

Interactive comment on “Response of the large-scale subglacial drainage system of North East Greenland to surface elevation changes” by N. B. Karlsson and D. Dahl-Jensen

Anonymous Referee #1

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General comments

The paper describes the application of an ice flow model to investigate the impact of changes in the ice sheet surface on the subglacial hydrologic system of the North East Greenland Ice Stream. The topic is of interest and is well justified in the introduction. The paper uses a simple ice flow model and assumes the water is at overburden pressure. The simplicity of the approach allows an easy understanding of what is going on in the system, so while some of the assumptions (e.g. using shallow ice) are perhaps known to not represent the system well, the paper is open about the deficiencies and justifies why they shouldn't impact on the work too much.

C52

The simplicity in the approach should allow a number of different scenarios to be investigated, however, there is really only one experiment carried out in this paper which limits the conclusions to a very general finding, which perhaps one could have reached intuitively anyway without the need for the model. The paper is largely well written, but the experiment is not clearly explained which led me to have to try and work out what had been done.

The paper is acceptable with the current level of experiments, as the paper can form a basis for further experiments, resulting in a method description paper (though may perhaps have been more suitable for the Geoscientific Model Development journal). However, it would be a much stronger paper if a more extensive range of experiments were carried out – i.e. what has to happen to get major reorganisations in the water system; is this realistic? How much water can be rerouted into other catchments under what circumstances? The option is either to leave the results as they are but introduce a discussion as to the potential of the model and further experiments that could be carried out, or to devise a more extensive range of experiments.

I have detailed more specific changes below which should help clarify exactly how the model experiment works.

Specific comments

p726 section 2.2 title and elsewhere: Be consistent in the use of routes/routeways/ways for describing flow paths.

p727 line 10: A note to highlight that these sorts of routing methods are sensitive to the algorithm used, grid orientation and size would be useful here – see for example Le Brocq et al. 2006, Computers & Geosciences.

p727, end of section 2.2: Information about the time step of the model would be useful here, you present outflux over time, it would be good for a clearer description of how this is come by would be useful.

C53

p727 section 2.3: This section is not clear to me to describe the model runs. Do you initialise from present day? Why do you use a low sliding coefficient to start with? Why not start with the inverted parameter and then do a set of sensitivity experiments to see what happens to the water routes under potential future scenarios of sliding change? A full outline of the model runs is needed here to prepare the reader for the results they are going to see.

p728, line 3: Change to 'Using the simple inversion technique described in Appendix A, ...'

p728, line 13: How does Budd et al (1979) come by his value – is it transferable to Greenland? Is it from fieldwork or lab work?

p731, line 15: Again, this needs a bit more explanation how you come about the outflux over time.

p732, lines 3-5: The mechanism of feedback which causes changes in the ice surface needs explaining here.

Figures:

Figure 2 – this dataset looks like it has been smoothed/interpolated by the plotting software? It would be better to present the raw data which would help to demonstrate the resolution of the model. The labels on the scale bar also need to be tidied to have superscript for the power of 10.

Interactive comment on The Cryosphere Discuss., 9, 719, 2015.