# Overview of used joint field methodology

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**“Climate Change Mitigation in Organic Soils in Agricultural and Forest lands”**
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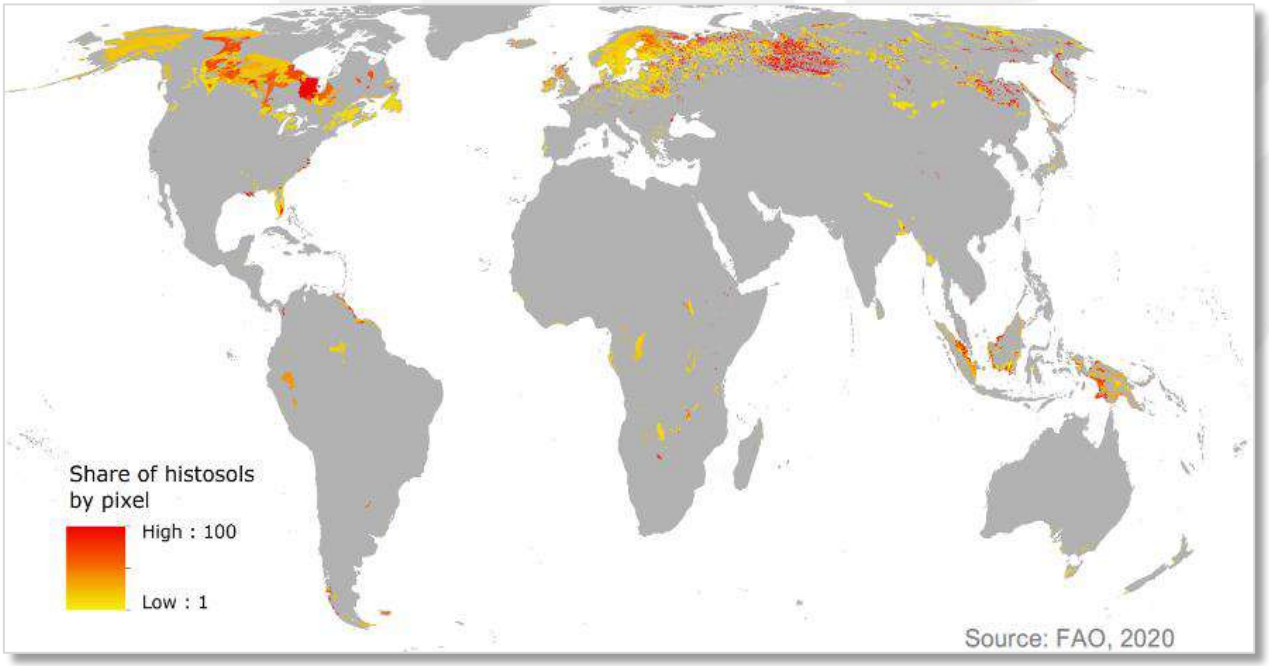
EU LIFE Programme project
“Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland”

# Drained organic soils

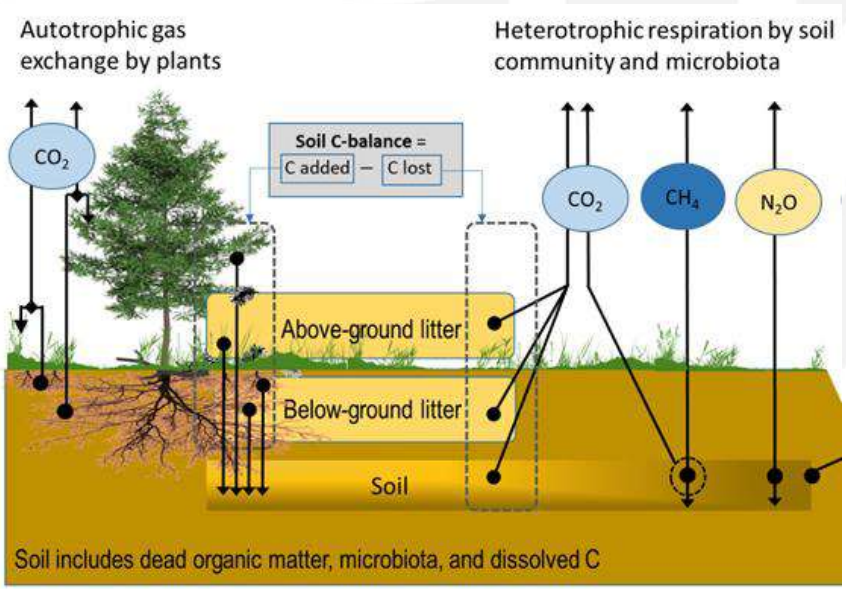
- Ecosystems forming organic soils have accumulated significant labile soil carbon pool over millenia, but in drained conditions these soils form major source of greenhouse gas (GHG) emissions.
- Drained organic soils are regionally important for food and fodder production, and for producing raw materials for the forest industry
- In 2019, the total area of drained soils was 25 million hectares (1990: 23 million hectares), with approximately 14 million hectares located in the temperate zone and boreal regions of the Northern Hemisphere (FAO, 2020).



# Soil carbon and GHG balance in short

Soil C-balance = added C into soil – lost C from the soil

- Vegetation produces dead organic matter (litter) on the soil surface and into soil (=> C added into soil)
- Soil animals and microbial community decompose dead organic matter to gain energy, and the processes release GHGs (=> C lost from soil)
  - GHGs; e.g., carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$)
- Rate in decomposition processes relate to
  - Litter chemical composition, -amount deposited, -structure
  - Environment conditions in soil, e.g., soil moisture, oxygen availability (water level), temperature



# Reporting soil GHG emissions

- 'Emission Factor' (EF), is a number providing estimate of GHG emission from defined soil area over time in specific land use and environment/management conditions (e.g., '$CO_2$ emission to the atmosphere, tons $CO_2$-C $ha^{-1}$ $y^{-1}$')
- The Intergovernmental Panel on Climate Change (IPCC) offers:
  - (1) Tier-1 default EFs for reporting (when country-specific data is not available)
  - (2) guidelines for monitoring GHG emissions (e.g., IPCC, 2006, 2014) for reporting at more advanced levels:
    - Tier-2: EF based on country-specific data
    - Tier-3: EF based on recurrent national inventories and/or advanced modeling
- Several EFs in the Baltic and Nordic countries are still completely or partly based on Tier-1 for drained organic soils (cropland/ grassland/ forest land)
- Life OrgBalt is one of the projects working for improving GHG accounting methods and data availability for drained nutrient-rich organic soils

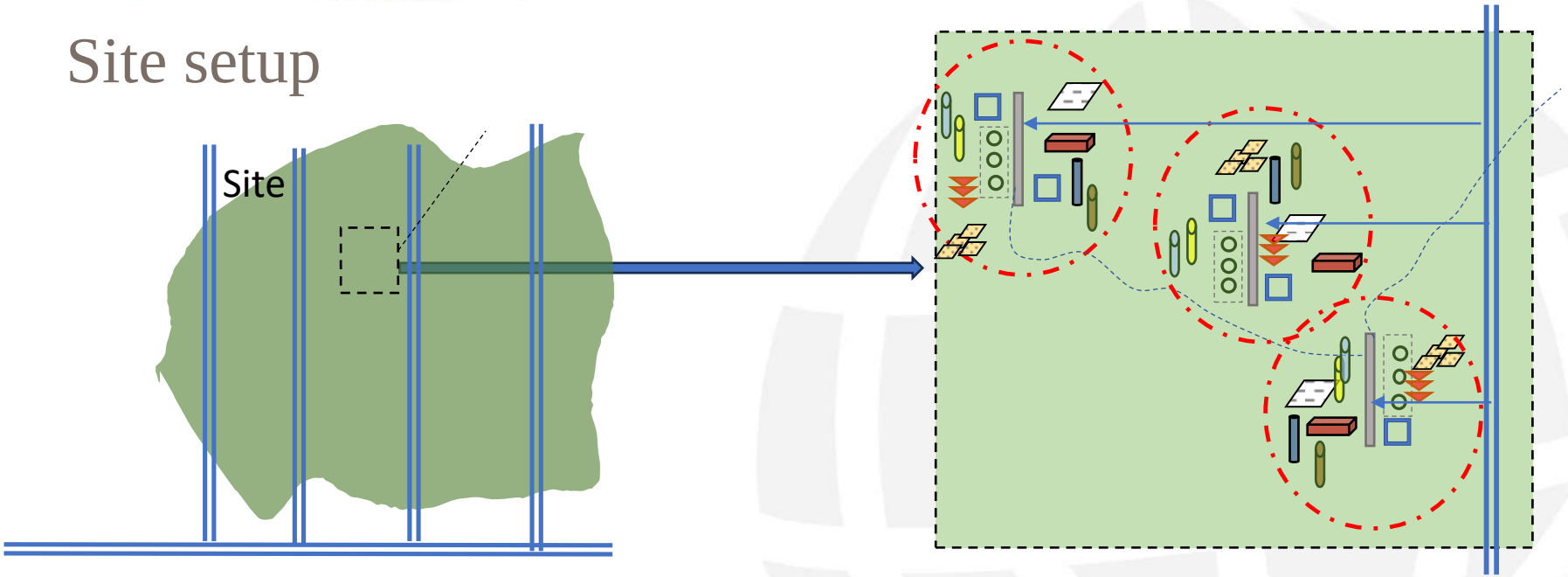
# LIFE OrgBalt project – field methods

Key features on the methodology approach:

- Harmonized data collection setup on the sites
- Spatial and temporal coverage better than the average in previously published studies
- Goal to produce site specific or site-type specific data pool

Data collection at field on 29 forest sites, 8 croplands, 12 grasslands

# Site setup



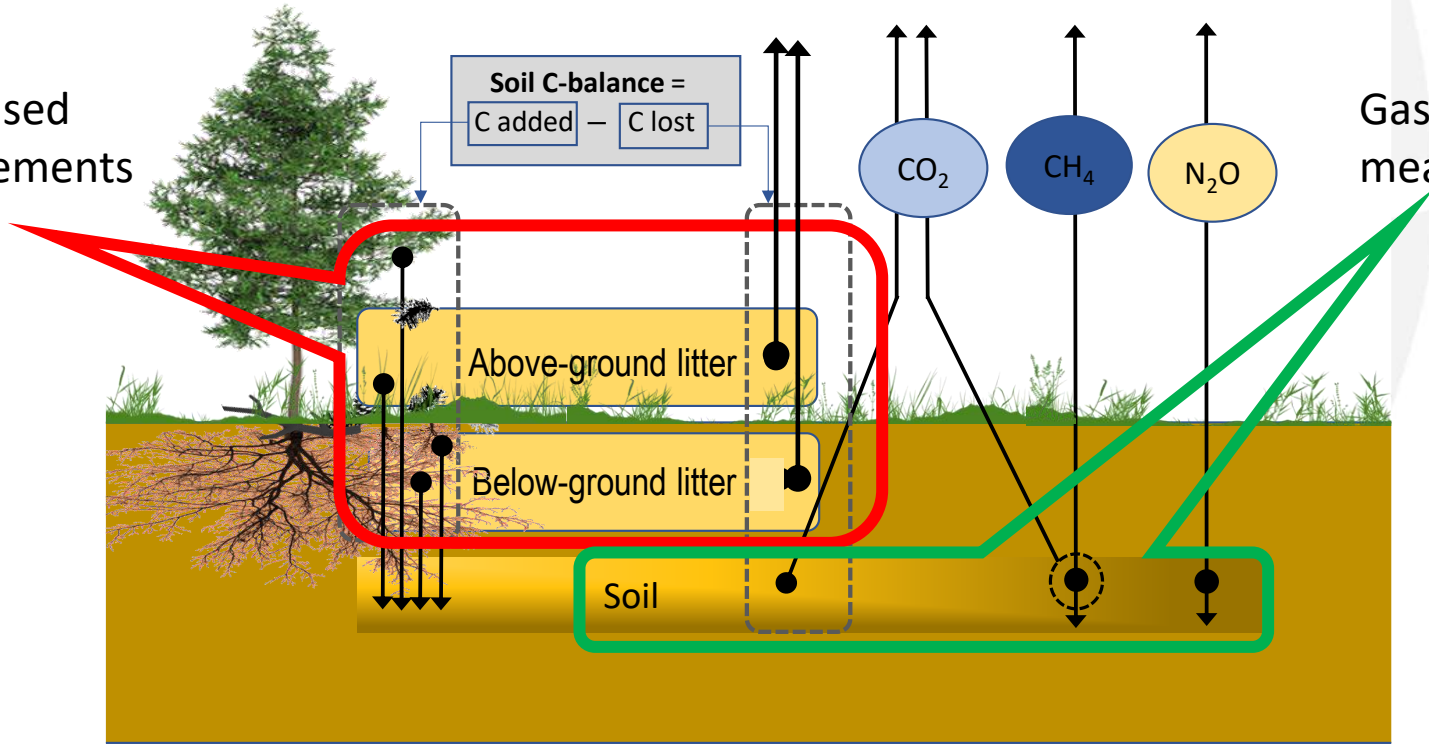

GHG monitoring points — Gases

Water level/quality monitoring/sampling
Soil moisture monitoring
Temperature monitoring
Soil cores
— Environment data

Litter collectors
Ground vegetation monitoring plots
Root ingrowth cores
Decomposition bags (above-/belowground)
— Mass based

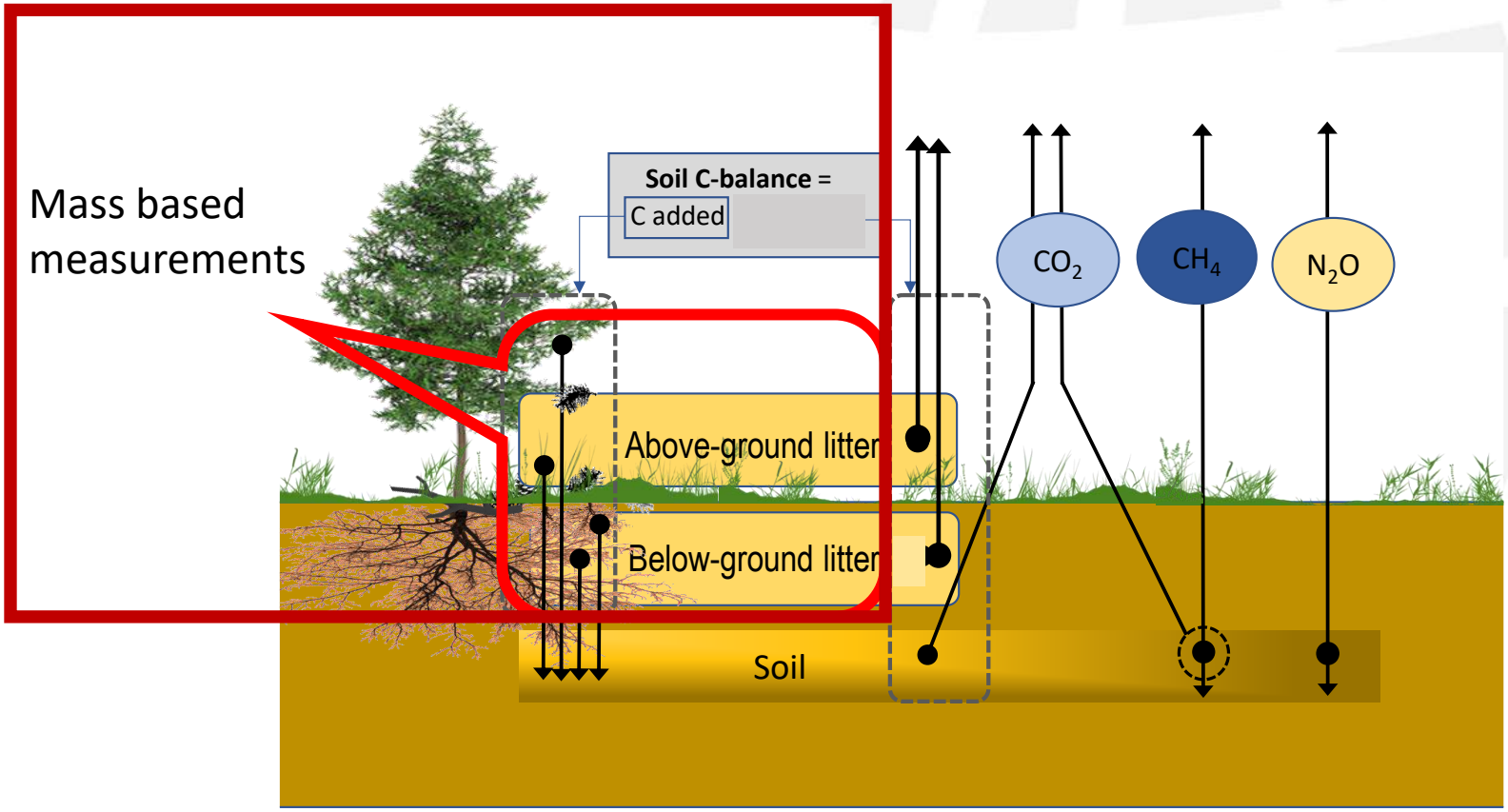
# Soil C and GHG balance monitoring methods

Mass based measurements




Gaseous flux measurements

# Soil C balance – C added as litter



# Soil C balance – C added in litter

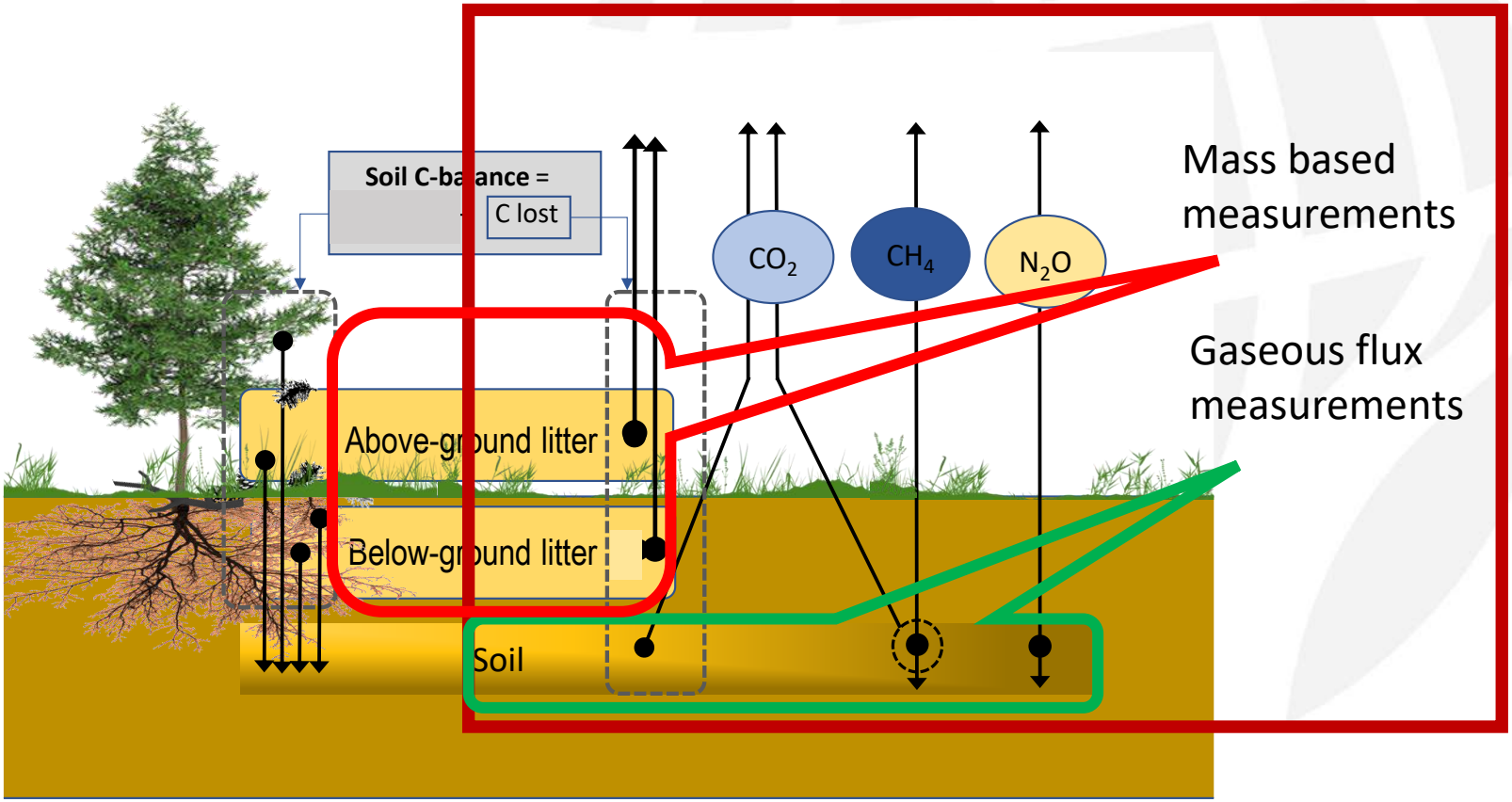
<u>Carbon additions from above-ground litter</u>

- Litter deposition monitoring (2 years)
  - Litter types separated and weighed
- Vegetation community composition and biomass sampling (1-2x/2 years)
  - Ground vegetation litter production (shrubs, herbaceous, grasses, mosses)
  - Tree stand measurements (largely for models)
  - Cropped plants at fields

<u>Carbon additions from below-ground litter</u>

- Fine-root biomass from soil cores (1x)
- Fine-root biomass production from root ingrowth socks/root nets (experiment set for 1-3 years)

# Soil C balance – C lost



# Soil C balance – C lost (,... and 2 other GHGs)

C-loss from litter decomposition (in forest land)

- Above-ground litter mass loss experiment (3-4 years)
  - Wood (2 sizes), tree needles/leaves, forest- and *Sphagnum* mosses
- Below-ground litter mass loss experiment (4 years)
  - Dominant tree fine roots (≤ 2 mm)

Gaseous C losses from soil as $CO_2$, and $CH_4$ and $N_2O$ fluxes

- Soil GHG flux monitoring 3-4-week intervals (2 years)
  - ≥9 points for $CO_{2het}$ (respiration from soil heterotrophic processes in trenched points)
  - ≥5 points for $CO_{2tot}$, $CH_4$, and $N_2O$ (soil- and vegetation dark respiration and soil respiration included)

# Process controls in soil – environment data

<u>Water</u>

- Water level (periodic(*) and continuous by loggers)
- Water temperature, pH, conductivity, oxygen content (periodic)
- Water chemistry; $NH_4^+$, $NO_3^-$, Org-P, elements (periodic)


<u>Soil environment variables</u> at various depths

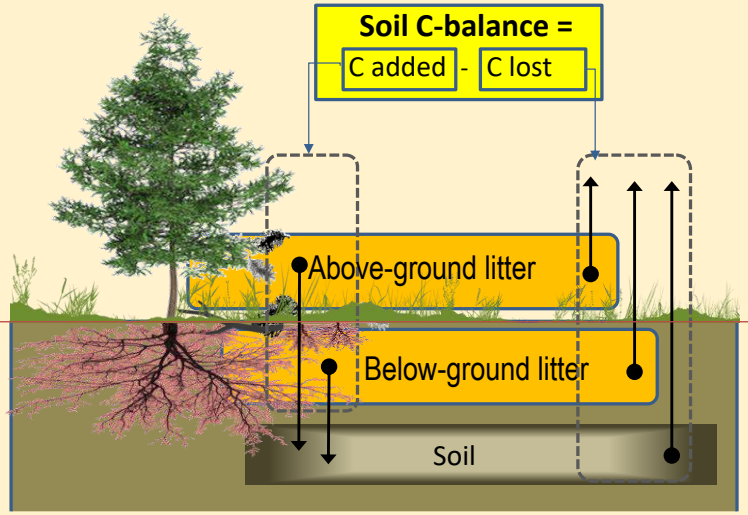
- Soil temperature (periodic and continuous by loggers)
- Soil moisture (periodic)
- Soil physical structure and chemistry (1x)

(*) during GHG monitoring events

# Summary

**C added**
- Vegetation community composition and biomass (monitoring)
- Aboveground litter production (harvesting from litter collectors on the ground)

**C lost (mass loss)**
- Loss from aboveground litter (decomposition bag experiment)




**C lost (gaseous loss)**
- Flux monitoring on bare organic soil surfaces (free from vegetation litter and live roots)

**C added**
- Belowground root biomass (soil cores)
- Belowground root biomass production (root ingrowth socks experiment)

**C lost (mass loss)**
- Loss from belowground litter (decomposition bag experiment)

- Harmonized field methods implemented over 2 years
- Periodic/frequent monitoring & sampling on GHGs, deposited litter, and vegetation community
- Environment variable monitoring & sampling; water, temperature, and soil characteristics

OrgBalt LIFE project

EU LIFE Programme project "Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland"

# Thank you!

Aitäh! Ačiū! Palīdzība! Danke! Kiitos!

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