Overview of used joint field methodology

International Conference
“Climate Change Mitigation in Organic Soils in Agricultural and Forest lands”
13.6.2024,
University of Latvia Academic Center in Riga

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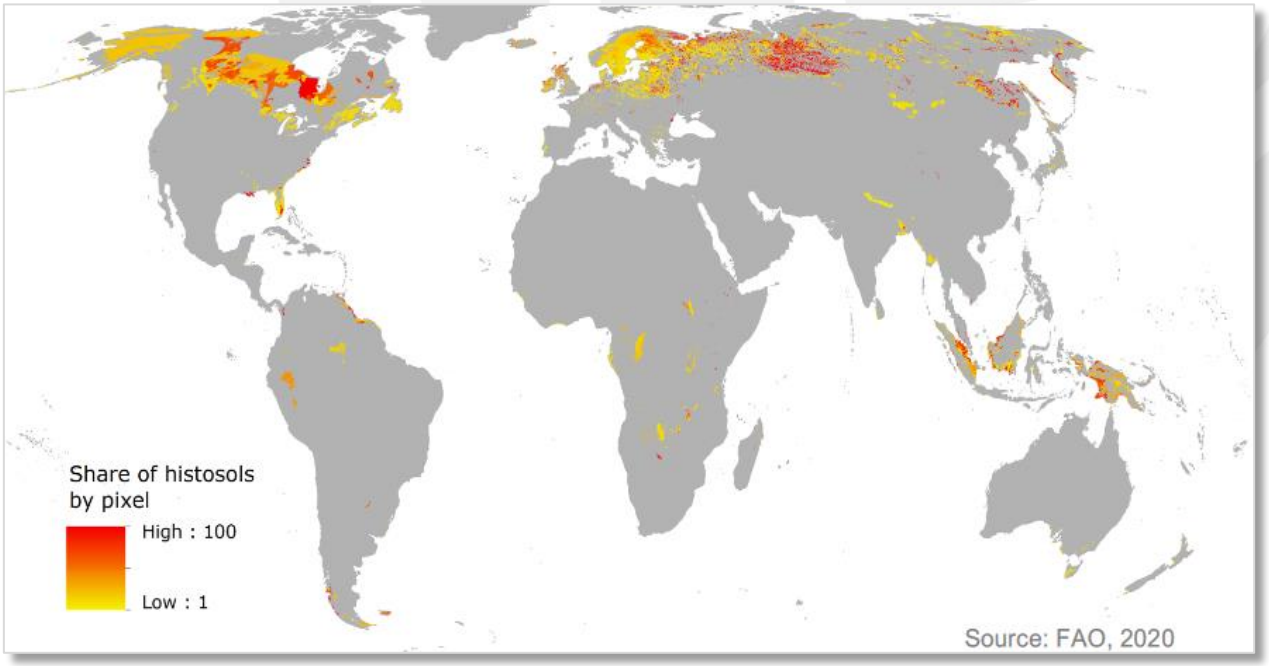
EU LIFE Programme project
“Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland”

Drained organic soils

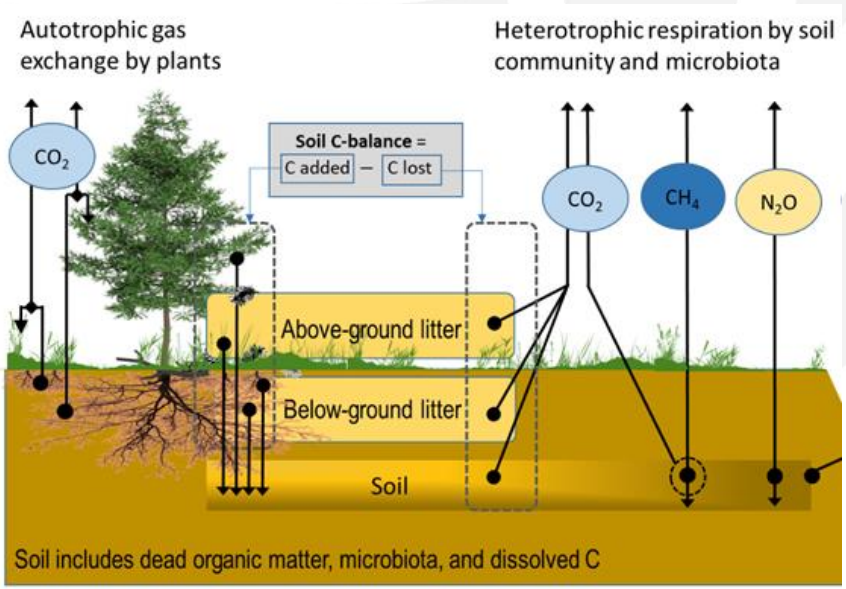
- Ecosystems forming organic soils have accumulated significant labile soil carbon pool over millenia, but in drained conditions these soils form major source of greenhouse gas (GHG) emissions.
- Drained organic soils are regionally important for food and fodder production, and for producing raw materials 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

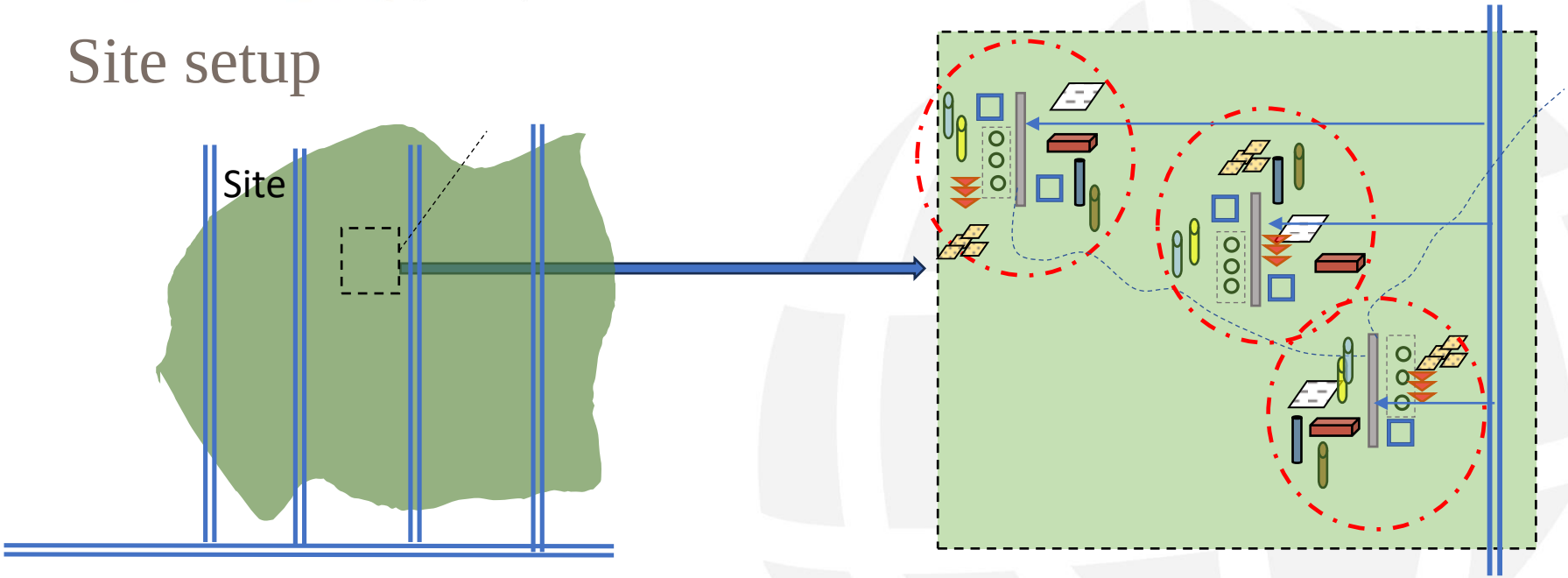
LIFE OrgBalt project – field methods

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

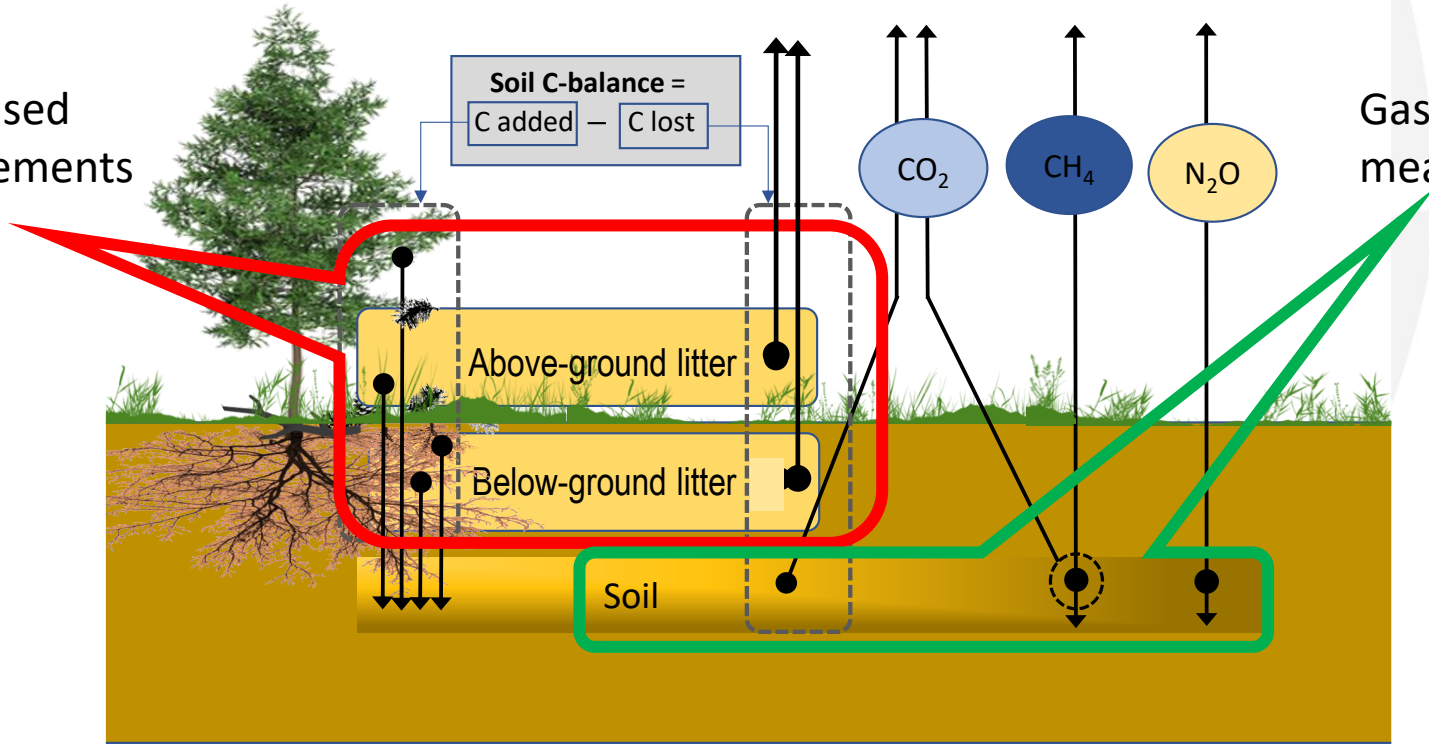
Site setup



- 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

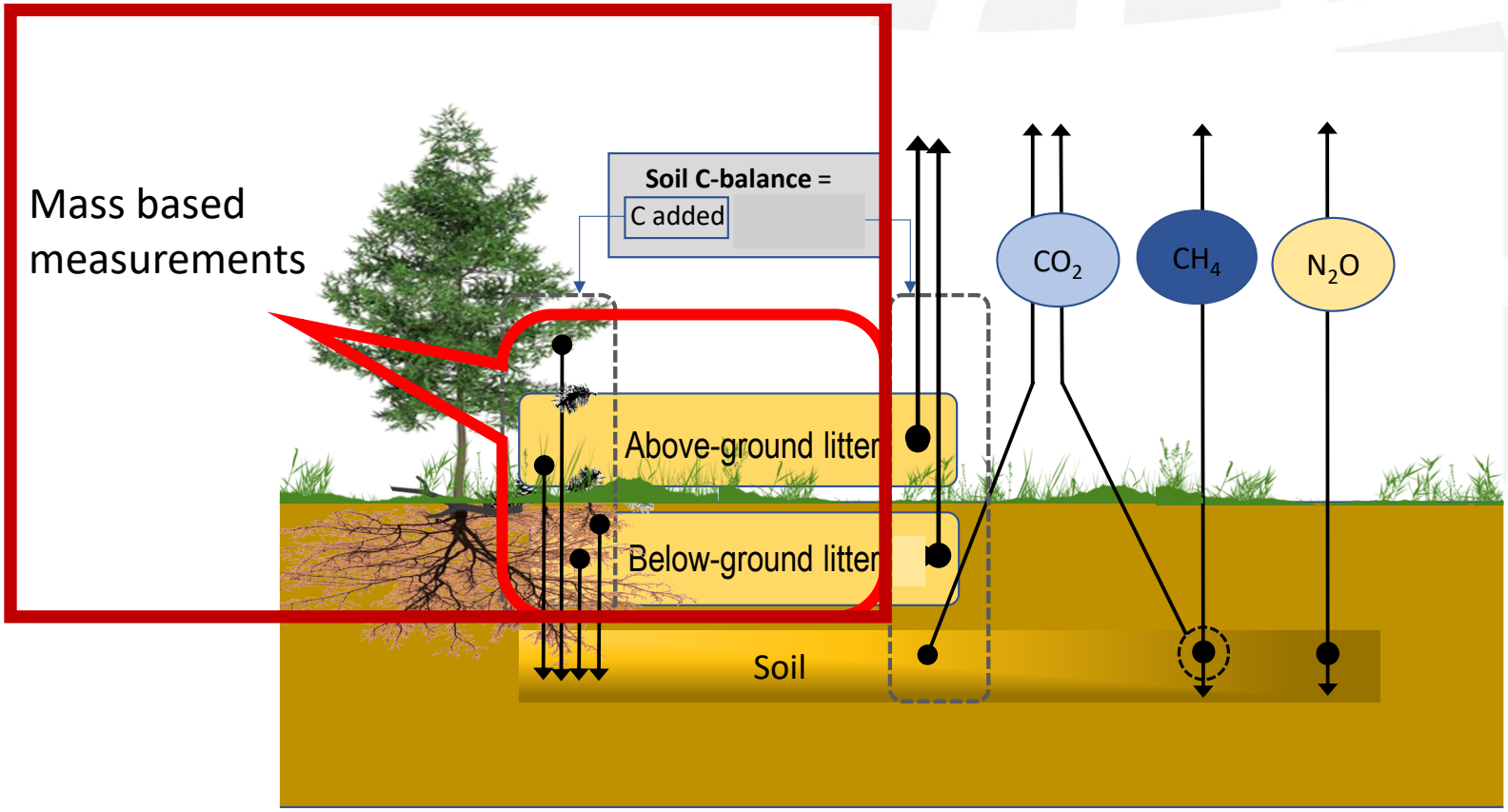
Soil C and GHG balance monitoring methods

Mass based measurements



Gaseous flux measurements

Soil C balance – C added as litter



Soil C balance – C added in litter

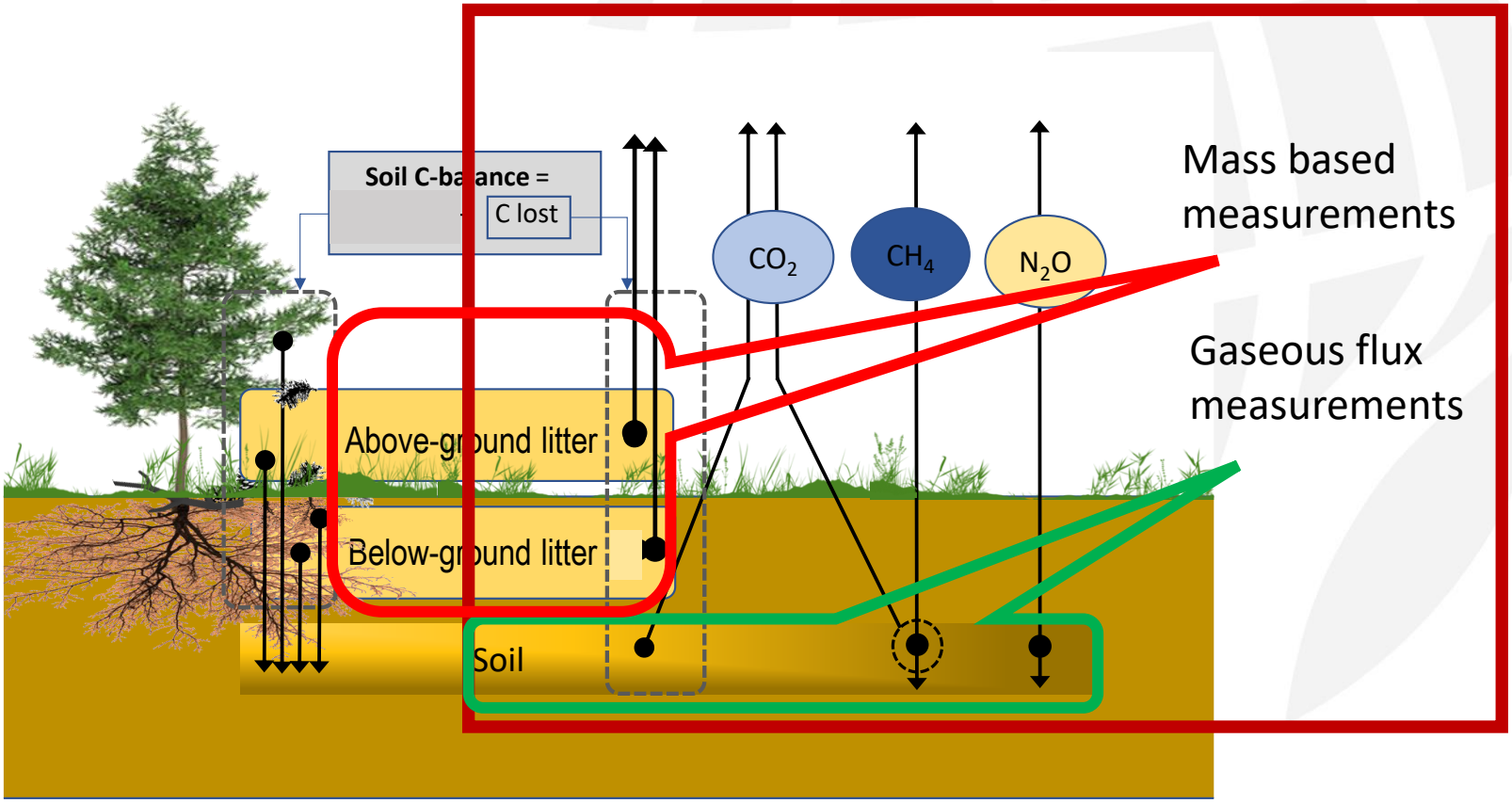
<u>Carbon additions from above-ground litter</u>

- 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

Water

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

Soil environment variables at various depths

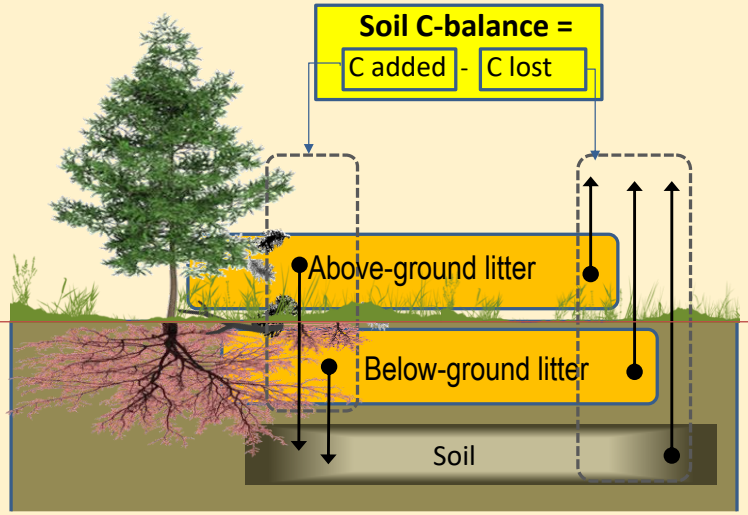
- Soil temperature (periodic and continuous by loggers)
- Soil moisture (periodic)
- Soil physical structure and chemistry (1x)

(*) 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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The project "Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland" (LIFE OrgBalt, LIFE18 CCM/LV/001158) has received funding from the LIFE Programme of the European Union and the State Regional Development Agency of Latvia. www.orgbalt.eu

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