When the ice gives way:
Observing the development of an ice-buttressed landslide

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Project background and aim

The aim of this research has been to investigate the development of an ice-buttressed landslide; the Mueller Rockslide, New Zealand (Fig.1). At ~150 M m^3 in volume, and currently moving 1-4 m/yr, the rockslide is arguably the largest and fastest ice-buttressed rockslide known to exist in the world [1]. While glacier recession is predicted to increase slope hazards, few studies have explored how failures actually develop during glacier thinning [2]. McColl and Davies [3] hypothesised that development is accompanied by deformation of the glacier, and that the ductile ice moderates the landslide speed. Quantification of this process and testing of this hypothesis requires knowledge of the movement rate, glacier geometry, and timing of rockslide initiation with respect to glacier thinning. The accessible Mueller Rockslide provides an excellent opportunity for investigating the evolution of this type of slope failure and testing this hypothesis.

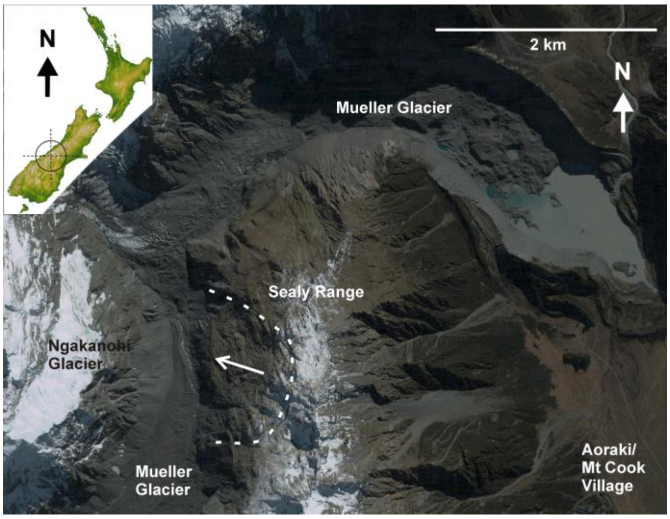

Figure 1: Mueller Rockslide (dashed white line) with movement direction shown by arrow

Project methodology

The proposed methodology was to: 1) collect samples of the landslide head-scarp for surface exposure dating to establish the link between landslide initiation and glacier thinning; 2) install time-lapse cameras to quantify surface movement rates and relate these to external drivers; and 3) to deploy ground penetrating radar to assess the glacier geometry and image the sub-glacier rockslide surface for input to stability models.

Project outcomes

An unfortunate combination of logistical, snow-cover, and weather constraints over the last two NZ summers prevented the completion of all but Task 2 (the installation of a time-lapse camera). The camera was installed in February 2016 (Fig. 2) and is taking photos of the lower half of the landslide every hour during daylight hours. These images will be used to quantify movement rate, assess the distribution of movement across the lower part of the landslide, and link movement patterns to climate. The first photos will be downloaded in the 2016/2017 NZ summer, when the remaining objectives (SED sample collection, and GPR imaging) will be completed. During the site visit in February 2016, monitoring pegs were re-surveyed with RTK dGPS (Fig.3), and new pegs were installed.

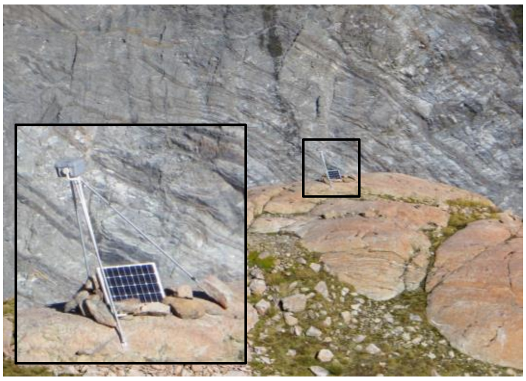

Figure 2: Time-lapse camera

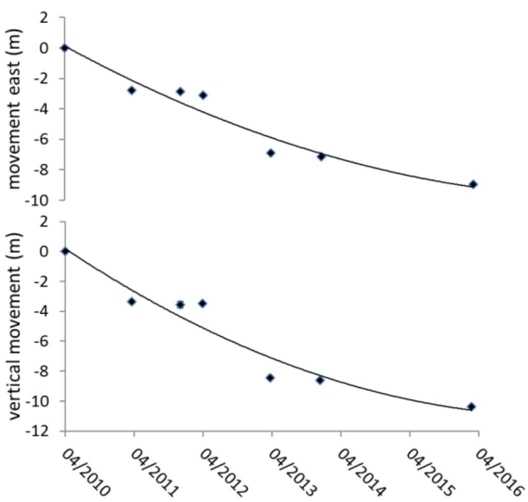

Figure 3: Movement in a mid-section of the landslide between 2010-2016. The best-fitting (polynomial) regression model indicates that this part of the landslide could be slowing.

Thanks to the BSG grant and despite the delays, the landslide investigation has gained momentum, and the author is now establishing a larger, collaborative project, with Dr Daniel Draebing at the Technical University of Munich, investigating the landslide processes and mechanics. In addition, the author is has begun working with GNS Science to provide advice to the Department of Conservation with respect to the safety of a hut located above the landslide.

References

[1] Deline, P. *et al.*, 2014; Snow and Ice-related Hazards, Risks and Disasters. Elsevier, pp. 303-344.
[2] McColl, S.T., 2012; Geomorphology, 153-154:1-16.
[3] McColl, S.T. and T.R.H. Davies, 2013; ESPL 38:1102-1115.