EGUsphere, author comment AC3
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Reply on CC1

Jordan R. W. Martin et al.

Author comment on "Predicting trends in atmospheric CO_2 across the Mid-Pleistocene Transition using existing climate archives" by Jordan R. W. Martin et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-574-AC3, 2022

Comment 1:

Response:

We will include the form of the equation as:

CO2 = -33.37 x d18O + 365.16, autoregressive correlation factor (AR): 1

We will also include the lr04 stack in fig 1

Comment 2:

Response: The blue ice data at 1.5 Mya does not offer any information as to the CO2 trends across the MPT. It may be argued that the higher (assumably interglacial) CO2 concentrations at this time may offer support to our theories upward departure of the CO2 records from our LR04 based predictions, but the extremely large age uncertainty (~213 kyrs) means we don't feel we can draw any meaningful conclusions from its inclusion in this paper.

Comment 3:

Response: This paper certainly was very interesting. It is amazing how well the pattern in the CO2FA match up with the observed CO2 record over the past 800 kyrs. In fig. 1b of Yamamoto et al., the trend in their reconstructed CO2 record from the fatty acid record appears to *in part* affirm what we deduced.

Overall, the reconstruction shows a departure from the LR04 benthic stack over and preceding the MPT. However, the departure is not in the direction we deduce through our comparison to the d11B and blue ice data and therefore doesn't support the idea of stable interglacial with declining glacials. But this was not our null hypothesis, simply a deduction based on the data we used and the current studies of CO2 across the MPT. This paper concludes that "*These results suggest that the CO_2–ice interaction was reorganized during the MPT*" - This agrees with the general rejection of our null hypothesis which states that

no change had occurred in the CO2-ice relationship between the observable and currently non-observable CO2 record. In a way, it is another proxy record that differs from our predicted record indicating the relationships between the carbon-climate-cryosphere from 0-800 kya are not consistent 800 + kya.

Comment 4:

Response: You're right, average coverage across the MPT, it's not enough to filter into G/IG averages as we have done with d11N and the blue ice. But the data does seem to support our conclusion of a gradual "upwards" departure of CO2 from the LR04 benthic stack across and prior to the MPT (800 kyr +). Thank you, we will add some discussion on this.

Comment 5:

Response: This paper (Berends et al., 2021a) does have a similar point to ours in which "*Our results should not be interpreted as a realistic reconstruction of what the world looked like in terms of global climate, ice-sheet geometry, sea level, and CO_2 during these periods of geological history. Rather, we believe they should be viewed as scenarios which can help in interpreting an expected new ice-core record*." Our record was also constructed under the currently observed conditions to act as a comparison to the upcoming million+ year records. Our simple model in comparison yields a high correlation to the same observed CO2 record by Bereiter et al. (r2 0.68). We differ in that we have taken it a step further in the comparison to the discrete d11B and blue ice data over the MPT; by treating the available data we have as snapshots of the future continuous record we were able to make a (low-resolution) but reasonable conclusion that a change in carbon-climate-ice sheet relationship has occurred in the time prior to the current continuous records. From what I understand, this paper does not attempt to draw potential conclusions of CO2 trends across the MPT.

Comment 6:

Response: We are happy to include discussions of Kolhler and Bintanja (2006); from our understanding the paper also creates a model based on the LR04 benthic stack as a null hypothesis, which sets precedence to our method. We only used the model by Willeit *et al.,* as an example of the trajectory we expect CO2 to depart from the LR04 based predictions, while the main focus of this paper was to compare our model to realised proxy data. So comparing our hypothetical model to another hypothetical model might not offer much by the way of our conclusions, however we will explore the paper by van de Wal *et al.,* but inclusion will be dependent on relevance.

Comment 7:

Response: Thank you for the reference, it will be used to bolster some of the mechanisms behind the MPT.

Comment 8:

Response: Thank you. We will add references and discuss the precedence in using d18O to predict CO2 according to N. Shackleton and Berends et al., 2021a