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Decadal-Scale Response of the Antarctic Ice sheet to a Warming Ocean using the POPSICLES Coupled Ice Sheet-Ocean model

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We present POPSICLES simulation results covering the full Antarctic Ice Sheet and the Southern Ocean spanning the period from 1990 to 2010. We use the CORE v. 2 interannual forcing data to force the ocean model. Simulations are performed at 0.1 degree (∼5 km) ocean resolution with adaptive ice sheet resolution as fine as 500 m to adequately resolve the grounding line dynamics. We discuss the effect of improved ocean mixing and subshelf bathymetry (vs. the standard Bedmap2 bathymetry) on the behavior of the coupled system, comparing time-averaged melt rates below a number of major ice shelves with those reported in the literature. We also present seasonal variability and decadal melting trends from several Antarctic regions, along with the response of the ice shelves and the consequent dynamic response of the grounded ice sheet.

POPSICLES couples the POP2x ocean model, a modified version of the Parallel Ocean Program, and the BISICLES ice-sheet model. POP2x includes sub-ice-shelf circulation using partial top cells and the commonly used three-equation boundary layer physics. Standalone POP2x output compares well with standard ice-ocean test cases (e.g., ISOMIP) and other continental-scale simulations and melt-rate observations. BISICLES makes use of adaptive mesh refinement and a 1st-order accurate momentum balance similar to the L1L2 model of Schoof and Hindmarsh to accurately model regions of dynamic complexity, such as ice streams, outlet glaciers, and grounding lines. Results of BISICLES simulations have compared favorably to comparable simulations with a Stokes momentum balance in both idealized tests (MISMIP-3d) and realistic configurations.