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Climate of the Past Discussions
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Interactive comment on "Differing pre-industrial cooling trends between tree-rings and lower-resolution temperature proxies" *by* Lara Klippel et al.

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(1) comments from Referees, (2) author's response, (3) author's changes in manuscript

Comment 1: (1) The authors note that there are 415 "temperature-sensitive" tree-ring chronologies in the global PAGES 2k database and proceed to use them to illustrate the lack of a pre- industrial cooling trend in tree-ring series relative to the other temperature proxies (Fig. 2). The 50-year binned composite tree-ring series do have a very slight negative trend, but it is not statistically significant compared to the much larger negative trends found in the other proxies. While this initial comparison sets the stage for the investigations carried out in the rest of the paper, it is somewhat strange

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because by my calculation (using the 402 NH chronologies noted in Fig. 1a) there are 415-402=13 SH tree-ring series in the 415-chronology total that could have orbitally-driven positive temperature trends in them. Thus, including the 13 SH chronologies in the binned composite (Fig. 2b) likely weakens the chance of finding a statistically significant negative trend in the 402 NH chronologies. Figure 2b should therefore be redone using only the 402 NH chronologies for the binned evaluation of the temperature trend. I do not necessarily expect a change of outcome, but it should be done to be consistent with the argument. On line 60, the reference to “average global tree-ring record” should consequently be changed to “average Northern Hemisphere tree-ring record” as well. Later in the paper it is finally mentioned that the SH tree-ring data were excluded from further analysis (lines 128-129). This should have been mentioned in the beginning, and the SH chronologies immediately excluded, as suggested above. (2) We acknowledge the point that there might arise a trend distortion. (3) Changed, but not only for tree-ring records. Fig. 2a and Fig. 4 were changed accordingly.

Comment 2: (1) At the hypothesis testing stage (pg. 5) the original 415 global chronologies were winnowed to a subset of 70 NH tree-ring collections, each at least 800 years long (line 143). It would be useful to have a table in the paper (as an appendix?) that lists these data sets by location, species, length, and modeled climate sensitivity (e.g., maximum correlation with monthly summer temperature), so that others can download the same tree-ring data and repeat the same evaluations on their own. (2) Due to additional consideration of Signal Free (see below), the number of records had to be reduced to 67 NH records, because the program failed to detrend 3 of the datasets. (3) Metadata table (selection of information provided by PAGES) was added to the appendix.

Comment 3: (1) Regardless, selecting only the longer series for further evaluation is quite sensible because the preservation and detection of a negative pre-industrial temperature trend (if there) will be far easier to accomplish with $\geq$800 year-long series due to issues related to the ‘segment length curse’. This being the case, I cannot fathom

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why experiments with (i) 100-year spline de- trending (SPL) were carried out. The result is totally predictable with respect to the preservation of multi-centennial to millennial-long trends; they are all removed. Therefore, no negative pre-industrial temperature trend can ever be expected to be detected. Thus, SPL detrending has no relevance to testing the effects of detrending on the presence or absence of the expected negative temperature trend. (2) The 100-year spline detrending was added to show how close the results are compared to to a method removing multi-centennial variability. Anyway, we understand that true insiders find the result predictable. (3) The 100-year spline detrending was removed (and Signal Free added. See below.).

Comment 4: (1) This leaves (iii) regional curve standardization (RCS) as the only de-trending option that may preserve the negative pre-industrial temperature trend from ring widths being sought. Thus, the authors are right in stating that that this method is the best of the three. Unfortunately, they are also right in stating the tree-ring measurements in the PAGES 2k database are for the most part inadequate for the application of RCS detrending. Besides the datasets not being nearly large enough in general, there are other reasons detailed in Briffa and Melvin (2011) on why use of RCS on inappropriate data sets can lead to the creation of utterly spurious long-term trends. This is because it is rarely appropriate to use RCS on datasets based only on living trees from the same site. Yet, I suspect that this is the case for most of the datasets in the PAGES 2k database. Applying RCS to such datasets can introduce what Briffa and Melvin (2011) call 'modern sample bias' in the form of an artificial positive slope to the final RCS chronology, which is exactly the opposite to what is expected here based on orbital forcing. This being said, the 50-year binned RCS composite may still be useful to evaluate because any 'modern sample bias' in individual chronologies may be attenuated in the large-scale multi-site composite. This is still not optimal, however. On a positive note, I actually find the results shown in Fig. 5 to be encouraging. The 2/3 of the tree-ring chronologies (based on RCS? unclear in the text.) have negative trends up to 1800 CE. (2) Sure not all datasets are fully appropriate for applying RCS. (3) As an additional test, we performed Signal Free Regional Curve Standardization

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that should cope with some of the biased in the TRW chronologies.

Comment 5: (1) Although most are declared not statistically significant, it would be useful to test for the probability that the combined outcome is in fact statistically significant in favor of a cooling trend being there more than by chance alone in 2/3 of the series. This can be easily done using Fisher's combined probability test (https://en.wikipedia.org/wiki/Fisher%27s_method) assuming (quite reasonably here) independence between the individual test outcomes. (2) We have chosen another option in line with a comment of reviewer 3. The reviewer claimed that we do not account for a latitudinal sampling bias. This was addressed by adding uncertainty estimates retrieved from Monte Carlo based tests. (3) Figure S.4 was added.

Comment 6: (1) However, again there appears to be a mismatch in the number of series longer than 800 years declared for use (70) (line 143) and the number indicated in the left-hand bar chart in Fig. 5 (89). The same problem is apparent in the total chronology count (89) shown in Fig. 7b. This inconsistency must be corrected. (2) We are simply not able to access all 89 raw datasets, a circumstance we have to accept (and point to in our paper). (3) Further information was added to explain the varying numbers.

Comment 7: (1) The results of the other two tested hypotheses – climate sensitivity and spatial distribution – appear reasonable to me, although it is unclear which version of the chronologies is being used; SPL, NEG, or RCS. This ambiguity must be corrected. (3) Information was added.

Comment 8: (1) I would, however, caution about using chronologies with "mixed climate sensitivity", i.e. a com- bination of temperature and moisture sensitivity in the ring widths. Published work by Matt Salzer and Andy Bunn show that even at the highest, most temperature lim- ited, elevations in the White Mountains of California it is easy to find bristlecone pine trees that have mixed precipitation/temperature signals in their ring widths. When this occurs, the correlation with summer temperature can be negative, leading to the suggestion here to invert those chronologies to rectify the correlation with temperature (lines 125-126). I am not sure this is a good idea. This form of negative temperature sensitivity is completely different from that for trees with positive temperature sensitivity because the negative correlation with temperature most likely reflects an evapotranspiration demand signal associated with a positive response to soil moisture content and precipitation amount. It is not clear that one should expect this relationship to have the same trend (in inverted form) as that due to the direct effect of summer temperatures on radial growth because this mixed-signal climate response is likely to include the direct effect of changing precipitation amount, which behaves more like a 'white noise' process compared to temperature. At the very least, one might expect the temperature trend expressed in the inverted tree-ring series to be reduced by the effects of a precipitation signal on ring width. (2) The inversion of records affected only some non-tree ring records. (3) Explanation about the records that were inverted was added to the methods section.

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