



Interactive comment on “A detailed radiostratigraphic data set for the central East Antarctic Plateau spanning the last half million years” by Marie G. P. Cavitte et al.

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Response to RC1 comments on the submitted paper *A detailed radiostratigraphic data set for the central East Antarctic Plateau spanning the last half million years*

We thank the reviewer/editor for his constructive comments and detailed review of our manuscript. We have responded to all of them and have modified the paper accordingly, our point-by-point answers follow. Review comments are in grey italics while our

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answers are not.

Please note that Fig. 8 was moved up in the manuscript following Reviewer 3's suggestion. It now features as Fig. 4 and all subsequent Figs have been renumbered.

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Answers to RC1

Page 2, item 1

Answer: We have removed “at the time”.

Page 2, item 2

Answer: We replaced “ice core chemistry variations” with “conductivity variations”. And have modified slightly the the second radar return origin description given above to: “(2) ice chemical composition variation, and therefore conductivity variation, resulting from the successive...”

Page 2, item 3

Answer: We have added a reference to the official first Report of AntArchitecture Workshop, July 2017, entitled “AntArchitecture: Archiving and interrogating Antarctica’s internal structure from radar sounding” here.

Page 3, item 1

Answer: We have made this subsection into a new section (Section 2).

Page 3, item 2

Answer: The reference has been fixed.

Page 3, item 3

Answer: We have added the Lilien et al., TCD, 2020 reference.

Page 4, item 1

Answer: We now specify it is MCoRDS, version 2, that was used to collect the data.

Page 4, item 2

Answer: There was an issue with the table typesetting. We have now corrected all the table numbers appropriately. Here, it now reads “Table 1 and 2”.

Page: 5 item 1

Wouldn't it be more appropriate to provide the center frequency for an impulse system and 1-sigma bandwidth? It is not defined in the same way as a chirp.

Answer: We prefer to keep the same notation for all three systems. From the range given, the center frequency and the bandwidth can be back calculated.

Page 5, item 2

Onboard Presumming - which is equivalent to vertical stacking?

Answer: We are very specific here in our choice of vocabulary because we refer to the horizontal stacking that happens onboard, *before recording*. For consistency, we have changed it to “onboard stacking”, term that was used in the Young et al., 2016, Phil. Trans. R. Soc.

Ref: Young D. A., Schroeder D. M., Blankenship D. D., Kempf Scott D. and Quartini E. 2016 The distribution of basal water between Antarctic subglacial lakes from radar sounding, Phil. Trans. R. Soc. A. 374:20140297, <http://doi.org/10.1098/rsta.2014.0297>

Page 5, item 3

Answer: Same issue with table typesetting. Here, it now reads “Table 2”.

Page 6, item 1

For better readability, I suggest to use italic pik1, foc1, foc2 throughout the manuscript

Answer: We agree and have made the suggested change throughout the manuscript.

Page 6, item 2

Answer: Pulse length and pulse width are synonyms. We prefer to retain pulse width, which we and co-authors have also used in previous papers (Peters et al., 2005, Gogineni 2014, etc).

Page 6, items 3 & 4

Answer: This has been changed.

Page 6, item 5

Answer: Same table issue. This has been fixed.

Page 6, item 6

Answer: Space has been added.

Page 6, item 7

Answer: The two references (Arnold et al., 2020; CReSIS, 2016) were added.

Page 8, items 1 & 2

Answer: The two footnotes have now been fixed.

Page 8, item 3

Answer: Table number has been fixed. It now reads “Table 2”.

Page 8, item 3

Answer: Table number has been fixed. It now reads “Table 2”.

Page 9, item 1

Answer: Removed.

Page 9, item 2

Does that mean lower SNR = larger window? What does that information help here, how did you use it?

Answer: This window is the picking window that the software uses to find the maximum return in amplitude. Depending on the roughness of the IRH traced, the window (in twtt) is adjusted. We have reworded slightly this sentence for clarity to: “...as a function of the local roughness of the specific...”.

Page 9, item 3

Answer: We have clarified that it is wind redistribution, subsequently buried, and have generalized the processes that can act to truncate an IRH: “A traced IRH can start off looking bright and easy to follow, but due to various processes (e.g. wind redistribution of surface snow which then gets buried, enhanced ice flow, ...), can get truncated further along a survey transect.”.

Page 9, item 4

Answer: Added.

Page 9, items 5 & 6

Answer: Footnotes have been fixed.

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Page 9, item 7

Answer: Multiplication sign has been removed.

Page 9, item 8

Answer: Changed to: $3 \times 10^8 \text{ m s}^{-1}$.

Page 9, item 9

Answer: Modified as suggested.

Page 10, item 1

Answer: Added.

Page 10, item 2

Answer: twt was a typo, it should have been twtt. We prefer to keep the acronym “twtt” in the equation for clarity for the readers, rather than define a new variable “t” that we would then have to equate to twtt.

Page 10, item 3

Answer: We have chosen to retain “electromagnetic velocity” everywhere.

Page 10, item 4

Answer: Changed as suggested.

Page 10, item 5

Answer: Changed.

Page 10, item 6

Answer: The sentence has been modified accordingly as follows: “Since all our IRHs are below the firn transition, temperature and ice fabric variations have a small effect, i.e. we can ignore variations in ϵ'_{ice} with depth and use a constant value.”

Page 10, item 7

Answer: This transect is now highlighted in grey on Fig. 1 and in the figure caption as follows: “The HiCARS MCM/JKB1a/EDMC01a radar transect is highlighted in dark grey”. We have added the Cavitte et al., 2016 reference.

Page 11, item 1

Answer: Paragraph removed.

Page 11, item 2

Answer: Indeed. The start of the sentence has been modified to: “The first source of depth uncertainty comes from the vertical resolution...”

Page 11, item 3

Answer: Table number fixed.

Page 11, items 4, 6, 7, 8

Answer: Multiplication signs removed.

Page 11, item 5

Answer: We have changed “ p_w ” to “ p_w ”.

Page 11, item 9

Answer: We have chosen to add `lambda_ice` in Table 1.

Page 11, items 10 & 11

Answer: We wanted to retain the same typology as in the Cavitte et al. (2016) paper, but for clarity, we have chosen to modify $\sigma(r^*)$ to σ_r .

Page 11, item 12

Answer: Indeed, the SNR needs to be converted to a linear scale. This is now mentioned right after equation 4: “with SNR given on a linear scale”. There was a typo in Eq. 4 that we have now corrected.

Page 11, item 13

Answer: Not sure why a full stop is asked at the end of “SNR” in the equation. We have left it as is.

Page 11, item 14

Answer: Changed as suggested.

Page 11, item 15

Answer: Modified as suggested.

Page 11, item 16

Answer: Modified to “Table 3”.

Page 12, items 1 & 2

Answer: Here, we want to make it clear that we are providing a depth error and an age error, which is \pm the value given.

Page 12, item 3

Answer: We have added the information here: "...considering the radar resolutions (4.30 m minimum) and the surface accumulation rate (~ 25 mm yr⁻¹, Stenni et al. 2016), we assume..."

Page 12, item 4

Answer: Modified as suggested.

Page 12, item 5

Answer: The name has been added here and in several other places in the manuscript where the chosen site was mentioned.

Page 12, item 6

Answer: The Lilien et al., 2020, TCD has been added.

Page 13, item 1

Answer: Modified.

Page 13, item 2

Answer: We did not understand the suggested addition.

Page 13, item 3

Answer: Fixed.

Page 13, items 4 & 5

Answer: Changed

Page 13, item 6

Answer: It now references Table 3.

Page 13, item 7

Answer: By cold ice, we mean that surface conditions are very cold, which implies good preservation of the internal stratigraphy (good specular returns). We have slightly modified this sentence for clarity as follows: “The LDC is a region where the combination of the very flat internal stratigraphy (due to the low surface velocities) and very cold surface conditions ($\sim -54.5^{\circ}\text{C}$ on average year-round, EPICA community members et al., 2004) results in good preservation of the internal stratigraphy and therefore all 19 dated IRHs continuously traced over the whole area.”

Page 13, item 8

Answer: We choose to not specify which direction because this is true for all directions, as soon as the IRHs are no longer over the LDC massif.

Page 13, item 9

Answer: We have reworded it to “become difficult to trace”

Page 13, items 10, 11 & 12

Answer: We have simplified the “we can then” heavy sentence structure as follows: “From the measured undated IRHs depths, we sample the simulated age-depth field

and assign a modeled age to every trace along the radar transects (Fig. 8). We then calculate a mean modeled age for each undated IRH, provided in Table 4, as well as the age standard deviation,...". Note that it should have stated "Table 4" and not Table 3. It has been corrected as well.

Page 14, item 1**Answer:** Modified***Page 14, item 2*****Answer:** Modified***Page 14, items 3 & 4***

Answer: This paragraph has been moved to the discussion, and the Young et al (2017) and Lilien et al (2020) papers, as well as the Cavitte 2017 published thesis, that all mention this stagnant ice have been added as follow: "Note that there is now evidence that there is a layer of ice just above the bed, and in particular over the LDC highland plateau, with different electromagnetic properties, which is assumed could be stagnant (Young et al., 2017; Cavitte 2017; Lilien et al., 2020). The Parrenin et al. (2017) ice flow model version used does not take this stagnant ice into account, which could make the basal ages, and therefore the seven bottom IRHs, too young in the present modelling. A new version of the 1-D model that takes into account this stagnant layer has been developed and it will be interesting to compare the new ages obtained (Fred Parrenin, pers. comm.)."

Page 14, item 5

Answer: We have added this information as follows: "cold surface temperatures year round ($\sim -54.5^{\circ}\text{C}$ on average, EPICA community members et al, 2004, and therefore

absence of melting at the surface) and the lack of..."

Page 15, item 1

Answer: We have added "(HiCARS, MCoRDS or DELORES)" after "radar returns" to be explicit. BedMachine is shown on the figure as a basemap only.

Page 15, items 2 & 3

Answer: Added.

Page 15, item 4

Answer: We have added " which show no overlap" to be explicit.

Page 16, item 1

Answer: The basemap greyscale has been adjusted, and geographical coordinates have been added.

Page 16, item 2

Answer: Added.

Page 16, item 3

Answer: The insulating thick ice above and the GHF do not compete but rather act together to increase the basal temperature. We have left this sentence unchanged.

Page 16, item 4

Answer: Yes, we mean a lower SNR. We have added this information: "Temperature affects the dielectric permittivity of the ice and can result in a strongly attenuated radar

return and a lower signal to noise of the IRHs”.

Page 17, item 1

Answer: Tractable is the correct word here, in the sense of “possible”.

Page 17, item 2

Answer: Added.

Page 18, item 1

Answer: Changed

Page 18, items 2-5

Answer: We agree with the changes but have written a slightly modified form: “The formulated goal of the AntArchitecture community is to have a joint community effort to build an Antarctic-wide IRH data set to check the match between all previously traced and published IRH data sets that can be directly connected for the East Antarctic Plateau region (to name a few, Siegert et al., 1998a; Winter et al., 2019). Eventually, the aim is that IRHs from currently disconnected surveys (e.g. Steinhage et al., 2001; Leysinger Vieli et al., 2011; Steinhage et al., 2013) are also connected after the collection of additional radar campaigns in the gap areas.”

Page 18, item 6

Answer: Added.

Page 19, item 1

Answer: Added.

Page 19, item 2

Answer: Added.

Page 19, item 3

Answer: We have chosen to change the sentence to relate to the historical use of these data instead, and add the information suggested. The sentence now reads : “This data set was used to corroborate suspicions of 1.5 million-year-old ice in the Little Dome C region (Van Liefferinge and Pattyn, 2013; Parrenin et al., 2017), and will also provide the basis for a regional assessment of age at depth for other planned deep drillings in this region (e.g. Australia)”