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Biogeosciences Discussions

Interactive comment on "Relating ring width of Mediterranean evergreen species to seasonal and annual variations of precipitation and temperature" *by* W. Nijland et al.

W. Nijland et al.

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Our complete reactions on both referee reports are added below. We are pleased with the positive and constructive comments of both referees and wish to thank them for their efforts.

W. Nijland et al.

Anonymous Referee 2 (C187–C190, 2011) received and published: 16 March 2011

General comment: The presented study deals with climate-growth relationships of two Mediterranean tree species (Quercus ilex and Arbutus unedo) on different soil

substrates based on dendrochronological studies. So far, only a few studies have been performed in the Mediterranean climate. Analyses of the climate-growth relationships based on tree rings (dendroclimatology) are important for a better understanding of tree physiology and of possible impacts of future climate scenarios. The study is well conducted using adequate techniques for analysis and modelling of climate-growth relations. However, there are some concerns which should be considered by the authors.

We are grateful for the accurate characterisation and the positive reaction of the referee on our manuscript and wish to thank the referee for the useful suggestions. The specific comments are discussed below with our reactions as italic text.

Specific comments:

Abstract: Page 356; line 6: Please mention authors and family of the studied tree species when citing the species names for the first time.

The author was added to the species in the abstract and the first citing in the paper, also for other species mentioned. The family was added only with the species description in the full paper.

1. Introduction: Page 357; lines 4-12: The authors focus on possible negative impacts on forests productivity in the background of a changing climate. What about the impacts on biodiversity and other environmental services which the Mediterranean forests deliver?

Biodiversity and environmental services are likely to be impacted by a changing climate in the Mediterranean region. This possibility is added to the manuscript.

Page 360; line 6: After citing the full name of the genera Quercus and Arbutus, it is sufficient to use initials when citing the genus, Q. and A., respectively.

The full citing is kept with the detailed description of the species in paragraph 2.2, in other parts of the manuscript the genus is changed to the abbreviation where necessary.

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2.1 Study area: A small map which could be integrated in figure 1 would be nice for a better understanding of the location of the study site.

We agree with the referee that a map of the study area will contribute to the understanding of the study site location. An additional figure showing the location and general geography of the study area was added to the paper as fig 2.

2.2 Trees: The existing knowledge about the potential for dendrochronological studies should be clearer indicated for the two tree species.

Existing knowledge on dendrochronology in Mediterranean region and also for the specific species used in this study is discussed in detail in the introduction (Page 358 line 15 – Page 359 line 19). In paragraph 2.2 the species used in the paper are introduced with their general characteristics. We think that the discussion of existing knowledge is at a better place in the introduction.

2.3 Data Collection: Page 362; lines 27/28: The method of cross-dating should be better described. This method is crucial to (1) identify missing, false and wedging tree rings and (2) to evaluate, if there is an external oscillating factor which triggers tree growth leading to the formation of similar temporal sequences of ring widths or other wood anatomical parameters between different individuals of a species in a certain region. Cross-dating can be performed either by Skeleton plots (Stokes and Smiley 1968) or by comparing ring-width curves. In the second case also non-statistical parameters such as "Gleichläufigkeitsprozent" and statistical parameters (T-values, correlation coefficients) are used to verify the correct dating of tree rings (Schweingruber 1989).

To improve the description of our cross dating and verification methods the following part was added to the manuscript, replacing Page 362; lines 27/28.

"For the dating and comparison of tree-ring curves using the program Past4 (Knibbe 2009). The steps were:

Cross dating the series:

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1) Detrending measurement series using logarithms of first differences between adjacent ring widths (xi – xi-1) (Hollstein 1980). 2) Calculating Student's t-values based on Pearson cross-correlation coefficients between the series (Wonnacott and Wonnacott 1990; Jansma 1995). 3) Calculating percentage of parallel variation between the series 'Gleichlaufichkeit' (Hollstein 1980).

Verification of results:

to verify results and check for measuring mistakes and missing rings we used: 1) COFECHA (Holmes, 1983). 2) Visual verification of anomalous growth, possible missing rings and measuring mistakes by on-screen comparison of undetrended (raw) ring-width curves and microscope observations of the colour and cell structure of the wood."

3. Results: Page 364; lines 2-4: These two sentences are part of the methodology.

Although the sample planning is part of the methodology the actual samples are also a result. We feel that these sentences provide a coupling between these parts in the paper and contribute to the clarity and readability of the manuscript.

Page 364, lines 5-9: How did cross-dating techniques contributed for the exact dating of tree rings in the case of anomalies in ring formation described at the lines 10-21?

The combination of COFECHA and on screen comparison of the data and detailed microscope observation led to a reliable detection of the anomalies described in lines 10-21. In paragraph 2.3 we improved the description of dating and verification techniques providing additional information towards this concern.

Page 364, lines 25-27: What is the basis for this statement? "The root mass is large compared to the shoot and leaf biomass in this first growth phase and competition for light and water is greatly reduced. Around five years after the logging the canopy closes, resulting in a decrease and stabilisation of ring widths". Is this based on other published studies, unpublished data, personal observations or hypotheses?

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The statement is mostly based on personal observations on recently coppiced stands in our study area, where we saw recovery of the leaf area within a few years after the clear cutting. The reduction of competition for light and the increased productivity after coppicing is also mentioned in literature. Two references were added to support the statement. (Khatouri, M., 1992. Growth and yield of young Quercus ilex coppice stands in the Tafferte forest (Morocco) Plant Ecology Volume 99-100, Number 1, 77-82, DOI: 10.1007/BF00118212) and (C. Floret, M. J. Galan, E. Floc'h and F. Romane. 1992 Dynamics of holm oak (Quercus ilex L.) coppices after clearcutting in southern France, Âă Plant Ecology Volume 99-100, Number 1, 97-105, DOI: 10.1007/BF00118214)

Page 365; lines 18/19: How are these similarities between the indexed ring-width chronologies expressed? The authors should provide a table indicating the statistical basis for these similarities. This table should also provide the statistical basis to build up the (a) one single chronology representing all series regardless of tree species and substrate; (b) two species-specific chronologies; and (c) three substrate-related chronologies.

The correlation of the individual series within a chronology is indicated in table 1. An extra part is added to table 1e to indicate the correlation between the chronologies (all trees, species specific, and substrate specific).

Page 365; lines 20/21: How do the authors define pointer years? Please include the definition in the methodology.

Pointer years were selected according to the method proposed by Schweingruber, F.H., Eckstein D., Serre-Bachet F., Bräker O.U. (1990): Identification, presentation and interpretation of event years and pointer years in dendrochronology. Dendrochronologia 8: 9-38. Reference to this method is added to the manuscript

Page 366; lines 1-14: The use of "vegetation period" would improve the understanding of the highlighted climate-growth relationships. For instance (lines 2-4): "This means that tree growth benefits from high temperatures at the beginning of the vegeta-

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tion period and that growth is reduced if summer temperatures are high" or lines 13/14: "The growth potential in autumn is low because of the declining temperatures and day length at the end of the vegetation period".

A very useful suggestion, the manuscript is improved following the proposed changes.

Page 366; lines 15-18: Should be moved into the discussion part.

Agreed, this part fits better in the discussion and is therefore moved to the second paragraph of the discussion.

Page 367; lines 10-19: The comparison with GPP data should be already mentioned in the methodology section **Page 367; lines 20-30:** The relation between the GPP curves and the ring-width obtained in the years 2004 and 2006 should be better expressed.

A section on the flux data is added to the method section and the discussion of this topic in the results section has been revised. In the method section the explanation of the relation between GPP and tree-ring data is extended.

4. Discussion and Conclusions: Page 369; lines 5-10: It should be mentioned that the potential of dendroclimatology is underused for the Mediterranean and also tropical regions, however, for temperate and boreal climate zones there a huge number of chronologies is available.

Tree- ring data is indeed much more commonly used in high temperate and cold climates. We revised this section to mention the Mediterranean region specifically forÂă having much unused potential for tree-ring analysis.

Page 369; lines 21-23: This database for such a statement is not sufficient in my point of view. (1) the detected climate-growth relationships in this study explain only a part of the stem growth, but for sure there might be other abiotic and biotic factors which triggers stem growth. (2) The authors should also consider that the obtained climate-growth relationships from 1970-2008 have been established in a period with

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already increasing temperatures. To evaluate the impact of a future climate on tree growth climate reconstructions it is necessary to highlight climate-growth relationships for periods before increased greenhouse gas concentrations.

There are indeed many other or even unknown factors that may influence future tree growth. The text was revised to include more nuance and to discuss these factors and uncertainty.

Figure 1: Please describe the meaning of the dotted line (standard deviation of monthly temperature or minimum/maximum values).

The dotted lines are the monthly maximum and minimum temperatures. This is added to the figure description.

Figure 2: Is the indicated scale of 5 mm valid for all 4 photographs? If yes, please mention it in the figure legend. If not, please indicate the scale in each picture.

The scale bar is valid for all 4 photographs; this is added to the figure description

Figure 4: Format the title of the y-axis: "RingWidthIndex".

Corrected

Figure 5-7: Indicate the title of the y-axis.

The y-axis represents the correlation; this is added to the figures

Figure 8: Indicate the units of GPP at the second y-axis.

The unit of GPP in this figure is [g CO2 m-2 week-1], this is added to the figure

Technical corrections:

Page 370; line 4: Change "moths" to "months". *> Corrected*

Page 370; line 10: Change "august" to "August". *> Corrected.*

Anonymous Referee 3 (C490–C491, 2011) Received and published: 7 April 2011

With great interest I read the paper on the relation of tree rings and annual variations of precipitation and temperature within the Mediterranean. The paper is very well written and clearly demonstrates the ability to derive climate signals from evergreen species. They use a novel approach with striking results. I recommend this paper for publication in Biogeosciences with only minor revisions.

We are grateful for the positive reaction of the referee on our manuscript. The suggestions for impotent are discussed below.

Page 357: Climate productivity relations: I would suggest to add a small section on the work of researchers from the remote sensing community. They have been studying the relationship between vegetation and climate for a long time and made quite some progress (e.g Sellers et al., 1989, Field et al., 1995).

A short section on remote sensing was added to the introduction including references to some relevant papers.

Page 360: Please add a figure with the location of the catchment

We agree with the referee that a map of the study area will contribute to the understanding of the study site location. An additional figure showing the location and general geography of the study area was added to the paper as fig 2.

Page 363: line 25 Bootstrapped: : :. Significance testing. Please cite this statement. In addition, other researchers (e.g. Hooten and Wikle, 2007) often use EOFs to obtain the dominant signal. Please explain why bootstrapping is a better way to compare the time series in relation to EOF.

EOFs separate the data from its original variables to obtain the most dominant signal, and are therefore less useful in our study where we make a direct comparison between the ring widths and measured meteorological data and we specifically aim at interpreting the statistical results against the processes. The method of bootstrapping is explained in Guiot (1991). This reference was moved to the end of the sentence to

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clarify this part of the text.

Page 367: The link between the tree ring and GPP is very interesting (although we are in this case just looking at two years). Personally I would also be interested in the Evaporation signal from the Fluxnet sites, because this signal can directly be linked to water availability.

Because we had only limited flux data available this data is not extensively analysed but rather shortly discussed as a reference and illustration to the results from the tree-ring analysis. Evaporation/Transpiration is potentially very interesting, but in this study we chose to use GPP because it is more closely related to growth and also includes the effects of illumination and temperature. In reaction on the comments of Referee 2 we revised the part of the manuscript on flux data and split it into a method and a results section. In the method section, our choice for GPP is explained.

Interactive comment on Biogeosciences Discuss., 8, 355, 2011.