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Spatio-temporal monitoring of water infiltration in weathered clay-shale slopes with electrical resistivity tomography

J. Travelletti (1), P. Sailhac (1), G. Grandjean (2), J.-P. Malet (1), J. Ponton (1), and S. Garambois (3)

(1) CNRS – University of Strasbourg, School and Observatory of Earth Sciences, Strasbourg, France (julien.travelletti@eost.u-strasbg.fr), (2) BRGM, Bureau des Recherches Géologiques et Minières, Orléans, France, (3) CNRS – University Joseph Fourier, Laboratory of Internal Geophysics and Tectonophysics, Grenoble,France

Time-laps Electrical Resistivity Tomography (ERT) surveys have been used for monitoring hydrological processes linked to time-varying resistivity changes in the topsoil. The ERT monitoring has been performed at high spatial (electrode spacing of 0.5m to 1.0m) and temporal (3h) resolution during controlled rainfall experiments on some landslides developed in black marls. Several representative plots of a few meters square with different initial hydrological conditions (unsaturated, nearly saturated) and soil surface characteristics (slope gradient, fissure density, grain size of the matrix) have been investigated with a $\sim$15 mm.h^{-1} rainfall during several days. After filtering the electrical tension values lower than the resistivimeter device sensibility ($<$5 mV), apparent resistivity values ρ_{app} were inverted into true resistivity values ρ_{true} with a damped least-squared Gauss-Newton algorithm. In the more permeable and resistant plots characterized by unsaturated conditions, a decrease of ρ_{true} of 20$\pm$10 ohm.m is observed during the water infiltration (eg. which corresponds to a decrease of ca. 50% of the initial resistivity). Inversely, no significant resistivity variation can be monitored in the more impermeable and less resistant plots, also characterized by important water runoff at the surface. Consequently, the initial hydrological condition plays an important role on the detection of smooth resistivity changes in these environments. An attempt to express ρ_{true} in terms of soil water saturation S$_w$ is proposed in order to analyse preferential water flows within the experiment plots.