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Modeling studying the role of bacteria on ice nucleation processes.

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Certain bacteria have been recognized as efficient ice nuclei at temperatures above -10 C. Inhabiting plants, soils and ocean surfaces, these ice-nucleating bacteria were found in almost all climate regions, even in the polar-regions. These ice-nucleating bacteria are readily disseminated into the atmosphere and have been observed in clouds and hailstones; bacteria thus should play a more important role than any other ice nuclei in ice formation of clouds at temperatures above -10C. High concentration of ice crystals exceeding background ice nuclei were often observed in the warm-based cumulus clouds, which were caused mainly through collisions of graupels with cloud droplets (riming process). The formation of graupels is responsible for ice multiplication process under suitable conditions. The initiation of graupels highly depends on the initiation process of ice crystals at relative warm temperatures (growing stage of cumulus clouds). Thus, we hypothesize the ice-nucleating bacteria plays a key role in graupel formation and the subsequent ice multiplication process. A 1.5-D non-hydrostatic cumulus cloud model with bin-resolved microphysics was developed to investigate the interaction between aerosols and clouds. The ice nucleation process by bacteria was simulated and the relationship between this process and graupel formation was determined. On one important aspect of the global aerosol indirect effect, this finding will improve estimation accuracy of radiation budget of the Earth with the aerosol-climate model.