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Shallow landslide susceptibility in the Astroni volcano (Pozzuoli - Naples, Italy)

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In this paper we examine the susceptibility to rainfall-induced shallow landslides in the pyroclastic deposits of the Astroni volcano (Pozzuoli-Naples, Italy). Since 1996 the inner slopes of the volcano have been repeatedly affected by many instability phenomena, primarily of the slide-flow type. Of particular importance were the landslides occurred recently (2004 and 2005) in the southern sector of the volcano, which caused the interruption of the only road running within the crater.

Field observations integrated by air-photo interpretation enabled us to compile a landslide inventory map inventory of both the most important landslides in the volcano (debris slides, debris flows, and falls) and a related database. Consequently, the mobility of the most important slide-flows were evaluated using a classical empirical approach, based on volumes and reach angle.

In order to characterize the mechanical and hydraulic behavior of the soil involved in landslides, undisturbed soil samples were collected at the source area of one of the main events; physical, mechanical and hydraulic properties were evaluated by laboratory analyses.

Finally, a physically-based model, TRIGRS (Baum et al., 2002), was used to evaluate shallow landslide susceptibility of the inner slopes of the volcano. By combining an infinite-slope stability analysis with a non steady-state hydrological model that evaluates the transitory effects of rainfall on variations in pore-pressure, TRIGRS allowed to compute time- and depth-dependent safety factors in response to rainfall over the study area, providing an area- distributed and time-dependent model for rainfall-induced initiation of shallow landslides.

For the application of TRIGRS, a DEM of the study area was created using the available 1:5000-scale digital cartography with a 5m x 5m grid. The mechanical and hydraulic properties of the model were derived from the above laboratory test results, while the hydraulic initial conditions were obtained from the results of in situ matrix suction measurements (Scotto di Santolo et al., 2005). The rainfall history of the March 4, 2004 event was used to calibrate the model. By comparing the simulation results with the shallow landslide inventory map, a good agreement was found, even though the results demonstrate the model's tendency to overestimate the areas of potential instability.