REPORT

ON IMPLEMENTATION OF THE PROJECT

DEMONSTRATION OF CLIMATE CHANGE MITIGATION MEASURES IN NUTRIENTS RICH DRAINED ORGANIC SOILS IN BALTIC STATES AND FINLAND

WORK PACKAGE

TOOLS FOR MODELLING OF IMPACT OF CLIMATE CHANGE ON GHG EMISSIONS (C.2)

ACTIONS

Deliverable title	**Activity data for accounting and projections of GHG emissions from organic soils**
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Authors	J.Ivanovs, A.Lazdiņš, A.Butlers, A.Bardule, I.Licite, A.Lagzdiņš, A.Nipers, K. Soosaar, A.Kull, A.Sims, V.Kazanavičiute, A. Haber, B. Tiemeyer, M. Haakana
Photos and drawings	J.Ivanovs
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Organization	Latvia State Forest Research Institute "Silava"
Contact information	Riga street 111, Salaspils, LV-2169
	Phone: +37129183320
	E-mail: ieva.licite@silava.lv
	Web address: www.silava.lv
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"LIFE OrgBalt compiled the first regional Baltic/ Finnish GHG emission factors for managed nutrient-rich organic soils (current and former peatlands), which have been made available for the customary scientific review and further verification for national GHG inventories in the hemiboreal region in Finland and the Baltic countries. While the project analysed selected CCM measures for drained organic soils in agriculture and forestry and developed spatial models and tools, it also identified remaining knowledge gaps. To bridge the remaining limitations and fill the gaps, it is essential to continue GHG measurements and model development, as well to broaden and complete the scope of the evaluated CCM measures in the after-LIFE-project period, notably by including rewetting and restoration of peatlands that are currently considered to be among the most recommended CCM measures on drained peatlands in the EU. In addition, the developed Simulation and PPC models still include limited macroeconomic considerations and lack assessment of all environmental impacts. For all these reasons, these models should be used carefully in CCM strategy development for identification of gaps in climate neutrality transition policy and funding frameworks and need further optimization for broader applicability as decision-making tools."

SUMMARY

Activity data gathering task for reporting and projections of GHG emissions from organic soils is targeted on elaboration of activity data for GHG projections and integration of climate sensitive emission factors into GHG modelling tools. Within this paper activity data related to water regime are developed, work within the Project C2 activity will be continued to get additional activity data harmonized at a national level and comparable between Baltic states and definitions provided in IPCC 2006 and IPCC 2014 Wetlands supplement (Eggleston et al., 2006; Hiraishi et al., 2013).

Water regime is one of the most important factor affecting greenhouse gas (GHG) emissions from organic soils - increase of groundwater level raises methane (CH4) emissions, deeper groundwater level can be associated with increase of carbon dioxide (CO2) emissions and regular fluctuations of groundwater level usually increases emissions of all GHG. Therefore, it is important to develop mapping tools characterizing groundwater level and its seasonal fluctuations in organic soils. The OrgBalt project will contribute to development of Depth to water (DTW) maps and wet area maps, which, in combination with historical soil data, spatial information on land use and carbon turnover data, will be used to predict presence of the organic soils and GHG emissions from the soil. The approach utilized in the project - development of DTW and wet area maps for all Baltic countries - will ensure implementation of harmonized approach for calculation of GHG emissions in the whole region. The DTW and wet area maps can also be used to improve planning of amelioration systems in farmlands and forest lands, as well as to improve forest management planning, e.g. selection of proper species and management approach for each parcel. At this stage DTW maps with two different catchment area sizes are generated for whole study area.

ABBREVIATIONS

ALS – Airborne laser scanning

DEM – digital elevation model

CH_4 – methane

CO_2 – carbon dioxide

GHG – greenhouse gas

DTW - Depth to water maps

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1. INTRODUCTION

Poorly drained and wet soils are a challenge in forestry, agronomy and other industries (McNabb, Startsev, & Nguyen, 2001). Wet soils are important for the different habitats, species and biodiversity, as well as water exchange and chemical processes (Detenbeck, Galatowitsch, Atkinson, & Ball, 1999), wet forest depressions can serve as a source of data to reconstruct past climatic conditions at the local scale (Stivrins et al., 2017), thus the data about spatial distribution of wetlands is important for both sustainable forest management and research (Moore, Grayson, & Ladson, 1991). This type of information helps to improve land management practice, helps avoid financial losses as well as reduce business risks (Christensen et al., 1996).

The topography of the earth's surface and the bedrock of the soil are the main factors determining the formation of wet conditions. Terrain determines runoff formation, hydrological network connectivity, and water accumulation (Jencso et al., 2009). Climatic factors also play an important role in regulating soil moisture. Precipitation regulates groundwater levels, runoff, reduction processes and the accumulation of organic matter, while temperature regulates the activity of microorganisms and plants, as well as determines the rate of accumulation and decomposition of organic matter (Deluca & Boisvenue, 2012). Temperature, together with plant growth, regulates the evaporation and total water regime of aquatic soils. In boreal forests, moist soil conditions are common and this is mainly due to high groundwater levels. High groundwater levels, combined with relatively low temperatures, slow down the decomposition of organic matter and promote peat accumulation (Luke, Luckai, Burke, & Prepas, 2007). The peat layer has a higher water-binding capacity than mineral soil, thus promoting the accumulation of additional moisture in a specific area (Åström, Aaltonen, & Koivusaari, 2001). Wet soil conditions not only serve as an area for the accumulation of organic matter, but also as a source of organic matter. Both qualitatively and quantitatively similar levels of organic carbon compounds have been found in runoff areas associated with wet soils. The recent origins of organic carbon also point to the close interaction between streams and soil. The removal of organic matter from wet soils is also evidenced by the dynamics of elements such as organic nitrogen, organic phosphorus and organic sulphur compounds, which is similar to the release of organic carbon (Ledesma et al., 2018).

DEMs can be used to assess natural processes related to terrain features and by using additional thematic maps, it is possible to assess the impact of these processes in different areas. DTW maps can be used to model groundwater levels near known surface water bodies, such as rivers and lakes (Lidberg, Nilsson, & Ågren, 2020), while wet soil maps show the distribution of soil wetness depending on the soil bedrock (Ivanovs & Lupikis, 2018). The aim of this study is to determine the distribution of organic soils by comparing historical soil maps and predictions obtained from remote sensing data. To achieve this goal, DTW and wet area maps should be developed at this stage of the project.

2. METHODOLOGY

The study area covers all Baltic States (Estonia, Latvia and Lithuania) (Figure 1). According to historical soil maps, mire distribution data, forest growth condition data, peat extraction license data and other data sources, organic soils in the Baltic States cover an area of 2.35 million hectares. Data on a Baltic scale are derived from the results of the Paliduculture in the Baltics project (Piirimäe et al., 2020).

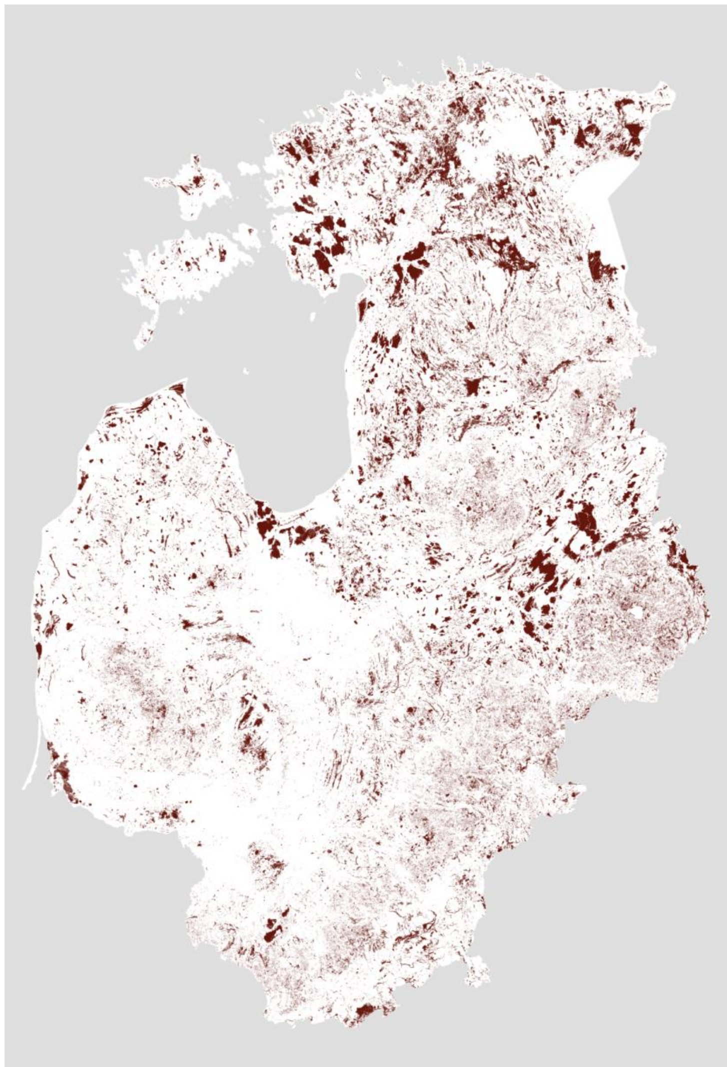

Figure 1. Organic soil distribution in the Baltic States

DTW maps and wet soil maps developed for the needs of the research are created using ALS data and various thematic maps. The summary of the data to be used is shown in the *Table 1*.

Table 1. Summary of data used to develop DTW maps and wet soil maps

	Estonia	Latvia	Lithuania
ALS	DEM in 1m resolution from Estonian Geoportal	ALS data from Latvian Geospatial Information Agency	DEM in 5m resolution from National Land Service
Quaternary sediments		Digitized map in scale 1:200 000 (Meirons, 2002)	Digitized map in scale 1:200 000 from Lithuanian Geological Survey
Soil data	Historical soil data in scale 1:10 000	Historical soil data in scale 1:10 000	Historical soil data in scale 1:10 000
Drainage systems	Topographical data from Estonian geoportal	Topographical data from Latvian Geospatial Information agency	Georeferential spatial data set M 1:10000 of the Republic of Lithuania

In order to have the same resolution for all Baltic countries, it has been decided to use a resolution of 5m for DEM data. DEM in such detail cannot be processed simultaneously on ordinary computers, so it is divided into map sheets with sides of 50 km long. Each map sheet is accompanied by a 1km wide buffer, thus ensuring a smooth transition between individual map sheets. The distribution of map pages and DEM can be seen in the *Figure 2*.

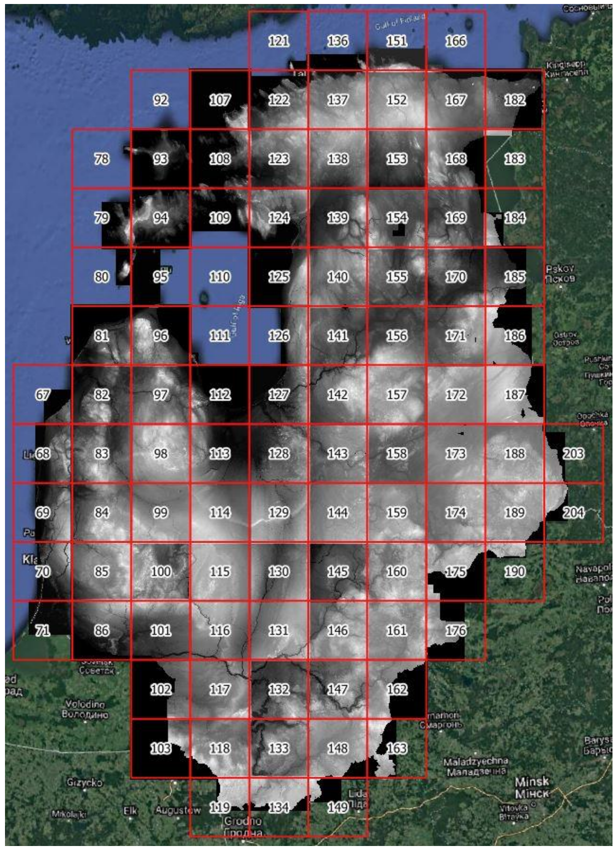

Figure 2. Individual map sheet distribution

4. RESULTS

At the moment, DTW maps for all three Baltic countries have been completed and work is underway to create wet area maps. DTW maps is generated in 5m horizontal resolution at two different catchment sizes. Maps of a 10 ha catchment basin size can be used in places where clayey sediments are found, while maps of a 30 ha catchment basin size can be used in places with sandy soil bedrock. Figure 3 shows the final product for the coverage of DTW maps in the Baltic States. In the later stages of the project, this map will be used in combination with historical soil data to assess changes in the distribution of organic soils in recent decades.

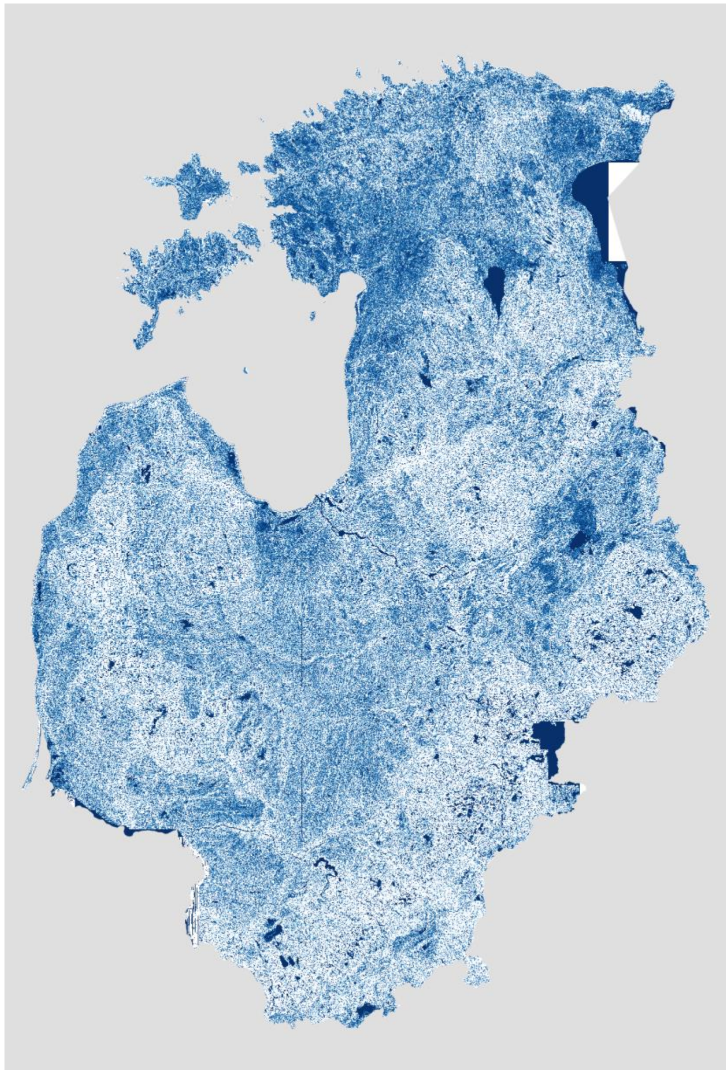

Figure 3. DTW map

A visual example of comparing the distribution of historical organic soils with the developed maps can be seen in the *Figure 4*. This example shows the coverage of historical soil data compared to *DTW* and wet area maps at close scale. The project will assess the relationships of these data layers in the scale of all Baltic countries.

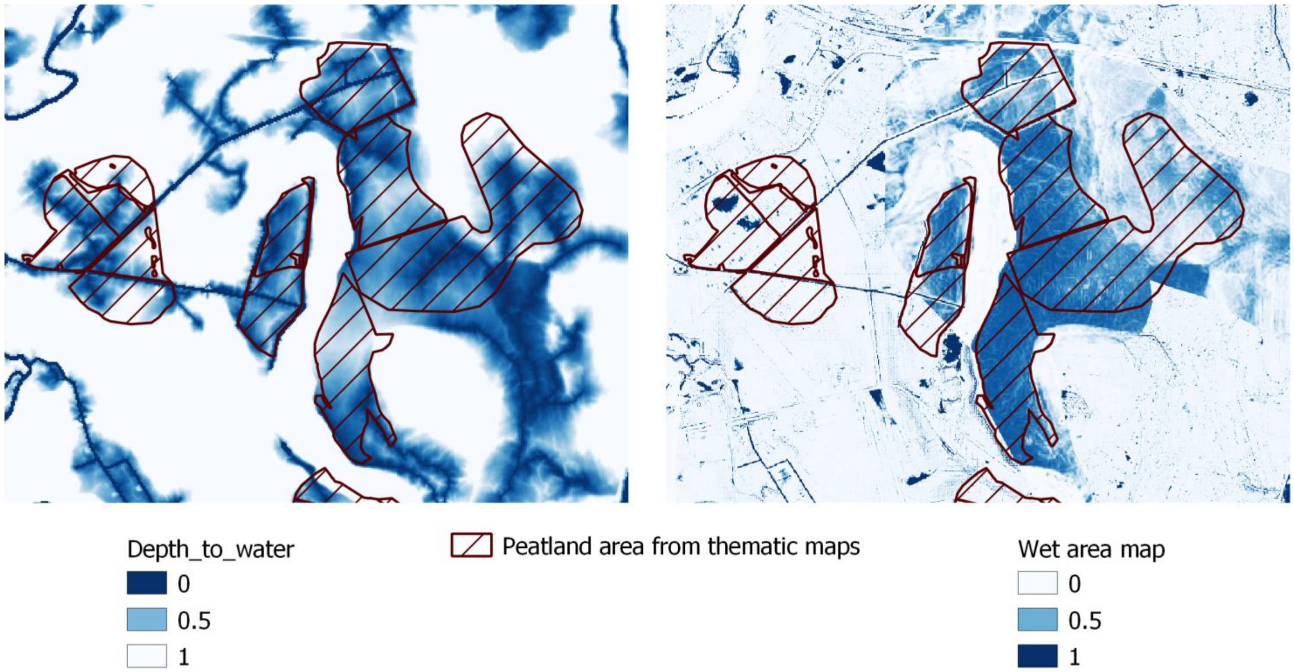

Figure 4. Historical organic soil data compared to generated data

Depth-to-water maps for the territory of Latvia have been created within the framework of the WAMBAF Tool Box project, while depth-to-water maps for the entire territory of the Baltic States have been created within the framework of the LIFE OrgBalt project. Developed maps for viewing are available as WMS service at https://silava.forestradar.com/geoserver/silava/wms.

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