

Biogeosciences Discuss., author comment AC3
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Reply on CC1

Bharat Sharma et al.

Author 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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Dear authors,

this is a very interesting study exploring how the balance between positive and negative extremes in NBP shift over time and how these shifts are related to different driving mechanisms. We have done something very similar while back using CMIP5 data and found the opposite result, see Fig. 3 in Zscheischler et al., 2014. The methodology is slightly different -- we focused on large spatiotemporal contiguous extremes and used a suite of different models -- but I was wondering whether you could comment on these differences and possibly offer some hypotheses for an explanation. As far as I can see, the data preprocessing is quite similar.

Best regards,

Jakob Zscheischler

Reference:

Zscheischler, J., Reichstein, M., Buttler, J. von, Mu, M., Randerson, J. T., and Mahecha, M. D. (2014), Carbon cycle extremes during the 21st century in CMIP5 models: Future evolution and attribution to climatic drivers, Geophys. Res. Lett., 41, 8853– 8861, doi:10.1002/2014GL062409.

Response: Dr. Zscheischler, thank you for your comment. I agree with you that most of the preprocessing steps are similar to Zscheischler et al. (2014). While Zscheischler et al. (2014) found that over time, the strength of positive carbon cycle extremes becomes larger than negative carbon cycle extremes, we found the opposite in our analysis for CESM2. There are a few possible reasons for these differences:

- There are other negative fluxes in NBP (investigated in our paper) that are not in NEP (investigated in Zscheischler et al. (2014)), e.g. carbon loss due to fire. And we found fire is an increasingly dominant driver of carbon cycle extremes.
- We have analyzed NBP extremes from CESM2 which is part of CMIP6 and Zscheischler et al. (2014) analyzed NEP using CMIP5 ESMs. Assuming the variability in NBP and NEP extremes is comparable across successive generations of CMIP ESMs, the ratio of negative to positive extremes from our study fall within the multi-model spread of relative strengths of that ratio shown in Figure 3 of Zscheischler et al. (2014).

- We looked at all extremes however Zscheischler et al. (2014) focused on the top 100 spatiotemporal extremes. A few large isolated negative events if not accounted for in spatiotemporal extremes could also contribute to underestimating the magnitude of negative extremes in Zscheischler et al. (2014).