



Integrated geophysical-geodetic-geotechnical systems for slope-scale landslide monitoring

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Moisture induced landslides in clay slopes are generally driven by heterogeneity in both saturation levels and material properties and their arising complex and dynamic interactions in the subsurface. The use of time-lapse geophysical imaging can illuminate four-dimensional subsurface moisture dynamics and geotechnical property changes at the slope-scale, thereby complementing conventional geotechnical point sampling and sensing, and geodetic observations of the ground surface. Here we consider: (1) the development of novel time-lapse geoelectrical, seismic and fibre-optic geophysical imaging technologies for landslide monitoring; (2) in-situ and laboratory derived petrophysical relationships to enable geotechnical information to be estimated from geophysical models; (3) surface topography determination and ground deformation tracking using geodetic observations; (4) coupled geophysical-hydrological modelling of slopes; (5) perspectives and recommendations for the incorporation of integrated geophysical-geodetic-geotechnical technologies into landslide early warning systems – illustrated using results from a number of long-term field observatories.