Continuous parameterization of phenological phases and leaf area index within deciduous forests based on temperature measurements

Anita Zolles

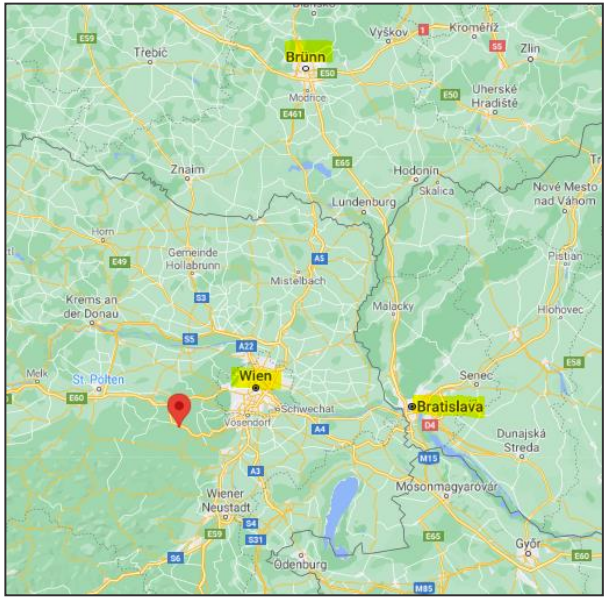
Department of Forest Growth, Silviculture and Genetics

Birmensdorf

08.06.2021

Data

- Beech stand (*Fagus Sylvatica*) in Klausen-Leopoldsdorf (Lower Austria)
- Local radiation conditions are modulated by the canopy
- Daily maximum temperature is dependend on incoming radiation and for us more widely available



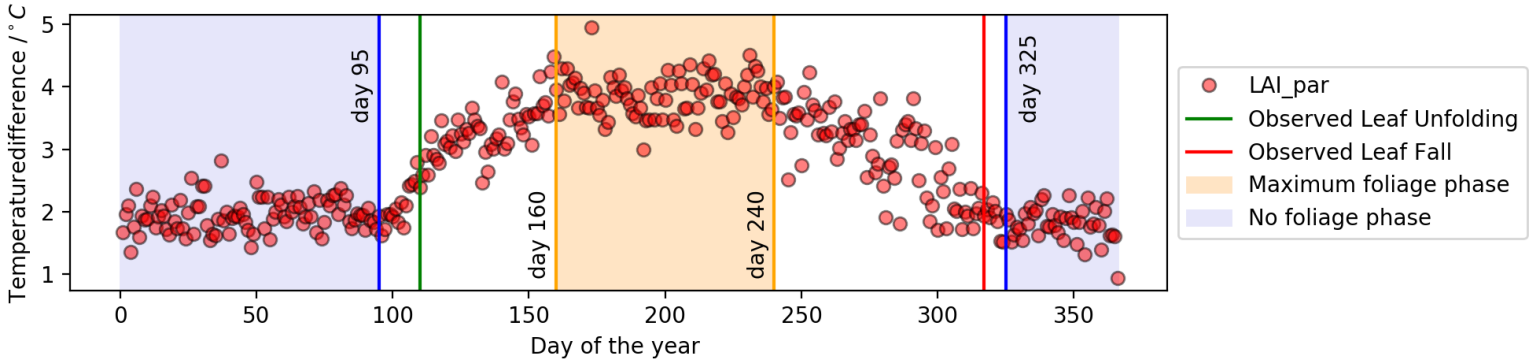
We used:

- **Stand daily maximum temperature**
  Measurements conducted as part of the icp forests programme
- **Open land daily maximum temperature**
  Measurements provided by the Austrian national weather service (ZAMG)
- **LAI measurements** via hemispheric photographs (conducted once a year at 16 photographic points)
- **Phenological observations** of leaf unfolding and leaf fall (provided by the ZAMG)

Foliage during the course of the year

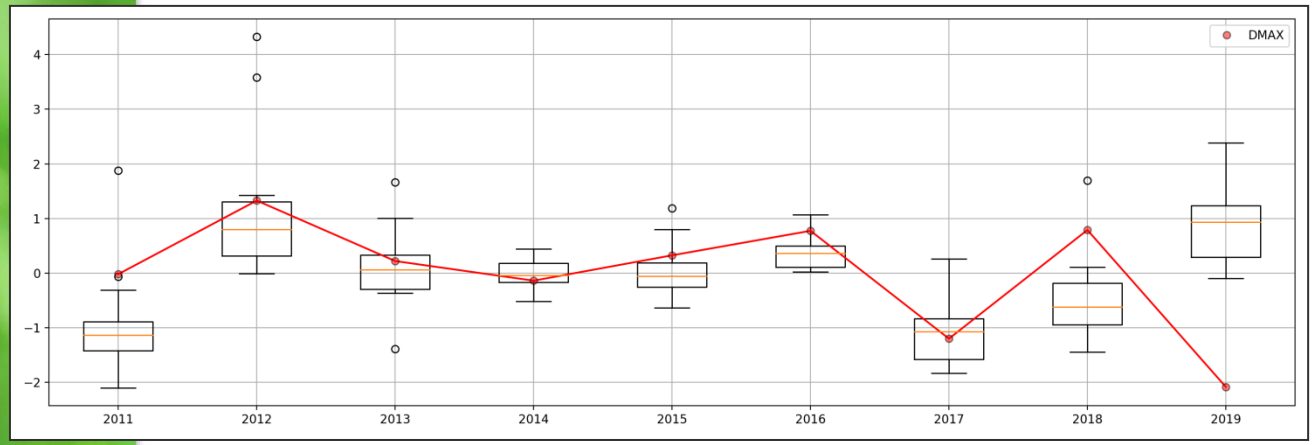
Assumption: Tree crown dampes maxmimum temperature inside the stand

1. Calculate the difference in maximum temperature for the forest and the reference site
   $DMAX = TMAX_S - TMAX_R$
2. Sign correction $LAI_{par} = -DMAX$
3. Calculate average course of the year for LAI_{par}



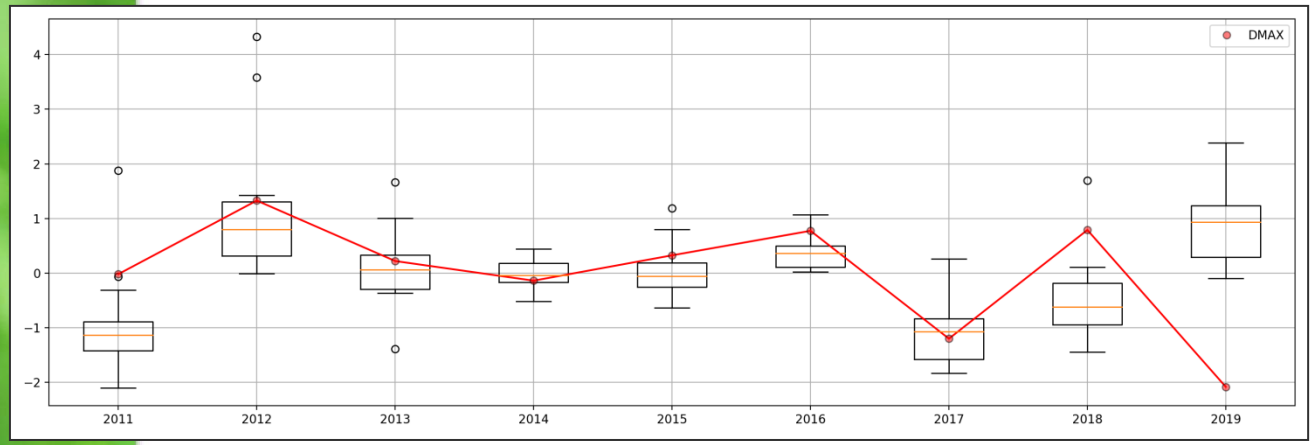
Comparison to LAI measurements

1. Extract LAI_par values at the day of the hemispheric measurement (to ensure similar radiation conditions for the comparison)
2. Standardize both time series
3. Compare LAI_par values to boxplots of LAI_hem
4. Correlation is at



Comparison to LAI measurements

1. Extract LAI_par values at the day of the hemispheric measurement (to ensure similar radiation conditions for the comparison)
2. Standardize both time series
3. Compare LAI_par values to boxplots of LAI_hem
4. Correlation is at 0,32 (pvalue 0,76)



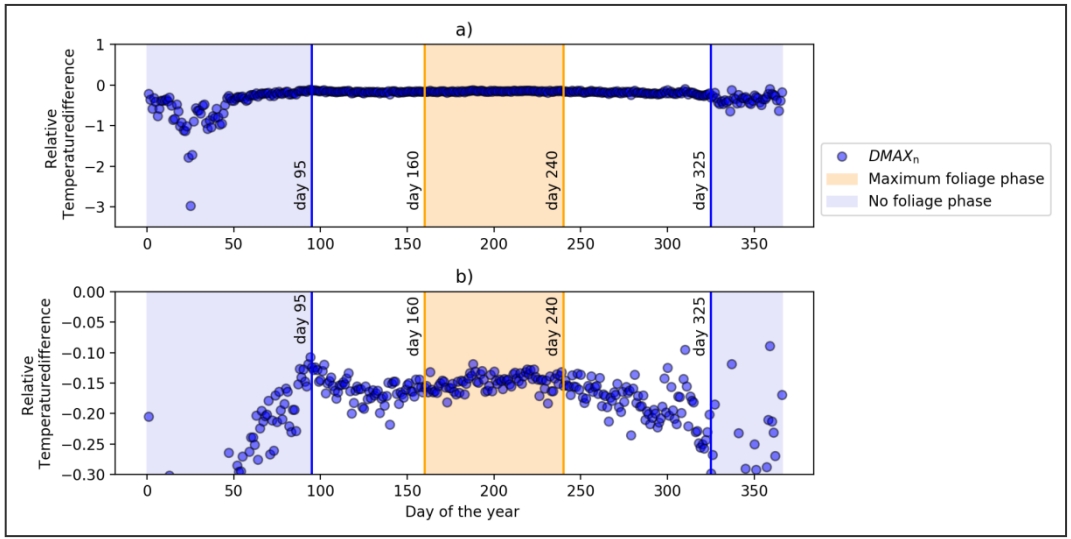
Between 2011-2017 corr. at 0.93 (pvalue 0.006)

Between 2011-2018 corr. at 0.69 (pvalue 0,021)

Quantification of temperature dimming

Formula: $DMAX_N = \frac{DMAX}{TMAX_r} = \frac{TMAX_b - TMAX_r}{TMAX_r}$

$DMAX_N \sim const. = -0{,}15$ during the maximum foliage phase (standard deviation is at 0,02)



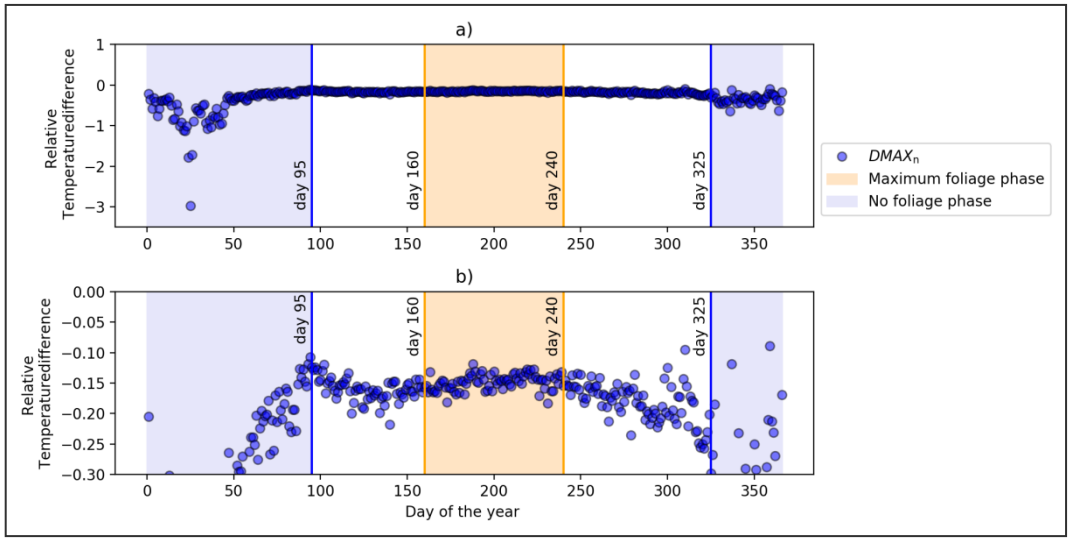
The constant factor describes the reduced heating inside of the forest:

$TMAX_b = TMAX_r(1 + DMAX_n)$

Quantification of temperature dimming

Formula: $DMAX_N = \frac{DMAX}{TMAX_r} = \frac{TMAX_b - TMAX_r}{TMAX_r}$

$DMAX_N \sim const. = -0{,}15$ during the maximum foliage phase (standard deviation is at 0,02)



The constant factor describes the reduced heating inside of the forest:

$$TMAX_b = TMAX_r(1 + DMAX_n)$$

Example for maximum temperature estimation:

TMAX prediction in Klausen Leopoldsdorf (open land):

$$\boldsymbol{TMAX_R = 30°C}$$

Estimated TMAX at the forest site:

$$\boldsymbol{TMAX_S = 30°C(1 - 0{,}15) = 25.5°C}$$

Picture | Filmstyle from „See Aural Woods“ (Luma.Launisch & Takamovsky)

anita.zolles@bfw.gv.at

Federal Research and Training Centre for Forests, Natural Hazards and Landscape

Austria, 1131 Wien
Seckendorff-Gudent-Weg 8
Tel.: +43 1 878 38-0
direktion@bfw.gv.at
http://www.bfw.ac.at

https://www.facebook.com/BundesforschungszentrumWald

https://twitter.com/bfwald

https://www.youtube.com/user/Waldforschung