Modelling of subglacial hydrological development during a rapid lake drainage event, West Greenland

Christine Dow,[1] **Bernd Kulessa,**[1] **Sam Pimentel,**[2]
Victor Tsai,[3] **Sam Doyle,**[2] **Ian Rutt,**[1] **Glenn Jones,**[1,2]
Adam Booth,[1] **Alun Hubbard,**[2]

[1]College of Science, Swansea University, Swansea, UK
[2]Institute of Geography and Earth Sciences, Aberystwyth University, UK
[3]Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, USA

Abstract: We present results from a local-scale model of subglacial hydrological development during a rapid lake drainage event on the Russell Glacier catchment in West Greenland. Previous models applied to rapid lake drainage events include a turbulent radial model (Tsai and Rice, 2010) and a 1-D flowband model (Pimentel and Flowers, 2011). Both models have limitations for application to lake drainage events. For the former, the radial extent of water flow is restricted to several ice thicknesses and no provision is made for the development of basal channels. For the latter model, the input of water directly from the lake to the bed without modulation by englacial flow, together with the fact that lateral basal flux is neglected, causes unrealistic subglacial pressure levels. To resolve these limitations, we link the two models together, thus allowing both local radial flux and downstream development of a coupled efficient and distributed drainage system.

Our model is constrained by inputs from fieldwork completed in summer 2010 at a rapid lake drainage site in the land-terminating region of West Greenland. Passive seismic records indicate the region of basal water injection. Reflection seismic amplitude vs. angle (AVA) surveys allow analysis of the basal material characteristics. Lake drainage rate and differential GPS vertical and horizontal motion records are used as constraints for our model outputs.

Our preliminary results suggest that large basal channels do not necessarily form during the rapid drainage of supraglacial lakes. A lack of an efficient drainage system has an impact on the local ice dynamics and the treatment of lake drainage events in larger-scale dynamic models.