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Rapid landslide risk assessment of transport infrastructure following the 13 November 2016 Kaikoura, New Zealand, earthquake

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Earthquake-generated landslides pose a significant risk to critical infrastructure, especially transport networks. For post-earthquake emergency response, identifying where landslides have affected transport networks is vital for understanding the ground access available to affected locations. However, post-earthquake landslide mapping is a difficult and time-consuming task, hindered by issues relating to the collection and processing of satellite images, cloud cover, and manual mapping. The development of rapid landslide modelling techniques for post-earthquake application can allow landslide hazard and risk to be modelled within hours of the earthquake occurring, leading to faster understanding of the likely losses to transport infrastructure.
This study presents the results of efforts to rapidly model the extent of and losses related to landsliding following the 13 November 2016 Kaikoura earthquake in New Zealand. Using previously published data on landslide pre-disposing factors, the landslide hazard resulting from this earthquake was modelled in order to identify locations where landslides were most likely. This was combined with a simple horizon-scanning method along critical transport lines to identify zones in which landslides could potentially impact the networks. Landslide hazard in these zones was subsequently weighted by the reach angle to the respective network and averaged for the entire zone. The results show the relative risk of landslides impacting different sections of the transport networks and were derived within 48 hours of the earthquake occurring. These models rapidly and correctly highlighted the numerous blockages along the vital State Highway 1 link between Christchurch and Kaikoura, as well as those on the only alternative inland route. This demonstrates that accurate and rapid analysis of landslide losses can be undertaken immediately post-earthquake, with results potentially available within hours of the event, far sooner than current satellite mapping techniques allow. Such information is crucial for informing emergency response to earthquake disasters.