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Sedimentary processes on an Antarctic ice stream bed: comparison between modelled ice dynamics and subglacial bedform imprint

Stewart Jamieson (1), Chris Stokes (1), Stephen Livingstone (2), Andreas Vieli (1,3), Colm Ó Cofaigh (1), and Claus-Dieter Hillenbrand (4)

(1) Department of Geography, Durham University, Durham, UK., (2) Department of Geography, University of Sheffield, Sheffield, UK., (3) Department of Geography, University of Zurich, Zurich, Switzerland., (4) British Antarctic Survey, Cambridge, UK.

Numerous studies describe subglacial landform assemblages and these are often used as a proxy for ice dynamics. However, very few have compared these to numerical models of ice dynamics. As a consequence, we have a limited understanding of what determines how and where bedforms are generated. For example, although there is a widely held assumption that long bedforms equate to fast ice flow it is unclear whether elongation might be related to maximum velocity, long-term averaged velocity, or cumulative ice velocity.

We compare the characteristics of a model of palaeo-ice stream flow and retreat against a detailed map of ice stream bedforms on the continental shelf of Marguerite Bay in the Antarctic Peninsula. The geomorphological map includes over 17,000 landforms which have been digitised in a geographic information system. These include mega-scale glacial lineations for which we calculate their length, elongation ratio, density and amplitude and how these characteristics change along the flow axis of the ice stream. We also map till thickness throughout the lineated region. The dynamic numerical model has been used to independently reproduce the nonlinear retreat pattern experienced in this region following the Last Glacial Maximum. From the model output, we extract information about ice velocity, ice flux, basal shear stress and lateral shear stress and how they vary along the ice stream flow axis. Using these two spatial datasets, we assess whether landform characteristics relate to long-term 'averaged' ice stream dynamics, or whether there is a strong relationship with the final stages and retreat pattern of an ice stream.