18

One year time-lapse electrical data to monitor natural hydrological processes acting on a clayey landslide

Gance Julien[1,2], Sailhac Pascal[1], Malet Jean-Philippe[1], Supper Robert[3], Jochum Birgit[3], Ottowitz David[3] and Grandjean Gilles[2]

[1]*CNRS, Institut de Physique du Globe de Strasbourg, France*
[2]*BRGM, French Geological Survey, France*
[3]*Geological Survey of Austria*

Movements of water in the topsoil influence changes in slope stability which is the main controlling factor of landslide triggering. Among the petrophysical parameters that can provide time-lapse sections of the topsoil, we consider the electrical conductivity for its sensitivity to soil water contents.

Based on recent works which showed the possibility of monitoring the hydrological response of a clay-shale slope to a controlled rainfall experiment (Travelletti et al., 2012), we installed a permanent electrical monitoring experiment at the Super-Sauze landslide for long-term monitoring of natural meteorological events. We used the GEOMON4D resistivity meter, developed by the Austrian Geological Survey (Vienna, Austria) for experiments needing high rate of data acquisition, records of full signal samples for noise detection, remote controlled management and automatic data transfer (Supper et al., 2002, 2003 & 2004).

Several hydrological sensors were installed along the profile to measure soil temperature, water temperature and conductivity, ground water level and soil humidity in the vadose zone.

The main challenge is the processing of ca. 4.2 million of electrical resistivity data. In this difficult context, the potential factors influencing electrical resistivity with time without modification of soil saturation are the relative changes in the dipole geometry (linked to the displacement of the electrodes), changes in soil and water temperature, changes in material porosity due to compaction/dilatation caused by the landslide movement. Therefore, before any inversion of data, we verify the presence of possible 3D effects, and assess the measurement accuracy and uncertainty. An apparent resistivity variation threshold, from which a modification of the saturation can be attributed, is determined.

From those first results, we first investigate changes in the apparent resistivity. Responses to different hydrological processes (such as soil freezing/thawing, snow melting, high intensity rainfall, debris flow events) occurring during the monitoring period are detectable on the inversed resistivities over short periods.

The results of the study highlight the difficulty to monitor hydrological changes on a clay-shale landslide, and will permit to improve such future device. Although a quantitative interpretation of the apparent resistivity is impossible, typical responses are clearly detectable and allow a first qualitative interpretation of hydrological changes in the landslide.