Geophysical Research Abstracts
Vol. 19, EGU2017-7567, 2017
EGU General Assembly 2017

Importance of viscous deformational heating for estimating ice basal velocity – numerical study

Aleksandar Licul (1), Frédéric Herman (1), Yuri Podladchikov (2), and Ludovic Räss (2)

(1) University of Lausanne, Institute of Earth Surface Dynamics (IDYST), Faculté des géosciences et de l'environnement, Lausanne, Switzerland (aleksandar.licul@unil.ch), (2) University of Lausanne, Institute of Earth Sciences (ISTE), Faculté des géosciences et del'environnement, Lausanne, Switzerland

Today, ice surface velocity can be measured at unprecedented resolution using satellite or airborne measurements. However, ice velocity measurements at the base of glaciers are scarce primarily because of the limited access to the glacier beds. Therefore, accurately constraining the ice velocity at the base of the ice sheet or glaciers still remains challenging for the ice flow modelling community. The highest uncertainties arise from both the poorly known parameters like the basal friction coefficient and rheological parameters. Furthermore, motion and dynamics of ice sheets and glaciers are strongly coupled and nonlinearly dependent on the ice temperature field, itself a function of the actual ice velocity and stress distribution within the ice domain due to the ice advection velocity and viscous deformation mechanism.

Here we investigate the extent to which this strong nonlinear dependence of the ice viscosity on the ice temperature may impact estimates of basal conditions. We use a recently developed thermo-mechanically coupled Stokes model. Our forward model uses an iterative finite difference method based on the dynamical force balance equation and artificial compressibility method. All equations are discretized on a regular staggered grid. To efficiently solve the coupled momentum and energy system of equations we have ported our code to C-CUDA and utilized the speed up potential of computer graphic cards (GPUs). The results of forward and inverse modeling experiments show that basal sliding velocity can easily be overestimated if heat sources like strain heating are not properly taken into account.