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Model for an assessment of lahar-endangered regions, to be applied in developing countries, based on expertise gained from the Mt. Rainier volcano (USA)

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Due to their large aerial extension and high propagation speed, two major hazards caused by volcanoes are pyroclastic flows and lahars. Developing countries could be more severely affected by these natural hazards because they seldom have the technical expertise or access to funds for the necessary analysis.
In this study it was attempted to create a model of lahar risk assessment based on ice-cover assessment and on topography-induced lahar travel times. The model should be easy to apply and cost-effective. It is followed by a vulnerability assessment of the areas at risk and a proposal for potential countermeasures.
As a base for validation of the model, the hazard map, the specific travel times and the evacuation map of Mt. Rainier (Washington, USA) was chosen. Mt. Rainier is an active, currently dormant stratovolcano, with the biggest glacial volume in continental USA. The primary focus was placed on the especially vulnerable city of Orting.
The model's database utilizes satellite images from Landsat and digital elevation models (DEM) from ASTER. The information was processed with ArcGIS (Version 9.3) and ENVI (Version 4.3). The satellite images were used to define the area of investigation. The stream network generated from the DEM shows the path a lahar would take, thus defining the areas at risk. The travel time of a lahar is defined as the actual time a lahar takes to travel from the erupting volcano to the city, thus providing an estimation of the time available for evacuation. Lahar travel time was calculated for five cities in the endangered areas, by plotting the specific elevations of the path a lahar would take from the summit down to the cities. The paths were divided into different sections, according to the slope inclination, for which different velocities were assumed. It was then calculated how much time the lahar would need for every section and for the entire distance from the summit to the cities. Five evacuation sites have been identified for the city of Orting of which four can be considered as suitable. Comparing these results with the data published by USGS, the two hazard maps show a high level of correlation. Comparing calculated travel times, some match the USGS data, others do not. The USGS evacuation map, however, shows the same evacuation sites as the ones identified in this work. The main risk derives from the fact that the city of Orting is situated between two rivers. In the event of an evacuation, the rivers must be crossed, but to date only three bridges exist.
The study additionally suggests that instead of confronting the lahars in the city - as proposed by the Orting Lahar Risk Mitigation Plan – it appears more favourable to shift the lahar mitigation front 5 to 10 km upstream. A series of SABO dams, concrete barriers which hold back the solid parts of the lahar while allowing the fluid parts to pass, would significantly reduce the impact of the lahars, thus allowing the existing bridges to withstand the floods. Finally it became very clear from the study, that the risk to the populations of Orting and all the other affected cities such as Ashford, Packwood and Carbonado is very high.
The model presents a reliable method of creating hazard maps for ice-covered volcanoes with the potential to generate lahars. Furthermore, it was able to present lahar mitigation measures and to define evacuation sites. Due to its low cost and speedy implementation, the model may be utilized readily by developing or under-financed countries. The application of this model may thus prevent bigger disasters and reduce the number of fatalities. The model assists with the initial identification of endangered areas.