Radiative effect of clouds at Ny-Ålesund, Svalbard, as inferred from ground-based remote sensing observations

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1) Outline
- Clouds strongly impact the available energy at the surface, at the top of the atmosphere as well as its vertical distribution within the atmosphere.
- Cloud radiative effect (CRE), i.e. the difference between the all-sky and clear-sky fluxes, strongly depend on the cloud macrophysical (e.g. frequency of occurrence, cloud vertical distribution) and microphysical (e.g. phase, water content, hydrometeor size distribution) properties.

Question: What is the radiative effect of clouds at the Arctic site Ny-Ålesund?
- For the first time, the impact of clouds on the shortwave (LWP) and longwave (LW) fluxes is estimated for Ny-Ålesund exploiting more than 2 years (06/2016 -10/2018) of continuous vertical cloud measurements at the German-French research station AWIPEV.

2) Methodology

Retrieval of cloud macro- and microphysical properties
- Based on Cloudnet target classification (Fig. 1; SE = 30 °, ΔZ = 20 m), retrieval of liquid and ice water content and effective radii (see Table 1).

Table 1: Overview of applied cloud microphysical retrieval algorithms.

3) Evaluation of simulated surface fluxes
- Analysis period: 10 Jun 2016 - 5 Oct 2018
- 30 s radiative transfer calculations averaged over 10 min and compared to observations of the baseline radiation network (BSRN)
- Reasonable agreement of simulated and observed downwelling fluxes (Fig. 2)
- Clear-sky: small bias and small interquartile range for both SW and LW surface fluxes
- Cloudy sky: small bias but larger interquartile range for SW fluxes due to 3-D effects, misclassification, uncertainties in cloud properties

4) Cloud properties and cloud radiative effect

Cloud properties and surface CRE

5) Conclusions & Outlook
- For the first time, the cloud radiative effect has been characterized for the Arctic site Ny-Ålesund.
- Coming next: analysis of vertical redistribution of energy by clouds and how clouds impact the atmospheric heating rates at Ny-Ålesund
- Cloud radar measurements will be continued at AWIPEV from summer 2019 onwards
  - Expansion of time series by further years and analysis of interannual variability of CRE

References

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