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Interactive comment on "Water use strategies of a young *Eucalyptus urophylla* forest in response to seasonal change of climatic factors in South China" *by* Z. Z. Zhang et al.

Anonymous Referee #1

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General comments

This paper addresses drought responses in Eucalyptus urophylla plantation in south China, mainly focused on two periods (wet vs dry). Sap flow was used to obtain stand transpiration and Gs and leaf water potentials were measured in the two periods. The main results show that transpiration was largely controlled by evaporative demand, resulting in higher transpiration during the dry season (because of higher D). Large trees were more sensitive to drought, as they showed higher reductions in Gs and ks compared to the wet period. Gs was also shown to be limited at low light, and this limitation was higher during the wet period.

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In this study, drought effects were very weak (relatively high SWC and pre-dawn leaf water potentials). Therefore, the results may not be very relevant to describe drought responses in this species. The authors discuss an interesting interaction of tree size with seasonally-variable responses to D and light, but the overall presentation of the paper could be greatly improved.

Methods should be rewritten, linking specific statistical models and analysis to each of the hypotheses. Results should be limited to the actual outcome of the measurements, without including any material describing methodologies or analyses. Figures should be understandable with the support of legends and captions. The discussion should be clear and concise, discussing whether the results support or not the hypotheses; in its present state, it is very difficult to follow. I have made some comments that I hope help the authors to improve

Specific comments

Title: I would not refer to 'seasonal change of climatic factors' as climate is the long-term average of meteorological conditions at a given site.

pg. 10471, L. 10-11. Vapour pressure deficit (VPD) increases exponentially with increasing air temperatures and therefore warming is expected to have a larger influence in future VPD than reduced precipitation.

L. 13-17. As the authors point out, there are good examples of drought vulnerability in tropical forests, but also please check a recent review which deals with several stabilizing mechanisms of vegetation in response to extreme climate events (Lloret et al., 2012).

pg. 10472, L. 1-2. New paragraph? L. 23-24. What do you mean by 'deviated physiological response'? L. 26. Which 'abovementioned effects' are you referring to? L. 26-27. There is a link between the differential drought responses of different-sized trees (opening sentence of the paragraph) and the closing line on the different impact

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of water stress on tree growth of different-sized trees. Changes in hydraulic allometry are indeed mediated by sihfts in growth and biomass allocation. However, this link is not clearly explained in the paragraph, please clarify.

pg. 10473, L. 'Reducing Gs to water vapor' please reword. L. 5-7. I cannot see the difference here between 'regulation of stomatal aperture' and 'stomata must react rapidly...'. L. 10. 'isohydric', not isotonic. L. 11-13. There are many studies dealing with seasonal changes in Gs responses to D. L. 14-18. The most frequent response is that trees reduce Gs before changes in hydraulic conductance (Martínez-Vilalta et al 2014).

Martínez-Vilalta J, Poyatos R, Aguadé D, Retana J, Mencuccini M. 2014. A new look at water transport regulation in plants. New Phytologist 204:105–15.

pg. 10475, L. 1-2. Not really an assumption of sap flow measurements per se, but one related to upscaling of point measurements of sap flow. L. 19-20. Delete sentence, it is not needed here.

pg. 10476, L. 4-6. Please clarify whether you are referring to stand transpiration here. Provide details on how you did it: did you multiply the mean sap flux density per unit sapwood by the sapwood area: ground area ratio? Did you use s stratified scheme (by diameter classes)? L. 15. In the previous equation, ks should be whole-plant conductance per unit sapwood (not only sapwood conductance).

pg. 10478. L. 11, please see previous comment on ks and be consistent with equation (1). L. 17-18. It would be easier to refer to the seasonal periods always with the same name, wet vs dry, and not mix it with 'April' vs 'October'.

pg. 10479. L. 3-25. Please make this paragraph shorter, there are sentences that can be omitted; for example L. 11-12. L. 17-20. How was the boundary-line analysis conducted? Using a binning approach or using quantile regression? Please specify.

Pg 10480, L. 8-9. Please describe better the scaling procedure from Fd to Et in the

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methods, starting with defining Et there. See previous comment on page 10476, L. 4-6. L. 18. The method of calculation of ET-NOC needs to be described in the methods.

pg. 10481, L. 1-2. Hence, there are no differences in soil water availability between wet and dry periods (see discussion). L. 13-21. This paragraph should be placed in the methods section. The methodology for deriving boundary-line responses needs to be described. L. 23-24. There is no statistical model and test reported to claim that m differed significantly among light levels. L. 26-29. These lines belong to the methods section; for example, Qo is mentioned here and the equation defining it is provided later. L. 14-22. Part of this paragraph also should be in the methods section; please rearrange the text accordingly. The data analysis section should contain a description of the various analyses and why they were performed. L. 14-27. Same as previous comment.

pg. 10482. L. 7. Does Gs,ref-max correspond with parameter a in Eq. 5? L. 18-20. Please simplify your sentences, here and in other instances within the text: 'Gs,ref was significantly higher in the wet season (88.6) compared to the dry season (68.8, $p<0.01$)' L. 21. Here you define the ratio dry/wet for Gs,ref-max, but previously you use the terms 'ratio of Etnoc between wet and dry seasons (pg. 10480, L. 25-26). Please be consistent and use always the same ratio. Paragraph starting on line 23: Again, the paragraph is a mix of the explanation of an analyis (methods) and results. It is difficult to understand: please specify which are the variables in the boundary line analysis, don't refer to the analysis 'above' (L. 24); which 'slope' (L. 27)?; what do you mean by 'improved' or 'suppressed'? Please use simple clear terminology (i.e. positively or negatively correlated).

pg. 10483, L. 10. Has 'Hp' been defined in the methods? Also, the following sentence can be omitted, because it's wrong: conductance is ks, not 1/h. L. 15-22. It is not clear how ks was estimated (and it is not clearly explained in the methods either). I understand that it was calculated from Eq. 1, but is there a reason to not calculate it using the measured Fd and the water potential difference? This seems easier to me.

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pg. 10484, L. 9-11. The problem is that there is no really 'drought' here.Predawn water potentials were the same as in the wet period and SWC was still high. Tree transpiration may be little affected by reductions in SWC before a threshold is reached, there is plenty of evidence for this. In this study, tree transpiration is largely controlled by evaporative demand, not by SWC. You don't even need to invoke access to deep water in the soil to explain your results (SWC in the upper soil is already high). It is unclear to me what is being discussed in the paragraph, mixing the effects of rooting depth with aerodynamic coupling.

pg. 10485, L. 6-17. What is the message of this paragraph? Soil evaporation is an important component in this low-LAI forests? There is no specific hypotheses or measurements on this. L. 23-25. Stem capacitance has not been measured in this study, so this claim is not appropriate here. In fact, the entire paragraph does not discuss a relevant result arising from the study and could be highly shortened, or even omitted.

pg. 10486, L. 12-13. There are many different views on the mechanisms of stomatal closure, and the direct response to leaf water potential is only one part of the story. L. 17-21. The difference in 234.4.% (GS constant) vs 159.5% (Gs decreasing in response to increasing VPD) is kind of obvious. I may be missing something, though; what is the novel result here? L. 21.24. I can't see the link between these lines and your results... L. 25-28. This should go to results.

pg. 10487, L. 5-16. Here is an interesting result, which the authors could discuss further. Is this behaviour (i.e. not complete stomatal closure under low leaf water potentials) general among Eucalpytus? Can the authors provide more references and values of residual Gs in other Eucalyptus species? Another question, how low are the values of water potential (-1.6 Mpa) compared to absolute values of minimum water potentials recorded for the species? L. 26-27. Any explanation as to why ks decreases more than Gs? Where in the plant is this decline in ks expected to occur (leaves, stem, roots)? This is much more relevant than the discussion on WUE...(see next comment).

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L. 27 and following. It is merely speculative to discuss about WUE because you did not measure assimilation and the reader has no way of knowing what these trees were doing in terms of WUE.

pg. 10488, L. 11-20. Unclear the link between your results and WUE (and difficult to assess without actual measurements). How did you estimate PLC? Is it for stems, roots or leaves? Differences in PLC would be relevant for patterns in ks across tree sizes; why do you insist discussing WUE? L. 21-end of paragraph. This paragraph mixes discussion on the effects of tree size, growth rate and natural vs restored habitats on drought responses. The logig in lines 25 to L.2 in the following page is difficult to follow. Please keep to one clear message per paragraph.

pg. 10489, L. 4-14. Again, this discussion on WUE is not relevant here. The discussion should be focused on your results, guided by the hypotheses of the study. L. 15. Isohydry not isotonicity. L. 16-29. Most of this paragraph should be moved to the methods section.

pg. 10490, L. 3. You mean -m, not GS,ref. L. 5-8. Please clarify this sentence: why an analysis of -m at different light levels indicated differences in D?? L. 11-13. Do you think that the decreasing pattern of -m with radiation is actually mediated by changes in D? Because the D range will also change across light levels, and the D range has a known impact on the fitting of Gs vs D responses. L. 24 and following. The interactions between Gs, D and radiation might be more complex than what is mentioned here. For example, check this paper:

Ewers B, Oren R, KIM HS, Bohrer G, LAI CT. 2007. Effects of hydraulic architecture and spatial variation in light on mean stomatal conductance of tree branches and crowns. Plant, cell & environment 30:483–96.

pg. 10491, L. 12-14. Where does this result come from? L. 14-5. As mentioned here, the high SWC (and high pre-dawn leaf water potentials) probably preclude the interpretation of any relevant drought response in this study,

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L. 21. In short, transpiration was largely controlled by evaporative demand, with a weak effect of SWC.

Pg. 10492, L. 1-4. Neither hydraulic failure nor WUE were measured in this study. L. 5-8. What about Gs? It's also more drought-sensitive as tree size increases (Fig. 5).

Figures

Fig. 1. Please add values of VPD to see the changes in evaporative demand; the main periods of analysis (wet vs dry) can be highlighted in the figure. Fig. 3. Use dry vs wet, not October vs April. Are symbols trees or light levels? A legend for the symbols is missing. Fig. 4. Are symbols different trees? Legend is missing for both symbols and lines. Fig. 6. Please define 'normalised architecture', 'standardised architecture' and Hp in the methods section. Fig. 7. These analyses are not described in the methods. Fig. 8. How are PLC curves obtained?

S2: It is not clear whether all data or a subset of the dataset is represented here. I would expect more scattered points in the space below the curves. S3. According to the legend in Fig S3a, different symbols depict light levels, but the caption says that symbols represent trees. Please clarify. For S3b, different symbols are individual trees right? Please also consider using different symbols to represent different thigs (open vs closed), otherwise it can be a little confusing.

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