Comment on essd-2022-15
Anonymous Referee #1


This study presents an NEE dataset based on flux inversion analysis that assimilate 10 years of ACOS GOSAT v9 XCO$_2$ retrievals. To my knowledge, this is the first published flux dataset using the full ACOS GOSAT v9 XCO$_2$ retrievals and believe it to be a significant contribution to the community. I find that the dataset is well described and evaluated, and recommend publication after addressing several generally minor comments.

My most significant comment is that the atmospheric growth rate reported here seems to deviate substantially from that reported by GCP2020. From line 227 it is stated that the bias (GCAS2021 minus GCP2020) is 0.25 PgC/yr. Over the 10 year inversion, this amounts to 2.5 PgC or 1.2 ppm (using 1ppm/2.086PgC from https://acp.copernicus.org/preprints/12/C8465/2012/acpd-12-C8465-2012.pdf). I would expect such a difference to be evident in the comparison against independent CO2 data (which does not appear to show this bias). It would be useful to also compare the growth rate with that reported by NOAA (https://gml.noaa.gov/ccgg/trends/gr.html) and discuss this difference some more.

For the comparison against independent CO2 data, it would be useful to show whether these mismatches are decreased relative to the prior (would be fine to have this in the supplement).

L35: remove "could" in "ecosystems could uptake"

L40: remove ",," in NBE, = NEE + wildfire carbon emission

L77-78: Please double check whether Liu et al. (2021) actually optimizes fire emissions. I think they just optimize NEE but report NBE because errors in fire would alias into NEE.

L128: What is the data assimilation window length?

L141: I did not see the quantity "BIO" or "FCC" explicitly defined. Please make sure that these and other abbreviations are explicitly defined in the text.

L162: "pfp" should be "PFP"

L210: "low latitudes (30 S ~ 30 N, TL)" should be "tropical latitudes (30 S ~ 30 N, TL),"
L238: "NEE constraint with" should be "NEE constrained with"

L254-261: "strongest NEE" should be "strongest sink". Similarly, "weakest NEE" should be "weakest sink"

L287-289: In general, OCO-2 XCO2 or GOSAT XCO2 flux inversions find northern sub-saharan Africa to be a strong source of CO2, while in situ CO2 inversion do not (e.g., https://doi.org/10.5194/acp-22-1097-2022). However, due to the lack of validation data for XCO2 and few in situ CO2 measurements, it is hard to know for sure which is more accurate.

L324-325: I would be careful about calling this a "trend". It appears that this is primarily coming from Australia (Fig. 8j) which had very wet seasons at the start of the record (during 2011 La Nina) and has had drought for the last few years. So the "trend" might be strongly impacted by these events at the end points. Interestingly, the variability for Australia in this study looks very similar to the variability for southeast Australia reported in Fig 5 of https://doi.org/10.1029/2021AV000469.

L326: “global land NEE” should be “global land sink”

L326-237: It is unclear which regions are being correlated for each of these numbers. Please state explicitly.

L368: “Unite States” should be “United States”

L368: “Unite States in 2011-2012 (He et al., 2018; Wolf et al., 2016)”. There are several more studies that used atmospheric CO2 to study this event that could be cited:


L375-377: Could cite some previous studies that use atmospheric CO2 to study NEE over Russia in 2010:


L434: “on extreme climates” should be “to climate extremes”

Figure 7 caption: Give the latitude range of these regions in the caption. Rename “low latitudes” to “tropical latitudes” to be consistent with the abbreviation “TL”

Figure 10: It is hard to see the difference because the trends are so large. Please either
add panels showing the data-model differences or add a plot to the supplement showing these differences.

Supplementary figure S2: This caption is incomplete. What are the individual dots? Different Years?