Interactive comment on "Abrupt seasonal transitions in land carbon uptake in 2015" *by* Chao Yue et al.

Anonymous Referee #1

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The article "Abrupt seasonal transitions in land carbon uptake in 2015" by C. Yue and coauthors presents a detailed analysis of anomalies in carbon sinks and sources, climate and vegetation greenness during recent decades with an emphasis on the year 2015. Understanding the carbon cycle and its interaction with climate change is a highly relevant research topic, and the authors refer to state-of-the-art literature and datasets. The authors combine a number of observational datasets and model results, and my impression is that their methods and results are sound. The description of the work steps is clear and the data sources are well documented. In this regard, the article is good at what it does.

My major concern however is that it remains unclear what the authors are trying to achieve with this article. I would guess that the results might tell us something about how climate affects vegetation and the carbon cycle. What do the results imply about

the relevant processes, about past climates and potential future developments, or about our potential to model these processes? The authors address such questions only briefly in the last paragraph of Sect. 4 and in the very short Sect. 5, stating that they go beyond the scope of the article.

I also wonder why the authors focus so much on the year 2015. What is so special about this year (apart from being relatively recent) that would justify this focus, and what can we learn from this case study that is valid in a greater context? If there is something I am overlooking, I suggest that the authors reframe their article to bring out their message more explicitly, and that they stress what the progress is compared to previous articles. I believe that this would improve the impact of their article. For example, the authors could systematically relate anomalies in climate, carbon fluxes and NDVI using the whole record, and not only focus on 2015. They should also consider to include the year 2016 (if possible) to capture the full recent El Nino event. It appears a bit arbitrary that they pick the year 2015 and one other previous El Nino event for their analysis, using the rest of their data only to calculate linear trends. A more comprehensive statistical analysis of the available data might allow more general conclusions without the need of running climate models.

So far, the main selling points of the paper seem to be

(i) the (arguably) counterintuitive combination of high NDVI and negative carbon uptake anomaly

(ii) large anomaly of the year 2015.

Regarding (i), I find it little surprising that greening and carbon loss (or a reduced carbon sink) can go together since both anomalies can be dominated by different locations and different seasons, and because they are not linearly related given the complex ecological processes involved. The authors point this out themselves, hence invoking a "paradox" seems a little exaggerated to my taste. (But I would be curious if this anti-correlation is a temporal feature or a robust trend that can be expected to continue in

the future; something the authors might choose to give more attention to.) Regarding (ii), I find it misleading to speak of an "abrupt transition" (title, abstract and line 263+). This term gives the impression of a singular event with long-lasting consequences, like a forced non-reversible switch to another state or regime. However, the phenomenon discussed in the paper appears to be an anomaly that is the realisation of natural variability, hence an extreme but temporal event. This comes on top of a gradual trend to larger growth rates, so the year 2015 will most likely not be unique. In fact, the atmospheric growth rate of CO_2 in 2016 was even higher than in 2015. I therefore wonder whether the term "abrupt transition" is useful here, and would suggest a more suitable term, e.g. the land carbon uptake anomaly in 2015. I therefore also strongly suggest a change in the paper's title.

Minor comments

- line 85-86: "We used ... includes"

- line 89: What is a validity period, and in what sense are the other years are not valid?

- line 108: Why do the authors pick MAI to characterise the ENSO state?

- line 141-148. At the first reading I did not understand the role of the "historical trend" for the growth rate in a given year. I understand now that specific anomalies in 2015 are later related to climate anomalies, with anomalies being defined as residuals after removing a linear trend. The reasoning behind this could be explained more explicitly here.

- line 201: both instead of bother

- line 136: It would help non-experts to briefly explain how the sources and sinks are quantified in the GCP. How independent is this dataset from the inversion calculations?

- Sect. 2.2.1: It would help me to already see time series and a map as a visualisation of the rank analysis. I understand the structure of the paper and find it reasonable, but it could make sense to merge the data analysis section 2.2 with Results Sect.

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3. Otherwise, one has to read the methods section without visualisation, and later remember each methodological detail when the results are shown. This is a matter of taste and I leave it to the authors to reconsider the structure.

- line 226: "the seemingly paradox" is grammatically wrong.

- line 350: data suggests (not suggest)

- Supplementary Material: I suggest to put captions underneath (not above) the figures and increase the space between the figures. There is too much space between the caption of Fig. 2 and Fig. 2. These things make it difficult to identify the right caption for each figure.