Review of Paolo et al. 'Widespread slowdown in thinning rates of West Antarctic Ice Shelves'

Summary

This study presents a new dataset of ice shelf thickness change derived from satellite radar altimetry from 1993 to 2017. The authors use this dataset to investigate the temporal evolution of ice shelf thickness patterns in the Amundsen and Bellingshausen Sea sectors over the course of this 26 year record showing that thinning rates have recently abated.

This paper confirms previous findings that thinning of ice shelves in the Amundsen Sea sector has slowed down since 2008 (e.g Adusumilli et al., 2020), and allows for further investigation of temporal fluctuations in ice shelves thinning and basal melt rates owing to methodological improvements leading to a higher temporal resolution. This paper is well-written and the methodology is clearly explained. However, I have some comments and suggestions that would need to be addressed before this paper can be published.

Main comments

- This study covers the years 1993 to 2017 but it might be worth considering extending this record further in time to cover the years 2018 to 2021 using the most recent CryoSat-2 baseline product (now in baseline E instead of baseline C), especially since Adusumilli et al. dataset (2020) covers the years 1994 to 2018. Adding more recent data would be a great addition to this paper and would add some interesting discussion on more recent changes in ice shelf thickness not published elsewhere. In addition, having an up-to-date dataset would be helpful to the scientific community.
- The methodological improvements implemented in this study are clearly explained in the manuscript. However there is no quantitative statements in the paper describing how those improvements have led to a better/more robust dataset compared to previous work. For instance, does the surface scattering correction effectively removes the height changes induced solely by changes in the scattering properties? What are the improvements afforded by the modified plane fitting procedure implemented here?
- The authors use the GEMB model to correct for firn air content. While the model is clearly explained in the paper, there is no validation of the model outputs. Has this model been used before in similar studies? Figure 3 shows the FAC volume change and SMB time-series from GEMB, GSFC FDM and IMAU FDM but this does not give enough information to the reader on how GEMB performs. It would be interesting to add a map of spatial differences between the three models as previous studies (e.g. Mottram et al. 2021) have shown that there are significant spatial differences between SMB models in Antarctica and while different models might agree on the total SMB, there might be some important biases regionally.
- The simple ice-ocean modelling experiment doesn't seem to bring much to the paper as the aim of this experiment is not very clear. In the abstract it is stated that this experiment will help test the resolution capability of the ice shelf thickness and basal melt rates datasets, but this is not discussed in the paper and there are no comparisons of observations and model results.

Specific comments

L79-80: How and at what stage of the processing chain do you bring the ascending/descending data points together?

L83-84: How many points are required to perform the bilinear/biquadratic fit? When do you pick one of the fits over the other?

L85: What range radii are you using?

L95: Please specify the range of your inversion cells size.

L100-104: Is your buffer size sufficient to account for grounding line migration in areas that have significantly evolved over the course of these 26 years?

L143-146: What is the magnitude of the correction based on correlations with the waveform parameters? Is there one of the waveform parameters that exhibits a higher correlation or do all three parameters need to be used together?

L208: What are the seven densification methods available in GEMB?

L251: Why using 5-month intervals? (It's stated later in the paper, but as it is first mentioned here, it'd be best to add this justification here)

L259: What's the average proportion of ice shelf area covered at each epoch before interpolation?

L260: How many random locations do you use to calculate the empirical covariances?

L271: 'improved' compared to?

L281: 'varying in time in the Amundsen Sea sector' and what about the Bellingshausen Sea sector? At L289, you construct a velocity product for both the Amundsen and the Bellingshausen Sea sectors so it's a bit confusing whether you are also using a time-variable dataset for the Bellingshausen Sea sector.

L282-284: There have been significant changes in ice flow in some basins of East Antarctica and in the Getz region as well. What's the time resolution of the ice velocity data used in the Amundsen Sea Sector? In recent years, annual velocity maps have been generated for the whole of the continent, can you use those annual maps to create a time-varying dataset for the whole of Antarctica for recent years?

L289-290: Why do you combine those two products? Are they complementary, do they use different satellite datasets or use a different methodology or cover different areas?

L391-392/L412-413: I suggest stating at the start of this section what variables you are computing for your comparison to Adusumilli et al. (2020) results as it will improve the clarity of this section.

L411-413: Can you give the total volume control that you use? I suggest also adding the total ice shelf extent area and number of ice shelves that your dataset covers earlier in the paper (these values are given in Table 3 but are worth adding the main text)?

L435-437: Can you quantify this 'good agreement'? This sub-section, while explaining how the different parameters have been calculated to allow a comparison to Adusumilli et al., is missing a paragraph on the differences/similarities found between the two datasets. For instance, remarking that accounting for thickness changes leads to a better match for this study would be an interesting point to make and needs to be expanded in the text.

L509: How many kilometres from the grounding line?

Figure comments

Figure 1: Can you add a reference to this statement on the GPS record in the caption?

Figure 6: Specify from what area this map shows.

Figure 7 (right panel): Can you label the ice shelves directly on the map rather than by order of magnitude given in the caption?

Figure 8: What does the black line represent on in the inset map?

Figure 9: What is the acquisition date of the grounding lines shown? Can you perhaps change the brightness of the green velocity vectors as they are a bit difficult to discern on the map?

Figure 11: As the mean values are plotted inside the error circles, it looks like the values refer to the error values and not the mean values. I suggest either increasing the font size to the size of the full circle (not just to fit the size of the inner error circle) or adding a mention on the figure directly (not just in the caption).

Figure 17: Can you add the same map of basal melt rates from your observations? Do the patterns of basal melt rates from observations in 1993 and 2017 look similar? It would be worth expanding on this in the main text as well to integrate the ice-ocean modelling experiment better with the rest of the paper.

Table 2: Can you add a column with the corresponding ice shelf areas over which the calculations have been made?

Technical comments

L233: missing word ‘as a function <u>of</u> C’

L243: typo ‘plateau’

L258: remove superscript ‘28’

L290: remove ‘(‘ at the end of the sentence

L348: ‘comprises’

L415: remove ‘where’

L483: ‘reflects’

L506: ‘4.’ Remove ‘.’