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Climate of the Past Discussions

Interactive comment on "Contribution of tree-ring analysis to the study of droughts in northwestern France (XIX–XXth century)" *by* O. Planchon et al.

Anonymous Referee #2

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Review of "Contribution of tree-ring analysis to the study of droughts in northwestern France(XIX-XXth century" by Planchon et al

This manuscript is exploring the possibility to reconstruct the occurrence of droughts in north western France using negative characteristic years from local tree ring chronologies. This aspect is potentially innovative for this region but the present paper must be undergo major revisions before it can be considered for publication. In particular, the description of the dendrochronological dataset is not complete enough, as well as the study of the links between tree growth and climate. Key references regarding the state of the art are missing. I would recommend to restructure the discussion and make a first section on the extreme growth years, their links with climate parameters, their spatial coherency and their intensity. The meteorological data could then be used to

discuss the typology of droughts and the specific signature of different drought types on the tree growth. This aspect would deserve to have a "calibration" and a "verification" statistical dimension.

Suggestions :

- The authors should clearly describe the construction of the referential site chronologies (number of trees, methodology to correct the growth trends and to identify the characteristic years).

- There should be a detailed analysis of the negative characteristic years themselves: coherency within the referential tree ring width profiles, spatial coherency, independently of the analysis of droughts identified from meteorological data. Is it possible to build a regional growth drop index using both the magnitude and the spatial coherency of the signals? It would be also valuable to test in the coherency is better for specific subsets of data for instance after the local topography?

- The authors mention that the comparison between the results of the dendroclimatological analysis and the climate data allowed to identify the prevailing features which caused the growth drop of the oaks: the analysis of the links between climate parameters and growth parameters deserves a very detailed presentation of results.

- The impact of drought on tree growth could induce multi-year effects : the authors could analyse the auto-correlation of the growth series and compare it with the auto-correlation of the climate data.

- Different responses to drought could be linked to the type of oak trees and the tree hydraulic conductivity. The authors should give more details about the Quercus types, and should refer to ecophysiological studies of the reaction of different types of oak trees to drought (e.g. Ponton et al, Plant Cell Env. 2001).

- The response of tree growth to drought is also relevant for the understanding of the continental carbon cycle. Recently, it was shown that the 2003 heat wave had a dra-

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matic effect on the European forests (Ciais et al, Nature, 2006). This aspect could be mentioned as a perspective of the proposed study.

- The impact of the slope of the stands has impacts on the water uptake has been studies by earlier works that could be cited (see for instance Barij et al, Tree Physiol. 2007).

- There should be key references to earlier works already focusing on the links between weak oak growth and drought (see for instance Kelly et al, The Holocene, 2002)

- There could be a comparison with the droughts identified using tree ring stable isotopic composition from the area of Rennes (Raffalli-Delerce et al, Tellus, 2004, expanded by Masson-Delmotte et al, 2005). Are the growth anomalies somehow related with the cellulose isotopic anomalies, well correlated with the local water deficit?

- The authors could refer to other studies conducted using tree rings in order to characterize the spatial scale of droughts, for instance by Brewer et al, Clim Past, 2006. Some authors suggest that the Palmer Drought Severity Index could be also suitable for temperate areas. Have the authors considered to use this index?

- Do the authors use homogenised meteorological data? This is not clear from the references given page 254.

- Why do the dendrochronological time series stop in 1980? It would be very valuable to include the recent decades, with well characterised recent droughts in north western France. The archeological dendrochronological data could be complemented with the current monitoring of French forests (monitoring network RENECOFOR, see http://www.gip-ecofor.org/f-ore-t/mesures.php).

- When considering soil moisture deficit, is the definition the most relevant? Could more recent methodologies be compared with this simple estimate (e.g. hydrological balance, PDSI index)? How much is this criteria influenced by the uncertainty on meteorological data prior to 1950? It is quite well know that for instance maximum summer

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temperatures are systematically overestimated during warm and sunny summers, by 1 to 2°C, because the old thermometers were not well protected from the radiation. This could induce an uncertainty on the reconstructed droughts prior to 1950 compared to the more recent period. There could also be a discussion about the cause of the droughts (lack of precipitation or high temperatures).

- The typology of droughts should be explained with precise criteria (what does "remarkable winter drought" mean in terms of deviation from the climatological average?).

- Have the tree ring data been considered in terms of total ring width, late wood ring width? Could the early versus late wood growth be used as a supplementary information?

- I do not understand exactly how the initial drought typology was confirmed by other methods (precipitation differences?) (page 256). Please explain more precisely (quantitatively) the methods.

- Is the pattern shown for one year of Type I drought robust with respect to other years of this type? Reversely, is a specific growth anomaly pattern associated with a specific drought type? Objective statistical methods (cluster analysis or EOF analysis) could be used to compare the characteristic years and the climatic / drought data.

- An objective selection of the sites more clearly responding to drought could be used to build a drought index using the amplitude of the characteristic years and the number of sites to share this signal.

- The last paragraph of page 258 is the section that really deserves to be expanded by a more detailed analysis of the qualitative and quantitative links between growth and drought. The authors should quantify the uncertainties on past drought estimates using tree ring chronologies, and also make an assessment of the "regional signal to noise ratio", and estimate the number of regional chronologies that need to be used (possibly under a specific hydrogeographic context) in order to minimize the error on

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the identification of drought years, frequency and intensity of past droughts.

- Regarding European droughts, some recent works suggest a link between winter rainfall deficit in southern Europe, soil moisture atmospheric feedbacks, and drought and heat waves in northern Europe in the next summer (see for instance Vautard et al, GRL, 2007). In this respect, it would be very interesting to compare the north western drought occurrence to the winter rainfall deficit in southern France. This could be a possible outlook for this work, expanding the tree ring database.

- The last paragraph, page 259, is difficult to follow and suggests to analyse the weather types with the occurrence of summer drought. Why do not the authors perform this analysis? Long term pressure data are available at the scale of Europe and could well be used to test the coherency between the anticyclonic conditions and the reconstructed droughts.

Figures and tables

- Figure 1b displays a drought index that is not used in the text for comparison with the tree ring growth anomalies.

- Is table 1 fully useful? It would need to include as well the growth index characteristics (anomaly intensity, spatial extent = number of sites showing the anomaly)

- Figure 2a should show the locations for the referential data series displayed on Figure 3 (16 reference series) and the other locations used to build these referential series.

- Figure 4 shows examples of negative growth years. How representative are these maps with respect to other growth years? Is it possible objectively to associate a drough type with a growth pattern? Does a drought have consequences on the drought on the next year? Is it possible to classify the referential sites with respect to the topography of the forest area in order to highlight a possible specific response depending on the topography as discussed in the text?

- Again Figure 5 only gives 4 examples. It would be better to show if there is a com-

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mon pattern for all type I droughts, using for instance the representation of the mean temperature and accumulation but also the representation of the inter-annual type I drought standard deviation of monthly data. It is very difficult to compare the different diagrams because different vertical axes are used. I suggest to use the same vertical axes for an easier comparison.

- The caption of Figure 6 should explain that it is the result of a hydrological calculation (by the way, does the Turc calculation apply for a forest or is it more suitable for a grassland?). What is the representativity of this calculation conducted for Rennes with respect to the surrounding regions? This calculation should be compared to the growth anomalies and their coherency should be assessed (linear or non linear response of the growth with respect to drought, to be compared for instance with the tree ring cellulose 18O response).

Interactive comment on Clim. Past Discuss., 4, 249, 2008.