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Zooming in on Arctic clouds: A case study comparing A-Train and airborne remote sensing measurements.

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Despite their importance, our knowledge on arctic clouds and in particular their vertical structure is limited.

In the essentially remote regions of the Arctic, the only continuous measurements available usually are those of satellites, like the A-Train constellation. Climatologies have been derived from A-Train products, i.e. the combination of radar and lidar. However, due to the coarser resolution and bigger footprints of the sensors and the blind zone of CLOUDSAT in the boundary layer many features are missed. In the framework of the Collaborative Research Centre TR 172 “Arctic Amplification” four major aircraft campaigns with the AWI research aircraft POLAR5 took and will take place in the vicinity of Svalbard with emphasis on the Atlantic Arctic region close to the marginal sea ice zone.

On board of the POLAR5 aircraft active measurements by radar (MiRAC) and lidar (AMALi) were performed and supported by microwave radiometer measurements in 9 frequency channels and a high spectral resolution solar imager (AISA Eagle/Hawk). We have calibrated and processed radar and lidar measurements and deduced highly resolved (7.5 m, 1.3 Hz) vertical profiles of backscatter, attenuation and reflectivity and retrieved a preliminary classification of cloud top. The potential of these measurements for a detailed characterization of Arctic clouds is assessed via the comparison with CALIPSO and CLOUDSAT as well as MODIS measurements for an A-Train underflight. Measurements cover a cold air outbreak in May 2017 with a complex situation with multiple layers of mixed phase clouds and several inversions evident in the thermodynamic structure given by dropsondes. A high resolution model simulation with ICON, which reproduces the general features of this situation, is used together with instrument simulators to investigate how much information on cloud processes can be gained from the measurements.