Geophysical Research Abstracts
Vol. 13, EGU2011-3915, 2011
EGU General Assembly 2011

Numerical improvements and extensions in a hybrid ice sheet-shelf model

David Pollard (1) and Robert DeConto (2)

(1) Pennsylvania State University, Earth and Environmental Systems Institute, University Park, Pennsylvania, United States (pollard@essc.psu.edu), (2) University of Massachusetts, Department of Geosciences, Amherst, Massachusetts, United States

Three extensions to the capabilities of an existing hybrid 3-D Antarctic ice sheet-shelf model are described. The first two are aimed at sub-grid representations of fine-scale variations that improve coarse-grid results, and the third is aimed at inverse estimates of basal roughness on large scales.

(1) Sub-grid-scale calculations of surface mass balance are performed in the ablation zone near terrestrial ice-sheet margins,by simply interpolating surface elevations and assuming a constant atmospheric lapse rate. This is motivated primarily by van den Berg et al. (2006, J.Glaciol.), who found serious errors due to erroneous surface mass balance in flowline models with grid sizes of $\sim$10 km or more. The scheme works well in flowline applications, yielding nearly correct results for grid sizes of several 10's of km.

(2) A modification is made in imposing C. Schoof's (2007, J.Geophys. Res.) ice flux parameterization across grounding lines. The basic imposition enables coarse-grid models to simulate reasonably correct grounding-line migration, with grounding-line location errors of a few km in idealized flowline tests. The new modification takes into account equilibrium-constraints implicit in the Schoof (2007) formulation, using the interpolated position of the grounding line between grid points, and reduces the location errors to $\sim$100 m.

(3) A simple inverse method of deducing large-scale basal roughness coefficients over the Antarctic continent is described, by minimizing the errors in modern ice-surface elevations. In contrast to relatively sophisticated control methods previously used with shelfy-stream models, the method is very simple: the full model is run forward in time, periodically making local adjustments to basal roughness as an ad-hoc function of the current model-minus-observed error in surface elevation. Results are assessed for possible relevance to the real world, and extensions are mentioned for internal-flow enhancement factors and sub-ice-shelf oceanic melt rates.