Monitoring of Landslides I

10

Active landslide monitoring using structurally constraint 4D ERT monitoring

S. Uhlemann[(1,2)*], J.Chambers[(1)], P. Wilkinson[(1)], S. Hagedorn[(2)], H. Maurer[(2)], T. Dijkstra[(1)], B. Dashwood[(1)] and D. Gunn[(1)]

[(1)] British Geological Survey, Keyworth, Nottingham, UK
[(2)] Institute of Geophysics, ETH Zurich, Zurich, Switzerland
* suhl@bgs.ac.uk

Future environmental and climate change will affect the frequency and magnitude of landslide occurrences. A major focus of research is therefore to gain an improved understanding of the processes leading to slope instability. This study considers the use of a combination of one-off seismic and 4D (i.e. 3D time-lapse) geoelectrical monitoring measurements, from a 34 month period, to gain detailed understanding of the hydrological conditions leading to landslide reactivation and first time failure.

The study site is the Hollin Hill landslide field observatory that comprises a suite of geophysical, geotechnical and environmental sensors, thus offering the opportunity to compare and inform interpretation of the different data streams. 4D electrical resistivity tomography (ERT) inversion was structurally constrained employing results of a combined P- and S-wave seismic refraction tomography (SRT). As mass movements of up to 3.5 m were recorded during the monitoring period, a workflow was developed to integrate variable electrode positions in the 4D inversion.

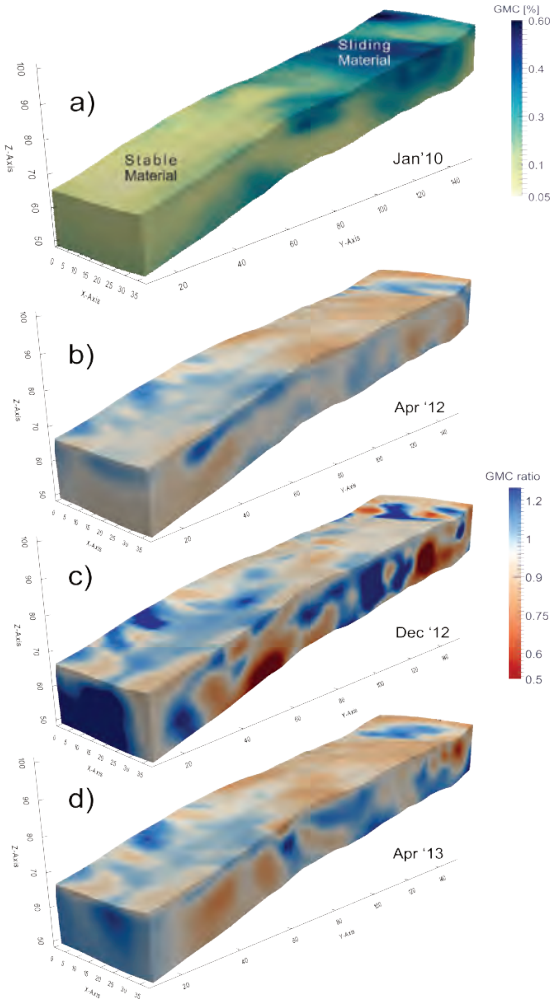

Figure 1 a) Baseline image of gravimetric moisture content (GMC). b)-d) Ratio images showing changes in moisture content compared to baseline image. b) before reactivation, c) during reactivation, d) after reactivation.

The ERT results were temperature corrected and translated into values of gravimetric moisture content (GMC) using laboratory derived GMC-resistivity relationships. The GMC models show seasonal effects for the first two years of monitoring, followed by imaging of crack build-up and deep moisture penetration leading to failure of the back scarp. Elevated moisture contents and thus pore water pressures, caused by prolonged rainfall, were imaged throughout the landslide during its reactivation, and in particular in areas of accelerated movements beneath two lobes.