

Response to reviewers for

“Reconstructions of biomass burning from sediment charcoal records to improve data-model comparisons”

Reviewer #1

Below we have paraphrased the excellent questions posed by Reviewer #1 as accurately as possible, and respond with the changes that were made in the manuscript to address them.

[Added information about the revisions actually made in the revised ms appear in blue beneath each response.](#)

1. How is temporal uncertainty accounted for in the dating of charcoal and in the final gridded product?

Temporal uncertainty in the final gridded product is not formally incorporated into the reconstructions. The number of radiocarbon dates or other chronological constraints in a record does provide some indication of the magnitude of age uncertainty, and this information is available in the GCD. Formally assessing every age-depth model for the records in the GCD is a non-trivial task, however, and should ideally be undertaken with the researchers who produced the record. Smoothing and gridding the data does account for age uncertainty in the records informally however as it only reveals trends and shifts in biomass burning that are robust across multiple records.

[REVISION: We added a modified version of this paragraph to the end of section 4.2, lines 345-363.](#)

2. How does the conversion to z-scores and the lack of weighting among the merged records in a grid cell affect the representativeness of different records and how does it shape the uncertainties of the reconstructions?

The myriad factors that affect charcoal production, transportation, and deposition in sediments means that there is no universal relationship between charcoal quantities and area burned that can be applied to all records. The conversion of all units to z-scores therefore allows the detection of trends in biomass burning over time but removes any information that may exist about the specific magnitude of area burned recorded by different records in the same grid cell. Also, the size of the grid cells can be controlled in the paleofire R package when grids are produced, but no weighting scheme is applied to the different records that are composited within a given cell. Thus, records are merged that may reflect burning at different spatial scales. This is a recognized weakness of the general approach, but the benefit of standardizing the records comes from our ability to detect and map large changes in charcoal influx at multiple sites over time that would otherwise be impossible.

REVISION: We incorporated the response above into the additional paragraph added to the end of section 4.2, lines 345-363.

3. How can it be that a recent time period has less data than an older time period?

Records do not always include sediment from the most modern time period even when older sections of a core can provide robust data. Sections can be lost or destroyed during collection in the field or during extraction, or disturbances at the site can make sections (including the top) of the sediment core unusable. In some cases hiatuses occur, such as when a site dries out for a period of time. Most lake sediments provide continuous records, but soil and bog profiles often have hiatuses, and occasionally this happens in lake and marine sediments as well. Another reason that a site may have less data closer to present than in the distant past is when sedimentation rates decline towards the more modern period. In this case, a section of the core that represents the most recent past may only have one or two samples, whereas sections of the same size further down core may contain many samples.

REVISION: This explanation was modified and added to the end of section 5, lines 402-410.

Response to minor comments:

P3L20: Will replace “vital” with a word that has more neutral connotations.

REVISION: Changed vital to key.

P3L21: Will replace with “affecting”

REVISION: Changed to “influences”.

P4I5-6: Will replace with Mouillot et al. 2014

REVISION: Changed to Mouillot et al. 2014.

P19I7-8: Will add more refs to make list comprehensive.

REVISION: Added citations to the beginning of section 6.

Reviewer #2

The first issue raised here requests clarification of the use of multiple records for the same site. It is true that the GCD sometimes contains multiple metrics for quantifying charcoal from the same site. This issue was considered carefully at the time the database was constructed, and it was determined that multiple types should be retained whenever available because different quantification techniques and measurements can reflect burning at different spatial scales (for example when

microscopic and macroscopic particle size classes are included), or different types of fuels burned (for example when herbaceous and woody particles are tallied separately). As a result, individuals synthesizing data from the database have the choice of selecting one record to be representative of each site, or of using all the data from a single site, depending on the research question. For those wishing to select just one record from each site, there is a field in the table containing the metadata for the sites (the Site table) that specify the preferred (“PREF”) units and refer to the most commonly used metric. For example, for sites that contain both macroscopic and microscopic particle measurements, the preferred units would be macroscopic, and for counts versus areas, counts would be retained instead of area measurements. In most cases, the long-term trends in the different measurement types are very similar. Unfortunately, in the absence of local calibration data (which is not stored in the GCD), it is impossible to determine which records are most reliable when multiple options exist.

P2112-13: Will remove repeated references.

REVISION: Removed extra citations.

P10117: Will add “of” here: “...be of tectonic. . .”

REVISION: Added “of”.

P11111: Will refer to table 3.

REVISION: Now refers to table 3.

P11127: Will refer to figure 2.

REVISION: Figure 2 actually does not show the tie points discussed so did not add reference.

P14122: Will fix: “...again fitted to the pooled. . .”(-ted added)

REVISION: Added “-ted”.

P1919: Will remove of from: “compared of paleofire trends. . .”

REVISION: Fixed.

P2615: Will correct the space in wrong place: “. . .high levels of burning overt he. . .”

REVISION: Fixed.

Table 2: What are the size categories? The charcoal particle size categories span a large range, from a few microns to large visible pieces over 500 micrometers in size. In general, particles are considered either microscopic, which is typically less than 100 micrometers in size, or macroscopic, which is typically greater than 100 micrometers in size. Also, some records are analyzed chemically, for black carbon for example, but there are few of these records currently in the database.

Figures 9 and 10 were intended for the Supplement and we agree that they can be merged into a two-panel figure, and the units added back to the small size definition.

REVISION: Figures 9 and 10 were removed as they are redundant with the information that is already provided in the data tables (which is why they were not referred to in the text).

Supplementary figures should be reordered. -500-500 BP should read -60-500 BP.

REVISION: Fixed.