Coordinated airborne high spectral resolution lidar and in-situ observations of different aerosol types

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During three recent field campaigns aerosol properties have been measured by the DLR airborne high spectral resolution lidar (HSRL) and an extensive set of aerosol in-situ probing instruments. SAMUM-1 (Saharan Mineral Dust Experiment, Morocco, 2006) aimed at the characterization of physical, chemical and radiative properties of African mineral dust. SAMUM-2 (Cape Verde Islands, 2008) focused on the observation of aged Sahelian dust and biomass burning aerosol from the African tropical regions. EUCAARI-LONGREX (European integrated project on Aerosol Cloud Climate and Air Quality Interactions, Long-range experiment, 2008) was conducted as a joint project to investigate the physical and chemical properties of aerosols on a European scale.

The comprehensive data sets obtained through-out these field experiments contain information about some of the most prominent atmospheric aerosol types: Mineral dust aerosol, sea salt aerosol, biomass burning aerosol, continental background aerosol, and urban pollution aerosol.

During all campaigns the DLR HSRL was operated aboard the Falcon research aircraft together with the in-situ probing instruments. The HSRL measured aerosol optical quantities at $\lambda = 532$ nm such as the aerosol backscatter coefficient, aerosol extinction coefficient, aerosol optical depth, the lidar-ratio and aerosol depolarization-ratio. By means of coordinated in-situ soundings, aerosol number size distribution, aerosol absorption, and aerosol volatility analyses have been performed. The sampling strategy during the field experiments generally consisted of two parts: Firstly, remote sounding at high altitude to observe and identify interesting aerosol layers by HSRL and then in-situ sounding within the layers at several flight levels defined by lidar before.

Based on the HSRL measurements two aerosol-specific quantities the lidar-ratio and the depolarization-ratio, respectively, are derived. The analyses of both quantities reveal that characteristic values can be attributed to the different aerosol types. Capabilities and limitations of this classification are analysed using the coordinated in-situ data for each aerosol type. Therefore, variations of the in-situ measured aerosol properties are compared to the HSRL derived quantities.

We will highlight the capability of the HSRL to classify different aerosol types and show synergy effects of the coordinated in-situ measurements.

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