Effects of rockfall protection forests and their implementation in the Swiss risk concept

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INTRODUCTION

Roughly half of the Swiss forests serve as a natural protection against a variety of natural hazard processes. Many of these forests protect villages and traffic ways directly from gravitational mass movements such as rockfalls. The risk-based approach for natural hazards in Switzerland (risk concept) aims at a uniform and objective management of natural hazards including an optimal allocation of financial resources for hazard prevention.

One of the key concepts in the Swiss risk concept is that existing technical and biological preventive measures principally should be taken into account when assessing natural hazards - under the condition that certain criteria regarding condition, maintenance and durability are met. A methodology was developed in the project „Protect“ of the National Platform for Natural Hazards (PLANAT) to assess the efficacy of technical measures. The project „Protect-Bio“, initiated by the Federal office for the Environment FOEN, succeeded in developing a method for evaluating the effects of biological protective measures (i.e., protection forests), in such a way that they can be compared to technical protection measures (Wasser and Perren, 2014).

METHODS

One of the questions raised during Protect-Bio was how the effects of protection forests can be accounted for in rockfall risk analyses in an appropriate way. In general, protection forests reduce rockfall risks in three different ways (Fig. 1): (a) reduction of intensity (energy of falling rocks) after collisions with tree stems; (b) reduction of frequency of occurrence of a given scenario; (c) reduction of spatial probability of occurrence of a given scenario in case of multiple fragments during one event.

This paper describes a project initiated by the Federal Office for the Environment (FOEN) aiming at the development of methods for adequately implementing the effects of rockfall protection forests in risk calculations. This aim shall be achieved through a combination of detailed field validation and rockfall simulations taking collisions with trees into account.

On the test sites, detailed knowledge on past process activity shall be gathered by combining investigations of impacted trees (tree-ring data), analysis of documented historical events and deposits in the field.

EXPECTED RESULTS

Based on data on past rockfalls, a methodology shall be developed that allows transferring real past rockfall activity to simulation results obtained with the three-dimensional, process-based model Rockyfor3D. In a next step, we will consider different ways of quantifying the protective role of forests by comparing simulation results with and without forest cover. Based on 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.

Furthermore, the investigation of impacted trees will allow gathering experience on how tree-impact data can assist the definition of realistic scenarios in case of fragmentary or missing historical records.

The practical applicability of developed methods will be tested on several case study slopes. This shall ensure practical applicability of these methods to a broad range of rockfall situations on forested slopes.

REFERENCES

Wasser B., Perren B. (2014). Wirkung von Schutzwald gegen gravitative Naturgefahren - Protect-Bio. Schweiz Z Forstwes 165(9): 275-283.

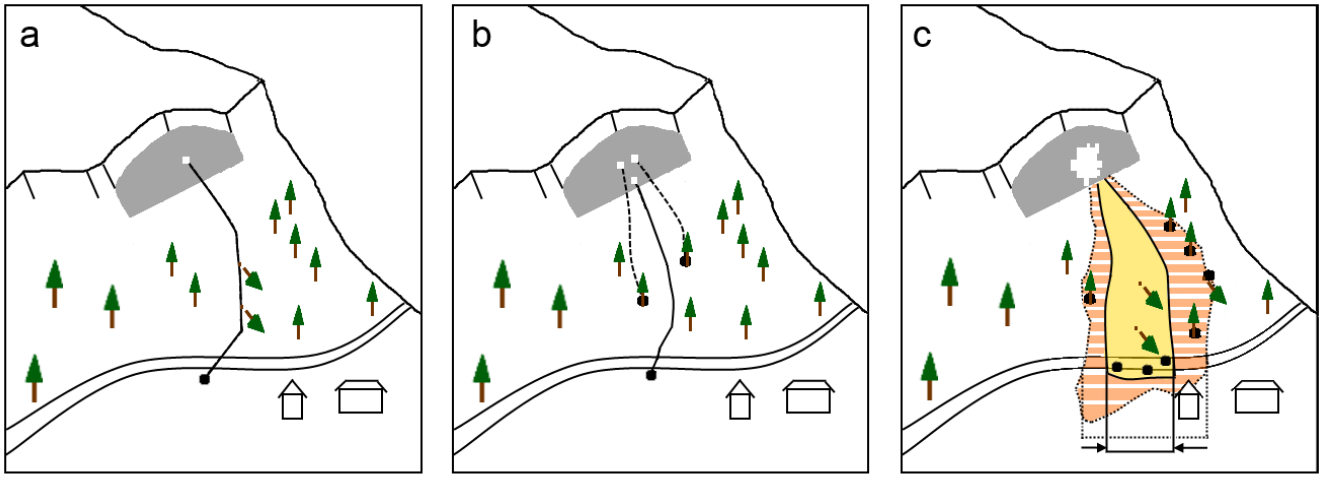

Figure 1. Three ways in which protection forests can reduce rockfall risks.

KEYWORDS

rockfall, protection forest, tree ring, simulation, quantitative risk assessment

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