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High-resolution simulations around point measurements at Ny-Ålesund – searching for representativity

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Cloud processes and their contribution to climate feedbacks are still a challenge in the arctic region, due to a lack of understanding and relevant cloud measurements as well as a poor representation in current models. Especially, the synoptic conditions in the arctic and the complex topography around some arctic measurement points (like Svalbard) are a challenge for representative observations as well as for high-resolution modeling. Within the Transregional Collaborative Research Centre TR172 – ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms $(AC)^3$ – numerous cloud measurements have been established at Ny-Ålesund (Svalbard), which provide insights into relevant cloud processes. These new measurements are complemented by several high-resolution simulations with the new ICON Large-Eddy-Model. The model is run in a nested setup, which allows open boundary conditions and includes a realistic topography. The model domains start with a 100km circle and 600m resolution and go down by one-way nesting to 50m resolution in a 20km circle around the point measurements. Especially in the arctic, a reasonable information on the composition and transformation of arctic air masses are a key requirement for the simulations. For this reason, also observations from an aircraft campaign (ACLOUD - Arctic CLoud Observations Using airborne measurements during polar Day) in 2017 are included in our study. As a first part of this study, we will show a basic evaluation of the model performance and the potential of ICON-LEM at such challenging observational sites.

A strong advantage of high-resolution simulations is their potential to complement point measurements with a 4-dimensional context. While observations are usually limited in dimensions, a model covers the whole space. This information can be used to investigate the representativity of point measurements – especially under such challenging conditions like Svalbard. Are the measured clouds representative for arctic clouds? How strongly is the spatial variability of integrated water vapor or liquid water path influenced by the surface conditions and topography? Which role plays the resolution in the analysis of these quantities? We will show how a synthesis of novel observations and high-resolution simulations can help us to gain insight into these questions and present some first results.