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Grounding line dynamics inferred from a 3D full-Stokes model solving the contact problem

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The mass balance of marine ice-sheets, such as the West Antarctic Ice Sheet, is mostly controlled by their grounding line dynamics. Most numerical models simulating marine ice-sheets involve simplifications and do not include all the stress gradients. First results obtained with a 3D full-Stokes model for the grounded ice-sheet / floating ice-shelf transition, using the finite-element code Elmer/Ice, are presented. The initial geometry, which takes into account a dome and a calving front, has been laterally extruded from a previously investigated 2D flowline geometry. The grounding line migration is computed by solving the contact problem between the ice and the rigid downward sloping bedrock, where a non linear friction law is applied in the two horizontal directions. The evolutions of the sea-air and sea-ice interfaces are determined by the solution of a local transport equation. The consistency between the 3D model and the analogous results of the flowline model is shown by comparing the results in the basic extruded case, with no normal flux through lateral boundaries. Thereafter, spatially non uniform perturbations are introduced, to simulate the grounding line dynamics under fully three-dimensional perturbations.