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Uncertainties in marine ice-sheet retreat are dominated by basal melt

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The loss of ice in Antarctica is dominated by the melting of floating ice shelves due to warming oceans. However, the relation between changing ocean temperatures and rates of sub-shelf melt is poorly constrained. Ice-sheet models currently employ a range of different approaches to this problem, varying in complexity from simple parameterizations based on linear temperature-melt relations to fully coupled ocean models. While several studies have compared two or more parameterisations, such efforts are complicated by the complex geometry of the Antarctic ice-sheet, as well as the uncertainty in (future) patterns of ocean circulation and atmospheric forcing.

The MISMIP/ISOMIP/MISOMIP family of experiments (Asay-Davis et al., 2016) provides a framework for intercomparing basal melt parameterisations in an idealized geometry, reducing the many difficulties of applying them in a realistic setting. Here, we present results of the MISOMIP1 experiment with the ice-sheet model IMAU-ICE. We show that the differences in simulated ice-sheet retreat caused by the use of different basal melt models are much larger than those arising from other model uncertainties such as the formulation of basal sliding, stress balance approximations, and model resolution. This suggests that basal melt is likely the largest source of uncertainty in future projections of Antarctic ice-sheet retreat.