Earthquake-induced landslide inventory and landslide susceptibility mapping for the Ionian Islands

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Abstract

The synergy of different methods was used for the creation of an earthquake-induced landslides (EIL) inventory for the Ionian Islands. More specifically, post-earthquake field surveys were conducted shortly after recent earthquakes (2003 and 2015 in Lefkada, 2014 in Cephalonia and 2018 in Zakynthos) in order to obtain detailed field information of the EIL among other earthquake effects. The available literature on historical earthquakes were reexamined with emphasis on their environmental effects and especially EIL. Remote sensing products including satellite imagery and orthophotos were interpreted. All qualitative and quantitative information related to EIL and derived from the aforementioned steps were inserted in a database especially designed and developed in GIS environment for the purpose of this study and the respective inventory map was produced. This landslide inventory map was used and combined with other thematic maps in order to test the earthquake-induced landslide susceptibility (LS) of the Ionian Islands. The Analytical Hierarchical Process was applied along with the Weighted Linear Combination method in the frame of a multi-criteria decision analysis for the calculation of the spatial distribution of the Landslide Susceptibility Index (LSI). Along with the inventory, morphological data were derived from a TanDEM-X elevation model of the Ionian Islands based on data produced by TanDEM-X and TerraSAR-X satellite pair. Lithological and geological data were digitized from previous already published geological and neotectonic maps updated with corrections from field mapping for the purpose of this study. Land use and soil thickness were derived from the 2018 version of Corine Land Cover. Road network was digitized from the topographic maps of the Hellenic Military Geographical Service, while rainfall data was collected from the database of the National Meteorological Service. Data classification of each factor according to their estimated LS followed, by using the reverse ranking method, where 1 is the least and 10 is the most susceptible. Each category was normalized to 100% and the final raster thematic maps of landslide controlling factors were produced. Finally, using numerical weight for each factor, which was assigned by the Analytic Hierarchy Process using Pairwise Comparison Method and according to the weighted linear combination, a map was generated where each cell has a

certain LSI value. The higher the LSI value, the higher the LS, whereas lower LSI value means lower LS. The resulted map, classified with natural breaks method, constitutes the earthquake-induced LS map of the Ionian Islands with five LS categories: very low, low, moderate, high and very high LS. Comparison of the EIL inventory map and the LS map show that the EIL in the Ionian Islands are structurally controlled as the majority of them have been generated along morphological discontinuities formed by active faults or inactive thrusts and overthrusts.