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Implementation of numerically efficient, Coulomb friction (plastic) basal boundary conditions in a three-dimensional, higher-order ice flow model

Stephen Price (1) and Georg Stadler (2)

(1) Los Alamos National Laboratory, Fluid Dynamics and Solid Mechanics Group, Los Alamos, United States (sprice@lanl.gov, 505-665-5926), (2) Institute for Computational Engineering and Sciences, University of Texas, Austin, United States

Previous work has demonstrated that Coulomb friction basal boundary conditions can be efficiently implemented within two-dimensional, Shallow-Shelf Approximation (SSA, or "shelfy-stream") ice flow models in order to represent glacier sliding over plastic till (e.g. Schoof, 2006; Bueler and Brown, 2009). To date, little work has been done on exploring the implementation of this same type of basal boundary condition in fully three-dimensional, higher-order ice flow models. Here, we present an efficient method for doing so, based on methods developed for Coulmb-friction boundary conditions in elastic contact problems (e.g. Hueber et al., 2008). Analytical solutions (Raymond, 2000; Schoof, 2006) are used as targets to compare the rate of convergence for this new implementation versus that applied previously to SSA models.

References

Bueler, E. and J. Brown. 2009. Shallow shelf approximation as a "sliding law" in a thermomechanically coupled ice sheet model. J. Geophys. Res. 114(F03008), doi:10.1029/2008JF001179.

Hueber, S., G. Stadler, and B. I. Wohlmuth. 2008. A primal-dual active set algorithm for three dimensional contact problems with Coulomb friction. SIAM Journal on Scientific Computing, 30(2), 572-596, 2008.

Raymond, C.F. 2000. Energy balance of ice streams. J. Glaciol., 46(155), 665-674.

Schoof, C. 2006. A variational approach to ice stream flow. J. Fluid Mech., 556, 227-251.