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Identifying effective parameters for characterizing the scattering of ice and snow aggregate particle ensembles

Kwo-Sen Kuo (1,2), Ziad Haddad (3), Simone Tanelli (3), Bill Olson (1,4), and Gail Skofronick-Jackson (1)

(1) NASA Goddard Space Flight Center, Greenbelt, Maryland, USA, (2) Goddard Earth Science Technology Center/Caelum Research Corporation (K-S.Kuo@nasa.gov), (3) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA, (4) University of Maryland-Baltimore County, Joint Center for Earth System Technol, Baltimore, Maryland, USA

Expanding on the success of using two effective radii (one based on particle surface area and another on orientation-averaged projection area) in characterizing the scattering of ensembles of pristine ice and snow particles, we examine their effectiveness when applied to ensembles of aggregate particles.

The component particles of the aggregates are generated using a numerical crystal growth model that is capable of simulating diffusion growth of realistic ice crystals. The crystals simulated by this model possess many of the intricate details observed in nature. Therefore we no loner need to use the simplistic geometric models for these particles. We have implemented a heuristic aggregation process to produce the aggregate particles by combining the pristine component particles. The resultant aggregate particles are in turn used to produce particle size distributions (PSDs) that must satisfy the constraints of some prescribed effective radii. DDSCAT program, based on discrete-dipole approximation, is used to calculate the single-scattering properties for each aggregate particle. The single-scattering properties of the aggregate ensemble are then obtained by compositing the single-scattering properties of individual particle with the PSDs.

Previous studies using pristine particles of different habits have demonstrated marvelous results: given the constraints of a volume distribution and a pair of effective radii values, the scattering properties of an ensemble of particles display little variation despite substantial variations in the bin-to-bin details of member particles' number concentrations in the PSDs. In this study we examine the characterizing power of these two effective radii for the scattering of ensembles composed of aggregate particles and suggest potential, additional parameters