

RAMMS::RISK: a tool for mapping natural hazard risks

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INTRODUCTION

The threat posed to humans and their living environment by natural hazards is an old one and yet professionals in the field of natural hazard assessment and risk management continuously find themselves confronted with new problems as landscapes evolve, climate changes and settlements expand. The challenges are numerous, ranging from the recognition and correct appraisal of a natural hazard to the gauging of endangered assets and persons at risk. Finally, risk hotspots must be carefully evaluated and appropriate mitigations measures decided upon. These tasks can be very complex, especially when many assets are involved. Risk maps, giving an overview of the situation, help specialists reach decisions and communicate information. Indeed, visualizing and mapping risk has become an indispensable part of risk management (Van Westen 2013).

Considering the already existing, limited palette of risk mapping applications, we identified the need for a tool independent of commercial GIS products, which is not country-specific and can accommodate mountain natural hazards, such as avalanches, debris flows and rockfalls.

METHOD

An ideal backbone for this project was found in the program RAMMS, which was developed to aid professionals with the task of natural hazard assessment by simulating snow avalanches, debris flows, hillslope debris flows and rock fall events in three-dimensional terrain (Christen et al. 2012). We have taken RAMMS one step further along the line of risk management by implementing a new module called RAMMS::RISK, which estimates risk quantitatively, adhering to the risk concept described in Bründl et al. (2009), and automates risk mapping for buildings and linear objects such as roads and railway lines in an easy and appealing way. Required input data are an intensity map

(ASCII format) critically assessed by experts, geo-referenced asset information (CSV or shapefile) and optionally a map or orthophoto to aid spatial analysis.

The two principle features of RAMMS::RISK are the Classification and Selection tabs, which provide the means to spatially analyze the data by grouping assets according to attributes of interest (see Fig. 1 for an example) or by highlighting assets which fulfill certain criteria as specified by the user. The new tool was tested on a showcase project for integrated risk management of avalanche tracks, commissioned for Davos Frauenkirch in the aftermath of the extreme avalanche winter of 1999. This detailed risk expertise of the avalanche situation in Davos Frauenkirch prior to mitigation measures has served as a source of input and comparison for our RAMMS::RISK case study.

RESULTS AND DISCUSSION

The cumulative loss and risk values calculated by RAMMS::RISK for a 30-, 100- and 300-yearly avalanche in Davos Frauenkirch are of the same order of magnitude as the results presented by the expertise (see Tab. 1).

Table 1. Comparison of calculations for the avalanche risk situation in Davos Frauenkirch prior to mitigation measures

<i>Method</i>	<i>Risk of death [fatalities/year]</i>	<i>Collective risk [kCHF/year]</i>
RAMMS: :RISK	0.08	704
Frauenkirch expertise	0.07	500

An example of a possible spatial risk analysis with RAMMS::RISK is shown in Fig. 1. The displayed map makes apparent, that the buildings with the highest collective risk (ca. 6'200 CHF/year and higher) are not necessarily affected by high intensity (orange intensity zone), which can be explained by the affected damage potential. Thanks to the highly specialized nature of RAMMS::RISK,

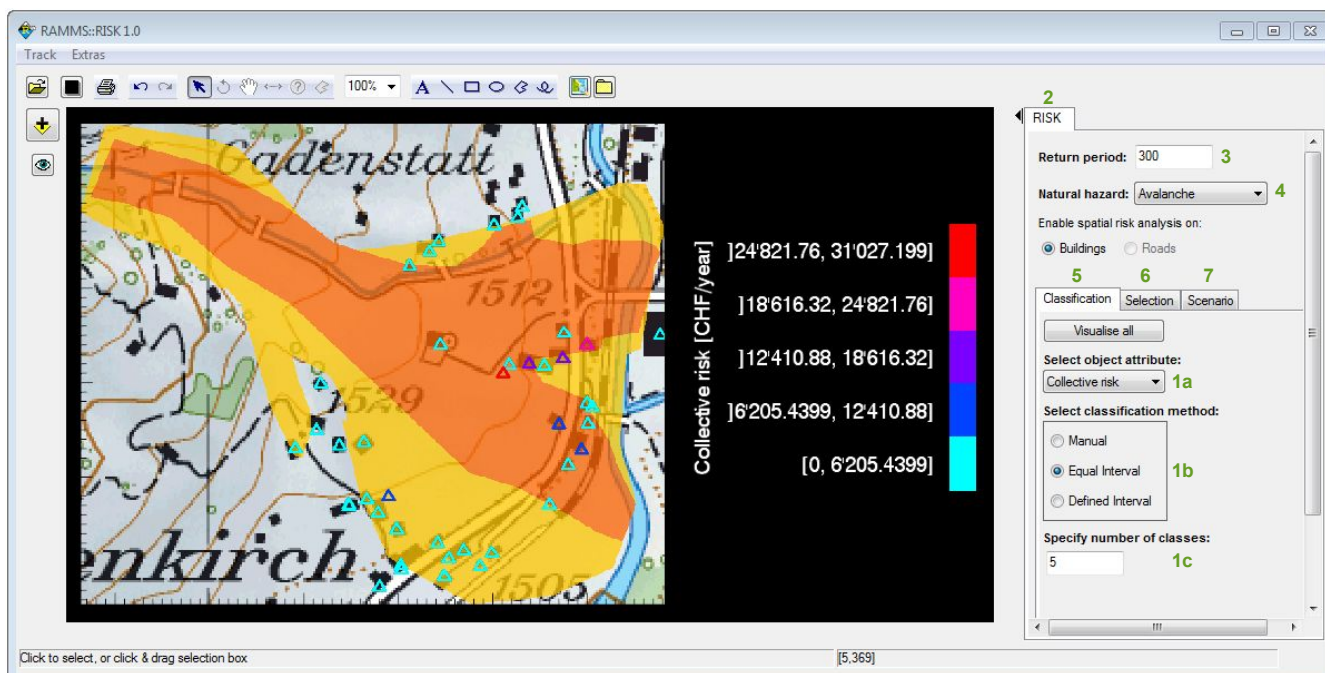


Figure 1. Demonstration of the classification functionality: The buildings (triangles) are grouped in five classes according to their collective risk (1abc). Only seven buildings fall into the highest classes with risk values between 6'200 and 31'000 CHF/year. Scenario: 300-yearly avalanche prior to mitigation measures, Davos Frauenkirch. Further information on the RAMMS::RISK user interface: the Risk tab (2), containing information on the scenario's return period (3), the type of natural hazard (4), the risk calculation results (Scenario tab (7)), and spatial risk analysis functionalities (Classification (5) and Selection tabs (6)). Topogr. map: pixmaps © 2014 swisstopo (57 04 000 000).

identifying a pattern such as this is made possible with little effort or software training.

CONCLUSIONS

As shown in a case study for the avalanche endangered village of Davos Frauenkirch, RAMMS::RISK calculations are comparable to earlier assessments. The user must, however, be aware that the interpretation of the results requires expertise and critical thinking, which cannot be provided by the mapping tool itself.

KEYWORDS

risk management, risk mapping, RAMMS, GIS

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