Archival processes of the water stable isotope signal in East Antarctic ice cores.

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General comments: The submitted manuscript presents field measurements of water stable isotope signal in East Antarctic ice cores. Combine observations of isotopic composition in the vapor, the precipitation, the surface snow and the buried snow from Dome C were done. The results of this study are interesting: Surface snow isotopic composition is affected by post-deposition processes, in particular, exchanges between the atmosphere and the snow pack which were also observed in the laboratory work by Ebner et al. (2017). Further, the variations of the $\delta^{18}O$ signal with depth in shallow firn cores do not correspond to past climatic seasonal variations.

Specific comments: It is not easy to understand the manuscript. Especially the section with the results lacks a comprehensible structure. In order to get a context, the individual contents have to be gathered together over the sections. Additionally, more explanations of the extracted values are needed and some statements are far out because no work can be cited (only personal communication of researchers). In addition, important data (e.g. the depth where the samples were taken, …) are too much spread out throughout the whole manuscript, I would recommend adding these values into a table to have an easier overview. The nomenclature of the parameters in the text and figures are sometimes different and also some figures need better captions. Also, the comparison with other locations in the Antarctic is hard to understand as they have totally different conditions and sampling procedure. Finally, I would recommend plotting the extracted slopes to the corresponding data to see how well they fit.

Based on my comments I would suggest that the authors revise the manuscript carefully and rewrite the method and result part to make it better understandable for the reader. In my opinion, either a clearer focus is needed or the reasons for using the additional data sets must be clearly defined on an individual basis. Otherwise, I would recommend the editor to reject this paper. Although these data are very interesting, the authors are unable to explain and link them plausibly. For a publication of the manuscript in its present state, the structure is simply inadequate and some statements are formulated too vaguely. Beside good results, it is necessary to present it to the readers in a clear and comprehensible way.

Detailed comments:

Page 4, Line 16 – 22: There are experimental results where an interaction of the stable isotopes between snow and the surroundings were observed. More information can be found here: https://www.the-cryosphere.net/11/1733/2017/tc-11-1733-2017.pdf

Page 5, Line 7: "This study mainly focuses on Dome C,…" -> already 2 sentence later, you're explaining the comparison to all the others sites. So what are you really focusing on?

Page 5, Line 11: What do you want to say with the expression "joining"?

Page 6, Table 1: Why is the "AWS mean temperature" for Dome C equal to "NA" but they measured a "firn temperature" of -55.1?

Page 6, Line 13: What is a "clean area"

Page 6, Line 15: "average value of two samples" -> Can you say anything about the standard deviation?

Page 7, Line 4: "If the amount of snow on this second table was sufficient, …" -> What does "sufficient" mean?

Page 7, Line 7: "… that the protocol of surface snow sampling from the PRE-REC campaign differs greatly from the protocols from the NIVO and SUNITEDC programs due to the presence of the wood plate" -> If they "differs greatly", does it make sense to compare each other?

Page 7, Table 2: What does "Resolution" mean? Did they take for every e.g. 7 days samples? And I would also suggest mentioning the depth and sickness of the samples.

Page 7, Line 13: "For one of them, …"-> It would be good to mention which one was taken.

Page 7, Line 14: "plastic flasks" -> Were they air-tight and what did you analyze?

Page 7, Line 15: "… we compare the isotopic profiles to other snow pit samplings performed …" -> Where were the other snow pit samplings taken in East Antarctica? Do you have an overview on a map? Are they comparable?

Page 7, Line 20: "… beyond the decorrelation scale of the stratigraphic noise …" -> What is the distance to be "beyond the decorrelation scale of the stratigraphic" noise?

Page 8, Table 3: I would suggest adding more information, like the depth of the snow pits.

Page 8, Line 4: "… any impact of the sampling technique …" -> Why don't you expect any impact of the sampling and impact on what? Please provide some information.

Page 8, Line 15: "… we found a good agreement at the seasonal scale and fairly good agreement at the event scale (not shown here)." -> What does this statement mean for the presented results? And what is an "event scale"? Why don't you want to show it?

Page 9, Line 2: "When available, we include SSA measurements …" -> Why was it not possible to always include the SSA measurements?

Page 9, Line15: "… and the temporal slope of the isotopic …" -> What is the temporal slope? Can you provide some information?

Page 10, Line 27: "$\delta^{18}O_s$" -> Does this stand for the isotopic composition of snow? And is it the same like $\delta^{18}O_{snow}$ in Figure 3?

Page 11, Table 3: What is the resolution of these data, hourly, daily, averaged over the time, …?

Page 11, Line 1: "… are in agreement with the isotopic composition of precipitation (Dreossi, personal communication)" -> Where can I see it that it is in agreement? Please, can you provide the data of the personal communication, etc.?

Page 13, Line 13: "$\delta^{18}O_p$" -> Does this stand for the isotopic composition of precipitation? And is it the same as $\delta^{18}O_{precipitation}$ in Figure 3?

Page 13, Line 26: "The results of this modelled surface snow isotopic composition are …" -> Where is the modeled surface snow isotopic composition descripted?

Page 14, Line 3: "The model accurately reproduces some of the differences between the signal in the surface snow and in the precipitation …" -> It is hard to compare the signal in the surface snow and in the precipitation because there is only one year of overlapping (Figure 3).

Page 14, Line 9: "$\delta^{18}O_m$" -> Does this stand for isotopic composition of the model? And if yes, where is the model defined?

Page 15, Figure 5: Why are there some data missing (12:00 – 16:00) for the "Snow $\delta^{18}O$"? In the text, it is mention that every hour samples were taken.

Page 15, Figure 5: At which height have you measured the water vapor?

Page 15, Line 1: "… represents the noise on the surface snow due to the spatial variability" -> Have you extracted the noise from two measurements (Page 14, Line 32: "… two samples were taken from a random location …")?

Page 15, Line 4: Why is the exchange of moisture "important"?

Page 15, Line 7: "$\delta^{18}O_v$" -> Does this stand for the isotopic composition of vapor? And is it the same as "Vapour $\delta^{18}O$" in Figure 5? (uniform nomenclature?)

Page 16, Line 1: "… without being impacted by meteorological events …" -> Could you give more details: what do you mean by "meteorological events"?

Page 16, Line 7: "… ranging between 105% and 125% …" -> That is a big difference compared to "100% and 180%" shown in Figure 5. So, with the absorbed ice crystals the humidity graph in Fig 5. is worthless? Why don't you show the effective humidity measured by this "other hygrometers"? What other effects can the absorbed ice crystals have on the measured signal?

Page 16, Line 10: "… is synchronous with observations of mist and solid condensation due to local large supersaturation." -> Where have you observed the mist and solid condensation? Do you have any data?

Page 16, Line 32: "… (personal communication from …)" -> I see this explanation a bit questionable, please provide more details.

Page 16, Line 32 and 34 and following Lines: Remove the points between the units

Page 17, Line 14: "… $\Delta n_v^{18} = 5.6 \ 10^{-4}$ mol m^{-2}" -> How do you get this number? What value did you take for R_v^{18}, Δn_v, n_v, ΔR_v^{18}? And what is R_v^{18} and n_v?

Page 17, Line 15: "… with the fractionation $n_v \Delta R_v^{18}$ accounts for less than 10% …" -> Can you please provide more information? I cannot see how you get the 10%.

Page 18, Line 12: "… 1.91 ‰ close to the observed value of 1.99 ± 0.3 ‰ in the surface snow $\delta^{18}O$ (see Fig. 5)" -> Can you provide more information how do you extract the value of 1.99 ± 0.3 ‰ from Fig. 5? What is the initial and final state of the frost deposition?

Page 19, Line 1: "… the vapor is enriched in heavy isotopes while snow is depleted during frost deposition events." -> Is there an explanation for this? Why isn't it the opposite: If there is an exchange between vapor and snow, the vapor should be depleted in heavy isotopes because due to the higher mass than light isotopes, the heavy isotopes prefer more the solid state than the vapor state.

Page 19, Line 1-9: How can you compare your results at Dome C with other stations like Kohnen or NEEM if they have totally different conditions?

Page 19, Line 9: "Similar studies measuring …" -> Can you name them?

Page 19, Line 34: … during summer 2015, we observe significant variations of the surface snow isotopic composition while no precipitation input was identified, …" -> Please provide more information because according to Fig. 3 there was precipitation (snowfall) during summer 2015.

Page 20, Line 2: "… variations of roughly 8 ‰ observed in the surface snow isotopic composition are in phase with the temperature variations." -> I wouldn't say that they are in phase e.g. 1/2013 they are not in phase. I would recommend to say that there is a similarity in the variation.

Page 20, Line 16: "… are associated with a small and delayed increase of grain index (in both case, the main increase of grain index happens after the 15th of January, whereas for normal years, it starts the first week of December)." -> But what about 2011, it is also small and delayed and the increase is also at beginning of January.

Page 20, Line 21: "By contrast, there is no apparent relationship between the isotopic composition of precipitation and the grain index from 2008 to 2011." -> Please provide more explanation for this statement because the peaks between the isotopic composition of precipitation and the grain index matches well.

Page 21, Figure 7: The colors in the plot and in the caption are different.

Page 21, Line 1: "From the 16th of December, we observe … a first decrease of SSA indicating …" -> Due to the large variation in the SSA it is quite hard to say that there is a SSA decrease and how do you explain the high SSA around 20th of December?

Page 21, Line 3: "… numerous drift events mix the snow and therefore cause strong spatial variability." -> Do you have evidence for this conclusion?

Page 21, Line 4 – 14: -> Please provide more measurements/results to validate this statement. Why is there a sudden drop around 8th of January?

Page 22, Line 1: "… include both spatial and temporal variations as only one sample per day was taken, therefore some of the variability might be due to spatial variability." -> Does it make sense to use the data if you can have a variation of up to 18 ‰ which is quite large?

Page 22, Line 28: "… from the annual accumulation at Dome C (7.7 cm)." -> How did you get this value (7.7 cm)?

Page 22, Line 31: "… spacing between $\delta^{18}O_N$ …" -> What does "N" stand for?

Page 22, Line 31: "…between $\delta^{18}O_N$ maxima in the profiles … present a systematic average value of 20 cm" -> I cannot see systematic maxima in these graphs but a variation between 20 cm and 40 cm …

Page 23, Figure 8: At which depth were the snow pits taken? How did you make sure that the snow samples were air-tight, especially from the year 1977 and 1978?

Page 23, Line 14: "… Vostok with seven snowpits with …" -> It's six according to Table 4.

Page 24, Line 1: "… but our manual counting method, applied to a limited number of pits with relatively low resolution, would not enable to detect small differences." -> What do you mean by "small differences"? What differences?

Page 24, Line 8: "… of the potential climate signal and non-climate noise." -> What do you mean by "non-climate noise"? Is it a local signal?

Page 25, Line 10: "The limited resolution of the S2 profile may thus explain why no seasonal cycle of isotopic composition is visible." -> Please mention again the resolution of the S2 profile. In this statement, you say that no cycle is visible of the S2 profile but in Figure 12 a cycle of isotopic composition is visible…

Page 25, Line 28: "… similar to the one found from the data from the transect between Terra Nova Bay and Dome C …" -> Please provide the number.

Page 25, Line 26 – Page 26, Line 2: Please show in Figure 10 all the extracted slope you mention in this section.

Page 26, Line 8: "The reduced summer temperature inversion at Dome C is thus not taken into account in the MCIM which could also lead to a reduced slope." -> Does it

make sense to compare the Model with measurements? How big is the reduced summer temperature inversion?

Page 27, Line 15: "As the phase lag is smaller in 2011 …" -> Which "phase lag"?

Page 27, Line 14 – Page 28, Line 2: Please show the extracted slopes in Figure 10.

Page 29, Line 1: "(d – *excess* or ^{17}O – *excess*)" -> I would recommend to change it to "(d_{excess} or $^{17}O_{excess}$)"