Geophysical Research Abstracts
Vol. 20, EGU2018-12458, 2018
EGU General Assembly 2018

Large-Eddy-Simulation for supporting Arctic cloud measurements

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Cloud climate feedbacks in the Arctic are still not fully understood, which is partially due to a distinct lack of relevant cloud measurements at high latitudes. However, challenges for cloud resolving modeling in these conditions also contribute to this prevailing lack of insight. Especially the difficult terrain around Arctic supersites, in combination with complex atmospheric conditions, require a rethink of how to best combine fine-scale simulation and observations at these locations. 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). Additional in 2017 an intense aircraft observation campaign (ACLOUD) took place in the same region. In this study we will present ongoing work to complement these observational data with reliable and realistic Large-Eddy-Simulations. The simulations around Ny-Ålesund are performed with the new ICON-LEM in a nested setup with open boundaries, and also features a realistic topography. At the top of the nesting hierarchy sits a 600 m resolution in a 100 km circle around Ny-Ålesund, followed by 3 one-way nested domains down to a resolution of 50 m in a 20 km inner domain. First case studies compare reasonably well to observed data and show the potential of the ICON-LEM to cope with the difficult terrain. But also some issues are revealed, which offer opportunities for model improvement and point out the need for refined initial- and boundary-conditions. For the aircraft campaign various model setups are used – ranging from the ICON-LEM to semi-idealized simulations with the DALES model – based on the investigated question. This variety allows us to include observations directly into model simulations and to explore the capabilities and limits of different model setups.