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The Cryosphere
Discussions

Interactive comment on "Antarctic grounding zone characteristics from CryoSat-2" *by* Geoffrey J. Dawson and Jonathan L. Bamber

Anonymous Referee #3

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The paper present results of a newly developed tool to map the grounding zone of Antarctic ice shelves from CryoSat-2 POCA and Swath data. The method was partly introduced by the authors in 2018 using a case study and was refined and updated and applied to whole Antarctica for the present study. In total 41% of the Antarctic grounding zone and its width could be mapped in an automatic way.

The authors present in a clear and understandable way the method and compare the findings against independent grounding line data sets which were mapped using DIn-Sar methodes. The standard deviation to those datasets is around 1km with regional differences. Additional the authors compare their results directly with cross section of DInsar interferograms from Sentinel 1 and can clearly show how well both methods match but also explain differences and shortcomings of their method.

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Discussion paper

In the last section they apply an elastic beam model to find a relation between ice thickness and grounding zone width with similar findings as Bindschadler (2011).

The paper is well written, figures are clear and of high quality. The scientific outcome is of interest to the community, at least to my opinion, as it provides another independent data set of the grounding line and grounding zone width which is derived from Altimetry alone.

I would like to thank the authors for this excellent work as the pre-processing already incorporates a full retracking of CryoSat-2 SARin data, the estimation of the POCA and a full interferometric swath processing. This dataset is then explored in a new way to derive grounding line and grounding zone width.

I do have some minor comments and questions.

1. Can you please argue why you selected a 3-year moving window to estimate 6-yearly measurements per grid cell which were then averaged instead of using the full time series or 5-year moving windows. I could imagine that with more data points per grid cell more tidal states are covered which might allow you better results in areas with low tidal signals or sparse coverage. I can understand the argument with GL retreat however you mentioned that your approach was not able to detect a retreat in the Amundsen sector.

2. Please explain in more detail which criteria you used for the selection of SWATH and POCA data. I don't see any coverage of SWATH across the shelf ice, which makes sense as the SWATH shouldn't give useful information in flat terrain. However, Gourmelen et. al. showed some good results across Dotson. Is it possible to use Swath in the vicinity of Dotson as well in your study?

3. Please include in your validation against other grounding line data sets the ASAID dataset (Bindschadler, 2011) ASAID provides also the F and H lines and it would be a valuable information how much they differ and if you can see if and where H and F

shows better agreement. Maybe you find some systematic difference.

4. Hogg et. al. (2017) mapped the grounding line from CryoSat-2 data as well. They used a different technique (break in slope) using only POCA data. Can you please show the differences to your data set and as reference to the ASAID one. It would be really interesting to see how much the additional use of Swath data and your new approach differs. Maybe in future one can find a combined approach to overcome shortcomings e.g. your approach has difficulties in areas of low tidal signal.

5. Did you use a reference elevation model (REMA or global Tandem-X) to subtract topographic phase from your interferograms prior forming the DInSar interferogram? This might help to get rid of phase wrapping and to get a clearer picture in areas where you were not able to unwrap the DInSar phase (cross section C in Fig. 3, 4).

5. Your are following the method of Bindschadler et. al. 2011 to estimate a relation between width and ice thickness. Can you please apply the fit to different regiones to see if you can reduce the spread in cases of low measurement error.

Can you please derive your best fit using another Young modulus to show the influence of E. e.g. Rack et. al. 2017 used 1.5 Gpa to analyse the tidal flexure in the grounding zone and where able to account for horizontal motion in DInSar derived grounding line position. Whereas Wild et. al. 2019 found 1.0 +/- 0.56 GPa as best fit to tiltmeter measurements and a numerical model.

Figures:

Please note which grounding line you used in the figures 1,2, A1 and A2

Fig 1 and A2: Please change the colour scale. Red-Green blind people can't see anything.

Fig 3: Why did you select cross section C in Figure 3 as validation against DInSar? It would be also worth to show a second DInSar pair from a different tidal state, to illustrate how much the width of the fringe belt can vary. Maybe you can include the F and H line of the ASAID data set as well.

Fig 6: Please double check the number and citation and the position of the blue line. Bindschadler (2011) derived 22.2 +/- 6.2 referring to values estimated by Vaughan (1995).

Typo: Please double check the numbers given for X in line 191 and 204 and Fig 6.

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