Vertical measurements of aerosol number concentrations and optical properties and the relation to remote sensing during "Melpitz Column 2015"

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The Campaign ‚Melpitz Column 2015' was performed from May 4 until July 10, 2015. During this time a complex and complementary setup of aerosol and boundary layer measurements was installed at the TROPOS measurement site Melpitz. Besides a detailed aerosol characterization on ground and ground-based remote sensing, several platforms performing airborne measurements were applied to investigate the aerosol distribution in the whole column. The combination of several unmanned aerial systems (UAS), the helicopter-borne platform ACTOS (Airborne Cloud and Turbulence Observation System), research aircraft, and a tethered balloon within one campaign is unique and provides a dataset that is subject to ongoing investigations.

This work will focus mainly on vertical measurements or aerosol parameters such as particle number concentration and absorption. A special focus of this study is the vertical distribution of absorbing aerosol as well as the comparison between airborne in-situ and ground-based remote sensing measurements.

Measurements

The helicopter-borne platform ACTOS (Siebert et al, 2013) performed 13 2-hour flights between June 15 and 28, 2015 around Melpitz, the measurement site of TROPOS (40 km NE of Leipzig). During these flights measurements of the total particle number concentration *N*, number size distributions as well as particle absorption (450, 535, and 624 nm, STAP, Single Channel Absorption Photometer, Brechtel) and scattering/extinction (630 nm, CAPS-PMssa, Aerodyne Inc.) under dry conditions (< 40% *rH*) were performed. In addition, the unmanned aerial system ALADINA (Altstädter et al., 2015) was operated between June 16 and July 1 2016 at the same site measuring aerosol number concentrations in different size ranges as well as particle absorption using the microAeth AE 51 (AethLabs). ALADINA performed approximately 50 flights of usually 30 min during this period. Parallel to the flights the Raman lidar Polly^{XT} performed continuous measurements over the whole campaign.

Results

A case study is shown in figure 1 presenting vertical profiles of selected parameters measured on June 26 at 8:30 UTC. A well-mixed layer exists below 500 m capped by an inversion and followed by a decrease in the particle number concentration *N*. With increasing height *N* increases slightly as well as the optical parameters σ_{abs}, σ_{sca}, and σ_{ext} up to approximately 1800 m indicating a lofted, aged aerosol layer. This is also clearly visible in the profiles of the lidar backscatter β_{bsc} showing a much stronger increase in height. The lidar profiles are measured under ambient conditions, thus β_{bsc} increases also with *rH* which needs to be considered when comparing both results.

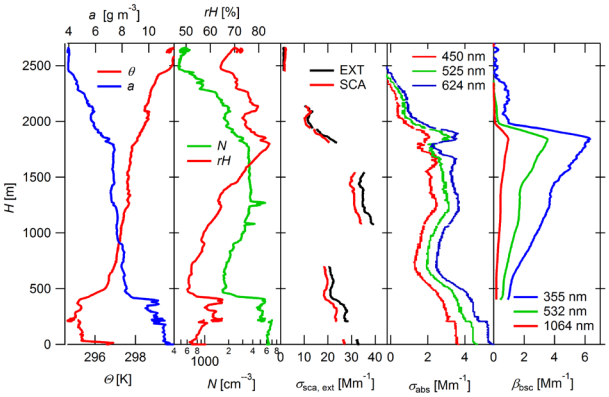

Figure 1: Vertical profiles of potential temperature Θ, absolute humidity *a*, particle number concentration > 7 nm *N*, relative humidity *rH*, particle extinction and scattering at 630 nm $\sigma_{sca,ext}$ as well as absorption σ_{abs} measured using ACTOS on June 26, 2015 at 08:30 UTC over Melpitz and vertical profiles of aerosol backscatter coefficients β_{bsc} from Polly^{XT}.

Outlook

A detailed analysis of ACTOS and UAS measurements focussed mainly on the vertical distribution of absorbing aerosol is currently done. The combination of results from the different platforms will provide a highly complex picture about the vertical distribution of aerosol particles and its optical properties.

The next step will be a comparison between aerosol microphysical measurements and remote sensing measurements using Mie-theory.

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