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Multidisciplinary approach to evaluate landslide susceptibility along highway in northern Calabria, Italy

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The interaction of landslides with linear infrastructures is often the cause of disasters. In Italy landslide impact on roads, railways and buildings cause millions of Euro per year in damage and restoration as well. The proposed study is aimed to the landslide susceptibility evaluation using a multidisciplinary approach: geological and geomorphological survey, statistical analysis and GIS technique, along a section of highway "A3 (Salerno-Reggio Calabria)" between Cosenza Sud and Altilia, northern Calabria. This study is included in a wider research project, named: PON01-01503, Landslides Early Warning-Sistemi integrati per il monitoraggio e la mitigazione del rischio idrogeologico lungo le grandi vie di comunicazione - aimed at the hydrogeological risk mitigation and at the early warning along the highways.

The work was first based on air-photo interpretations and field investigations, in order to realize the geological map, geomorphological map and landslide inventory map. In the study area the geomorphology is strongly controlled by its bedrock geology and tectonics. The bedrock geology consists of Neogene sedimentary rocks that cover a thick stack of allochthonous nappes. These nappes consist of crystalline rocks mainly gneiss, phyllite and schist. A total of 835 landslides were mapped and the type of movement are represented mainly by slides and complex and subordinately flow. In order to estimate and validate landslide susceptibility the landslides were divided in two group. One group (training set) was used to prepare susceptibility map and the second group (validation set) to validate the map. Then, the selection of predisposing factors was performed, according with the geological and geomorphological settings of the study area: lithology, distance from tectonic elements, land use, slope, aspect, stream power index (SPI) and plan curvature.

In order to evaluate landslide susceptibility Conditional Analysis was applied to Unique Conditions Units (UCUs), that are a unique combination of the predisposing factors. Subsequently, the landslide area is determined within each UCU and the landslide density is computed. The outcome of the study was a classification of the study area into four susceptibility classes, ranked from low to very high. The results showed that the 33% of the study area is characterized by a high to very high degree of susceptibility. The validation procedure results, obtained by crossing the group of the landslide of validation set with the susceptibility map, showed that the predictive model is generally satisfactory; therefore, over 75% of the landslide of validation set is correctly classified falling in high and very high susceptibility classes. The consistency of the model is also suggested by computing the seed cell area index (SCAI) because the high and very high susceptibility classes have very low SCAI values, whereas the SCAI values of the very low and low susceptibility classes are very high.

Finally, the landslide susceptibility map provides the baseline information for further evaluations of landslide hazards and related risks.