MEASUREMENTS OF SOIL GHG FLUXES WITHIN THE LIFE ORGBALT PROJECT

One of the LIFE OrgBalt project key assignments is elaborating and evaluating the soil greenhouse gas (GHG) balance, especially for carbon dioxide (CO_2), but for methane (CH_4) and nitrous oxide (N_2O), too. However, determining those in forests and other ecosystems on organic soils is challenging from technological and capacity perspectives: the annual soil CO_2 balance is formed using summarized CO_2 flux data over the year in monitoring and coherent data on mass-based Carbon (C) stock changes from above and below the ground (Fig. 1).

The project partners started with different levels of expertise and experience to monitor in total more than 50 different sites across Finland, Estonia, Latvia and Lithuania. Considering this, commonly used guidelines for site preparation, installation, and sampling protocols were mutually created, and the respective domestic teams were training each other on how to apply and use them (Fig. 2).

Typically, the data used to calculate the soil GHG balance includes at least one year of monitoring; however, in the case of LIFE OrgBalt, two consequential years of periodic sampling were applied to gather a more precise picture: determination of GHG and environmental parameters such as soil temperature and soil water content, and the chemical analysis of soils, soil

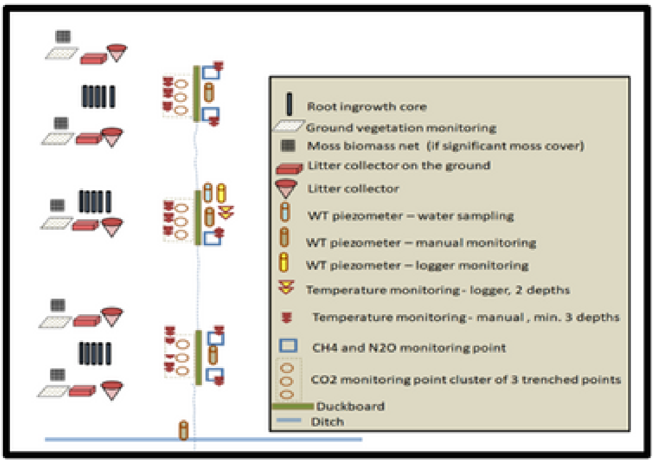

Figure 2. Harmonized site setup, with monitoring spots for GHG, environmental parameters, continuous biomass collection

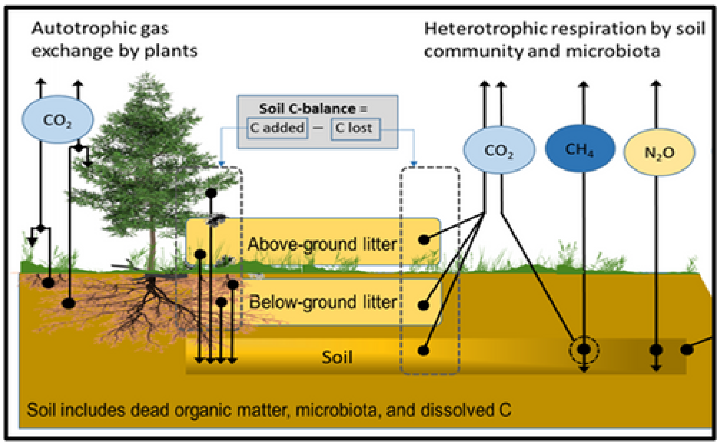

Figure 1. Soil carbon balance, based on GHG exchange and carbon stock from above and below ground compartments. Figure modified from Jauhiainen et al. (2019), Biogeosciences, 16,4687–4703 https://doi.org/10.5194/bg-16-4687-2019

water, and carbon content from above and below ground compartments such as defined litter fractions. Thus, for instance, approximately 30,000 gas samples have been analyzed for the Baltic states. Consequently, the complexity of data gathering requires systematic data handling, including quality assurance, before stepping over for the in-depth data analysis (Fig. 3).

The GHG fluxes for each monitoring spot were calculated from the linear fitting change in gas concentration of up to four consequential gas samples per spot in the chamber headspace over time, adjusted by the ground area enclosed by the soil collar, volume of chamber headspace, air density and molar mass of gas at the measured chamber (ideal gas law).

The GHG fluxes for each monitoring spot were calculated from the linear fitting change in gas

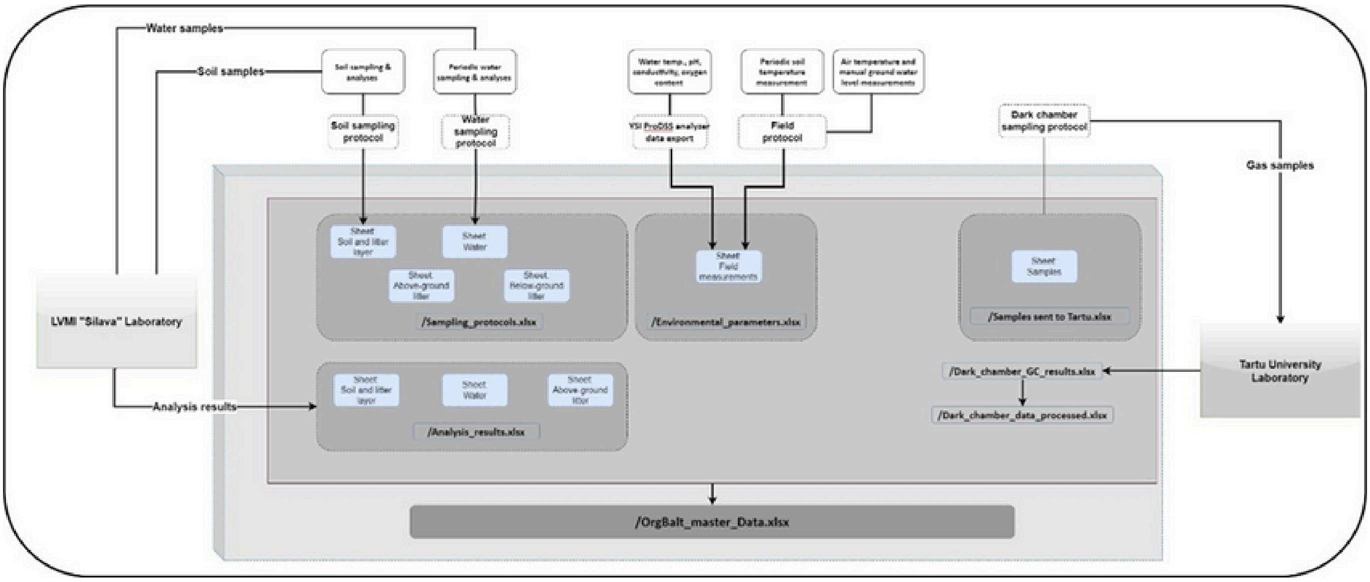

Figure 3. LIFE OrgBalt data collection and analysis structure, simplified data management scheme (by A. Butlers, modified)

concentration of up to four consequential gas samples per spot in the chamber headspace over time, adjusted by the ground area enclosed by the soil collar, volume of chamber headspace, air density and molar mass of gas at the measured chamber (ideal gas law).

To achieve our goal of calculating area-based emission factors, the complex experimental and site design structures require detailed installation, measuring, sampling and analyzing protocols for every single process step. Consequently, all partner institutions in the Baltic States and Finland produce replicable and comparable results. Our harmonized methodologies represent a balancing best-fit approach for >50 sites monitored sites in parallel, dedicated to all partners' experience, respective allocated financial, technical and human resources for field work, laboratory analytics and final data collation and analysis. However, continuous technological developments enhance the periodic re-evaluation of our used state-of-the-art research methods to, for instance, increase the frequency.

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