BEECH PHENOLOGY AND PRODUCTIVITY AT THE VIELSALM TERRESTRIAL OBSERVATORY

Quentin Hurdebise[1], *Caroline Vincke*[2], *Anne De Ligne*[1] *and Marc Aubinet*[1]

(1) Université de Liège, Gembloux Agro-Bio Tech, TERRA Teaching and Research Centre, Belgium
(2) Université catholique de Louvain, Earth and Life Institute, Forest Sciences, Belgium

Introduction

Context

- Understanding how temperate forests react and will react in a changing environment requires long-term monitoring of both forest productivity and phenology as well as of climate variables.

Content

- Determination of phenological and productivity indicators.
- Relations between indicators and between indicators and climate.

Site description

The Vielsalm Terrestrial Observatory

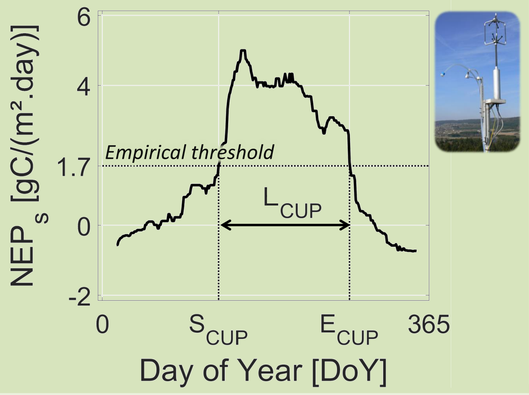
- ICOS candidate eddy covariance site located in a temperate mixed forest (beech, spruce, Douglas and silver fir) in East Belgium (alt. ~ 470m).
- Only the wind sector dominated by beech was considered (180 to 330°N).
- 17 years (from 1998 to 2014 except 2009) of gapfilled data were used. In early 2009, there was a tower change and no data were collected.

Material & Method

Phenological indicators derived from

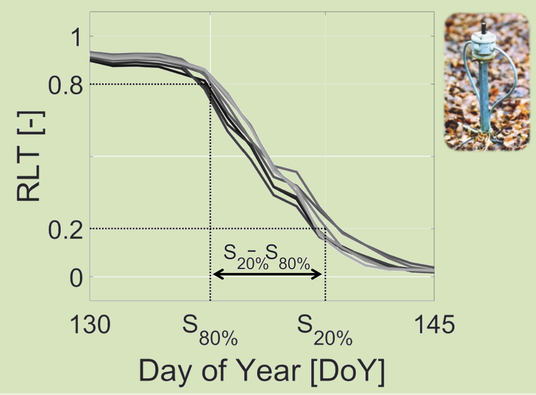
- A median smoothing of daily **Net Ecosystem Productivity** (NEP_s) (eddy covariance measurements).

  S_{CUP}: Start of the carbon uptake
  E_{CUP}: End of the carbon uptake
  L_{CUP}: Length of the carbon uptake



- A median smoothing of **light transmissivity** (RLT) through the canopy (8 sensors under the canopy).

  $S_{80\%}$: Start of the leaf out period
  $S_{20\%}$: End of the leaf out period
  $S_{20\%}$ - $S_{80\%}$: Leaf out duration



Productivity indicators derived from

- Gapfilling and summation of half-hourly **Net Ecosystem Productivity** (eddy covariance measurements from the site)

- Double de-trended tree ring width series (**Growth Index**) (cores in 24 dominant beeches from the site)

- Seed production (**Masting intensity**) (records for Wallonia (“Comptoir Forestier Wallon”))

Results

Phenological indicators

(*Numbers refer to the Figures below*)

1. The start of the leaf out period ($S_{80\%}$) is significantly related to, S_{F^*}, the day of the year when the sum of above zero daily temperature from the 1st April reached *F** (202 °C . Day).
2. The leaf out duration ($S_{20\%}$ - $S_{80\%}$) is shorter if the temperature during the leaf out period (T_{air}) is higher.
3. The start of the carbon uptake (S_{CUP}) is significantly related to the end of leaf out period ($S_{20\%}$), but not to $S_{80\%}$ (not presented).

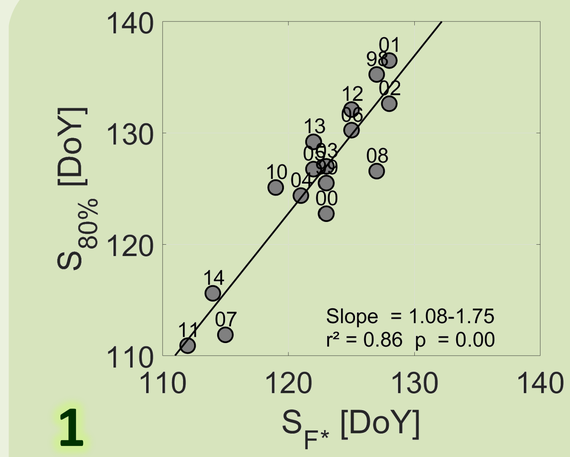
NEP interannual variability

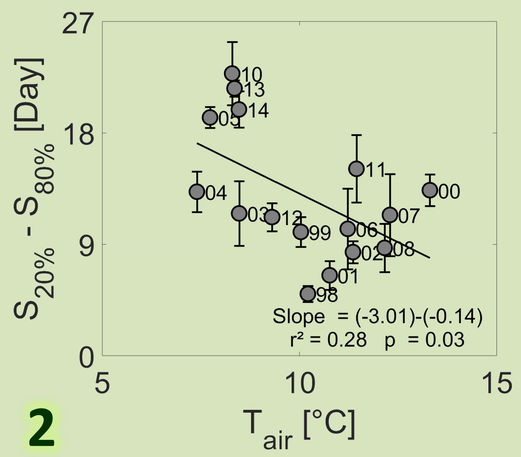
4. The beech annual NEP (NEP_y) is significantly related to length of the carbon uptake period (L_{CUP}).
5. The residuals of this relation ($NEP_{y,res}$) are related to NEP_{1500}, the value of the NEP at 1500 µmol/(m².s), obtained from the modelled light response curve during the vegetation period.
6. A model (NEP_{mod}) combining these two parameters (L_{CUP} and NEP_{1500}) explains two third of the variability observed in NEP_y.

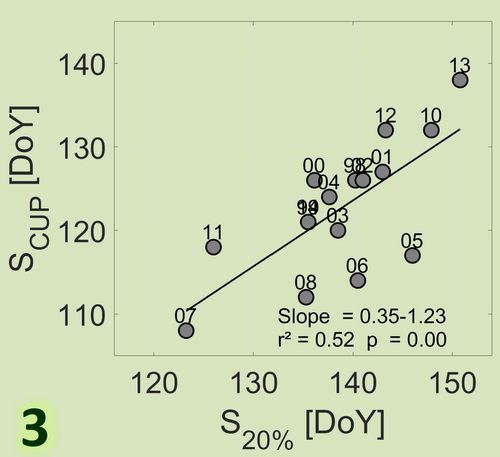
Productivity indicators

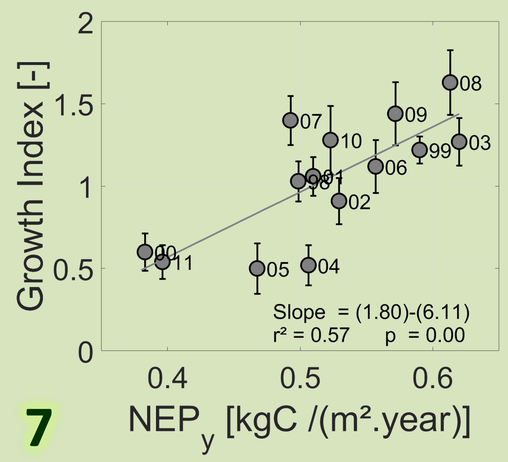
7. The beech stand annual Net **Ecosystem** Productivity (NEP_y) is significantly correlated to the growth index of the **trees**.
8. The more intense the masting of a current year is, the lower the growth index is. NEP_y was less sensitive to the masting intensity and only lower for the most intense masting events (++++).

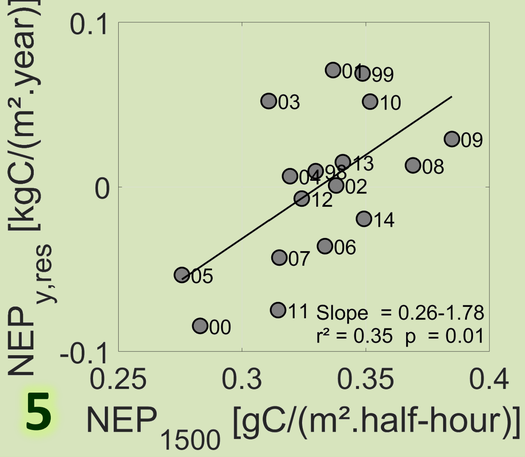
Figures

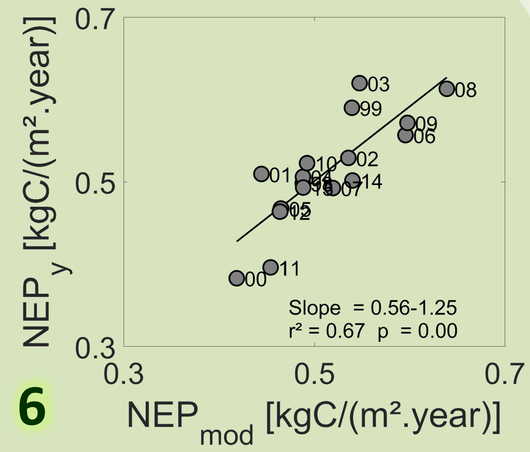


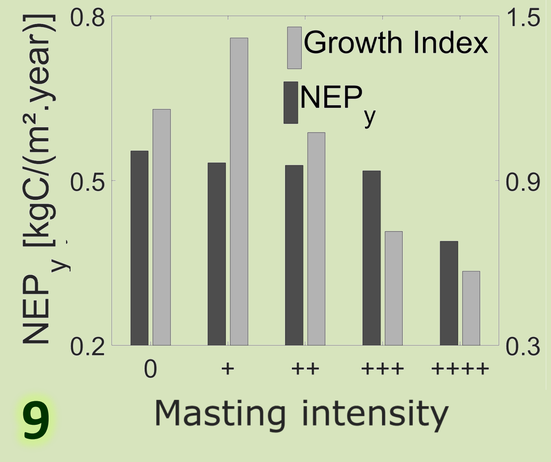












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Contact: quentin.hurdebise@ulg.ac.be

Highlights

- Temperature strongly explained the leaf out beginning ($S_{80\%}$) and duration ($S_{20\%}$ - $S_{80\%}$).
- Phenological indicators obtained from different datasets are significantly related ($S_{20\%}$ and S_{CUP}).
- Carbon uptake period length and Net Ecosystem Productivity at light saturation explain almost two third of the variability observed in beech annual Net Ecosystem Productivity.
- There is a significant relation between the carbon net assimilation of the stand and the tree ring increment for a given year, but not with the masting intensity. This underlines the role of the carbon allocation regulation system.