Geophysical Research Abstracts,
Vol. 11, EGU2009-11036, 2009
EGU General Assembly 2009

Diurnal variability of tracer flow speeds simulated by a two component model of the glacial drainage system

M. Werder (1), T.V. Schuler (2), and M. Funk (1)

(1) ETH Zurich, VAW, Zurich, Switzerland (werder@vaw.baug.ethz.ch), (2) Institutt for geofag, Universitetet i Oslo, 0316 Oslo, Norway

A simple two component model is used to interpret tracer flow speeds measured over diurnal discharge cycles. The model consists of a moulin element and a static channel element simulating the en- and subglacial drainage system, respectively. These two elements have different characteristics in terms of water flow speed: in the channel, flow speed increases with proglacial discharge and hence, with subglacial water pressure; in the moulin, flow speed decreases with subglacial water pressure but increases with discharge into the moulin. As we show, these two different characteristics can explain the diurnal fluctuations of the measured tracer flow speeds. We fit our model to three series of experiments: two series were conducted under 'normal' conditions, when the supraglacial discharge entering the moulin had large diurnal variations. The third series was conducted under 'special' conditions, when the discharge from a glacial lake provided water input into the moulin with a much smaller diurnal amplitude. The experiments under normal conditions show variations of flow speed in phase with discharge into the moulin. Under the special conditions during the lake drainage, the flow speed exhibits two daily maxima and minima and a much smaller amplitude. Both these very different observations can be explained by the model. For normal conditions, the diurnal variation of the total tracer residence time is dominated by the residence time in the moulin. Therefore, the observed variations of tracer speed do not directly reflect the variations of subglacial water flow speed. Instead, to interpret tracer flow speeds the entire glacial drainage system needs to be taken into account.