Cloud statistics at Ny-Ålesund using ground-based sensor synergy

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Clouds have a strong effect on the radiation budget, especially in the Arctic region where the climate change is significantly faster than at low latitudes. The impact of clouds on the energy transfer depends on their macrophysical and microphysical properties, which are often characterized using a set of active and passive remote-sensing instruments. In 2016 the French-German Arctic Research Base AWIPEV cloud observatory at Ny-Ålesund was complemented by a 94 GHz FMCW cloud radar, which allows for implementation of state-of-the art cloud property retrieval methods. For example, the CLOUDNET algorithms [1] are applied to the ground-based observations from ceilometer, microwave radiometer and the 94 GHz cloud radar in order to provide vertical profiles of cloud phase categorization and of corresponding microphysical properties.

In this study, we will present for the first time statistical analysis of clouds at Ny-Ålesund and their relation to the thermodynamic conditions under which they occur. Since cloud formation strongly depends on meteorological conditions, different types of clouds are set into the context to the environmental conditions such as temperature, integrated water vapor, and ice and liquid water path (LWP). In this work we will also present first results on the derived cloud microphysical properties such as liquid water content (LWC), ice water content (IWC), effective radius for liquid and ice particles (Refl and Refi). Further, the retrieved microphysical properties from ground-based observations will be compared to ones derived from in-situ measurements.

The statistics on different types of clouds and their properties can be used to test their representation and dependency on temperature and humidity in models. In this respect, we also analysed data from the numerical weather prediction (NWP) model ICON. Since the parameterization of cloud phase partitioning in NWP models depends on atmospheric conditions, the relation between cloud top temperature and liquid fraction, i.e. the ratio LWP to total water path, for mixed-phase clouds will be also analysed and shown.

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References

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