



Various flavours of ice multiplication and their role in the aerosol-cloud-lightning system

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The modeling of cold clouds and their dependencies on environmental aerosol concentrations have been hindered by lack of accurate numerical representations of ice multiplication. It has even been claimed that the most detailed cloud models currently lack the ability to simulate cold cloud properties accurately for given aerosol and thermodynamical conditions. The past lack of laboratory experimentation in the community explains this current situation.

In this presentation, two new mechanisms of secondary ice production are shown to prevail in determination of the microphysical and electrical properties of cold clouds. These are fragmentation in ice-ice collisions and fragmentation of freezing drops. Positive feedbacks of ice multiplication arise from such fragmentation processes, causing an explosion of the ice concentration. Impacts on cloud phase, precipitation and lightning are shown from a numerical model of a storm in 3D and from a parcel model of a tropical convective updraft.

Finally, the niche of conditions of cloud-base temperature and updraft speed favouring each multiplication mechanism is discussed, as are the ramifications for modeling aerosol indirect effects on cold clouds.