Preliminary ice shelf-ocean simulations from ISOMIP+ and MISOMIP1

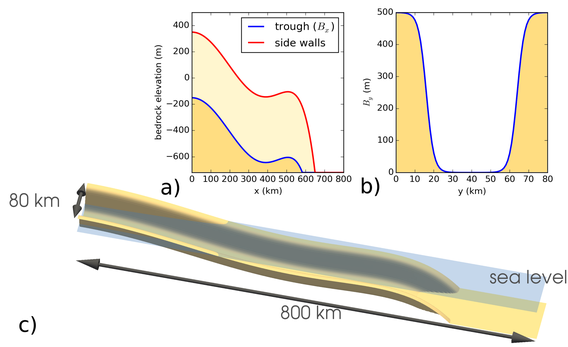
Authors X. S. Asay-Davis, *D. F. Martin*
PIK Research Domain I Earth System Analysis, ***Lawrence Berkeley National Laboratory*** *Computational Research Division*

ABSTRACT

The second Ice Shelf-Ocean MIP (ISOMIP+) and the first Marine Ice Sheet-Ocean MIP (MISOMIP1) prescribe a set of idealized experiments for ocean models with ice-shelf cavities and coupled ice sheet-ocean models, respectively. ISOMIP+ and MISOMIP1 were designed together with the third Marine Ice Sheet MIP (MISMIP+) with three main goals, namely that the MIPs should provide:

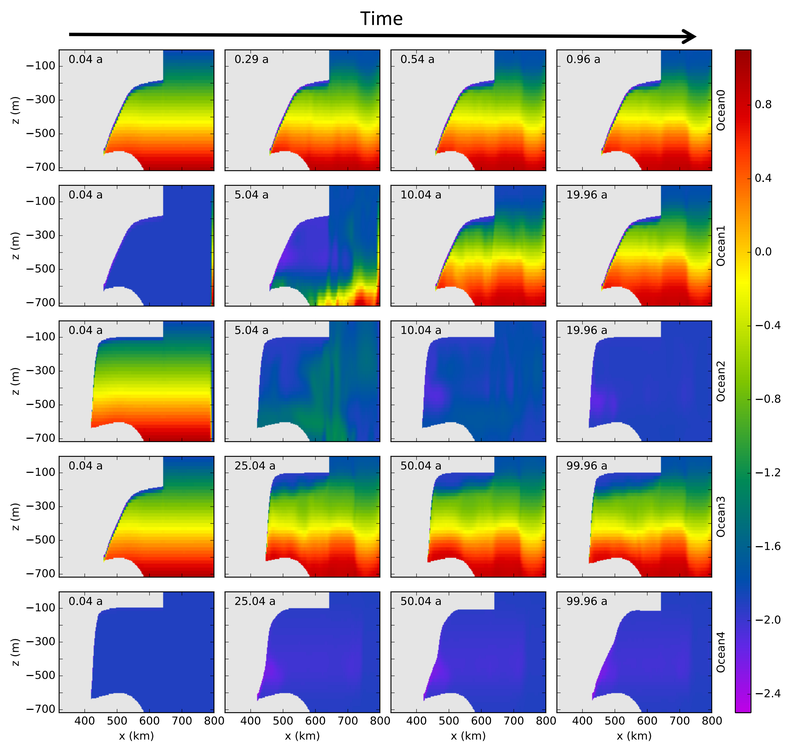
1. a controlled forum for researchers to compare their model results with those from other models during model development.
2. a path for testing components in the process of developing coupled ice sheet-ocean models.
3. a basic setup from which a large variety of parameter and process studies can usefully be performed.

The experimental design for the three MIPs is currently under review in Geoscientific Model Development (Asay-Davis et al. 2015).

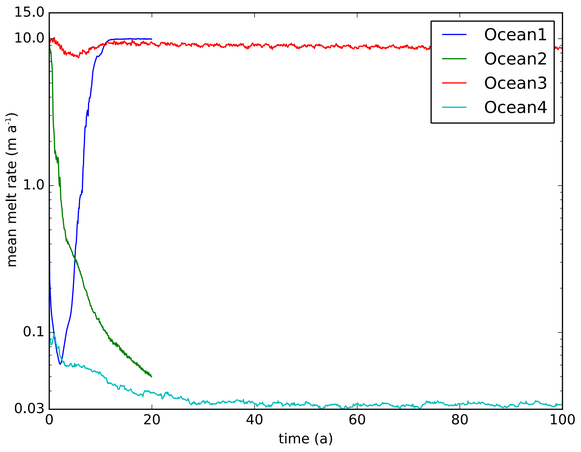


The bedrock topography (bathymetry) used for three MIPs. Bedrock has a steep trough that leads to a strongly buttressed ice shelf that has a stable grounding line on a retrograde bed slope.

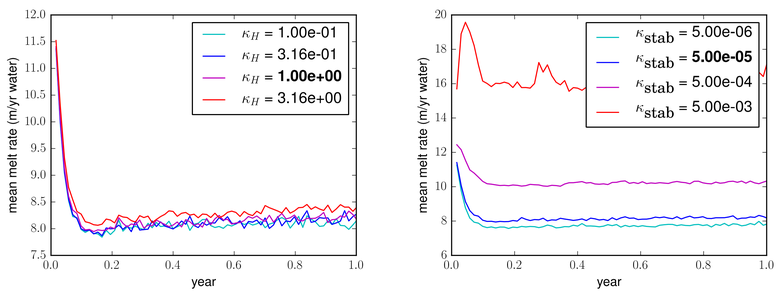
ISOMIP+ (STANDALONE OCEAN)



Ocean temperature from Parallel Ocean Program v. 2x (POP2x) results for the five ISOMIP+ experiments, Ocean0 to Ocean4 (rows) as functions of time (columns). The experiments have different far-field ocean conditions ("warm" or "cold"), various durations and either static or dynamic prescribed ice-shelf topography.

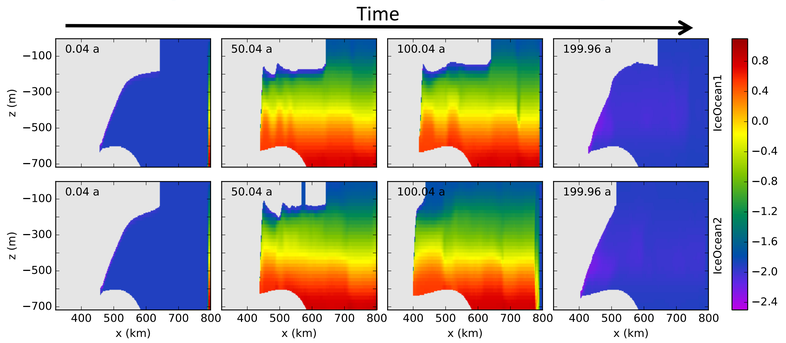


Melt rates as functions of time from the Ocean1-4 experiments, showing how melting is influenced by changes in ocean temperature and, in the cases of Ocean3-4, the ice-sheet geometry.

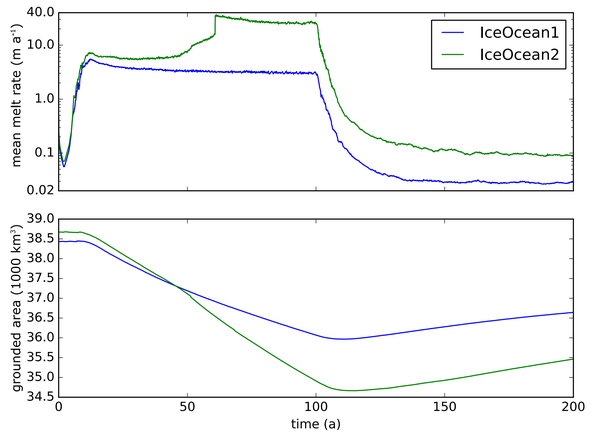


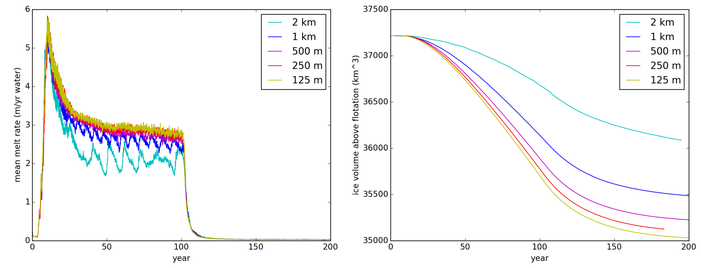
In POP2x, the Ocean0 melt rates show little sensitivity to the horizontal diffusivity of temperature and salinity (κ_H) but are relatively more sensitive to the vertical diffusivity (κ_{stab}).

MISOMIP1 (COUPLED ICE SHEET-OCEAN)



The coupled experiment is forced by warm far-field ocean restoring for the first century, driving strong melt and ice retreat. During the second century, cold forcing leads to diminished melting and ice re-advance. Above: ocean temperature and ice-shelf geometry from POPSICLES (POP2x coupled to the BISICLES ice-sheet model) results for MISOMIP1 experiments. IceOcean1 has no dynamic calving while IceOcean2 has calving when the ice is less than 100 meters thick. Below: mean melt rate and the total area of grounded ice as functions of time over the 200-year simulation.





Sensitivity of IceOcean1 melt rate and volume of ice above flotation to the finest BISICLES resolution.

REFERENCE

Asay-Davis, X. S., Cornford, S. L., Durand, G., Galton-Fenzi, B. K., Gladstone, R. M., Gudmundsson, G. H., Hattermann, T., Holland, D. M., Holland, D., Holland, P. R., Martin, D. F., Mathiot, P., Pattyn, F., and Seroussi, H.: Experimental design for three interrelated Marine Ice-Sheet and Ocean Model Intercomparison Projects, Geosci. Model Dev. Discuss., 8, 9859-9924, doi:10.5194/gmdd-8-9859-2015, 2015.

Contact Xylar Asay-Davis
xylar.asay-davis@pik-potsdam.de

Contact Presse- und Öffentlichkeitsarbeit
Telegrafenberg A31 | D-14473 Potsdam
www.pik-potsdam.de