Geophysical Research Abstracts
Vol. 18, EGU2016-4046, 2016
EGU General Assembly 2016

Aerodynamic roughness of ice surfaces derived from high resolution topographic data

Mark Smith (1), Duncan Quincey (1), Timothy Dixon (2), Robert Bingham (3), Jonathan Carrivick (1), Tristram Irvine-Fynn (4), and David Rippin (5)

(1) University of Leeds, School of Geography, Leeds, United Kingdom (m.w.smith@leeds.ac.uk), (2) University of Leeds, School of Earth and Environment, Leeds, United Kingdom, (3) University of Edinburgh, School of GeoSciences, Drummond Street, Edinburgh, United Kingdom, (4) Aberystwyth University, Department for Geography and Earth Sciences, Aberystwyth, United Kingdom, (5) University of York, Environment Department, Heslington, York, United Kingdom

The aerodynamic roughness of glacier surfaces is an important component of energy balance models and meltwater runoff estimates through its influence on turbulent fluxes of latent and sensible heat. In a warming climate these fluxes are predicted to become more significant in contributing to overall melt volumes. Ice aerodynamic roughness (z0) is commonly estimated from measurements of ice surface microtopography, typically from topographic profiles taken perpendicular to the prevailing wind direction. Recent advances in surveying permit rapid acquisition of high resolution topographic data allowing revision of assumptions underlying conventional topographic profile-based z0 measurement. This poster presents alternative methods of estimating z0 directly from Digital Elevation Models (DEMs) or three-dimensional point clouds, and examines the spatial and temporal variability of z0 across the ablation zone of a small Arctic glacier. Using Structure-from-Motion (SfM) photogrammetry to survey ice surfaces with millimeter-scale accuracy, z0 variation over three orders of magnitude was observed but was unrelated to large scale topographic variables such as elevation or slope. Different surface-types demonstrated different temporal trajectories in z0 through three days of intense melt, though the observed temporal z0 variability was lower than the spatial variability. A glacier-scale topographic model was obtained through Terrestrial Laser Scanning (TLS) and sub-grid roughness was significantly related to z0 calculated from a 2 m resolution DEM. Thus, glacier scale TLS or SfM surveys can characterize z0 variability over a glacier surface and allow distributed representations of z0 in surface energy balance models.