

Interactive comment on “An ice sheet model validation framework for the Greenland ice sheet” by Stephen F. Price et al.

Anonymous Referee #1

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This paper presents a new tool, the Cryospheric Model Comparison Toll (CMCT), to compare ice-sheet model results to remote sensing observations (altimetry and gravimetry). The paper clearly presents the data sets currently used in CMCT, the processing steps and the maps and metrics produced to validate module outputs. The use of these maps and metrics is illustrated by comparing 4 “model” simulations of the Greenland Ice Sheet between 1991 and 2013. Two of these simulations are non-dynamic, the two others are produce with the Community Ice Sheet Model coupled with Albany-Felix.

This new framework fills a gap between ice-sheet models and remote sensing observations and will allow easier and more efficient model validation and improvement. The paper is well written, with a clear description of the different processing steps and assumptions used for the simulation.

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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 metrics 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.

There is few additional points requiring clarification:

- I210: “(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?
- 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.
- 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.

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- L355: “e.g. Figure 11”, missing closing “)”
- Fig. 10: labels of the colorbars are not visible.
- Fig. 11 caption : “kernal” → kernel
- 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.
- References are not in alphabetical order; modify with respect to GMD requirements for references.

References:

Alexander, P.M., Tedesco, M., Schlegel, N.-J., Luthcke, S.B., Fettweis, X., Larour, E., 2016. Greenland Ice Sheet seasonal and spatial mass variability from model simulations and GRACE (2003–2012). *The Cryosphere* 10, 1259–1277. doi:10.5194/tc-10-1259-2016

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