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Inaugural dust and climate model simulations with the new EMIT global mineral abundance maps

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Minerals in dust shape the interaction of this ubiquitous aerosol with relevant components of the Earth system. Iron oxides absorb short-wave radiation, while quartz or k-feldspars act as efficient ice nuclei, contributing to the formation of mixed-phase clouds. In addition, iron and phosphorus containing minerals transport nutrients to terrestrial and marine ecosystems. Other minerals, like calcite, affect aerosols' pH and intervene in atmospheric chemistry processes. Incorporating these complex effects into Earth System Models (ESM) has proven challenging due to our limited knowledge about the mineralogy of dust sources and its particle size distribution at emission.

The ongoing NASA Earth Surface Mineral Dust Source investigation (EMIT) project has produced a first version of a global mineral abundance map at an unprecedented resolution based on spaceborne imaging spectroscopy observations from the International Space Station. Using this new product, we have conducted multi-annual simulations with several ESMs that explicitly represent dust mineralogy. Our study characterizes the relevance of the new map in the ESM results by comparison with our previous baseline simulations. We conduct a thorough evaluation against a global mineral fraction compilation derived from concentration and deposition measurements. Our results are also compared against single scattering albedo (SSA) retrievals from dusty AERONET sites. Our focus is primarily iron oxides, hematite and goethite, which, together with particle size, control the dust SSA in the short-wave.

By providing a first set of simulations with the new EMIT mineral abundance maps and their evaluation, our work contributes to advancing the representation of this key aerosol within ESMs and to further assessing its significance within the global climate system.

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