

## ***Interactive comment on “Carbon burial in deep-sea sediment and implications for oceanic inventories of carbon and alkalinity over the last glacial cycle” by Olivier Cartapanis et al.***

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Response to interactive comments on “Carbon burial in deep-sea sediment and implications for oceanic inventories of carbon and alkalinity over the last glacial cycle” (cp-2018-49) by referee 2 (<https://doi.org/10.5194/cp-2018-49-RC2>).

The manuscript of Cartapanis et al. is a very interesting study that contains a tremendous effort on compiling and standardising paleoceanographic data from across the global ocean. In this study the authors use this dataset to eventually estimate the global burial flux of carbonate over the last glacial cycle. Their main results indicate that carbonate burial in the deep-sea across the last interglacial was similar to the

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Holocene but that it decreased during the glacial until MIS 3, and how this fact would have had an impact in the DIC, ALK and d13C inventories across the glacial. In order to achieve their final conclusions, the authors divide the ocean into 20 provinces and use their MAR calculations to simulate 8 possible scenarios isolating the impact of several variables. This study highlights that carbonate burial fluxes played a role in glacial-interglacial carbon cycle changes and therefore the potential importance of taking them into account in any further calculation/interpretation. This is a very relevant and well-performed study very useful for the whole paleoclimatologic community. However, I have found relatively hard to go through the whole document, fundamentally due to its organization and length, which in my view affects the clarity of the main messages. Obviously, I completely understand that to capture such a big job and complicated topic in a single document is not an easy task to accomplish, but I find that the manuscript in general, and several sections in particular, might perhaps be shortened. The feeling sometimes is that this study might be split in two documents. The Results section, for instance, might well be the Discussion section in a more methodological paper, since there is indeed a lot of discussion about the results rather than a simple description of them. I would suggest that the authors consider transferring some of the results to the discussion section, and not only leave it for the more strict paleoceanographic interpretations. My recommendations are therefore mostly related to the format.

-We thank the reviewer for his supportive comments on the quality of our study and the effort required to achieve such analyses. We also recognize that the huge amount of information required to properly describe our work can sometimes obfuscate our message, and that it has been quite a challenge to keep the length of our study sufficiently short to fit into a single paper. But we think that the combination of data based estimates and model derived scenarios is the best option to fully show the relevance of our study.

In the Introduction, section 1 leaves clear the current situation and the purpose of

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the study, and the review of sources and sinks in section 2 supplies with very useful data. However, some of the sentences within and between paragraphs in this section 2 seem to expose a large amount of information but without a clear purpose and not being entirely connected. Some of my suggestions, a part from trying to shorten these subsections in general, would be to separate paragraphs in clear groups of ideas and link the sentences with more connectors, as well as perhaps to state clearly what the general current 'agreements' in each subsection are and then go into the details of each study.

-In order to facilitate reading of our manuscript, we added subtitles in section 2 and slightly modified the paragraphs and text as suggested.

For Methods and Results, I would suggest to make a complete scheme of the methodology applied (including the analysis performed in the results section) followed by the correspondent explanations. I would also highly recommend shortening both sections and I think it would be very useful to start the Results with a brief summary of what is going to be told, as well as with a complete explanation of all the experiments that have been performed and how they link with the plots in Figures 7, 8 and 10 (it is mentioned in the caption of Table 2 in methods, but I think it would help to explain all this straight and clear in results).

-We recognize that the original organization of the manuscript wasn't optimal. We have now reorganized the material and method and results sections. The CaCO<sub>3</sub> reconstruction section and modeling aspects are now more clearly organized and separated.

Regarding the Discussion, as I said before, I think it would be useful to transfer part of the results into the discussion section.

-We agree, and hope that the reorganization of the manuscript will help with readability.

When referring to the Appendices, the authors should try to consistently be specific.

-We corrected the references to the appendices.

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A more clear explanation about the connection between the experiments and the final results might be stated. It seems confusing why the authors talk about organic carbon burial in the final conclusions of the study as main results. Are not those results from Cartapanis et al. 2016?

-Here, we used the deep-sea organic carbon burial reconstruction from Cartapanis et al. 2016 but we also include the Corg burial on shelves, which was not included in Cartapanis et al. 2016. The potential impact of Corg burial on shelves has significant implications for the global mean oceanic  $\delta^{13}\text{C}$  value, given that the estimated shelf fluxes are larger than those of the deep sea.

The authors should explain more clearly how particular changes in the Atlantic vs Pacific in figure 11 (or even in figure 6) could be inferred.

-We have more clearly addressed this particular aspect in the revised manuscript (p. 33 L7)

There are, sometimes, quite long and complicated sentences that might be rephrased for better understanding, e.g. line 23 page 10, line 31 page 12, line 1 page 26, line 13 page 31, etc.. In the same way, I personally find the use of commas excessive making the reading harder.

-We corrected some of the sentences that appeared clumsy and tried to avoid the use of commas where adequate.

I would consistently use Corg and  $\text{CaCO}_3$ , as well as DIC and ALK across the manuscript, as it might allow the reader to rapidly identify what the authors are referring to.

-Corrected

I would avoid starting sections with 'Moreover' or 'However', like in sections 5.2 and 5.4, respectively. In my view, those connectors are used to either add or rebate information that has been mentioned in the same paragraph or in the previous one, but not in

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another section. I think those sections should either be together with the previous ones, or include an initial brief summary highlighting the reason why they are going to be discussed once again.

-Corrected

Some technical mistakes spotted: Section 3.5 should be numbered as 3.4. Line 23 page 31: proper references are missing. CO32- is sometimes typed as CO32 or CO32=. It should be corrected. The titles of sections 5.2 and 5.4 have typos, as well as lines 16 and 20 in page 31. There are at least a couple of negative contractions that should be corrected; line 14 page 31 and line 23 page 26.

-Corrected

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