Geophysical Research Abstracts
Vol. 20, EGU2018-7759, 2018
EGU General Assembly 2018

Integrated statistical landslide susceptibility modelling: combining release and propagation

Martin Mergili (1,2), Leonhard Schwarz (3), and Arben Kociu (3)

(1) University of Vienna, Department of Geography and Regional Research, Vienna, Austria, (2) BOKU University, Institute of Applied Geology, Vienna, Austria (martin.mergili@boku.ac.at), (3) Geological Survey of Austria, Department of Engineering Geology, Vienna, Austria

Statistical landslide susceptibility analyses are nowadays conducted for many mountainous and hilly areas all around the world. Thereby, the spatial relationships between a landslide inventory (polygons or points) and GIS layers of predisposing factors are explored in order to produce landslide susceptibility maps. However, such maps only depict the spatial patterns of the susceptibility to landslide release, whereas runout is not a subject of these maps. Landslide runout models – whether empirical-statistical or physically-based – have commonly been applied to selected observed or inferred landslide areas, but hardly yet at a level that consistently combines the susceptibility of landslide release, and the susceptibility of a given point in space to be hit by a landslide starting somewhere else. We compare two approaches to perform such a combination, and thereby critically reflect the related challenges. The surroundings of Schnepfau in Vorarlberg, western Austria, are chosen as study area, where a comprehensive inventory of shallow landslides that have developed into debris flows was mapped by the Geological Survey of Austria, using Airborne Lidar data and aerial images.

Based on this high-quality inventory, a landslide susceptibility map is computed using logistic regression for those areas free of rocks, where shallow landslides can occur. This map is used as the basis for the further analyses. Our approaches employ the density functions (pdf and cdf) of the angles of reach of the observed landslides, and use a constrained random walk approach for downslope routing of mass points:

A. Bottom-up approach: for each point in space (i.e. GIS raster cell), the probability that landslide release is observed anywhere in its catchment is computed from the pixel-based release susceptibilities and the catchment area. This zonal release probability is then multiplied with the probability that the same pixel is reached by a landslide released in its catchment.

B. Top-down approach: for each point in space, a number of random walks proportional to the release susceptibility is started. Each random walk proceeds until a given angle of reach is met. This angle of reach is probabilistically derived from the pdf, separately for each random walk. Each time a GIS raster cell is impacted by a random walk, its susceptibility score is increased by 1.

The spatial patterns of the resulting maps are largely similar among A and B. However, whereas A produces a spatial probability at the cost of a high level of spatial blurring of the release information, B results in a qualitative score which retains the signal of the release susceptibility and performs better in terms of empirical adequacy than the probability yielded with A. Visually, both maps are comparable and dominated by the effects of landslide runout rather than by those of the release. We recommend using the approach B for qualitative spatial overviews, whereas the approach A is still needed as the basis of quantitative risk analyses.