General Comments

This manuscript essentially summarizes more than two decades of research on stratified ice-wedge-filled lacustrine deposits indicative of interglacial warmth at two nearby sites in NE Siberia: Bol'shoy Lyakhovsky Island and the Oyogos Yar coast. Much of the biostratigraphic evidence has been published previously in specialty journals but is helpfully summarized and compared here, and includes important new geochronological evidence confirming an Eemian (MIS 5e) age and summarizes all of the biostratigraphic evidence in climate terms. As such, this is a very useful synthesis for the Quaternary community and is well suited for Climate of the Past. It provides an important synthesis of a massive amount of work, including a wider range of climate proxies than for almost any other LIG Arctic site. I am not especially familiar with these deposits, but there is quite an extensive literature on them.
Many thanks for this very friendly assessment.

An OSL expert should review those results as these are essential to the story and as near as I can tell, have not been previously published, whereas much of the other data have been published in specialty journals previously. I have no reason to be suspicious, although the stated precision is somewhat better than most OSL ages in this time range. There are an amazing amount of specific analytical results, all at least modestly useful, but certainly not of equal informative power. Still, the less significant results take up less space and document the breadth of effort put into these studies.
Many thanks for this very friendly assessment. Indeed, the luminescence ages (IRSL) are new and unpublished, and we addressed the remarks of the reviewers on luminescence dating in our revised manuscript and replies.

Paragraph indents would have been very helpful
Thank you for this suggestion. We have made the paragraph indentations.

Specific Comments

Abstract: This should be a single paragraph that succinctly explains what is newly published in this paper and what is being summarized from previous (mostly proxy-specific) publications. And ending with a summary of what the authors think are the key interpretations for Eemian climate (both winter and summer), how these compare with model-based reconstructions and what appears to be the important factor of the higher Eemian sea level, and ending with how what they have learned has relevance for predictions of future Arctic warming in an enhanced greenhouse world. The current abstract is several paragraphs long and reads more like an Introduction than an Abstract.
Thank you for your thoughtful comments and suggestions regarding the abstract of our manuscript. We appreciate your guidance on refining the abstract to ensure it is succinct while remaining informative. We agree with your suggestion to streamline the abstract and have shortened it considerably. However, we would like to clarify our approach to structuring the abstract, which we believe aligns with the journal's directive that the abstract should be intelligible to the general reader without reference to the text. We intend to provide not only a summary of our findings but also a brief introduction to the topic, which sets the stage for the significance of the new proxy analyses conducted. In response to your comments, we have made efforts to condense the abstract while ensuring that it remains a comprehensive

overview of the study's contributions. We added a summary of the key interpretations for the Eemian climate in both winter and summer. We do not believe that the discussion of sea level differences between models and the real world fits into the abstract. We think that our revised abstract now effectively communicates the core contributions of our work.

Specific comments by page and line number

p.2 Abstract

Line 16 *sed*aDNA not *seda*DNA; looks OK in main text
Thank you very much. We change the "a" in *sed*aDNA from italic to non-italic.

Line 11. "*new luminescence ages"* Are the luminescence dates new with this publication? If so, then line 8 might best read "*Here, we present new geochronological results and synthesize cryolithological,…."*
The abstract was generally rewritten and condensed.

Line 19*: "proxy data and also paleoclimate model results indicate a* ***regional*** *LIG climate significantly (ca. 5 to 10 °C) warmer than today"* What region? Maybe make this specific to high northern latitudes?
The abstract was generally rewritten and condensed

p.3 Line 19 "*The globally warmer-than-today Last Interglacial (LIG, ca. 130-115 ka)*
Do we really know LIG is globally warmer than today? The primary forcing (insolation) is limited to Northern Hemisphere summer and is actually negative for summer in the S Hemisphere. Rising sea levels from NH ice sheets can destabilize some of Antarctica without warming. The Holocene appears to show no early Holocene warmth globally but strong early Holocene warmth in the Arctic…can Eemian be the same? This needs a reference it the authors want LIG warmth to be global.
We added
Past Interglacials Working Group of PAGES: Interglacials of the last 800,000 years, Rev. Geophys., 54, 162–219 (2016). https://doi.org/10.1002/2015RG000482.
Fischer, H., Meissner, K.J., Mix, A.C. et al. Palaeoclimate constraints on the impact of 2 °C anthropogenic warming and beyond. Nature Geosci. 11, 474–485 (2018). https://doi.org/10.1038/s41561-018-0146-0.
Snyder, C. Evolution of global temperature over the past two million years. Nature 538, 226–228 (2016). https://doi.org/10.1038/nature19798.
Wilcox, P.S., Honiat, C., Trüssel, M., Edwards, R.L., and Spötl, C.: Exceptional warmth and climate instability occurred in the European Alps during the Last Interglacial period. Commun Earth Environ 1, 57 (2020). https://doi.org/10.1038/s43247-020-00063-w.

p.8 Line 20 and following ***3.2 Luminescence dating***
The section on Luminescence dating is important because it seems to be new results that confirm the age of the deposits to be indeed MIS 5e. Please clarify (1.) when the sampling occurred and(2.) when the analyses were made and (4.) whether the dates cited came from only one of the two sites. (3.) Were earlier efforts inconclusive? Is this the first time these MIS-5e dates are being published? (5.) Can you show a section where the OSL samples were taken and the context of other biostratigraphic samples in the same section. This seems

important to convince the reader that the dates have direct relevance to the climate reconstructions.
In the text, it was written:

1. “In 2014, Krest-Yuryakh deposits were sampled at the southern coast of Bol’shoy Lyakhovsky Island for luminescence dating. [...] exposure was sampled for luminescence dating at heights of 4.5 m a.s.l. (L14-12-OSL1) and 2.7 m a.s.l. (L14-12-OSL3) (Table A1).”

2. We inserted the information on sample processing in the luminescence laboratory at the Institute of Applied Physics, TU Bergakademie Freiberg and clarified the information on samples involved in sample processing.

3. Earlier dating of such ice-wedge pseudomorphs (see Andreev et al., 2004 and Opel et al., 2017) does not show an exact MIS 5e age. However, it does point to the same age range. The ages published here are the first to fit this time frame directly.

4. We added: “Krest-Yuryakh deposits were sampled **at one site** (L14-12) at the southern coast of Bol’shoy Lyakhovsky Island for luminescence dating

5. We have included a photo of the sampling site with the sampling points as Figure S1 in the supplement.

There are no citations in Section *4.2 Luminescence dating*, hence I gather these results have not been previously published, and should be reviewed by an OSL expert.
That's right. The new ages have not been published yet.

p.10 Top
Pollen data are discussed in terms of processing, but no mention of how to deal with pollen from taxa with highly efficient wind-dispersal mechanisms. Particularly *Alnus, Salix, and Betula* that are very efficiently wind transported. However, it appears that actual plant fragments of at least *Betula* and *Alnus* were recovered. I suggest presenting the plant macrofossil evidence first as its authenticity for on-site plant grow this much higher than for pollen, especially for taxa dependent on wind dispersal of their pollen.
We completely agree that plant macrofossils evidence better the presence of plants in local vegetation. It is also correct that wind-pollinated plants such as *Betula, Alnus, Pinus, Artemisia,* Poaceae, and many others produce a large number of pollen grains, and their pollen is easily transported by wind. However, only single grains are normally transported for long distances. The biggest part of the pollen of such wind-pollinated plants is accumulated a few hundred meters from the flowering plants. Thus, if pollen percentages in the sediments are relatively high (>10-20%), the producing plants grew in the close vicinity of the study site. Moreover, pollen-based vegetation and climate reconstructions are not based on the presence of single grains but on the pollen percentages.
We prefer to leave the order of the proxy results as it is. Considerably more profiles and sediment samples were analyzed for pollen (10) than for plant macrofossils (5).

Table 2 is very helpful in this regard
Thank you for this friendly comment.

Also a discussion on page 37 addresses some of these issues
Thank you for this friendly comment.

Fig 4 very helpful and convincing for ID of Eemian

Thank you for your encouraging comment.

p.12 Section 3.5 ***Clumped isotope analysis of biogenic carbonates and derivation of lake water δ18O***
Wouldn't this make more sense to read: ***Clumped isotope derived lakewater paleotemperatures***
We calculate the isotopic composition of lake waters in addition to the clumped isotope temperature, but this is not included in the reviewer's suggested title. However, we agree that a more succinct title may be advantageous. We would suggest:
"Clumped isotope derived lake water temperature and $\delta^{18}O$ signatures"

p.30-32 ***5.2 Last Interglacial chronology and dating uncertainties***
I'm not sure the summary of the range of ages available is essential here. Seems like focusing on luminescence techniques, as that is all that is presented for age control of these deposits. Other dated deposits are listed but as those results are not really discussed, I don't see why they are relevant to the paper. Although Fig 11 is somewhat helpful even though not particularly relevant to the main thrust of this paper.
We believe that the new luminescence ages of the MIS5e deposits are a substantial part of the study and worth to be shown as they provide age control for the proxy interpretations. Thus, the aim of showing Fig. 11 is not only to present the newly obtained luminescence ages but also the stratigraphic context of previous dating attempts. Therefore, also the other available MIS5 age determinations from Bol'shoy Lyakhovsky Island and the Oyogos Yar coast are shown here. As the previous age determinations are extensively discussed in the cited references, we focused on highlighting the new dating results. Therefore, we changed the title of section 5.2 to "Luminescence dating results of Last Interglacial deposits". Given the age of these deposits, luminescence dating is indeed the chosen technique.

Section 5.3 is important and very helpful, as is Table 7
Thank you for this encouraging comment!

p.36, line 13 "farther vs further" "farther describes physical distance; further describes figurative distances"
corrected

p.38&39 Conclusions

This is the one paragraph that most "general readers" will look to. Page 39 first paragraph discusses the temperature estimates from a range of proxies, especially warmest month. But it gets a bit muddled on exactly "how much warmer than present day", or pre-industrial, summer temperature estimates they are. It would be very helpful to have a better presentation of

- Recorded summer temperatures (or estimated pre-recent-warming warmest month temperatures

We added the sentence:

"According to ERA5 (1990-2019) simulations, the present-day MTWA of Bol'shoy Lyakhovsky Island and the Oyogos Yar coast is 2.7 and 7.5 °C, respectively, and the MTCO is -32.7 and -34.1 °C."

- The range of LIG estimated warmest month temperatures for the various proxies and an attempt to summarize how these might be compared to contemporary measured air or lakewater temperatures

We added the sentence:
"This suggests summers warmer than today by 5.5 to 12.8°C for Bol'shoy Lyakhovsky Island and by 0.2 to 7.5°C for Oyogos Yar coast, and winters warmer than today by up to 7.1°C and 8.4°C, respectively."

- The modeled Eemian warmest month temperatures

We added the sentence:
"The PIobs+(lig127k-PI) MTWA for Bol'shoy Lyakhovsky and Oyogos Yar are very close to each other (4.4±1.0 and 4.5±1.2 °C) and also the MTCO with –31.1±1.4 and –31.6±1.4, respectively."

And then the discussion of how a higher sea level during teh Eemian may in its own altered warmest month temperatures.
We agree that changes in circulation due to the higher sea level during the Eemian might have influenced the warmest month temperatures. Looking at present day climate, the coastline of Siberia is more impacted by cyclones than areas farther away from the coast. An inward shift of the coastline during the Eemian could, therefore, have caused higher cyclone frequencies at our proxy locations in comparison to the present-day climate, with associated lower temperatures of the warmest month. However, without model simulations that reflect the paleogeography - modeling protocol for the lig127k simulations asked modelers to use present-day land sea masks - it is difficult to investigate what circulation changes in the Eemian compared to today might really look like, and the impacts they may have had on warmest month temperatures would be rather speculative, which is why this was not included in the discussion.

The simple existence of our terrestrial profile already shows that there was no coastline in the study area during the LIG.

In the chapter 5.3 Proxy-based quantitative paleoclimate reconstructions compared to PMIP model simulations are written:
"The differences between the PMIP model's land-sea mask and the actual coastline during the LIG, especially MAP and MTWA, might lead to underestimated MAP and MTWA"

and in the conclusion chapter:
"Paleoclimate models generally agree well with the mean temperature of the coldest month (MTCO) proxy data but consistently underestimate the mean temperature of the warmest month (MTWA) across proxy records when using modern land-sea configurations. This mismatch is significantly reduced when models incorporate land-sea distributions that more closely reflect those of the LIG. This adjustment highlights the importance of considering past land-sea configurations in regional paleoclimate modeling when comparing proxy and model results, a critical step in refining our understanding of Arctic climate dynamics during MIS 5e."

This section is so important to the general reader that a bit more effort to distill all their amazing data into a comprehensive summary is important.