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Landslide hazard scenario assessment at a large spatio-temporal scale: the case of a municipality in the Getic Subcarpathians, Romania

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Performing a landslide hazard assessment requires both a spatial and a temporal-probabilistic modelling of landslide occurrence. Nevertheless, most landslide 'hazard' maps only present the zoning of susceptibility (i.e. spatial probability) without including information on the temporal component of the hazard. One of the difficulties in estimating temporal probabilities of landslides lies in identifying frequency-magnitude relationships for landslide occurrences since historical landslide records are usually incomplete. However, even in scarce data conditions, the possibility remains to address recent occurences of landslides that can be related to particular triggering events (e.g. earthquake, rainfall). The present paper proposes to produce a landslide hazard scenario, claiming that by analysing more particular frequency-magnitude relationships and developing hazard scenarios, the assessment of a general landslide hazard map could be more easily envisaged in future.

The study is part of a top-down approach, which, in a previous phase, has completed a regional scale (1:100,000) semi-quantitative susceptibility assessment of a wider administrative unit in southern Romania (the Vâlcea county), constantly under the threat of landslides. Based on the landslide hotspots provided by this synoptic map, the case of a municipality in the Subcarpathian hills was selected for perfoming a much more detailed hazard scenario assessment, i.e. at a large scale (1:10,000 spatial scale and daily temporal scale).

A first stage of the present study aims at zoning the terrain in terms of spatial probabilities of landslide occurrence by statistically analysing the relation between inventoried landslides and several predisposing factors. Considering the large scale of analysis, a special focus was given to predicting areas probable to generate landslides and thus only the mapped depletion zones were entered into the analysis. Moreover, in order to correctly reflect causal relations, a procedure was developed to associate these to conditions prior to landsliding.

The second work stage proposes the prediction of future landslides based on the observed effects of a past landslide-generating rainfall-snowmelt pattern. The general methodology is based on the one developed by Zêzere et al (2004). The triggering threshold of water supply to the slopes was defined as the extreme couple amount-duration resulting from the statistical processing of daily measurements. Since limited data was available (i.e. only on rainfall and temperature but not on snow cover), a correction was applied to adjust the raw rainfall series when snow-related phenomena are present.

The final landslide hazard scenario map resulted from the integration of the susceptibility map, the computed reccurrence interval of the landslides-triggering threshold and the corresponding geomorphic response in terms landslide density.