

Earth Syst. Sci. Data Discuss., referee comment RC1
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Comment on essd-2022-328

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Referee comment on "Global Carbon Budget 2022" by Pierre Friedlingstein et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2022-328-RC1>, 2022

Review of the 2022 Global Carbon Budget, by Friedlingstein et al.,

The authors are to be greatly complimented on their work, for the outstanding number of data sources used, performed analysis, as well as for the continuous inclusion of new products. This series of studies represent useful resource for scientists but to a lesser extent to policymakers, given the content, depth of treatment and length. However, the authors do their best in disseminating the scientific findings and convert it into policy messages (e.g., COP meetings). A broader dissemination of results and conclusions could be done for NGOs, stakeholders and the non-expert citizens i.e., common language press releases, focusing on key findings like the reduction of the period needed to limiting global warming to 1.5 degree, reduction of fossil emissions in 24 countries etc.

General comments

Given its increasing length, an option for future versions would be to transform it into a communication like paper, highlighting key messages and the paper as it is now to be the Supplement. The GCB it is a very well known study, and in a shorter format would beneficiate of a broader audience.

A great improvement is the inclusion of country level ELUC estimates and decomposition of the flux, the regional discussion, as well as the inclusion of peat degradation data sets.

Do simulations and projections for 2022 take into account the long drought period in some regions?

Why Results fossil and ELUC chapters do not have model (data sets) evaluation sections?

To follow-up on a recent "VERIFY" project discussion, would the "median" instead of mean (average) be more appropriate for large ensembles (e.g. DGVMs, inversions) where the min/max show large ranges?

Given the emphasis on using more and more inversions in the future using satellite data, it is great to have OCO-2 based products included in this study, however I find it poorly highlighted in the discussion.

A more focused discussion/conclusions based on this year's budget and updates would be welcomed. Few points have been added to discussions but conclusions from previous work still repeat, giving more the feeling of "aim of the study" and "general statements" than concluding upon this year's findings. Perhaps authors could keep their general remarks and add a short and more results-focused paragraph.

Line by line suggestions

Abstract: If 2020 registered a decline of 5% fossil emissions compared to pre-pandemic (2019) and in 2021 was noted an increase of 5.1% relative to 2020, I think would be good to clearly state that EFOS are almost back to the levels of 2019, with 2020 being an atypical year.
L 190-191: start with "...further increased in 2021" with values and then refer to the 2022 projection
L 191: add 2019 "...above their 2019 pre-COVID19 levels"
L 193: "Preliminary estimates" I think the end month for the data availability should be mentioned, is it July, August 2022?
L 200: why is the decade till 2019 when all analysis is focuses on 2012-2021? If some data sets are not available should be mentioned.

L 201: is "only" needed? A quarter or world's fossil emissions is pretty significant. The decades seem to be different for different pools...L234: why previous decade is 2000-2009?
Should not be 2002-2011? for oceans we have 2011-2020, the executive summary talks about 2012-2021.

L 338: 2.1.1. the period "1850-2021" appears only here, I would suggest to add this historical period to the general paragraph in Methods or add it to all sections (2.2.1, 2.3.1 etc.) as done in the Results sections

L 348-350 mention the number of fossil data sets used (N=7 as in Fig 12?) Why Table 4 does not include the fossil sources? It is not clear from the main text which seven data sets are used.

L 371: Peters et al.,
L 539 and L1029: please add (Appendix C.3.2) for sim D

L 582-584: 16 DGVMs in total, only 11 include the effect of N input, what happens to the other 5? are estimates comparable? Was the N effect quantified in terms of sink between DGVMs with and without N?

L 610-611: Why talking about refining, aren't the a-priori fluxes harmonized for all inversion systems?
at least I would believe so when reading L 626-L 630.

L 678: three global data sets additional to which ones ?

L 715: can you quantify the least accurate? How large were the changes?

L 774 DR Congo, L210 and L812 Democratic Republic of the Congo and (DRC) L324
L 791: "Deforestation is thus the main driver of global gross sources" – an important message to be highlighted in conclusions

L 826, L 1226 and references: please update Ciais et al 2020 with Ciais et al., 2022 <https://gmd.copernicus.org/articles/15/1289/2022/>

L 939-949: how does this one model simulating a strength change the average (N=10) when the other 9 simulate weakening?

L 1193: are these biases known? Perhaps add few in brackets (parametrization (T), tiers?)

L 1411: Totally agree with the "pragmatic fix" in Grassi et al., shifting and adding-up numbers from different BU data sets is not a long-term solution to solve the reconciliation between BU and inventories...I believe the two perspectives should only inform/complement each other and remain two different entities.

Tables and figures

Table 4: add if possible the fossil data sets

Table 5 there is no column 2022 (Projection)?

Figure 3 caption: again not clear what this mosaic of data sets is for the fossil emissions (Andrew and Peters 2021?)

Figure 12 caption: In the main text you talk about nine inversions, here the caption talks

about six

and the figure about seven. Also perhaps informative to add in the figure the value for the GCB grey point (in brackets).

Figure 15: Y-axis should be the same for all panels. Interesting to see 2009 has similar behavior as

2020 (was it a consequence of the economic recession felt strongly by developed countries (not seen much in India, China))?

Appendix C.2.4. Reference for HILDA+ (<https://landchangestories.org/hildaplus/>, Ganzenmüller et al.

2022)

Appendix D: Can you please explain what do you mean by: "Anthropogenic emissions of fossil CH₄

are however not included in EFOS, because these fugitive emissions are not included in the fuel inventories"

Fugitives are reported in the CRF tables, 1B (1B1 and 1B2), see chapter 4, ipcc 2006

[https://www.ipcc-](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf)

[nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf)

Or are you referring to inventories as to other BU data sets.