

The Cryosphere Discuss., referee comment RC3  
<https://doi.org/10.5194/tc-2021-79-RC3>, 2021  
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## Comment on tc-2021-79

Anonymous Referee #3

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Referee comment on "Advances in altimetric snow depth estimates using bi-frequency SARAL and CryoSat-2 Ka–Ku measurements" by Florent Garnier et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-79-RC3>, 2021

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The presented manuscript by Garnier et al. shows promising results on the timely topic of snow thickness both in the Arctic and the Antarctic for use especially in sea-ice altimetry to derive sea-ice thickness and subsequent data products. It is therefore relevant and clearly in the scope of TC. However, I found the manuscript is overall lacking some clarity in writing and presenting and I therefore recommend major revisions.

My comments/suggestions are detailed below and are also meant to be challenged.

General Comments:

- In general, I find the manuscript lacks clarity and readability due to a lack of proper use of articles (e.g., the Arctic) and other frequent grammatical errors that need to be corrected.
- Starting with the abstract, parts of the manuscript are hard to grasp for the reader as they are not well structured or flooded with acronyms and multiple line-long passages put into parenthesis.
- Furthermore, while this might sound a bit picky, I found it quite irritating to read Antarctica throughout the manuscript as this would reference the continent, not the region (which would be the Antarctic). This goes in line with the usage of unfamiliar specific terms such as sea ice sinking in L32, which I think should be avoided and replaced by proper, i.e., commonly used terms.
- Aside from these rather editorial remarks, I found the inclusion of the model data rather redundant and fail to have a clear take-home message from this aside from that model data appears to be very bad in general for snow depth. Could the authors

elaborate a bit more on why they choose to include this in the presented way for the different datasets?

- The usage of different time periods for different comparison exercises for the ASD even with the same "reference" such as OIB (e.g., L14-16) comes along quite unintuitively and should be better justified/clarified by the authors!

#### Specific Comments:

L1: Do not capitalize sea-ice thickness (also consider hyphenation); potentially add "retrieval" after sea-ice thickness for clarification!

L2: Please include "the" in front of the term "Arctic" most likely throughout the whole manuscript – but I'll try to point most of them out.

L2: Maybe it is just me, but shouldn't it be the "modified Warren climatology" and not the "Warren modified climatology"?

L3: Please consider using "the Antarctic" instead of "Antarctica" as this geographically references the continent where we would not expect much sea ice anyways.

L9/11: add "the"; see L2

L10: The official website from JAXA uses the acronym "AMSR2" without a hyphen.

L11: "It's" refers to DuST?

L14/16: Why are these time periods different?

L29: For the sake of completeness, a reference to the ESA CCI sea-ice thickness product covering both the Arctic and Antarctic should be included when detailing available sea-ice thickness products. This would be in line with the authors detailed introduction to available snow on sea ice products later on.

Paul, S., Hendricks, S., Ricker, R., Kern, S., and Rinne, E.: Empirical parametrization of Envisat freeboard retrieval of Arctic and Antarctic sea ice based on CryoSat-2: progress in the ESA Climate Change Initiative, *The Cryosphere*, 12, 2437–2460, <https://doi.org/10.5194/tc-12-2437-2018>, 2018.

Or the referenced data publications by Hendricks et al. (2018).

L32: sea ice sinking a very unfamiliar terminology

L37: “transfer of solar heat energy of the ice-ocean interface” reads kind of clunky and should be rephrased as energy from the ocean directed upwards probably does not fall under the term of “solar heat energy”.

L42: “the” again

L56: Insert a space before “Their”

L68: If I am not mistaken, this should be “have” instead of “has” as we talk of the campaigns

L69/70: “the Antarctic” again

L71: There is also an English URL [seaiceportal.de](http://seaiceportal.de)

L86: no “ the” needed before radiometric data

L89 and 58: two different Names for the AMSR-E/2 missions and acronyms... please correct!

L122: remove “over”

L128 following: This part would profit from a numbered list format or bullet points

L134: In general discussion comes before the conclusion

L139/140: In Line 109 the authors referenced CryoSeaNICE as source of the development?

L144: 500x500 of what? Pixels?

L147: Technically, these are still elevations that are compared from what we read before in the text and not yet freeboards.

L150 and 154: The authors reference the Baseline C handbook but use Baseline B data? Is that an error/typo and in case it is not, could the authors elaborate a bit more on their reasoning why they use a quite outdated baseline for their data? And what differences if any they would expect to more recent Baseline-based products?

L170: The abbreviation should be "TFMRA"

L170/174: Could the authors elaborate a bit on their reasoning for a two-time smoothing? Is the data otherwise that noisy?

L175/176: Would one expect comparable results between the two approaches of crossover calculations and monthly maps? Did the authors look into the differences and can provide a bit of insight?

Figure1: I would highly suggest to use "named" subpanels such as a), b), c), etc. as they can be more easily references in the text and the figure caption. This could improve the overall readability of the manuscript.

L219: There is a "." missing before "Because".

L221: Starting in which year ending in 2019?

L247: The sentence reads incomplete after the URL, please change.

Figure2: "winter months" should be clarified in the figure caption

L277: how are they projected? Or rather resampled – using a NN approach? How are multiple assignments dealt with (mean,max,min)?

L293: What do the authors mean by in-situ tracks? The OIB data?

L294: "monthly maps corresponding to that day" – does that mean, e.g. the the 12<sup>th</sup> of January gets monthly map of January? Please clarify.

L303: "lower than" – this means the snow is 3 cm thinner compared to AMSR2B? Please clarify!

L307: "the" Appendix

L309: This reads like we are comparing complete winter seasons but from what I read before I assumed DuST data is only available and used for the months of March and April? This should be clarified by the authors.

L314: only by the spatial availability or also by the temporal?

Table A1 in general is referenced frequently in this section. Maybe the authors should consider to actually include it here and not the Appendix.

Figures 3/4: see comment on Figure 2

L343: "weaker" is quite judging... maybe rephrase to "lower"

L359: I am not familiar with the DuST product in any detail but form what the authors provide as information it is specifically tuned/recalibrated using OIB data yet falls short in

every comparison to OIB data? Could the authors elaborate on their opinion why that is the case and what they do specifically better?

L359: The authors should also stay consistent with their use of Ka/Ku or band/-band throughout the manuscript!

Figure 6: It is quite hard to separate in other figures as well but I found it especially hard in this one between the three different red colors!

L404: "a more optimal" – maybe just say "better/improved"?

L420: Again, this lacks a proper reference to the ESA CCI product, see comment above.

L497: The double "mean" in this term is very confusing and should be clarified.

Figure 12: The order and titles of the figures do not match the figure caption (min, mean, max). The last caption sentence is also unclear from the remainder of the figure caption.

L537: "based"