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Interactive comment on "A likelihood perspective on tree-ring standardization: eliminating modern sample bias" *by* J. Cecile et al.

Anonymous Referee #2

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The manuscript submitted to Climate of the Past Discussions by Cecile et al. presents a novel method to consider and remove biases/unwanted noise from both age trends and tree productivity in tree-ring data by a technique dubbed fixed effects standardization. The age trend in tree-ring data represents a combined biological, geometric, and ecological noise that must be removed prior to using tree-ring data to reconstruct past climate variability. How this age-related signal is removed is arguably one of the larger sources of uncertainty in using climatically-sensitive tree-ring data to estimate a wide variety of environmental phenomena. Efforts to reduce these uncertainties and improve estimation of the age-related noise (and also tree specific noise) are significant research priorities. The manuscript and efforts by Cecile et al. are thus welcome and important contribution in this direction.

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Interactive Discussion
Discussion Paper

I find the manuscript is generally well written, but for better or worse employs unconventional structure (e.g. placement of the third section). The motivation, the scientific background for the proposed methods, their implementation (and some challenges thereof) are well described. Similarly, the ecological context is given a rather extensive treatment. Nevertheless, there are several aspects of the manuscript that I feel should be addressed prior to publication. In my opinion, after these major revisions this manuscript could make a nice contribution to Climate of the Past.

1. The results and conclusions regarding the sign tendencies of the sample bias in the large fraction of the ITRDB dataset require further support, particularly given this result contradicts essentially all past work on this topic. It seems that to reach this conclusion, the authors should demonstrate that the difference in the G=ITA versus G=TA models which they use to attribute changes in I, the individual tree growth, has not resulted in offsetting modifications of the T and A terms. Furthermore, I would have expected more discussion and exploration supporting these unexpected findings. The $\sim$2 short paragraphs in the discussion does not seem to be appropriately balanced with the 4 pages of text in section three providing background on the likely source of this biases and its (now debated?) sign.

2. The emphasis on statistical metrics to determine the applied model, while perhaps appropriate in theory, does not yet appear to be well guided in practice here. E.g., it seems odd to me that based upon these metrics, the age related trend, classically described as a age-dependent (e.g., negative exponential model), should be neglected in $\sim$85% of cases based upon the AIC and in $\sim$99% of the ITRDB datasets analyzed based upon the BIC (text on page 4519). Should we allow the BIC to give us “strange time-insensitive” tree-ring chronology? Should we defer to these "objective" statistical metrics to justify not removing age-related trends anymore?

In the abstract the authors note “we can use powerful and transparent tools such as R2 and Akaike’s Information Criteria to assess the quality of tree ring standardization allowing for objective decisions between competing techniques.” In the text, e.g., in

CPD
9, C2347–C2350, 2013

pages 4512-4513 and 4518-2519 the authors somewhat subjectively (?) describe limitations and relative merits of these tools. More consideration is necessary.

3. Overall, I find the selection of figures could be improved, and should be expanded upon to provide deeper insights into the proposed methods. My take on the figures is: figure 1 is fine but could also be moved to the supplement or later in the text; figures 2 and 3 are useful; figure 4 is trivial; figures 5 and 6 do not really depict well (at least on my computer screen and printouts) the differences in selection percentage (but see point 2 above); figure 7 and particularly 8 are useful and interesting (but see point 1 above). I look forward to seeing some more specific examples as already indicated by the authors in the online discussion, and hope that these and additional new illustrations/analyses (e.g., testing methods on datasets composed only of living trees, providing a more detailed assessment of possible growth rate biases) will provide insights on the methods and conclusions.

4. The authors do not really address the abilities to retain the long-term climate signal with this method. It has been traditionally (and by traditionally I mean following the widespread use of RCS) viewed that it is necessary to preserve information about the absolute growth rates of trees growing in different times to fully retain long-term climate variation. Can the authors please assess if these techniques overcome, in practice, the "segment length curse"? This may come down to the vagaries in how well the I, T, and A terms can be faithfully separated with the newly described methods.

5. In the discussion of signal free standardization, it would be helpful to clarify applicability to signal-free RCS versus signal free individual tree detrending.

6. I would appreciate if the authors would compare their standardization approach to "classical" detrending e.g., by negative exponential or spline fits to all series. The classical methods do in fact consider both the productivity of the individual tree and the age trend simultaneously. This seems to be rather close to what full mixed model (G=ITA) does?

CPD
9, C2347–C2350, 2013

7. How do the generalized cross-validation spline specifications compare with splines typically (flexible enough to remove the age-trend and rigid enough to retain longer term climate trends) applied in dendroclimatology?

8. In my opinion the text unnecessarily (inappropriately?) downplays, if not demeans, some prior work in what might be a natural effort to &sell8 the results/methods presented in this study. The authors may wish to consider such aspects in their revisions. I feel the fixed effects standardization will promote interesting discussion and further innovation in this field. The authors may prefer to describe in greater detail the more general limitations of their proposed methods, rather than leave this to others. The techniques described here are a novel and thought provoking way to analyze tree-ring data, yet these techniques will likely still require refinement, if not more major evolution, in the next years.

Interactive comment on Clim. Past Discuss., 9, 4499, 2013.