Clim. Past Discuss.,
https://doi.org/10.5194/cp-2020-73-RC1, 2020

Climate of the Past Discussions
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Interactive comment on "Lower oceanic δ^{13}C during the Last Interglacial compared to the Holocene" *by* Shannon A. Bengtson et al.

Anonymous Referee #1

Received and published: 29 June 2020

This paper describes a data compilation of benthic δ^{13}C data from the Last Interglacial (LIG), consisting of already publöished data. The authors compile material from two previous δ^{13}C compilations (Lisiecki and Stern 2016, Oliver et al 2010), and also add a few other cores. They compare their findings with benthic δ^{13}C from the mid-Holocene (HOL) and discuss 3 different hypothesis, which they suggest are the only possible ones to explain the observed LIG-HOL offset. They conclude, that AMOC change was probably not the reason for their findings, but changes in the balance of weathering and sedimentation.

The paper in principle covers a nice piece of work, however, I believe it is a bit loosely constrained at certain points and misses some of the already available / published literature. I suggest a major overhaul following replies and response to the points given

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below.

1. Definition of analysed data: Some data analysis covers the whole LIG, some 125-120 ka, some all available data including part of Termination II and of the glacial inception. Similarly for the HOL, with which they compare. This needs to be focused. Define your time interval, but also give reasons for your chosen definition. So far, it is said, that 125-120 ka and 7-4 ka are chosen because δ^{13}C is stable. Looking at figure 4c (Pacific in HOL), this does not seemed to be the case, here 5-2 ka is much more stable. Maybe use as has been done in Peterson et al. (2014) the late Holocene 6-0 ka. I also believe taking two time windows which are of the same length might be a valid idea. Furthermore, check on the definition of interglacials (Past Interglacials Working Group of PAGES, 2016) when the community thinks Termination I or II was over and when the last glacial inception started. Please discuss your choice based on such literature widely. Also: I believe somewhere it was written, that only data below 2500m water depth are analysed. Is this always the case? If not, please specify in each and every section, which water depth is considered, also add this information in the figure caption, if this info is not popping up from the figure itself.

2. You are missing one important review on simulating LIG vs HOL carbon cycle, which is Brovkin et al. (2016), which also deals with δ^{13}C. Discuss your potential explanations within the framework of that study, which contained results from different models, and which finds some explanations for the carbon cycle in the HOL, but not for the LIG. You might also note, that during the end of LIG / during glacial inception CO_2 and sea level / land ice volume / temperature was decoupled on a multi-millennial timescale, which might indicate towards some processes that are important here (Barnola et al., 1987; Hasenclever et al., 2017; Köhler et al., 2018).

3. line 13: PI is NOT 0.7K cooler than the peak Holocene, this differences in Marcott

et al 2013 compares peak Holocence with the Little Ice Age. The PI-peak-HOL difference is about 0.4K. The maximum Holocene peak is also not at 5 ka, but early, check the Marcott paper for details.

4. line 25: CO_2 in the Holocene rose by maybe 18 ppm, but not by 28 ppm.

5. line 27: The details on CH4 need to condense.

6. line 28: The given warming on Greenland is for the NEEM site, not for the whole of Greeland. Please revise.

7. line 38; SST record were 0.5K WARMER (not higher)

8. All-in-all, the introduction on climate changes in the LIG needs some revision. Please focus on already existing stacks (which also have regional subdivions), that should also be plotted in Fig 1, e.g. Hoffman et al 2017, cited here.

9. Revise Figure 1: Consider using splines including uncertainites instead of single lines, e.g. CO_2 from Köhler et al. (2017), temperature (should be SST) from Hoffman et al. (2017) and Marcott et al. (2013), atmospheric δ^{13}C from Eggleston et al. (2016), which also closes the gap at the onset of the Holocene (no data so far). In Eggleston et al. (2016); Köhler et al. (2017) the newest ice core age model AICC2012 is already included, which might not have been the case in the plotted data. Mark which time windows you analyse in this figure. If you do not use the suggested splines, please include data uncertainties in the plotting, and explain the chosen time series in more detail, e.g which age model, b is tempertature change in certain ice cores (which cores). Subfigure (c) would need a further motivation (why plotting a mediterranean SST here?). The legend is not useful, since all records are plotted on individual subfigures and explained in the caption.

10. line 78: I do not understand how atmospheric δ^{13}C is influenced be the total amount of carbon in vegetation and soil, please expend.

11. line 80: If you compare atmospheric δ^{13}C with modern values you need to include a sentence on the contribution of the 13C Suess effect. Either extend or rewrite to a comparison of the pre-Suess effect values.

12. Introduction: I believe the subsections are not necessary here.

13. line 123 and 133 (maybe elsewhere): Uncertainties are typically going symetrically in both direction, so "$\pm$" is not necessary. Also, please state, what these uncertainties are, is this 1σ?

14. Table 1 and Fig 3: Please use error propagation and also include an uncertainty in the calculated anomaly $\Delta\delta^{13}C$.

15. section 3.1. Use the same time window for analysis throughout, here 130-118 ka instead of 125-120 ka has been used.

16. lines 172ff. As said in #1, 7-4 ka is not a constant period. Please redefine.

17. Fig 3: If I got it right these are only benthic forams from deep sedimemt cores from below 2500 m water depth, please say so. Revise the x-axis label: You have your mean times at full kiloyears, but the labels partly at half kiloyears.

18. line 192: It is not clear that the mentioned Fig A1 is from this paper, I though it was from Peterson et al 2014.

19. line 215, 222: 3 possible explanations. Maybe there are others which you did not think of so far (e.g. decoupling of CO_2 with other climate records at the end of LIG, see #2). Also, you only in detail investigate AMOC changes, and briefly discuss the others. This should be a bit better balanced. I therefore suggest to move section 3.3 to the discussion, and also ask for some more thoughts on the alternative explanations.

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20. Fig 4: Again, revise your calculated offset in δ^{13}C based on a revised definition of time windows and include uncertainties in it.

21. Fig 5: I do not understand the backgorund shading which is labels as "reconstructed δ^{13}C. Reconstructed by what? Is this a model result or an interpolation.

22. line 310: It could be that not only weathering and sedimentation but also volcanic CO_2 might add to this mentioned imbalance.

23. No data availability is given. Please upload your data base to a repository, e.g. PANGAEA.

24. The SI reference list of cores should be contained in the main text.

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