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Comparison of peri-Antarctic sub-shelf melt rates in coupled and uncoupled ice-sheet model simulations

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Sub-shelf melting is the main driver of the mass loss of the Antarctic ice sheet. Various parametrizations exist to estimate basal melt rates within standalone ice sheet models, but they are not able to capture complex ocean circulation. Therefore, high resolution coupled ice sheet-ocean models are the ultimate approach to simulate observed sub-shelf melt rates on short time scales and thereby improve projections of future Antarctic sea level contribution.

Here, we present first results of a hindcast (last 30 years) of the new circumpolar coupled Southern Ocean – Antarctic ice sheet configuration, developed within the framework of the PARAMOUR project. The configuration, which captures whole Antarctica, is based on the ocean and sea ice model NEMO3.6-LIM3, providing the ice sheet model with monthly sub-shelf melt rates, and the Antarctic ice sheet model f.ETISh v1.5, providing the updated ice shelf cavity geometry to the ocean model. Different difficulties are tackled for the coupling: The initialisation of the ice sheet model is optimised for the chosen resolution of 8km, which is a tradeoff between capturing the main features for the peri-Antarctic setup and respecting the model purpose as fast ice sheet model. Framework conditions for the coupling, e.g. a constant ice-ocean mask, are tested and implemented. The optimal solution to estimate sub-shelf melt for small ice shelves that are not resolved in the ocean model due to the different resolution of the ice sheet and the ocean model, is investigated.
Sub-shelf melt rates of the coupled setup are compared to those modeled by the standalone ocean model and those of the standalone ice sheet model with different sub-shelf melt rate parametrizations (ISMIP6, plume, PICO, PICOP) and the sensitivity of the response of the ice sheet for the different basal melt rate patterns are investigated.