Geophysical Research Abstracts
Vol. 14, EGU2012-11172-1, 2012
EGU General Assembly 2012

Prognostic simulations of Pine Island Glacier using a 3D full-Stokes model and an inverse method to infer basal drag

L. Favier (1), T. Zwinger (2), F. Gillet-Chaulet (1), G. Durand (1), and O. Gagliardini (1)

(1) UJF – Grenoble 1 / CNRS, Laboratoire de Glaciologie et Géophysique de l'Environnement (LGGE) UMR 5183, Grenoble, F-38041, France, (2) CSC - IT Center for Science Ltd., Espoo, Finland

Ice discharge and grounding line retreat in West Antarctica have been accelerated during the last decades. One of the most striking example is Pine Island Glacier (PIG) which accelerated dramatically over the last 30 years. Such rapid changes in this part of Antarctica are due to large modifications of ice dynamics which are nevertheless poorly understood, and badly represented in numerical models, as pointed out by the IPCC fourth assessment report. Here, a 3D full-Stokes model of a marine ice sheet is used to carry out prognostic simulations of PIG over the next two centuries. The flow problem is coupled with the evolution of the upper and lower free surfaces, and the position of the grounding line is determined by solving the contact problem between the ice-shelf/ice-sheet lower surface and the bedrock. The upper and lower surfaces, and the bathymetry provided on a 1 km grid (courtesy of A. Le Brocq) are used to produce the initial geometry of the entire PIG basin. The mesh refinement is a function of the surface velocities (also provided on a 1 km grid by A. Le Brocq) Hessian matrix and the distance to the grounding line. Surface velocities are also used to infer the basal drag through the resolution of an inverse Robin problem. The initial surface is first relaxed and the results are compared to the observed current surface elevation, surface velocity and change in surface elevation. A perturbation experiment is then performed for which the whole ice-shelf is instantaneously removed. This test can be seen as a worst case scenario as all the buttressing induced by the ice shelf is lost instantaneously. The effect of the ice-shelf disintegration for the following two centuries is discussed in terms of grounding line retreat and increase in sea level.