MISMIP+ suumary of SCO_SSA_TSAI_250m

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September 16, 2015

1 Model Detail

1. Model: BISICLES [1]

2. Englacial stresses: SSA, Glen's law, $n = 3$, $A = 2.0 \times 10^{-17}$ Pa^{-3} yr^{-1}.

3. Basal traction: Modified power law [2], $|\tau_b| = \min(\alpha^2 \rho g(h - h_f), \beta^2 |u|^{1/3})$, $\alpha^2 = 0.5$,$\beta^2 = 10^4$ Pa m$^{-1/3}$ yr$^{1/3}$.

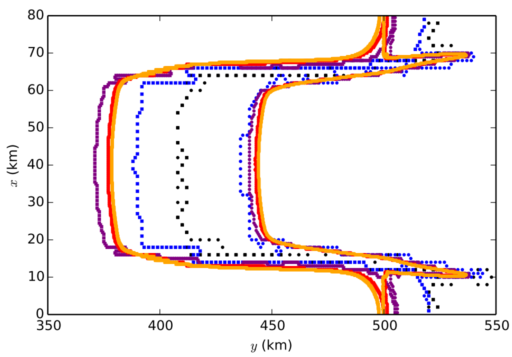
4. Space discretization: Finite volume, adaptive non-uniform grid, block structured AMR, square cells with $0.25 < \Delta x < 4.0$ km

5. Time stepping: Piecewise Parabolic Method[3], explicit, $\Delta t < \Delta x/(4|u|)$

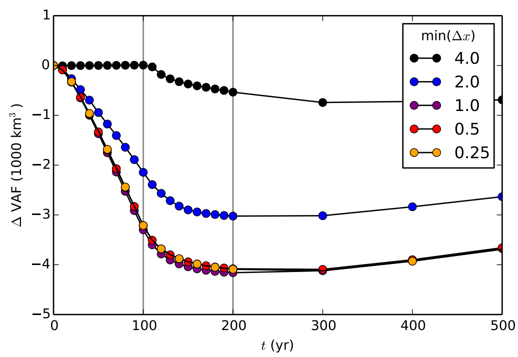
6. Grounding line: One-sided differences of surface elevation.

7. MISMIP3d name: DMA6 (different mesh resolution)

2 Mesh resolution



(a)



(b)

Mesh resolution is tested with a convergence study of a set of models. Each model has the same coarsest mesh spacing $\max(\Delta x) = 4$ km but a different finest mesh spacing $\min(\Delta x) \in 4, 2, 1, 0.5, 0.25$ km, concentrated around the grounding line. Starting from a uniform 100 m thickness, the models were evolved for 25,000 years, then experiments Ice1r and Ice1ra were carried out. 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 1.5 km. Plot(b) shows the volume above flotation change ΔVAF over the course of the experiments: there is little retreat for $\min(\Delta x) > 2$ km. Once $\min(\Delta x) \leq 1$ the ΔVAF curves lie progressively closer together and differ by a fraction of the total change.

References

[1] Cornford, S. L., Martin, D. F., et. al, J. Comput. Phys, 232, 529–549, doi:10.1016/j.jcp.2012.08.037, 2013.

[2] Tsai, V. C., Stewart, A. L., and Thompson, A. F.: J. Glaciol., 61, 205–215, doi:10.3189/2015JoG14J221, 2015.

[3] Colella, P and Woodward, P. R., J. Comput. Phys., 54, 174, doi:10.1016/0021-9991(84)90143-8, 1984