Geophysical Research Abstracts
Vol. 20, EGU2018-13625, 2018
EGU General Assembly 2018

Physical model study of the infiltration processes in pyroclastic slopes subject to instability

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Rainfall-induced landslides cause diffuse damage to people, structures and infrastructures. The prediction of these natural processes is of great importance. A good predictive model can allow the implementation of an equally good warning system, reducing the risk caused by such phenomena. Many research activities aim at understanding landslide processes and improving early warning systems. Infiltration processes and underground water circulation have an important role to define failure process characteristics. Our research uses an integrated approach, i.e. experimental data from both field sites and tests in a physical model are coupled with mathematical model, to study the infiltration process leading to landslide triggering in slopes mantled with layered pyroclastic deposits. The intent is to observe and interpret laboratory experiments to reproduce and simulate the phenomenon with mathematical models.
In this work, some results from tests performed with the physical slope model are reported. The model consists of two connected independently tilting flumes (respectively, to study triggering and propagation), each 1 meter wide and 3 meters long. It is equipped with miniaturized tensiometers for measuring soil suction inside the slope, miniature pressure transducers at the bottom of the flume to measure positive pore water pressure, a TDR system for measuring soil volumetric water content, and laser-displacement transducers for measuring surface displacements orthogonal to the sliding plane. Furthermore, the physical model is equipped with a PIV scan device, with high-resolution cameras to determine surface displacement fields and with a remote controlled artificial rainfall system.
Some infiltration and evaporation tests were conducted, in a slope made with pyroclastic soils from Sarno area (Southern Italy - near the volcano Vesuvio), affected by landslide events on 5 May 1998. Tests with homogeneous volcanic ash deposits, as well as with stratified deposits of ashes and pumices were carried out. Through the flume tests, it was possible to study the infiltration processes leading to slope failure, highlighting the different behaviour of stratified and homogeneous deposits.