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ESTIMATING LANDSLIDE HAZARD AT THE REGIONAL SCALE CONSIDERING DISTINCT CLIMATE CHANGE SCENARIOS

Jose Zezere[1], Eusébio Reis[1], Susana Pereira[2], Pedro Santos[1], Sérgio Oliveira[1], Ricardo Garcia[1], Raquel Melo[1]
[1]Instituto de Geografia e Ordenamento do Território, University of Lisbon, Centro de Estudos Geográficos, Lisboa, Portugal, [2]Faculdade de Letras da Universidade do Porto, Centro de Estudos Geográficos, Portugal

Purpose: Shallow landslides triggered by rainfall occur nowadays worldwide and will continue to occur in the future. However, ongoing climate change produces modifications in rainfall patterns that will be reflected in changing patterns of landslide activity, and thus in future landslide hazard. This research aims at evaluating landslide hazard at the present time and at the end of the 21st century, considering two climate change scenarios: RCP 4.5 and RCP 8.5. The study area is the Arrábida, a small mountain with a Mediterranean climate that spans 35 km across the southern part of the Lisbon Metropolitan Area (Portugal).

Methods: A statistical method (Information Value) was employed to evaluate the landslide susceptibility, using seven landslide predisposing factors and a landslide inventory comprising 4047 rainfall-triggered landslides occurred in the Lisbon and Tagus Valley region, which includes the study area. The landslide susceptibility model was validated using a sub-set of 197 rainfall-triggered shallow slides identified in the Arrábida in 2012. The exact dates for most of these landslides are unknown, but we assume that their morphological maintenance in the landscape is no longer than 20 years. Landslide susceptibility classes were defined based on the slope breaks of the prediction-rate curve. The future landslide activity was assessed considering the critical rainfall thresholds established for the Lisbon region by Vaz et al. (2018) and the projections of these thresholds for the end of the 21st century, for both RCP 4.5 and RCP 8.5 scenarios provided by Araújo et al (2022).

Results: We estimate for the end of the 21st century an annual average landslide affected area of 40,400 m2 and 34,600 m2, for RCP 4.5 and RCP 8.5, respectively, assuming a linear relationship between changes in rainfall occurrence and landslide affected area. These features compare with the 38,440 m2 yearly average landslide area estimated for the present time. The landslide probability was computed for each grid cell within each landslide susceptibility class. Nowadays, the annual landslide probability for each 10 m grid cell covered by the highest landslide susceptibility class is 0.407 and will increase to 0.427 in the end of the 21st century for the RCP 4.5 scenario. In the case of RCP 8.5, the same feature will decrease to 0.366.

Conclusions: Projecting future landslide hazard is a difficult task because of uncertainties related to climate change, but also because of uncertainties regarding the effects of changes on the rainfall patterns on the landslide activity at the regional scale. The assumption of the maintenance of the predictive capacity of each susceptibility class along time is an additional source of uncertainty of the model.

References
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