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Structure and characteristics of landslide input data and consequences on landslide susceptibility assessment and prediction capability

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For the territorial planning and management it is of crucial importance the knowledge of the landslide susceptibility, in order to minimize the physical damages and economic losses associated to a certain instability scenario. Resultant mitigation measures can only be effective if we were able to predict where future landslides will occur. In order to improve the quality of data driven landslide susceptibility assessment, recent research developed worldwide as been focused on some fundamental questions: What is the quality of landslide inventories? What is the most appropriate terrain-unit to adopt? What is the most reliable statistical model? What are the best tools to validate results?

In contrast, little attention has been given in the literature to the consequences on the landslide susceptibility assessment resulting from the structure and characteristics of the landslide database. Under the assumption that the conditions that led to slope instability in the past are more likely to generate new instability in the future, the statistically-based landslide susceptibility evaluation for a specific area is based on the spatial correlation between a set of independent, predisposing landslide geo-environmental factors, and the distribution of past landslides, which are considered the dependent variable. Landslides are usually included in the susceptibility models as a single point or as a polygon representing the entire unstable area. The selection of the way landslide information enter into prediction models (point vs polygon) is frequently conditioned by software constrains, and surprisingly, the effects of this choice in landslide susceptibility results has not been made.

The purpose of this study is to evaluate the quality of susceptibility results obtained for rotational slides in a 12 km2 test site located at north of Lisbon, Portugal considering: (i) the structure and characteristics of landslide input data; (ii) the capacity of different landslide inventories to predict new unstable areas; (iii) the differences resulting from the use of different statistical methods.

In a first step, three dependent landslide inventories were produced: the first includes the total set of rotational slides (64 cases) identified in the study area, and the two additional landslide inventories are composed by 32 cases each, resulting from the random partition of the original landslide database. For each landslide inventory, individual landslides were considered both as the total unstable area, and as a single point representing the landslide centroid. Therefore, six dependent landslide inventories were built (3 with landslides represented by polygons, and 3 with landslides represented by points). Finally, these landslide inventories were integrated with the landslide predisposing factors (lithology, slope angle, slope aspect, slope curvature, soil type, and land use) using three bi-variate statistical methods (Bayesian Probability, Information Value and Fuzzy Logic). Results of susceptibility models are critically compared through success rate and prediction rate curves, as well as by the computation of the respective Area Under the Curve (AUC).

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