SIMULATION OF POTENTIAL HAZARD AREAS TO DETERMINE PROTECTION FOREST IN SWITZERLAND

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THE PROJECT SILVAPROTECT-CH

Many mountain forests effectively protect people and assets against natural hazards. In order to provide a most favorable protective effect, these forests are mostly managed by means of public funds. For an efficient application of these funds, the spatial definition of protective forests first needs to be comparable on a national level. For this purpose, the Federal Office for the Environment FOEN launched the project SILVAPROTECT-CH. The project has two major aims, namely (i) to provide an objective nationwide distribution frame for the distribution of public funds and (ii) to supply basics for a standardized segregation of protective forests in the long-term.
SILVAPROTECT-CH is organized in **five modules** (Giamboni & Wehrli 2007). In the EVENT module, different natural hazards such as snow avalanches, rockfall, shallow landslides and debris flow were modeled nationwide, using different process models. The working group Geotest AG, Geo7 AG, Oeko-B AG has been charged with assessing the potential hazard areas for rockfall, shallow landslides and debris flows, which are part of the EVENT module.

METHODOLOGY AND FUNDAMENTALS

The potential hazard areas have been determined with particular simulation models. All simulation models are well proved by the use in various projects in Switzerland and Italy:

- **Rockfall:** The model Geotest+Zinggeler calculates 3D-trajectories, the energies and the bouncing heights of falling blocks. The crucial input parameters are the surface-roughness, the soil-elasticity (damping) and the blockshape (Liniger 2000).
- **Shallow landslides**: The model SLIDISP is based upon an Infinite-Slope-Analysis and calculates the local probabilities for potential shallow-landslide starting areas. The major model inputdata are the slopes (DEM), geotechnical parameters, depth and water-saturation of subsoil (Liener 2000). Based on the starting areas the trajectories of shallow landslides were simulated with the model SLIDESIM.
- **Debris flow**: In a first step the model MGSIM determines the soil material relevant for building debris flows and simulates the possible starting points for debris flows. In a second step the model MGSIM/dfwalk simulates the trajectories for possible debris flows (Gamma 2000).

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The simulation models process digital elevation models and other spatial data sets, which are used as input data. They produce digital data sets (grid or polygon structure) with the particular hazard areas.
In order to ensure intercomparability of the modelling results throughout Switzerland, exclusively uniform digital data of nationwide availability was used. The digital elevation model DEM25/10, processed into a 10 m-grid, is the most important digital database, the simulations rely on. Furthermore, for landslide as well as debris-flow simulations, geological properties of the subsoil are a crucial input parameter. In default of more detailed alternatives (the Swiss Geological Atlas 1: 25'000 not yet being available for all of Switzerland), the new Geotechnical Map of Switzerland (1 : 200'000), edited by the Swiss Geotechnical Commission (SGTK) had to be used. For the rockfall simulations, the modelling parameters are derived from the slopes (DEM) and vegetation data.
In a first step, the models were performed to selected study areas for calibrating purposes. Subsequently, the calibrated model parameters were applied to all of Switzerland. Due to the extensive quantity of data, the country had to be subdivided into 11 sections.

RESULTING HAZARD AREAS

The precision of the resulting hazard areas highly depends on the quality of the input data. Protection structures and detailed topological structures are not considered in the simulations. Most parameters must be generalized and are generally rather pessimistic. Therefore the results should only be used on a scale similar to the one of the input data of about 1:25'000. The resulting hazard areas give an overview over entire Switzerland and correspond to a hazard index map. They are stored as hazard trajectories.
The amount of simulated hazard trajectories for entire Switzerland is big: 9.3 mio. rockfall trajectories, 47.6 mio. shallow landslide trajectories and 6.7 mio. debris flow trajectories.

INTERSECTION OF THE HAZARD AREAS WITH THE DAMAGE POTENTIAL

The intersection of the hazard trajectories with the damage and the forest area - allowing the determination of the protection forest – as has been done in the modules INTERSECT and SYNTHESIS. The modular structure of SILVAPROTECT-CH allows to calculate the protection forest for different damage potentials. This permits to adapt the protection forest if the damage potential changes.

LITERATURE

Gamma, P. (2000): dfwalk – Ein Murgang-Simulationsprogramm zur Gefahrenzonierung, Geographica Bernensia G66, Verlag des Geogr. Inst. Univ. Bern.

Liener, S. (2000): Zur Feststofflieferung in Wildbächen. Geographica Bernensia G64, Verlag des Geogr. Inst. Univ. Bern.

Liniger, M. (2000): Computersimulation von Stein- und Blockschlägen. Sonderdruck aus Felsbau 18 (2000) Nr.3: 56-63.

Giamboni, M & Wehrli A. (2007): Improving the management of protective forests in Switzerland: The project SilvaProtect-CH. Interpraevent 2007

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