Response to Editor comments on "TanDEM-X PolarDEM 90 m of Antarctica: Generation and error characterization" by B. Wessel et al. https://tc.copernicus.org/preprints/tc-2021-19/

Point-by point reply to Editor Etienne Berthier's comments

Line numbers refer to the manuscript version (pdf) of 7 August 2021.

COMMENT: L3. This reads as if the DEM computation had been done was in 2013 in 2014. I think here you want to mention the dates of the TDX acquisition campaign. Avoid this ambiguity using "derived from images acquired from April..." or something similar.

RESPONSE: Right, but this sentence is getting too long with too much information that is not needed here. For a better readability, we have decided to delete all acquisition times in the abstract completely, they are mentioned in Sec. 2.1 and in Appendix A. New sentence: "Improvements compared to the global TanDEM-X DEM version ***comprise*** filling of gaps with newer bistatic synthetic aperture radar (SAR) acquisitions of the TerraSAR-X and TanDEM-X ~~***twin***~~ satellites ~~until September 2017~~, interpola***tion*** of smaller voids, smoothing of noisy areas and replace***ment of*** frozen or open sea areas with geoid undulations."

Please note that we adjusted the time frame of the TanDEM-X DEM acquisitions by one month, as they ended actually in October 2014 (in Sec. 2.1 and in Appendix A).

COMMENT: L37. A reference should be given for this mean value. We do not know where it comes from

RESPONSE: Thank you for noting. The approx. 3 m penetration bias is referring to the results of this study: the found overall penetration bias compared to ICESat heights of -3.22m. In order not to anticipate, we will omit this information here.

COMMENT: L51. To be updated maybe

RESPONSE: Thank you. We changed the last access date to 27 Sept 2021

COMMENT: L99. It was unclear to me how the degree of reliability for individual point is defined. To be clarified.

RESPONSE: Thank you. We added a new sentence for the selection of the ICESat points in general: "The quality of the ICESat points is estimated by the number of ICESat peaks and the ICESat signal width (Gruber et al., 2012) in order to obtain ground control points on mainly bare and flat terrain and to avoid points on slopes, local relief or over noisy areas. … For reliable validation points, in addition the standard deviation of the TanDEM-X DEM within the footprint must be below 1 m." and

"For each geocell only the 1,000 most reliable points ***in terms of the lowest TanDEM-X height standard deviation within the ICESat footprint were selected for validation.*** "

COMMENT: L111. I do not think a cap letter is needed for "Laser"

RESPONSE: changed to -> laser

COMMENT: L171. Should be TanDEM-X. Check homogeneity.

RESPONSE: Thank you for your note, we checked it for the whole paper.

COMMENT: *L323. Delete "of" and add ","*

RESPONSE: changed.

COMMENT: *L332. repetition of "the". I would like to ask the author to do a very careful proof-read.*

RESPONSE: thank you, deleted. We proof-read the whole paper again.

COMMENT: L351. Could cite here : *https://tc.copernicus.org/articles/15/4399/2021/*

RESPONSE: We found no quantitative evaluation for blue ice areas there. This reference will be cited for the correction method in the conclusions, see response to L473.

COMMENT: *L355. Authors need to call the figures in a continuous order (may need to reorder the figures)*

RESPONSE: Thank you, we already re-arranged the Figures for the last update. Confusingly, the aforementioned references refer to figures that are further ahead.

COMMENT: *L374.* Authors need to remove all occurence of superlative such as "impressive". This is to the reader to judge this not the authors themselves.

RESPONSE: We agree and changed "impressive" in two occurrences with "… value of ***just XXm***…"

COMMENT: L403. "High" not needed.

RESPONSE: omitted.

COMMENT: L409. This statement suggest no penetration of the Cryosat-2 signal. Is it the case? Need a reference for that and a sentence of discussion.

RESPONSE: As CryoSat-2 is a radar measuring system in Ku-Band, it has a signal penetration into the snow&firn e.g. of up to 1m, see https://geusbulletin.org/index.php/geusb/article/view/5369 . Though it is much smaller than that for TanDEM-X. Here, we simply added "higher" to indicate that both systems have a penetration.

COMMENT: *L418. Why would the penetration bias be related to the type of processing, this is unclear to me. At first sight, it looks more like a CS2 processing issue than a penetration issue.*

RESPONSE: You seem to have got the point right. The authors of the CryoSat-2 DEM have a follow-on publication about a processing method which reduces the penetration depth (Slater et al. 2019 https://ieeexplore.ieee.org/document/8790972). We changed this sentence to a more objective description: " On the one hand, the TanDEM-X DEM elevations in this area are less affected by a penetration bias. On the other hand, it seems that CryoSat-2 DEM has ***a penetration dependency on the processing ~~mode~~ method (Slater et al. 2019),*** because the mode mask boundary between CryoSat-2 LRM and SARIn processing modes is obviously visible (Figure 17).

New reference: Slater, T., Shepherd, A., Mcmillan, M., Armitage, T. W. K., Otosaka, I., and Arthern, R. J.: Compensating Changes in the Penetration Depth of Pulse-Limited Radar Altimetry Over the Greenland Ice Sheet, IEEE Transactions on Geoscience and Remote Sensing, 57, 9633–9642, https://doi.org/10.1109/TGRS.2019.2928232, 2019.

COMMENT: L421 : -4.00 (minus sign needed)

RESPONSE: Thank you very much for this finding!

COMMENT: L433. AIS, see inset of Fig 18)

RESPONSE: changed to "(… AIS, see inset of Fig. 18)

COMMENT: L439. Here should start a new paragraph.

RESPONSE: Paragraph inserted.

COMMENT: L456. See my comments above about "impressive". Avoid superlative.

RESPONSE: We agree and substituted "brilliant" by "very good".

COMMENT: Fig 19. Can the authors make the lines thicker, including in the legend? It is not so easy to distinguish them.

RESPONSE: We changed the line width in the profiles of Fig. 19 incl. legend from 0.5mm to 1.0mm.

COMMENT: L473. Rott et al., TC, 2021, should be cited here as they propose a correction based on the cohérence.

RESPONSE: Reference integrated: "A further refinement of this data set might be possible by correcting the penetration bias, as shown shown e.g. by Abdullahi et al. (2019) on the base of coherence and amplitude ***or by Rott et al. (2021) on the base of the interferometric volume correlation coefficient***,"

COMMENT: L475. And also further South where you clearly described a bias.

RESPONSE: added: "a re-calibration near the Antarctic Peninsula ***down to Getz glacier***"

Finally, we would like to thank the editor again for his very careful reading and valuable comments, which have significantly improved the manuscript.