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Interactive comment on "Time-evolving mass loss of the Greenland ice sheet from satellite altimetry" *by* R. T. W. L. Hurkmans et al.

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Reply to all comments from both referees is provided in the supplement

Interactive comment on The Cryosphere Discuss., 8, 1057, 2014.

Response to reviews of "Time-evolving mass loss of the Greenland ice sheet from satellite altimetry", paper tc-2014-6.

For readability, the reviews are cited in full in this document. Our response is presented in italic font, where actual adjustments to the manuscript are in bold. We thank both referees for their careful evaluation of the submission and their comments, which were appreciated and which have lead to a number of improvements in the paper.

Review 1 (by anonymous referee #1)

p. 1058, line 4: Please state that the "ice-sheet-wide" mass loss from GRACE agrees well with the IOM method. GRACE cannot deliver mass loss of individual glaciers.
Changed as suggested: ***"...reconstructing ice-sheet wide mass changes...."*** *(line 3).*

p. 1059, line 6-7: This paper was submitted before Khan et al. (2014), which actually do provide shorter term mass loss estimates from altimetry (3 year interval). Please include Khan et al (2014), also in table 3. Khan et al (2014) provides mass loss estimates for 2003-2006, 2006-2009.
Thank you for pointing us to this paper, which is indeed useful. We added the Khan et al., (2014) results to Table 3 and to the discussion: ***"The near doubling in mass loss that Khan et al., (2014) find based on ICESat, i.e., 172 Gton yr^{-1} for 2003--2006 to 292 Gton yr^{-1} for 2006--2009, is*** is a larger increase and larger absolute value than we obtain for the latter period. We note, however, that their GRACE-based estimate of 257 Gton yr^{-1} for 2006-09 is identical to our value for this period.. "

p. 1064, line 5-10: Jakobshavn Isbræ (also other glaciers) has velocities of more than 10 km/yr. Have you removed the points near the glacier front in figure 2a? If so, please state it in the text.
We capped the axis of the figure for readability. The points near the glacier front (of which there are very few) have indeed very high velocities. They are included in the relationship but not shown in Figure 2a. We also mention this now in the caption of Figure 2a: ***"Note that the x-axis is limited at 3 km/year for clarity. The few points that have higher velocities are included in the relationship but not in the plot."***

p. 1068, line 13-20: Figure 4 show trends for 2003-2009. Please show trends for 1995-2001. Figure 4b shows dH/dt caused by firn compaction. What is the total rate in km3/yr for the GrIS? List the rate in the test, as it will make it easier to compare with other studies.
We added a figure showing modelled trends for 1995-2002. For 2003-2008 we calculated the requested value, which amounts to 20 km^3/yr (on average about 1 cm/yr). However, the anomaly in firn compaction, which determines this value and is shown in Figure 4 (and now also 5), strongly depends on the previous anomalies in SMB: a thicker than usual snowpack will cause more than usual firn compaction (i.e. an downward trend). Therefore, we do not think this number of 20 km3/yr is easily comparable to other studies and we choose not to add it to the text.

p. 1069, line 8: I assume the elastic uplift of bedrock has been taken into account in the final mass loss estimate? If so, please mention it in the text. GIA is small, less than 2 Gt/yr and can be ignored (ice5g).
We did not include elastic uplift as a correction to the volume change estimate as its impact is significantly less than that of other uncertainties in our calculations.

p. 1073, line 24: I do not like that you state that mass loss peaked around 2006. This is true only if you ignore 2010-2014 data. As many GRACE studies have shown, 2010 and 2012 were extreme years with huge melt and mass loss.

Fig. 1.

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