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Hindcasting the impact of bio-physical erosion mitigation

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Mass movement erosion is influenced by land management practices that affect slope hydrology and/or soil strength. Most research on erosion in New Zealand's pastoral farmland has focused on highly erodible North Island hill country with soft or crushed rock geology where space-planted trees (mainly willows and poplars) and afforestation are the most commonly used practices for mitigating against shallow landsliding, gullying, earthflows, and bank erosion. The most common types of mass movement in New Zealand are rapid, shallow slides and flows involving soil and regolith. Individual, mature poplar and willow trees influence the amount of landsliding within a radius of up to 12 m, and the influence of neighbouring trees through intermeshing of roots has also been shown to be important. The degree of slope stabilisation achieved is inversely related to the distance from individual trees and is also dependent on tree ages and the species. Previously quantified reductions in shallow landsliding using 10-m space-planted trees range from 70 to 95 %, but measured or assessed reductions of landsliding are often far less than this because plantings are inadequately spaced and/or poorly maintained.

In 1977, a study area at Te Whanga in Wairarapa, New Zealand, was severely impacted by a rainfall event that triggered a large number of shallow landslides. In the 1990s widely-spaced trees were planted at a reasonably high density across the study area in an effort to reduce landslide erosion. We assess the effectiveness of the plantings by mapping landslides in 2010 and 2013/14 orthophotos and spatially relating their locations with those of the fully established trees, accounting for distance from trees and slope gradients. We then hindcast the potential erosion-reducing effect of today's fully established trees for the storm event in 1977, had they already been established by then. The objective is to both quantify the effectiveness of trees and illustrate the importance of targeting the most susceptible locations on slopes when implementing bio-physical mitigation measures. The results can be used to guide future planning and implementation of on-farm measures to reduce rates of landslide erosion and sediment delivery to waterways.