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Interactions between Arctic boundary layer and 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 of and the processes in Arctic mixed phase clouds and the interaction between the clouds and their environment using a combination of instruments operating at the French-German Arctic Research Base AWIPEV in Ny Ålesund, Svalbard. 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 potentially also the associated clouds. The corner stone of our study is a novel frequency modulated continuous wave radar (94 GHz) installed at the AWIPEV station in June 2016. The high vertical (5 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. To supplement the radar measurements, liquid layers inside the cloud are detected with a ceilometer and a microwave radiometer. A Doppler lidar is used to obtain a three-dimensional wind field, which we utilize to describe the turbulent state of the boundary layer. We take advantage of synergistic approaches developed for classifying hydrometeor phase (i.e. Cloudnet) and boundary layer turbulence. Using the 1,5 years long time series of cloud observations now available, we investigate how large scale weather conditions as well as local boundary layer processes are associated with the occurrence and properties of mixed phase clouds. Furthermore, micro-physical processes are examined for selected case studies.

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