Sensitivity of ice-shelf/ocean interactions to vertical resolution and thermodynamic parameterizations in the ROMS model

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Recent studies demonstrate that ice shelves play an integral role in moderating the offshore flow of Antarctic glaciers and ice streams. The extreme case of a collapsed ice shelf (e.g., Larsen B) has been shown to cause an acceleration of contributing ice streams. While conditions for collapse depend on various processes (e.g. downward percolation of surface meltwater in response to atmospheric warming, iceberg calving, and basal melt/refreezing processes), we focus on the influence of ocean circulation on changing ice shelf thickness through melting and refreezing at the ice-ocean interface.

Models of ocean/ice-shelf interactions have already been run for several ice shelves; however, model solutions are sensitive to setup choices, such as grid resolution and different parameterizations. Thus, in this study we step back from real-world applications to explore the sensitivity of basal melt rate (M_b) to model setup. We use the Regional Ocean Modeling System (ROMS) community ocean model (version 2.2), augmented with basal thermodynamic processes following Dinniman et al. (2007). George VI Ice Shelf is used as a test environment, as it is a small shelf with relatively well-known grounding line, ice thickness, and seabed bathymetry. At this time, thermodynamic forcing is provided by idealized initial ocean temperature and salinity. We compare the steady-state melt rate for various model configurations, focusing for now on the sensitivity of M_b to the model’s vertical resolution under the ice base. Future studies will include an assessment of M_b sensitivity to the sophistication of the thermodynamic exchange processes at the ice/ocean boundary, and dependence of M_b on the representation of tidal forcing.