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Earth System Dynamics
Discussions

Interactive comment on "Contrasting terrestrial carbon cycle responses to the two strongest El Niño events: 1997–98 and 2015–16 El Niños" *by* Jun Wang et al.

Anonymous Referee #2

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The response of terrestrial carbon cycle to ENSO has been a hot topic for terrestrial carbon cycle community for a long time. Most of the earlier studies focus on the general responses built on an ensemble of ENSO events. However, it is clear that each ENSO is different, and therefore, their resulting response from the terrestrial ecosystems is expected to differ. Yet, such event-based case study is lacking in literature is due to the lack of appropriate data constraints. Thus I believe that Wang et al. paper has the potential to complement current literature.

But my major concern regarding this paper is the data constrains they applied. The authors need to confirm their readers that atmospheric CO2 growth rate can provide

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constraint on a single event, and on small regional scales. The authors have shown that VEGAS is highly correlated with atmospheric CO2 growth rate, however, this does not ensure that VEGAS can capture net CO2 flux anomalies from a single event. For example, a recent study on ERL by Fang et al. found that mechanistic models can capture ENSO response fairly well when all years are considered, however, they all have some issues when considering only El Nino or La Nina years. It is ok to use VEGAS to explore the driving mechanisms; however, some caveats are needed.

I agree with the other reviewer that statistical significance tests for anomalies, composites etc are needed, which may help strengthen the paper (i.e., Figure 2,3,4 etc).

I also agree with the other reviewer that it would be good to check whether seasonal evolution of climatic drivers, GPP and Respiration matter.

My other comment is about the fire emissions. The authors mentioned that FTA anomaly is 1.95 Pg C per yr during 1997-1998, while is 0.8 Pg C per yr during 2015-2016 (that is, 1.1 Pg C per yr difference between two events). In their paper, they showed that the difference of fire emission of CO2 from GFED is 0.82 Pg C per yr between these two events, so fire emissions only can explain 70% of the difference between two ENSO events, is this correct? Is it fair to conclude that fire emission dominates the difference and thus explore why fire emission differs in the paper?

Detailed comments: 1. abstract: seems to be too long, and has two paragraphs. Better to shorten it. 2. I wonder if “two strongest El Nino events” used in the title and throughout the paper is appropriate. First, two strongest events are defined only since 1980, right? So it is not in history. Second, how to define how strong an El Nino is depends on which aspects you talked about. I would probably just use two strong El Nino events or two extreme El Nino events instead to make the statement more accurate. 3. Explain somewhere early in the paper that positive sign of the cartbon fluxes discussed here means to the atmosphere. 4. Introduction: There are actually more observation-based studies that argue temperature is more important driver. While many of the paper cited

here in Line 78 are mostly model-based results, and models have be shown to overestimate the role of precipitation (see, Piao et al., 2013 and Fang et al. 2017) . 5. Introduction: line 86, here “sensitivity analysis” is not the right word and is misleading for this paper (wang et al., 2013), I think this number is the slope based on regression analysis. 6. Results: Line 184-185: it is true that models can capture the general response to ENSO with a moderate correlation coefficient. However, a recent ERL study shows they have problem in capturing response to El Nino vs Response to La Nina. 7. Results: line 196-197, why use the mean of CAMs and MACC? 8. Figure 2c and 3d, why there appears to be two strong peaks for the inversion?

References: 1. Piao et al 2013 http://onlinelibrary.wiley.com/doi/10.1111/gcb.12187/ 2. Fang et al. 2017 http://iopscience.iop.org/article/10.1088/1748-9326/aa6e8e/

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