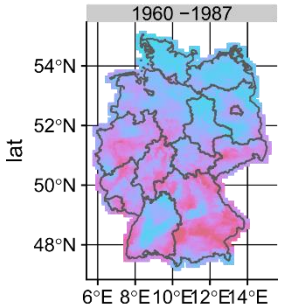
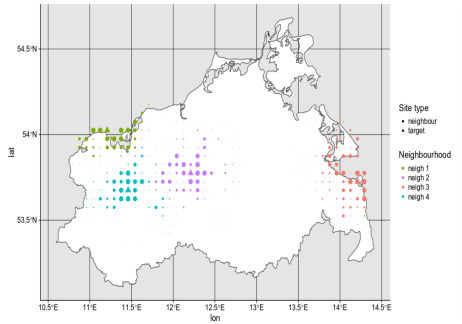
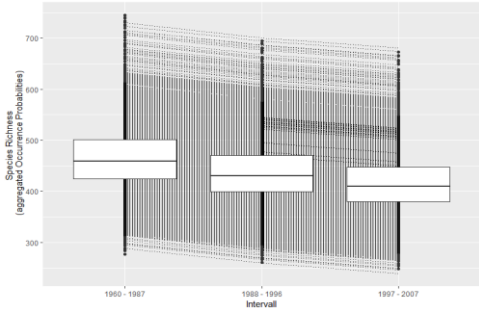


Advances in plant trend analyses

sMon – Analyzing trends in German biodiveristy data



Workshop 3rd – 7th December 2018
iDiv - Leipzig



Data source:

Plant occurrence records (i.e. presence only data) from different sources:

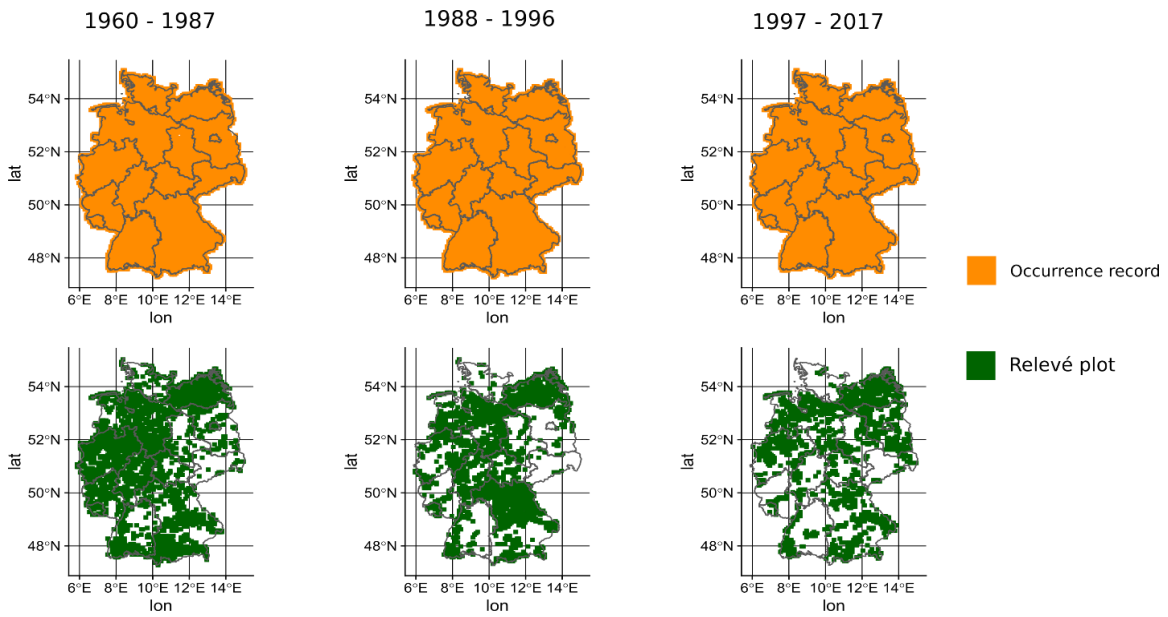
FlorKart Database (BfN)

Occurrence records from federal states

Occurrence records deduced from plant relevées

approx. **28 Mio** occurrence records from 1960 - 2017

Standardized taxonomy

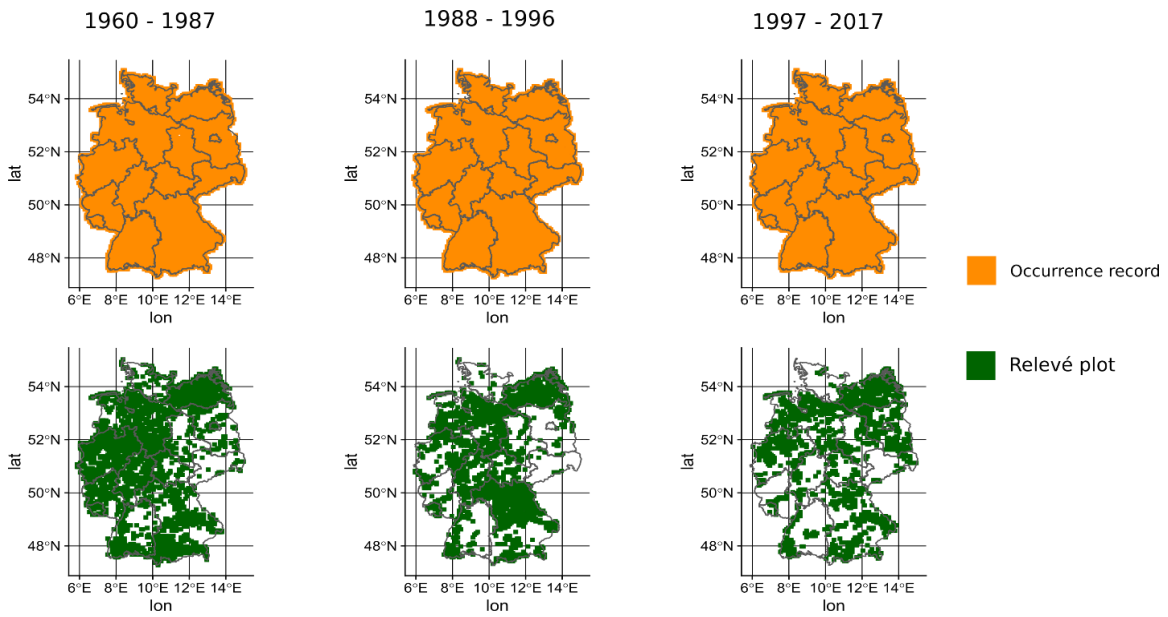


Deduction of trends:

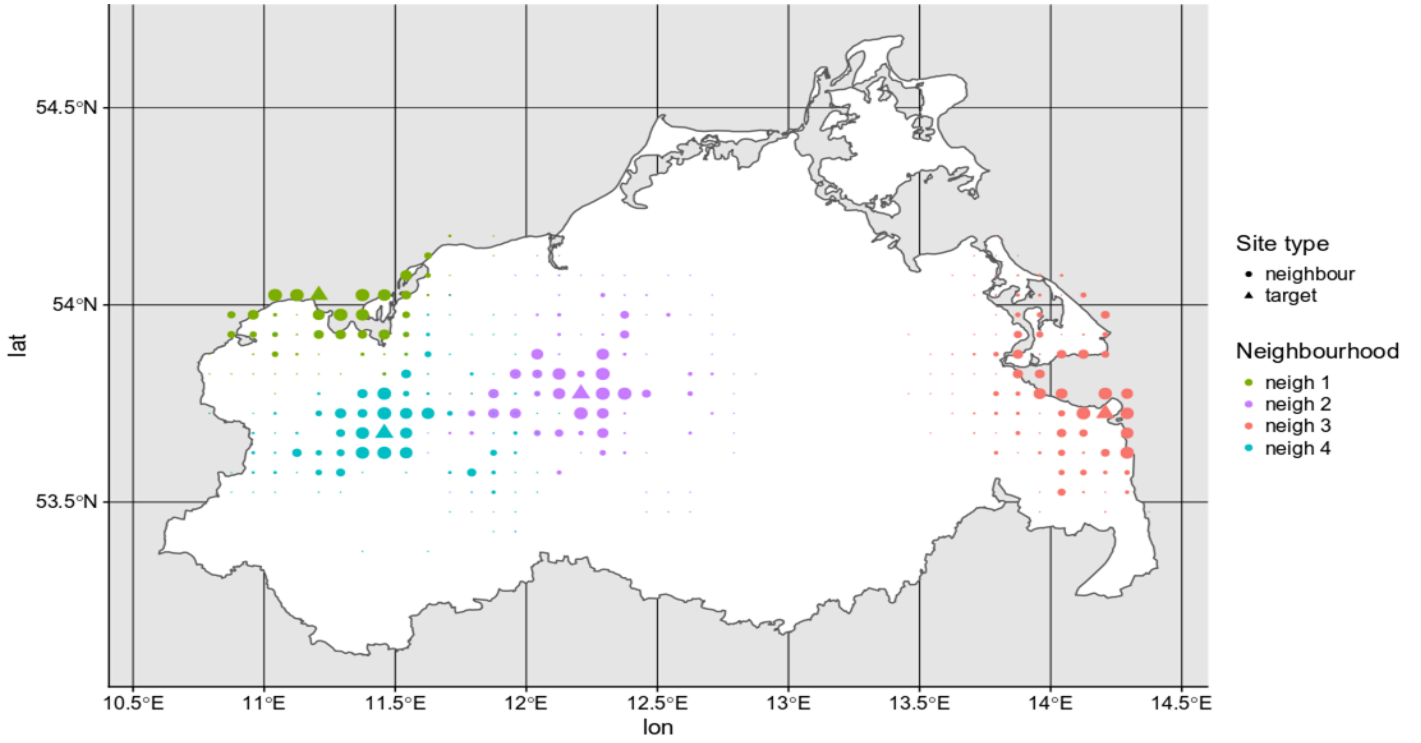
FreScaLo Algorithm (Hill 2012)

Correction for observer bias through neighbourhood occurrences.

Calculation of **„probaility of being present“** of *species i* at *location j* and *time t*



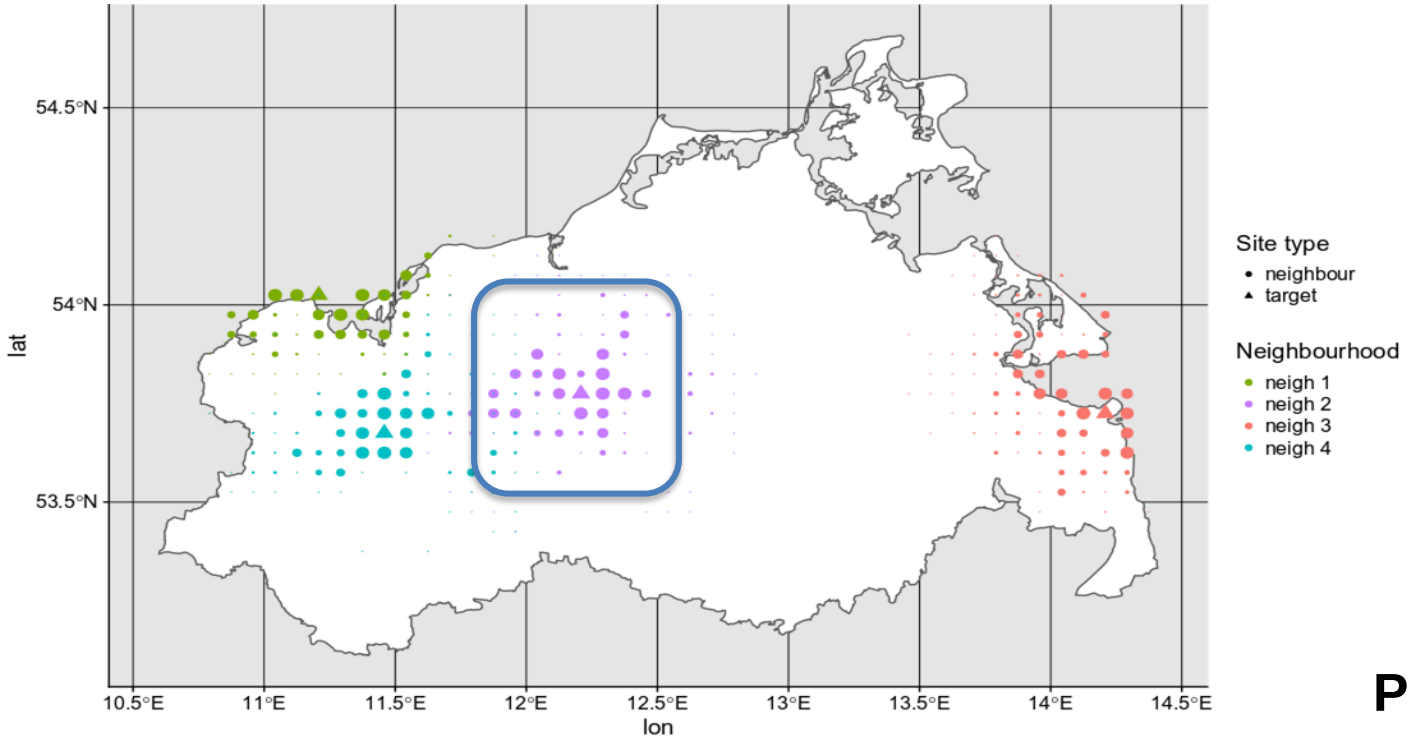
FreScaLo Algorithm (Hill 2012)



Ecological similarity of a region

- edaphic
- climatic
- topographic

FreScaLo Algorithm (Hill 2012)



Proportion of species i being present in the neighbourhood of site j

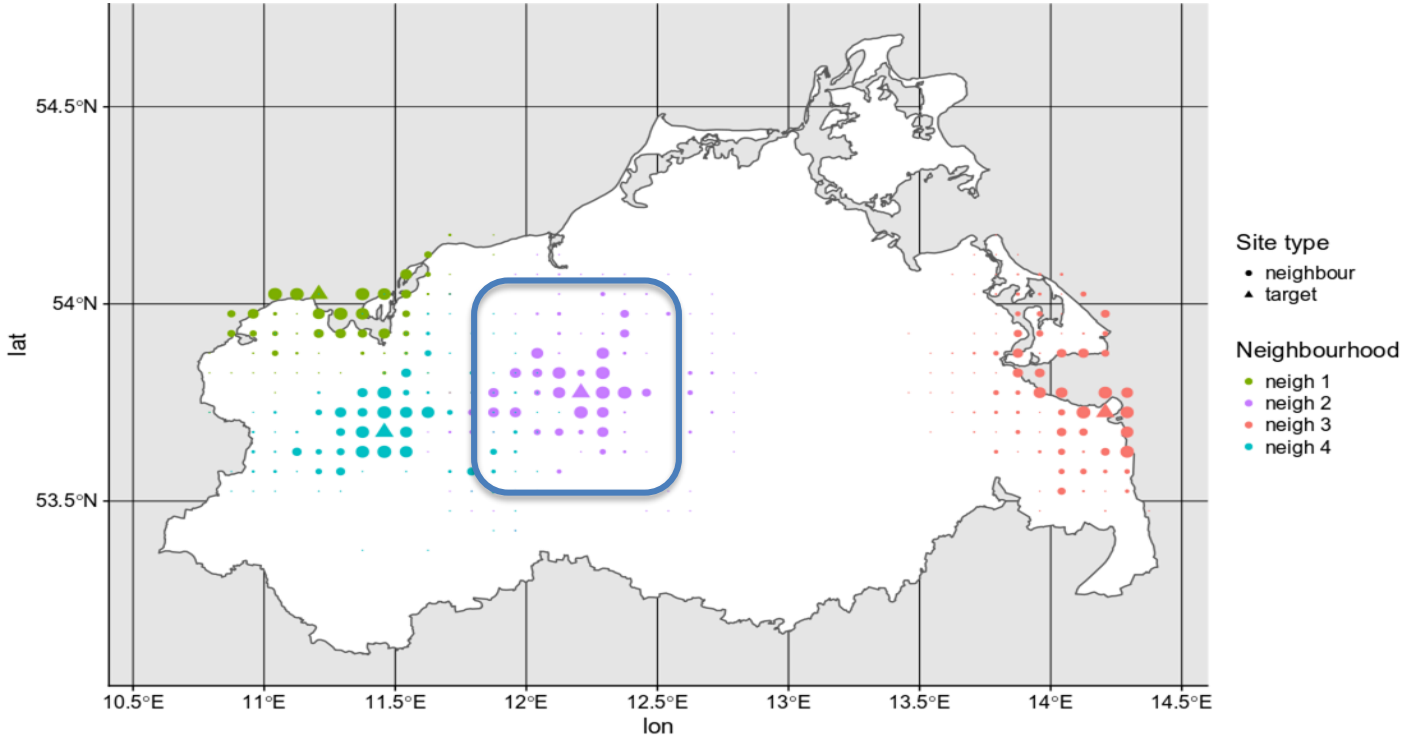
Ecological similarity of neighbouring sites

Distances of neighbouring sites

Probability of being present in site j

FreScaLo Algorithm (Hill 2012)

Probability of being present in site j



Number of characteristic (i.e. most frequent) species in the neighbourhoods

-> „Wants list“ of so-called benchmark-species

Proportion of number of benchmark specs found in site j

Measure of sampling effort

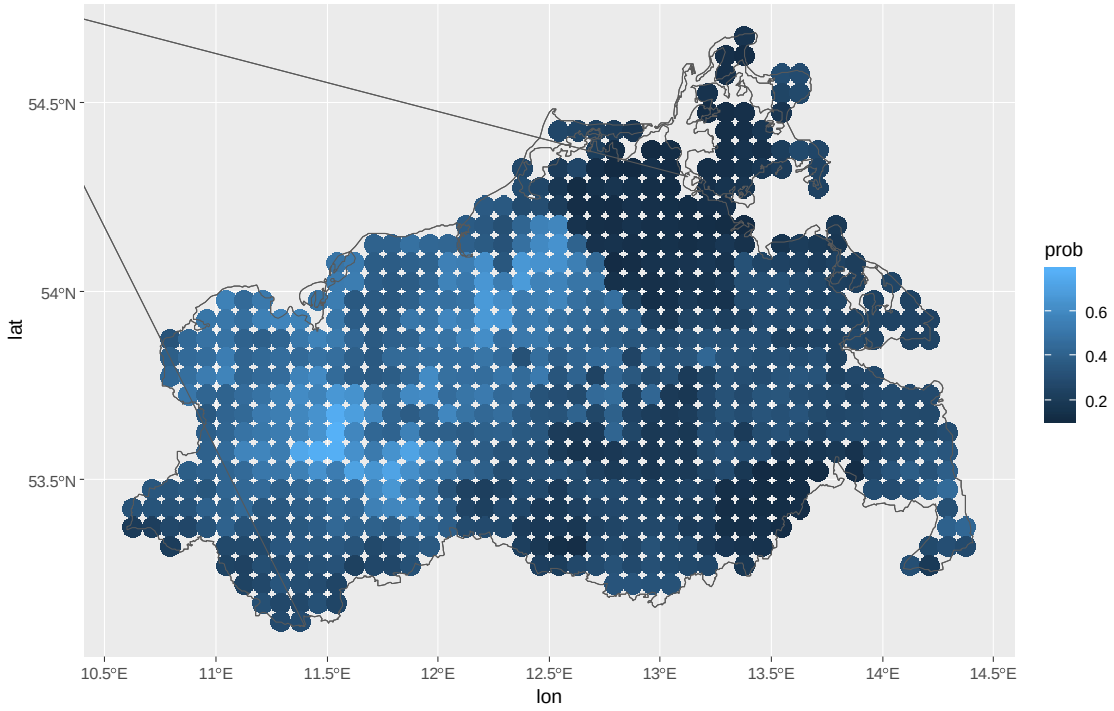
FreScaLo Algorithm (Hill 2012)

Proportion of species i being present in the neighbourhood of site j

Proportion of number of benchmark specs found in site j

Probability of being present in site j

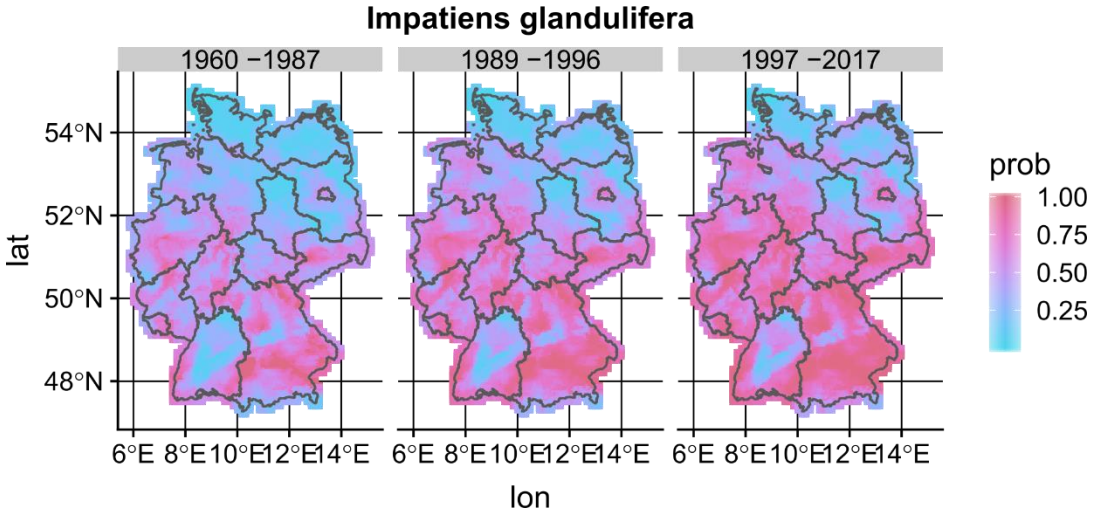
Probability of *species i* being present at *site j*

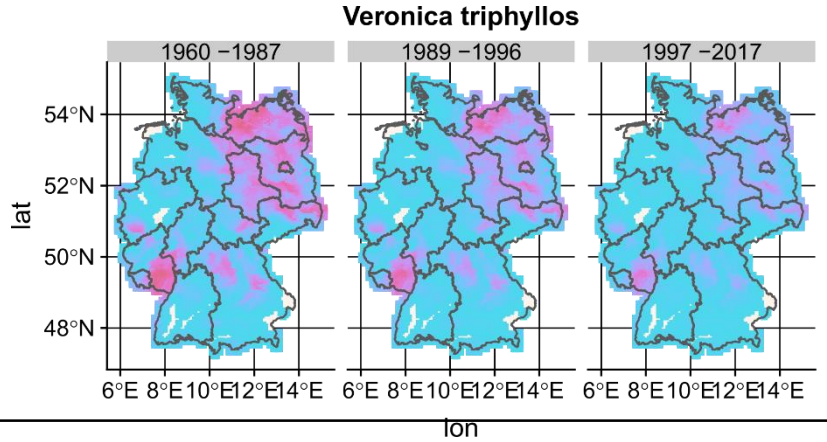


Scales between 0 and 1 (percentage)

Computed for all time *steps t*

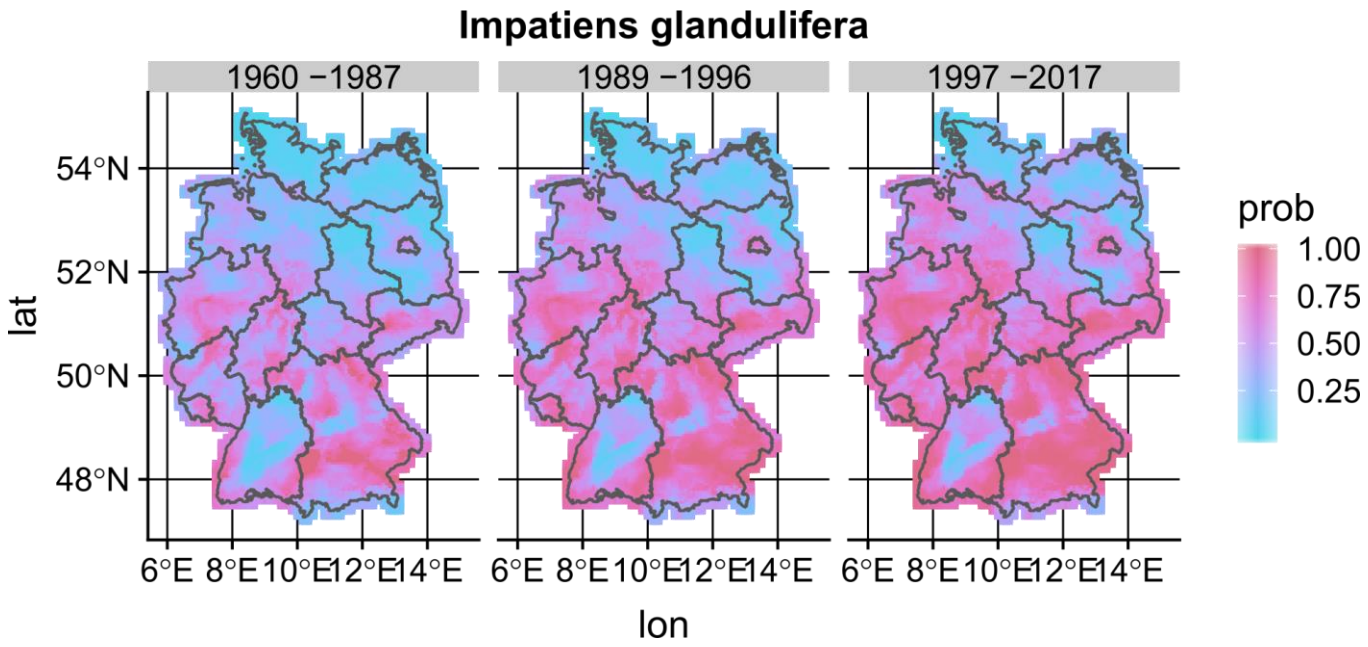
Probability of *species i* being present at *site j*





prob
0.75
0.50
0.25

Probability of *species i* being present at *site j*



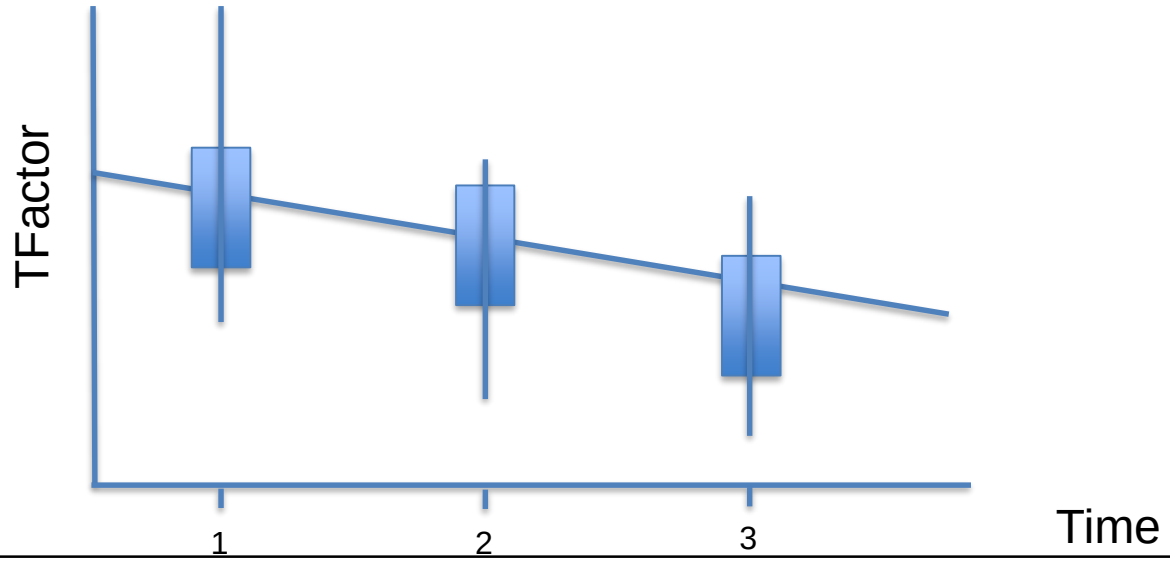
Spatial autocorrelation!

Across time?!??!

FreScaLo Algorithm (Hill 2012)

Calculation of the TFactor:

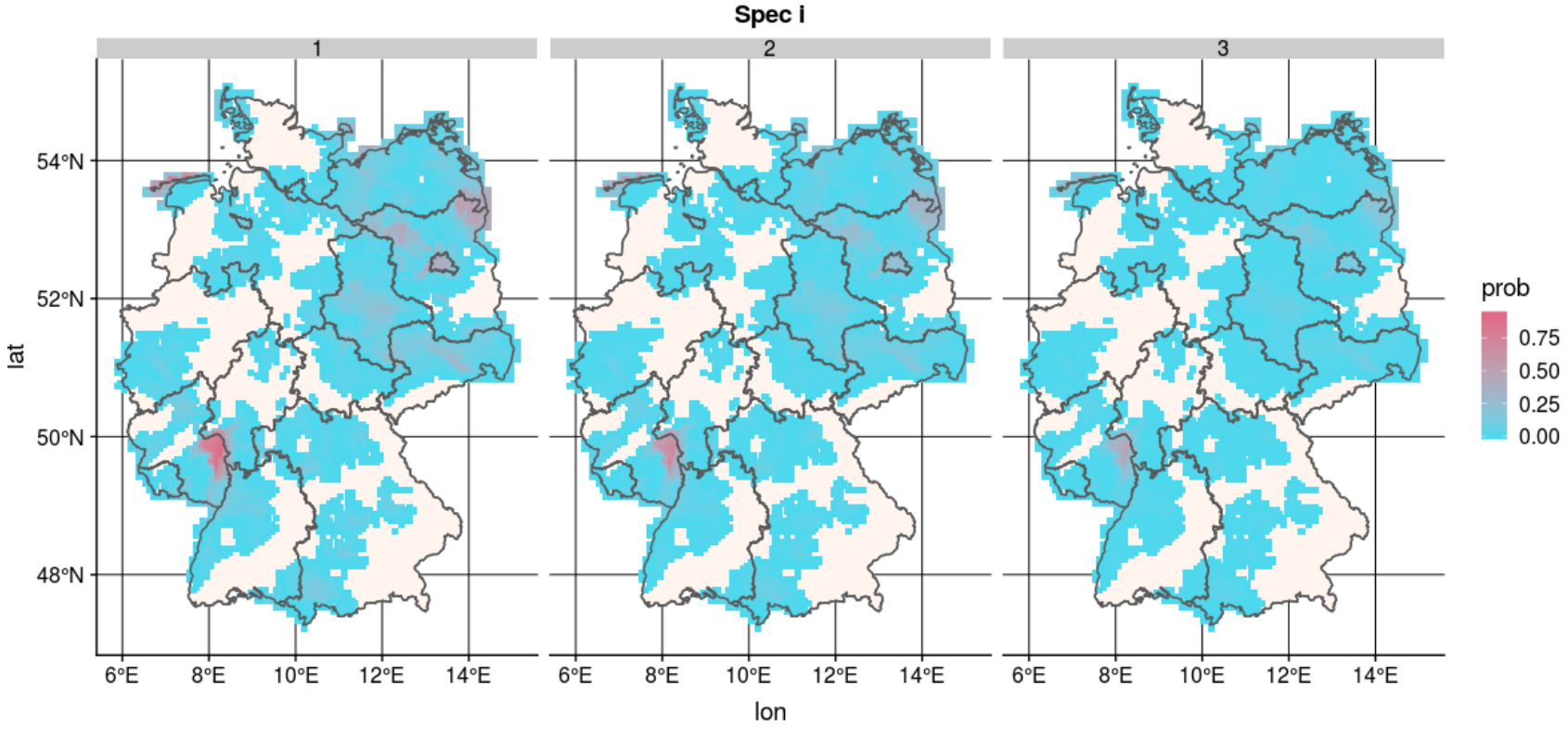
The estimated frequecy of species j at time t



Linear Model

$$y = x*b + a + e$$

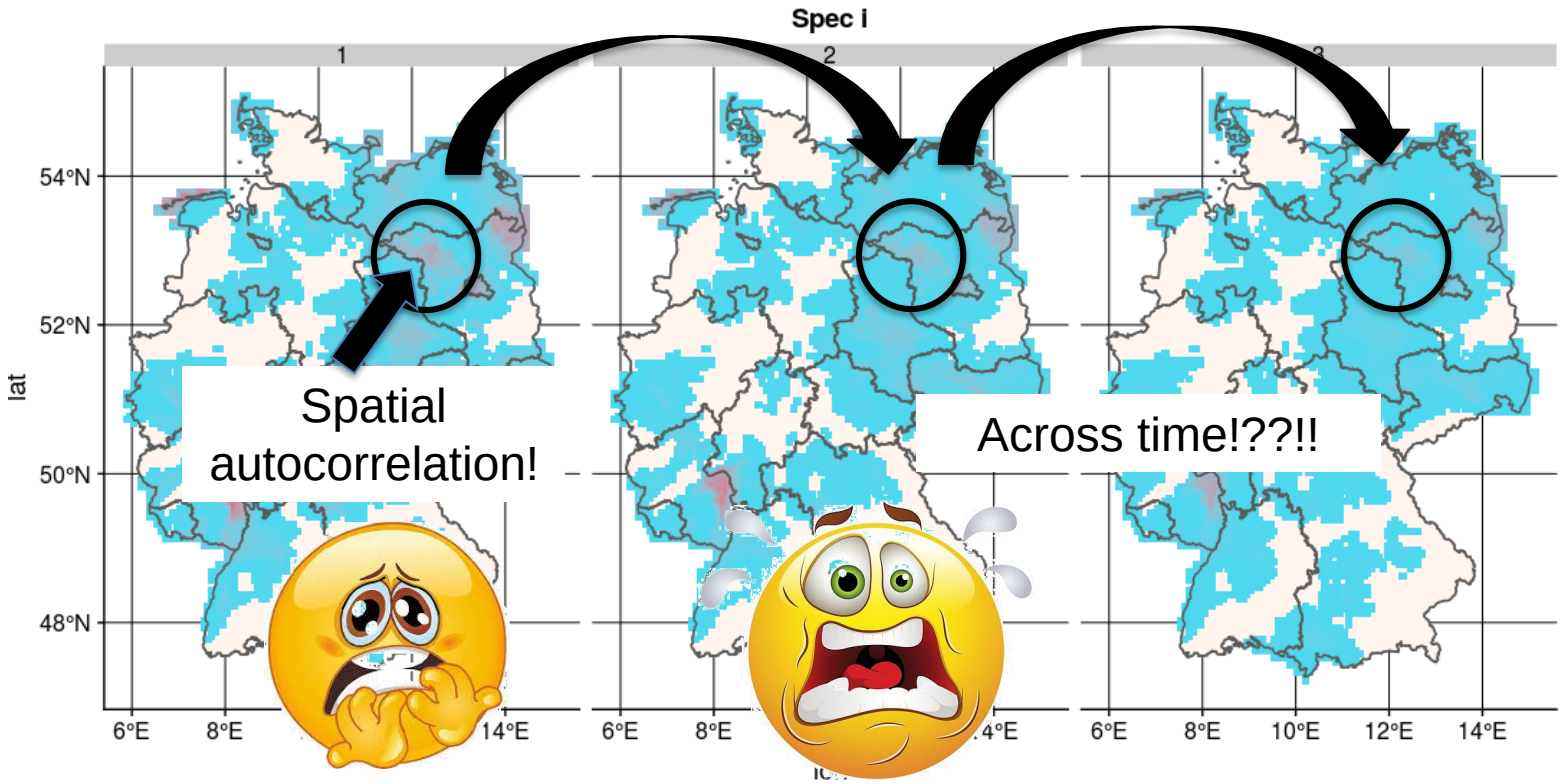
FreScaLo Algorithm (Hill 2012)



What about all this precious data?

What about all this precious data?

Complicated!



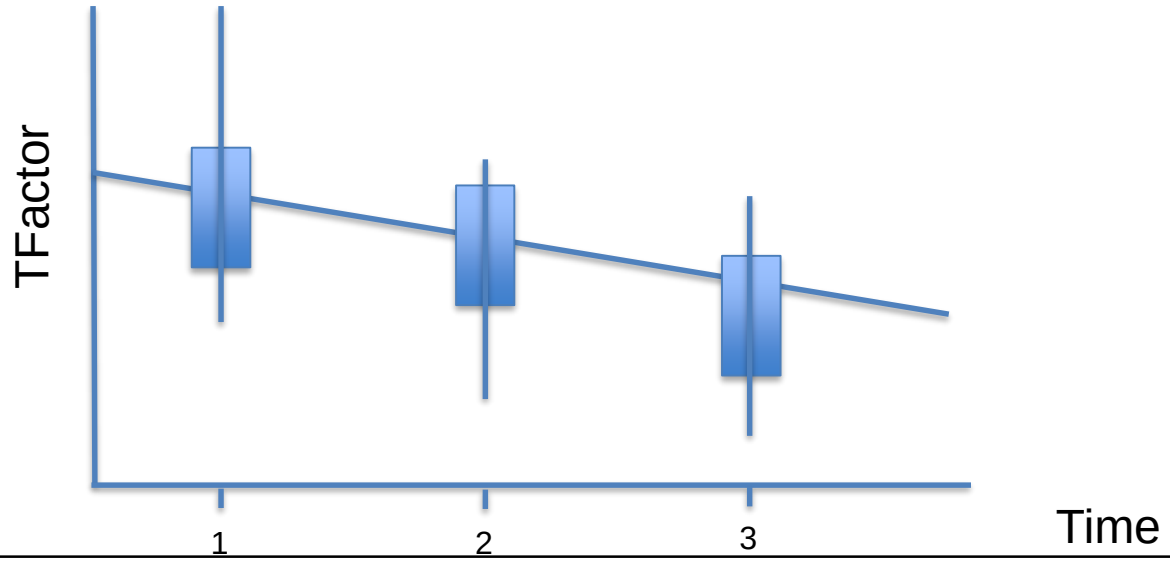
0 – 1
?!?????!!!!

Bugger!!

FreScaLo Algorithm (Hill 2012)

Calculation of the TFactor:

The estimated frequecy of species j at time t



Linear Model

y= x*b + a + e

Spatial autocorrelation

Temporal autocorrela

0 – 1?

INLA is my Friend!!!!

E approach

ped

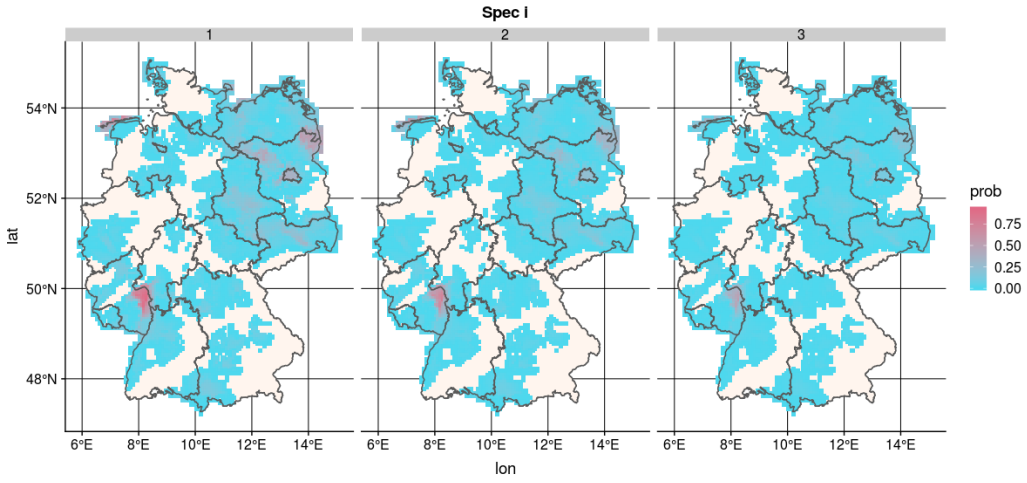
th autoregressive component!

d heaps of beautiful probability density

ons!

Among them:
Beta distribution (0-1)

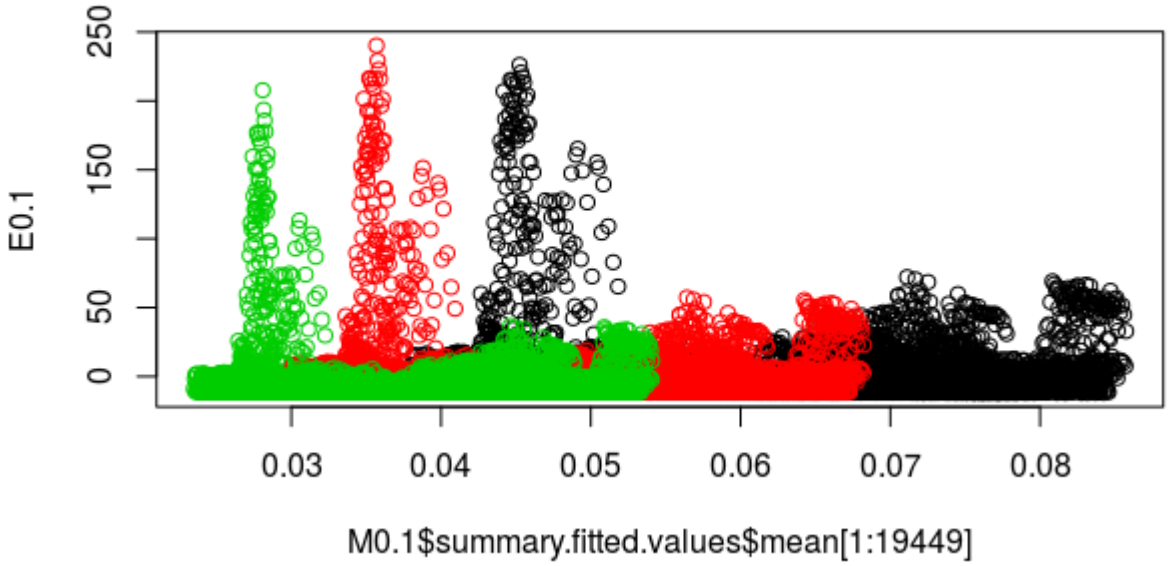
Integrated Nested Lapla e Approximation!



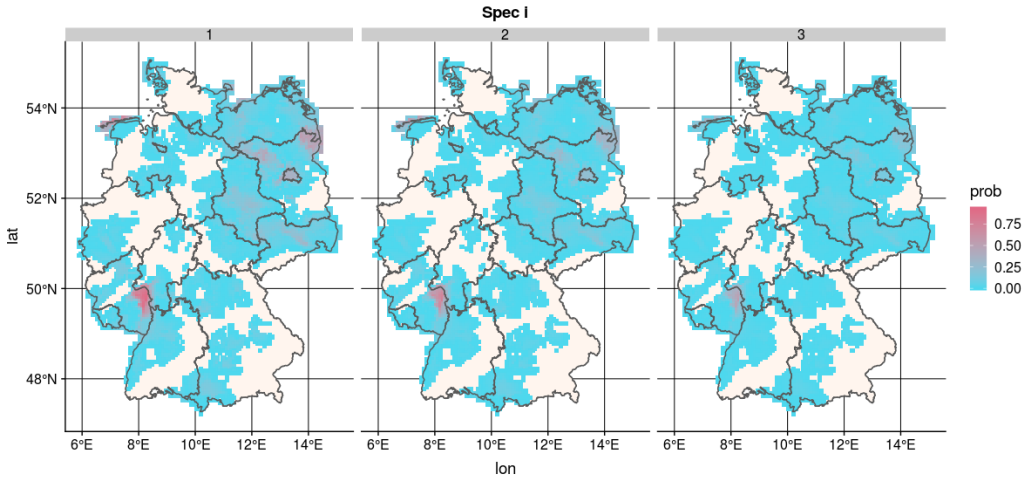
Model with timestep and coordinates

Check the residuals

v.s. fitted



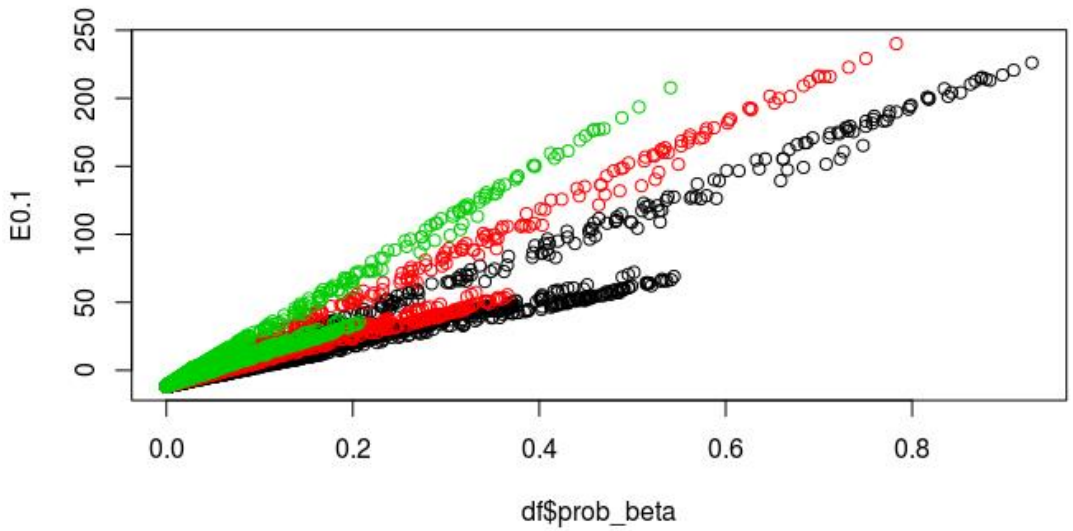
Cols= Timesteps!



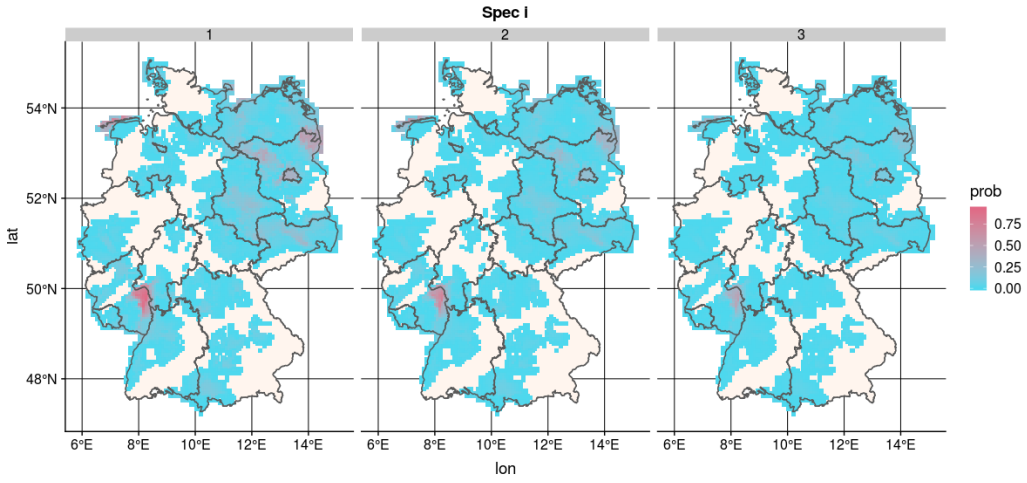
Model with timestep and coordinates

Check the residuals

v.s. response



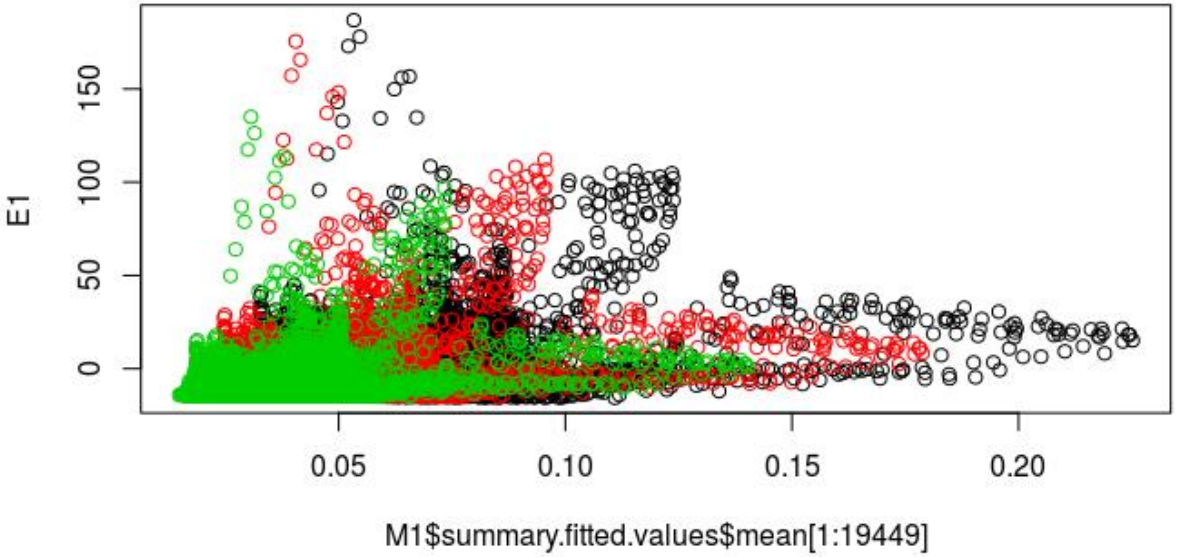
Cols= Timesteps!



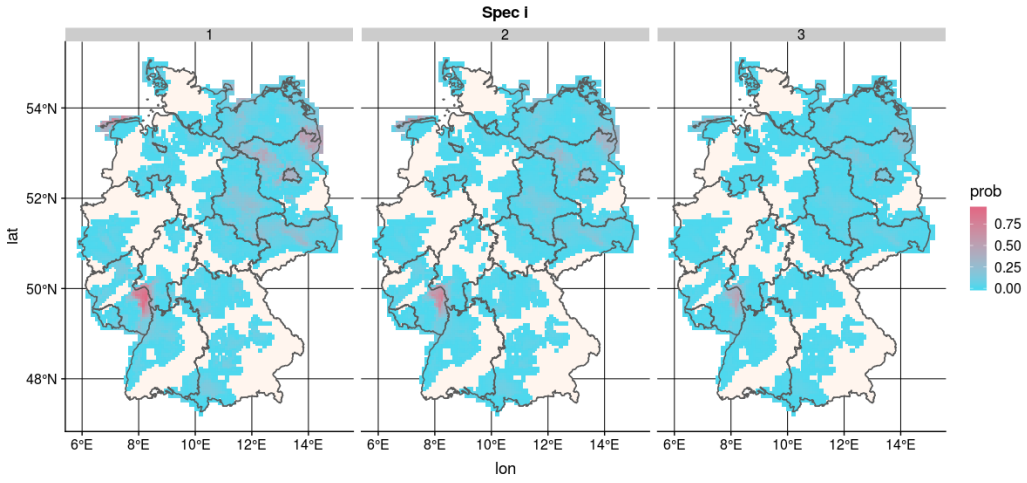
Model with timestep and coordinates;
Including spatial random term (i.e. latent process)

Check the residuals

v.s. fitted



Cols= Timesteps!

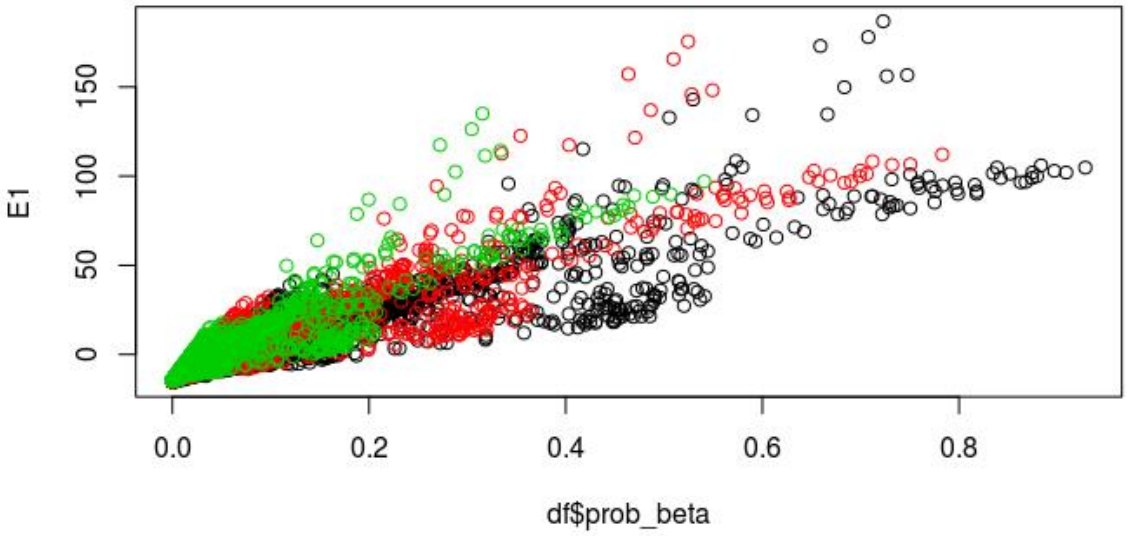


Model with timestep and coordinates;

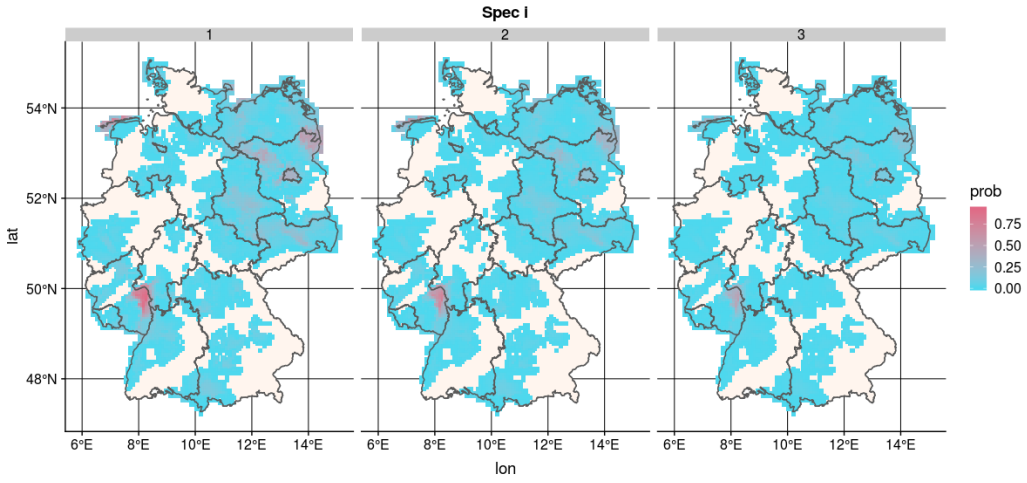
Including spatial random term (i.e. latent process)

Check the residuals

v.s. response



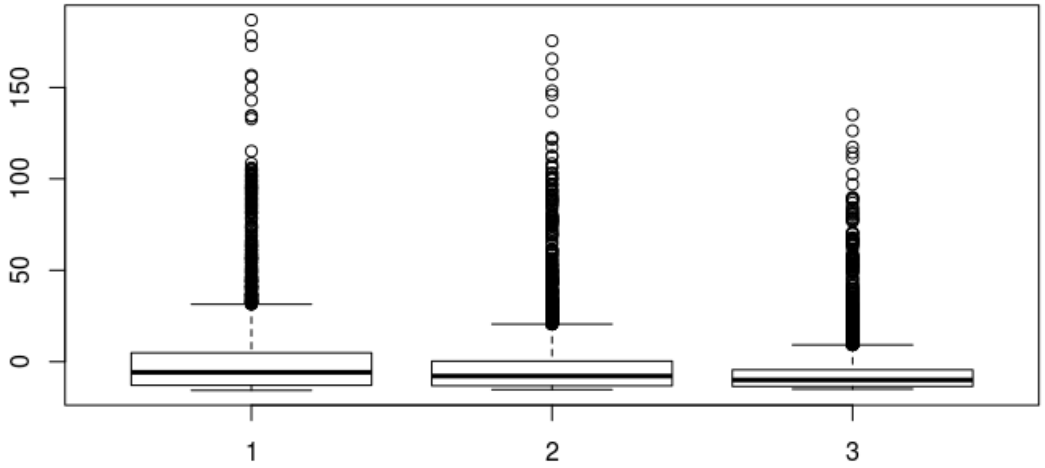
Cols= Timesteps!



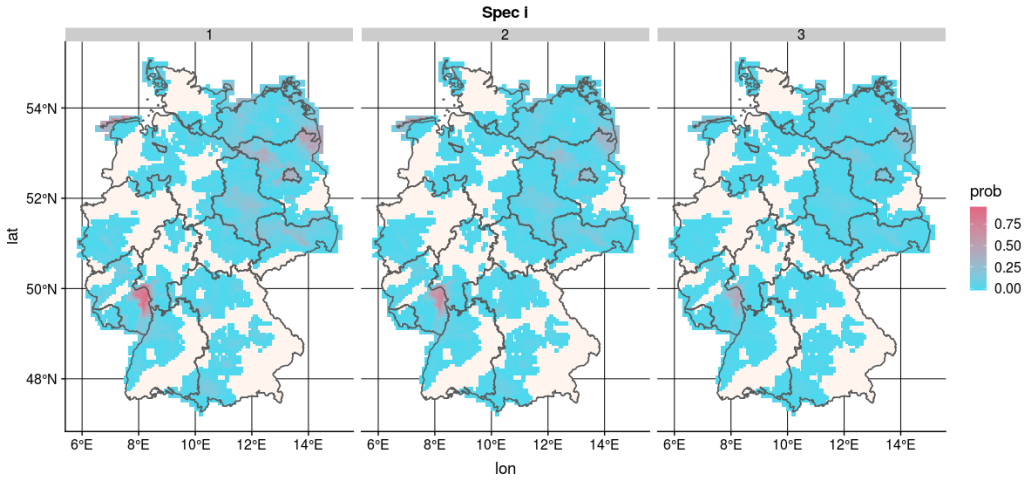
Model with timestep and coordinates;
Including spatial random term (i.e. latent process)

Check the residuals

v.s. timestep (predictor)



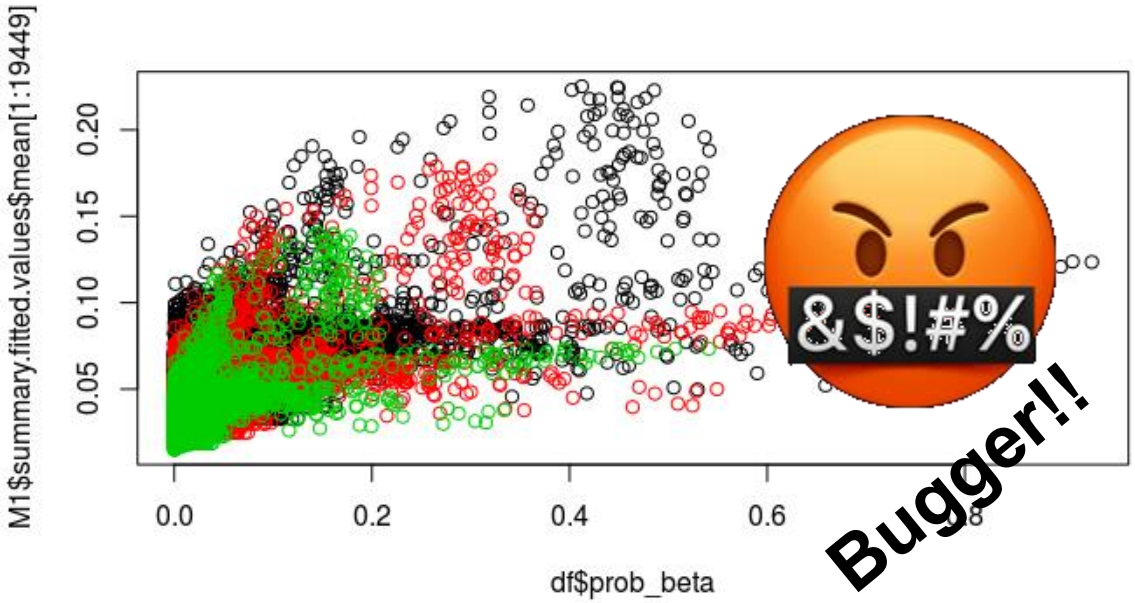
Cols= Timesteps!



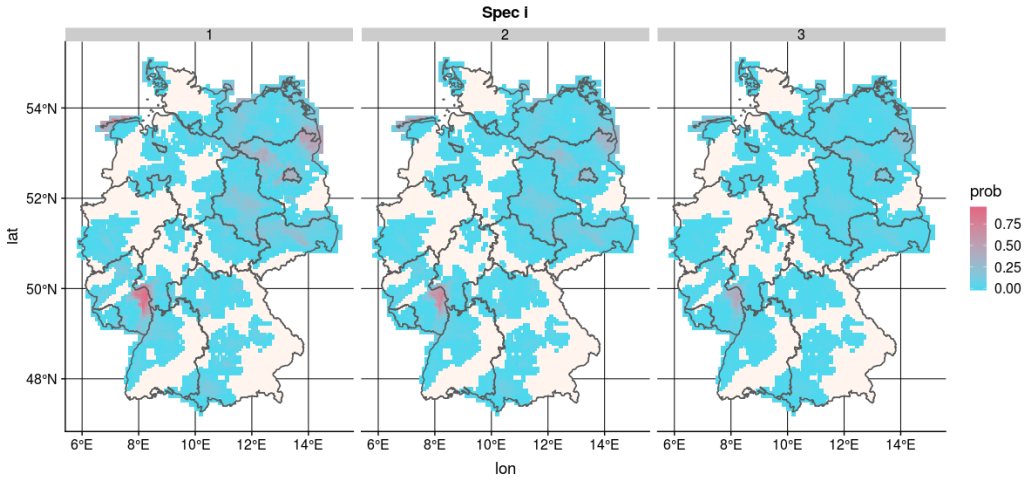
Model with timestep and coordinates;
Including spatial random term (i.e. latent process)

Check the **predictions**

v.s. **response**



Cols= Timesteps!

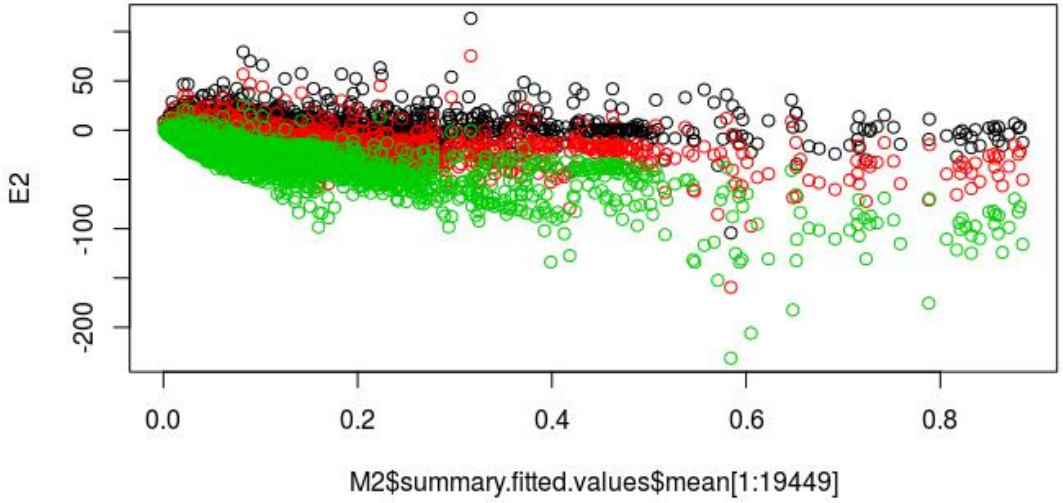


Model with timestep and coordinates;
Including spatial random term (i.e. latent process)

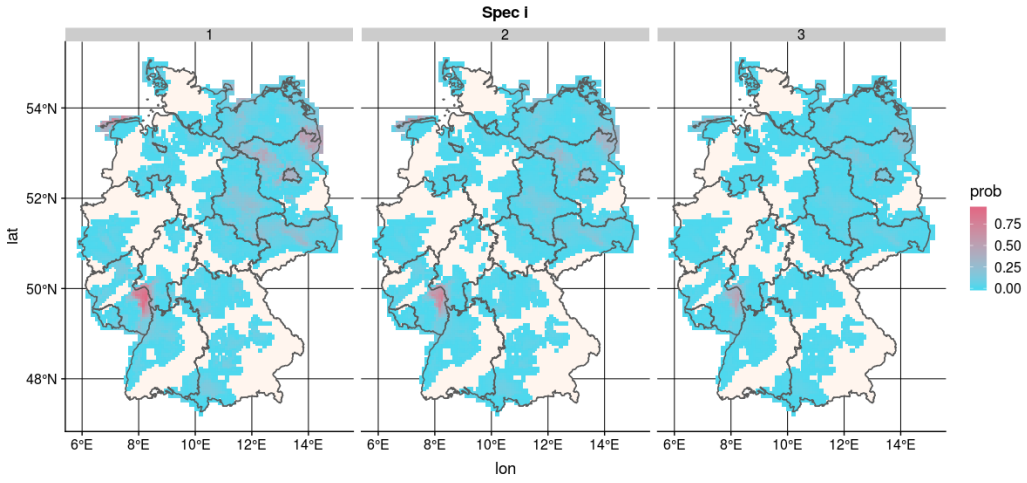
For each time step

Check the residuals

v.s. fitted



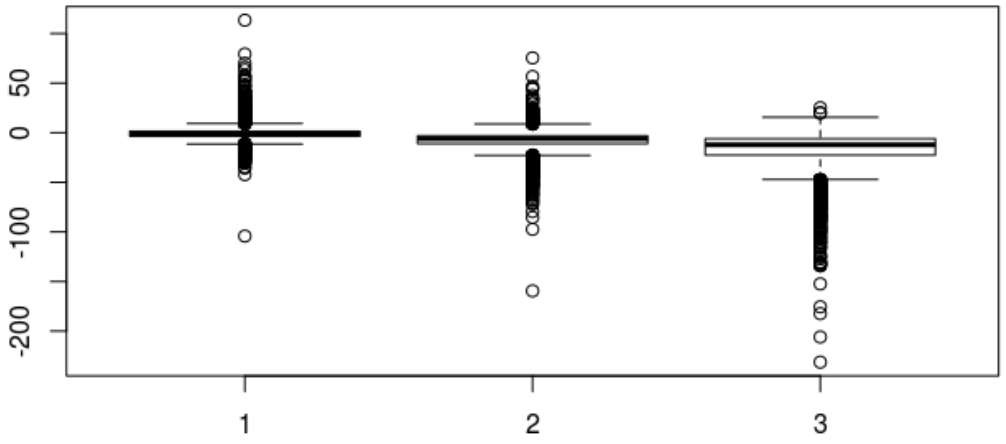
Cols= Timesteps!



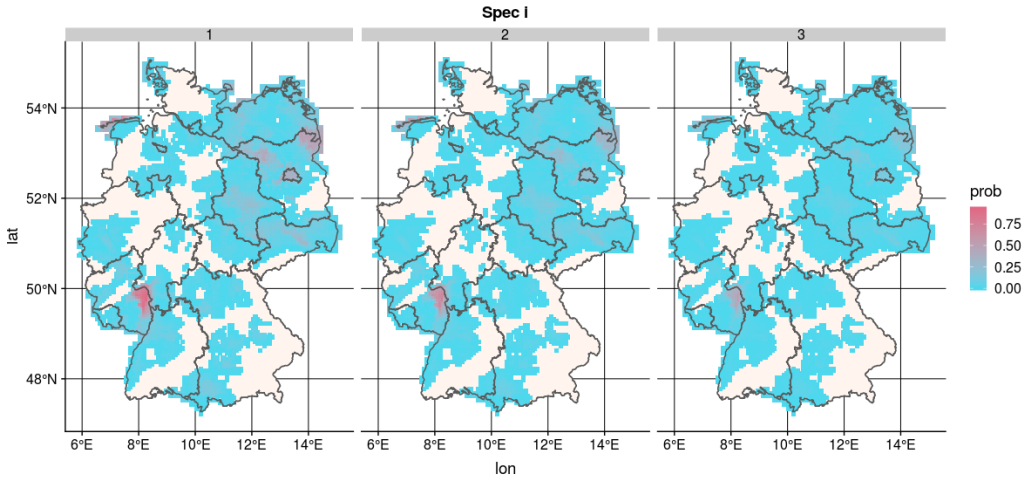
Model with timestep and coordinates;
Including spatial random term (i.e. latent process)
For each time step

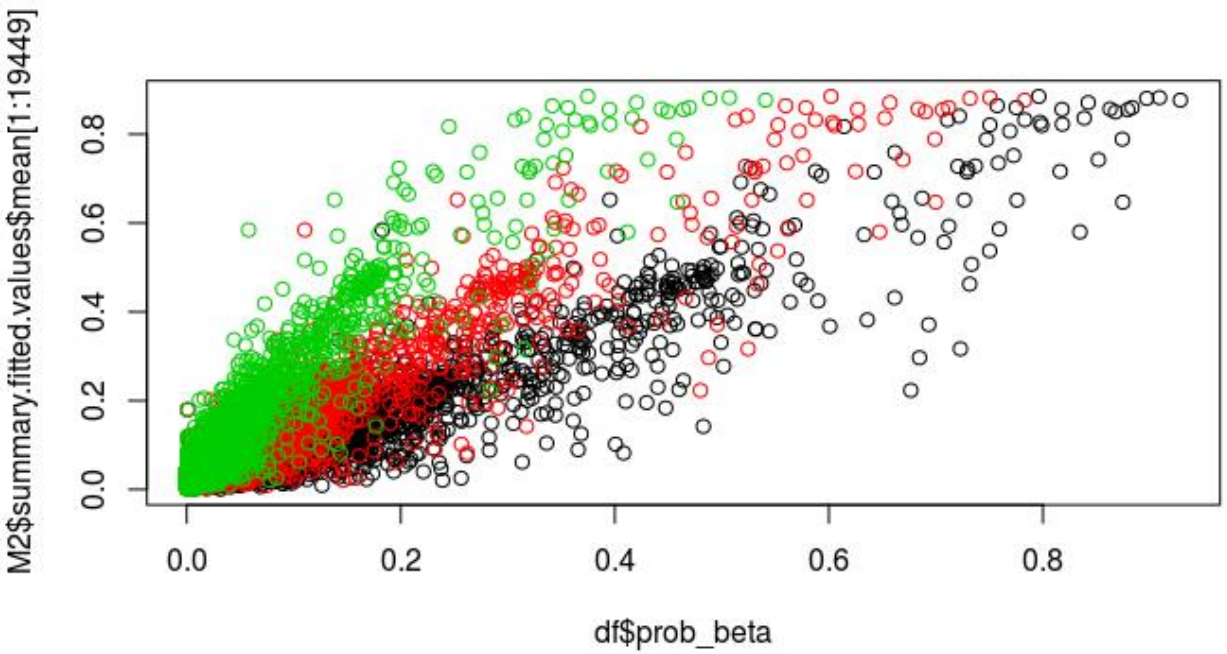
Check the residuals

v.s. Timestep (predictor)



Cols= Timesteps!





Model with timestep and coordinates;
Including spatial random term (i.e. latent process)
For each time step

Check the **predictions**

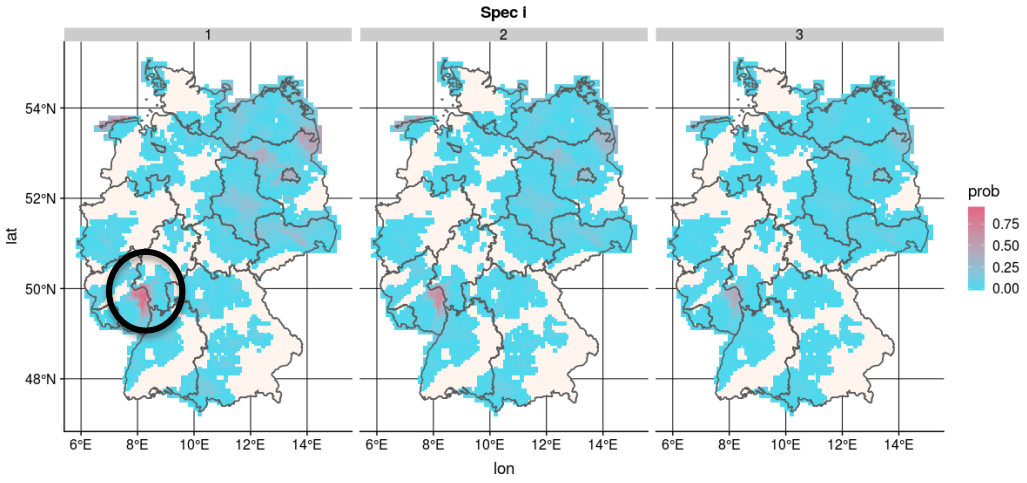
v.s. **response**

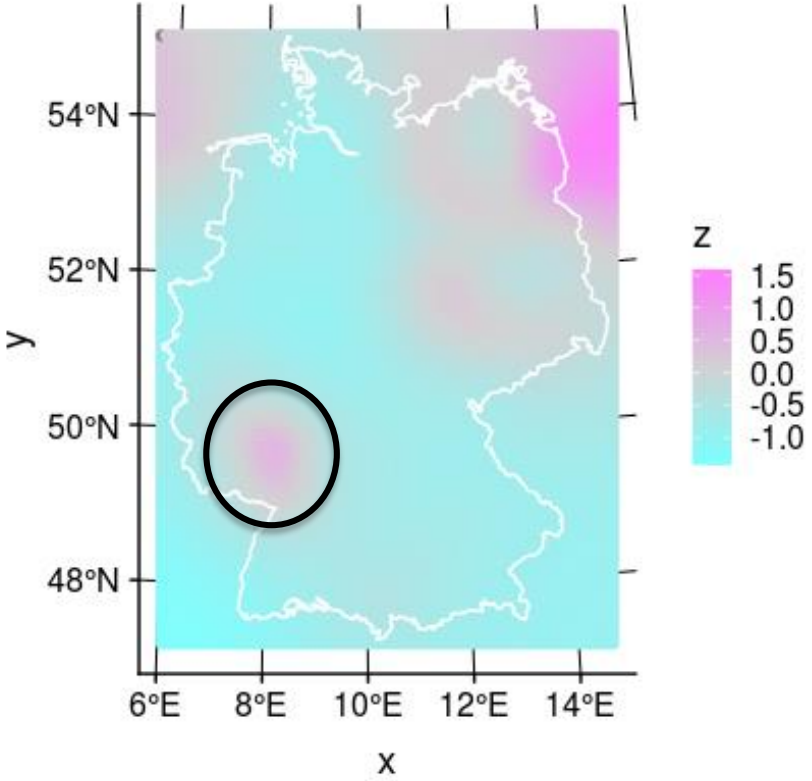
Cols= Timesteps!

Model comparison	AIC
Model with timestep and coordinates	-91636.01
Model with timestep and coordinates; Including spatial random term (i.e. latent process)	-96220.72
Model with timestep and coordinates; Including spatial random term (i.e. latent process) For each time step	-372525.12

The „latent process“ (i.e. spatial component in the model)

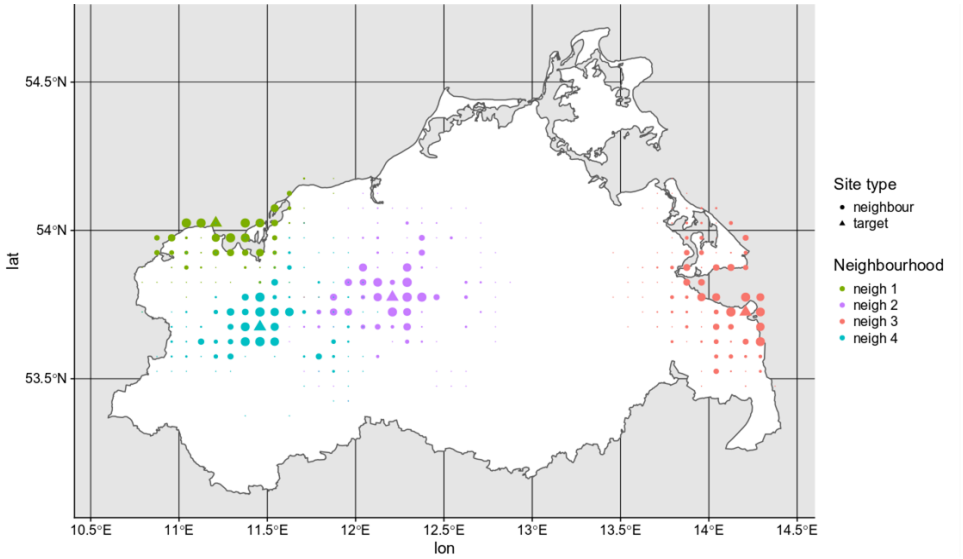
Model with timestep and coordinates;
Including spatial random term (i.e. latent process)

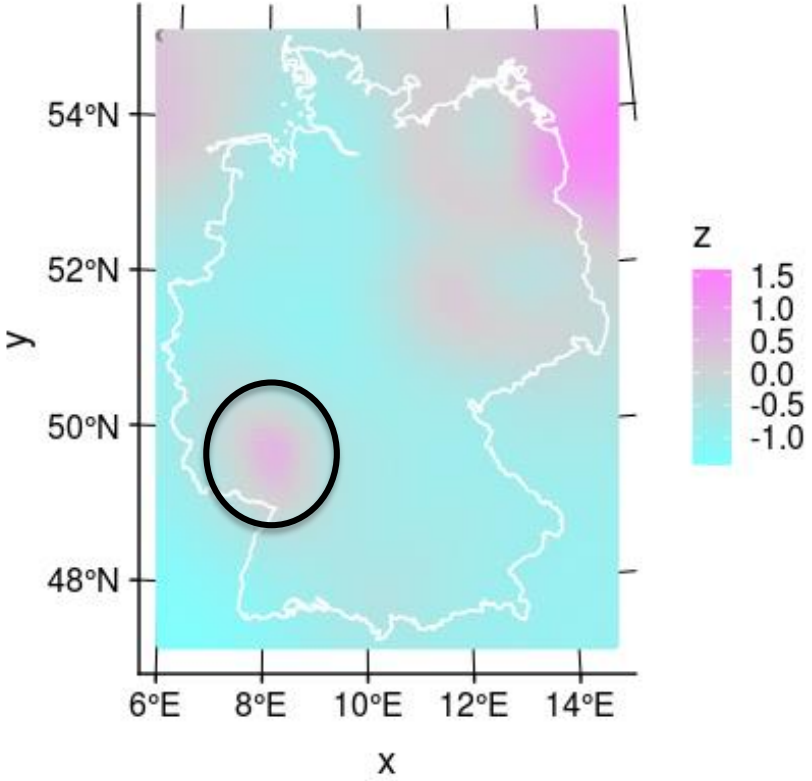




The „latent process“ (i.e. spatial component in the model)

Model with timestep and coordinates;
Including spatial random term (i.e. latent process)

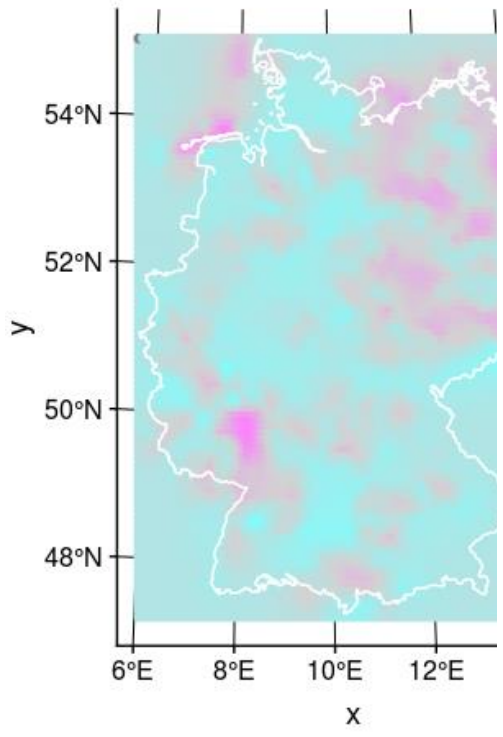


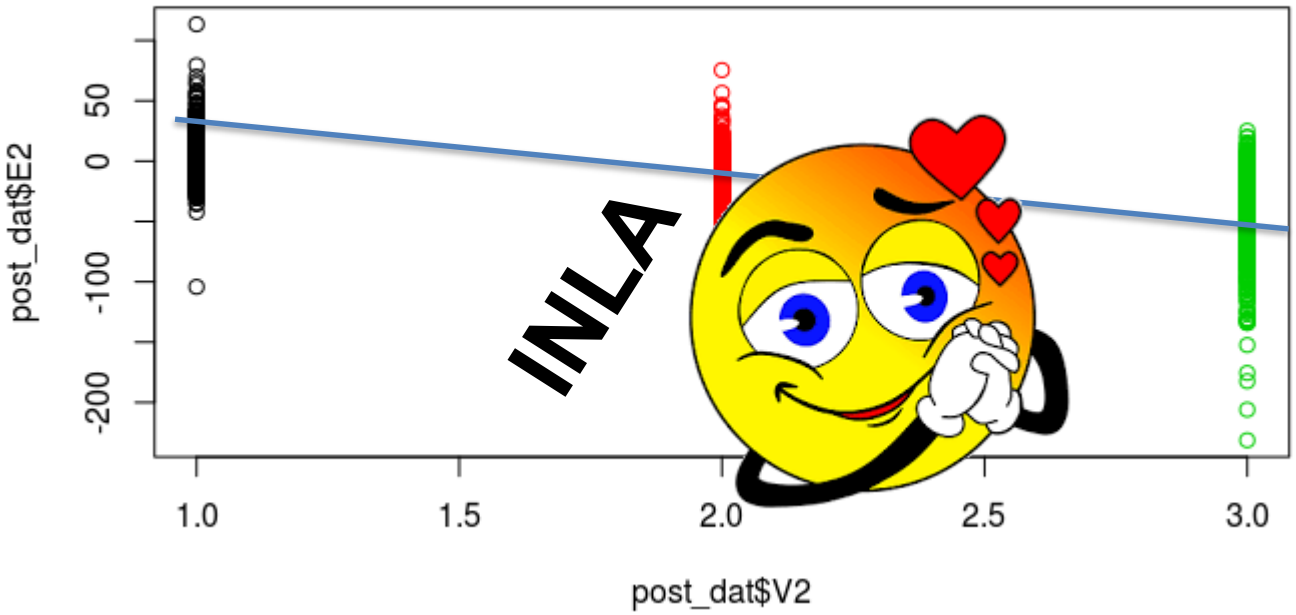


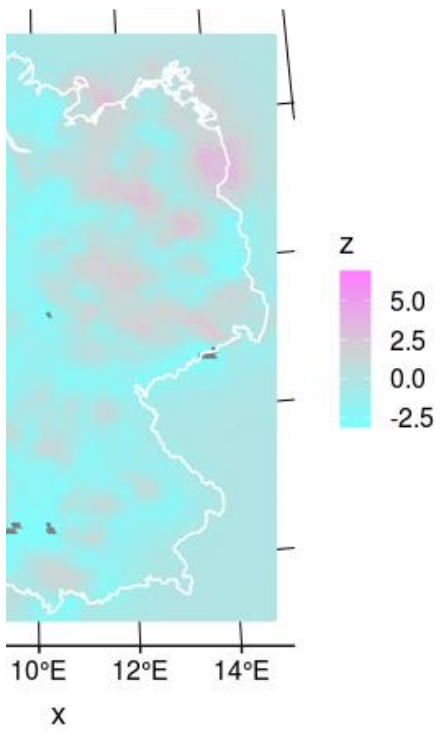
The „latent process“ (i.e. spatial component in the model)

Model with timestep and coordinates; Including spatial random term (i.e. latent process)
For each time ste

```
Fixed effects:
                mean     sd 0.025quant 0.5quant 0.975quant    mode kld
(Intercept)   8.2992 0.2317     7.8443   8.2991     8.7537  8.2992   0
Timestep     -8.4227 0.1072    -8.6333  -8.4227    -8.2123 -8.4227   0
```

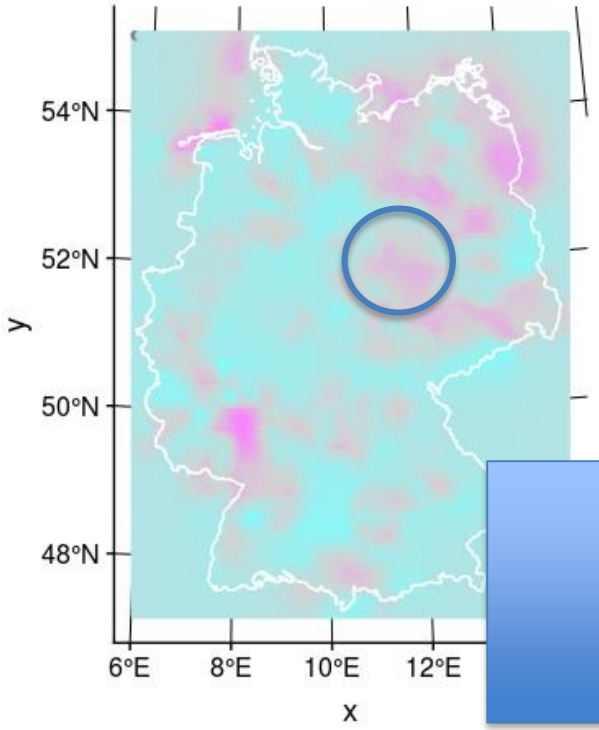


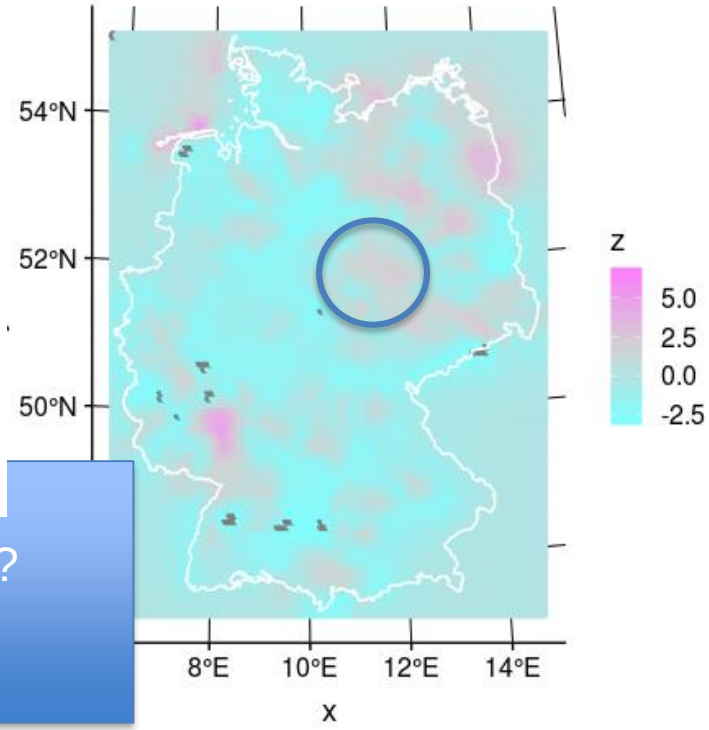




The „latent process“ (i.e. spatial component in the model)

Model with timestep an e. latent process)
For each time step





What drives the change in spatial dependency?
(i.e. what is the „latent process“?)