Geophysical Research Abstracts
Vol. 12, EGU2010-8467-2, 2010
EGU General Assembly 2010
© Author(s) 2010

Altelsgletscher 1895: Gigantic breaking-off. New insights from spring-block model

Jerome Faillettaz (1), Martin Funk (1), Didier Sornette (2,3)

(1) Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETH Zurich, Switzerland, Faillettaz@vaw.baug. ethz.ch., (2) Department of Management, Technology and Economics, ETH Zurich, Switzerland, dsornette@ethz.ch, (3) Department of Earth Sciences, ETH Zurich, Switzerland.

A large part of the Altelsgletscher broke off September 11, 1895. The ice volume of this catastrophic rupture was estimated to 4-5.10^6 m^3, which is the largest known ice fall in the Alps. However, the causes of this collapse are not entirely clear. Based on former studies, we have reanalyzed this glacier fall with help of a new numerical model.

This model, initially developed by Faillettaz et al. (2009) for gravity-driven instabilities, was applied on this glacier. It takes into account the progressive maturation of an heterogenous mass towards a gravity-driven instability, characterized by the competition between frictional sliding and tensile cracking. We use an array of slider blocks on an inclined (and curved) glacier bed, which interact via elastic-brittle springs. A realistic state- and rate-dependent friction law established in the laboratory is used for the block-surface interaction. We model the inner material properties of the mass and its progressive damage eventually leading to failure, by means of a laboratory-based stress corrosion law governing the rupture of the springs.

Results show that this collapse can only occur if basal shear resistance at the bedrock decreases in a restricted area, probably induced by the storage of infiltrated water within the glacier. Since the summer preceding the collapse was exceptionally hot, the strong melt water production in that summer may have played an important role in the destabilization process. Moreover, the rate of changes in basal conditions seem to play a decisive role in the breaking off process. Once the crown crevasse opened, the instability develops rapidly, within a few days, resulting in this impressive ice avalanche. As a consequence, the phase of destabilization of such events can only be recognized by traditional remote sensing techniques a few days prior to the collapse, which makes an early warning difficult.

Faillettaz J., Sornette, D. and Funk, M., 2009. Interplay between state-and-velocity dependent frictional sliding and stress corrosion damage cracking in gravity-driven instabilities. arXiv :0904.0944 (April 2009), Journal of Geophysical Research, *in press*.