CHASING CLOUDS
OR HOW CLOUD DYNAMICS

Surface air temperatures in the Arctic have shown a significant increase especially in the past few decades. Temperature changes are strongly linked to changes in the radiative fluxes caused by changes in clouds, water vapor and greenhouse gas concentrations. Therefore, clouds play a key role in the Arctic by modulating the radiation balance.

Clouds are essential to understand the net surface energy balance influencing surface warming as well as ice and snow melt, as the difference between the radiation budget components for average cloud conditions and cloud-free conditions (also known as cloud radiative forcing) is positive over most of the year (Vihma *et al.,* 2016). While clouds reduce the shortwave incoming radiation to the surface through their high albedo, clouds also augment the downward longwave flux to the surface increasing surface warming (Serreze and Barry, 2011).

The role of clouds to enhance snow and glacier melt is still poorly known. While some authors claim clouds enhance meltwater runoff (Van Tricht *et al.,* 2016) others claim that decreasing cloud cover drives the recent mass loss on the Greenland ice sheet (Hofer *et al.,* 2017). Despite their crucial importance for understanding Arctic climate change, present numerical models struggle to represent Arctic surface energy balance (Tjernström *et al.,* 2008), which is partly due to poor representation of cloud properties (de Boer *et al.,* 2014). Thus, improving the current knowledge of cloud type and cover is paramount to understand their influence on Arctic systems.

Disko Bay, a highly relevant region for the Greenlandic society, has been identified as a hotspot of recent climate change in Greenland (Abermann *et al.,* 2017) showing changes in surface temperature trends (Westergaard-Nielsen *et al.,* 2018). More than 20% of the Greenlandic population that lives in the Disko Bay area relies on fishing and hunting for income (Goldhar and Ford, 2010). Changes in surface warming patterns due to changes in cloud dynamics may influence species composition and abundance, as well as sea ice and snow melt thus affecting Disko Bay's population economy and traditional way of life.

To improve the current knowledge on cloud dynamics Asiaq – Greenland Survey in collaboration CENPERM at University of Copenhagen and supported by the GEM ClimateBasis program installed a state-of-the-art profiler and a sky camera in 2016 (Fig. 1) at Qeqertarsuaq (Disko Island). While the sky camera data provides crucial data to derive cloud type and cover (Fig. 2), the atmospheric profiler provides vertical humidity and temperature data needed to characterize clouds and their radiation properties (Fig. 1). In addition, a high precision pyrgeometer was installed to understand cloud dynamics and its effects on the surface warming.

Furthermore, these datasets also support GEM Remote Sensing initiatives by providing essential ground truth data for remotely assessing cloud cover. Preliminary data (Figure 1 and 2) also show that high-resolution temperature profiles are useful to quantify the duration and frequency of inversion layers, characterized by warmer air masses with increasing altitude which has important implication for upscaling soil-plant interactions in mountainous areas of Greenland.

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Data source:

GEM ClimateBasis - Profiler and sky camera

GEM ClimateBasis - Meteorology

GEM RemoteBasis - Clouds

MIGHT INFLUENCE THE CLIMATE IN THE ARCTIC

(Photo:Jakob Abermann).

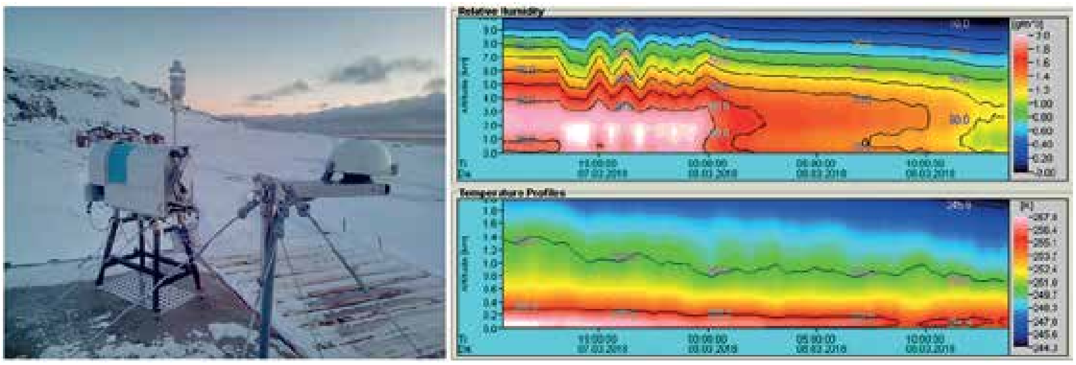

Figure 1. Left panel: RPG-HATPRO atmospheric profiler (left) and hemispherical sky camera (right) instruments at Arctic Station (photo taken by Jordi Cristóbal Rosselló). Right panel: Hourly humidity and temperature vs. altitude data acquired by the RPG-HATPRO atmospheric profiler for 07-03-2018.

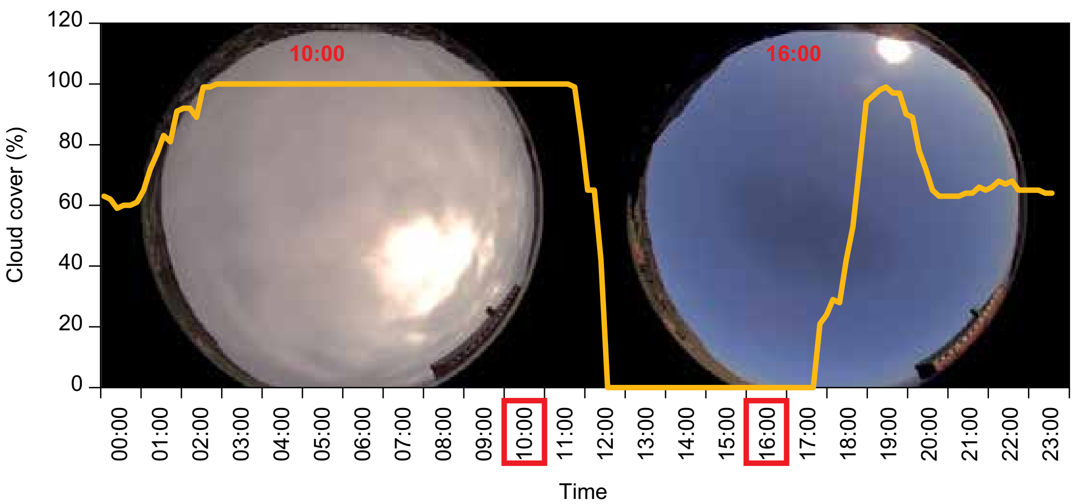

Figure 2. Hourly fractional cloud cover (in %) for 10/08/2016 at Disko using hemispherical sky camera imagery (Wacker et al., (2015)). Image acquisition times of the background image are marked in red.

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