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Global distribution of minerals in arid soils as lower boundary condition in dust models

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Mineral dust eroded from arid soils affects the radiation budget of the Earth system, modifies ocean bioproductivity and influences human health. Dust aerosol is a complex mixture of minerals. Dust mineral composition has several potentially important impacts to environment and society. Iron and phosphorus embedded in mineral aerosol are essential for the primary marine productivity when dust deposits over the open ocean. Dust also acts as efficient agent for heterogeneous ice nucleation and this process is dependent on mineralogical structure of dust. Recent findings in medical geology indicate possible role of minerals to human health.

In this study, a new 1-km global database was developed for several minerals (Illite, Kaolinite, Smectite, Calcite, Quartz, Feldspar, Hematite and Gypsum) embedded in clay and silt populations of arid soils. For the database generation, high-resolution data sets on soil textures, soil types and land cover was used. Tin addition to the selected minerals, phosphorus was also added whose geographical distribution was specified from compiled literature and data on soil types. The developed global database was used to specify sources of mineral fractions in the DREAM dust model and to simulate atmospheric paths of minerals and their potential impacts on marine biochemistry and tropospheric ice nucleation.