Community (Kees Nooren)

The article is well written, and has beautiful figures that nicely supports the results. I very much liked the first part of the article that analysis the relation between modern fire activity and current vegetation and climate. This part of their work could be an article on its own.

Response#1. We sincerely thank Kees Nooren for the positive feedback.

The second part of their work is very much restricted to the lack of enough long records, as the authors also emphasize in the last paragraph of their conclusions. This easily leads to wrong interpretations. The authors for example found for the NNeo a significant negative correlation between charcoal influx, and Arboreal pollen percentage. However, this correlation is heavily influenced by one charcoal record from lake Tulane in Florida, which record is very different from the other long record used (see figure). The Tulane charcoal record is extracted from the Reading Palaeofire database, also occur in Neotoma, but can't be found in the referred article (Grimm et al., 2006). Another charcoal record from lake Tulane (WaΣs and Hansen, 1988), also in the Reading Palaeofire database, is very different (see figure), but hasn't been used. An updated record for lake Tulane is likely to be published soon (Perroţ et al., 2023). I would suggest that the authors concentrate their work on the Holocene, or the last 6000 years, with a minimum number of palaeofire records for each subregion of at least ~10. They should define a minimum number of records for each subregion, and adjust the period studied accordingly. The authors should use a pre-binning of 400 or 500 years, instead of 20 years. In their current analysis many datapoints from low resolution records are missing.

Response#2. Thank you for the remark on specific records from Florida, USA. However, despite some variability, we still find a significant negative correlation between charcoal influx and arboreal pollen when considering only Holocene pollen and charcoal records, as shown in Fig. R4.1.

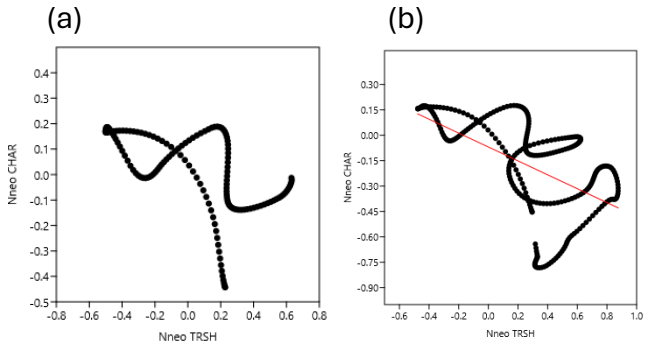

Fig R4.1. Correlation of charcoal influx (Nneo CHAR) and arboreal pollen (Nneo TRSH) z-scores for the northern Neotropics over (a) the last 6 ka ($p < 0.01$, $r2 = 0.33$, $r = -0.57$), and (b) the last 11.7 ka ($p < 0.01$, $r2 = 0.31$, $r = -0.56$).

We agree that the Pleistocene period is represented by fewer and lower-resolution records, resulting in less robust spatial and temporal coverage, which is acknowledged in the manuscript. Nevertheless, we believe that analyzing the full 21 ka period provides a more valuable contribution to understanding both vegetation and fire dynamics, as well as their uncertainties, than restricting the study to a shorter interval with smaller changes in some of the boundary conditions (e.g., atmospheric CO_2 concentration, temperature). That said, we acknowledge that interpretations for periods with a smaller number of records should be treated with greater caution. In response, we will further include in the methods a note of caution about the intervals with lower confidence:

"*Caution is warranted when interpreting trends during periods with wide confidence intervals or when the composite curve approaches the upper or lower bounds of the confidence interval. These cases usually relate to periods with few records and indicate greater uncertainty and sensitivity to individual records. Strong fluctuations during such periods are likely highly uncertain and may reflect local variability of specific sites.*"

We applied the two-stage smoothing method with a pre-binning half-window of 20 years (40-year bins) to prevent high-resolution records from disproportionately influencing the composite. This was followed by smoothing using half-windows of 400 and 1000 years. While changing these parameters does not significantly affect long-term trends, it can influence short-term variability. We therefore interpret short-term patterns during the Pleistocene with caution, as sparse data lead to large confidence intervals and unstable composites. Bootstrap resampling further indicates periods of disagreement among records or where individual records may dominate. In general, z-score values are very stable in terms of trends to varying pre-binning half-window values, although half-window smoothing can yield more stable curves, while losing details. For a brief discussion on this matter, please see our Response #3 and Fig. R2.3 to Reviewer #2 (Raquel F. Cassino). As such, increasing the pre-binning to 400 or 500 years would require a broader smoothing window, which could diminish the resolution of Holocene features without necessarily improving confidence in the Pleistocene, a period for which we already refrain from drawing further inferences due to the low data reliability.

Regarding the Tulane record, we will also include the record from Watts and Hansen (1988) in our analysis. However, we will keep the Tulane record available from the Reading Database. This record is also available and referenced in Neotoma (DOI: 10.21233/a8jq-7f35) with the following dataset notes: "*Grimm et al (2006) publication describes core, but charcoal dataset not used.*". In fact, the data available from the Reading Database were directly provided by Eric Grimm and Jim

Clark for the compilation published by Daniau et al. (2010) and later incorporated into the ACER compilation by Sanchez-Goñi et al. (2017). Thus, although it is not in the 2006 publication, this data was produced by the same authors and has been previously used in other publications. As for the record likely to be published soon (Perrott et al., 2023), it cannot be included in the current synthesis as it is not yet available.

References:

Daniau, et al.: Fire regimes during the Last Glacial, Quat. Sci. Rev., 29, 2918–2930, https://doi.org/10.1016/j.quascirev.2009.11.008, 2010.

Sanchez-Goñi, et al.: The ACER pollen and charcoal database: A global resource to document vegetation and fire response to abrupt climate changes during the last glacial period, Earth Syst. Sci. Data, 9, 679–695, https://doi.org/10.5194/essd-9-679-2017, 2017.

Grimm, et al.: Evidence for warm wet Heinrich events in Florida, Quat. Sci. Rev., 25, 2197–2211, https://doi.org/10.1016/j.quascirev.2006.04.008, 2006.

Unfortunately, for many sites or the pollen or the charcoal record has been used. It would have been nice if the authors first of all investigate the relation between the charcoal and pollen record from individual sites. This would mean that more effort should have been put in the digitalizing of records. It is at least a message to the palaeoecology community that more records should be added to the online databases. As long as the number of records included in the analysis is low, compared to the enormous size and heterogeneity of the study region, one should be careful with interpretation of the data, even if correlations seem significant.

Response#3. We agree that this suggestion represents a very interesting and valuable approach. However, incorporating such an analysis would considerably broaden the scope of the manuscript and further increase its already substantial size. Moreover, it would require selecting a subset of our compiled database that includes only records with both pollen and charcoal data, which would represent large structural changes to the entire study. While we recognize the potential of this approach, we believe it extends beyond the current scope and would be better suited for future research.

Watts, W.A., and Hansen, B.C.S., 1988. Environments of Florida in the late Wisconsin and Holocene. In: Purdy BA (ed). Wet site archaeology. Telford Press, Caldwell, pp 307–324.

Perroţti et al., 2023. Does fire drive Quaternary ecosystem transformation at Lake Tulane, Florida? In: Abstracts of the 2nd Conservation Paleobiology Symposium. Bulletin of the Florida Museum of Natural History 60(2): 103.