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Discussions

Interactive comment on "Quality assessment of chronologies in Latin American pollen records: a contribution to centennial to millennial scale studies of environmental change" *by* S. G. A. Flantua et al.

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Received and published: 13 July 2015

Response to T. Giesecke: Interactive comment on "Quality assessment of chronologies in Latin American pollen records: a contribution to centennial to millennial scale studies of environmental change" by S. G. A. Flantua, H. Hooghiemstra, and M. Blaauw. doi:10.5194/cpd-11-1219-2015

We much appreciate the review report on our paper and we found it very helpful indeed to prepare an improved draft. We have included nearly all suggestions in the text and

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here we address each comment with explanation.

1) The authors need to make the results of their work available with this publication.

- This is a very good suggestion, thank you. We will organize all the results in easy accessible folders and make all chronologies, R code and results of star classification available as a dataset in the Supplementary Information.

2) Flantua et al. adopt the age uncertainty reporting from the EPD (which needs to be cited as Giesecke et al. 2014) but focus in the text only on the classification system based on the density of dates in time. Giesecke et al. 2014 stress that this classification has to be used in conjunction with the propagation of age uncertainty from the dates through the age model. The intention of this system was also to provide information for individual samples in a database rather than for full records, as dating control often varies through the record.

- We updated the reference Giesecke et al. 2014 in the paper, thank you for the correction.

- Concerning the lacking information on the classification system for individual samples, we could not go into that detail within this paper. As we are aware of this specific recommendation mentioned by Giesecke et al., 2014, we think that by making all results available, researchers will have the necessary data to use the classification at the level of the record and individual samples throughout the age model. To reinforce the importance of the assessment at different levels, we will include the comment from the reviewer in the final section: "Dating control often varies throughout the record, therefore we emphasize the recommendation provided by Giesecke et al. (2014) that the star classification should be used in conjunction with the propagation of age uncertainty from the dates through the age model".

3) Flantua et al. discuss sources of age information including seismic activities that were not discussed by Giesecke et al. 2014, however, I missed a discussion on the un-

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certainties of these types of age information. Particularly in the case of biostratigraphic dates, the situation in South America is certainly more complex than in Europe. However, the information that samples date to the Lateglacial versus the Holocene is still important information that could be used in Bayesian methods without causing circularities.

Thank you for this observation. Indeed we discuss uncertainties of radiocarbon dates, but we did not address chronological uncertainties of tephra, seismic activities and OSL. Therefore in Section. 3.1 we will briefly discuss potential sources of these uncertainties.

For tephrochronology and OLS we will use: 1) Lowe, D.J., 2008. Uncertainty in tephrochronology. SUPRAnet consortium workshop 'Studying uncertainty in palaeoclimate reconstruction', Sheffield, U.K., 23-27 June 2008. Presentation available at http://caitlinbuck.staff.shef.ac.uk/; 2) Lowe D.J. (2011) Tephrochronology and its application: A review. Quaternary Geochronology, 6, 107–153.

To assess chronological uncertainties in seismic activities, we will use the list of "Sources of uncertainty in fault-activity studies" provided by Lund W.R. (2005) Consensus preferred recurrence-interval and vertical slip-rate estimates: review of Utah paleoseismic-trenching data by the Utah Quaternary fault parameters working group. Utah Geological Survey, 106-107 pp.

In the case of biostratigraphy we will address uncertainty using Gladenkov Y.B. (2010) Zonal biostratigraphy in the solution of the fundamental and applied problems of geology. Stratigraphy and Geological Correlation, 18, 660–673.

4) I am also curious how bottom ages were derived and why you think that 50 years is an adequate age uncertainty for all core tops while we used uncertainties of up to 250 years in Europe.

- Concerning bottom ages we mention P1225, l.24: "Similarly we did not use the basal

ages of the authors when based on extrapolations, but allowed the recalibrated age model produce new down-core ages". With this we mean that we used the recalibrated age model to produce the bottom ages.

- Concerning the core tops, we have adjusted the text (P1225, l.20) to explain that only when the authors from the original age model claim to have certainty over the core top (being the sampling year or not), did we use an uncertainty of ± 50. We did not use any of the estimated core tops, but as with the bottom ages, let the recalibrated age model produce the ages of the core tops. We decided to use the uncertainty range of ± 50 considering that this standard deviation results in ca. 300yr of total uncertainty. We consider this value an appropriate estimate of uncertainty of core top ages. As we will be providing the R-code, anyone interested may adjust this value accordingly.

5) I find the discussion of uncertainties of age estimates important including the shape of particular probability distributions, as Bayesian methods can use them in a statistical way.

- Thank you.

6) The title, abstract and introduction should reflect the two different results presented, namely a database containing all dating information for all Latin America and new age models for north-west South America.

- Thank you for this very valuable suggestion. We adjusted the title to "Chronology of Latin American Pollen records: LAPD Geochronological database and age models", and modified the abstract and introduction accordingly.

7) I also do not understand the reason for focusing on the different time periods in this manuscript. I gather that this manuscript is part of a special issue and can imagine that another paper refers to these periods. Otherwise, I cannot see the value of singling out particular periods in the presented manuscript and would consider removing it.

- We understand that being part of the Special Issue of "Millennial-scale variability in

the American tropics and subtropics" and the INQUA workgroup of LaACER (Latin-American Abrupt Climate Changes and Environmental Responses) has been insufficiently addressed. We aimed to fulfill the specific goals of the Special Issue and workgroup, but understand that the selection of time periods caused confusion. Therefore we made important adjustments to main thread of the paper to improve the general context of this study and clarify the aims and purposes of the paper. We do believe that it is valuable to present a full analysis of chronologies from MIS5 to the present independently of the purpose of the Special Issue. The time windows we discuss are continuous and specifying these periods facilitates the integration of results into other initiatives. Therefore removing a figure such as Figure 3, which provides an important overview of the last 60 kyr BP, would exclude the discussion on the late Holocene chronologies.

9) The text is in some sections unnecessary long as it includes anecdotal accounts on particularities of different sites that could be reduced or omitted altogether. Also some in-between explanations are not always needed and make the text unnecessarily long e.g. the explanation of conventional radiocarbon dates P. 1229, L. 10ff.

- Thank you for this observation. We reduced text throughout section 3.1 Control Points.

10) The title is unfortunate as it suggests the assessment of the quality of work of other palaeoecologists whose data are used.

- We understand the confusion of the suggestive title on data assessment. Therefore the title has been adjusted: Chronology of Latin American Pollen records: Geochronological database and age models.

11) Also in the text the authors should consider that the purpose of the individual contributions that were reviewed was not to contribute to large-scale analysis but to address a local problem.

- Thank you for this suggestion. In the introduction we added the phrase: An additional

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difficulty is that the development of large-scale analyses is relatively recent, demanding occasionally a different approach to and data handling of individual pollen records. The latter were most often developed to explore questions on a local or regional terrain, unacquainted with requirements for multi-site integration.

12) P. 1220, L. 4: This is a strong statement and maybe not what you mean to express.

- We understand that the statement "Heterogeneous paleoecological databases are not suitable to be integrated without an uncertainty assessment of existing chronologies" might be strong, but we consider that uncertainty assessment of chronologies should be a first step in all multi-site and multi-proxy studies before making statements on observed "synchronous" events. To smooth off the rough edges of the statement, we changed it to: "However, all efforts to integrate paleoecological databases would highly benefit from an uncertainty assessment of existing chronologies".

13) The LAPD is not a heterogeneous database (see also P. 1221, L. 10) as it contains only pollen data. The age control between sites is heterogenic, hampering detailed comparisons and meta-analysis.

- Thank you for this observation. We removed "heterogeneous" in P.1221, L 10 as it is actually redundant.

13) P. 1221, L. 24 and throughout: You probably mean Giesecke et al. 2014 rather than 2012.

- Yes, thank you for this correction. We had an older version of this paper where 2012 was mentioned, but now we corrected this throughout the paper.

14) P. 1222, L. 20: Our intention was to describe the age uncertainty for individual samples rather than sites. In that system the classification needs to be combined with the uncertainty from the age model.

- We regard the purpose of this paper to provide an overview at the level of the sites. By providing all produced results and mentioning the importance of combining the as-

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sessment at the age model and sample level (now addressed in the Conclusions and Recommendations), each researcher has the possibility to review the findings and use them accordingly. The Supplementary information will contain the star results for the entire sites and individual depths per site.

15) P. 1225, L. 9-10: Confusing statement please consider revising.

- We adjusted the statement to: For example, the "Guantiva interstadial" (van der Hammen and González, 1965; van Geel and van der Hammen, 1973) and "El Abra stadial" (Kuhry et al., 1993; van der Hammen and Hooghiemstra, 1995) are commonly used biostratigraphic dates within Colombia. These periods are considered to be equivalent to the European Allerød Interstadial and the Younger Dryas sequence, respectively (van der Hammen and Hooghiemstra, 1995).

16) P. 1225, L. 21: What do you mean by 1 SD in brackets after 50 year uncertainty?

- Without further explanation, we understand that this comment causes confusion. We removed "1SD".

17) P. 1228, L. 14: The explanation of the abbreviation kyr BP in between MIS 5 and MIS3 is confusing.

- We adjusted this sentence as followed: Therefore, we focused on the following time windows: MIS 5 (c. 130–70 thousand years before present, here abbreviated to kyr BP), MIS 3 (c. 60–27 kyr BP), Heinrich event 1 (H1; c. 18–15 kyr BP), and the YD/Holocene transition (c. 12.86–11.65 kyr BP).

18) P. 1228, L. 14ff: I would assume that few records fall into this time period. Why was there no focus on a period in the Holocene, e.g. the moisture increase during the late Holocene? See also general comment on time periods.

- We understand that the reviewer would have preferred additional assessments on other periods of time. Within the projects in which we collaborated, the main focus has been on rapid climate events over a longer time period, such as the MISs here shown.

Now that all results are made available, we hope that other researchers will elaborate more on other time periods such as changes during the Holocene.

19) P. 1229, L. 26: New sentence starts with citation in brackets.

- Corrected, thank you.

20) P. 1235, L. 19: It should be made clear that this is what was submitted by the authors or reported in publications. The heading is not reflecting the content of this section.

- We adjusted the heading to: Current age models and calibration curves

21) P. 1237, L. 4-5: The star assignment is fairly simple and I suppose M. Blaauw could either fix the R-code to make it more robust or the classes could be assigned manually.

- We agree that the star assignment system can be further developed to also solve the problem here mentioned that: "The star system classification did not assign stars to 4 chronologies, when the calibrated ages overlapped over a very short time range creating conflicts within the star calculation function". We think that for now this simple approach is sufficiently suitable for the wide range of age models assessed here, leaving open the possibility to improve the star classification system in collaboration with other researchers on South America.

22) P. 1237, L. 23: May this be due to the fact that the top is a date for a large number of sites? - Probably not, because from many sites we did not use their top age when based on an estimate solely. Only sites with a measured top age were used.

23) P. 1240, L. 20ff: In discussion on why people are not using Bayesian methods I miss the motivation of why the presented study did not use these tools.

- Very good observation, thank you. As we describe for the example of applying Bayesian methods (P. 1236, L.13), these authors used "a priori information on sedimentation rates and tephra layers to construct the age model and consequently derive

the best age for an uncertain tephra deposition". The success of the use of Bayesian methods depends partly on the background knowledge of the researchers (e.g. knowledge of accumulation rates of comparable sites in the region) to adjust the age model accordingly. As we do not pretend to have this a priori information to make full use of the results obtained from Bayesian modelling, we think it's more appropriate to motivate researchers to consider this method for future studies. In a paper currently in preparation, Blaauw et al will address the fact that even if the researchers find themselves without much prior knowledge of regional accumulation rates, Bayesian methods could well provide more realistic estimates of chronological uncertainties than classical methods. Therefore we mention at P. 1241, L. 8: Researchers should make use of the freely available character of the Bayesian software packages to test multiple age-depth models, compare models that best approximate their knowledge of the sediment conditions, and address these comparisons in their studies.

24) P.1242, L. 15-16: The stars are only a classification of the temporal density of radiocarbon dates and need to be considered in conjunction with the age uncertainties provided by the age depth model.

- We added this important comment to the Conclusion and Recommendations section, thank you.

25) P. 1242, L. 25: I appreciate your frustration with the reporting of age determinations, but would disagree in two points: 1) the original research question leading to a site based investigation may NOT require detailed chronological information. 2) Ideally the information should be submitted by the authors to database and may not need to be presented in full in the publication.

- We understand your comment more as an additional recommendation than as a disagreement with our statement that "it is important that authors report at the necessary detail the chronology of their sediment core". Research questions may not have the purpose to develop detailed chronological information, but all studies considering a

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temporal feature should provide at least the minimum chronological backup to support their temporal assessment and statements. We encourage researchers who currently do not report the basic chronological information (e.g. depths of 14C dates, calibration method used, etc.), to work within a minimum set of information. We agree with the second suggestion of the reviewer that submitting the information to a database would be an important achievement.

We thank the reviewer for his excellent contribution to the current version of the paper and are positively sure that our paper has been greatly improved with the reviewer's suggestions.

Interactive comment on Clim. Past Discuss., 11, 1219, 2015.