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Aggregation of Ice Crystals in a Cirrus Cloud Model

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There are four microphysical processes that control the evolution of a cirrus cloud: ice nucleation, ice growth by deposition of water vapour (and the corresponding sublimation), sedimentation of ice crystals due to gravity, and aggregation if ice crystals to form larger crystals with more complex shapes. The latter process is mainly important under warm conditions and when the population of crystals has a broad size distribution, such that the spread in fall speeds is large. Broad size distributions can occur simply because ice crystals of different origin become mixed, e.g. ice crystals from heterogeneous and homogeneous nucleation, or ice crystals from a contrail embedded within an old mature cirrus.

Spichtinger and Gierens (2009) have formulated a 2-moment bulk microphysics cirrus model that is in particular able to track ice crystals of different origin. However, the aggregation process was so far not formulated for this kind of model. Here we present a formulation of the aggregation process that is appropriate for a 2-moment model, show how it is implemented, and present some first results.