LIFE OrgBalt and LIFE REstore projects

GHG sequestration effects, the methods of GHG flux measurements and modelling, lessons learned and results

LIFE Platform Meeting on Action for European peatlands

Towards Restoring Peatlands and Realizing their Multiple Benefits

WG "Peatland restoration and climate change mitigation"

Berlin, 26-28 April 2023

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LSFRI "Silava", *Ieva Licite*

LIFE OrgBalt, LIFE18 CCM/LV/001158

EU LIFE Programme project

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

LIFE OrgBalt as successor of **LIFE REstore**

Two consecutive LIFE programme projects to work on GHG inventory improvement targets for organic soils - LIFE REstore and LIFE OrgBalt

The main target for both projects - develop the country or regionally-specific GHG emission factors for organic soils, but also to acquire better activity data and methods for evaluating land use and management changes' impact on GHG emissions.

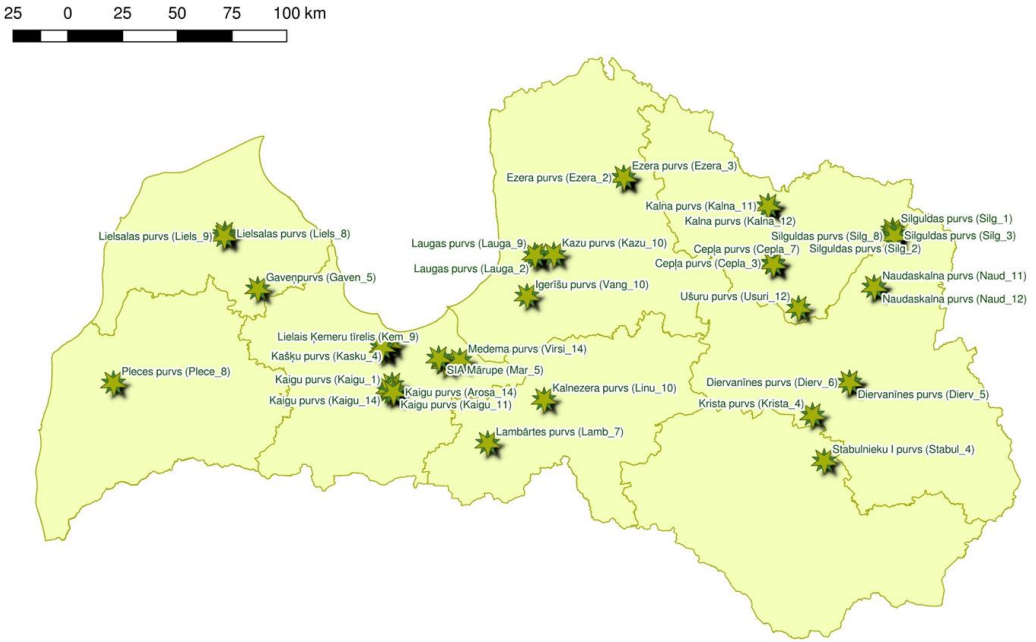
LIFE REstore, LIFE14 CCM/LV/001103 (2015-2019) dealt with **nutrient-poor** organic soils. Only Latvian partners.
LIFE OrgBalt, LIFE18 CCM/LV/001158 (2019 – 2023/24) deals with **nutrient-rich** organic soils. LV, EE, LT, FI, DE partners.

The combined results of both projects cover the whole range of organic soils and significantly extend the management strategies' impact evaluation possibilities.

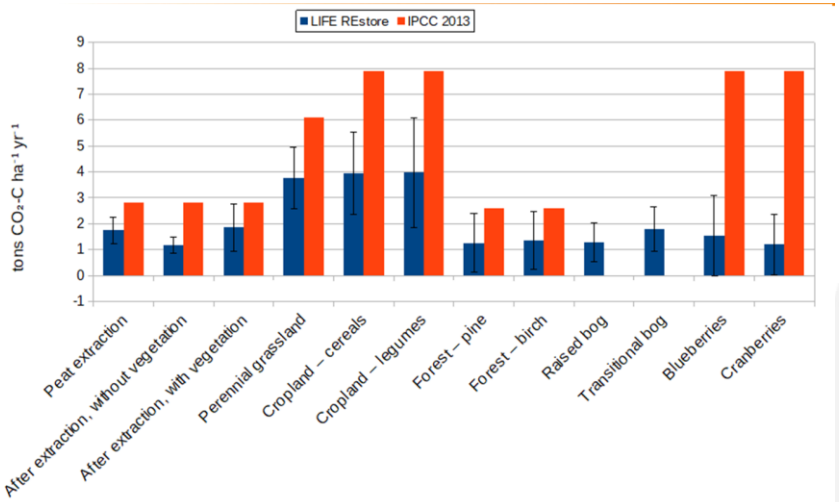
LIFE REstore work and results I

Each land use type represented by 3-4 plots:

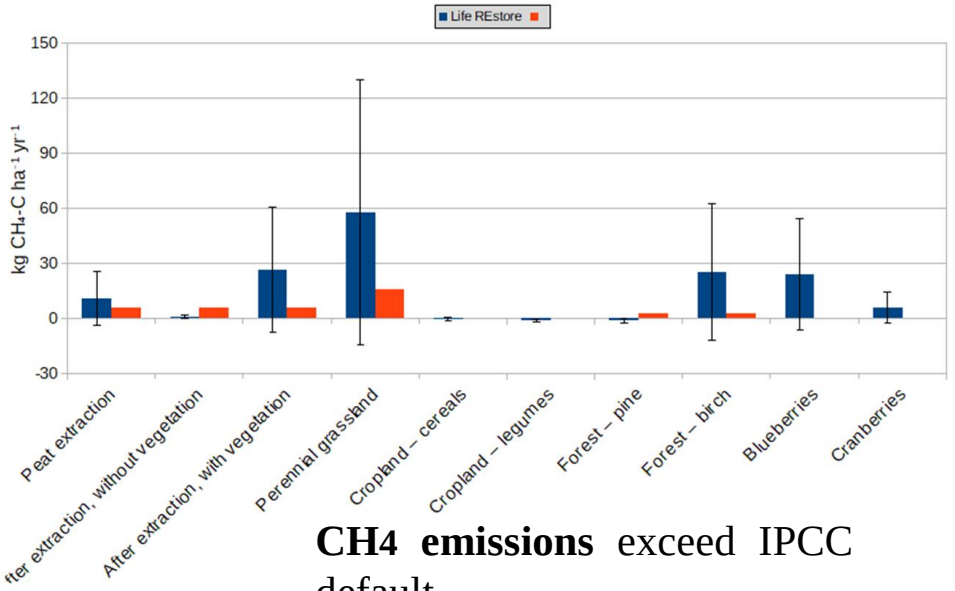
- Peat extraction site.
- Partially restored peatland, poorly developed vegetation.
- Partially restored peatland, covered by bushes and herbaceous plants.
- Perennial grassland (pasture).
- Cropland (cereals and sown grasses).
- Cropland (legumes).
- Plantations of blackberries.
- Plantations of cranberries.
- At least 20 years old pine or spruce stands.
- At least 20 years old birch stands.



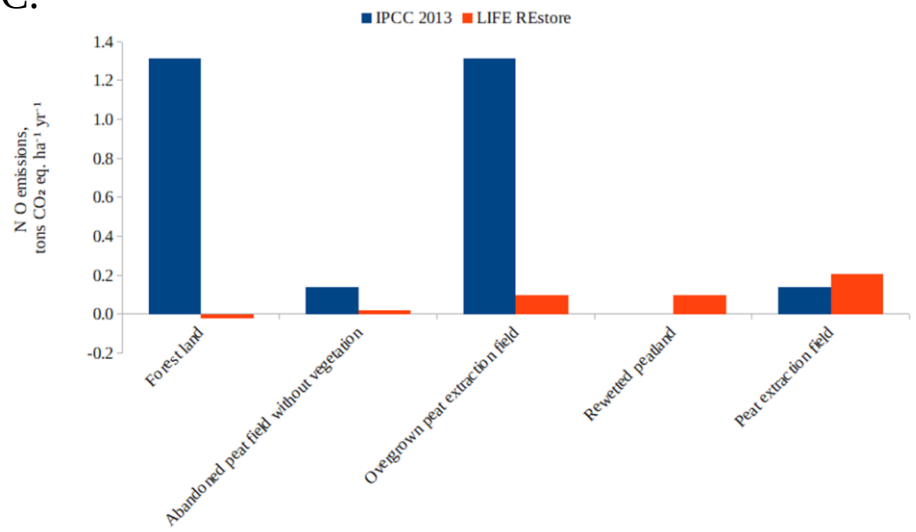
LIFE REstore work and results II



Net CO_2 emissions from soil in all land use - about as twice as small to compare to the default IPCC.



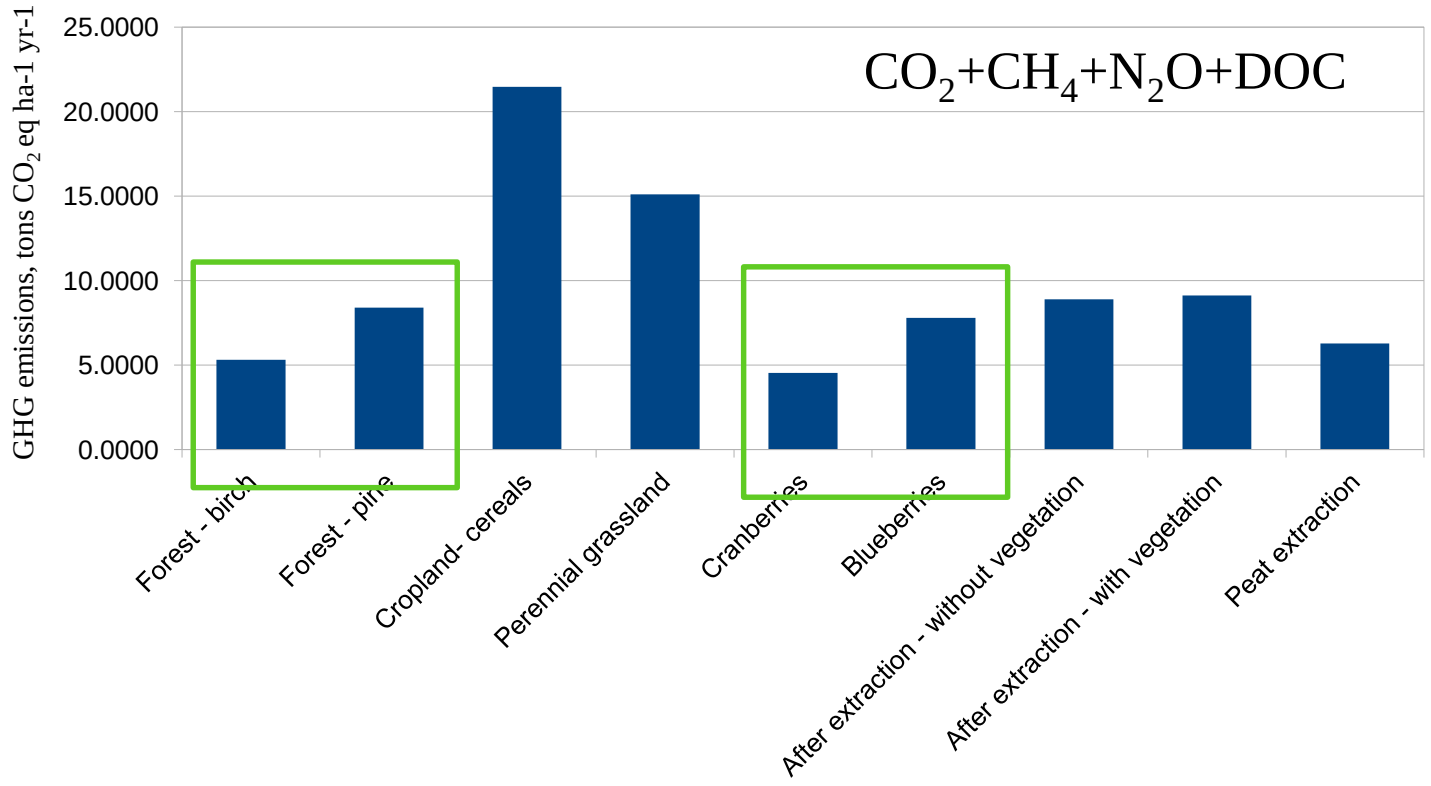
CH4 emissions exceed IPCC default.



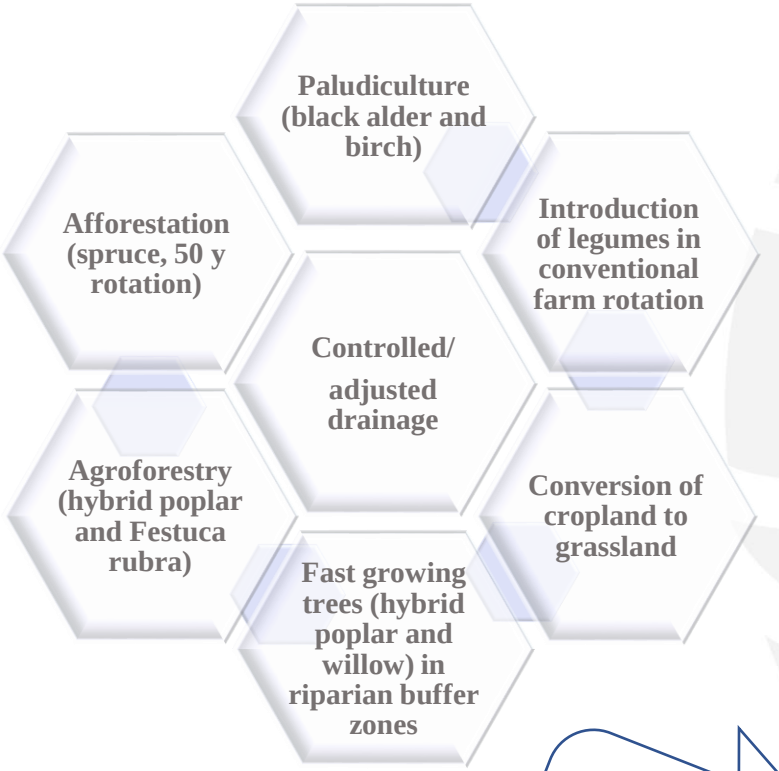
N_2O emissions from soil are significantly smaller in comparison to IPCC guidelines.

LIFE REstore work and results III

Scenario comparison *(removals in living biomass not included)*



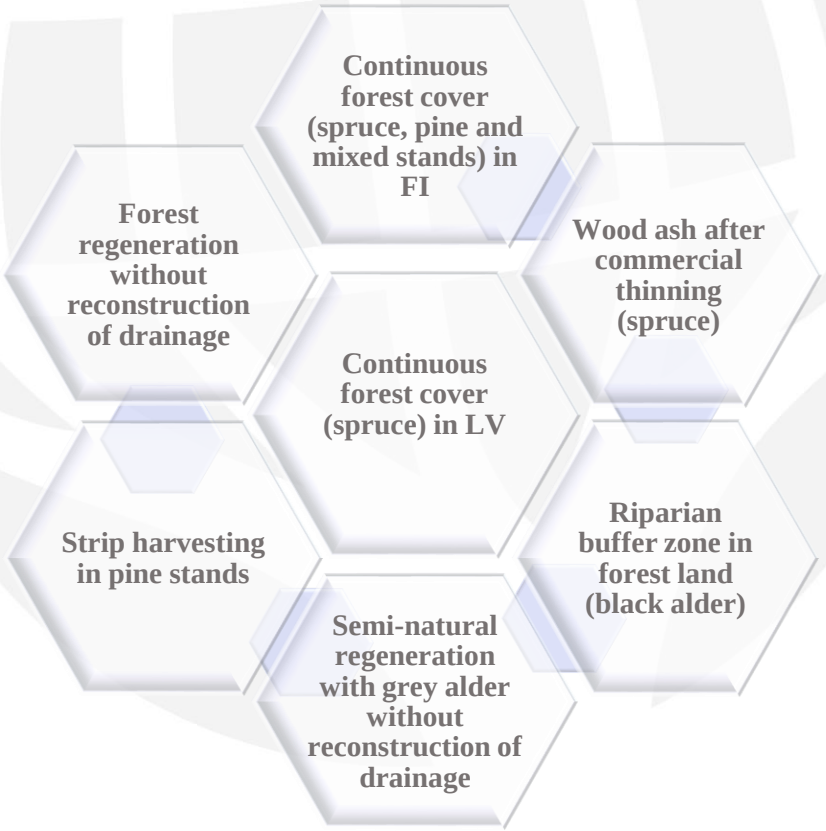
LIFE OrgBalt – measurement sites (demonstration and reference)



Agriculture sites

In total 54 measurement sites in all 3 Baltic States and Finland

Forest sites

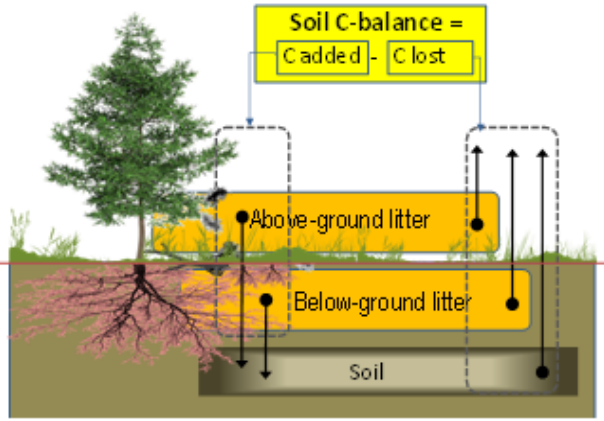


LIFE OrgBalt - methods of GHG flux measurements and modelling I

Method: GHG flux monitoring (N_2O, CH_4, CO_{2tot}, CO_{2het}) by dark chambers and C-transfer & -decomposition in dead organic matter

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)

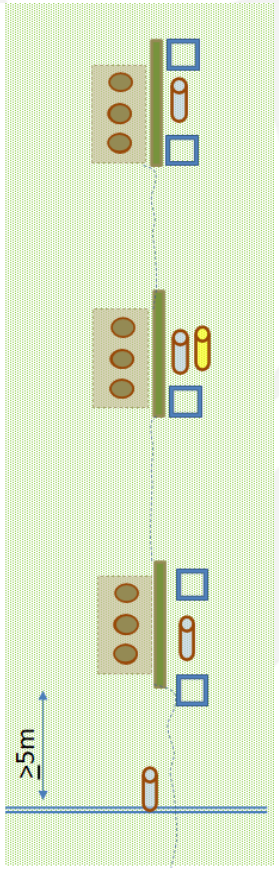
C lost (mass loss)
- Loss from belowground litter (decomposition bag experiment)

LIFE OrgBalt - methods of GHG flux measurements and modelling II

Monitoring at each site

- **Spatial approach:** transect of 3 subplots
  - 9 pcs CO_{2het} flux points (trenched)
  - 5 pcs CO_{2tot}, CH_4 and N_2O flux points (avoided surface disturbance)
  - Soil moisture, temperature at each flux point
  - Continuous water table and temperature at subplot level

- **Temporal approach:** data collection over 2 years (*)
  - Every 3 weeks (every 4-6 weeks c. Nov.-Feb.)
    - GHGs,
    - Water table, soil moisture, temperature, water parameters
    - Litter harvesting
  - Continuous
    - Water table, temperature
  - Annual: root ingrowth & decomposition experiments, ground vegetation biomass collection
  - 1 event: soil coring (biomass, peat characteristics), tree stand

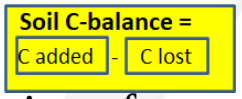


(*) over 1500 campaigns conducted

LIFE OrgBalt - methods of GHG flux measurements and modelling III

Modelling 1

- **CH_4 and N_2O balance**: Calculating site-specific cumulative annual flux averages (option: modelling exercises)
- **Soil C-balance**:
  - **I** Tests for best nonlinear model on momentary CO_{2het} flux and
    - environment variables (soil temperature, water table data)
    - site descriptors (management/vegetation, soil characteristics, ...)
  - **II** Gap filling in continuous soil temperature and WT data
  - **III** Estimating annual soil CO_{2het} balance based on the flux data and environment data
  - **IV** Budgeting mass-based C-data (i.e., annual litter deposition and decomposition)
  - ->**V** Forming soil annual C-balance (from CO_{2het} and mass-based C transfer)



Modelling 2

- Mechanistic peatland simulator **SUSI**(*) is the selected platform for estimation of carbon stock changes in different soil, forest type and climate conditions by using tree stand and weather data

(*) Laurén, A.; Palviainen, M.; Launiainen, S.; Leppä, K.; Stenberg, L.; Urzainki, I.; Nieminen, M.; Laiho, R.; Hökkä, H. Drainage and Stand Growth Response in Peatland Forests—Description, Testing, and Application of Mechanistic Peatland Simulator SUSI. *Forests* **2021**, *12*, 293. https://doi.org/10.3390/f12030293

LIFE OrgBalt – lessons learned so far

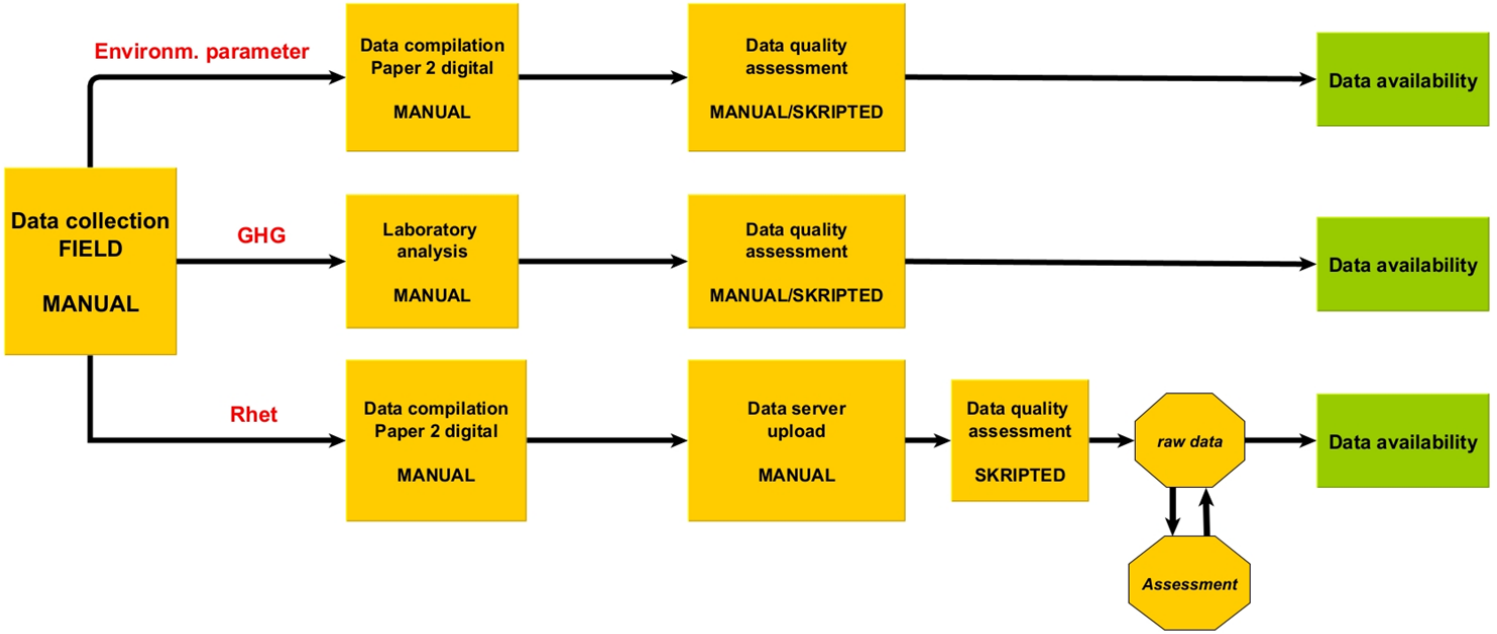
- **Harmonisation of the GHG measurement methods** among 4 countries and people with different knowledge and experience challenges you more than anticipated

Protocols document – open for discussions for ~ a year..
Tons of remote meetings and discussions, calibration seminar in Tartu, video tutorials.
WG Measurements and 7 smaller groups focusing on work packages.

- Background and principles
- Site preparations
- Heterotrophic CO_2 flux monitoring
- Static dark chamber monitoring (incl. CH_4 & N_2O)
- Environment data (water & soil data)
- Litter production and decomposition belowground
- Biomass production aboveground
- Data management (codes and storage)

LIFE OrgBalt – lessons learned so far

- **Data processing is challenging** in the case of more than 1 500 sampling campaigns organised, and several 1000s of data lines gathered in 4 different countries.



- **Definitions matter!**

E.g. organic soil/peat soil or the different understanding of the terms based on regional perceptions.

LIFE OrgBalt – awaited results

- Regionally specific GHG emission factors for different land management systems – to be ready and used in partner countries` GHG inventory, especially in the Baltic States.

BUT in the current regulatory framework (Revised LULUCF Regulation (EU) 2018/841), countries are a bit hesitant to introduce new methods or activity data since this can impact the climate change mitigation targets` amounts.

- Direct policy implications are awaited – inclusion of the most potential (according to the project results) climate change mitigation practices into policy documents – e.g. CAP Strategic Plans, National Energy and Climate Plans, GHG projections etc.

BUT the new regulatory framework is developing (e.g. Nature Restoration Law), and there could be competing interests as regards organic/peat soil management.

Way forward from the current perspective

- To implement tested and generally accepted methods on site specific and site-type specific data collection.
- To produce the best available knowledge based unique data set gathered about managed/drained nutrient-rich organic soils under different management scenarios in forestry and agriculture in the partner countries.
- Provide measurements and science-based results (GHG emission factors, catalogue on climate change mitigation measures, modelling tools and improved GHG activity data) for policymakers and by doing this, avoid being involved too deeply in policy discussions.


Vielen Dank
Thank you!
Aitäh!
LIFE OrgBalt
Paldies!
Aciu!
Kiitos!