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The Cryosphere Discussions

Interactive comment on "Hindcasting to measure ice sheet model sensitivity to initial states" *by* A. Aschwanden et al.

Anonymous Referee #1

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TC-2012-179 *"Hindcasting to measure ice sheet model sensitivity to initial states"* - A. Aschwanden, G. Aðalgeirsdóttir, and C. Khroulev

In this paper, the hindcast method, classically use in other geophysical fields, is presented and applied to the ice-sheet model PISM for the period 1989-2011. The hindcast method is here used to compare three different initial states of the model. Using known inputs for past events to see how well the model matches observations (not only the ice-sheet volume) is, surprisingly, an exercise that has never been addressed by any of the ice sheet models used to forecast the continental ice contribution to sea level rise. I hope this paper will pave the way to new practises in the glaciology community. For that purpose, I think this is an important contribution and I recommend its publica-

tion, but I have the feeling that the writing could be smoothed to be easier to read. I have made few general comments that might be accounted for to improve the quality of the paper as well as some minor comments. All these comments are listed below.

General remarks

My first general comments concerns the data used to validate the model. We don't expect the model to reproduce the exact value but to belong in the error interval associated to each value. Are these incertitudes available for all dataset? How the incertitude associated to each dataset can be incorporated in the method should be discussed. For example, when it is said *"The root mean square error (RMSE) is 43–46ma^{-1} (Table 1), having a similar magnitude as obtained in a data assimilation study (38ma^{-1}, Price et al., 2011)"*, this should also be compared to the mean error associated to the data themselves. What is the influence of having a dataset which have been acquired along a quite long period in comparison to the total period, as for example the surface speeds which include speeds measured from 2007 to 2010. How can we account for this. Is it negligible? Is this application using all the possible data? This point is tackled in the conclusion regarding isochrones, but it might be interesting to include a discussion listing all available data, their limits, errors and how they can be used in future hindcast applications.

I understand that it is not the main objective of this paper, but I would have like to see a deeper discussion about which of the three initialisation is working the best. Just saying "this initialisation works well with these data and not well with these ones" doesn't allow to really conclude which initialisation is the best here. Can the method be push further by calculating a pondered mean error to give a global mark to each method using all datasets available? This might be done using a cost function as for control methods. Moreover, this cost function could then account for data errors.

Or may be we cannot conclude which initialisation method is here the best, but this should be discussed.

I would have like to see which differences in term of sea level contribution you then get running the three different initialisations forward in time over a century or so. I agree this is somehow beyond the scope of this paper, but since hindcast has the objective to validate the initialisation of the model before running a forecast simulation, the last part of the exercise is missing.

Other minor remarks

page 5071, line 7: *We validate these ... changes.* Not very clear if it is a general statement or a statement related to this particular application. In that case, I would suggest to move this further in the introduction. Moreover, should write: *We validate these initial states using observations of ice thickness, ice discharge, surface elevation changes, surface speed, and time-series of mass changes.*

page 5071, line 20: Morlighem et al. (2010) paper is not applying inverse method to a whole ice-sheet. In Gillet-Chaulet et al. (TC, 2012) inverse methods were applied to infer the basal friction below Greenland and the discharge of individual catchments was used to validate the initialisation.

page 5073, line 3: can you be more precise about what is the *last part of the simulation*.

page 5075, line 6: The root mean square error (RMSE) of the surface velocities . . .

page 5075, line 21: this last sentence about ice-stream velocities should be before (line 8)? Why the ice-stream speeds are underestimated should also be discussed here.

page 5077, line 10: *By assuming the same equal split . . .* This paragraph is not really clear. Why simulated values cannot be compared directly to the observed cumulative mass change of -1695 Gt?

Table 1: the RMSE of which quantity? Should be specified.

The legend of Figs. 4 and 5 should be smaller and included in the frame of the figure.

Caption of Fig. 6: the sentence *MODIS mosaic in the background is courtesy of M. Fahnestock.* is missing. By the way, I wonder if it is necessary to repeat it in each caption?

Supplementary Information: Enhancement factor E is not defined. May be you should write Glen's flwo law? Either the caption or the table 4.1 itself is wrong, but I cannot see where the numbers for the different grid sizes are.

Interactive comment on The Cryosphere Discuss., 6, 5069, 2012.