GHG EMISSIONS MEASUREMENT AND SAMPLING IN FOREST LANDS: A VARIETY OF METHODS FOR ASSESSING THE EFFECTIVENESS OF CLIMATE CHANGE ADAPTATION MEASURES

Within the project LIFE OrgBalt, measures for mitigating climate change impacts on nutrient-rich organic soils in agricultural and forestry lands are demonstrated and tested. Climate change mitigation (CCM) measures selected for testing to be implemented in forest land can be divided into three groups: (1) measures related to afforestation and forest restoration, (2) measures that target increasing of tree cover through agroforestry and (3) measures that aim at increase in forest carbon stocks (in soil and biomass) through the modification of forest management practices.

Figure 1. Ring for the SEG fluxes collecting chambers.

In the article on measurements done in agricultural lands, some of the key measurements done in forestry lands are described. Measures of GHG flux measurement, soil screening with infrared spectroscopy, and soil and water analyses are the basis of data gathering pursued in the project and are applicable to all types of demonstration sites. Detailed descriptions about these measuring processes can be found in the 4th popular article – “GHG emissions measurement and sampling in agricultural lands: towards data-driven decision making for managing carbon rich organic soils”. However, in forestry lands, additional measurements are taken, which are described in depth in this article.

The measuring processes unique to forestry lands are:

1. Tree stand biomass measurements

Tree stand aboveground and belowground biomass (coarse root) estimation are based on measuring the tree stand diameter distribution (breast height diameter) of all trees on the sample plot, and further parameters (e.g., tree height and length of the live crown) for sample trees. Biomass of different stand components are estimated with allometric functions that use breast height diameter, either alone or together with the complementary variables, as explanatory variables. Biomass production estimations are based on the annual diameter growth of measured sample trees. The growth data will be used to construct diameter distributions and the complementary set of variables for the stand in consecutive years after the implementation of the CCM measures.

2. Ground vegetation measurements

The aboveground biomass of the ground vegetation, fine root biomass (<2mm), fine-root production are measured in forestry lands. Fine root biomass (<2mm) is estimated from volume-exact soil cores, analysed down to the rooting zone lower limit in 10-cm sections. Fine-root production is estimated by the ingrowth-core method modified for peat soils (Laiho et al., 2014; Bhuiyan et al., 2017), or the root mesh method (Uri et al., 2017) for annual plants. The

Figure 2. Measurement plot in forest area.

amount of ingrown roots represents fine-root production over the 1-2 years-long incubation period, which will be generalised into annual production per square meter.

3. <u>Carbon inputs with dead biomass and carbon loss rates</u>

Estimates of current carbon stock in litter and deadwood are obtained by the area-based sampling in each site. For forested sites, annual tree mortality estimates will be based on monitoring data from other projects or tree mortality models (e.g., Jutras et al., 2003), where applicable. Estimates on the amount of deadwood will be made as the data from tree stand biomass becomes available.

Carbon input with the annual aboveground litter from perennial plants are based on a recurrent collection of litter from litter traps of known area (e.g., Ojanen et al., 2013; Uri et al., 2017), following the litter classification and analysis by methodology defined for ICP forest monitoring. Litter traps will be set at the sites at the time of site establishment and the start of gaseous flux monitoring.

Decomposition of aboveground litter C pools is estimated using decomposition models, separately for the coarse woody debris of conifer and deciduous trees (e.g., Pearson et al., 2017; Tuomi, Rasinmaki, et al., 2011; Tuomi et al. 2011a), and fine litter (e.g., Strakova et al., 2012; Tuomi et al., 2011a) in different climatic conditions. The litterbag method (Strakova et al., 2012) is used for estimating litter decomposition rates in cases where no applicable models exist.

Litter traps collecting litterfall from trees and ground level are set at forest sites in all partner countries. The traps are emptied for deposited litter materials monthly during the warm season and after snow melts.

4. <u>Characterising soil microbial communities</u>

The whole microbiota: fungi, archaea and bacteria are analysed within the project. The microbiome is analysed by amplicon sequencing using ITS and 16S primers. 30 sites are included in the analysis of soil microbial communities, totalling 180 separate soil samples. Selected forest sites can be grouped to include differences in tree composition (deciduous, conifer, and mixed tree stands), tree stand age, and typical water table levels in soil (high and low water table sites).

The extensive set of data collected in demonstration sites on forestry lands of LIFE OrgBalt will contribute to the understanding of CCM measure effectiveness and provide with new findings about the dynamics of GHG emissions in nutrient-rich organic soils in the region.

Discover the measurement processes in action in this short documentary: https://www.youtube.com/watch?v=fktSVWquuus

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Figure 3. Litter trap for small size litter.

References

Bhuiyan, R., Minkkinen, K., Helmisaari, H-S., et al. (2017). Estimating fine-root production by tree species and understorey functional groups in two contrasting peatland forests. Plant and Soil 412: 299–316. doi:10.1007/s11104-016-3070-3.

Jutras, S., Hokka, H., Alenius, V., and Salminen, H. (2003). Modeling mortality of individual trees in drained peatland sites in Finland. Silva Fennica 37: 235–251. http://urn.fi/URN:NBN:fi:ELE-883193

Laiho, R., Bhuiyan R., Strakova P., et al. (2014). Modified ingrowth core method plus infrared calibration models for estimating fine root production in peatlands. Plant and Soil 385: 311–327. DOI: 10.1007/s11104-014-2225-3

Ojanen, P., Minkkinen, K., and Penttilä, T. (2013). The current greenhouse gas impact of forestry-drained boreal peatlands. Forest Ecology and Management 289: 201–208. https://doi.org/10.1016/j.foreco.2012.10.008

Pearson, M., Laiho, R., and Penttilä, T. (2017). Decay of Scots pine coarse woody debris in boreal peatland forests: mass loss, nutrient retention and release. Forest Ecology and Management 401: 304–318. DOI: 10.1016/j.foreco.2017.07.021

Strakova, P., Penttilä, T., Laine, J., and Laiho, R. (2012). Disentangling direct and indirect effects of water table drawdown on above- and belowground plant litter decomposition: Consequences for accumulation of organic matter in boreal peatlands. Global Change Biology 18: 322–335. https://doi.org/10.1111/j.1365-2486.2011.02503.x

Tuomi, M., Laiho, R., Repo, A., and Liski, J. (2011a). Wood decomposition model for boreal forests. Ecological Modelling 222: 709–718. doi:10.1016/j.ecolmodel.2010.10.025

Tuomi, M., Rasinmaki, J., Repo, A., Vanhala, P., and Liski, J. (2011b). Soil carbon model Yasso07 graphical user interface. Environmental Modelling and Software 26: 1358–1362. https://doi.org/10.1016/j.envsoft.2011.05.009

Uri, V., Kugumagi, M., Aosaar, J., et al. (2017). Ecosystems carbon budgets of differently aged downy birch stands on well-drained peatlands. Forest Ecology and Management 399: 82–93. https://doi.org/10.1016/j.foreco.2017.05.023

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