Progress in national-scale landslide susceptibility mapping in Romania using a combined statistical-heuristical approach

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Landslide processes represent a very widespread geohazard in Romania, affecting mainly the hilly and plateau regions as well as the mountain sectors developed on flysch formations. Two main projects provided the framework for improving the existing national landslide susceptibility map (Bălteanu et al. 2010): the ELSUS (Pan-European and nation-wide landslide susceptibility assessment, EC-CERG) and the RO-RISK (Disaster Risk Evaluation at National Level, ESF-POCA) projects. The latter one, a flagship project aiming at strengthening risk prevention and management in Romania, focused on a national-level evaluation of the main risks in the country including landslides.

The strategy for modeling landslide susceptibility was designed based on the experience gained from continental and national level assessments conducted in the frame of the International Programme on Landslides (IPL) project IPL-162, the European Landslides Expert Group - JRC and the ELSUS project. The newly proposed landslide susceptibility model used as input a reduced set of landslide conditioning factor maps available at scales of 1:100,000 - 1:200,000 and consisting of lithology, slope angle and land cover. The input data was further differentiated for specific natural environments, defined here as morpho-structural units in order to incorporate differences induced by elevation (vertical climatic zonation), morpho-structure as well as neotectonic features. In order to best discern the specific landslide conditioning elements, the analysis has been carried out for one single process category, namely slides. The existence of a landslide inventory covering the whole country's territory ($\sim$ 30,000 records, Micu et al. 2014), although affected by incompleteness and lack of homogeneity, allowed for the application of a semi-quantitative, mixed statistical-heuristic approach having the advantage of combining the objectivity of statistics with expert-knowledge in calibrating class and factor weights. The maps obtained for the different units were subjected to evaluation and validation using both expert judgment and two additional landslide inventories with national coverage. Expert evaluations were provided for several parts of the country, where possible also using available regional zonations, and derived knowledge was subsequently used for map improvements. The external landslide datasets allowed for validation of the maps through prediction-rate curves (PRC).

An improved national landslide susceptibility map of Romania (100 m resolution) resulted from merging the various unit maps and classifying them according to the PRC-thresholds. The final map reveals good performance for most areas. Finally, improvements compared to the previous version of the national map as well as model limitations and possible enhancement requirements are discussed.

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