



## **Rapid gully erosion along uncemented gravel cliffs (Canterbury Plain, New Zealand): Insights from repeat UAV surveys**

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The distal margin of the Canterbury Plain (South Island, New Zealand), which comprises valuable farmland on uncemented outwash gravel terraces, has been eroded by numerous U-shaped gullies with theatre heads and steep walls. The origin and temporal evolution of this widespread landform is still unclear. We carried out a 4.5 month long survey of the Ashburton coast, during which aerial photos were acquired on a weekly basis along a  $\sim 1.7$  km stretch of the coastline using a DJI Mavic Pro drone. The images were integrated and processed to generate high resolution orthophotomaps and digital elevation models of the study area. Google Earth Pro and LINZ historical aerial imagery were used to provide a medium term (11 years) and long term (73 years) record of gully occurrence. Our results indicate that gully development can be a relatively fast process, with over  $3000 \text{ m}^2$  of terrain being eroded from across a 1.7 km long coastline within just 36 hours. The primary cause of gully formation or reactivation appears to be groundwater seepage, which erodes the finer sediments, creating alveoli that result in loss of support and, ultimately, slope failure. The minimum rainfall amount required to trigger extensive gully erosion is 55 mm/4 days, whereas cliff erosion rates reach values of 0.42 m/year. This means that inactive gullies are likely to disappear if the gully erosion rate is exceeded by the cliff erosion rate. However, an increasing trend in gully development can be observed in the short and medium term.