Geophysical Research Abstracts
Vol. 20, EGU2018-8297, 2018
EGU General Assembly 2018

Quantifying ice thickness, sub-surface characteristics and surface topography of a large debris-covered glacier: Annapurna South Glacier, Nepal

Rachel Carr and Neil Ross
Newcastle University, Geography, Politics & Sociology, Newcastle, United Kingdom (rachel.carr@newcastle.ac.uk)

Himalayan glaciers represent a key water resource for large populations, and feed some of the largest river systems in the world. In recent decades, they have shrunk rapidly and forecasting their ice loss in the future is essential for predicting changes in water supply. Many of these glaciers have substantial debris-covered tongues, which alter their mass balance characteristics: they primarily lose ice by melting downwards in-situ, rather than undergoing terminus retreat, as observed on clean-ice glaciers. As such, it is imperative to quantify changes in ice thickness, in order to accurately quantify ice loss and forecast the future longevity of these glaciers. However, very little data are available on ice thickness from debris covered glaciers in the Himalaya, not least due to the logistical challenges of data collection. Here we present Ground Penetrating Radar (GPR) data from Annapurna South Glacier (ASG), Nepal, acquired between October and November 2017. ASG has a large debris covered tongue (∼5km long) and is cut off from its high-elevation accumulation areas, and is therefore broadly representative of debris-covered glaciers in the region. During the field season, we collected ten cross profiles and one long profile over the lowermost 3.5 km of the glacier. Our data show an intermittent bed reflection of variable strength that is apparent in both cross and along glacier profiles, with ice as thick as 200 m sounded. Data also indicate that glacier ice (∼ 50 m thick) persists ∼ 1km further down valley than previously inferred from surface morphology. Based on the GPR data and surface observations, we identify three distinct layers with different radar characteristics: 1) an upper layer of continuous debris, although the thickness cannot be resolved at this GPR frequency; 2) a layer characterised by a series of strong englacial reflections, which are often dipping; and 3) Comparatively clean ice, above a deep reflection, which we interpret as the glacier bed. We suggest that the reflections in Layer 2 may be debris layers and/or reflections from englacial water. The former is consistent with up-thrusted debris layers exposed in several ice cliffs. In addition to our GPR data, we also surveyed the surface topography of the lower ice tongue, using a combination of an Unmanned Aerial Vehicle and ground-based photography from the surrounding ice moraine.