ESSD-2024-306: Reply to comments from Referee #1

(Reviewer comments in **bold**, author responses in **blue**)

This study holds significant scientific and methodological value for reconstructing vegetation cover in Europe during the late Last Glacial period (60-20 ka BP). The authors applied the REVEALS approach based on numerous palynological records. An important methodological contribution of the work is the comparison between REVEALS results and palynological analysis data, along with attempts to explain the obtained discrepancies.

We would like to thank Referee #1 for the positive assessment of our manuscript and his/her constructive suggestions that help us to further strengthen our argumentation, data interpretation and increase to overall quality of the manuscript. Below we provide specific, point-to-point responses to all his/her comments and suggestions.

The authors present interesting data for stadials and interstadials of MIS 3 - an important yet controversial period of the Late Pleistocene. I found lacking the attempts to explain the obtained data for northeastern Europe, where unlike other regions, the reconstructed forest cover decreases during interstadial warming and humidification. What climatic mechanism could lead to such consequences? For instance, during the Holocene, warming and increased moisture typically result in northward forest expansion.

We thank R1 for highlighting this. We fully agree that we expect a higher tree cover during interstadials compared to stadials due to the higher temperatures and higher moisture availability. After having a closer look at the data itself, we came to the conclusion that e.g., the observed pattern of lower forest cover during early and mid-MIS 3 (Fig. 2, top right, ca 60–40 ka BP) is the result of the available data for this region during that time.

For some time intervals, very little pollen data are available from NE Europe (i.e., 3-5 records at times). Hence, the mean forest cover is substantially affected by the spatial distribution of those records. For example, the forest covers of Lake Yamozero (65°N, 70–40 ka BP) and Nesseltalgraben (Alpine region, 60-30 ka BP) are much more affected by their respective latitudes or proximity to ice sheets than by stadial-interstadial variability. As a consequence, the regional mean forest cover in NE Europe during mid-MIS 3 is heavily skewed towards lower forest covers as observed at Lake Yamozero and Nesseltalgraben. In turn, the 40–16 ka BP interval is skewed towards higher forest covers due to the inclusion of the data from the Carpathian Mountains (e.g. Jablunka and Safarka) and the exclusion of the Lake Yamozero data.

This effect is of particular importance for NE Europe due to the wide latitudinal range of the records as well as the generally low number of records available. We will clarify this in our manuscript and add an additional subfigure that highlights the data scarcity in certain regions that can lead to a bias in the mean forest cover percentages.

The paper repeatedly mentions that understanding vegetation variability during stadial-interstadial cycles and extreme glacial conditions is highly significant for demographic developments among Paleolithic hunter-gatherers, particularly regarding Neanderthal replacement by Homo sapiens. However, this aspect remains largely unexplored. Perhaps the authors have insights into how described natural conditions and climatic fluctuations influenced the development of human communities in Europe?

We thank Referee #1 for this comment and we fully agree that our discussion regarding the impact of vegetation dynamics on demographic developments of early humans is insufficient. In the revised manuscript, we will go into more detail on the ramifications of the observed vegetation dynamics and

how these might have affected the dispersal of Palaeolithic hunter-gatherers into Europe and the disappearance of Neanderthals.

Line 316: South-West Asia? Why Asia?

We appreciate the reviewer's comment. However, we are unable to locate the specific text mentioned at the indicated line. It's possible there was a mismatch in line numbering or manuscript version. We repeatedly refer to South-West Asia throughout the manuscript, because some of the pollen records included in our study are from Israel, Syria, eastern Turkiye, and Iran (see Fig. 1 in the original manuscript). We include these datasets in an attempt to gain a better picture of vegetation dynamics in Eastern Europe and the easternmost Mediterranean area – areas which otherwise lack datasets.

Figs 3,4,5 B: What do the pollen percentages represent?

We thank Referee #1 for highlighting that our plot labels lack clarity. All pollen percentages mentioned in Figs 3-5 B refer to the sum of "open land" taxa. We will change the figure captions accordingly to make this clearer to the reader.