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Microwave scattering from ice crystals: how much parameters can differ from equal volume spheres

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Abstract. The scattering properties of ice crystals at centimeter and millimeter wavelengths are fundamental for their measurement with radars or radiometers as well as for many other applications in remote sensing. Only the scattering properties of homogeneous spheres can be computed in a mathematically exact way using the Mie theory. Therefore, for many approaches ice crystals and other frozen hydrometeors are approximated by ice spheres that have the same volume as the crystal or hydrometeor – so called equal volume spheres. However, many frozen hydrometeors are non-spherical. They exist in a huge variety of shapes and exhibit different mixtures of ice, water and air. Therefore it is desirable to accurately compute scattering from non-spherical particles in order to clearly understand the effect the shape of a hydrometeor has on its scattering pattern.

In this study, single scattering parameters like scattering cross section (Csca) and absorption cross section (Cabs) were calculated for six pristine ice crystals by means of the Discrete Dipole Approximation (DDA). The calculations were carried out for frequencies from 1 GHz to 300 GHz – leading to size parameters of up to 4.

The study calculates the scattering parameters for randomly oriented ice crystals and investigates to what extent the exact scattering parameters can differ from an approximation by equal volume spheres.

Full Article in PDF (PDF, 3025 KB)

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