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Climate of the Past Discussions

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

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Referee #2:

RC#2: Dear editor and authors of the manuscript "Two millennia of Main region (southern Germany) hydroclimate variability". To the best of my knowledge, the 2000 years long chronology is a novel idea through integration all available tree-ring width samples in this work, which would be an important contribution in the denderochronology community. Another new information is to calibrate the tree-ring width chronology using the daily instrumental data.However, the robust of the reconstruction should be furtherly analyzed, and the mechanism of precipitation variability should be conducted for reader to understand the origin of variability in the high-impart journal Climate of the

past. Thus, I suggest that the manuscript should be accepted for publication after a revision.

RC#2: There are very long chronologies in Europe where is a hotspot in dendroclimatology. It is highly encouraged to carefully review the previous studies to place much more stress on innovation or difference of this study. The current motivation of this study is not very attractive to me. e.g. the first sentence in the abstract, the climate reconstruction covering the entire Holocene is important, but the TRW chronology in this study only covers the past two millennia.

AC: In a previous version of the manuscript we deeply reviewed other accessible reconstructions from Europe as well as from southern Germany. For example: Wilson et al. 2013 (DOI 10.1007/s00382-012-1318-z), Cooper et al. 2013 (DOI 10.1007/s00382-012-1328-x) or Wilson et al. 2005 (DOI 10.1002/joc.1150) to place much more stress on spatio-temporal differences between them and how important it is to get a long (two millennia) highly-resolved precipitation reconstruction entirely developed from a small region (here the Main region, southern Germany). But this was criticised by a colleague, which caused us to use reconstructions only from the same grid box (here from Pauling et al. 2006, Cook et al. 2015) and for Central Europe (Büntgen et al. 2011).

Author's changes: The first sentence in the abstract will be rephrased.

RC#2: The mechanism and origin of the precipitation variability (e.g. the influence of the Northern Atlantic Oscillation) should to be furtherly analyzed through comparison of the other reconstructions or model simulation. Another option is to select a more specific journal, e.g. dendrochronologia or Tree-Ring Research. The readers of Climate of the past would like to know some information about the mechanism of climate variability not only the phenomena.

AC: To my best knowledge the NAO, SO, AMO ENSO etc. have no significant influence on long-term rainfall variability in Central Europe. Thus I would assume that

there should be no significant influence also on our dataset. As can be read in Qian et al. (2000, https://doi.org/10.1029/2000JD900102): [...The North Atlantic Oscillation plays an important role in nonseasonal variability over the sector and leaves a significant signature in precipitation. But it does not seem to be the most important signal of atmospheric variability in precipitation over Europe, although it does in winter.]. Brázdil et al. (2015, https://doi.org/10.1002/joc.4065) studied the forcings of spring-summer droughts in the Czech Land and found that [...solar irradiance and Southern Oscillation (SO) made only minor contributions to central European drought variability, while the effect of ... Atlantic Multidecadal Oscillation (AMO) were weaker and statistically insignificant.]. But on the other hand a study performed by Miksovsky et al. (Clim. Past Discuss., https://doi.org/10.5194/cp-2018-61) might give some hints that long-term drought variability could be forced by AMO.

Author's changes: Actually we intensively compare/analyse the influence of reconstructed AMO from Gray et al. (2004, doi: 10.1029/2004GL019932), Mann et al. (2009, doi: 10.1126/science.1177303), Singh (2018, https://doi.org/10.5194/cp-14-157-2018), sunspot number etc. on our developed spring-summer precipitation time series via cross-wavelet analysis and other suitable methods. In the revised version these results could be part of the discussion or part of a new section. Currently no results/Figures can be provided. But we work on this topic very intensively together with some other specialists.

RC#2: The logic of the article is a bit problematic. The main target in this study is to reconstruct the precipitation variability over the past millennia. However, the following some evidences and discussion do not support this reconstruction. e.g. Page 10, line 9 'The TRW chronology does not track extremely low or high precipitation rates adequately.' The sections 4.3 also shows this weak relationship between the TRW chronology and the instrumental precipitation. Even the authors emphasize that the human influence may have a severe impact on forest in Page 17, lines 12-20. All prove that it is not very reasonable to reflect the extreme precipitation events over the past

millennia. Another option to try to reconstruct the 'mixed' variable, e.g. the PDSI index.

AC: This is a crucial point. In most of the tree-ring studies dealing with oaks this fact is present in the data. But only in a few of them it is explicitly mentioned/shown that extreme low rainfall is only poorly modelled by oak ring-width data (e.g. see Wilson et al. 2013 (Fig. 7, DOI 10.1007/s00382-012-1318-z), Copper et al. 2013 (Fig. 10, DOI 10.1007/s00382-012-1328-x) and many, many others). In my opinion this point needs more attention in general and thus it is explicitly mentioned in our work. So, the logic of the manuscript is not problematic.

RC#2: Specific Comments: 1. Page 1, Lines 18-19. The bootstrap method is not an innovative analysis in dendroclimatology, please see the literatures e.g. (Guiot 1991; Till and Guiot 1990).

Author's changes: The sentence will be rephrased: To test the stability of the developed transfer function a bootstrapped transfer function stability test (BTFS) as well as ...

RC#2: Page 2, Line 3. It is difficult to predict future impact through climate reconstruction. The climate model is usually used to project the future scenario.

AC: As also mentioned by Referee #3 the Introduction needs some rewording and will be rephrased.

RC#2: Page 6, Line 13. Why is the 100-year cubic smoothing spline used to detrend the tree growth? To my knowledge, the standard standardization method depends on the special situation of each sample.

AC: The 100-year cubic smoothing spline was used to preserve as much as high- to mid-frequency as possible. Due to the minimum in the MSL of $\sim$100 years, the length of the chosen smoothing spline is appropriate. Using the standard chronology does not severely impact how much decadal and longer term information is extracted from these data.

RC#2: Page 8. The section 2.5 should be moved to the introduction to emphasize the

innovation of this paper through a review of previous reconstructions.

Author's changes: Parts of the section 2.5 will be moved to the Introduction.

RC#2: Page 8, Line 26. The reason selecting 51-year should be given. As we known, the window size would affect the results of running correlation.

AC: The relatively "short" 51-year window length was chosen to show agreements between the time series even on short time scale. At the beginning of the project a 101-year running window was also used, but the results remain more or less the same.

Author's changes: A sentence will be added to state why a 51-year window was used.

RC#2: The discussion of phase variability in the cross-wavelet transform and squared wavelet coherence is ignored. e.g. The MR and B11 has an obvious variability in phase in the upper right panel of Figure 5.

Authors's changes: A section about phase variability will be added in the discussion part.

RC#2: Page 18, Line 24. The seasonal resolution would lead a misunderstanding. Here, it is really an annual resolution.

Author's changes: Will be changed in annual resolution.

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