

Interactive comment on “Changes of Wilkins Ice Shelf over the past 15 years and inferences on its stability” by M. Braun et al.

M. Braun et al.

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COMMENTS BY M. KING

My comment relates to only a small section of the manuscript - the post-processing of the ICESat data to gain ice shelf "freeboard". They may not all be completely relevant to the application (L1, p351), but should be considered. 1. OSU91A is now regarded as being a very inaccurate geoid model. It should no longer be used for glaciological applications (the same also applies to EGM96). There are many modern easy to access geoid models located at the International Center for Global Earth Models (<http://icgem.gfz-potsdam.de/ICGEM/ICGEM.html>). It could be that OSU91A is in error by many metres (3-5 metres would certainly be possible). I would suggest either EGM2008 (currently offline) or EIGEN-GL04C (both GRACEbased geoid models with higher resolution gravity data). The above link provides an online computation service

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to derive grids.

Answer: We are grateful for this comment and have changed our ellipsoid-geoid conversion to the EGM96.

2. an important geodetic/oceanographic point is that applying such a geoid-ellipsoid separation will get you to the geoid, but this is not the same as the sea surface; to get there you need a mean dynamic topography correction, which is of the order of 0.5-2m around Antarctica. There are various sources of estimates of these, including <http://gracetellus.jpl.nasa.gov/dot.html>

Answer: It is correct that for open water the sea surface is not equal to the geoid. We think that under ice shelves, which damp the sea surface topography due to the load, the sea level is however not too far away from the geoid.

3. The statement about no tidal observations for the WIS seems correct (http://www.esr.org/antarctic_tg_index.html), but were comparisons made to a range of ocean tide model estimates to see if one or more fit the observed height changes (see, for example AntPen04.01 via the above link)? At the moment it seems like the data were not de-tided, but an explicit statement is not included, nor an assessment of its likely consequence.

Answer: In fact we used not de-tided data and the two reviewers also request a more detailed description of the data processing, which we fulfilled now. None of the authors is oceanographer, but as far as we understand, the tide models are very sensitive to the bathymetry, which is under WIS unknown. Tide models use a bathymetry based on intelligent guessing there in some way. Our analysis showed for the first time much more than 100 locations where the ice is grounded and the bathymetry thus zero. Therefore, we believe that the bathymetry data which is used for the tide models is not representing the situation at WIS well and we decided not to de-tide the data.

The same question applies to the InSAR data.

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Answer: The chosen double-differential interferograms have a small baseline and is hence quite insensitive against errors in elevation or geoid. The height ambiguity is about 150m per fringe and hence errors resulting from geoid variations are within the overall precision of the interferometric measurements, estimated to about 1/5 of a fringe. Our described error analysis in rocky areas with no flow reveals no spatial pattern or offset that could be attributed to the geoid.

COMMENTS BY H. FRICKER

I would like to comment on your use and application of ICESat satellite laser altimeter data. I am on the ICESat Science Team and it is great to see the data being used in the community outside of the ST. However care needs to be taken when using these data. I have recently analysed all the repeats of all tracks that cross the Wilkins Ice Shelf. This is a very cloudy region, there are a total of 13 repeats possible for most tracks (campaigns L2a through L3j), and of the 8 tracks across the main part of ice shelf, the number of "good" (i.e. no clouds) repeats varies from 2 to 5. That means we lose approximately 80% of the possible data over this region. Campaign L3d has almost no valid shots over Wilkins. It appears from the paper that you do not filter for clouds, and you must (you can do a simple gain filter, keep shots with gain < 50, which is crude, but helps). The impact on surface elevation due to clouds can be large (it can "lower" the surface by several metres).

Answer: We apologize that we missed to include stating that the data has been filtered for gain lower than 50 and energy above 4000 aJ. These are values that have been recommended to us by our collaborator C.A.Shuman, who provided the data to us.

It is stated in the paper that there are no tide corrections applied to ICESat data. This is incorrect: a tide model is applied to the elevations during processing. The tide model used is currently a global tide model (GOT99.2) that is not accurate around Antarctica. On ice shelves, it must be removed and a better tide model then applied. This tide model is going to be replaced in Release 29 by an better global model (TPX07.1). For

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precise repeat-track work on ice shelves, however, I would not rely on this tide model either, and apply a better, regional model.

Answer: We state that we did not use the tide correction that is provided by the ICESat team. This has the following reason: we believe that the accuracy of the tide prediction is directly related to the accuracy of the bathymetry data they use. As we do show for the first time that WIS is grounded at quite many locations, we infer, that whatever bathymetry grid the current tide models use, it will not represent the reality well. Therefore, we went a different path and used the not de-tided data. The differences between the various OPS shown in Fig.7 thus contain tidal differences as well as all other changes in the surface elevation as they arise from mass balance as well as rift development. At locations where we were able to correlate the peaks in the elevation difference along track to a rift location on a satellite image, we discussed a projected crack growth. Since we follow the recommendations of the reviewers and tighten the manuscript, this figure will however not be included in the revised manuscript.

I do not understand why you needed to calculate a histogram to calculate shot-to-shot spacing; it is 732;172m. Nor do I understand the "base" point from which to calculate distance.

Answer: The satellite orbits are not exactly the same for the repeated tracks, so the lat/lon path is not exactly the same for each track in the different OPS. Therefore, shot #1 in OPS 2A will not have exactly the same lat/lon as shot #1 in OPS 3H. In to avoid that this influences the calculated difference in elevation the track have virtually been shifted to one path by calculating a distance from a base point on.

One final point: please state what ICESat data product and Release you are using (GLA12, Release 428).

Answer: Yes, we are sorry that we missed to include this. It is GLA 06, R28.

Interactive comment on The Cryosphere Discuss., 2, 341, 2008.

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