



Statistical and deterministic analysis of landslide hazard. Application to a forested catchment of the South French Alps.

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Landslide hazard quantification is often restricted to statistical analyses of landslide susceptibility, *ie.* the spatial and static component of the hazard. The probability of occurrence of landslides, *ie.* the temporal and dynamic component of the hazard, is rarely estimated or computed. Developing new strategies to add to the already available susceptibility maps a temporal dimension in order to produce real hazard maps is a challenging task.

The objective of this study is to apply both a statistical model and a deterministic dynamic model on the same dataset of environmental factors to produce hazard maps. Several methods have been developed from simple landslide inventories to more complex probabilistic or deterministic approaches. Statistical analyses are generally used at coarse scales (1:50,000 to 1:10,000), while deterministic analyses of slope stability are used at detailed scales (1:10,000 to 1:2000).

Our methodology is split in two steps. First the statistical analysis is performed in order to identify and map the landslide prone areas. The analysis is funded on the Weight of Evidence (WofE) modelling technique (bivariate approach based on Bayesian theorem). This approach is considered as one of the most objective and most robust if the conditional problem is adjusted. Furthermore it is possible to include expert opinion in the analysis. Second, the deterministic analysis is performed for 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. Rainfall data (1961-2005) are introduced in order to assess landslide frequency and identify some triggering thresholds.

The study site is the Bois Noir forested catchment located in the Barcelonnette Basin (South French Alps). This catchment is affected by shallow rotational and translational slides occurring at the surficial deposit-bedrock interface.

Application of both models has allowed to identify the main predisposing and triggering factors of the landslides. This information can be used to assess and map landslide hazard.