Response to reviewer 1

1) For the relationship between canopy disturbances and rainfall, I am worried if it makes sense to mention the 99.4th percentile in the Abstract because it may sound like cherry picking, like why '99.4' and not '99.3'? The correlation seems to change a lot in between 98-99 percentiles which may be a sign that the correlation may be spurious and not causal (Figure 5b). Moreover, if you look to Figure 5a and remove for example the most frequent rainfall event, the relationship would likely fall apart. How is the correlation for lower than 90 percentile? If the correlation would be causal I think it would be expected much weaker or no correlation at lower rainfall percentiles

R: Thank you for pointing this out. We tested the analysis removing the highest canopy disturbance rate: the relationship remains significant and the highest Pearson decreases to 0.36 for the same 99.4th percentile. We also tested the correlations above the 80th percentile, and we found reduction in the Pearson values as the percentiles decreases, or even lose of significance (p-values around 0.1).
Following changes made in response to comments by reviewer 2, we have revised our analyses to use log-transformed data. The best predictor of temporal variation in canopy disturbance rates in the new analyses was the frequency of 1-hour rainfall events above the 97.7th percentile ($r = 0.48$). The residuals are better-distributed under log-transformation, and there is no longer any single point that exerts undue influence. (See responses to reviewer 2 for details of the revised analyses including the proposed revised figure.)
We propose to modify this sentence of the abstract to read: "The strongest correlate of temporal variation in canopy disturbance rates was the frequency of extreme rainfall events, here above 21.8 mm hour^{-1} ($r = 0.48$)."

2) I suggest authors consider adding a last paragraph of Discussion offering some advice for future studies, e.g. do you have recommendations for other researchers interested in replicating the experiments in other tropical forests, in regards to drone acquisition (camera, altitude, etc.), temporal frequency, etc. How would the replication of this study in other tropical forests help us understand the mechanisms better? This is a question to reflect and perhaps add something about these implications in this last paragraph. Some of these info is already scattered throughout the text but it could be important to have a concise paragraph on this.

R: Thank you for the constructive criticism. We propose to revise and expand the section on Conclusions and future directions section to address these points (new text in blue below; the entire section is given for context):

"A mechanistic understanding of the controls on woody residence time in tropical forests is urgently needed to predict the future of tropical forest carbon stocks and biodiversity under global change. Canopy trees account for a majority of the productivity and carbon stocks in tropical forests, and their fates are disproportionately important for determining stand-level woody residence time. Advances in drone hardware and photogrammetric software now make it relatively inexpensive and straightforward to quantify forest canopy structure and dynamics at high spatial and temporal resolution through digital aerial photogrammetry and repeat drone imagery acquisitions. Here we applied these methods to 50 ha of old-growth tropical forest for five years, and analyzed the resulting products to quantify major drops in canopy height such as those created by branchfalls and treefalls, and thus calculate the canopy disturbance rate. We found that canopy disturbance rates are highly temporally variable, and are well-predicted by extreme rainfall events. Spatial resolutions of 3-7 cm in the orthomosaics, as used here, are now easily attained, and proved sufficient to capture canopy dynamics and visually classify disturbances as treefalls, branchfalls, or decomposition of standing dead trees.

Future research building on these approaches and expanding them to additional sites has much to contribute to our understanding of tropical forest dynamics. The relationship of standing dead tree mortality to temporal climate variation could be investigated from these same data by conducting additional analyses of the orthomosaics to quantify temporal changes in leafing status of standing dead trees, prior to these trees decomposing. A better understanding of the relationship of storm conditions to treefall and branchfall rates could be obtained by combining such drone-acquired data with mechanistic models of wind damage risk (Jackson et al. 2020), collecting higher frequency three-dimensional wind data, and/or measuring canopy dynamics at even higher temporal resolution. The use of drones with high accuracy GPS systems, either post-processed kinematic (PPK) or real-time kinematic (RTK) systems, would also be advantageous, and could enable elimination of the alignment step of the processing as well as automation of the identification of canopy disturbances based on elevation model differences alone. Finally, we recommend carrying out flights under cloudy conditions when possible, as these diffuse lighting conditions improve visibility deeper in the canopy and reduce complications associated with shadows. The expansion of these methods to additional and larger areas, potentially in part through citizen science initiatives, has great potential to improve our understanding of tropical forest tree mortality, and the future of tropical forests under changing climate regimes."

3) In the Results/Discussion you say that you did not analyze the standing dead trees because you may miss those in your analysis. In the Abstract you suggest future studies of it. Perhaps in Discussion you could add some suggestion to better deal/analyze standing dead trees in future works.

R: Good point. We have included a sentence on this in the proposed new concluding paragraph, which we present in response to the last point.

4) L331-332, but did you find the effect of gap contagiousness? I was thinking about this when looking to the disturbances map, where lots of gaps were occuring nearby each other. Your data should allow you to test this hypothesis and likely is one of the best datasets around to do it.

R: We agree that our data provides a good opportunity to analyze gap contagiousness. We are analyzing this as part of another study we are conducting comparing patterns of canopy change between canopy gaps associated with treefalls vs. those associated with standing dead trees.

Technical corrections: L30, Strong -> robust?

R: Good point, we modified the wording.

L124, why put this in between parenthesis? it is useful infomation, should remove parenthesis

R: As suggested, we removed parenthesis. The text now reads: "We then pre-delineated major canopy disturbances by filtering for areas in which canopy height decreased more than 10 m in contiguous areas of at least 25 m^2, and that had an area-to-perimeter ratio greater than 0.6. We note that 25 m^2 is the minimum gap area used in previous studies of this site by Brokaw (1982) and Hubbell et al. (1999)."

L170, remove parenthesis – similar as before

R: As suggested, we removed parenthesis.

L172, what do you mean by "graphed"?

R: We propose to change the wording to "calculated".

L177, remove parenthesis – similar as before

R: As suggested, we removed parenthesis.

L182, remove parenthesis – similar as before

R: As suggested, we removed parenthesis.

L235, Figure 5, It is a bit strange to show Pearson's correlation r besides a linear regression, it may misguide for R2

R: We agree. Our proposed revised figure does not include the regression line. Our analyses are based on Pearson correlations rather than linear regressions, and are now on log-transformed data, following changes made in response to suggestions from reviewer 2.

L352, this information about the criteria should be in methods

R: This information is about the methods Marvin and Asner (2016) used in their paper, not the methods of our study. We propose to reword for clarity (red highlights changed wording):

"In contrast, a landscape level analysis of LiDAR data concluded that branchfalls were seven times more frequent than treefalls and accounted for five times more area (Marvin and Asner, 2016). However, Marvin & Asner (2016) classified branchfalls and treefalls based purely on the proportional decrease in canopy height…"