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Different Data-Driven Bivariate Statistical Approaches to Landslide Susceptibility Mapping (Uzundere, Erzurum, Turkey)

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Abstract : The main goal of this study is to produce landslide susceptibility maps using different data-driven bivariate statistical approaches; namely, entropy weight method (EWM), evidence belief function (EBF), and information content model (ICM), at Uzundere county, Erzurum province, in the north-eastern part of Turkey. Past landslide occurrences were identified and mapped from an interpretation of high-resolution satellite images, and earlier reports as well as by carrying out field surveys. In total, 42 landslide incidence polygons were mapped using ArcGIS 10.4.1 software and randomly split into a construction dataset 70 % (30 landslide incidences) for building the EWM, EBF, and ICM models and the remaining 30 % (12 landslides incidences) were used for verification purposes. Twelve layers of landslide-predisposing parameters were prepared, including total surface radiation, maximum relief, soil groups, standard curvature, distance to stream/river sites, distance to the road network, surface roughness, land use pattern, engineering geological rock group, topographical elevation, the orientation of slope, and terrain slope gradient. The relationships between the landslide-predisposing parameters and the landslide inventory map were determined using different statistical models (EWM, EBF, and ICM). The model results were validated with landslide incidences, which were not used during the model construction. In addition, receiver operating characteristic curves were applied, and the area under the curve (AUC) was determined for the different susceptibility maps using the success (construction data) and prediction (verification data) rate curves. The results revealed that the AUC for success rates are 0.7055, 0.7221, and 0.7368, while the prediction rates are 0.6811, 0.6997, and 0.7105 for EWM, EBF, and ICM models, respectively. Consequently, landslide susceptibility maps were classified into five susceptibility classes, including very low, low, moderate, high, and very high. Additionally, the portion of construction and verification landslides incidences in high and very high landslide susceptibility classes in each map was determined. The results showed that the EWM, EBF, and ICM models produced satisfactory accuracy. The obtained landslide susceptibility maps may be useful for future natural hazard mitigation studies and planning purposes for environmental protection.

Keywords : entropy weight method, evidence belief function, information content model, landslide susceptibility mapping
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