Landslide databases for applied landslide impact research: the example of the landslide database for the Federal Republic of Germany

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This contribution presents an initiative to develop a national landslide database for the Federal Republic of Germany. It highlights structure and contents of the landslide database and outlines its major data sources and the strategy of information retrieval. Furthermore, the contribution exemplifies the database potentials in applied landslide impact research, including statistics of landslide damage, repair, and mitigation.

The landslide database offers due to systematic regional data compilation a differentiated data pool of more than 5,000 data sets and over 13,000 single data files. It dates back to 1137 AD and covers landslide sites throughout Germany. In seven main data blocks, the landslide database stores besides information on landslide types, dimensions, and processes, additional data on soil and bedrock properties, geomorphometry, and climatic or other major triggering events. A peculiarity of this landslide database is its storage of data sets on land use effects, damage impacts, hazard mitigation, and landslide costs. Compilation of landslide data is based on a two-tier strategy of data collection. The first step of information retrieval includes systematic web content mining and exploration of online archives of emergency agencies, fire and police departments, and news organizations. Using web and RSS feeds and soon also a focused web crawler, this enables effective nationwide data collection for recent landslides. On the basis of this information, in-depth data mining is performed to deepen and diversify the data pool in key landslide areas. This enables to gather detailed landslide information from, amongst others, agency records, geotechnical reports, climate statistics, maps, and satellite imagery. Landslide data is extracted from these information sources using a mix of methods, including statistical techniques, imagery analysis, and qualitative text interpretation. The landslide database is currently migrated to a spatial database system running on PostgreSQL/PostGIS. This provides advanced functionality for spatial data analysis and forms the basis for future data provision and visualization using a WebGIS application.

Analysis of landslide database contents shows that in most parts of Germany landslides primarily affect transportation infrastructures. Although with distinct lower frequency, recent landslides are also recorded to cause serious damage to hydraulic facilities and waterways, supply and disposal infrastructures, sites of cultural heritage, as well as forest, agricultural, and mining areas. The main types of landslide damage are failure of cut and fill slopes, destruction of retaining walls, street lights, and forest stocks, burial of roads, backyards, and garden areas, as well as crack formation in foundations, sewer lines, and building walls. Landslide repair and mitigation at transportation infrastructures is dominated by simple solutions such as catch barriers or rock fall drapery. These solutions are often undersized and fail under stress. The use of costly slope stabilization or protection systems is proven to reduce these risks effectively over longer maintenance cycles. The right balancing of landslide mitigation is thus a crucial problem in managing landslide risks. Development and analysis of such landslide databases helps to support decision-makers in finding efficient solutions to minimize landslide risks for human beings, infrastructures, and financial assets.