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A new implementation of a flux condition at the grounding line in a flow line ice sheet model

vincent peyaud, catherine Ritz, and Gaël Durand
CNRS, LGGE, St Martin d, France (peyaudv@yahoo.fr)

Among the main issues concerning the future of marine ice sheets, grounding line dynamics is a key process that governs the evolution of the grounded ice volume. Grounding line position is driven by the balance between upstream and downstream fluxes which control ice thickness evolution. It is thus crucial to represent ice flow as well as possible in this key area characterized by a transition from vertical shearing (in the grounded zone) to longitudinal deformation (in ice shelves).

It has been shown (Pattyn 2012) that correct simulation of grounding line migration requires either a very small grid, close to 100 meters near the grounding line, or a moving grid. Fixed grid models with too large spatial resolution are unable to reproduce the behavior of the grounding line without the use of a parameterisation. Schoof (2007) developed an analytical solution for the ice flux at the grounding line and up to now parameterisations are based on this equation. Pollard (2009) proposed an implementation that prescribes this "Schoof" flux on a point close to the grounding line. Because of the fixed grid, this point is not exactly at the grounding line and an heuristic choice between upstream and downstream grid points has to be made. Here we propose an other kind of implementation with a additional moving grid point that fixes the flux condition at the exact location of the grounding line.

Results and analysis are shown for a flow line model. They are compared to the MISMIP intercomparison experiments, and to the complementary analysis from Drouet (2013) that inquired the transient behavior of the various type of models.