

Review of “A GCM comparison of Plio-Pleistocene interglacial-glacial periods in relation to Lake El’gygytgyn, NE Arctic Russia” by Coletti et al.

This paper analyses a number of climate model simulations for 4 interglacial periods and also examines the effect of glacial boundary conditions on the Arctic and compares the results with data from Lake El’gygytgyn in NE Arctic Russia. The authors attribute much of the boreal warming to the orbital forcing although cannot explain the exceptional warmth of MIS11c. This conclusion is in line with several other studies. This paper does not add anything particularly new to the field as the experiments and data have already been published in Melles et al. (2012). It does, however, bring together further documentation of the model simulation outputs and data comparison which might be of interest to the interglacial research community. Before it can be considered for publication I feel that the following need to be thoroughly addressed:

- 1) The text needs to be more precise and focussed 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?
- 2) Where is the E-lake record? There should at least be a figure showing this data for the relevant time periods as it is so central to the paper. Furthermore, a separate map include the location would also be very useful.
- 3) A Table of temperature changes for different time periods at E-Lake/Beringia etc. from data and model would be useful. It is somewhat confusing 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.
- 4) The analysis of NH glaciation has no context as there is a sudden jump from discussing super interglacials to glacials and feels as if it has been appended at the end. Could this be revised so it fits in better?
- 5) It would be beneficial to include spin-up plots of the simulations as this paper is focussed on the modelling 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?
- 6) Please be consistent with the use of acronyms. Once stated use the abbreviation. Also some have been stated twice.
- 7) 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).

- 8) 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.

Additional 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?

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?

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

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

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

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

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

P3132, line 7: the 8°C warming at NEEM actually has a large uncertainty of $\pm 4^\circ\text{C}$. Please include this.

P3132, line 16: Please remove “on” from “on the on”

P3132, line 17: Insert “extent” after “sea ice”

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.

P3133, line 3: Please be more precise. The phrase “apparently” implies that you are not sure the statement you are making is true or not.

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

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

P3135, line 11: Insert rate after “precipitation”.

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...”)

P3136, line 16: Remove the capital “S” from “South”

P3137, line 3: Remove “the” from “...for the most...”

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

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.

P3139, line 8: Change “replace” to “replaced”

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.

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.

P3139, line 26: Remove “an” before 2a mostly ice-free...”

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

P3140, line 9: I suggest not using the phrase “exactly matching...”

P3140, line 28: change “record” to “records”

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.

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

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

Figure 1: Are these plots using 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?

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

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

Figures 5 & 6: Make it clearer that these refer to inclusion of large Northern Hemisphere ice sheets.

Additional references:

Bakker, P., et al., 2013: Last interglacial temperature evolution – a model inter-comparison. *Clim. Past*, 9, 605–619.

Lunt, D. J., et al., 2013: A multi-model assessment of last interglacial temperatures. *Clim. Past*, 9, 699–717.

Quiquet, A., C. Ritz, H. J. Punge, and D. Salas y Méliá, 2013: Greenland ice sheet contribution to sea level rise during the last interglacial period: A modelling study driven and constrained by ice core data. *Clim. Past*, 8, 353–366.

Robinson, A., R. Calov, and A. Ganopolski, 2011: Greenland ice sheet model parameters constrained using simulations of the Eemian Interglacial. *Clim. Past*, 7, 381–396.

Stone, E. J., D. J. Lunt, J. D. Annan, and J. C. Hargreaves, 2013: Quantification of the Greenland ice sheet contribution to Last Interglacial sea level rise. *Clim. Past*, 9, 621–639.