Peatland Restoration for Greenhouse Gas Emission Reduction and Carbon Sequestration in the Baltic Sea Region

LIFE PeatCarbon

Greenhouse Gas Flux Monitoring in Finland (WP3)

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April 2025


Thank you!
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Background

- In Finland, about half of the original peatland area has been drained for forestry (largely in 1950-1980)
- Drainage of peatlands risk the long-term carbon storage accumulated over the millennia
  - lower water level
  - increased CO2 release from peat due to aerated conditions and tilling etc.
  - decreased CH4 emissions
  - increased N2O emissions in nutrient rich conditions
- Restoration via rewetting aims to return the original water saturated conditions
  - original hydrology and plant assemblages
  - decrease decomposition of the old peat and CO2 release to the atmosphere
  - return CH_4 dynamics
  - N2O fluxes?

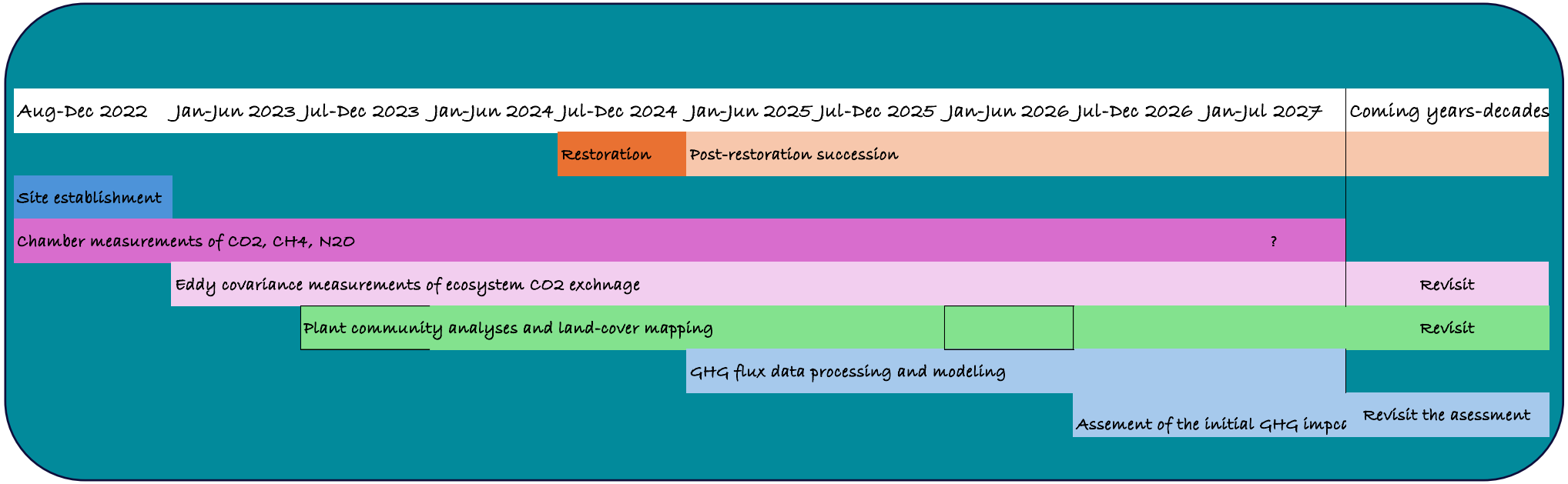
Objectives of the GHG monitoring

- Assess the annual estimates of ecosystem carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) balances before and after the peatland restoration (rewetting)

- Provide knowledge of post-restoration ecosystem succession and data to develop emission factors for rewetted managed lands

Timeline

We are here



Two forestry drained peatlands were restored in 2024

Two peatlands in Pallas Research Area

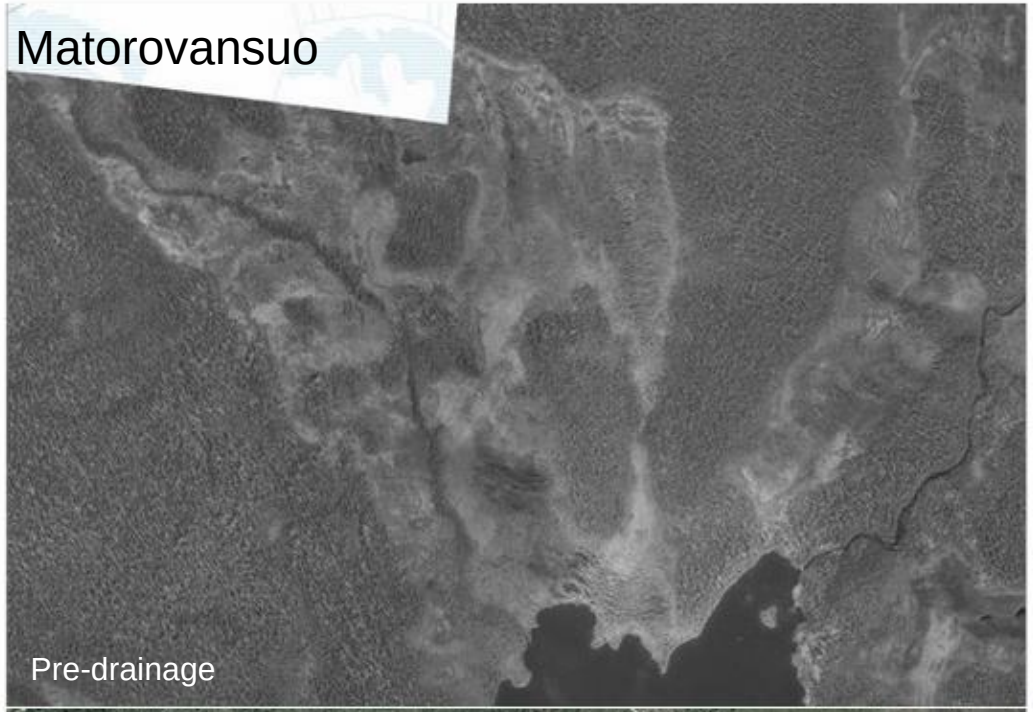
- Välisuo
- Matorovansuo

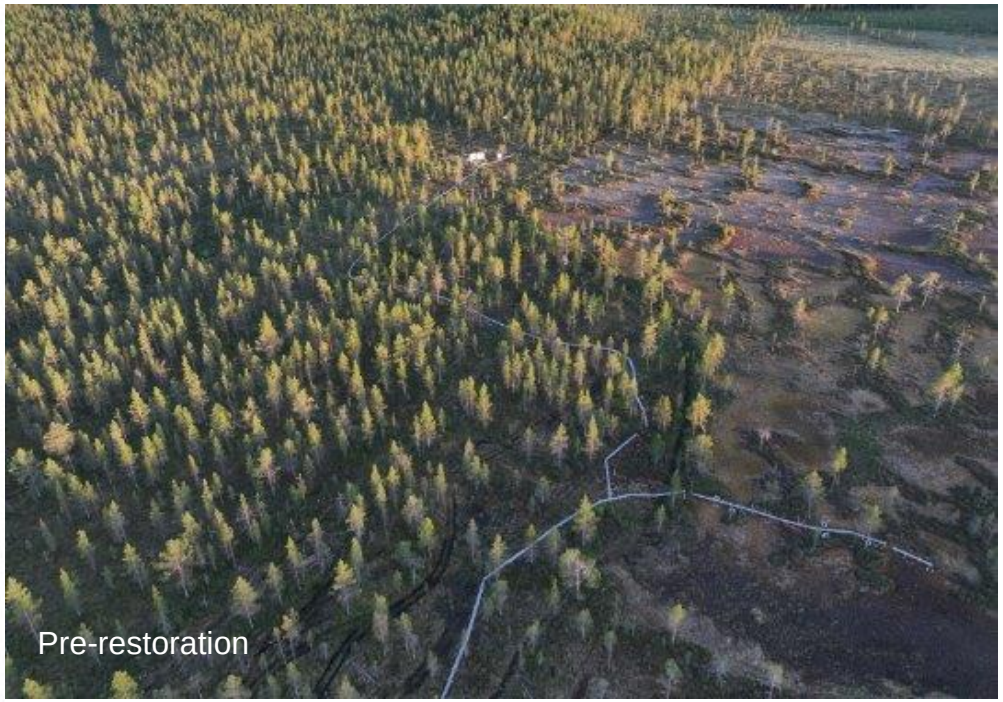
Site for long-time collaboration of FMI, LUKE, U Oulu, U Helsinki, SYKE, Metsähallitus

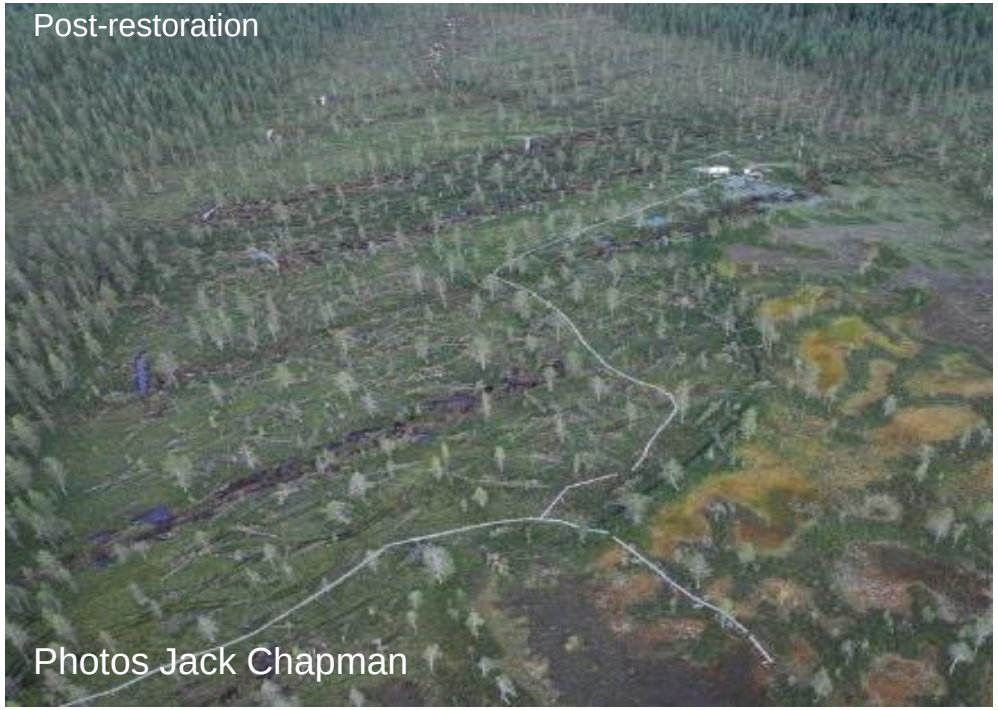
FMI ecosystem measurement stations in the area

6

Matorovansuo







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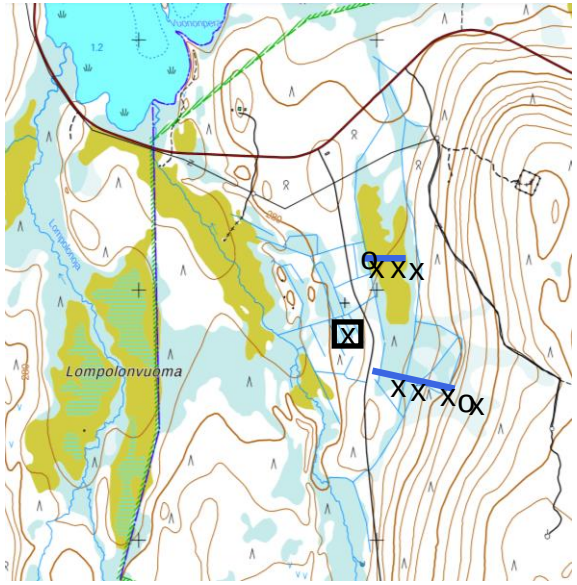
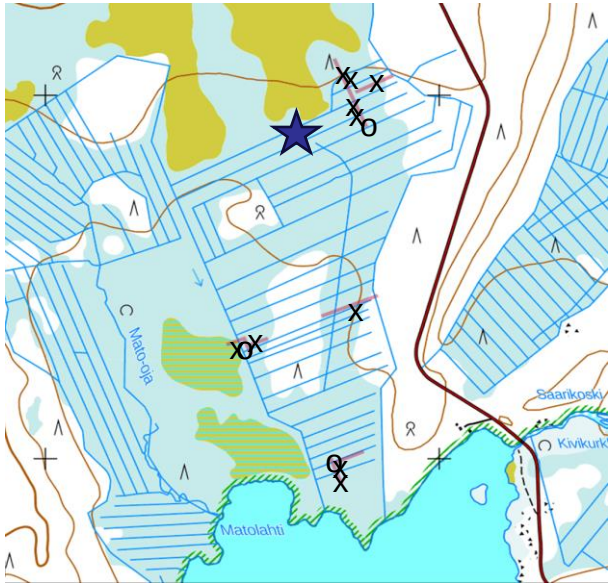
GHG Flux Monitoring Fall 2022 onwards

Välisuo



Matorovansuo

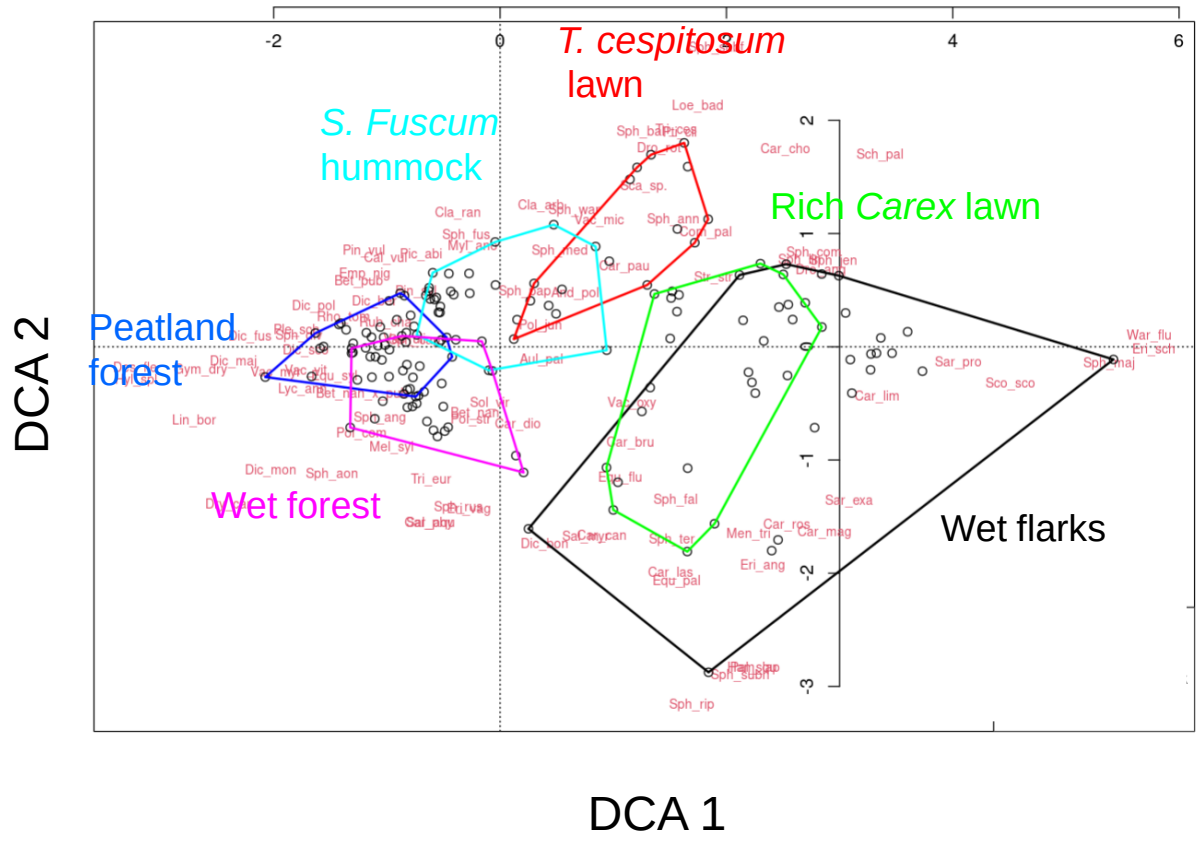


X chamber measurement plots (n=3/plot)
O ditch plots (n=3/plot)
□ Reference plot (n=3)
★ Eddy covariance measurement of CO_2 exchange

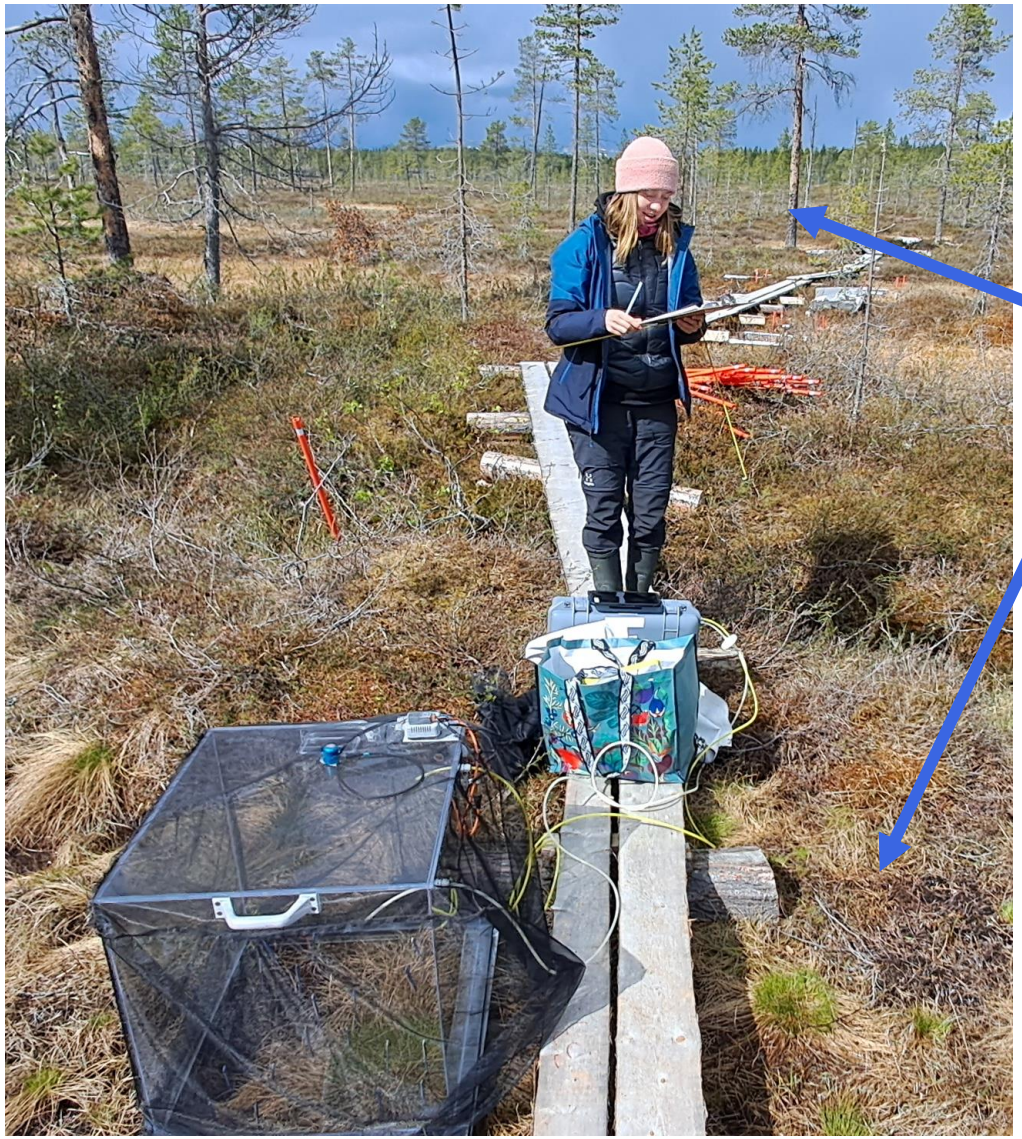
- GHG fluxes at 60 points fortnightly (monthly in snow period)
  - Incl. 12 trenched points, 15 ditch points, and 24 points of net ecosystem CO_2 exchange measurements
    - Species-level leaf area index measurements (fortnightly) , plant species abundance (2023 & 2026), & frequent water chemistry data collection
  - EC measurements of ecosystem CO2 exchange incl. meteo data : preliminary data screening and postprocessing (2023-2024),
  - Post-restoration tree survey in 2024, above-ground and b-g biomass sampling/analyses in 2023
  - Pine LAI models and estimates in 2023-24

Vegetation distribution across the peatlands (> 200 points)

Well drained forested, moderately drained open, and only slightly affected habitats



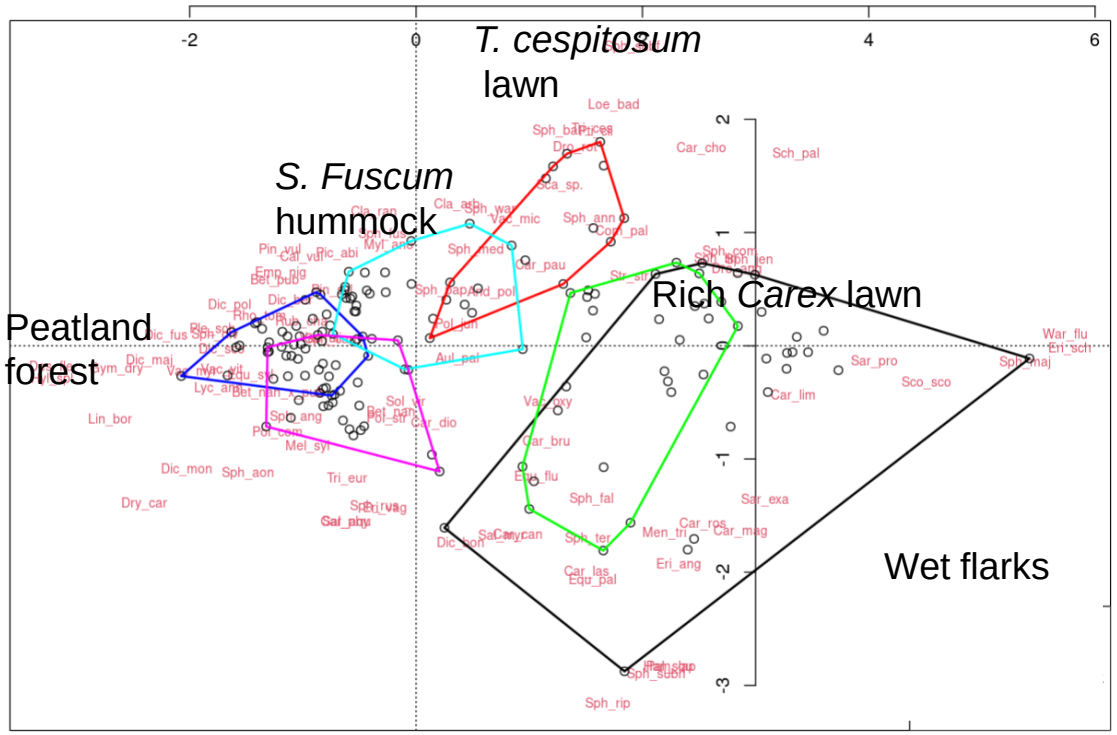
- Wetness and presence of forest were the main environmental gradients
- Plots were grouped into habitats based on species (cluster analysis)
- GHG flux upscaling can be based on spatial distribution of these habitats



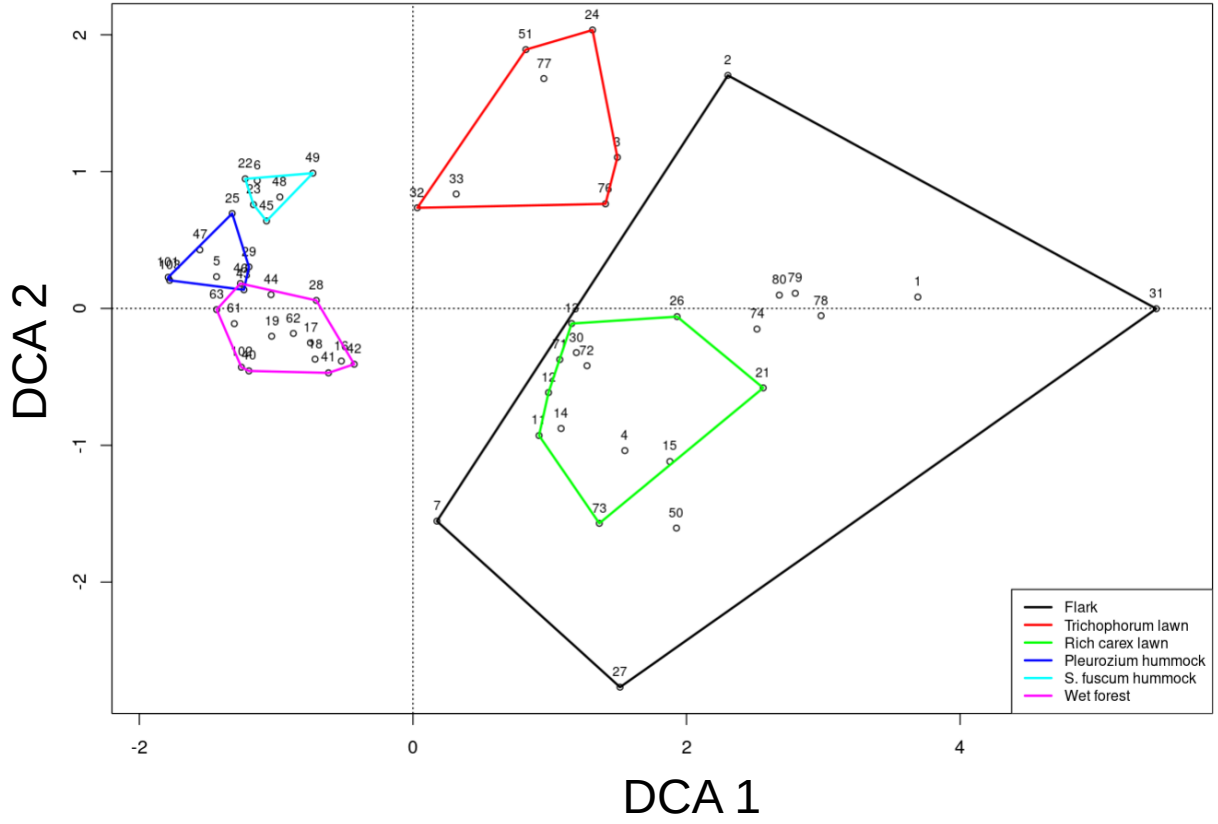
- *Pleurozium* hummocks – understory, well drained & treed
- *Trichophorum* lawn-drained flarks
- *S. fuscum* hummocks –a feature of pristine aapa mires
- Flark – very wet, mosses, only little vascular plants

GHG flux measurement points represent the overall vegetation across the peatlanlands

Vegetation inventory points



GHG flux measurement points



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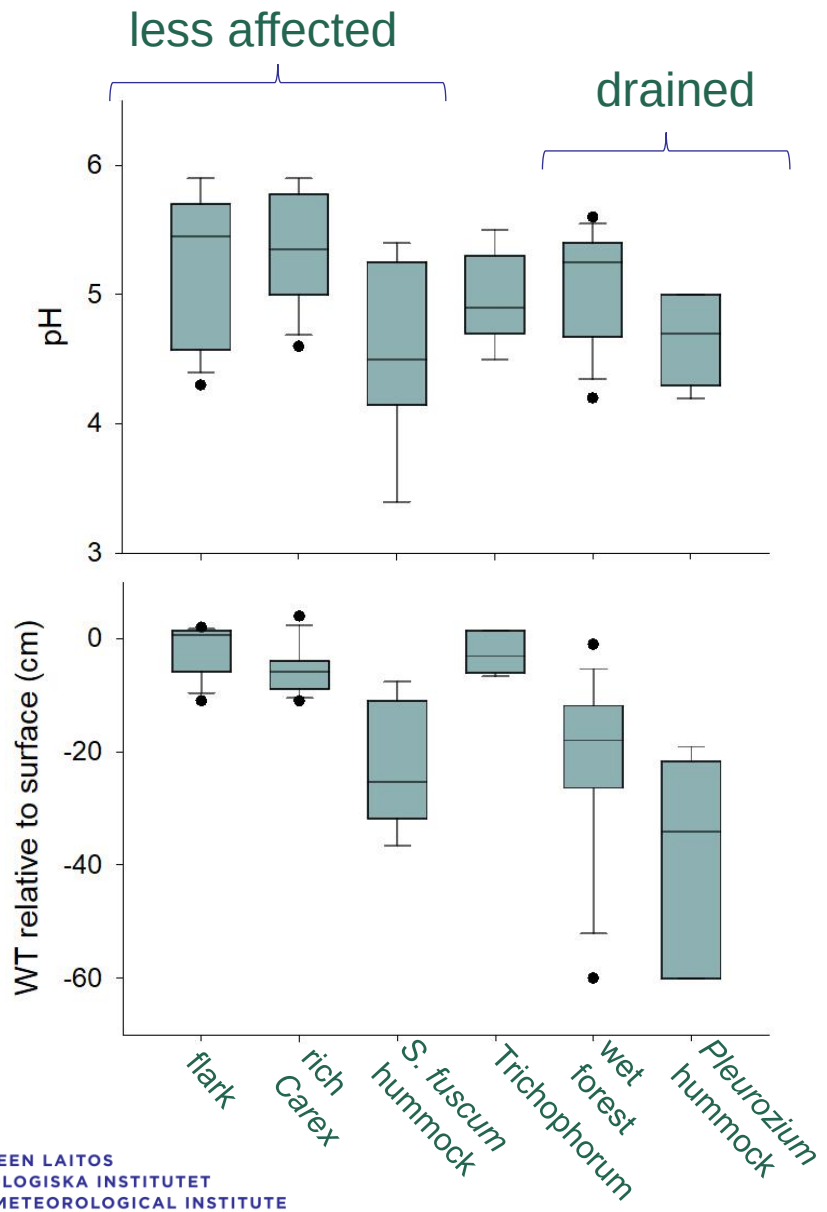
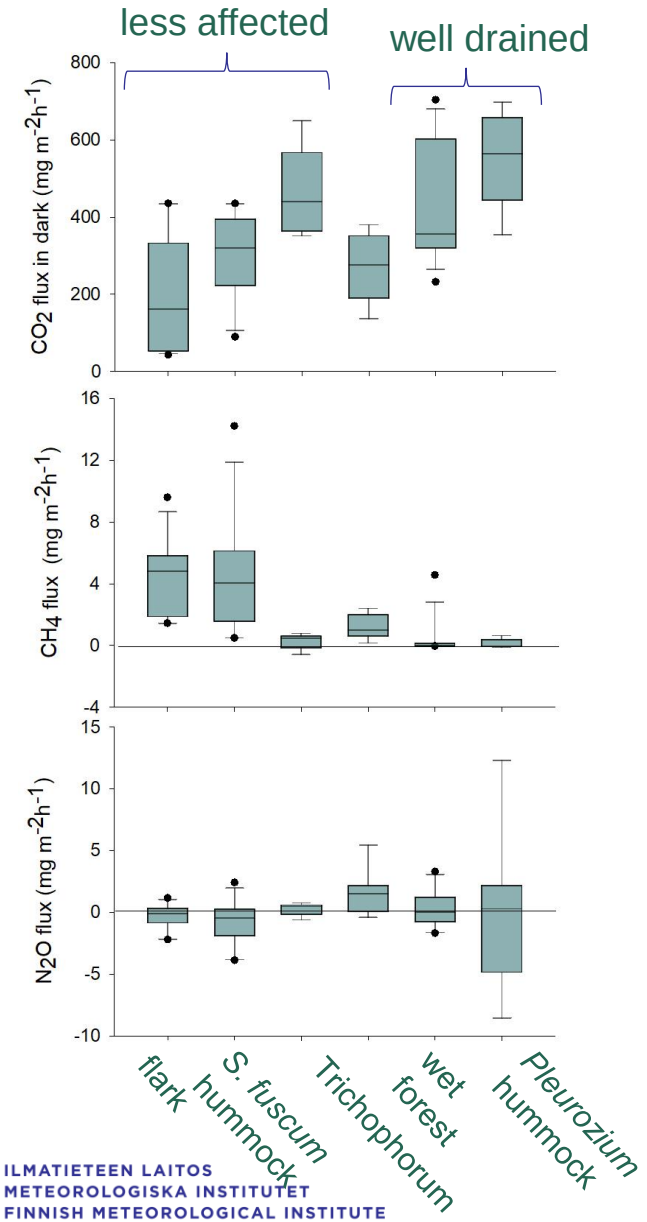
pH and water level in the GHG flux measurement points by habitat



- Gradients in pH and WT
- GHG flux upscaling can be based on spatial distribution of these habitats

Distribution of the habitat-specific CO_2, CH_4, and N_2O fluxes (pre-restoration)



- Large microtopographic and WT variation within habitats
- Well drained habitats released slightly more CO2 than their less aftected counterparts
- The drained habitats and high hummocks had the lowest CH4 release, however, all habitats were mainly CH4 sources
- N2O fluxes were small, although the well drained peatland forest had both the smallest (influx) and largest fluxes

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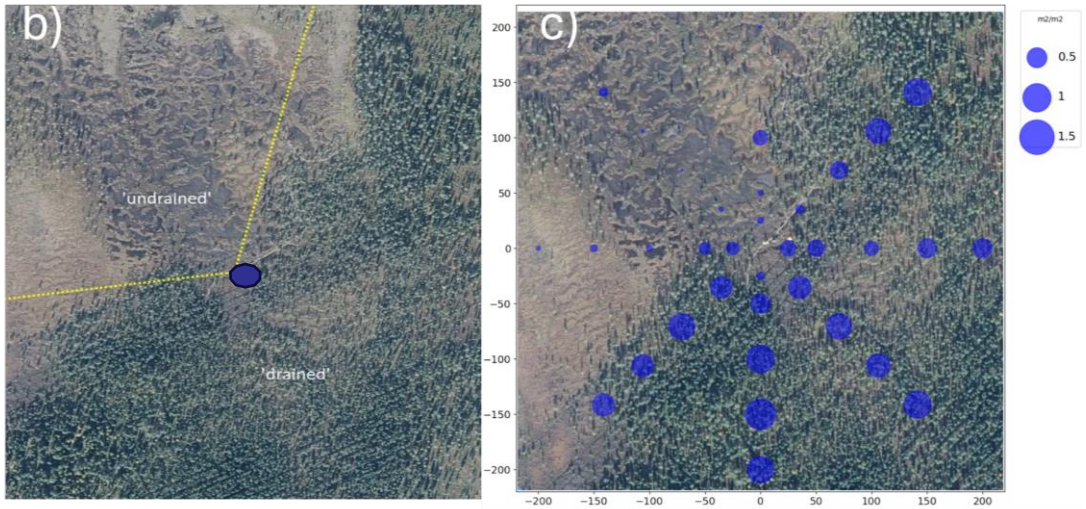
Eddy covariance measurements of CO2 exchnage

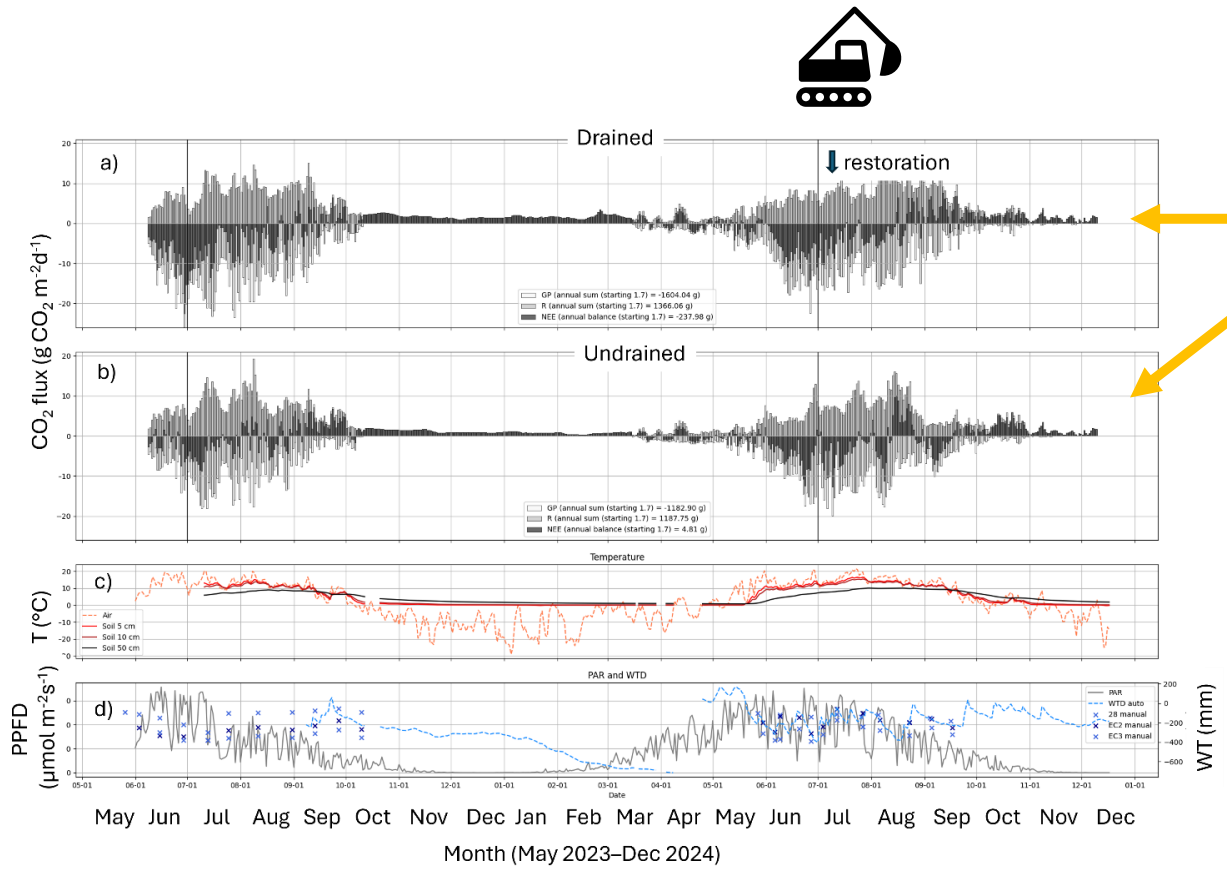
Sectors

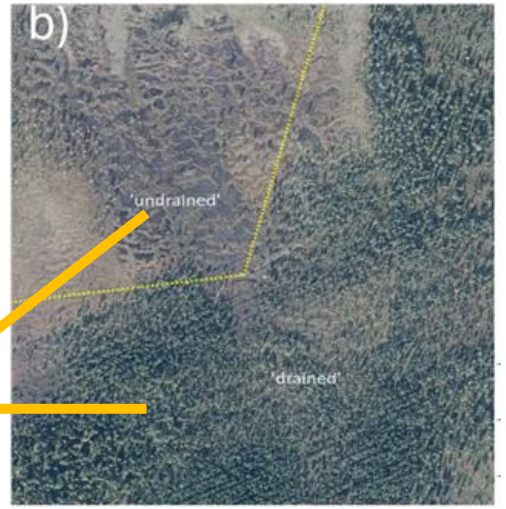
Pine LAI in the survey plots



- well drained and less affected source areas

Daily net ecosystem exchnage of CO_2

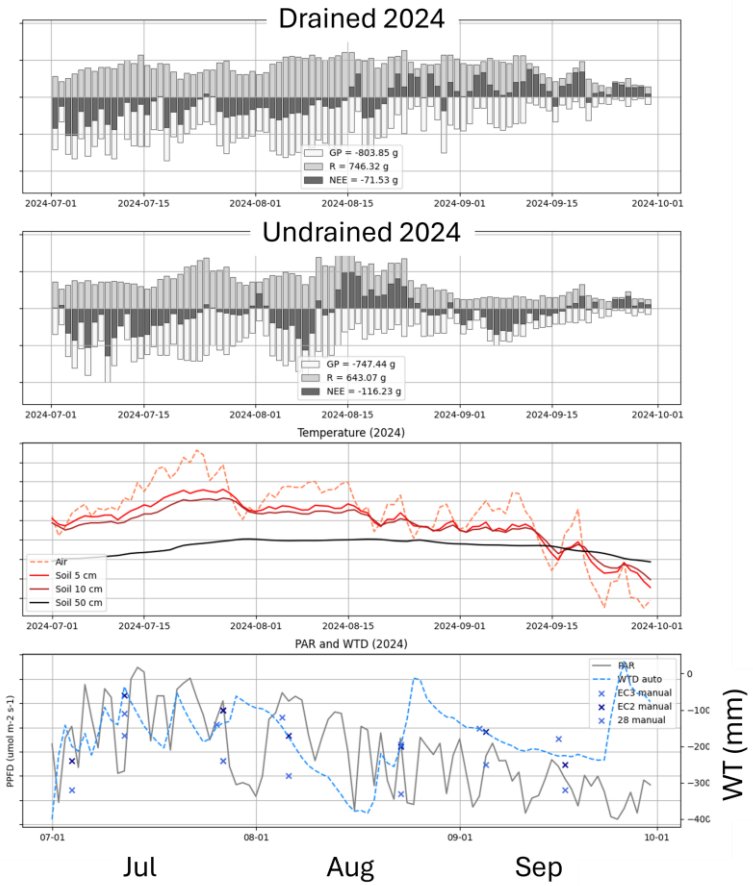




- Drained peatland forest was larger net C sink than undrained open peatland (Jul 2023–Jun 2024)
- gross photosynthesis and respiration were larger in the peatland forest than in the open peatland

Effect of restoration on ecosystem CO_2 exchange?

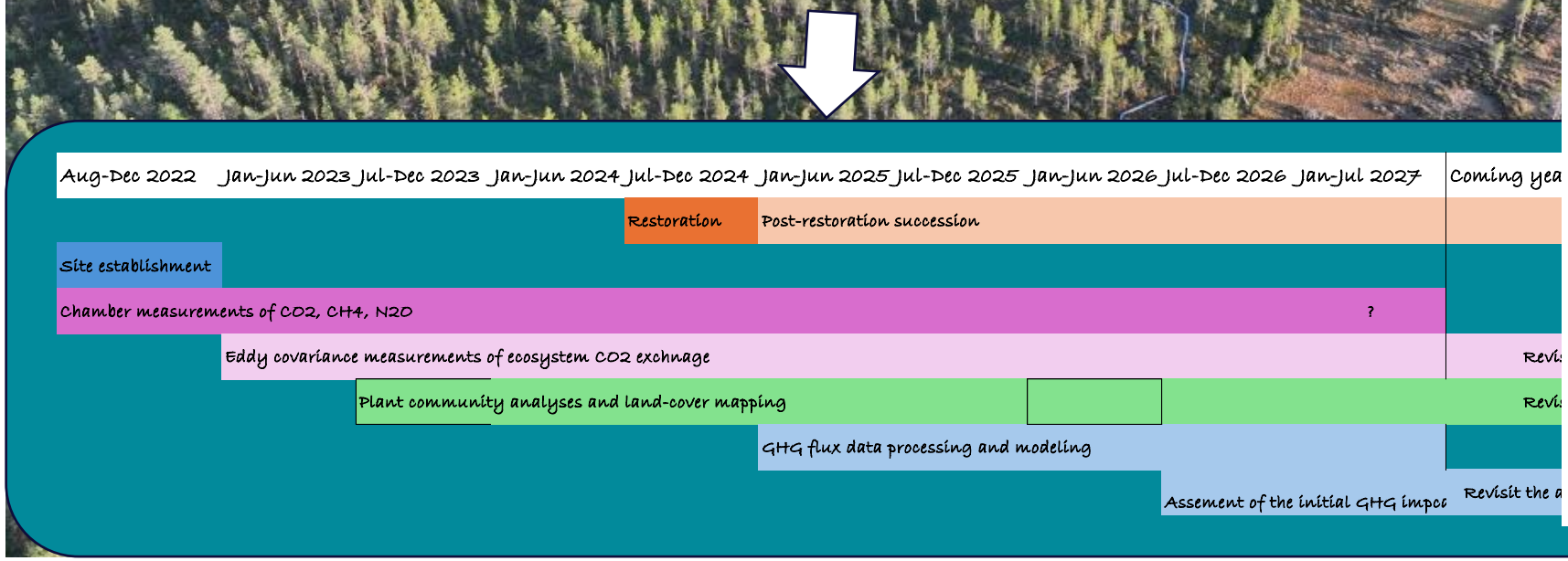
restoration



- too early to conclude anything, however,
  - ”well drained” was a smaller net C sink than the open ”less affected” area
    - photosynthesis decreased (harvests)
    - respiration was still large (root residues, harvest residues)
- C-pool of the trees remains at the site

Monitoring and data processing will be continued

start of the summer program launch in the end of May



Thank you

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Latvia, Finland, Denmark & Germany