Inclusion of biochar hydrological properties in a C dynamic model with field data

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Presenting: **Simone Pesce**

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BLACK TO THE FUTURE

Outline

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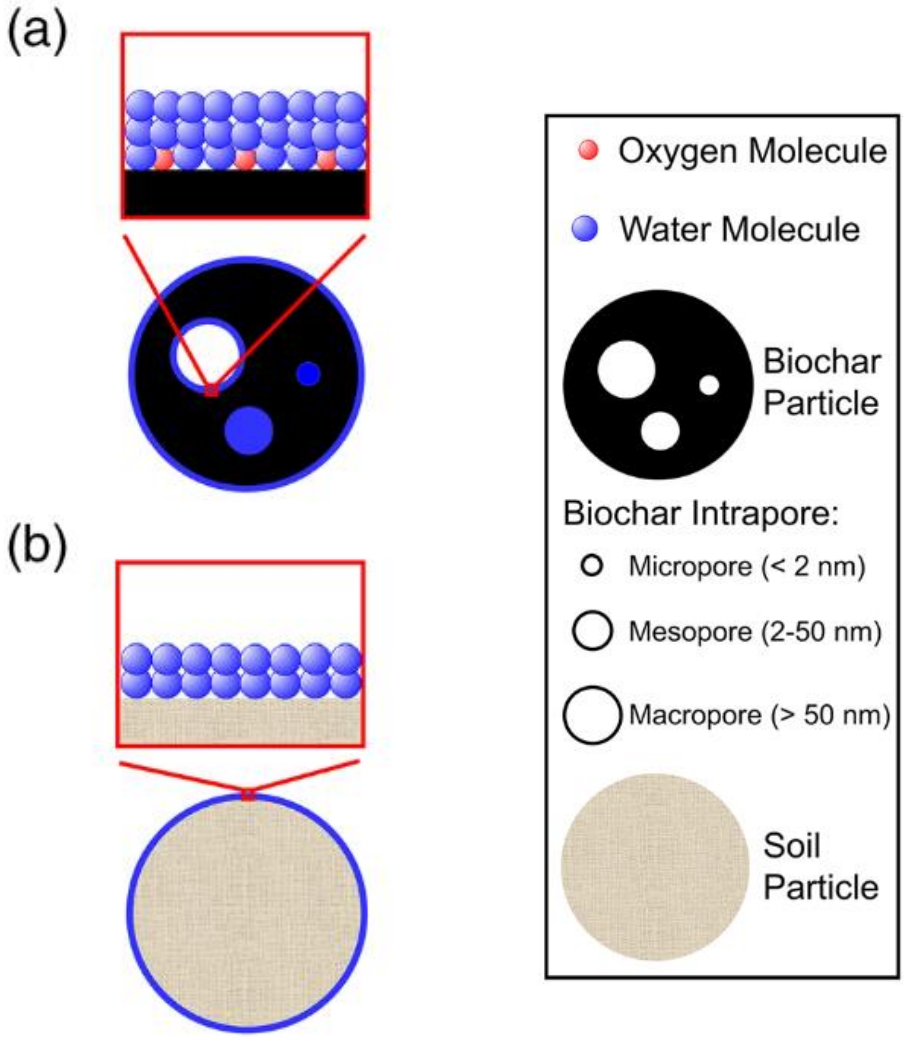
Biochar – water – soil interactions

Biochar, produced by heating organic material without oxygen, is a tool to enhance soil fertility and sequester carbon.

Biochar water retention is a function of either or both pore structure and surface chemistry (Nakli and Imhoff, 2020)

Modeling the interaction of biochar and soil hydraulic properties is important for several reasons:

- Predicting the potential effects of biochar application on soil hydraulic properties (e.g water holding capacity, under different soil and environmental conditions)
- Evaluating land management practices that incorporate biochar as a tool for improving **soil fertility** and **water conservation**.

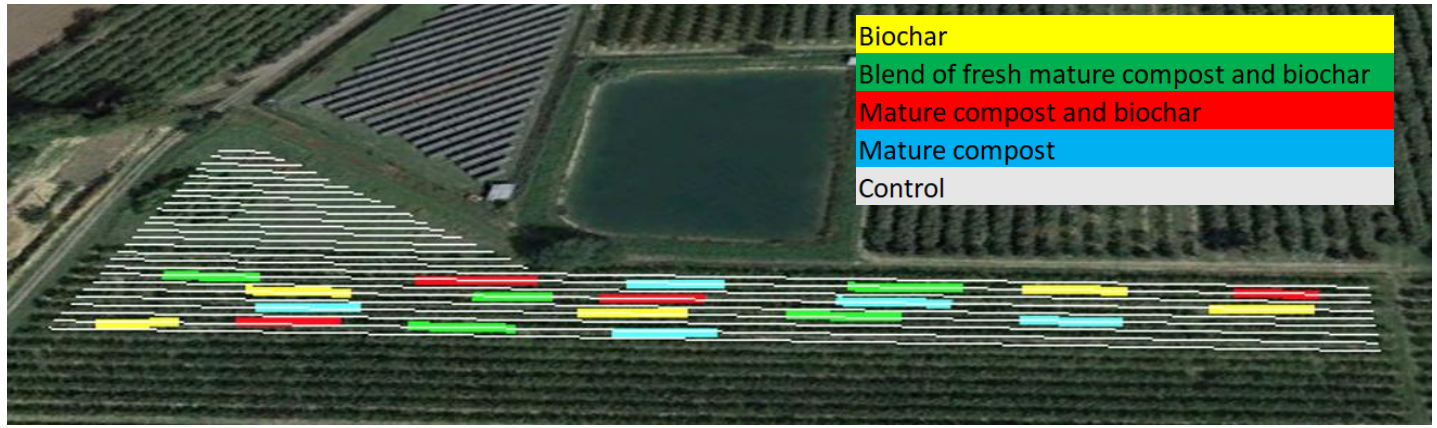


Schematic of water retention mechanisms in biochar (a) ad soil (b) particles (Nakhli and Imhoff, 2020)

The Field experiment

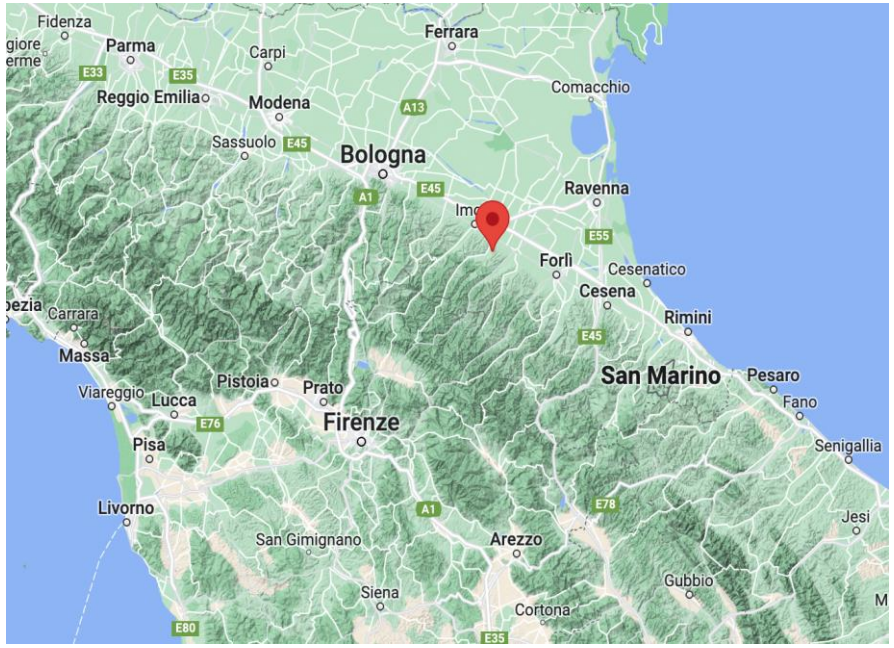
The field experiment was set in a new vineyard planted in March 2017 in Tebano (RA), Emilia Romagna region (Italy)

The soil is a sandy clay loam(USDA,2005) with a neutral pH of 7.5 and SOC 1.40 %



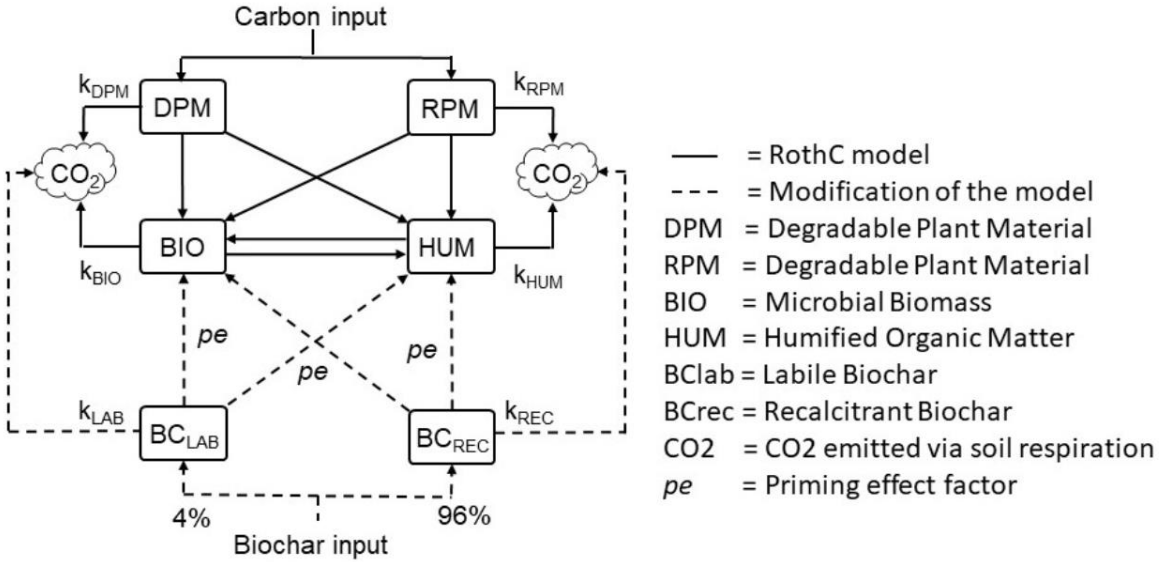
Biochar and its applications:

- Vineyard pruning residues **biochar 22 t/ha**
- Blend of fresh compost and biochar **13 t/ha**
- Mature compost and biochar **13t/ha**
- Mature compost **10 t/ha**



Aim of the study

- The series coupling of **Criteria** (Bittelli et al 2010), agroclimatic model, and **RothC** (Coleman and Jenckinson 1996), carbon dynamic model, both in its modified version **RothC-Biochar** (Pulcher et al 2022), to obtain more accurate estimates of hydrological parameters used in the C model in soil.

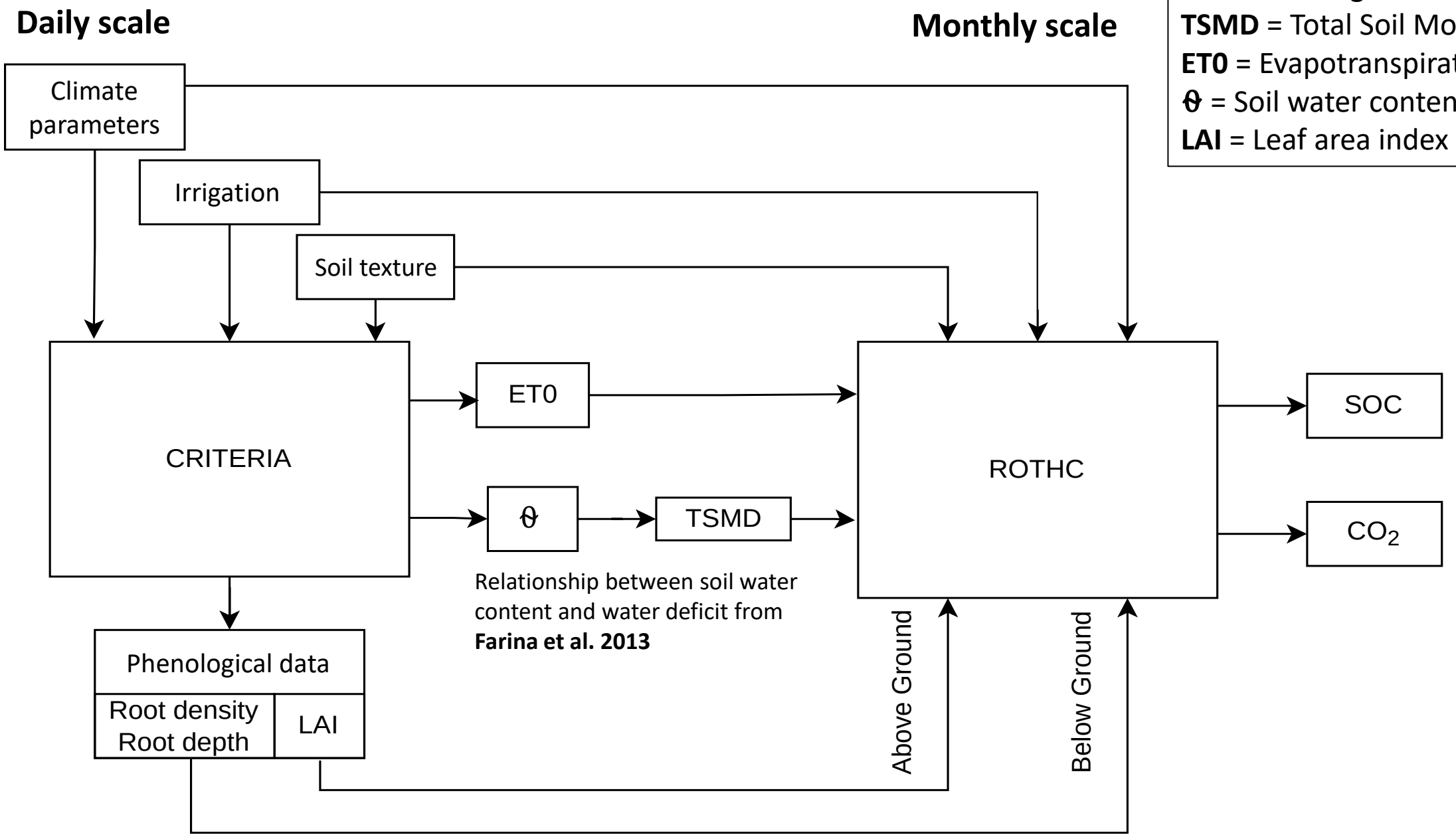


Modification of the RothC model with the inclusion of labile and recalcitrant biochar pools and the priming effect on BIO and HUM. The CO2 pool is assumed to be comparable to soil heterotrophic respiration. (Pulcher et al 2022)

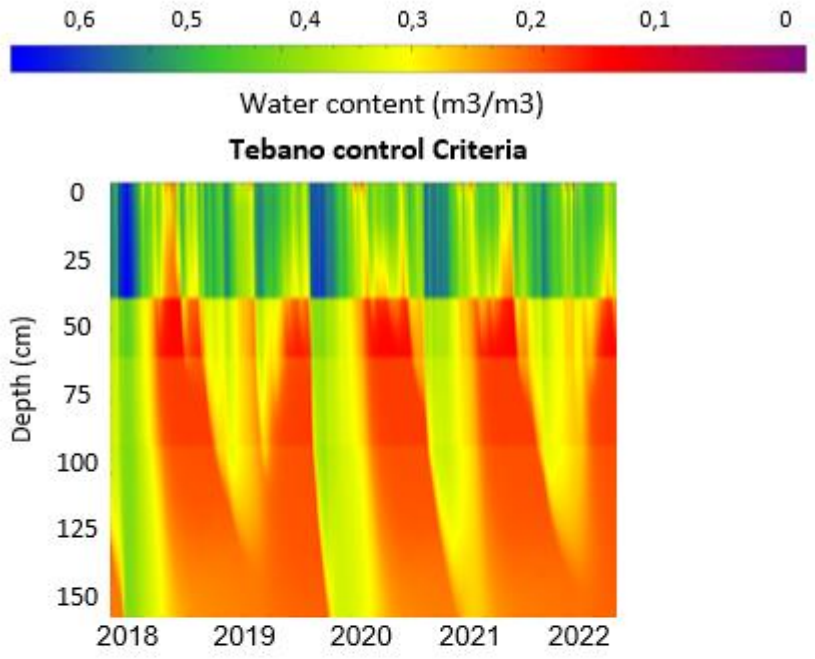
- The study utilized **meteorological data** from the vineyard experiment in Tebano (RA) since 2017.
- The hydrological functions parameters of the biochar-amended treatment were evaluated using **Criteria**, while the temporal soil C content was predicted using **RothC.**

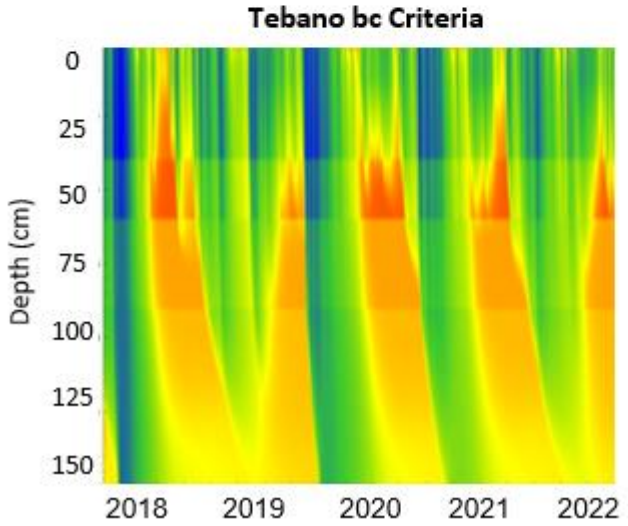
Coupling framework

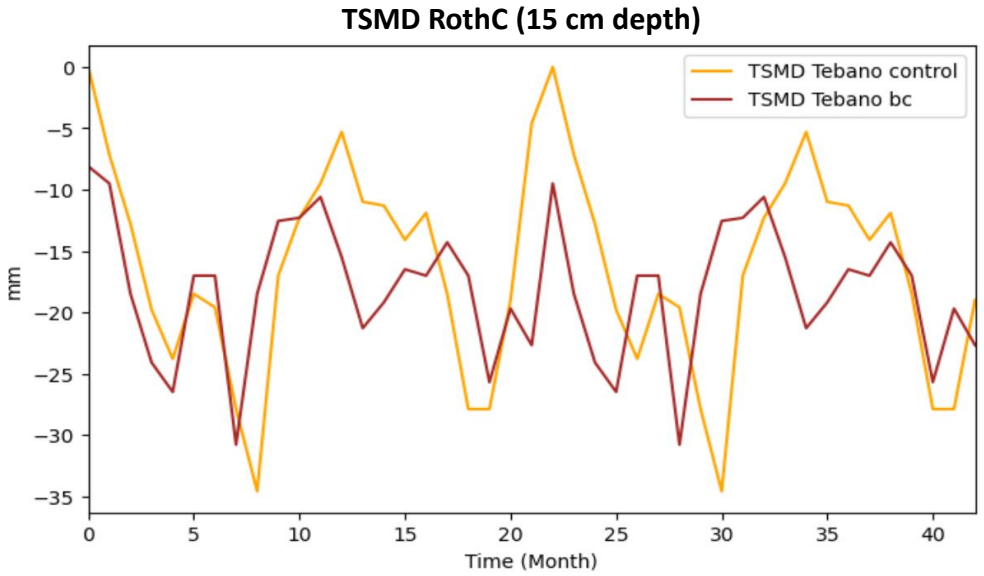
SOC = Soil Organic Carbon
TSMD = Total Soil Moisture deficit
ET0 = Evapotranspiration
θ = Soil water content
LAI = Leaf area index



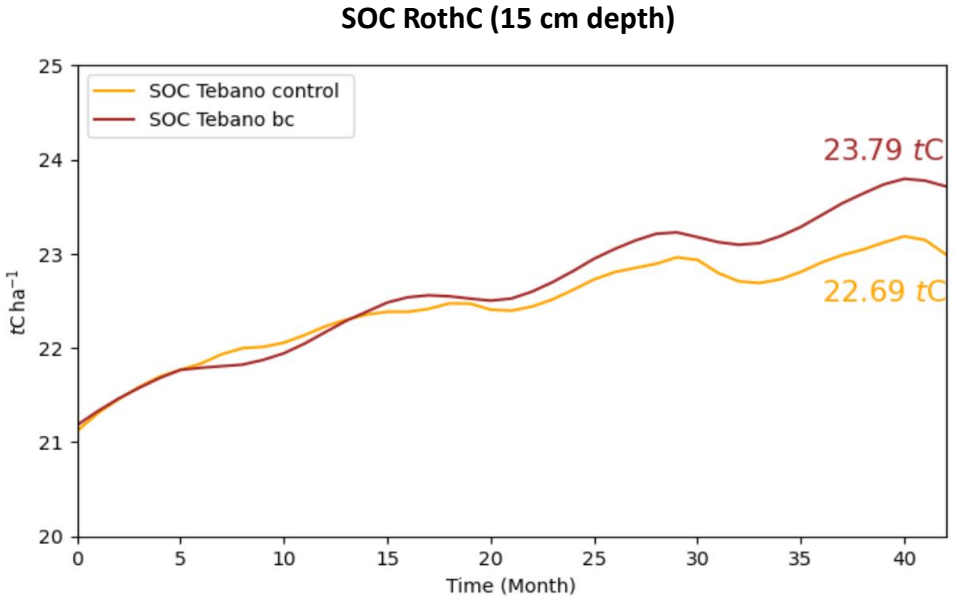
Results







Maximum and minimum TSMD values are higher in control plot then in biochar plot



Future developments

- Phenological output of **Criteria** as aboveground and belowground input in **RothC**
- Integration for biochar in Criteria.
- Parallel coupling of Criteria and RothC.
- Field measurements for a period longer than 10 years to compare with simulations.

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