Geophysical Research Abstracts
Vol. 19, EGU2017-14892, 2017
EGU General Assembly 2017

Subglacial roughness of the Greenland Ice Sheet: scale-dependence, anisotropy, and implications for contemporary ice dynamics.

Michael Cooper (1,2), Thomas Jordan (1), and Jonathan Bamber (1)

(1) University of Bristol, Bristol Glaciology Centre, School of Geographical Sciences, Bristol, United Kingdom, (2) m.a.cooper@bristol.ac.uk

Subglacial roughness has been quantified from bedrock topographic profiles, derived radio-echo sounding, using a variety of different statistical analysis methods. Spectral (frequency-domain) approaches are most commonly applied, but variogram (space-domain) methods better reveal the scale-dependence of subglacial roughness (e.g. power-law scaling behaviour). Previous studies of subglacial roughness beneath the Greenland Ice Sheet are limited, and only describe the broad spatial patterns in topographic roughness, with no rigorous consideration of anisotropy (roughness with respect to flow direction). Consequently, the control that roughness has upon ice dynamics, in particular through its predicted influence on basal traction, has yet to be investigated quantitatively. Moreover, the recent increase in Operation Ice Bridge radio-echo sounding data presents an opportunity for comprehensive ice-sheet-wide analysis.

Here, for the first time, we present a framework for anisotropic analysis of subglacial roughness beneath the Greenland Ice Sheet, using a space-domain formulation of roughness. This analysis includes consideration of roughness with respect to ice flow direction (filtering roughness parallel and perpendicular to flow), and velocity flow field characteristics (e.g. regions of flow divergence). A central theme of our approach includes a comparison of roughness at various length-scales, alongside contemporary ice sheet model outputs, presenting a glacier-by-glacier approach where data allows. This allows us to investigate the relationships that have been proposed to exist between subglacial roughness and basal traction and ice velocity.