



Ice particle properties in Arctic in-situ and liquid origin Cirrus clouds

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It is known that particle properties such as size, shape and number concentration in cirrus clouds have a great influence on their optical properties and thus also on the clouds net radiation effect. Of particular interest are Arctic cirrus clouds, on the one hand, because they have been rarely explored until now due to poor accessibility, and on the other hand because the Arctic is a large area on Earth where climate change is intensifying and leading to changes.

For an accurate modeling of cirrus clouds, it is important to be able to parameterize ice particle properties as good as possible to ensure that they are close to reality. To achieve this, balloon-borne in-situ measurements are carried out in Kiruna, northern Sweden. Kiruna is a unique place north of the Arctic Circle and east of the Scandinavian mountains, which can cause mountain lee-waves.

An in-situ particle imager, carried by a balloon, takes high-resolution images of ice particles in clouds. Size and shape are determined from the images. Particles are sorted into different shape classes. With a pixel resolution of $1.6 \mu\text{m}/\text{pixel}$, the shape of ice particles with a size of $20 \mu\text{m}$ or larger can be clearly discerned. This is an advantage over aircraft instrumentation. Another advantage of balloon-borne measurements is that there is no ice crystal shattering and therefore no bias with regard to many small particles.

The measured clouds were classified according to their origin as either liquid or in-situ origin. Ice particle properties are then analyzed separately for these two origins. It is remarkable that in the case of in-situ origin clouds, the particles are all smaller than $350 \mu\text{m}$ and mostly compact or irregular. Liquid origin clouds have wide size distributions with particles from 10 to $1200 \mu\text{m}$. Furthermore, in the case of liquid origin clouds, most particles are of irregular, rosettes or columnar shapes. In this case, the rosettes and columnar are almost always hollow.