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Effect of rapid grounding line migration investigated with 3D ice sheet-ice shelf models (MISMIP3d)

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Understanding and attributing future sea-level changes demands serious efforts on the development of efficient ice sheet—ice shelf models that capture the essential physics and mechanics of grounding line behavior.

While semi-analytical solutions for grounding line behavior are available for the flowline case, such solution fails to exist for more complex three-dimensional geometries. A way of evaluating the quality of ice sheet models is to verify them against more complex model solutions under controlled conditions (Marine Ice Sheet Model Intercomparison — MISMIP).

Given the computational demands of such models, it is extremely attractive from a computational point of view to use flux/thickness parameterizations in 3d models. Here we investigated the transition between ice sheet and ice shelf with series of different numerical models, ranging from full Stokes (Elmer/Ice) models, pseudo-spectral methods to a 2d vertically integrated finite-difference 'shelfy-stream' model, taking into account grounding line dynamics, and using parameterizations by Schoof (2007) and Pollard and DeConto (2009). Rapid grounding line migration was provoked by changing sliding at the grounding line, resulting in curved grounding lines influenced by lateral effects. We tested whether flux parameterizations are still valid under such conditions, especially when buttressing effects are taken into account.

Results of other participants in the intercomparison exercise are presented alongside the initial benchmark results.