Responses to editorial comments

Thanks so much for these additional remarks. This study builds on our recent previous studies, so we perhaps relied too much on that material in this study. We have now addressed that point with additional text, as suggested. Except for a few points (highlighted below), we have addressed all the comments. We have tracked changes from the previous (clean) version of the manuscript we uploaded so you can see what we have changed based on your comments. We have also revised Figures 4 and B3 so the labels are consistent with the variable names used in the text.

General comments:

One major point of criticism I have is that I find it quite difficult to follow what actually has be done and how. Since you have several papers published using the same method important details are omitted. Just writing this is a well established method and then listing a bunch of papers is not enough. You cannot expect every reader or referee to read 4 or 5 additional papers. I had quick look through them and found that the Feng et al. papers provide some more information on the method. I would appreciate if the most important points about the used method could be repeated in this manuscript with clearly referencing the corresponding papers at the respective places so that the reader knows where the more detailed information is provided.

Fair point. We have now included some text that describes the methodology, including references.

What also became not clear to me (being a non-expert on this topic) is if all figures show model data or are in some figures also pure measurement data shown? Has one model experiment been used and shown or have here several different model runs been used and shown.

The figures show *a posteriori* CO_2 flux estimates *inferred* from data and the ensemble Kalman filter (EnKF) or data, as described in the captions. All figures in the study use the GEOS-Chem model and the EnKF with the same set of in situ and OCO-2 data. The figures shown in the main part of the paper use the same set of emission inventories and meteorological analyses. In Appendix B we describe sensitivity experiments in which we use different inventories, different meteorology, and different types of data.

I also had trouble understanding how you came to your conclusion based on your results. Also here, I have the feeling that a lot of important information is missing. So please have a careful check through the manuscript and add what is missing.

We have now highlighted the figures needed to follow our argument. There was a missing piece of information. The moderate El Nino event led to an outsized impact on CO2 fluxes over the Amazon basin because this region was already subject to extensive drought that other studies have attributed to changes in climate. This is now clearer and we have included the appropriate reference (Clarke et al, 2024).

Specific comments:

Unless otherwise stated, we have addressed all the comments raised. We have used highlighted text to emphasise the points with which we respectively disagree.

P1, L25: Add OCO-2 in parentheses after Orbiting Carbon Observatory

P3, L82 and throughout the manuscript: Section should be abbreviated as “Sect.

” unless it appears at the begin of the sentence.

P4, L102: Time period somewhat lost here. Is that the time period of the measurements considered? What is the time period for which the model run has been made? Has here only one model run been made/considered for this study or several?

P4, L110: Abbreviation JPL-ACOS should be introduced.

P4, L120: Abbreviations of well-known institutions like NOAA (and also in the abstract NASA) may be

introduced as well.

P4, L122: Either add the abbreviation “GPP” in parenthesis or write “gross primary productivity”

,

using small letters as first letters.

P4, L124: Add “at”

-> available globally at a spatial…….

P4, L126: Add “of CO2” after “annual mean global total” to be more clear.

P5, L131: Add “GRACE” in parentheses after “experiment” or write “recovery and climate

experiment” (using small letters as first letters).

P5, L139: Reanalyses -> reanalyses

P5, L140: Better to use a small s as subscript than writing “TS”?

P5, L134, L142 and 155: Remove comma after “et. al.”

.P5, L136: Introduce abbreviations.

P5, L153: ppm/year -> ppm year-1 (write units according to the Copernicus style, see manuscript

preparation guidelines)

P5, L157: Add “TCCON” in parentheses after “Network”

P6, L175: 2015/2015? You mean 2015/2016?

P6, L183: remove comma after et a.

P6, L190: Abbreviation “SIF” should be introduced.

P7, L195: Add “the” and “of” so that it reads “describe the large-scale changes of CO2 fluxes”

P7, L198: Don’t start a new sentence with “And”. Please rephrase.

P7, L201: dynamic -> dynamical?

P7, L207: Before the surface temperature was introduced as “TS”, not it is only “T”. Use a consistent

naming throughout the manuscript.

P7, L225: What is meant here with the time period? In this sentence this does not make sense. I

would suggest to mention the time period considered already at the begin of the paragraph where

Figure 5 is described.

P8, L226: Concluding Remarks -> Conclusion

Note, the conclusion is too long. I would suggest to split this section and to have a discussion or summary section and a short conclusion section where the major findings and implications are summarized.

We have used concluding remarks for several of our ACP papers, which merges a succinct conclusion with a summary discussion, including some comments on previous work and the wider implications of our study. We have appreciated this level of editorial

freedom in the past with ACP, which allows the reader to absorb the key points and wider implications of the study in one section.

P8, L231: Further examination of what? Please be more clear.

P8, L231: “foci”

-> please rephrase.

P8, L240: Could you please refer to the respective figure or section of the manuscript?

P8, L251: change -> change of

P8, L254: In 2023 appears twice in the sentence, one is obsolete and should be removed.

P9, L261: remove comma after e.g.

P9, L266: over temperate North America not clear, please rephrase. Why “temperate”? Why not just over North America?

We also have boreal North America (see Figure B2, for example). This nomenclature is defined in the TransCom-3 experiments (for comparing top-down flux inversions) and is used widely in this field to separate it from ‘Boreal North America’ .

P9, L267: ppm/yr -> ppm yr-1. Note, before your wrote year, now it is yr. Please use a consistent

writing of units and check the ACP guidelines if it should be yr, y, or year.

P9, L279-280: I have difficulties to follow you here. Why does a moderate El Nino cause extensive droughts? Why does it have now a severe effect, But not in earlier years?

P11, Reference of Baker et al.: The half of author names is written in capital letters. Please correct to

normal writing (names starting with capital letters and the rest with small letters).

Figures: Add a full stop after the figure number.P21, L577: Rephrase “Number shown inset”

We weren’t sure what you meant this. “Number(s) shown inset of each panel…” makes sense.

P27, Table A2 caption: The time period is a bit lost year. Write it that way that it is understandable

what time period is considered.

P28, Table B1: To my knowledge in printed ACP papers bold text is not allowed. You need to find an other way to emphasize this.

We are sure about this. In any case, we have underlined text. We will explore this with the copyeditors. Our preference would be bold text.

P28, Table 1 caption: Full stop at the end of the sentence is missing.

P28, L613: Also here the abbreviations need to be introduced.

P29, Figure B1: Replace colon after figure number with a full stop.

P29, L637: PgC/yr -> PgC yr-1

P30, Figure B2: Decrease figure or font size. Note, all figures should be prepared in a similar style.

P30, L544: NBE has already been introduced in the manuscript.

P30, L647: Abbreviations “EVI” and “GOSIF” should be introduced.

P31, Figure B3: Replace colon by full stop after figure number and write either Pearson correlation

coefficient or put r in parentheses.

P32, Table B2: There is a lost opening parenthesis. Is here the header line missing? Or is that here

the continuation of the table from the previous page? Please take care that tables are appear

correctly in the manuscript.

P33, L676: Remove text “taking advantage to access to the necessary data during the review

process”

. There is no need to point out what has been done based on the referee comments.

P33, L670: “with loci”? Please rephrase.

P34, Figure C2: Replace colon after Figure number with a full stop and decrease figure or font size

(see my comment on this further above).