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Interactive Comment

Interactive comment on "French summer droughts since 1326 AD: a reconstruction based on tree ring cellulose δ^{18}O" *by* I. Labuhn et al.

Anonymous Referee #1

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Isotopes from oak tree-rings increasingly appear to be a viable source of high quality proxy climate information for the mid-latitudes. This manuscript adds to this body of information by extending two previously published records. In general I am in favour of publication but they are a few changes and additions I would like to see made first. The biggest flaw with this manuscript is the relatively small sample size prior to the late C19, this will inevitably limit confidence in the reconstruction and is probably responsible for the various data problems encountered by the authors (offsets and low inter-series correlations).

1. Since this paper was submitted a new European drought atlas, mainly based upon tree ring widths and density (I think), has just been published (Cook et al 2015). I feel that some discussion of this should now be included and ideally a comparison with the

published data over this region. For example I see no sign of the Cook et al (2015) fiftieth century mega-drought in either of these records.

2. Title says "a reconstruction" should read "two reconstructions", however you could (should) combine the two as the distances are not too great and produce one reconstruction. I will come back to this later.

3. In the introduction you should cite and discuss Young et al (2015) Rinne et al (2013), both have used isotopes from oak to reconstruct precipitation not far away in the UK and are therefore highly relevant to your research.

4. Page 5117 1st paragraph, should also discuss Loader at al. (2013). A strong common signal (e.g. EPS) and an accurate estimate of the population mean are not the same thing, but both are very important when reconstructing climate especially when using non-detrended proxy series. You probably need to do your level corrections because your sample depth is rather small and not due to any systematic offsets. Please discuss.

5. Introduction. Some discussion of why d18o in oaks may reflect both temperature and precipitation is required.

6. Page 5118, second paragraph and Table 2. Are there longer climate records available with which to verify your proxy data? Why reconstruct SPEI (which I agree is better than PDSI) but I think SPI would be more meaningful as it is based upon a single climate parameter, you must have looked at this what is the correlation with SPI? Are there are regional records available in France equivalent to the UK England and Wales precipitation (EWP) and Central England temperature (CET) records as these might be very helpful in interpreting tour data.

7. Page 5118, lines 18 and 19. Why only those two combinations of months? If SPEI it is like SPI you can choose a month and lag it with a decay effect over a number of previous months which often is very effective.

8. Can you test your data against GNIP d18o data? Also a comparison with mean summer atmospheric pressure (e.g. 850 hPa) may be interesting. If your data are strongly linked to d18o in precipitation mean summer atmospheric circulation is probably the closest meteorological link. 9. Page 5119, line 16-17. Is this hypothesis supported by the dendro dating?

10. Page 5119, Line 18, nine is a reasonable sample depth but two (and anything below four or five) is too low to draw any serious inferences with.

11. Page 5120. Line 25. I agree that it is very important to use only latewood from oak.

12. Page 5122, line 21. This is a very sophisticated approach, but I think simply splitting the data into two equal parts and doing the same statistics may be an equally good (if not better) test, especially if the climate data has a trend in it. Any reason why 2/3 and 1/3 instead of 50/50?

13. Page 5123. You have a big spread in you data and I think quite a low N in each cohort I think (the sample depth of the cohorts should be clearly presented I can't see it). Low sample depth is probably the main reason for your offsets between cohorts I expect. In your case some level correction is probably necessary but the best solution would be to increase N to $\geq$10 trees and hold this constant throughout your whole reconstruction (including calibration period).

14. More explanation of your pooling strategy and offset correction is required. Figure 4 is quite confusing. It would be much better if the two graphs were on the same x axis scale so that the reader could make some visual comparison between the chronologies. What does the dotted line mean in the top graph? Please explain. The dotted line in the bottom graph is where one of the series was only analysed at low frequency, were these data included in the mean value? This is also a period where the correlation between the two series is very poor.

15. Page 5124, section 3.3. You need to be careful with low filter correlations and must

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adjust the significance levels for autocorrelation, this is quite simple but necessary to determine significance.

16. Page 5124, section 3.3. The relationship between the series is very good over the C20th when you have a reasonably high sample depth; I suspect the decline is due to a drop in N rather than any climatic effects. This would lead me to combine the two series to create a single regional reconstruction with a much greater sample depth; this should help to resolve the earlier part of both series with relatively low sample depth.

17. Page 5126, line 1. There should be more discussion, with references, of the links between d18o from oak trees and precipitation. I would avoid the word "drought" as this is not really possible to define with a summer proxy "dry summers" would be better.

18. Page 5127, line 4. Explain normalisation, is this a z-score?

19. Page 5127, section 4.2, lines 26 and 27. I think both of these hypotheses are more unlikely than reduction of sample depth, the earlier high correlation may just be good fortune. If you sample depth were much higher and consistent and the results the same then I would give your two hypotheses more credence, see below.

20. With a pooled series, especially beyond instrumental data range, it is not easy to estimate how well the individual trees match and therefore how strong a common signal they contain: however series variability (or SD) is a good indications. Some trees simply do not respond as well as others to the same environmental conditions and this can occur for a variety of reasons. Generally in a mean or pooled series high variability = good common signal and low = poor common signal, sample depth is also important here as low sample depth also usually leads high variability. So if you consider Figure 7: in the modern period you have a high N and a moderate SD, a good climate signal, and good common signal between sites, this is great and exactly what one would hope for, so good news for climate science. Then both your N and SD decline sharply, so not only do you have a much smaller sample but it also looks as if your trees are not responding in the same way, this could also mean that some of the timbers are from

trees that respond poorly to climate (bad luck). With your data you cannot really say which hypothesis is correct, unless your N was held constant which it is not. As you SD increases so does your common signal between the two sites. So I would say that Figure 7 a and d explain one another fairly well the big difference being the modern part but the reason for reduced SD here is your high (adequate) sample depth. You could maybe do some more stats on the data in figure 4 to and look at the common signal between cohorts from both sites. It would be much better is the two panels in figure 4 were on the same scales and showed all the data from both sites to ease comparison. I do not think that such a major divergence in climate over the two regions is very likely. I would say that a decline below an optimal sample depth is probably the most likely explanation.

21. Figure 10. Some estimate of uncertainty should be added to these reconstructions, which should be considerably larger as your sample number drops.

If you can improve these chronologies in the future to increase and stabilise the sample depth I think that these could represent two very strong precipitation records. With the data you have at present I think the best record would be derived by combining the two series. But this would have quite high uncertainty prior to about AD1800. Comparisons with any early instrumental data may help verification.

Cook ER, et al. (2015) Old World megadroughts and pluvials during the Common Era. Science Advances 1: DOI: 10.1126/sciadv.1500561

Loader NJ, Young GHF, McCarroll D, Wilson RJS (2013) Quantifying uncertainty in isotope dendroclimatology. Holocene 23:1221-1226, doi: 1210.1177/0959683613486945

Rinne KT, et al. (2013) 400-year May-August precipitation reconstruction for Southern England using isotopes in tree rings. Quaternary Sci Rev 60:13-25

Young GHF, et al. (2015) Oxygen stable isotope ratios from British oak tree-rings provide a strong and consistent record of past changes in summer rainfall. Clim Dynam

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