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Ice nucleation of Snomax® particles below water vapor saturation: immersion freezing in concentrated solution droplets

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Heterogeneous ice nucleation has received an increasing amount of interest in the past years, as it initiates the ice phase in mixed phase clouds (MPCs) and, to some extent, also in cirrus clouds. The presence of ice influences cloud radiative properties and, for mixed phase clouds, also the formation of precipitation.

Immersion freezing is thought to be the most important mechanism through which ice formation could take place in MPCs. Here, we examine the ice nucleation activity of biological ice nucleating particles (INP) derived from bacteria, namely, particles generated from Snomax® suspensions, both above and below water vapor saturation. During a measurement campaign in Leipzig, ice nucleation measurements were conducted with PINC (Portable Ice Nucleus Counter, Chou et al., 2011) and LACIS (Leipzig Aerosol Cloud Interaction Simulator, see e.g. Wex et al., 2014a). Immersion freezing measurements from PINC and LACIS were in agreement in the temperature regime for which both instruments operate reliably. Here, we will show that measurements done below water vapour saturation and above the deliquescence relative humidity of the Snomax® particles follow what would be expected for immersion freezing in concentrated solutions, similar to what was suggested for coated kaolinite particles in Wex et al. (2014b). Additionally, some measurements reported in the literature that were done in the water vapour sub-saturated regime will be evaluated based on the assumption made above, showing that at least some of the ice nucleation which previously was ascribed to deposition ice nucleation rather follows the behavior of immersion freezing in concentrated solutions.

Literature:

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