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How to link statistical and deterministic models for assessing landslide hazard?

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Landslide hazard assessment at coarse scales (1:50,000 to 1:10,000) is often restricted to the analyses of landslide susceptibility by direct or indirect approaches, i.e. the spatial and static component of the hazard which is considered as a 'relative hazard assessment', while the analyses of the probability of landslide occurrence, i.e. the temporal and dynamic component of the hazard, is restricted to detailed scale (1:10,000 to 1:2,000). Because the scales of work are different for both approaches, the thematic data are dissimilar especially in terms of nomenclature and investigation scale. Therefore, linking both methods to obtain realistic landslide hazard maps needs specific strategies. The objective of this study is the application of a statistical and a deterministic dynamic model on the same dataset of environmental factors to produce hazard maps at 1:10,000 scale.

The methodology is split in two steps. First, a statistical analysis, based on the Weight of Evidence (WOE) modelling technique, is performed to identify the landslide prone areas. The statistical model is performed with simple thematic data easy to map. Then, the main predisposing factors and the main susceptible macro-areas are deﬁned. Second, a deterministic analysis is applied on the most susceptible landslide prone areas. The analysis uses a distributed and coupled model of landslide hydrology and stability. The model includes a transient unsaturated/saturated hydrological component incorporating Darcian saturated flow; the stability analysis is a limit equilibrium model based on the Mohr-Coulomb failure criterion. The same dataset, used for the statistical analysis, is introduced in the model. Rainfall data (1961-2005) are introduced in order to assess landslide frequency and identify some triggering thresholds.

The study site is the Bois Noir catchment located in the Barcelonnette Basin (Alpesde-Haute-Provence, France), known for its translational and rotational slides occurring at the surficial deposit-bedrock interface.