GHG emissions from drained versus undrained organic soil:

is it consistent with IPCC Guidelines to report GHG emissions from drained soil rather than the impact of drainage

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Presentation content

Introduction with results of recent studies on drained and undrained hemiboreal forest organic soil C balance and GHG emissions:

- LIFE OrgBalt – Demonstration of climate change mitigation measures in nutrients rich drained organic soils in Baltic States and Finland:
    - Butlers A., Laiho R., Soosaar K., Jauhiainen J., Schindler T., Bārdule A., Kamil Sardar M., Haberl A., Samariks V., Vahter H., Lazdiņš A, Čiuldienė D, Armolaitis K., Līcīte I. Soil and forest floor carbon balance in drained and undrained hemiboreal peatland forests. **Manuscript submitted for publishing to Biogeosciences**
    - Kamil Sardar M., Schindler T., Vahter H., Butlers A., Vigricas E., Kull A., Līcīte I., Bārdule A., Čiuldienė D, Lazdiņš A., Jauhiainen J., Mander Ü., Laiho R., Soosaar K. Emission factors of soil CH4 and N2O from drained and undrained hemiboreal peatland forests. **Manuscript in preparation**
- LV MNKC - Elaboration of guidelines and modelling tool for greenhouse gas (GHG) emission reduction in forests on nutrient-rich organic soils
    - Butlers A., Lazdiņš A., Kalēja S., Bārdule A. (2022). Carbon Budget of Undrained and Drained Nutrient-Rich Organic Forest Soil. Forests, 13(11), 1790. **DOI: 10.3390/f13111790**
    - Butlers A., Lazdiņš A., Kalēja S., Purviņa D., Spalva G., Saule G., Bārdule A. (2023). CH4 and N2O Emissions of Undrained and Drained Nutrient-Rich Organic Forest Soil. Forests, 14(7), 1390. **DOI: 10.3390/f14071390**

Soil C balance and GHG emission monitoring sites

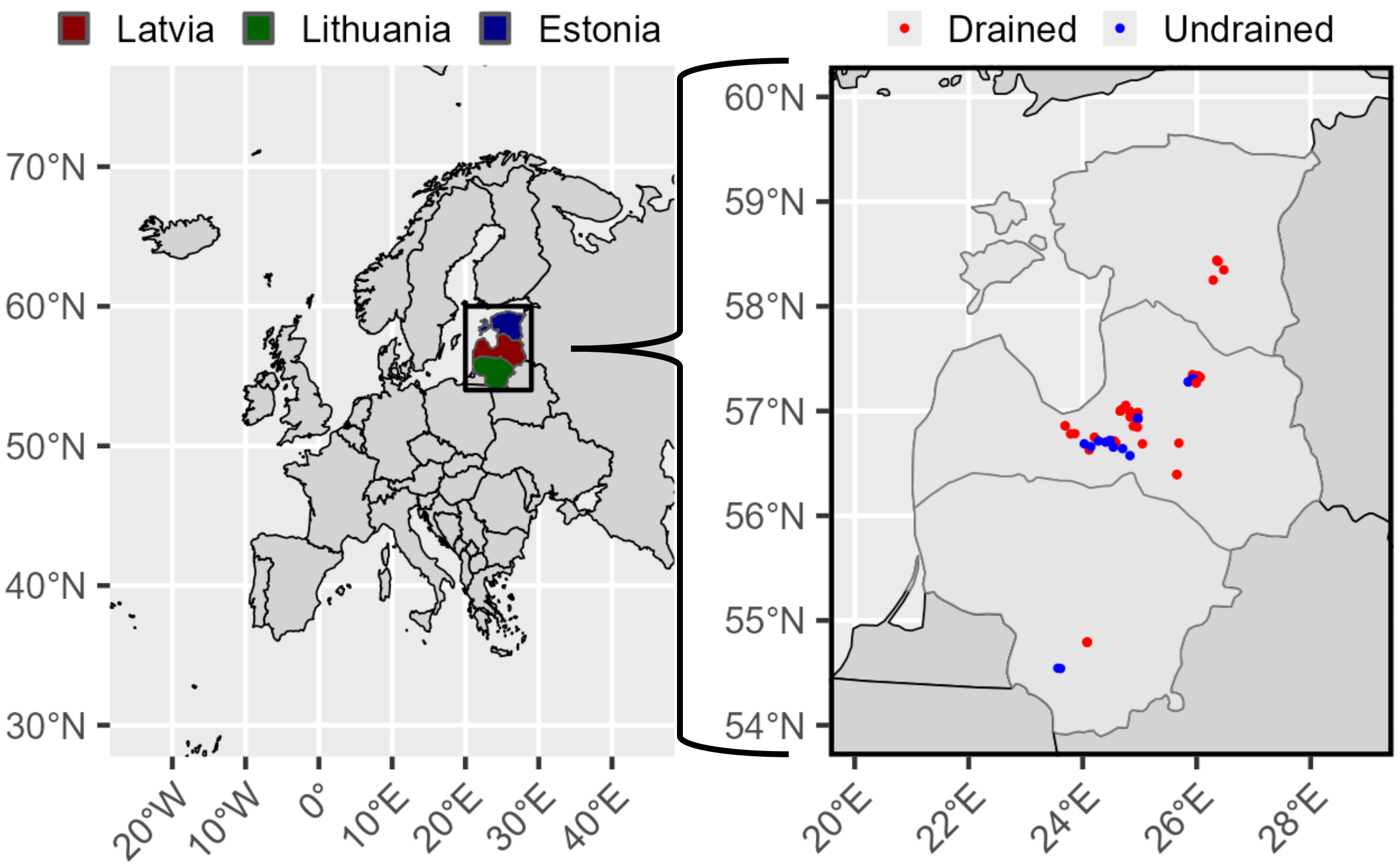
57 study sites in forest land

52 forest stands:
- Drained: 36
- Undrained: 16

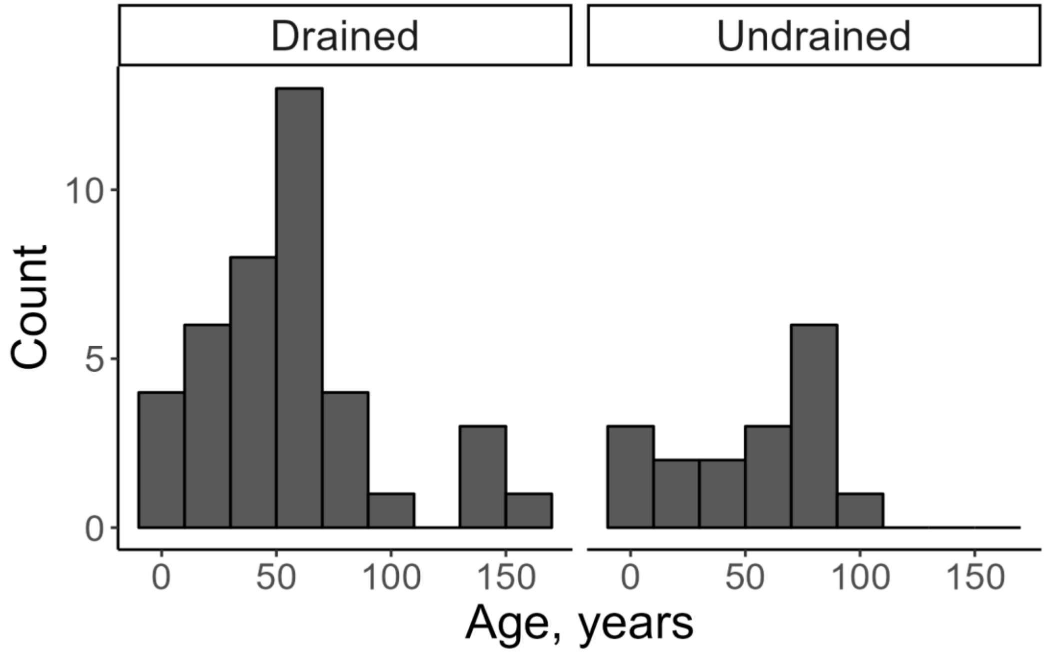
5 Clearcuts:
- Drained: 4
- Undrained: 1

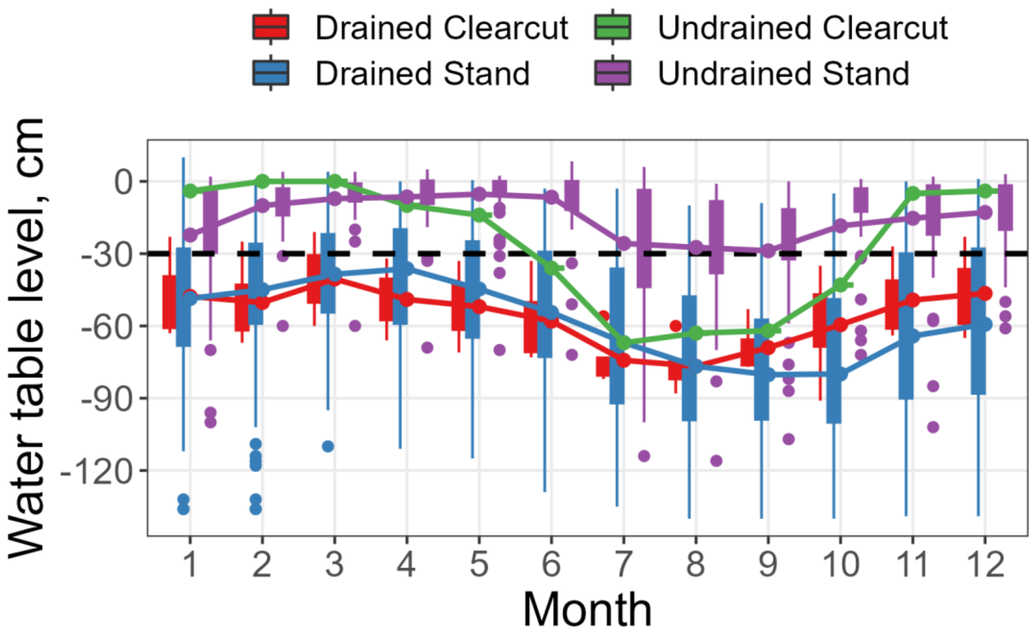
Peat layer depth, cm:
- Drained: >20
- Undrained: >30

Dominant tree species:
- Silver birch
- Black alder
- Norway spruce
- Scots pine



Age of forest stands and water table level





Age, years	Min	Q1	Mean ± SD	Q3	Max
Drained	14	41	64 ± 36	71	162
Undrained	10	40	58 ± 26	78	96

Mean WTL, cm	Min	Q1	Mean ± SD	Q3	Max
Drained	159	79	61 ± 30	39	20
Undrained	83	28	25 ± 22	12	4

Measured fluxes

<u>C input to soil:</u>

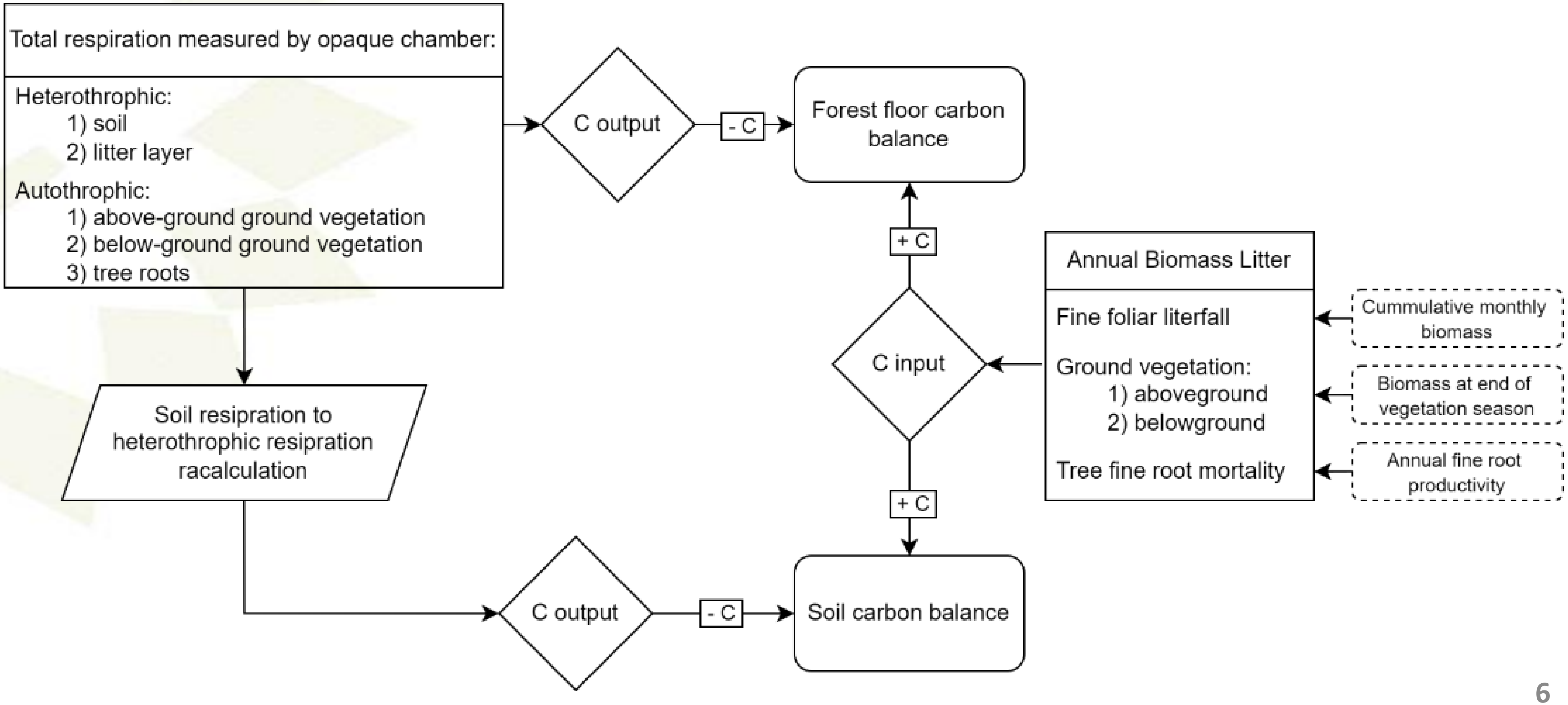
- Foliar fine litter;
- Ground vegetation;
- Fine roots of trees

<u>Soil GHG emissions:</u>

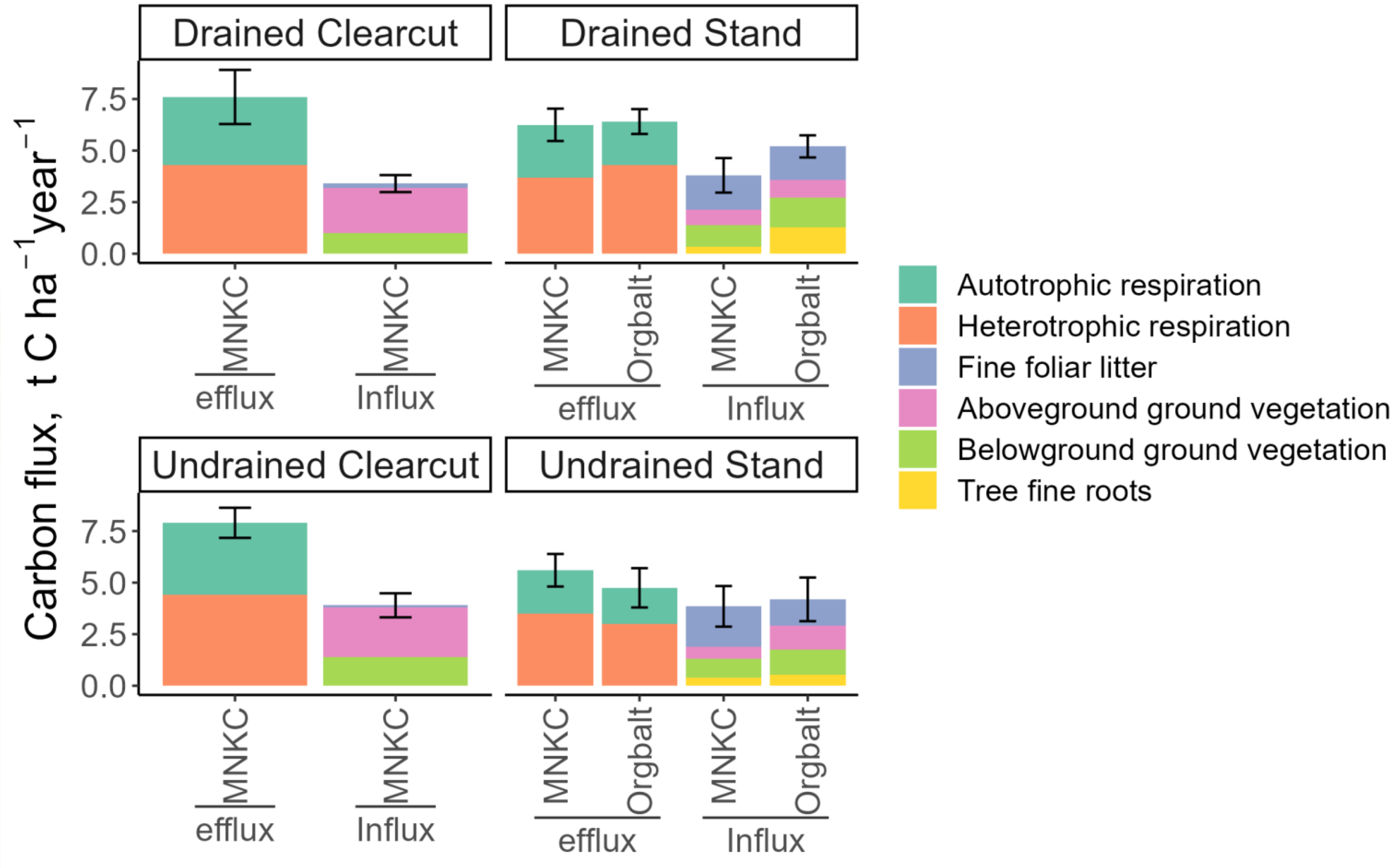
- Heterotrophic respiration
- Total respiration
- CH_4 and N_2O

+ auxiliary data

Soil and forest floor C balance estimation



Soil and forest floor C balance

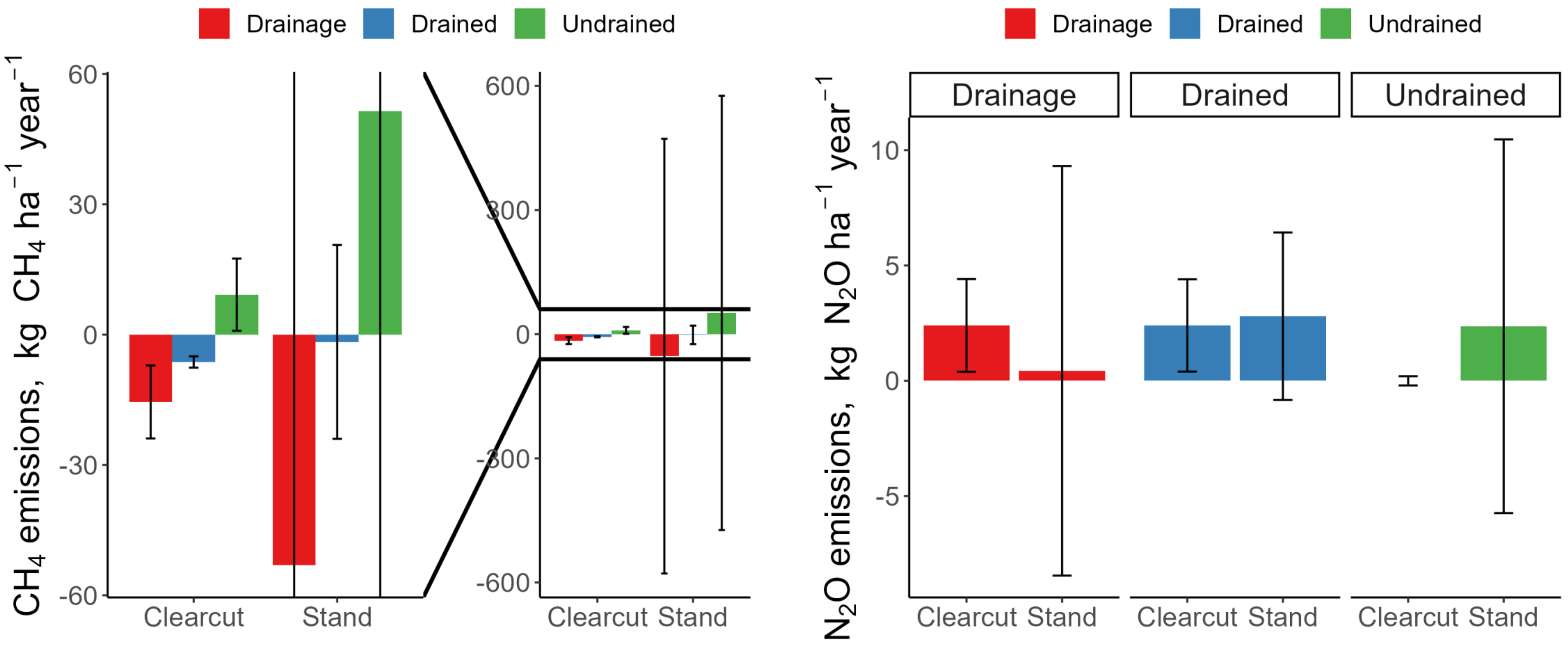


C balance in clearcut*	Drained	Undrained	Drainage impact
Forest floor	-4.2±2.2	-4.0±1.33	-0.2±2.61
Soil	-0.9±0.7	-0.4±0.4	-0.4±1.25
Mean	-2.55±2.45	-2.25±1.54	-0.3±2.89

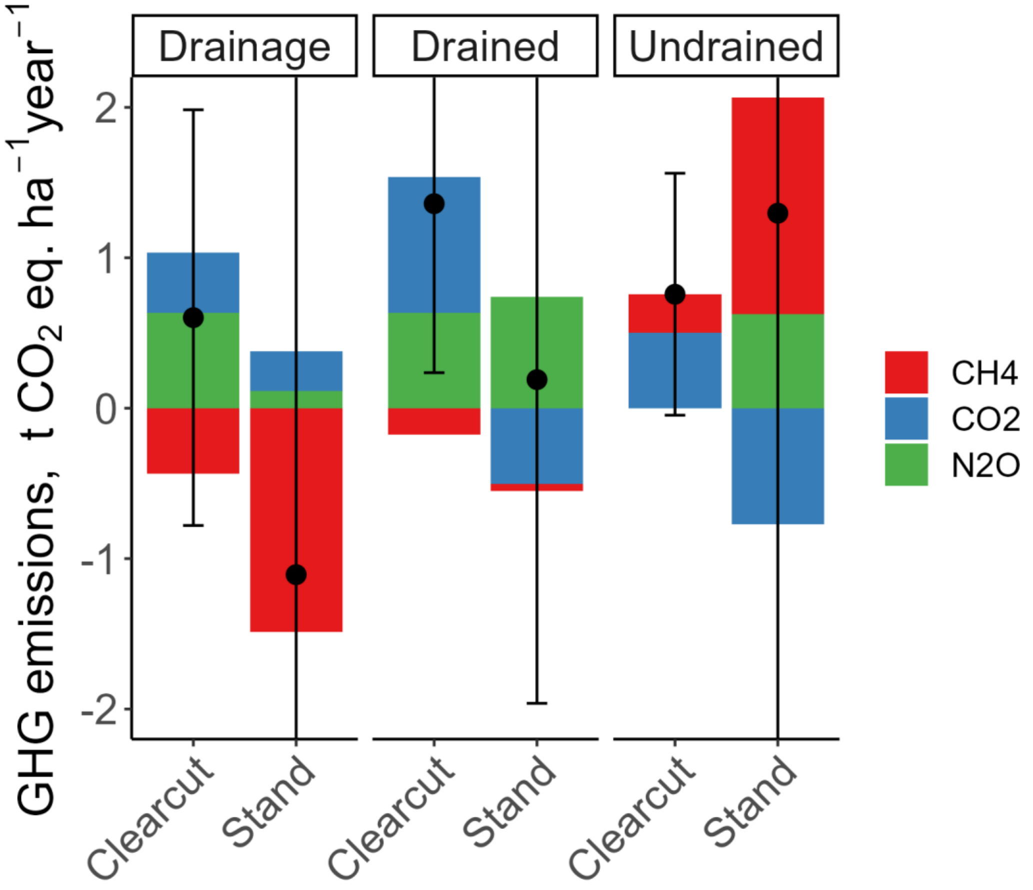
C balance in stand*	Drained	Undrained	Drainage impact
Forest floor	-1.75±1.83	-1.12±2.34	-0.64±2.97
Soil	0.51±1.82	0.77±1.87	-0.27±2.61
Mean	-0.63±2.58	-0.17±3.00	-0.45±3.96

*Negative values indicate C loss, t C ha^{-1} $year^{-1}$

Soil CH_4 and N_2O emissions



GHG emissions in CO_2 equivalents (AR5)



t CO_2 eq. ha^{-1} year^{-1}	**Drained**	**Undrained**	**Drainage impact**
Stand	0.19 ± 2.15	1.30 ± 14.97	-1.11 ± 15.12
Clearcut	1.36 ± 1.12	0.76 ± 0.80	0.60 ± 1.38

Pros and Cons of Estimating Relative Anthropogenic GHG Emission Impact

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Advantages and Challenges:

- Comparing GHG emissions from drained and undrained sites offsets potential estimation biases
- More accurate estimate of drainage's human-induced climate impact, avoiding overestimation of emissions
- More empirical data needed, consequently requiring the combination of relevant uncertainties

Opportunities:

- Enables a more accurate comparison of projected impacts resulting from climate change mitigation measures
- Mitigates the risk of achieving the opposite effect when implementing climate change mitigation measures