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Geoelectrical monitoring of landslides: results from the sites of Laakirchen (Austria) and Rosano (Italy)

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One of the main precursors for landslide activation/reactivation is intense and prolonged precipitation, with consequent pore water pressure rise due to infiltration of rainfall that seeps into the ground. Monitoring hydrological parameters such as precipitation, water content and pore pressure, in combination with displacement analysis for early warning purposes, is necessary to understand the triggering processes. Since the reduction over time of electrical resistivity corresponds to an increase of water content, electrical resistivity monitoring can help to interpret the modifications of slope saturation conditions after heavy rainfalls.
In this study, we present the results of the ERT monitoring data from two landslide areas, Laakirchen (47.961692N, 13.809897E) and Rosano (44.662453N, 9.104703E). During March 2010, a shallow rotational landslide was triggered by snow melting and intense rainfall in Laakirchen, in the vicinity of a newly constructed house. Laakirchen landslide was monitored by geophysical/geotechnical measurements from September 2011 to June 2013. In December 2004, Rosano landslide reactivation affected rural buildings: slope deformations caused mainly damages to properties, infrastructures and lifelines. Rosano landslide has been defined as a composite landslide, with a general dynamic behavior that can be regarded as a slow earthflow. The installation of the monitoring system took place in July 2012 and the data acquisition lasted until April 2015. These sites are part of the geoelectrical monitoring network set up by the Geological Survey of Austria for testing the self-developed GEOMON4D geoelectrical system, in combination with complementary geotechnical monitoring sensors (rain gauge, automatic inclinometer, water pressure and water content sensors) to support the interpretation of the electrical response of the near surface (R. Supper et al., 2014). The measurements were funded by the TEMPEL project (Austrian Science Fund, TRP 175-N21) and the LAMOND project in the frame of the ESS program of the Austrian Academy of Science.
Focusing on the most intense precipitation events, the apparent resistivity data have been processed with an innovative 4D-inversion algorithm (J. H. Kim, 2009, developed within the cooperation between GSA and KIGAM). The results show that intense rainfalls have a direct and immediate impact on resistivity pattern, causing identifiable reductions (around 10%) in the near surface, due to the greater variation of the saturation coefficient. We conclude that long-term resistivity monitoring is capable of providing wide-area knowledge with high spatial resolution about the achievement of a certain degree of saturation in the subsurface.

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