

Biogeosciences Discuss., author comment AC1
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Reply on RC1

Sirwan Yamulki et al.

Author comment on "Effects of clear-fell harvesting on soil CO₂, CH₄, and N₂O fluxes in an upland Sitka spruce stand in England" by Sirwan Yamulki et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-15-AC1>, 2021

Authors comment:

We are grateful for the careful consideration of our paper by the referee, and have considered all the points; our responses are given below.

Referee #1 comments:

Yamulki et al. present a four-year study quantifying the effects of clearfell harvesting on important soil greenhouse gas fluxes. Overall, the study is well designed and executed and descriptions of methodology and interpretation of results are thorough. Studies monitoring GHG fluxes across ecosystem and biomes are imperative to assessing present and future carbon source-sink dynamics following disturbance. However, I suggest the authors consider several comments below before a decision on acceptance. These concerns primarily relate to justification of scientific significance and clarification of how GWP results complement GHG flux analysis.

General Comments:

Justification of scientific significance:

The authors argue that there is inconsistency across the literature regarding the effect of clearfelling on soil GHGs. They present an extensive literature review of these inconsistencies, making up a bulk of the introduction. However, by the discussion and conclusion sections the authors have not specifically addressed how this study has helped to resolve the inconsistency issue, creating some disconnection between the knowledge gap that was set up in the intro and the interpretation of results. A meta-analytical or synthesis framework would be more appropriate to address this issue of inconsistency, which is not the goal of this contribution. Therefore, the authors should consider revising this initial pitch laid out in the introduction and focus more on knowledge gaps that this study directly addresses in order to avoid overstating or misrepresenting the scientific significance.

Authors comment:

We have carefully considered this point. We reviewed the literature to point out the variation in effects of clearfelling on GHG balances that have been found, and to outline the key factors that contribute to the variation. Our purpose was not to emphasise that there are 'inconsistencies' (we only used the phrase 'there is little consistent information' – which we have now reworded), but that the effect is (understandably) site specific and depends on many soil and climatic factor. We have shortened our introduction and reference less literature giving only the necessary examples to illustrate the factors and effects observed.

We disagree that we've overstated or misrepresented the scientific significance of our study. We specifically addressed in our "Discussion" all the key soil factors that affect GHG balance due to felling (e.g. temperature, moisture, pH, bulk density, roots, monitoring period length and methodology) that we mentioned in the "Introduction". We showed how our results compared with the relevant literature, and did not extrapolate wider, but only report and discuss how these measurements have helped towards the characterisation of the GHG balance of this country & climate specific forestry system (upland Sitka spruce plantations in the British Isles).

Referee #1 comment on "Clarification of how GWP results complement GHG flux analysis":

The authors do a thorough job interpreting results from each GHG flux, but there is a lack of synthesis to highlight the most important results and the broader implications of those results. Specifically, while I think the addition of GWP is an intriguing and powerful part of the analysis, the significance, relevance and context isn't fully developed relative to the GHG flux analysis. Authors state they measured GWP to assess the total GHG budget following clearfelling and alluded to the importance of including emissions from clearfell management in IPCC reports, for which it currently does not. However, they do not follow-through with how these results could be contextualized in this applied context and what conclusions can be made about "predicting rate and duration of changes in GHG balance by clearfelling..", as they stated in the introduction. Without such discussion, the calculation of GWP seems out of place and incomplete.

Authors comment:

With respect, we disagree with this view, and note that a similar criticism is not made by referee 2. As indicated above we believe we have shown and discussed the most important findings throughout this study in the Discussion, Conclusion and in the paper Abstract sections. However, we have made these clearer with rearrangements to the discussion about N₂O as suggested by the referee, thank you. We've shown (and quantified) how fluxes of CO₂, CH₄ and N₂O changed through the 4 years monitoring period as summarised in Fig 7 (will be Fig 6) and their main soil drivers.

With regards to referee's comment on how GWP results complement GHG flux analysis, we think there is a misunderstanding of what was implied by the term GWP in the Discussion section 4.4. We used it here only as a way to compare the relative importance of the different GHG fluxes, and to calculate the total GHG emissions in 'CO₂ equivalents' (as very commonly done). This follows the recommendations given in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), with CH₄ having a 34 and N₂O a 298 times greater GWP than CO₂ on a per mass basis over a time horizon of 100 years. We have rearranged this section to show the summary of the GHG balance first, then compare the GWP-weighted fluxes later, to avoid any misinterpretation of this simple (and common) analysis and used the term 'CO₂ equivalents' when describing the fluxes in Table 5 (will be table 4).

Referee #1 "Specific (line-by-line) comments" (RC1) and authors comments (AC):

Introduction:

RC1, Line 57-79: This paragraph is very lengthy and could be reduced to fewer examples of inconsistencies in the literature.

AC: We agree with referee 1. We've now reduced the paragraph to streamline it and include only a few recent relevant literature examples.

RC1, Line 81-82: There is very little explanation of why long-term studies of soil GHG are important, or could potentially clarify the inconsistency problem.

AC: Thank you - we have rephrased this to make the point more clearly that longer-term studies are necessary to characterise the changes that occur over time (periods of years)

since harvesting disturbance, which are not captured by short, post-felling period studies.

RC1, Line 83: "life-cycle analysis" needs to be defined/clarified.

AC: Thank you - we have rephrased this to clarify that we meant the complete forest growth cycle (i.e. not meaning LCA as is used in other disciplines).

Methods:

RC1, Figure 1: Include a scale for map.

AC: Thanks for pointing this out. Figure 1 is revised to include the scale and scale bar.

RC1, Line 102: Specify distance between A and B sites.

AC: The distance between areas A and B was approx. 2.5 km and is now included in the text.

RC1, Figure 2: Consider moving this Figure to an appendix

AC: Thanks for the suggestion. we've moved the Figure to Supplementary info as requested.

RC1, Line 178: If soil parameters were only taken once, differences between felled and unfelled could also be site-level variation. Authors should acknowledge this limitation.

AC: We acknowledge the referee's point that soil parameters were only measured on one occasion post-felling and were not sampled prior to felling, so could be due to site differences, not felling. We have noted this limitation in the results and discussion where e.g. bulk density comparisons are made as possible factors affecting altered GHG fluxes.

RC1, Table 1: Consider moving this table to an appendix.

AC: Thanks for the suggestion; we've moved this Table to Supplementary info as requested.

Results:

RC1, Table 2: Consider adding significance levels to this table.

AC: Thanks for the suggestion. As requested, we've added that the significance p-values for the mean differences were all < than 0.01.

RC1, Figure 4: This graph is clunky and challenging to read. Consider substituting for a line graph.

AC: Thanks for the suggestion; we've changed Figure 4 (will be Figure 3) to line graph as requested.

RC1, Table 3: Consider condensing this table down to the most important output and the rest could go in the appendix.

AC: Thanks for the suggestion. We agree with Referee 1 and have rearranged the Table and therefore we prefer to leave it in the main paper for the reader's benefit.

Discussion/conclusion:

RC1, Line 443-473: The main take-away from the N₂O results are not made clear in this section. In previous paragraphs, authors led with a concise summary of how CO₂ and CH₄ were overall affected by clearfelling, but that type of synthesis is lacking in this section.

AC: Thanks for the suggestion. We've now highlighted the main effect of felling on N₂O flux at the beginning of the section, by rearranging existing text.

RC1, Line 487-489: The sentence starting with "Over the 3 years since felling..." is the most important and concise synthesis of the GWP results from all GHG fluxes, consider emphasizing this point in the conclusions and placing this sentence towards the beginning of the paragraph.

AC: Thanks for the suggestion. We agree with the referee 1 about the importance of this

statement; however, this is already emphasized at the end of the conclusion as a closing statement indicating an overall reduction of 45% on a CO₂e basis; now further defined as GWP between brackets.

RC1, Line 503-506: Authors stated large discrepancies (3 fold differences) between GHG flux estimates and the previously published EC ecosystem respiration measurements at their site, calling to question the accuracy of scaling to large earth-system calculations of GWP, which rely on accurate absolute flux measurements. While it is important authors acknowledged this limitation here, they should also consider including this potential source of error directly in their discussion of GWP.

AC: With regards to the GWP question, please refer to our earlier response to the "Clarification of how GWP results complement GHG flux analysis" question above. The expression of GWP is only to enable all measured GHGs to be summed into total flux in CO₂ equivalents.

The differences between gas fluxes from the soil measured in this study and total ecosystem fluxes we reported should not be looked upon as a source of error. The differences arise from completely different temporal and spatial sampling as we noted in section 4.4. where we highlighted key possible reasons, including brash and belowground respiration of the colonising vegetation, which were not included due to the limitations of our commonly used small flux chamber methodology. We also discussed how the GHG balance would have changed if it was possible to also measure CH₄ and N₂O fluxes at a much larger scale from brash and soil below.