Geophysical Research Abstracts
Vol. 18, EGU2016-6417, 2016
EGU General Assembly 2016

A database of microwave and sub-millimetre ice particle single scattering properties

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Ice crystal particles are today a large contributing factor as to why cold-type clouds such as cirrus remain a large uncertainty in global climate models and measurements. The reason for this is the complex and varied morphology in which ice particles appear, as compared to liquid droplets with an in general spheroidal shape, thus making the description of electromagnetic properties of ice particles more complicated.

Single scattering properties of frozen hydrometers have traditionally been approximated by representing the particles as spheres using Mie theory. While such practices may work well in radio applications, where the size parameter of the particles is generally low, comparisons with measurements and simulations show that this assumption is insufficient when observing tropospheric cloud ice in the microwave or sub-millimetre regions.

In order to assist the radiative transfer and remote sensing communities, a database of single scattering properties of semi-realistic particles is being produced. The data is being produced using DDA (Discrete Dipole Approximation) code which can treat arbitrarily shaped particles, and Tmatrix code for simpler shapes when found sufficiently accurate. The aim has been to mainly cover frequencies used by the upcoming ICI (Ice Cloud Imager) mission with launch in 2022.

Examples of particles to be included are columns, plates, bullet rosettes, sector snowflakes and aggregates. The idea is to treat particles with good average optical properties with respect to the multitude of particles and aggregate types appearing in nature. The database will initially only cover macroscopically isotropic orientation, but will eventually also include horizontally aligned particles.

Databases of DDA particles do already exist with varying accessibility. The goal of this database is to complement existing data. Regarding the distribution of the data, the plan is that the database shall be available in conjunction with the ARTS (Atmospheric Radiative Transfer Simulator) project.