Radiative effect of clouds at the Arctic site Ny-Ålesund, Svalbard

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Clouds strongly impact shortwave (SW) and longwave (LW) fluxes in the atmosphere. In particular in the Arctic, the interaction of clouds and radiation can be quite complex due to the prevailing boundary and atmospheric characteristics. In order to better understand the processes of cloud-radiation interactions in the Arctic, cloud, thermodynamic and boundary conditions need to be well known. In this respect, ground-based remote sensing observations provide a detailed characterization of clouds which can be used to assess their radiative impact. Such observations are thus crucial from both, campaigns (providing information e.g. for the rather inaccessible central Arctic) and ground-based ``supersites'' (providing continuous long-term observations).

For the first time, the CRE has been recently characterized by Ebell et al. (2020) for the Arctic supersite Ny-Ålesund, Svalbard, Norway, including more than 2 years of data (June 2016–September 2018) of the French-German research station AWIPEV. Here we present the results of this study which is based on a combination of ground-based remote sensing observations of cloud properties and the application of broadband radiative transfer simulations.

The simulated fluxes have been evaluated in terms of a radiative closure study. Good agreement with observed surface net shortwave and longwave fluxes has been found giving confidence in the estimated CRE values. The monthly net surface CRE at Ny-Ålesund is positive from September to April/May and negative in summer. For 2017, an annual surface warming effect by clouds is 11.1 Wm^{-2} is found. As seen in other studies, the longwave surface CRE of liquid-containing clouds is mainly driven by liquid water path (LWP) with an asymptote value at Ny-Ålesund of 75 Wm^{-2} for large LWP values. The shortwave surface CRE can largely be explained by LWP, solar zenith angle and surface albedo. Liquid-containing clouds clearly contribute most to the shortwave surface CRE (70-98%) and from late spring to autumn also to the longwave surface CRE (up to 95%). Only in winter, ice clouds are equally important or may even dominate the signal in the longwave surface CRE.

In future, the analysis will be extended by further years and set into context to the measurements of other Arctic campaigns (e.g. MOSAiC) and supersites.

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References

Ebell, K., T. Nomokonova, M. Maturilli, and C. Ritter, 2020: Radiative Effect of Clouds at Ny-Ålesund, Svalbard, as Inferred from Ground-Based Remote Sensing Observations. *J. Appl. Meteor. Climatol.*, **59**, 3–22, https://doi.org/10.1175/JAMC-D-19-0080.1