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Aging of mineral dust during transport from the Sahara into the Cape Verde area – results from airborne measurements during SAMUM

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The Saharan Mineral Dust Experiment (SAMUM) was conducted to better understand the properties of fresh and aged mineral dust. Within SAMUM, two field missions were performed: SAMUM-1 (summer 2006, Morocco) focused on the chemical, microphysical, optical and radiative properties of fresh dust aerosol in the vertical column over the Sahara, while SAMUM-2 (winter 2008, Cape Verde) concentrated on the properties of aged dust and the mixing of mineral dust with biomass burning aerosol. During both field experiments, the DLR Falcon research aircraft was equipped with an extensive set of aerosol instruments for size, volatility, and absorption measurements, impactor sampling for chemical analyses and with a nadir-looking High Spectral Resolution Lidar (HSRL).

In the Cape Verde area, we found a complex stratification with dust covering the altitude range below 2 km and tropical biomass burning layers aloft. We show that the aerosol type of individual aerosol layers can be classified based on depolarization and lidar ratios and, in addition, on in situ measured Ångström exponents of absorption $å_{\mathrm{ap}}$. The dust layers had a geometrical depth of 1.3 $\pm$ 0.4 km and showed a median $å_{\mathrm{ap}}$ of 3.95. The median effective diameter D_{eff} was 2.5 μm and the dust layers over Cape Verde yielded clear signals of aging: large particles were depleted due to gravitational settling and the accumulation mode diameter was shifted towards larger sizes as a result of coagulation. The tropical biomass layers had a depth of 2.0 $\pm$ 1.1 km and were characterized by a median $å_{\mathrm{ap}}$ of 1.34. They always contained a certain amount of large dust particles and showed a median D_{eff} of 1.1 μm and a fine mode $D_{\mathrm{eff,fine}}$ of 0.33. The dust and biomass burning layers had a median aerosol optical depth (AOD) of 0.23 and 0.09, respectively. The median contributions of the dust and biomass burning layers to the AOD of the total atmospheric column below 10 km were 75 and 37%, respectively.

We present the properties of aerosol layers in the Cape Verde region and compare the properties of aged dust with those of fresh dust observed close the Sahara. Changes in the size distribution during transport will be discussed and the impact of the changed size distribution on the radiation budget will be evaluated.