

Earth Syst. Sci. Data Discuss., referee comment RC2
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Comment on **essd-2022-104**

Philippe Ciais (Referee)

Referee comment on "Carbon fluxes from land 2000–2020: bringing clarity to countries' reporting" by Giacomo Grassi et al., Earth Syst. Sci. Data Discuss.,
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The study by Grassi et al. presents a database of LULUCF fluxes of CO₂ based on national greenhouse gas inventories (NGHGI) reported to UNFCCC, as an update from Grassi et al. 2021. These data are publicly available but for non-Annex-1 (NAI) countries, different national sources exist, not necessarily consistent with each other. The LULUCF fluxes data are gap-filled by the authors, including by using expert judgement. More NAI countries are present in this database compared to Grassi et al. 2021.

NGHGI data are compared to data from the UNFCCC GHG data interface and to the forest resource data reported by countries to FAO. Global LULUCF is a sink of CO₂ that ranges from 1.6 GtCO₂ y⁻¹ in NGHGI (gap filled), 5.4 GtCO₂ in "new" data from UNFCCC GHG data interface and 1.3 GtCO₂ y⁻¹ in FAOSTAT.

The effort to collect, gap fill, and compare different nationally reported estimates is a valuable contribution to the Global Stock Take process and to scientific assessments of the carbon budget in general. Previously, less attention has been paid to differences between various country submissions to UNFCCC than to differences between 'scientific' estimates and country submissions. Differences between three data sources, all based on country submission are examined, and tentatively explained. I found the explanation of differences between TBFRA, FAOSTAT and NGHGI very interesting even though it remains partly qualitative.

In addition, this study brings tentative estimates of the area of managed lands based on available information from countries.

Main comments:

1- The data from NAI countries are a 'mixed bag' of national communications, Biennial Update Reports, REDD+ submissions and NDCs. For NAI, a gap filling procedure was applied, with both interpolation and extrapolation. A gap filling rate of 47% indicates a large difference between the database of this study and original "raw" national reports.

Therefore, a comparison between the raw data reported by countries (from different sources) and the gap-filled data produced by this study would need to be provided, in order to be able to appreciate the effect of the data 'processing' applied to different NGHGI data sources.

2- A point of concern is the lack of a detailed per country uncertainty assessment of the data compiled in the database : uncertainties arising from the gap-filling vs. averaging procedures, from different thresholds of forest sink being considered as "implausible" and from differences between estimates coming from two or more national sources (such as BUR, NDC and NC).

Such a detailed evaluation of uncertainty per country is strongly needed e.g., for

assessing the significance of differences between this database and other 'scientific' estimates in further work. The authors are encouraged to further assess uncertainties at national level beyond a mean relative uncertainty value for AI and NAI, even if their value is deemed to be conservative. NAI countries are very diverse. Some of them have detailed inventories (e.g., China) and / or frequent communications and revisions, while others may have only one or two reports and a sheer lack of national data. A 50% uncertainty for all NAI country is thus not a credible estimate being 'good for all'.

3- The notion of 'uncertainty' is not defined in this study. If the difference between two NGHGI datasets is for instance larger than 200% for a given country, then an "uncertainty" of 50% is clearly underestimating the uncertainty of the whole approach.

4- A comparison of TBFRA vs NGHGI for the few NAI countries that have a stock change based approach should be provided to test the hypothesis provided by the authors.

Other comments:

L265. How do AI and NAI estimates of uncertainties compare with the detailed analysis of Glynn et al. 2022 of LULUCF CO2 fluxes uncertainties (<https://doi.org/10.1007/s10584-021-03254-2>).

L305. The compilation of UNFCCC country reported data by FAO is intriguing. Could more information / comparison be given here about this dataset ?

L374. Should be clarified in the abstract that what is called "NGHGI data" also combine (although for a small fraction) FAO data

L390. Please precise the rationale for comparing NGHGI "managed land" only with forests area from FAO. There are likely to be managed "other wooded land" and cultivated lands. Why should both variables be comparable ?

L420. What is done for averaging / gap filling when the same year has two different estimates, e.g., from a national communication and a BUR

L455. Please explain why, without gap filling, the global CO₂ sink is less than with gap filling for NAI.

L450. If there is a 50% error on each NAI report and each report is independent, what is the uncertainty propagated on the global CO₂ sink of these countries. Please explain what are the countries that dominate the global uncertainty

L465. Central African Republic was filtered due to an implausible sink rate. Here using NGHGI DB, a sink of 1.7 GtCO₂ is given for this country, which also seems 'implausible'. Please clarify what is done with CAF – is it kept or removed? Does this single country (+ few others) explain most of the difference between the 'old' and 'new' GHGI database ? or is this difference really due to numerous data updates from many other countries

How can the data change from a 1.7 GtCO₂ sink to 0.2 GtCO₂ source between a 2015 NC and the 2016 NDC.

L 505. I am a bit confused, please explain what is the gap filling applied by the Washington Post, if any – and which countries were removed

L539. It is the first time that the "NGHGI' forest sink is called "implausible' ? Should clarify in section 3.4 which version of NGHGI data is more or less plausible. A global sink of 5.4 GtCO₂ y⁻¹ in forests does not look at first glance 'implausible' when compared to the land sink of the global CO₂ budget.

L575 and p 22. This text makes the discussion of differences between FAO and NGHGI easier to understand. Could it be placed before

L585. Please name NAI countries that measured C stock changes in FL and how much of the NAI sink do they contribute.

L645. Comparison to Donegan et al. which is not published should be explained in details or removed. Unclear how a deforestation / degradation map can be estimated to be 'consistent' with FAOSTAT

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