Project: 1512
Project title: High-Resolution ICON Simulations for the AC3 Project
Principal investigator: José Miguel Vicencio Veloso
Report period: 2025-05-01 to 2026-04-30

COMPEX Campaign

Approximately 3,200 node hours were used for daily 2 km resolution forecasts in support of the COMPEX airborne campaign on Svalbard (15 March – 15 April 2026). The forecasts supported the planning of 15 research flights by identifying cloud structures of interest and predicting air-mass trajectories. Forecast output was also used to run high-resolution (600 m) `pamtra-insitu` simulations, producing synthetic radar reflectivities along the research flight tracks. Comparing these simulated reflectivities against in-situ observations will help assess whether specific terrain or meteorological conditions affect the model's representation of clouds. The forecasts will continue to serve both as a reference during campaign data analysis and as boundary conditions for further high-resolution simulations.

For instance, a comparison between dropsonde observations and the ICON output (Figure 1) reveals that the model struggles most to reproduce the moisture distribution (relative humidity) in the marginal ice zone, relative to the open ocean and sea ice regimes. This appears to be linked to an incorrect representation of the boundary layer height, which in turn affects cloud formation and the vertical distribution of moisture. This analysis will be extended to additional variables and observational platforms to provide a more comprehensive validation of the ICON simulation for several other campaigns performed in the Arctic.

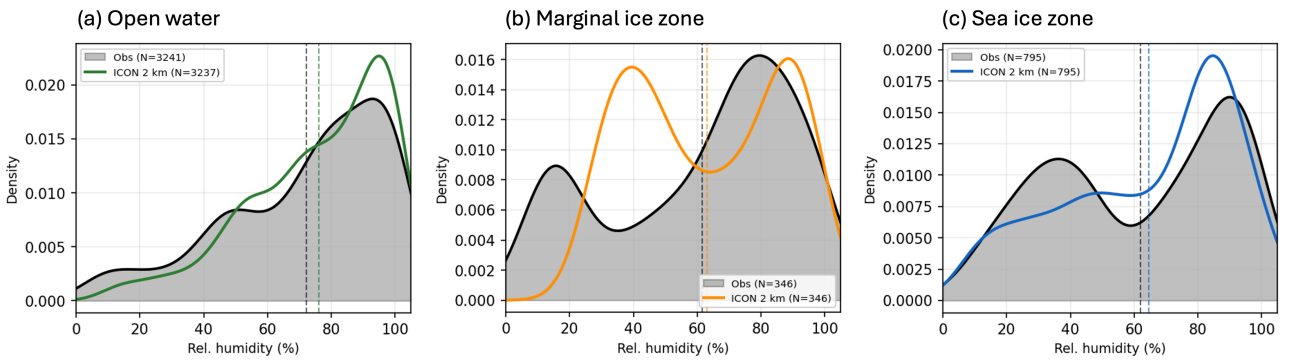

Figure 1: Relative humidity distributions from 88 dropsondes deployed during COMPEX and from a 2 km resolution ICON simulation nearest grid point, classified by sea ice fraction at the time of each drop: (a) opean ocean, i.e., sea ice fraction <10%, (b) marginal ice zone (sea ice fraction between 10 and 85%), and (c) sea ice zone (sea ice fraction >85%).

Station North Campaign

During this allocation period, approximately 1,000 node hours were used to run limited-area ICON simulations over northwestern Greenland, covering the period of the BELUGA balloon measurement campaign (19 March – 18 April 2024). These simulations provide regional context for the in-situ measurements and enable direct model–observation comparisons, with a focus on understanding model performance during the transition from polar night to polar day. Additional high-resolution simulations targeting specific weather events are planned, and a manuscript reporting these results is currently in preparation.

COMPEX-EC Campaign

Two high-resolution simulations have been completed for the COMPEX-EC campaign, which took place in northern Europe (02-04-2025 to 16-04-2025). Further simulations covering each individual research flight are planned for the future to compare Earthcare data, observations from the POLAR-5 plane, and ICON.

ICON for Observationalists Workshop
A total of 12 participants attended the ICON for Observationalists Workshop, held from 1 to 3 December 2025 in Cologne, Germany. The node hours allocated to this activity were used to set up and test example simulations for the workshop, as well as to support the ongoing development and testing of `pamtra-insitu` — a package that leverages ComIn to run PAMTRA synchronously within ICON, enabling radar reflectivity output at the model time-step level. The training was a success, and we expect to hold more workshops in the next allocation period.