Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11056, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11056
EGU General Assembly 2008

Assessment of an infinite slope stability approach for shallow landslides: validation and sensitivity analyses

L. Leoni, S. Segoni, L. Cinti, G. Falorni, F. Catani
Earth Sciences Dept., University of Florence (lorenzo.leoni@unifi.it)

In recent years several severe rainstorms have occurred in the Armea basin (Liguria, Italy). In at least two cases these have triggered numerous shallow landslides that have caused victims and damaged roads, buildings and agricultural activities. These events have also led to several scientific studies and one of these has designated the area as pilot site for testing a methodology for forecasting the probability of occurrence of shallow landslides. In its current stage the basic basin-scale model applied for predicting the probable location of shallow landslides involves several stand-alone components. A module for estimating soil saturation according to recorded precipitation, a soil depth prediction scheme and a limit-equilibrium infinite slope stability algorithm which produces a factor of safety (FS). Additional ancillary data (DEM, material cohesion and angle of internal friction) are also required. The single components are seamlessly integrated into a system that publishes constantly updated FS values to a WebGIS in near-real-time so that local administrators responsible for public safety can access and download the data from the internet. This system has been running for several months and is now being validated and, where necessary, improved. Several types of problems hinder a correct validation of the system. One major obstacle was overcome when a major storm triggered several tens of soil slips in the basin in December 2006. This event provided both the necessary rainfall data for the soil saturation component, which until then was lacking, and a new landslide inventory for comparison with the FS produced by the slope stability model for the same event. The inventory was derived from a newly acquired VHR satellite image. However, to precisely overlay the image on the DEM used as topographic base for the limit-equilibrium infinite slope stability model it is necessary to carry out an orthorectification of the image.

This entails a time consuming procedure that in any case does not always lead to completely satisfactory results: in the case of the Armea basin offsets were up to a few tens of meters, thereby sometimes decoupling the produced FS values from the landslide inventory by the same distance. For small events such as these this can make the difference between accurately predicting an area of landslide occurrence and producing an error. Further uncertainty derives from how to consider a prediction as accurate. How many pixels within the landslide area should have a value near or below unity? Is one unstable pixel enough to destabilize a larger area? Where should the unstable pixels be located within the landslide scar? The work carried out to date attempts to answer some of these questions. Although the study is still ongoing, initial results are quite good: most landslides generally occurred in the higher susceptibility areas and the number of false positives is rather low. Another important aspect of the research being performed regards the assessment of the relative importance of the different parameters involved in the limit-equilibrium infinite slope stability model. This statistical sensitivity analysis has the aim of determining which errors in the input variables slope gradient, soil depth, soil saturation, cohesion and angle of internal friction produce the largest errors in the output FS values. Preliminary results indicate the importance of topographic attributes and of soil depth.