

Interactions between Arctic boundary layer and low level mixed-phase clouds

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Low level mixed-phase clouds occur frequently in the Arctic, and can persist from hours to several days. However, the processes that lead to the commonality and persistence of these clouds are not well understood. The aim of our work is to get a more detailed understanding of the dynamics and the processes in Arctic mixed-phase clouds and the interaction between the clouds and their environment using a combination of instruments operating at AWIPEV station in Ny  lesund, Svalbard. The Svalbard archipelago lies in the warmest part of the Arctic and is influenced by relatively large mean transport of moisture and heat from the lower latitudes, and a large variability in this transport. Moreover, the surroundings of the station exhibit large variations in surface properties (glaciers, seasonal snow cover, and open water) as well as orography. These features modify the local boundary layer and also the associated clouds.

The corner stone of our study is a novel frequency modulated continuous wave cloud radar (94 GHz) installed at the AWIPEV station in June 2016. The high vertical (4 m in the lowest layer) and temporal (2.5 sec) resolution allows for a detailed description of the structure of the cloud. In addition to radar reflectivity and mean vertical velocity, we also utilize the higher moments of the Doppler spectra for detecting micro-physical signals. Supplementary instruments operated by AWI are used to detect super-cooled liquid inside the cloud: a ceilometer and a microwave radiometer. We take advantage of synergistic approaches developed for classifying hydrometeor phase (i.e. Cloudnet algorithm).

Using the 1.5 years long time series of cloud observations available, we investigated how large scale weather conditions as well as local boundary layer processes are associated with the occurrence and physical properties of persisting low level stratiform mixed-phase clouds. We find that these clouds prefer certain weather conditions to occur, and that some macro- and micro-physical properties depend on the weather type while others seem rather independent on the large scale situation. Furthermore, to describe the micro-physical processes we have investigated selected case studies of persistent mixed-phase clouds occurring above the AWIPEV station using height-resolved Doppler spectra of the 94 GHz cloud radar. The results presented are the first step of studying a long time series of Arctic mixed-phase clouds in Svalbard. By characterizing the cloud properties we are able to state in which regards the clouds observed at AWIPEV are similar to Arctic mixed-phase clouds observed at other sites, and what kind of special features occur. This is necessary both for our future work, as well as for many other efforts studying stratiform mixed-phase clouds in the region.

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