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Interactive comment on "The DeepMIP contribution to PMIP4: methodologies for selection, compilation and analysis of latest Paleocene and early Eocene climate proxy data, incorporating version 0.1 of the DeepMIP database" *by* Christopher J. Hollis et al.

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Overview

This DeepMIP contribution outlines methods for compiling proxy land and sea temperature and CO2 data for the latest Paleocene (LP), PETM and EECO across widely distributed sites in order to provide 1) insights into controls on warm climates and 2) boundary conditions and verification data for climate models. An initial database or

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"atlas" is provided with the anticipation of expansion, and requirements for proxy methods and data reporting are listed. The authors have done a very nice job thoroughly explaining complex paleothermometry theory and methods for the non-expert. They offer a detailed discussion of the strengths and weaknesses of each proxy, which is expected as the author list contains many of the best experts on the proxies discussed in the paper. As I am an end user of data from many of these proxies, and not a geochemist, I am pleased to see such a complete description of each proxy. It is clear that this contribution will have the added benefit of serving as a reference for climate scientists who are not intimately familiar with the entire array of proxies.

General Comments

Building a global dataset of past climate proxy data is challenging because in the course of data collection, new proxies are developed, existing proxies are improved, and age models are refined. Especially important is the collection of raw data and original sample designations. I am pleased to see in this manuscript the importance placed on the reporting of raw clumped isotope data. This requirement should be extended to all proxy data. Since we know that proxies evolve and develop over time, the availability of raw data will allow for reanalysis and new applications should they appear. On a similar note, the authors mention that brGDGT datasets should be scrutinized for temperature plateaus, which would suggest that the calibration has saturated. This scrutiny should be applied to other proxies as well, including those calibrated to modern data sets that may not be able to estimate temperatures warmer than modern.

I appreciate this multi-proxy approach – collecting a diverse array of paleoenvironmental data with the goal of better understanding the climate system as a whole. This is a necessary step in developing a global temperature reconstruction and will ultimately aid in future analyses of more nuanced, regional, non-temperature reconstructions. As we have seen in other global paleoenvironmental reconstructions, paleothermometry proxies become useful in discerning other aspects of the climate system, like water column structure (e.g., thermocline depth) and ocean circulation (e.g., upwelling strength),

that will be useful as the models develop and will provide additional insight into climate dynamics. It is important to remember that these different temperature proxies record different aspects of “temperature”, (i.e., the temperature at a certain water depth or during a certain season) and are likely complementary, yet not always directly comparable.

This DeepMIP atlas is a fantastic compilation of data and represents just the beginning of LP, PETM, and EECO paleoenvironmental global climate reconstruction. What’s next? Specifically, how will this database be used in the DeepMIP models? Are the data compiled here enough to set model boundary conditions? I believe a short statement in the conclusions addressing these questions is warranted.

Specific Comments

In Section 6.5, briefly define C3 plants. So much detail has gone into defining the basis of the other proxies, but a simple description of why C3 plants are useful is not included.

Alkenones are not among the SST proxies discussed here, presumably because they are not terribly useful during these time intervals. TEX86 is recommended as a good proxy for when alkenones are not present or are outside their calibration range, and this would be a good place to mention that alkenones are scarce before 40 Ma (as is mentioned later) and that they saturate at temperatures below those expected during these warm intervals. Alkenones are, however, listed as a CO2 proxy, though no alkenone-based CO2 estimates are included in Supplementary Data File 8, possibly because none exist prior to the middle Eocene. Are alkenones included here because they could be a useful CO2 proxy if they were found in LP, PETM and EECO sediments? What is the likelihood of this? Also, Supplementary Data File 8 is not listed in the text or in the supplementary contents in Supplementary Data File 1.

In Supplementary Data File 3, please better define “Setting” on the cover sheet. Are these water depths in meters? Are they modern or paleodepths? If “Setting” is the

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same as “Environment” on the following sheets, please use the same terminology. Also, please explain the 2.5, 50 and 97.5 columns. I assume these are percentiles? What do the shaded cells of different colors mean? Please make any changes and explanations consistent across all data tables.

Technical Corrections

Please look at these pages/lines more closely for minor mistakes. I’ve suggested corrections below. 4/5: Paleogne - Paleogene 9/12: foraminifer - foraminifera 9/15: undertake - undertaken 9/17: biasin - bias in 11/2: are - is 11/22: allows - allow 17/11: foraminifera - foraminiferal 17/34: semi-quantitatively - semi-quantitative 20/10: includes - include 24/13: TEX86 (needs subscripts) 24/15: in for - for (delete "in") 26/24: pShouteroxy - proxy 31/12: 28C - 28°C 33/4: results - result 33/11: 25 - 25°C 35/9,9,14: Ma - Myrs 40/29: are - is 42/31: delete "from a single" 43/15: C3 (not subscript) 47:27: missing a parenthesis 49/30: 20° - 20°C 50/18: sample - sampled

Check the proper order of references. Some are ordered by year after the first author; others are ordered alphabetically by second author. Please also check for consistent punctuation in and around citation parentheses in the text.

Should Farquhar et al. (1982) on page 44, line 18 be cited as Farquhar and Sharkey (1982)? Should Goericke et al. (1994) on page 37, line 16 be cited as Goericke and Fry (1994)? Zeebe (2007) is cited once in the text on page 12, line 33, but two Zeebe (2007) references are listed. Which one is correct?

Check the following references for correct usage of a and b designations: Eagle et al., 2013 a and b Edgar et al., 2013 b Evans et al., 2018 a and b Schouten et al., 2013 a and b Sluijs et al., 2007 a and b

The following citations appear in the manuscript text but not in the References section: Bains et al., 1999: p91, l4 (Figure 2 caption) Crouch et al, in prep: p92, l6 (Figure 3 caption) D’Hondt and Zachos, 1993: p10, l7 Gradstein et al., 2004: p95, l7 (Figure 6

caption) Huff et al., 2003: p30, l25 Kennett and Stott, 1991: p91, l4 (Figure 2 caption) Liu et al., 2009: p23, l25 Lauretano et al., 2016: p90, l4 (Figure 1 caption) Royer et al., 2005: p30, l25 Si and Aubry, 2018: p8, l16 Thomas et al., 2002: p91, l4 (Figure 2 caption) Thompson et al., 2015: p32, l13 Torsvik et al., 2012: p96, l4 (Figure 7 caption) Urey, 1984: p8, l12

The following references appeared in the References section but not in the manuscript text: D'Hondt et al., 1994 Roij et al., 2016 Sluijs et al., 2008 Sluijs et al., 2009 Wilke et al., 2006

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