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A new Geo-Information Architecture for Risk Management in the Alps

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During the last decades land-use increased significantly in the Swiss (and European) mountain regions. Due to the scarceness of areas suitable for development, anthropic activities were extended into areas prone to natural hazards such as avalanches, debris flows and rockfalls (Smith 2001).
Furthermore, the transalpine transport system necessity to develop effective links in an important area collides with the need to ensure the safety of travelers and the health of the population.
Consequently, an increase in losses due to hazards can be observed.

To mitigate these associated losses, both traditional protective measures and land-use planning policies are to be developed and implemented to optimize future investments. Efficient protection alternatives can be obtained considering the concept of integral risk management.

Risk analysis, as the central part of risk management, has become gradually a generally accepted approach for the assessment of current and future scenarios (Loat & Zimmermann 2004). The procedure aims at risk reduction which can be reached by conventional mitigation on one hand and the implementation of land-use planning on the other hand: a combination of active and passive mitigation measures is applied to prevent damage to buildings, people and infrastructures.

As part of the Swiss National Science Foundation Project 54 “Evaluation of the optimal resilience for vulnerable infrastructure networks - An interdisciplinary pilot study on the transalpine transportation corridors” we study the vulnerability of infrastructures due to natural hazards.
The project aims to study various natural hazards (and later, even man-made) and to obtain an evaluation of the resilience according to an interdisciplinary approach, considering the possible damage by means of risk criteria and pointing out the feasibility of conceivable measures to reduce potential damage.
The project consists of a geoscientific part and an application. The fist part consists in studying the dangers (natural) and related risks in terms of infrastructure vulnerability.
The application considers different types of danger (logically intersected with the transport infrastructure) and compares them with fixed values to obtain a so-called deficit. As framework we adopt The Swiss system for risk analysis of gravitational natural hazards (BUWAL 1999). In this way the project develops a methodology that makes possible a risk analysis aiming to optimize the infrastructure vulnerability and therefore allows to obtain a model designed to optimize the functionality of the network infrastructure.

A simulation environment, RiskBox, is developed within the open-source GIS environment GRASS (Geographic Resources Analysis Support System) and a database (PostgreSQL) in order to manage a infrastructure data catalog. The targeted simulation environment includes the elements that identify the consecutive steps of risk analysis: hazard – vulnerability – risk.

The initial results of the experimental case study show how useful a GIS-based system, which identify the risk of any single vulnerable element in the corridor and to assess the risk to the global system on the basis of priorities of the actors involved, can be for effective and efficient disaster response management, as explained in (ARMONIA Project 2007).
In our work we wanted to highlight the complexity of the risk analysis methodology, difficulty that is amplified by

many peculiarities in the mountain areas. In particular, the illustrative performed process can give an overview of the interests and the need to act to reduce vulnerability and the hazardous nature of the Gotthard corridor.

We present the concept and current state of development of our project and our application to the testbed, the Alps-crossing corridor of St. Gotthard.

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