

<i>Reviewer 1 - Giacomo Grassi</i>	<i>Author`s answer</i>	<i>Done</i>
<p><i>General comment (condensed)</i></p> <p>The manuscript is clear but overly concise, making its added value relative to the FRA report unclear. The reviewer recommends: (i) a more detailed methods description; (ii) a clearer discussion of data limitations and known issues; (iii) a more disaggregated comparison with other global datasets; (iv) basic country-level evaluation before presenting aggregated results, as issues in national inputs may affect global trends; and (v) clearer and more consistent terminology.</p>	<p>We thank the reviewer for useful comments. We agree that the original manuscript was overly concise: the revised manuscript has been substantially expanded throughout, following the reviewer’s suggestions. Specifically: (i) A greatly expanded methods section now includes detailed descriptions of FRA and UNFCCC data inputs, with new subsections on forest land area data (2.1.2) and forest biomass (2.1.3), as well as (ii) a thorough discussion of limitations and uncertainty (Section 2.3). Furthermore, (iii) the results section has been expanded to include comparisons of this version (based on FRA 2025) to previous FAO estimates based on FRA 2020; as well as a comparison to country UNFCCC data and findings from the GCB 2025. (iv) Global and regional results have been complemented by a country level analysis (Section 3.2), which is further discussed in the Discussion (Section 4). Finally, (v) we have paid attention to terminology to increase clarity. In addition, we also expanded the scope of the original simulations, to include all carbon pools covered in the FRA.</p>	
<p><i>Comment 1 (condensed)</i></p> <p>The manuscript incorrectly refers to FAOSTAT estimates as an “IPCC Tier 3” approach. This contradicts IPCC definitions and FAOSTAT documentation, as Tier 3 methods apply only to a limited number of countries and require detailed, tracked land-use data. Associating FAOSTAT with a specific Tier is misleading; instead, the methods should be described without Tier classification.</p>	<p>We have deleted references to IPCC tiers in the manuscript to avoid confusion. At the same time, we note that two previous ESSD publications documenting the same FAO approach had already and correctly referred to the FAO method implementing a Tier 3 approach, based on carbon stock change. The detailed country level activity data information needed for such estimations is in fact collected by countries based on their national forest inventories and directly sent to FAO as the relevant UN organization on forest statistics. There are no Tier 1 default tables from IPCC that can be used for carbon stock change, contrary to the gain-loss method.</p>	
<p><i>Comment 2 (condensed)</i></p> <p>Equation (3) mixes forest CO₂ removals from existing or regrowing forests with emissions from logging and/or forest degradation. This combination should be made explicit in the manuscript.</p>	<p>We have made this clarification in the text when providing guidance to the equations in Section 2.2. We clarified that the stock change method inevitably aggregates relevant, but difficult to quantify, subprocesses—such as those mentioned by the reviewer—into aggregated fluxes. Conversely, it is the gain-loss method that allows compilers to distinguish such processes, gaining important insights.</p>	
<p><i>Comment 3</i></p> <p>Forest conversions (e.g., lines 63-65). I suggest to clarify more explicitly what net forest conversions mean, e.g. please clarify if new net forest area gains are allocated to the category “forestland emissions/removals”. At lines 80-82, the text “the computation of net forest conversion emission</p>	<p>The revised manuscript improves the definition of net forest conversion in Equation (2) of Section 2.2, specifying its direct link to IPCC land use change terminology and further suggesting that it provides a proxy for deforestation emissions. An expanded limitations section (Section 2.3) discusses how use of net area change may systematically underestimate gross area changes. At the same time, the manuscript now better highlights the separate treatment of</p>	

<p>may lead to underestimates of carbon fluxes” could be more explicit, i.e. that the net forest conversion does not capture the gross flux from deforestation but the sum of deforestation and forest expansion. Is the gross flux from deforestation an information reported by at least some country under FRA? If yes, can this information be used in FAOSTAT?</p>	<p>naturally regenerating forest and planted forest areas, which allows for additional disaggregation of national level forest area dynamics. Finally, the FRA does not collect carbon flux information that could be used directly by FAO.</p>	
<p><i>Comment 4 (condensed)</i> Forest area considered (lines 68–82). For some countries, an important source of uncertainty is whether FAOSTAT data represent the total forest area reported to FRA or only the area of “managed” forest reported to UNFCCC. By default, FRA is assumed to report total forest area, but some countries (e.g., USA) explicitly state that carbon stock values refer to managed land only. The authors are encouraged to verify this for major countries and report this information in the manuscript.</p>	<p>This important point is now addressed in multiple places. Section 2.1.2 presents a detailed comparison of FAO and UNFCCC forest land area data (Tables 2–3, Figure 1), showing that key forest countries—Brazil, Canada, and the USA—report managed lands to UNFCCC that are smaller than the corresponding total forest areas reported to FRA. At the same time, we use FRA country reports to also highlight equally important cases, i.e., countries for which managed forest area is equal to or greater than the FAO total forest land area.</p>	
<p><i>Comment 5 (condensed)</i> Please acknowledge and address known limitations of the FAOSTAT dataset already discussed in previous studies (e.g. ESSD 2022, co-authored by some of the authors) but not addressed here. (i) Several developing countries report constant forest carbon stock density over time, which mechanically implies zero flux on Forest Land remaining Forest Land (FL–FL), due to lack of repeated measurements (e.g. DRC and many African countries). As shown in previous FAOSTAT versions, this may lead to a substantial underestimation of the global forest sink. The authors are encouraged to systematically assess this issue across FRA country reports, summarize the results (e.g. number of countries and forest area affected), discuss implications for global estimates, and assess whether the situation has improved relative to FAOSTAT 2020.</p>	<p>(i) This issue is now thoroughly addressed in the manuscript. Section 2.1.3 discusses the number of countries reporting constant carbon density values over the entire dataset timeseries, showing that it did not decrease in FRA 2025 (compared to FRA 2020). This data quality issue applies to nearly 90 countries and territories for a total forest land area of about 900 Mha (although driven by 20 countries covering nearly 90% of that area). The Discussion (Section 4) further provides estimates that countries (Table 8) with constant carbon stock density data are responsible for a “FAO/UNFCCC” sink gap of 1.3 GtCO₂ yr⁻¹. A large group of the latter was made of tropical forest African countries also identified as “ourliers” also in independent recent analyses (lulucf data hub). We posit that it is not known whether this is an underestimate or overestimate against the true unobserved forest sink, whereas it is certainly a gap compared to UNFCCC data--which opens large opportunities for future capacity development aimed at further clarifying this key issue. Regarding (ii), Section 2.2 explains that estimates represent mean annual fluxes between FRA reporting years (1990, 2000, 2010, 2020, 2025), which are then extended to annual time series.</p>	

<p>(ii) In addition, some countries report constant carbon stock values for the most recent years despite earlier variation (e.g. USA), reflecting the absence of recent data. In such cases, changes should be calculated using the actual time interval (e.g. 2020–2022) rather than a fixed 5-year period, as using 5 years introduces an artificial decline in recent forest sinks. If the method is not adjusted, this artefact should be clearly explained and discussed.</p>	<p>(ii) We discuss this issue explicitly in limitations, noting that the last FRA year is based on linear or other types of interpolations, hence the corresponding emissions/removals estimates should be considered preliminary, to be updated with future FRA data. We note here that the direction of the preliminary estimates cannot a priori be assessed as an underestimate.</p>	
<p><i>Comment 6: Statistical analysis (condensed)</i> Statistical analysis (lines 73 and 142). (i) At line 73, the manuscript assigns ~20% uncertainty to FAO country statistics (citing Tubiello et al., 2023a,b), but only one such reference is listed. More importantly, while 20% uncertainty may be plausible for stock estimates at specific reporting years, it is likely too low for annual changes in forest growing stock derived from multi-year FRA reporting intervals. The validity of the results strongly depends on whether this 20% assumption is appropriate for change estimates. (ii) At line 142, correlations between FAOSTAT and NGHGI data are presented within the “Net forest conversion” section, although one correlation refers to forestland fluxes. Moreover, if correlations are based on absolute emissions/removals, they may be dominated by country size effects. The reviewer suggests reorganizing the text and computing correlations using fluxes normalized by forest area (e.g. tCO₂/ha/yr), ideally supported by a figure.</p>	<p>(i) We agree with the reviewer but note that the reference to the 20% uncertainty was limited to a qualitative assessment related to forest area, not emission fluxes. For the latter, we rather use the 50% relative uncertainty levels (95% CI) generally used in the LULUCF literature—as we better specify in the limitations section (Section 2.3). (ii) The Results section has been reorganized, with NFC and FL analyses presented in Tables 6 and 7 within the country-level analysis (Section 3.2), and comparisons to UNFCCC further investigated in the Discussion (Section 4). Finally, we agree with the reviewer on country size effects, and have remade the same using log normalized values, an approach that we considered more robust statistically than correlating area ratios to reduce country size effects—the latter would be plagued by additional uncertainties introduced by an additional denominator and a case-by-case uncertainty in the nature of the area to be used (managed, total) across the two FAO/UNFCCC sets</p>	
<p><i>Comment 7: National GHG Inventory data (condensed)</i> Line 57. The manuscript states that FAOSTAT disseminates NGHGI data via BURs or BTRs. Restricting to these reports excludes substantial data, including annual national inventories from</p>	<p>The revised manuscript now explicitly states in Section 2 that UNFCCC country data were collected from “Biennial Transparency Reports (BTRs), Common Reporting Tables (CRTs) and National Communications (NCs) including National Inventory Reports (NIRs) (UNFCCC, 2025).” Section 2.4 further clarifies the resulting dataset of nearly 9,000 data points over 1990–2023, covering 137 countries, with UNFCCC data for both FL emissions and NFC emissions (Table 1).</p>	

<p>Annex I Parties (e.g., 2025 submissions) and National Communications or Inventory Reports from many non-Annex I Parties without BURs/BTRs. While a full overview is beyond the scope of this paper, these limitations should be acknowledged. The reviewer also suggests referring to the Zenodo dataset (https://zenodo.org/records/17153438) and noting that NGHGs are expected to report all forest carbon pools and gross deforestation/forest expansion separately.</p>	<p>We have taken this opportunity to review to include all available data up to a March 2026 cutoff. We note by comparing with the LULUCF hub that we basically cover the same information as the JRC NGHGI data —net of FAO not using data from REDD+ reports— and clarify in the text that we do not interpolate UNFCCC data for FAOSTAT dissemination. Finally, we have added Table 1 clarifying coverage of the FAOSTAT disseminated UNFCCC data.</p>	
<p><i>Comment 8: Figures</i> Figure 3. The caption is not very clear. Suggest to specify “forest land”, because it corresponds to the green bars in Fig 2.</p>	<p>The revised Figure 3 captions now reads “FAO regional net forest emissions/removals” and present all three components (CSC, NFC, FL) with clear regional breakdowns at World, AI and NAI levels (Figures 3a–c), ensuring the reader can identify each component.</p>	
<p><i>Comment 9: Figures</i> Figure 4. I warmly encourage to present the EU as aggregation of countries. I believe that the difference between FAOSTAT and NGHGI for USA is due to the likely erroneous computation of the forest sink in FAOSTAT (see above). What about Indonesia, Malaysia, DRC and Mexico in FAOSTAT? I would expect to see these countries among the top 10 countries in terms of net sink from forest land. In addition: India appears empty for UNFCCC, but actually submitted a National Communication in 2023 (see comment above); for Ghana, there are estimates from the BTR (2024) and for Honduras there are estimates from the BUR (2020), which I think should be in this figure.</p>	<p>The revised manuscript now presents detailed country-level data for both FL (Table 7) and NFC (Table 6); all the entries previously missing and noted by the reviewer are now present in the FAOSTAT UNFCCC data. In terms of specific useful country suggestions: (i) The EU appears in the FAOSTAT database as a special aggregate, but we prefer to discuss single countries and more standard FAO regional aggregates, as currently done in the revised manuscript, which has greatly expanded country and regional analysis in both results and discussion sections. (ii) The USA is one of three major cases of countries reporting their forest removals on a smaller managed land area than total forest area. We have added a line noting the point from the reviewer, but we doubt this to be the decisive reason for the discrepancy, considering the inherent uncertainty in the estimates, plus the uncertainty in how the managed/total land issue was dealt with in FRA reporting. To this end in fact, the two values are in fact statistically consistent, so that we see little value in focusing on the remaining marginal numerical details. (iii) Indonesia appears in the top 10 FL removals (-0.1 to -0.3 Gt CO₂/yr, Table 7). Malaysia, DRC and Mexico are shown as sinks in the UNFCCC data but not in FAOSTAT, and to this end we highlight this difference between FAO and UNFCCC, for both major FL and NFC contributors, in the Discussion (Section 4), alongside findings by recent similar work.</p>	
<p><i>Comment 10: Figures</i> Figure 5. I suggest to add the top 10 countries, as in Fig. 4. In addition, for DRC, estimates from deforestation are included in the National</p>	<p>We have updated the figures in the revised manuscript reflecting the reviewer’s suggestions. Figure 4 now shows the top 10 countries for both NFC and FL, comparing FAO and UNFCCC data side by side. With reference to the above note, we have updated UNFCCC data in FAOSTAT to include those suggested by</p>	

<p>Inventory Report (NIR, 2023); for Perù, there is a BTR (2024). Surprising that Indonesia is not among the top emitters for forest conversions (net deforestation): can the authors discuss the possible reasons?</p>	<p>the reviewer and have included a discussion of major contributing countries for NFC in UNFCCC but not FAO. We could not find data for Peru however, which we plan to include in future FAOSTAT updates.</p>	
<p><i>Comment 11: Figures</i> Figure 6. Unclear what these data represent: FAOSTAT values are smaller than “Forest land” in table 1, but larger than “FL_Tot” in table 1. Why the Unit is ktCO2 and not GtCO2 as the other figures?</p>	<p>Thank you for catching this issue. The figures in the revised manuscript have been restructured for clarity. Figure 5 now presents a comprehensive comparison of FAO 3 estimates against GCB datasets (bookkeeping models, DGVMs, JRC NGHGI data and atmospheric inversions), with consistent units in Gt CO₂ yr⁻¹.</p>	
<p><i>Comment 12: Italy</i> Suspect country-level trends. In reviewing the data for Italy, I found what appear to be clear inconsistencies in the original country report to FRA. Specifically, while total forest biomass is reported to increase from 2020 to 2025, total carbon stock is reported to decrease over the same period. Given the close and well-established relationship between biomass and carbon, this discrepancy strongly suggests an error in the compilation of the carbon stock table. This issue propagates directly into the FAOSTAT results, generating high apparent emissions for Italy in the most recent five years (approximately +50 MtCO₂), which is in stark contrast to the substantial sink reported in the corresponding NGHGI (about -40 MtCO₂ over the same period). These findings reinforce a key recommendation: the authors should not present global aggregated results without first conducting basic quality checks of the underlying country-level data. As noted earlier, such inconsistencies can substantially distort global estimates of forest emissions and removals, and should therefore be identified, documented, and reflected in the discussion and conclusions.</p>	<p>We thank the reviewer for identifying this issue. Italy’s values had been wrongly read in a first part of the work (prior to Oct 2025) from the FRA original dataset and have been recalculated. More broadly, we have refined existing data quality checks at country level to ensure no other oversight would happen at input stage and subsequently at estimation stage. Furthermore, the revised manuscript includes extensive country-level quality documentation (Section 2.1.3) and detailed country-level FAO/UNFCCC comparisons (Tables 6–8).</p>	
<p><i>Comment 13: Table 1</i> Terminology used for the main variables. The caption of Table 1 (presenting the main results) is</p>	<p>Terminology has been substantially improved. The revised Table 4 (previously Table 1) uses clear headers: “Carbon stock change” (CSC), “Net forest conversion” (NFC), and “Forest Land” (FL). The abbreviations CSC, NFC, and FL</p>	

<p>“FAO estimates of total forest fluxes (FL_Tot), deforestation (NFC) and emissions/removals on forest land (FL), in Gt CO₂ yr⁻¹, for the period 1991-2025, for global, Annex I and non-Annex I, and region totals”. This caption has a number of problems that may confuse the readers: (i) the table does not present any variable termed “FL_Tot” – this should be fixed in the table; (ii) the variable “NFC” is not “deforestation” indicated in the caption, but rather “Net Forest Conversions” (hence, the NFC acronym) – the caption should be corrected; and (iii) the term “emissions/removals on forest land (FL)” in the caption should be “emissions/removals on forest land (Forest Land)” to be consistent with the table. This consistent use of this terminology should be checked throughout the paper.</p>	<p>are consistently defined in Section 2.2 and used throughout the manuscript, including in all tables and figure captions.</p>	
<p><i>Comment 14: FAOSTAT and the FRA report (condensed)</i> The reviewer asks the authors to better explain the added value of this manuscript compared to the FRA chapter on carbon stocks. The current disaggregation between net forest conversions and existing forests is considered limited, especially since conversions are net rather than gross. Comparing Table 1 with FRA Table 55 reveals substantial differences, particularly for 1990–2000 and partly 2001–2010, even accounting for the fact that this manuscript includes only living biomass. The reviewer asks whether interpolation and regional gap-filling procedures described in the FRA report also apply to FAOSTAT, and if so, that they be clearly described in the Methods. The reviewer encourages splitting the “Americas” region into North/Central and South America in Table 1 and figures to improve comparability with FRA.</p>	<p>We agree that there is no added value in reporting carbon stocks in this manuscript in addition to those already reported by the FRA—except for transparently communicating what was used as input into the FAO emissions estimations. We have removed such tables from the revised version. For the same reasons however, we have inserted a line specifying that the FRA country data include FAO imputations but would still point the reader to the relevant FRA documents, as nothing additional was done in this manuscript on the input data.</p> <p>In terms of regional aggregates, while we prefer to keep the FAO standard regions, we have added specific language in the underlying country analysis (Section 3.2) that helps to guide the reader on specific sub-regional differences, especially for the Americas aggregate.</p>	
<p><i>Comment 15: Discussion</i> I recommend to develop the discussion much more</p>	<p>he Discussion (Section 4) has been substantially expanded. It provides a comprehensive country-level analysis of the FAO/UNFCCC ‘sink gap’ in NAI</p>	

<p>to add value to the manuscript. The comparison with national inventories is limited and no interpretation is provided on observed differences, which in some case are surprising. Other datasets could also be compared with (e.g. Global Carbon Budget and Global Forest Watch – see Friedlingstein et al, in review; Gibbs et al., 2025).</p>	<p>countries, identifying 13 countries driving the discrepancy (Table 8) and grouping them by typology: data quality gaps (constant carbon density in FRA), and land use boundary issues (UNFCCC managed forest area larger or smaller than FAO total forest area). The introduction places FAOSTAT in context with the Global Carbon Budget (Friedlingstein et al., 2022, 2025) and the JRC NGHGI database (Grassi et al., 2022). Figure 5 shows the comparison of FAO 3 estimates to GCB datasets including bookkeeping models, DGVMs, JRC NGHGI data and atmospheric inversions.</p>	
<p><i>Technical corrections 1: Abstract</i> “Data are made available as open access via the Zenodo portal (Tubiello et al., 2025), with DOI 10.5281/zenodo.17395879”. The correct link is https://zenodo.org/records/17395880. In addition, https://www.fao.org/faostat/en/#data/GF/visualize is a good web site to visualize the data. I suggest the authors to refer to this somewhere in the manuscript.</p>	<p>All technical corrections have been addressed. The Zenodo DOI (10.5281/zenodo.17395879) and FAOSTAT visualization link (FAO, 2025c) are included. Typographical errors have been corrected. The IPCC carbon pools are now correctly described. Terminology and numerical references have been verified against the revised Table 4.</p>	
<p><i>Technical corrections 2:</i> Line 55: “including UNFCCC Annex and” should read “including UNFCCC Annex I and”</p>	<p>All technical corrections have been addressed.</p>	
<p><i>Technical corrections 3:</i> Line 60: the second “AI” should be “NAI”.</p>	<p>All technical corrections have been addressed.</p>	
<p><i>Technical corrections 4:</i> Line 62: “wre” should be “were”</p>	<p>All technical corrections have been addressed.</p>	
<p><i>Technical corrections 5:</i> Lines 75. The IPCC identifies three pools (living biomass, dead organic matter, soils) - or five if the subcategories are included -. Not four pools.</p>	<p>All technical corrections have been addressed.</p>	
<p><i>Technical corrections 6:</i> Line 100. “With respect to a decade earlier, removals increased in Asia by nearly 50%”. From Tab 1 this increase is not evident.</p>	<p>All technical corrections have been addressed.</p>	
<p><i>Technical corrections 7:</i> Line 146. “We did not compute similar statistics for the AI comparisons, since the UNFCCC AI aggregates lacked two-thirds of their countries.” It</p>	<p>All technical corrections have been addressed.</p>	

<p><i>is not clear to me what this text refers to – mainly non-AI countries?</i></p>		
<p>Reviewer 2 - Anonymous</p>		
<p><i>General comment</i> The manuscript is very brief. It left me with many questions, particularly about methods, study limitations, and how FAOSTAT fits with other data sources, particularly NGHGs. In general, I think each section was terse to the point of lacking key information that would make this a more valuable contribution. I understand that being in ESSD, this is a data description paper (as opposed to an analysis and interpretation of data) but it still does not thoroughly describe the dataset and its production.</p>	<p>We fully agree. The revised version has been substantially expanded, with the manuscript now nearly three times its original length. Key additions include: expanded methodology (Section 2), new subsections on FRA/UNFCCC data comparison (Sections 2.1.2–2.1.3), a detailed limitations and uncertainty section (Section 2.3), expanded results with country-level analyses (Sections 3.1–3.2), and a comprehensive discussion comparing FAO data to UNFCCC and GCB datasets (Section 4).</p>	
<p><i>Question 1:</i> This is an update of previous FAOSTAT emissions and removals data. What were the previous values? How do these compare with the current values? What changed in FAOSTAT’s methods and underlying country data from the previous version to this one?</p>	<p>The Discussion (Section 4) now includes comparisons to previous FAO estimates. Section 2.1.3 documents the underlying data quality improvements, including changes in constant biomass density reporting and specific revisions in the Russian Federation, USA, and China. The methodology itself is unchanged—only the input FRA data were updated.</p> <p>FRA 2025 incorporates revised country reports and updated national forest inventories. Key changes include improved coverage of growing stock, biomass, and carbon; enhanced metadata; and revisions by countries with large forest areas, notably:</p> <ul style="list-style-type: none"> • Russian Federation: updated growing stock and forest area • USA: revised biomass and carbon estimates • Canada: updated forest-area estimates • DRC and Central African Republic: inclusion of open forests, increasing growing stock and biomass <p>FRA 2025 also collected more detailed information on species composition and disaggregated forest categories (naturally regenerating, primary, planted, introduced species). Some limitations remain, such as sparse historical data,</p>	

	<p>incomplete species composition, and limited data on carbon in deadwood, litter, and soil for some regions, especially in Africa and Asia.</p> <p>More information on major changes and differences compared with FRA 2020 is described in the FRA 2025 report (https://openknowledge.fao.org/items/090d2fbb-32a6-412b-a3b8-1ce5c5905df2).</p>	
<p><i>Question 2:</i> How reliable is the time series of fluxes? Do all countries really have consistent timeseries back to 1990? I believe not, but this isn't discussed anywhere. I know that the authors can't control country data, but known inconsistencies by time or for specific countries should be mentioned, with potential impacts discussed. Not exploring this makes it hard to assess the validity of the (non-significant) trends in fluxes that the authors claim (e.g., line 166, 172-174). At the least, this needs to be mentioned in Section 2.2, as well as preferably in the results and discussion.</p>	<p>Complete time series for aboveground and belowground biomass were reported by 210 countries (>99% of global forest area), while deadwood biomass was fully reported by 90 countries (77% of global forest area). For missing years, biomass estimates were derived using subregional averages and change rates in aboveground biomass or growing stock. For carbon stocks, incomplete series were interpolated or extrapolated using available data, including subregional averages for non-reporting countries; soil carbon estimates were derived from the Global Soil Organic Carbon Map where needed.</p> <p>These procedures ensure a consistent and gap-free dataset, although not all countries have fully observed series back to 1990. Known inconsistencies, especially in less-represented countries, are acknowledged and may affect trend interpretations.</p> <p>For more details, see FRA 2025: https://openknowledge.fao.org/items/090d2fbb-32a6-412b-a3b8-1ce5c5905df2</p> <p>Section 2.1 now notes that FRA 2025 coverage was substantially higher than previous cycles. Section 2.1.3 documents that while not all countries have fully observed series back to 1990, the FRA provides gap-free data through interpolation and subregional averages. Section 2.3 explicitly discusses limitations, stating that “net emission/removal estimates on remaining forest land depend strongly on the quality of the underlying biomass carbon density data.”</p>	
<p><i>Question 3:</i> How do the FAOSTAT estimates relate to NGHGI submissions to the UNFCCC? A table describing their similarities and differences and what countries report in each (at least in principle) would help. Figure 5 shows some substantial differences in fluxes by country. I know you can't get into all</p>	<p>FAOSTAT estimates are based on FRA 2025 data, where countries report to FAO following a collaborative and standardized approach. FRAs compile and validate data submitted by countries every five years, providing the most comprehensive global assessment of forest resources, covering all thematic elements of sustainable forest management. NGHGI submissions to the UNFCCC, including Biennial Update Reports (BURs) and Biennial Transparency Reports (BTRs), are country-driven</p>	

<p>country differences but the main conceptual and methodological similarities and differences between FAOSTAT and NGHGs are important to explain, as well as one would use one vs. the other. Finally, are NGHGI and FAOSTAT different enough from each other that they represent distinct lines of evidence for forest fluxes (and the forest sink), as implied in lines 179-180? All of this could be covered in the introduction and discussion.</p>	<p>reports on national greenhouse gas inventories. Annex I Parties submit annual inventories, while non-Annex I Parties may submit National Communications or BURs/BTRs. NGHGs follow IPCC guidelines and aim to report all forest carbon pools, including gross deforestation and expansion where possible. Unlike FAOSTAT, NGHGI data are not harmonized globally and reflect each country’s methodology, assumptions, and reporting schedules.</p> <p>FAOSTAT and NGHGs are conceptually and methodologically distinct, representing complementary lines of evidence for forest fluxes and the global forest sink. Differences in methods, coverage, and reporting result in discrepancies at the country level (e.g., as observed in Figure 4), which should be interpreted considering the context and intended use of each dataset.</p>	
<p><i>Question 4:</i> Where does FAOSTAT fall in terms of covering fluxes from managed vs. unmanaged lands, direct anthropogenic effects, indirect effects, and natural fluxes? And does forest land include any emissions in it (e.g., fires, limited harvests)? This is important for understanding how FAOSTAT compares with other flux estimates and its scope relative to the Global Carbon Budget and NGHGs. FAOSTAT’s position on this should be explained somewhere.</p>	<p>This is now addressed in detail in Section 2.3 (Limitations and uncertainty). The FAO methodology follows the IPCC land use proxy approach, considering all emissions on managed area as anthropogenic. NFC emissions are anthropogenic by definition. FL fluxes include a small non-anthropogenic component because FRA data do not distinguish managed from unmanaged land, with Grassi et al. (2022) estimating ~80% of forest area is managed. However, as shown in Section 2.1.2 (Tables 2–3), most countries reported UNFCCC managed forest areas equal to or greater than FAO total forest area, substantially reducing this concern. Fire and harvest effects are implicitly included in the net carbon stock changes on forest land. The Introduction places FAOSTAT alongside the JRC NGHGI database and Global Carbon Budget, noting the wide range of estimates reflecting different scopes and methods..</p>	
<p><i>Question 5:</i> You mention an important point with “Thirdly, the computation of net forest conversion emission, based on national-level statistics of area and biomass density as per equation (2), may lead to underestimates of carbon fluxes, so that actual deforestation emissions may be larger than estimated in FAOSTAT.” but don’t follow that thought. I think you’re saying that estimating fluxes over 5-year intervals based on carbon stock changes at a national level may underestimate fluxes. You should explore this point further. What is FAOSTAT missing in terms of emissions and</p>	<p>Section 2.3 now discusses this more thoroughly, identifying four specific limitations. Using initial biomass stock density for NFC underestimates emissions in countries with growing stocks and overestimates them in countries with decreasing stocks. Using national biomass density tends to underestimate NFC in countries where lost forests have above-average density. By construction, the 5-year stock-change approach captures net changes between reporting years but does not resolve interannual variability; it is a reasonable proxy for average annual fluxes but may not capture short-term events such as large fires or pest outbreaks.</p> <p>The uncertainty framework ($\pm 50\%$, 95% CI) is presented in Section 2.3, and the shaded areas in Figures 3a–c represent the corresponding uncertainty bounds around the intermediate FAO 2 model.</p>	

<p>removals by using stock-changes over 5 years instead of annually (e.g., interannual variability)? When are 5-year stock-changes a reasonable or unreasonable proxy for annual data (stock-change or gain-loss)?</p>		
<p><i>Comment 1:</i> Gross vs. net: It would be helpful if net emissions and removals were identified as such, to contrast them with the net fluxes.</p>	<p>The revised manuscript consistently uses “net emissions/removals” for FL, “net forest conversion emissions” for NFC, and “carbon stock change” (CSC) for their sum.</p>	
<p><i>Comment 2:</i> Where does non-forest converted to forest get assigned? Is it part of forest land? Either way, that should be explicitly stated. More generally, what is covered by forest land and net forest conversion? Does this vary by country (or over time)?</p>	<p>Section 2.2 clarifies with equations that NFC is computed from changes in naturally regenerating and planted forest areas, while the FL component captures carbon density changes on remaining forest land, including the afforestation component. Figure 2 illustrates these relationships..</p>	
<p><i>Comment 3:</i> How do the FRA and FAOSTAT relate to each other? This is described very briefly in the intro. Is FAOSTAT derived from the FRA itself, or just from the same country data?</p>	<p>Section 2 now clearly states that “FAO estimates were based on a carbon stock change approach (IPCC, 2019) applied to FRA country data.” FAOSTAT uses FRA data as input and applies consistent IPCC-based equations. FAOSTAT estimates are derived from FRA 2025 data. The FAOSTAT “Emissions from Forests” domain computes CO₂ emissions and removals following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). FRA data are available by country, with global coverage, for 1990–2025. Thus, FAOSTAT uses FRA data as input and applies consistent IPCC-based methods to generate harmonized global estimates, rather than being a separate independent dataset.</p>	
<p><i>Comment 4:</i> You say that “FAOSTAT statistics of CO₂ emissions and removals from forests include estimates of CO₂ fluxes on both forest land and on land lost due to net forest conversion. They are computed using carbon stock changes following the IPCC (2006) Tier 3, approach 1 guidelines (Tubiello et al., 2020), based on inputs of forest land area and biomass data from the FRA.” Has every country reported carbon stocks in 1990, 1995, 2000... (5-year intervals)? How does the FRA infer carbon stocks in years that countries don’t report? More generally, how is missing country data filled, if it is? This</p>	<p>Section 2.2 explains that estimates represent mean annual fluxes between FRA years (1990, 2000, 2010, 2020, 2025) and are extended to annual time series by repeating the mean annual flux. Section 2.1 lists FRA data sources including national forest inventories, remote sensing, administrative data, and expert opinion for gap-filling.</p>	

<p>would be another place to clarify the relationship between FRA and FAOSTAT.</p>		
<p><i>Comment 5:</i> Please include the uncertainty propagation calculations (and results) mentioned in Section 2.2.</p>	<p>Uncertainty in FAOSTAT estimates is propagated through the calculation of emissions and removals, based on assumed uncertainties in input data following IPCC 2006 guidelines. Section 2.3 presents the uncertainty framework ($\pm 50\%$, 95% CI), and Figures 3a–c show the corresponding uncertainty bounds as shaded areas around the intermediate FAO 2 model.</p>	
<p><i>Comment 6:</i> In “The FAOSTAT data show that forests acted globally as sinks of atmospheric CO₂ during the period 1991-2025 (-4.0 Gt CO₂ yr⁻¹) and specifically during 2021-2025 (Fig. 2).”, I think this is actually forestland, not forests, which I take to be forestland and NFC combined. Although, I am confused about the difference between the -4.0 and the -3.6 in the next sentence (which is also apparently forestland). Is -3.6 for 2021-2025?</p>	<p>Table 4 now provides clear breakdowns of CSC, NFC and FL by period; world total FL ranges from -3.6 to -5.7 Gt CO₂ yr⁻¹ in 2021–2025 (across the three FAO models), while CSC was approximately -0.8 to -1.8 Gt CO₂ yr⁻¹ in the same period. Terminology has been clarified throughout.</p>	
<p><i>Comment 7:</i> Where is the NGHGI data coming from, e.g., correlation with FAOSTAT (Section 3.2)? Why is the correlation between NGHGI and FAOSTAT for forestland included in the net forest conversion paragraph (line 142/143)? Aren’t FAOSTAT and NGHGI using similar data at their root (nationally reported data), which would mean that correlations between them are to be expected? A scatterplot of the forestland and NFC NGHGI-FAOSTAT correlations should be included if statistics are provided. Also, might not large forested countries skew this analysis?</p>	<p>UNFCCC sources are stated in Section 2; NFC and FL are now analyzed separately in Tables 6 and 7 within the country results (Section 3.2), and Figure 4 presents a side-by-side comparison for the top 10 countries. The high correlations provide meaningful validation since FRA and UNFCCC are independent reporting processes. Log-normalized values are used to reduce the effect of country size.</p>	
<p><i>Comment 8:</i> I think that lines like “in particularly removing on average more than -1 Gt CO₂ yr⁻¹ during 2001-2025 (-0.4 Gt CO₂ yr⁻¹ since 1990)” are confusing. I think this is referring to forestland + NFC, but Table 1 doesn’t show -1 Gt/yr for 2001-2025. Where is -1 Gt/yr coming from?</p>	<p>We agree with the reviewer and have reworked the sentence to increase clarity. The revised Table 4 now clearly separates CSC, NFC and FL values by period, eliminating the ambiguity.</p>	

<p><i>Comment 9:</i> What does “but never previously detected with this magnitude” mean (line 178)? Are you saying that this is a larger forestland sink than other approaches estimate? If so, you should explore this.</p>	<p>The Conclusions now state findings in context with established literature (Nabuurs et al., 2022; Friedlingstein et al., 2025), without the ambiguous phrasing.</p>	
<p><i>Comment 10:</i> Figure 2: I suggest including another set of bars at the right side of the graph to show the 1991-2025 averages (like in Table 1).</p>	<p>Figures have been updated for comprehensive time coverage.</p>	
<p><i>Comment 11:</i> Why does Figure 4 show 10 countries but Figure 5 only show 5 countries?</p>	<p>Figure 4 now shows the top 10 countries for both FL and NFC, presenting FAO and UNFCCC data side by side.</p>	
<p><i>Comment 12:</i> To what do you attribute the apparently high correlation between FAOSTAT and NGHGs in Figure 4 and the lower correlation in Figure 5?</p>	<p>The Discussion (Section 4) addresses this; NFC differences are concentrated in few countries (Brazil, DRC, and Indonesia), while FL differences are more widely distributed across the 13 countries identified in Table 8, reflecting data quality and boundary issues.</p>	
<p><i>Comment 13:</i> Given that this dataset ends in 2025, how are 2021-2025 values calculated? I imagine this varies by country but it needs to be explained. Are values from the most recent year extrapolated to 2025? Is the most recent year of data simply extended to 2025?</p>	<p>FRA 2025 data are provided for the years 1990, 2000, 2010, 2015, 2020, and 2025, as described in Section 2.1. For years without reported data (e.g., 1991–1999, 2001–2009, etc.), FAOSTAT uses mean annual fluxes computed between successive FRA periods, as explained in Section 2.2.</p>	
<p>Terminology is harmonized with CSC, NFC, and FL defined in Section 2.2 and illustrated in Figure 2, used consistently throughout the manuscript, tables and figures.</p>	<p>Terminology is harmonized with CSC, NFC, and FL defined in Section 2.2 and illustrated in Figure 2, used consistently throughout the manuscript, tables and figures.</p>	
<p><i>Technical corrections 1:</i> Line 84: Missing “for” after “available” in “The updated FAOSTAT dataset makes values available forest emissions/removals estimates by country”.</p>	<p>All technical corrections have been addressed in the revised manuscript.</p>	
<p><i>Technical corrections 2:</i> Line 89: Zenodo link doesn’t look complete.</p>	<p>All technical corrections have been addressed in the revised manuscript.</p>	
<p><i>Technical corrections 3:</i> Use of homogenously could be replaced with “equally” (e.g., like 103).</p>	<p>All technical corrections have been addressed in the revised manuscript.</p>	
<p><i>Technical corrections 4:</i></p>	<p>All technical corrections have been addressed in the revised manuscript.</p>	

Line 131: Should this heading also be
"Emissions/removals on forest land", like in line 98?

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