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Testing numerical techniques to solve the mass continuity equation in a coupled ice-sheet / ice-shelf model

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Numerical models are a powerful tool to study the response of a marine ice sheet, such as West-Antarctica, to past and future climate and sea level changes. Such a three-dimensional coupled ice-sheet / ice-shelf model must include all relevant physical processes that govern ice sheet flow, ice shelf flow and grounding line migration. Several models that treat the marine ice-sheet problem and grounding line dynamics exist. Unfortunately, most of these existing models lack numerical consistency (Vieli and Payne, 2005). Here we present a numerical three dimensional model, solved with finite differences on a fixed grid, and coupled to different flow regimes. We tested different numerical schemes for solving the mass continuity equation. Results and drawbacks of these tests are presented. Finally, a new algorithm to model the grounding line at subgrid precision in order to study the role of transition zones in marine ice sheet dynamics is being tested in two dimensions and the first results are promising (Pattyn et al., submitted). This algorithm is being implemented in the 3D-model. This will allow to have a better understanding of the reaction of grounded ice on perturbations on the grounding line due to ice shelf changes.