MISMIP+ summary of MHO_BP_POWER_500m

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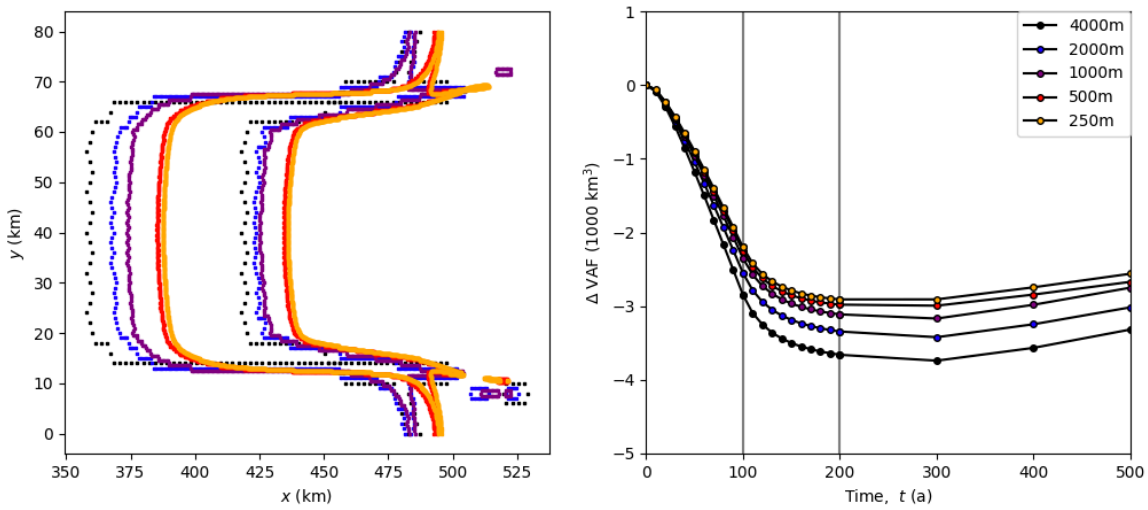
Model Detail

1. Model: MPAS-FELIX [*Tezaur et al.*, 2015; *Hoffman et al.*, 2017]
2. Englacial stresses: 3d First Order Stokes approximation (Blatter-Pattyn), Glen's law, n=3, $A=2.0\text{x}10^{-17}$ Pa^{-3} yr^{-1}
3. Basal traction: Power law, eq. 6 from *Asay-Davis et al.* [2016], $\beta^2 = 3.160 \text{ x } 10^6$ Pa $m^{-1/3}$ $s^{1/3}$
4. Space discretization: Finite volume/Finite element, unstructured centroidal Voronoi tessellation / Delaunay Triangulation, hexagonal cells with cell spacing of 500 m.
5. Time stepping: explicit Forward Euler with adaptive time step: $\Delta t < \Delta x/(8|u|)$
6. Grounding line: Grounding line parameterization evaluate floatation criterion at cubature points of degree 5 within each basal element.
7. MISMIP3d name: Did not participate in published MISMIP3d comparison paper. MISMIP3d results will be included in model description paper [*Hoffman et al.*, 2017].
8. Model version: development version 0129239

Mesh Resolution

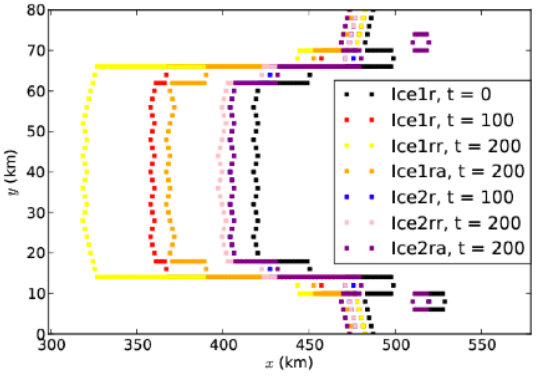
Mesh resolution is tested with a convergence study of a set of grids. Each grid has a different grid spacing $\Delta x \in 4, 2, 1, 0.5, 0.25$ km. The coarsest resolution simulation (4 km) is started from a uniform 100 m thickness and evolved for 15,000 yr. It was confirmed that no drift in grounded area existed at that point. For each subsequent finer resolution, the final state of the previous coarser grid is interpolated onto the finer mesh, and the finer mesh is run until there is no longer drift in grounded area. These spinup times varied from 1000 to 9000 yr. At all resolutions there was not a true steady state, but slight variations (~0.3% of grounded area) about an approximate equilibrium state. After spinup, experiments Ice1r and Ice1ra were carried out for all resolutions. Additionally, all experiments were carried out for all but 250 m resolution configuration.

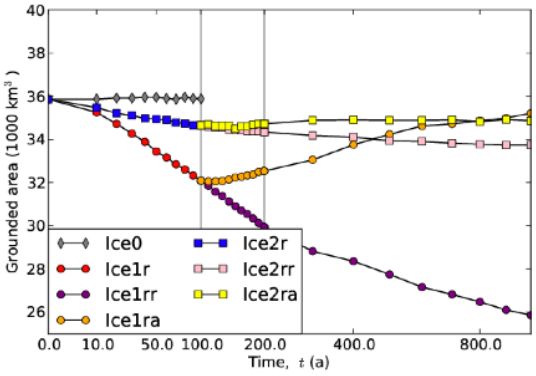


Plot (a) above shows the grounding line positions at the start and end of Ice1r: the initial and final grounding lines are progressively closer to one another as the finest mesh spacing shrinks and the two finest resolutions have grounding lines within 3.0 km. Plot (b) shows the volume above flotation change, ΔVAF, over the course of the experiments. All resolutions show similar behavior. The 500 m resolution simulation has a maximum of ~4% error relative the 250 m resolution simulation. Because of these modest differences, the 500 m resolution was chosen to complete all experiments to limit computational cost.

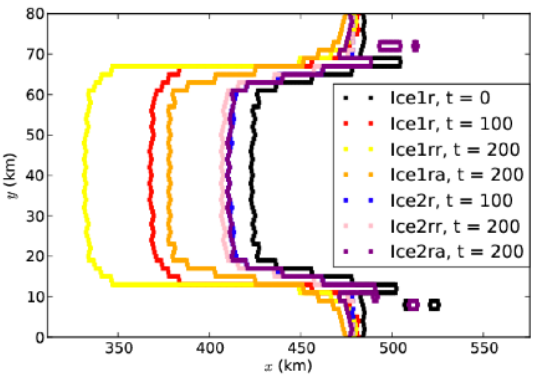
For completeness, the complete results for each resolution are provided below, following Figure 4, *Asay-Davis et al.* [2016].

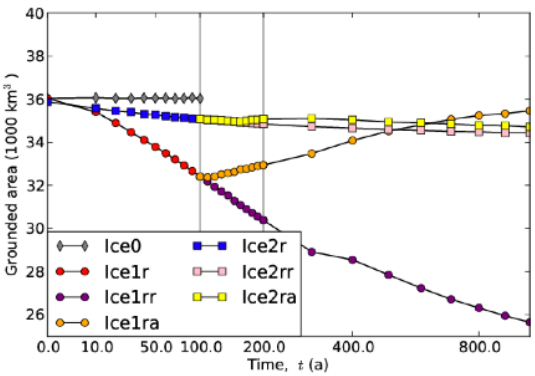
4000 m:



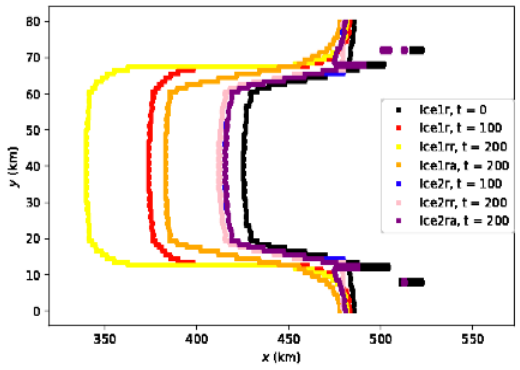


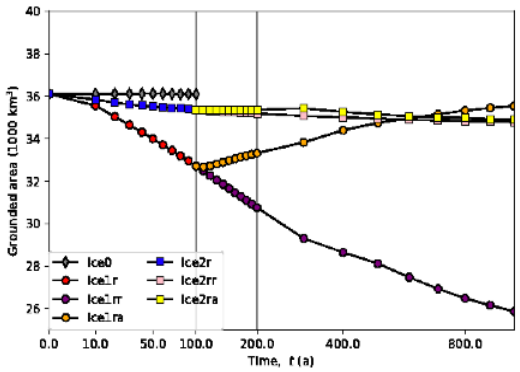
2000 m:



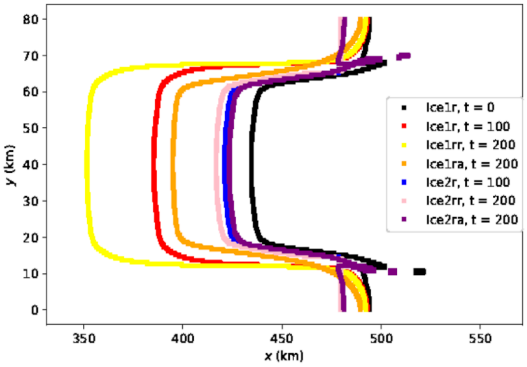


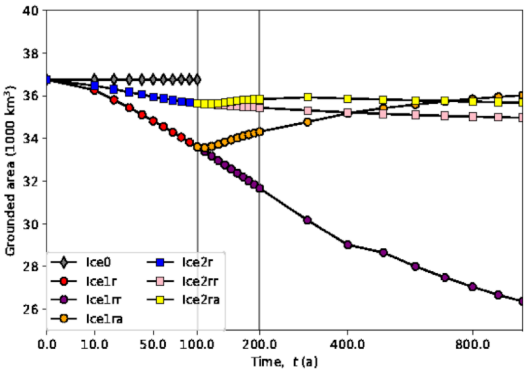
1000 m:



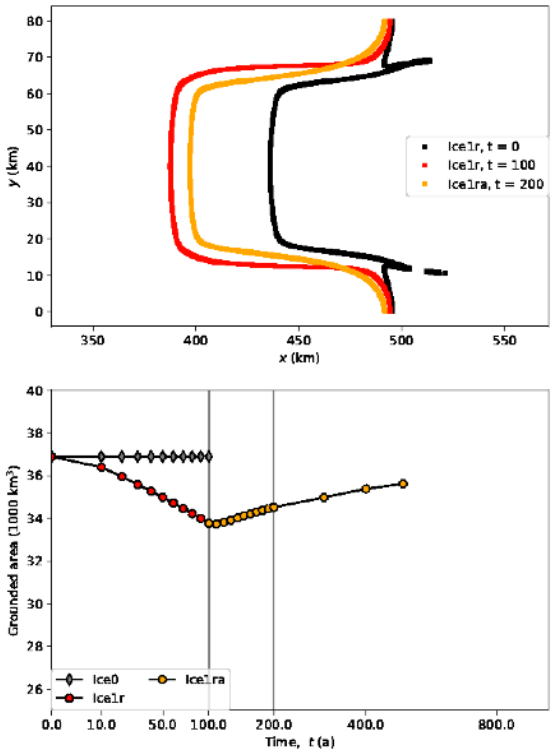


500 m:





250 m:



References

Asay-Davis, X. S. et al. (2016), Experimental design for three interrelated marine ice sheet and ocean model intercomparison projects: MISMIP v. 3 (MISMIP +), ISOMIP v. 2 (ISOMIP +) and MISOMIP v. 1 (MISOMIP1), *Geosci. Model Dev.*, *9*(7), 2471–2497, doi:10.5194/gmd-9-2471-2016.

Hoffman, M. J., M. Perego, S. F. Price, W. H. Lipscomb, A. G. Salinger, I. Tezaur, and R. S. Tuminaro (2017), MPAS-Land Ice: A New, Variable Resolution Ice Sheet Model, In prep., *Geosci. Model Dev. Discuss.*

Tezaur, I. K., M. Perego, A. G. Salinger, R. S. Tuminaro, and S. F. Price (2015), Albany/FELIX: a parallel, scalable and robust, finite element, first-order Stokes approximation ice sheet solver built for advanced analysis, *Geosci. Model Dev.*, *8*, 1–24, doi:10.5194/gmd-8-1-2015.