

## ***Interactive comment on “Rapid waxing and waning of Beringian ice sheet reconcile glacial climate records from around North Pacific” by Zhongshi Zhang et al.***

**Zhongshi Zhang et al.**

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Dear Martin and Volker,

We agree that the age model from Lake El'gygytgyn is the best solution available now. However, unavoidable uncertainties are included in the age model. Thus, the age model was adjusted in 2002, 2007, 2013 (Nowaczyk et al., 2013). Moreover, the gaps and mass movements in glacial facies from Lake El'gygytgyn should be further investigated, since they bring uncertainties in explaining glacial sediments from Lake El'gygytgyn.

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Due to these uncertainties, the interpretation of the glacial facies remains controversial. Based on the concept of Laurentide-Eurasia-only ice sheets (without the BerIS), the perennial lack-ice explanation is reasonable. On the contrary, based on a new scenario with the BerIS involved, the subglacial lake explanation is not unacceptable. The subglacial lake can stop receiving sediments (or sediments are eroded or reworked by ice) when the BerIS is very big, while receive sediments again when the ice melts.

As we wrote in the reply to Juile, “Did a BerIS once exist? To answer the question, we should put each piece of evidence (not only the direct glacial evidence) into one framework, without conflicts. Since the direct evidence cannot really answer the question, we turn our eyes to investigate the continuous climate records with precise age controls.”

In our study, with the same climate model, we test the two ice sheet scenarios to investigate which one could reconcile the climate (temperature) evidence from around the North Pacific. Unfortunately, the scenario of Laurentide-Eurasia-only ice sheets fails. To make our simulations convincing, we validate our climate model by carrying out sensitivity experiments forced with the ICE6G reconstructions. Forced by the Laurentide-Eurasia-only ice sheets, our sensitivity experiments demonstrate that the simulated large-scale atmosphere and ocean responses agree with early modelling studies. Please see lines 236-256 in the paper.

To further strengthen the concept of Laurentide-Eurasia-only ice sheets, there are two questions that should be answered.

1) What forcing limits the growth of the BerIS? As proved by our and the early study (Bakker et al., 2020), the buildup of a BerIS is not hampered by the absence of precipitation.

2) How to reconcile the temperature evidence from around the North Pacific within the Laurentide-Eurasia-only concept?

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Before these two questions are well answered, it is not fair to reject the possibility of the BerIS now.

We suggest that whether a pre-LGM BerIS once existed remains to be an open question. We hope our current work can encourage more studies in the Beringian regions. From modelling side, we need to “further distinguish the climate feedbacks due to the BerIS and the Laurentide-Eurasia-only ice sheets” with more climate models. We suggest that “experiments of MIS 4 could be a new benchmark in the PMIP”. From data side, “new field and marine field investigations across NE Siberia-Beringia, to acquire sea level sequences, glaciostatic changes, and paleoclimate records in the Beringian regions, are clearly key targets to provide more precise age controls and robust constraints to the extent and timing of the BerIS.”

If you have more comments, please let us know.

Zhongshi on behalf of all co-authors

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