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Strategies for seismic hazard mitigation in landslide-prone regions

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Landslides represent one of the major natural hazards in volcanic and seismic areas, and pose a threat to the population, properties, and environment. The effect of seismically-induced landslides on human lives and facilities may exceed the damage directly connected to the shaking. Thus, a comprehensive approach to guide decision-making in connection with mitigation of seismic hazard in a landslide-prone region should involve a detailed assessment of the seismic slope stability, to be carried out at different scales/levels.
In this paper we describe a new strategy for qualitative zonation on seismic-induced landslide susceptibility and show its application to two areas of Southern Italy that were affected by several historical earthquake-induced landslides: the Campania Region (Level-1 Zonation, scale 1:100.000) and the volcanic island of Ischia (Level-2 Zonation, scale 1:25.000). In the Campania Region failures (deep-seated slides often evolving in earth flows) mainly affected loose deposits made of sands and sensitive clays. At Ischia landslides occurred on weathered tuff rocks (falls) and debris deposits (slides and flows). Here a high-resolution aeromagnetic survey was used to map structures important for the assessment of seismic hazard and guide the analysis.
The described GIS-based method is rather simple and employs only three factors for the susceptibility assessment: i) the properties of the rocks/soils that crop out, expressed as transversal seismic velocity (Vs). The attribution to each lithological unit of its representative Vs value is a key issue and was performed through a careful evaluation of the unit's geotechnical and geophysical features; ii) the incline angle of slopes, obtained from high resolution digital elevation model of the topography of the investigated areas; iii) the MCS (Mercalli-Cancani-Sieberg) Intensity that most likely will affect the study area. For the zonation of the Campania Region the input seismic intensities were derived from the national scale hazard estimates used as reference by the most recent Italian seismic regulations. For the more detailed study at Ischia the seismic input was instead derived from the macroseismic "scenario" for the worst event expected in the area.
Each of the three parameters was then expressed in terms of "Significance Percentage" and the map of the "Seismic-induced Landslide Susceptibility Level" was obtained by properly combining the three significances. A comparison of the so-obtained susceptibility map with the location of the seismic-induced historical landslides in the studied areas shows the effectiveness of the method, highlighting a fairly good agreement between the pattern of the most susceptible areas and the distribution of the failures.