Clouds at the Arctic atmospheric observatory AWIPEV: results from high-resolution observations and modeling

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In order to better understand the role of clouds in affecting the Arctic climate and in the so-called Arctic Amplification, high quality cloud observations are needed. Such observations require a combination of various remote sensing instruments, e.g. cloud radar, ceilometer, and microwave radiometer, which continuously monitor the Arctic atmospheric column.

Within the Transregional Collaborative Research Centre TR172 "ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms $(AC)^3$" (www.ac3-tr.de), the French - German Arctic Research Base AWIPEV at Ny-Ålesund/Svalbard will state a further important puzzle piece of Arctic cloud observations in the warmest part of the Arctic. With the installation of a 94 GHz frequency modulated–continuous wave (FM–CW) cloud radar at Ny-Ålesund in June 2016 and the combination with existing instrumentation, clouds and related physical processes can now be characterized in Ny-Ålesund in a much more comprehensive way than done so far. In this work, we will present results of almost 2-year vertically resolved cloud observations at Ny-Ålesund.

In addition, to the continuous ground-based remote sensing observations at Ny-Ålesund, extensive aircraft-based remote sensing measurements of clouds have been performed in May/June 2017 as part of the $(AC)^3$ ACLOUD campaign. The measurements encompass observations from the new Microwave Radar/radiometer for Arctic Clouds MiRAC and the Airborne Mobile Aerosol Lidar AMALi. While observations at the ground-based measurement site mainly provide information on the temporal variability of atmospheric variables, observations from aircraft also add information on the spatial variability of clouds. Here, the aircraft-based measurements will also be set into context to the observations of their ground-based counterparts.

Further insight into the spatial variability of atmospheric variables can be gained by high-resolution modelling studies with large eddy simulations (LES). LES can also be used as virtual lab to test our understanding of cloud processes. In addition to the new observational capabilities for clouds at Ny-Ålesund, we will also present first results of model simulations at Ny-Ålesund with the new high resolution model ICON-LEM. Due to the complex topography, simulations are particularly challenging here. We will demonstrate the potential of such simulations in terms of a case study for the 23 June 2017, for which both, high-resolution observations from ground and aircraft, and model results are jointly analyzed.