We thank the two reviewers for their very helpful comments on the manuscript, which will greatly improve the manuscript. Here we provide a point-by-point response to those comments, indicating either how we intend to respond to the comments (**future tense**), or how we have already addressed this in our current working version (**past tense**). For a small number of comments we give **reasons** why we prefer not to make the change.

Reviewer 1:

Paleogeography - I am generally happy with both the field and your explanation of it. However, I note that there appears both an isolated very high peak as well as a 'lake' at the join between Greenland and (what I think is) Scandavia. This feels unrealistic to me. Can you either smooth them out if that's the case, or explicitly discuss the geological evidence for them?

Yes, we will check this.

Figure 4. Can you please harmonise the shape and color between the panels? It is the ice cover that switches with savannah that is most confusing.

Yes, we will harmonise the colour scales.

ESGF. On L386 you state that participants should upload their simulation to the DeepMIP archive. Is there a reason you do not also allow the possibility of uploading data created using CMIP7 models onto the ESGF? [Now is the time to establish the relevant controlled vocabulary, and you are within the CMIP7 special issue]. This would have the advantage of combining the Eocene with the other PMIP experiments.

We are currently exploring registering the "main" DeepMIP-Eocene simulation as an official CMIP experiment. If this is successful then yes, we will add some text about uploading to ESGF.

Experiment name: Are you sure that you have selected the most helpful experiment names?

- The precedent from the wider PMIP and CMIP efforts does not include phase numbering. Bear in mind that all phase 2 data is stored within a specific directory (L391).
- No period is included in the name. This is especially pertinent, as I understood the Miocene is also included in DeepMIP. Since you focus only on the EECO, why not choose either 'eocene' or 'EECO' instead of deepmip
- I find the inclusion of 'stand' to be unhelpful. I can understand defining subsidiary experiments, with a 'sens' flag. Surely this implicitly assumes that other than the named feature being changed, everything else is as set as standard - inconsistent with the requirement of a 'stand' flag.
- If you do choose to allow ESGF inclusion, your main experiment name will be the longest around (and will not make sense to people not involved in deepMIP).

Please be aware that equilibrium-4xCO2 could be exactly the simulation (but at a different point) as abrupt-4xCO2. How is CMIP7 DECK treating this possibility?

All good points – we will consider these.

Sect 3. You state this section includes 'plans for analysis', but it doesn't really. Either expand on this a little, or perhaps just removed them from the section title.

Removed.

Sect 2.3.4: Can you please shout out to the relevant sensitivity experiments listed in Table 1

Clarified that this section describes additional sensitivity studies not listed in Table 1.

L148: can you please move 'red' to before 'line'? This would fit the same structure as description of the other lines in the figure.

Done.

L154: can you clarify the word 'records'? I believe that you mean that two compilations ingest multiple of the same individual readings. But it could mean that the error bars on the two timeseries overlap.

Clarified.

e.g. L178, L255: there are a couple of instances of the wrong \cite command, leaving the bracket in the after, rather than before the authors.

Done.

L239: Consider removing `field of'

Re-worded.

L241: I appreciate you stating that Herold et al provide river routing. Can you comment of this fields relevance, given the different topography?

Done.

L263: add CO2 after 6xPI

We have now clarified the nomenclature in an earlier Section.

L294: "in, that" -> "in and that"
Reworded.

Sect 2.4: I am happy with the explanation of all the various methods. Can you please reiterate that whatever approach is selected should be documented in the simulation publication?
Done.

L402: Can you please spell out that 'std' stands for 'standard deviation'
Done.

L402 and L404: 'timeseries' seems to be doubly defined, and I don't understand the distinction.
Not changed. One occurrence is in the directory and one in the filename.

L407: You ask for temperatures at 3500m depth. Can you clarify if you just want the layer containing 3500m, or to vertically interpolating the full profile to get the value at 3500m for intercomparison?
Clarified – the layer containing 3500 m.

Reviewer 2:

L20: The Mallory reference is perhaps belittling the importance of learning about processes and mechanisms that led to things being the way they were/are even if they are not so directly relevant for future climate change. I suggest removing.
We have added more detail here emphasise the important improved understanding that this 'curiosity-driven' research brings.

L76-78: Do we have any idea why there are such differences in CO2 estimate for the best agreement with the data?
Added that the reason for the discrepancy is yet to be explored.

L97-98: Can you perhaps infer that this may be the cause of some disagreement between models?
Yes, done.

L98: Over what period were the simulations run but still did not reach equilibrium?
Reworded – none of the simulations reached full equilibrium.

L63-92: I wonder if this section could be reorganised into consistencies between models and data, consistencies between models but disagreement with data, inconsistencies between models (some of which may agree with the data), and inconsistencies between models and data so that is clearer what the main certainties and uncertainties are?
We have considered this, but prefer the current structure of going through the papers in an order related to the processes that they focussed on, as this is more intuitive, in our view.

Figure 1: I presume the divergence in the colour scheme around the EOT is to highlight the shift from the greenhouse world to the icehouse world - might be worth adding those labels to the figure to explain why that was chosen as the divergence point.
We will incorporate this when we update this Figure in response to other comments.

L122: Include Eocene/EECO in the simulation naming to avoid confusion with the other DeepMIP simulations. I believe MioMIP is using Deepmip-Mio, perhaps here therefore they should be Deepmip-Eo or Deepmip-EECO?
Same comment as Reviewer 1 – we will consider this.

L254-244: Ambiguous as to whether you are suggesting that this runoff routing field could be used for Phase 2 or not
Clarified.

L270: What criteria is used to determine if regions have "sufficient" data coverage? A comment on the vegetation data availability for this period would also be useful
We will clarify this.

L330-331: Is the best-fit GCM CESM1.2 for Thomspon in BIOME4 the same as the best-fit GCM CESM1.2 for Brugger in LPJ-GUESS? If so, worth commenting on that.
Done.

L336-338: Are the discrepancies between the BIOME4 version of the vegetation and the data because these are where the model has been corrected towards the data in the LPJ-GUESS version of the vegetation? i.e. because the BIOME4 version has not undergone the hybrid proxy reconstruction correction step? Or are these different regions?
We will clarify this.

L362-363: You suggest that groups can use initial conditions from the Phase 1 model database, but in L98 you state that many models did not reach full equilibrium but the end of their simulations. Are there some models in the Phase 1 data that you would

therefore recommend are NOT used for the initial conditions for Phase 2? Similarly, are there any in the database that suffered from crashing early or running away that should NOT be used? Or are these not in the database?
We will add a comment on this.

Figure 4: It is very difficult to see the details of the legends for (a) and (b), and the distinction between some of the greens is so small it is nearly impossible to discern which is which on the map. It also appears that the same colour has been used for Ice in (a) as Savannah in (b) and (c). Can you try to use a more distinctive colour scheme?
Figure 5: Similar comments on the colour scheme to Figure 4.
We will do this – see also similar comment from Reviewer 1.

L416: This section is very short and the title is misleading. Perhaps Section 2.5 might fit better here. Maybe Summary and Next Steps or similar might be a better descriptor?
Section title renamed, see also comment from Reviewer 1.

L424: Are there plans to version control the proxy database so it is clear which dataset is being used for model-data comparisons and to ensure consistency between the analyses by different groups?
Yes, we will ensure that future versions of the database are version controlled.

Figure A1. The colour scheme used may prove difficult for some colour blindness conditions.
We will modify this colour scale.

L1-2: No commas required
My feeling is that the sentence is clearer with commas.

L2: Define when the early Eocene is
Done

L8: Word missing, a new vegetation... scheme/distribution/boundary condition
Done

L10-12: Pluralisation of concentrations seems a little odd in the context of the model simulations where preindustrial CO2 is a constant and 4 x preindustrial CO2 is therefore also a constant.
We are now consistent throughout the paper with the use of "concentrations" (proxy estimates which vary with time) versus "concentration" (model values, or preindustrial control value).

L38: Word missing, we/DeepMIP extend...
I think this is fine as-is. It is DeepMIP-Eocene and DepepMIP-Miocene that are extending.

L38: Comma after Quaternary not required
As this is a long sentence I prefer the commas.

L46: Word missing, also indicate
Done

L47: No comma required before 'and a vegetation consistent'
As this is a long sentence I prefer the commas.

L47: Duplication of wording, perhaps change 'a generally warmer and wetter climate than modern' to something like 'those warmer and wetter conditions'?
Prefer to keep as-is because hydrological proxies indicate wetter high latitudes, and separately from that the vegetation indicates generally warmer and wetter conditions.

L53: Is Herold the only reference for all these differences? Or do you mean to say Herold and references therein?
Done

L55: No comma required before 'and has been used'
As this is a long sentence I prefer the commas.

L61: No comma required before 'and have been discussed'
Done

L70: Pluralisation of concentrations again
We are now consistent throughout the paper with the use of "concentrations" (proxy estimates which vary with time) versus "concentration" (model values, or preindustrial control value).

L73: Unnecessary 'and' before 'drier conditions'

Done

L120: Maybe introduce PI=preindustrial when talking about CO2 concentrations earlier in the manuscript
Done

L157 & 161: Inconsistent wording, runaway versus 'runs away'. Maybe also explain what this term means.
'Runs away' is a verb, whereas 'runaway' is a noun. Added an explanation.

L173: Typo, Appemdix
Corrected.

L200: Wrong wording?, should be 'or between' rather than 'as well as between'
We will check this.

L205-206: Incorrect wording, 'As the paleogeographic reconstructions used here all have modified' should be 'As all the paleogeographic reconstructions used here have modified'
Done.

L222: Commas needed around the word 'particularly'
Reworded

L227: No comma needed after the word 'resolved'
As this is a long sentence I prefer the commas.

L286-289: The long sentence is a little confusing. Perhaps reword to something like 'The recommendations for all other boundary conditions remains unchanged from Phase 1 (refer to Lunt et al. 2017). Using the section numbering from Lunt et al. (2017), detailed recommendations are given for soils and lakes in Section 4.2.2,' etc

Other changes:

In addition to the changes listed above, we propose to make the following additional changes:

- **Following offline comments, we will correct the caption to Figure 1, and to the text that references it, including the correct citation, and the fact that this is a composite, not a stack.**
- **We will register our main experiment with CMIP.**
- **We will check/update the zenodo links, some of which appear to be broken.**
- **We will add some more quantitative guidance on model initialisation from deep ocean temperature proxies.**
- **We will add uncertainties to co2 figure.**
- **We will check the 0 longitude transition in the paleogeography.**
- **We will add a github link for the rotations.**
- **We will add clumped deep water temperatures to Figure 1.**
- **We will provide an ocean tidal mixing file.**
- **We will provide data on zenodo for some of the sensitivity study experiments.**