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Lodeve test site (Languedoc, France) for the downhole geophysical and hydro-geochemical monitoring of landslide dynamics

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Lodeve test site is located in the central part of Languedoc, 60 km northeast of Montpellier (South of France). This site constitutes a long-term high-frequency subsurface hydrogeophysical monitoring laboratory to study landslide processes. The landslides in this area are associated to the presence of Triassic evaporite layers, which determine the morphology and the quaternary evolution of the local valley. The Lodeve landslide is a deep mass movement (up to 50 m) with a slow slip displacement (4-6 mm/year) controlled by a rapid recharge of the aquifer linked to intense rainfall episodes (300-500 mm in few days) and the related dissolution of evaporite layers at depth. Here no seismic or other tectonic activities contribute to the slope instabilities. Considering a relatively simple geological context and the presence of a unique triggering factor, the Lodeve test site corresponds to a preferential subsurface natural observatory to study the impact of heavy rainfalls on slope landsliding.

At the Lodeve site, a complete and original instrumentation was deployed in two nearby boreholes since 2012. The aim of this specific subsurface set-up is to image the groundwater flow systems within the landslide in order to better constrain the role of fluids in the slope instability. The landslide is investigated down to 60 m depth by two permanent dowhnhole observatories for a geophysical (electrical resistivity, deformation) and an hydro-geochemical (pore pressure and temperature, fluid sampling) monitoring. The data recorded during the five years of investigations show the hydrological seasonal behaviour of the landslide, in particular the low-water and recharge periods. We also detected electrical resistivity and geochemical changes occuring in the vicinity of the failure zones that aree correlated with heavy rainfall events. This underlines that the downhole monitoring records revelant data to progress towards a better understanding of the underground slope processes in relation with climate forcing.