

Reply to Anonymous Referee #2

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We thank the reviewer's comments. However, we do not agree with some of his/her views. Below we clarify each of the following points:

Comment 1: There should be more documentation of the source material (archives usually have accession numbers to refer to specific documents or collections of documents) and a Figure of a sample of the documents would be nice. There should also be some discussion as to the potential errors in using the documentary data. As well as the gaps and changes in “observers” mentioned in the text, changes or uncertainties in language, in expected values, in crops (which seem to be the basis of the documentary evidence) could all be discussed. What, for example, are the typical texts which are used as weather reports?

Reply to comment 1:

The documentary data used in our manuscript are detailed qualitative weather observations. This weather reports belong to the specific subsection 0101 “Consultas y Decretos” of Zafra Municipal Archive. This subsection belongs to section 01 “Gobierno”. The reports are arranged into boxes from 1750 to 1840. Each box contains report of a year. We will show in the new version of the manuscript an image of a sample of the documents and of weather reports looked up (Fig. 1).

Regarding to potential errors in using the documentary data, we have a source with a high temporal resolution. These documentary proxies are weekly weather observations which were carried out by accountants. Frequently, there were changes in the accountants. Each accountant used his own vocabulary. Therefore, there is great variability in the information. But is easy to discriminate three kinds of week: weeks without rainfall (index 0), weeks with scarce rainfall (index 1) and weeks with abundant rainfall (index 2).

Comment 2: The paper as a whole provides very little quantitative evaluation of the series. Words such as “similar”, “confirmed”, “reliability” all seem to be used in vague statements without providing any quantitative or statistical evidence; these statements appear to be based only on a visual inspection of the time series presented.

Reply to comment 2:

This paper is based mainly in the collection of descriptive weather information and the reconstruction of precipitation from this source. This series is the first high-resolution reconstruction of rainfall in the southwest of IP.

Only there are rainfall instrumental data before to 1850 in Lisbon, Cadiz and Gibraltar. However, these stations are coastal locations and their precipitation regimes are quite different from that of Zafra, especially in high temporal resolutions. Moreover, modeled data do not enough reproduce local meteorological variables in the eighteen century in West Iberia, as Trigo et al. (2009) have shown, due to lack of proxies near of this region.

Comment 3: The reconstruction itself makes several very large leaps of faith: first, that the estate reports are reliable as precipitation indicators; second that documentary evidence is as reliable as measurements (there is no discussion of potential biases towards

undercount or exaggeration), and third, that the precipitation régime of the 90 years from 1750-1840 is the same as that of the 30 years from 1960-1990.

Reply to comment 3:

1) As is mentioned above, the documentary data used in our manuscript are detailed qualitative weather observations especially about the precipitation, not agricultural and state reports. Therefore, these weather descriptions are reliable information as precipitation indicators. Some weather reports even informed about the number of rain days. Below, we show some weather reports as examples:

October, 15th 1751: “El tiempo se mantiene sin disposición de llover, de que se siguen notables perjuicios, así por la falta de pastos para los ganados como por imposibilitarse la sementera, que se avrá de excutar con alguna retardación”. [“The weather continues without aim of rain, provoking great damages, in pastures for the livestock and the impossibility of sowing, task that will suffer some delay in time”] (Index 0).

September, 24th 1781: “El día 21 llovió medianamente en este país, habiéndose serenado el tiempo”. [“On day 21 it rained moderately in this field, having calmed the weather”] (Index 1).

December, 26th 1785: “En esta semana ha llovido con mucha abundancia”. [“This week it has been raining in abundance”] (Index 2).

2) Obviously, the weather reports are not an instrumental measurement. However, these documentary data provide information about if a week was very rainy, rainy or dry. Therefore, these direct observations of weather have temporal resolution higher than other indirect proxy data as tree rings, ice-cores....

3) Finally, we understand that is a "leap of faith" to assume that the regime of the 90 years from 1750-1840 is the same as that of the 30 years from 1960-1990. However, in order to reconstruct the precipitation (mm) from the indices is necessary to assume some more or less robust characteristic of the precipitation climatology. On the other hand, the reconstruction from the instrumental data before 1860 from Cadiz, Lisbon and Gibraltar involves a similar large "leap of faith".

Comment 4: The fact that there does seem to be some kind of unspecified correspondence between the index presented here and the instrumental series for the same time period in other parts of the Iberian Peninsula in the same region suggests that there is some kind of precipitation signal which could possibly be extracted from this data. The only way to perform a reconstruction, however, is to have some kind of temporal overlap between the information being used and variable attempting to be reconstructed, which is not possible here. This makes it even more important to assess possible errors, biases and uncertainties as thoroughly as possible given the material that is available to work with. The authors would need to either 1) accept that there is no temporal overlap and leave this series as an index, rather than reporting the values as mm of precipitation (and certainly reporting values to the nearest tenth of a millimeter does not seem to reflect the accuracy of the estimates), 2) find some contemporaneous instrumental measurements of precipitation, or 3) use one of the published instrumental series cited in the paper as the target values and perform a statistical regression or other reconstruction method. It would be very difficult to find arguments sufficiently persuasive to convince readers that they should expect the precipitation regimes from 1750-1840 and 1960-1990 to be identical.

Reply to comment 4:

1) We are ready to publish only the rainfall indices.

2) At this epoch in Spain there is not a meteorological network that recorded meteorological data, only individual initiatives in few main cities (it is not our case) performed this task. Near to Zafra no contemporaneous instrumental measurements of precipitation have been found.

3) Reconstruct using the series of Cadiz, Lisbon and Gibraltar is a “leap of faith” similar to our reconstruction methodology, due to these series are located in the coast with different precipitation regimes. Moreover the overlap period is rather short in all series.

Comment 5: Update: Having read the comments of the first reviewer and the author’s response, It should be pointed out that Gimmi et al. (2007) used much more data than are used here. They used nearly 150 years of modern measured data, which would provide more robust measures of precipitation categories. They also calculated an estimated reconstruction from 174 stations over Europe. They were thus able to calculate uncertainties and errors by comparing the two results. They also provide much more detailed information concerning the documents and texts used. Their series is not a reconstruction in the sense that is often used in proxy data but a different method of estimation. In their conclusions, they state three conditions which they feel must be met to use their method, the first of which appears to invalidate this study for their method: “The qualitative observations need to be sufficiently detailed in order to distinguish different degrees of duration and intensity”. Gimmi et al. (2007) were using direct daily descriptions of precipitation events, which (as I understand it) is not the case here: the authors here are using agricultural and estate reports. There is much good evidence that can be found in such reports, but the method used here over-reaches the limit of the data. There is a considerable body of literature devoted to extracting climate signals from indirect documentary evidence such as is used here.

Reply to comment 5:

Citing Gimmi et al. (2007) and Rodrigo et al. (1995) we only want to demonstrate that not always is possible use the “standard methodology” cited by referee 1. Unfortunately we have not the great amount of meteorological series that Gimmi has. Zafra is a peripheral location in Spain where systematic weather readings started in early twentieth century and no close contemporary stations with meteorological records exist.

References

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Rodrigo, F. S., Esteban Parra, M. J., and Castro Diez, Y.: Reconstruction of Total Annual Rainfall in Andalusia (Southern Spain) During the 16th and 17th Centuries from Documentary Sources, *Theor. Appl. Climatol.*, 52, 207–218, 1995.

Trigo, R. M., Vaquero, J. M., Alcoforado, M. J., Barriendos, M., Taborda, J., García- Herrera, R., and Luterbacher, J.: Iberia in 1816, the year without a summer, *Int. J. Climatol.*, 29, 99–115, 2009.

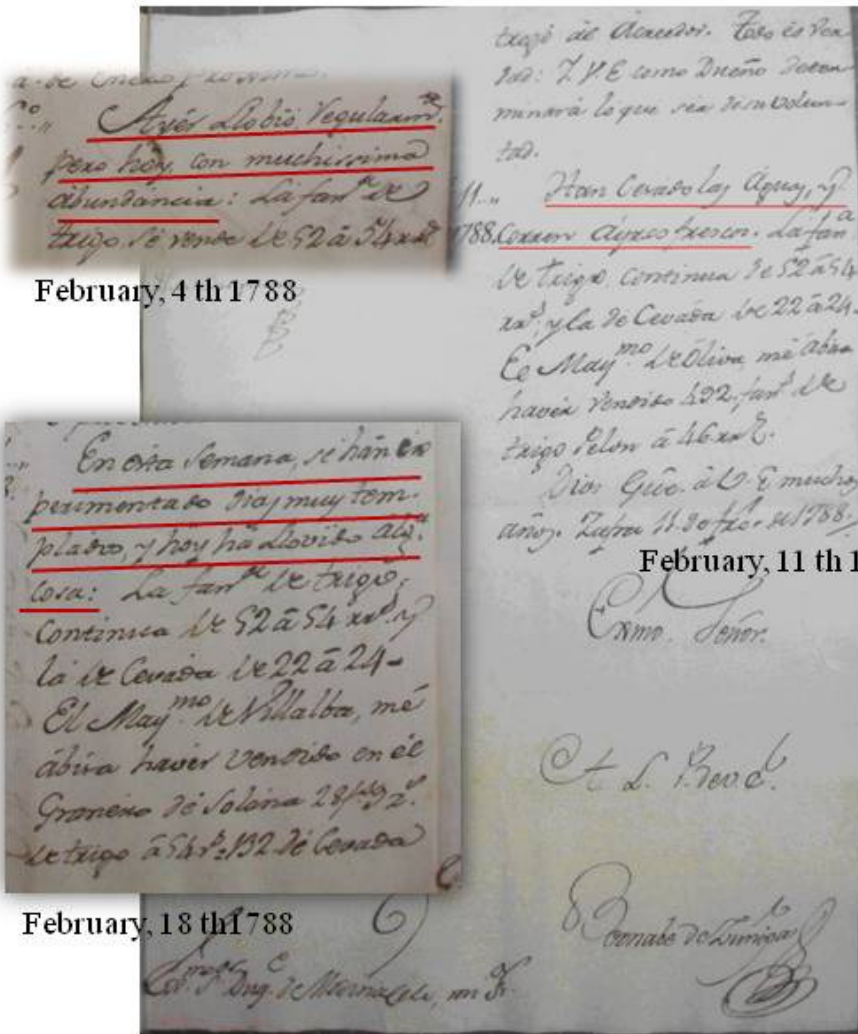


Fig. 1: Three documents from the subsection "Consultas y Decretos" of Zafra Municipal Archive. Dates of the documents are February, 4th, 11th and 18th of 1788. Weather reports are underlined (red lines) indicating that: "Yesterday it rained regularly, by today it rain with abundance" (February, 4 th 1788); "The waters have ceased and it is cool windy" (February, 11th 1788) and "In this week, the days have been mild and today it something has rained" (February, 18 th 1788).