

Biogeosciences Discuss., referee comment RC1
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Comment on bg-2022-178

Anonymous Referee #1

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.,
<https://doi.org/10.5194/bg-2022-178-RC1>, 2022

In this manuscript, the authors assessed the impacts of climatic extremes on terrestrial carbon budget, based on the simulation with the CESM2. They analyzed top-5% extreme net biome production (NBP) through historical to future periods, and showed an increasing trend of negative extreme NBP, especially in tropical regions. They attributed the trend to factors and found that compound hot, dry, and fire events had a strong impact.

General comments

This study is well focused on detection and attribution of the impacts of extreme conditions on terrestrial carbon budget, such that the trends of extreme-related carbon budget shown in Figure 1 look convincing. The prevailing impact of soil moisture is reasonable, although it could not be independent from precipitation variability. Several results of regional anomalies and dominant factor were remarkable for me. For example, large loss of NBP in East Asia, as much as 3 Pg C (Figure 3), is surprising, because this region is outside of the tropics. Also, I was impressed by the strong impacts of fire on NBP anomalies in many tropical to temperate regions (Fig. 4).

As stated by the authors, this study used only one model (CESM2), and then uncertainty associated with multiple models were not included. I guess that the authors could analyze output data of other models in the CMIP6, but I agree that this remained for forthcoming studies. Similarly, I felt a bit uncomfortable about the use of sole SSP585 result, because this scenario itself is a kind of extreme case. Nevertheless, I found merits in this study and recommend major revisions.

Specific comments

Line 1: Abstract. Please give a short sentence explaining methodology used in this study.

Figure 2: I guess that this figure shows total NBP for each region, i.e., not only extreme NBP but also NBP of usual conditions.

Line 233: I agree with the mechanism but am unsure whether CESM2 has corresponding root structure.

Line 248: Again, I am unsure how CESM2 simulated the post-fire recovery.

Line 316: Why Southeast Asia showed such high (much higher than Amazon and Africa) negative sensitivity to temperature? Please explain the underlying reason.