Integrated multi-parameters Probabilistic Seismic Landslide Hazard Analysis (PSLHA): the case study of Ischia island, Italy

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The Ischia island is a large, complex, partly submerged, active volcanic field located about 20 km east to the Campi Flegrei, a major active volcano-tectonic area near Naples.

The island is morphologically characterized in its central part by the resurgent block of Mt. Epomeo, controlled by NW-SE and NE-SW trending fault systems, by mountain stream basin with high relief energy and by a heterogeneous coastline with alternation of beach and tuff/lava cliffs in a continuous reshape due to the weather and sea erosion. The volcano-tectonic process is a main factor for slope stability, as it produces seismic activity and generated steep slopes in volcanic deposits (lava, tuff, pumice and ash layers) characterized by variable strength.

In the Campi Flegrei and surrounding areas the possible occurrence of a moderate/large seismic event represents a serious threat for the inhabitants, for the infrastructures as well as for the environment. The most relevant seismic sources for Ischia are represented by the Campi Flegrei caldera and a 5 km long fault located below the island north coast. However those sources are difficult to constrain. The first one due to the on-shore and off-shore extension not yet completely defined. The second characterized only by few large historical events is difficult to parameterize in the framework of probabilistic hazard approach. The high population density, the presence of many infrastructures and the more relevant archaeological sites associated with the natural and artistic values, makes this area a strategic natural laboratory to develop new methodologies. Moreover Ischia represents the only sector, in the Campi Flegrei area, with documented historical landslides originated by earthquake, allowing for the possibility of testing the adequacy and stability of the method.

In the framework of the Italian project MON.I.C.A (infrastructural coastlines monitoring) an innovative and dedicated probabilistic methodology has been applied to identify the areas with higher susceptibility of landslide occurrence due to the seismic effect.

The (PSLHA) combines the probability of exceedance maps for different GM parameters with the geological and geomorphological information, in terms of critical acceleration and dynamic stability factor.

Generally the maps are evaluated for Peak Ground Acceleration, Velocity or Intensity, are well related with anthropic infrastructures (e.g. streets, building, etc.). Each ground motion parameter represents a different aspect in the hazard and has a different correlation with the generation of possible damages.

Many works pointed out that other GM like Arias and Housner intensity and the absolute displacement could represent a better choice to analyse for example the cliffs stability. The selection of the GM parameter is of crucial importance to obtain the most useful hazard maps.

However in the last decades different Ground Motion Prediction Equations for a new set of GM parameters have been published. Based on this information a series of landslide hazard maps can be produced.

The new maps will lead to the identification of areas with highest probability of landslide induced by an earthquake.

In a strategic site like Ischia this new methodologies will represent an innovative and advanced tool for the landslide hazard mitigation.