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Structure-from-Motion (SfM) and Electrical Resistivity Tomography (ERT) evaluation of the Ohuka landslide, North Island, New Zealand

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Globally, slope failures cause many thousands of deaths per year and damage infrastructure, costing billions of dollars to repair. There is a clear need for efficient and affordable techniques that can assess and evaluate ongoing slope instability. Of particular importance when assessing and evaluating ongoing landslide deformation is the availability of high-resolution Digital Surface Models (DSMs). Here, we applied the Structure-from-Motion (SfM) approach to low-altitude aerial images collected by an unmanned aerial vehicle (UAV) at the Ohuka coastal landslide on the North Island of New Zealand. The SfM image-based approach was selected as a mapping tool in order to provide a rapid, cost-effective, and highly automated method, generating high-resolution topography and coregistered texture (colour) from an unstructured set of overlapping photographs taken from varying viewpoints. This overcomes many of the cost, time, and logistical limitations of LiDAR and other topographic surveying methods. The SfM photogrammetry was undertaken in conjunction with Electrical Resistivity Tomography (ERT) to image the subsurface and provide an interpretation of the hydrogeology, due to the technique's high sensitivity to lateral and vertical changes in moisture content. Landslide features include a large arcuate scarp, flanked by gullies, which indicate the lateral boundaries of initial slope failure. Other topographic features include a $\sim$200 m wide bench with uphill-facing scarps, pull-apart zones, and surface flows from ongoing reactivation. ERT has proved useful in imaging the near-surface moisture movement driving the landsliding processes. Failure mechanisms include block-sliding along a clay seam in the early-Miocene Koheroa siltstone, and weathered deposits of the c. 1 Ma Kidnappers tephra. Cyclic variation in moisture content and formation of perched water tables above clay and tephra seam aquitards plays a key role in reactivation.