Clim. Past Discuss., 5, C99–C4, 2009
www.clim-past-discuss.net/5/C99/2009/

Climate of the Past Discussions

Interactive comment on "Extracting a common high frequency signal from northern Quebec black spruce tree-rings with a Bayesian hierarchical model" *by* J.-J. Boreux et al.

J.-J. Boreux et al.

jj.boreux@ulg.ac.be

Received and published: 25 April 2009

[12pt]article color,calc [latin1]inputenc amsmath,amsthm,amssymb calc natbib, color, graphicx latexsym amsfonts

Reviewer 1 (Clim. Past Discuss, 5, C62-C63,2009, by Boreux *et al.*)
We would like to thank Vincent for his thoughtfully and exhaustive comments that have been very helpful to clarify and improve our manuscript. Below are our answers to his questions.

"1. strong and detailed arguments for the use of "blind extraction" instead of classic climate-ring width modelling (I think this is the innovative point of the method)"

We fully agree with the referee that the "blind extraction" is the forte of our approach. Following his suggestions, we plan to change the introduction by adding a discussion around the "blind-test" used in medical studies (allowing less subjective linking between climate and tree rings). As suggested by the referee, we will also add in the conclusion section that our model could be a starting point to simulate "trees".

Both referees asked about the relevance of our results with respect to climate, we hope that the following elements will clarify our views on this issue. As stated in the second paragraph of Section 1, our goal is neither to reconstruct precipitation and/or temperatures time series nor to climatically interpret our extracted signal. In this context we have made sure that the word "climate" never appears in sections 2, 3 and 4 (the main body of our work) and in the title. Contrary to Vincent's statement in the first paragraph of his review, we do not assume that the common signal is "climatic". It is very likely but, for some tree specie on some specific site, the main part of the extracted signal may not be connected to climate but to other environmental aspects (soils, competition, etc). Hence, the strength of our modeling strategy is that no prior assumption on possible covariates is made (we let the data "speak"). Of course, one motivation of our research is to derive (in future work) how extracted signals from various species could be connected to climate. By developing a new "blind extraction" method for dendrochronologists, the objective of the present article is **methodological**. The proposed techniques could be applied to other research domains like for upscaling problems (ie. how to extract a common regional signal from different weather stations). The question asked by the referee ("how relevant is this (interannual extracted) information for climate study") can only be answered by saying that, as written in the conclusion, "our present work should ... be viewed as an addition of a simple statistical procedure to the mathematical toolbox of dendroclimatologists". As stated by the reviewer, one important remaining point is to "propose reliable ways to fulfill climate reconstruction work". We believe that this fundamental and very complex statistical question is beyond the scope of this work. During the next few years, we are planning to reach this goal but we were not satisfied with classical average-based approaches to extract common signal

in trees. Hence this work can be viewed as a first step in our reconstruction scheme. We understand that our present methodological objective could be currently viewed as very limited in terms of climatological interpretation. We prefer to be honest and not oversell our method. Our future goals are to improve this model to deal with both high and low frequencies and to make an exhaustive study to identify connections with climate variables and the extracted signals.

"2. more details and clarification of the model's temporal feature. There is presently a mix between inter- annual/high frequency/temporal correlation.
This is an interesting remark. Concerning the interpretation of Y_{ts} defined as a log-difference between two consecutive ring area values, the following simple facts need to be recalled. Whenever the relative ratio of two inter-annual consecutive ring areas from the same tree is close to one, then Y_{ts} is close to zero. If this relative ratio is very large (ie the ring area from year t is much larger than the one formed during year $t-1$), then Y_{ts} has to strongly positive. Conversely, a negative Y_{ts} represents a large decrease in ring areas between two consecutive years. As exemplified by Figure 3, working with Y_{ts} instead of the raw ring areas X_{ts} allows us to remove long-term trends, to focus on the inter-annual relative variability and to work with time series that can be assumed to be stationary and Gaussian. One drawback is that we have lost the absolute value of X_{ts}, ie working with the couple $(X_{ts}, X_{t-1,s})$ is equivalent to analyzing the couple $(aX_{ts}, aX_{t-1,s})$ for any $a > 0$, independently of the value of a. Keeping in mind this drawback and those advantages, the correlation meaning in Y_{ts} and Z_t can be viewed as the short term memory in the relative log-transfom rate between two consecutive ring areas.

"3. a defence in the context of climatology of your waste of data when discarding all information after the youngest tree."
This is correct. We are currently working on a new version of our algorithm that could handle missing values and consequently avoid the limitation brought by the age of the youngest tree. Still not all the technical issues of this coming version are solved.

Our hope is to provide a R package of the extended version to the dendrochronology community in coming months. Concerning the article, it mainly focuses on the presentation of the model and its implementation. Discussing how to handle missing values in a Bayesian Hierarchical Models would only bring heavier notations and make the statistical discourse unnecessarily more complex. Also see the following point.

"4. slight change of the level of speech: less statistics and more interpretation, climatology and dendroclimatology".
We fully agree that the difficulty of such a methodological article is to keep the statistical part as clear and short as possible and to emphasize the applied aspects. We have tried to implement all the specific comments proposed by the reviewer (see below). Concerning the climatological interpretation, we are a little bit reluctant to draw conclusions from our example. This may due to the fact that we are statisticians by training. Consequently, we don't want to interpret (over-interpret??) our results about the northern Quebec climate from only a single site. In addition, none of us are dendrochronologists or climatologists. So we prefer to leave the interpretation to the experts in those fields. Finally, we want to insist that our goal in this article is to propose a new statistical method and not to reconstruct the northern Quebec climate.

Technical corrections and specific comments will be taken into account in the new version