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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.

Thank you for these suggestions, most of them being already implemented in our communication strategy when the paper is released (provision of key messages from key findings, slide deck and short slide presentations, key datasets in user friendly format, data for key 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.

Point taken but we want to state that for the carbon cycle community, it is important for this paper to report the latest results and key messages but also to report and to be transparent on the methodology used, assumptions made, models/data used, assessment of uncertainty, etc. We did revise the format of the paper last year and we moved most of the methodology in the supplement section (Appendix C). We don't think changing the format to a short "communication-like paper" is what the community wants, keeping in mind that we publish in Earth System Science Data.

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.

Thank you

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

It does for land-use changes emissions as discussed in section 3.2.4, and also to some extent for the land and ocean sink 2022 projections as they use the ONI ENSO index as predictor.

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

For land use emissions, there are simply no independent observations of land use CO2 emissions that we could use to evaluate the models. The DGVMs land use estimate is used as independent supporting evidence of the ELUC estimate from the bookkeeping models.

For fossil emissions, as discussed in section 3.1.1, there are other datasets (CDIAC-FF, CEDS, and PRIMAP-hist), although not fully independent as ultimately relying on the same raw energy data. We provide a brief comparison, for the global historical emissions.

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?

Nonparametric statistics would only be relevant if the distributions of models were skewed, and significantly departed from the implicit gaussian assumption. Figure 12 suggests this is not the case for DGVMs (see green shaded distribution). For Inversion models, we present the range from the models (see Table 6), rather than the average as these estimates are only based on 7 models.

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.

We indeed do not highlight this specifically in the text, as we prefer to first have a scientific highlight that derives from the inclusion of OCO-2 based inversions. This would be a stronger reason to label them great than just the fact that they are now used. With the inversion group, we expect to have a larger ensemble of OCO-2 based estimates in the future, and to specifically assess their added value for GCP.

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.

Thank you for this suggestion. We feel we already partly do what the reviewer is suggesting. Most of the new findings is the current year (2022) projection, which is already clearly highlighted (separate sections for each component). The executive summary also tries to step back and highlight the key findings from this year's manuscript (as for example the 2022 emissions, the country level land use estimates). Other changes from year to year are more minor and mainly methodological (summarised in Table 3).

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.

We don't mention the 2019-2020 change in the abstract, hence it's probably not the best place to add this statement. Note that we have such a statement in the Executive Summary (first paragraph).

L 190-191: start with "...further increased in 2021" with values and then refer to the 2022 projection

The bold headline is about 2022, which is what really matters this year. The 2021 increase and the further 2022 increase are presented in the following sentence.

L 191: add 2019 "...above their 2019 pre-COVID19 levels"

Done, thank you.

L 193: "Preliminary estimates" I think the end month for the data availability should be mentioned, is it July, August 2022?

Data availability varies across countries and fuel type. It would be misleading to give one single month (e.g. July or August) here.

`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.

Sorry, that was a typo, it is 2012-2021 indeed.

L 201: is "only" needed? A quarter or world's fossil emissions is pretty significative.
Agreed, "only" removed, to be more neutral

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.

Across the entire manuscript (see table 5 and 6 for example) we present the last decade, i.e,the last 10 years: 2012-2021. However, when presenting previous decades we use the conventional time period (1960-1969, 1970-1979, …, 2000-2009). To avoid confusion we rephrased the sentence on the land sink as ".. larger than during the 2000-2009 decade." We also rephrased the ocean sink sentence as "The ocean CO2 sink resumed a more rapid growth in the past two decades after low or no growth during the 1991-2002 period". Thanks also for spotting that in the ocean section (line 229) the decade 2011-2020 should read 2012-2021. This typo is now corrected and the ocean sink number for this decade was correct.

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

Done, thank you.

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.

There is a confusion here. We do not have 7 datasets for fossil fuel data. The N=7 in figure 12 refers to the atmospheric inversions (described in Table 4).

L 371: Peters et al.,

Done, thank you

L 539 and L1029: please add (Appendix C.3.2) for sim D

We already refer to Appendix C3 at the end of section 2.3: "More details on the S_{OCEAN} methodology can be found in Appendix C.3.". Not sure why it would be needed specifically 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?

11 models represent the nitrogen cycle in addition to the carbon cycle. This is clarified now.

We have further analysed the 16 DGVMs grouping into -CN (11) and -C only models (4). We find that over different time horizons the NBP results are not substantially different, e.g. for the decade 2012-2021 the annual mean SLAND and ELUC for the two model groups are not significantly different (P>0.05). With a small set of -C only models it will be difficult to attribute differences to inclusion of a N-cycle alone. A more informative study would be to compare -CN vs -C only of the same models, but that is a major endeavour and beyond the scope of GCB2022. However, we are also in the process of preparing a new study on benchmarking -CN models from GCB2022.

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.

The atmospheric inversions prescribe the fossil fuel emissions, as described in that section. other apriori fluxes for land and ocean uptake are not harmonised, these are part of the specific design of each inversion model.

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

Clarified: "In addition to the estimates of fossil CO2 emissions that we provide here (see Methods), …"

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

This is presented in Table 7, for the rest of the world, the prediction was 3.2% while the actual change was 4.5%. We now report the error in the text: "Of the regions, the projection for the 'rest of world' region was least accurate (off by -1.3%), largely because of poorly projected emissions from international transport (bunker fuels), which were subject to very large changes during this period. "

L 774 DR Congo, L210 and L812 Democratic Republic of the Congo and (DRC) L324

Changed all instances to "Democratic Republic of the Congo"

L 791: "Deforestation is thus the main driver of global gross sources" – an important message to be highlighted in conclusions

Thank you, added in the executive summary

L 826, L 1226 and references: please update Ciais et al 2020 with Ciais et al., 2022

Thanks, updated.

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

Sorry, there was a missing negative sign ahead of the "4.2%" value, now added. Should clarify that the effect of climate is to reduce the sink on average: "The effect of climate change is much weaker, reducing the ocean sink globally by 0.11 ± 0.09 GtC yr^{-1} (-4.2%) during 2012-2021 (nine models simulate a weakening of the ocean sink by climate change, range -3.2 to -8.9% and only one model simulates a strengthening by 4.8%)"

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

The biases are not known. This is work in progress within the RECCAP (REgional Carbon Cycle Assessment and Processes) project. Model biases were investigated in Earth System Models, but the forced ocean models used here have smaller biases. This is work in progress. We have changed 'model biases' to 'potential biases', added a sentence on the Earth System Model biases, and will revisit next year.

"Dominant biases in Earth System Models are related to mode water formation, stratification, and the chemical buffer capacity (Terhaar et al. 2021, Bourgeois et al. 2022, Terhaar et al., 2022)."

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.

Thank you

Tables and figures

Table 4: add if possible the fossil data sets

Please see our response above to comments regarding L 348-350

Table 5 there is no column 2022 (Projection)?

Indeed, the 2022 projection of the land sink is not from DGVMs (see section 2.5.2), so we feel that including the projections here would add unnecessary complexity to the table.

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

Please see our response above to comments regarding L 348-350

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).

Thank you, there are 7 inversions shown on Figure 12, there was a typo in the caption. Note that we have 9 inversions but two inversions based on OCO-2 only cover the 2015-2021 period, hence not shown on this figure.

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))?

Y-axis are different because magnitude of annual changes varies widely across countries. Indeed 2008-2009 was the result of the global financial crisis, which primarily impacted USA and EU.

Appendix C.2.4. Reference for HILDA+ (https://landchangestories.org/hildaplus/, Ganzenmüller et al. 2022)

We do cite the paper, Ganzenmüller et al. 2022, not clear why we should also refer to the website.

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-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.

Clarified and simplified to: “The diffuse atmospheric source of CO2 deriving from anthropogenic emissions of fossil CH4 is not included in EFOS. In reality, the diffuse source of CO2 from CH4 oxidation contributes to the annual CO2 growth rate.”