Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-210-AC1, 2019

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "When trees don't act their age: size-deterministic tree-ring standardization for long-tern trend estimation in shade-tolerant trees" *by* Rachel Dietrich and Madhur Anand

Rachel Dietrich and Madhur Anand

rdietric@uoguelph.ca

Received and published: 11 September 2019

Response to reviewers

We thank both anonymous reviewers for their insightful and thoughtful comments on our manuscript. We have implemented a vast majority of the suggestions highlighted in their reviews and in doing so believe the results are more statistically robust and the reasoning is clearer. To assist comprehensibility of our response this document is structured as follows: 1) Reviewer comment 2) Author response 3) changes to

Printer-friendly version

Discussion paper

manuscript (if applicable). We will begin our response by addressing the comments of reviewer two as they are more extensive and similar to many comments from reviewer 1. Review 2: Main comments: Introduction: 1. In the current manuscript it is not clear how the proposed methods solve the problem presented in Figure 1. Probably, the size-based solution should also be illustrated in Figure 1. a. This is addressed in the introduction lines 113-116. 2. The C-method is mentioned but not referenced in the discussion. It should be mentioned in the introduction and cite the paper that describes it - Biondi and Qeadan 2008. a. We agree with the reviewer that mentioning the C-method is important given its prevalent use in tree ring studies. We have amended our analysis to include C-method as one of the tested standardization methods. As requested, Biondi & Qeadan 2008 is referenced in the introduction (line 73) as well as methods (line 202). 3. The use of similar mixed-effect modelling approaches for tree-ring standardization should also be mentioned in the introduction. It is mentioned only in the discussion in Lines 361 and 402. a. The introduction has been amended to include a more thorough account of the use of explicit BAI models in the literature and their purpose (line 67-70). Methods 1. It is not clear if the standardization using the proposed models is applied based on individual series or based on a model fitted to the cloud of all data and then subtracted from each series (as in Fig 4). Please explain it more clearly. a. As with traditional RCS the model is indeed fit to the cloud of data NOT individual series. We have changed the explanation to make it clearer that the function is derived communally (Line 153-155) 2. For the sake of reproducibility, I recommend the authors to present a worked example with the corresponding R code as supplementary material. a. A sample R code has been included in the supplementary materials S5 3. It should be explained in the main text how SORTIE simulates tree-ring widths, what is the underlying formulation and the environmental drivers. a. A brief explanation of the calculation is provided on line 211-212. “In SORTIE annual radial tree growth is calculated as an asymptotic function of light availability and previous tree diameter.” 4. As a sensitivity test, the authors should repeat the analysis of Figure 2 for an imposed growth decline and vary the shape of the growth increase to linear

and present it as supplementary material. It seems that in Figure 3 the standardization models get a more linear-like increase in growth instead of the sigmoid saturating trend imposed on the synthetic data. To clarify this apparent issue it would help if the mean chronologies of each method are shown as an inset for the last 100 years along with the imposed signal. This would make easier to evaluate if the fitted models suffer from end effects. a. We have added 3 trends to our analysis in both simulated and real tree ring data, the first, a logistic declining trend, is investigated in the main body of the manuscript, while a positive and negative linear trend are interpreted in the supplementary materials. However, we chose not to change Fig 3 as adding the mean chronologies (100 for each method) would decrease from legibility of the figure. We believe the 95% confidence intervals of the resampled mean chronologies adequately show the models' capabilities to reproduce the trends. 5. Compare the same methods for real world data and not just RCS as currently done. a. Previously the CD and BAI methods were not included in the real tree ring data as they were difficult to evaluate on the basis of parsimony (AIC); BAI because its not an explicit model that allows for AIC calculation and CD because variance explained by the model would be artificially inflated (leading to low AIC) due to inappropriate removal of the long-term trends we are attempting to maintain (and reconstruct in the chronologies). Accordingly, in order to include analysis of BAI, CD (and Cmethod) in real ring data we have adjusted our statistical methodology to be more similar to that performed in the simulated data. Lines (272:289) highlight this methodology. This change in methodology both 1) allows for evaluation of all standardization methods in tree ring data and 2) allows for stronger conclusions regarding the implications of each method for long term trend reconstruction. Results 1. Isn't it more logical to start with Figure 3 instead of Figure 2? In this way the reader sees first how the chronologies look like and on what the comparison is based. a. We agree with the reviewer. The figure order has been switched. 2. In Figure 4 it is clear that the GAM fitting is very noisy at large sizes or ages when there are fewer data points. How much does this noise affect the overall fit? What is the frequency response of the underlying spline in the GAM if any? Melvin et al. 2007 solved

Printer-friendly version

Discussion paper

this problem by using a time-varying-response smoothing spline, which gets stiffer with age as the data availability declines. Can a similar solution work for this case in the GAM? a. We agree with the reviewer that these are valid concerns and good discussion points regarding the usage of splines in dendrochronological models. However, we believe the assessment of the implications of regression spline parameters for the SDS, RCS and COMB models to be beyond the scope of this paper. Problems with end-fitting and spline frequency choice are not unique to the models presented in this study. To appease the reviewer, we have amended the methods to provide more details on the regression splines used in this study and to provide interested readers with other alternative techniques. (Line 155-158) 3. What are the different curves in Figure 4 and what are the gray points? It is not stated in the caption. a. We have removed the previous Fig 4 as we do not believe the results presented in it added significantly relevant information. 4. Why the resulting chronologies are not shown in the current results? I recommend adding a figure with the resulting mean chronologies for each method. a. We have added Fig 4 which presents confidence intervals for the site-wise chronologies produced by each standardization method for both species. As above we present C.I.s not mean chronologies as it eases in interpretation of the figure. 5. What is COMBred? This comes out of the blue. a. This has been removed. 6. It is not clear what Figure 5 tells. What does the Rsq mean? a. This figure was removed and replaced with a figure that shows correlations of real tree ring chronologies with imposed trends (similar to Fig 3). Discussion 1. The finding that BAI works for recovering mid-frequency growth signals when only large dominant trees are sampled is interesting because it suggests that this method should be less sensitive to the typical big-tree sampling bias of traditional dendrochronological collections. a. We do not believe our results suggest that BAI is less susceptible to big-tree selection bias. In the case of SORTIE simulated data it is less likely that contemporaneous differences in growth rates are significant. As such the probability of big-tree selection bias occurring is low. Further, mortality is stochastic, so slow-grower survivorship bias is unlikely. Accordingly, the only interesting interpretation of this result is that BAI performs poorly

when young/ small trees are included in the sample. Lines (462:468) in the discussion highlight that our results should not be used to make conclusions regarding sampling biases. 2. The discussion should touch on the potential advantages and shared shortcomings of the proposed methods with RCS and BAI in terms of data requirements and biases. How sensitive are the proposed methods to the proportion of aged/unaged trees in the sample and the number of trees in a site? a. Biases and data requirements of RCS and BAI are discussed briefly in Lines (462:468) and (477:481). We do not test the sensitivity of COMB method to unaged trees as we believe it to be beyond the scope of the study. The goal of this study was not to provide a review of conventional standardization methods but instead to evaluate new ones in a concise manner, as such we direct the interested reader to an appropriate reference for a systematic review of the use of other standardization methods for long-term trend estimation (line 458). We have added discussion regarding the motivation for this and call for future research in lines (428-433).

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2019-210, 2019.

Printer-friendly version

Discussion paper