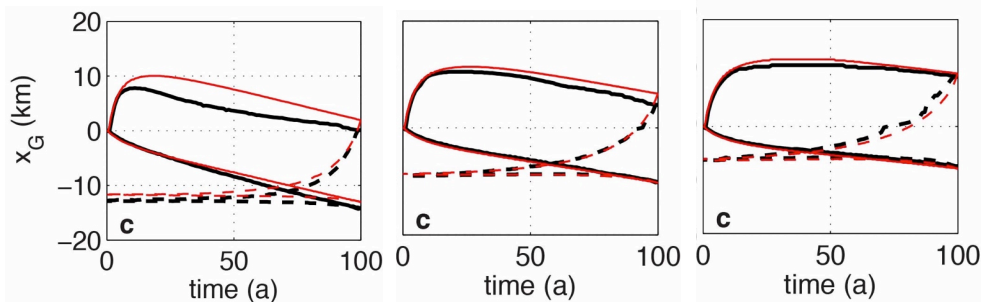


Comparison of Stokes Ice Sheet Models for Marine Ice Sheet Experiments

Objective

Stokes models are routinely used to generate reference solutions for ice sheet model intercomparisons. We examine the veracity of this practice through detailed comparisons of two Stokes models, *Elmer/Ice* and *Felix-S*, applied to a marine ice sheet model benchmark test

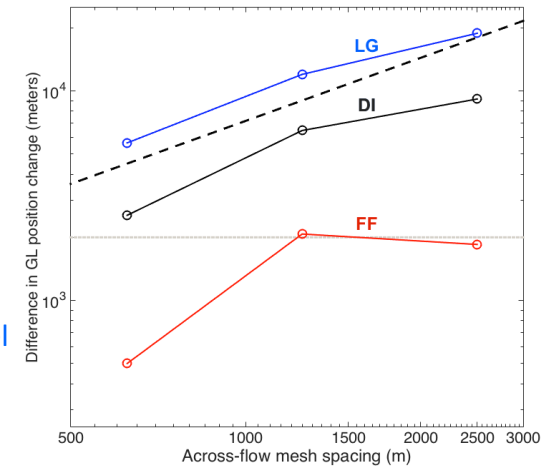


Grounding line positions over time during ice sheet advance (solid) and retreat (dashed) for *Elmer/Ice* (red) and *Felix-S* (blk). Model resolution doubles for each successive panel (moving from left to right).

Approach

- conduct detailed comparison of model numerics and implementation of critical grounding line physics
- conduct benchmark experiments with the two models under conditions as close to identical as possible
- conduct a detailed examination of differences in model outputs under mesh refinement

Difference in grounding line positions vs. model resolution for different implementations of grounding line physics (colored lines). With increasing resolution, all differences converge to near or below the model truncation error (grey horizontal line).



Impact

- grounding line positions in Stokes models are keenly sensitive to the implementation of grounding line physics
- despite this, solutions from two Stokes models with different numerics and different physics converge under mesh refinement
- agreement between multiple models at adequate spatial resolution lends confidence to the practice of treating Stokes model solutions as reference solutions in model intercomparison exercises

Reference: Zhang, T., S.F. Price, L. Ju, W. Leng, J. Brondex, G. Durand, and O. Gagliardini. 2017. A comparison of two Stokes ice sheet models applied to the Marine Ice Sheet Model Intercomparison Project for plan view models (MISMIP3d). *The Cryosphere*, **11**, doi:10.5194/tc-11-1-2017