Single particle chemical and mineralogical composition and derived optical parameters of the aerosol at and over Tinfou, Morocco, during SAMUM 2006

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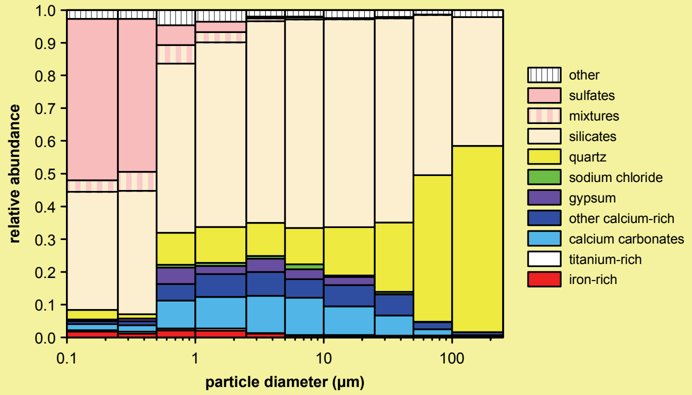
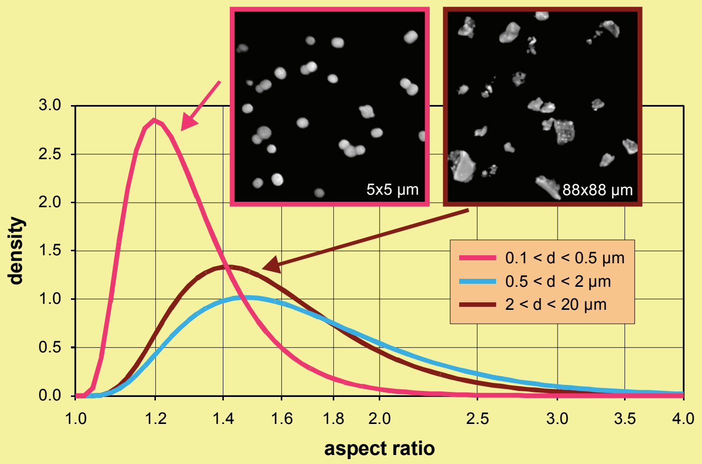
Introduction

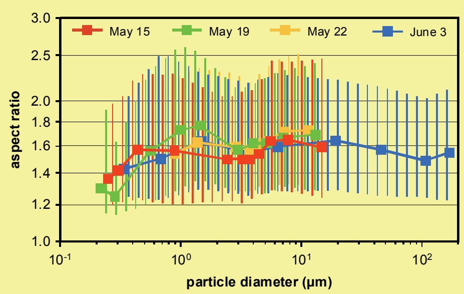
The Saharan Mineral Dust Experiment (SAMUM) is dedicated to the understanding of the radiative effects of mineral dust. A joint field campaign focused on the investigation of fresh Saharan dust was carried out in the region of Tinfou, south east Morocco. Ground-based and airborne measurements were performed in the early summer season, where mineral dust from the central Sahara is transported towards the measurement region.

Chemical and morphological characterization



The average chemical composition of particles collected at Tinfou (above) shows three size regimes. Smaller than 500 nm in diameter, a variable composition of ammonium sulfate and silicates occurs. Between 500 nm and 50 µm, the aerosol is dominated by silicates and calcium-rich particles. Larger than 50 µm, quartz becomes a major component.



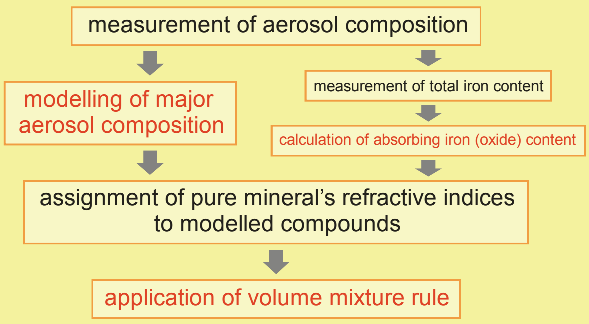


Aspect ratio distributions for several days at Tinfou ground station

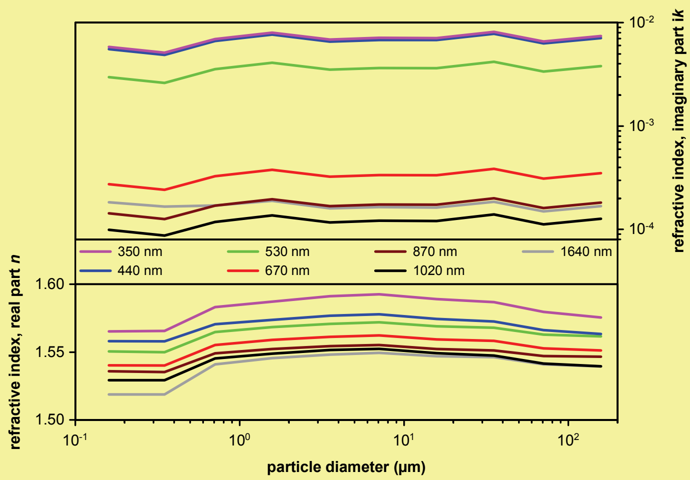
Aspect ratio distributions (above) show a modified log-normal distribution form. Small particles consisting of ammonium sulfate show aspect ratios of 1.3. The larger mineral dust particles have an aspect ratio of 1.6. The temporal variability at the Tinfou ground station is rather low, especially for the large mineral dust particles.

Methods

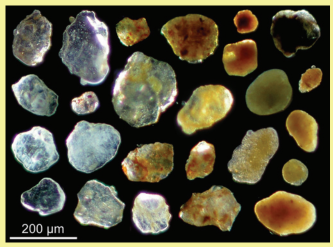
The samples were collected with a miniature impactor system, a free-wing impactor, a Mobile Cascade Impaction System, and a sedimentation trap. Carbon-coated nickel discs and polyvinylformal foil with carbon coating on nickel grids were used as substrates. The ground-based sampling equipment was installed 4 m above ground (30°14'15" N, 5°36'29" W, 684 m asl.) on the Drâa river flood plain. The airborne sampling equipment was mounted on the DLR Falcon D-CMET and on the Enviscope Partenavia P68B. The size-resolved particle aspect ratio and the chemical composition is derived by means of electron-microscopical single particle analysis and energy-dispersive X-ray analysis with an Environmental Scanning Electron Microscope FEI, Quanta 200 FEG.
From the chemical composition the complex refractive index is derived by a mixture model of pure mineral components (see scheme below).



Optical properties



The average complex refractive index at Tinfou ground station (above) shows a very strong wavelength dependency, which derives from the hematite absorption characteristics. Lower values of the real and imaginary part for particles smaller than 500 nm reflect the high sulfate content in this size range. The maximum in the real part at a few micrometer particles size corresponds to the mode of calcium-rich particles found at Tinfou. The collection of particles on the right shows the occurrence of homogeneous and inhomogeneous as well as surface-bound and internally mixed iron-derived coloring.



Acknowledgments

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