Characterization of the cloud conditions at Ny-Ålesund using sensor synergy and representativeness across Arctic sites

1. Abstract

Arctic clouds often contain ice particles which form and develop at different environmental conditions. Atmospheric temperature and humidity are one of the main factors affecting ice particle shape, deposition growth rate, aggregation and riming efficiency, and ice multiplication. This study presents preliminary statistics of ice-containing clouds (pure ice and mixed-phase) at Ny-Ålesund Observatory (Svalbard, Norway) where a novel 94 GHz cloud radar has been operating since June 2016. The results are compared with observations from the Barrow site (Alaska, USA).

2. Ice-containing clouds at Ny-Ålesund and Barrow

- Cloudnet categorization [2] was used to find profiles containing ice particles at Ny-Ålesund. Cloudnet for Ny-Ålesund utilizes temperature information from Global Data Assimilation System (GDAS).
- For Barrow site vertical profiles of the radar reflectivity from the 35-GHz cloud radar KZAR and interpolated radiosonde (ARM database) were used. Profiles with radar scattering at temperatures below 0 °C were considered as ice-containing.

3. Long-term characterization of the atmosphere

Temperature and humidity are key factors for ice formation and development processes due to less microphysical processes in comparison to deep precipitating cloud systems. As a first step, thin (< 1000 m) non-precipitating single-layer ice-containing clouds were considered as representative across Arctic sites.

4. Thin single-layer ice-containing clouds

As a first step, thin (< 1000 m) non-precipitating single-layer ice-containing clouds were chosen for the analysis. Such clouds are relatively easier to characterize due to different environmental conditions.

5. A closer look at clouds in July and October

The retrieval of ice water content from radar reflectivity factor and lidar attenuated backscatter coefficient at Ny-Ålesund homogenized radiosonde record, Theoretical and Applied Climatology, doi: 10.1007/s00704-016-1864-0. Evidence of enhanced ice production in autumn will be gathered and compared with remote sensing observations.

6. Summary and Outlook

- Preliminary analysis of ice containing cloud occurrence and phase of clouds at Ny-Ålesund and Barrow
- Minimum of ice occurrence in July at both sites
- Evidence of enhanced ice production in autumn
- Indications of riming and/or multiplication processes were found in October
- In-situ observations during the measurement campaign in May – July 2017 will be gathered and compared with remote sensing observations.
- Doppler spectra analysis

Acknowledgements:
This work was supported by the German Research Foundation (Deutsche Forschungsgemeinschaft) within the Transregional Collaborative Research Center (TR 172) “Arctic Amplification: Climate Relevant Atmospheric and Surface Processes, and Feedback Mechanisms (ARCTIC);” Data for Barrow site were obtained from the Atmospheric Radiation Measurement (ARM) Program sponsored by the U.S. Department of Energy, Office of Science. Office of Biological and Environmental Research. Climate and Environmental Sciences Division. We gratefully acknowledge Ewan O’Connor for applying the Cloudnet algorithms to the Ny-Ålesund measurements.

References:

European Geosciences Union General Assembly 2017, Vienna, Austria, 23-28/04/2017