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Analysis of shallow landslides and soil erosion induced by rainfall over large areas

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Due to heavy rainstorms, steep hillslopes may be affected by either shallow landslides or soil superficial erosion (Acharya et al., 2011), which originate different flow-like mass movements in adjacent or overlapping source areas (Cascini et al., 2013). Triggering analysis (Cascini et al., 2011) is a relevant issue for hazard assessment that is, in turn, the first step of risk analysis procedures (Fell et al., 2008). Nevertheless, the available approaches separately consider shallow landslides and soil erosion.
Specifically, quantitative models for landslides triggering analysis allow simulating the physical processes leading to failure such as pore water pressure increase and soil shear mobilization and provide estimates of the amount of material potentially involved; however, success of quantitative methods must be carefully evaluated in complex geological setting as recently outlined (Sorbino et al., 2010) and further applications to real case histories are straightforward. On the other hand, a wide range of models exist for soil erosion analysis, which differ in terms of complexity, processes considered and data required for the model calibration and practical applications; in particular, quantitative models can estimate the source areas and the amount of eroded soil through empirical relationships or mathematical equations describing the main physical processes governing soil erosion (Merritt et al., 2003).
In this work a spatially distributed analysis is proposed for testing the potentialities of two available models to respectively investigate the spatial occurrence of first-time shallow landslides and superficial soil erosion repeatedly occurring in a large test area of the Southern Italy. Both analyses take into account the seasonal variation of soil suction, rainfall characteristics and soil cover use (Cuomo and Della Sala, 2013).
The achieved results show that the source areas of shallow landslides strongly depend on rainfall intensity and duration and soil initial suction. On the other hand, the source areas for erosion phenomena depend on rainfall characteristics and soil cover, with simulated eroded areas larger in autumn season. In addition, for a past event, the simulated source areas of shallow landslides are smaller than those observed in the field while the simulated eroded areas with thickness greater than 5 cm are comparable with the in-situ evidences if the analysis takes into account high rainfall intensity and a spatially variable soil cover use, thus providing a consistent interpretation of the event.

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