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Patterns of glacial erosion affected by initial topography

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Spatial and temporal variations in glacial erosion patterns are generally difficult to unravel on longer timescales. Methods constraining glacial erosion rates have proven very dependent on the timescales on which they work, and long-term measures are often accompanied with a lack of temporal detail. In addition, numerical approaches simulating glacial erosion are often forced to choose between either spatial or temporal resolution due to extensive computational costs. The linking of observations and numerical modeling results is complicated further by the fact that the initial pre-glacial landscape is often poorly constrained. This poses significant challenges when considering the topographic control there exists on ice flow and glacier sliding.

Here we investigate the effect of the initial pre-glacial topography on patterns of glacial erosion using numerical modeling. We investigate 1) characteristic glacial sliding patterns when simulating glacial conditions in high-resolution landscapes for a number of characteristic natural settings including wedge-type topography and plateau-type topography, and 2) high-resolution long-term patterns of glacial erosion for characteristic landscapes. In order to accomplish this latter part, we use spatially constricted generic models, designed to capture the long-term evolution of glacial landscapes over multiple glacial-interglacial cycles at high spatial resolution.

Studies examining glacial erosion processes often use either an existing present-day landscape or a reconstructed fluvial steady-state configuration. However, it is important to investigate the effect of initial pre-glacial topography on patterns of glacial erosion, as fluvial steady state is not often found to occur. Glacial erosion patterns therefore need to be understood in the context of the pre-existing topography when trying to link observations of glacial erosion rates and long-term landscape evolution.