



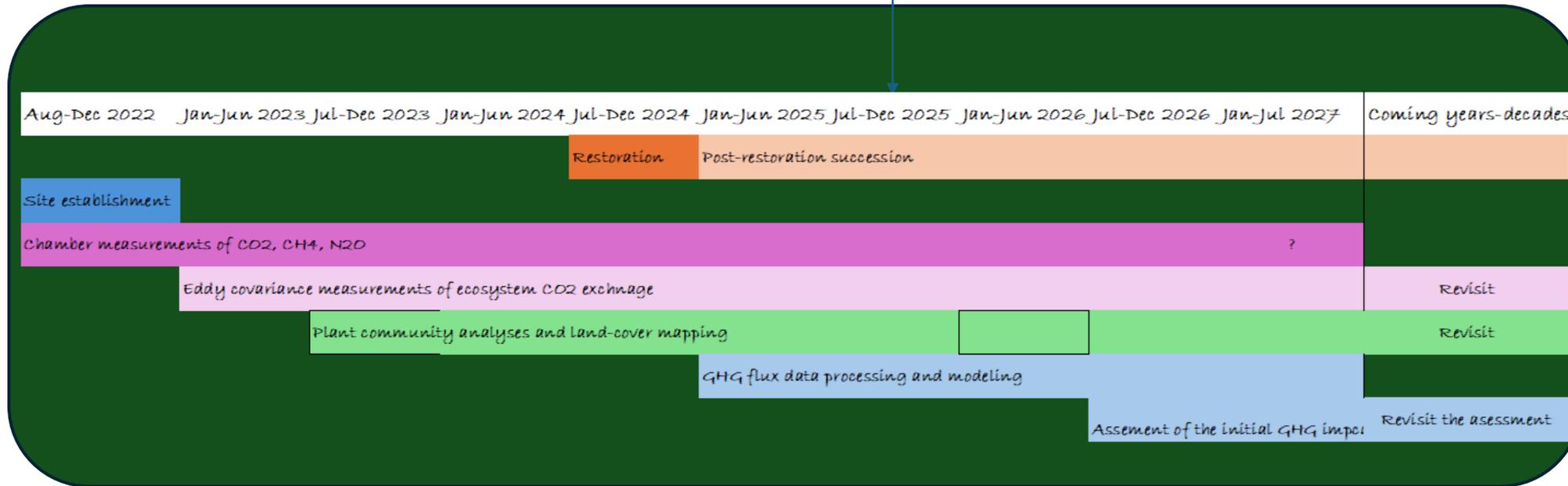
# Progress on LIFE Peat Carbon project activities in Finland

Tuula Aalto (Finnish Meteorological Institute), Jenni Hultman (LUKE, Natural Resources Institute Finland), Hannu Marttila (University of Oulu) , FMI: S Juutinen, J. Chapman, T. Markkanen, K. Isomäki, M. Aurela, A. Lohila  
LUKE: A Isoaho, K Peltoniemi, A Korrensalo, P Mäkiranta, I. Mella, H Rokkonen R-K Ruotila, K Pasanen, T Penttilä and UOULU: A Autio, O Nimr, K Jadoon, P Ala-Aho, L Ikkala, A Räsänen

# Timeline



We are here



# WP2.4 Peatland restoration



Two restoration sites in Northern Finland:

- Matorova Mire (224 ha)
- Välisuo Mire (114 ha)
- Both drained in ~1960

# WP2.4. Restoration



- Restoration of Finnish project sites took place in 2024 and lasted about 6 months:
  - removal of trees in winter (50% of the biomass)
  - filling of the ditches, building dams (96 altogether) and directing water to peatland in summer
- Monitoring of restoration impacts continued in 2025: Water table, GHG fluxes, vegetation, microbes



Pre-restoration



Post-restoration works



# WP2.4. Restoration

- Pre-drainage, drainage and restoration of Matorovansuo, NLS aerial images
- Changes in tree cover and ditching visible



# WP2. 4. Restoration



- Matorovansuo flux tower before and after restoration

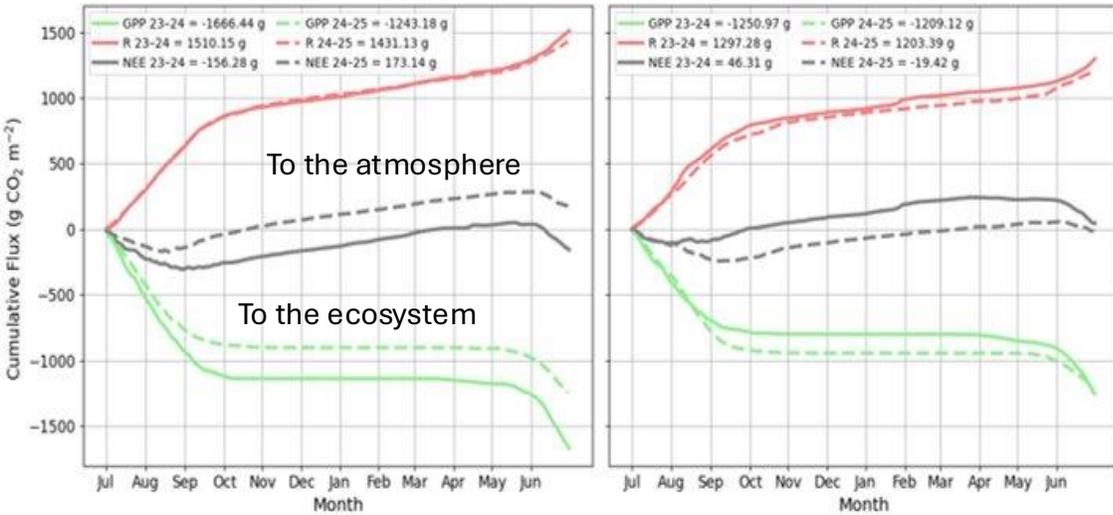


# WP3.4. GHG measurements

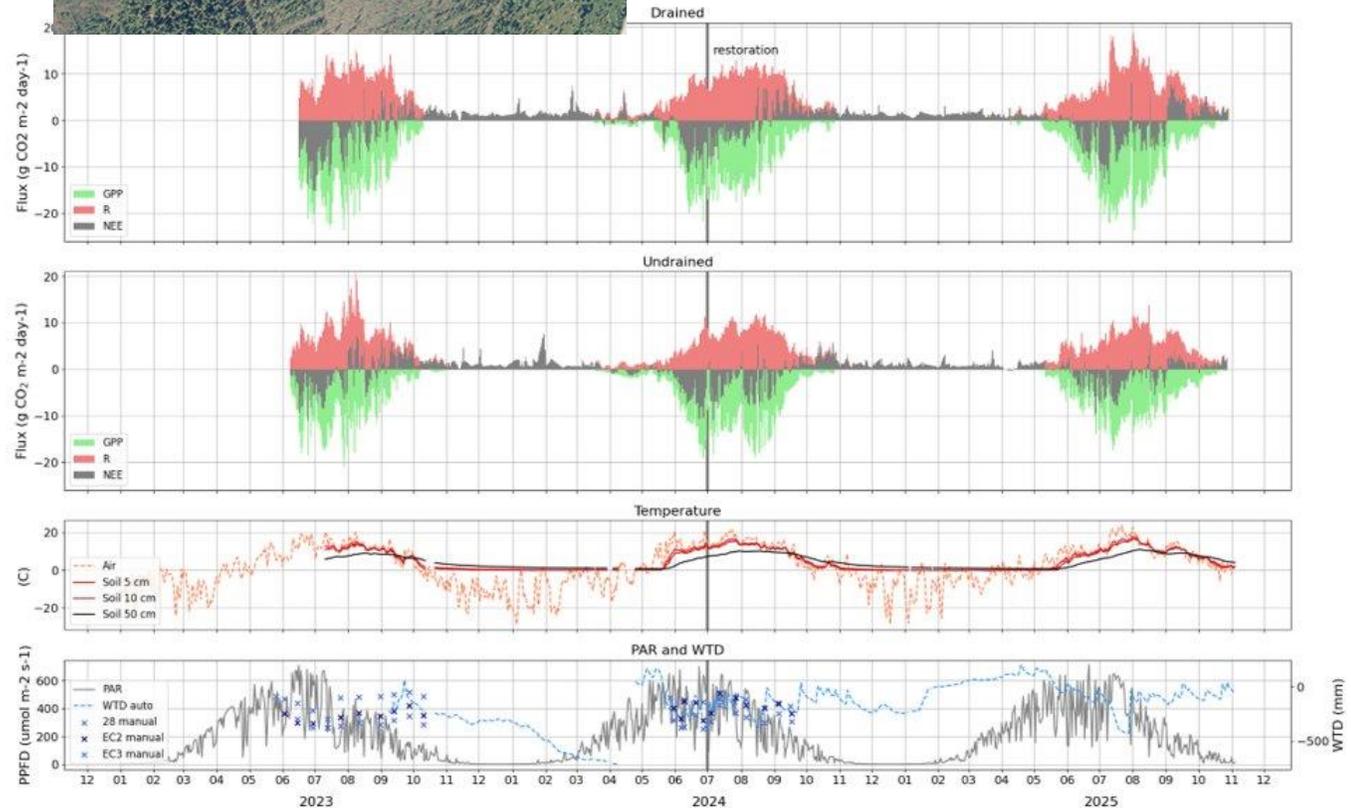
- Continuing CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O measurements in Välisuo and Matorovansuo
- Eddy covariance tower at Matorovansuo

Drained (Jul 2023 to Jul 2024)  
Rewetted (Jul 2024 to Jul 2025)

Undrained



PeatCarbon

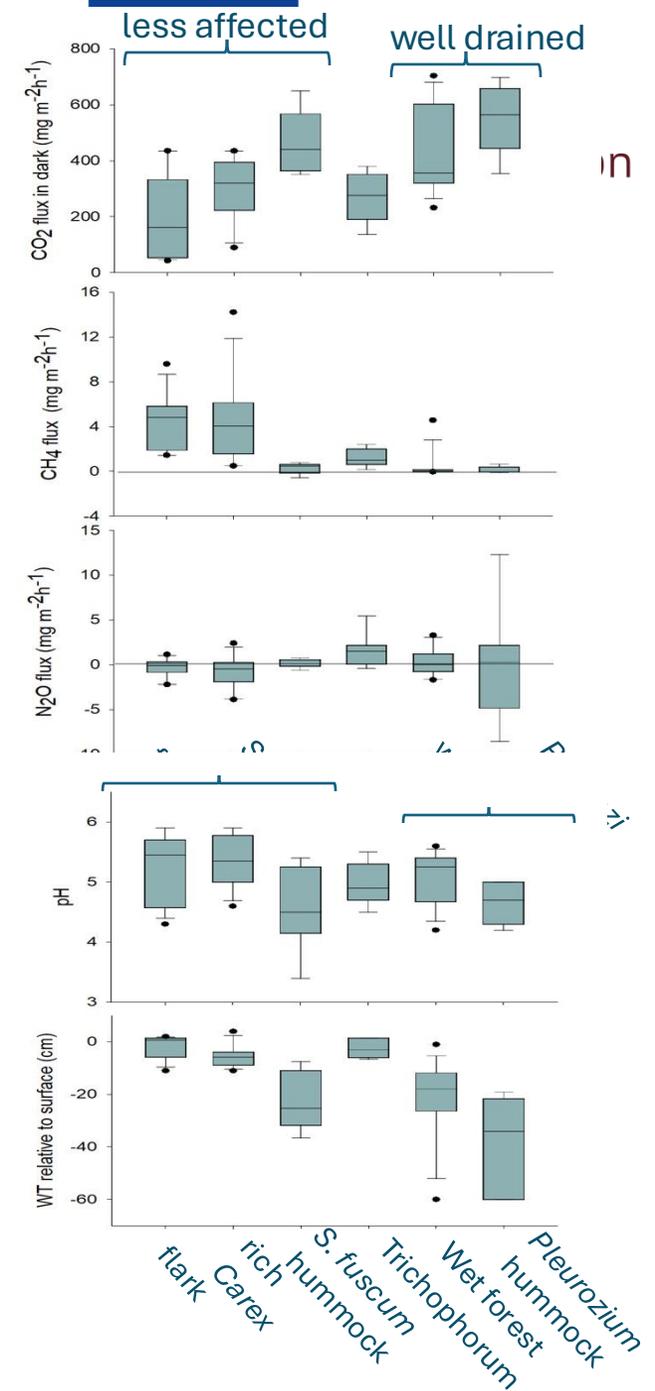
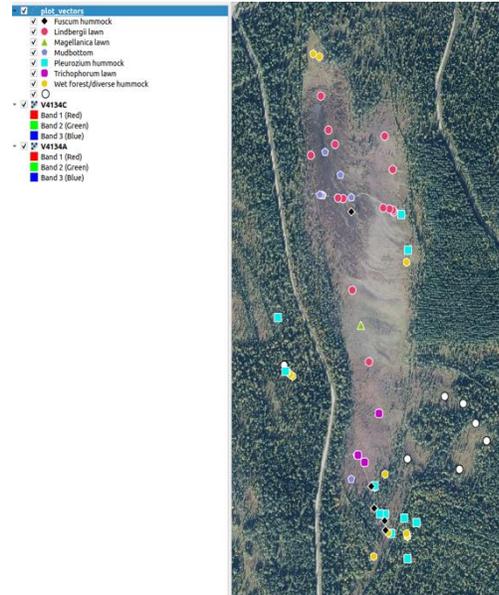


- See presentation by Kiello Isomäki/FMI



# WP3.2. GHG and Vegetation measurements

- Chamber flux measurements at 60 points
- Visits in Pallas 2025 for GHGs and vegetation: Last week of May, Mid-June, first and last week of July, August, September, October
- Vegetation inventory in the GHG-collars: Clustering of plots to six microhabitats

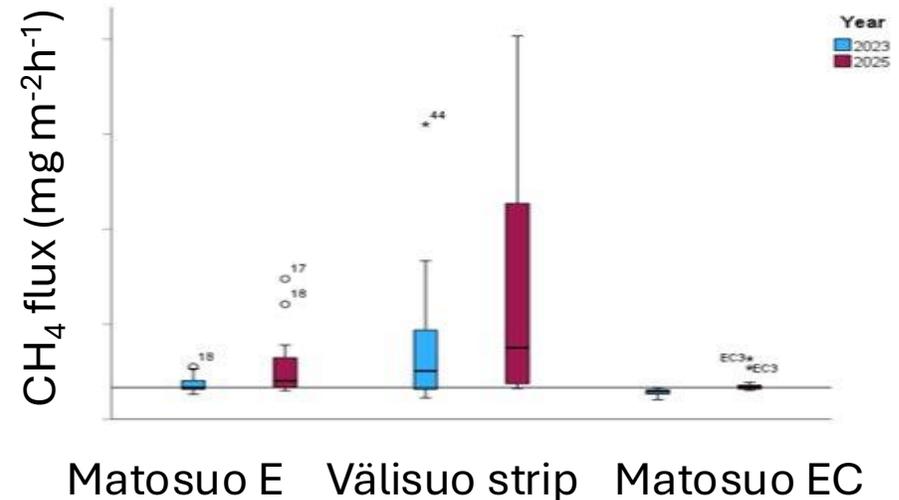
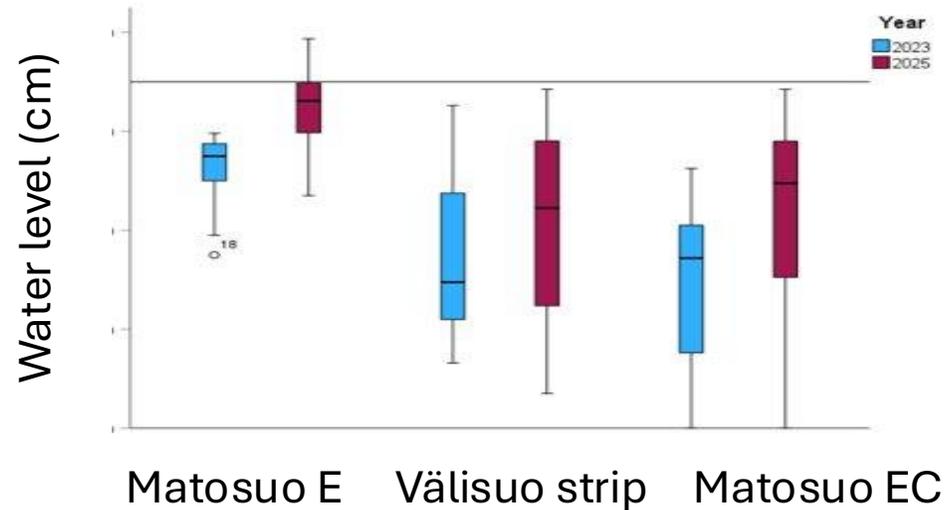


# WP3. 4. GHG measurements

## Chamber measurements:

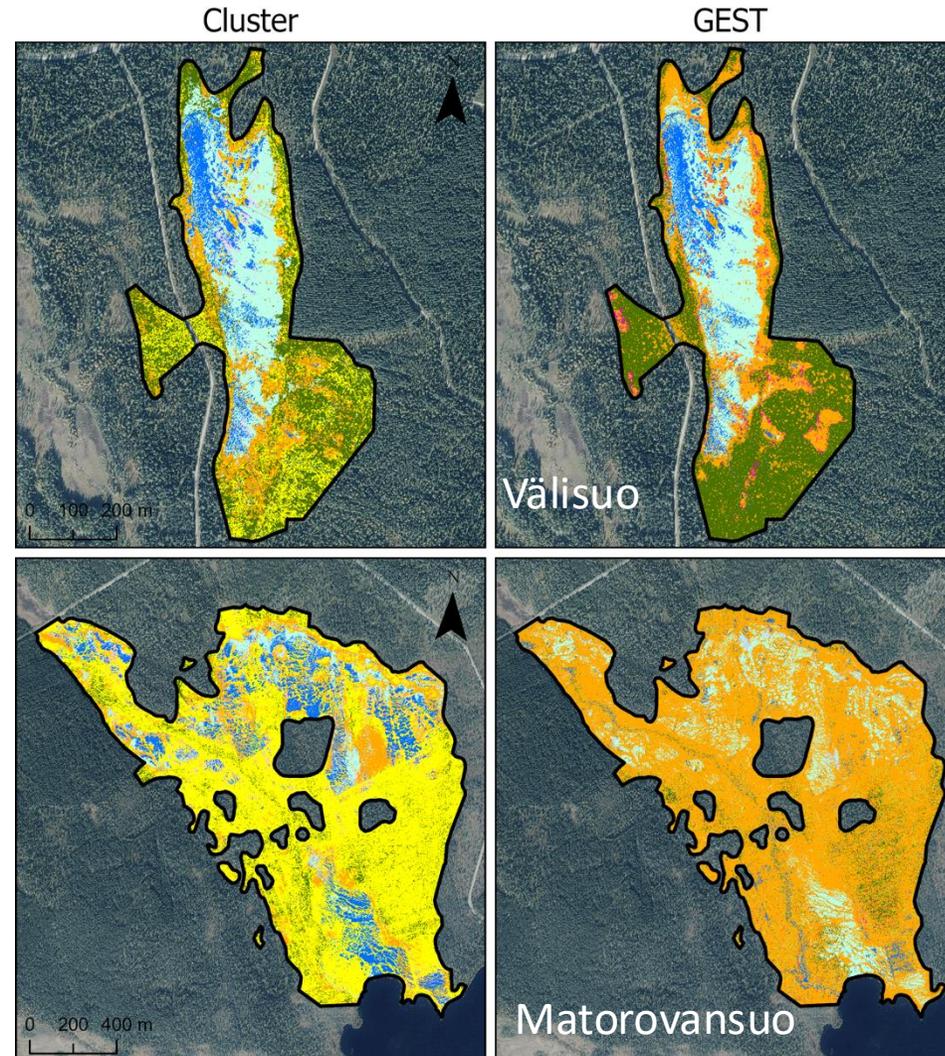
- Undrained sites: No difference in mean cluster specific WTD or CH<sub>4</sub> flux before and after rewetting
- All drained: No significant changes in CH<sub>4</sub>, some in WTD for the driest locations
- Drained sites that had changed most after ~1970: Median WT and CH<sub>4</sub> fluxes increased from 2023 to 2025

Sites with large drainage impact: Before rewetting (2023, blue) and after (2025, red)



# WP3. 7. Vegetation studies

- August 2025: Water table measurements from vegetation plots
  - Vegetation inventories: 206 plots, linked to FMI clustering
  - Drone flights (UEF): Multispectral and thermal imagery, drone LIDAR for topography
  - NLS aerial images
  - Upscaling of microhabitats and comparison to upscaled GEST types
- > see presentation by Aleksi Isoaho



## Cluster

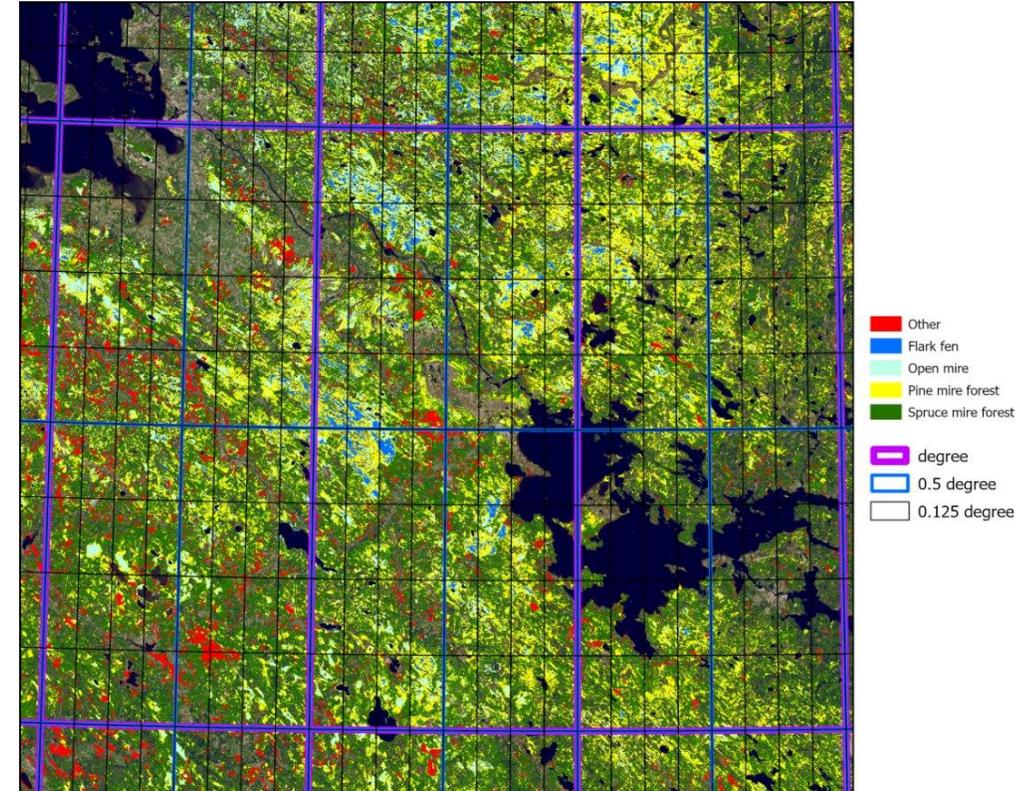
- (1) Flark
- (2) Trichophorum lawn
- (3) Rich carex lawn
- (4) Pleurozium hummock
- (5) S. fuscum hummock
- (6) Wet forest

## GEST

- Moderately moist forest and shrubberies (OL)
- Moist forests and shrubberies (OL)
- Very moist bog heath
- Very moist forests and shrubberies (OL)
- Wet meadows and forbs
- Wet peat moss hollows resp. flooded peat moss lawn
- Wet peat moss lawn with pine trees
- Wet small sedges reeds mostly with moss layer

# WP3. 7. Vegetation studies

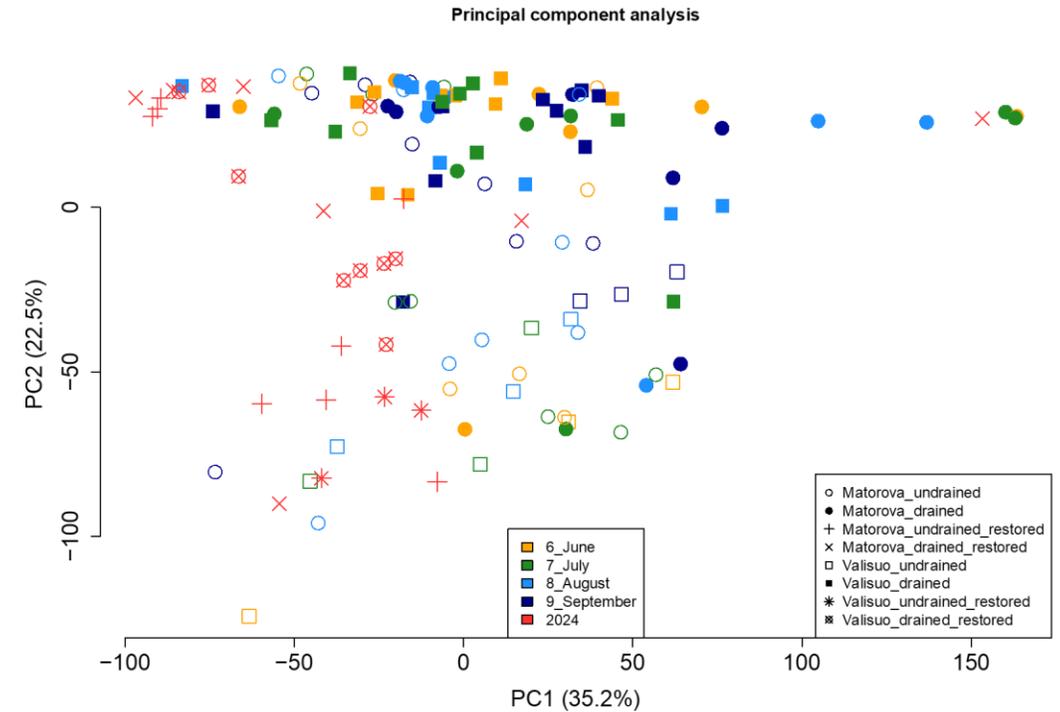
- Upscaling to country level using four habitats:  
flark fen, mire, spruce mire forest, pine mire forest
- Water table statistics for the habitats from University of Oulu  
-> see presentations by Aleksi Isoaho and Kielo Isomäki



# WP3 T6 Microbial and soil studies



- Samples for microbial community composition and activity from 53 GHG points before and after restoration
- Right after restoration: microbial response on functional level. The samples with red color are the ones after restoration and a shift from the before restoration samples can be seen.
- Soil sampling for analysis for testate amoeba and radio carbon dating in August
- Soil decomposition experiment started in September, running for two years



Active microbial genes

# WP3.3. Hydrological monitoring



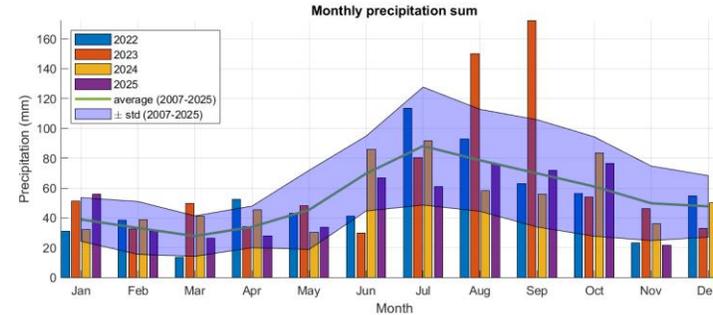
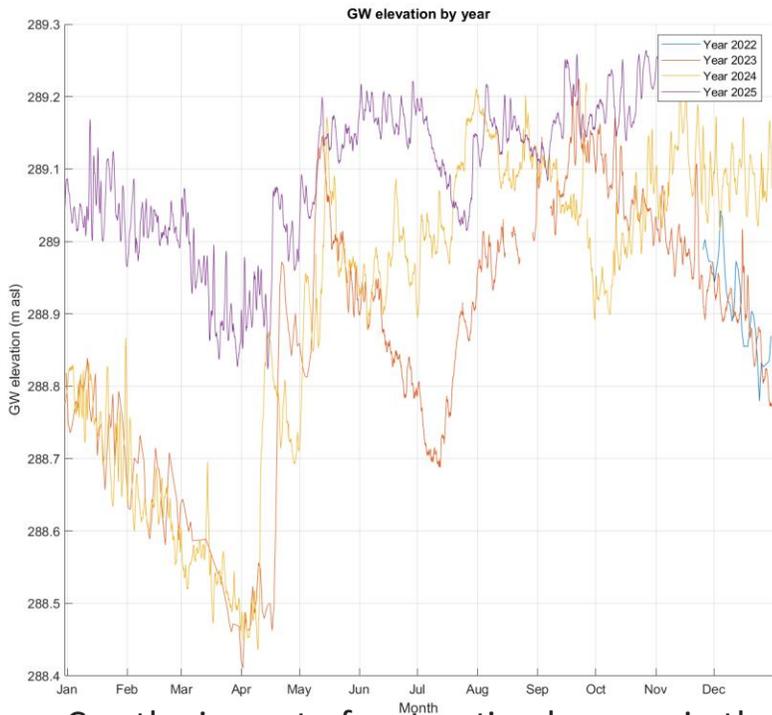
## Field work activities:

- Installation of the water level sensor in the Mato-oja stream  
June 2025
- Summer GW monitoring campaign 8-10th July 2025

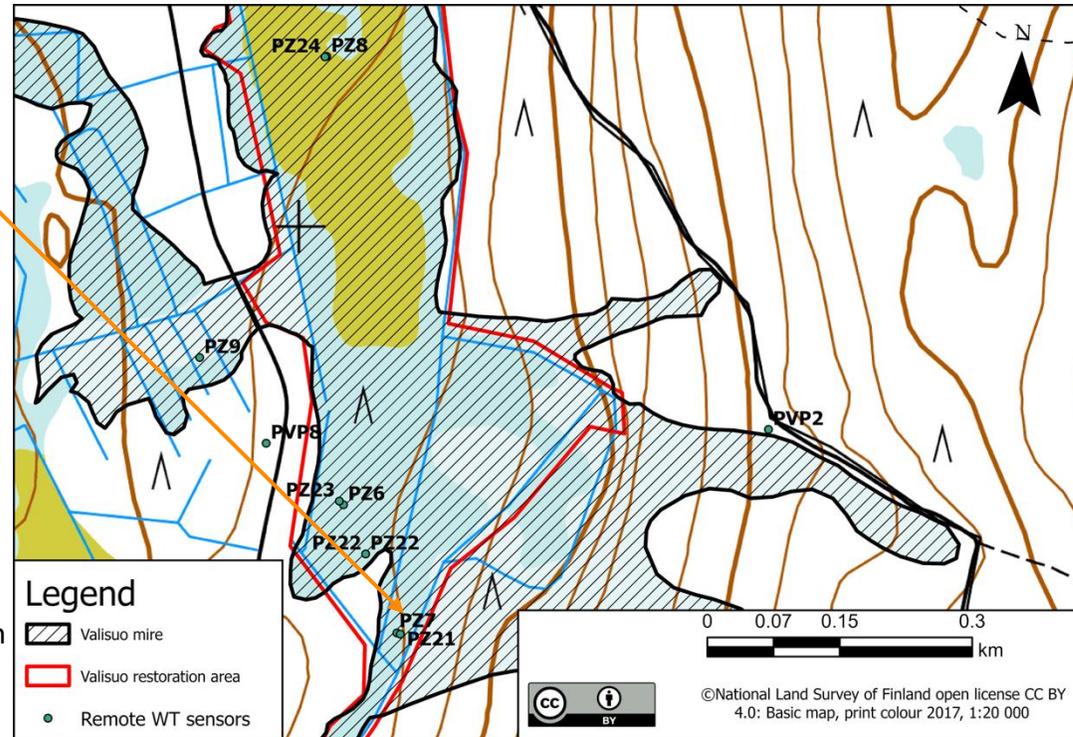
## Modelling and data analysis:

- Continuous GW measurements
- Steady-state/transient models for the drained and restored cases in Matorovasuo

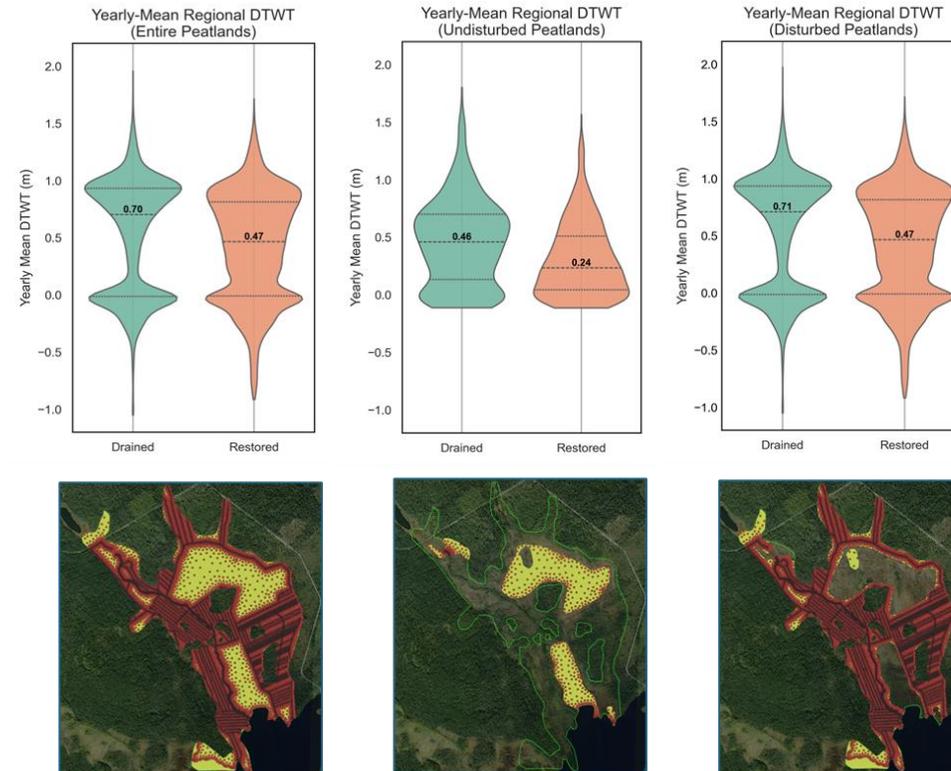
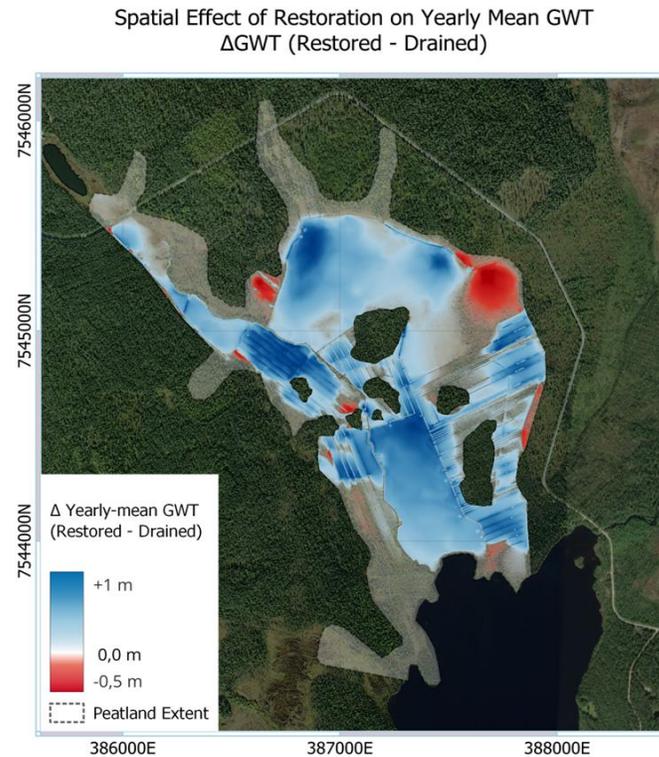
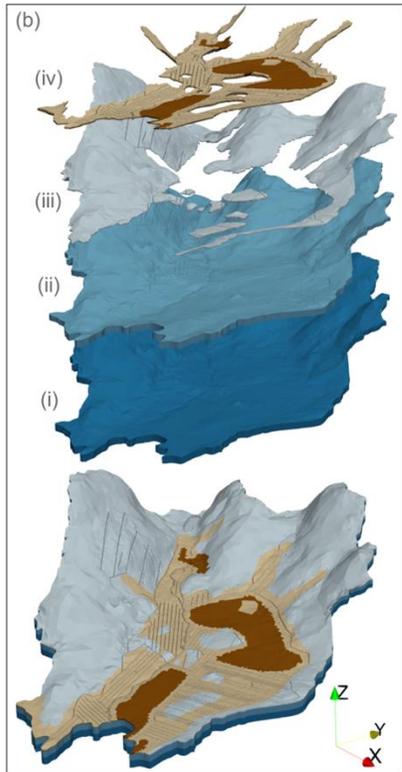
# WP3. 3. Hydrological monitoring



- Can the impact of restoration be seen in the measured groundwater levels?
- Some of the wells show significant gw level rise like in the example above
- Overall, the impact of the restoration can be seen clearly in Välisuo in most of the wells, but this is not in the case Matorovasuo



# WP3. 3. Hydrological modelling



Restoration effects reach beyond their local boundaries, influencing areas far from where actions occur.

- See presentation by Omar Nimr/ University of Oulu

# WP3 T8-9 JSBACH ecosystem model: Pallas habitats

- Six habitats for the sites
- PFTs assigned to each habitat

*Boreal evergreen coniferous trees*  
*Boreal deciduous broadleaf trees*  
*Evergreen shrubs*  
*Deciduous shrubs*  
*Mosses*  
*Sphagnum*  
*Herbs*  
*Aerenchymatous plants*

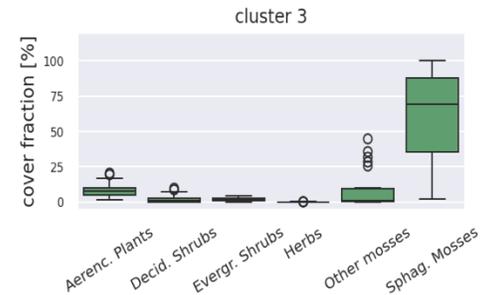
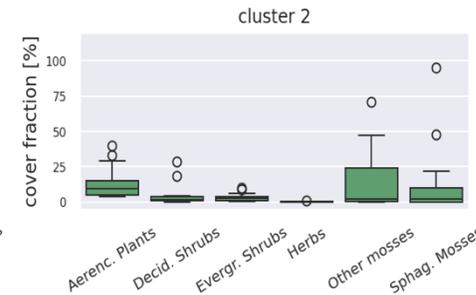
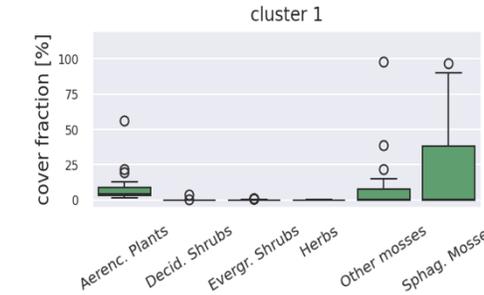
Habitat 1:  
Flark



Habitat 2:  
Trichophorum  
lawn



Habitat 3:  
Rich  
carex lawn



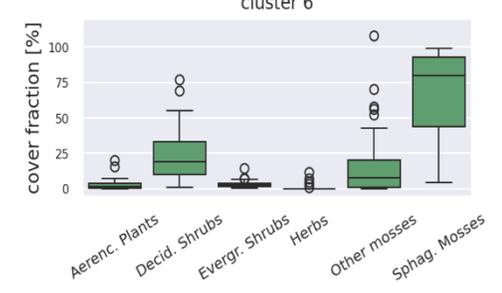
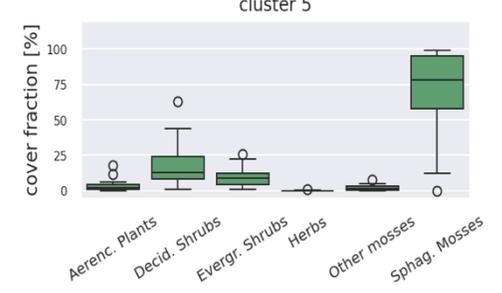
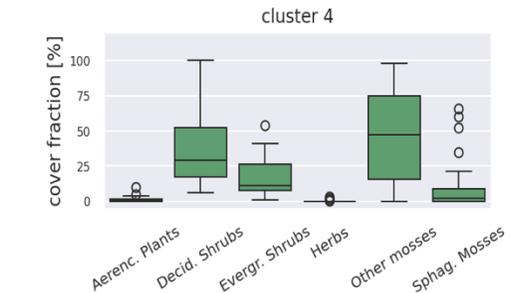
Habitat 4:  
Pleurozium  
hummock  
+ tree cover



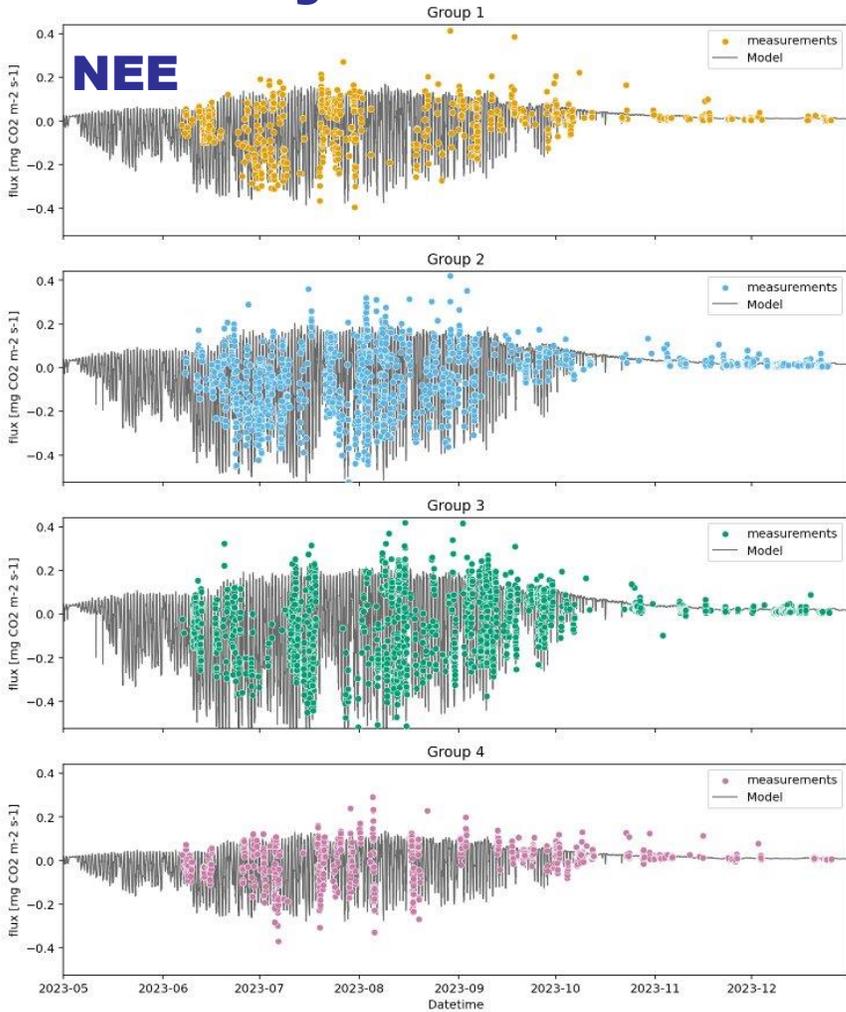
Habitat 5:  
S. fuscum  
hummock  
+ tree cover



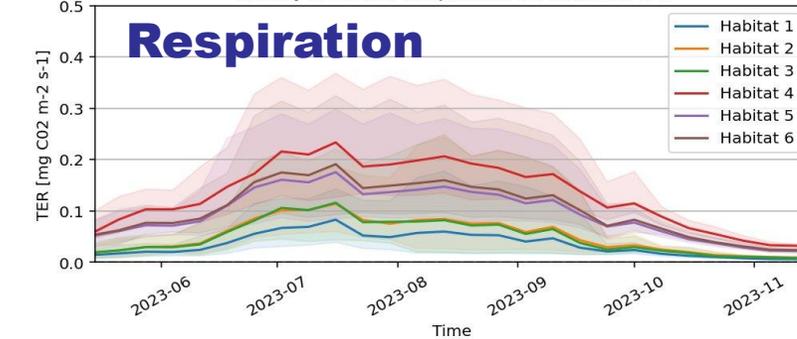
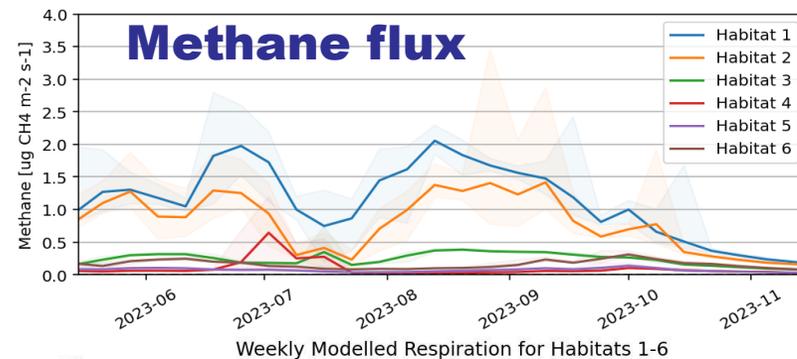
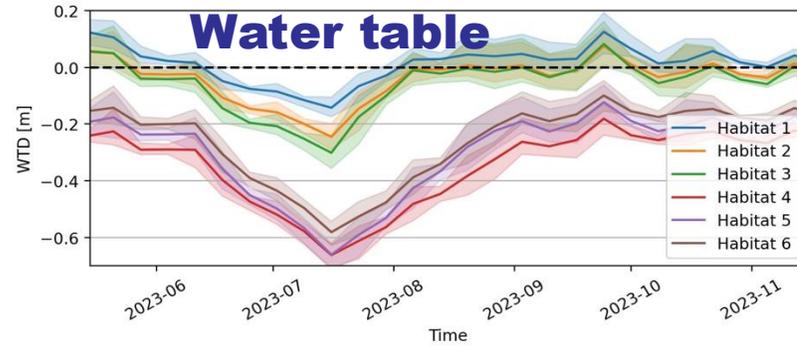
Habitat 6:  
Wet forest  
+ tree cover



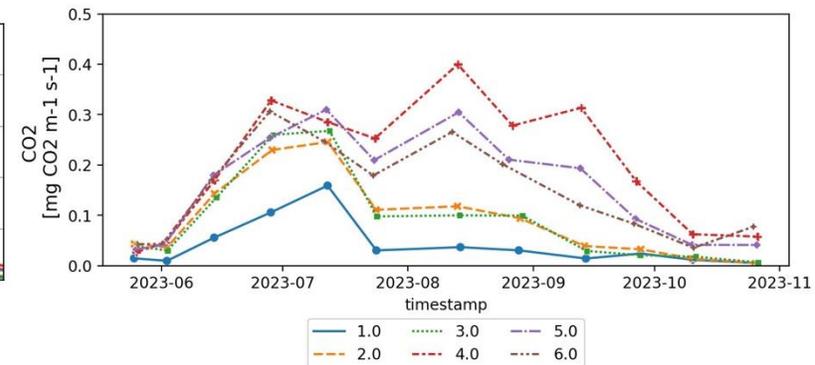
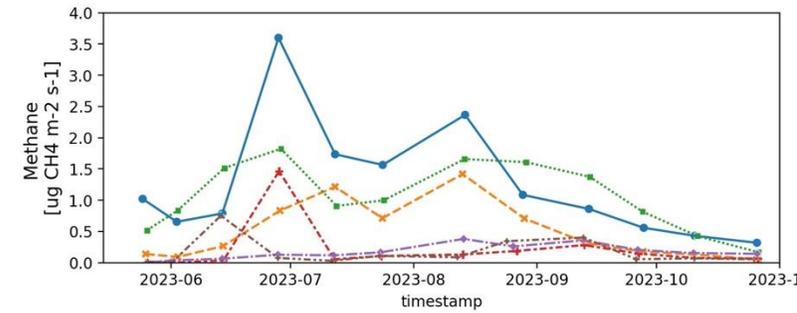
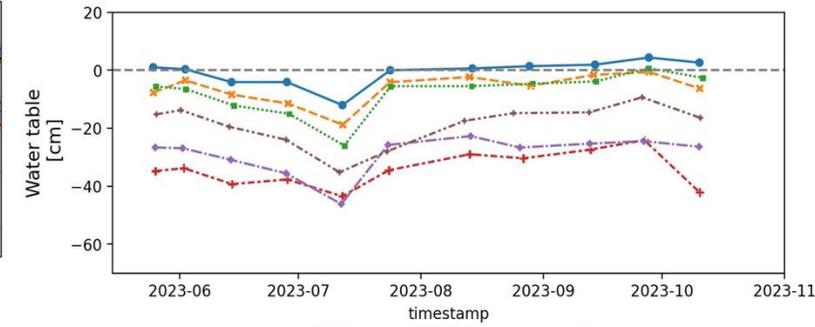
# Comparison against Matorova eddy covariance fluxes by wind sector



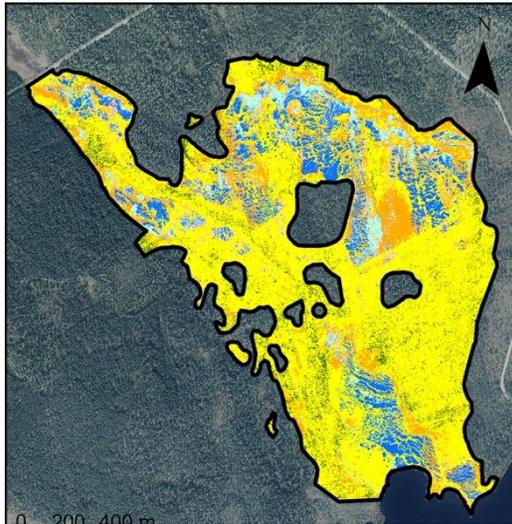
## Habitat simulations



obs



# Matorovansuo growing season (June-August) GHG balances



## Cluster

- (1) Flark
- (2) Trichophorum lawn
- (3) Rich carex lawn
- (4) Pleurozium hummock
- (5) S. fuscum hummock
- (6) Wet forest

Habitat	Area [ha]	CH <sub>4</sub> [gC m <sup>-2</sup> ]		CO <sub>2</sub> [gC m <sup>-2</sup> ]	
		Model	Chamber	Model	Chamber
Flark	18.2	8.7	10	-13	-13
T. lawn	8.3	5.5	4.9	-29	-
R. carex lawn	19.1	1.6	7.8	-31	-28
P. hummock	60.7	0.8	1.7	124	-
S. fuscum hummock	35.7	0.4	1.0	57	-
Wet forest	33.9	0.8	1.0	80	-

# Aggregated balances from JSBACH and GESTs

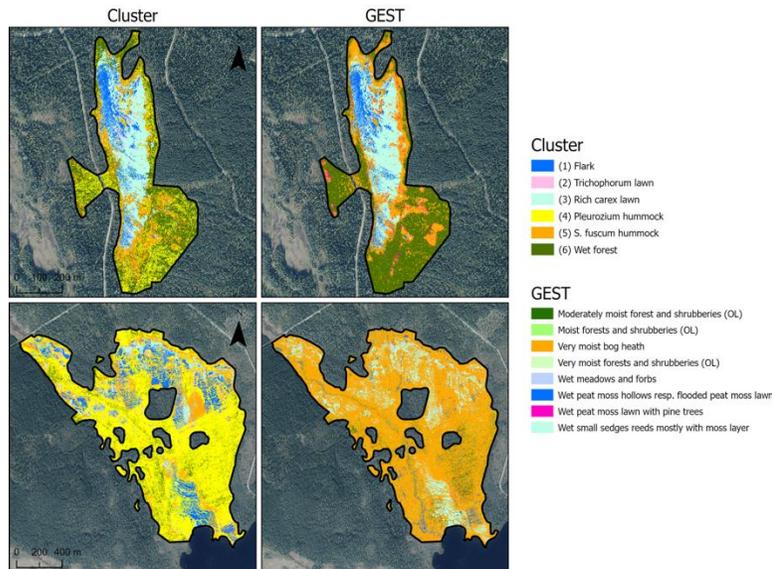


## Välisuo

	Area [ha]	Annual CH4 [t CO2 -eq.]	Annual CO2 [t CO2 -eq.]
JSBACH	28.4	15	-33
GEST	28.4	128	144
Chambers	28.4	35	Not ready

## Matorovansuo

	Area [ha]	Annual CH4 [t CO2 -eq.]	Annual CO2 [t CO2 -eq.]
JSBACH	175	88	-224
GEST	175	878	435
Chambers	175	201	Not ready



- Chamber balance includes only June-August, other values are annual
- GEST balances were computed using values for ground vegetation only.
- JSBACH simulations include tree biomass which explains the CO2 sink capacity
  - Comparable to the forest CO2 from eddy covariance data

**The comparability between the values is approximate at best, but the differences are logical when taking the differences into account.**

**-> Further development of JSBACH PFT descriptions**

**-> Regional simulations of climate change mitigation potential of peatland restoration in Finland and Latvia: Future scenarios with four new habitats**

# WP5-6 Outreach

- **Project meetings**

- Remote meetings related to vegetation analysis, remote sensing, modeling, upscaling

- **Conferences and meetings**

- Scientific meeting of Finnish environmental infrastructures (ACTRIS, AnaEE, eLTER & ICOS), April 2025
- Visit to MPI Hamburg for JSBACH development, July 2025
- INTECOL Wetlands conference, Tartu, July 2025
- Remote meetings with VU regarding peatland model development

- **Communication with policy makers and stakeholders**

- A meeting with inventory makers at FMI (April 2025)



# WP5-6 Outreach

- Web-stories and news

- Related to restoration, meetings and visits
- LIFE Finnish pages in FMI, LUKE, UOulu webpages:
  - <https://www.ilmatieteenlaitos.fi/peatcarbon>
  - <https://www oulu.fi/en/projects/peatland-restoration-for-greenhouse-gas-emission-reduction-and-carbon-sequestration-baltic-sea>
  - <https://www.luke.fi/en/projects/lifepeatcarbon>
- Peatland-project focused web-page at FMI with info on LIFE Peat Carbon in english:

<https://en.ilmatieteenlaitos.fi/climate-impacts-of-peatland-land-use>



# WP5-6 Outreach

- LIFE PMT V Project meeting, June 10-12, Helsinki
  - Programme of the meeting included the following topics:
    - Evaluation of ecosystem services
    - Remote sensing, GEST types, vegetation analysis and habitats, microbes
    - Ecosystem and hydrological modeling
    - Upscaling, replication, exploitation of results
    - Communication activities
  - Invited Guest Lecture by Igors Semjonovs ' Peatland restoration and carbon crediting: experiences in Latvia' for FMI personnel (~50 researchers at site and remotely)
  - One day field trip (~18 pers) to restoration sites near Helsinki (restored Rottasniitunsuo, undrained Tervalaminsuo)
  - After meeting visit to Pallas for vegetation analyses and GHG sampling with Latvian colleagues

