Zemes izmantošanas SEG akualitātes, izaicinājumi un jaunākās atziņas

Greenhouse Gas Emissions from Land Use: Recent Developments, Challenges, and New Insights

Latvijas Mežu sertifikācijas padomes 11. starptautiskā konference
Vide un ilgtspējīga meža uz zemes pārvaldība – Aktuālākie risinājumi

2026. gada 29. okobris,
Latvijas Biozinātņu untehnoloģiju universitāte, Meža un vides zinātņu fakultāte

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Latvian State Forest Research Institute "Silava"

Presentation outline

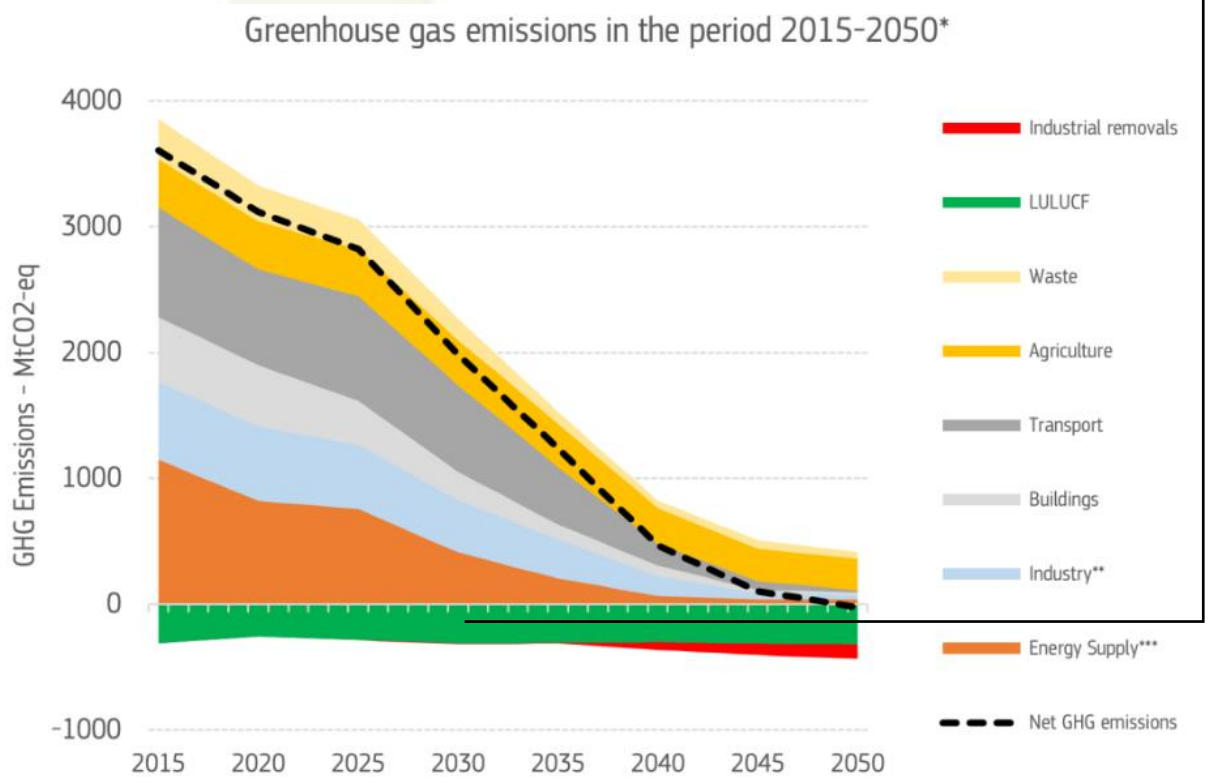
Pressing Land-Use Questions for Achieving Climate Policy Goals:

- Are harvesting restrictions a climate change mitigation measure?
- Should rewetting be prioritised over afforestation to reduce emissions from agricultural lands with organic soils?



  - Limitations and Opportunities of carbon sequestration in biomass
  - Importance of temporal perspective and local conditions

EU climate target 2050: net zero emissions



*Source: PRIMES, GAINS, GLOBIOM
**Excluding non-BECCS industrial removals
***Including Bioenergy with carbon capture and storage (BECCS)

LULUCF is expected to offset GHG emissions in other sectors

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Forest land

↘

Biomass

↘

Requires continuous accumulation of living and dead biomass in forests

↘

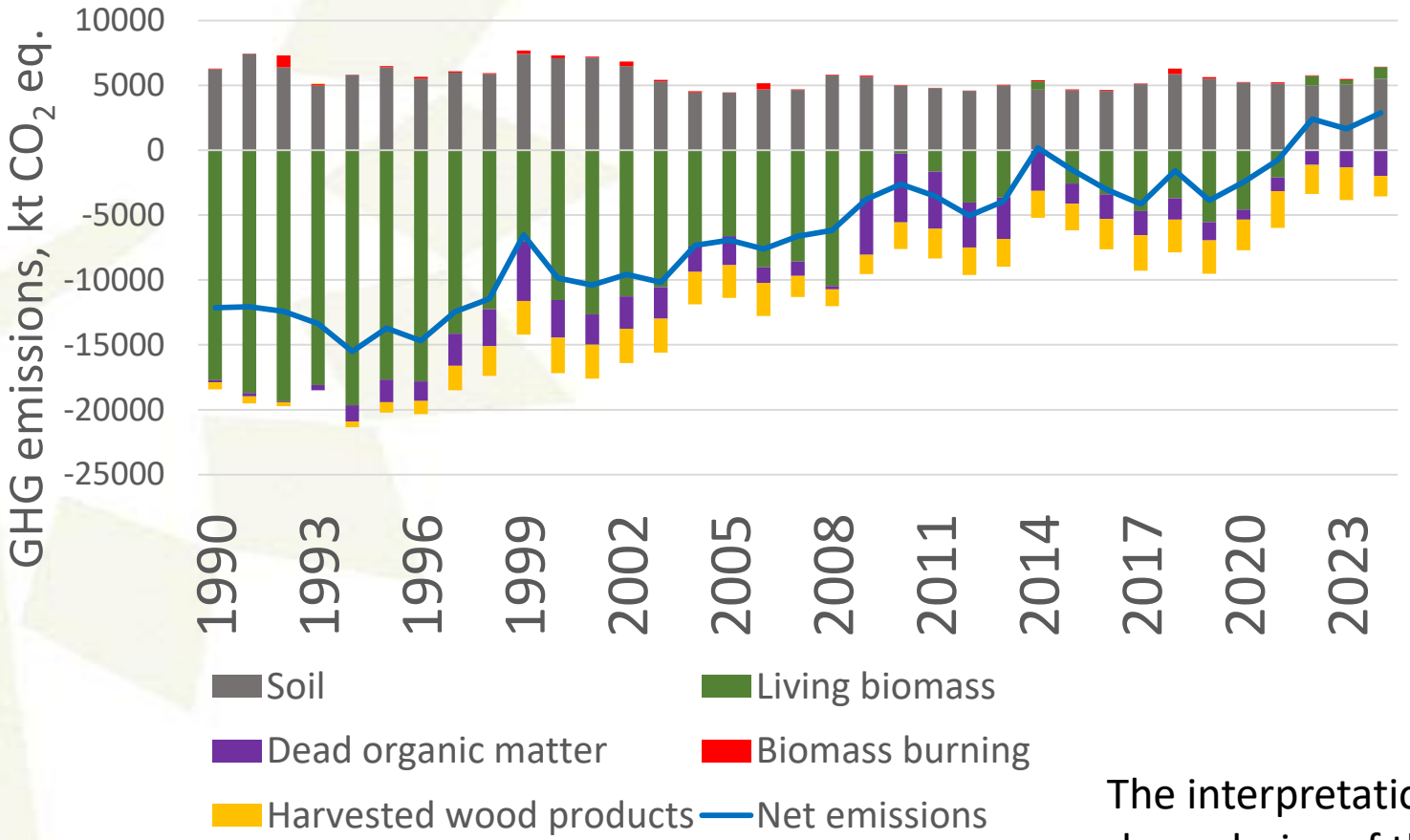
Is this possible without afforestation and reforestation?

↑↑↑

In the short term – yes!
Should we do it?

GHG emissions and removals of LULUCF sector.

Is the window 1990 - 2024 sufficient to assess the climate impact of land use (forestry)?



Typical LULUCF sector outlook of a country with high forest cover/developed forestry

A declining rate of biomass carbon-stock increase is perceived as undesirable—but should it be?

Can the continuous increase in forest carbon stocks expected by policy be sustained indefinitely

The interpretation of carbon dynamics depends on the temporal boundaries of the assessment in the context of the forest area.

Latvia's forest cover has doubled in 100 years

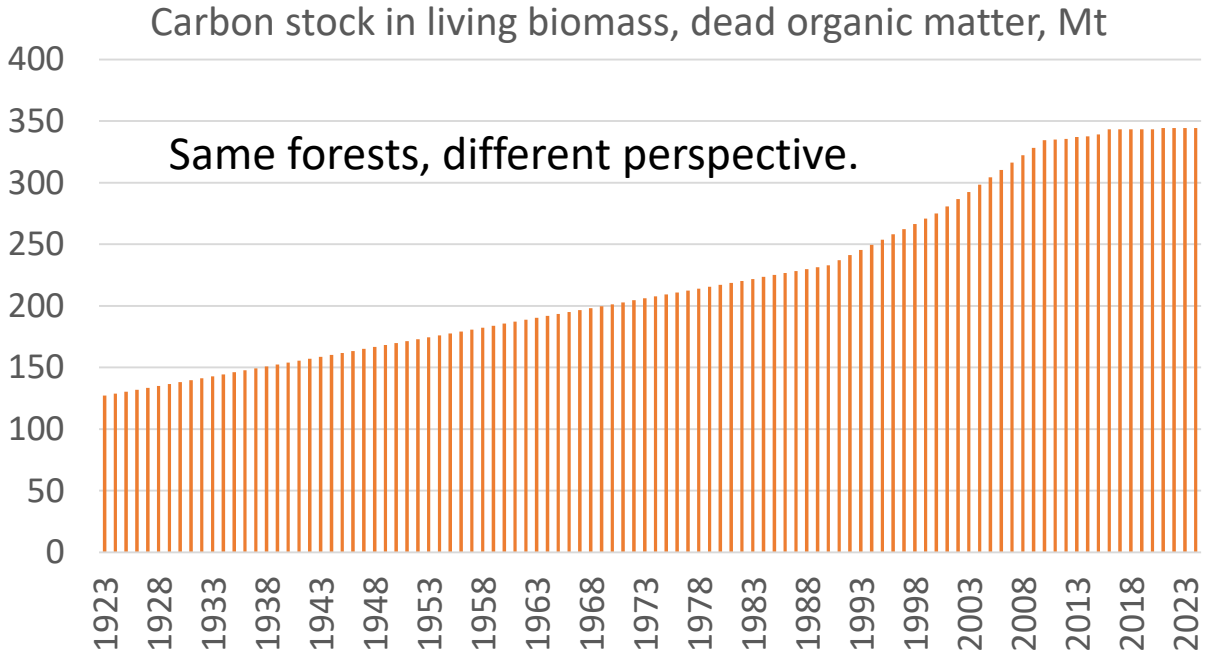
Implications on Forest land "CO_2 emissions"?



(Donis et al., 2017)

Donis J., Kitenberga M., Šņepsts G., Matisons R., Zariņš J., Jansons Ā. (2017). The forest fire regime in Latvia during 1922–2014. Silva Fennica vol. 51 no. 5 article id 7746. https://doi.org/10.14214/sf.7746

- Increase in C stocks is limited by forest area and capped with or without harvesting
- Unmanaged forest cap may be higher, but **is harvesting undesirable?**

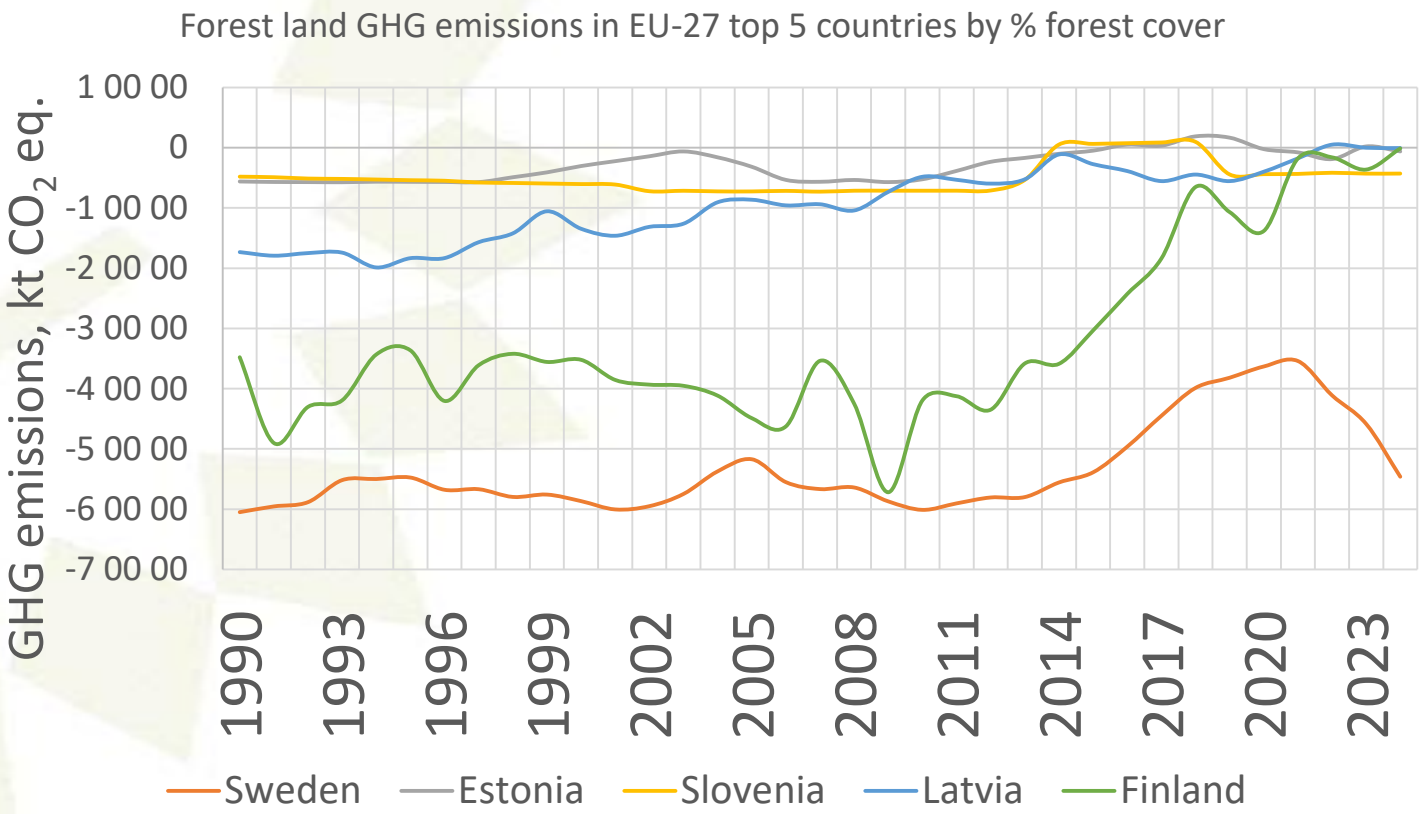


Source: FAO

1990 C stock (t ha^{-1}) of deadwood, litter, above- and belowground biomass assumed for 1923-1990,

GHG emissions and removals of LULUCF sector.

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Typical LULUCF sector outlook of a country with high forest cover/developed forestry

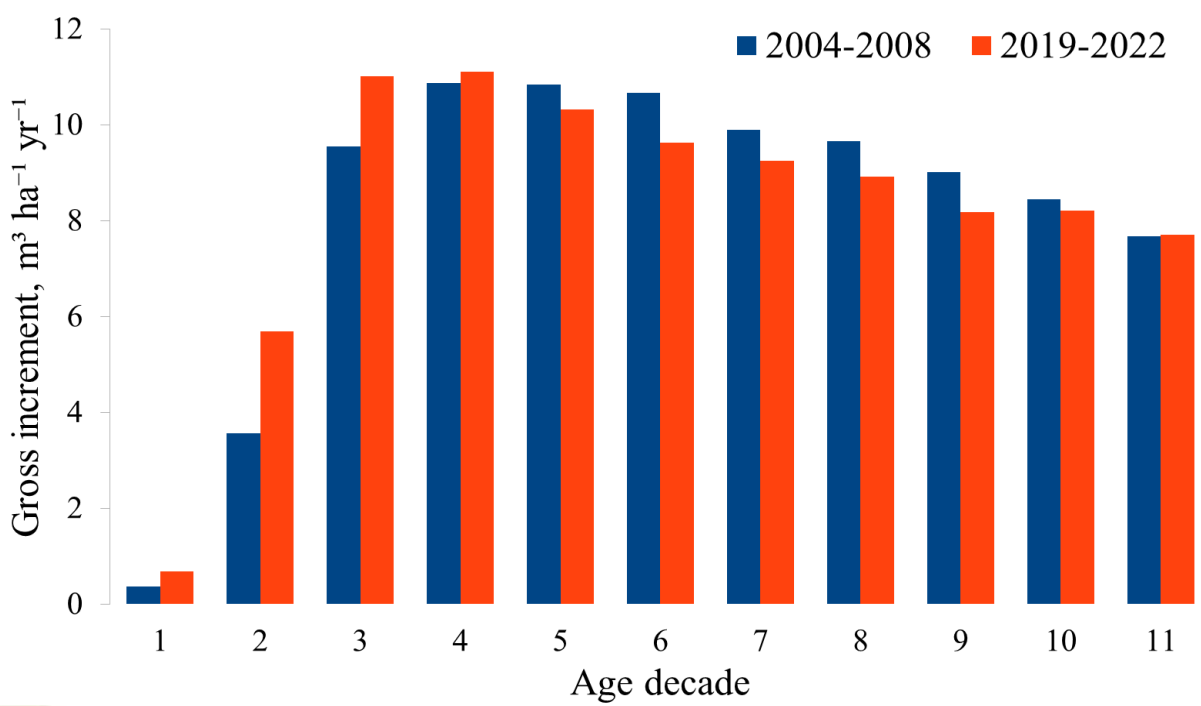
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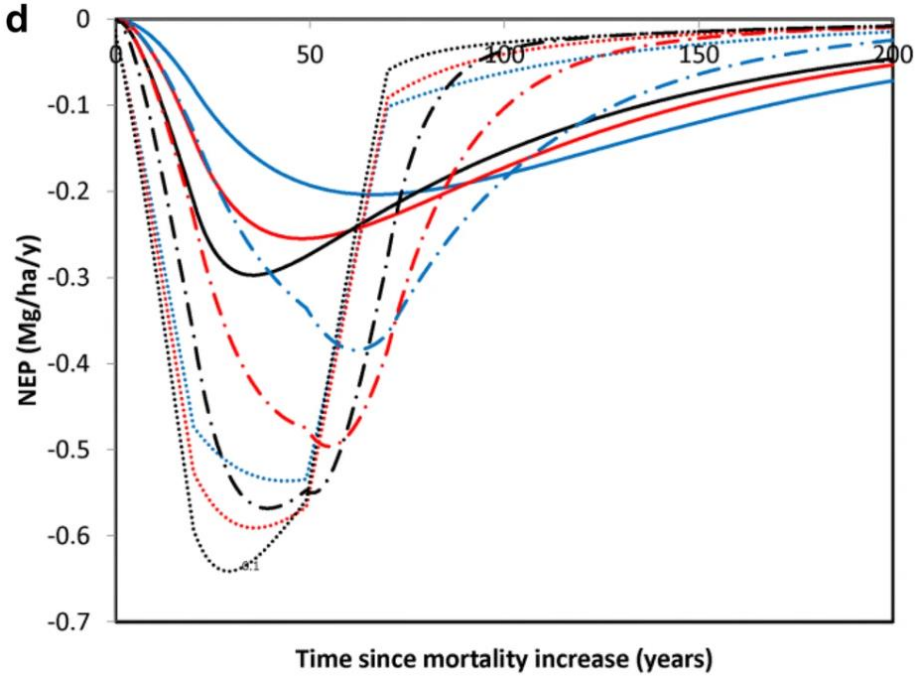
The interpretation of carbon dynamics depends on the temporal boundaries of the assessment in the context of the forest area.

Effects of forest age structure and natural mortality on increment and net primary productivity

Gross increment by forest age decade



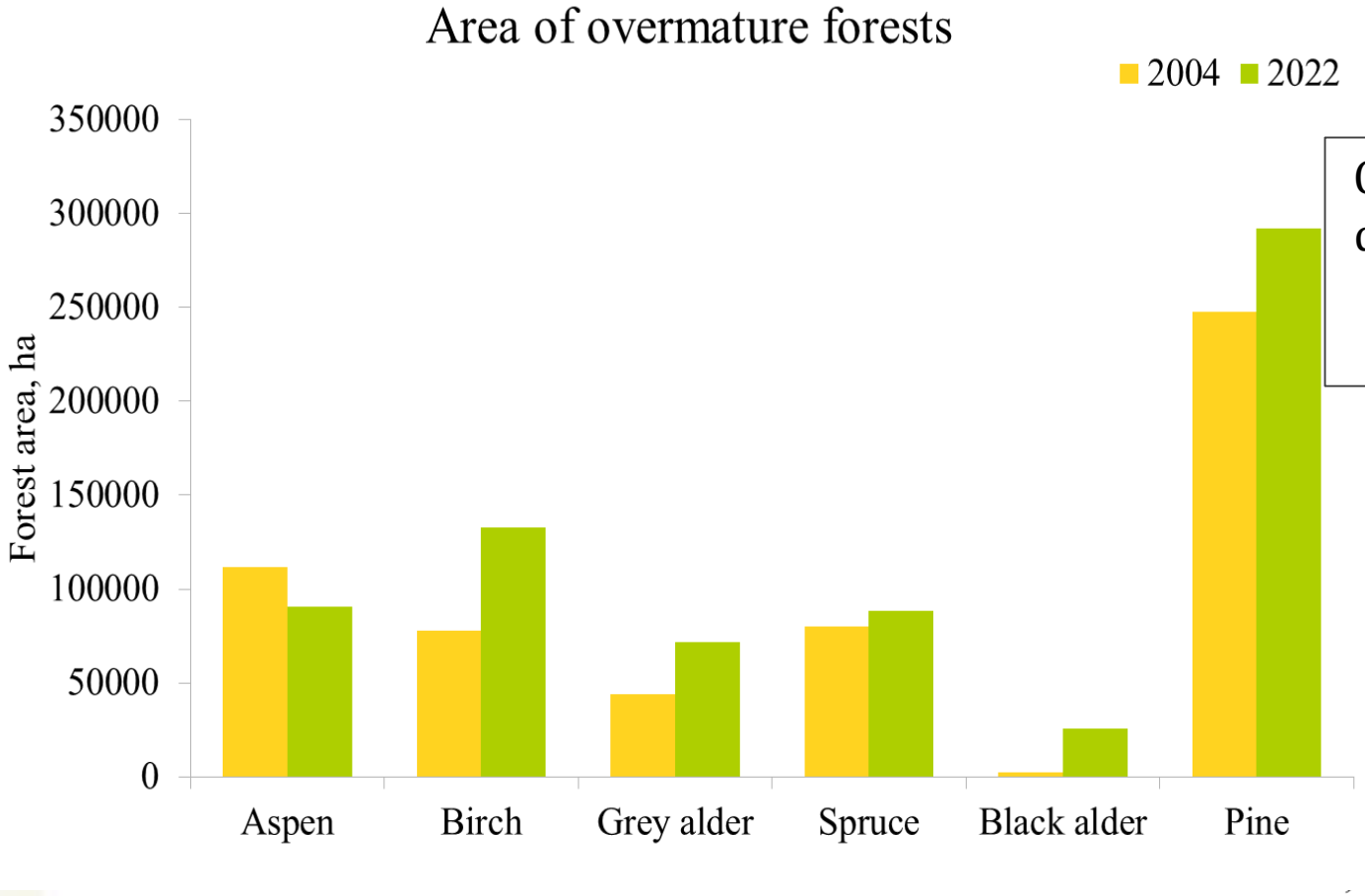
Increased natural mortality and reduced NPP, can turn forests from carbon sinks into carbon sources

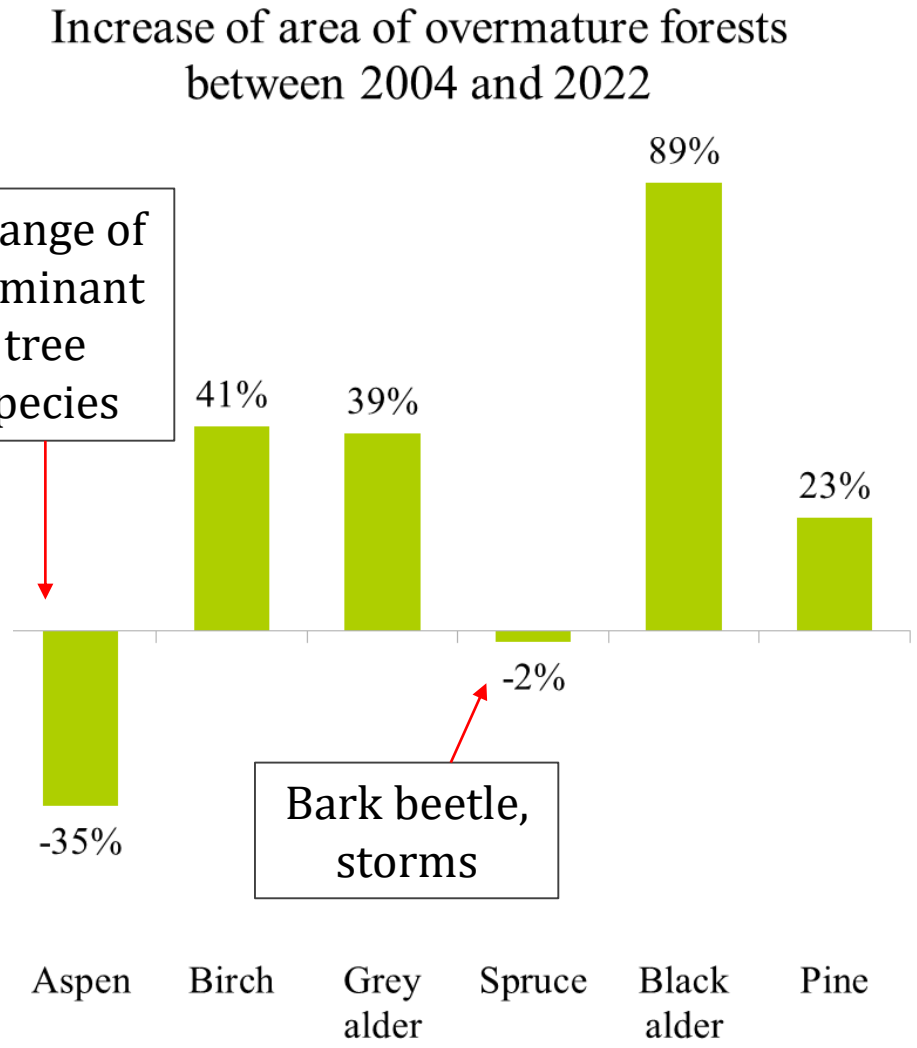


Negative NEP represents net ecosystem carbon loss. Hypothetical model simulation of a permanent 20% increase in mortality and a temporary 20% reduction in NPP for 50 years

https://doi.org/10.1186/s13021-019-0136-6

The proportion and age of overmature forests in Latvia are increasing

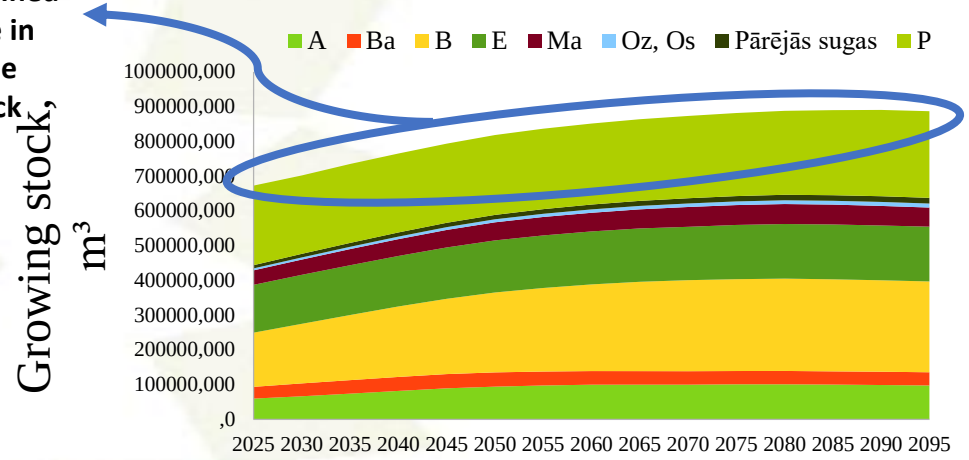


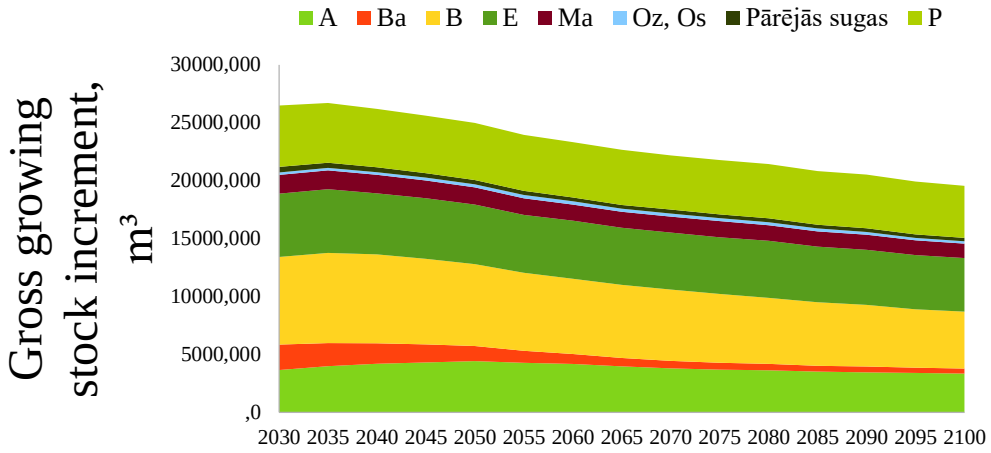


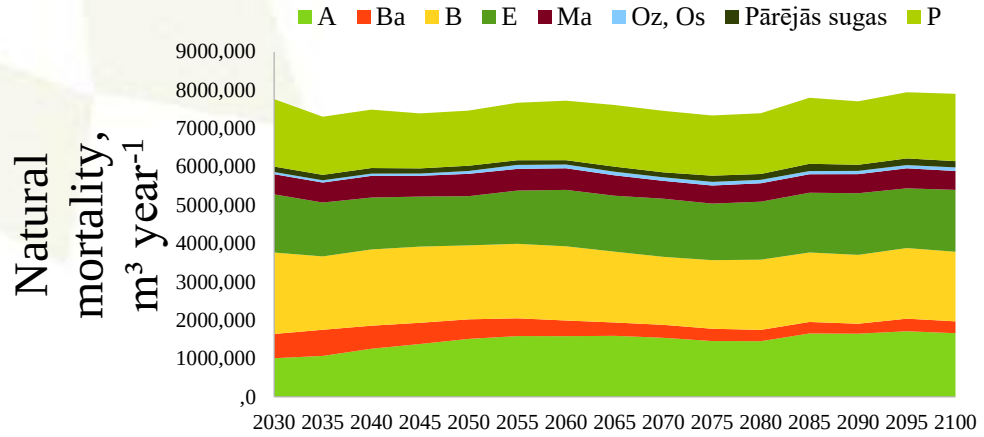
Projected impact of a 30% reduction in harvesting

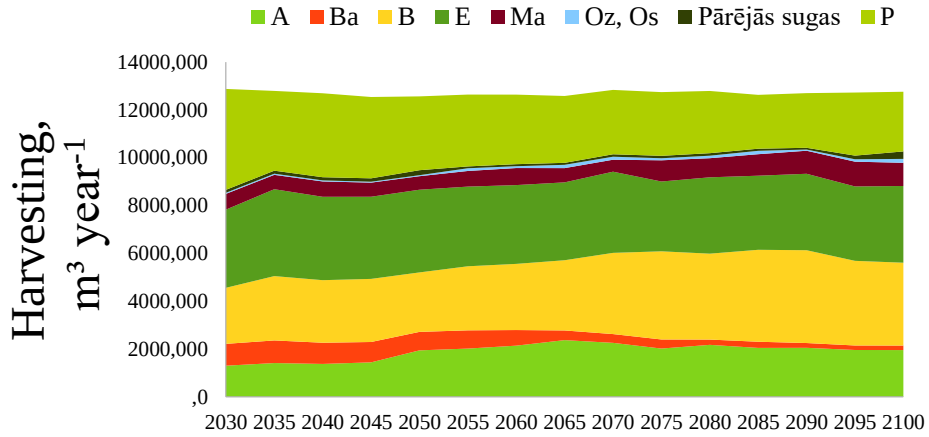
Forest growth outlook

The GHG inventory result is determined by the change in stock, not the absolute stock



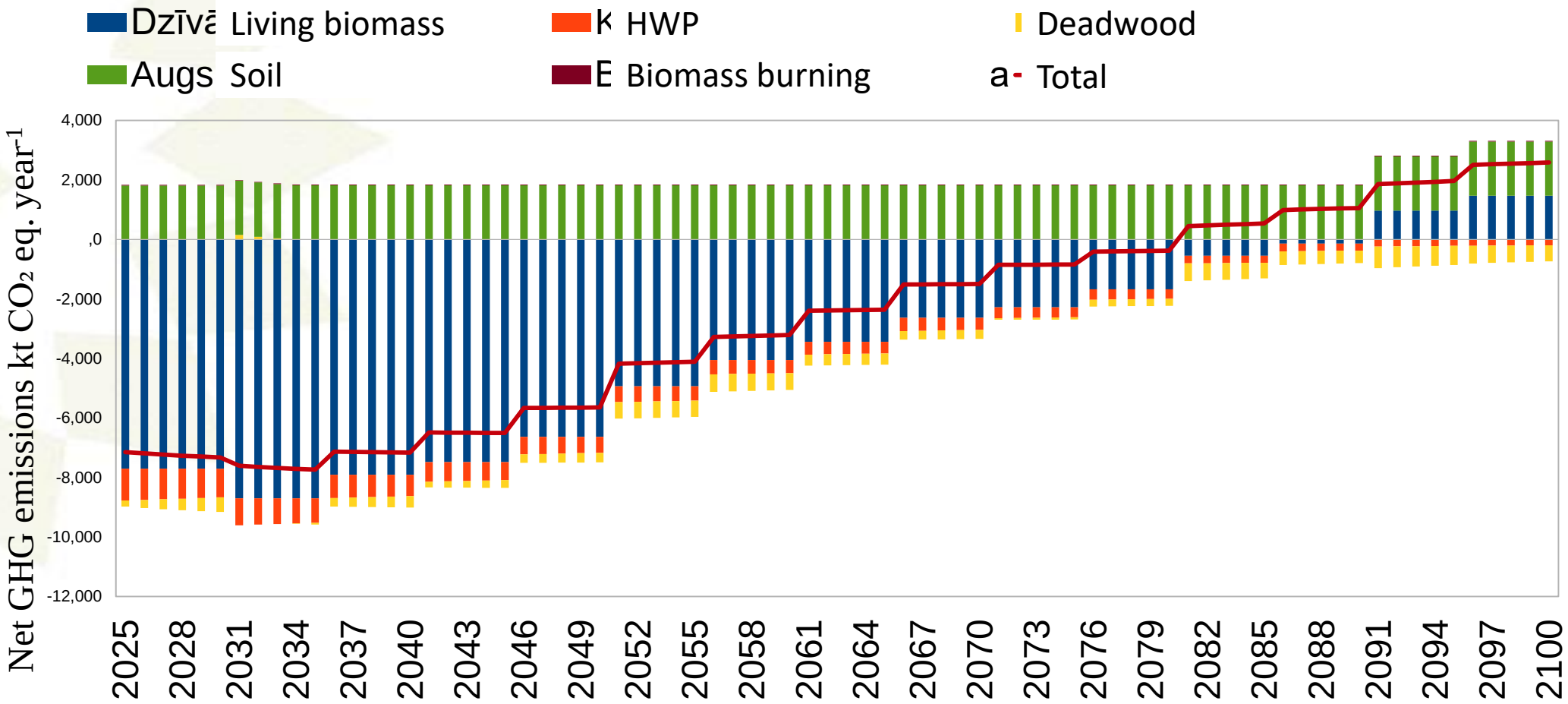






Projected impact of a 30% reduction in harvesting

GHG inventory outlook



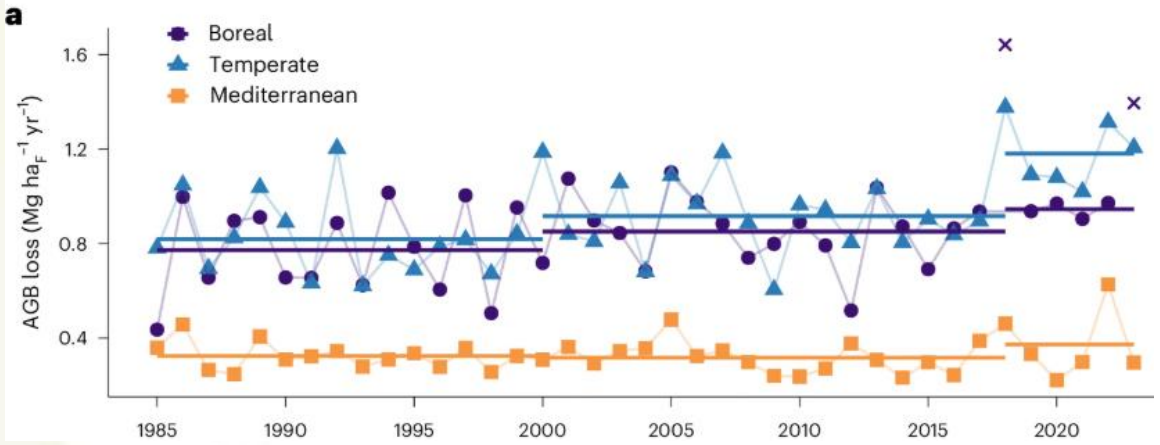
Natural disturbances challenges European forests as a climate solution

Analysis | Open access | Published: 05 August 2026

Accelerating biomass loss from forest disturbances across Europe

Katja Kowalski, Alba Viana-Soto, Martin Brandt, Philippe Ciais, Wanda De Keersmaecker, Rasmus Fensholt, Thomas A. M. Pugh, Yidi Xu & Cornelius Senf

Nature Geoscience **19**, 1132–1138 (2026) | Cite this article



From 1985 to 2023, 18% of gross aboveground biomass losses, were caused by high-severity natural disturbances

Total annual biomass losses increased by 46% from 2018 onward, coinciding with unusually high natural-disturbance activity in biomass-rich temperate forests

What do people think about forests in the EU?

Published 23 February 2021 By Ranacher et al.

«The preference for the environmental benefits of forests partially translates into the perceptions of forest management in Europe.»

- timber and fuelwood benefits are generally ranked below environmental forest benefits;
- the carbon-storage and material-substitution benefits of wood are often questioned or poorly recognised.

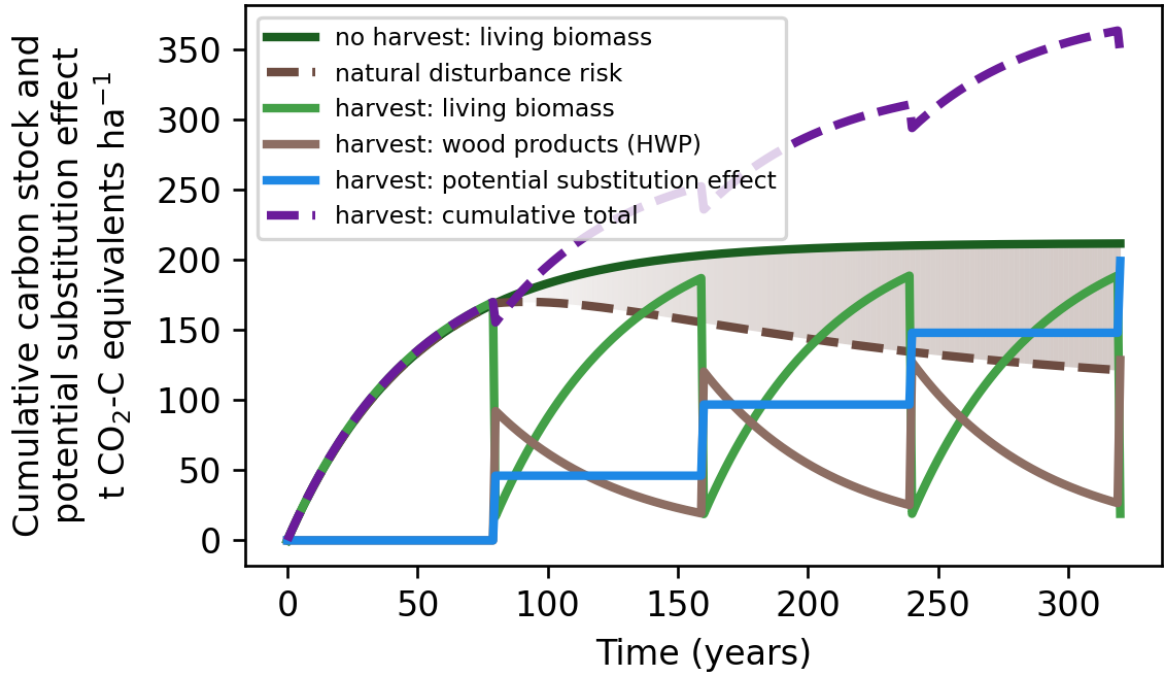
As disturbance risks increase, should sustainable harvesting be increasingly recognised as carbon-risk management?

Longevity and permanence of climate mitigation from Harvested Wood Products

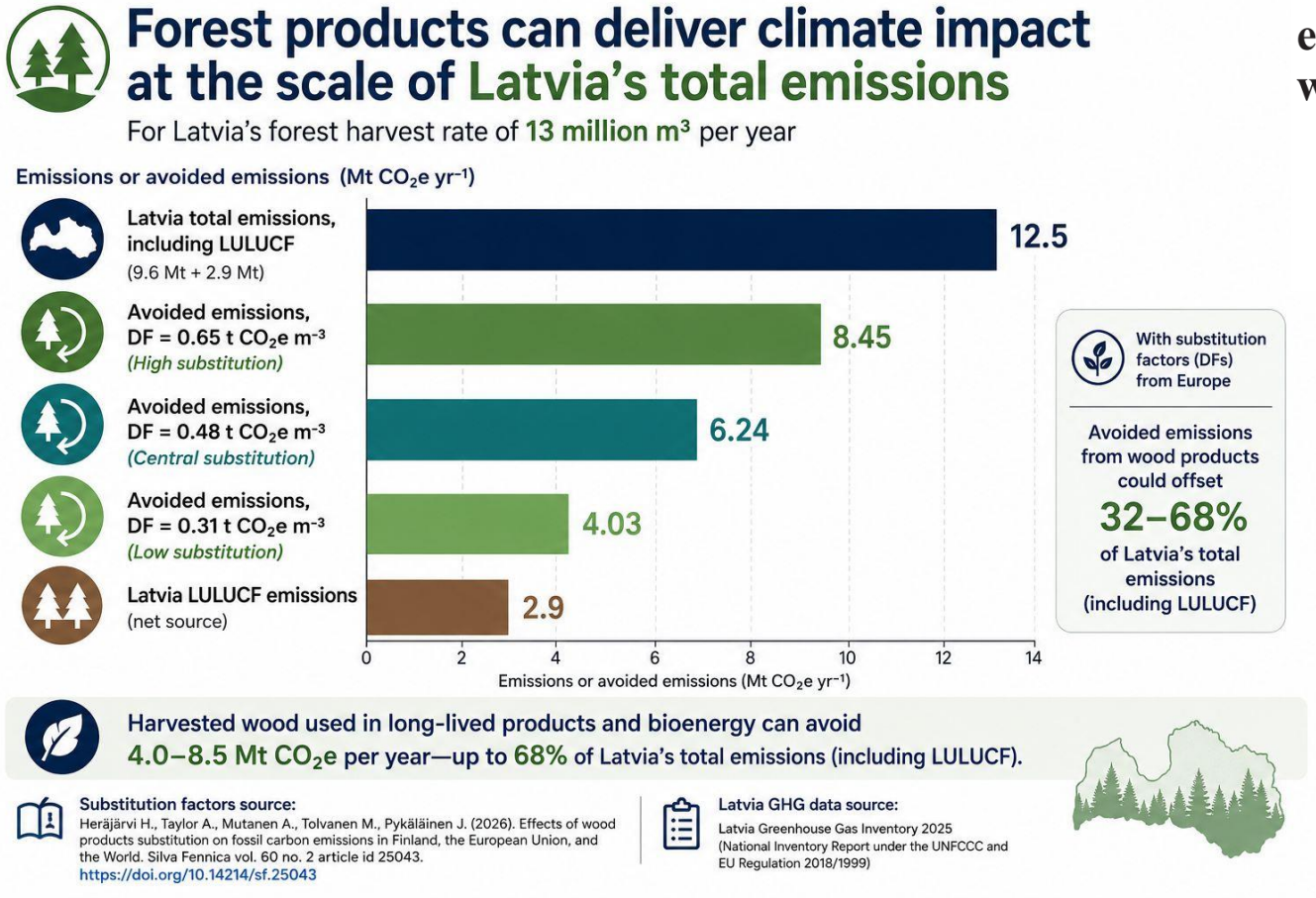
Misconception: the climate benefit of harvested wood products is short-lived.

Reality: carbon storage may be temporary, but sustainable production and fossil-carbon substitution can provide immediate and permanent benefits.





Harvesting is the main forest management related climate change mitigation measure



Effects of wood products substitution on fossil carbon emissions in Finland, the European Union, and the world

Heräjärvi H., Taylor A., Mutanen A., Tolvanen M., Pykäläinen J. (2026). Effects of wood products substitution on fossil carbon emissions in Finland, the European Union, and the world. Silva Fennica vol. 60 no. 2 article id 25043. 18 p. https://doi.org/10.14214/sf.25043

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Harvesting

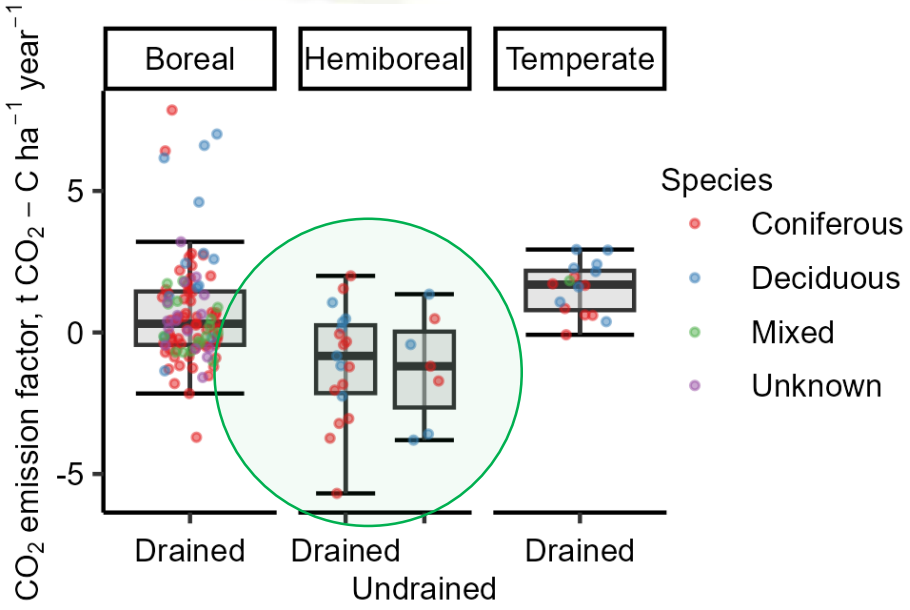
- **Use of forests** is an important component of climate change mitigation with **instant impacts**.
- Product and energy substitutions are the only known forest-related mechanisms **substantially affecting fossil greenhouse gas emissions**.
- Substitution impact by wood use corresponds to the fossil emissions of Finland, while in the EU and the world it is **similar to the reported LULUCF emissions**.

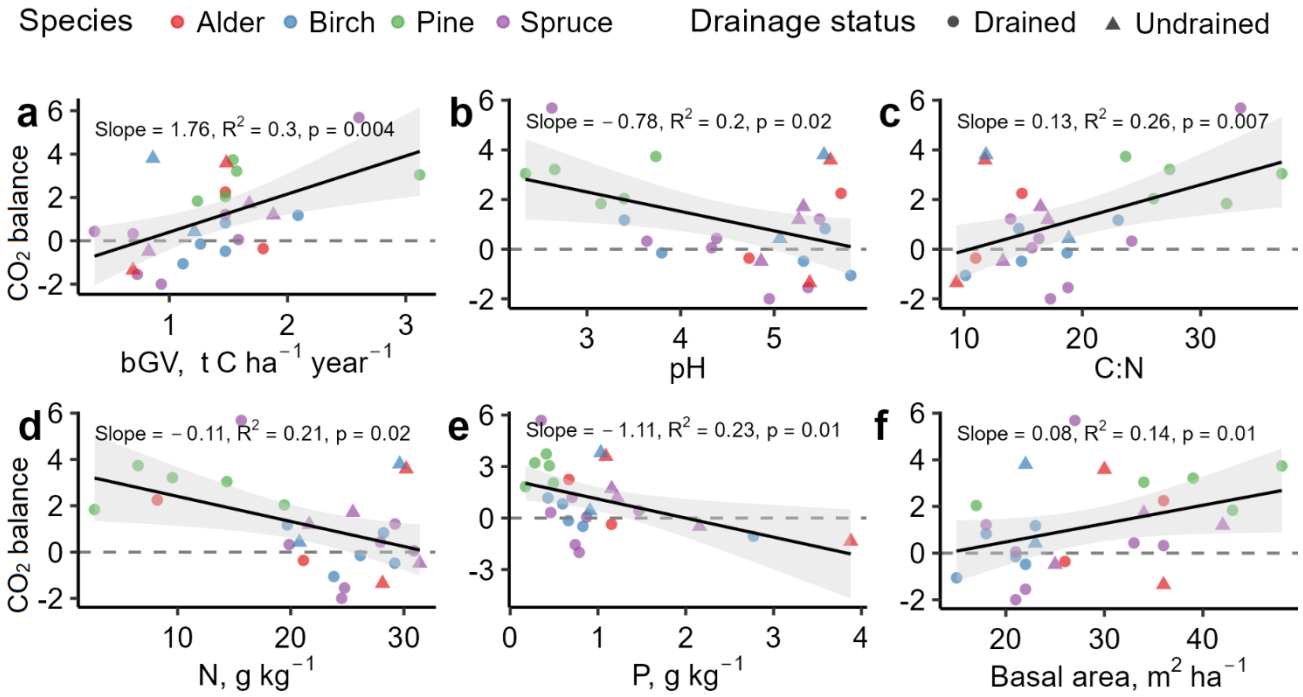
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Potential of afforestation

Drained forest organic soils can be a CO_2 sink

(Jauhiainen et al., 2023; Butlers et al., 2022; Butlers et al., 2025)



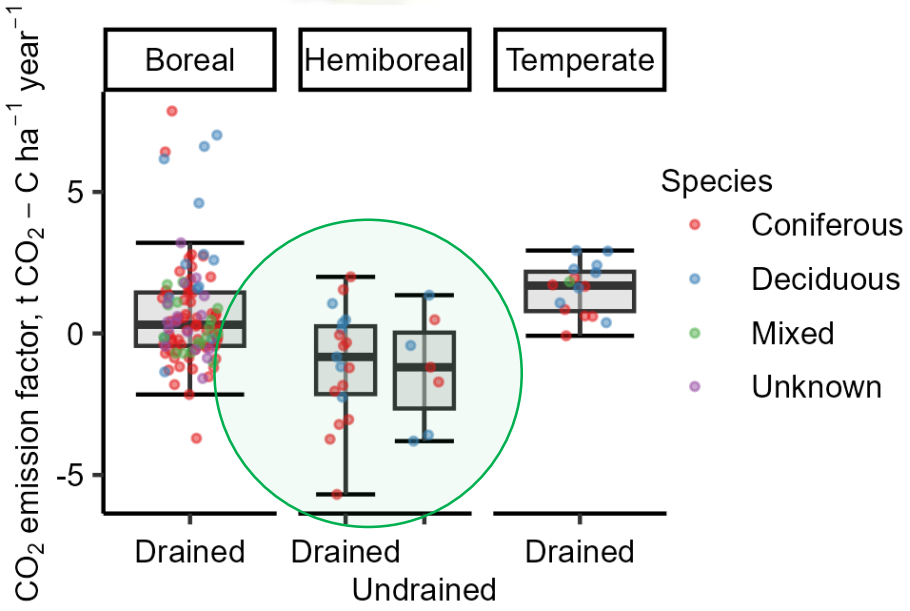


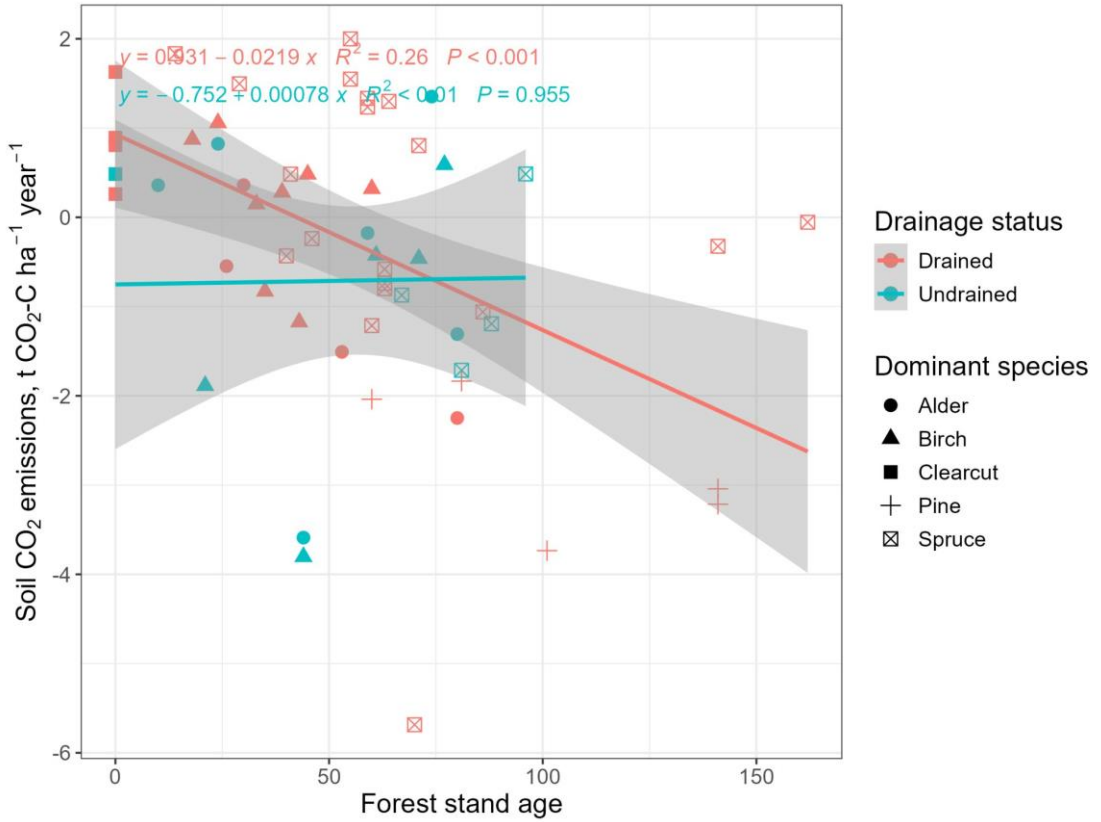
Variability in results is not an error. Organic soils can act as either carbon sinks or sources, depending on site-specific conditions.

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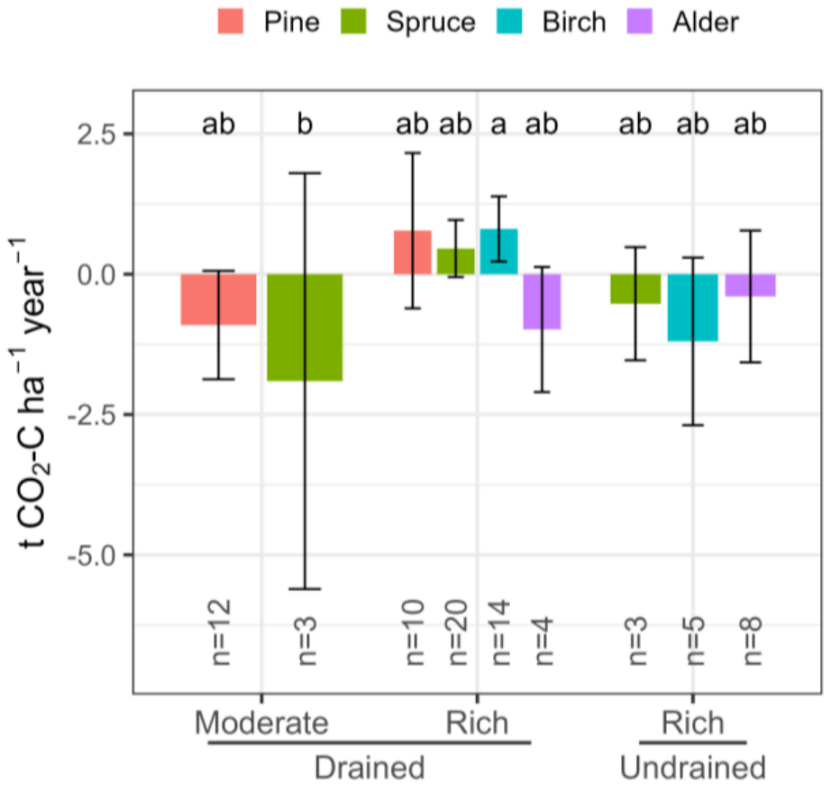




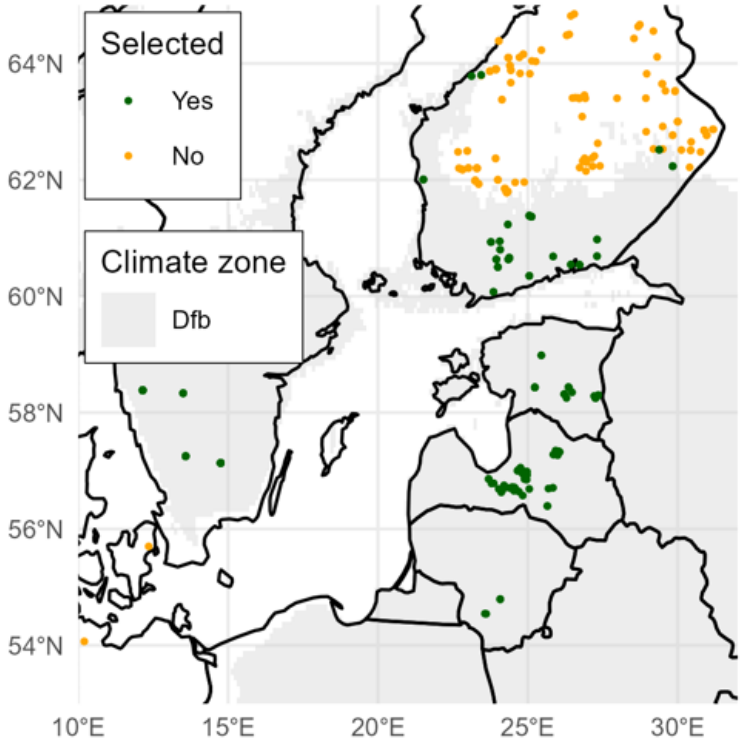
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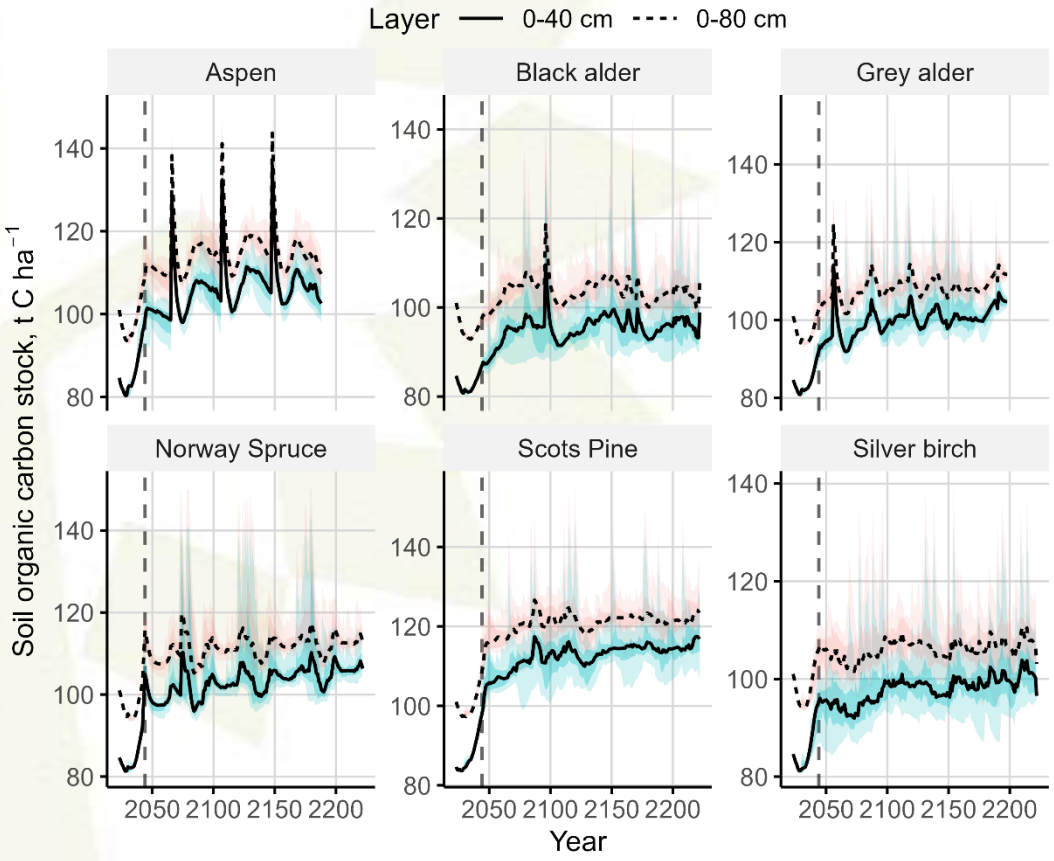
https://doi.org/10.5194/egusphere-2026-162



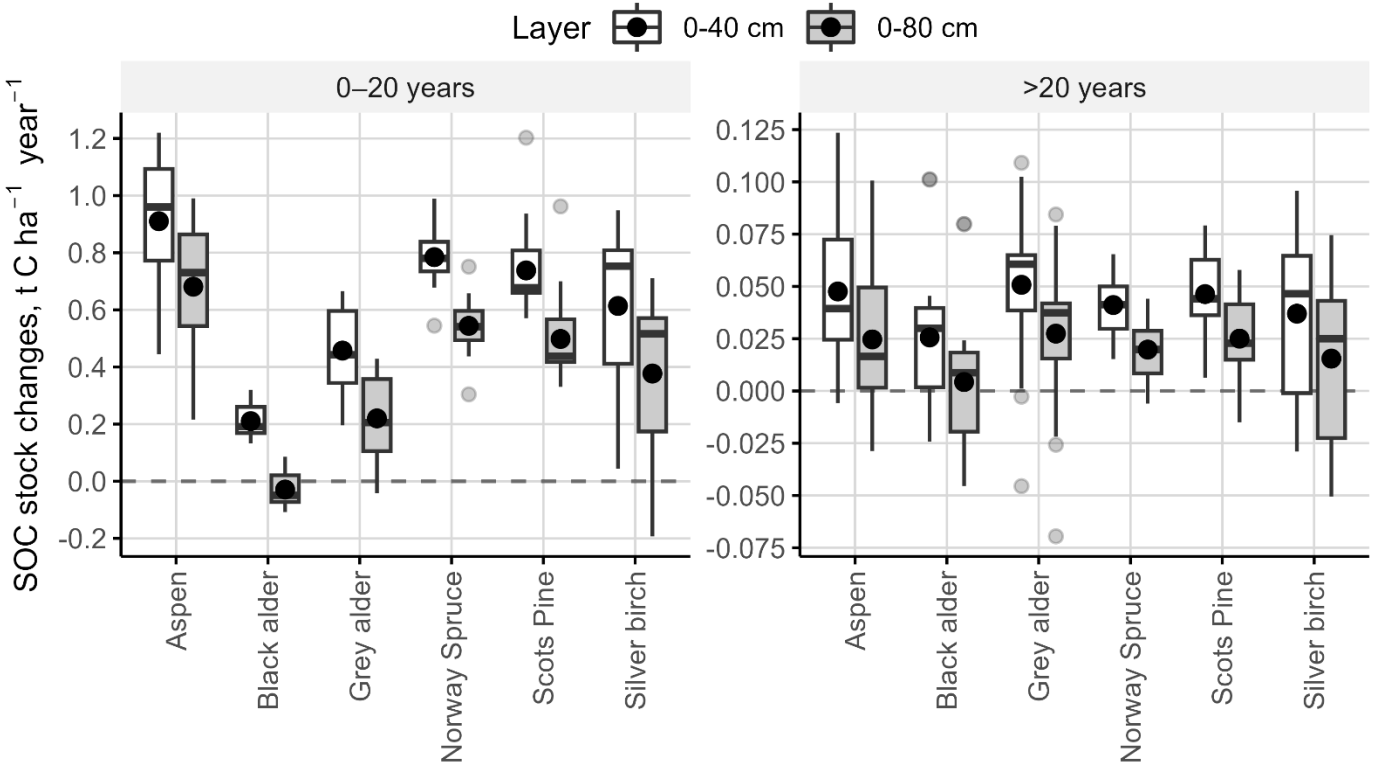
Whether forest organic soils act as a carbon sink or source at the national scale depends on the distribution of forest types

Potential of afforestation

Predicted mineral soil carbon stock changes following afforestation



https://doi.org/10.46490/BF865



Averaged GHG emission factors for organic soils in agricultural land, established forests, afforested land, and rewetted areas

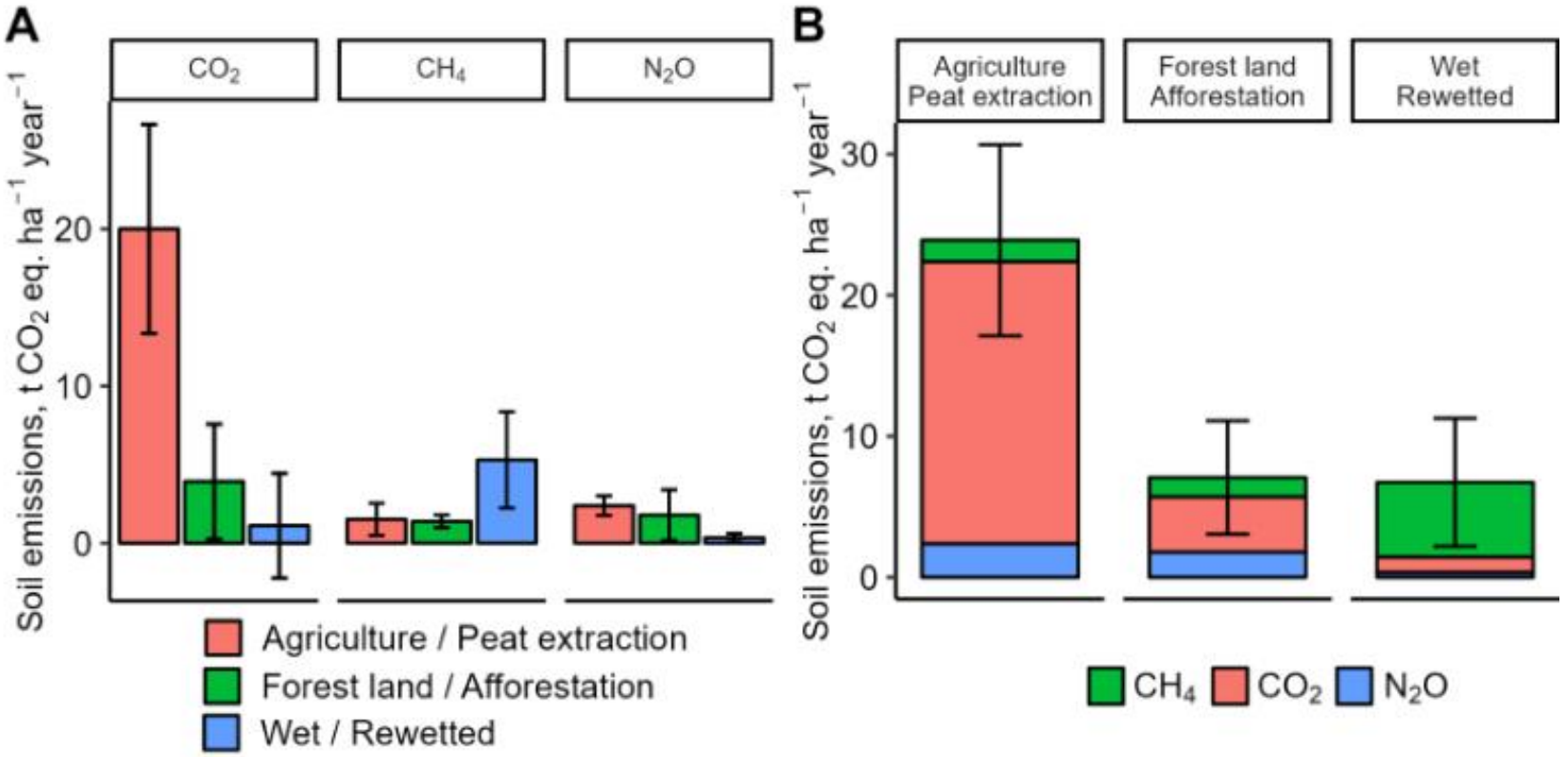


Figure from a scientific article submitted for publication.

References for illustrated data:

Jauhiainen J. et al. Reviews and syntheses : Greenhouse gas emissions from drained organic forest soils – synthesizing data for site-specific emission factors for boreal and cool temperate regions, Biogeosciences, no. June, 2023.

Lin F., Zuo H., Ma X., Ma L. Comprehensive assessment of nitrous oxide emissions and mitigation potentials across European peatlands, Environ. Pollut., vol. 301, no. January, 2022, p. 119041, DOI: 10.1016/j.envpol.2022.119041

Bianchi A., Larmola T., Kekkonen H., Saarnio S., Lång K. Review of Greenhouse Gas Emissions from Rewetted Agricultural Soils, Wetlands, vol. 41, no. 8, 2021, pp. 1–7, DOI: 10.1007/s13157-021-01507-5

Hiraishi T. et al. 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, IPCC, Switzerland, 2013.

Insufficient empirical evidence exists to determine whether afforestation or rewetting delivers greater reductions in soil GHG emissions

Conclusions

Are harvesting restrictions a climate change mitigation measure?

Reduced harvesting may deliver short-term climate benefits at the expense of long-term mitigation potential through forest ageing, declining productivity, and reduced substitution benefits.

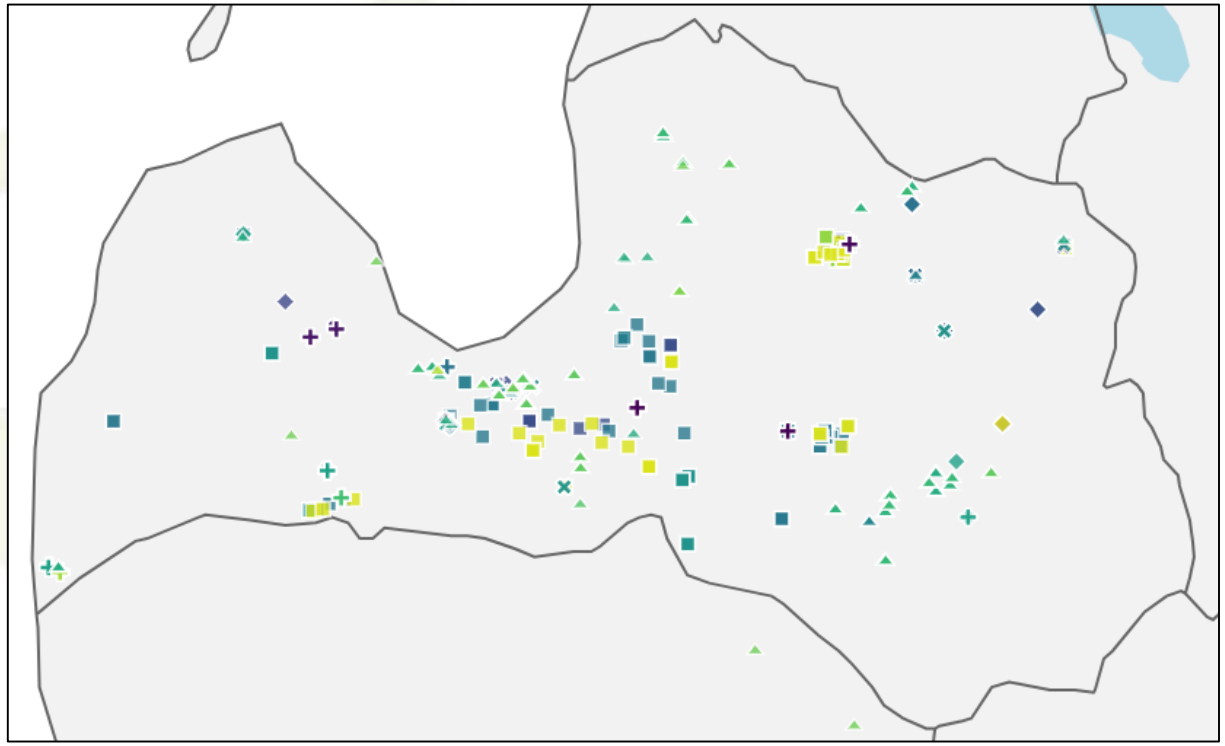
Should rewetting be prioritised over afforestation to reduce emissions from agricultural lands with organic soils?

Considering the uncertainties, both measures may deliver comparable reductions in soil GHG emissions. However, afforestation can offer greater long-term climate mitigation potential through additional carbon sequestration in biomass, carbon storage in harvested wood products, and avoided emissions through substitution effects.

Nevertheless, the choice between afforestation and rewetting should be made on a site-specific basis, considering local conditions, long-term climate benefits, and ecological objectives, with priority given to measures that also support nature restoration.

Thank you for the attention!

Soil GHG Monitoring Plots in Latvia: 73 welands, 38 peat extraction fields, 40 agricultural land, 110 forest land, 3 flooded land



Cropland
- Aluvial Wheat
- Alvial Rape
- Cropland
- Drainage ditch

Forest land
- Ash spreading
- Clearcut
- Drainage ditch
- Drained growing stand
- Fertilization
- Old-growth forest
- Selective felling
- Thinning
- Undrained growing stand
- Wood ash application

Former peat extraction site
- Afforestation
- Blueberries
- Bushes, grasses
- Cereal
- Cranberries
- Drainage ditch
- Perennial grass
- Vegetables

Grassland
- Afforestation
- Afforestation with rewetting
- Aluvial Pastures
- Drainage ditch
- Perennial grass
- Poplar plantation
- Raised groundwater
- Shelter belt

Peat extraction site
- Bushes, grasses
- Drainage ditch
- Non-vegetated
- Peat extraction

Wetland
- Degraded
- Ditch crossing
- Natural afforestation
- Pristine
- Pristine and elevating
- Pristine and subsiding
- Reeds
- Restoration
- Restored
- Rewetted
- Sphagnum paludiculture