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Assessing frequency of landslide rainfall-triggering events for landslide hazard evaluation at the regional scale

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Landslide hazard is usually defined as the probability of occurrence of a potentially damage phenomenon within a given area in a given period of time. Therefore, besides the assessment of the landslide susceptibility, a hazard map has to include an evaluation of the probability of occurrence of future landslides. In the present work we apply to a test site located in the area North of Lisbon a comprehensive methodology to evaluate landslide hazard at the regional scale, coupling susceptibility information with frequency and magnitude of landslide rainfall-triggering events. The evaluation of the susceptibility of occurrence of a particular type of a landslide is made using Spatial Data Analysis techniques, under the general assumption that spatial probability of future landslide occurrence can be measured by statistical relationships between past landslides of a given type and spatial data sets of given landslide predisposing factors (e.g., slope, angle, slope aspect, transversal slope profile, lithology, superficial deposits, geomorphological units, and land use). Data integration of variables is made using the entire number of unique conditions sub-areas resulting from the overlay of the total set of thematic layers. Independently on the statistical method applied to model susceptibility, the obtained results can be independently validated trough a cross-validation technique supported by the temporal partition of the original landslide data set. The computed prediction-rate curves are also used to interpret and classify the susceptibility maps, providing an estimation of the spatial probability of occurrence of future landslide events. Information on expected number and size of landslides that are to occur within a specific future time period must to be available in order to evolve from susceptibility to hazard. This information is obtained through frequency analysis of rainfall, which is the main landslide triggering factor in the study area. We assume that critical rainfall amount-duration that triggered instability on slopes in the past

will produce similar effects each time they occur in the future (i.e. the same type of slope movements and comparable total affected area). Therefore, if the return periods of triggering events are known, different landslide hazard scenarios can be modelled, each one corresponding to a specific return period.