Longwave indirect effect of mineral dusts on ice clouds

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In addition to microphysical changes in clouds, changes in nucleation processes of ice cloud due to aerosols would result in substantial changes in cloud top temperature as mildly supercooled clouds are glaciated through heterogenous nucleation processes. Measurements from multiple sensors on multiple observing platforms over the Atlantic Ocean show that the cloud effective temperature increases with mineral dust loading with a slope of +3.06 °C per unit aerosol optical depth. The macrophysical changes in ice cloud top distributions as a consequence of mineral dust-cloud interaction exert a strong cooling effect (up to 16 Wm−2) of thermal infrared radiation on cloud systems. Induced changes of ice particle size by mineral dusts influence cloud emissivity and play a minor role in modulating the outgoing longwave radiation for optically thin ice clouds. Such a strong cooling forcing of thermal infrared radiation would have significant impacts on cloud systems and subsequently on climate.

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