



## **Shallow landslides triggered by rainfall: numerical analyses on Richards' equation based models**

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The clearly evident relationship of cause and effect between rainfall events and shallow landslides supports the idea that coupled approaches, unifying hydrologic and geotechnical aspects, are to be strongly encouraged and analysed. Recent contributions on this topic (e.g. Iverson, 2000) show that the role played by the partially saturated soil condition can not be ignored. The analysis of flow motion is currently carried out by using Richards' equation (1931). In this framework a research program, on shallow landslide triggering mechanisms, taking place in partially saturated soils having different initial conditions, has been planned; this paper represents a contribution on the topic, dealing with an extensive sensitivity analysis performed on the occurring hydrologic and geotechnical parameters that have to be considered. Their evaluation is often a critical task, owing to the inherent difficulties in having reliable values, characterising soil conditions in a representative period of time.

A numerical approach has been chosen, using a code that solves 1-D Richards' equation (Simunek et al., 1998). More than 200 analyses supply useful remarks on the application limits of the coupled approach and, owing to the basic relationships which govern the physical mechanisms, allow to ascertain the roles played by the different phenomenological factors. In particular, the adopted model has shown a rather significant dependence as far as the soil initial moisture conditions and the permeability variations are concerned. Among the different scenarios, with regard to rainfall intensity and soil hydraulic conductivity, conditions leading to positive pore pressures rise-up in limited and well defined soil strata have been pointed out. The results of the performed analyses allow useful observations and comments on the mutual interaction phenomena occurring among pre-existing and triggering factors. The evidences sorted out from comparisons with case histories and literature review, help in validating the obtained results.