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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 #1

RC#1: Dear authors, I very much appreciate the attempt of analyzing and publishing some (why not all) of the unique oak ring-width data stored at the University of Hohenheim, Germany. This is a very important step towards generating exciting new science.

RC#1: However, I am reluctant in recommending acceptance of the submitted work, mainly because it represents an intermediate step rather than drawing methodological-sound conclusions from a final dataset (i.e. entire Holocene). This stepwise publishing procedure seems unnecessary in the case of central European oak ring-width measurements, as it has been successfully demonstrated in the recent past that such data

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are useful (and most relevant indeed) for reconstructing hydroclimate (i.e. a more complex reflection of spring to early-summer soil moisture availability instead of simple precipitation totals) on inter-annual to multi-centennial time-scales. While this has been done for several regions in Germany, France and England, Ed Cook's OWDA describes a European-wide milestone with regard to spatially explicit reconstructions of droughts and pluvials during the Common Era.

AC: I think there is a misunderstanding here. Ring-width data stored at the University of Hohenheim (Germany) are regularly contributed to different projects/studies to generate exciting science. Tree-ring data from the dendrolab Hohenheim are contributed to a wide variety of different dendro projects (only a few examples are given): 1) "Five millennia of European hydroclimate" (head of the project: W. Tegel, University of Freiburg, Germany; U. Büntgen, University of Cambridge, UK), 2) "Long-term trends in European tree growth over the past 1000 years - an interspecies comparison" (head of the project: A. Seim, University of Freiburg, Germany, funded by the DFG, project no. 389131207). Most of the Hohenheim ring-width data are already provided via data repositories (e.g. Zenodo or PANGAEA). Smaller data(sub)sets are indeed not published yet and are only accessible via personal contact/correspondence. This is mainly ring-width data from very local findings or sites (e.g. from the Rhine river) spanning a few centuries within the Holocene, but NOT the entire Holocene. For the presented study, tree-ring series (you called that a data(sub)set) from a specific region (here the Main region, southern Germany) were needed to develop a regional hydroclimate record and to compare this record to already existing reconstructions (during the past two millennia). The original (raw) dataset used here is made accessible to give others the opportunity to specifically reproduce our results and to have unrestricted access to all data underlying our study. This is transparent, in line with the data policy of the Copernicus Publications and good practical science. This is not in any way "politically" motivated or "strategically" aligned. Any suspicions that we have deliberately withheld tree-ring data are completely unfounded. We, as a research group, have strived in recent years to make our institution a positive example of transparency and

scientific cooperation. We are more than happy to collaborate with and provide our data to others in the hopes of gaining new insights into past climate.

RC#1: In addition, the authors suggest that some of their data has been already incorporated into earlier studies (Büntgen et al., 2011, Cook et al., 2015), therefore only limited comparisons with these reconstructions are possible. Why did not the authors clarify this before? I am confident Büntgen and Cook would provide this information to the authors.

AC: I am pretty sure, and so I do agree with your comment, that if requested, Büntgen and Cook would have provided their datasets for a detailed analysis regarding duplicates in the dataset used here, which would allow for a clear statement of independence/dependence between the different reconstructions. Perhaps I am totally wrong and the original datasets are accessible via a data repository, or there were good reasons not to make these datasets accessible/public for unknown reasons. The widely accepted data policy of scientific journals requires all authors to make materials, data etc. available. So one could argue that an independent study should be feasible (even without a direct correspondence during the publication process). I would like to mention that the mistake in this regard could be that I have simply failed to find the data (and the original datasets are accessible/public), meaning that this part of the manuscript has to be reanalyzed and modified.

RC#1: In short, the submitted work does not provide any ground-breaking methodological and/or intellectual novelty, and the relatively small data(sub)set does not appear to be robust between 800 and 1100 C.E. and again during the 4th century C.E. when the sample size dramatically drops (see Fig. 2 of the submitted draft). Although the EPS is above the common applied threshold of 0.85, the temporal replication changes can strongly affect the chronology behavior. Possible uncertainties might emerge from the integration of predominantly juvenile or mature/adult wood during these periods. Moreover, it is a pity that the low-frequency hydroclimate variability is not expressed in the presented reconstruction.

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AC: In this study we used precipitation records with a daily resolution, which is relatively new to dendroclimatology (chapter 2.4 Calibration, verification and reconstruction of hydroclimate variability). The applied bootstrapped transfer function stability (BTFS) test to assess the temporal stability of the relationship between ring-widths and daily precipitation data (first introduced by Buras et al. 2017) is another example for a new (and innovative) method that was used. While I do agree that most of the presented results were obtained using standard and widely accepted dendroclimatological methods, the presented results nevertheless show e.g. that in the first millennium C.E. (fully-independent dataset) differences to other reconstructions (B11, C15) appear, which could be due to local/regional precipitation characteristics (see chapter 3.3 Comparison of MR reconstruction to others, Fig. 5, Fig. 6). This underlines the need to set up as much as possible local/regional hydroclimate reconstructions (even when standard methods are applied) to study spatial and temporal rainfall variability in the near future. Thus, this work does indeed provide additional information leading to a more detailed understanding of climate variability. In the past few years intensive sampling of subfossil trees in the Main region was conducted, but did not lead to an increase in sample size in the 4th century and from 800-1100 C.E. The drop in sample size (as well as in the mean segment length) in the mentioned periods give evidence for fundamental environmental changes in the Main valley. It is possible that uncertainties in the reconstruction could emerge from the use of predominantly juvenile trees in these periods, but it underlines the statement (see previous comment) that there is a strong need to develop hydroclimate reconstructions on local/regional scale with tree-ring width datasets to ensure whether the uncertainty occurred from e.g. changing sample size.

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