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Comparison and validation of Logistic Regression and Analytic Hierarchy Process models of landslide susceptibility in monoclinic regions. A case study in Moldavian Plateau, N-E Romania

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The regions with monoclinic geological structure are large portions of earth surface where the repetition of similar landform patterns is very distinguished, the scarps of cuestas being characterized by similar values of morphometrical variables. Landslides are associated with these scarps of cuestas and consequently, a very high value of landslide susceptibility can be reported on its surface. In these regions, landslide susceptibility mapping can be realized for the entire region, or for test areas, with accurate, reliable, and available datasets, concerning multi-temporal inventories and landslide predictors. Because of the similar geomorphologic and landslide distribution we think that if any relevance of using test areas for extrapolating susceptibility models is present, these areas should be targeted first.
This study case try to establish the level of usability of landslide predictors influence, obtained for a 90 km2 sample located in the northern part of the Moldavian Plateau (N-E Romania), in other areas of the same physio-geographic region. In a first phase, landslide susceptibility assessment was carried out and validated using logistic regression (LR) approach, using a multiple landslide inventory. This inventory was created using ortorectified aerial images from 1978 and 2005, for each period being considered both old and active landslides. The modeling strategy was based on a distinctly inventory of depletion areas of all landslide, for 1978 phase, and on a number of 30 covariates extracted from topographical and aerial images (both from 1978 and 2005 periods). The geomorphometric variables were computed from a Digital Elevation Model (DEM) obtained by interpolation from 1:5000 contour data (2.5 m equidistance), at 10x10 m resolution. Distance from river network, distance from roads and land use were extracted from topographic maps and aerial images. By applying Akaike Information Criterion (AIC) the covariates with significance under 0.001 level, were chosen. As measures of validation for the fit of the model, we have used AUROC value, cross-validation estimates of predictive accuracy and the percent of mapping units correctly classified.
For the same sample, the Analytic Hierarchy Process (AHP) approach was applied for landslide susceptibility assessment, using 7 predictors (slope angle, slope aspect, plan and profile curvature, distance to river network, distance to roads, and land use). The validation of the LR and AHP approaches was assessed using the inventories with active landslides for 1978 and 2010 situations.
For estimating the level of replicability of the results, an extra-domain sample it was used, situated in the vicinity of the first area, having the same size (90 km2). For the extra-domain area, the same weights obtained for LR approach and the same predictors and weights assigned for the AHP approaches, were used in the modelling. The extra-domain resulted AUROC values are closed with the ones from the original area, but there is small variance, a decrease by 0.07% for LR and by 0.05% for AHP approach.
These results allow us to consider that applying both quantitative (LR) and semi-quantitative (AHP) methods for landslide susceptibility assessment at medium scale, in regions with high level of geomorphologic uniformity, such as monoclinic areas, could be applied with good results. Using these two methods for an extra-domain area, we can assess the sensitivity of the input covariates. Also, two maps showing the differences between the two models of landslide susceptibility, both for the first and for the extra-domain sample, were carried out and interpreted.