

## **Low-level, mid-level and multilayer clouds in polar regions: climatology and case studies on the vertical structure and thermodynamic cloud phase**

Radiative biases over the Southern Ocean as well as in the Arctic persist in the many weather and climate models. One of the reasons is a misrepresentation of the cloud phase, which is not only driven by temperature, but by microphysical processes involving aerosol-cloud interactions. In addition, complex vertical layering poses a challenge for coarse-grid models.

In this talk, I will approach this topic from three angles: First, in case studies on multilayer clouds observed in the high Arctic during the MOSAiC campaign, simulations with the ICON model in different grid spacing are constrained with observed CCN and INP concentrations. Second, a two-year climatology of low- and mid-based clouds over the Arctic and Southern Oceans is constructed based on CloudSat/Calipso data. Their phase distribution is shown to be correlated with sea ice coverage, sea salt and dust aerosol concentrations. Finally, we examine whether global storm-resolving simulations with ICON reproduce the same relationship with sea ice coverage.