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An Overview of Secondary ice Processes.

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Ground based and airborne observations of ice crystal concentrations are often found to exceed the concentration of ice nucleating particles by many orders of magnitude. This discrepancy between the expected ice particle concentrations formed through primary ice nucleation and observed ice particle concentration has led to the search for missing physical processes capable of creating new ice crystals. Secondary ice production (SIP) is a mechanism that produces new ice crystals without requiring the action of an ice nucleating particle. Evidence has now been found for several of these

Increasingly sophisticated cloud microphysical representations are being used in Numerical Weather Prediction and climate models to provide more realistic simulations of clouds. This drive towards greater complexity is motivated by the recognition of the importance of microphysical processes to the evolution of clouds, precipitation and the atmospheric environment.

One important challenge for the successful implementation of cloud microphysics is the prediction of ice crystal concentrations, these influence the water budget of the cloud s through precipitation processes and the radiative properties of clouds especially when the ice crystals are in the majority over water droplets. The understanding and quantification of primary ice nucleation has grown in recent years, secondary ice production processes have received relatively little attention but are potentially very important for controlling the ice concentrations found in some types of clouds.

In this stalk a number of SIP mechanisms will be discussed: The Hallett-Mossop process, by far the most powerful mechanism when conditions are right; the fracture on freezing of supercooled raindrops, the fragmentation of falling snow flakes; the detachment of frost crystals from a surface.