Assessing landslide hazard in Loja city, Ecuador, and its probable evolution due to climate change

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ABSTRACT

In the framework of the project "Indice de vulnerabilidad al cambio climático en las ciudades de Loja (Provincia de Loja) y Santa Cruz de Galápagos (Provincia de Galápagos) en Ecuador", founded by "Banco de Desarrollo de América Latina" (CAF), and executed by the consortium FIC-Lavola-UTPL, a landslide hazard map was performed for Loja city area in Ecuador in order to provide a tool to manage the urban planning of the city.

Loja city basin, is located at the south of Ecuador. It is a N-S valley bounded by two mountain ranges reaching around 3000 m a.s.l., composed by metamorphic Paleozoic rocks. The valley is dominated by hills covered by sedimentary lacustre Negogene rocks. Annual mean precipitation is around 900 mm. Seismic activity is moderate. These factors make the Loja basin an area especially susceptible to landslides, and landslide cycles are relatively frequent.

For elaborating the landslide hazard map, in a first stage, a susceptibility map was obtained. Previous hazard maps were already done by other authors based on different landslide inventories and with different results [1] [3]. The goal was to update the landslide hazard map by increasing the landslide inventory. For such purpose, the inventories used in previous works were combined (211 landslides), and additional data obtained by photointerpretation of the available orthoimage (2008), the Google Earth images (2014-2018), and the digital terrain model 3x3, was added (469 new landslides). They were classified in slow motion landslides (rotational and translational), including very slow motion landslides (creep movements), and fast movements flow-type.

The entire inventory was used for applying the Weights of Evidence (WoE) method. This is a bivariate statistical analysis method used to conduct landslide susceptibility mapping, widely used in landslide hazard mapping, and allows obtaining reliable results [2]. Elevation, slope angle, aspect, lithology, terrain coverture, distance to river, landscape, land use, geomorphology, distance to roads and precipitation maps were processed for analyzing the relationship between landslide distribution and the factors controlling the landslide. The result show how susceptibility is low at the bottom of Loja Valley and reach higher values at the slopes of the basin, which are highly susceptible.

At this point, next steps will be to obtain the susceptibility of the entire basin, and to obtain the hazard by adding landslide frequency and magnitude parameters. Finally, the results will consider the climatic projections obtained in the project from data from several meteorological stations in the area. The goal is to predict how landslide hazard will evolve in the XXI century and therefore providing a tool for a better planning of the city growth.

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