

Interactive comment on “A complete glacier inventory of the Antarctic Peninsula based on Landsat7 images from 2000–2002 and other pre-existing datasets” by Jacqueline Huber et al.

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Author response on:

Interactive comment on “A complete glacier inventory of the Antarctic Peninsula based on Landsat7 images from 2000–2002 and other pre-existing datasets” by Jacqueline Huber et al.

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Huber et al. present a complete and comprehensive inventory of glaciers on the Antarctic Peninsula, based on the aggregation of a diverse set of previously published data.

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The availability of such data sets is a prerequisite for understanding, and quantifying, the sensitivity and response of glaciers to climate variability and change, including all the consequences (in the case of the AP, primarily sea-level rise). A data set as presented here is long-needed for the AP, is a great step towards completion of such inventories on the global scale and will be used in many future studies. The manuscript is generally well written (see below for a few specific comments), and the authors describe the workflow well and understandable also for non-specialist readers. However, before I can recommend the manuscript for publication, one general (and somewhat major) and several specific (and mostly minor) comments should be addressed. Please see below for the details.

General comments: I see only one issue with the manuscript that will require some more substantial work to address: the handling (or lack of handling) of uncertainties. The authors address uncertainties in section 6.3. However, they do not attempt to translate the discussion here into uncertainties regarding their results - e.g., the hard-to-determine grounding line (Sect. 6.3.3) has a strong influence on the glacier area: how does that translate into uncertainty of the total area number for the AP given in the abstract and elsewhere? Addressing this properly, i.e. trying to come up with uncertainty estimates for the numbers given in the abstract, the main text, and Table 3, will also require a reorganization of the manuscript. What is now in Sect. 6.3 would have to be discussed (together with the derivation of the uncertainty estimates) before the results section (Sect. 5). It may not be possible to estimate the uncertainties for all the derived variables, and for some where it is possible, it may only be very indicative (e.g., is the error in the 1 % range or in the 10 % range). But in the current shape, the manuscript creates the (wrong, I'm sure) impression of blindness of the authors towards this issue – also because of the way many numbers are presented (e.g., mean thickness including digits on the mm scale, or the total area of glaciers on the AP to the 0.1 km² scale).

Response: We agree, that specific uncertainty estimations are missing and have thus

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added the estimates from the related studies. We are fully aware that uncertainties in glacier area (e.g. due to uncertainties in the position of grounding lines or drainage divides) impact on other parameters such as hypsography, topographic indices and glacier volume. In a similar way uncertainties of the DEM propagate into these parameters as well as into the derived area. As the impact of these multiple-dependencies are difficult to determine (has it ever been done?) and might thus give a nice study on its own (requiring to manipulate the original datasets), we prefer here to just report the uncertainties for the individual datasets as given in the related studies. To better illustrate the complexity of the issue for the reader, we have re-structured the section and added a systematic description of the mutual dependencies.

Regarding the decimals: We are aware, especially considering the uncertainties, that giving three decimals might be seen as inappropriate and have reduced the decimals to one digit (this is also required as the smallest glacier in the sample has a size of 0.3 km²). However, to retain full traceability with the original datasets and allow comparisons to other studies, we would prefer to stay with this precision rather than rounding values to the appropriate uncertainty. We hope that together with the now added more detailed and systematic description of uncertainties the reader can interpret the given numbers correctly.

Specific comments: L20ff: all the numbers given in the abstract should include an uncertainty estimate

Response: See above, these are difficult to determine correctly. (We have thus used standard values from the literature to give at least an indication).

L26ff: since you do not discuss the ELA in the manuscript, having point (1) in the abstract is a bit of a surprise without additional information, I would recommend removing it; points (2) and (3) could be combined into one statement on the sensitivity of the region to marine-induced ice dynamic effects.

Response: We discuss the ELA in Section 6.2 and 6.4. Also points (2) and (3) are

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discussed separately. Therefore, we would like to keep these three points.

âĀĀ L39/Fig. 1: the first reference to Fig. 1 comes before the definition of the abbreviation LIMA - so this definition should perhaps be in the caption of Fig. 1.

Response: Done.

âĀĀ L65: “the part of the AP north of 70 S represents...”

Response: Done.

âĀĀ L78: “experience” is typeset is a smaller font?

Response: Done.

âĀĀ L79: delete “help”.

Response: Done.

âĀĀ Sect. 3: it would help in some places to change the formulation to better separate what was done by the authors of this manuscript from what was done by the authors of the references. E.g., instead of writing “.. grounding lines ... were used, modified in places...” (L119) an active voice clarifies: “... they used grounding lines and modified them in places...”; or instead of “Other sources ... were used” (L164): “They used other sources...”.

Response: Done.

âĀĀ L107: it would be good if you indicate (one sentence) how Cook et al. (2012) deal with these gaps.

Response: Cook et al. (2012) do not further comment or deal with these gaps. They just note that they exist (“Some anomalies along the coast have been removed, resulting in small gaps, and the DEM has a small number of remaining artefacts.”). As our intention here was bringing the different datasets together as is (for traceability) rather than manipulating them for improved results, we have not further corrected them. How-

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ever, we fully agree that this could be a next issue to look at in future study.

â€” L188: “...glaciers on Greenland with a strong dynamic connection the Greenland ice sheet should...”

Response: Done.

â€” L190: “strong connection” – I think “strong” is ambiguous here (especially in connection with the word “strong” in the previous sentence. As it refers to space here, perhaps “broad” or “extended” would be better?

Response: Done.

â€” L207ff: I think the greater problem (still not very big...) than the spatial inconsistency is that the thickness estimation also depends on velocity, which is of course connected to ice divides, outcrops, etc. That is, there is a certain degree of internal inconsistency among the data sets used. This could only be fixed by repeating (perhaps even iteratively) certain parts of the analyses that lead to the data sets used – this would obviously be too much to ask for, but I think this problem needs to be mentioned in the manuscript, probably best in the discussion section.

Response: We agree and have now described the problem in Section 6.3.1 in detail. There is indeed little we can do about it now, but we hope that once more complete and accurate information becomes available (e.g. better DEMs, complete flow velocity fields) calculations will be redone by the respective authors.

â€” L219ff: can be shortened to “The sea level equivalent (SLE) of the ice volume is calculated by assuming a mean ice density of 900 kg m⁻³ and dividing it by the ocean surface area (3.625 _ 108 km²; Cogley, 2012).”

Response: Done.

â€” L225: isostatic effects (increasing ocean volume and lifting the land surface) probably have a bigger effect than the dilution, cooling, and ocean dynamics.

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Response: We agree and mention now, that also the isostatic effect is not taken into account.

âÄ L230: “100 m bins”

Response: Done.

âÄ L238f: isn’t this the same as stating “the rock outcrops cover an area of 1709 km²”? - it would be simpler.

Response: Done.

âÄ L240: giving the area of the smallest glacier in the data set has limited value, as it is the smallest “detected” glacier, and there are presumably a large number of very small glaciers missing in the data set (see the discussion in Pfeffer et al., 2014, around that). It would be more helpful to refer to the histogram (Fig. 4).

Response: We agree and have deleted the sentence about smallest and largest glaciers. Later in the paragraph we already refer to Figure 4.

âÄ Table 2: remove digits in the numbers that are clearly within the uncertainty range (e.g., giving minimum elevation on a mm scale...).

Response: Done.

âÄ L247: “a csv-file”.

Response: Done.

âÄ L259/Fig. 4: please specify the size classes (either in a small table, or perhaps better, on the figure axis).

Response: Done on the figure axis.

âÄ L268: “...being 300 m or more higher than ...”

Response: Done.

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âĀĀ L269: what does “in the south” mean here?

Response: Clarified: “The highest elevation is in southern Graham Land. . .”

âĀĀ Tab. 3: it would be good to have uncertainty estimates also here.

Response: See above.

âĀĀ Fig. 6 (also Fig. S3): please indicate the percentiles corresponding to the box and whiskers in the caption.

Response: Done.

âĀĀ L399: “For instance, for a glacier with missing values at the coast, the...”

Response: Done.

âĀĀ L405f: this would also help removing internal inconsistencies, see above.

Response: See above.

âĀĀ L435: “...of a land-terminated glacier...”

Response: Done.

âĀĀ L459: repetition from the paragraph above.

Response: Done. Removed.

âĀĀ L470f: “The lowest 800 m and hence 50 % of the glacierized area are prone to rising ablation and mass loss,...” I don’t understand where the number 800 m comes from?

Response: Above we mention that the hypsometry reveals the half of the glacierized areas being situated below 800 m a.s.l. We refer to that. For clarification we have now written: “With respect to the hypsometry, the lowest 800m and hence. . .”

âĀĀ L238/L481: excluding islands < 0.5 km² or 0.05 km²?

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Response: Done. (0.5 km²).

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