Geophysical Research Abstracts, Vol. 8, 00182, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00182

Spatially explicit valuation of avalanche risks using Bayesian networks

A. Grêt-Regamey (1,2), D. Straub (3)

1. Swiss Federal Institute for Snow and Avalanche, Division Alpine Environment, Davos, Switzerland
2. Institute for Landscape and Environmental Planning, Swiss Federal Institute of Technology (ETH), Hönggerberg, 8093 Zürich
3. Institut für Baustatik und Konstruktion, Swiss Federal Institute of Technology (ETH), Hönggerberg, 8093 Zürich

Considering the significant monetary losses associated with avalanche disasters, it is crucial that decisions made in regard to hazard mitigation are based on a consistent assessment of the risks. This in turn necessitates a proper assessment of the uncertainties involved in the modeling of the avalanche frequencies and intensities, the possible avalanche extent, as well as the estimations of the damage potential.

In this study, we propose a Bayesian network for avalanche risk assessment, which facilitates the explicit modeling of all relevant parameters, their causal relations and the involved uncertainties in a probabilistic framework. The avalanche release zones and the associated run-out areas are estimated using a numerical simulation model, the AVAL-2D. We estimate model uncertainties by calculating run-out areas using stochastic input parameters and updating the results with the paths of observed avalanches. We calculate the damage potential by combining observational information and expert opinion, thereby explicitly considering the related uncertainties. The joint influence of the different risk indicators is clearly structured in the network in order to be understandable by all involved specialists and decision-makers. We then implement the Bayesian network in a Geographic Information System in order to obtain a spatially explicit valuation of the risks and their associated uncertainties.

We illustrate the procedure in a case study area (Davos, Switzerland), where we estimate the monetary risks under different land-use scenarios. We show that the un-

certainties generate large changes in the run-out areas and the damage potential. We finally demonstrate how Bayesian networks can also be used to identify optimal risk mitigation strategies.

The presented approach may serve as a basis for developing a consistent and unified risk assessment approach for multiple natural hazards. This is relevant, as land-use planning activities such as hazard maps are partly based on the calculations of the likelihood of potential avalanche risks. Therefore, uncertainties in avalanche risk assessment can have a large impact on decision-making, especially in view of the increasing pressure to build into the near boundary of the endangered areas.