Hereby we thank the Editor for valuable and constructive comments. We provide the response to main comments as well as point-by-point response to detailed comments from the manuscript file.

Main comments:

1. **The main issue with the manuscript at this stage is the structure, which remains unclear. Some of the newly added sections do not belong in the Results part, as they mix results and interpretation. A restructuring of these sections is necessary, as outlined in my comments.**

Suggested changes were applied to improve structure of the manuscript:

- Former section 2.2 concerning Holsteinian Interglacial was integrated with Introduction part and information about post-Holsteinian (MIS 11b) climatic conditions were added;
- Former section 3.1 was splitted into two parts and integrated with 2.1 Study area section (lithological description part) and with 4.1.2 (interpretative part);
- Order of pollen- and chironomid part was reversed, both in section 2 (Materials and methods) and 3 (Results), placing chironomid part first (as 2.2, 2.3, 3.1, 3.2) and the pollen part the second (as 2.4, 2.5, 3.3, 3.4).

2. **I would also like to see, in the next version, a synthesis figure comparing your record with other MIS 11b sites — this is currently missing and would greatly enhance the paper for C. Past.**

Respective figure (Fig. 5) was added to the revised manuscript (section 4.1.2) as suggested. It includes comparison of the climatic reconstructions from the following MIS 11b records:

- the Marine Isotope Stage (MIS) 11b pollen- and chironomid-based summer temperature reconstructions from Krępa
- a summer temperature reconstruction based on branched glycerol dialkyl glycerol tetraethers (brGDGTs) from Tenaghi Philippon, Greece (Ardenghi et al., 2019);
- a pollen-based summer temperature reconstruction from Lake Ohrid, Balkan Peninsula (Kousis et al., 2018; Kountsodendris et al., 2020)
- a pollen-based summer temperature reconstruction from ODP Site 976, Alboran Sea (Sassoon et al., 2025)

- a biomarker-based (Uk'37) sea surface temperature (SST) reconstruction from marine core MD03-2699, Iberian margin (Rodrigues et al., 2011)

The results were also discussed in the text.

3. The age model (or the absence of one) also needs to be discussed.

Due to the inability to apply radiocarbon dating (e.g. 14C) and the challenges in developing an age–depth model, the direct dating of Holstein interglacial sediments is highly limited. In this context, palynology plays a key role, as pollen analysis enables biostratigraphic comparison between sites. Vegetation changes that occurred during the Holstein interglacial show a relatively uniform pattern across Central Europe from boreal phases to the development of thermophilus deciduous forests. Thanks to the repeatability of this vegetational succession, it is possible to correlate sediment profiles from different locations and assign them to a common stratigraphic framework. Thus, palynology becomes the primary tool for reconstructing and comparing environmental records from this period, despite the lack of precise absolute dating.

4. Additionally, the number of components and analogues selected in the WAPLS and MAT reconstructions should be checked: using only 1 or 2 components is very low for WAPLS (3 is more typical), and 2 analogues is not acceptable for MAT.

The pollen-based temperature reconstruction was reconducted, with increased number of components (4) for WA-PLS method and analogues (7) for MAT.

5. Finally, I recommend that the manuscript be proofread and corrected by a native English speaker. Although the language has improved significantly, some unclear phrasing still remains and should be polished before publication.

According to the suggestion, the manuscript was proofread and corrected by a native English speaker (British).

Point-by-point response to detailed comments:

Line 22: "as well as in the trophic state or pH of water bodies" – you can remove this part.

This fragment was deleted.

Line 33: "…which, however, show a certain delay compared to the chironomid-based temperature 33 reconstruction" - I don't agree with that: not seen in the figures and not discussed in your discussion part.

This fragment was deleted.

Line 49: foraminiferas without S.

This was corrected accordingly.

Line 55: "…human impact on the 55 environment during the last 300 years." - human impact is recorded from the Iron age to now.

This fragment was corrected as follows:

"In general, palaeoecological and palaeoclimatological reconstructions record human impact on the environment from the Iron Age (Dumayne-Peaty, 1998; Szal et al., 2014)."

Line 60: Why the MIS 11 instead of, for example, the Eemian? or MIS 19? Please justify.

This was corrected as follows:

"In this regard, a particularly suitable targets are interglacial periods, e.g. Holsteinian Interglacial (or Mazovian Interglacial in Poland), which is commonly estimated to have lasted from 423 to 395 ka BP, thus corresponding to MIS 11c (Lauer and Weiss, 2018; Lauer et al., 2020; Fernández Arias et al., 2023). Holsteinian Interglacial is considered the analogue of the Holocene in terms of astronomical parameters (eccentricity, precession, insolation), climatic conditions and greenhouse gases levels (Koutsodendris et al., 2010; Yin and Berger, 2012; Kleinen et al., 2016)."

Line 64: Please also add Lapellegerie et al., 2024.

Respective reference was added.

Line 67: And the marine core in Alboran sea (Sassoon et al., 2023, 2025), and Lake fucino in Italy (Vera-Polo et al., 2024).

Respective reference was added.

Line 75: Check the English

Manuscript was proofread by a native English speaker (see our response to main comment #5 above). The sentence was corrected as follows:

“The contemporary state of knowledge on MIS 11 has been reviewed by Candy et al. (2014).”

Line 83: Verify with the Dael’s paper.

This issue was verified and the sentence was changed as follows:

“”Although the OHO has been described at multiple sites across northern Europe (Koutsodendris et al., 2012), it has so far been identified in few southern European sites (Kousis et al., 2018; Sassoon et al., 2023, 2025)

Line 90: Here, you have to be more precise as you mainly focus your introduction on the MIS11c. But you don’t give the state of the art for the MIS 11b. Why is this time period important? What are your objectives? Your hypothesis?

This part was extended and the necessary justifications were added. The fragment after changes reads as follows:

“Aiming at improving the knowledge about climate variability at the demise of the Holsteinian Interglacial, we present the first quantitative climate reconstructions for the post-Holsteinian in Central Europe, based on chironomid and pollen analyses.The aim of analysing this post-interglacial period is to investigate temperature and vegetation changes and to determine if climate at the time was considerably cooler than today. This choice was also dictated by Chironomidae head capsules’ presence in post-Holsteinian section of the core (unlike the Holsteinian part). In addition, we discuss the potential of chironomid analysis for palaeoecological study of Quaternary sediments as well as the challenges for chironomid analysis arising from both the evolution and interchanging adaptations to species ecological preferences and the preservation of fossil remains.”

Line 106: Details on the core, the stratigraphy and the age model are lacking. You can here move your part in the results on the core description.

The requested details was moved to section 2.1 as requested. As far as the age model is concerned – please see our response to the main comment #3 where we provide justification of depth-age model lacking.

Line 111: foto → picture

This was corrected accordingly.

Line 114: I don't understand this part here: better to move to the introduction part, not here in the mat/meth part.

Please see our response to main comments.

Line 120: Italic.

This and other similar mistakes were corrected throughout the manuscript.

Lines 123-125: What about the 11b which is the core of your paper?

Requested information was added:

"Holsteinian Interglacial was followed by gradual cooling period (MIS 11b) which resulted in annual temperature decline and forest contractions (Tzedakis et al., 2006; Kousis et al., 2018; Hrynowiecka et al., 2019; Sassoon et al., 2025)."

[…]

"MIS 11b brought the AP percentages decrease in Central Europe (Hrynowiecka et al., 2019). Lake Ohrid pollen record reveals the domination of *Pinus* and plant open communities at the time, with Poaceae and *Artemisia* species included (Kousis et al., 2018). ODP Site 976 pollen-based climate reconstructions shows annual temperature drop to around 10 °C and summer temperature to 20 °C (Sassoon et al., 2025)."

Lines 131-132: You can also compare with the temperature reconstructed at Ohrid (Kousis et al., 2018).

This was corrected accordingly.

Line 156: More details are needed

Section 2.3 (now 2.4) was rewritten as pollen-based reconstruction parameters changed and details requested further were added – please see our response to the main comment #4 and comments below.

Lines 157-158: Mean annual precipitation; temperature of the warmest month, because with the pollen we don't necessary reconstruct the temperature of July, it can be those of August; MTWA; mean temperature of the coldest month; MTCO.

These were corrected accordingly.

Line 159: Replace by: Guiot, J.: Methodology of the last climatic reconstruction in France from pollen data, Palaeogeogr. Palaeoecol., 80, 49–69, 1990

This was corrected accordingly.

Line 165: Standard errors of prediction (SEP) – how do you calculate them?

Following information was added to the text:

"In the WAPLS approach, sample-specific SEP were obtained via a bootstrapping implemented in the rioja package (Juggins, 2022). For the MAT model we used the cross-validated RMSE as a uniform error estimate for the fossil MAT reconstructions."

Line 167: How many modern pollen records? How many taxa? How the climate parameters are calculated?

The following fragment was added to the manuscript (section 2.4. Pollen analysis) to address the questions above:

"This geographic filtering yielded a regional calibration set of 4955 modern pollen samples, out of the original global dataset. From the fossil pollen dataset, only taxa present in at least 50% of the samples and reaching at least 1% pollen value at least once were included. Additionally we ensured taxonomic consistency between the modern and fossil pollen data by harmonizing taxa names and then removing taxa with zero abundance in the filtered modern set. After this filtering, 10 pollen taxa remained in common between the modern calibration set and the fossil record (primarily major arboreal and herb taxa such as Larix, Betula, Pinus, Salix, Picea, Juniperus, Artemisia, Asteraceae, Poaceae, and Amaranthaceae). Using only these common taxa helps avoid noise from spurious taxa and improves model robustness. All data processing and modeling were carried out in R (RStudio), making use of the analogue and rioja packages for calibration and reconstruction (Simpson, 2007; Juggins, 2022; Simpson and Oksanen, 2025)."

Line 170: How many samples?

The pollen-based reconstructions were restricted to the interval of the succession where chironomid remains were also present and were performed on 44 samples.

Line 175: Please remove this part.

This part was removed as requested.

Lines 198-203: Move this part at the end of 2.5.

This was corrected accordingly (now section 2.2 Chironomidae analysis).

Line 205: 14 in the figure.

This was corrected accordingly.

Line 209: I'm having a structural issue with this new section, which I don't think should be included in the Results. I suggest splitting it into two parts: the entire lithological description should go in the Materials and Methods section, where such information is currently lacking; and the interpretative part (lines 228–236) should be moved to the Discussion.

As suggested, lithological description was moved to section 2.1 Study area, and interpretative part to section 4.1.2.

Line 237: Move this part after the Chironomid part.

This was corrected accordingly – please see also our response to the main comment #1.

Line 238: Lack a few words to introduce this part. How many PAZ? obtained with CONISS? As the goal of your paper is on MIS 11b, please remove the parts on MIS 11c (in your text and in your pollen diagram) as you don't discuss it after.

Initially, 14 Local Pollen Assemblages Zones (LPAZ) covering the end of MIS 12 and MIS 11 period were extracted (using CONISS and were adjusted visually). Post-holsteinian (MIS 11b) covers LPAZ from 12a to 13a.

LPAZs covering MIS 11c part were removed from the text as well as from the pollen diagram.

Line 240: "Pollen of temperate species is sourced from redeposition" – why?

This sentence was deleted in the revised version of the manuscript.

Comments in lines 256-293

The whole section was removed from the manuscript as it concerned MIS 11c period.

Line 312: Italic

This was corrected accordingly.

Line 334: Move before the pollen part

This was corrected accordingly.

Lines 336-364: Move this part to the discussion part: its very interesting but its not your results, it's a discussion!

As suggested, this part was integrated with section 4.1.2.

Lines 365-367: I disagree with this argument: these are two independent proxies, and PAZs cannot be used to describe chironomid variations. The description should be based on depth if defining zones is not feasible. The following paragraph needs to be fully revised and synthesized. No interpretation should be included at this stage in the Results section.

In the revised version of the manuscript, chironomid assemblages variations were described using depths instead of LPAZs. This fragment itself was deleted. The following paragraph was completely rewritten to restrain from interpretation in the results part.

Lines 391-392: Simplified pollen diagram: please changes the colors as its done usually in pollen data as follows: Orange is for steppic and/ or NAP and green colors are for arboreal pollen. How do you calculate your pollen sum? With or without *Pinus*? Most important: remove the part MIS 11c: not discussed in the texte, not important for this paper!

Colors in the figure were adjusted accordingly and MIS 11c section was removed – please see modified Figure 3.

Pollen sum was calculated including *Pinus*.

Line 393: July in the text – homogenise.

This was corrected accordingly – as far as chironomid-based temperature reconstruction is concerned, "July" is used throughout the text and as section title.

Line 396: I agree, you have to remove the pollen characterising the MIS 11c.

This was corrected accordingly.

Line 405: Remove "Air".

This was corrected accordingly.

Line 414: The figure legend needs to be written in a larger font — it is currently too small. I suggest splitting this into two separate figures: one figure to show the variations in chironomid assemblages only. The chironomid-based summer temperatures can be added to the existing figure showing pollen-based temperature reconstructions, as is already partially the case.

Figure 3 was edited taking into account suggestions above – the legend font was enlarged and July temperature reconstruction was removed and is present now in the Figure 4 (and additionally in the new Figure 5 for comparison).

Line 420: "The pollen-based climate reconstructions from the Krępa sediment core reveal a distinct climate variability throughout MIS 419 11b, in general following the vegetation-indicated stadial-interstadial transitions" Please avoid: for me its circular reasoning as you did the transfer function on the same pollen record.

This sentence was deleted in the revised version of the manuscript.

Line 424: Move this Table in the supplémentary. Could you check carefully your methods and results? Usually, we kept at least 3 components for WAPLS and we never kept 2 analogs (k?) for the MAT (it's too low). Please check!

The table was moved to the Supplement as Supplement Table 1. For changes in pollen-based reconstruction methods – see our response to the main comment #4.

Line 427: Are the two pollen-based methods in agreement? This should be clarified, as it is important — especially since WAPLS is used for both chironomid and pollen reconstructions.

This issue was clarified in the revised manuscript:

"Pollen-based climate reconstructions from the Krępa sediment core reveal distinct climate variability throughout MIS 11b, reflecting stadial–interstadial transitions (Fig. 4). Conducted cross-validation indicated that MAT reconstructions achieved the highest predictive skill, particularly for the reconstructed temperatures (Table 2). The two pollen-based methods show broadly similar trends across all zones, with MAT generally producing warmer summer values than WAPLS except in KR-12c. Where chironomid data are available, pollen-based MTWA reconstructions reproduce similar patterns, with differences falling within their respective uncertainty ranges. Among the two pollen-based models, MAT generally corresponds better to the chironomid WAPLS reconstructions, showing overall closer alignment in reconstructed summer temperatures.

WA-PLS reconstructions were somewhat less robust, especially for precipitation, while the TANN and MTWA estimates still showed moderate predictive ability (Tab. 2). Reconstructed MTWA from both pollen-based methods generally ranged between approximately 15°C and 19°C. The two pollen-based methods show similar trends across all zones, with MAT often producing slightly warmer summer values than WAPLS."

Line 450: Remove the pollen percentages and keep only the climate data in the figure. Clearly indicate "pollen-inferred climate reconstruction" on the figure. Do not show precipitation as histograms — use line curves instead. Include the modern (present-day) value for each climate parameter. Also, there are 14 samples for the chironomid data, not 13 as stated in the text.

Figure 4 was edited according to the suggestions.

Line 461: The sentence may be too long.

This sentence was divided in two and corrected as follows:

"Because of the excellent preservation of their larvae's head capsules in lake and peat bog sediments, the analysis of their subfossil remains offers the possibility to reconstruct environmental and climatic changes in the past. This includes quantitative reconstructions of the average July air temperature and the trophic state of the inhabited water body as well as the type and dynamics of the lake, the water pH, and microhabitats."

Line 464: "climate" → "temperature".

This was corrected accordingly.

Line 465: "The basic principle of palaeoecological reconstructions is geological actuality implying that processes taking place on Earth 465 in the past were the same as today (Krzeminski and Jarzembowski, 1999)." – not clear.

"Geological actuality" was replaced with "uniformitarianism".

Line 535: "Chironomid-inferred <u>temperature</u> reconstruction […] pollen-based <u>climate</u> reconstruction".

This was corrected accordingly.

Line 537: Age? not clear! Not possible to build an age model?

Please see our response to the main comment #3.

Lines 548-549: How do you know that these PAZ correspond to these colds events of MIS 11c?

This sentence was removed from the revised version of the manuscript.

Line 555: You may add Lapellegerie et al., 2024

Respective reference was added to the text.

Line 558: Would be interesting to compare your results (MIS 11b) with cold part just after the Eemian.

Information concerning Chironomidae assemblages from Siberia was added to the text:

"A similar phenomenon has so far only been observed in the Laptev Sea region (Arctic Siberia), where Chironomidae also appear only in the cold period after the Eemian Interglacial, when the site was surrounded by wet grass-sedge shrub tundra period (Andreev et al., 2004). Assemblages from this site consist mostly of unidentified Tanytarsini individuals, eutrophic *Chironomus plumosus* and semi-aquatic taxa such as *Limnophyes/Paralimnophyes, Smittia* and *Paraphaenocladius*. The three species from the latter group were not identified at Krępa as opposed to *Chironomus plumosus* and Tanytarsini."

Line 563: What about the rapid events depicted in your reconstruction?

There are no rapid changes in MTWA reconstructed by both MAT and WA-PLS during LPAZ 12a.

Line 581: "Our MAT and WA-PLS reconstructions support this shift" – Avoid this circular reasoning: climate reconstruction are based on the same pollen record!

This sentence was deleted.

Line 588: "The gradual cooling indicated by our chironomid- and pollen-based reconstructions during subsequent LPAZ KR-13a is 588 consistent with the presence of sparse Betula forests at the onset of this zone." – circular reasoning.

This part was reformulated as follows:

"The gradual cooling indicated by our chironomid-based reconstruction during LPAZ KR-13a is consistent with the presence of sparse *Betula* forests at the onset of this zone. Pollen-based reconstructions suggest that MTWA remained relatively mild (~17.3 °C MAT, ~15.3 °C WA-PLS), closely aligning with the chironomid-inferred mean $T_{jul\text{-}Ch}$ value of ~17.5°C for this interval."

Line 596-598 and 609-612: I would like to see a climate synthesis figure with the values of your study and results of these studies.

Suggested figure was added to the revised version of the manuscript as Figure 5 – please see also our response to the main comment #2.

Line 599: "These Mediterranean records indicate generally warm conditions during MIS 11b, punctuated by recurrent 598 cooling and drying events that led to repeated forest contractions." – avoid, circular reasoning.

This was corrected accordingly.

Lines 695-697: Replace with: ter Braak, C. J. F. and Juggins, S.: Weighted averaging partial least squares regression (WA-PLS): an improved method for reconstructing environmental variables from species assemblages, Hydrobiologia, 269–270, 485–502, https://doi.org/10.1007/BF00028046, 1993.

This was corrected accordingly.