Microphysical and optical properties of Mineral Dust Aerosols –

Investigations during the Mineral Dust campaign 2008 at the AIDA facility, Forschungszentrum Karlsruhe

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Mineral dust aerosols from desert regions affect the earth's radiative budget. The assessment of dust aerosols contribution to the direct radiative forcing is difficult, due to the fact that the dust particles do not only scatter but also absorb electromagnetic radiation over a broad spectral range. Furthermore mineral dusts are complex mixtures of different mineralogical compositions, with broad variations in particle size distribution and particle morphology.

Due to uncertainties in the relation between the microphysical and optical properties of mineral dust aerosols, the Mineral Dust Campaign 2008, at the aerosol and cloud chamber facility AIDA, Forschungszentrum Karlsruhe, was initiated to investigate several mineral dust samples of naturally occurring composition. Aerosol samples from different geographical regions of Africa are investigated. Among these samples, two samples were taken during the field campaigns AMMA/SOP2 and SAMUM-I.

The aim of this chamber experiment was to provide a dust aerosol of defined size distribution and known mineralogical composition. The experimental set-up was intended to realize both inter-comparison of instruments and the closure between micro-physical and optical measurements. Finally, a model for the determination of effective refractive indices of the investigated dust aerosols should be derived.

For aerosol generation, the soil dust samples were sieved first and the fraction of 20 to 75 µm was dry dispersed by a rotating brush generator (RGB 1000, PALAS) in combination with a dispersion nozzle. The re-dispersed aerosol then passes through a stage cyclone with a cut off size of about 1 µm. Altogether six different pure dust aerosols were investigated.

During the experiments the microphysical characterization was performed by APS (TSI), SMPS (TSI), and OPC (Grimm) instruments. For chemical and mineralogical characterization aerosol samples for single particle analysis were taken directly from the chamber.

The optical properties were determined by extinction, scattering and absorption measurements. The extinction coefficients of the dust aerosol were determined by the Long Path Extinction Spectrometer LOPES (FZK). The scattering phase function as well as the total scattering coefficient was determined by a Dual polarization Polar Nephelometer D2PN (LaMP). An integrating nephelometer (TSI) measured the total scattering and back-scattering coefficients simultaneously. Absorption coefficients were determined by the three filter based methods PSAP, MAAP and SOAP and by photoacoustic spectroscopy of airborne particles. The 3λ-PSAP (DLR) and the 1λ-MAAP (DLR) measured the absorption at 660nm, 550nm, 467nm and 670nm, respectively. The SOAP (IfT) determined the absorption coefficients between 800-300nm, with a spectral resolution of 50nm. The 4λ-PAS (FZK) measured the absorption coefficient at 1064nm, 532nm, 355nm and 266nm.

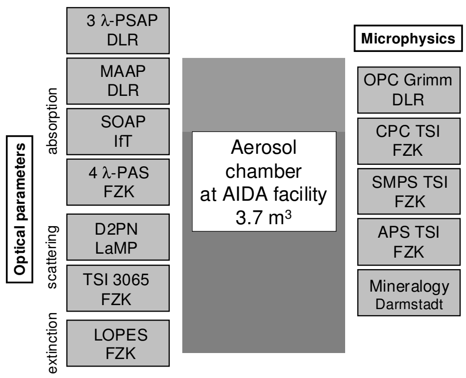

Figure 1. Instrumentation of the aerosol chamber during the Mineral Dust Campaign 2008.