On the way the friction is applied in the close vicinity of the grounding line in Elmer/Ice

Olivier Gagliardini (1,2), Julien Brondex (1), Fabien Gillet-Chaulet (1), Laure Tavard (1), Vincent Peyaud (1), Johannes Fuerst (1), and Gaël Durand (1)

(1) LGGE UGA / CNRS, Grenoble cedex, France (olivier.gagliardini@ujf-grenoble.fr), (2) IUF, Paris, France

Few recent publications have emphasised the importance of the way the friction is applied in the close vicinity of the grounding line (GL). In Elmer/Ice, by construction of the finite element model, the friction parameter C is a nodal value and the GL belongs at the interface of two elements. So far, in all published results using Elmer/Ice, the friction parameter was imposed on all nodes in contact with the bedrock, down to the nodes defining the GL. Doing so, due to the interpolation at integration points, the first elements downstream the grounding were experiencing a small friction. We here propose and discuss two other options for the application of the friction in the vicinity of the GL. The first one assume that the friction is null at the GL. In the second, the friction is discontinuous at the GL, allowing friction up to the GL but pure sliding on the first elements downstream the GL. The 3 methods are compared using the MISMIP and MISMIP3d setups. We show that despite an insignificant change in the total force at the base, the three methods lead to significantly different results. Nevertheless, the three methods converge to a unique solution as the mesh refinement is increased. Such sensibility of the model to the way the friction is imposed is certainly specific to the high friction at the GL in the MISMIP and MISMIP3d experiments, but should decrease for more realistic setups.