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Microwave single-scattering properties of randomly oriented soft-ice hydrometeors

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Large ice hydrometeors are usually present in intense convective clouds. Many operating satellite-borne passive microwave radiometers (i.e., Special Sensor Microwave Imager/Sounder and Advanced Microwave Sounding Unit-B) measure radiances up to 183 GHz of frequency, that are strongly affected by ice scattering. Thus, retrieval of precipitation from these measurements requires an accurate method to compute the single scattering parameters of ice particles. On the other hand, shape and internal structure of ice particles (especially, the larger ones) are very complex and variable. Thus, it is necessary to resort to simplifying assumptions in order to compute their single-scattering parameters.

In this study, we compute the absorption and scattering efficiencies and the asymmetry factor of two species of non-spherical and non-homogeneous soft-ice particles. The first kind of particles are modelled as quasi-spherical ice particles having randomly distributed spherical air inclusions. The second kind are modelled as random aggregates of ice spheres of random radius. In both cases, particle densities and dimensions are coherent with snow – defined as the University of Wisconsin – Non-hydrostatic Modelling System's snow category. For our scattering calculations, we use the discrete dipole approximation (DDA) in a range of frequency from 50 to 183 GHz. Then, our results for randomly-oriented soft-ice hydrometeors are compared to the corresponding ones that make use of: a) homogeneous-medium theories, b) equivalent solid spheres, and c) cylinder-shaped snow particles.