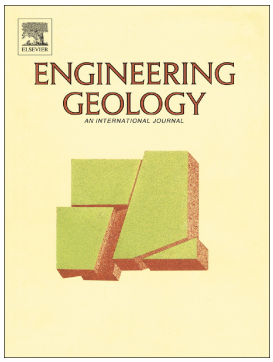


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# Regional-scale modelling of shallow landslides with different initiation mechanisms: sliding versus liquefaction

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**ABSTRACT**

Rainfall-induced landslides can result from different soil failure mechanisms each leading to slope instabilities characterized by varying times and depths of occurrence. This paper discusses the performance of a physically-based model for the spatially-distributed analysis of landslide susceptibility. The model allows the simultaneous assessment of two failure modes: frictional *slips* and liquefaction-induced *flowslides*. The underlying mechanical formulation relies on stability principles for unsaturated soils, while infiltration is treated as a transient process described by the Richards equation. The model has been applied to a series of landslides occurred in 1998 in Campania (Italy), using laboratory data to constrain the input parameters. The analyses provide spatial and temporal patterns of landslide initiation consistent with field evidences, in that they capture most of the affected landslide source areas and predict a temporal evolution of instabilities in agreement with reported failure times. Similar to available regional inventories, the computed fraction of flowslides corresponds to 75% of the total unstable area, while the resulting ratio between success and error indices is twice as large as those reported in other studies for the same site. Parametric analyses conducted by varying the hydraulic conductivity ($K_s$) have pointed out a strong interplay between the dynamics of infiltration, the mode of slope instability and the depth of failure. In particular, it has been found that low values of $K_s$ promote shallow flowslides due to moisture perching and high saturation at the surface, while larger values of $K_s$ favor deeper infiltration fronts and frictional slips initiating at higher suction. The comparison between these scenarios showed that simulations based on calibrated hydraulic properties encompass the widest distribution of failure depths, thus reproducing more accurately the typical landslides of the site.

***Keywords:*** *shallow landslides; unsaturated soils; infiltration; liquefaction; pyroclastic soils*