Reconstructing the Kea Point glacier lake outburst flood, Southern Alps, New Zealand

Tristram Irvine-Fynn[1], Richard Williams[2], Rachel Carr[3], Joe Williams[4]

1. *Department of Geography and Earth Sciences, Aberystwyth University* tdi@aber.ac.uk
2. *Department of Geography and Earth Sciences, Aberystwyth University* rdw5@aber.ac.uk
3. *School of Geography Politics and Sociology, Newcastle University* rachel.carr@ncl.ac.uk
4. *Department of Geography and Earth Sciences, Aberystwyth University* jow48@aber.ac.uk

Project Background and Aims:

Following the end of the Little Ice Age (LIA) ice in the 18th century, New Zealand's glaciers began to thin and retreat at accelerating rates: recent estimates suggest a 15% reduction in ice volume in the Southern Alps since 1970. Concurrently, rapid lake expansion has occurred at the termini of many larger glaciers, where LIA moraines form natural but unstable topographic barriers. Together, these factors produce ideal conditions for the generation of glacier outburst floods (GLOFs). In 1913, in response to exceptional rainfall events, a GLOF occurred in Aoraki/Mt Cook Village, where waters from Mueller Glacier overtopped the LIA moraine at Kea Point. This destroyed the original Hermitage Hotel, reworking debris through a narrow chute and creating an alluvial fan between the LIA moraine and Mt Ollivier. This project aimed to quantify the hydraulic and geomorphic characteristics of the Kea Point flood event through (i) high-resolution topographical surveying the GLOF channel, and (ii) quantifying hydraulic parameters of the GLOF and sediments from field observations.

Field Methods and Preliminary Results:

Over a period of 5 days, the 4 project members successfully mapped the flood channel with RTK-dGPS, taking 2 full along-channel profiles and multiple channel cross sections. These data were supplemented with ground-based digital photography covering an area of 0.5km^2 for use in modern "structure from motion" (SfM) photogrammetry using PhotoScan (Fig.1). Further, sedimentological characteristics of the flood channel deposits were measured from GLOF initiation site to the depositional fan. A total of ~1000 clasts across the study area were recorded providing details of roundness, size and orientation (Fig.2). In addition, although reports indicated the flood that destroyed the Hermitage was triggered by a rainfall event alleged to have provided 24" of rain in 24hrs, further investigation revealed there were other, smaller flood events during 1913. Consequently, to extend to a broader context, the project is compiling a record of archived reports, through involvement with colleagues at Massey and Auckland Universities and contacts at the National Institute of Water and Atmospheric Research (NIWA).

Continuing Project Progress:

Due to the complex morphology of the GLOF channel and surrounding terrain, imagery from the initial survey was not sufficient to resolve the entire channel course using SfM. Richard Williams returned to the site in April 2015 to collect more imagery from an unmanned aerial vehicle (UAV). Current analyses are developing the digital elevation model and exploration of the potential for numerical modelling of the flood is on-going. We anticipate that the findings, when analyses are completed, will form the basis of a publication for submission to ESP&L. Such a paper will look to document the historical records of the 1913 floods, and use the digital elevation models and sedimentological data to compare these records to the physical evidence left in the channel's morphology and sedimentology. Results will help provide track record for the team for future grant applications focused on glacio-fluvial hazards. The project has initiated collegial contact with researchers in New Zealand, develops international collaboration, and will build on Richard Williams' recent involvement with a NERC Urgency Grant investigating landslide and glacier-fed river interaction on the Dart River, New Zealand.

Figure 1: Ground control points set up with blue tarpaulin along the channel for SfM image acquisition.

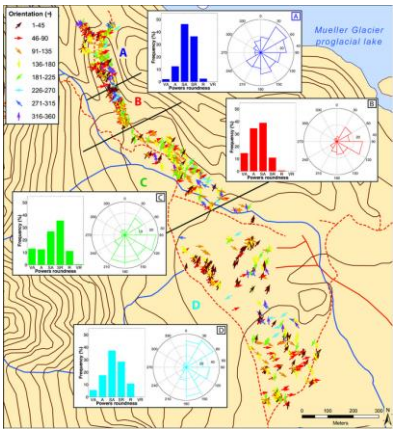

Figure 2: Map of clast data along Kea Point flood channel, examining data in sections A to D for orientation and roundness.