Responses to Anonymous Reviewer #2

Reviewer's comments in **black**
Authors' comments in red

Comments:

The text needs to be more precise and focused as at the moment it feels somewhat rushed. Furthermore, it is not at all obvious what is new analysis compared with the Melles et al. (2012) paper. Many of the statements/conclusions are very similar to this paper. Figure 2 has already been published in almost identical form in Melles et al. (2012) for example. It is important that the authors make it clear what new analysis they have performed for this work to be publishable. In addition, I was often confused whether the authors were discussing comparisons in relation to E-Lake, Beringia or the Arctic and relative to what reference? Modern or pre-industrial?

Thank you for your detailed and constructive comments. The text has been made more precise and clear in many parts of the manuscript. A very thorough and in-depth review is being made to ensure the revised manuscript does not cause any confusion. Additionally, tables have been re-done to also avoid or clear up any confusion readers may have. References in the body of the manuscript (with respect to anomalies) have also been made clearer.

Where is the E-lake record? There should at least be a figure showing this data for the relevant time relevant time periods as it so central to the paper. Furthermore, a separate map include the location would also be very useful.

Thank you for your suggestions. We will include temperature and precipitation reconstructions from the Lake-E core in our paper. A star on all figures denotes the location of Lake-E.

A table of temperature changes for different time periods at E-Lake/Beringia etc. from data and model would be useful. It is somewhere confusion what is being compared with what in the text. For example, temperatures are quoted for different months regions etc. There does not appear to be a direct focus on E-Lake, which the title of the article implies – perhaps the title should be more general.

A new, revised table with temperature at Lake-E during our different time periods (simulations) has been made and will be in the new revised document. This table should now address many aspects that cause confusion in the manuscript. A more direct focus on Lake-E has been made clearer in the revised manuscript. Thank you for your suggestions.

The analysis of NH glaciation has no context as there is a sudden jump from discussion super interglacials to glacials and feels as if it has been appended at the end. Could this be revised so it fits better?

NH hemisphere glaciation was another simulation performed during our study to simulate temperatures and precipitation of NH glaciation and relate them to the Lake-E core. However, we agree that there it has little context with regards to the scope of this manuscript. We also

found it difficult to tie in this section with the rest of the paper. Therefore, we have removed this section from our manuscript.

It would be beneficial to include spin-up plots of the simulations as this paper is focused on the modeling aspect of this work. Ten years is a short average time and may not be capturing the overall signal, as decadal variability is not taken into account. Furthermore, the slow components of the land surface (i.e. trees) often require > 1000 years to reach equilibrium. Is there some sort of acceleration forcing for the vegetation component?

This is a great comment and is very much appreciated. In response to your comment and question, the GCM is running with a 50m-slab ocean component. The slab ocean GCM spins up within the first few decades. The same can be said for the vegetation model. Our vegetation model is an interactive vegetation model as opposed to a dynamical vegetation model. Based on my experience with this GCM in slab ocean mode, it spins up rather quickly. Ttest done on 11 years of annual temperatures at the lake show that the values are significant at the 95% confidence interval with a $p<0.05$. The vegetation model calculates the biome distribution in each grid cell relative to last years (model time) climatology (temp, precip, humidity etc.) and picks the appropriate biome based on a biome ranking system in the vegetation model instead of actually growing trees. Therefore, the vegetation model does have an acceleration-type feature component.

Please be consistent with the use of acronyms. Once stated use the abbreviation. Also some have been stated twice.

Thank you. This has been noted.

The introduction states that the results are assessed in terms of teleconnections implied by other far field records including Antarctica. However, I see very little evidence for this type of analysis with the only mention of Antarctica in terms of previous studies and the conclusions presented in Melles et al. (2012). If this is to be included there should be a more thorough examination of these teleconnections with the SH and not just a repetition of what is written in Melles et al. (2012).

Thank you for your comments. You are correct and we have edited these statements so that they fit into the scope of our manuscript.

Although the authors have included the yin & Berger (2012) reference other references such as Lunt et al. (2013) and Bakker et al. (2013) could be included when discussing the results in comparison to other studies.

Thank you for the suggestion. We will insert these references to further solidify our findings.

Detailed comments

P3128, line 7: is the temperature for MIS 11c (0.5˚C) correct? Why have you only quoted three temperatures and not four corresponding to the four interglacials?

We have added the comparison for MIS-1 vs. modern temperature. Noted. Thank you.

P3128, line 10: "extraordinary warmth compared with other interglacials" – not according to the value stated on line 7. Also, this is not very clear. I assume you mean extraordinary warmth considering the moderate orbital forcing and GHG concentrations compared with other interglacials?

Here, the extraordinary warmth refers to the Lake-E core proxy reconstructions of temperature. This has been made clearer.

P3129, line 6: What do you mean by "long" terrestrial archives? Context might be useful.

"Long terrestrial archives" refer to temporally long terrestrial archives.

P3129, line 11: Current trends in what? Temperature, precipitation?

This refers to climate trends such as temperature and precipitation. This has been fixed and made clearer. Thank you.

P3131, line 6-7: 30 to 40 year equilibrium run is very short as is the ten year average (please see comment above).

Please see comment above.

P3131, line 9-10: Warmest monthly mean climate (July). Is this always July for all simulations?

Yes. When referring to temperature of the warmest month, it is July for all simulations.

P3131, line 19: Younger-Dryas –state when the end of this event occurred.

Noted. Thank you.

P3132, line 7: the 8˚C warming at NEEM actually has a large uncertainty of ±4˚C. Please include this.

Noted. Thank you.

P3132, line 16: Please remove "on" from "on the on"

Fixed. Thank you.

P3132, line 17: Insert "extent" after "sea ice"

Fixed. Thank you.

P3132, line 21-24: This paragraph needs re-writing as it is not at all clear. For example the orbital parameters are calculated from the Berger solution and not estimated and GHG concentrations are measured.

Fixed. Thank you.

P3133, line3: Please be more precise. The phrase "apparently" implies that you are not sure the statement you are making is true or not.

Fixed. Thank you.

P3133, line 27-28: Please modify to include what the prescribed distributions are of.

Fixed. Thank you.

P3135, line 10: Insert "air" in front of "temperature".

Fixed. Thank you.

P3135, line 11: Insert rate after "precipitation".

Fixed. Thank you.

P3136, line 19: Please be more precise –either the mixed forest types dominate further south or they do not in the simulation ("not seem to dominate…")

Fixed. Thank you.

P3136, line 16: Remove the capital "S" from "South"

Fixed. Thank you.

P3137, line 3: Remove "the" from "…for the most…"

Fixed. Thank you.

P3137, line 8: The minus signs in front of 2 and 20 are not necessary.

Fixed. Thank you.

P3138, line 17-19: Firstly, the uncertainty of the NEEM ice core measurement puts the value of 5˚C within the measured range of temperature change for MIS5e. Secondly, the comparison with modern day suggests that the temperature difference over Greenland relative to preindustrial is 4˚C which seems very high. Could this be an artefact of your averaging time period for the simulations? Otherwise, I have misinterpreted your sentence.

Thank you for this point. The sentence is not clearly articulated. MIS-5e summer temperatures (JJA) with respect to Pre-Industrial (JJA temperatures) show a warming of +5 °C over GIS and the same comparison with respect to Modern (JJA temperatures) only shows a ~2 °C warming over the GIS. Modern simulation with respect to Pre_Industrial simulation in our model only shows a 1.8°C difference in summer temperatures. We have edited this statement so that it is clearer to the audience.

P3139, line 8: Change "replace" to "replaced"

Fixed. Thank you.

P3139, line 9: "Additional experiments involving sea ice extent…" This is unclear. Please be more explicit and state that it is the sub-sea ice heat flux you are changing which affects the sea ice extent.

Fixed. Thank you.

P3139, line 11-15: It is unclear whether you are referring to the data or the model. Please make sure you state what source you are talking about.

Fixed. Thank you.

P3139, line 26: Remove "an" before 2a mostly ice-free…"

Fixed. Thank you.

P3140, line 6: The Arctic Ocean is dry compared with what?

Compared with modern observations.

P3140, line 9: I suggest not using the phrase "exactly matching…"

Noted. Thank you.

P3140, line 28: change "record" to "records"

Fixed. Thank you.

P3143, line 3: Please update the current estimate of Greenland ice sheet contribution to sea level rise in line with the IPCC (2013) report (1.4 to 4.3 m). References such as Stone et al. (2013), Robinson et al (2011), Quiquet et al. (2013) should be included.

Thank you for this suggestion. We have addressed these citations.

P3145, line 15: What do you mean by "thick" needle-leaf and deciduous forests?

Thick should mean dense. This has been fixed. Thank you.

P3145, line 29: You have already used the acronym WAIS previously so do not need to define again.

Thank you. Fixed.

Figure 1: Are these plots using a fixed month calendar?

Yes. This is a fixed month calendar.

Figure 2: Do you mean areas of no shading are NOT statistically significant at the 95% level. Also do they represent annual, July, summer anomalies?

Yes, this is what we mean. We have clarified this. Thank you.

Figure 3: please state that D is with the ice sheet removed.

Fixed. Thank you.

Figure 4: What is the reference for the summer sea surface temperature anomalies? Also state the time period these plots represent.

The temperature difference is with respect to the same run with the default sub-surface heat flux.