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Small Ice Detector 2: Characterization of Ice Crystals Using Analysis of Azimuthal Scattering Patterns

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Cloud particle shape is important from the point of view of both atmospheric dynamics and radiative properties. For this reason, many in situ probes for shape characterization have been developed. Most of them rely on direct imaging of particles onto a variety of one or two-dimensional sensors, so their resolution is limited by the usual optical constraints. The Small Ice Detector 2 (SID-2) probe was developed at University of Hertfordshire to circumvent these limitations. It provides information on the size and shape of single particles ≈1 to 50μm in size by measuring the spatial distribution of scattering. Discrimination between droplets and non-spherical ice crystals is simple, since the former produce highly uniform scattering patterns and the latter generally do not [1]. It is also possible to derive more detailed information about particle shape by comparing experimental patterns with databases of computed ones, so that classification into basic shape classes can be achieved. We use a method recently proposed for this purpose, which is based on converting azimuthal scattering patterns from angular into frequency domain using fast Fourier transform [2]. The scattering patterns used to construct the database are computed using the Ray Tracing with Diffraction on Facets (RTDF) model [3,4]. The crystal shapes in the databases include hollow as well as solid ones. We will present a selection of laboratory and cloud chamber results, including: laboratory tests using ice analogues [5], comparisons of SID-2 results with high-resolution images from the PHIPS probe at the AIDA cloud chamber [6] and crystal shape classification using Fourier analysis of scattering patterns.

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