A011-0012 - The influence of surface processes and orographic effects on mountaintop observations of Arctic mixed-phase clouds

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Poster

Abstract

Mixed-phase clouds (MPCs) play an important role in controlling the surface radiative energy budget and the global hydrological cycle. They are ubiquitous in mountainous regions and in the Arctic. Furthermore, MPCs have been associated with Arctic amplification and thus, their accurate representation in earth system models is necessary for predicting future climate in the Arctic.

Several strategies for in situ measurements of MPCs are employed globally, including airborne field campaigns and continuous measurements at mountaintop observatories. However, previous MPC measurements at mountaintop observatories have shown enhanced ice crystal number concentrations relative to airborne measurements. Indeed, several studies have shown that surface processes such as blowing snow, secondary ice production and ice crystal convergence may contribute to higher concentrations of ice crystals at mountaintop observatories than in ambient clouds. However, due to flight rules in complex terrain, there has yet to be a comparison between airborne and mountaintop measurements where MPCs were sampled simultaneously and at the same altitude.

During the fall of 2019, a holographic cloud imager, which measures phase resolved particle size distributions between 6 μm and 2 mm, was installed at the Zeppelin Observatory above the town of Ny-Ålesund, Norway. Simultaneously, the tethered balloon borne holographic cloud imaging platform, HoloBalloon, was deployed 1.5 km to the north of Zeppelin Observatory in the town of Ny-Ålesund. Thereby allowing concurrent observations of low-level MPCs at mountaintop and in ambient cloud conditions. Thus, these two simultaneous measurements provide the unique opportunity to quantify the influence of surface based processes on Arctic MPCs measured at a mountaintop observatory and assess any influence that local orographic effects have on Arctic MPCs.

Here we will present comparisons in the microphysical properties from the MPCs sampled at the mountaintop and at the same altitude from HoloBalloon. We will focus on assessing the influence of surface processes including blowing snow and secondary ice production processes based on sonic anemometer wind speed data and ice crystal sizes and shapes. We will also investigate the influence of orographic lifting on Arctic MPCs by comparing the cloud droplet size distributions at the two measurement locations. Thus, improving the understanding of biases associated with mountaintop measurements of MPCs and the role of orographic lifting on Arctic MPCs.

Authors

Huiying Zhang
University of Oslo

Julie Pasquier
ETH Swiss Federal

Institute of Technology
Zurich

Jan Henneberger
ETH Swiss Federal
Institute of Technology
Zurich

Tim Carlsen
University of Oslo

Jörg Wieder
ETH Swiss Federal
Institute of Technology
Zurich

Guangyu Li
ETH Swiss Federal
Institute of Technology
Zurich

Rosa Gierens
University of Cologne

Kerstin Ebell
University of Cologne

Paul Zieger
Stockholm University

Trude Storelvmo
University of Oslo

Robert David
University of Oslo