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# *Interactive comment on* "Rapid response of habitat structure and aboveground carbon storage to altered fire regimes in tropical savanna" *by* Shaun R. Levick et al.

**Anonymous Referee #2**

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Levick et al. Rapid response of habitat structure and aboveground carbon storage to altered ïňĄre regimes in tropical savanna.

This is a useful application of LiDAR technology to examine effects of burning on vegetation structure. The results are important, but I must admit that I was disappointed there were no analyses of how fire affected 3D vegetation structure, despite multiple claims to the contrary (Page 1, lines 8 and 11; Page 2, line 34; Page 12, Line 13; Page12, line 17 Figure 6, caption). These claims should be removed or actual analysis of 3D structure should be added. Figure 2 is a great reconstruction of the 3D structure of the vegetation, but the information contained therein was ultimately distilled into met-



rics that lose this 3D information. I do not have the expertise to suggest what metrics should be used to compare 3D structure, but certainly such metrics must exist, such as the various methods to measure aggregation. It would have been helpful to have a brief overview of the research approach at the end of the introduction. For example, as I was reading the methods, it was not clear to me why you used Lidar to estimate biomass of the fire plots when you already had more direct measurements of aboveground biomass for the same plots. Of course your approach allowed you to estimate biomass for a 3-fold greater area of each experimental plot, which I suspect is the reason that you did this, but this was not clearly laid out. Considering that you possess the ground-based data for comparing fire impact on AGB, a direct test using these data should be included. Even though the area sampled is lower, the ground measurements avoid the additional error introduced by relying on a model relationship (even though the fit was quite good). What is the difference between Figure 7 and the corresponding data from figure 6? At first glance, it appeared that Figure 7 was presenting data already presented in figure 6, but upon close examination, the corresponding data in figure 6 are different than figure 7. For example in figure 6, there is more vegetation at heights of about 8 to 15m in the 2-yr early treatment than in the unburnt treatment, in contrast to Figure 7. The figure legends and text do not help clarify these differences. Also, are the error bars standard errors? Were they calculated using variation and n of 30x30 plots or of experimental plots? The latter should be used if we are to use them to compare treatments. The fire intensity data in Table 1 are important for this study, but no details are given. How were these data collected? Were they obtained for every fire between 2004 and 2013 or just for representative fires? If these data have not been published elsewhere then the methods should be described. Page 2, Line 23. It seems like an overstatement that detailed 3D measurements are the best way to quantify carbon dynamics. Perhaps it could be the best choice for non-destructive measurements of certain C pools. Page 3, line 15 and line 19. In these instances replace "blocks" with "block." Page 4, line 3. In what year were these tree measurements made? Page 5, lines 8-12 and page 6, line 3. Are references available for these software tools? Page 6, line 12. I presume that two of these six quadrats corresponded with the plots sampled on the ground. It would be helpful to clarify this. If not, I am not sure how figure 3 was generated. Page 6, line 15. I disagree that including quadrats as a random resolves the issue of pseudoreplication. One foolproof way of avoiding pseudoreplication would be to average your data across quadrats to get a single value for each experimental plot. Traditionally the blocks are considered to provide the replication, but this is lost if block and block x treatment are treated as a fixed factors. For a randomized full block design, block is typically treated as a random factor, treating the blocks as replicates of the experimental treatment, and in a least-squares approach, the block x treatment interaction would be used for the denominator MS. Of course the denominator df would be rather small in a design like this. I am not quite sure what is accomplished by treating the subplot as a random factor, but certainly it is not eliminating the pseudoreplication issue. I believe there are ways of estimating df for lme4 tests, and these should be presented, and I strongly recommend that the authors archive their data and r code as supplementary information. All this being said, this is a large-scale experiment, which commonly suffer from pseudoreplication, so I am not as concerned about pseudoreplication here as I am about the claim that pseudoreplication has been avoided. Figure 3. The legend should state what each point represents. I presume the ground-estimated AGB corresponds to one 30m x 30m plot. Page 7, line 6-7. I don't think is what you really mean to say. It is always true that the model including all factors and interactions will explain the most variance. Besides, Table 2 doesn't really show how much variance is explained. Page 8, line 18. It is stated here that the late burns had significantly less canopy than the unburnt, but no statistical tests were performed. Perhaps this conclusion is based on the non-overlap of error bars in figure 7. This should be clarified, and it is important to provide details on how these errors bars were generated. Page 9, Line 2. It isn't clear what "this study" is. Does it refer to the present study, to Murphy et al 2013, or to Fensham et al 2017? Figure 5. Are these relationships significant if you do not aggregate them by treatment? Presumably you have fire intensity data for each 1-ha plot, which would allow you to test this for a larger



number of true replicates. Page 10, Lines 1-3. Please be specific about what results from your study suggest this. Figure 6. Please provide more information about the data in this figure. Are these frequency distributions of the returns themselves, or are they a reconstruction of vegetation density that takes into account the fact that foliage high in the canopy has a higher probability of being detected than foliage low in the canopy. Also, figure 6 shows 1-D vegetation structure, not 3-D structure as indicated by the caption. Page 11, Line 3. Where do you show this correlation? You show a relationship with fire intensity, but I don't think you showed this for frequency. Page 12, line 3. This mention of herbaceous volume here raises a relevant point regarding the interpretation of your figures. In figure 7, do the data corresponding to 1-m above the ground correspond in reality to 0-1 m, or to 1-2 m, or to 0.5 to 1.5 m. When looking at figure 7, it wasn't clear whether grasses would be included in the lowest point. Page 12, line 12. I am not sure what minimal overlap means here. I don't think you are referring to overlap of individual trees, since you did not examine this. And looking at figure six, I would say that there is a lot of overlap in these distributions, since some distributions fit wholly within others.

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