Monitoring of infrastructure slopes: an example of an operational railway cutting

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The British railway network is one of the busiest in the world; annually more than 1.3 billion passenger journeys are made and more than 100 million tonnes of freight are transported. In the context of ageing infrastructure assets, remote condition monitoring has been identified as one of the most cost-effective techniques to inform about asset degradation and performance, while requiring fewer site visits. We present data delivered by a novel, pro-active infrastructure monitoring and evaluation (PRIME) system, which remotely acquires ERT and conventional geotechnical point sensor data. Using laboratory-derived petrophysical relationships, resistivity variations are translated into moisture dynamics. The study site, an operational railway cutting, has a history of slope instabilities; a relict landslide is situated in the centre of the monitoring area. This grass-covered area provides contrast to surrounding densely vegetated woodlands and offers the opportunity to use resistivity data to study the effects of vegetation on the shallow moisture dynamics and assess their impact on the slope stability. Our results show that evapotranspiration and canopy cover led to strongly increasing resistivities in summer, indicative of significant loss of moisture in the vegetated part of the slope, while the grassland only showed minor variability. In winter, rainfall and groundwater dynamics led to rapid saturation of the entire slope, during times when biological activities were at their minimum and no canopy was present. Resistivity and moisture dynamics show significantly greater variability in the vegetated than in the grass-covered part (Fig. 1). This may lead to faster weathering of the surficial materials in the vegetated part, as the material cycles between states of very low saturation, where desiccation cracks may occur, and full saturation. These insights into the moisture dynamics will aid engineers in designing future infrastructure slopes and intervention strategies for existing unstable slopes.

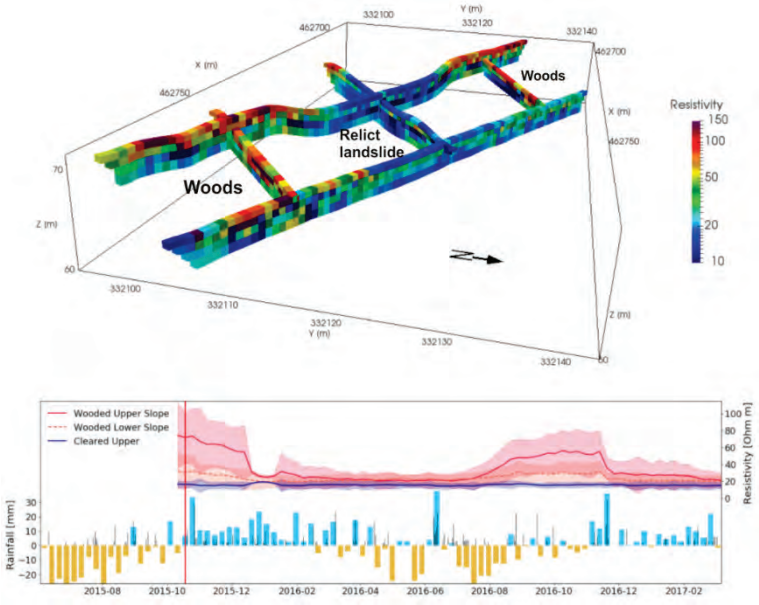

Figure 1: Resistivity baseline image, showing low resistivities of the relict landslide and high resistivities in the wooded areas. Lower panel shows resistivity dynamics and effective rainfall.