4.163 Global scale variability of the mineral dust shortwave and longwave refractive index: a new dataset of in situ measurments for climate modelling and remote sensing.

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Abstract:

Modeling the interaction of dust with short-wave (SW) and long-wave (LW) radiation is still a challenge because of the scarcity of information on the complex refractive index (n-ik) of dust and its variability as a function of the particle mineralogical composition, which depends on the specific emission source. As a consequence, to date, climate models and remote sensing retrievals use a spatially invariant value for the dust SW and LW refractive index.
In this study, the global variability of the mineral dust SW (0.37-0.95 µm) and LW (2-16 µm) refractive index as a function of its mineralogical composition is explored by in situ measurements in a large smog chamber. Investigated dust aerosol samples were issued from major desert sources worldwide, including the African Sahara and Sahel, Eastern Asia, the Middle East, Southern Africa, Australia, and the Americas.
Results from the present study provide a regional mapping of the SW and LW optical properties by dust and show that the imaginary part of the refractive index largely varies for the different source areas due to the change in the particle composition. In the LW k varies between ~0.001 and 0.92 due to changes in the clays, quartz, and calcite content in dust. In the SW range k varies in the range ~0.002-0.030 at 0.37 µm and 0.0005-0.005

at 0.95 μm in relation to changes of the iron dust content.
A linear relationship between the magnitude of k at specific wavelengths and the mass concentration of minerals absorbing at these wavelengths was found. Predictive rules could be thus established to estimate the SW and LW refractive index of dust in specific bands based on an assumed or predicted mineralogical composition. These rules can be used to implement regional–dependent SW and LW refractive indices in models and remote sensing retrieval algorithms.