Mathematical Modeling Applied to Prediction of Landslides in Southern Brazil

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Mass movements are natural phenomena that occur on the slopes and are important agents working in landscape development. These movements have caused serious damage to infrastructure and properties. In addition to the mass movements occurring in natural slopes, there is also a large number of accidents induced by human action in the landscape. The change of use and land cover for the introduction of agriculture is a good example that have affected the stability of slopes. Land use and/or land cover changes have direct and indirect effects on slope stability and frequently represent a major factor controlling the occurrence of man-induced mass movements. In Brazil, especially in the southern and southeastern regions, areas of original natural rain forest have been continuously replaced by agriculture during the last decades, leading to important modifications in soil mechanical properties and to major changes in hillslope hydrology. In these regions, such effects are amplified due to the steep hilly topography, intense summer rainfall events and dense urbanization. In November 2008, a major landslide event took place in a rural area with intensive agriculture in the state of Santa Catarina (Morro do Baú) where many catastrophic landslides were triggered after a long rainy period. In this area, the natural forest has been replaced by huge banana and pine plantations. The state of Santa Catarina in recent decades has been the scene of several incidents of mass movements such as this catastrophic event. In this study, based on field mapping and modeling, we characterize the role played by geomorphological and geological factors in controlling the spatial distribution of landslides in the Morro do Baú area. In order to attain such objective, a digital elevation model of the basin was generated with a 10m grid in which the topographic parameters were obtained. The spatial distribution of the scars from this major event was mapped from another image, obtained immediately after the landslide event. Numerical simulations with the SHALSTAB model were carried out in the basin and the results compared to the original location of the scars in the field. The results suggest that the combination of field mapping with the numerical simulation scenarios may contribute to the definition of better land management practices in such environment. Besides this, the replacement of the natural rain forest by huge banana plantations in this environment may have played a major role in defining the spatial distribution of landslides scars and the magnitude of the landslides generated.