Field Report for Educational Resources – Grand Alpine Tour

Introduction

The Grand Alpine Tour looks at how the Alpine landscape is responding to thinning and retreating glaciers. Specifically, the team are looking to quantify the magnitude and frequency of landslides that occur above and around wasting glaciers. As glaciers retreat, they expose an environment that is particularly susceptible to rapid change. Deglaciating landscapes are thought to undergo a period of more intense, or more frequent, failure before returning to the background state. The rates and magnitude of such activity, as well as the spatial relationship to past glacial extents, are poorly constrained due to a lack of significant monitoring data and accessibility to remote alpine catchments. The team will be using a unique combination of 3D modelling to quantify change, and historic archive material to understand the spatial relationship of this change to previous ice extent.

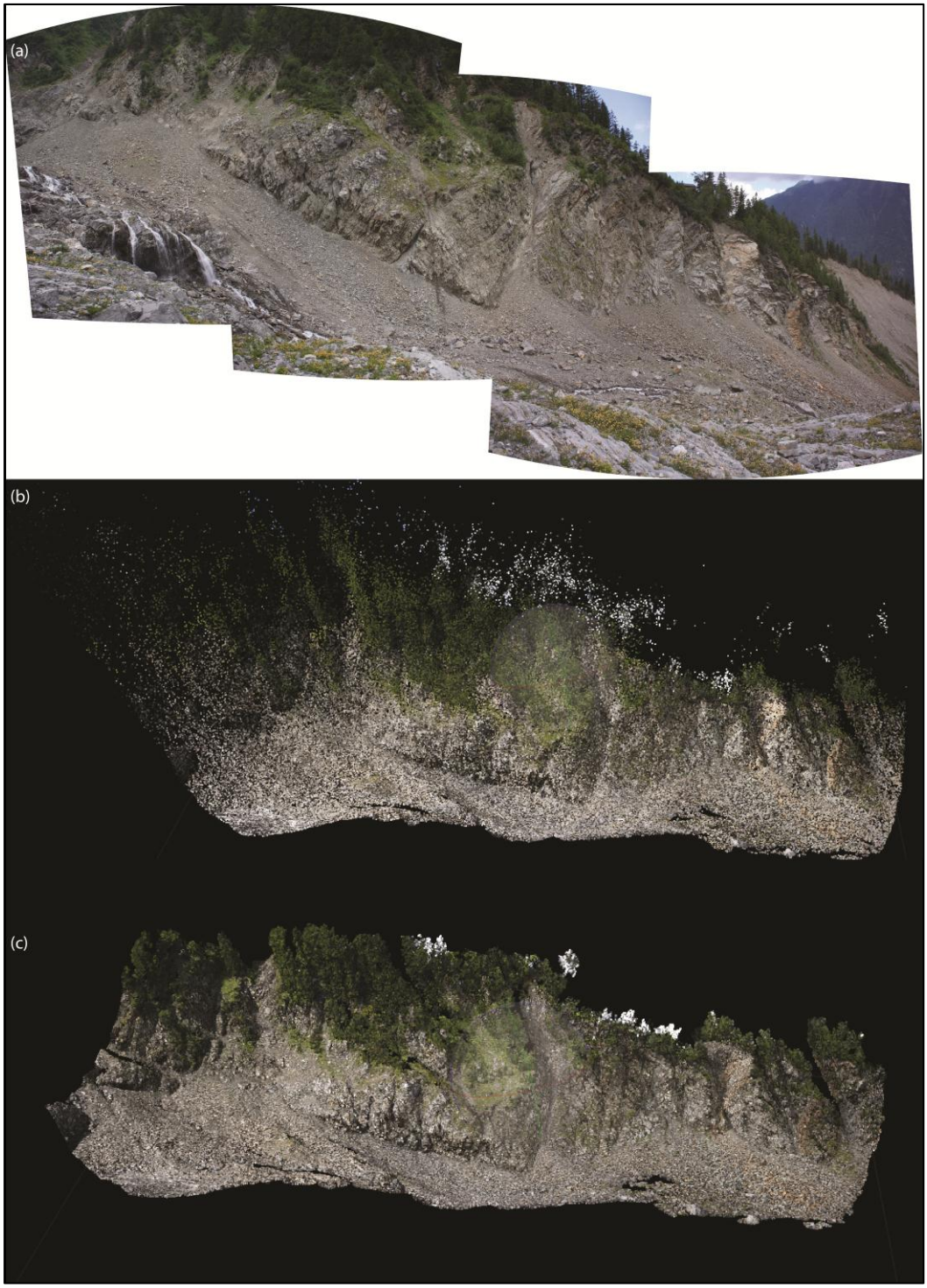
Principal Study Sites

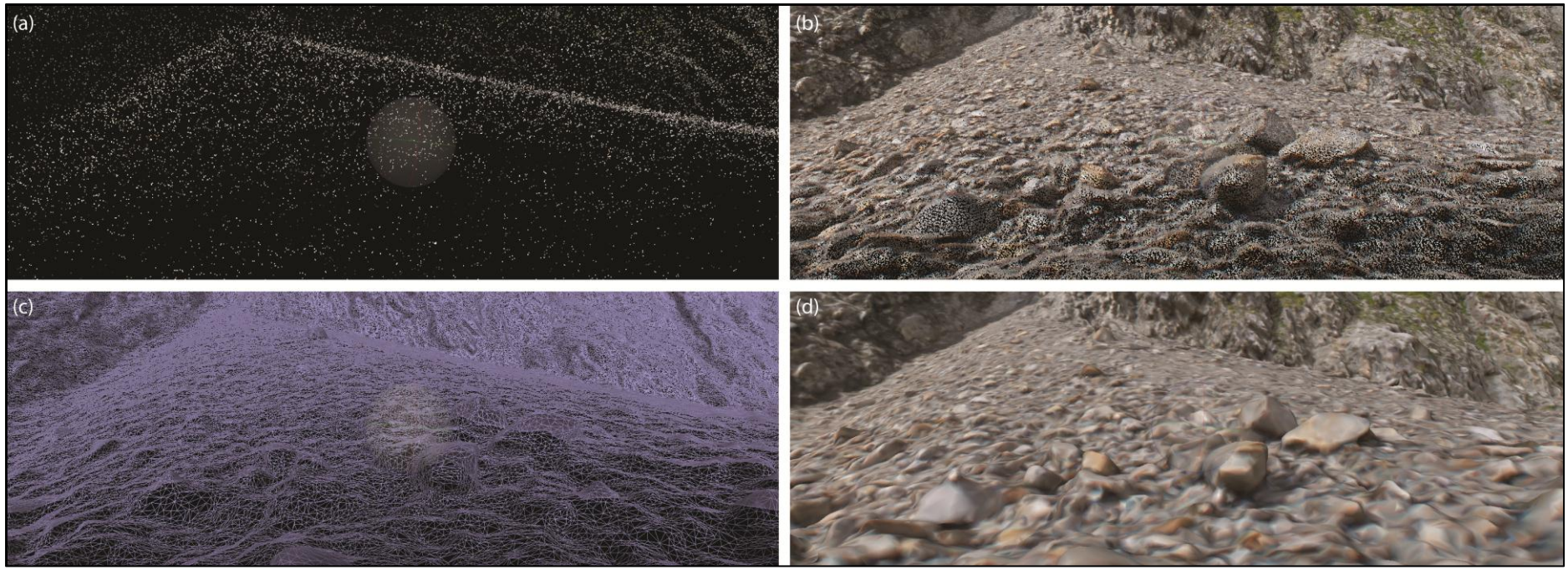
The principal sites of the Grand Alpine Tour were; Argentiere, Mer de Glace, Bossons, Bionnassay, Miage, Pre de Bard and Rhone glaciers. The Mont Blanc massif has an area of approximately 350 km^2 and is characterised by steep ridges and roughly 40 % glacier coverage. The Argentiere is a 9 km long valley glacier which has retreated 1 km from 1870 to 1967 and over the last 5 years has retreated rapidly to its current position atop of a steep slope. The Mer de Glace is the longest and largest glacier of the western Alps and is a 12 km long valley glacier which has retreated 2.3 km since the LIA and the lowest 12 % is currently stagnant. The Bossons is a 7.5 km long glacier which flows down a steep valley slope. In 1900 the terminus was at 1050 m.a.s.l. from which it retreated to approximately 1200 m.a.s.l. in 1980 and just below 1400 m.a.s.l. in 2008. The Bionnassay descends from Mont Blanc, covers 4.73 km^2 and is 5 km in length. The front of the glacier is flanked by large lateral moraines. The Miage is a 10 km long debris-covered glacier. During the 1970s and 1980s, the glacier thickened and almost breached LIA moraines, though has continuously thinned at an accelerating rate through the 21^{st} century. The Pre de Bard lies between 3500 and 2200 m.a.s.l. and at the end of the 2012 summer season; the intense ablation and bedrock morphology resulted in the separation of the lower part from the upper glacier. The Rhone was the largest glacier in the Alps during the LGM and remains one of the largest in the Swiss Alps, though has retreated 3 km upvalley since the LIA.

3D Modelling

To model the slopes above and around glaciers, a technique called *Structure from Motion* will be used. The method is an emerging technique within the geographical sciences which the team are helping to pioneer and makes use of a series of offset overlapping images to resolve 3D structure. Once the slopes have been recreated in 3D, multiple surveys which were taken at different times can be overlain to identify which areas have changed (i.e. a landslide has occurred). The volume of change can be calculated and this can then be examined in relation to the previous ice extent to infer possible triggering mechanisms. The leading causes of landslides in this region are permafrost degradation (i.e. the thawing of ice within the rockwalls), glacial debuttressing (i.e. the release of pressure from valley walls as glaciers retreat) and precipitation (i.e. increased rainfall resulting in the destabilisation of loose debris).

Below are a few examples of the 3D processing in progress – it is still very much in the early stages of data processing, and no change detection has been performed though this will be communicated as and when it happens with the RGS-IBG.


(a)
(b)
(c)


(a)
(b)
(c)
(d)


1875
1900
2014