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Soil water contents and displacements monitoring, integrated into a Hydrological-Geotechnical Model for the evaluation of large-scale susceptibility to landslides triggered by rainfalls

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Soil water content is often a landslide's trigger factor, in particular the shallow ones. Although there is no simple relationship between the water content into the soil and the hydraulic conditions of the slopes at the depths at which the landslides develop, the knowledge of the actual soil moisture is fundamental for the study of landslides, thus, it should be monitored.
The LAMP (LAndslide Monitoring and Predicting) system is employed in the INTERREG-ALCOTRA project called AD-VITAM. LAMP (Bovolenta et al., 2016) was yet formulated for the analysis and forecasting of landslides triggered by rain. It adopts a physically based Integrated Hydrological Geotechnical (IHG) model (Passalacqua et al., 2016) and is implemented in GIS. In this Project, the IHG model is fed by data measured using a Wireless Sensor Network (WSN), this formed by low-cost and self-sufficient sensors. The WSN may gather rainfall, temperature, surface's displacement data (these by mass-market GNSS receivers in RTK) and, in this case, soil water content (by capacitive sensors).
The WaterScout SM100 capacitive sensors were lab-analyzed then, recognized as satisfactory, installed on-site together with their related equipment. These sensors connect to a "Sensor Pup", which has four available channels; therefore, four sensors are installed at each node, at different depths from ground-level, in order to achieve a vertical soil-moisture profile and the rate of infiltration.
The selection of the most suitable spots for the water content soil-sensors' installations depends on the presence of shallow soil layers and of the radio signal emission-reception's too.
The sensors may be set up both in vertical or horizontal direction. In general, the vertical installation is preferable. This implies the creation of small adjacent vertical holes, each one reaching a different depth, where the sensors are singularly pushed. Alternatively, the horizontal one may be adopted, by the opening of a small trench where the sensors are manually inserted at different depths, along a quasi-vertical vertical line. The full contact between the soil and the sensors is always verified, immediately after the installation, using a directly connected FieldScout reader to any single sensor. Furthermore, it is necessary to protect the emerging cables and to avoid preferential ways for water infiltration along the wiring lines.
The monitoring networks, installed at the two Italian sites of Mendatica and Ceriana, are currently providing informations in real-time. The data acquired at five nodes, distributed at each of these

two sites (40 sensors in total), are currently relayed on a specific web-portal by a GSM connected Retriever-Modem, marking the evolutions of soil moisture profiles at depths between 10 and 85 cm from ground level: these continuous data allow the analysis of the infiltration and evapotranspiration phenomena. Moreover, a correlation between the soil moisture contents and the local displacements is made possible. Finally, a specific calibration of the SM100 sensors’ in relation to the on-site soil types is in progress.