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Representation of basal melting in idealised coupled ice sheet ocean models

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The ocean-driven basal melting has important implications for the stability of ice shelves in Antarctic, which largely affects the ice sheet mass balance, ocean circulation, and subsequently global sea level rise. Due to the limited observations in the ice shelf cavities, the couple ice sheet ocean models have been playing a critical role in examining the processes governing basal melting. In this study we use the Framework for Ice Sheet-Ocean Coupling (FISOC) to couple the Elmer/Ice full-stokes ice sheet model and the Regional Ocean Modeling System (ROMS) ocean model to model ice shelf/ocean interactions for an idealised three-dimensional domain. Experiments followed the coupled ice sheet–ocean experiments under the first phase of the Marine Ice Sheet–Ocean Model Intercomparison Project (MISOMIP1). A periodic pattern in the simulated mean basal melting rates is found to be highly consistent with the maximum barotropic stream function and also the grounding line retreat row by row, which is likely to be related with the gyre break down near the grounding line caused by some non-physical instability events from the ocean bottom. Sensitivity tests are carried out, showing that this periodic pattern is not sensitive to the choice of couple time intervals and horizontal eddy viscosities but sensitive to vertical resolution in the ocean model, the chosen critical water column thickness in the wet-dry scheme, and the tracer properties for the nudging dry cells at the ice-ocean interface boundary. Further simulations are necessary to better explain the mechanism involved in the couple ice-ocean system, which is very significant for its application on the realistic ice-ocean systems in polar regions.