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ISMIP6-based projections of ocean-forced Antarctic ice loss using the Community Ice Sheet Model

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The future retreat rate for marine-based regions of the Antarctic Ice Sheet is one of the largest uncertainties in sea-level projections. The Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6) aims to improve projections and quantify uncertainties by running an ensemble of ice sheet models with forcing derived from global climate models. Here, the Community Ice Sheet Model (CISM) is used to run ISMIP6-based projections of ocean-forced Antarctic Ice Sheet evolution. Using several combinations of sub-ice-shelf melt schemes, CISM is spun up to steady state over many millennia. During the spin-up, basal-friction and thermal-forcing parameters are adjusted to optimize agreement with the observed ice thickness. The model is then run forward to year 2500, applying ocean thermal forcing anomalies from six climate models. In all simulations, ocean warming triggers long-term retreat of the West Antarctic Ice Sheet, especially in the Filchner-Ronne and Ross sectors. The ocean-forced sea-level rise in 2500 varies from about 150 mm to 1300 mm, depending on the melt scheme and ocean forcing applied. Further experiments show relatively high sensitivity to the basal friction law, and moderate sensitivity to grid resolution and the prescribed collapse of small ice shelves. The Amundsen sector exhibits threshold behavior, with modest retreat under many parameter settings, but complete collapse under some combinations of low basal friction and high thermal-forcing anomalies. Large uncertainties remain, as a result of parameterized sub-shelf melt rates, simplified treatments of calving and basal friction, and the lack of ice–ocean coupling.