The Cryosphere Discuss., 7, C1026–C1028, 2013
www.the-cryosphere-discuss.net/7/C1026/2013/

The Cryosphere
Discussions
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Interactive comment on "Changing basal conditions during the speed-up of Jakobshavn Isbræ, Greenland" *by* M. Habermann et al.

Anonymous Referee #2

Received and published: 9 July 2013

The paper describes an inversion for basal slipperiness of Jakobshavn Isbrae performed using data from several different years. This is one of very few such studies performed to date. I found the paper very interesting and I recommend it for publication subject to some revisions.

I could not see any description of the actual minimisation procedure used. The only information is that the 'Toolkit for Advanced Optimisation' was used. I am guessing that some sort of gradient-based minimisation method was used. How was the gradient of the cost function obtained? Was tau_c enforced to be positive, and if so how was that done? I would like to see some further technical details of the inversion procedure.

I could also not see any statements about the spatial resolution of the numerical model. What were the boundary conditions applied to the lower limits of the numerical model?

Did the model extend towards the calving front? I could not see this information anywhere in the paper. Figure 1 is a bit confusing in this respect. Is the model domain the whole area shown in the Figure?

I would like to see a better description of the boundary condition applied at the lower boundary. Is it possible that the changes in velocity might be due to decrease in buttressing at the grounding line?

The reference to tau_c as basal yield stress is confusing. tau_c is defined in equation (1). As far as I can see equation can also be written as \tau_b= C^{-1/m} |u|^{1/m-1} u with m=1/q and C^{-1/m}=tau_c/u^q_{threshold} So is this not just the standard (viscous) Weertman sliding law? Why talk about a yield stress in this context? It appears that the inversion effectively solves for basal stickiness (inverse of basal slipperiness). Since u^q_{threshold} is fixed at 100 m/a one can always calculate C directly from tau_c. The value q=0.25 corresponds to Weertman stress exponent m=4.

As mentioned in the text the bed is not know in complete detail. How can this be expected to affect the inversion? Will errors in bed geometry affect the estimate for tau_c? Was an inversion performed for some other possible bed geometry to test the effect of errors in bed topography on tau_c estimates? I found the reference to the Mohr-Coulomb puzzling. After all tau_c is not a basal yield stress. However, at the same time I found it useful to see that the variation in tau_c could not be explained from the difference between ice overburden pressure and ocean pressure (\rho g H - \rho_w).

Fig. 6 gives a nice overview of the results for different years. But it is very difficult to see the spatial pattern of tau_c in the figure. Spatial scale of x and y axis is missing in both Fig 4 and Fig 6.b I suggest producing at least one figure showing tau_c/u_{\threshold} in greater detail.

Minor comments: -p 3, l 1:Not sure what is meant by 'dynamic evolution'? -p3, l 2: the term 'stable' is used in a few places where presumably 'steady-state' or 'stationary' would be a more accurate term to use. -Why should one expect tau_c and tau_d to be similar? Is that because the surface velocities are about 100m/a?

Interactive comment on The Cryosphere Discuss., 7, 2153, 2013.