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Climate of the Past Discussions

Interactive comment on "Spatial climate dynamics in the Iberian Peninsula since 15 000 Yr BP" *by* P. Tarroso et al.

Anonymous Referee #1

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Tarroso et al. Spatial climate dynamics in the Iberian Peninsula since 15 000 Yr BP

The authors use a probability density function (pdf) pollen-climate method to reconstruct the climate of Iberia from 15,000-3,000 years BP from 31 pollen sites.

The manuscript is generally well written and laid out, and the results would be interesting to the readership of the journal. I am not aware of any previous attempt to reconstruct the late Quaternary climate of Iberia in such detail.

The methodology however is not fully explained and critically there is no evaluation of the pollen-climate transfer function or consideration of reconstruction uncertainties in the presentation of the results and the discussion. An evaluation of the robustness of the method and the reconstructions absolutely needs to be included, and need to

be taken into account when discussing the apparent climate changes shown in the results. In addition, the results are presented as absolute values and not anomalies, making them difficult for the average reader to place in context relative to the present day climate, and making it difficult to compare the results with other studies.

Major issues:

1) page 3903, Introduction; page 3906, Methods and other: The authors do not include in their analysis the last 3000 years. This they explain is because of the influence of anthropogenic disturbance on the vegetation, which has disturbed the equilibrium state between vegetation and climate over the last 3000 years. However, the authors also use the modern vegetation distribution to calibrate their transfer function, despite the modern period having had probably the greatest human impact on the vegetation. They then also highlight the role of future climate change as having an important impact on future vegetation distribution rather than being dominated by even greater human impact. The authors seem aware of the contradiction but it nevertheless seems to somewhat undermine the justification for their methodology. While the calibration of the pdf transfer function based on modern vegetation occurs at continental scales where climate is probably dominant, the transfer function will in actuality be more heavily reliant on the vegetation distribution of the study region, since this is where the closest analogue vegetation/climate is to be found. Part of the problem here is that the authors do not assess the robustness of their pdf method (see point 6).

2) page 3906, Data Sources: The authors apply the PDF approach by georeferencing the distribution of 246 taxa from Flora Europaea and the Global Biodiversity Information Facility. It is not clear how these botanical taxa were matched against the pollen taxa used in the reconstruction. They need to include a table providing a list of pollen taxa and their botanical taxa equivalent used in the calibration. Without this information it is impossible to see how this took place, and to be able to potentially reproduce this aspect of their methodology. There are many problems that are likely to be associated with this, particularly since many pollen taxa are only resolved to genus or family level,

and this needs to be shown.

3) page 3907: The authors reconstruct 3 climate variables. They need to explain why they chose these three particular variables, since they are not commonly (have ever been?) used in pollen-climate reconstructions. They also need to explain what these variables are; “January minimum temperature” for example, is this the mean monthly minimum, or the lowest ever recorded in this month?, “July maximum temperature” , is this the mean monthly maximum, or the highest ever recorded in this month?, “Minimum annual precipitation” what is this? The lowest mean monthly precipitation recorded in any month? Or the lowest ever? And why is it described as annual? Very confusing and not at all clear why this is preferable to the much more commonly used mean annual precipitation, or moisture balance. Following on from this, it is also confusing to then refer to these variables as Tjul, Tjan since these are usually used to denote mean monthly values, and Pmin is similarly confusing. Try and choose something a bit more self-explanatory. Problems with the chosen climate variables also extend to the discussion, where these are used much too loosely in discussions of warmer/colder and wetter/drier conditions. For instance, 3913, 17-22, the authors talk about precipitation values showing more humid conditions, but is this appropriate given that the reconstruction is for the driest month only (if this is really what was reconstructed). For instance, what if the mean annual precipitation increased but the driest month got drier? We then have wetter conditions on an annual basis, but drier conditions for the one month. Similar on page 3914, lines 20-25.

4) 3907, 11-12: You need to explain which software was used for the PDF analysis, and state precisely which method. Is this a direct reproduction of a previous method using the same software, or something new or adapted? Following from point 2, you seem to have added additional taxa information, if not additional taxa. Also, why did you choose to use the PDF method and not other more commonly applied methods such as modern analogue? There are certainly known weaknesses in other methods, what are the strengths and weaknesses of the PDF method that led you to choose it

over other methods?

5) 3907, 16-17: We need to know how the pollen sum was calculated since the percentage values appear important and are strongly influenced by what is included in/excluded from the sum. For instance, a standard sum based on total terrestrial taxa, or just the taxa used in the transfer function? (see point 2).

6) 3908: A serious failing of the whole analysis appears to be the lack of any evaluation. How reliable is the reconstruction? What have you done to evaluate the method and what evidence is there to support the robustness of your reconstructions? Can you provide some form of evaluation using modern pollen surface samples for instance? Or perhaps provide some direct comparison of other reconstructions for the study area based on other proxies and/or pollen-based studies? Interpolation uncertainties are shown in figure S2, but no reference is made to reconstruction uncertainties. The time series area-averages shown in figure 5 are a combination of reconstruction and interpolation uncertainties, but these are not acknowledged.

7) page 3909: How were the time windows calculated? For example, by averaging all the samples within a time frame eg 11,000 +/- 500 years BP? Or by choosing the sample closest to the target time eg 11,000 BP? Or by interpolating to the target time.. Please explain. Also, how were the individual age-depth models arrived at and how were 14C calibration issues dealt with?

8) pages 3909, 3911, 3912: The interpolation is based on anomalies, but the results in the main figures are presented as absolute values, which are also the basis of the discussion. Why the use of absolute values?, and especially for area-average calculations? I can see how you might like to use these to make the maps look nicer, since it will help pick out the topographic features, but they are of little value to the average reader who is unfamiliar with (for instance) the area-average maximum July temperature of Iberia and simply wants to know the change relative to the present. Was it warmer or cooler or drier or wetter than today? This also allows us to compare with

other studies both within and distant from the study region, and is particularly useful in this case because the reconstruction does not include the present day values of the climate variables.

9) 3909: How was the interpolation done?, please describe. It looks like a 2-dimensional spline was fitted, since the interpolated anomaly maps are very smooth. If you had used a 3-dimensional spline you might have found that the interpolation uncertainties were reduced. Using a 2-d method assumes that lapse rates have been constant for the last 15,000 years, something that is extremely unlikely. Climate varies vertically as well as horizontally. Sites at different altitudes will undergo different temperature/precipitation changes relative to each other as a result of these lapse rate changes. The difference between your 'C1' region and the other regions probably reflects this (3912, 18-19), and using a 3-d interpolation would have highlighted this more.

10) page 3910: The maps shown in figure S1 and S2 need to be bigger, and the scaling easier to read with more numbers. Space is not limited in online materials so make the most of it, you have some interesting results here. The scaling of Figure S2 would be easier to read if it was monochromatic. What are the units of the 'variance' shown in figure S2 and how was this calculated? I am presuming this is the standard error of the interpolation generated by the spline (an output of the fields package), please state this. The text says that this is 'low', although the values in figure S2 actually look very large compared to the changes in the Holocene shown in figure 5, again uncertainties need to be considered.

11) pages 3912, 3913: The discussion talks about climate change in terms of values, but not in terms of climate itself. There are some interesting results here, what is causing them? How and why did climate in the past potentially differ from that of the present? The role of the Atlantic and Mediterranean, the interaction of air masses, the trajectory of the winter storm tracks, the strength of the westerly circulation, continentality etc? There is one attempt where the authors state that the increase in summer

insolation from 15k BP was the cause of the observed increase in winter temperatures (3912, 11-12); but how could this be so?? And why no change in summer temperatures? This the authors appear to explain by some kind of physiological upper limit to the growth response to temperature (3913, 4-5), but how and why? Does this mean that we cannot reconstruct summer temperature from vegetation beyond a certain limit? The authors also appear to explain the increasing variability of minimum January temperature after 14k as a result of the expansion of trees, which modified albedo (3913, 27-28); how and why do trees/albedo increase winter temperature variability on this timescale?, and how are alternative explanations discounted? It is not clear from the cited reference. Similar on page 3915, line 1; how and why does human impact cause lower temperatures, and why can other reasons be discounted?

Minor issues:

1) 3904, 7: at the molecular

2) 3904, 10: predicted for future decades

3) 3910, 8-10: Please state more clearly what software was used for what analysis

4) 3913, 4-5: "are likely resulting in non-responsive July temperature" what does this mean?

5) 3913, 10, 12; 3914, 2 etc: 'OD', 'BA', 'YD' etc acronyms need to be defined

6) 3915, 28: precipitation was

7) Table 1: Please include site altitude, number of 14C dates (or other absolute dates)

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