A synthesis of Aleppo pine phenology: from the primary growth to sap velocity

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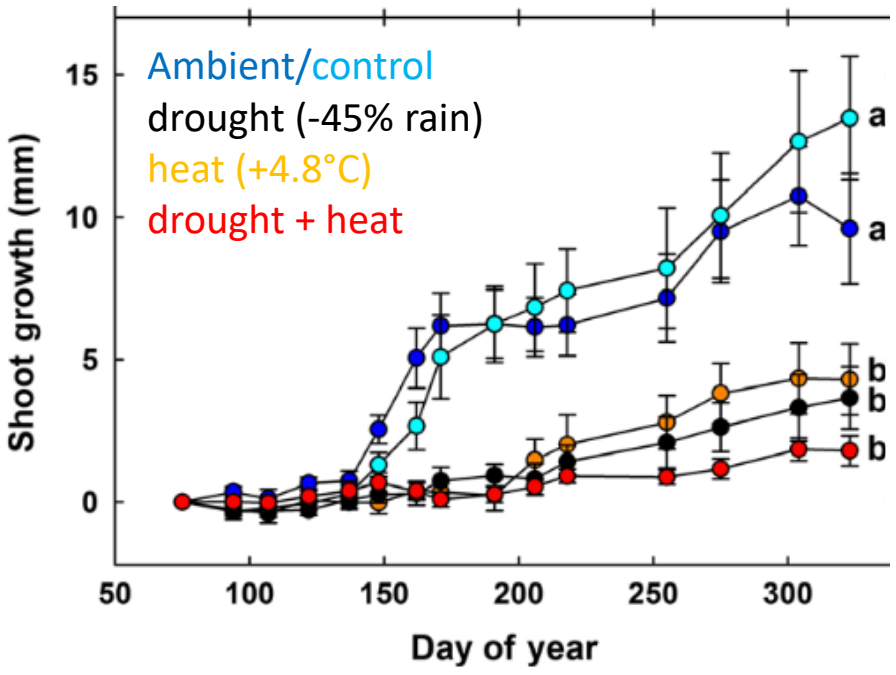
Context

Phenology is an important component of forest functioning in terms of carbon and water absorption and use.

But most of the studies focused on leaf phenology and secondary growth, and neglect:

- Shoot elongation
- Reproductive organs
- Multi-variable and integrated approach

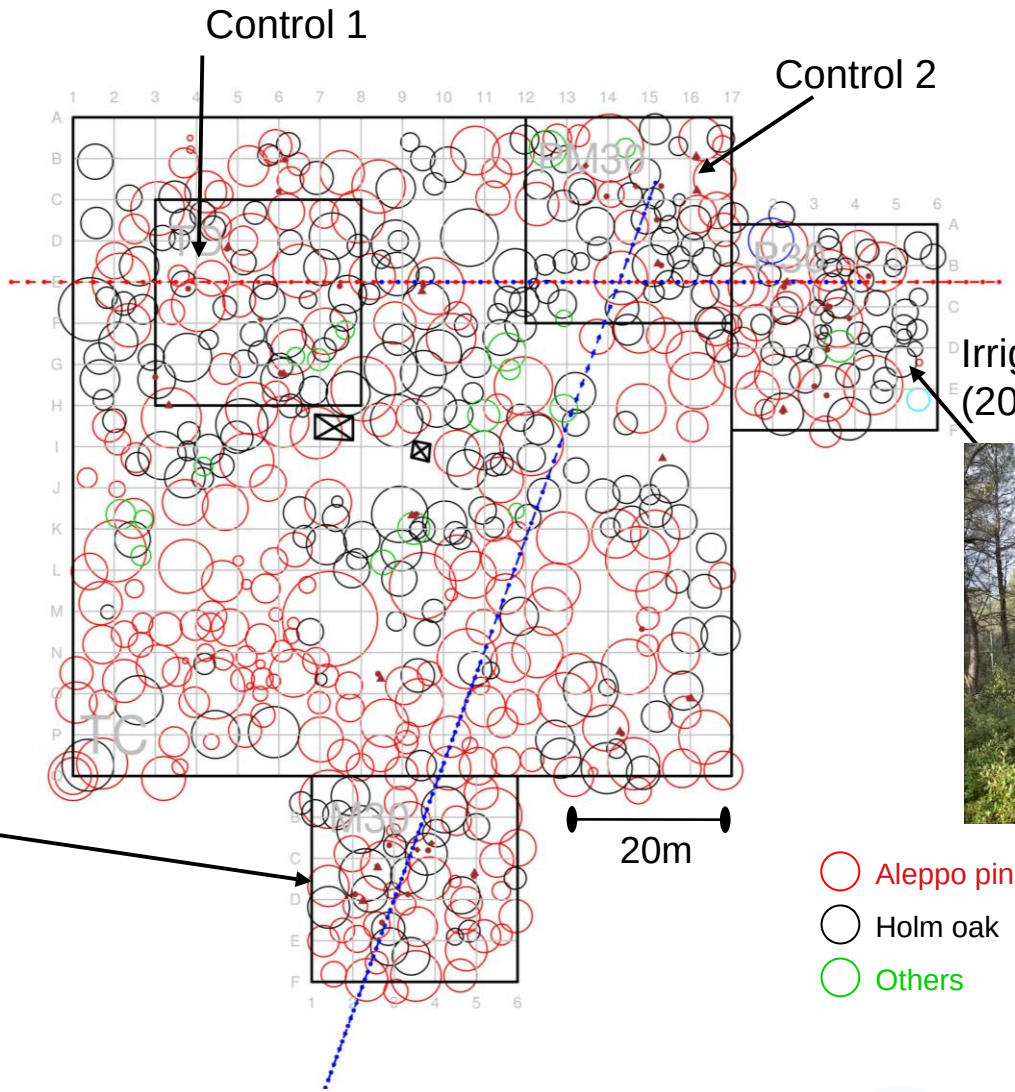
And such informations are scarce in field conditions



Pinon pine in open-top chambers
(Adams et al. 2015 GCB)

Study Aleppo pine at the experimental site of Font-Blanche

Exclusion (-30%) since 2009



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Measures of primary growth

Monthly measurements; 2008-2021

Branches at different positions within the canopy

+600 branches from 8 trees = +3000 Growth units ; 10 variables

Measures of secondary growth and sap-flux

Xylogenesis : micro-cores (8 trees; weekly ; April-November; 2008-2010)

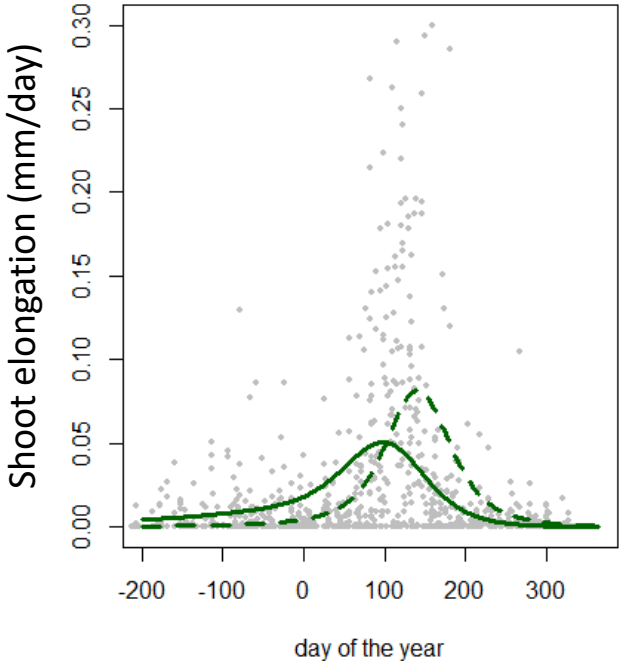
Sap velocity : Granier's method (14 trees; half-hourly resolution; 2008-2021)

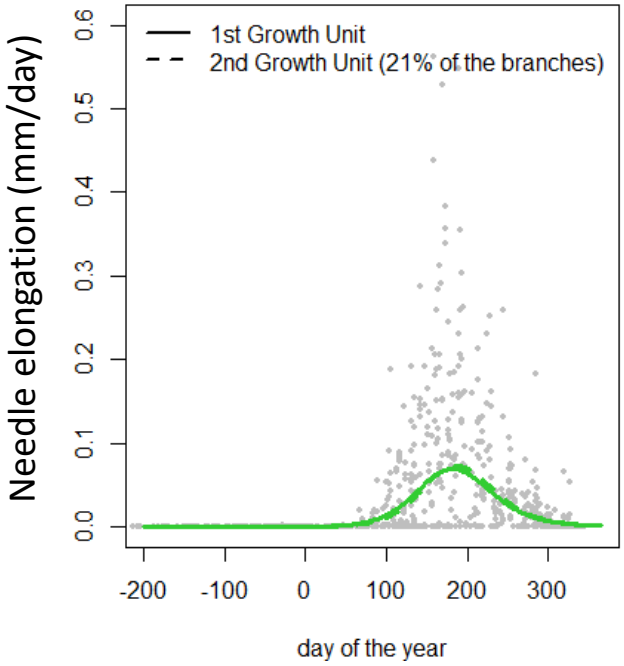
Focus on the intra-annual dynamics using GAMs and segmented regressions

Aggregate all years and all individuals together -> large spread in the data

Shoot and needle elongation

Shoot elongation occurs throughout the year with 2 peaks in spring

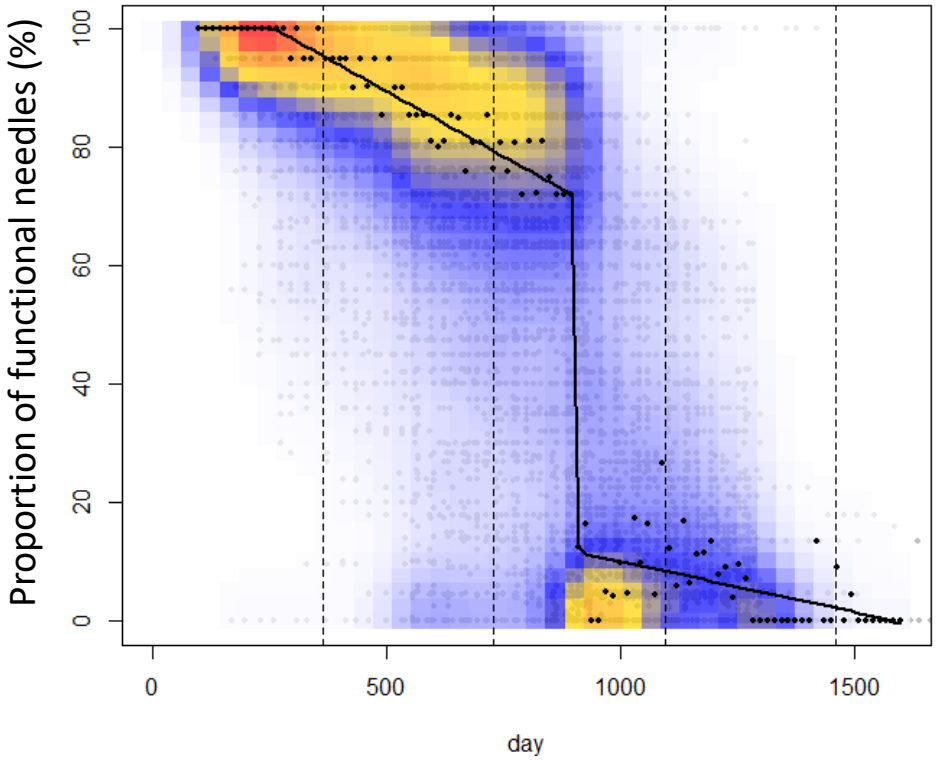




Needle elongation from May to end-July without differences between Growth Units

Needle senescence

Most of the needles fall after 2 years and 3 months



A Growth Unit at a given date

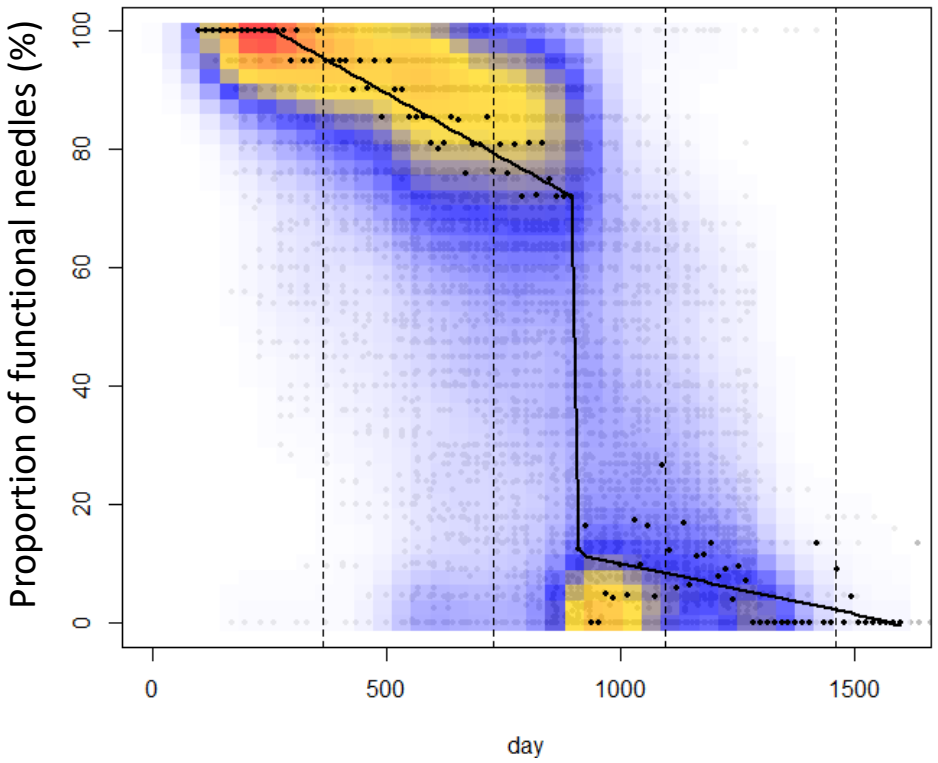
Density of the points

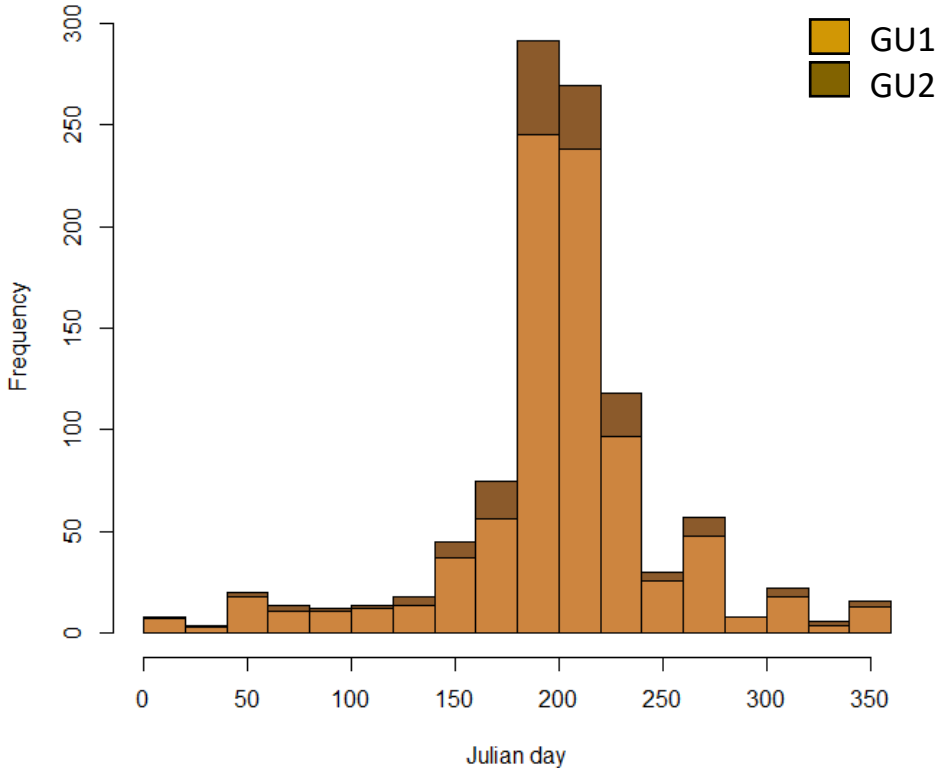
15-days median

Segmented regression

Needle senescence

Most of the needles fall after 2 years and 3 months





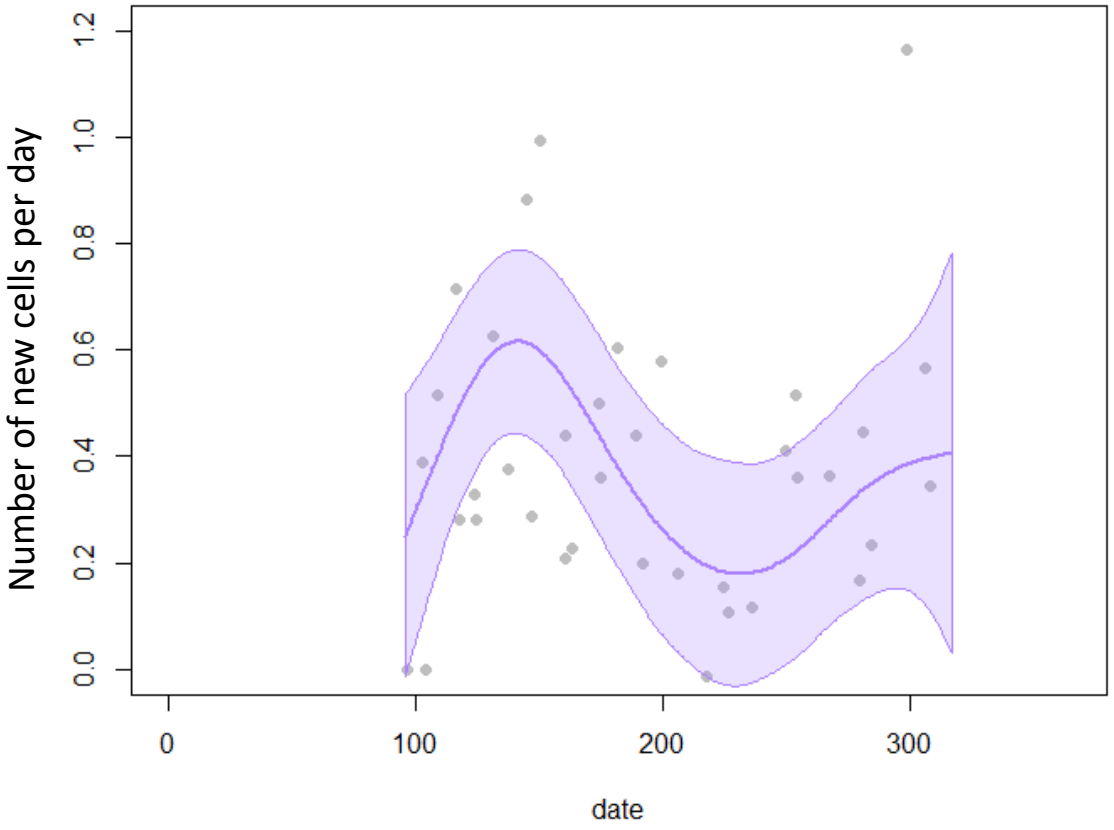
Needle fall occurs mainly in July and in beginning of August

This is a strategy against summer drought, and probably to increase fire risk

Balaguer-Romano et al. 2020 *Forests*

Xylogenesis

2 phases of cambial activity: in spring and in autumn, but lack of data



2008-2010

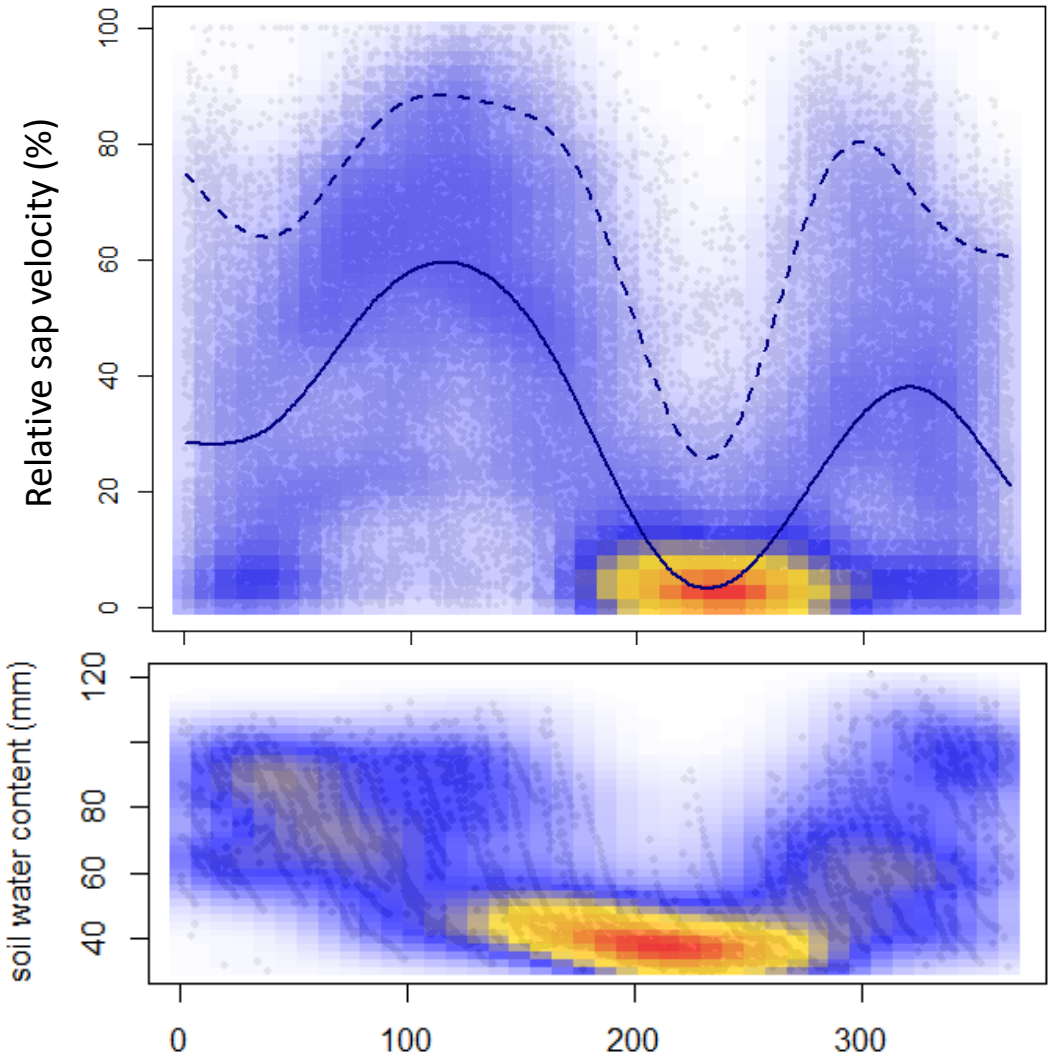
Mean for 8 trees

De Luis et al. 2011 *Dendrochronologia*
Pacheco et al. 2018 *Sci. Tot. Env.*

The remaining micro-cores and the dendrometer data are in process to confirm this bimodal pattern and assess the onset/end of cambial division

Sap-fluxes

Bimodal pattern in sap velocity due to drought-induced stomatal closure



2008-2021

14 trees

½ hourly data for a given tree

Density of the points

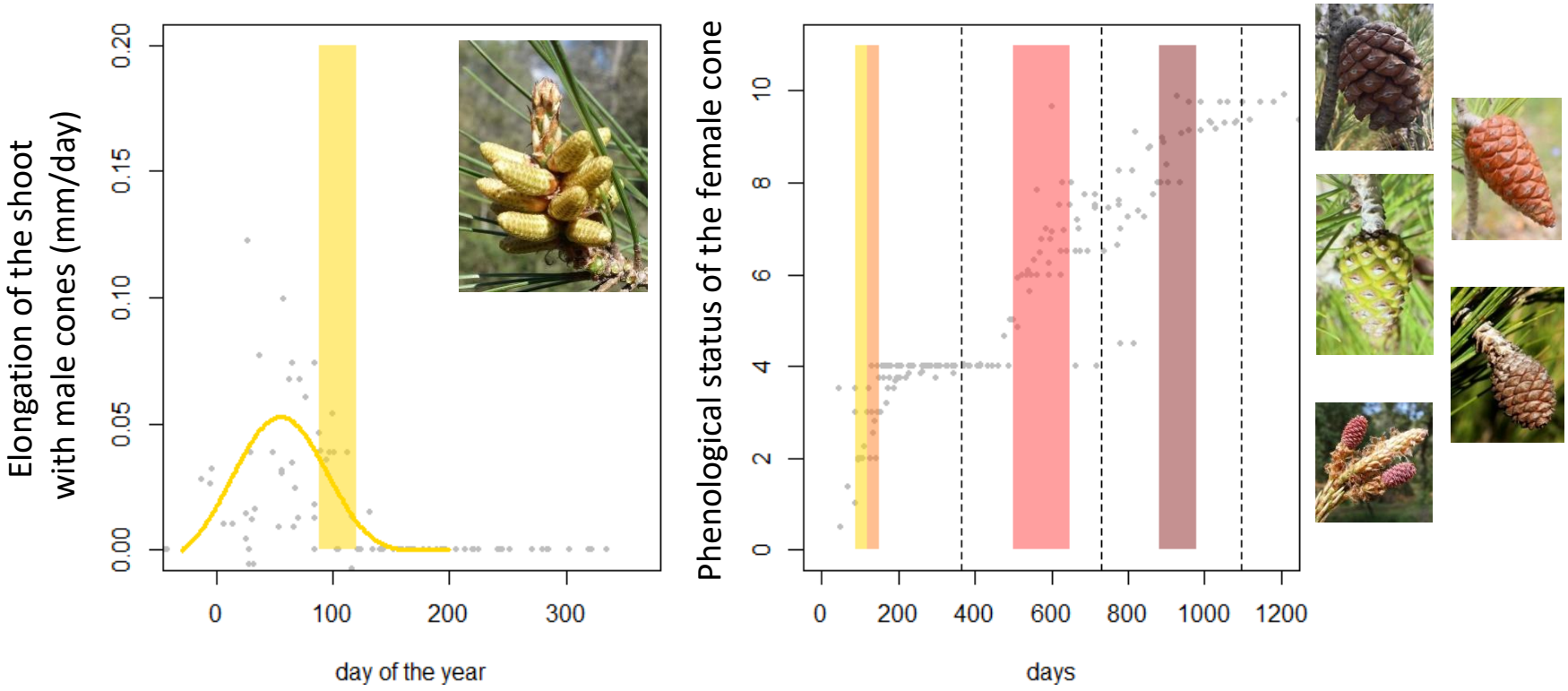
50% Quantile GAM

90% Quantile GAM

Moreno et al. 2021 *Agr. For. Meteo.*

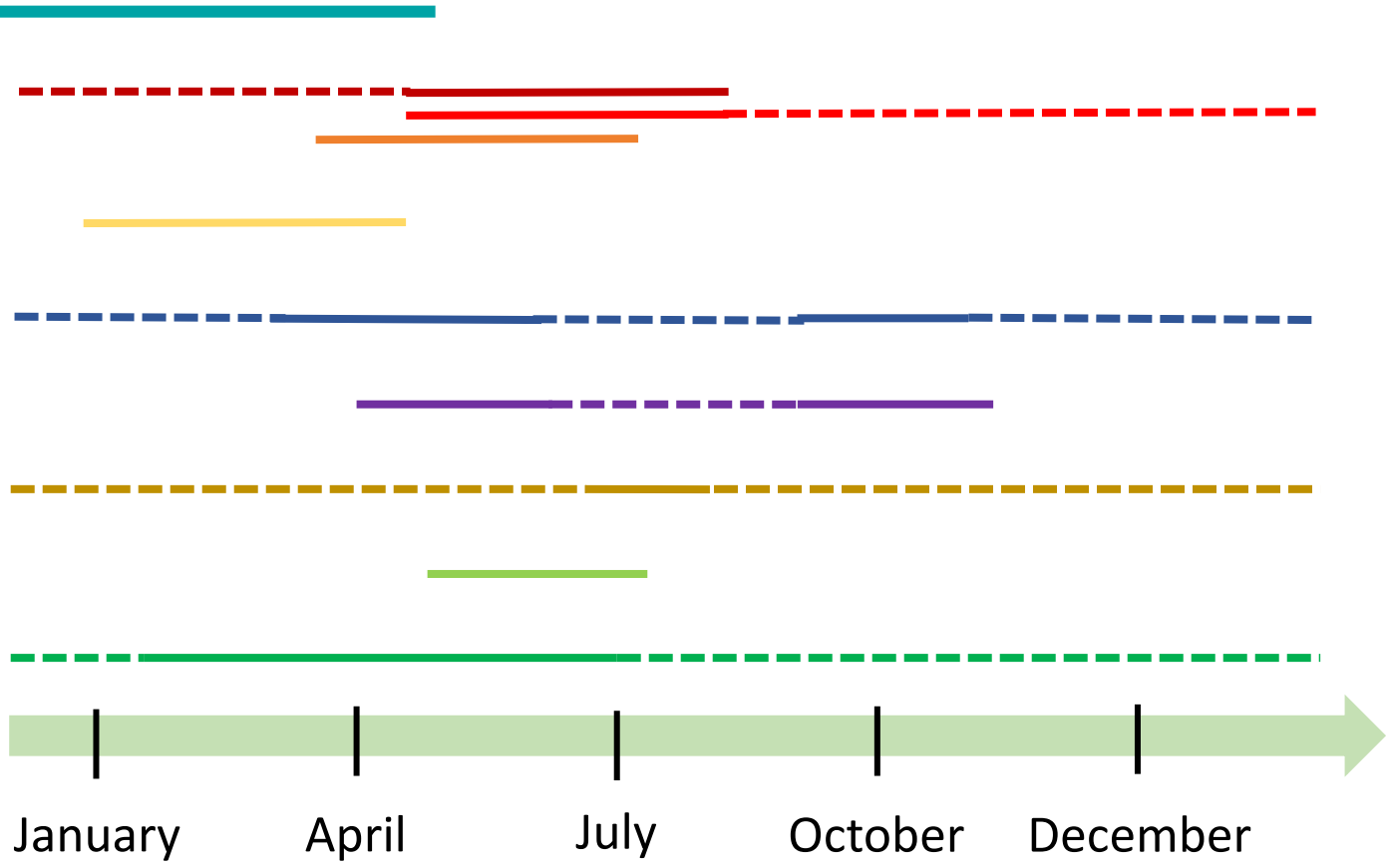
Reproductive phenology

Development of the male cones in winter during shoot elongation



Development of the female cones in 3 years, with elongation and maturation phases in spring and summer

Synthesis of Aleppo pine phenology



Primary meristems are always working, but mainly in spring

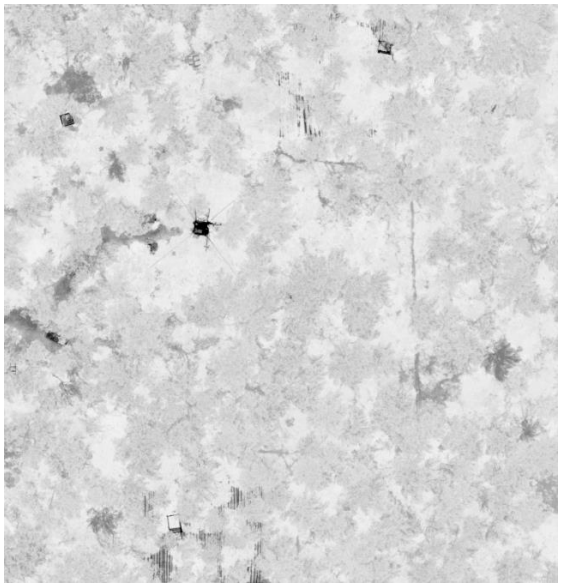
Different cycles : 2 in spring for shoots, spring-autumn for cambial activity

Perspectives

These results are mainly descriptive ; need a quantative analysis to disentangle the various effects of climate on Aleppo pine phenology

Consider variability among years and between individuals

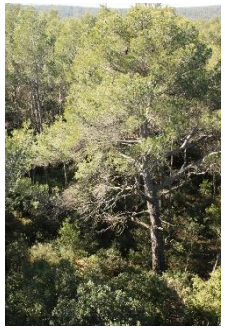
Phenocam to improve temporal resolution – drone to increase spatial extent



Insights on the effects of the rainfall experiments : talk by L. Veuillen on Friday

Moreno et al. 2021 *Agr. For. Meteo.*

Thanks for your attention





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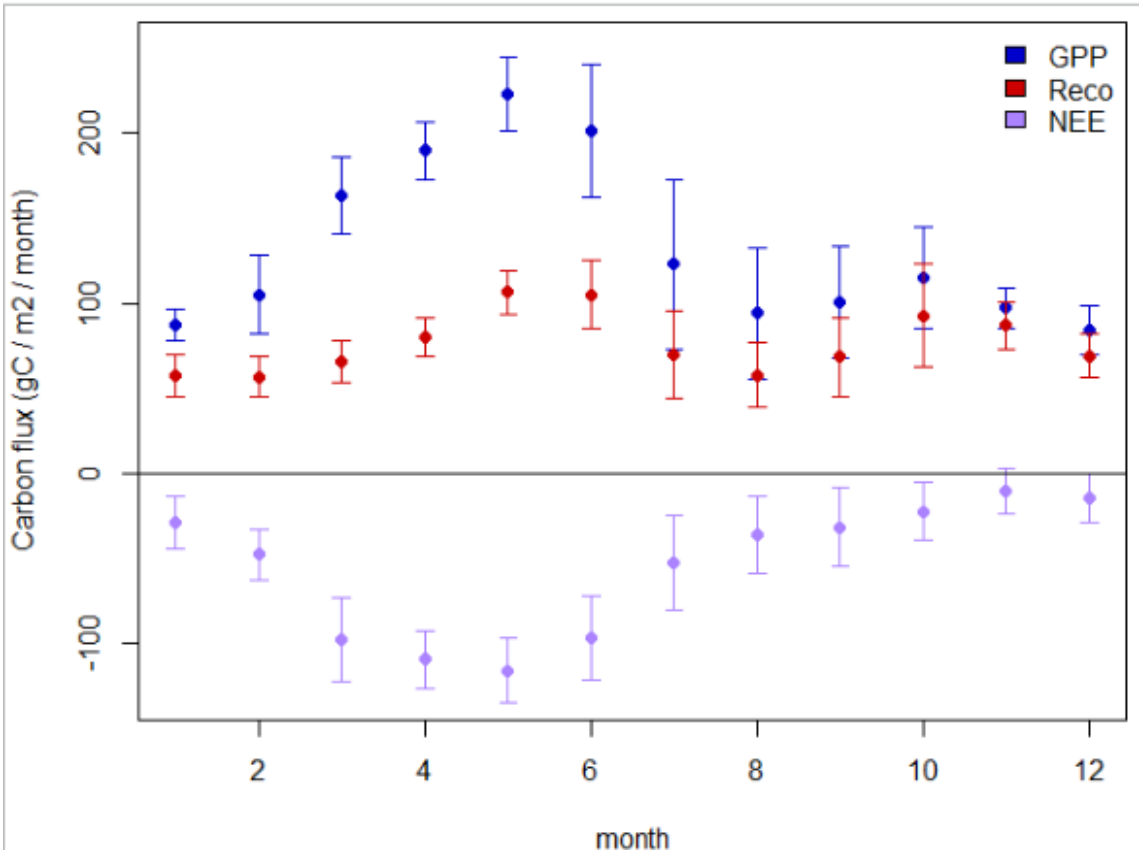
Eddy-fluxes


GPP
Reco
NEE
Carbon flux (gC / m2 / month)
200
100
0
-100
2
4
6
8
10
12
month