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Vertical profiles, optical and microphysical properties of Saharan dust layers determined by a ship-borne lidar

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Abstract. A unique data set of ship-borne lidar measurements of Saharan dust layers above the Atlantic ocean has been collected aboard the research vessel Polarstern with a mobile Aerosol Raman Lidar (MARL) during the LIMPIDO-campaign in June 2000. Extended Saharan dust layers have been observed in the region between 8.5° N and 34° N in an altitude range between 2 and 6 km. The continental, North African origin of the probed air masses is confirmed by 8-day backward trajectories. The Saharan dust is characterized by an optical depth in the range of 0.1 and 0.3, a depolarization around 10% and high lidar ratios of 45 sr at 532 nm and 75 sr at 355 nm. The backscattering by the dust particles at the UV-wavelength is relatively weak, resulting in a negative color index. From the measured optical properties the effective radius and the refractive index of the dust particles are derived using a new approach based on Mie Theory and non-spherical scattering calculations. The low backscatter coefficient observed at 355 nm is due to significant absorption which increases with decreasing wavelength. This finding agrees very well with results from satellite and sun photometer measurements. The effective radii decrease from about 3 μm at the base to 0.6 μm at the top of the dust plumes. The non-spherical shapes of the dust particles are responsible for the high values of the lidar ratios.

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