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Inverse modelling of basal friction using a 2D higher-order ice-flow model

B. De Smedt (1), P. de Groen (2) and F. Pattyn (3)

(1) Department of Geography, Vrije Universiteit Brussel, Belgium (2) Department of Mathematics, Vrije Universiteit Brussel, Belgium (3) Département des Sciences de la Terre et de l'Environnement, Université Libre de Bruxelles, Belgium (bdesmedt@vub.ac.be / Phone: +32 (0)26293385 / Fax: +32 (0)26293378)

Basal processes remain one of the least understood aspects of ice dynamics. We are working towards a methodology to derive the basal friction of ice bodies from observations of geometry and surface velocity. Here, we present preliminary results.

Our method uses minimisation techniques to tune basal friction parameters so that, when used in a 2D higher-order isothermal ice-flow model, modelled surface velocities match observations. The ice-flow model is a finite element model with basal drag as a linear function of basal velocity. Adapted numerical techniques assure fast and stable convergence.

The novelty of our method lies in the fact that it properly accounts for vertical shearing. As such, it can be applied to any ice body where geometry and surface velocity are known. We show applications to real (Pine Island Glacier, West Antarctica; McCall Glacier, Alaska) and synthetic data along a flowline. We discuss an exploration of several minimisation techniques: fixed point, Gauss-Newton and Levenberg-Marquardt.