EGU2020-19935
https://doi.org/10.5194/egusphere-egu2020-19935
EGU General Assembly 2020

Geomorphic feedbacks on the moraine record

Leif Anderson[1] and Dirk Scherler[1,2]
[1]GFZ, German Research Centre For Geosciences, Section 3.3, Potsdam, Germany (leif@gfz-potsdam.de)
[2]Institute of Geological Sciences, Freie Universität, Berlin, Germany

Glacial moraines represent one of the most spatially diverse climate archives on earth. Moraine dating and numerical modeling are used to effectively reconstruct past climate from mountain ranges at the global scale. But because moraines are often located downvalley from steep mountain headwalls, it is possible that debris-covered glaciers emplaced many moraines preserved in the landscape today.

Before we can understand the effect of debris cover on the moraine recored we need to understand how debris modulates glacier response to climate change. To help address this need, we developed a numerical model that links feedbacks between mountain glaciers, climate change, hillslope erosion, and landscape evolution. Our model uses parameters meant to represent glaciers in the Khumbu region of Nepal, though the model physics are relevant for mountain glaciers elsewhere.

We compare simulated debris-covered and debris-free glaciers and their length evolution. We explore the effect of climate-dependent hillslope erosion. We also allow temperature change to control frost cracking and permafrost in the headwall above simulated glaciers. Including these effects holds special implications for glacial evolution during deglaciation and the long-term evolution of mountain landscapes.

Because debris cover suppresses melt, debris-covered glaciers can advance independent of climate change. When debris cover is present during cold periods, moraine emplacement can lag debris-free glacier moraine emplacement by hundreds of years. We develop a suite of tools to help determine whether individual moraines were formed by debris-covered glaciers. Our analyses also point to how we might interpret moraine ages and estimate past climate states from debris-perturbed settings.