Clim. Past Discuss.,
https://doi.org/10.5194/cp-2018-143-AC6, 2019

Climate of the Past Discussions

Interactive comment on "Two millennia of Main region (southern Germany) hydroclimate variability" *by* Alexander Land et al.

Alexander Land et al.

alexander.land@uni-hohenheim.de

Received and published: 18 January 2019

Referee #3:

RC#3: This article has a potential to be a valuable scientist contribution but it needs, in my opinion, much additional work prior to publication. There are a number of issues that I would like to see addressed, or at least discussed, by the authors. In order to make them easier to follow, I list them in bullet points below (in no particular order of importance):

RC#3: A discussion is needed with regard to what extent any, likely non-linear, temperature sensitivity in the data affects the precipitation reconstruction. Given the region, some temperature influence on the reconstructed precipitation signal is likely to exists

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and such a signal is likely to be non-linear and thus different between warmer and colder climate states during the past two millennia.

Authors's changes: A section within the discussion will be added.

RC#3: I would like to see some "sensitivity tests" in the use of calibration window by using other seasonal windows than February 26 to July 6. It would be interesting to see how sensitive the skill of the reconstruction is to particular seasonal windows, especially as the presently used seasonal window is extremely well-defined down to single dates rather than months.

AC: These sensitivity tests were conducted at the beginning of the project. The temporal changes as well as the changes in the length of the sensitive interval were studied including the well-defined interval Feb. 26-Jul. 06 as well as "classical" seasonal window lengths (e.g. April-June, March-July). This can be provided as a Figure/Table (or in the text) in the Appendices. However, the "classical" seasonal windows are always well-defined, too: e.g. April-June = April 01-June 30. So to me our well-defined interval is nothing else than a prolonged "classical" window.

RC#3: I would like to see a longer discussion about the implication is the huge differences in MSL (see, e.g., Fig 2b). In my opinion, this is likely to result in a bias of the results to a larger extent than the authors acknowledge. Even if the problem cannot be solved (although it may be possible to use a subset of the data of the same segment length to conduct a "sensitivity test"), it needs to be discussed much more critically.

AC: Here I would like to mention, that the minimum MSL is 110 and the maximum is 230 years. In the Figure 2b the fluctuation in MSL seems to be huge, because of the scale (y-axis) ranging from 90-240. The range of this axis was explicitly used to give the reader a more detailed information about the fluctuation of MSL. The fluctuation of MSL is not as "huge" as the line graph implies. Compared to other oak tree-ring studies, in my opinion, it is not really dramatic (even normal when dealing with subfossil and historical tree-ring series).

Author's changes: However, this issue will be addressed and critically discussed in the associated sections.

RC#3: It would be better to present all the result with regard to the climate mean of 1961– 1990 instead of the mean of 1901–2000. This would make the results more comparable to other studies.

AC: Mean precipitation sum (Feb. 26-Jul. 06) in the investigated Main region is 219.7 mm during the past century (1901-2000), whereas the mean precipitation sum from 1961 to1990 is 241.0 mm. The reason for choosing the one-century reference period has the following reason: "outside" 1961-1990 some more droughts appeared (e.g. 1921, 1934, 1991, 1993) characterising the climate of the region. When the previous millennia are compared to the reference period 1901-2000, in my opinion, it becomes much clearer that in some periods the droughts/wets are more "outstanding". In many other studies the reference period 1901-2000 is also used (and sometimes 1971-2000 can be found), see also e.g. Karl et al. 2009: Global Climate Change Impacts in the United States or Meehl et al. 2003: Solar and greenhouse gas forcing and climate response in the twentieth century. Journal of Climate, 16, 426-444, DOI:10.1175/1520-0442(2003)0162.0.co.

RC#3: The implications of the detrending choice much critically be discussed and the possibilities, or limitations, to apply RCS detrending (or "signal-free" detrending) must be seriously addressed.

AC: The 100-year MSL ($\sim$ minimum) restricts the potential to get low frequency information from such data, and one can use a 100-year smoothing spline. But indeed, our discussion about that topic is not seriously addressed.

Author's changes: In the revised version of the manuscript this point will be seriously addressed/critically discussed.

RC#3: Page, 1, lines 13–15: This first sentence of the Abstract seems a bit out of place

as the article only addresses the past two millennia and not the whole Holocene.

Author's changes: The sentence will be deleted.

RC#3: Page, 1, lines 27–28: The exact amplitude of the precipitation reduction is likely very sensitive to scaling/regression method.

AC: Please specify this comment.

RC#3: Page 2, lines 1–3: The introduction is a bit vague and a bit out of place here. It is simply too general and not clearly related to the research problem in the article.

Author's changes: The introduction will be rephrased to clearly relate to the research problem.

RC#3: Page 2, lines 6–8: This is actually wrong. A number of two millennium-long calibrated precipitation reconstructions do exist. This is especially true for western North America. Moreover, MORE millennium-long hydroclimate reconstructions from tree-rings exist to date than millennium-long tree-ring based reconstructions of temperature. This whole part needs to be rewritten and up to date with the present state of research.

Author's changes: This part will be rewritten.

RC#3: Page 2, line 8: I would also cite here: Cook, E.R., Woodhouse, C.A., Eakin, M., Meko, D.M., Stahle, D.W., 2004. Long-term aridity changes in the western United States. Science 306, 1015–1018. Ljungqvist, F.C., Krusic, P.J., Sundqvist, H.S., Zorita, E., Brattström, G., Frank, D., 2016. Northern Hemisphere hydroclimate variability over the past twelve centuries. Nature 532, 94–98. Prokop, O., KoláËĞr, T., Büntgen, U., Kyncl, J., Kyncl, T., BošeÄÂ£a, M., Choma, M., Barta, P., RybníËĞcek, M., On the palaeoclimatic potential of a millennium-long oak ring width chronology from Slovakia. Dendrochronologia 2016, 40, 93–101.

Author's changes: Cook et al. 2004 and Ljungqvist et al. 2016 will be cited.

RC#3: Page 2, line 13: I would also cite: Büntgen, U., Trouet, V., Frank, D., Leuschner, H.H., Friedrichs, D., Luterbacher, J., Esper, J., 2010. Tree-ring indicators of German summer drought over the last millennium. Quat. Sci. Rev. 29, 1005–1016. https://doi.org/10.1016/j.quascirev.2010.01.003. Helama, S., Meriläinen, J., Tuomenvirta, H., Multicentennial megadrought in northern Europe coincided with a global El Niño–Southern Oscillation drought pattern during the Medieval Climate Anomaly. Geology 2009, 37, 175–178. Klippel, L., Krusic, P. J., Brandes, R., Hartl, C., Belmecheri, S., Dienst, M., Esper, J., A 1286âËŸA ËĞ Ryear hydroâËŸARËĞ climate reconstruction for the Balkan Peninsula. Boreas 47 2018, 1218–1229. Kress, A., Hangartner, S., Bugmann, H., Büntgen, U., Frank, D.C., Leuenberger, M., Siegwolf, R.T.W., Saurer, M., 2014. Swiss tree-rings reveal warm and wet summers during medieval times. Geophys. Res. Lett. 41, 1732–1737. http://dx.doi.org/10.1002/2013GL059081

Author's changes: Helama et al. 2009 and Kress et al. 2014 will be cited.

RC#3: Page 2, lines 16–18: Strange formulation here. What is said is unclear to me.

Authors's changes: The sentence will be rephrased.

RC#3: Page 4, Fig. 1: The Figure can be much improved, i.e. using ArcGIS or similar software, as well as be in colour for better clarity.

AC: In general, a black/white map is as good as a coloured one as long all relevant information can be gained. But I do agree, that some additional information (e.g. Long./Lat.) can be added.

Author's changes: A coloured Figure will be provided. Long./Lat. will be added (see attached Figure).

RC#3: Page 5, Section 2.2: Are any references available for the various instrumental datasets from the various stations?

AC: The references are stated (line 7 on page 5).

RC#3: Page 5, line 22: Please, provide the standard references for RBAR and EPS.

Author's changes: Wigley et al. (1984). J Clim Appl Meteorol 23:201–213 will be provided.

RC#3: Page 8, line 5: It should be mentioned that the Old World Drought Atlas is calibrated to scPDSI.

Author's changes: It will be mentioned.

RC#3: Page 8, lines 8–9: Are there any references to these datasets?

AC: The references are mentioned in lines 2-6.

Author's changes: . . . from the above mentioned references. . . will be added.

RC#3: Page 8, line 10: For the Old World Drought Atlas (Cook et al., 2015), all included datasets are listed in the Supplement to the article in a table there.

AC: This is correct. All included datasets are listed.

Author's changes: The sentence will be rephrased: The set of original TRW series used by the mentioned authors is, to the best of our knowledge, not accessible, which makes the comparison between the different records impossible.

RC#3: Page 9, lines 7–9: Please, discuss the implication of these RBAR values more in detail.

Author's changes: A more detailed discussion will be given.

RC#3: Page 9, lines 12–13: A more detailed discussion about this problem is needed here.

Author's changes: A more detailed discussion will be given.

RC#3: Page 10, lines 11–12: A number of other references could also be added here.

Author's changes: To make clear that the given references are only a small selection

“e.g.” will be added.

RC#3: Page 13, lines 17, 21: The word “connection” here could be replaced with “agreement” or “correlation”.

Author’s changes: The word connection will be replaced by agreement.

RC#3: Page 16, line 28: The same problem has also extensively been discussed in numerous other studies, e.g.: Bürger, G., and U. Cubasch (2005), Are multiproxy climate reconstructions robust?, Geophys. Res. Lett., 32, L23711, doi:10.1029/2005GL024155. Bürger, G., I. Fast, and U. Cubasch (2006), Climate reconstruction by regressionâËŸAËĞT32 variations on a theme, Tellus A, 58, 227–235. Christiansen, B. (2011), Reconstructing the NH mean temperature: Can underestimation of trends and variability be avoided?, J. Clim., 24, 674–692. Christiansen, B. and Ljungqvist, F. C. 2017: Challenges and perspectives for largescale temperature reconstructions of the past two millennia, Reviews of Geophysics, 55, 40–96. Smerdon, J. E., A. Kaplan, D. Chang, and M. N. Evans (2011), A pseudoproxy evaluation of the CCA and RegEM methods for reconstructing climate fields of the last millennium, J. Clim., 24, 1284–1309. Wang, J., J. Emile-Geay, D. Guillot, J. E. Smerdon, and B. Rajaratnam (2014), Evaluating climate field reconstruction techniques using improved emulations of real-world conditions, Clim. Past, 10, 1–19.

Author’s changes: The following references will be added: Christiansen and Ljungqvist (2017) as well as Bürger and Cubasch (2005).

RC#3: Page 17, line 4: Would blue intensity be an alternative to traditional density measurements in this context?

AC: To our best knowledge, traditional density and blue intensity (BI) measurements were only performed on coniferous wood. As our investigation deals with oak trees this would not be an alternative.

RC#3: Page 19: Would not storage at the ITRDB also be a good option for long-term

availability?

AC: Storage at the chosen data repository (Zenodo) is a good option for long-term availability and due to the assigned doi number easy to access.

RC#3: Page 27: It would be informative to also have a table for the wettest and driest decades.

Author's changes: Table 1 will be extended. Wettest and driest decades will be added.

RC#3: Page 27: "Low pluvials" appears a strange expression to me. Do the authors means "Droughts" here?

Author's changes: "Low pluvials" will be changed in "Droughts" and "High pluvials" will be changed in "Wets".

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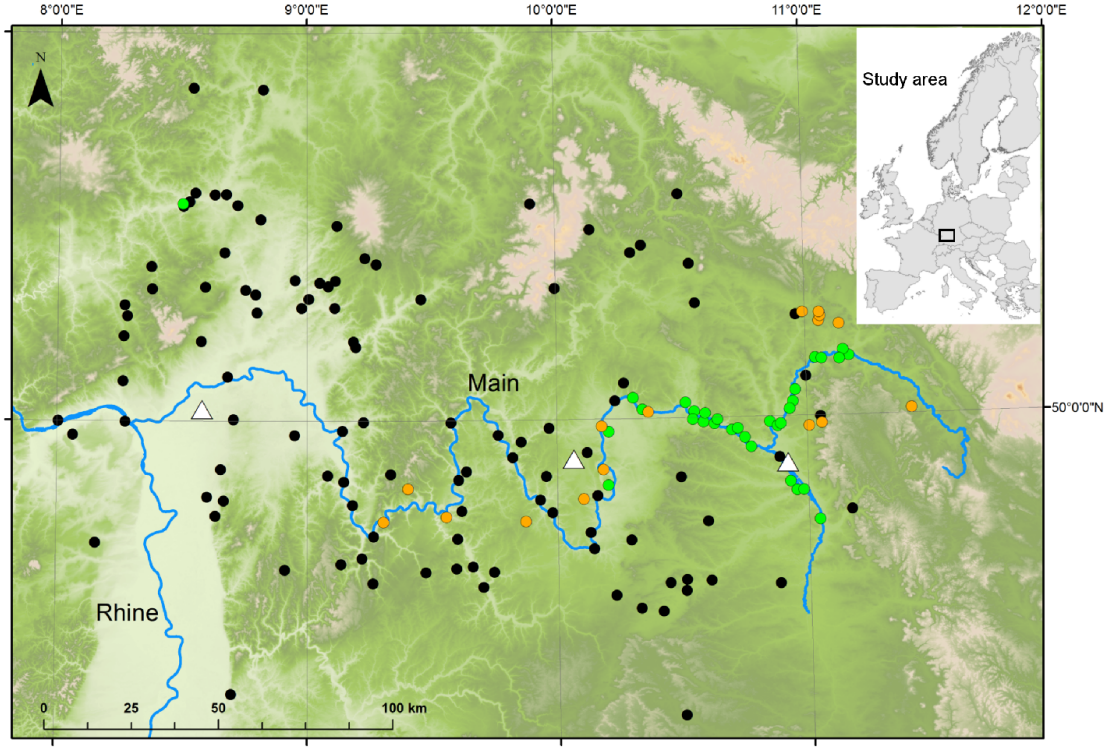

Fig. 1. Map of study area

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