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Assessing reactivation of the Pourewa Landslide Zone, Auckland, New Zealand, using Structure-from-Motion, LiDAR, and geophysics

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Landslides pose significant risks to communities and infrastructure particularly in urban areas, and mitigating these risks relies on understanding landslide triggering processes that may cause reactivation. Previous work has shown that landslides are often complex, multiphase processes where gradual deterioration of shear strength within the subsurface precedes slope failure and the appearance of surface morphological features. Here, we combine a suite of remote sensing and direct invasive testing techniques to assess reactivation of the Pourewa Landslide Zone (PLZ), located in Auckland, New Zealand. The PLZ is located on the inner wall of the north-eastern flank of the Orakei volcano, 4 km east of Auckland CBD. The landslide zone occupies slopes above the east bank of the tidal Pourewa Creek, which lies within a residential area. Four landslides are located within the PLZ (from west to east): Ngapipi Road Landslide, Kepa Road Landslide, St Josephs Landslide, and Pourewa Landslide. Inward collapse of the crater walls since the initial eruption (>85 ka) has enlarged the crater to c. 1000 m diameter, with some slopes prone to ongoing mass movements. Indeed, reactivation during the 20th century led to the realignment of Kepa Road, and surface cracking of roads in the vicinity is ongoing. LiDAR imagery was used to develop high resolution geomorphological maps, and this data was compared with more recent Structure-from-Motion (SfM) photogrammetry, obtained from an unmanned aerial vehicle (UAV). The digital surface models and derived cross-sections developed from these data allow both the initial failure, and subsequent reactivations to be assessed in detail. Geophysical surveys included Electromagnetic Induction (EMI), augmented by information relating to lithological, moisture and strength variation with depth, allowing initial interpretation of zones likely to be prone to reactivation. Ongoing slope deformation includes shallow, retrogressive failure on the upper slopes, and translation and flow toward the toe. Taken together, results indicate that reactivation is strongly controlled by lithology, as well as porewater pressure. The study highlights the value of a combined geophysical and direct testing approach for landslide hazard assessment in order to mitigate risk to infrastructure.