Investigating mixed-phase clouds at Ny-Ålesund

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Arctic clouds and feedbacks are still a big challenge for our understanding as well as for our current modelling systems. Especially the heterogeneous terrain (water, sea-ice, land, glaciers, …) and atmospheric conditions lead to difficulties and force us to combine models and observations closely to gain more understanding and trust in our simulations. Within the Transregional Collaborative Research Centre TR172 "ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms (AC)3" an observational site with numerous cloud measurements has been established at Ny-Ålesund (Svalbard). Ny-Ålesund is located in the warmest part of Arctic and surrounded by glaciers, mountains and a fjord, which made it unfeasible for high-resolution modelling studies for a long time. But the current progress in high-resolution modelling, allowing to include heterogeneous surface and lateral boundary conditions, makes it possible to combine the longterm observations with detailed modelling studies.

Part of this presentation will be the introduction of our current mixed-phase clouds suite including longterm observations as well as quasi-operational simulations with the ICON-LEM at a resolution of 600m around Ny-Ålesund. We will show how well the ICON-LEM is able to reproduce realistic mixed-phase clouds around Ny-Ålesund, but also point out the existing deficiencies and the potential for improvements in the modelling system. Continuously operated remote sensing observations make it possible to analyse mixed-phase clouds at Ny-Ålesund under various synoptic and seasonal conditions, i.e. we have found that low-level mixed-phase clouds occurring with westerly free tropospheric winds contain on average more liquid, and that ice content is highest in spring. Furthermore, by using a radar forward operator we can evaluate model simulations of mixed-phase clouds directly in the observational space and so take advantage of the information on microphysical properties available from the Doppler cloud radar measurements. Especially the combination of remote sensing observations and high-resolution modelling in a statistical way allows us to develop robust methods for the identification of strength and weaknesses of our current microphysical schemes.