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Linking above- and belowground phenology of hybrid walnut in temperate agroforestry systems

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Introduction

Climate models predict that an increase in atmospheric CO₂ concentration, precipitations and temperature could affect many biological phenomena and increase the frequency and magnitude of extreme weather events. Root and shoot phenology could be strongly influenced by the variations in soil water content, soil temperatures and air temperatures. Changes in plant phenology are considered to be a very sensitive and observable indicator of plant responses to climate change. In contrast, very little is known about the relationship between shoot and root phenology especially in the natural soil environment.

Objectives

We installed rhizotrons, or 'root windows' and minirhizotrons or 'root tubes' at 10 to 70 cm soil depth in the field. We monitored shoot and root phenology of hybrid walnut (*Juglans nigra* × *regia*) in relation to soil temperatures.

Study sites

Three agroforestry systems comprising hybrid walnut (*Juglans nigra* × *Juglans regia*) cultivars (16-20 year old) and pasture/crops along a climatic gradient of precipitation and temperature in France.



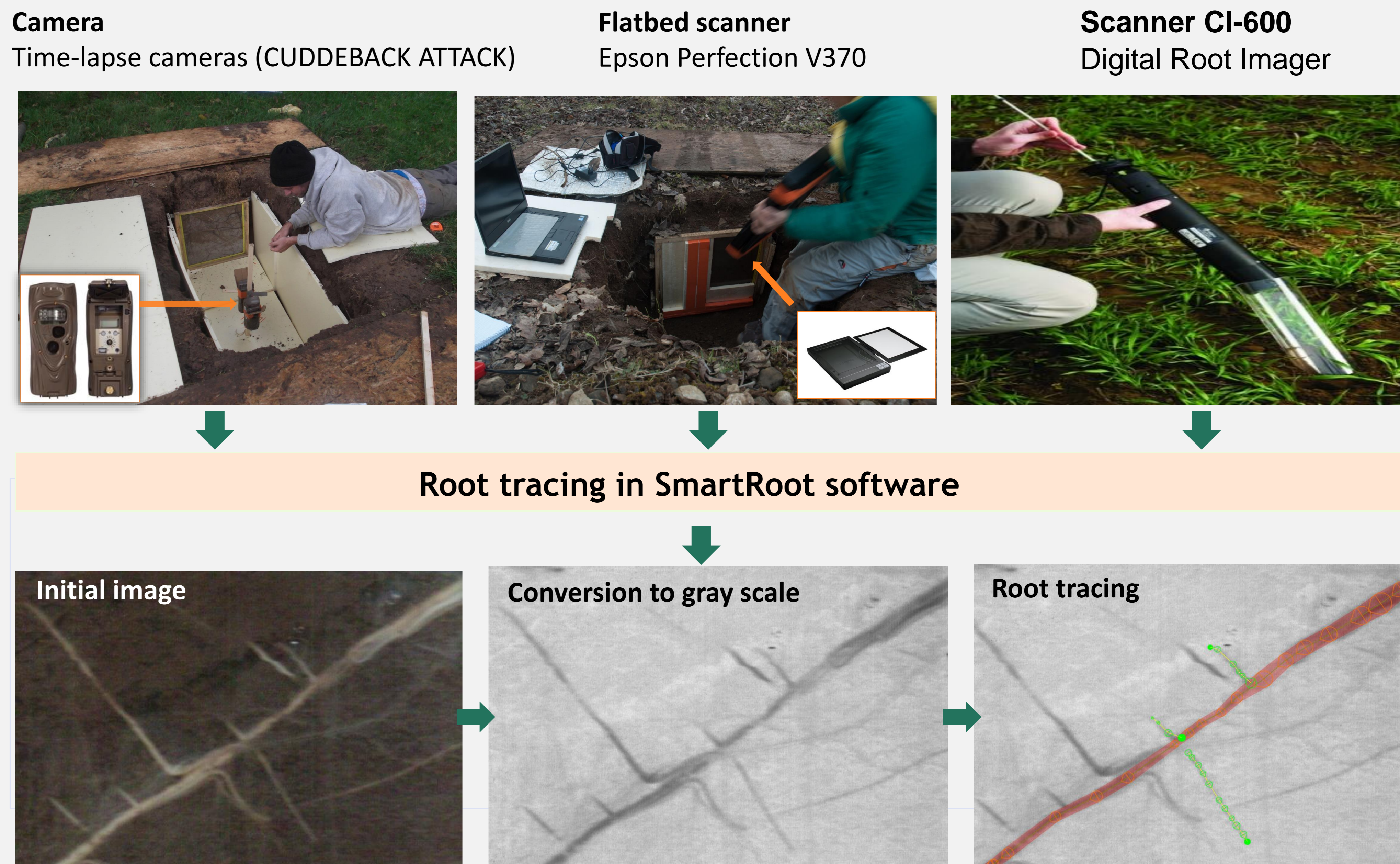
Methods

I. Root observation methods

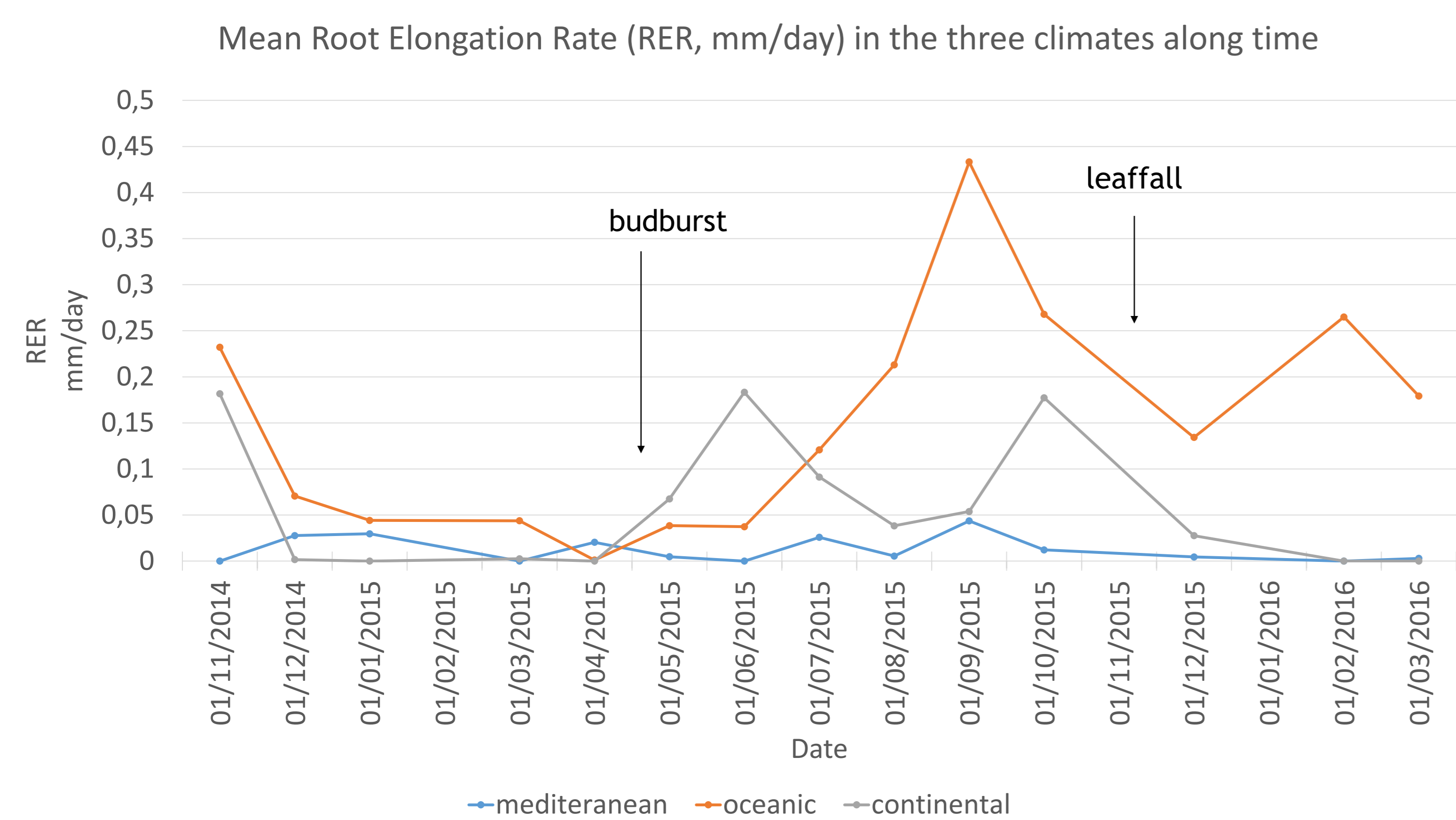


The big pit (4m depth) in Mediterranean climate containing both rhizotrons and minirhizotrons.

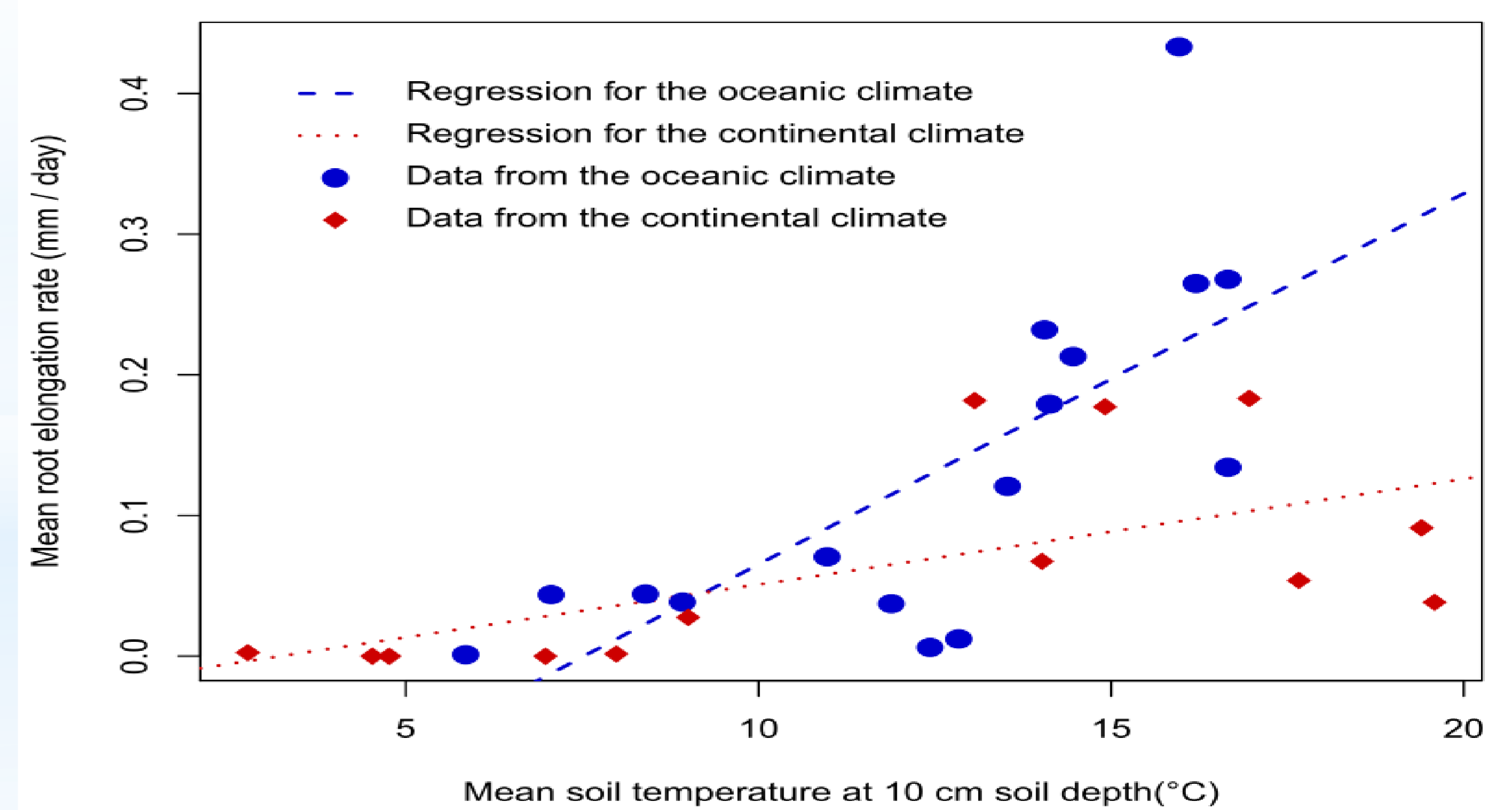
II. Techniques for image acquisition in rhizotron & minirhizotron



Preliminary results



Correlations between mean root elongation rate and mean soil temperatures in the two climates



- Fine root elongation (mm) occurred in early May corresponding to the beginning of budburst period, peaked during May (Mediterranean), June (continental) and July (oceanic), and almost ceased by mid-November with the leaf-fall in all sites except in the oceanic climate where roots grow even in winter. In contrast, the rate of root elongation in Mediterranean climate in our data was less than that observed in the two previous years (see Germon et al, 2015).

- Significant and positive correlations were found between mean fine root elongation rate and soil temperatures at the two depths of soil (10 cm & 50 cm depth) in oceanic ($r^2=0.70$) and continental ($r^2=0.68$) climates.

Conclusion

Our preliminary results highlight that shoot and root phenology are synchronized in hybrid walnut in agroforestry systems regardless of the climatic gradient (except oceanic climate) with a lag of one week between the climates.

Reference

Germon, A., R. Cardinael, I. Prieto, Z. Mao, J. Kim, A. Stokes, C. Dupraz, et al. 2015. Unexpected phenology and lifespan of shallow and deep fine roots of walnut trees grown in a silvoarable Mediterranean agroforestry system. *Plant and Soil* 401: 409–426.