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The importance of accurate glacier albedo for estimates of surface mass balance on Vatnajökull: Evaluating the surface energy budget in a Regional Climate Model with automatic weather station observations

Louise Steffensen Schmidt (1), Guðfinna Aðalgeirsdóttir (1), Sverrir Guðmundsson (1,2), Peter L. Langen (3), Finnur Pálsson (1), Ruth Mottram (3), Simon Gascoin (4), and Helgi Björnsson (1)

(1) Institute of Earth Sciences, University of Iceland, Reykjavik, Iceland, (2) Keilir Institute of Technology, Reykjanesbær, Iceland, (3) Danish Meteorological Institute, Copenhagen, Denmark, (4) Centre d'Etudes Spatiales de la Biosphère, Université de Toulouse, CNES/CNRS/IRD/UPS, Toulouse, France

The evolution of the surface mass balance of Vatnajökull ice cap, Iceland, from 1981 to the present day is estimated by using the Regional Climate Model HIRHAM5 to simulate the surface climate. A new albedo parametrization is used for the simulation, which describes the albedo with an exponential decay with time. In addition, it utilizes a new background map of the ice albedo created from MODIS data. The simulation is validated against observed daily values of weather parameters from five Automatic Weather Stations (AWSs) from 2001-2014, as well as mass balance measurements from 1995-2014. The modelled albedo is overestimated at the AWS sites in the ablation zone, which we attribute to an overestimation of the thickness of the snow layer and the model not accounting for dust and ash deposition during dust storms and volcanic eruptions. A comparison with the specific summer, winter, and annual mass balance for all Vatnajökull from 1995-2014 shows a good overall fit during the summer, with the model underestimating the balance by only 0.04 m w. eq. on average. The winter balance, on the other hand, is overestimated by 0.5 m w. eq. on average, mostly due to an overestimation of the precipitation at the highest areas of the ice cap. A simple correction of the accumulation at these points reduced the error to 0.15 m w. eq. The model captures the evolution of the specific mass balance well, for example it captures an observed shift in the balance in the mid-1990s, which gives us confidence in the results for the entire model run. Our results show the importance of bare ice albedo for modelled mass balance and that processes not currently accounted for in RCMs, such as dust storms, are an important source of uncertainty in estimates of the snow melt rate.