Review of “Using Satellite Laser Ranging to measure ice mass change in Greenland and Antarctica” submitted to The Cryosphere by J. A. Bonin et al.

As a whole

Considering that the GRACE satellite system can go back only to 2002 in time, the authors used data sets of SLR including not only $C_{20}$ but coefficients up to higher degree/orders. They validate their method by comparing the data during periods with overlap with GRACE, and explore mass changes in Greenland and Antarctica in 1990s. They found that the mass changes over the Greenland and Antarctic ice sheets cannot be separated with the 5 x 5 model, but their sum can be discussed. The authors present results in Figure 4, which looks somewhat similar to the Greenland ice loss trend by 4 x 4 model in Matsuo et al. (2013). The result shows insignificant mass loss during 1990s and its acceleration toward the present time. This is an interesting study, and the manuscript is well written. In addition to minor comments at the end of this review, I would like to ask two major questions which need to be discussed (need not be solved) in the revised version.

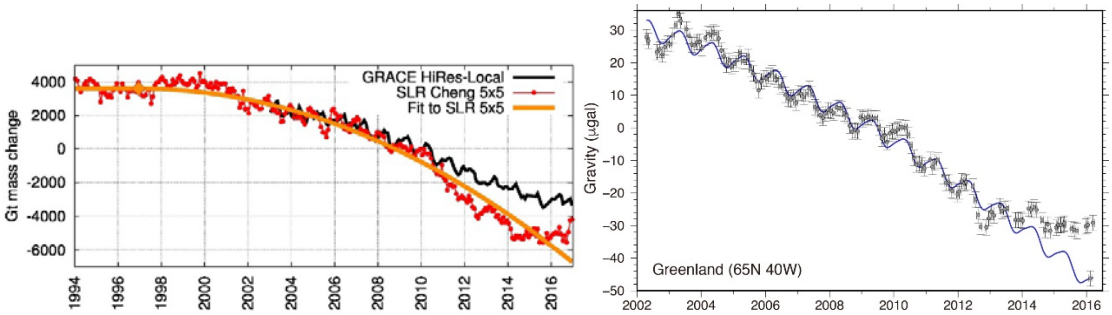
No. 1 Separation of Greenland and Antarctica using external information

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 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.

No 2. Reality of the departure of SLR data from GRACE

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 some

similarity 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?




Minor comments

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).

Page 11 line 9: Please explain the “input-output method”?

Page 12 line 13: “before” what (words missing)?

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