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Enhanced Greenland melting: Effect of mesoscale ocean dynamics on distribution, timing and impact

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Enhanced melting of the Greenland ice sheet under globally rising temperatures in past and future climate is expected to have an impact on the formation of deep water in the subpolar North Atlantic with possible consequences for the Atlantic meridional overturning circulation. The role of mesoscale eddies in distributing the meltwater and influencing timing and intensity of the meltwater impact is studied in a series of 100-year long experiments with a global coupled climate model.
Our model setup is part of the new Flexible Ocean and Climate Infrastructure (FOCI) at GEOMAR. The infrastructure is based on the atmosphere model ECHAM6.3 (grid T63L95) and the ocean-sea ice model NEMO$_3$.6/LIM2 (grid ORCA05.L46). While the global ocean grid with 0.5° spatial resolution necessitates the parameterization of mesoscale eddies, regional refinement of the North Atlantic between 30°N and 85°N by an ocean nest (VIKING10) of 0.1° resolution implemented within the global climate model enables the explicit simulation of eddies in subpolar latitudes.
We apply a step function of enhanced, spatially and seasonally varying Greenland runoff to the model, which enables us to measure the response time of the ocean and climate system to this instantaneous change and to derive the climate response functions (CRFs) associated with Greenland melting (Marshall et al., 2017, GMD). The enhanced runoff is derived from the data of Bamber et al. (2012, GRL), which we scaled to match an annual total freshwater flux of 0.05 Sv. This forcing is weaker than in past hosing experiments, which used a uniform forcing of 0.1 Sv or more, in order to tease out the role of ocean dynamics in the subpolar North Atlantic.
First results show that the prescribed Greenland meltwater flux is able to shut down deep convection in the Labrador Sea within 5 years in the coarse resolution model using eddy parameterization. In contrast, deep convection persists much longer, weakening only over decades in the eddying simulation with the 0.1° ocean nest. This hints at the possibility of a too rapid response to Greenland melting in coarse resolution climate models. We discuss the effect of parameterization choices regarding eddy transport, diffusivity and viscosity on the quality of the coarse resolution model results.