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Total cloudiness over the Arctic in winter: an intercomparison of different climatologies, an assessment of inter-annual variability and connection with surface air temperature

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An increase of air temperature in the Arctic is accompanied with changes in other climate variables, particularly with a decrease of the Arctic sea ice extent and cloud cover changes. The sensitivity of the cloud radiative forcing is about 1 Watt per square meter per 1% of cloud cover in the Arctic. Thus, relatively small changes in cloud fraction could result in an sufficient climate forcing. Considering an importance of clouds in the Arctic, it is crucial to know exactly when and where clouds exist and how cloud cover is changing in time. Here, we analyze climatology of winter cloudiness over the entire Arctic (north of 60N), its interannual variability in the Norwegian Sea - Kara Sea region and its connection with surface air temperature.

Based an intercomparison of 16 cloud climatologies (including satellite and surface observations as well as reanalyses data), we show significant distinctions among different cloud climatologies based on various observations and reanalyses. Clouds cover 55-72% of the Arctic according to surface and satellite observations and 47-93% according to reanalyses. Coefficient of spatial correlation of different observation-derived cloud climatologies varies from 0.7 to 0.95 over the ocean and from 0.3 to 0.75 over land and it is negative for particular reanalyses. In general, winter cloud climatologies from reanalyses are in a bad agreement with observational ones.

We use long-term visual observations from Norwegian and Russian meteorological stations in the Norwegian Sea - Kara Sea region to assess cloud interannual variability during the last century and its connection with surface air temperature. We find that a number of warm and overcast winter days is higher in the recent warming than during the cooling of 60-80s years of the 20th century. However, the early 20th century warming was even more cloudy then the recent warming. In general, surface air temperature in the ice band regions and during the cold periods is more sensitive to changes of a number of overcast days. On the other hand, surface air temperature in the open water regions and during the warm periods is more sensitive to changes of a number of clear days.

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