

Response to Anonymous Referee #1: “Interactive comment on *An ice sheet model validation framework for the Greenland ice sheet*”

We thank the reviewer for the detailed comments, each of which is addressed in our response below.

Response to main point

I see maybe one point which could be discussed with more details. For the use and interpretation of the altimetry data, the conclusion is that the proposed metric are not sufficient to discriminate between the simulations. I think this is true on the global scale as surface elevation changes are very small but on very large areas, so GRACE data are more appropriate as they spatially integrate this information. However the altimetry data have a much better spatial resolution that is not used in the metrics proposed here. I think some fine scales metrics could help to discriminate simulations, by example by comparing only points where elevation changes have been significant. Ok clearly 3 data sets over 4 years will not be sufficient but we may expect that things will improve as more data become available.

We discuss this point already with respect to our basin-only comparisons. By going to any finer resolution than that, we risk not having enough data (points) for the comparisons to be meaningful / interpretable. To some extent, this is an artifact of problems inherent to the ICESat campaign, and the much sparser spatial coverage and repeat coverage than was initially anticipated. As the reviewer suggests, and as we note in the conclusions, we expect this problem to become less of an issue as new data from other satellites come on line and are made available to the CmCt. Note that we have added a sentence to the 3 paragraph of section 6 to clarify this.

Response to additional points

l210: “(the time series of spatially integrated, net SMB, relative to the 1960-1990 mean, is implied by the black-dotted line in Figure 4).”: the time series in Figure 4 is really the integrated net SMB. I think the “implied” can be removed?

The word “implied” has been changed to “indicated” in the revised manuscript.

Bottom of p7, top of page 8: discussion on the dynamic forcing: not sure I fully understand the part “starting in 1999, we “play back” the converted time series...”. I understand that there is no forcing from 1991 to 1999, then the forcing is applied as Dirichlet conditions relative to the 1999 model velocities? More precisions are needed for the choice of the location for the Dirichlet conditions. Why “several kilometres upstream from observed grounding line”? How is it chosen? A new figure made from Fig.1 with zooms on particular outlets glaciers could be useful.

We have re-written this section of the paper to be clearer. It now reads:

“Under the assumption that the Enderlin et al. (2014) flux changes are dominated by velocity changes (discussed further below), we apply these changes in our model by first converting the data to a velocity increase *relative to* the 1999 observations (all 22 outlet glaciers would have a relative flux increase of 1 in 1999, i.e. no increase). Starting in 1999, we “play back” this time series, relative to the modeled 1999 velocity field, as the model is marched forward in time. In this way, the Enderlin et al. (2014) velocity changes are applied as Dirichlet boundary conditions on the model velocity several km upstream from observed grounding line locations (i.e., at the same locations as the Enderlin et al. (2014) observations).”

We have also added a zoom to the Figure 1, showing in more detail what a single flux gate looks like.

Page 9: “Processing of model Output and observations”. I understand that model output should be processed before online submission to the CMCT website. There is no documentation on the website (at least as far as we don’t ask for login informations); It would be useful to give a table with the variables, their units, the time dimension, etc . . . that should be included in the netcdf for processing by CMCT.

A users guide for the CmCt is in the process of being written and contains this (and other relevant) information. When that users guide is ready, it will be clearly linked to and made available from the CmCt website.

L355: “e.g. Figure 11”, missing closing “)”

Corrected.

Fig. 10: labels of the colorbars are not visible.

We have added some text to the caption to indicate that the colorbars refer to the relative spatial weights applied when calculating the whole-ice-sheet mass changes (the color contoured values have no units).

Fig. 11 caption : “kernal” → kernel

Corrected.

A paper comparing GRACE data with flow model simulations has just been published in The Cryosphere (Alexander et al., 2016). It could be cited and discussed.

A reference to Alexander et al. (2016) has been added to the introduction where related previous work is mentioned. Also, we now mention additional similarities between simulations conducted by these two different efforts in our Results and Discussion section (section 6).

References are not in alphabetical order; modify with respect to GMD requirements for references.

Corrected (an incorrect style file was used in the submitted version of the manuscript).