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Sensitivity of simulated Greenland climate to the COSMO-CLM model setup

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About 50% of the ice mass loss of Greenland is connected to ice sheet dynamics. Global climate simulations are not able to resolve the accumulation and ablation of ice sheets over steep topography gradients correctly. Within the PalMod project, we aim to develop parameterisations to account for the effects of such unresolved scales and to optimize existing parametrisations.

Simulations with the non-hydrostatic regional climate model COSMO-CLM allow to estimate mesoscale effects on the ice sheet surface mass balance. We adapted and set up COSMO-CLM for simulations of the Greenland ice sheet. The sensitivity to different model setups concerning e.g. the modeling domain, the resolution, or the importance of considering sea ice is investigated. The model is driven with reanalysis data from the European Centre for Medium-Range Weather Forecast (ECMWF) Interim Reanalysis (ERA-Interim) with a horizontal resolution of $\sim$0.7° on 60 vertical levels. Results are validated with an ensemble of observations and gridded reanalysis datasets for the period 1995-2015. The main focus is on precipitation and temperature, which are the main factors affecting the surface mass balance of the Greenland ice sheet. As the Greenland orography and climate characteristics are quite inhomogenous, the analysis is seperated in 7 regions: North, Northwest, Central, Northeast, Southwest, Southeast and South.

Preliminary results show that the mean of precipitation and temperature generally agree well with observation data although biases are present, which depend on the region and season. For all regions, best agreement with observations of precipitation and temperature is achieved for the CORDEX-Arctic region as modeling domain. Furthermore, the consideration of sea ice contributes to more realistic results. The mean precipitation amount show good agreement with observation data for Greenland as a whole, while it is slightly overestimated in the North and slightly underestimated in southern regions. As a next step, surface exchanges contributing to the Greenland surface mass balance will be analysed and parametrisations of the accumulation and energy balance over the ice sheets will be developed.