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Permanent electrical resistivity measurements for monitoring water circulation in clayey landslide

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Landslides developed on clay-rich slopes are controlled by the soil water regime and the groundwater circulation. Spatially-distributed and high frequency observations of these hydrological processes are important for improving our understanding and prediction of landslide triggering. This work presents observed changes in electrical resistivity monitored at the Super-Sauze clayey landslide with the GEOMON^{4D} resistivity instrument installed permanently on-site for a period of one year. A methodological framework for processing the raw measurement is proposed. It includes the filtering of the resistivity dataset, the correction of the effects of non-hydrological factors (sensitivity of the device, sensitivity to soil temperature and fluid conductivity, presence of fissures in the topsoil) on the filtered resistivity values. The interpretation is based on a statistical analysis to define possible relationships between the rainfall characteristics, the soil hydrological observations and the soil electrical resistivity response. During the monitoring period, no significant relationships between the electrical response and the measured hydrological parameters are evidenced. We discuss the limitations of the method due to the effect of heat exchange between the groundwater, the vadose zone water and the rainwater that hides the variations of resistivity due to variations of the soil water content. We demonstrate that despite the absence of hydrogeophysical information for the vadose zone, the sensitivity of electrical resistivity monitoring to temperature variations allows imaging water fluxes in the saturated zone and highlighting the existence of matrix and preferential flows that does not occur at the same time and for the same duration. We conclude on the necessity to combine electrical resistivity measurements with distributed soil temperature measurements.