The Cryosphere Discuss., 6, C562–C564, 2012
www.the-cryosphere-discuss.net/6/C562/2012/

The Cryosphere Discussions

Interactive comment on "Simulating the growth of supra-glacial lakes at the western margin of the Greenland ice sheet" *by* A. A. Leeson et al.

Anonymous Referee #2

Received and published: 14 May 2012

Review of

Simulating the growth of supra-glacial lakes at the western margin of the Greenland ice sheet

by A. Leeson et al.

General This is an original paper that attempts to model an interesting phenomenon, namely the buildup of supraglacial meltwater storage on the surface of the Greenland ice sheet. The paper describes the routing model that uses a fixed, high-resolution DEM in combination with runoff produced by a regional climate model (RCM) to simulate the filling of supraglacial meltwater lakes (SGLs) in a 16,000 km2 region of the west Greenland ice sheet.

Overall assessment Scientific quality: within the limitations of the chosen approach (no drainage allowed, small ice sheet area only) the results are encouraging. The model is reasonably well able to simulate filling onset and total area in four different summers (2003, 2005, 2006 and 2007). The technical quality of the paper is good, although the text is too long relative to the message it tries to convey. The readability of the paper could be improved by condensing the discussion and conclusion sections, see comment below. Moreover, the description of the model and its numerical behavior should be explained in more detail, see specific comments below.

Specific comments Like the other reviewer I am concerned about the time-step dependence of the model results. It does not become clear from the model description where this dependence derives from, and why the sensitivity is so large. An effort should be made to explain this better. Also the choice for the final time step of 60 seconds as a trade-off between accuracy and computational expense should be better motivated, given the strong dependence of results on time step, and the fact that this works in a single direction.

Another point of concern is that the model is driven by daily runoff rates from a regional climate model (RCM) at 25 km resolution. This lack of temporal and spatial resolution introduces two uncertainties. The first one is that in reality, summer runoff strongly peaks around noon, following the daily cycle in insolation. From the model description I derive that a constant runoff flux is prescribed over the day (page 1314, line 23). This, in combination with the time-step dependence (see point above), could lead to significantly different results compared to the situation in which a daily cycle in runoff is be prescribed. Please comment.

Secondly, the RCM only has about 26 data points in the selected domain. Because of the steep SMB gradients in this part of the ice sheet in summer (Van de Wal and others, 2005), this introduces large spatial discontinuities in prescribed runoff (Figure 1). Was an effort made to smooth these spatial runoff gradients when the RCM data were interpolated to the high-resolution grid?

TCD
6, C562–C564, 2012

What is the effect of ignoring all modeled lakes smaller than nine grid boxes (page 1315, line 4)? Why was this threshold chosen and how does it impact results?

I suggest to combine sections 5 ('Discussion') and 6 ('Conclusions') into a single section (Discussion and Conclusions) and remove all overlap to arrive at a more concise paper.

Reference Van de Wal, R. S. W., W. Greuell, M. R. van den Broeke, W. Boot, H. Snellen, C.H. Reijmer and J. Oerlemans, 2005: Surface mass balance observations and AWS data along a transect near Kangerlussuaq, West-Greenland, Annals of Glaciology 42, 311-316.

Interactive comment on The Cryosphere Discuss., 6, 1307, 2012.