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Investigating recent environmental change through geomorphological mapping of glacial landforms in Ladakh, India: a geomorphological outreach project

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Introduction

A geomorphological research project was undertaken during a youth expedition to the Indian Himalaya in July-August 2016. The expedition visited the Suru Valley, Ladakh, an area of high altitude desert (Figure 1). The area receives low amounts of precipitation which mostly falls as snow in winter. As a result meltwater (from glaciers and snow) makes a substantial contribution to the discharge of rivers, providing an important water resource for many communities. Most glaciers in the Himalayas are thought to be in a state of negative balance; however a recent study reported that many Himalayan glaciers are stable (Bahuguna *et al.*, 2014). These findings are controversial and further studies are needed.



Figure 1a: Study area location

Overall project aim: to investigate recent glacial and environmental change in the Indian Himalaya by combining geomorphological mapping with recent lacustrine palaeoenvironmental data.

The work reported here covers two of the project's **objectives**:

1. To produce geomorphological maps from remotely sensed data and field mapping
2. To engage young people with geomorphological research

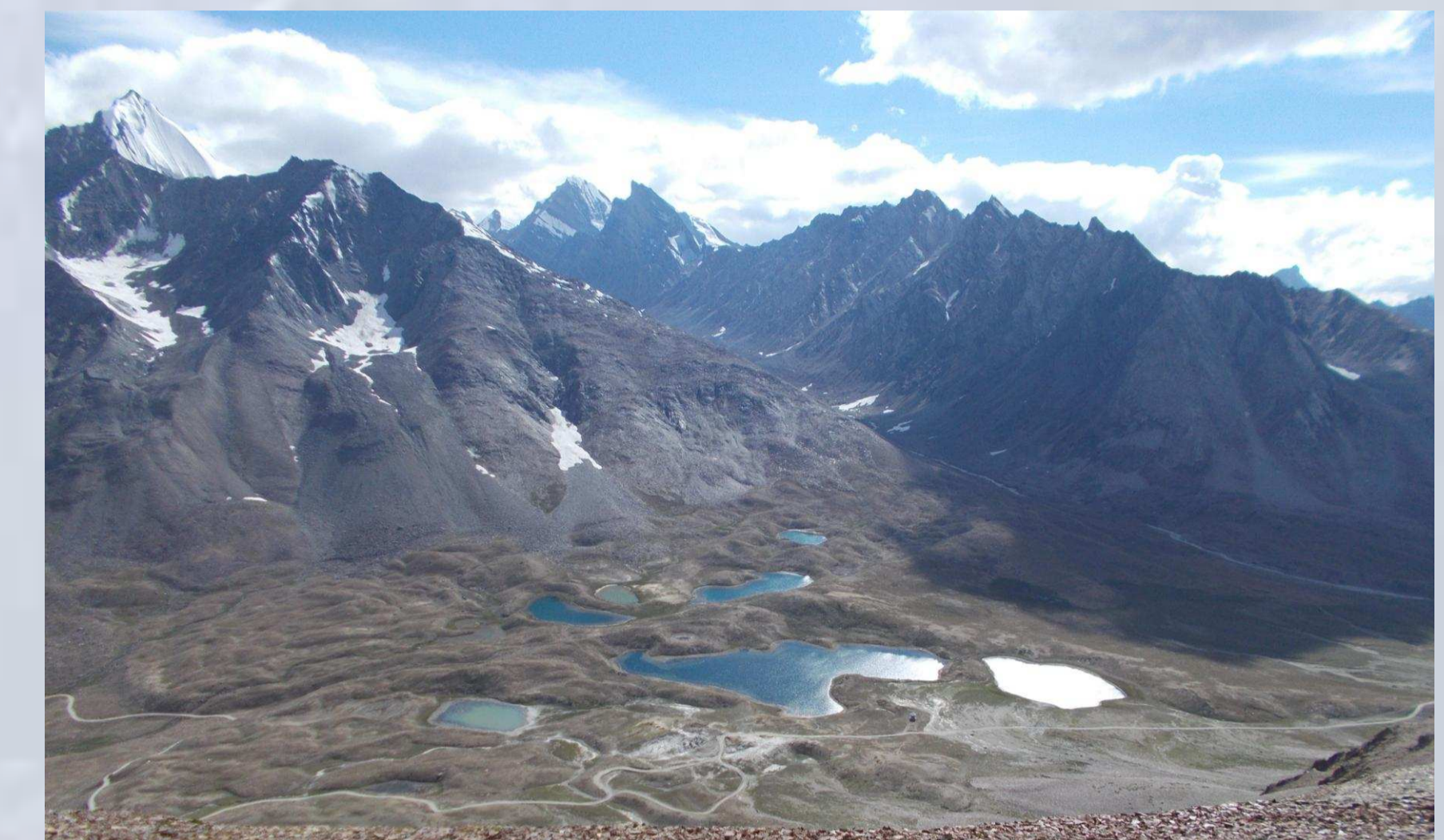


Figure 1b: Study area landscape

Methods

Pre-expedition mapping from remotely sensed data: Before the expedition a number of participants mapped the geomorphological features of the wider area from Google Earth imagery. Prior experience of the participants ranged from none, to those who were studying undergraduate Geography degrees. A short instruction handout was produced and circulated to all participants.

Ground-truthing during the expedition: During the expedition it was intended that as many of the geomorphological features in the Pensi La area would be mapped using GPS. Unfortunately limited data were collected due to a mid-expedition change in location as a result of circumstances beyond our control.

Preliminary findings

Objective 1: The maps produced by expedition participants from the Google Earth mapping were combined to produce a map of the whole study area (Figure 2). The field data that were collected need to be collated and geomorphological maps produced. A preliminary look at Figure 2 shows that limited moraines have been mapped. All participants found the mapping of moraines to be challenging, with many moraines missing from the map. It was also clear that many of the glaciers are debris covered. The debris covered snouts of the Drang Drung (Figure 3a) and Pensilungpa (Figure 3b) glaciers were mapped by groups in the field.

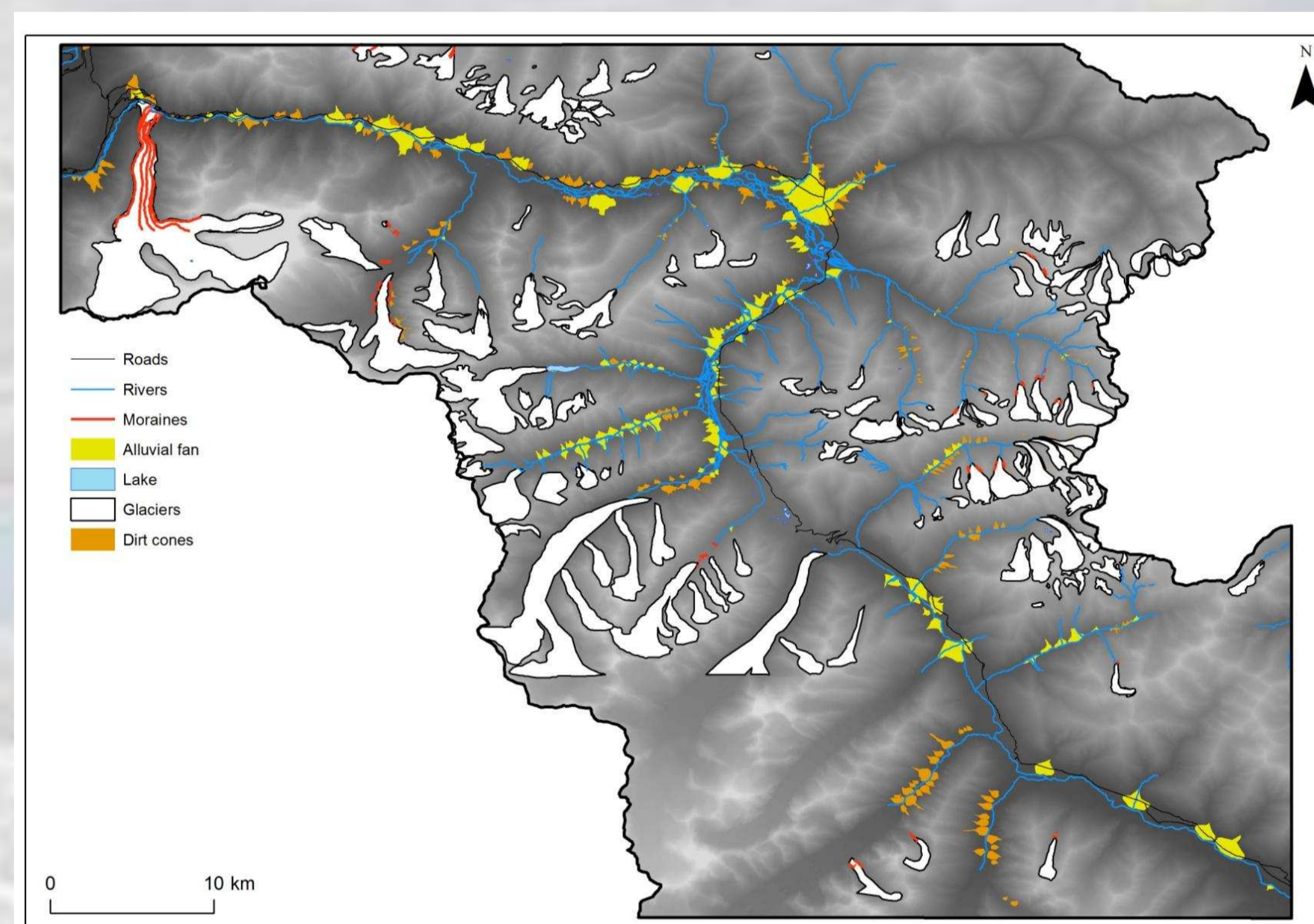


Figure 2: Geomorphological map produced by expedition participants from Google Earth imagery



Figure 3a: Drang Drung glacier snout;
Figure 3b: Pensilungpa glacier snout

Objective 2: The project successfully engaged a number of the expedition participants. Ten were involved in the pre-expedition mapping using remotely sensed data. Feedback suggested this was a really positive opportunity with one participant stating that the 'experience of mapping using Google Earth pre-expedition was enjoyable and a great opportunity' while another highlighted their new 'familiarity with Google Earth mapping of geomorphological features' as a benefit of participating in the expedition science programme.

Future work

The expedition returned to the UK on August 28th 2016 and the field data still need to be collated and analysed. The expedition participants' Google Earth mapping will be compared with that of a geomorphologist. The field data will then be used to ground truth the Google Earth mapping where possible. Some of the expedition participants will be involved in the data analysis and in writing up the project in order to provide them with further scientific experience.

Acknowledgements

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Reference

Bahuguna, I.M., Rathore, B.P., Brahmhatt, R., Sharma, M., Dhar, S., Randhawa, S.S., Kumar, K., Romshoo, S., Shah, R.D., Ganjoo, R.K. and Ajai. (2014) Are the Himalayan glaciers retreating? *Current Science*. **106**: 1008-1013.