



EGUsphere, referee comment RC1
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Comment on egusphere-2022-1424

Anonymous Referee #1

Referee comment on "A new method for estimating carbon dioxide emissions from drained peatland forest soils for the greenhouse gas inventory of Finland" by Jukka Alm et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-1424-RC1>, 2023

Review report, egusphere-2022-1424

The paper addresses a very important and timely research question, i.e. the CO₂ balance of drained forested peat soils. The CO₂ emissions from drained forested peat soil receives currently a very strong attention in many countries. Accurate and precise methods to estimate the soil CO₂ fluxes, as well as the full ecosystem level CO₂ fluxes are urgently needed.

The overall approach is statistical modelling with the main data input from the national forest inventory and meteorological data and parametrization based on empirical data on litter production as well as decomposition of different main components from dominating plant functional types.

The main results is that forested drained organic soils in Finland represents source of CO₂ and that the total soil CO₂ emissions from these soils have increased from 1.4 to 7.9 Mt CO₂

for the period 1990–2021. Accounting for the entire ecosystem, i.e. also including photosynthesis and calculated for the whole country, forests growing on drained peatlands were a net sink of 0.2 Mt CO₂ in 2021, i.e. close to C neutral.

The paper is an important contribution to a science based ground for accessing the land-

atmosphere CO₂ balance of forested drained organic soils.

My major concern is that critical validation of the method is missing. The authors have made an extensive comparison with other emission factors. Still I am missing comparisons with direct measurements for a few example systems representing dominating types and climate settings. It is not an easy task, still urgently needed.

Also the current version of the abstract is hard to digest. It currently require that the reader has read the full article before reading the abstract. Please see detailed comments on the abstract.

Detailed comments:

L 15 Discharge C export needs at least to be considered and potential bias if not included must be discussed. Necessarily not in the discussion section

L15 conceptually I agree that the soil C balance is made up by just by above- and below- ground litter input and heterotrophic (saprotrophic) CO₂ respiration. AND possibly also discharge C-export. It is though important to clarify why autotrophic root respiration is excluded.

16-17 Reformulate. Peatlands drained for forestry release CO₂ even if the WT is not change. The change in WT due to drainage and forest ET may change the soil CO₂ flux but also non-drained peatlands release soil CO₂.

L 20 here it is absolutely necessary that you clarify that the CO₂ flux you model emanate from saprotrophic CO₂ production only. Not stating this explicitly will confuse many readers.

L 24 do not understand. How is "harvested" trees included?

L25 what area is the CO₂ emission representing? Is it total or per unit area? I would very much prefer first presenting per unit area, e.g. m⁻² or ha⁻¹ and then areal totals. Currently it is very confusing.

L25 "1.4 to 7.9 Mt CO₂" You must add time unit, i.e. yr⁻¹.

L27 is this totals for northern and southern Finland or what?`

L28 what about the forest floor PFT's contribution to CO₂ uptake. It can be substantial. If it is not in your data it must be clearly stated that its contribution is so small that it can be neglected, which I really doubt.

L25-30 this result section is very confusing. I suggest presenting both unit area based estimates (also adding the time unit (yr⁻¹)) and areal totals

L49 In the abstract you state an annual drained peatland soil CO₂ flux during 2021 of 7.9 Mt and in the introduction state 3.8 for 2020. Thus you need to be specific in the introduction and clarify that according to method xx the annual peatland soil CO₂ during 2020 was 3.8 Mt

L63-63 does these references really refer to saprotrophic CO₂ flux, NOT including ANY autotrophic respiration. It is very important that you make this very clear. As "soil CO₂ flux" normally includes also the autotrophic root respiration I think it is very important that you make it very clear in all of the text what you actually include.

L80 "... by the old method" You must add reference after this statement

L 87 C mass input

L 91 think the sentence "Negative values denote net removal of CO₂ from the atmosphere" is confusing. While a forested peatland represent a net removal from the atmosphere depends on the entire system (ecosystem) and not just the soil.

I suggest that you instead use something like "Negative values denote net increase of soil C and also suggests that the reference to the atmosphere only is valid when considering the entire ecosystem, not just the soil system.

L117 "The areas and proportions of FTYPEs of all drained *peatland forests remaining forest* in southern and northern Finland,"

!Something is missing in phrase in italics above

L258 ??? "uncertainty less than 100 %;" what does this mean, 2% or 98% or what?
Reformulate

L256 – 264 would very much prefer to have data first presented related to unit area, e.g. ha and then as areal totals. Just having national or regional totals makes it impossible to relate to quantitative data from other sources.

L296 give reference to "Yasso07 modelling"

L 320-321 for the autotrophic CO₂ sink strength you must include also the forest floor vegetation component. If not including you must at least do a sensitivity analysis on how not including that term affects the results.

L 330-331 the increase in annual temperature is NOT relevant. It is only changes in temperatures above zero (simplifying but much better than referring to annual averages) that actually affects the production or decomposition. If winter time temperatures are -10 or -4 does not affect either litter production or decomposition. Please refer to only

seasonally relevant temperatures. Also differentiate between direct temperature effects and e.g. changes in growing season lengths.

L 332 how can the temporal increase in soil CO₂ flux be 8.1 when you in the result section state a change from 1.4 to 7.9 Mt over the studied time period?