Large-Ensemble modeling of past Antarctic variations in the Amundsen Sea Embayment

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Recent observations of thinning and retreat of the Pine Island and Thwaites Glaciers identify this sector of West Antarctica as particularly vulnerable to future climate change. To date, most future modeling of these glaciers has been validated using recent and modern observations. As an alternate approach, we apply a hybrid 3-D ice sheet-shelf model to the last deglacial retreat in this sector, making use of geologic data of ice extents from ~20,000 years BP to present.

Following recent ice-sheet studies, we use Large-Ensemble statistical techniques, performing sets of ~500 to 1000 runs with varying model parameters. The model is run for the last 20 kyrs on 5 to 20-km grids spanning West Antarctica, with lateral boundary conditions from a prior continental-scale simulation. An objective score for each run is calculated using reconstructed past grounding lines, shelf extents, and modern conditions. Runs are extended into the future (few millennia) with simple atmospheric and oceanic forcing. The goal is to produce calibrated probabilistic envelopes of model parameter ranges and future ice retreat.

Preliminary results are presented for Large Ensembles with (i) Latin HyperCube sampling in high-dimensional parameter space, and (ii) dense sampling with a lower number of parameters. One preliminary finding is that most reasonable parameter combinations produce drastic future retreat into the interior Pine Island and Thwaites basins within ~2000 years, contributing ~2 m to global sea-level rise.

For theme: Modelling of ice and polar ocean (California Dreamin')