**Response to the review by Referee #1 on the manuscript cp-2021-66 "Biomarker proxy records of Arctic climate change during the Mid-Pleistocene Transition from Lake El'gygytgyn (Far East Russia)**

We thank Dr. Worne for providing a careful review of our manuscript and for the useful suggestions.

***General Comments***

*The MPT is a perplexing component of Quaternary climate change which provides a unique opportunity to understand the interconnectivity and feedbacks between different components of the climate system on orbital and sub-orbital timescales. Lindberg et al. present an interesting dataset from a unique archive to assess Arctic response to MPT climate dynamics and provide thorough discussion on the role of the North Pacific, Bering Sea, and inter-hemispheric teleconnections which could result in the observed changes in vegetation and temperature in north-eastern Russia. They properly outline the limitations of their datasets and calibrations, interpreting their data to a suitable resolution and using statistically robust techniques. The study concludes that the warm interglacial conditions widely observed during MIS 31, as well as subsequent MPT cooling, are not apparent at Lake El'gygytgyn. They discuss potential causes for this, as well as the detected sub-orbital cyclicity in the temperature record, including the interplay between temperature and moisture availability resulting from teleconnection with Arctic and sub-Arctic, as well as tropical and Atlantic Ocean feedbacks. Overall, I recommend that this manuscript be accepted subject to minor revisions. I have outlined some areas which I feel could benefit from additional discussion, as well as some technical corrections. I hope that the authors find these recommendations helpful.*

***Specific Comments***

***Review:*** *Could a short discussion be made on the difference between the results from the original and re-analysed samples from de Wet et al. (2016)?*

**Reply:** Yes, we can include a short discussion of this in the supplement. As the samples in this part of the core have low amounts of 6-methyl isomers, re-analyzing the samples with the newer HPLC methods yielded results similar to the original ones. Indeed, there is a very strong correlation between the original de Wet MBT values and the MBT values of the re-analyzed samples, with a slope near 1.

That said, the calibration that de Wet et al. (2016) applied (from Sun et al., 2011) was based on the combination of MBT and CBT values, and was also based on a smaller set of lakes than the new BayMBT calibration. While there is a good correlation between the reanalyzed BayMBT-based temperature values and the original MBT/CBT-based values, the slope of these data is approximately 0.5, indicating that that amplitude of temperature variability based on the BayMBT calibration is approximately half that of the MBT/CBT-based calibration.

***Review:*** *Figure 5 presents an MBT/CBT calibration from Sun et al. (2011) in light brown squares, however there appears to be no mention of this calibration is made in the text. There is clearly an offset in values in the MBT/CBT record compared to the African lakes and BAYMBT calibrations at ~1.1 ma. Could the author include some information on this calibration and the likely reason for this discrepancy, as they have for the Greenland lakes calibration? This is particularly relevant for the later discussion on MIS 31 as the MBT/CBT calibration has notably higher temperatures which would support superinterglacial warmth,* *compared to the BAYMBT and African Lakes which do not show a similar peak in temperature or subsequent cooling trend.*

**Reply:** We agree with the reviewer that, based on the BayMBT temperature reconstruction, MIS 31 does not stand out as such a strong interglacial as it does based on the MBT/CBT-based reconstruction. The reason for including the MBT/CBT calibration is this is the calibration that de Wet et al. (2016) published their brGDGT data on. Overall, as this calibration is based on the older HPLC methods that did not separate the 5-methyl and 6-methyl isomers, it is not the best one to apply currently. We will add some information to the text about this calibration and its offset from the others.

***Review:*** *The authors include a very interesting discussion on suborbital cyclicity at ~11 kyr. Some mention is given to the potential control of the monsoon. I wonder if the authors has considered the amplification of the Walker Circulation as a mechanism of suborbital cyclicity? Intensification of the Walker Circulation is suggested to have occurred in the build up to the MPT from ~1.17 Ma, propagating to the high latitudes through changes in the El Nino Southern Oscillation and East Asian Winter Monsoon (McClymont & Rosell-Melé, 2005; Stroynowski et al., 2017). Evidence from the adjacent Bering Sea supports this, where sea ice is suggested to have responded to the resultant changes in wind strength, temperature and moisture delivery (Stroynowski et al., 2017; Worne et al., 2021). This would also fit with the authors discussion of changing wind strength and wetter conditions.*

**Reply:** Thank you for this suggestion, we had not seen the Worne et al. (2021) paper yet. We will incorporate the idea that Walker Circulation may have played a role in initiating the changes around 1 Ma into our discussion and also will include the suggested additional citations.

***Review:*** *Line 437: Evidence from the Site U1343 does not show reduced diatom productivity, where the opal MAR record (Kim et al., 2014) is high through this interglacial, indicating high productivity. Furthermore, Detlef et al. (2018) states that "beginning at MIS 25, [Site U1343] is characterised by an ice-free eastern Bering Sea". Recent diatom data may be in better support of your discussion here, where fossil assemblages suggests that MIS 25 represents an interval of peak marginal sea ice conditions across the MPT interval, suggested to be a result of increased wind strength and longer sea ice melt seasons (Worne et al., 2021).*

**Reply:** The climatic and oceanic changes that took place during Marine Isotope Stage 25 are complex, and we thank the reviewer for pointing out the need to improve the discussion around Site U1343 at that time. Indeed, high opal accumulation rates at Site U1343, together with the low sea-ice biomarkers may indicate highly productive, ice free conditions. On the other hand, as the reviewer points out, recent results of Worne et al. (2021), based on diatom assemblages at Site U1343, suggest an increase in marginal sea-ice conditions, possibly related to a lengthened sea-ice melt season. We will revise this paragraph to better characterize the changes going on in the N. Pacific and how they may relate to temperature change at Lake El'gygytgyn.

***Technical Corrections***

Thank you for catching these technical errors. We will make all the corrections listed below.

*Line 12: comma after "Arctic"*

*Line 35: comma after "(Brigham-Grette et al., 2013)"*

*Line 36: rephrase, perhaps to "tundra vegetation, where the tree line lies…"*

*Line 67 and 75: capitalise Arctic*

*Line 114 and 116: extra space before methanol needs removing.*

*Section 3.1: be consistent with capitalisation of Eq or eq.*

*Figure 3: Caption for E and F appears to have errors with references in the wrong place and text missing, perhaps because of referencing software. Needs to be re-written.*

*Line 334: NE has been fully written as northeast earlier in the text, needs to be consistent.*

*Line 450: "short-lived" needs hyphenating.*

***References cited here, not included in original manuscript:***

We will consider these references in our revisions, particularly in the revised discussions on sub-orbital variability and N. Pacific climatic/oceanographic changes. Thank you for bringing them to our attention.

Kim, S., Takahashi, K., Khim, B. K., Kanematsu, Y., Asahi, H., & Ravelo, A. C. (2014). Biogenic opal production changes during the Mid-Pleistocene Transition in the Bering Sea (IODP Expedition 323 Site U1343). Quaternary Research, 81(1), 151–157. https://doi.org/10.1016/j.yqres.2013.10.001

McClymont, E. L., & Rosell-Melé, A. (2005). Links between the onset of modern Walker circulation and the mid-Pleistocene climate transition. Geology, 33(5), 389–392. https://doi.org/10.1130/G21292.1

Stroynowski, Z., Abrantes, F., & Bruno, E. (2017). The response of the Bering Sea Gateway during the Mid-Pleistocene Transition. Palaeogeography, Palaeoclimatology, Palaeoecology, 485(March), 974–985. https://doi.org/10.1016/j.palaeo.2017.08.023

Worne, S., Stroynowski, Z., Kender, S., & Swann, G. E. A. (2021). Sea-ice response to climate change in the Bering Sea during the Mid-Pleistocene Transition. Quaternary Science Reviews, 259, 106918. https://doi.org/10.1016/j.quascirev.2021.106918

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