

Climates of the Past Discussion: Author Final Comments CPD

Interactive comment on “The effects of past climate variability on fire and vegetation in the cerrádo savanna ecosystem of the Huanchaca Mesetta, Noel Kempff Mercado National Park, NE Bolivia” by S. Y. Maezumi et al.

D. Urrego (Editor)

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Comments:

Please address in particular concerns regarding the zonation of phytolith data, and provide additional detail on the classification analysis used.

SYM: An additional zone (Zone 5) was added along with a clarification on the use of CONISS vs CCA analysis.

It would be useful to include a short description on the use of constrained cluster analysis in the Materials & Methods section, including relevant details on distance measure and linking method.

SYM: More detail on CONISS was added to the methodology.

Both CONISS (Fig. 3) and CCA (Results) are used as acronyms for the cluster analysis, but CCA may create confusion as this is often used for canonical correspondence analysis. Please also address questions on the development of the chronology and double check the reference for the IntCal13 calibration dataset.

SYM: more detail was added to the construction of the age model in the methods section and appropriate references were added for IntCal13.

Additionally, both reviewers suggest a number of format changes including the length of the title, use of acronyms, the reference list and Figures

SYM: Reviewers comments were included into the revised version of the manuscript and the title was shortened as suggested by Dr. Hooghiemstra.

I would also like to see an improved version of Figure 1 that uses the space more efficiently, maybe by enlarging the pictures and reducing the blank space.

SYM: I have revised figure 1 by enlarging pictures to eliminate blank space.

H. Hooghiemstra (Referee)
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Received and published: 18 February 2015

Comments:

I have penciled many corrections and improvements in the text: I have uploaded a scan of the annotated manuscript which is part of this review report. I assume the authors will make the corrections as indicated. In the text below I focus on a selection of issues that I will explain in more detail:

- Title: The title is very long and is a burden for all that like to make reference to this paper. A shortened version with the same content could read as follows: "Effects of past climate variability on fire and vegetation in the cerrado savanna of the Huanchaca Mesetta, NE Bolivia".

SYM: The title has been changed to the above as suggested.

25: There is an essential difference between 'prediction' and 'projection'. IPCC reports make projections (if unclear, please ask for my class room slide).

SYM: This correction was made throughout the manuscript.

31: Geological formations are written with caps (e.g. Lower, Middle, and Upper Mekkelhorst Member) whereas intervals of time are written in lower case (e.g. early, middle, and late Holocene). Corrections are needed all over the manuscript.

SYM: Throughout the manuscript, Early changed to early, Middle to middle, and Late to late

40: In Latin America is very usual to use komma's in ages below 10,000. However, there is no need to do so. Please omit all komma's in ages below 10,000 all over the manuscript (saves much space)

SYM: All commas were removed on numbers less than 10,000.

119: 'cal yr BP' is a unit. As units are not abbreviations no points should be used. Thus "B.P" and "B.P." should be corrected into "BP" all over the manuscript (saves another time much space and improves readability)

SYM: B.P. and B.P were replaced with BP throughout the manuscript.

257: On page 43 I have monitored where acronyms have been first introduced: corrections are needed in lines 257, 271, and 281. Figure 6 is not in sequence and should be re-numbered.

SYM: 257: corrected.

271: ITCZ first introduced on line 84. Changed throughout document.
281: LOI first ref. on line 142, changed throughout doc.
Reordered Figure 6 and 7.

305: cc is not a unit of the metric system: cm³ should be used.

SYM: Changed to cm³ in the document

320: I am confused by reading this sentence. I guess you mean ‘charcoal influx’ which has the unit “particles cm⁻² yr⁻¹”.

SYM: Reworded to charcoal influx for clarification.

393: a confusing situation here: because you write “Late Glacial” instead of “Lateglacial” (compare Pleniglacial), it seems that “Late” should be written here in lower case. However, “Late Glacial” is a geological interval of time and, therefore, correctly written with a cap. To be consequent with Pleniglacial, beter to write “Lateglacial”. It should be kept in mind that each glacial of the Pleistocene has a ‘late glacial’ (not “Late Glacial”) interval, but not a “Lateglacial” as the latter is restricted to the interval of ca. 15,000-11,500 cal yr BP !

SYM: Changed to Lateglacial throughout the document

- The list of references shows many mistakes, and inconsequent use of issue numbers of journals. In the current electronic era, issue numbers are not relevant any more. A book reference always should mention: publisher, city, and country.

SYM: I have reformatted all references to exclude issue number for journals and added publisher, city and country for any book cictations.

1028: Indeed Dutch names such as “T. van der Hammen” may cause problems. Always insert the author under “V”, not under “H”. According to the rules of Dutch language the correct spelling is “van der Hammen, T”. However, to serve the foreign reader I always write “Van der Hammen, T.” to make clear that the family name should not be split up. Thus, in line 1028 “. . . and Drecht, G. Van” should read as “. . . and Van Drecht, G”.

SYM: Correction Made in the reference list.

Table 1: give the last column a unit.

SYM: Correction made

Fig. 2: along the X-axis ‘cal BP’ = ‘cal yr BP’ Delete all “cal yr BP” along the curve.

SYM: Corrections made

Fig. 3: Give the X-axis a unit.

[SYM: Added Pollen percentage data on the X-axis](#)

Fig. 4 Show the unit above the column of ages, and delete the unit after each dated sample.

[SYM: Made a header of Age cal yr BP](#)

Records c, d, and e are missing the unit in which values are expressed.

[SYM: Values added to each axis](#)

Fig. 5: Curve (a): $\delta^{13}\text{C} = \underline{\delta}^{13}\text{C}$

[SYM: Proper delta notation added for Carbon and Nitrogen](#)

Fig. 6: figure caption and on top figure: charcoal accumulation = charcoal influx. at curves a) and c): Particle/cm²/yr = particles cm⁻² yr⁻¹ at curve e) Fire Episodes per 1000years⁻¹ = Fire episodes 1000 yr⁻¹ (mind that “per” is equivalent to “-1 ”)

[SYM: Changes Made to captions](#)

Fig. 7:

same corrections needed as in previous figures Curve J showing insolation: W/M² = W m⁻²

[SYM: Changes Made to captions](#)

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Received and published: 2 March 2015

GENERAL COMMENTS

The title is a little clunky and I would reconsider the depth of geographical detail provided here.

[SYM: Title was shortened as suggested by Dr. Hooghiemstra.](#)

I have a few suggestions/corrections to make with respect to the discussion and the presentation of the stable isotope data. My greatest concern is the zonation of the phytolith data (see 'Specific Comments'), which influences interpretation of key transition points. I would like to see that the zonation changed or my concerns addressed in a response from the authors.

[SYM: The comments are addressed below.](#)

SPECIFIC COMMENTS

2. Materials and Methods

2.2. Chronology: Please provide further details of the options adopted in the creation of the age-model in CLAM; for example, what options, such as the age estimations, were selected in the creation of the model? Does the grey shading in Figure 2 represent two-sigma error?

[SYM: I have added more detail on the creation of the age-model in the methods section including the use of 2 sigma error \(indicated by grey bars in Figure 2\).](#)

2.7. Phytoliths: Please clarify how the phytolith sums were calculated. i.e., were percentages of non-Mauritia phytoliths calculated on the basis of the total sum of phytoliths excluding Mauritia?

[SYM: I have added a clarifying sentence stating: Percentages of non-Mauritia phytoliths were calculated on the basis of the total sum of phytoliths](#)

3. Results:

Zonation of phytolith data: There are several points about the zoning methodology that I find unclear and/or problematic. Firstly, it is stated that the zones were determined by constrained correspondence analysis (CCA), but the authors do not indicate what environmental variable constrained the analysis. It is possible that CONISS is meant here, given that a dendrogram is provided with the phytolith data.

[SYM: CONISS, not CCA was used. The text was changed to clarify in line 395.](#)

Secondly, if CONISS was the clustering method chosen to create the zones, the authors have not chosen the divisions that create the lowest dispersion within each cluster (often chosen by drawing a straight line at a given height of the hierarchical tree, see Grimm [1987]). From the dendrogram provided, and assuming that the authors intended that

minimized dispersion was the goal of the zonation exercise, the order of the zonation divides should be as follows:

First order : boundary between zones 3 and 4, as is currently designated

SYM: Left as previously designated.

Second order : within zone 4, around 2 kyr BP

SYM: Added another zone at 2ka (Zone 5)

Third order : boundary between zones 2 and 3, as is currently designated

SYM: Left as designated

The zone boundary between Zones 1 and 2 is of a lower order than further divisions within Zone 3 (ca. 4500 yrs BP) and Zone 4 (ca. 1800 yrs BP).

Finally, was the number of recognized zones determined by any statistical methods, such as a broken stick model? Grimm, E.C. (1987) Computers and Geosciences, 13: 13-35

SYM: We added the use a broken stick model to determine that there were 5 significant zones. The additional of this analysis was added to the methods section and reflected in the additional of Zone 5 into the results section.

Zones 3.1 – 3.4:

The authors have presented a considered and nuanced interpretation of the climatic, ecological, edaphic and altitudinal controls on fire and vegetation on the mesetta. My only concern is the relative changes to fire frequency shown throughout the record. Although charcoal accumulation shows some fairly large shifts, I question whether the range of 2-5 fire events per 1000 yrs is a significant shift in the palaeofire record? How does this compare to other sites in similar vegetation assemblages?

SYM first comment to Bron: As this is one of the first high-resolution charcoal records from the cerrádo savanna, there are not existing records in similar vegetation assemblages in the region to compare it to. However, in ecosystems in North America an increase from 2-5 episodes is considered an important change in paleofire activity. It is important to note here, that the FRI does not represent an isolated fire “event”, rather is the FRI represents episodes (defined as periods of increased burning). In this case an increase from 2 to 5 periods of increased burning over a 1000 yr period is a significant change in the paleofire record, particularly when there is not a significant change in the vegetation record.

Page 152, lines 1-2: Please rewrite. I find this sentence difficult to follow.

SYM: Sentence was rewritten

Discussion:

Pg. 156, ca. ln 5: Give references for Late Glacial climate change.

Shira 4/15/15 3:34 PM

Deleted: ..

[SYM: References added](#)

Pg. 157, This is an excellent discussion of possible climate drivers of changes in Mauritia abundance. However, the estimated of the temperature increase reported in Whitney et al. (2011) is 19,500 yrs BP, not 15,900 yrs BP, as indicated in twice in this section. I'd also like to add that the vegetation shift reported in the Pantanal probably reflects a threshold response (such as the removal of regular frosts), so I support the authors' interpretation of potentially cooler temperatures in the Late Glacial, as explained by higher frequency surazos (Bush and Silman 2004), despite the erroneous citation.

[SYM: The error was corrected from 15,900 to 19,500 yrs BP.](#)

Pg. 159, Ln 3: The insolation minimum occurred ca. 12,000 yrs BP, not in the mid-Holocene as indicated. Although increasing precipitation in the late Holocene has been linked to increasing insolation in the southern hemisphere during the austral summer, the opposite pattern does not hold true for the transition into the Holocene.

[SYM: This sentence was removed from the discussion.](#)

Pg. 162, Ln 22: Maize pollen was recovered from sediments dating to ca. AD 940 to AD 1700, not yrs BP as indicated, and only in L. Chaplin, not L. Bella Vista. Many apologies if the dates I provided were unclear. Please amend to 1000 to 400 cal yr BP.

[SYM: Amended the sentence to reflect the correct dates.](#)

Figures:

Figure 4. It would be helpful if you specified in the caption that the zones are derived from the phytolith data.

[SYM: This was added to each of the figure captions](#)

Figure 5. The stratigraphic presentation of stable isotope data makes it difficult for the reader to interpret the data, given they need to consider a combination of variables to determine the source of the carbon. I would like to see bivariate plots of stable isotope data (i.e., $\delta^{13}C$ v. C:N) to show the organic source matter. The zones can be displayed by using different plotting symbols for each zone (such as shown in Cordon et al. (2005), for an example).

[SYM: An additional figure was created plotting C:N ratios against \$\delta^{13}C\$ values using different colors for each zone.](#)

TECHNICAL CORRECTIONS

1.4 Vegetation:

Section 25: Many of those families are not true grasses, is 'Monocot families' meant

here? Or perhaps, 'Families of the order Poales' is meant (with the exception of Orchidaceae).

Correct the spelling of Orchidaceae, Eriocaulaceae, and Rapateaceae.

SYM: Change to Monocot families.

Spelling Corrections Made.

References:

I haven't checked through the citation list thoroughly, but I did notice the following were missing from the list: Mittermeier et al. (2000) Perdue and Koprivnjak (2007) Smith et al. (1997).

SYM: Checked all references added missing references listed above.

April 15, 2015

Editor Initial Decision: Publish subject to technical corrections (15 Apr 2015) by Dunia Urrego

Comments to the Author:

Dear Dr. Maezumi,

Thank you for submitting a revised version of your manuscript, now entitled "Effects of past climate variability on fire and vegetation in the cerrado savanna of the Huanchaca Mesetta, NE Bolivia", and a detailed list with responses to individual comments. I am happy to confirm that your contribution is now ready for publication in Climate of the Past, subject to technical corrections.

There are only two corrections that I consider should be addressed in the manuscript:

1. Regarding the zonation of the phytolith data and the clustering method. You have added more detail in lines 391 to 394 and refer to the Broken-stick model as the method used to determine statistically significant zones. Dr. Whitney's original comment refers to the method chosen to create the zones, but also asks whether or not "minimized dispersion was the goal of the zonation exercise". It is still not clear to me whether i) the divisions chosen created the lowest dispersion within the clusters, and ii) if this is what the Broken stick model achieved.

I think it would be useful to add a sentence clarifying this at the very end of the 2.7 Phytoliths section.

SYM: a clarifying sentence was added at the end of 2.7 Phytoliths.

2. Regarding Dr. Whitney's comment on how significant 2 to 5 fire episodes over a 1000 year period is considered in the palaeofire record, and how it compares to records from similar vegetation assemblages. You have included a concise and clear response to this comment in the "responses to reviewer's comments", however I am unsure this is explained as clearly in the manuscript.

I would suggest taking this paragraph and adding it to the discussion of the paper itself.

SYM: a additional section was added:

This section was added to the manuscript to respond to Dunias Comment:

4.2.2 Interpreting CHAR Analysis in Paleofire Reconstructions at Huanchaca Mesetta

The charcoal record from the Huanchaca Mesetta provides one of the first sub-centennial paleofire records from the *cerrádo* savanna ecosystem. Previous experimental studies on sedimentary charcoal from African savanna ecosystems support the use of sedimentary charcoal to reconstruct past fire activity in savanna systems (Duffin et al., 2008). The Huanchaca Mesetta charcoal record presents a novel approach, combining charcoal influx data, CHAR Analysis software (Higuera et al., 2007), and arboreal/non-arboreal charcoal ratios in Neotropical savanna ecosystems. Originally, CHAR Analysis was designed as a peak-detection tool for forest ecosystems with low FRI in the Northern Hemisphere (Higuera et al., 2007). Paleoeological investigations in fire-prone systems such as savannas, which detect fire peaks or isolated fire events, can be challenging because of the annual to multi-annual FRI.

To address the challenge of reconstructing *cerrádo* paleofire activity, charcoal influx was compared with the ratio of arboreal to non-arboreal grass charcoal to infer the primary fuel source during periods of elevated fire activity. Low charcoal influx values, coupled with low arboreal charcoal, were interpreted as the background component of charcoal influx data. Increased charcoal influx values and/or increased arboreal charcoal that exceeded the background threshold were identified as fire episodes. Because of the temporal resolution of the record, fire episodes were not interpreted as isolated fires but rather as periods of time that experienced increased fire activity (indicated by higher FRI values). Thus, an increase in the FRI from 2 to 5 episodes/1000 yrs, as seen from 8000 to 6000 cal yr BP, represents more than a 50% increase in the periods of burning over that 2,000-yr period. These data indicate a substantial shift in paleofire activity during the middle Holocene, particularly as there were no significant changes in the vegetation record on the Huanchaca Mesetta during this time.

I would like to invite you to address these two technical comments, and submit an updated version of the manuscript so typesetting of the paper can begin.

Many thanks again for submitting your contribution to the LaACER special issue.

Kind regards,

Dunia H. Urrego
Handling Editor