Referee #1:

We would like to thank the anonymous referee for his/her comprehensive review and valuable suggestions. These suggestions help us to present our results more clearly. In response, we have made changes according to the referee's suggestions and replied to all comments point by point. All the page and line number for corrections are referred to the revised manuscript, while the page and line number from original reviews are kept intact.

Referee: General comments. The authors make contribution to an under-explored topic of understanding differences between the global fluxes estimates based on GOSAT and OCO-2 satellite observations of atmospheric carbon dioxide. By applying same inverse modeling system, same prior fluxes and inverse modeling setup, and using retrievals made with a very similar algorithm, they constructed a good base for comparing performance of the GOSAT and OCO-2 data in application to a problem of quantifying regional carbon fluxes. The study has a potential to contribute to an important problem of understanding the global carbon cycle response to 2015 El-Nino climate anomaly, by providing the alternative views to the phenomenon from the 3 independent observing systems. Although most of important work is already done in this study, more analysis and possibly more extra model runs are required to arrive at robust conclusions, as there is still inconsistency between global annual terrestrial flux estimates made with different observing systems, that should be addressed and elaborated. The study should benefit from giving authors extra time for making necessary revisions.

Response: We appreciate the referee's suggestion on conducting more model runs and addressing the inconsistency between global annual terrestrial flux estimates from different observing systems. During this revision, we have run two more inversions based on the comments from another referee. In the revised manuscript, in order to make the comparison between satellites based inversions and in situ observations based inversion more consistent, we remove the comparison with CT2016 results, and conduct an inversion using in situ measurements so that we don't have to deal with the differences in transport models and inversion settings between this study and CT2016,

which might compound the comparisons. We also conduct a poor man's inversion to a benchmark (Chevalier et al., 2009), against which more robust evaluation of posterior flux from other three inversions can be made.

To investigate the inconsistency between global annual terrestrial flux estimates from different observing systems, we add evaluations for the satellite XCO2 retrievals using TCCON retrievals and simulated CO_2 field as a reference. We found that even with bias-correction applied, both GOSAT and OCO-2 XCO2 retrievals still have relatively large biases. The distinctive differences between GOSAT and OCO-2 data could result in quite different annual global terrestrial land flux estimates.

We have updated the manuscript with new experiments results and more detailed analysis in the revised paper.

Specific comments.

Line 1: Title can be simplified to "Terrestrial ecosystem carbon fluxes estimated using GOSAT and OCO-2 retrievals."

Response: Thanks for this suggestion. The title has been simplified to the suggested one. See lines 1-2 in the revised manuscript.

Line 66: OCO-2 observations have lower random noise compared to GOSAT, but it is not related to vertical difference in sensitivity. Generally, SWIR observations by both sensors have flat sensitivity to CO_2 from the surface to the upper troposphere, thus citing sizable difference between GOSAT and OCO-2 in sensitivity to lower troposphere concentrations requires elaboration, giving more details. Suggest to replace "higher sensitivity near the surface" by "higher sensitivity to column CO2".

Response: Many thanks for this suggestion. "higher sensitivity near the surface" has been replaced by "higher sensitivity to column CO_2" as suggested. See line 66 of the revised manuscript.

Line 171: It is useful to elaborate on application of scaling factors to carbon flux – are those factors applied to total carbon flux in each grid or separately by each optimized

component.

Response: We have added "The scaling factors are applied to each carbon flux components to be optimized monthly in each model grid point." in the first paragraph of Section 2.3.3. See lines 176-177 of the revised manuscript.

Line 237-240: The differences between net flux for 2015 should be related to different atmospheric CO2 growth rate between ground based (also used used in CT2016), GOSAT and OCO-2 observations. Suggest to add those atmospheric CO2 growth rate estimates to comparison, along with inversion-optimized posterior growth rate for all experiments. If the difference between observed ground-based, GOSAT and OCO-2 growth rates is not as much as appears in the inversion results, the inversion setup should be adjusted to provide sufficient constraint on fluxes, so that the growth rate in the inversion optimized simulation matches the observed growth rate.

Response: The differences of net flux are indeed related to the different atmospheric CO_2 growth rate between different observing system. However, as shown by Figure 1 in the manuscript, satellite retrievals are unevenly distributed spatially and temporally, which makes it difficult to estimate global atmospheric CO_2 growth rate accurately. We have evaluated the uncertainties of the two satellite retrievals using TCCON retrievals, which might better explain the differences of inverted net flux.

For details, please refer to Lines 379 to 391, page 20 in the revised manuscript.

Technical corrections

Line 26: Suggest to spell out CT2016 as Carbontracker 2016.

Response: As suggested by another referee, to make the comparisons between different observing systems more consistent, we have replaced CT2016 results with estimates from in-situ observations using our inversion method.

Line 43: Need to add "et al." to Chevallier 2007

Response: We have added "et al." to that reference. See line 44 in the revised manuscript.

Line 54: Note that in Takagi et al 2011 only flux uncertainty and uncertainty reduction are estimated, not the fluxes themselves.

Response: Thanks. We have removed "Takagi et al., 2011" from the reference. See line 55 in the revised manuscript.

Line 82: Reference to GEOS-Chem adjoint is needed here.

Response: The reference "Henze et al., 2007" has been added. See line 82 in the revised manuscript.

Line 105: Replace "Before used" to "Before being used" or "Before using"

Response: We have changed "Before used" to "Before being used". See lines 106-107, page 5 in the revised manuscript.

Line 212: Add period in Single et al, 2011

Response: We have done the revision. See line 215 of the revised manuscript

Line 219: Uncertainty is assigned to ocean flux, while it was stated that only terrestrial fluxes are not optimized on

Response: Actually, ocean flux has also been optimized in our inversions. We have added "Both terrestrial ecosystem CO_2 exchanges and ocean flux are optimized in our inversions" in Lines 212-213 of the revised manuscript.

Line 209-210: Need to make the text consistent.

Response: Yes, we have made it consistent. we have added "Both terrestrial ecosystem CO_2 exchanges and ocean flux are optimized in our inversions" in Lines 212-213 of the revised manuscript.

Line 256: Change 'priori' to 'prior' here and further in the text.

Response: Thanks for pointing out this error. We have checked the manuscript and changed all inappropriate "priori" to "prior".

Line 275: Reference is missing.

Response: The missing reference "Gurney et al., 2002" has been added. See line 294, page 14 in the revised manuscript.

Line 523: Suggest correcting "Bron" to "Breon"

Response: We have corrected "Bron" to "Breon". See line 540, page 27 in the revised manuscript.

Reference:

Chevallier, F., et al. (2010), CO2 surface fluxes at grid point scale estimated from a global 21 year reanalysis of atmospheric measurements, J. Geophys. Res., 115, D21307, doi:10.1029/2010JD013887.