Landslide susceptibility evaluation by spatial data-driven technology under different resolutions of the slope units

Xia Zhao[1], Wei Chen[1], Paraskevas Tsangaratos[2,*], Ioanna Ilia[2],

[1]College of Geology and Environment, Xi'an University of Science and Technology, Xi'an 710054, China;
[2]Laboratory of Engineering Geology and Hydrogeology, Department of Geological Sciences, School of Mining and Metallurgical Engineering, National Technical University of Athens, 15780 Zografou, Greece.

Corresponding author: ptsag@metal.ntua.gr

Abstract

This research addresses the intersection of geological environmental issues and human engineering activities, which frequently trigger landslides, posing risks to human life and property. It highlights the significance of landslide susceptibility assessment in urban planning and disaster prevention, using a dataset of 224 historical landslide instances analyzed through remote sensing and field investigation techniques. The study focuses on 19 factors influencing landslides, employing the weight of evidence (WoE) algorithm to evaluate their spatial correlation and optimize factor selection. Through the use of GRASS GIS software and the r. slopeunits method, an analysis of 180 slope units of varying scales was conducted to identify the optimal units for landslide susceptibility modeling, based on accuracy and a comprehensive index. Multiple sets of landslide susceptibility models, including alternating decision tree (ADT), random forest - alternating decision tree (RF-ADT), ADT - alternating decision tree (RS-ADT), forest by penalizing attribute (FPA), random forest - forest by penalizing attribute (RF-FPA), random subspace - forest by penalizing attribute (RS-FPA) and random forest (RAF), based on decision algorithms were established on the basis of the optimal slope units for comparative analysis of landslide susceptibility. The results indicate that the internal uniformity/external heterogeneity of the 12,282 slope units extracted under the parameters of 200m spatial resolution, minimum circular variance (cv) of 0.1, and minimum surface area (amin) of 290,000m2 is the best. The study found that slope units extracted at a 200m spatial resolution with specified variance and area thresholds were most effective in achieving internal uniformity and external heterogeneity. Among the tested models, the Random Forest - Alternating Decision Tree (RF-ADT) integrated model showed the best performance (AUROC=0.791), proving to be a stable and reliable tool for creating landslide susceptibility zoning maps in Shenmu City. These maps are intended to guide government and engineering decisions, providing a valuable resource for safer urban planning and effective disaster mitigation strategies.

Keywords: Shenmu City; Landslide susceptibility; Slope unit; Hybrid model; Comprehensive index (S); data mining

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Data Availability Statement

The datasets generated and/or analyzed during the current study can be made available from the corresponding author upon reasonable request.