

Interactive comment on “Twelve years of ice velocity change in Antarctica observed by RADARSAT-1 and -2 satellite radar interferometry” by B. Scheuchl et al.

B. Scheuchl et al.

bscheuch@uci.edu

Received and published: 22 August 2012

We would like to thank the anonymous reviewer for the detailed review and for the encouraging feedback on our work. We appreciate the evaluation and the specific comments. Detailed responses are provided below.

I will start with some general comments and then address the questions posed on the website under m/s evaluation criteria. Minor typos, grammatical errors and poor sentence structure and use of unscientific or inappropriate terms are highlighted in the marked up pdf.

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Actions taken in response to the marked up pdf are also outlined below.

The paper addresses an important and noteworthy topic: dynamic stability and changes in dynamics of glaciers feeding the two largest ice shelves in Antarctica. The results reached are sufficient to warrant publication in TC and my concerns relate primarily to the structure of the paper, how it is written and the figures. I will address each of these topics next.

We appreciate the positive feedback. Actions to your detailed comments are outlined below.

The introduction, methods and results sections were largely OK. The discussion appears to be an almost seamless continuation of the results section. I could discern nothing about the discussion and conclusions that was not in same way part of the results. The authors need to have a clearer idea in their own minds about what the key take home messages from this study are. For example, Fig 1. is used largely to inform the reader that a tidal correction is needed to produce decent velocities on the ice shelves. This is not new or novel or a surprise. Why devote a whole panel of figures to this? Two sentences explaining that horizontal vels are sensitive to vert vels and that the tide model handles these mostly well would be entirely sufficient.

We will remove Figure 1 and text referring to it from the manuscript. The manuscript will be revised with this and the following comments specifically on Sections 5 and 6 in mind.

Where the discussion becomes informative and goes beyond describing the results is at l8 of p1729 on Byrd glacier. At least here they place their results in the context of other observations. The section prior is a continuation of the results. The authors need to make more effort and give more thought to section 5 and 6. For example, they could have contrasted the behaviour of these shelves with smaller ones in the same

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sectors or elsewhere from Pritchard et al 2012 and so on.

We will include the results by Pritchard et al. (2012) in the discussion. This paper was not available at the time of manuscript submission.

The figures. Other than Fig 1 being largely superfluous, all the figures are much, much too small. Even at 400% I could not see the apparent yellow-black dashed GL from MOA on Slessor that they claimed was there. Nor could I see they "markers" every 100 km. The "yellow arrow" in Fig 4 is completely unintelligible at 100%. I realise that most people will be viewing the PDF file on a screen but a printed version of these figures will be almost useless. At the very minimum they need to separate the dv image from the graphs of dv for Figs 3 and 4.

We will remove Figure 1 as suggested in a following comment. We will present the two velocity maps of Figure 2 in one line and the difference map in a second line below this allows the panels of the overview maps to be presented larger. The TC journal format would allow the figure to be presented even bigger. Figures 3 and 4 will be divided up to present maps and graphs in separate figures. Specific comments for the map presented in Figure 4 will be addressed.

Minor comments not in the pdf a) Use English not US spelling. b) Avoid non scientific terminology like "flaps up and down" for describing vert motion of ice shelves. c) Surge has a specific meaning in glaciology and you do not mean Byrd surged. Replace this word throughout and use speed-up or acceleration d) Quite a few sentences were poorly structured such as the use of i.e. twice in one sentence.

Thank you for these comments as well as for the annotated pdf.

a) We will ensure to use English spelling before resubmission

b) non-scientific terminology will be avoided. The phrase "flaps up and down" will be changed to "moves up and down".

c) We will replace the term surge with reference to Byrd Glacier

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d) Sentence structure will be revisited and changed where needed in accordance to all detailed reviewer comments.

M/s evaluation questions: 1. Does the paper address relevant scientific questions within the scope of TC? Yes. The topic is of relevance to the journal.

We appreciate your evaluation on this point.

2. Does the paper present novel concepts, ideas, tools, or data? The data and results are, as far as I am aware, new and although this group has published a number of studies of Antarctic velocities and their changes, I believe this is the first detailed assessment of glaciers feeding the two largest ice shelves. However, the earlier paper by [Rignot et al., 2011] appears to include annually resolved discharge values from 1992-2010 for the whole of Antarctica. This implies that annually resolved velocities for these ice streams exist for a longer period than has been presented here.

Interferometric SAR data of the region covered in this manuscript are available only for the years 1997 (partial coverage) and 2009 (full coverage) as described in the text. The setup of current spaceborne SAR systems leads to a coverage gap south of about 80 degrees South. This gap can only be filled when the sensor switches look direction from nominal right to left (available only for RADARSAT-2 and TerraSAR-X). For RADARSAT-1 it took a special manoeuvre to switch to left looking mode, this was achieved during a single time limited mission in 1997. From 2009 forward some limited left-looking acquisitions in the region are ongoing, using RADARSAT-2 and TerraSAR-X but no additional extensive coverage is available yet.

3. Are substantial conclusions reached? To some extent. Based on my comments above, it seems likely that an even longer annual record of discharge could, and probably will, be published for these sectors of Antarctica. Then again, from the discussion in this m/s it seems that SAR data this far south are limited primarily

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to two RADARSAT acquisition periods so perhaps the earlier study [Rignot et al., 2011] interpolated in time or used feature tracking or who knows what. I found the conclusions to be a little bland and confused. On the one hand it is stated that the sector studied shows little change and is therefore stable. On the other hand, they report a slow down of 25% which is significant for mass balance. This is for just one ice stream (Whillans) but it does presumably represent a 25% reduction in discharge. Our results show that dynamic changes are present in the region of interest. Central Antarctica is a region that deserves continued observation, with primary focus on Siple Coast. A 25% reduction in ice velocity of Whillans Ice Stream significantly affects the mass balance of this ice stream, a similar conclusion can be drawn for Mercer Ice Stream. Changes are significant and point to a possible shutdown of these ice streams if the trend continues. Mass balance changes of West Antarctica have shown to be driven by losses on glaciers in the Bellingshausen and Amundsen seas region and on the Peninsula (Rignot et al., 2008). We do want to make the point that the changes observed here remain relatively small compared to changes reported for other areas of West Antarctica.

We will rephrase the relevant text (in abstract and conclusions) to make our point clear.

4. *Are the scientific methods and assumptions valid and clearly outlined? The methods are described adequately for anyone who is relatively familiar with InSAR processing and make sufficient use of references where needed. InSAR and DinSAR are well established approaches.*

We appreciate your feedback on this point. No specific action taken.

5. *Are the results sufficient to support the interpretations and conclusions? Yes, as far as the conclusions go.*

No action taken

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6. *Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?*

No action taken

7. *Does the title clearly reflect the contents of the paper? No. The title says nothing about the glaciological results/conclusions, region studied. It is all about the data used. It needs revising to reflect the science not the data.*

We will change the title to:

Ice velocity changes in the Ross and Ronne sectors observed using satellite radar data from 1997 and 2009.

Rignot, E., I. Velicogna, M. van den Broeke, A. Monaghan, and J. Lenaerts (2011), Acceleration of the contribution of the Greenland and Antarctic Ice Sheets to sea level rise, Geophys. Res. Lett.

Please also note the supplement to this comment: <http://www.the-cryosphere-discuss.net/6/C776/2012/tcd-6-C776-2012-supplement.pdf>

Thank you for providing the highlighted in the marked up pdf. Actions taken in response to these comments are listed below.

Comments from Annotated pdf:

p1716 (3 comments): We will revise the abstract with these comments in mind.

p 1717 line 7: We will change: i.e. Bindschadler -to- e.g. Bindschadler

p 1718 line 10: We will change: maneuver -to- manoeuvre

p1718 line 13: We will change: limited data collect -to- limited data collection

p 1721 lines 26,27: We will remove the sentence in question

p1722 line 18: We changed the sentence to: An ice shelf moves up and down

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p1724 line 16: We will change the sentence to: The 1997 map is presented to its full extend and with improved calibration.

p1725 line 18: We will correct the spelling mistake

p1725 lines 19-21: We will split the sentence.

p1725 lines 28,29: We will change the sentence to: Plots and map contain markers every 100 km.

p1726 line14: We will change "I contrast..." to "In contrast..."

p1729 line 12: We will change to: ... a cycle in the glacier dynamics ...

p1729 line 14: We will change to: ... consistent with the values measured before the subglacial flood ...

p1729 line 15: We will change to: ... a temporal increase in speed between 2005 ...

References

Pritchard, H. D., Ligtenberg, S. R. M., Fricker, H.A., Vaughan, D. G., van den Broeke, M. R., and Padman, L.: Antarctic ice-sheet loss driven by basal melting of ice shelves, *Nature*, 484, 502–505, doi:10.1038/nature10968, 2012.

Rignot, E., Bamber, J. L., van den Broeke, M. R., Davis, C., Li, Y., van de Berg, W. J., and van Meijgaard, E.: Recent Antarctic ice mass loss from radar interferometry and regional climate modelling, *Nat. Geosci.*, 1, 106–110, doi:10.1038/ngeo102, 2008.

Interactive comment on The Cryosphere Discuss., 6, 1715, 2012.