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Geological database improvement influence on physically based landslide susceptibility assessment at regional scale

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A physically based method was applied to landslide susceptibility mapping in three small sub-basins (Salema, Laje and Galinhatos) located in Arruda dos Vinhos region, 30km north of Lisbon (Portugal), characterized by a considerably high landslide density.
The required input data for the landslide susceptibility assessment, based on the infinite slope soil stability analysis method, includes top soil properties (cohesion; friction angle; soil unit weight), slope angle, hydrogeology, thickness of potentially unstable soil layer and lithology.
The study area is characterized by a moderate steep slope, in a near horizontal geological structure with morphology strongly related with the presence of an upper Jurassic limestone dominated unit (Amaral Formation, Kimmeridgian), which forms the steep slopes and scarps of the higher areas in the region, overlain by marly limestones and sandstones (Pterocerian Complex, upper Kimmeridgian-Tithonian?). The limestone unit is underlain by a thick sequence of alternating marls, shales and lenticular sandstone beds (Abadia Formation, Upper Oxfordian-Kimmeridgian), which are the main (70%) bedrock of the area. These lithologies produce strong contrasts in terms of geotechnical and hydrogeological properties, with the later characterized by low permeability marl and shale, interbedded with much higher permeable sandstone and limestone beds.
As existing geological maps provided only the separation of the two main units in the area and were affected by geological limits and fault location inaccuracies, a detailed lithological map was compiled by aerial photo interpretation and field surveys, focused on the separation of the stronger limestone and sandstone beds from marls and shale, and also on fault, dyke and superficial deposits mapping.
A static hydrogeological model was set up using water well data and systematic mapping of morphological evidences of superficial runoff and erosion, connected with the presence of pervious sandstone and limestone strata which generate high piezometric levels during heavy rainfall periods.
Potentially unstable soil thickness was estimated using field observations and borehole data.
The geotechnical properties of the soil units were based on laboratory direct shear and index testing validated with systematic back analysis of landslides recorded in an extensive and substantially complete inventory compiled by different date aerial photo interpretation and repeated field surveys carried out mainly after the last heavy rainfall periods in the area. The slope angle was derived from a DEM built based on a 1:10,000 scale topographic map.
The results of the application of the infinite slope model for landslide susceptibility assessment using the improved geological map are compared with the results using the standard geological map. The predictive capacities of the landslide susceptibility assessments are validated using the landslide inventory, to enable the analysis of the influence of the improvement of the geological base on the final results.
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