

A decade beneath Arctic clouds: Continuous radar observations at Ny-Ålesund, Svalbard

Climate change signals are especially strong in the Arctic, where warming from 1979 to 2021 proceeded at nearly four times the global average rate (Rantanen et al., 2022). The magnitude of this warming varies across the region, and the Svalbard archipelago, located in the warmest part of the Arctic, has experienced particularly intense temperature increases (Dahlke and Maturilli, 2017).

The influence of clouds on the rapidly evolving Arctic climate system, as well as the processes governing their behavior, remains a key research challenge. Although detailed cloud observations are essential, only a limited number of Arctic sites provide continuous, high-resolution vertical measurements of cloud properties. One such site is the German-French Arctic Research Base AWIPEV at the Ny-Ålesund Research Station on Svalbard. Since 2016, a 94 GHz cloud radar has been operating at this location as part of the Transregional Collaborative Research Centre TR172 on Arctic Amplification (AC)³ (<http://www.ac3-tr.de>; Wendisch et al., 2023). In combination with complementary remote-sensing instruments, including ceilometers and microwave radiometers, this observational setup allows for continuous cloud monitoring with high temporal and vertical resolution. This presentation highlights key results derived from a decade of cloud radar observations.

Clouds are present at Ny-Ålesund during roughly 78% of the time, most frequently at low levels between 0.5 and 1.5 km. While pure liquid clouds show a distinct seasonal variability, mixed-phase clouds occur year-round and account for about 42% of all cloud observations. These liquid-containing clouds have a significant influence on the Arctic surface energy budget, leading to an overall warming at Ny-Ålesund due to the enhanced longwave downward radiation flux.

Based on the 10-year-long dataset, we will examine the interannual variability of clouds and precipitation at Ny-Ålesund, as well as their impact on surface radiation.

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