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Effect of particle settling on lidar profiles of long-range transported Saharan aerosols

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A large amount of desert aerosol is transported in the Saharan Air Layer (SAL) westwards from Africa over the Atlantic Ocean. Lidar profiles of transported Saharan aerosol may contain some information about the vertically-resolved aerosol microphysics that could be used to characterize processes that affected the measured aerosol during transport.

We present modelled lidar profiles of long-range transported Saharan aerosol assuming that initially the SAL is well-mixed and that there is no vertical mixing of air within the SAL as soon as it reaches the Atlantic. We consider Stokes gravitational settling of aerosol particles over the ocean. The lidar profiles are calculated using optical models for irregularly-shaped mineral dust particles assuming settling-induced particle removal as function of distance from the SAL top. Within the SAL we find a decrease of both the backscatter coefficients and the linear depolarization ratios with decreasing distance from the SAL top. For example, the linear depolarization ratio at a wavelength of 532nm decreases from 0.289 at 1000m to 0.256 at 200m and 0.215 at 100m below SAL top. We compare the modelled backscatter coefficients and linear depolarization ratios to ground-based lidar measurements performed during the SALTRACE field campaign in Barbados (Caribbean) and find agreement within the estimated uncertainties.

We discuss the uncertainties of our modeling approach in our presentation. Assumed mineral dust particle shapes, assumed particle mixture properties, and assumptions about processes in the SAL over the continent and the ocean are important aspects to be considered. Uncertainties are relevant for the potential of lidar measurements of transported Saharan dust to learn something about processes occuring in the SAL during long-range transport. We also compare our modeling results to modeling results previously published in the literature.