Round #1

Author's Reply:

by Hervé Cochard, 2021-01-13 16:47

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Revision requested for your preprint

Editor (Hervé Cochard)

(...,) I would like to draw your attention to the quality of the figures which can indeed be improved quite easily. I also invite you to restructure some paragraphs (well dissociate what is part of the M&M and Results sections) and, as one of the readers points out, to better tell a "story".

Thank you for your encouragements. This paper is based on an old dataset on reaction woods, that had been insufficiently valued, and our judgement was clouded by the need to make the most of it. In this new version we have chosen what seemed to us the most urgent point to focus on, and left other aspects for future work. We hope that it is clearer now. Most fgures have been redrawn.

Reviewer 1 (B. Gardiner)

I was expecting this paper to be a synthesis of tree growth stresses in angiosperms and gymnosperms and how these are related to reaction wood and their role in tree alignment. However, it was not such a paper and I found it to be full of interesting information but without a unifying "narrative".

My major criticisms of the paper are as follows:

(1) There is no "story" holding the whole paper together. There is a discussion about the relationships between green and dry wood properties, a discussion on growth stress indicators and the role of growth stresses in trees, and descriptions of different types of wood including reaction wood. But these are not brought together in a coherent way. What is the purpose of the paper?

Thank you for these most useful comments. Indeed, our first version had an unclear objective. In this new one we have focused on the question that seemed most important to us, and could be addressed with the analysis of our dataset on reaction woods: is it possible to reconstitute the biomechanical history of a tree from post-mortem observation of its wood, green or even dry? Now the paper has a more conventional structure: a short intro presenting the question, a state-of-the art chapter to introduce basic concepts of biomechanics, material and methods, results, discussion.

(2) The language needs some work. I have made a few suggestions in the annotated version of the paper that is uploaded. I also found it difficult to follow the arguments put forward in many places. I could not understand the logic.

Indeed, language and logic corrections were needed. We hope that this completely reworded version is clearer.

(3) There are no hypotheses put forward and tested. So it appears to be more a review paper or a data paper. It is not clear.

It should be now considered as a data paper, not a review. It does contain some elements of review, but only in the state-of-the-art chapter which follows the introduction and presents facts and concepts needed to understand the methodological choices and the approach.

(4) The choice of standing trees was unclear. Why these species? Also there is only one tree from each species so each tree is essentially an experimental unit. Becomes very difficult to do any statistical analysis.

From the state of the art it appears that the main source of variation of maturation strain was the tree adaption to the mechanics of growth. Apart from the difference between softwoods and hardwoods for reaction wood, no clear differences were found between species, but the diversity of studied species was not so high. So the first choice was to widen this species diversity in a tropical forest.

It was decided to select rather young trees (they are more efficient in restoring verticality) with a basal curvature, signature of a rather long process of vertical restoration, in order to have a sufficient thickness of reaction wood in the upper or lower part of the trunk, just above the curvature. For each putative tree, the species was determined by a botanist (MF Prevost) and was kept for measurement only if it was a species from a new family.

At the end there is only one tree per family in the tropical forest. For temperate species, more trees (3) were selected in a softwood family and in a hardwood family.

The objective was not to give a mean value or a range of values per species or family but to look at the links between maturation forces and wood properties, with the hypothesis that each measurement point is representative of wood maturation.

(5) There were lots of graphs but the quality was not publication quality. Need redrawing.

Was done, hoping OK now.

(6) The text was mixed up with test in Results that should have been in Materials and Methods and text in Discussion that should be in Results.

Thanks. Hopefully no more the case in this revised version

(7) Other comments and questions are in my annotated version of the paper, which is attached.

Thank you, we have taken them into account before taking the text back completely. Some are listed here:

(7a) Dynamic modulus is always higher than that obtained by bending

We added a comment on the dynamic modulus being slightly higher than the quasi-static modulus

(7b) Are you considering Green L MOE is not a basic property of the wood?

Yes, EL is a basic wood property. However, it makes sense frow the viewpoint of structure/properties relationships to consider it as the product d*(E/d) for the following reason. Due to the honeycomb-like structure of wood, in L direction (and below FSP) we have E/d~Ew/dw where Ew is the cell-wall modulus and dw~1.5g/cm3 the cell-wall density. So E/d is proportional to Ew, mostly dependent on MFA, while d expresses the porosity. Note that E/d equal the square of sound speed, both (below FSP) in wood and in cell-wall in L direction, so that it is directly obtained from vibrational test. This cannot be used with wood above FSP because of the influence of free water on density hence the need to measure basic density to calculate a basic specific modulus as an alternative to E/d.

(7c) Table 3 (now Table 4) *"Mean values of parameters per tree": no measure of uncertainty! is this because there was only one tree per species?*

See the response to point (4). For each tree, a correlation between datasets yields the slope ψ. Somehow the R^2 given for each tree is a measure of uncertainty.

Reviewer 2

Thank you very much for your contribution to the PCI Forest and Wood Sciences. The paper is well designed and edited, delivering important information to some investigators and engineers who are interested in sawmill and timber sciences.

The authors are one of well-known top-leading researchers of tree and wood biomechanics, who has been accumulating a plenty of knowledge of physical and mechanical properties of reaction wood (they referred it "compression wood" and "tension wood" in this contribution). The reviewer believes this contribution delivers not "a very novel discovery which requires consecutive discussions among researchers among researchers" but "a grand-sum theory to educate or lead young researchers and engineers who are interested in biomechanics of wood and timber". The present contribution is quite long and taking a style of semi-review paper; I am afraid that some readers sometimes feel tedious. Therefore, the authors should always keep their eyes open for describing each paragraph briefly so that readers could read easily. In any way, basically I strongly recommend the authors to publish the present contribution in PCI Forestry in agreement with the editor-in-chief.

Thank you for your feedback. We do hope that this paper will be useful for young researcher working on tree biomechanics, but its main purpose is nevertheless the original analysis of a dataset, that might require consecutive discussion among researchers and lead to further research. In order to reach that objective, we have modified the structure, removed some content and focused on one single scientific hypothesis: the possibility to reconstitute the whole biomechanical history of a tree from post-felling observation of its wood. The state of the art, concentrated in a section "basic of tree biomechanics" extending the short introduction, only contains the information needed to understand the approach.

Recommendations of corrections

(1) The figures should be edited in a typical and classic style. Explanation of each axis in the x-y diagram "must" be always put and in an accurate font. What does "BD=f(DD)" mean in Fig.3? I think many of explanation should be described not in the x-y diagram but in the caption as a Notes or Legends. Same could be checked in another some figures.

The figures were redrawn in the conventional format of a journal article

(2) Any abbreviated quantity should not be used in the text if it is not listed in the nomenclature table or without any explanation. Examples are, CIRAD in L.162, sigmaM in L.322, FSP in L.234.

All abbreviations used are explained at first occurrence and listed in the nomenclature table.

(3) Important mathematical equation should be described in a classic style using MathType in an independent line with numbering.

All equations are now centered on a separate line. Since we never need to refer to previous equations, we didn't number them.

(4) Some reader could not understand the difference between "maturation strain and growth strain", "maturation stress and growth stress". In Introduction chapter, brief definitions of key-terms are helpful for readers.

This has been clarified in the section “basic of tree biomechanics”

(another comments)

(1) The aim and/or goal of the contribution should be clearly declared in Introduction Chapter.

Now done, see above

(2) In Line 161~177, the CIRAD single-hole method should be graphically illustrated if possible. I discover an example in Gril et al. (2017).

Explanations of the method are now given in Annex 2, together with a new illustration.

(3) In Line 229-230, what Mk means? A subscripted k in Mk is a kind of suffix? This “k” causes more or less confusion with “k” in the equation in Line 207.

Mk was one measured value of mass M. The description of that experimental method is no longer present.

(4) In line 267 in caption of Fig.5, the unit of MOE is not “MPa” but “GPa”?

Corrected, thanks

(5) The authors should propose a final (or tentative) recommendation of formula to calculate the value of phi. Which is the most recommended one between in Line 297 (phi=-0.4811SMb+25.45) or in Figure 8 (phi=-0.4811SMb+25.45)?

Hopefully clearer now. This technical aspect has be moved to Annex 2

(6) In table 2, each sample species has each code number, while in Table 3, no code. Do you think about no need to put code number?

You were right, we do not need it. It was removed from the table

(7) What is difference between sigma-M in Line 323 and sigma-m (maturation stress)? Was the sigma-M already defined in the text?

Now made homogeneous.

(8) A sentence in Line 534 “It is natural and useful - - - - of maturation as basic - - - ” is difficult to be understood.

No longer expressed this way in current version

(9) In Line 550, “fond” is misspelling of “found”?

checked

(10) Signs of strains in Table 5 are confusable. Please check “expansion of alpha-m” is positive in CW, and “contraction of alpha-m” is negative in TW.

This part is no longer present in current version

The reviewer looks forward to reading the completer manuscript in a published style in PCI Forestry.

Again, thank you very much indeed