28*th* IUGG Conference on Mathematical Geophysics, June 7-11, 2010, Pisa, Italy
Session 6: Environmental systems and climate

Drainage of water through subglacial water sheets

Timothy T. Creyts[1], Christian G. Schoof[2]

[1] *Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA*
[2] *University of British Columbia, Vancouver, BC, Canada*

Keywords: *modelling; glaciers; hydrology; fluid dynamics*

Dynamic lakes that cause ice surface elevation change require ample generation and supply of water from upstream sources. The hydraulic system delivers water to these lakes either through a distributed or channelized morphology. In this paper, we investigate the effects of subglacial water drainage resulting from spatially distributed water sheets. In our model, the weight of overlying ice is supported by both water pressure and various sizes of bed protrusions that penetrate the water sheet. Each of the various sizes bears a different magnitude of the overlying ice based on a linear stress recursion that balances forces at the bed. Previous results have shown that water depth can be a multi-valued function of both effective pressure (ice overburden minus water pressure) that drives sheet closure and hydraulic gradient that drives water flow (Creyts and Schoof, 2009). Curvature and structure of this multi-valued water depth function depend on the protrusion size distribution. Switches between different branches of the water depth relationship correspond to either the establishment or shut-down of a 'connected' (or efficient) drainage system. We build upon and extend previous work to show how along-path discharge affects water depth and switches from one state to another. We conclude by relating state behavior to subglacial conditions where dynamic lakes are found.