Geophysical Research Abstracts
Vol. 12, EGU2010-11505-1, 2010
EGU General Assembly 2010
© Author(s) 2010

Rock avalanches and glacier dynamics: a case study in the Chugach Mountains, Alaska

Manuela Uhlmann (1), Luzia Fischer (2), Christian Huggel (3), Jeffrey Kargell (4), and Oliver Korup (5)

(1) University of Zurich, Switzerland (manu.uhlmann@gmail.com), (2) University of Zurich, Switzerland, (3) University of Zurich, Switzerland, (4) University of Arizona, USA, (5) University of Potsdam, Germany

Massive rock slope failures resulting in rock avalanches in glacierized environments can have serious consequences for downstream areas. Furthermore they are important drivers of erosion. The Chugach Mountains in south-central Alaska are a vast remote and strongly glacierized area with evidence of numerous rock avalanches, although a systematic documentation and assessment of their role as geomorphic agents is missing so far. Here we use glaciers as a unique archive of rock avalanches that have deposited extensive debris sheets on glaciers. A number of well preserved rock avalanche deposits from past years and decades furthermore facilitate the quantification of hitherto poorly known historic glacier surface velocities in the region.

The principal objective of this work was first to create an inventory of rock avalanches on the basis of Landsat satellite images in the Chugach Mountains, and to analyze their characteristics regarding lithology, climate, runout-distance, area and volume, as well as their spatial distribution.

The runout distances of mass movements are generally larger in glacial environments than in non-glacial environments. This characteristic was also shown in the studied cases as they always travelled over glaciers, firn or snow.

The distribution of the rock avalanches was compared with the occurrence of earthquakes in the region. It has been shown in this study, that especially big earthquakes trigger rock avalanches. Smaller earthquakes do not appear to have enough energy to trigger rock avalanches.

Furthermore, the climate conditions were analyzed of being responsible for the spatial pattern of the rock avalanches. The south-eastern part of the Chugach Mountains is affected by high precipitation and mild temperatures. Concentration of rock avalanches occurs in the same area.

To analyze glacier dynamics over more than 20 years, rock avalanche deposits on the glaciers were used to derive simple but robust measures of flow velocities over periods of several years to decades. Such long-term averaged flow velocities are difficult to be achieved by measurement techniques such as satellite based SAR or GPS as they operate over much shorter periods of time. Most of the inferred flow velocities are in the range of 50 to 100 m/a. A few calving or surging glaciers displayed flow velocities of > 300 m/a. In the case of several rock avalanche deposits on the same glacier, differential flow velocities were evaluated, which confirmed the expected patterns of faster velocities in the middle of the glacier and slower velocities at the margins.

This study adds important evidence on the spatio-temporal distribution of rock avalanches in glacial environments, their relation to seismic triggers and climate. The successful identification of glacier flow velocities over a larger mountain region and a larger period of time is unique and can provide important insights into glacier dynamics and change in a region that is highly sensitive to climate change, and the contribution to sea level rise from melting glaciers under ongoing debate.