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Infiltration into pyroclastic slopes

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Mountainous areas of Northern Campania, Southern Italy, are characterized by steep slopes covered with pyroclastic deposits, in form of alternating layers of volcanic ashes and pumices, laying upon a pervious fractured calcareous bedrock, in some cases covered by a thin layer of impervious weathered ashes. Slope inclination is often larger than internal friction angle of such ashes (around 38°), thus equilibrium is assured by the contribution of apparent cohesion due to soil suction in unsaturated conditions. That is why, during intense and persistent rainfall events, when soil approaches saturation and consequently suction decreases, shallow landslides are frequently triggered. The physical characteristics of involved soils are such that landslides often evolve in form of debris flows, which can cause huge damages to buildings and infrastructures and, in some cases, even casualties. Understanding the role played by rainfall infiltration processes is essential to develop reliable models of slope response.
To this aim, for the slope of Cervinara, where a large debris flow occurred in the past, laboratory infiltration tests and in situ monitoring are being carried out.
Infiltration and evaporation tests are performed on artificial deposit reconstituted in a model slope subjected to controlled uniform rainfall, with various inclinations and bottom boundary conditions. The coupled values of soil suction and water content, observed during the experiments, have allowed defining the water retention curves experienced by the pyroclastic soil in the model slope. The performed infiltration experiments have been simulated with a mathematical model based on the integration of Richards equation with the finite volumes technique. The use of the retention curves obtained from the experiments allowed to build up reliable mathematical models of infiltration also in the case of layered slopes.
Recently at the slope of Cervinara an automatic in situ monitoring station has been set up. The data of soil water content and suction collected during one year allow distinguishing different hydraulic behaviour of soil layers, and estimating soil hydraulic characteristic curves. In particular, the water retention curves derived from in situ monitoring show some differences compared to that observed in the infiltration tests on model slopes. The use of the in situ retention curves from the monitoring will allow better calibration of mathematical models of infiltration also in the case of complex geometry.