

Overview

The changes made to the Schröder et al. (2018) improve the description and presentation of the work. The additions help contextualize the challenges and unresolved issues in resolving both the volume and mass balances of the Antarctic ice sheet. There are a couple of issues that could be resolved before the publication of this manuscript.

General comments

- The comparisons with GNSS and NASA Operation IceBridge in the supplementary material are helpful. Could use in the main text to separate the OIB data by region and replace the “zoomed out” figure.
- The paper is still difficult to follow at times. The paper could be reworked for conciseness and to better separate the Results and Discussion sections.
- Significant figures (e.g. 1.8 ± 0.3 instead of 1.80 ± 0.31)
- Could list some of the mass changes observed in terms of sea level equivalents.

Line-by-line comments

P2, L1 Awkwardly constructed sentence. “As a consequence, results derived from a single mission and mean linear rates reported from a single mission have limited significance in characterizing the long-term evolution of the ice sheet”

P2, L5 could use “have been” instead of “were”

P2, L10–11 I’d recommend something like “Paolo et al. (2016) cross-calibrated ERS-1, ERS-2 and Envisat on each grid cell using overlapping epochs. We use a very similar approach for these missions and data from the low-resolution mode of CryoSat-2.” Could also reference Adusumilli et al. (2018) here.

P3, L20 remove “as well”

P4, L22 “the coarse POCA location”

P4, L31–33 possibly move “especially with a low threshold of 10%” to the end of the sentence.

P4, L34 possibly add a comma after amplitude and remove the comma after level.

P5, L7 use “and GNSS profiles” instead of “or GNSS profiles”

P5, L28 possibly “which helps confirm the findings of”

P6, L4 remove “already”

P7, L29 remove “furthermore”

P8, L2 remove “like the first group of authors did”

P8, L8–9 possibly “prefer the simplest viable model in order to keep the number of parameters small as compared to the number of observations”

P8, L16 change to “(i.e. PLRA, SARin and laser altimetry), the effective surface slope may also differ”

P9, L13 possibly “to exclude any res_i that exceed five times”

P12, L17 remove “thus”

P13, L7–8 Awkwardly constructed sentence

P13, L10–13 Awkwardly constructed sentence. Also remove “hence”

P13, L15 PPP processing of the GNSS data?

P13, L16–19 possibly “The ground-based GNSS profiles were completed between 2001 and 2015 on traverse vehicles of the Russian Antarctic Expedition. Most of the profiles cover more than 1000km”

P14, L1 possibly “been used due to poorly determined antenna height offsets.”

P14, L7 remove “nevertheless”

P14, L8 add a comma after terrain

Figure 7 results appear to be saturated in the Operation IceBridge portion of the plot. Could possibly rasterize the OIB data to be comparable spatially with the merged product. The discrepancies compared with OIB in uncrevassed areas is disconcerting.

P15, L13 The planes used in the Level-4 ATM product are ~100m across. While the data is affected by slope errors, the larger sources of uncertainty are roughness and crevassing.

P15, L14 How often are the vehicle track depths measured when acquiring the GNSS data?

Section 4.2 Could reference Helsen et al. (2008) in this section.

P15, L27 Remove “furthermore”

P16, L1 could add something like “and where large accelerations in ice velocity are observed, such as Pine Island Glacier”

P18, L8–9 perhaps “For Totten and Denman Glaciers, the 40-year rates at a distance of approximately 100km inland from the grounding line are similar to the rates over the 1992–2017 interval, which indicates a persistent rate of thinning.”

P18, L9–10 possibly “With our merged time series, elevation change rates can be derived for any sub-interval in time for which there is data available, as shown in Figures 9c-j.”

P18, L12–13 Somewhat awkwardly constructed sentence

P18, L14 for some regions

P18, L15–29 why were these regions chosen?

P25, L9 This sentence could be rewritten “Also Seasat and Geosat provide important information here”

P27, L6–14 Paragraph seems disconnected and difficult to follow.

P27, L13 remove “nevertheless”

P27, L19 could use “in the peninsula” versus “here”

References

- S. Adusumilli, H. A. Fricker, M. R. Siegfried, L. Padman, F. S. Paolo, and S. R. M. Ligtenberg. Variable Basal Melt Rates of Antarctic Peninsula Ice Shelves, 1994–2016. *Geophysical Research Letters*, 45(9): 4086–4095, Mar. 2018. ISSN 0094-8276. doi: [10.1002/2017GL076652](https://doi.org/10.1002/2017GL076652).
- M. M. Helsen, M. R. van den Broeke, R. S. W. van de Wal, W. J. van de Berg, E. van Meijgaard, C. H. Davis, Y. Li, and I. Goodwin. Elevation Changes in Antarctica Mainly Determined by Accumulation Variability. *Science*, 320(5883):1626–1629, June 2008. doi: [10.1126/science.1153894](https://doi.org/10.1126/science.1153894).
- F. S. Paolo, H. A. Fricker, and L. Padman. Constructing improved decadal records of Antarctic ice shelf height change from multiple satellite radar altimeters. *Remote Sensing of Environment*, 177:192–205, May 2016. doi: [10.1016/j.rse.2016.01.026](https://doi.org/10.1016/j.rse.2016.01.026).
- L. Schröder, M. Horwath, R. Dietrich, and V. Helm. Four decades of surface elevation change of the Antarctic Ice Sheet. *The Cryosphere Discussions*, 2018:1–25, 2018. doi: [10.5194/tc-2018-49](https://doi.org/10.5194/tc-2018-49).