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Interactive comment on "Contrasting photosynthetic characteristics of forest vs. savanna species (far North Queensland, Australia)" *by* K. J. Bloomfield et al.

Anonymous Referee #1

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The paper is based on an excellent new set of photosynthesis measurements at seven sites in the transition zone from forest to savanna in tropical far north Queensland, Australia. The photosynthesis measurements are complemented by leaf traits, and climate and soil characteristics of the sites.

The paper addresses different research questions and provides a range of results. I would appreciate, if the paper could be more focussed and concise.

Introduction:

Four research question are introduced, but I have the impression that the introduction not really leads to the research questions formulated as a framework of this paper.

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Several aspects are highlighted, but to me it is not evident why the research questions mentioned at the end of the introduction are relevant.

To me the research questions 1 and 3 seem to be redundant, because slope and intercept of Amax vs N and Amax vs P determine the respective nutrient use efficiency.

Research question 3: I did not find results in the main article quantifying Amax vs N and Amax vs P on the level of individual species. Figure 7 provides individual quantities for N, P, Ma and Amax, and only for one species.

Research question 4 to me seems a bit dangerous in the context of the comparison of forest and savannah trees: the forest trees seem to represent a mixture of trees with different light niches (sun-exposed and shaded trees) while the savannah trees probably are all sun-exposed. As the light environment is critical for leaf structure, nutrient content and photosynthetic capacity, to me it seems critical if the main aspect of the analysis (a comparison of forest and savannah trees) may be obscured by the selection of forest trees – including forest trees without full light exposure, which have no equivalent at the savannah sites. Maybe this aspect has been addressed in the multivariate statistics, but to me it is not obvious.

Materials and Methods:

The paper provides an excellent and in many aspects quantitative characterization of climate, soil and vegetation at the seven sites (Table 1). I am surprised that the quantitative site characteristics seem not to be used in the analyses of the leaf level data, apart from the categorical differentiation to savannah and forest – and despite the second sentence of the abstract:" Aside from precipitation patterns, boundaries between these two vegetation types are strongly determined by soil characteristics and nutrient availability." I would appreciate if the quantitative environmental characteristics could be used in the analyses, or at least in the discussion of results. To me it is a bit dissatisfying if the relevance of environmental drivers is mentioned in the abstract, the drivers are presented, but not used in the analyses. At least they could be used to

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identify if climate and soil were indeed different for forest and savannah. Better even to formulate as a research question, to which extent the differences between savannah and forest trees can be related to their respective environmental conditions. Maybe this was captured in the multivariate model. If so, it might be explicitly mentioned.

The outstanding high P availability on site KBL-01 seems to be a remarkable soil property, which nicely corresponds with results presented in Figure 1 (i.e. Ma, Amaxm, Nm, Pm).

Leaf photosynthesis characteristics were derived by measurement series of varying light and CO_2 concentration. However the characteristics of photosynthetic capacity derived from these curves (Vcmax and Jmax) were only presented in the context of table 2, and they did not contribute to results statistically analyzed and discussed, thus they did not contribute to the conclusions. The statistical analyses were based on measurements of photosynthesis at light and CO_2 saturation (Amax). The reason to use photosynthesis at light and CO_2 saturation instead of photosynthesis at light saturation and ambient CO_2 concentration (Asat) makes sense (impact of stomatal limitation). But following this argument it would be even more appropriate to use Vcmax and Jmax instead of Amax or Asat. If the authors decide that Vcmax and Jmax do not contribute to the analyses, discussion and conclusion, there is no need to present these results in table 2 and there is no reason to mention the light and CO_2 saturation measurement series in Materials and Methods.

Page 8976 line 5: "Trees of sub-canopy species were rarely found growing in full sunlight and so these leaves, although sampled from upper branches free of self-shading, had developed in a relatively low-light environment." Should trees developed in low-light environment be excluded from the forest – savanna analyses? Or the effect might be tested in the context of mixed effect model selection. If this has already been so, I have overlooked this and it might be worth mentioning more explicitly.

Results:

The results are presented without sub-headers in 2227 words (6 pages), 3 tables and 7 figures. At the end of the results chapter I was lost and confused by the details. Nevertheless I was surprised by the additional experiment in the greenhouse, which – I think - was not mentioned before (neither in Introduction, nor Materials, also not Abstract).

In some cases the references to figures seem not to be correct (e.g., page 8983 line 22).

I would appreciate if the results section could be structure by sub-headings and filtered to present only the relevant results. Does the additional glasshouse experiment provide relevant information? If so, please mention the experiment in Materials and Methods.

Discussion:

The Discussion might as well profit from sub-headings to structure the text.

I was surprised by the last sentence of the Discussion: "The sudden appearance of apparently significant terms when transforming area-based entities to a mass basis is, however, to be expected (Lloyd et al., 2013)." I was not surprised by the sentence, but that this sentence was chosen as the final statement of the Discussion. This aspect is not related to any of the four research questions formulated at the end of the introduction.

Conclusion (<> Abstract)

I think that the two final sentences of the abstract are somehow uncorrelated to the text before. I also have the impression that the main conclusions in the abstract and in the section conclusions are not consistent. I also don't see how explicit they answer the questions posed in the introduction.

I would appreciate if the research questions in the introduction would be reformulated and used as a consistent frame thoughout the manuscript to present results, discussion and conclusion. With respect to the presentation of results, I would suggest to

add subheadings, to filter for the main results and skip details, which do not directly contribute to answer the research questions. With respect to the discussion, I would suggest to add subheadings. I would also suggest to cross-check the section conclusions and conclusions in the abstract to present the same main conclusions. I think this might help the readers of the paper and avoid getting lost in details.

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