

***Interactive comment on* “Examining the sensitivity of the terrestrial carbon cycle to the expression of El Niño” by Lina Teckentrup et al.**

Anonymous Referee #2

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In this manuscript, Teckentrup et al. used LPJ-GUESS forced by manipulated climate datasets to study the influences of two expressions of El Niño (CP and EP) on the terrestrial carbon cycle. The authors suggested that the expressions of El Niño only influence interannual variability of NBP (e.g. CP caused larger IAV in NBP than EP at the global scale) but not the long-term change in NBP. They concluded that the relative frequency of CP and EP is not critical in models as CP/EP did not yield detectable changes in long-term NBP. The science question is interesting, the story is well told and there is no major flaw in the method. That being said, there are a few questions that puzzled me after reading the manuscript, which I hope the authors could clarify a bit before I could support it.

1. One of the novel points presented is that “impact (of CP and EP) on longer

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timescales is not well understood". El Nino, either CP or EP, is known to dominate the interannual variability of terrestrial carbon cycling. It is not clearly stated in the Introduction why we would expect an influence of CP/EP El Nino at longer timescales in the first place. In another word, would it be a surprise that CP/EP El Nino exert no change on long-term NBP, as we already know that El Nino influences IAV rather than long-term variability of the carbon cycle. Perhaps the relative more frequent CP occurrences in the future could be an issue long term but the current models may not include proper mechanisms (i.e. shift in species composition, acclimations) to answer the question.

2. The study is aimed at studying the sensitivity of the terrestrial carbon cycle to CP/EP El Nino. And the author did so by replacing the climate anomalies during CP to EP and vice versa. CP is reported to cause larger global IAV than EP. My concerns is: (using global simulation as an example) is this larger sensitivity of the terrestrial carbon cycle to CP is due to the changes in the inherent climate sensitivity of carbon during CP/EP, or is this simply caused by the generally larger climate anomalies during CP (Fig. B5). I would assume the reason is the latter, as the inherent climate sensitivity of carbon cycle is essentially predefined by the model (in this case LPJ-GUESS) structure, so what we see here (IAV of NBP in CP > EP) is perhaps just because the IAV of climate in CP > EP.

3. missed chance on the spatial and phenology of carbon fluxes. While I have doubts about the reported difference between CP and EP at interannual or longer time scales, I feel their difference is perhaps more pronounced at seasonal scales and spatial, when CP and EP show apparent contrasting temporal patterns (e.g. Fig 1). As was also noted by Clylek et al. 2018, the time delay of CO₂ rise after SST increase is one of the pronounced differences, and the difference is only around 3 months. Focusing on longer time scales might easily just averaged out these important characteristics. I think the authors have done a nice job in demonstrating the spatial difference of carbon sinks under CP/EP, and these results perhaps worth more highlights. With that, I would

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also say it maybe a stretch to say CP/EP is not critical in future models, as their major difference is likely to be clearer seasonally and spatially (e.g. different carbon sink distribution, phenology of carbon uptake).

Some minor issues:

L11. Please specify what kind of longer time scale effect (i.e. decadal mean, decadal variation or trend?) L84 and L104. If CRU-NCEP v7 covers 1901-2016, why not consider the 2015/2016 El Nino in the analysis. L84. By saying CRU, did you mean CRU-NCEP. L119-120. I am not sure I understand how to choose the replacements for CP and EP correctly. Why there is a need to resample climate anomalies using ONI and how do we locate the CP that is used to replace a EP (in the same 10-year window shown in Fig 1?). L210. Does LPJ-GUESS have a component to simulate species composition? B1-B4: Unit of carbon fluxes in supplementary figures. Per m2?

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