Extended Spring Index model assessment over the European continent

E. Izquierdo-Verdiguier[1], R. Zurita-Milla[2] and H. Scheifinger[3]

[1]Institute of Geomatics, BOKU, Vienna, Austria.
[2]Geo-information Processing, ITC, University of Twente, the Netherlands.
[3]ZAMG, Vienna, Austria.

PHENOLOGY 2022 - Phenology at the crossroads - Avignon, France - 20 - 24 June 2022

Outline

- SI-x models applied in Europe
- Recalibration
- Validation
- Error analysis

SI-x models applied in Europe

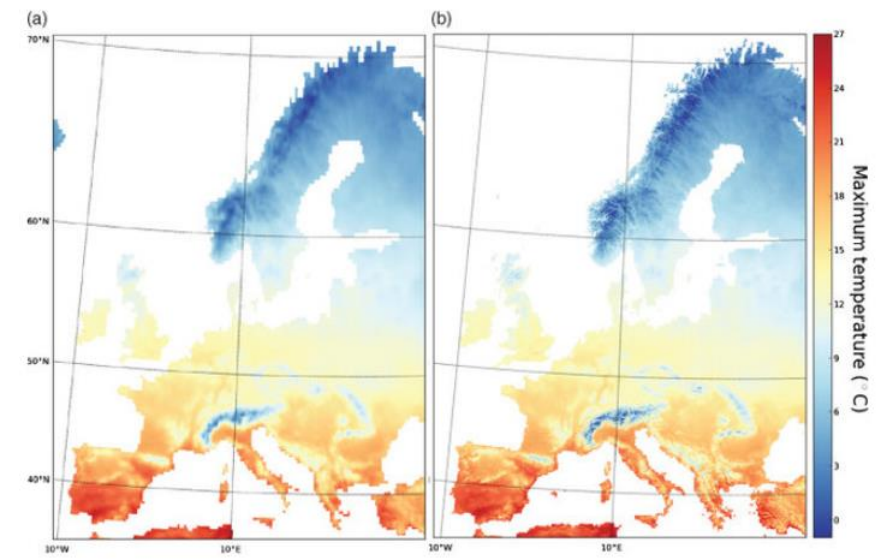
SI-x models

Schwartz et al. in 2013

- Simple models based on GDH.
- Max. and min. daily temperatures
- One Lilac and two Honeysuckle.
- Leaf and Bloom indices:
  - Leaf: four predictors.
  - Bloom: two predictors.

SI-x models: Input data

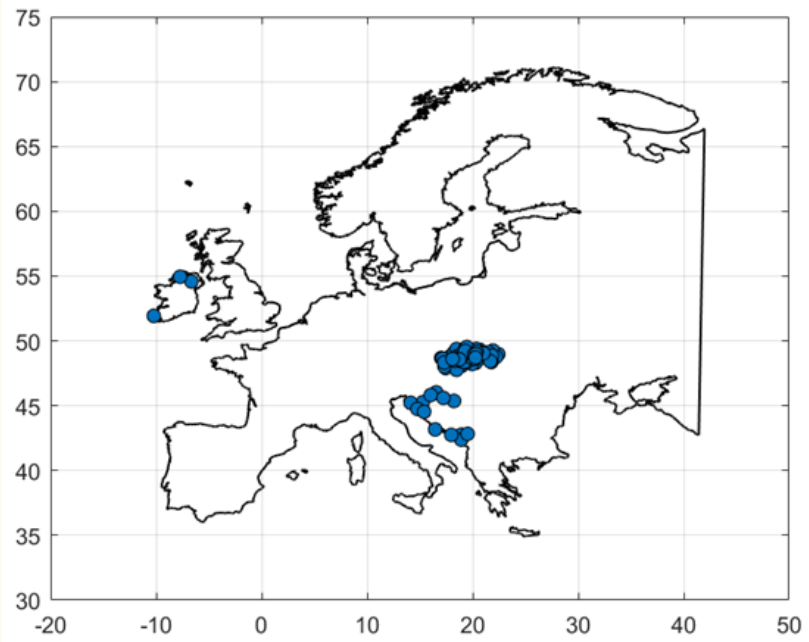
- Maximum and minimum daily temperature at 1-km spatial resolution over European continent from 1950 to 2017.



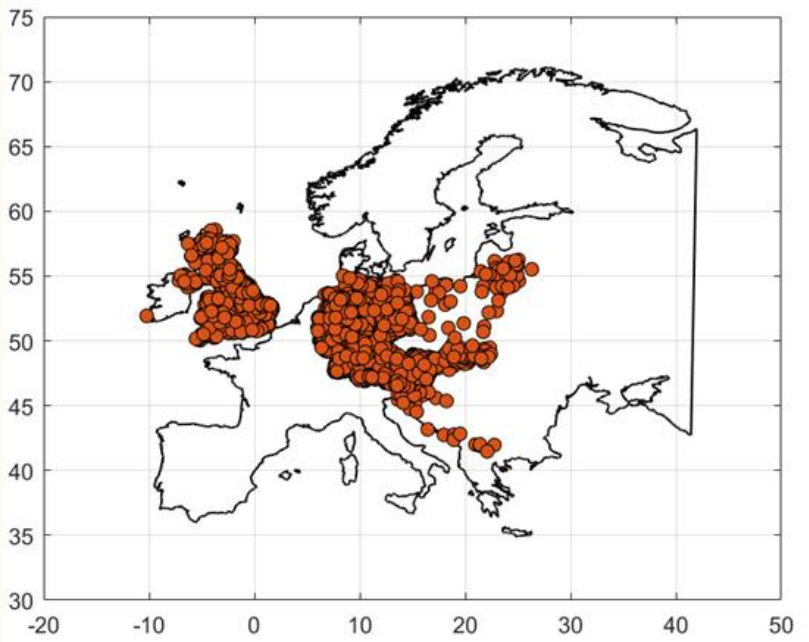
Downscaled average daily Tmax for the year 2001.

Source: Moreno, A., & Hasenauer, H. (2016). Spatial downscaling of European climate data. International Journal of Climatology, 36(3), 1444-1458.

PEP725 dataset, *Syringa vulgaris*



- 1,311 samples labeled as Leaf unfolding (first visible leaf stalk).



- 168,416 samples labeled as Beginning of flowering.

Recalibration: Recalculating the coefficients using European observations. (Schwartz, 1997)

Recalibration

Recalculating the coefficients in the model with the European observations

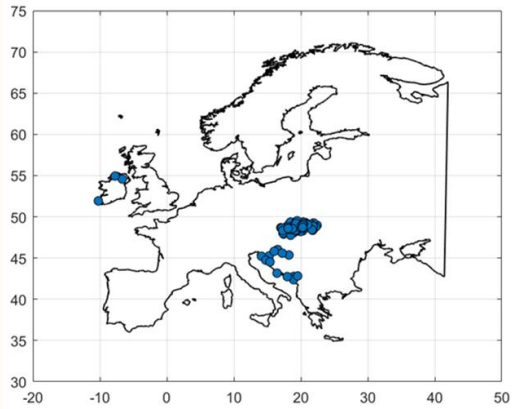
- Linear regression model (**WX**=**Y**)
- Predictors (X, input):

  Leaf : Four predictors.

  Bloom: Two predictors

- Observations (Y, output): *Syringa vulgaris* of PEP725 dataset.

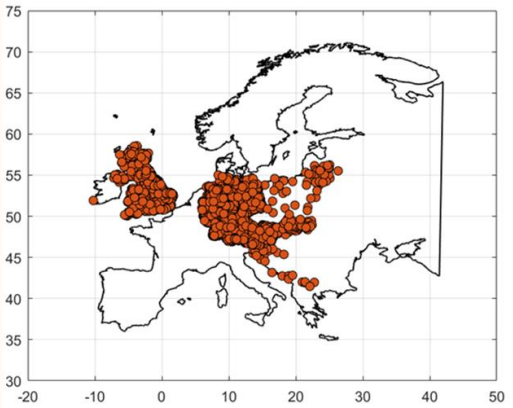
Leaf recalibration:



From the 1311 samples, 2/3 of the samples (874) are for re-calibrating the model and 1/3 of the samples (437) were reserved to test the new parameters, if it was necessary.

Predictors	SI-x param	Recalibration
1st Pred (DDE2)	0.201	0.184
2nd Pred (DD57)	0.153	0.152
3th Pred (SYNOPT)	13.878	13.862
4th Pred (MSD0)	3.306	3.245

Bloom recalibration:



From the 168,416 samples, 2/3 of the samples (120,000) are for re-calibrating the model and 1/3 of the samples (48,416) were reserved to test the new parameters, if it was necessary.

Predictors	SI-x param	Recalibration
1st Pred (AGDH)	-23.934	-23.177
2nd Pred (MDS0)	0.116	0.113

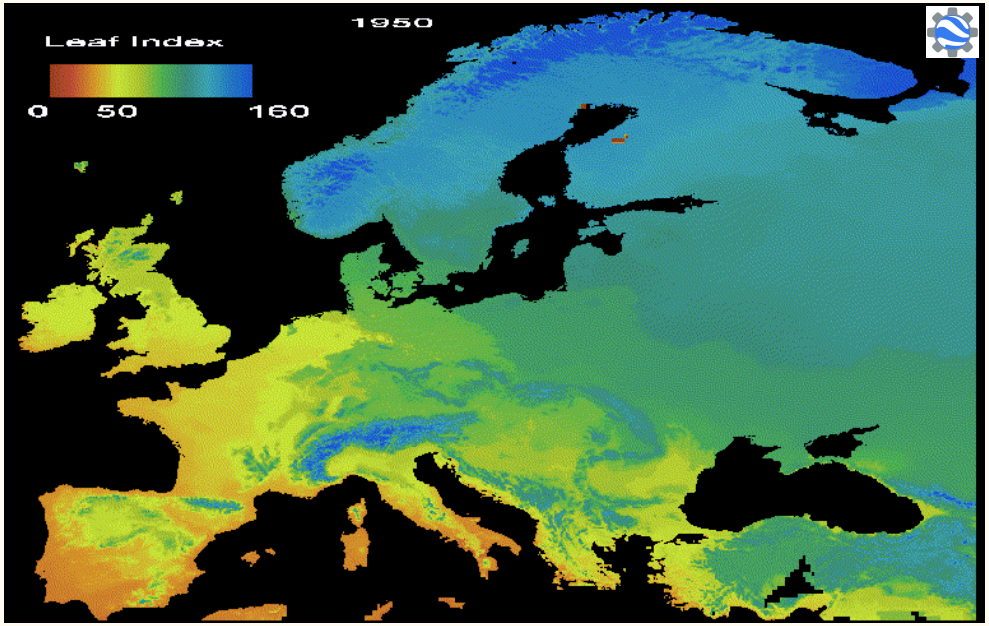
SI-x over Europe

Products

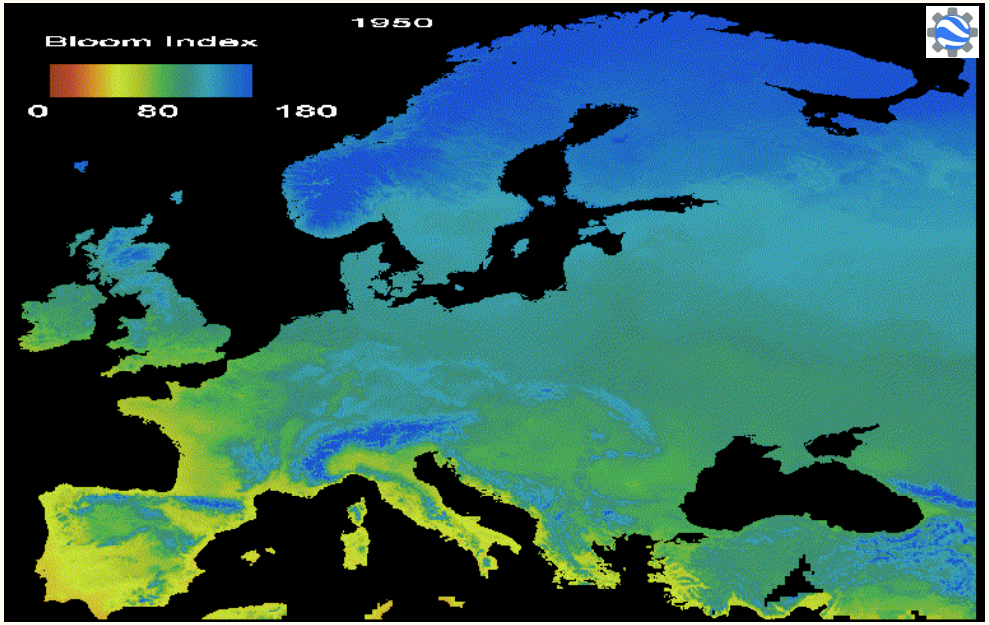
Leaf and Bloom indices

- Temporal series of SI-x products over European continent.
- 1 km spatial resolution
- From 1950 to 2017.

SI-x models: Lilac Leaf index



SI-x models: Lilac Bloom index



Validation

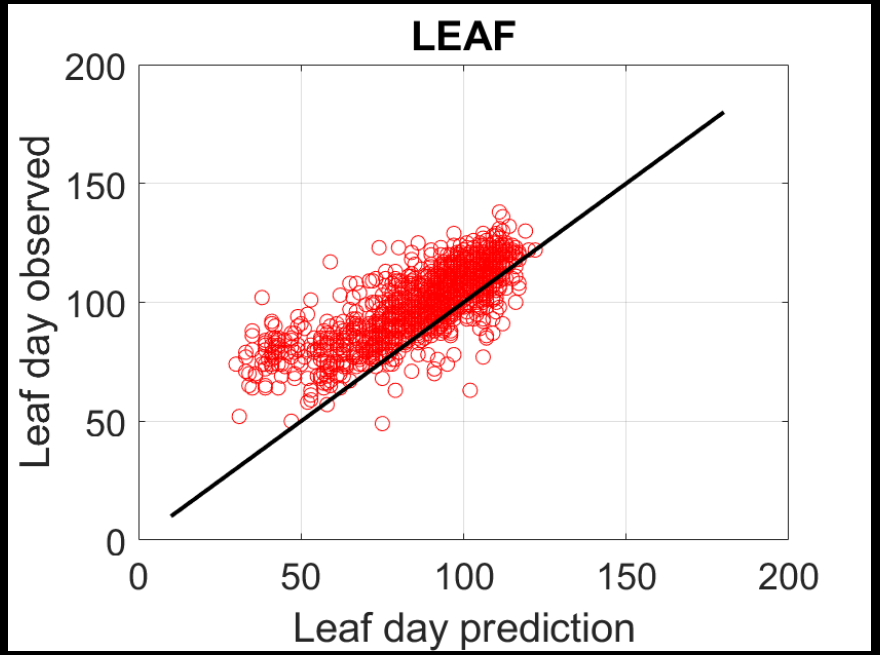
Validation

Leaf and Bloom indices

- European PEP725 dataset: *Syringa vulgaris* observations
- Leaf and Bloom (Lilac) index predicted.

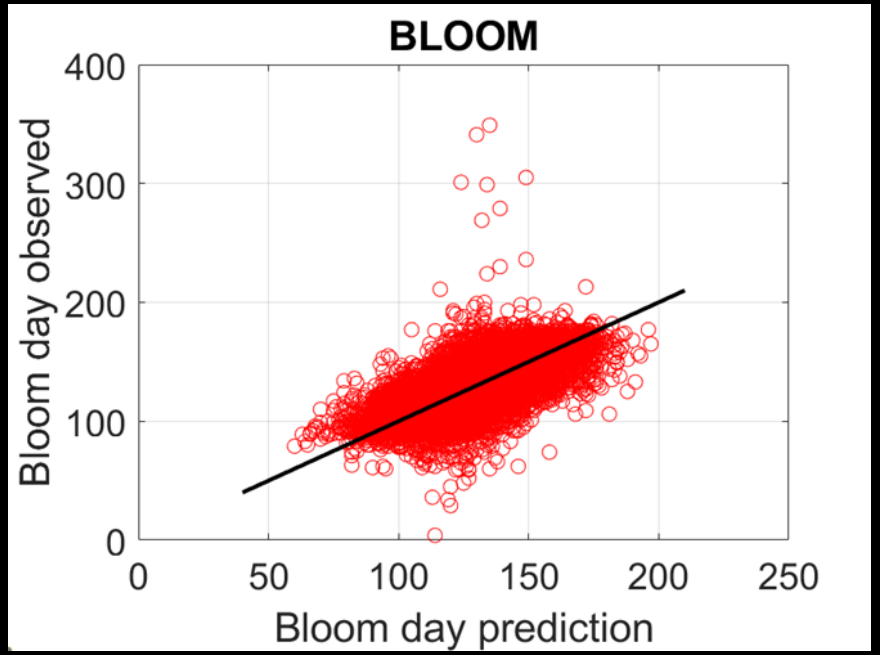
Leaf validation

ME: -12.20
RMSE: 16.82
MAE: 13.44
R: 0.79



Bloom validation

ME: -1.02
RMSE: 7.51
MAE: 5.18
R: 0.80



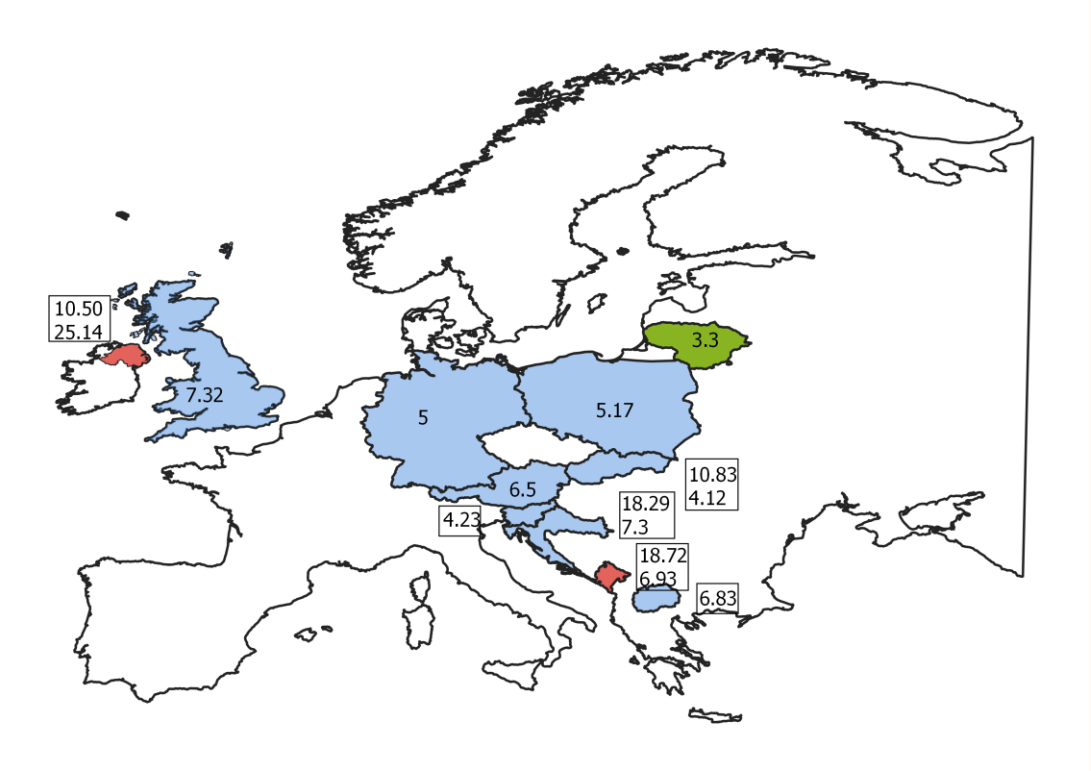
Error analysis

Error analysis

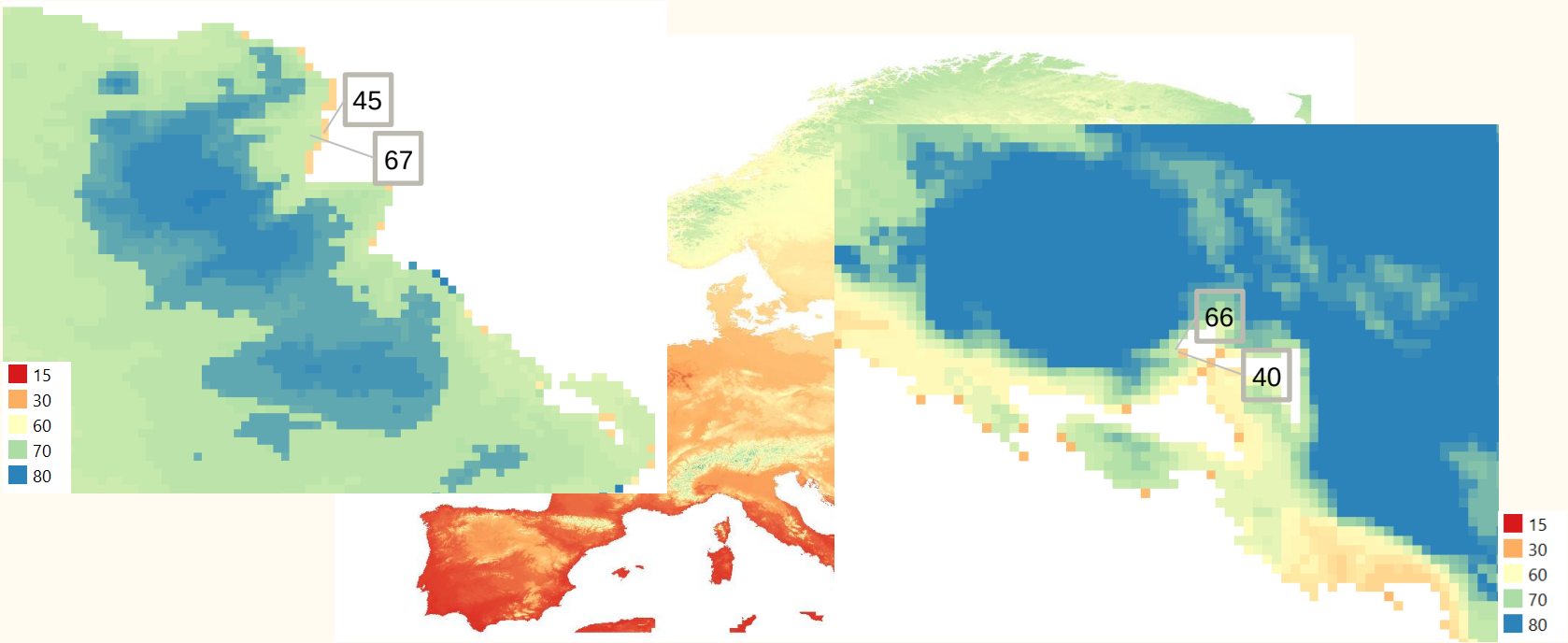
Spatial and temporal analysis of the SI-x errors over Europe

- Leaf and Bloom (Lilac) indices predicted
- European PEP725 dataset: *Syringa vulgaris* observations

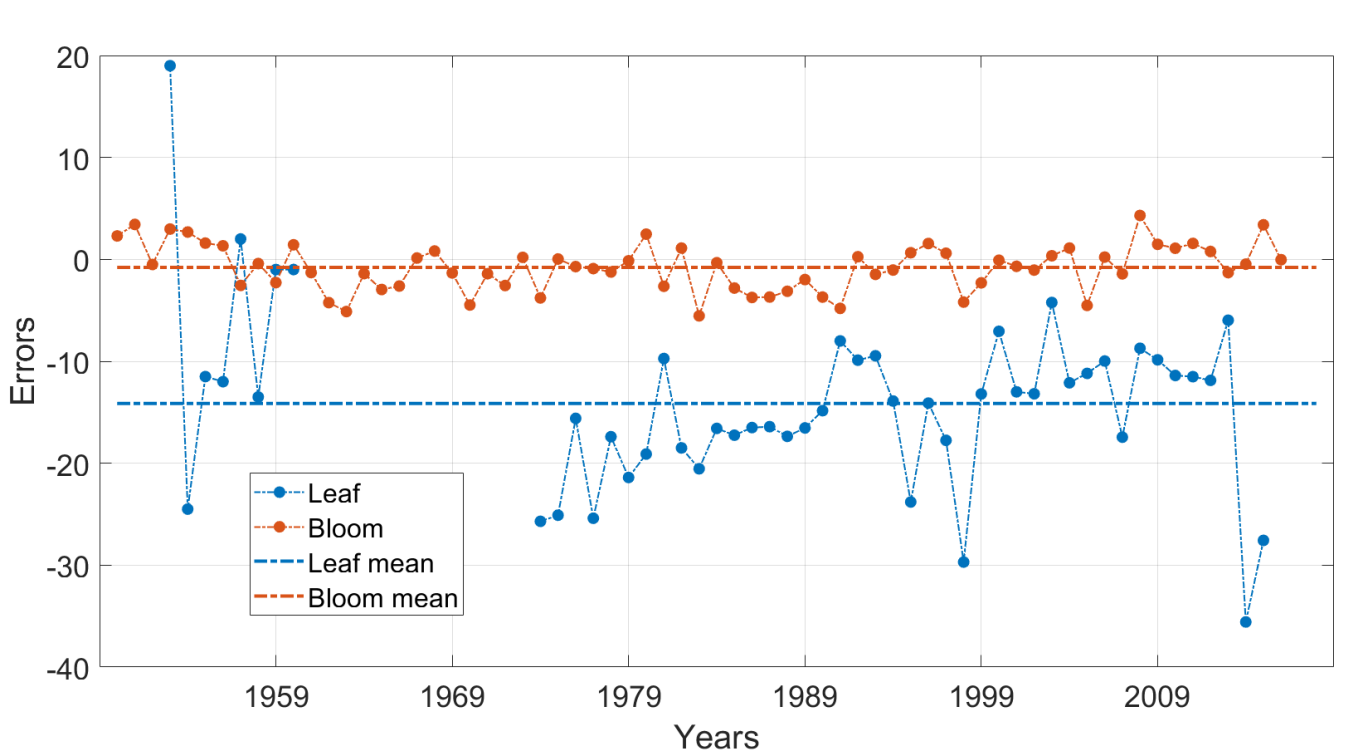
Spatial error



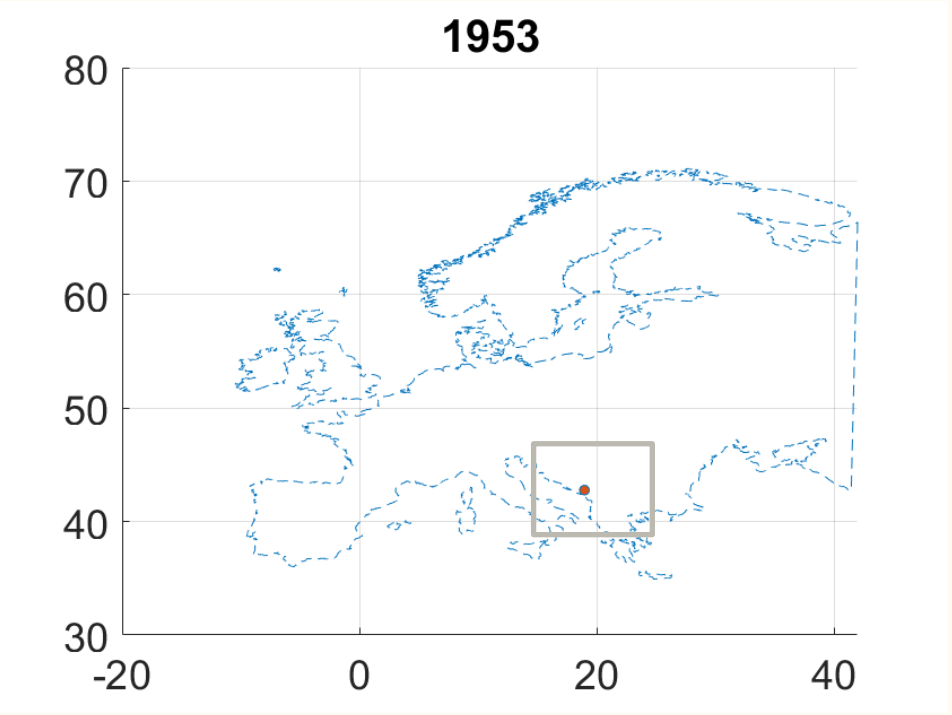
Leaf 1950

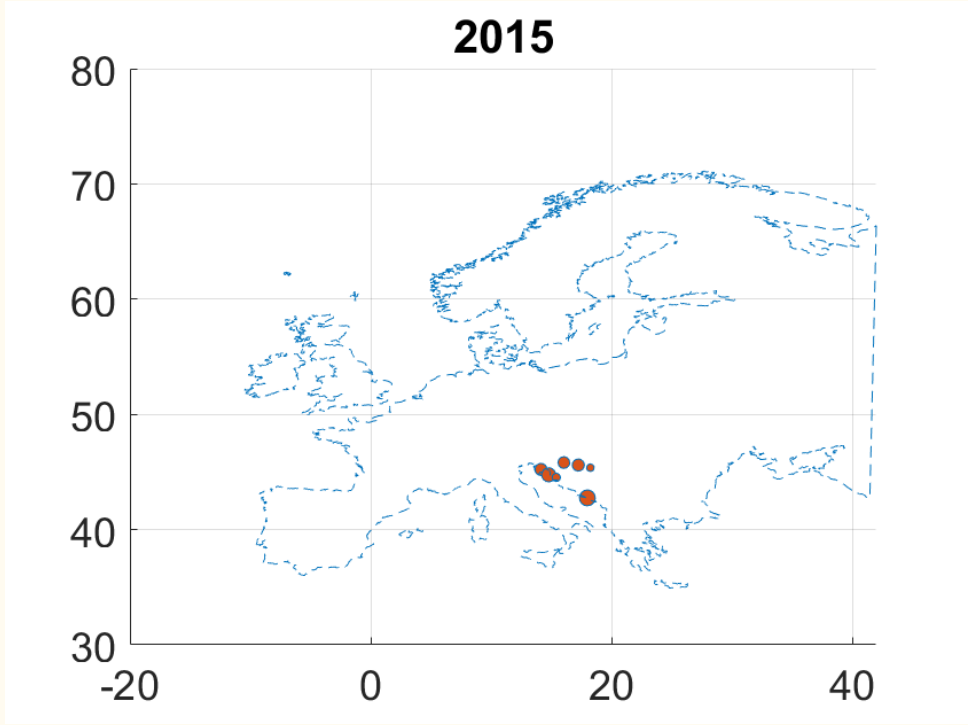


Temporal error

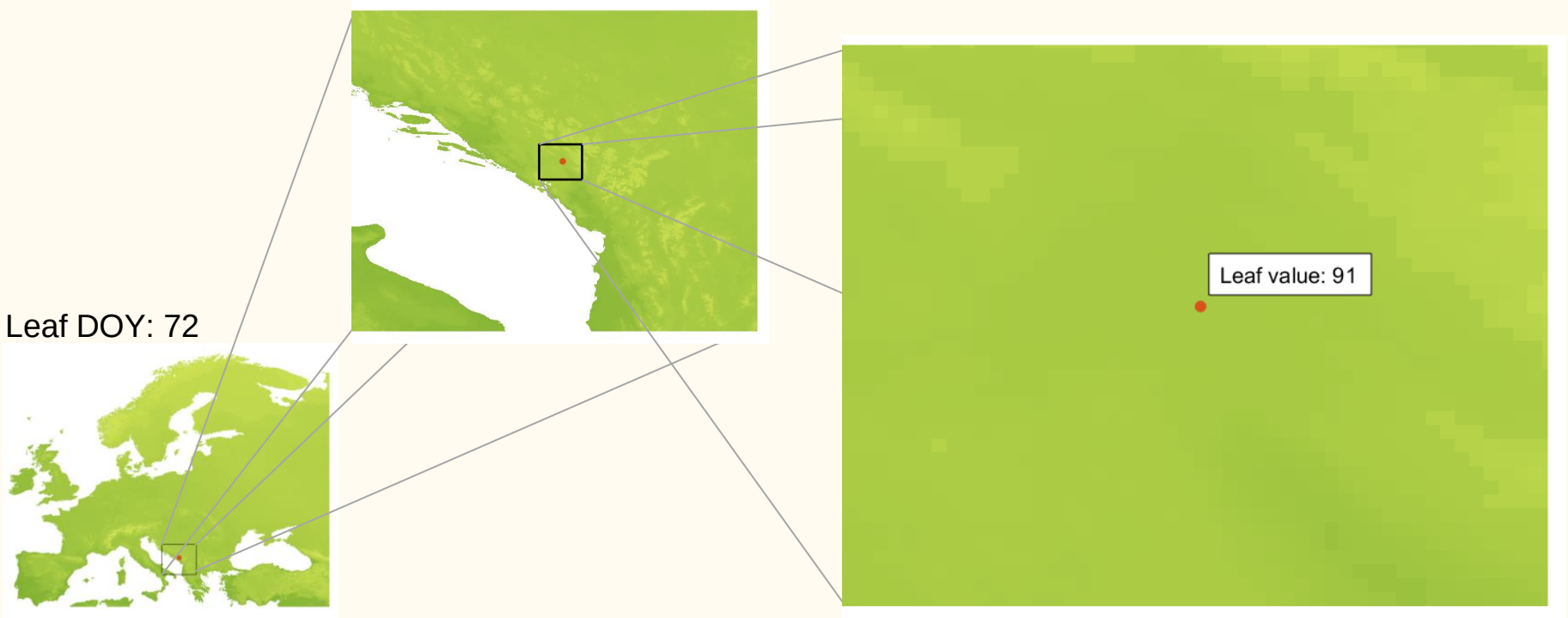


Leaf stations: Difference predicted and observed

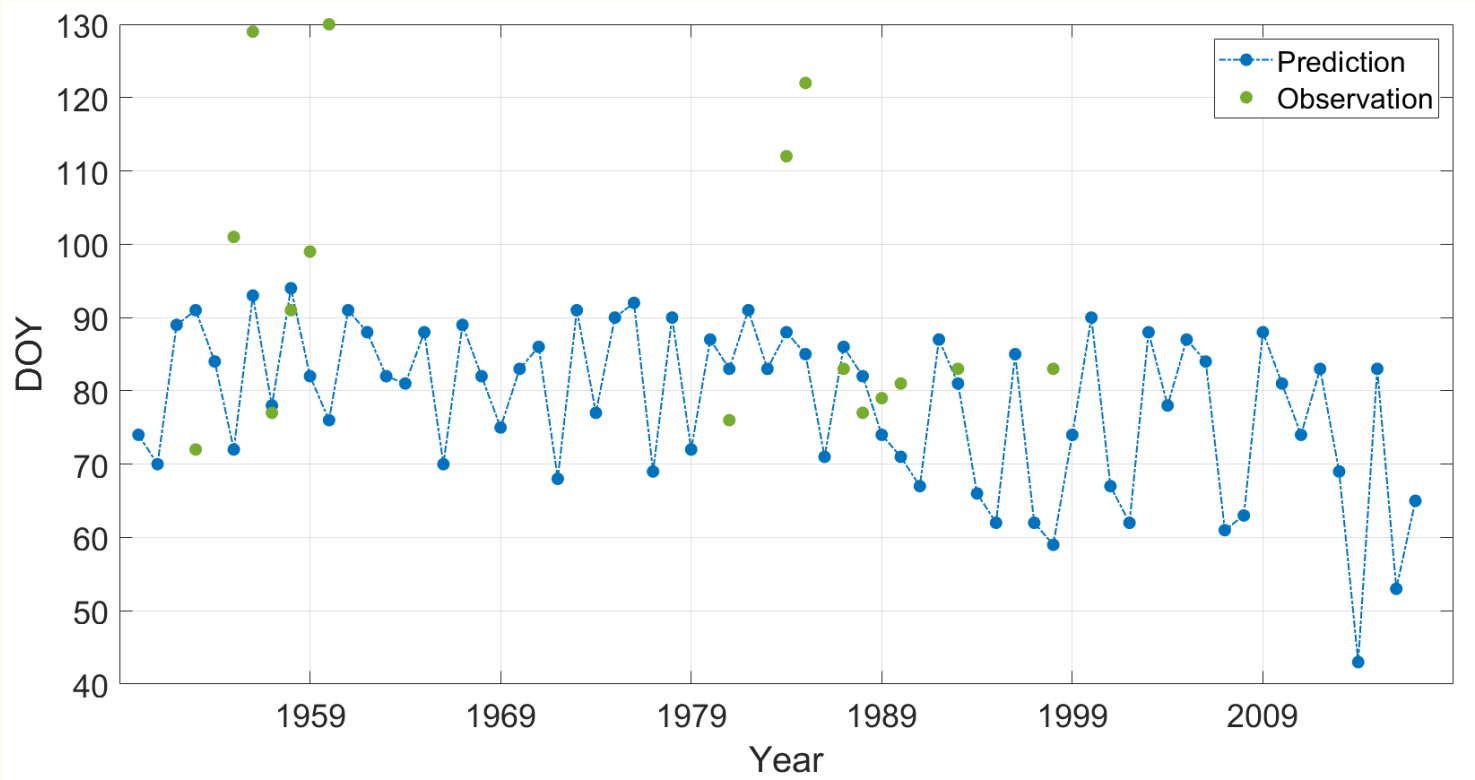




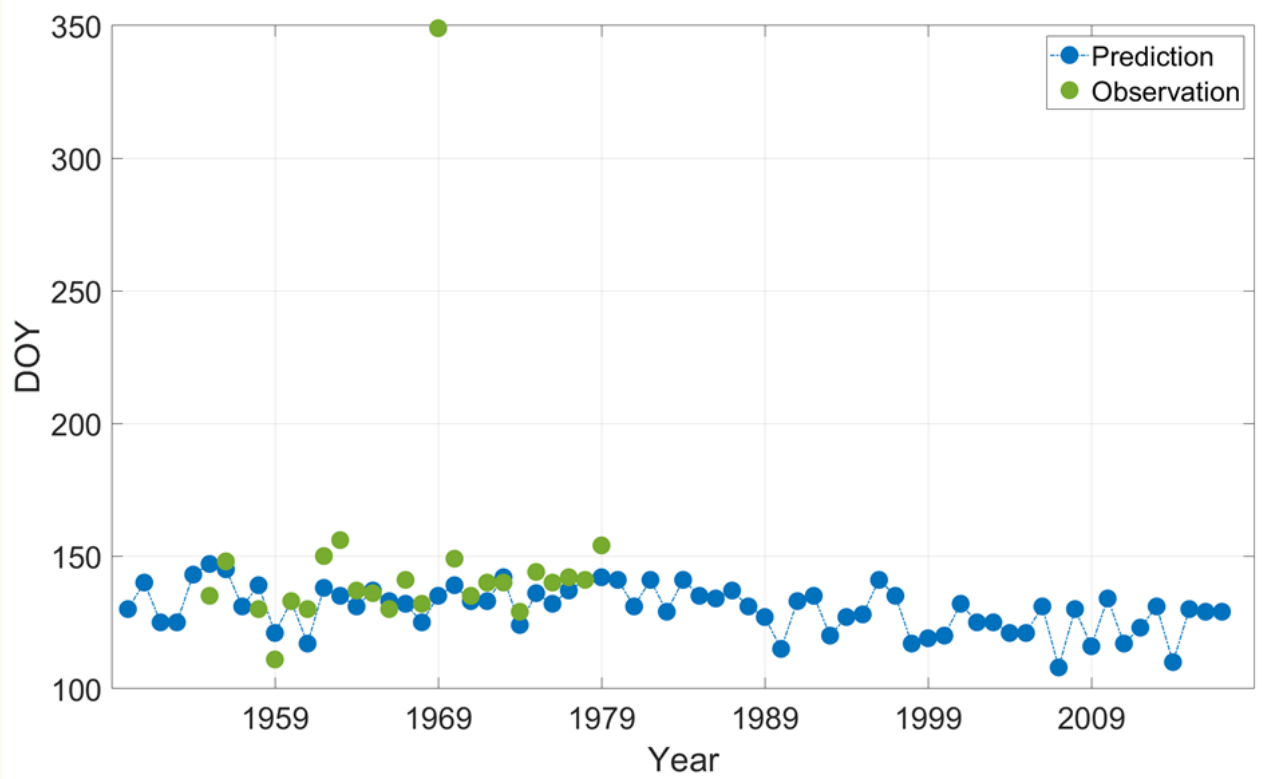
Leaf 1953: station 20449



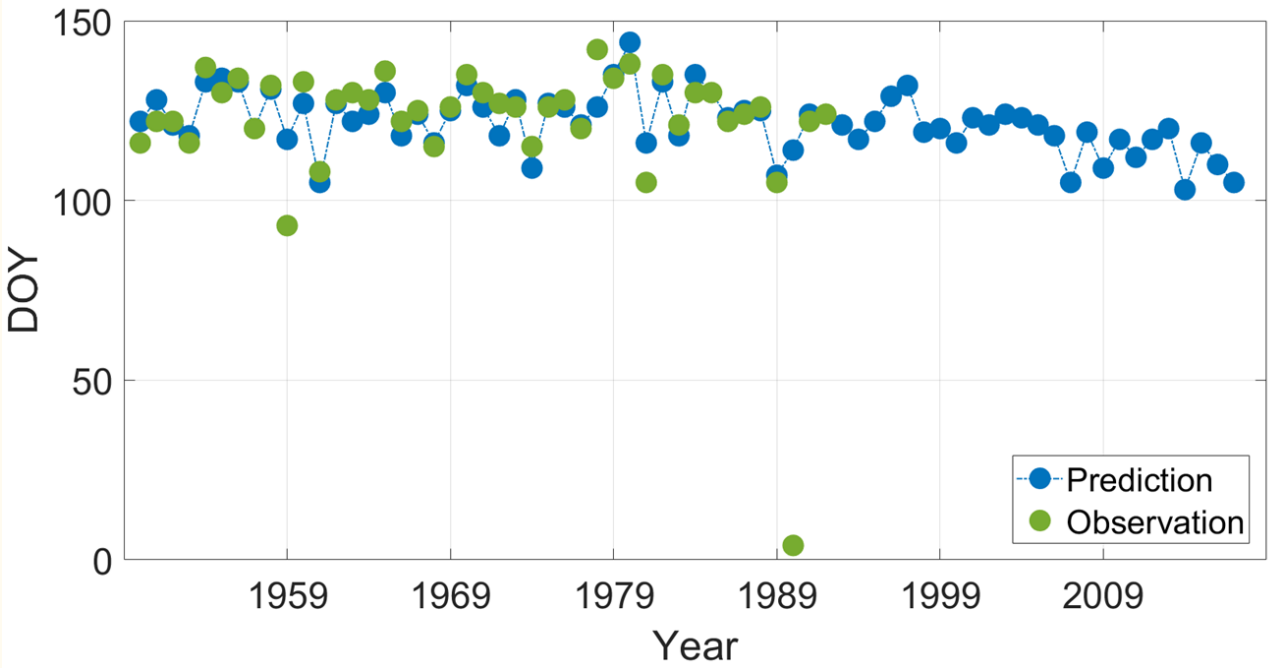
Leaf: station 20449



Bloom: station 837

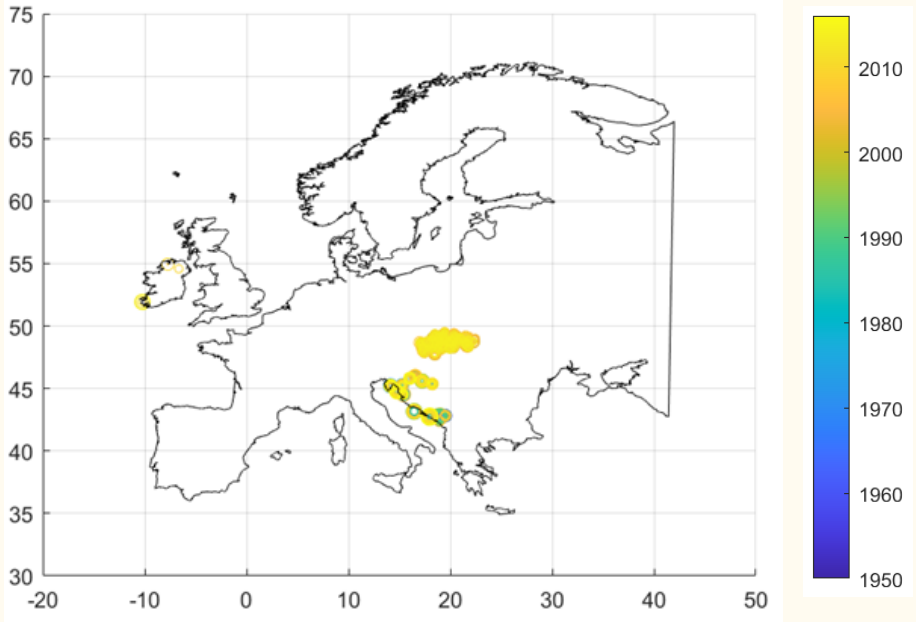


Bloom: station 6674

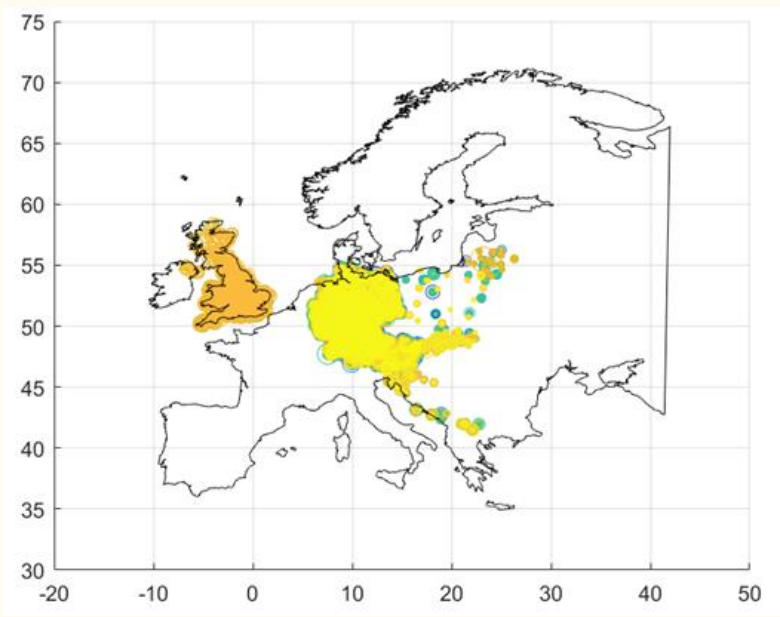


Differences over Europe considering time

Leaf index

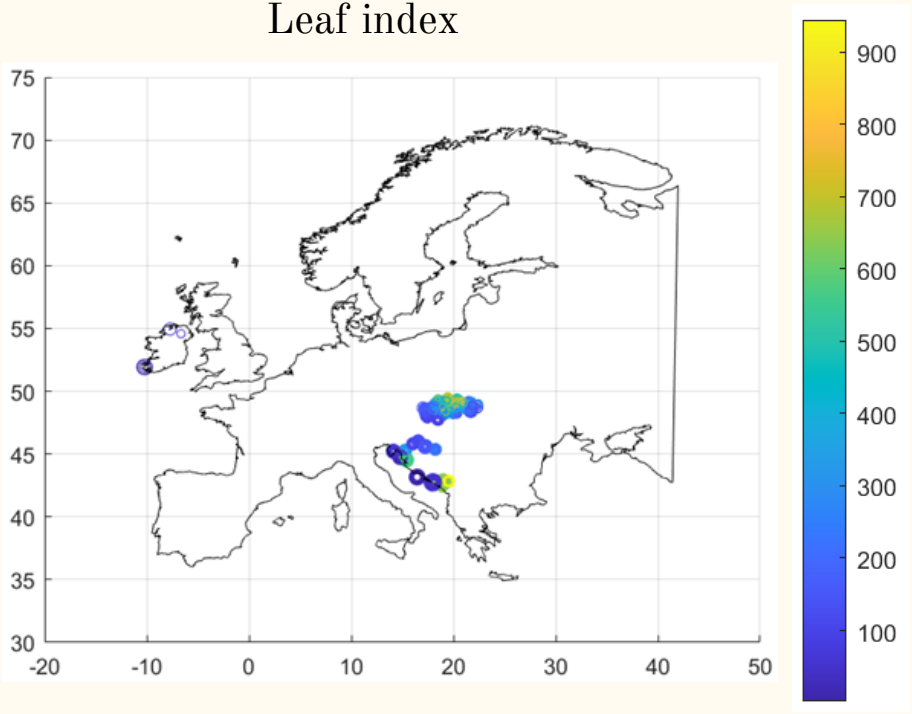


Bloom index

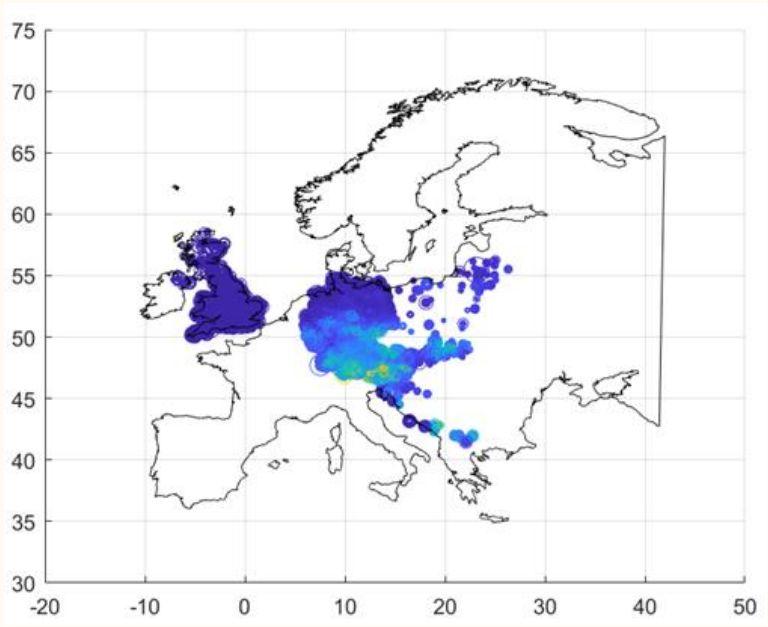


Differences over Europe considering elevation

Leaf index



Bloom index



Conclusions

Recalibration is not required, coefficients (in Leaf and Bloom indices) do not change.

First phenology gridded products at 1 km spatial resolution over Europe.

There is a bias, not related with the elevation, year or station.

The predictions have a lower standard deviation than the observations.

Projection and scale are fundamental, very small changes can affect the results.

Thank you for your attention.

—