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Characterizing Scattering of PSD-Integrated Aggregate Ensembles using a Comprehensive Particle Scattering Database

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We have constructed ∼10,000 realistic snow particles, including both pristine and aggregate types, with maximum diameter spanning ∼100 micron to 15 mm. The scattering property for each of these particles has subsequently been obtained using the open source discrete-dipole-approximation (DDA) code, DDSCAT, at thirteen (13) microwave frequencies ranging from 10 to 190 GHz. A scattering property database has thus been constructed to support precipitation remote sensing involving ice particles in the GPM era. Preliminary trial retrievals, utilizing radar and radiometer measurements from a field campaign and the GPM radar-radiometer combined algorithm currently under development, demonstrates that much better consistency between radar and radiometer is achieved when using scattering properties from this database rather than the ones derived with simplified assumptions.

Although this scattering database, using more realistic particles and being more comprehensive in scope, represents a considerable stride forward in the advancement of solid-precipitation remote sensing, there are still important tasks to be accomplished in order to effectively use this database for practical retrievals. One of such tasks is to find parameters, preferably a very small number of them, that can adequately characterize the single-scattering properties for realistic ensembles of these particles, i.e. with realistic particle size distributions, of these particles. This study reports an approach that holds great promise in reducing the seemingly insurmountable complexity in the plethora of particle shapes into a few parameters.