

Biogeosciences Discuss., referee comment RC2  
<https://doi.org/10.5194/bg-2022-178-RC2>, 2022  
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## **Comment on bg-2022-178**

Anonymous Referee #2

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Referee comment on "Carbon cycle extremes accelerate weakening of the land carbon sink in the late 21st century" by Bharat Sharma et al., Biogeosciences Discuss.,  
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The paper investigates extremes in NBP based on CESM2 simulations. It uses a rather rough spatial resolution - the 26 SREX regions - and monthly timesteps. No comparison to observations are used (taken for granted that CESM2 historical runs represent "reality" faithfully) and considers only a single scenario - SSP5-8.5. These two are severe limitations for the paper; in particular, extreme events are likely to be very sensitive on both model and scenario choice. Only at the end is an opening for multi-model and scenario runs, but they are strongly recommended already for this paper.

The authors do a good job in preparing the input, i.e. the calculation of anomalies, by taking out the annual cycle using SSA. The reviewer isn't that happy with the decision to define every SSA component with a dominant period > 10 years as "nonlinear trend". This is arbitrary and contrary to our knowledge of long-term cycles in observations, e.g. of Sea Surface Temperatures.

Another issue is while it is true that responses to climate drivers may vary over short time scales ("daily to monthly", l. 55) and CMIP6 simulations are available at daily scales, it is surprising that the authors nevertheless use monthly data only, depriving them from any conclusions on these shorter scales.

The explanation of compound events and in particular the concept of mutually inclusive / exclusive is confusing. It should be rephrased and in particular simplified.

Some specific comments:

l. 194: change LULUCC forcing from decadal to annual and back to decadal: do you mean

in the model? If so, the net carbon uptake change would just be an artefact of the model setup, which would be embarrassing since no proper conclusions (also for the other 25 year periods) could be drawn.

I. 207: "global anomalies": are you sure - the NBP TCEs are surely based on each SREX regions separately? It wouldn't make sense to put thresholds for anomalies worldwide, since some regions would have anomalies all the time, and others never.

I. 249: "Hot temperatures that persist for long periods induce heatwaves" - isn't that the very same? Remove the tautology in that case.

I. 264: "Reduction of fuel load by changing vegetation composition...": who does change the composition? In the model? The SSP5-8.5 is the "business as usual" scenario where no (major) changes (like e.g. forest restructuring) is foreseen. Also, not every change in vegetation composition reduces fuel load. What do you imply here?

I. 312: "enhancing stomatal closure and ecosystem respiration": this is a contradiction. It is possible that plants' response to increased CO<sub>2</sub> offer is a partial closing of the stomata, leading to sink saturation, but at the same time, this REDUCES respiration, i.e. the opposite.

There are more detailed comments and suggestions to changes in the attached pdf, please consider these as well.

Preferably, the paper should be enlarged in scope by including additional models and scenarios, leading to a major revision. If this is not an option, the other changes required are more of "minor" character.

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2022-178/bg-2022-178-RC2-supplement.pdf>