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Development of an Integrated Natural Hazard Assessment Method

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The concept of "natural hazards" is based on the probability of occurrence of a potentially damaging phenomenon within a specified period of time and within a given area (Varnes 1984). Hazards are commonly shown on maps that display the spatial distribution (zones) of hazard classes. Hazard zonation requires a detailed knowledge of the processes that are or have been active in an area, and of the factors leading to the occurrence of the potentially damaging phenomenon. An ideal map result of hazard assessment (i.e., hazard zones) should provide information on the spatial probability, temporal probability, type, magnitude, and other hazard-related specific parameters, as well as uncertainties.

In addition to the conventional multi-hazard processes assessment, a process-based combined multi-hazard assessment procedure will be developed within a GIS framework.

Hazard quantification procedures in GIS

The first research goal of the project is to produce a hazard map (3D concept) for each separate hazard identified in or defined for the investigated area, based on the research analysis of the various hazard related phenomena under investigation in the project. This parallel approach currently represents the globally used procedure and constitutes the first hazard assessment research step in this project. The hazard quantification procedure within the GIS system will be developed as routines and tools, following currently used modeling procedures (e.g., van Westen, 1993; Bezzola, 1993; Tognacca & Bezzola, 1997; Tognacca & Minor, 2000; Tognacca et al., 2000; Garcia et al., 2003; Hofmeister, 2003; Vollmöller, 2003; etc.) in natural hazard process-based research.

Starting from field-acquired data and previously compiled landslide inventory data, a number of existing modeling approaches for torrents stream and debris-flow hazards have to be compiled. The general model framework will target the three main zones of this phenomena: (1) initiation , (2) transport, and (3) deposition. The architecture of the future system has to allow the integration of environmental process-based modeling functions with classical GIS.

Development of an integrated multi-hazard representation (map or 3D)

The second research goal is to find methods that combine related hazards (in this pilot study, of debris flows and torrent streams in the Vispa Valleys, Valais) in order to obtain an integrated hazard representation, on a map or in 3D. This currently represents a true research challenge, and is in Europe addressed by projects like SIMAGE - Integrated Systems for Monitoring Risks and Emergencies (Nordvik 2003).

Process-based modeling approaches (numerical, statistical, geostatistical and others) will be used as inputs for the hazard assessment analysis. A better result than simple overlays can be obtained, if the interdependence of both processes is taken into account, yielding a more realistic hazard zonation. This approach represents a step towards more intelligent hazard assessment tools and serves as the basis for vulnerability and risk assessments.

Developing these new concepts represents the next serious challenge in hazard assessment in order to obtain a good and stable method that has additional growth potential. It will probably be the only way to obtain hazard maps that can be validated.

The above outlined idea for a Ph.D. thesis is part of a larger project titled: "Correlated Hazard Assessment Studies within an Alpine Valley - Establishing a Geo-Spatial System for Data Management, Analysis, Modeling, and Visualisation" inside the ETH HazNETH network (www.hazneth.ethz.ch)

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