



Shapes and size distributions of small ice particles from high-latitude cirrus clouds

Thomas Kuhn (1) and Andrew J. Heymsfield (2)

(1) Lulea University of Technology, Department of Computer Science, Electrical and Space Engineering, Division of Space Technology, Kiruna, Sweden (thomas.kuhn@ltu.se), (2) National Center for Atmospheric Research, Boulder, Colorado, USA

Thin cirrus clouds at high latitudes are often composed of small ice particles with maximum dimension smaller than $100\ \mu\text{m}$. Knowledge of the microphysical properties of these clouds is needed to predict their role in radiative transfer and for calibrating/validating passive and active remote sensors. Both the particle size distribution (PSD) as well as the shapes of the small cirrus particles are important in determining their influence in radiative transfer, in particular for the two important spectral ranges of solar radiation and longwave radiation from Earth. Cirrus clouds reflect incoming sunlight, creating a cooling effect. At the same time these clouds absorb the infrared radiation from Earth, creating a greenhouse effect. The net effect, crucial for radiative transfer, depends on the cirrus properties, including PSD and shapes of particles. However, these properties remain difficult to measure and consequently data is scarce.

Currently, balloon-borne in-situ measurements are being carried out at a high latitude location, Kiruna in northern Sweden (68N 21E). While most of in-situ data reported in the literature have been sampled with aircraft probes, which have known issues with such small particles due to sizing and shattering problems, in addition to having also a small and size-dependent sampling volume for these particles, the sampling technique used with the slowly ascending balloons avoids such problems. Furthermore, data from balloon measurements are from vertical profiles, more useful for calibrating or evaluating remote sensing measurements than data collected along horizontal traverses. Hence, these balloon in-situ data allow analysis with particular emphasis on small particles of $100\ \mu\text{m}$ or less in size. In particular, the ice particle shapes and PSDs are studied here and results are presented. The area ratio, a property related to shape and non-sphericity of particles is compared to in-situ data from literature, which exist almost exclusively for particles larger than $100\ \mu\text{m}$ in size. Hence, the current study can extend our knowledge of area ratio towards smaller sizes. In addition, the data from the in-situ balloon measurements is used to examine PSDs of small ice particles. The measured PSDs are compared to parameterizations currently available in literature.