

## ***Interactive comment on “Global mean surface temperature and climate sensitivity of the EECO, PETM and latest Paleocene” by Gordon N. Inglis et al.***

### **Anonymous Referee #2**

Received and published: 21 March 2020

The goal of this study is to estimate the global mean surface temperature (GMST) of the Late Paleocene (LP), the Paleocene-Eocene Thermal Maximum (PETM) and Early Eocene Climatic Optimum (EECO). For that purpose, the authors used an up-to-date compilation of sea temperatures (surface and bottom) and land temperatures and tested different approaches to estimate GMST. They estimate the “best” GMST estimate for LP, PETM and EECO and a “mean” climate sensitivity. The manuscript is clearly written. Its structure is logical. In some places, the authors refer to other papers that discussed a point in detail. A few sentences summarizing the key points of these papers would be helpful for less familiar readers. Some points need to be clarified.

General comments

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Line 165: The authors calculate the annual average surface temperature field and the uncertainty in the reanalysis product ERA-5 with the past distribution of geographic samples. It is not clear how the authors proceeded. Does it mean that the closest grid point corresponding to the past position of a site is selected? at the same elevation?

Line 177 and Lines 191-193: The global mean temperature changes from one climate model to the other. Thus, the authors should test other models (available through DeepMIP project)?

Lines 205-206: Two assumptions are considered: “global temperatures scale linearly with local temperatures, and a climate model can represent this scaling correctly”. These assumptions need to be tested. In addition, the two pairs of simulations have been obtained with two different climate models (and different boundary conditions). The influence of the type of model and the boundary conditions should be investigated (a table indicating the model and the boundary conditions used should be added).

Lines 218-220: How many proxy temperatures are greater than  $T_{high}$  or  $T_{low}$ ? how many global mean temperatures are thus obtained by extrapolation?

Lines 339-344: For DComb-1, how to be sure that the equation 5 can be used in case of warm climates?

Lines 356-382: GMST should be estimated using other climate models to explore model dependency.

Lines 386-387: The influence of proxy datasets is shown for EECO only?

Line 424: The authors should explain why the land air proxy data can suffer from a cold bias.

Line 430: The authors should explain why the inclusion of  $\delta^{18}O$  values from paleosols or mammals leads to a cold bias.

Lines 438-458: Curiously GMST estimates using Ddeep and Dcomb did not yield a

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similar cold bias.

Line 470: how the uncertainties on the best GSMT can be so small.

Minor comments

Line 75: Figure 1 and Table 1

Figure 2a: a site located to the north of South America is unnamed

Line 89: ECS is used before being defined (line 483)

Line 108: define GDGT (ie glycerol dialkyl glycerol tetraethers) Line 122: replace Table 1 by Table 2

Line 127: define MBT(')/CBT

Line 385: subsampling case must be explicitly indicated in the caption of figure 6

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Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-167>, 2020.