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Interactive comment on "An interactive tool for navigation within a database of water and carbon stable isotope records from natural archives" *by* T. Bolliet et al.

Anonymous Referee #2

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Recommendation: *Accept after major revisions*

Summary The article presents an online database of paleoclimate records suitable for PMIP-style time-slice investigations of past climate change. The paper presents the data synthesis, the online navigation tool, and some elementary analyses enabled by the dataset and platform. Overall the effort is laudable, but important philosophical and technical issues prevent publication in the current form. In particular, a lack of development on the data standards front severely limits the scope and ambition of the current work.

1 Scientific Comments

Unclear goal: the goal of the paper is somewhat unclear. Is it to present the interactive tool, which is the main subject of the title? If so, why does the paper spend most of its time on a description of the database? To me, the efforts are data standardizations presented here are quite preliminary, and the most unique and interesting part of the paper is the online portal, which should be further described.

Generalizability: Accordingly, are the software tools developed here (by far the most interesting aspect of the paper) open-source? Can other institutions (e.g. NOAA, PANGEA) benefit from this investment of programmer time? Right now there is no mention of a code repository (e.g. GitHub). It would seem contradictory for an open-access journal like Climate of the Past to promote work that is not open-source.

Data standardization: The authors rightly "highlight the needs for a standardized protocol of data storage". The thing is, such a protocol already exists (Linked Paleo Data, or LiPD), and the paper describing it is in press in the very same journal (discussion paper: *McKay and Emile-Geay*, 2015). In fact, the LiPD data

container is more comprehensive than what the authors describe, is machine-readable, web-searchable, and designed to carry all the metadata together with the data, so it would solve many of the problems raised here. The authors should mention such efforts in a revised version of the manuscript.

Data synthesis : The authors acknowledge in the discussion that MARGO-style data syntheses are of limited interest because they become obsolete almost as soon as they are published. The main value of their product, then, is to enable a system whereby the database can grow organically over time. The authors "highly encourage authors to upload their new data in our database using the user-friendly interface on the online platform." Is the platform meant to replace NCDC Paleo or PANGAEA? If not, how will it ensure a steady flow of records from those repositories to the platform? The LiPD-based LinkedEarth project (http://linked.earth) shares similar features, such as the ability to not only upload new datasets, but edit existing ones to correct errors or expand metadata. Importantly, LinkedEarth involves a partnership with NCEI to harmonize the two databases. A lack of harmonization would result in duplicate (and sometimes, conflicting) information in cyberspace, which may do more harm than good. I invite the authors to take a look at the LinkedEarth framework and see how it could mesh with their efforts.

Age modeling : It is somewhat disappointing that the authors focused only on "time slice" investigations, but I gather from the discussion that they are thinking more broadly, and I surmise that the science driver behind this data organization effort must be the PMIP project. Indeed, PMIP and other paleo projects should move towards evaluations of transient change, so it is critical that all age constraints be archived in a standard format. This was, in fact, the main motivation behind the creation of the LiPD standard. The authors are correct that there is no accepted standard for how to store age information for any archive. Even in the radiocarbon community, practices vary by country, lab or institution. A very useful contribution of the paper would be to list all the data columns necessary to reproduce an age

model (e.g. OxCal, BACON, BChron), since this should be the science driver: ensure that age modeling tools will be able to make use of the records archived in the database, by focusing on what information they need. The authors mention reservoir ages, which are essential. Just as importantly, the *uncertainty* about reservoir ages is absolutely fundamental, and neglecting it can result is grossly overconfident assessment of ages. It would be an important contribution if the paper made this clear, and proposed a format for how to report such ages and their uncertainties. The existence of inter-lab in radiocarbon dates of identical samples also makes it necessary to include lab (and a sample ID) as essential metadata to keep track of.

The authors also acknowledge that layer-counted records also harbor age uncertainties, though they seem to neglect them. That approximation is certainly justified for the time slices they consider here, but since they are building a case for how to more properly archive paleoclimate records, I think they should mention the work of *Comboul et al.* (2014) (also in this venerable journal) and its call to report the probabilities of under-counting and over-counting layers, since these are necessary ingredients to modeling the uncertainties in such records.

Chronology ratings : The authors devised a 5-point scale to grade the quality of chronologies. This seems like a useful semi-quantitative criterion that users will want to select records based on the requirements of their analyses. However, I was disappointed that the criteria are so qualitative. The only quantitative criterion involves the density of tie points, not the quality of the measurements. Can the scale be based on objective measures, like the width of the posterior distribution of ages (as measured, for instance, by a 95% highest-density region or the inter-quartile range)? It would seem less controversial to do this, otherwise I can envision endless arguments about the ratings. For instance, why "consider that the LGM (19–23 ka) is better constrained with two AMS dates at 19 and 23 ka than with four dates within the 20–22 ka interval"? This seems arbitrary to me.

Statistical Analysis : in section 6 the authors analyze differences between isotopic records for various time slices. However, there is no mention of the test that was used to determine significance. If it was a t-test (as seems likely), did it consider the reduction in the number of degrees of freedom due to the low-resolution? (i.e. having 10 points over the past 200 years may not been that there are 10 degrees of freedom going into the estimate of the mean). The authors need to explain in detail which methodology was used for this analysis. The results are quite interesting, but they are meaningless without more thorough methodological information.

2 Editorial Comments

- Eventual: this adjective, used in 3 instances, seems like a Gallicism for “potential” or “possible”. In English, eventual means final, which is not the intended meaning (I think).
- “Model outputs” is used a few times, whereas "model output” (non-denumerable) would be grammatically sound.
- P4: L8: “Past climate was the result...”. Awkward entry. How about "Past climate variations resulted from ... ”
- P5, in the enumeration of isotope-enabled GCMs, please add SPEEDY-IER, (*Dee et al.*, 2015b)
- P5, L13 “These new functionalities of climate models open the possibility to directly comparing the proxies measured in natural archives with model outputs”: this is not correct. Though isotope-enabled GCMs bring us a step closer to closing the proxy-model gap, proxy systems impose many more transformations of

the environmental signal, and they must be taken into account , e.g. via proxy system models (*Evans et al.*, 2013; *Dee et al.*, 2015a).

- P6, L10: depositories –> repositories
- P7, L3: “integratation” –> integration
- P7, “The last 200 years (1800 to 2013 CE, Common Era) ”: technically, this intervals comprises 214 years.
- P10, L26: “simple text tabulated standard format”. actually this is anything but simple, as tabs are not encoded the same way by every machine. Also, how are missing values encoded?
- P15,L12: “2s error” : do you mean $2\times$ the standard error of the mean?
- P15, L20, how are the layer-counting errors reported? They are measurable, and sometimes larger than radiometric dates (*Shen et al.*, 2013)
- P16, L11: affected by few –> affected by a few
- P18, L19: “a few $\delta^{17}O$ records”: How many?
- P21, L4: less than –> fewer than
- P23,24: this is far too descriptive, and very redundant with section 4. I recommend condensing or cutting if possible.
- P30, L14: “instauration of standard time units" . Firstly, instauration is not in common use in English. Consider “establishment”. Secondly, I am not sure this proposition is wise, because paleogeoscientists develop records for very different purposes and the time standard depends on the time frame (e.g. Common Era

vs Jurassic). Instead, what is needed is a more flexible data standard (like LiPD), that can accommodate many conventions.

FIGURES

- Fig 5 misses a legend about the meaning of the colors. (I know it is consistent with other figures, but it would be helpful for each figure to be self-contained).
- Fig 7, same thing: repeat the meaning of symbols for each archive type.
- Fig 8 : need a colorbar to explain colors.
- A1–4: consider binning on the x-axis for clarity. Right now they look a bit too spiky to be useful.

In summary, this is a valuable contribution, and I recommend publication after these points have been addressed.

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