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Development of a detailed ice melting scheme within bin microphysics in a 3D cloud model

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A high resolved 3D model with bin microphysics has been developed at the LaMP (Laboratoire de Météorologie Physique). The model couples the dynamics of the NCAR Clark-Hall cloud scale model (Clark et al., 1996) with the detailed scavenging model (DESCAM) of Flossmann and Pruppacher (1988) and the ice phase module of Leroy et al. (2007). The microphysics follows the evolution of aerosol particle, drop, and ice crystal spectra each with 39 bins.

The original version of DESCAM, like the most of the models, considers the ice melting process such as an instantaneous transformation of the ice crystals into drops at the 0°C altitude level.
A new continuous melting scheme has been introduced which takes into account the melting of the ice particles at temperature higher than 0°C. This scheme is based on the theory of Mason (1956) and on the experimental studies of Rasmussen et al. (1982). The procedure takes into account the water ice ratio of the ice particles with a wetted coat. In addition, aggregation which is most efficient around 0°C when the ice particles develop a pseudo-liquid layer is also added.

Accurate representation of melting is important for simulating the radar bright band. This facilitates interpretation of radar observations. Furthermore, this new microphysics scheme better describes the ice influence in the accumulate precipitation on the ground.

The impact of the inclusion of this detailed scheme is examined on cloud evolution and calculation of radar reflectivity for an idealized simulation case. This new scheme allows a more faithful simulation of observed radar reflectivities and the study of the evolution of the bright band in the future.