

Ecological and geographical considerations on environmental niche modelling

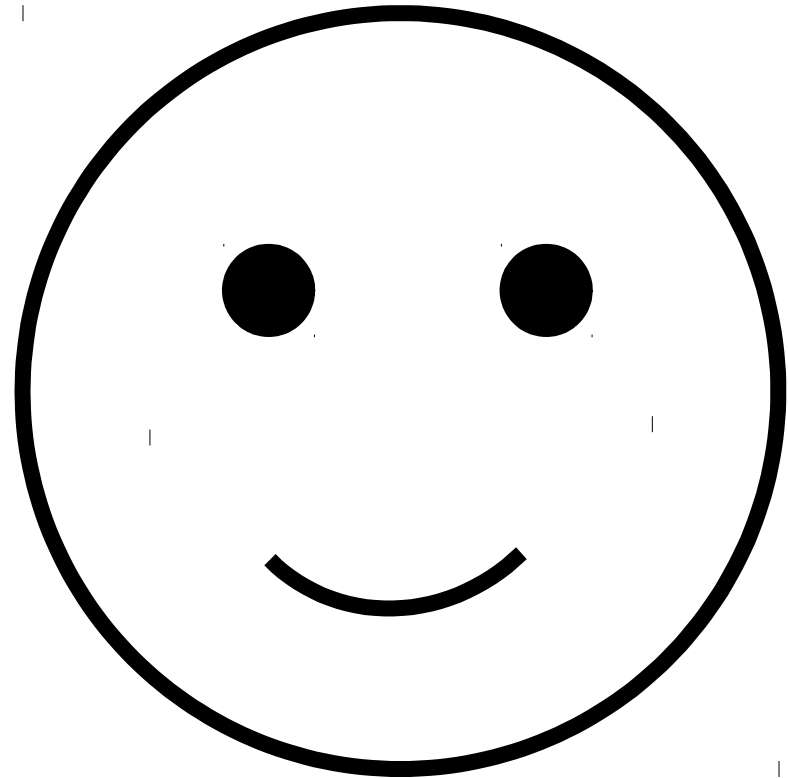
Daniele Da Re

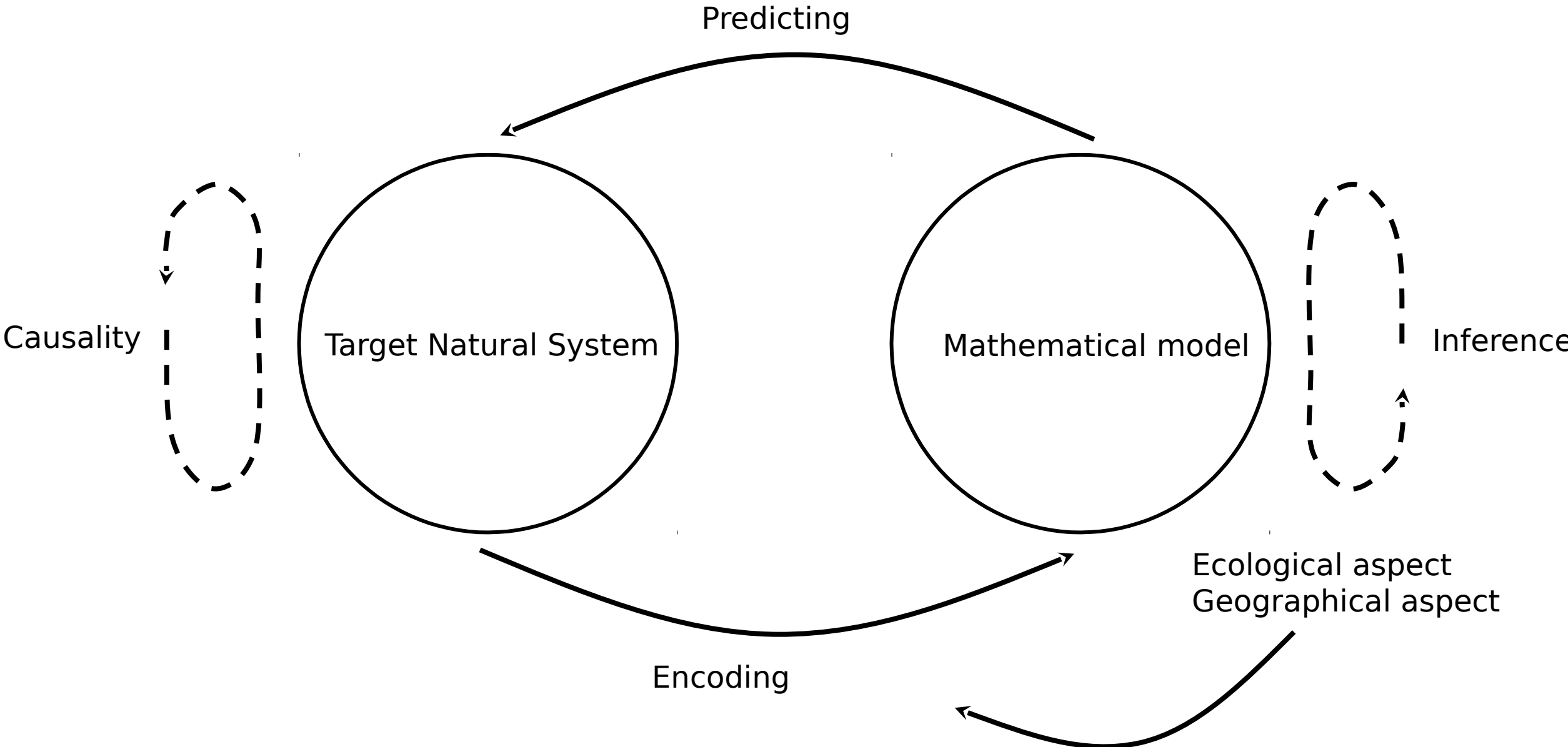
Sergio Rubin

Sophie Vanwambeke

What is a model?

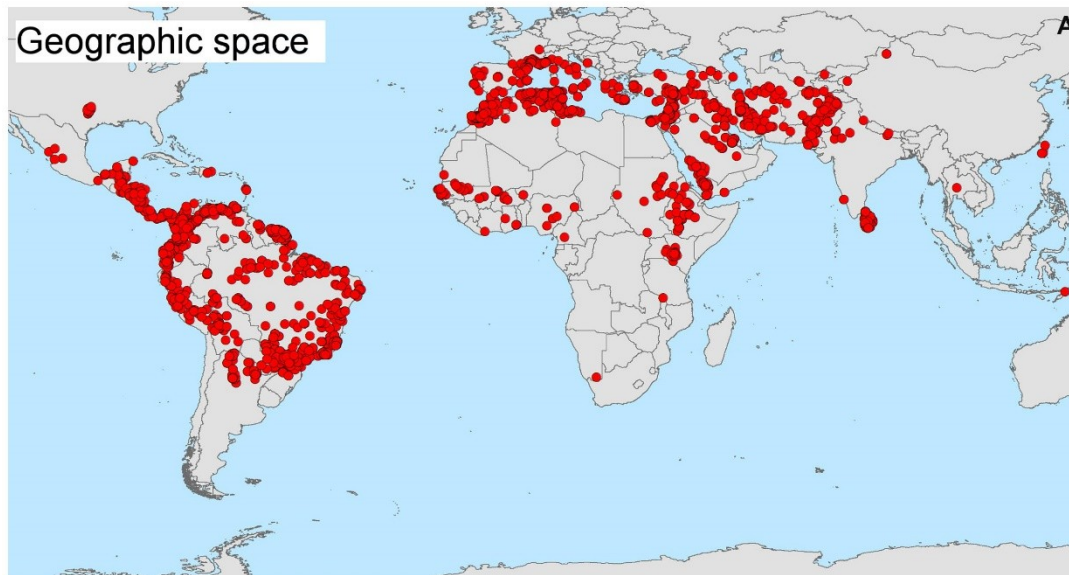
- One of the potential representations of a natural system



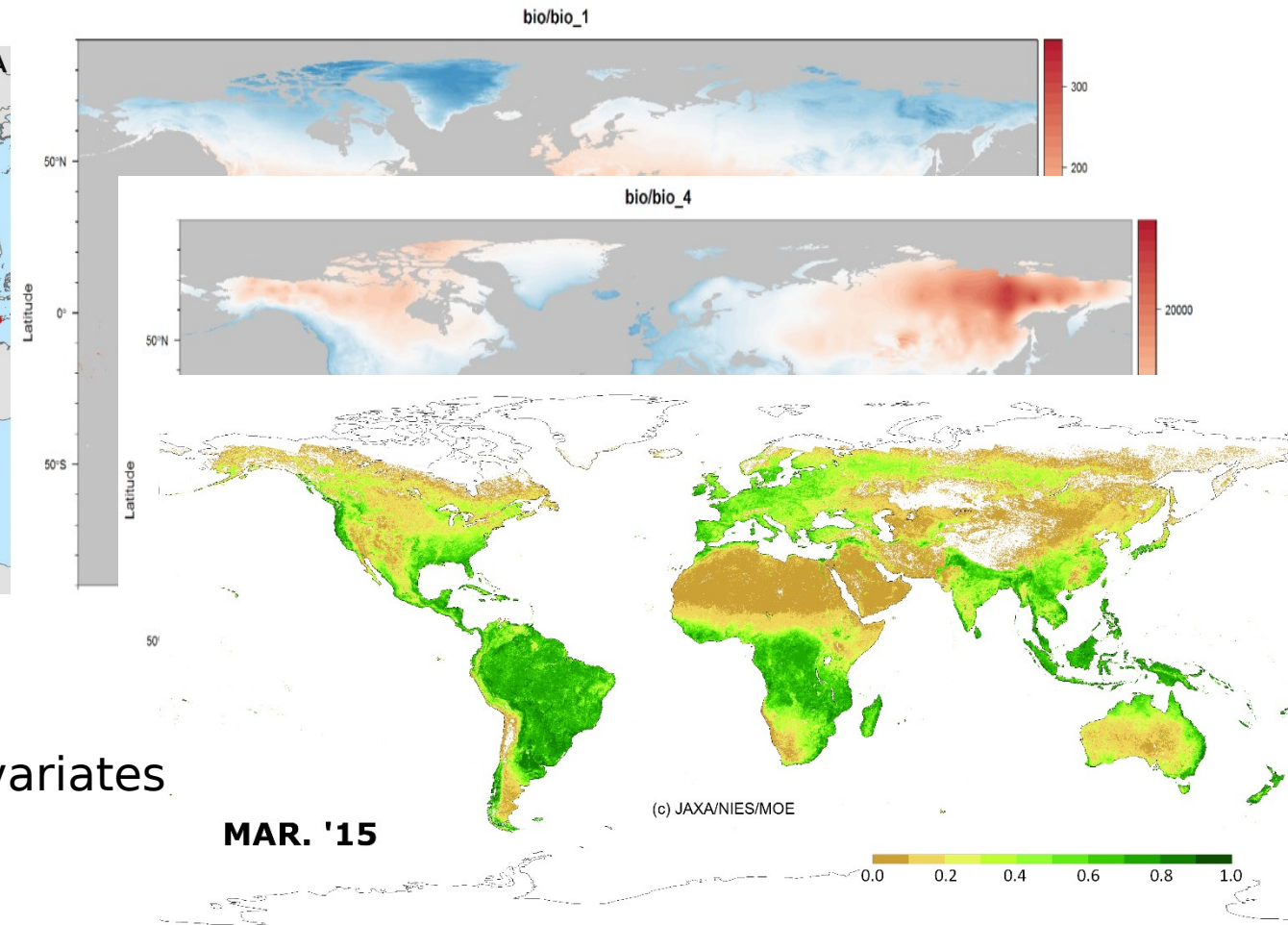


Ecological modelling

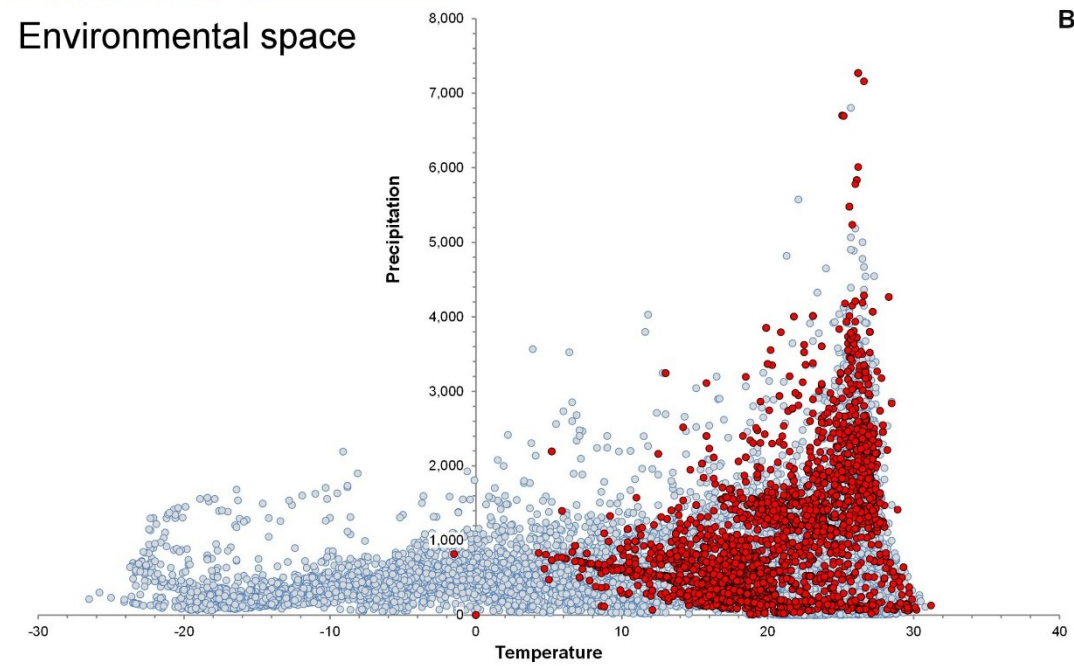
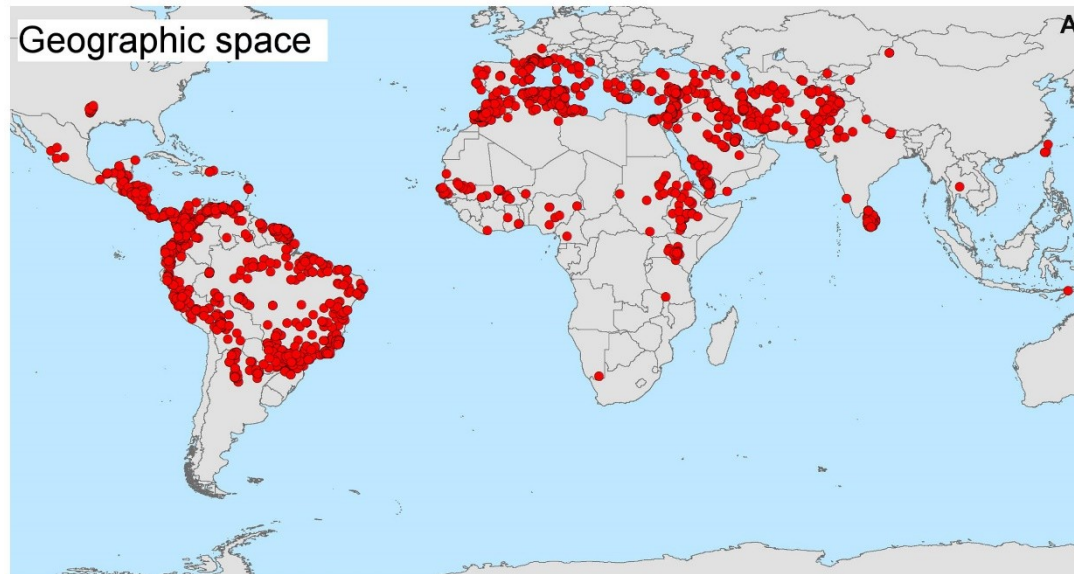
Geo-referenced occurrences



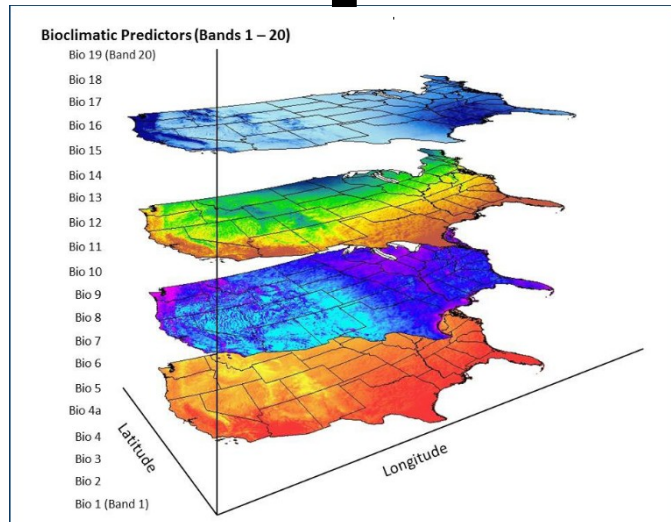
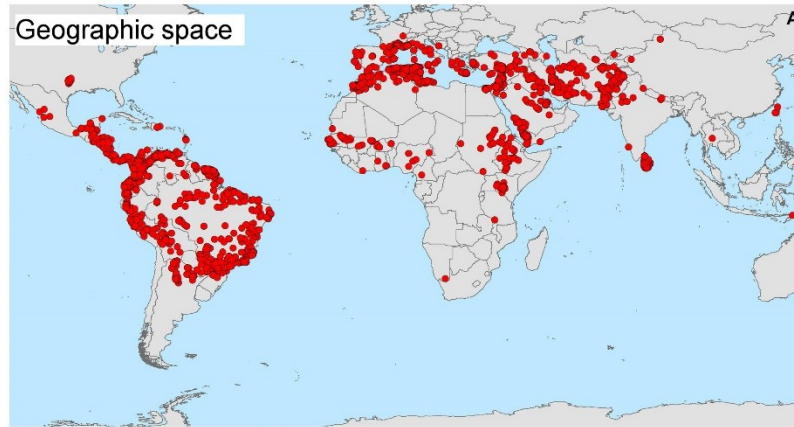
Covariates



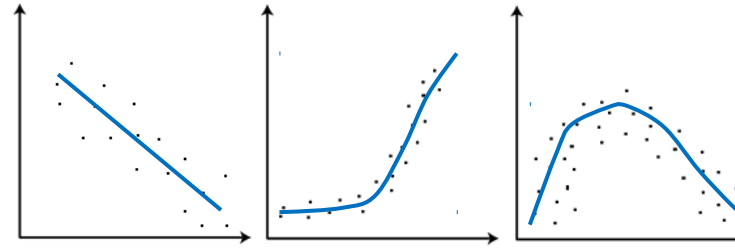
But also remote sensing covariates



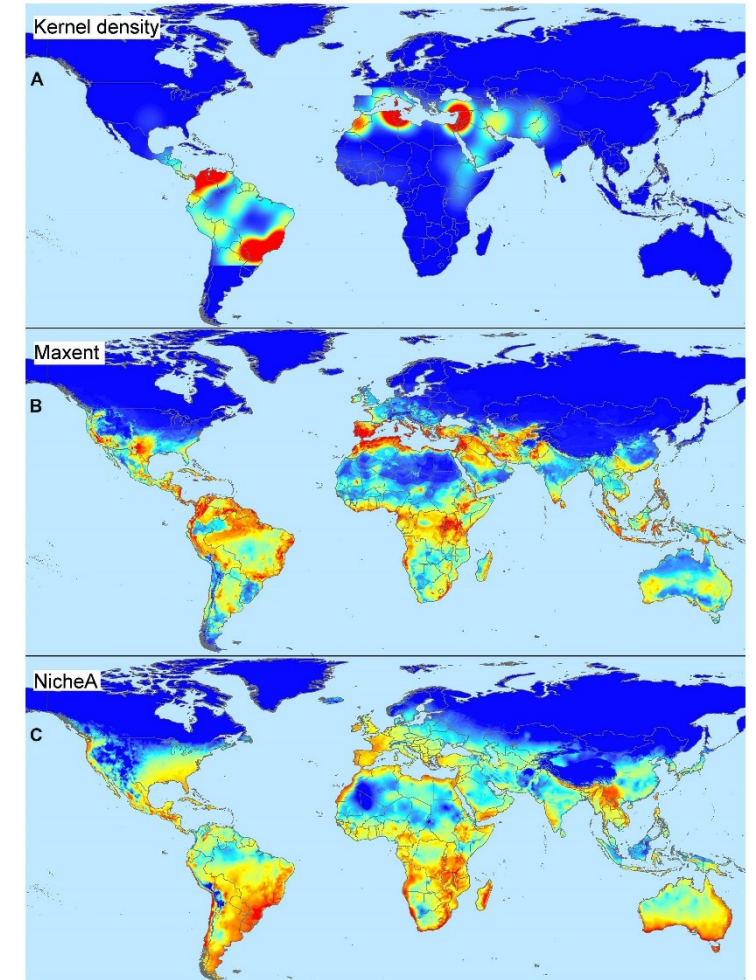
Different models have different assumptions



Modeled species
response function



Species
Distribution
Model



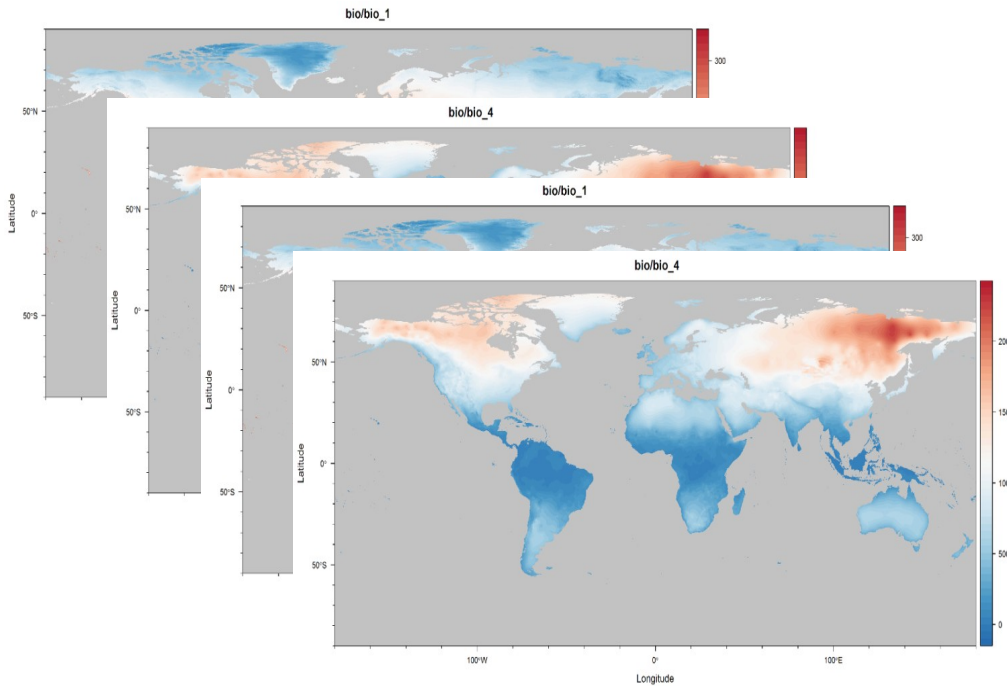
Suitable
habitat

So cool! So, what?

- Are the model (and thus the predictions) biologically relevant?
- Should we look for a causal mechanism rather than a correlation?
- Are geographical problems taken into account in the modelling process?

Usual practice:
download the predictors and (maybe) check for
collinearity

Worldclim



Pearson's r or VIF



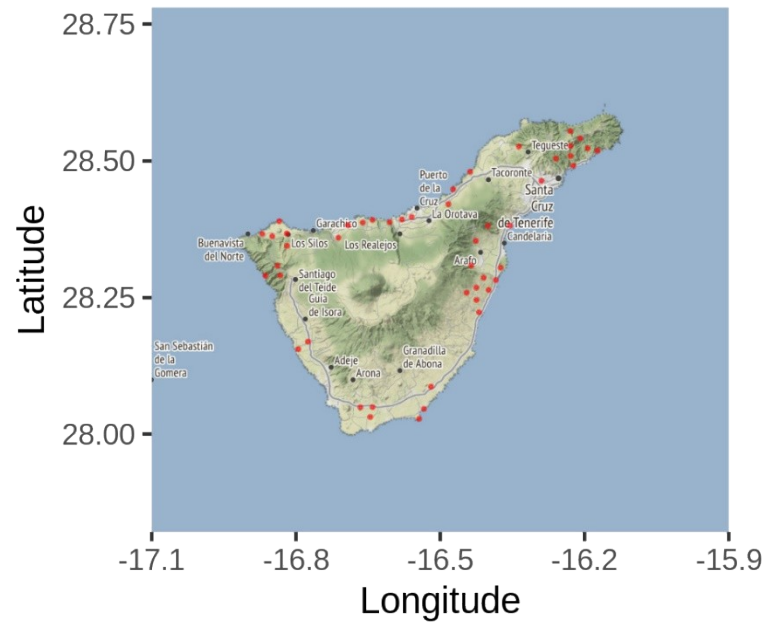
If Pearson's $r < 0.7$...

Cite **Dormann et al. 2013**
and that's it!

**BETTER: Choose biologically relevant
covariates**



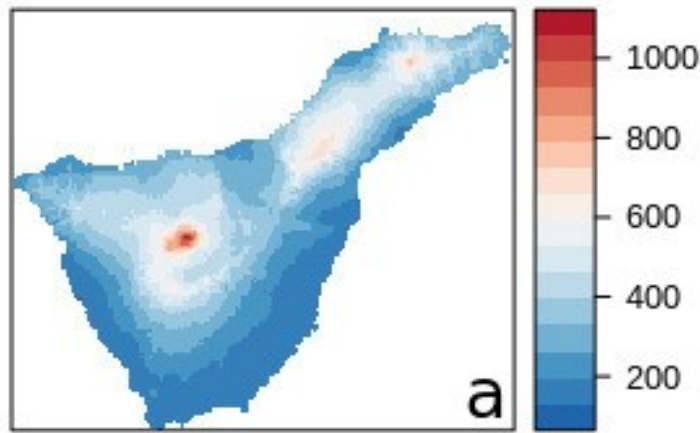
Pennisetum setaceum



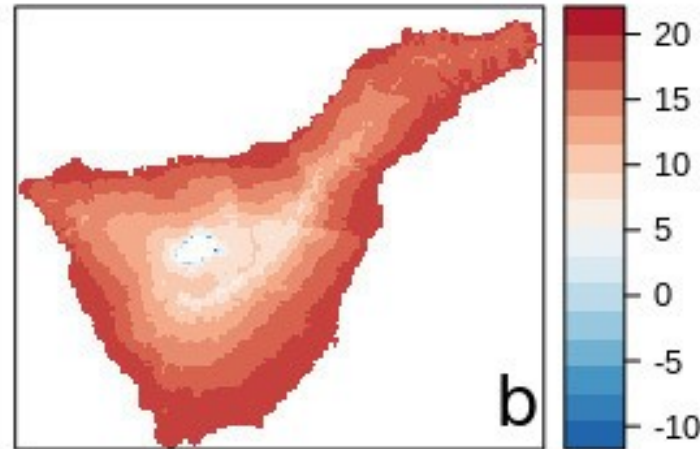
Da Re et al. 20-- (*Under rev.*)

Better: choose biologically relevant covariates

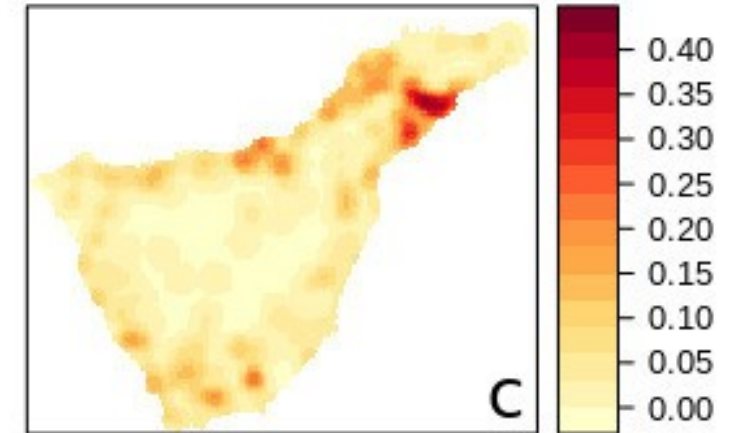
- Temperature and soil moisture sensitive
- High Propagule pressure



October-March
mean precipitations

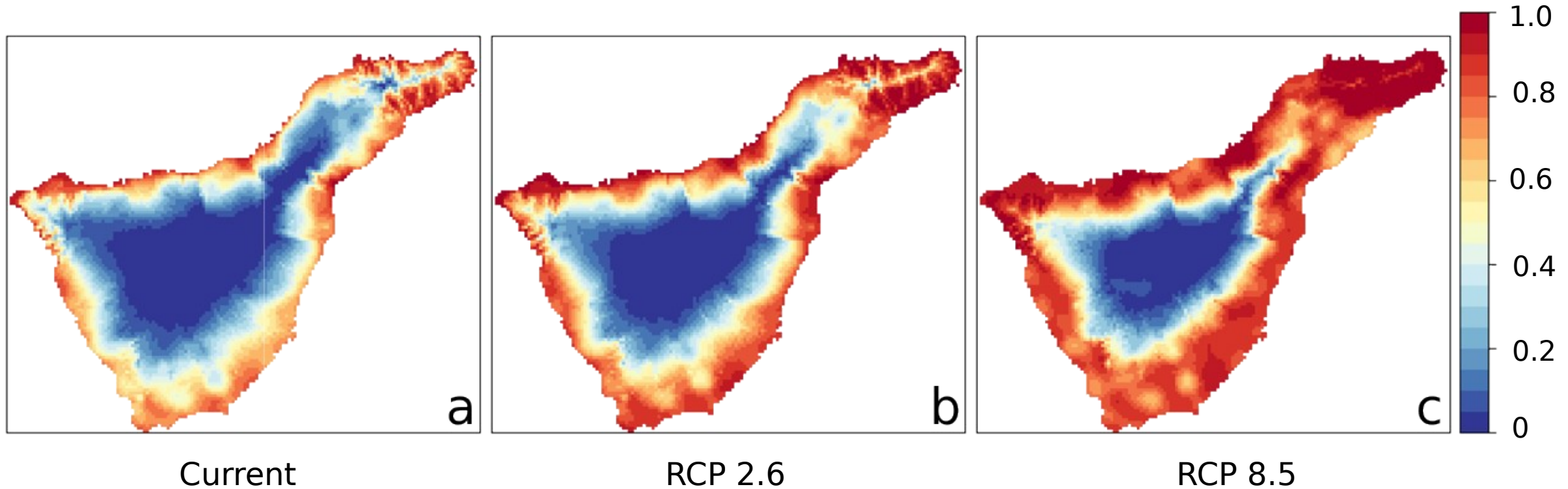


March-May
mean temperatures



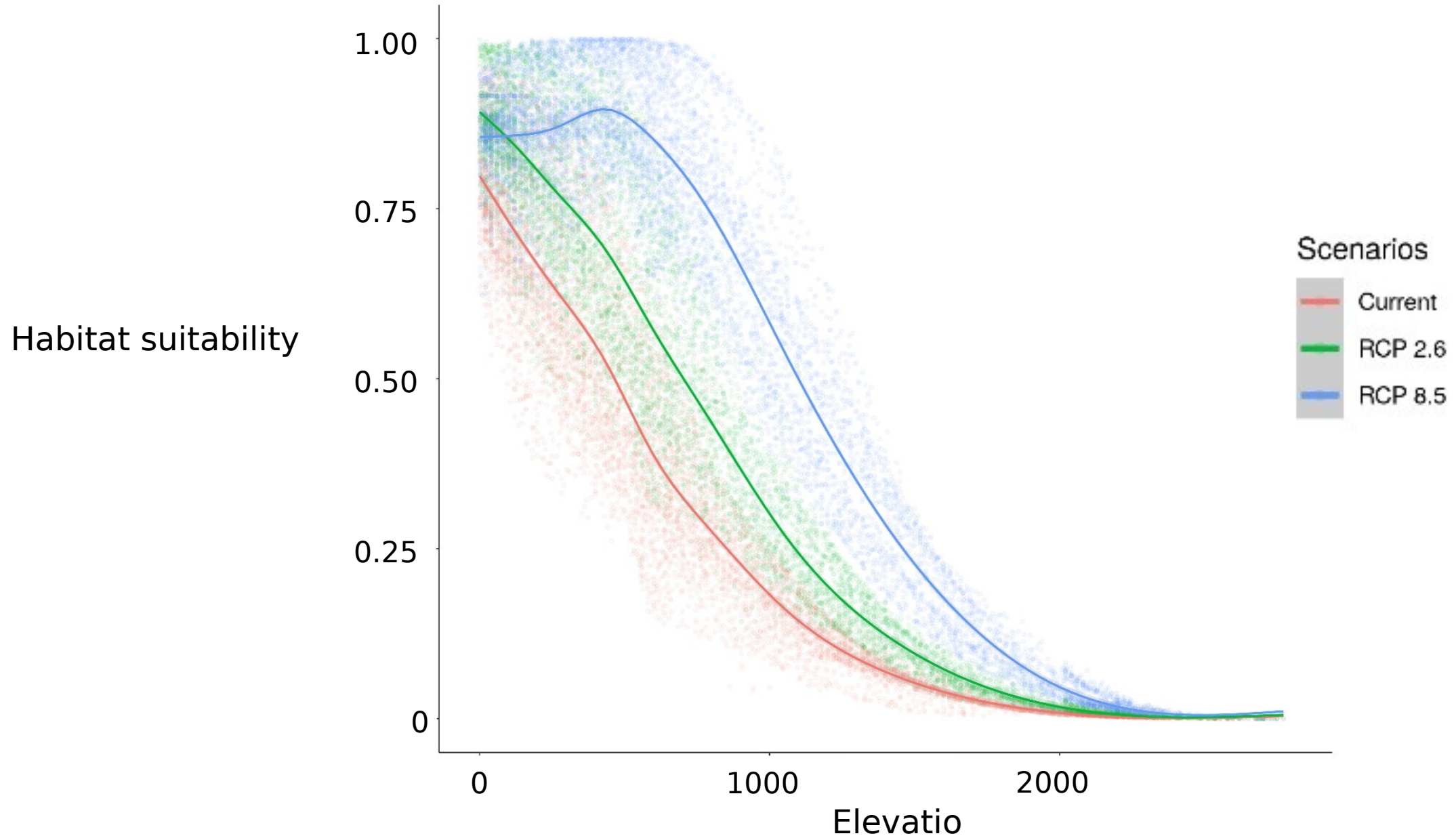
Roads Kernel densities

Habitat suitability index

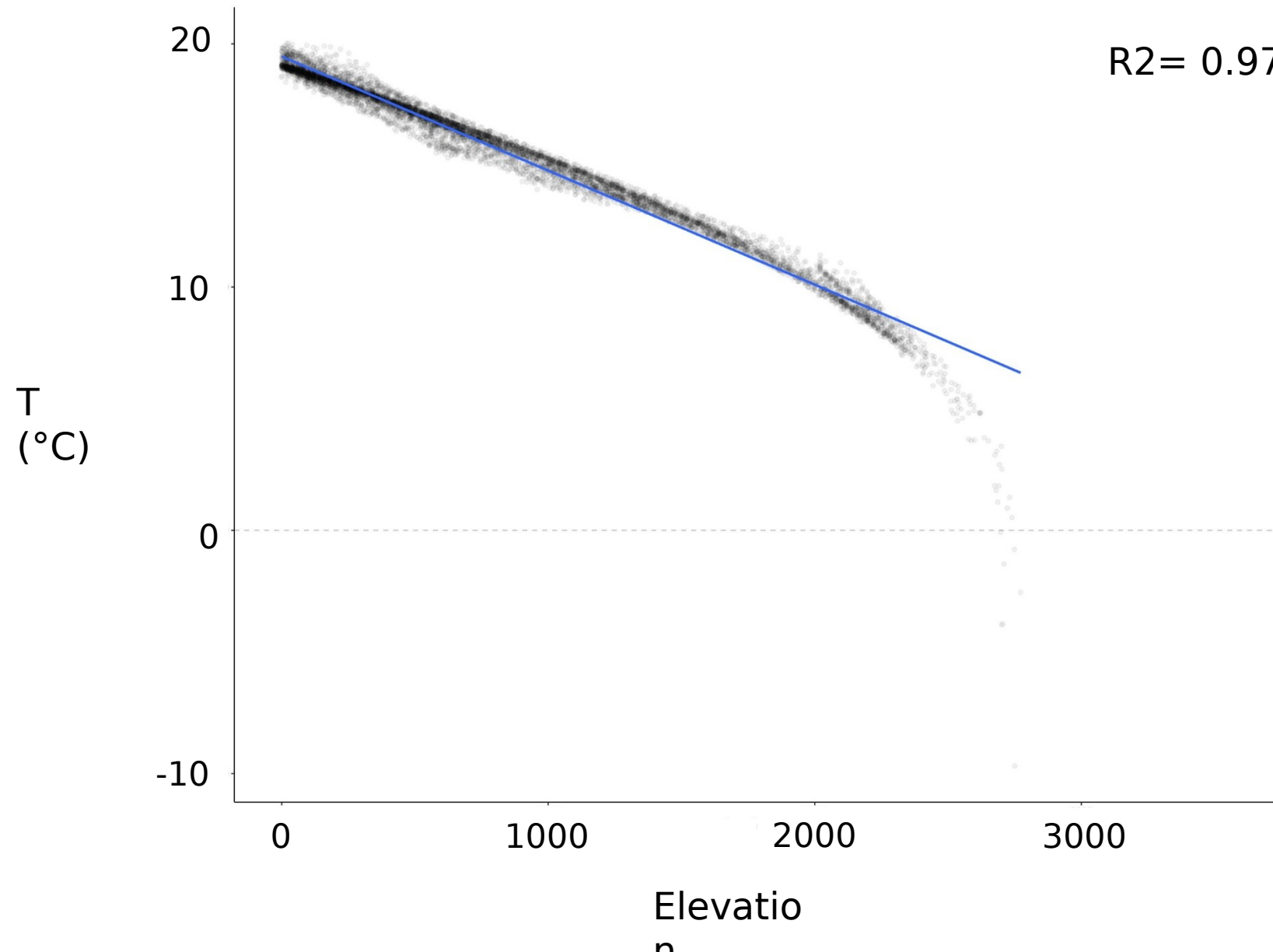


0 = not suitable habitat; 1 = suitable habitat

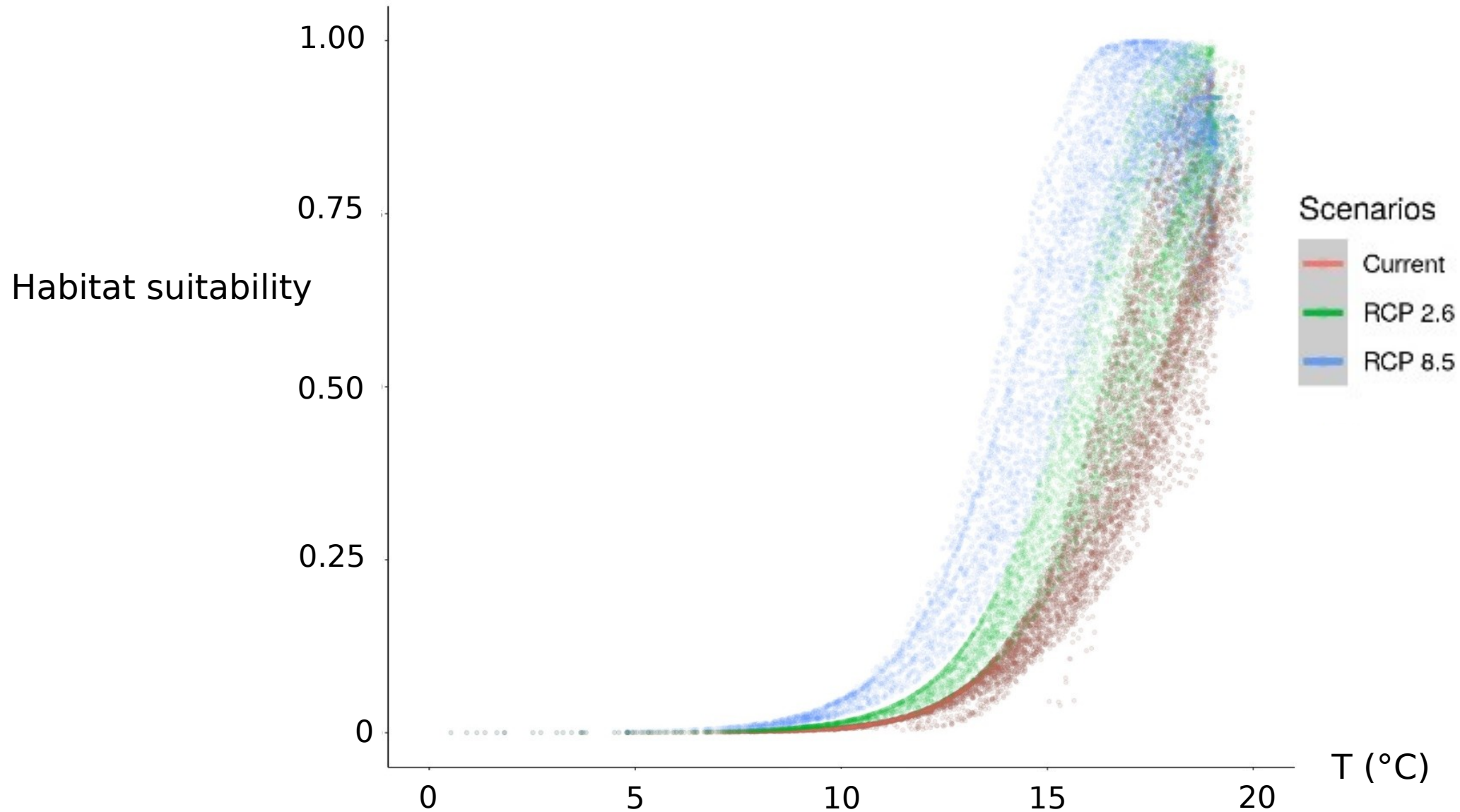
Habitat suitability decreases with elevation



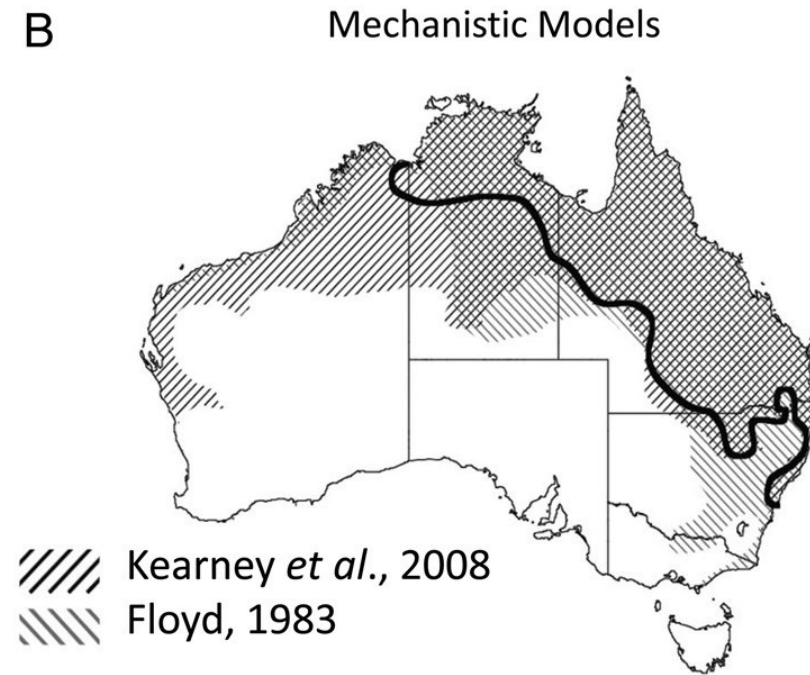
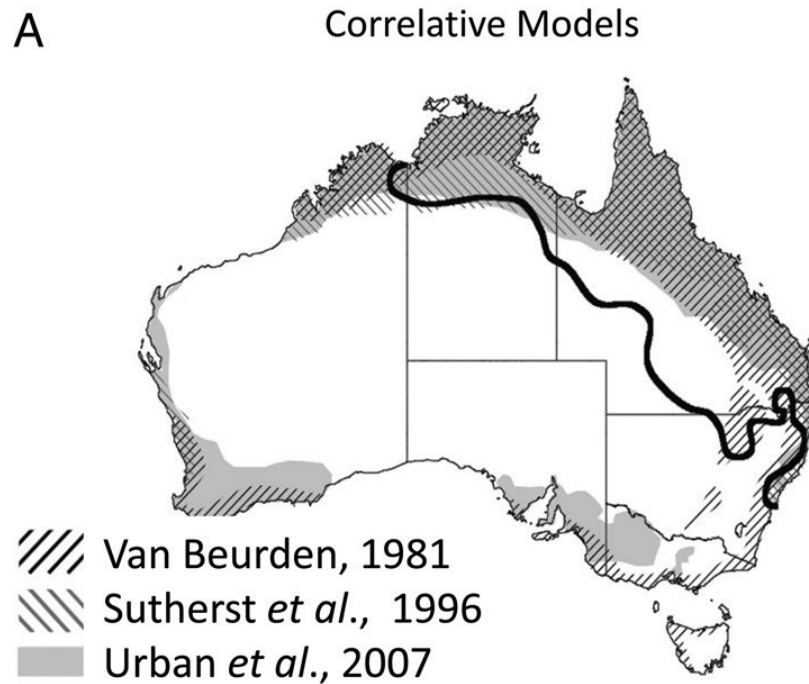
Temperature decreases as elevation increase



Under drier conditions,
areas located at higher altitude will become suitable



Nice, but it is still a correlative approach!



Evans, Diamond and Kelly, 2015

Geography matters

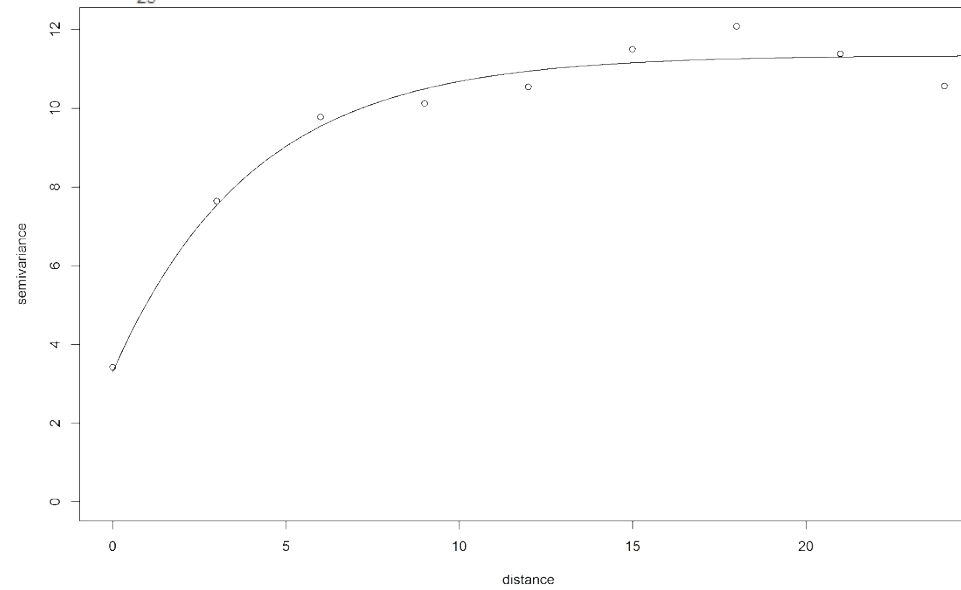
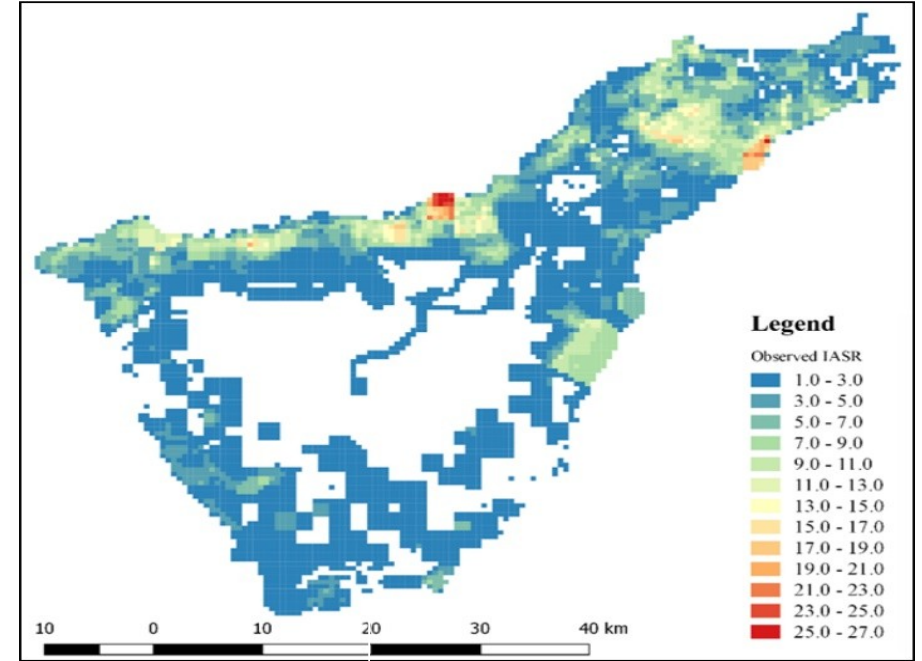
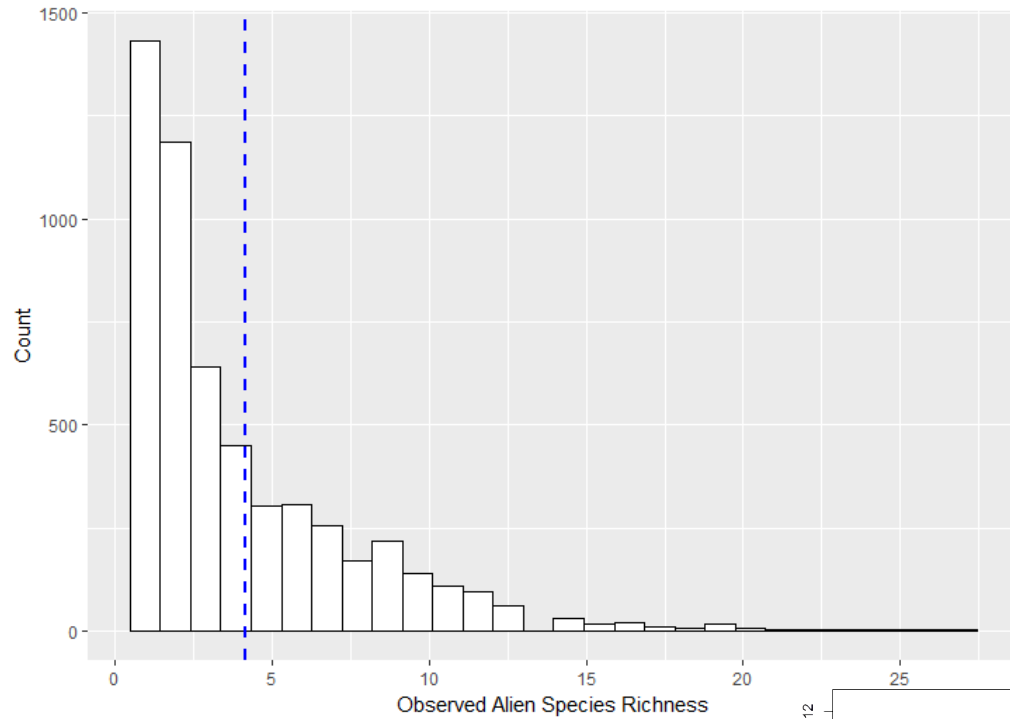
Everything is related to everything else, but near things are more related than distant things.

-Waldo Tobler

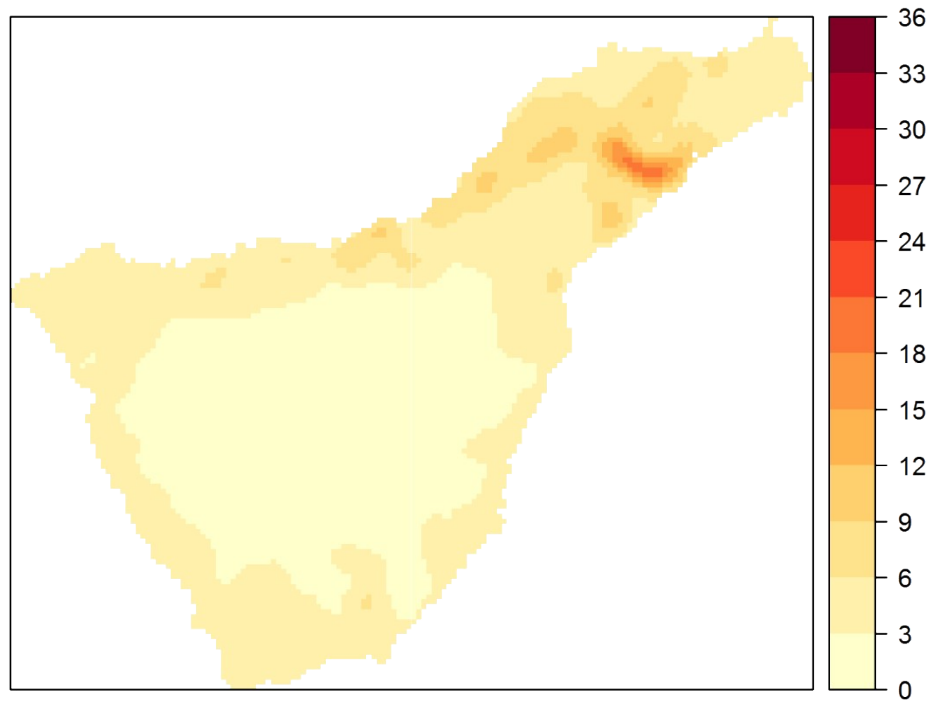


We should try to include it in ecological modelling

Including spatial autocorrelation into ecological modelling

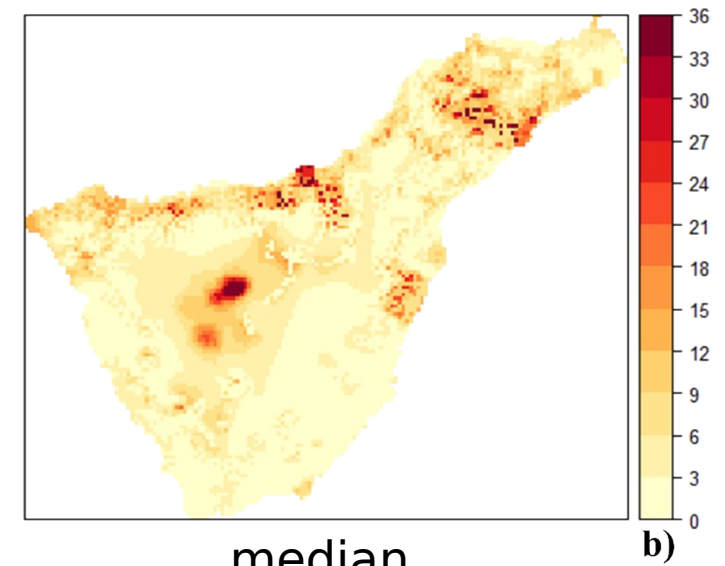


Generalized Linear Model



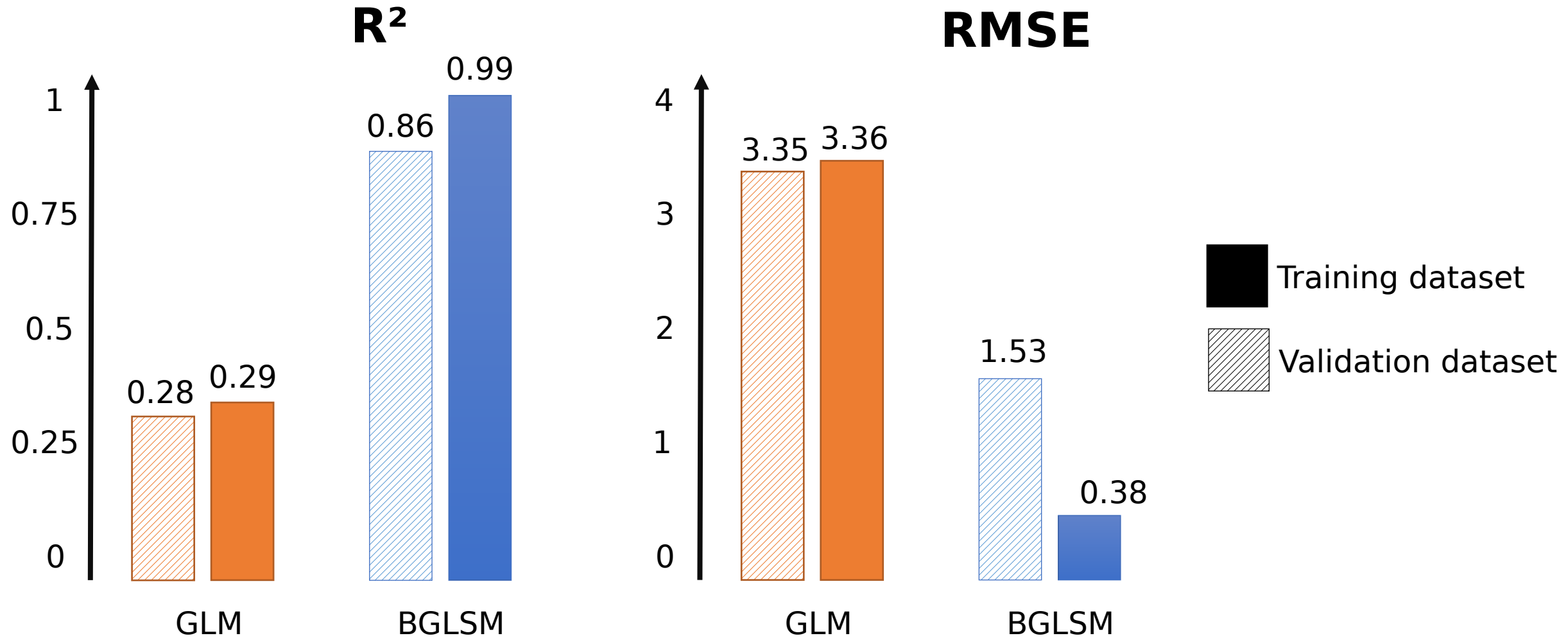
Predicted values

Bayesian Generalized Linear Spatial Model



median

Including spatial autocorrelation increase prediction accuracy



Choose the right minimum units

- Goal: downscaling livestock census areal data
- Problem: the **Modifiable Areal Units Problem**

a) Effects of aggregation

2	4	6	1
3	6	3	5
1	5	4	2
5	4	5	4

Mean = 3.75
Std = 2.60

3	3.5
4.5	4
3	3
4.5	4.5

Mean = 3.75
Std = 0.50

3.75	3.75
3.75	3.75

Mean = 3.75
Std = 0.00

b) Effects of zoning systems

2.5	5	4.5	3
3	4.5	4.5	3

Mean = 3.75
Std = 0.93

2.75	4.75	4.5	3.0
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Mean = 3.75
Std = 1.04

4	1
4	3.67

Mean = 3.17
Std = 2.11

Take home messages

- Try to explicit the biology of the target organism
- Geography matters (I know you know guys)



Complex models may help to answer complex questions

Thank you

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