Geophysical Research Abstracts
Vol. 14, EGU2012-13216, 2012
EGU General Assembly 2012

Validation of a novel 2D glacier drainage system model with Gornergletscher's seasonal evolution and lake outbursts

MA Werder (1,2), IJ Hewitt (3), C Schoof (4), M Huss (5), and GE Flowers (1)

(1) Department of Earth Sciences, Simon Fraser University, Burnaby, BC, Canada (mawerder@sfu.ca), (2) School of Geographical Sciences, University of Bristol, Bristol, UK, (3) Department of Mathematics, University of British Columbia, Vancouver, BC, Canada, (4) Department of Earth and Ocean Sciences, University of British Columbia, Vancouver, BC, Canada , (5) Department of Geosciences, University of Fribourg, Fribourg, Switzerland

We apply a novel glacier drainage system model to Gornergletscher, Switzerland. This two dimensional model combines distributed and channelised drainage at the bed coupled to an englacial storage and routing component. Notably the channel locations are not fixed but rather evolve as part of the model solution.

Here we present results of a model validation study using the extensive data set collected on Gornergletscher in 2004-2008. We force the model with meltwater and precipitation input derived from an energy balance model (25m spatial and 1h temporal resolution) which is fed to the subglacial drainage system via moulins at mapped locations. The model is tuned to the proglacial hydrograph and is validated by comparing: (i) modelled subglacial water pressure to measured water pressures in boreholes, (ii) subglacial water sheet thickness to uplift measured at GPS stations and (iii) modelled and measured tracer breakthrough times. Further, we use the yearly occurring lake outburst floods to test the model in a highly dynamic setting. In particular we look at the influence of the existing drainage system on the outburst and vice versa, water storage/release processes and the transformation of the lake outflow hydrograph into the proglacial hydrograph.

The model reproduces many of the features observed at Gornergletscher and elsewhere: seasonal evolution of the basal drainage system through the formation of an arborescent network of subglacial channels, delay between daily melt water input and proglacial discharge, large en- and subglacial storage during lake outbursts and transformation of the outburst hydrographs.