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Case study to reduce the impact of extreme environmental factors on berry plantations

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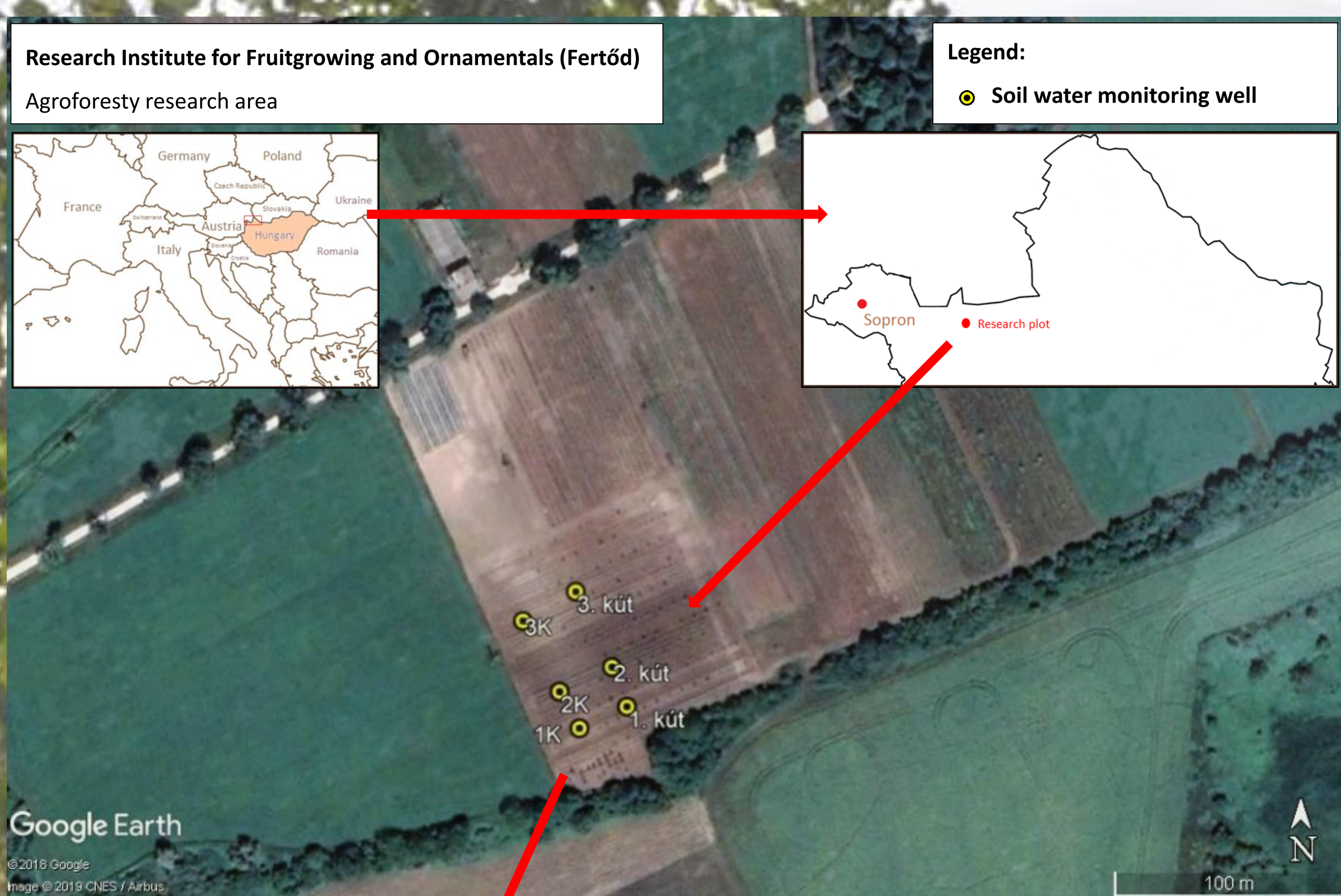
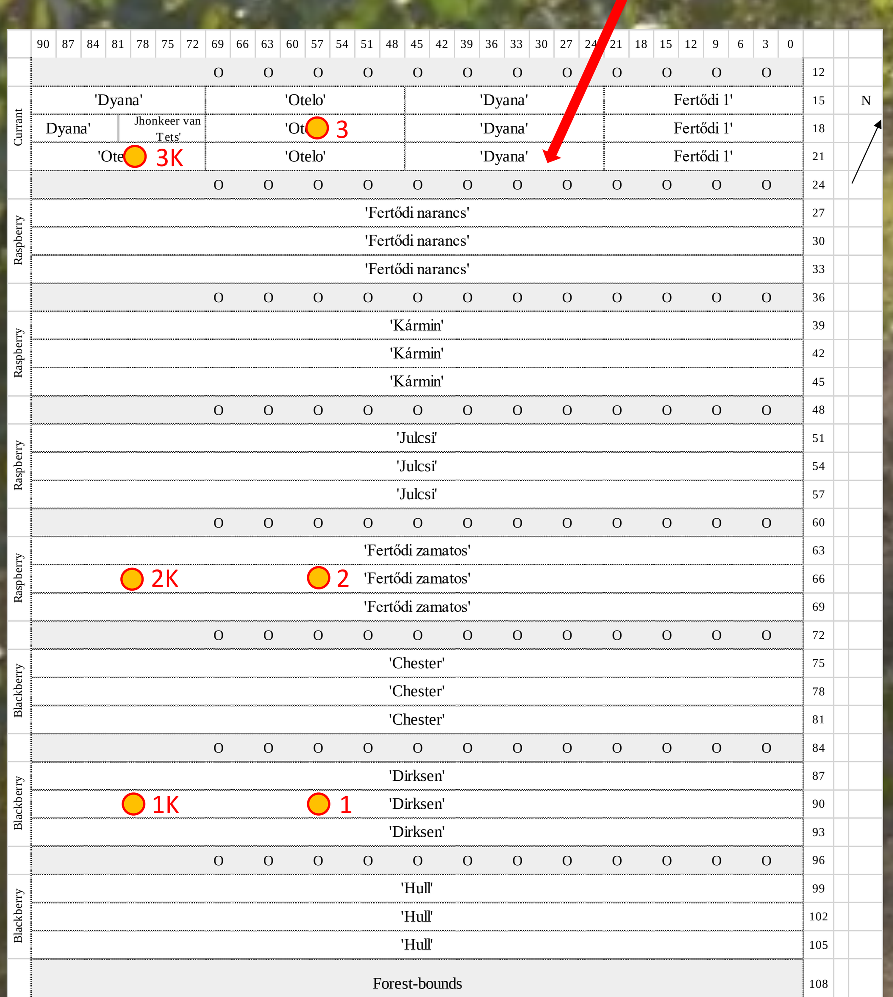
Climate extremes affect the vitality and health of the berry species. In some regions, if enough water is available, the impacts can be reduced. Long-lasting stress effect causes sunscald in case of leaves and berries. There are resistant and susceptible varieties of berry species. The disorder, likely caused by ultra-violet radiation, appears on susceptible varieties when the temperature suddenly increases (above about 30 °C), but the humidity is low. It can easily occur in the presence of wind.

Agroforestry systems offer a possible way to reduce direct sunlight by shading to sensitive agricultural crops. The humidity of the tree canopy can decrease the effect of hot dry air. Trees protect the berry species by slowing wind speed. This ongoing research focuses on how trees can influence the hydrological conditions.

Research area measurement layout

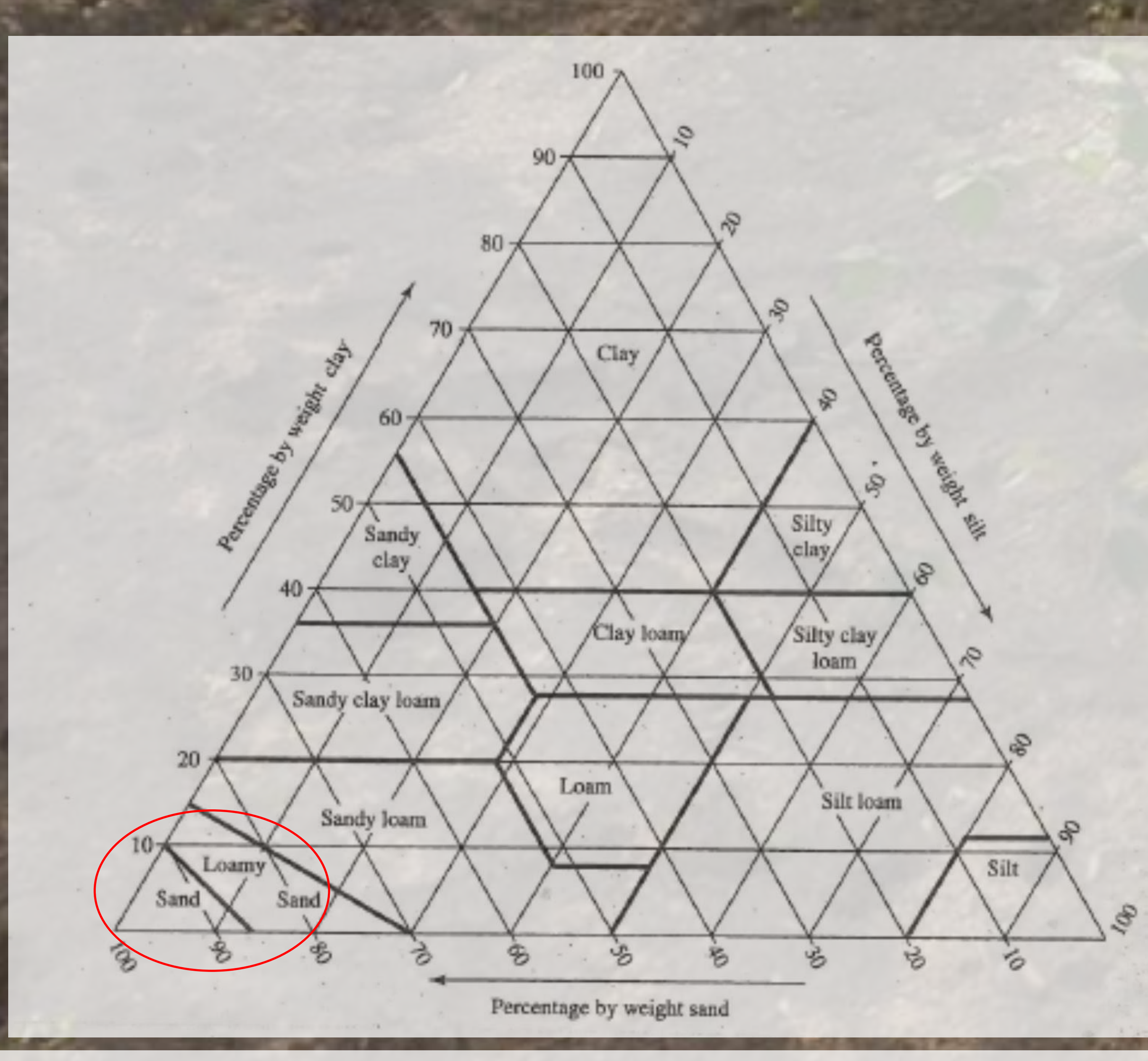




We installed a research plot to study the spatial and temporal variability of the soil moisture and groundwater level in an agroforestry system close to Lake Neusiedl (Hungary). Six monitoring points were located in this area, i.e. three wells in the agroforestry system and three control wells in the agricultural area without trees. A pair of wells are located on blackberry (Rubus fruticosus 'Dirksen'), raspberry (Rubus idaeus 'Fertődi zamatos') and blackcurrant (Ribes nigrum 'Otelo') plots. Hybrid poplars (Populus x euramericana) were planted as shadowing trees in 2017.

Layering of the soil was detected on the field, and soil analysis was performed in the laboratory.

The soil moisture and groundwater level are measured biweekly. The climatic parameters such as the precipitation, air temperature and relative humidity are continuously recorded at a nearby meteorological station.



Results of soil analysis (grain-size distribution) with soil-texure triangle

Data of groundwater wells:	well 1	well 1K	well 2	well 2K	well 3	well 3K
EOV Y	487351.686	487331.055	487345.725	487322.855	487330.858	487307.604
EOV X	256586.473	256577.875	256603.540	256593.710	256636.459	256624.418
Top of casing level above Baltic Sea level (mBf)	120.1559	119.6468	119.8888	119.5654	119.5721	119.5311
Distance between top of casing and soil surface (cm)	25.5	15.8	16.1	25.5	3.3	33.2
Depth of wells (m)	4.3	3.8	4.3	4.0	4	4
Saturation (m)	3.5	2.55	3.1	2.35	3.2	2.4
Water table (m)	3.6	3.35	3.4	2.8	3.4	3
Reductive zone (m)	3.1	3.4	3	3	3	2.4

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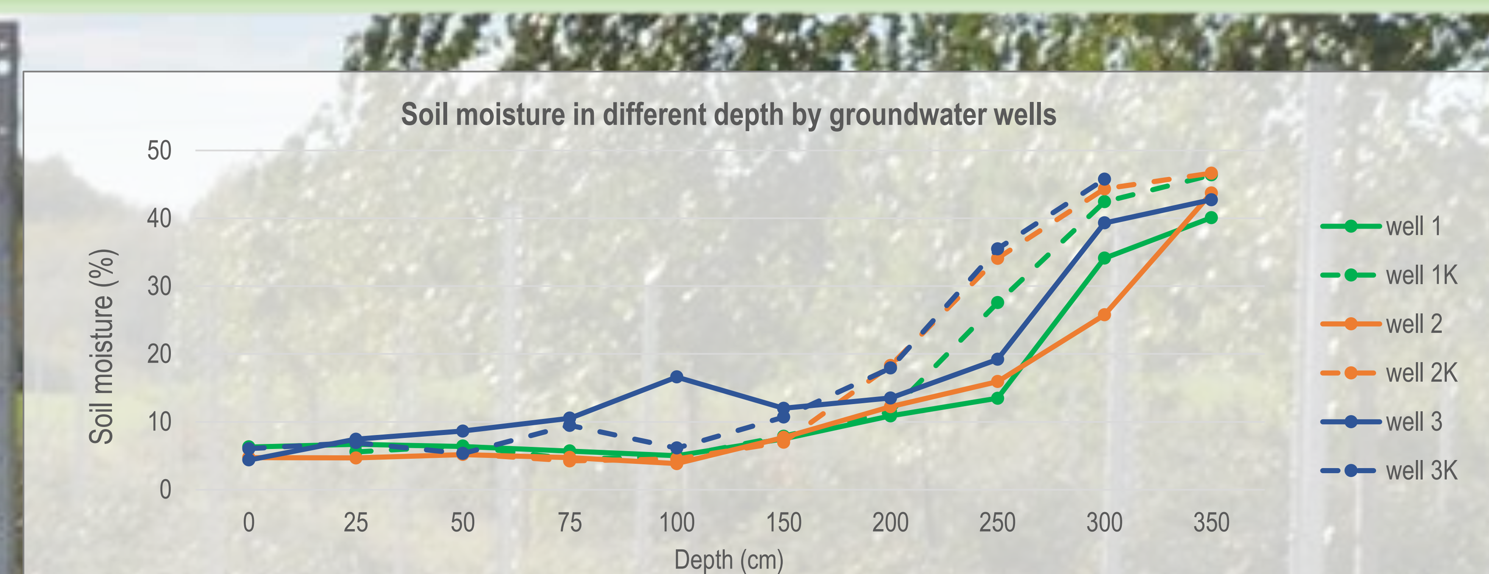
Hydrological interactions

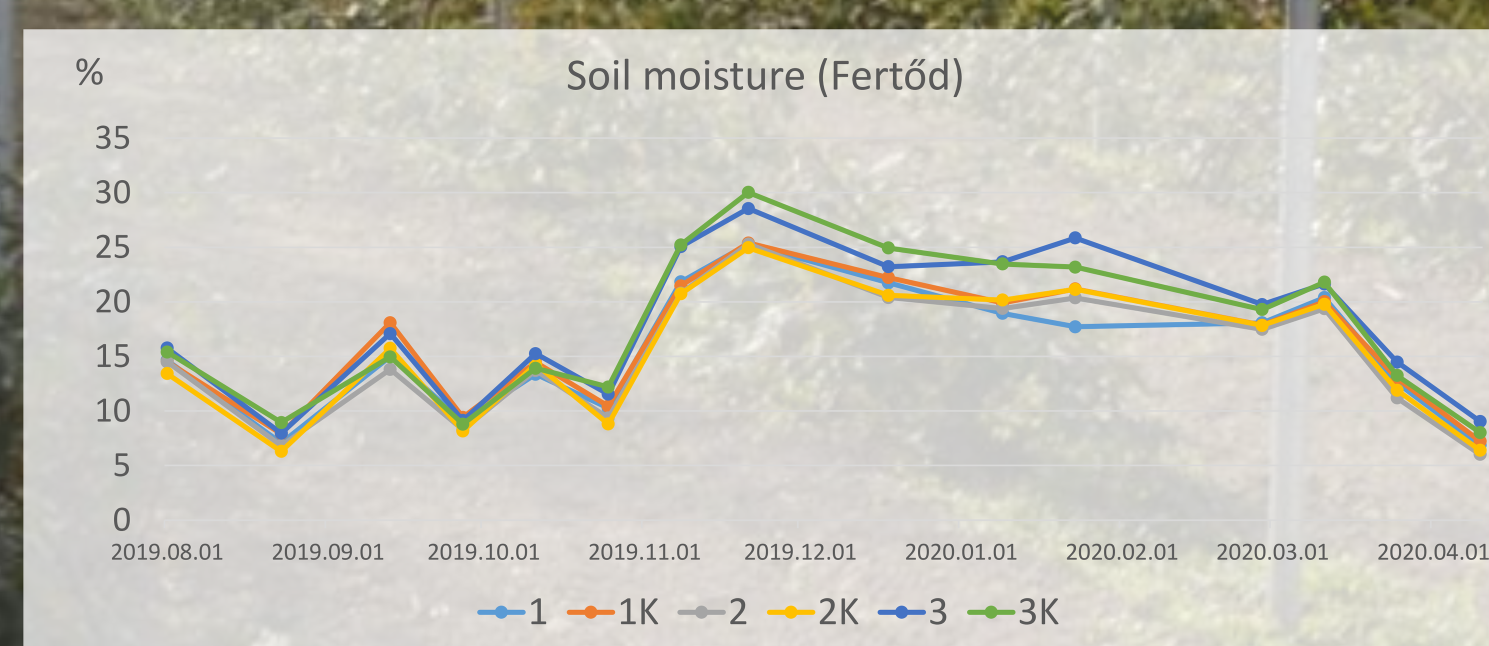
Characteristics of agro-forestry systems in relation to agricultural land:

- **evaporator surface increases** (depending on tree species, number of individuals, location, etc.)
- **evaporation rate decreases** (by windscreen and shading)
    - the amount of atmospheric drought decreases (the relative humidity of the air increases during the evaporation of the portion of rainfall that wetted the canopy, transzspiration of the canopy and the canopy can reduce the temperature)
- **water consumption increases** (according to Madas (1980) the light-demanding species require a fairly large amount of water for unit of dry matter production, while the shade-tolerant tree species are used much more sparing with water.)
- **root competition may occur** (Ong et al. 2014)
- in terms of **soil moisture,** trees can also have a **complementary relationship**
    - complementary spatial relationship (the root system of some intermediate plants is a shallower as a part of the tree root)
    - complementary temporal relationship (the maximum use of water in this case does not coincide with trees and agricultural vegetation (Dupraz et al., 2005))
- **hydraulic lift** (water movement from roots to soil at night in the process of this phenomenon (redistribution) rehydrates the layer of herbaceous roots (Caldwell et al. 1998))

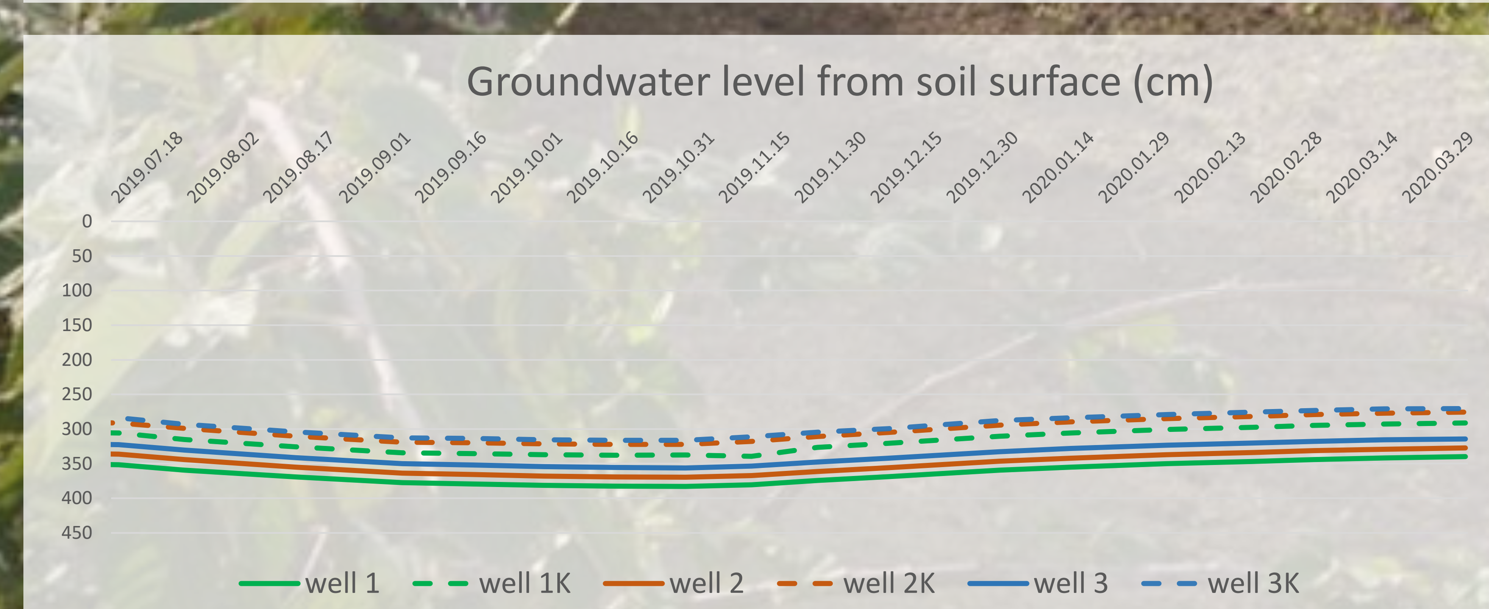
First results



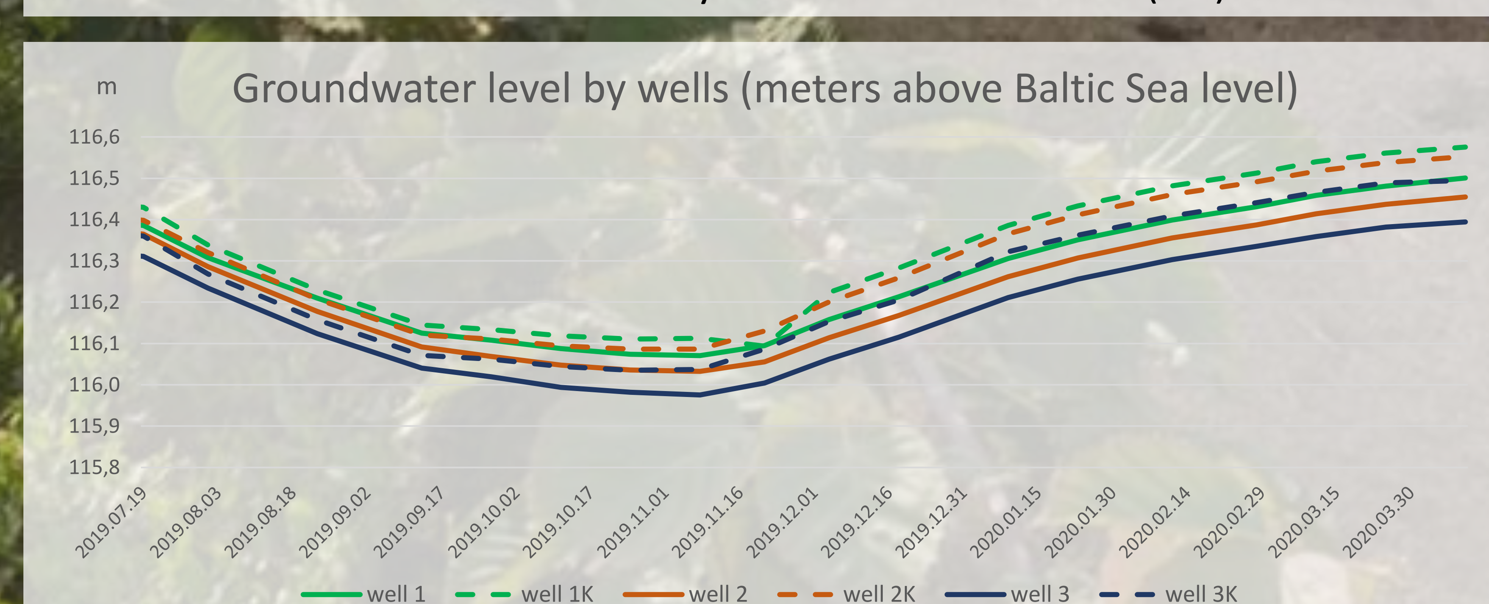
Soil moisture values of groundwater monitoring wells during installation



Time series of soil moisture values by groundwater monitoring wells



Groundwater levels by wells from soil surface (cm)



Groundwater levels by wells above Baltic Sea level

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