Fertigation management of mixed-species plantation versus monoculture in plantation forestry: key aspects and future perspective

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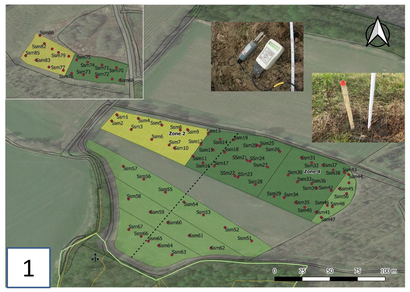
Introduction

According to the Forest European Process, the recent **Climate Change Conference (COP26)** [1], and EU policies, conservation of forest ecosystem is a critical step in mitigating climate change and combating deforestation; accordingly plantation forests will be critical achieving these goals.

In this context, scientific research on mixed-species forest plantations and changes to standard forestry management practices, such as, novel irrigation and fertilization system (e.g. fertigation), will hopefully provide new data on forest productivity, carbon sequestration, and any associated ecosystem services.

This study aims to provide important insights into how young tree plantations respond to different soil moisture conditions, which can aid in the **intelligent design and management of fertigation** of mixed-species and monoculture forest plantations, resulting in healthier and more productive forest ecosystems.

Field site description and experimental setup



Experimental setup to acquire data on superficial (5 cm) and deep soil moisture (10,20,30,40 cm) on weekly time resolution.

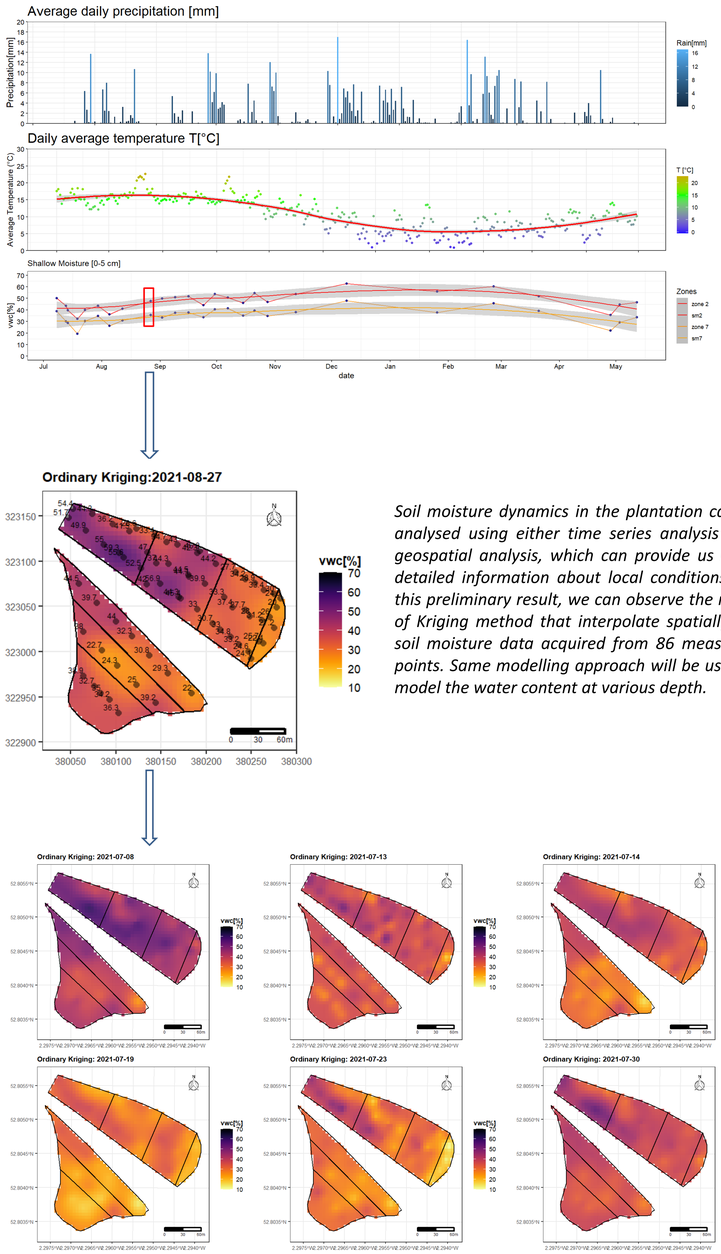
- ❑ TDR soil moisture at 5 cm depth across plots and vertical profile (4 depths down to 40 cm);
- ❑ 1800 trees across 11 different species;
- ❑ above micrometeorology;
- ❑ Tree phenology (phenocams);
- ❑ Soil properties and nutrients

Soil properties survey across the plots

Tree growth and phenology monitoring

Preliminary results

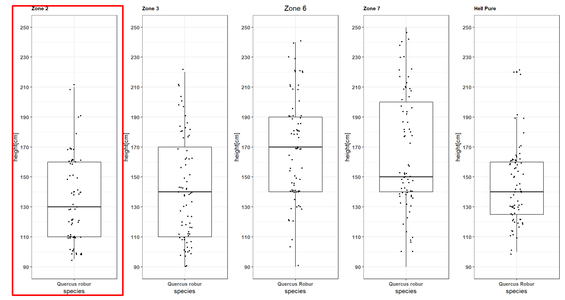
Rainfall, temperature, and soil moisture dynamic analysis



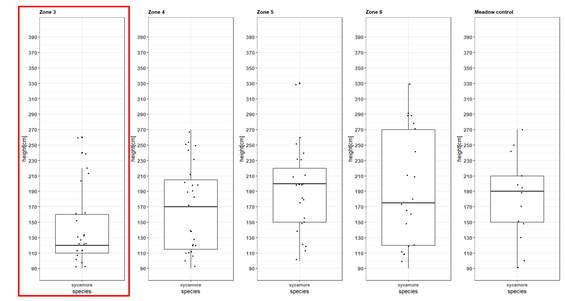
Soil moisture dynamics in the plantation can be analysed using either time series analysis or a geospatial analysis, which can provide us more detailed information about local conditions. In this preliminary result, we can observe the result of Kriging method that interpolate spatially the soil moisture data acquired from 86 measuring points. Same modelling approach will be used to model the water content at various depth.

Geospatial temporal dynamics of shallow soil moisture (5 cm) across the site

Some tree growth response to the treatment …



Oak trees growth performance…



…and Sycamore trees growth performance across fertigated areas and control

In this little data set it is, trees respond differentially based on local conditions. Zone 2, and zone 3 have less forest growth than others due to the higher water content (~ 45%), which is most likely attributable to the combined influence of soil properties, surface water table, and hill slope.

Summary

- The ongoing long-term monitoring of soil moisture will enable us to analyse the long-term trends, as well seasonal trends and the responses of the investigated treatment plots to hydrological events such as storms or dry periods;
- This study will contribute in the development of a smart irrigation strategy that takes into account soil local conditions;
- It will also help to define better tree planting designs, capable of matching site hydrological dynamics and tree water needs;

What comes next?

- Study of **greenhouse gas soil borne emissions** and **soil nutrient dynamics** as a result of fertilisation regimes;
- Hydrological and biogeochemical coupling using Hydrus 1-D.

Reference: [1] UK Government (2021, November 15). Retrieved from: https://www.gov.uk/government/publications/cop26-world-leaders-summit-on-action-on-forests-and-land-use-2-november-2021/world-leaders-summit-on-action-on-forests-and-land-use

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