DEPTH-TO-WATER MAPS FOR THE BALTICS: MODELLING OF DISTRIBUTION OF ORGANIC SOILS AND WET AREAS.

Poorly drained and wet soils are a challenge in forestry, agronomy and other land use because of low soil bearing capacity and other factors such as plants' high water stress. At the same time, they are also important for the existence of different habitats, for biodiversity, water exchange and various chemical processes. Spatial information about the distribution of wet soils and seasonal streams can help to improve land management practices, to avoid financial losses, as well as reduces the risks of forestry and agronomic activities, such as soil disturbance, pollution of streams, etc.

Detailed information on the spatial distribution of seasonal streams and wet soils is not available in the scale of the three Baltic States, and organic soils throughout the territory have been mapped only through field works from the 1960s to early 1990s. However, today, aero laser scanning (ALS) data are available in all three Baltic States providing very detailed information about ground surface relief. Elevation data allows us to model even the smallest streams and water accumulation sites, so they are an important tool to determine the distribution of organic soils more accurately.

Within the framework of the LIFE OrgBalt project, we have created depth-to-water maps for the entire territory of the Baltic States with a 5m horizontal resolution. Depth-to-water mapping methodology was developed by Murphy et al., 2008[1]. Depth-to-water maps are developed on the basis of elevation slope data and known surface water objects (streams, rivers, lakes, etc.).

Water table depth is calculated using cost surface analysis, where the initial depth is equal to the surface of a known water body and the cost surface is tangent to the slope. These maps have been created with two different catchment thresholds - 10 and 30 ha. The various threshold values indicate theoretical points at which surface water starts to run off as a result of precipitation or snowmelt on clayey and sandy sediments, respectively, and the map indicates the possible water table depth in metres (Figure 1). Though water table level is changing over time and depends on various aspects (seasonal weather conditions, soil bedrock, drainage, etc.), the water table level is shown static in these maps. ALS and water body (rivers, streams, lakes) data were obtained from the Estonian Land Board (Estonia), the Latvian Geospatial Information Agency (Latvia) and the National Land Service (Lithuania). Developed maps are available as WMS service at https://silava.forestradar.com/geoserver/silava/wms.

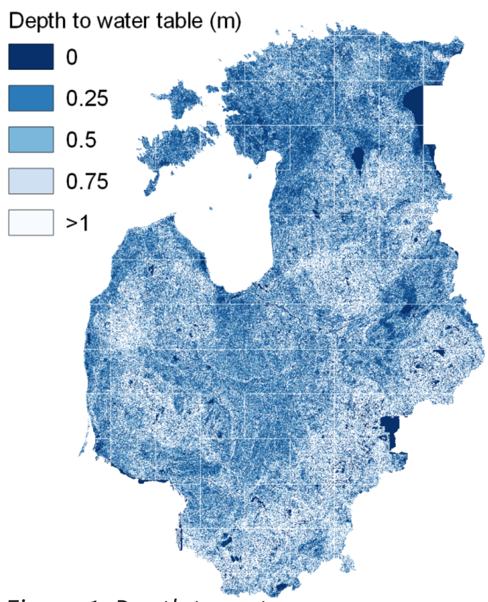

Figure 1. Depth to water map

Depth-to-water map conformances according to the authors of the methodology is at a level of 70% to 90% in forest conditions. Drainage has been carried out in large scale in agricultural areas and the accuracy of maps may be reduced in areas with operating drainage systems because the natural depth of the water table has been artificially altered.

Figure 2 shows an example of the results of depth-to-water map in comparison to Google satellite imagery. In this case high water table level correlates with colours in the satellite imagery and indicates that vegetation is experiencing high water stress in areas with high water table and that plant growth and productivity are severely diminished.

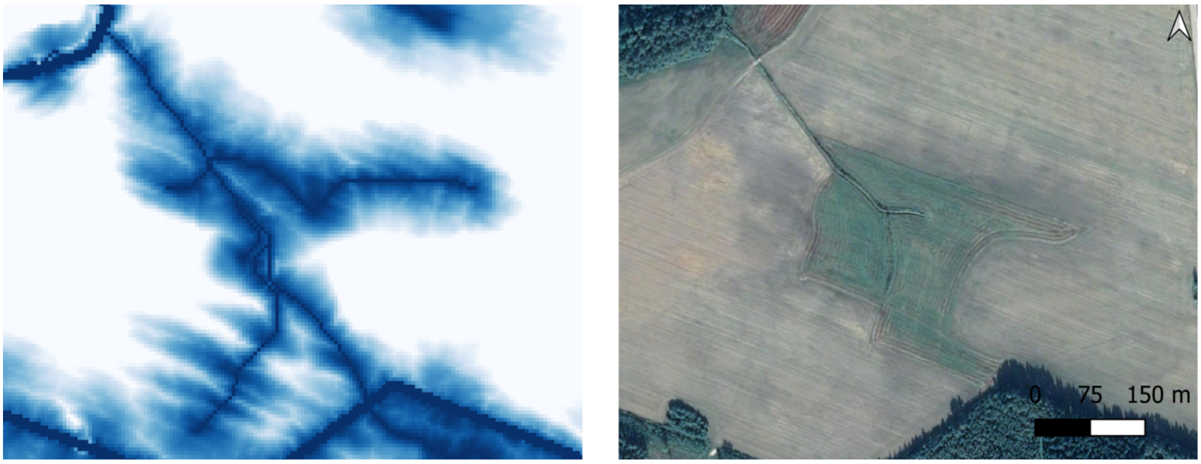

Figure 2. Depth to water example

As part of the LIFE OrgBalt project, depth-to-water maps in combination with wet area maps will be used to assess the distribution of historical organic soils according to elevation data and to improve data on organic soil distribution. Wet area maps will be developed based on a variety of different indices derived from elevation data (slope, relative height, depression depth, etc.) and will complement the depth-to-water maps in predictions on spatial distribution of soil moisture. In other aspects depth-to-water maps have a wide range of applications in both forestry and agriculture. In forestry, the data from these maps can be used for day-to-day planning, for planning the movement of forestry machinery depending on the bearing capacity of the soil and with the aim of minimising soil damage. These maps can be used in the organisation of water runoff by creating deep furrows in places where the water regime is too high. In both forestry and agriculture, these maps can be used to select planting species suitable for soil moisture regime. The efficiency of drainage systems on agricultural land can also be assessed by comparing the results of depth-to-water maps with orthophoto or field surveys. Depth-to-water maps offer unprecedented opportunities for modelling soil moisture and spatial distribution of organic soils, as they provide high-precision information on surface water runoff directions, accumulation sites, and overall water table depth over a large area.

[1]Murphy, P. N. C., Ogilvie, J., Castonguay, M., Zhang, C., Meng, F.-R., & Arp, P. A. (2008). Improving forest operations planning through high-resolution flow-channel and wet-areas mapping. The Forestry Cronicle, 84(4), 568–574.

JĀNIS IVANOVS, SCIENTIFIC ASSISTANT AT LATVIAN STATE FOREST RESEARCH INSTITUTE "SILAVA", LEADING PARTNER OF THE LIFE ORGBALT PROJECT

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