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Comparison of ERA-5 reanalysis and observed cloud cover in the high Arctic

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Knowledge and understanding of Arctic cloud properties is important for climate predictions and weather forecasts but limited because of scarcity of observational data on Arctic clouds in general and especially during the dark winter season. Prediction of clouds is known to be a major challenge in numerical weather forecasts and climate models and the shortage of observations for use in data-assimilation in the Arctic constitutes a further difficulty.

We present results from an analyses of cloud cover based on profiles of the attenuated backscatter coefficient from an 8-year long data series (July 2011 – April 2019). The observations are carried out in the high Arctic by a ceilometer with a maximum range setting of 7.7 km from the Villum Research Station at Station Nord, Greenland. Results show that the hourly cloud cover turned out to follow a U-shaped rather than Gaussian-like distribution.

Annual and seasonal cloud cover variation is illustrated. The cloud cover is larger during the autumn and winter as compared to summer and spring. The cloud cover exhibits a substantial variation from year to year without a clear trend. The cloud cover during spring is low and decreasing between 2012 and 2017. The cloud cover during the autumn of 2016 is lowest compared to the other years.

The observed cloud cover is compared to the cloud cover provided in the ERA5 reanalysis data-set. The cloud cover for low clouds and medium clouds are combined to represent a total height of 6 km. Both the observed and modelled cloud cover is larger during winter as compared to summer-time cloud cover. The measured reduction in the cloud cover for the autumn of 2016 is present in the reanalysis data as well but the measured low cloud cover during spring is not apparent in the reanalysis data.

The ability of the ERA-5 reanalysis data to predict the observed cloud cover was investigated. Because the cloud cover distribution is U-shaped rather than of a Gaussian nature, standard metrics are not applicable. We apply a generalized skill score that is developed for contingency tables or joint histograms. Three skill scores were calculated. It was found that for all three methods, skills for the predictability of the cloud cover by the ERA5 modelling is better for winter than summer and is poor during the spring.