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Contact freezing of supercooled cloud droplets on collision with mineral dust particles: effect of particle size

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The contact freezing of supercooled cloud droplets is one of the potentially important and the least investigated heterogeneous mechanism of ice formation in the tropospheric clouds [1]. On the time scales of cloud lifetime the freezing of supercooled water droplets via contact mechanism may occur at higher temperature compared to the same IN immersed in the droplet. However, the laboratory experiments of contact freezing are very challenging due to the number of factors affecting the probability of ice formation. In our experiment we study single water droplets freely levitated in the laminar flow of mineral dust particles acting as the contact freezing nuclei. By repeating the freezing experiment sufficient number of times we are able to reproduce statistical freezing behavior of large ensembles of supercooled droplets and measure the average rate of freezing events. We show that the rate of freezing at given temperature is governed only by the rate of droplet –particle collision and by the properties of the contact ice nuclei. In this contribution we investigate the relationship between the freezing probability and the size of mineral dust particle (represented by illite) and show that their IN efficiency scales with the particle size. Based on this observation, we discuss the similarity between the freezing of supercooled water droplets in immersion and contact modes and possible mechanisms of apparent enhancement of the contact freezing efficiency.

[1] - K.C. Young, The role of contact nucleation in ice phase initiation in clouds, Journal of the Atmospheric Sciences 31, 1974