

## Response to Referee #1's comments

In preparing this revision, we have fully considered the reviewer's comments and have revised the manuscript accordingly.

L16: suggest cutting "as evidenced by the ....topics."

L17, L19: replace "advancements" with "advances"

L19: cut ", but are not limited to,"

L27: awkward, ambiguous wording: "disentangle their relative effects" to "disentangle their [separate and combined] effects"

We have made these changes as suggested by the reviewer.

L30 to 33: wordy, should be stated more succinctly

We have rephrased this sentence for succinctness.

L 36 to 80: I found the use of IAV in MODIS GPP to be a somewhat awkward fit for the papers in the issue. Furthermore, I suggest reducing much of the text from lines 36 to 80, and quickly getting to the content of the present special issue.

We have replaced the interannual variability (IAV) map measured by standard deviation with the map measured by the coefficient of variation (CV;  $CV = \text{standard deviation}/\text{mean}$ ). CV better measures the IAV of carbon fluxes. We have also added a figure of the number of extreme annual values (i.e., outliers) (listed as Fig. 2). We identified the outliers on a per-pixel basis using the Boxplot concept. An outlier is defined as an annual GPP value that is either larger than the 75% quartile + 1.5 \* interquartile range or smaller than the 25% quartile - 1.5 \* interquartile range.

L 41: "Some tropical regions (ie...)" is awkward, maybe "IAV is particularly high in tropical regions such as ..."

This sentence has been removed because of the replacement of standard deviation with coefficient of variation (CV).

L 62: This is a fairly general set up and is not specific to the papers of this issue. You might cut or shorten this section, not because it's incorrect or irrelevant but only because a special issue preview might be best to quickly get to the review of the papers therein.

We have retained this paragraph as part of the brief summary of the literature on this topic.

L 64: "long-term observations" is vague, lacks a citation as example, and the sentence structure suggests that EC is long-term.

We added a citation for "long-term observations": Turner, M. G., Collins, S. L., Lugo, A. E., Magnuson, J. J., Rupp, T. S., and Swanson, F. J.: Disturbance dynamics and ecological response: The contribution of long-term ecological research, *Bioscience*, 53, 46-56.

L 65: Why cite Dong et al. 2011? This seems unrepresentative.

We replaced this reference with a global-scale cross-site synthesis study (Schwalm et al. 2010).

L 89: poor sentence structure, maybe “We highlight the findings in this special issue by grouping manuscripts that emphasize ...”

We have rephrased the sentence as suggested.

L92 to 96: This is somewhat awkward, almost seeming to undermine the usefulness of the works that are presented. I’d recommend saving the comment about need for work on interactive effects for the discussion of future research directions. Also, L92-93 seems redundant with L27, and has the same issue raised above regarding “relative effects”.

We have removed these two sentences.

L 110: extreme low precipitation is a key facet of drought, not its opposite. Should this be modified to read “extreme [high] precipitation...” ?

Extreme precipitation events typically refer to exceptionally high precipitation events, and therefore we keep the use of “extreme precipitation events”.

L 111 to 115: The setup to this paper’s highlight seems to suggest that the study focuses on non-drought conditions. Why then does Line 114 note that soil respiration would decrease if soil moisture continued to decrease? The narrative reasoning is incongruous here and should be fixed.

We clarified that this study examined the response of soil respiration to both drought and extreme high precipitation.

L 120: Replace “positive” and “negative” with something clearer. What is a “positive” response of a biome? Is it higher GPP, higher Respiration, higher NEP, higher biodiversity?

We have rephrased the sentence to clarify that extreme precipitation is likely to increase aboveground net primary productivity (ANPP) of xeric biomes and to reduce ANPP of mesic biomes.

L 139 to 143: This statement does not seem to be justified. Winter and spring are not key seasons for metabolic activity in irrigated croplands so the leading statement about smaller effects on the overall annual carbon balance seems to be misleading.

We have removed this statement.

L 143 to 144: “Combined...” This comment about the importance of timing and magnitude does not appear to be a synthesis statement, pertaining to only one study of those highlighted in the special issue.

L 145 to 147: “[However], extreme temperature events occur[ing] in the growing season could substantially alter carbon fluxes, while those events occur[ing] during ...”

L 145 to 147: This statement seems to correct or more correctly state the one above (L139 to 143).

These two sentences are synthesis statements. We have listed them as a separate paragraph to avoid confusion. “occurred” has been replaced with “occurring”.

L 155: Include citation to: Ghimire B, Williams CA, Collatz GJ, Vanderhoof M, Rogan J, Kulakowski D, Masek JG (2015) “Large Carbon Release from Bark Beetle Outbreaks across

Western United States Imposes Climate Feedback”, *Global Change Biology*, doi: 10.1111/gcb.12933.

This citation has been added.

L 159 to 160: clarify “benefit of herbivory to undamaged trees” and also, does this include understory non-tree species?

We have rephrased the sentence as follows: This study also indicates that the residual forest and the understory vegetation contributed to carbon uptake and could enable the forest to return to carbon neutrality at a faster rate than clear-cuts.

L 161 to 163: It seems the study highlighted here only looked at MPB and if so, how could it suggest that the impacts of herbivore outbreak depend on the type of herbivore?

This study (Mathys et al. 2013) only examined MPB. This study along with previous studies indicated that impacts of herbivore outbreak depend on the type of herbivore and the intensity of disturbance. We have made this clear in the revision.

L 166: It seems redundant to include NEP and “carbon exchange between the land and the atmosphere” given that NEP typically includes CO<sub>2</sub> and that non CO<sub>2</sub> carbon-containing molecules are rarely emphasized and do not seem to have been emphasized in the studies included in this special issue.

We have deleted “carbon exchange between the land and the atmosphere” to remove redundancy.

L 166: It might make sense to clarify what is meant by “subsequent changes in NEP” by noting the relevant processes such as respiration of disturbance-killed biomass, and any changes to net primary productivity.

We have clarified that the changes in NEP are due to changes in GPP and ecosystem respiration of the remaining live stand and the heterotrophic respiration of the damaged biomass.

L 173 to 174: Check the units on your trend, which should be Tg C yr<sup>-1</sup> yr<sup>-1</sup>... 8 to 18 Tg C yr<sup>-1</sup> is pretty big. Should this be over an interval of time?

The units are correct. This is a global-scale study. The rate of decreasing net carbon balance before the 1970s of the 20<sup>th</sup> century was estimated to be 8 Tg C yr<sup>-1</sup>, and the increasing rate was 18 Tg C yr<sup>-1</sup> during the remainder of the 20<sup>th</sup> century.

L 207: The geographic domain of the Zhou et al. study should be reported. Was it global? Was it in North America or Europe? The Amazon? The quantitative figures reported must be region specific.

This is a global-scale synthesis study. However, the sites are mainly distributed in North America and Europe. We have described this in the revision.

L 220 to 223: this statement is very general and does not offer much in the way of findings.

We have rephrased the statement.

L 222: “vulnerable” seems to be an odd term. All forests would be vulnerable only some are targeted because of economic value and modes of production.

We have rephrased this statement.

L 224: This heading “time since disturbance” does not appear to be a good fit for the studies highlighted below. You might think about a different heading / grouping.

We have changed the heading to “Disturbance legacy”.

L 228: “near the site” is vague and unclear.

We have changed “near the site” to “at the site”.

L 230: This paper does not seem to belong under the heading “Time since disturbance”. Can it be better linked to the flow of the preview?

This paper examines vegetation recovery following fire disturbance and thus fits into this section.

L 232: Replace “found” with “supported the notion that”. This is not a new finding, really, and is model based, so it seems somewhat out of place to state that it was “found”.

We replaced “found” with “supported the notion that”.

L 234: Maybe connect these sentences... “carbon sink conditions, highlighting the importance of ...”

We did not combine these two sentences because of the length of the combined sentence.

L 239 to 245: suggest cutting this paragraph. It seems out of place and is redundant with things already mentioned elsewhere, including an earlier highlight of the Wang et al. 2014 study. It has a discussion of its own with citations to works outside of the scope of the special issue and thus seems out of place.

This paragraph has been removed as suggested.

L 252: which two? Wang et al. is not described as supporting this statement, so the statement seems to apply only to the Bond-Lamberty et al. 2015 study.

We have clarified that this statement only applies to Bond-Lamberty et al. 2015.

L 256: Should there be a new heading here? Maybe “Challenges and Opportunities”?

This paragraph does not include discussion on extreme climate events, and therefore we have decided to keep it as a part of the *Disturbance legacy* sub-section.

L 265: “conforming” to “confirming”

L 274; “will likely help” to “are helping to”, and cite (e.g. Williams et al. 2014). Williams CA, Collatz GJ, Masek J, Huang C, Goward S (2014) “Impacts of disturbance history on forest carbon stocks and fluxes: Merging satellite disturbance mapping with forest inventory data in a carbon cycle model framework”, *Remote Sensing of Environment*, 151:57-71, <http://dx.doi.org/10.1016/j.rse.2013.10.034>.

These changes have been made.