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Consequences for dust radiative effects estimated from simulations considering dust particles as a multi-mineral composition

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The mineral composition of dust particles determines its optical, micro-physical, and biogeochemical properties. These characteristics mediate the impact of dust on various components of the Earth system. Controlled by its optical properties, dust alters directly the Earth radiation budget. Determined by its micro-physical characteristics, dust particle impact on cloud and precipitation forming processes. The delivery of micro-nutrients to the ecosystems depends on the availability of as fertilizer acting elements, which is determined by mineralogical composition of the dust particle. To estimate the multifaceted impacts of airborne dust on the Earth system, numerical simulations of the atmospheric dust life-cycle provide a fruitful framework for research studies.

In a recent effort, the on-line coupled aerosol – atmosphere model system COSMO-MUSCAT consisting of the meso-scale atmosphere model COSMO (Consortium for Small-scale Modelling) and the aerosol model MUSCAT (Multi-Scale Chemistry Aerosol Transport) is revised regarding the representation of dust properties. Compared to the standard version, in which the dust characteristics where set to fixed properties, the new version introduces dust as a spatially heterogeneous composition of nine minerals that are commonly abundant in dust particles: Illite, Kaolinite, Smectite, Calcite, Quartz, Feldspar, Gypsum, Hematite, and Phosphate. This way, mineral dust particles are considered as composition of minerals that is determined by its source region and may change over space and time.

First results from simulations using the new version of COSMO-MUSCAT will be presented. In particular, simulated fields of dust concentration will be analysed regarding the abundance of individual minerals. Furthermore, the radiative impact of mineral dust will be examined with regard to the optical properties determined by the actual mineral composition of the dust plume.