Geophysical Research Abstracts
Vol. 12, EGU2010-14921, 2010
EGU General Assembly 2010

Prediction of Rainfall-Induced Landslides in Tegucigalpa, Honduras, Using a Hydro-Geotechnical Model

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Central America is constantly being affected by natural hazards. Among these events are hurricanes and earthquakes, capable of triggering landslides that can alter the natural landscape, destroy infrastructure and cause the death of people in the most important settlements of the region.
Hurricane Mitch in October of 1998 was of particular interest for the region, since it provoked hundreds of rainfall-induced landslides, mainly in 4 different countries. Studies carried out after Hurricane Mitch have allowed researchers to identify the factors that contribute to slope instability in many vulnerable areas. As Tegucigalpa, Honduras was partially destroyed due to the various landslide and flooding events triggered by this devastating hurricane, various research teams have deepened in their investigations and have proposed measures to mitigate the effects of similar future incidents.
A model coupling an infinite-slope analysis and a simple groundwater flow approach can serve as a basis to predict the occurrence of landslides in Tegucigalpa, Honduras as a function of topographic, hydrological and soil variables. A safety map showing the rainfall-triggered landslide risk zones for Tegucigalpa, Honduras is to be created. As opposed to previous safety maps in which only steady-state conditions are studied, this analysis is extended and different steady-state and quasi-dynamic scenarios are considered for comparison. For the purpose of the latter settings, a hydrological analysis that determines the rainfall extreme values and their return periods in Tegucigalpa will account for the influence of rainfall on the groundwater flow and strength of soils.
It is known that the spatial distribution of various factors that contribute to the risk of landslides (i.e. soil thickness, conductivity and strength properties; rainfall intensity and duration; root strength; subsurface flow orientation) is hard to determine. However, an effort is done to derive correlations for these parameters based on the existing information (i.e. rainfall data, soil testing data, land-use data). In addition, the spatial data management and manipulation is done by means of a Geographic Information System (GIS). For such purpose, maps of land-use, topography and geology provided by JICA have bee manually digitized and converted into GIS raster maps.
The resulting safety map is then validated by comparing it with existing slope-failure-maps that have been created to show the affected areas during Hurricane Mitch. This safety map represents a useful tool in the prevention of landslide-related disasters, as it would be able to point out which segments of the population are at risk as a consequence of the rainfall-slope interaction in Tegucigalpa.