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Characterization of ice nucleation on Hoggar mountain dust

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The impact of aerosols on earth's climate is quite uncertain. Therefore a better understanding of direct and indirect effects of aerosols is essential to improve models and the ability to predict future climate change. A natural source of aerosols is desert dust. Laboratory measurements concerning the influence of dust on heterogeneous freezing of water droplets are presented. We performed measurements with a dust collected in the Hoggar mountains in the Sahara desert. The particle diameter of this dust is about 100 - 1000 μm. The results describe freezing processes relevant for mixed phase clouds as well as for cirrus clouds.
For the investigation of the ice nucleation ability of the Hoggar mountain dust, emulsion as well as bulk measurements were performed with a differential scanning calorimeter (DSC). For the emulsion measurements a suspension of the Hoggar mountain dust was mixed with water and an additional solute such as ammonium sulfate, malonic acid, glucose or PEG 300. Mixed with a mineral oil/lanolin mixture, the water droplets had a mean diameter of around 2 μm. Emulsions consisting of pure water suspensions froze with onset temperatures of around 247 K. Immersion freezing was found to be suppressed in the presence of solutes.
For the bulk measurements Hoggar mountain dust was mixed with pure water and droplets with radii of about 1 mm were subjected to repeated freezing cycles. Freezing temperatures in the range of 256-265 K were found for cooling rates of 10 K/min and nucleation rates were calculated. The difference between the freezing temperatures observed in the emulsion measurements and the bulk measurements gives support for the notion, that only very few best sites on the surface of the Hoggar mountain dust are responsible for freezing at the highest observed temperatures.