Nested ice-sheet modeling of long-term variations in the Pine Island-Thwaites Glacier basins

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Recent observations of thinning, acceleration, and grounding-line retreat of the Pine Island and Thwaites Glaciers (PIG/THW) identify this sector of West Antarctica as particularly vulnerable to future climate change. To date, most modeling of these glaciers has focused on recent and modern calibration, and few-hundred-year future timescales. As an alternate approach, we apply a hybrid ice sheet-shelf model to ice retreat in this sector from the Last Glacial Maximum (~15,000 yr BP) to present, and make use of geologic data of grounding-line position, shelf extent and other records to calibrate the model.

The model is run on a 5-km grid spanning the PIG/THW drainage basins and continental shelves, with lateral boundary conditions from a prior continental-scale run with the same model. The goal is to use large-ensemble techniques varying multiple model parameters, and to assess parameter ranges using objective scoring methods vs. geologic data. Here, preliminary results are shown, varying just two model parameters involving oceanic forcing, and using one basic scoring method.

A further goal is to use the validated model to simulate possible future envelopes of retreat on ~thousand-year time scales. Preliminary projections with crude future climate forcing consistently show dramatic grounding-line retreat into the interior of West Antarctica within ~2000 years, contributing +2 to 3 m of global sea-level rise.