Climate of the Past Discussions

Clim. Past Discuss., referee comment RC1
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Comment on cp-2021-37

Anonymous Referee #1

Referee comment on "Improving temperature reconstructions from ice-core water-isotope records" by Bradley R. Markle and Eric J. Steig, Clim. Past Discuss., https://doi.org/10.5194/cp-2021-37-RC1, 2021

Markle and Steig are presenting quantitative temperature reconstructions obtained from Antarctic ice cores using an improved methodologies which considers the non-linearities in the water isotope/temperature relationships both at the sites (surface and condensation temperatures) and in the precipitation moisture source regions (SST and initial evaporation temperatures). They use a new and relatively "simple" (at least as stated by them) isotopic model, named SWIM, which relies on previously Rayleigh type models (for example the MCIM) and technically explained in a long Appendix, longer than the manuscript itself, although useful for understanding the whole concept. Furthermore, the authors provide a Southern Hemisphere (SH) temperature changes through time, providing Antarctic stacked records, as well as a spatial pattern of LGM-Holocene temperature change in the SH.

The paper calls into questions previously quantitative temperature reconstructions that used isotopic models as well but were not considering the non-linearities embedded in the isotope/temperature relationships.

The paper is interesting, innovative and the topic is appropriate for Climate of the Past.

Nevertheless, the authors should consider some comments reported below before resubmitting a revised version. I will group these comments below and then some detailed and minor/technical comments will follow.

General comments:

- The structure of the manuscript: as reported above, the appendix is very long, and I am not sure that from an editorial point of view this is a good point. However, what explained in the appendix is useful for understanding the SWIM isotopic model and the differences respect to the previous ones. So, I would leave the decision on what to do to the editor. However, I would suggest moving at least 1 or 2 figures from the appendix into the main text, in particular those reporting the differences between previous temperature reconstructions and the one reported in the present study (figure A 27) and the one reporting the main moisture sources for the different ice core sites (A24 or A8).

- The figures: sometimes I found difficult to understand the different colours and, in some cases, for examples for EPICA Dome C the same colour is used for different reconstructions, as in the case of Stenni et al. 2010 and Uemura et al. 2012. Moreover, in some case it is not possible to understand the different ice core records. I believe that this information is needed. Indeed, for EPICA Dome C and probably also for EPICA Dronning Maud Land the old and new reconstructions are quite similar also considering the uncertainties in the reconstruction's methodologies.

- The impact of these new reconstructions seems to be more important for some sites. Something about this is already mentioned in the text but I would like to visualize better the major differences between previous and this study reconstructions. Perhaps also in the text. See the comments above on the figure colours.

- Regarding the discussion about past elevation changes in West Antarctica from LGM and the Holocene: I would also refer to the Werner et al. (2018 Nature Comm) paper regarding this. Regarding the EDML reconstruction, are the upstream effects considered?

Detailed comments:

Page 10, Figure 5: It would be important to have a legend for the different ice core records. Moreover, some colours are very difficult to see. One record, but I do not know which is (the blue one…) has more positive dxs values at 20 kyr … which is strange…

Page 13, lines 14-19: I do not understand the difference between the absolute and relative uncertainties. Please, may you explain better? An this obviously refers also to Figure 7.

Page 17, lines 9-15: here you are referring to the difference in reconstructions techniques. I would suggest adding here the figure A27 and change the colour for EDC between Stenni et al (2010) and Uemura et al. (2012). See also my comments above.

Page 17, lines 17-27: in this paragraph you are referring to other T reconstruction techniques. What about a recent paper by Buizert et al. 2021, of which one of the authors of the present study, is co-author? Also considering elevation changes effects and reporting quite different cooling during LGM than the ones reported here as well as previously by also other authors. Perhaps a comment on this would be the case, or here or also later in the discussion paragraph, also referring to Figure 11.

Page 42, lines 6-7: this is in contract with observations in precipitation at Concordia station (Stenni et al., 2016) where mean annual precipitation weighted isotopic values are less negative than arithmetical means and temperatures are warmer ….. if I understood correctly.

Page 42, lines 28-29: in Masson-Delmotte et al. most of the samples are from surface snow (or mean of firn shallow cores) rather than precipitation.

Minor and technical comments:

Page 1, line 16: Change "Barbante et al." in "EPICA Community Members"; change also in the References.

Page 1, line 19: add "$*10^3$";

Page 14, line 7: add "of" between "function" and "reconstructed".

Page 15, figure 8: the grey lines are not visible, and the same for light grey and thin dark grey ….

Page 16: figure 9: it is not possible to see in a clear way, moreover no way to understand to which ice core records you are referring.

Page 18, lines 8-10: I would suggest to add here something more about elevation changes ….. see paper from Werner et al 2018.

Page 19, figure 11: also here I had some difficulties with the colours in panel a).

Page 21, lines 1….. again the comment above on elevation changes

Page 21, lines 11-12: the linear definition of dxs is an unreliable …. At Dome C this doesn't seem the case..

Page 26, line 22: I suppose that "complication" is compilation…

Page 32, line 10: I suppose that "modification" is fractionation.

Page 58, line 21:I suppose that one of "Ts" is Tc.

Page 61, line 1: please, change "EPICA Dome Concordia" into EPICA Dome C.

Page 63, figure A27: see my comments above regarding EDC (please use different colours for Stenni et al and Uemura et al). Please check also EDML for upstream corrections.

Page 63, lines7-9 and also page 64 lines 1-2: there are two sentences that are repeated.