Geophysical Research Abstracts
Vol. 20, EGU2018-623, 2018
EGU General Assembly 2018

Glacio-hydrological melt and runoff modelling: a limits of acceptability framework for model selection

Jonathan D Mackay (1,2), Nicholas E Barrand (1), David M Hannah (1), Stefan Krause (1), Christopher R Jackson (2), Jez Everest (3), and Guðfinna Aðalgeirsdóttir (4)

(1) University of Birmingham, Geography, Earth and Environmental Science, Birmingham, United Kingdom (joncka@bgs.ac.uk), (2) British Geological Survey, Environmental Science Centre, Keyworth, Nottingham, NG12 5GG, UK, (3) British Geological Survey, Lyell Centre, Research Avenue South, Edinburgh, EH14 4AS, UK, (4) Institute of Earth Sciences, University of Iceland, 101 Reykjavík, Iceland

Glacio-hydrological models (GHMs) underpin our understanding how future climate change will affect river flow regimes in glaciated watersheds. A variety of simplified GHM structures and parameterisations exist, yet the performance of these are rarely quantified at the process-level or with metrics beyond global summary statistics. A fuller understanding of the deficiencies in competing model structures and parameterisations and the ability of models to simulate physical processes require performance metrics utilising the full range of uncertainty information within input observations. Here, the glacio-hydrological characteristics of the Virkisá river basin in southern Iceland are characterised using 33 'signatures' derived from observations of ice melt, snow coverage and river discharge. The uncertainty of each set of observations are harnessed to define 'limits of acceptability' (LOA), a set of criteria used to objectively evaluate the acceptability of different GHM structures and parameterisations. This framework is used to compare and diagnose deficiencies in three melt and three runoff-routing model structures. Increased model complexity is shown to improve acceptability when evaluated against specific signatures, but does not always result in better consistency across all signatures, emphasising the difficulty in appropriate model selection and the need for multi-model prediction approaches to account for model selection uncertainty. Melt and runoff-routing structures demonstrate a hierarchy of influence on river discharge signatures with melt model structure having the most influence on discharge hydrograph seasonality and runoff-routing structure on shorter-timescale discharge events. None of the tested GHM structural configurations returned acceptable simulations across the full population of signatures. The framework outlined here provides a comprehensive and rigorous assessment tool for evaluating the acceptability of different GHM process hypotheses. Future melt and runoff model forecasts should seek to diagnose structural model deficiencies and evaluate diagnostic signatures of system behaviour using the LOA framework.