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Methodologies for the assessment of earthquake-triggered landslides hazard. A comparison of Logistic Regression and Artificial Neural Network models.

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In recent years, interest in landslide hazard assessment studies has increased substantially. They are appropriate for evaluation and mitigation plan development in landslide-prone areas. There are several techniques available for landslide hazard research at a regional scale. Generally, they can be classified in two groups: qualitative and quantitative methods. Most of qualitative methods tend to be subjective, since they depend on expert opinions and represent hazard levels in descriptive terms. On the other hand, quantitative methods are objective and they are commonly used due to the correlation between the instability factors and the location of the landslides. Within this group, statistical approaches and new heuristic techniques based on artificial intelligence (artificial neural network (ANN), fuzzy logic, etc.) provide rigorous analysis to assess landslide hazard over large regions. However, they depend on qualitative and quantitative data, scale, types of movements and characteristic factors used. We analysed and compared an approach for assessing earthquake-triggered landslides hazard using logistic regression (LR) and artificial neural networks (ANN) with a back-propagation learning algorithm.

One application has been developed in El Salvador, a country of Central America where the earthquake-triggered landslides are usual phenomena. In a first phase, we analysed the susceptibility and hazard associated to the seismic scenario of the 2001 January 13th earthquake. We calibrated the models using data from the landslide inventory for this scenario. These analyses require input variables representing physical parameters to contribute to the initiation of slope instability, for example, slope gradient, elevation, aspect, mean annual precipitation, lithology, land use, and terrain roughness, while the occurrence or non-occurrence of landslides is considered as dependent variable. The results of the landslide susceptibility analysis are checked using landslide location data. These results show a high concordance between the landslide inventory and the high susceptibility estimated zone with an adjustment of 95.1 % for ANN model and 89.4% for LR model. In addition, we make a comparative analysis of both techniques using the Receiver Operating Characteristic (ROC) curve, a graphical plot of the sensitivity vs. (1 - specificity) for a binary classifier system in function of its discrimination threshold, and calculating the Area Under the ROC (AUROC) value for each model.

Finally, the previous models are used for the developing a new probabilistic landslide hazard map for future events. They are obtained combining the expected triggering factor (calculated earthquake ground motion) for a return period of 475 years with the susceptibility map.