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Size, shape and spatial arrangement of mega-scale glacial lineations

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Most glaciologists would agree that processes at the ice-bed interface are a, if not 'the', key component controlling fast ice flow. Unfortunately, this is one of the most difficult environments to access on the Earth's surface, but observation of past ice sheet beds reveals that numerous subglacial landforms are produced and we now know that Mega-Scale Glacial Lineations (MSGLs) are formed by fast ice flow and could provide important clues regarding ice stream dynamics.
While a few hypotheses have been formulated to explain the formation of MSGLs, there is little agreement as to which, if any, are correct, and very little formal testing. Arguably, this might reflect a lack of knowledge on the size, shape and spatial arrangement of these landforms. This paper presents the first quantitative characterization of MSGLs metrics based on several populations from different regions, including both onshore and offshore, palaeo and active ice stream beds. It aims to provide a quantitative foundation which can serve as a test for any future development on theories of MSGLs formation and, more widely, on the nature and behavior of the ice-bed interface. Results indicate that MSGLs reveal a specific, common size, shape and spacing, within and between various ice stream beds, a clear indication that they are all likely formed by the same mechanism, which is relatively insensitive of local characteristics. MSGL metrics also partially overlap with those of drumlins, thus providing a further argument in favor of the hypothesis that the two bedforms are part of a morphological bedform continuum.
The size, shape and spatial arrangements that characterize MSGLs are only partially compatible with the predictions made by some existing MSGL theories. However, because MSGLs appear to represent a self-organized (consistent spacing), possibly growing (log-normal distribution of their metrics) phenomenon that results in the formation of landforms characterized by a dominant size and shape, it is likely that some type of subglacial instability is an important ingredient for their formation, as hypothesised for other subglacial bedforms (e.g. drumlins and ribbed moraine).