# Response of the Antarctic ice sheet to ocean forcing using the POPSICLES coupled ice sheet-ocean model

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The POPSICLES model couples the POP2x ocean model, a modified version of the Parallel Ocean Program (Smith and Gent, 2002), and the BISICLES ice-sheet model (Cornford et al., 2012). Initial results from modeling the response of the continental Antarctic ice sheet to sub-shelf-melt forcing demonstrate the promise of our approach, and cover the full Antarctic Ice Sheet and the Southern Ocean. Simulations are performed at 0.1 degree (~5 km) ocean resolution and ice sheet resolution as fine as 500 m using adaptive mesh refinement. A comparison of fully-coupled and comparable standalone ice-sheet model results demonstrates the importance of two-way coupling between the ice sheet and the ocean.

BISICLES makes use of adaptive mesh refinement to fully resolve dynamically-important regions like grounding lines and employs a momentum balance similar to the vertically-integrated formulation of Schoof and Hindmarsh (2009). Results of BISICLES simulations have compared favorably to comparable simulations with a Stokes momentum balance in both idealized tests like MISMIP3D (Pattyn et al., 2013) and realistic configurations (Favier et al. 2014). POP2x includes sub-ice-shelf circulation using partial top cells (Losch, 2008) and boundary layer physics following Holland and Jenkins (1999), Jenkins (2001), and Jenkins et al. (2010). Standalone POP2x output compares well with standard ice-ocean test cases (e.g., ISOMIP; Losch, 2008) and other continental-scale simulations and melt-rate observations (Kimura et al., 2013; Rignot et al., 2013).
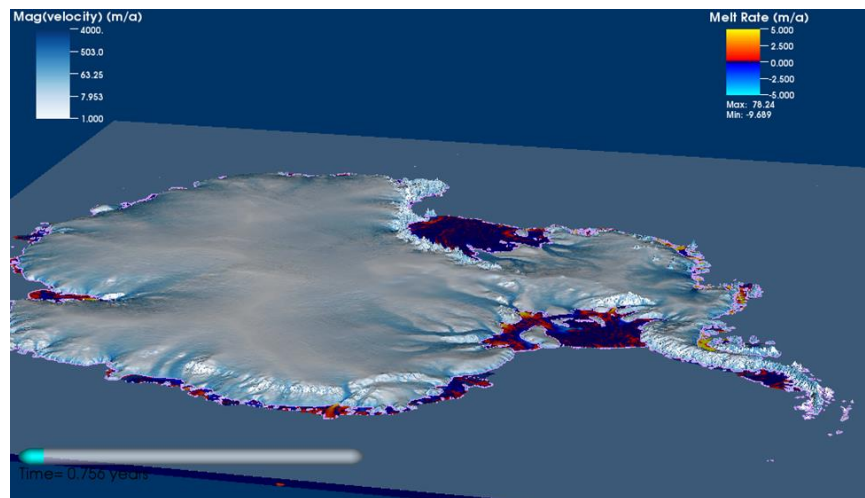
The figure shows the BISICLES-computed vertically-integrated ice velocity field about 1 month into a 20-year coupled Antarctic run, with the Filchner-Ronne ice shelf in the foreground. Grounding lines are shown in magenta. Subshelf melt rates are painted onto the ice shelves.

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