# A011-0007 - Understanding Microphysical Processes in Arctic Mixed-Phase Clouds from Balloon-Borne Holographic Instrument

Monday, 7 December 2020

13:00 - 05:59

*Poster*

## Abstract

The Arctic is warming faster than the rest of the world. Clouds have been associated with this Arctic Amplification as they influence downwelling solar and upwelling terrestrial radiative fluxes, which determine the surface radiative energy budget. Mixed-phase clouds (MPCs), which contain both cloud droplets and ice crystals, are highly abundant in the Arctic. The cloud phase partitioning within MPCs especially influences the atmospheric radiation balance due to the different scattering properties between liquid droplets and ice crystals. Additionally, the lifetime of MPCs depends on the spatial distribution of cloud droplets and ice crystals. However, the cloud phase partitioning in Arctic clouds is poorly understood due to the limited availability of in-situ measurements.

Measurements were conducted in Ny-Ålesund, Svalbard, Norway, during October and November 2019. The main instrument used was a tethered balloon system called HoloBalloon. HoloBalloon consists of a holographic cloud probe, a 3D sonic anemometer, four radiation sensors (up- and downward looking solar and terrestrial broadband irradiance), and two optical particle counters mounted on a 175 $m^3$ tethered balloon system which can fly up to 1000 m above ground. Additionally, ice nucleating particles (INP) and cloud condensation nuclei were quantified at the measurement site. The in-situ cloud measurements were complemented by a comprehensive set of remote sensing instruments deployed at the AWIPEV Observatory that profile the entire troposphere and additional radiosondes were launched.

Here we will present the observed microphysical properties of precipitating MPCs that were measured during five consecutive days from November 8 to 12, 2019. During the two first days, an occluded front influenced the formation of the MPCs. On the third day, despite ground temperatures below -10°C, the limited ambient INP concentration inhibited the glaciation of the clouds. Additionally, the entire cloud layer was probed and the cloud top radiative properties analysed. During the two last days, the MPCs were characterised by the collocated occurrence of large supercooled droplets up to 200 $\mu$m and high concentrations of pristine ice crystals. This suggests secondary ice formation through droplet shattering and rime splintering.

## Authors

**Julie Pasquier**
ETH Swiss Federal Institute of Technology Zurich

Jan Henneberger
ETH Swiss Federal Institute of Technology Zurich

Jörg Wieder
ETH Swiss Federal Institute of Technology Zurich

Robert David
University of Oslo

Guangyu Li
ETH Swiss Federal Institute of Technology Zurich

Tim Carlsen
University of Oslo

Rosa Gierens
University of Cologne

Kerstin Ebell
University of Cologne

Marion Maturilli
Alfred Wegener Institute Helmholtz-Center for Polar and Marine Research Potsdam

Christoph Ritter
Alfred Wegener Institute Helmholtz- Center for Polar and Marine Research, Climate Sciences, Atmospheric circulations

Roland Neuber

Paul Zieger
Stockholm University

Ulrike Lohmann
ETH Zurich