function (ACF) around the zero lag obtained from the temperature data shown in Fig. 4b at 468.75 m, 731.25 m and 993.75 m AGL and the power law fit for the zero-lag variance estimation.

The UHOH RRL resolves the temperature variance within the convective boundary layer. A pronounced convective boundary layer was observed in the late morning on 14 June 2007. A strong southwesterly flow prevailed througout the lower troposphere. Insolation led to the development of intense eddies within the boundary layer.

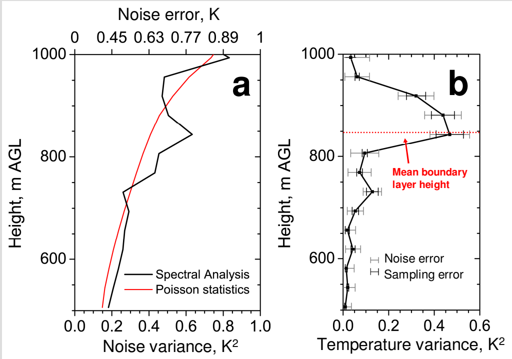
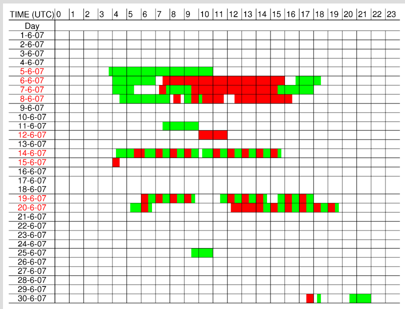


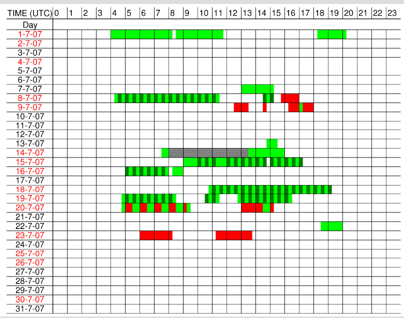
Fig. 8. a: Calculated noise variance by applying the ACF at each height using the power law fit. The upper axis shows the temperature error. Statistical temperature uncertainties arising from the photon-counting data are shown for comparison. **b:** Resulting profile of temperature variance. Error bars show the noise error of the variance and the sampling error.

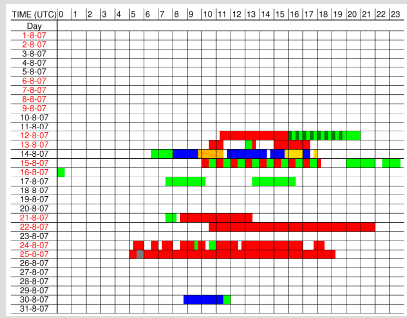
UHOH RRL measurements during COPS

Scan scenarios

- Vertical
- Vertical, 5 minutes RHI
- RHI scan (supersites)
- RHI scan (no-supersites)
- PPI scan (sector)
- Test







References: Radlach M., A. Behrendt and V. Wulfmeyer, 2008, *Atmos. Chem. Phys*, **8**, 159-169
Radlach M., 2008, PhD thesis submitted to University of Hohenheim