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Interactive comment on "Using Satellite Laser Ranging to measure ice mass change in Greenland and Antarctica" *by* Jennifer A. Bonin et al.

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Response to Reviewer #3 (Kosuke Heki)

Thank you for your time and effort. I really appreciate the review.

— No. 1 Separation of Greenland and Antarctica using external information: The limited spatial resolution of the SLR 5 x 5 model could not separate ice losses from the two ice sheets. Nevertheless, I think there are external clues to answer the question, how much coming from Greenland and how much from Antarctica. Matsuo et al. (2003) used the quadratic component in the vertical position time series of GNSS stations in

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Greenland to validate their results. Because of uncertainties in GIA models, it is not straightforward to discuss linear uplift/subsidence rates of the Antarctic GNSS stations. However, because GIA rates do not change in a short time-scale, quadratic (or higher degree) components in vertical position would entirely reflect the elastic response of the lithosphere to the present-day ice melting. Several GNSS station in Antarctica have been operational since 1990s, and the authors at least discuss if the signature of the accelerated ice mass loss ever exists in Antarctica.Âă

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You, Matt King and I went back and forth a little on this via email, but to recap for the editor, while I agree that some “guestimation” based on GPS is probably possible on this issue, I don’t think I know enough about the subject to do it myself. As Matt mentioned, there would be a lot of questions about mantle viscosity effects, in addition to the question of time-variable modern-day surface loading. More, I worry that any such process would have to assume a continuation of linearity in regions where the signal is linear now, during timespans when the signal might really have been accelerating (etc). So this sort of separation would have to be handled very delicately, I think.

It’s a good idea for someone to try to combine these data types, nonetheless, I think. For the time being, I have added a comment in the relevant appendix section suggesting: “While it might be plausibly possible to use external sources (such as ground GPS stations) to separate the two regions, that is likely to be a complex process, particularly as one goes backwards in time to periods when few GPS stations exist. We leave such efforts to a future paper.” Perhaps that will inspire someone.

— No 2. Reality of the departure of SLR data from GRACE:Âă Below I compare Figure 4 (left) and a figure drawn by the reviewer using the CSR Level-2 RL05 spherical harmonics data with standard filters (right). It shows the gravity time series at a certain point in southern Greenland (65N 40W), and indicate anomalous changes after 2012, a short-term accelerated mass loss in 2012 and a longer-term stationary behavior until

present (reflecting increased precipitation there). I see someÂăsimilarity between the 5x5 SLR data (rather than GRACE HiRes-Local) and the mass changes in southern Greenland. Is it conceivable that mass signals in southern Greenland leaked into the SLR 5x5 solution?Âă

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I noticed this visual similarity, too, initially. Two things convinced me that it's not a case of "overweighting" Greenland somehow. First, because any such signal would be seen by GRACE (as you note), but neither my "highres" case nor the 5x5 or global 60x60 GRACE inversions see the amount of decrease seen by SLR. (They all slow down somewhat in the later years, please note. They just don't show the strong acceleration in 2010-2011, then plateauing that SLR does.) Secondly and more importantly, though, as I mentioned in my email to you, last month I finally cajoled Minkang Cheng into making a new SLR series in which he combines 6 months of data into a single solution (rather than only a month). In that SLR series, the big deviation that his monthly solutions showed away from GRACE after 2010 totally disappears.Âă This proves to me that it was just an artifact of the SLR errors, not a real signal from Greenland or anywhere else.Âă It seems that the monthly SLR solutions are just barely stable, and adding more observations stabilizes them better.Âă So I'd like to put this question on hold for a future paper, until I can write up the results on this brand-new SLR series.Âă I still think it's important to put the results of the ordinary monthly solutions out there, though, since those are commonly available. Not to mention getting the method clearly down on paper.

— Minor comments:Âă Page 9 line 4: "trend errors are statistically indistinguishable from zero." sounds strange (trends could be indistinguishable from zero but errors should not be indistinguishable from zero).Âă

Page 11 line 9: Please explain the "input-output method"?Âă

Page 12 line 13: "before" what (words missing)?Âă

Page 14 line 19: Nerem and Wahr (2011) missing in the reference list

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All these things have been reworded or added.

Thank you again for your helpful thoughts, Jennifer Bonin

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