

Effects of protection forests on rockfall risks: implementation in the Swiss risk concept

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Forests growing on slopes below active rockfall cliffs can provide effective protection for human lives and infrastructures. The risk-based approach for natural hazards in Switzerland shall take such biological measures just like existing technical protective measures into account, provided that certain criteria regarding condition, maintenance and durability are met.

This contribution describes a project in which we are investigating how the effects of protection forests can be considered in rockfall risk analyses in an appropriate way. In principle, protection forests reduce rockfall risks in three different ways: (i) reduction of the event magnitude (energy) due to collisions with tree stems; (ii) reduction of frequency of occurrence of a given scenario (block volume arriving at the damage potential); (iii) reduction of spatial probability of occurrence (spread and runout) of a given scenario in case of multiple fragments during one event.

The aim of this work is to develop methods for adequately implementing these three effects of rockfall protection forests in risk calculations. To achieve this, we use rockfall simulations taking collisions with trees into account and detailed field validation.

On five test sites, detailed knowledge on past rockfall activity is gathered by combining investigations of impacted trees, analysis of documented historical events, and deposits in the field. Based on this empirical data on past rockfalls, a methodology is developed that allows transferring real past rockfall activity to simulation results obtained with the three-dimensional, process-based model Rockyfor3D. Different ways of quantifying the protective role of forests will be considered by comparing simulation results with and without forest cover. Combining these different research approaches, systematic considerations shall lead to the development of methods for adequate inclusion of the protective effects of forests in risk calculations. The applicability of the developed methods will be tested on the case study slopes in order to ensure practical applicability to a broad range of rockfall situations on forested slopes.