

Submitted Abstract

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Abstract

High mountains environments are highly affected by the effects of climate change. The main impacts of rising air temperature on the Alpine cryosphere are glacier retreat and permafrost degradation, which lead to rock slopes instabilities. Investigations in the European Alps have shown an increase of rock slope failures, especially during summer heatwaves. These events can provoke cascading hazards like debris flows threatening human lives and infrastructure, which underlines the need of knowledge about their triggering mechanism and propagation. Conform the GAPHAZ guidelines for hazard assessment (GAPHAZ, 2017), the aims of this study are (i) to propose a mapping approach of susceptible release areas of rock slope failures and resulting runout distances at a regional scale (105 km²) and (ii) to identify hotspots for hazard assessment.

To do so, we used an inventory containing 1172 rock slope failures events with volumes larger than 102 m³ recorded in the Mont Blanc massif between 2007 and 2019. A statistical analysis of this database revealed the distribution of the rock slope failures according to the topographical conditions (slope) and the permafrost conditions (Mean Annual Rock Surface Temperatures) that are most favourable to their triggering. These conditions are used in a multi-criteria GIS approach to identify the potential unstable slopes at a regional scale.

Then, the potential release area maps are used as input to map the propagation of potential events, using a model based on a normalised area dependant energy line principle (NELA). The calibration of the NELA model was done with 3630 alpine wide rockfall events covering all possible volumes. The validation of the modelled propagation was based on 70 events from the Mont Blanc database.

In a next step, the resulting maps of release and propagation areas will be intersected with human assets (mountaineering routes, high mountain infrastructure, tourism areas) and lakes (that can provoke cascading hazards) in order to identify areas which could be impacted by rock slope failure related hazards at a regional scale.

This work is a first step to point out hot spots where more detailed analyses will be required to evaluate the possible risks.

References:

GAPHAZ 2017: Assessment of Glacier and Permafrost Hazards in Mountain Regions. Prepared by Allen, S., Frey, H., Huggel, C. et al. Standing Group on Glacier and Permafrost Hazards in Mountains (GAPHAZ) of the International Association of Cryospheric Sciences (IACS) and the International Permafrost Association (IPA). Zurich, Switzerland / Lima, Peru, 72 pp.