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Bed roughness of palaeo-ice streams: insights and implications for contemporary ice sheet dynamics

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Bed roughness is the vertical variation of elevation along a horizontal transect. It is an important control on ice stream location and dynamics, with a correspondingly important role in determining the behaviour of ice sheets. Previous studies of bed roughness have been limited to insights derived from Radio Echo Sounding (RES) profiles across parts of Antarctica and Greenland. Such an approach has been necessary due to the inaccessibility of the underlying bed. This approach has led to important insights, such as identifying a general link between smooth beds and fast ice flow, as well as rough beds and slow ice flow. However, these insights are mainly derived from relatively coarse datasets, so that links between roughness and flow are generalised and rather simplistic.

Here, we explore the use of DTMs from the well-preserved footprints of palaeo-ice streams, coupled with high resolution models of palaeo-ice flow, as a tool for investigating basal controls on the behaviour of contemporary, active ice streams in much greater detail. Initially, artificial transects were set up across the Minch palaeo-ice stream (NW Scotland) to mimic RES flight lines from past studies in Antarctica. We then explored how increasing data-resolution impacted upon the roughness measurements that were derived. Our work on the Minch palaeo-ice stream indicates that different roughness signatures are associated with different glacial landforms, and we discuss the potential for using these insights to infer, from RES-based roughness measurements, the occurrence of particular landform assemblages that may exist beneath contemporary ice sheets.