

Review of Price, Stephan F. et al. (Geoscientific Model Development, gmd-2016-97)

The manuscript of Price and others describes and applies the method of a validation framework, called Cryospheric Model Comparison Tool (CMCT), that could potentially be extremely valuable for the validation of contemporary ice sheet model simulations against observations.

The observations comprise currently ICESat ice sheet elevation estimates and GRACE ice sheet mass change estimates. The presented ice sheet simulations of the Greenland ice sheet (GrIS) have used the dynamical “Community Ice Sheet Model” (CISM) version 2 with setups of different complexity and pseudo ice sheet simulations, where the applied spatial distribution of the surface mass balance (SMB) reduce the ice sheet elevation locally. These simulations are compared with the observations to highlight the added value of using dynamical models beside only applying SMB fields to the elevations and to show how the satellite products could be used seamlessly to validate ice sheet simulations of the contemporary Greenland ice sheet. This tool box reduces drastically the need for adjusting commonly available satellite products when comparing them with simulations, because it converts the simulations data on the fly to the grids and footprints of the applied satellite products. Detailed ice sheet and basin-wide diagnostics (ice sheet elevation anomalies, mass changes, explained ice mass changes by the simulations), temporal evolutions (elevation differences for few periods and cumulative total mass change), and overall metrics (ice elevation differences and mass trends differences) are provided. The service that is offered as a web service seems to be available after registration; although I have not tried to use this service yet.

The manuscript is very well written, has a clear structure and all tables and figures, which are generally well prepared, are necessary. It was a pleasure to review this manuscript. I hope that the manuscript could be published soon, because I will be extremely helpful to have this information and the offered service.

I recommend the publication of the manuscript after some minor corrections.

Major Issues

none

Minor Issues

First I give general comments followed by specific comments.

General Comments

The currently included and in the future planned observations are based on satellite products, which biases the observation-based validation towards surface properties, such as elevation and its change. What's about ice sheet-internal properties such as temperature profiles from existing ice cores or radar detected layers, that could help to verify the internal structure, which may be important for the susceptibility of the ice sheet to applied forcing in the future?

Specific comments

In the following specific comments are made, where "L123" means line 123, for instance.

L52: Could you please add after web-address that the service is available after registration.

L90-21: I'm sorry, but I haven't understood without a doubt what is meant. Please clarify.

L101-107: You may add a quantity such as "number of good data points" to guide the user to identify "good" years as the mentioned years 2003, 2004 and 2007.

L141: Since some may think instead of the calendar year (starting 01.Jan) about the hydrological year (starting 01.Sept). Therefore, could you please clarify.

L151: Interpolation are bi-linear, conservative, ...?

L154: Interpolation are bi-linear, conservative, ...?

L166: Do you mean: "... and another that evolves *its surface elevation* only according to ... " ?

L206: Do you mean: "... and optimization of sliding *parameters to meet observed velocities*, the ... " ?

L229-234: Ice beyond the flux gates are not taken into account for the comparison. Does it still exists and interacts with the ice flow upstream?

L243: Do you mean: "... changes in ice thickness are *always* an order of magnitude ... " ?

L250: The application of the mask to remove ice beyond the initial footprint acts as a sink. How large is this sink term? How large is its fractional size compared to the applied total SMB.

L252-254: You may split the sentence in two pieces: "... advance in limited marginal regions. In reality, strong negative mass balance at ... " ?

L261: Have I understood you correctly: "... steps, RACMO2 SMB fields are applied *to either increase (positive SMB) or decrease (negative SMB) the ice thickness accordingly.*" ?

L276-277: How large are the 2% compared to the other presented mass changes?

L281-284: Are corner points needed for each grid box. If optional, would the tool box than perform conservative interpolation?

L298: I guess you mean: "... averaged *weighted by grid size*."?

L299-301: Do you mean: "... cells by the ratio of the *ice-covered* model grid area in that cell to the total cell area... ."?

L302: Is it possible to change the density of the ice on the web page?

L355: You may dropped the closing bracket: "... of time (e.g. Figure 11), and"?

L380: You mean probably mean: "... of at least 15 cm of water *over the period 2003-2012*"?

L385: You may change: "... GRACE observations has a PVE=100 *at each location*"?

L388: Since math (equation 4) is clear you may change: "... the observed variance exhibit negative PVE values"

L391: You may replace M_{Trend} with δM_{Trend} to highlight that it is a difference between two trends.

L426: You may write: "... may be *too* small that they"?

L436: You may emphasize: "... hat initially good match (Figure 8) *on a period covering a decade*."

L510: This, of course, only applies if the driving model climate is identical or at least very similar to the current climate. Otherwise I expect that coupled climate-ice sheet models would lead to an ice sheet geometry that differs from the observed state.

L569-694: Reference. What's the style and sorting criteria for Geoscientific Model Development? If none, please sort using the last name and also have a consistent way to write the first names.

Tables

Here I refer to the table number

Table 1 and 2: Please give a remark that "Pers" means persistence and you may also indicate "CISM" as Community Ice Sheet Model and RACMO2 as regional model.

Figures

The figure number are given.

Figure 1: Could you add to the color bar of the first two left sub-figures (observed and modeled velocities) a second row that lists instead of $\log_{10}(v)$ the actual velocity (v)?

Figure 1: In the right figure (velocity difference) the black dots representing the flux gates and the

negative velocity differences (blue color) are hard to distinguish. What's about adding a tick ("-") slight away from the ice margin to indicate the locations of the flux gates?

Figure 3: To avoid any ambiguity you may change the caption slightly: "... from greatest (*Jakobshavn*) to least (*Nordre*) flux in 1999."

Figure 4: Could you increase the line thickness please?

Figure 7: Since all dots seem to fall within -300 and 300, you may reduce the ordinate axis to this range.

Figure 8: What do you think about increasing the size of the black entire ice sheet symbols?

Figure 9: Since the figure caption indicates a mass change the unit shall be accordingly. You may write: "... Units are meters of water equivalent height / 10 years." or "... Units are meters of water equivalent height for the given period."

Figure 11: You may change the caption: "Observed and modeled, *cumulative* whole-ice sheet trends ... "?

Figure 12: To guide the read just spotting the figures what is meant, you may add: "... percent of GRACE variance (*Eqn 4*) explained by"?