Comment on egusphere-2022-127
Anonymous Referee #1

Referee comment on "Regional pollen-based Holocene temperature and precipitation patterns depart from the Northern Hemisphere mean trends" by Ulrike Herzschuh et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-127-RC1, 2022

Review Summary

Herzschuh and colleagues present a very nice set of Holocene pollen-based reconstructions of $T_{\text{ann}}$, $T_{\text{July}}$, and $P_{\text{ann}}$ from 1676 sites from the Northern Hemisphere extratropics in order to characterize the continental, latitudinal, and regional patterns of Holocene temperature and precipitation changes in the Northern Hemisphere extratropics. This synthesis study is excellent and allows for the regional heterogeneity of the temperature and precipitation trend to be mapped.

I have four major comments and a few minor questions, as well as some very minor usage suggestions.

I would recommend the paper for publication after correction of these.

Major Comments:

1) The selection of records in the dataset for the Holocene quantitative reconstruction in this paper is unclear. The quality and accuracy of the synthesis studies depends largely on the chronological framework, archive type, sampling resolution of the original fossil pollen records, and so on. I note that those 991 records do cover the full period of 11 to 1 ka,
but do not see an evaluation of the age, resolution, and archive type of the selected records. Are there any selection criteria for chronology and archive type in the dataset? For example, how many age control points does the original record contain that will be selected for quantitative reconstruction? And what is the time resolution of each sample? This takes into account that the amplitude of changes in temperature and precipitation reconstructions would vary substantially with the resolution of the proxy record.

In addition, the range and quantity of selected modern sites in the calibration dataset can also affect the accuracy of temperature and precipitation reconstructions, as suggested by the authors. Then how many transfer functions are used to calculate the 991 records in this synthesis study? Does each record need to establish a transfer function, or does it establish by region? Is the spatial range of modern sites in the calibration dataset for establishing transfer function all within a 2000 km radius? Or are there some differences in different continents or regions? Of course, I believe that the trend of paleo-temperature and paleo-precipitation change will not change substantially, but it will affect the comparison of amplitude.

2) I agree with the authors that “Pollen data are one of the few land-derived proxies available that can theoretically contain independent information on both temperature and precipitation in the same record” (Lines 99-101). Therefore, the authors reconstructed the spatio-temporal patterns of temperature and precipitation from a single dataset simultaneously. However, it is a challenge to distinguish the effect and correlation between temperature and precipitation in quantitative analysis. In the section of Methods and Discussions, the author mentions the issue of the impact of precipitation on temperature reconstruction (Lines 143-145, 410-412). Could you give more explanation as to why such an approach would ‘restrict the impact of precipitation on temperature reconstruction and vice versa’? One or two sentences will do.

In addition, how do the effects of temperature and precipitation on each other differ across continents and regions? How is it evaluated in quantitative reconstruction analysis?

3) I do not see the expression of reconstruction uncertainty in Figures 2 and 5. The evaluation of the reconstruction errors is essential for quantitative reconstruction and comparisons of different results. Therefore, it would be appropriate to add each latitudinal reconstruction curve with 1σ uncertainty shaded to the supplementary file.

The number of records (n) for each curve in Figures 2 and 5 also needs to be displayed in the appropriate place. Is the large range of temperature and precipitation variations in
North America north of 60°N caused by the number of records (n)?

4) There is still a great controversy regarding the occurrence of Holocene thermal maximum between the proxy temperature reconstructions and climate models, named as “Holocene temperature conundrum”. One of the main controversies for Holocene temperature conundrum is the occurrence of a maximum in mean annual temperature (MAT) during the early to middle Holocene. The term ‘mid-Holocene optimum/late-Holocene optimum’ has been used in this paper, but in some areas, such as East Asia, there is a difference between mid-Holocene optimum and Holocene warm period/Holocene thermal maximum. Mid-Holocene optimum is thought to be a period of high temperature and high precipitation, when vegetation flourishes. The authors should define the mid-Holocene optimum and distinguish it from the Holocene warm period.

In addition, quantitative Holocene temperature records in East Asia (loess, lakes, marine sediments) reveal a clear early to middle Holocene thermal maximum, such as high-resolution Holocene pollen records from Xiaolongwan Maar Lake in northeastern China, Gonghai Lake in northern China, and Huguangyan Maar Lake in southern China. These records show the occurrence of a maximum in MAT during the early to middle Holocene, which does not support the conclusion of this paper that “The concept of a mid-Holocene temperature optimum only applies mainly to the mid and high northern latitudes in the circum-North Atlantic region while records from mid-latitude Asia, Western North America, and all subtropical areas do not fit into this concept but mostly show an overall Holocene increase or other pattern” (Lines 430-434).

Minor Line-by-Line Comments:

Line 202: for “in Europe north of 60°C” consider “in Europe north of 60°N”.

Line 275: for “~0.07K compared to ~0.18K” consider “...°C compared to...”.

Line 336: “...the modern pollen assemblages are not heavily biased by human impact”, please provide relevant literature here.

Line 362: for “from the early to mid-Holocene” consider “from the middle to late-...”
Figures 3 and 4: The map would be improved by changing some colors and size. Each 2°x2° grid cell was too small to see even zoomed in. Changing sizes of maps and/or colors may resolve this better.