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Prediction of shallow landslide occurrence in Rome (Italy) through physically based models: an approach for the estimation of initial soil conditions

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Most of shallow landslides are initiated after intense rainfall events, generally involving the top soil levels, i.e. eluvial/colluvial covers. Such phenomena are characterized by high velocities and often occur as clusters of slope failures spread over even wide areas. As a consequence, they can cause casualties and important threats upon human-made structures. Therefore, the prediction of their spatio-temporal occurrence is an important research topic and also a fundamental step in the framework of geohazard risk mitigation policies. However, the forecasting of such events is usually challenging, due to the numerous parameters involved in slope failure mechanisms. The evaluation of the triggering process is primarily based on a sharp knowledge of specific parameters (i.e. rainfall characteristics, saturated hydraulic conductivity, geometry of the slope, boundary conditions and initial soil moisture) that are referred to the interaction between hydrological fluxes and soil transient behaviour, which reflects on pore water pressure variations and, consequently, on slope stability conditions.
In this work, we present a methodological approach aimed at the improvement of hazard analysis and specifically focused on the evaluation of prevailing soil water conditions (induced by antecedent precipitations and soil physical characteristics) before the failure. This approach is based on the use of physically-based models which couple hydro-mechanical modelling with infinite slope stability calculation (in terms of Safety Factor). Since these models can be efficiently applied at the local and catchment scale, we back-analysed a recent landside event occurred in Rome (Italy) for the validation of such a methodology. Specifically, we compared the results from two different numerical models with the real landslide source areas mapped after the event. In respect to this, about 70 slope failures have been surveyed between 31st of January and the 2nd of February 2014 all around the City of Rome (with a Landslide Index of 0.05/km2). This study has been focused on a specific and representative area of the city (Monte Mario hill with 16.22/Km2 of Landslide Index) where slope failures occurred. Alongside these analyses, a laboratory flume test has been set to experimentally evaluate the effect of the initial water conditions within a soil slope model. The outcome of such an experimentation have to be analysed in relation with the results provided by numerical simulations.