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One year analysis of time-lapse electrical data on a clayey landslide: identification of elementary hydrological processes

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Water infiltration, evaporation and runoff are responsible of changes in the topsoil water content and can influence slope stability which is very often the main controlling factor of landslide triggering. In this work, time-lapse monitoring of electrical conductivity is used to observe variations in soil water contents. Based on recent work which demonstrated the possibility of monitoring the hydrological response of a clayey slope to controlled rainfall experiments, we installed an electrical monitoring system at the Super-Sauze landslide for long-term observation. We used the GEOMON4D resistivimeter (developed by the Austrian Geological Surve) and specifically designed for experiments needing high rate of data acquisition, records of full signal samples for noise detection, remote controlled management and automatic data transfer. The electrode positions varying with time, we installed two cameras to control the position of the electrodes. Several hydrological sensors were also installed along the profile to measure soil temperature, groundwater temperature, groundwater level, groundwater conductivity and soil humidity.

The challenge is the processing of 4.2 million of electrical resistivity data. In this difficult context, the possible factors controlling changes in resistivity values are the movement of the electrodes, the soil and water temperature, the change of porosity due to compaction and the soil degree of saturation. Therefore, before any inversion, the presence of possible 3D effects, and the measurement accuracy and uncertainty are assessed. A threshold in apparent resistivity change that could correspond to a change in soil saturation is determined. From those results, we investigate variations in the apparent resistivity. Responses to different hydrological processes (soil freezing/thawing, snow-melting, intense rainfall) occurring during the period of study are detected on resistivity values inversed on short periods.