Balloon-borne in situ measurements of high latitude cirrus clouds

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Cirrus clouds are of interest
- Play important role in radiative transfer
- Knowledge about microphysics important for climate models

Arctic cirrus and no shattering
- Less measurements in high latitudes (Arctic)
- Balloon measurements – no shattering
- Additional LIDAR

Measurement of very small ice particles
- Ice shape and size (>20μm)
- Number concentration
- Temperature, Pressure, height, humidity
- Backscatter coefficient, extinction coefficient, depolarization

Genesis of Cirrus
Measured cirrus in Kiruna are mainly originated from frontal systems. However, due to the main wind direction West and the Scandinavian mountains Lee-Waves can occur. We measured one fresh cold front cirrus on 20.2.2013 and an older warm front cirrus on 20.3.2014. We have one special conditions, an old warm front on 12.2.2016 with direction from south.

The differences in number concentration and particle size are striking
Number concentration correlates with ice particle size. The number concentration increases and the particle size decreases with height. The young cirrus (20.2.2013) has an order of magnitude larger number concentration and smaller particles (below 100μm) than the old cirrus (20.3.2014).

Additional Data from LIDAR
We also use data from LIDAR and compare them to our in situ measurement. This LIDAR has four channels and we can calculate depolarization. In future we will use Calipso data and a second LIDAR at ESRANGE.

Very big bullet rosettes
On 12.2.2016 we made a new experiment with cirrus from an older warm front from south. We observed many and very big bullet rosettes. Further analysis are on going.

References
Heymsfield et al. 2013, Ice cloud particle size distributions and pressure-dependent terminal velocities from in situ observations at temperatures from 0 to ~86 degrees C, J. Atmos. Sci., 70(12), 4123–4154, doi:10.1175/JAS-D-12-0124.1