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Monitoring of a slope affected by shallow landslides: preliminary results

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Shallow landslides can be defined as slope movements, due to extreme rainfall events, affecting superficial deposits of small thickness; their failure surface is, generally, located within the soil-bedrock interface. Although they involve small volumes of soil, due to their close proximity to urbanized areas, they cause significant damage to structures and infrastructures and, sometimes, human losses.
Therefore, identifying at slope scale the soil hydrological and mechanical processes which control the shallow landslide triggering mechanisms is becoming of crucial interest in order to assess the shallow landslide susceptibility using physically based models and to develop early-warning system.
For doing this an experimental monitoring station was installed in an area of the North–Eastern Oltrepo Pavese (Northern Apennines, Italy), where several shallow landslide events occurred in the last years. The objectives of the research are: (a) to monitor the saturated and unsaturated zone response to seasonal and extreme rainfall events in order to identify the processes that determine the formation of shallow landslides; (b) to determine how antecedent precipitation could affect pore pressure development.
The test site slope is representative of other sites in Northern Apennines subjected to shallow landslides: it is characterized by medium-high gradient (more than 15°), the land use is constituted by trees and shrubs developed on abandoned vineyards, the bedrock is made up of gravel, sand and poorly cemented conglomerates. The geotechnical characterization of superficial deposits was based on soils analysis conducted according to the ASTM standard, including assessment of the physical parameters of materials (grain size distribution, bulk and dry densities and Atterberg Limits), the shear strength parameters (direct shear and triaxial tests). A pedological and mineralogical characterization of the site were also carried out.
The experimental station consists in a pluviometer, a thermo-hygrometer, a barometer, a sonic anemometer and a net radiometer. Six TDR probes (Time Domain Reflectometer) are installed at 0.2, 0.4, 0.6, 1, 1.2, 1.4 meters from ground level to measure the soil volumetric water content. To measure soil matric suction three tensiometers and three heat dissipation sensors are installed at 0.2, 0.6, 1.2 meters from ground level. The data are collected by a CR1000 datalogger (Campbell Sci. Inc.) every 10 minutes.
In this work preliminary results obtained from 12 months of monitoring are presented: emphasis is given to the response of the cover materials after dry and wet periods in terms of soil water content and matric potential. These results will be linked to determine the hydro-geotechnical processes that could predispose the triggering of shallow landslides.