AN APPROACH TO QUANTIFY NATURAL HAZARD-RELATED RISKS ON THE SWISS RAILWAY NETWORK

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INTRODUCTION

Natural hazards such as rockfall or snow avalanches endanger sections of the Swiss Federal Railways (SBB). In order to quantify the corresponding risks, the project "natural hazard related risk overview" has been realized. The following abstract describes the goals and the methods of this project.

GOALS OF THE PROJECT

The project is intended to yield the following products:

- Hazard Index Map: Based upon national data on index map level, potentially vulnerable sections of the SBB network are identified. The main hazard types are distinguished and treated separately.
- Risk Analysis and Risk Overview: Using the hazard index map on the one hand and network-specific information on the other hand, the risks are analyzed and quantified. Network-specific information (such as the number of trains per day) is required to quantify the damage potential of the section.

The results of the project will constitute the basis for the natural hazard program of the SBB. Within the scope of this program, the SBB will schedule the prevention measures and plan the allocation of financial resources.

METHODOLOGY

The project comprises the following steps:

1. Processing of basic data to identify the hazard and damage potential
2. GIS analysis to separate the relevant hazard potential
3. Validation of the results
4. Calculation of individual and collective risks

Hazard and damage potential

In Switzerland different natural hazards such as snow avalanches, rockfall, shallow landslides, debris flow and flooding were modeled nationwide by means of different simulation approaches (Liener et al. 2008). The hazard potential affecting the SBB network is determined based upon this set of spatial data. Thereby, protective structures (such as rockfall catch fences) are not considered unless they are clearly visible in the elevation model. Protective effects of forests are only considered in avalanche starting zones, whereas tunnels are assumed to offer a complete protection against all types of hazards. The damage potential comprises the value of the SBB line and corresponding infrastructure (e.g. buildings). In order to quantify a realistic damage potential, the number of passenger trains per section and day, the respective occupancy rate as well as the speed of the composition has to be considered.

GIS analysis to separate the relevant hazard potential

The hazard potential is connected to the damage potential by overlaying both data layers. Process areas touching the railway line are considered as potentially relevant for the damage potential (Fig. 1).

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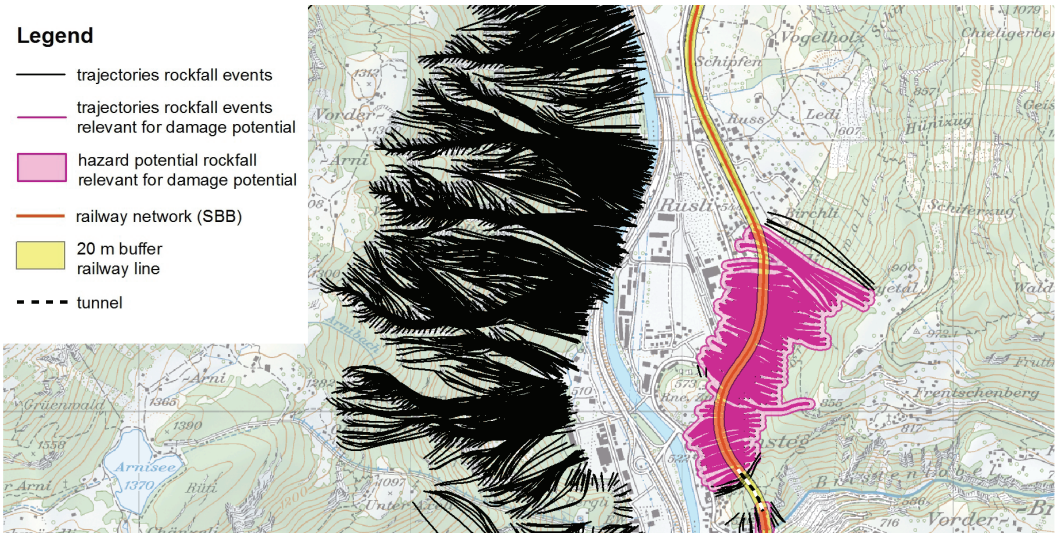

Fig. 1 The pink hazard trajectories (simulated with the model Geotest+Zinggeler) are touching the railway line (red) and/or its surrounding (yellow). They are thus relevant for the damage potential (Reference: Bundesamt für Landestopografie).

Validation of the results

The relevant hazard areas are validated by experts that have a profound knowledge of the hazard situation along the railway line. The validation step comprises the following tasks:

- Verification of the hazard area
- Allocation of recurrence periods

Calculation of individual and collective risk

Based on the validated hazard data and the damage potential, the individual and the collective risk of death can be calculated along the railway network. The calculation approach bases upon the software package EconoMe 2.1 (see BAFU 2010). High risks indicate a lack of protection. Based on this information, priorities can be assigned to protection measures.

CONCLUSIONS

The Risk Overview shows which part of the railway network have a lack of protection. Based on this information, the SBB can schedule the prevention measures and plan the allocation of financial resources.

REFERENCES

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