Climate of the Past Discussions

Clim. Past Discuss., referee comment RC2
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Comment on cp-2021-37

Anonymous Referee #2

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-RC2, 2021

General comments:
This manuscript describes the improved method for reconstructing Antarctic temperature based on ice core water isotope record. Although the manuscript is very long (70 pages), it is organized well and easy to read. The previous temperature reconstruction methods based on the Rayleigh-type model has been properly improved and many potential uncertainties and/or assumptions (closure assumption, inversion temperature, mixing of air mass etc.) are carefully evaluated. Overall, this manuscript is very interesting and suitable for publication in Climate of the Past. To improve the manuscript, I made some comments below.

Major comments
(1) Abstract "..However, there are important nonlinearities that significantly affect such reconstrugion..Here, we describe a temperature reconstruction method that account for these nonlinearities.."

I think the Abstract (and main text) overemphasizes only the difference between linear and non-linerar reconstructions. The difference between this and previous studies results from not only linear/non-linear technique but also different settings (evaporation, supersaturation, etc.) used for isotope modelling. I think the important contribution of this study is the careful examination of various factors one by one, which surely improve the understanding of uncertainty of several important assumptions. I think it is better to write this point in the abstract. In fact, the authors themselves noted that "The difference between the results of this study and the previous temperature reconstructions arise from differences between the linear and nonlinear reconstruction technique as well as differences in the underlying water-isotope models used for the estimation of scaling relationship".

(2) Evaporation from the ocean (Appendix A2.1).
P27 L15 ".. this "local" closure assumption.. "
> Since Merlivat and Jouzel (1979) assumed a global steady state of water cycle, the assumption (Rv=Re) has been commonly referred to as "global closure assumption". But, here, the authors termed this as "local" closure assumption. To avoid unnecessarily confusions, it is better to add short explanations about different terminology.
By the way, this section (A2.1) is interesting and includes important analyses. In fact, the different assumptions affect the T reconstructions (Fig A21). So, I think this section, at least some part, may be moved to main text.

(3) P20 L1-6 "We find smaller glacial-interglacial temperature change for East Antarctic sites compared to previous reconstructions .. The average warming at the two highest sites however, Dome Fuji and Vostok, is significantly less, just 6.9 degC or 59% of that at the lower sites."
> Previous T reconstructions at DF and Vostok are 7.5-7.8 deg C (e.g., Vimeux et al. EPSL 2002, Uemura et al., CP 2012) (depending on time intervals you choose). Thus, the difference between previous and reconstructions is only 0.6-0.9 degC, which is not significant. For objective comparison, it is better to describe the exact differences from past reconstructions and add short descriptions.

(4) P53. L11-13 "such as the value of the diffusive fractionation factors during transport.."
Does your model include the eddy diffusive fractionation during transport, like described in Hendrick et al. (GBC, 2000)? If so, please describe it in the Appendix.

Hendricks et al., GBC, https://doi.org/10.1029/1999GB001198

(5) Difference between delta-age based temperature.
A recent paper by Buizert et al. (2021) claimed that Antarctic temperature during LGM is less than those estimated with the water isotopes. And they suggest that the difference can be attributable to an altered Antarctic temperature inversion during the LGM. This finding is very closely related to the topic of this manuscript. Maybe this is beyond the scope of this paper. I would like to ask about some comments about the differences between this and Buizert et al. (2021) (actually, the second author of this manuscript is a coauthor of Buizert et al. 2021).

Buizert et al. (2021) Antarctic surface temperature and elevation during the Last Glacial Maximum, Science, 10.1126/science.abd2897

Specific comments
Figure 5 left panels > I don not see each profile corresponds to which ice core. Please add appropriate legends in left panels.

Figure 8 Legends > Please sort in order of condensation temperature, to make it easier to compare with color profiles in panel c and d.

Figure 9 panel a and b > I don not see each profile corresponds to which ice core.

P8 L5-6 ".. and the changes in slopes across the parameter space are larger than these local changes.."
>I do not understand this sentence.

P17 L3. " .. colder temperature then previous studies.."
> than

P21 L21-28 "There is a long-standing debate regarding the interpretation of "spatial" and "temporal .."
> Since this topic is not discussed in the main text, it seems strange to suddenly come up with a conclusion. How about moving this topic to the introduction?

P36 L31. ".. that condensation occurs at aa range of temperature up to.."
> a

Figure A23 > Colored profiles cannot be recognized.