Geophysical Research Abstracts
Vol. 19, EGU2017-182, 2017
EGU General Assembly 2017

Movement of a large, slow-moving landslide in the North Island, New Zealand, controlled by porewater pressure and river flow

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New Zealand has ~7000 mapped large (> 2 ha) landslides, most of which occur in the Neogene cover rocks, and many of which are active. Active landslides in New Zealand damage lifeline infrastructure, entire suburbs, agricultural land, and they deliver large but little-quantified sediment load to rivers. Despite their prevalence in the landscape and these impacts, much remains unknown of their initiation, movement patterns and processes, or their contributions to landscape evolution. This research assesses how toe cutting and rainfall at a daily to seasonal timescale drive movement of a large (50 hectare) slow-moving, translational rockslide that is severely damaging a farm in the Rangitikei catchment, central North Island. Geomorphological mapping has been undertaken to define the landslide boundary, drainage lines and to assess zones of movements. Since July 2015, 3-monthly GPS-occupations of a survey mark network, and hourly time-lapse photography of the toe of the landslide have been used to identify the distribution and patterns of landslide movement. Pixel-tracking software is being used to quantify movement at the toe from the time-lapse photography at an ~daily timescale. Movement data are being compared with river flow data (i.e. toe cutting potential) and local rainfall and groundwater from a nearby site (i.e. a proxy for porewater-pressure changes at the landslide). Results so far indicate movement of several mm to cm per year in the upper part of the landslide through a block sliding mechanism, increasing to several metres per year towards the toe where block-sliding transitions sharply to more mobile earth flow-slide behaviour. In the upper part of the landslide, vertical displacements are larger closer to earth flow-slide zone, expressed as decimetre to metre-scale scarps and mini-grabens. The failure surface is exposed at the toe, which is being actively cut by a major river, and reveals a highly remoulded landslide body 1-3 metres thick, overlaying intact sandstone. Based on existing structural data and the landslide surface morphology it is assumed that the landslide thickens to about 60 m towards the head. The geomorphology suggests extension and thinning of the landslide body – which corroborates the movement data showing movement rates at the head (mm per year) increasing downslope to some metres per year at the toe – and without a zone of compression at the toe, suggesting near-continuous toe-unloading. Movement is fastest in the winter-spring months when water tables are high due to reduced evapotranspiration and slightly greater rainfall. However, this period also coincides with a period of higher river flow and flood events (i.e. toe cutting), and the landslide appears to be particularly sensitive (i.e. surges forward) following high river flow events that cut the toe. This observation suggests that movement is driven by both local and catchment-scale rainfall events.