UNIVERSITÄT BAYREUTH

Welcome to the Science School on Quantitative Ecology!

Species Distribution Modelling I & II

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biogeografie uni bayreuth

Bayceer
Bayreuth Center of Ecology and Environmental Research

Aims of SDM I & II

1. Understand the basic functioning and the application of SDMs.
2. Get a feeling for the variability of SDMs.
3. Learn how to build a simple correlative SDM in R.
4. Learn about resources for future SDM building.

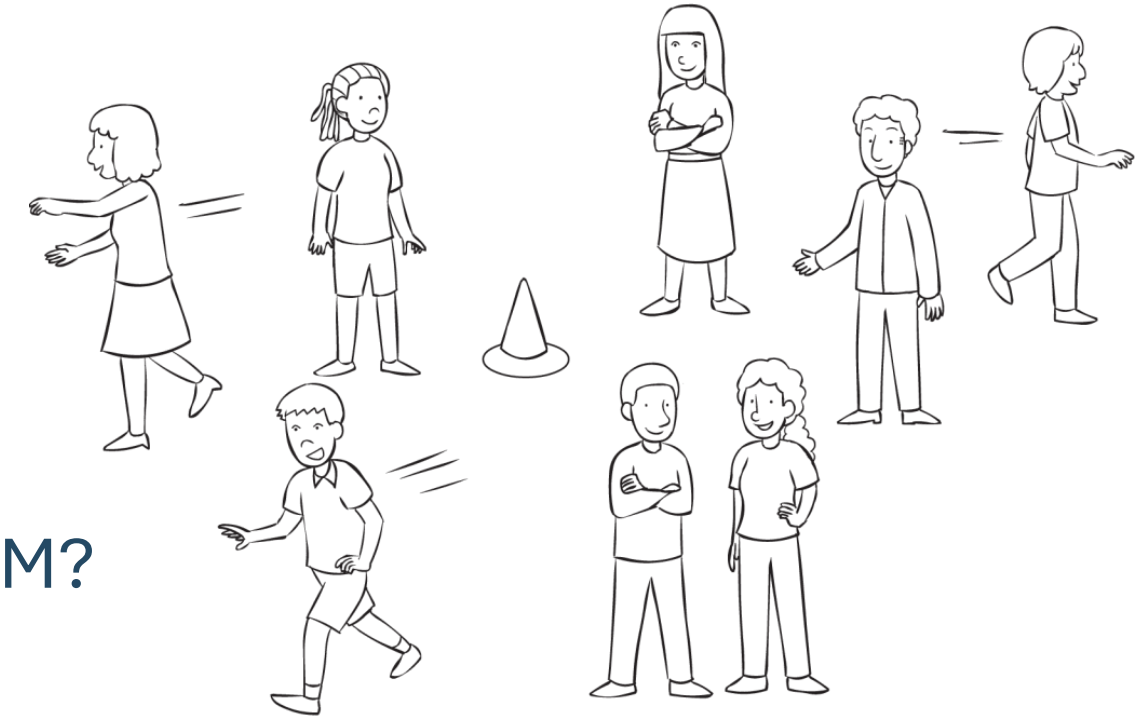
Roadmap SDMs I & II

1. Icebreaker
2. Introduction to SDMs
3. Activity break
4. SDMs in R (live coding together)
5. SDMs in R (individual exercise)
6. Pros and cons of correlative SDMs
7. Resources
8. Feedback

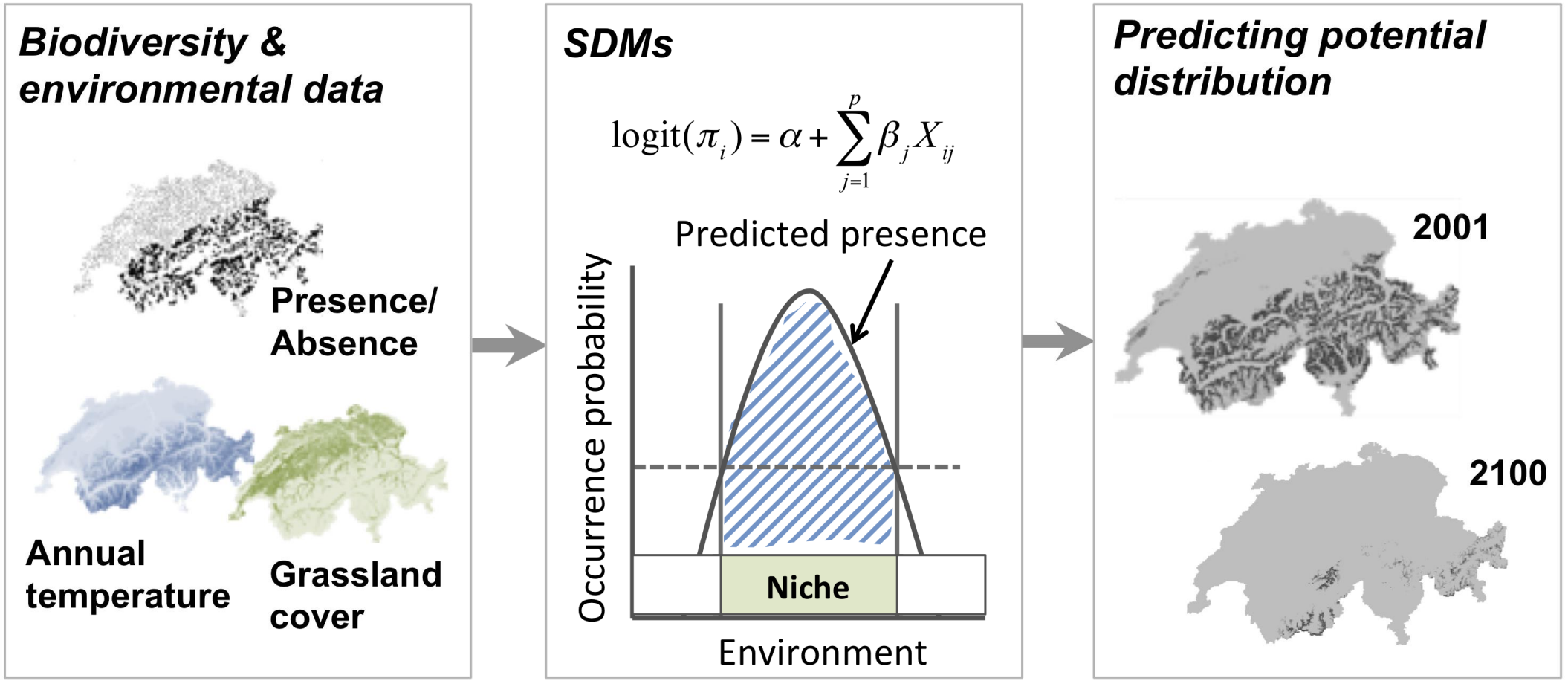
Icebreaker – group map

Activity: move in the room

- Where do you come from?
- How much do you know about SDM?
- How would you rate your experiences in building SDMs in R?

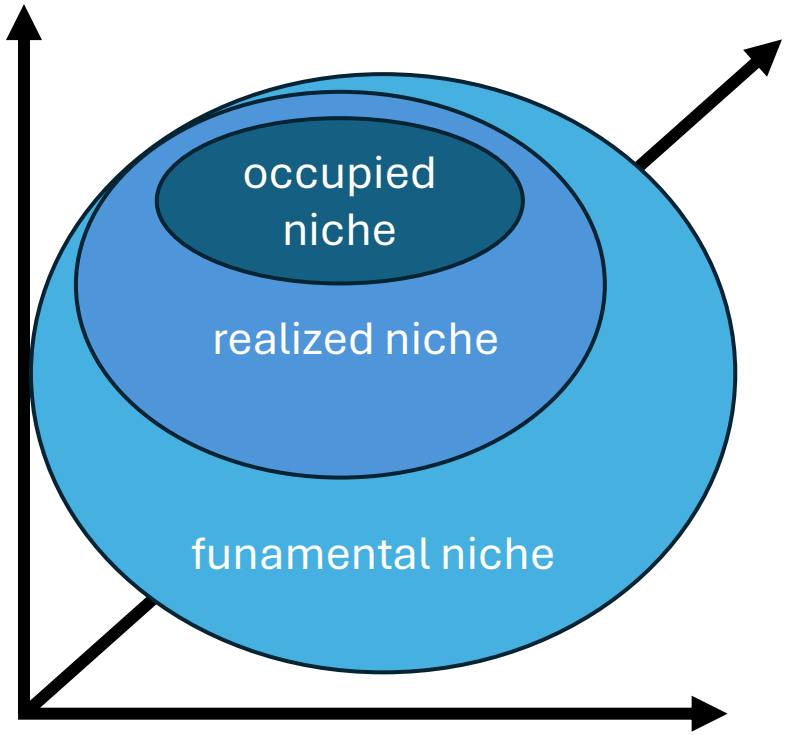


Main components of a SDM (correlative)



Zurell, 2022

Underlying niche theory



- SDMs are rooted in niche theory
- **Fundamental niche**: abiotic conditions under which a species survives
- **Realised niche**: Species survives despite presence of competitors
- **Occupied niche**: Presence of species considering dispersal limitations
- Ongoing debate which niche SDMs represent
- **Be aware what your model represents!**

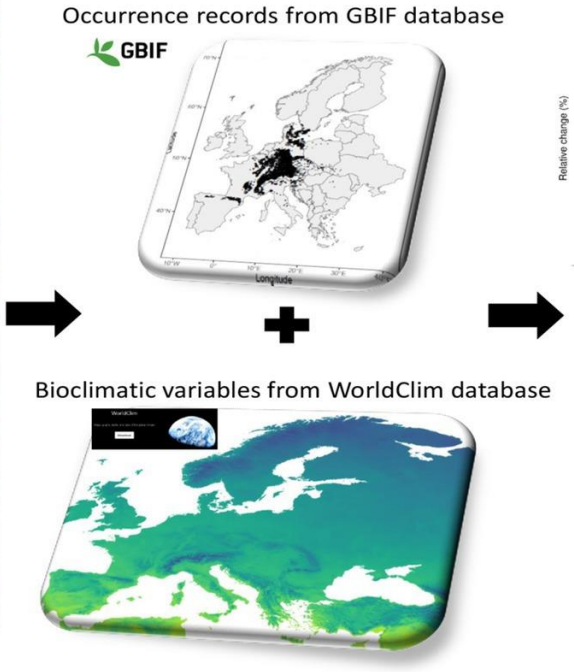
Zurell, 2020

The variability of SDMs - exampels

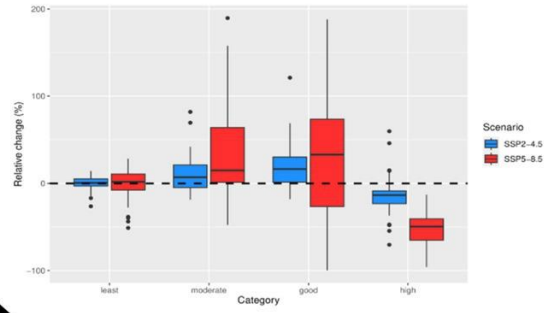
Predicting into the future

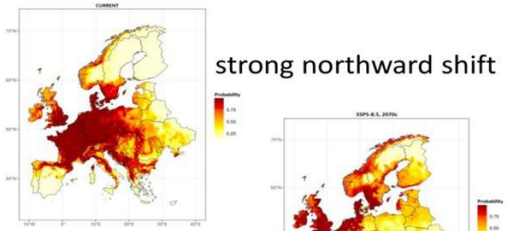
71 herbaceous plant species with affinity to *Fagus sylvatica* forests

Species distribution modelling (ensemble approach)



Climatic suitability is predicted to decrease in the future





strong northward shift

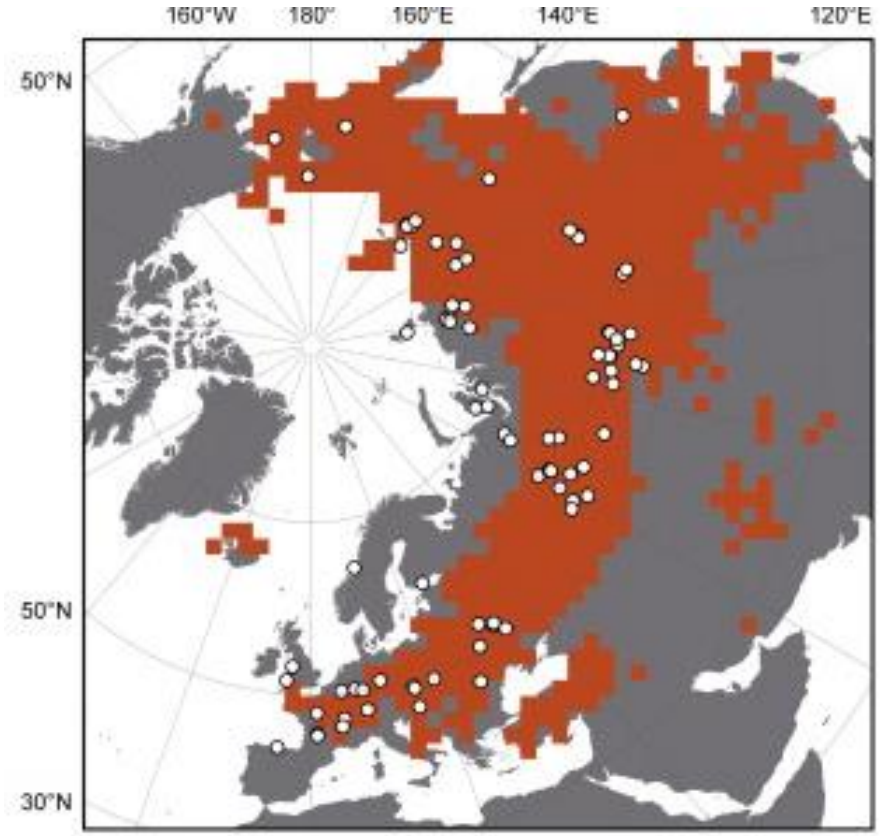
changes depend on biogeographic attributes of species

- Climatic suitability for European beech forest herbs under climate change

Kermavnar et al., 2023

The variability of SDMs - exampels

Predicting into the past

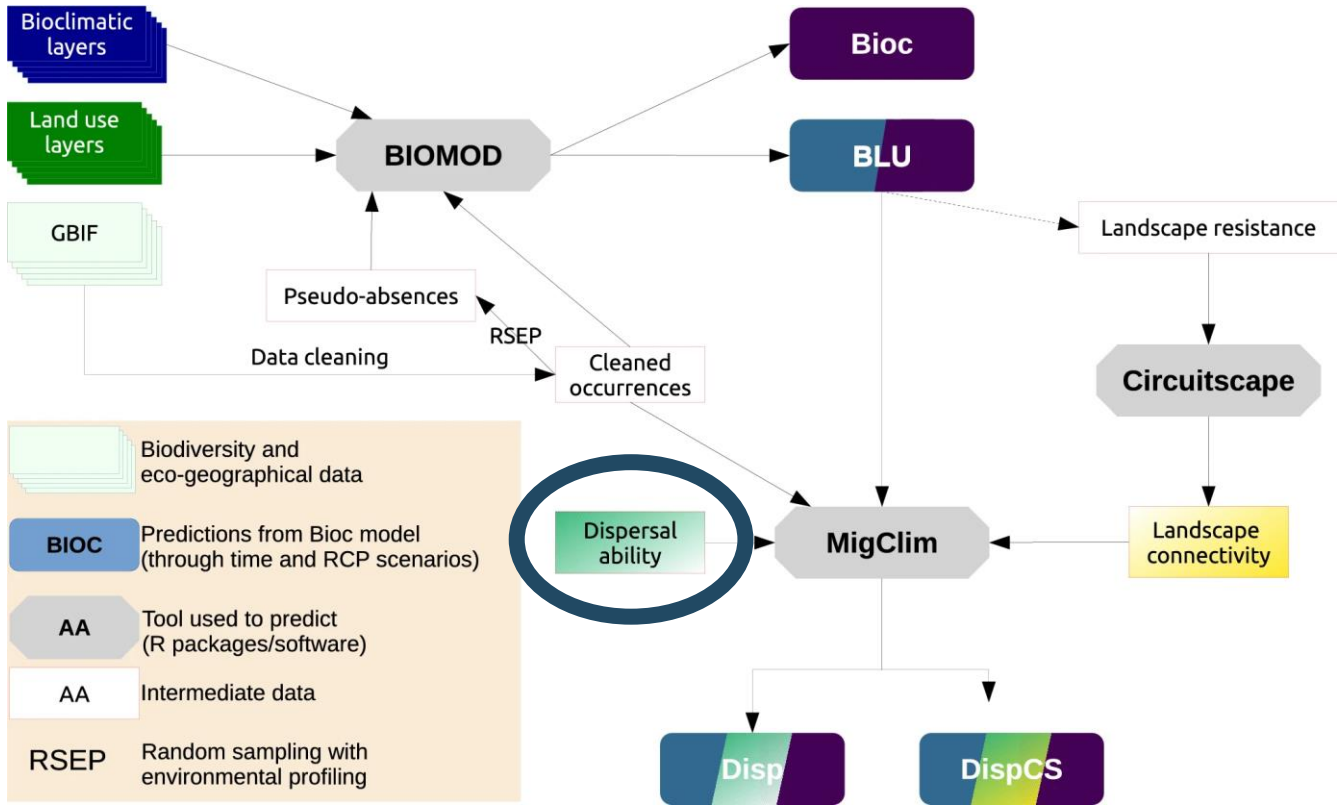


- SDM applied to palaeobiology
  - Here: SDM-estimated potential LGM distribution in Eurasia (red area) of woolly mammoth (*M. primigenius*) using fossils (dots) dated to the LGM (c. 21,000 ka BP)

Svenning et al., 2011

The variability of SDMs - exampels

Including dispersal

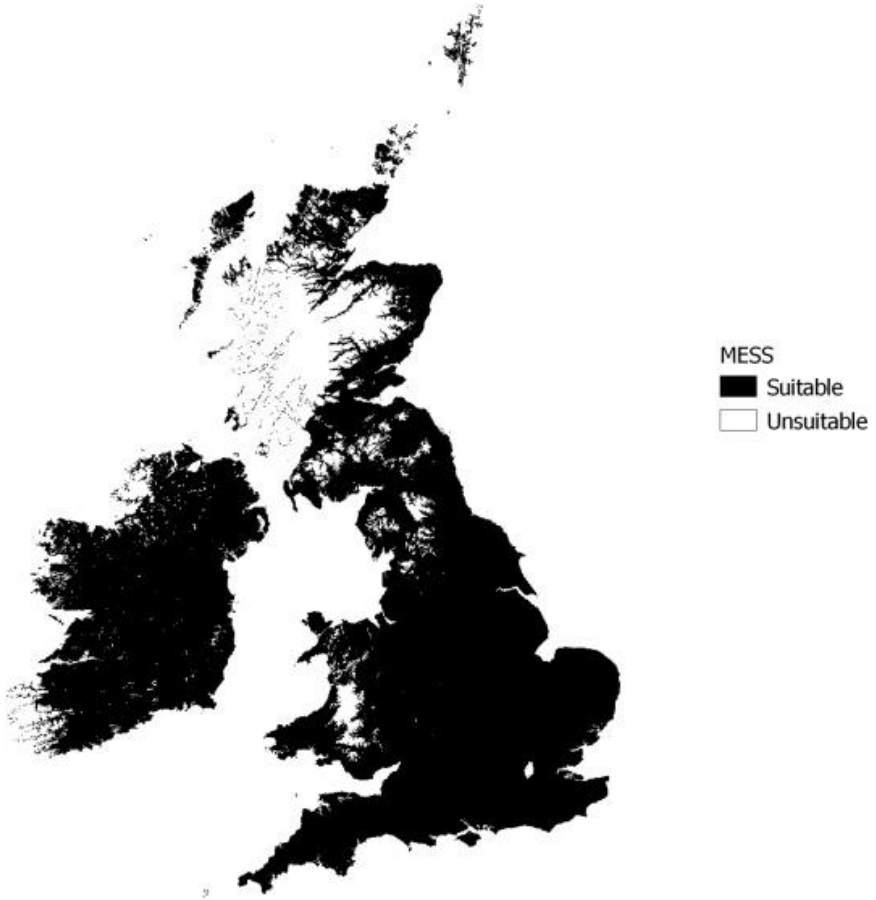


- Predictions of SDM in predatory arthropods in Europe

Monsimet et al., 2020

The variability of SDMs - exampels

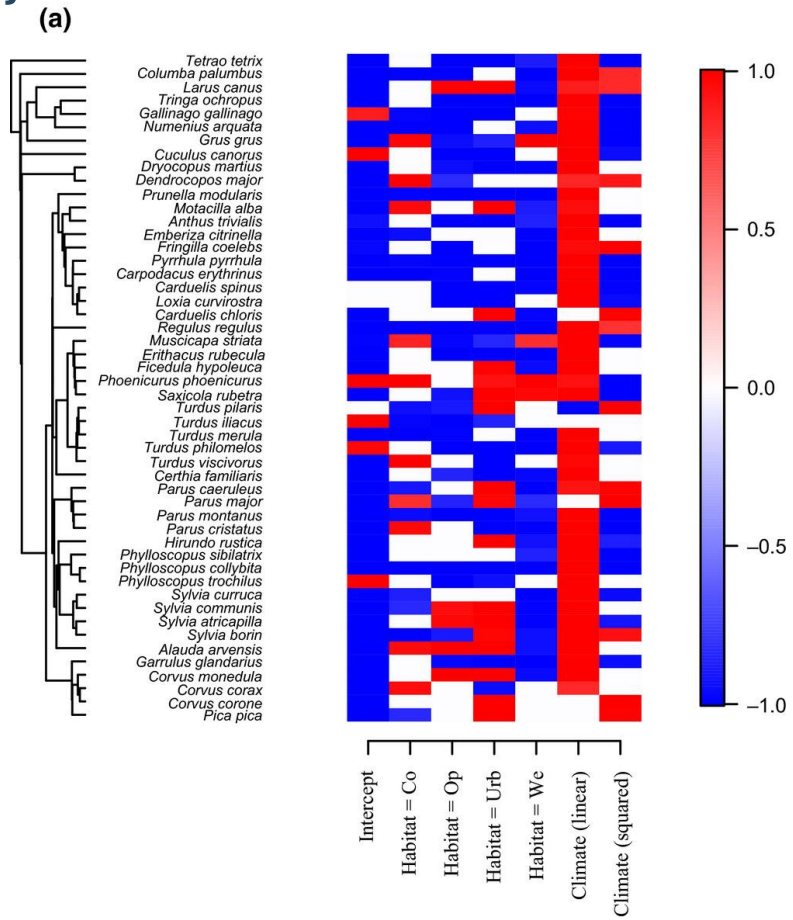
iSDM (invasive species distribution model)



- Predicting the range of muntjac deer in Britain and Ireland
- Incorporation of non-equilibrium bias and survey effort in presence-only iSDM

The variability of SDMs - exampels

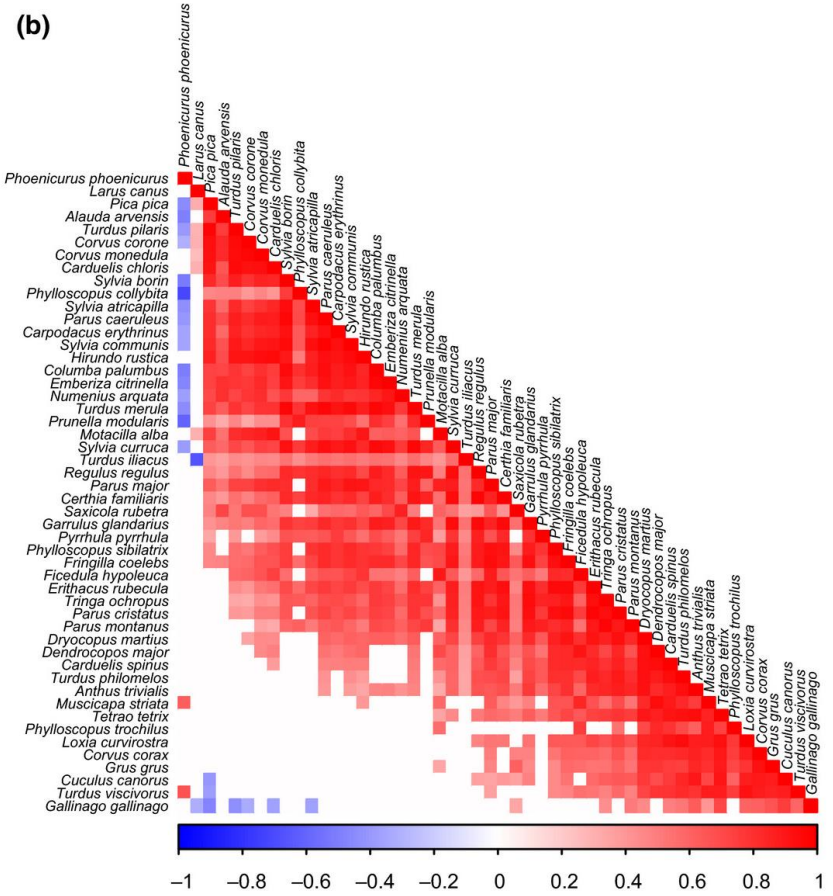
jSDM



Include species responses to environmental covariates…

The variability of SDMs - exampels

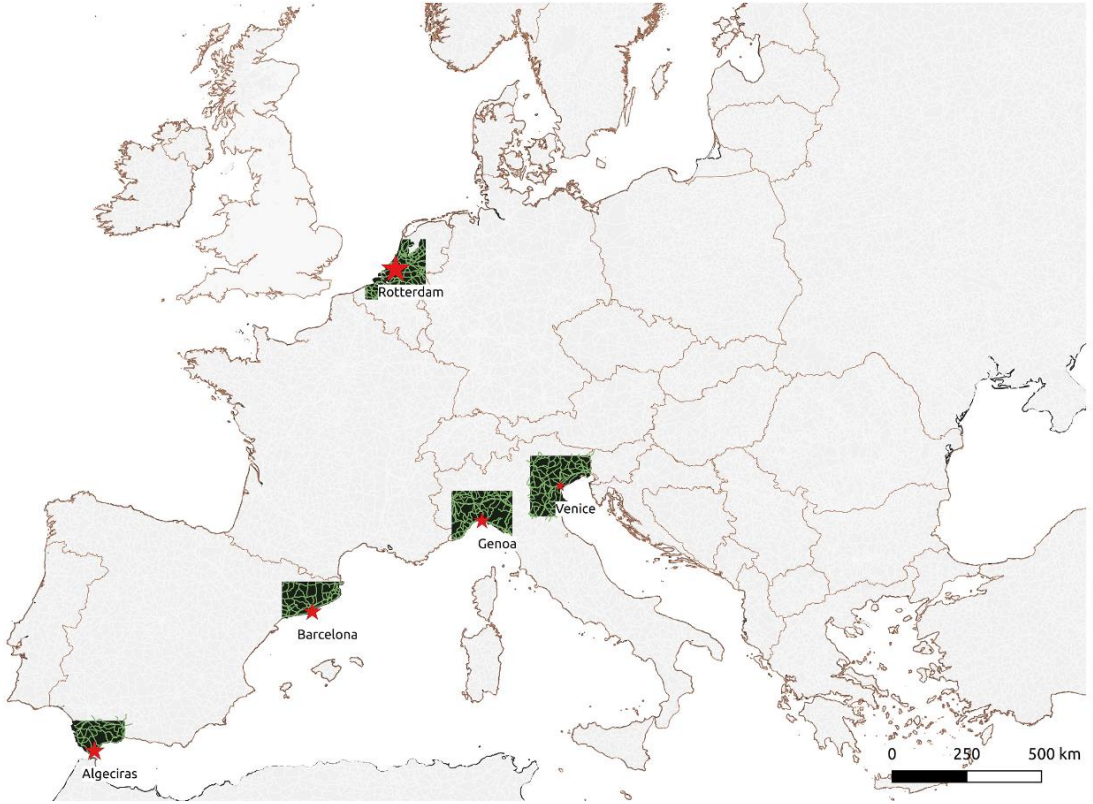
jSDM



… and species‘ associations based on residuals.

The variability of SDMs - exampels

process-based model



Aedes aegypti

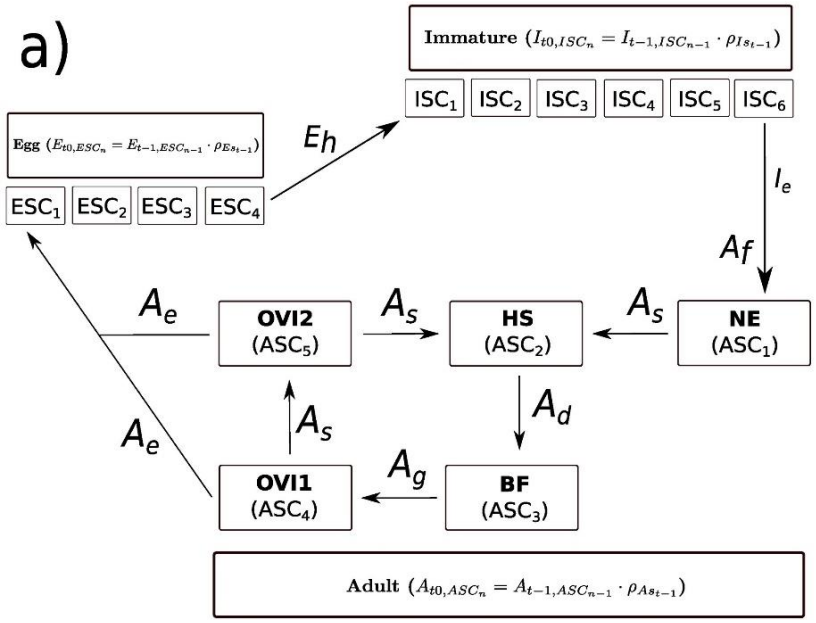
Modeling of *Ae. aegypti* population dynamics in European ports.

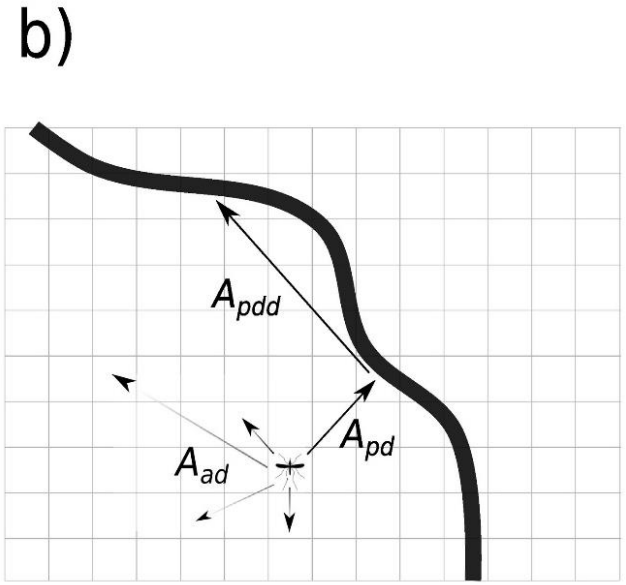
Ae. aegypti is a potential vector of yellow fever.

Da Re et al., 2021

The variability of SDMs - exampels

process-based model



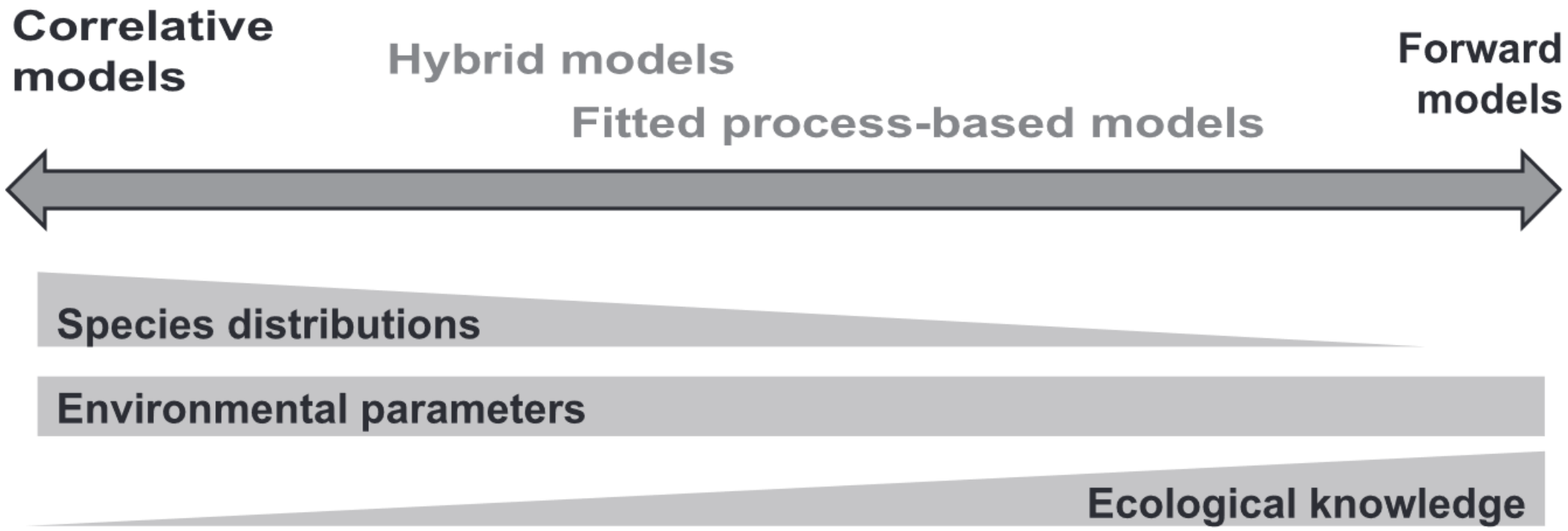


Modeling the life cycle...

... and disperal.

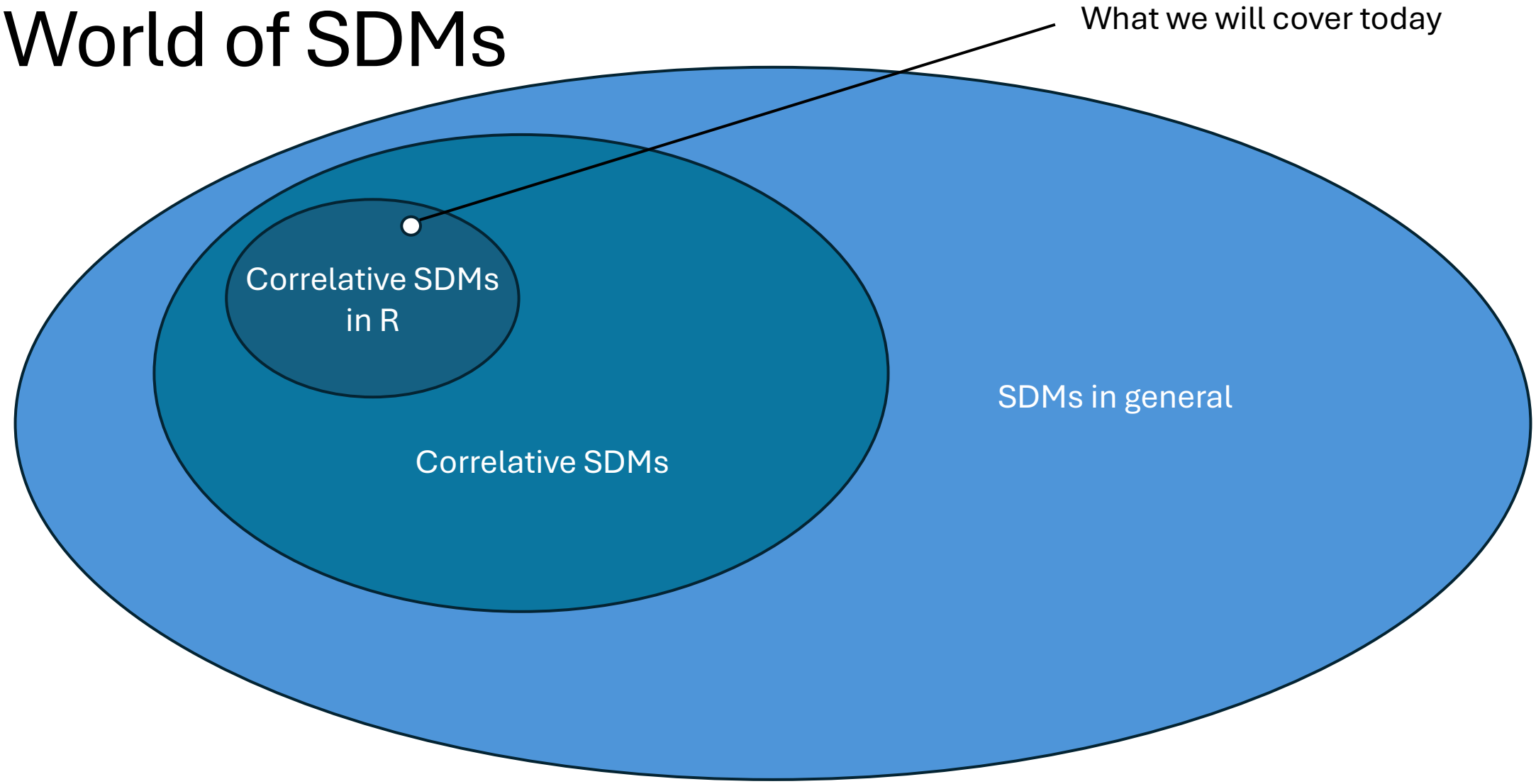
Da Re et al., 2021

Correlative vs. process-based models

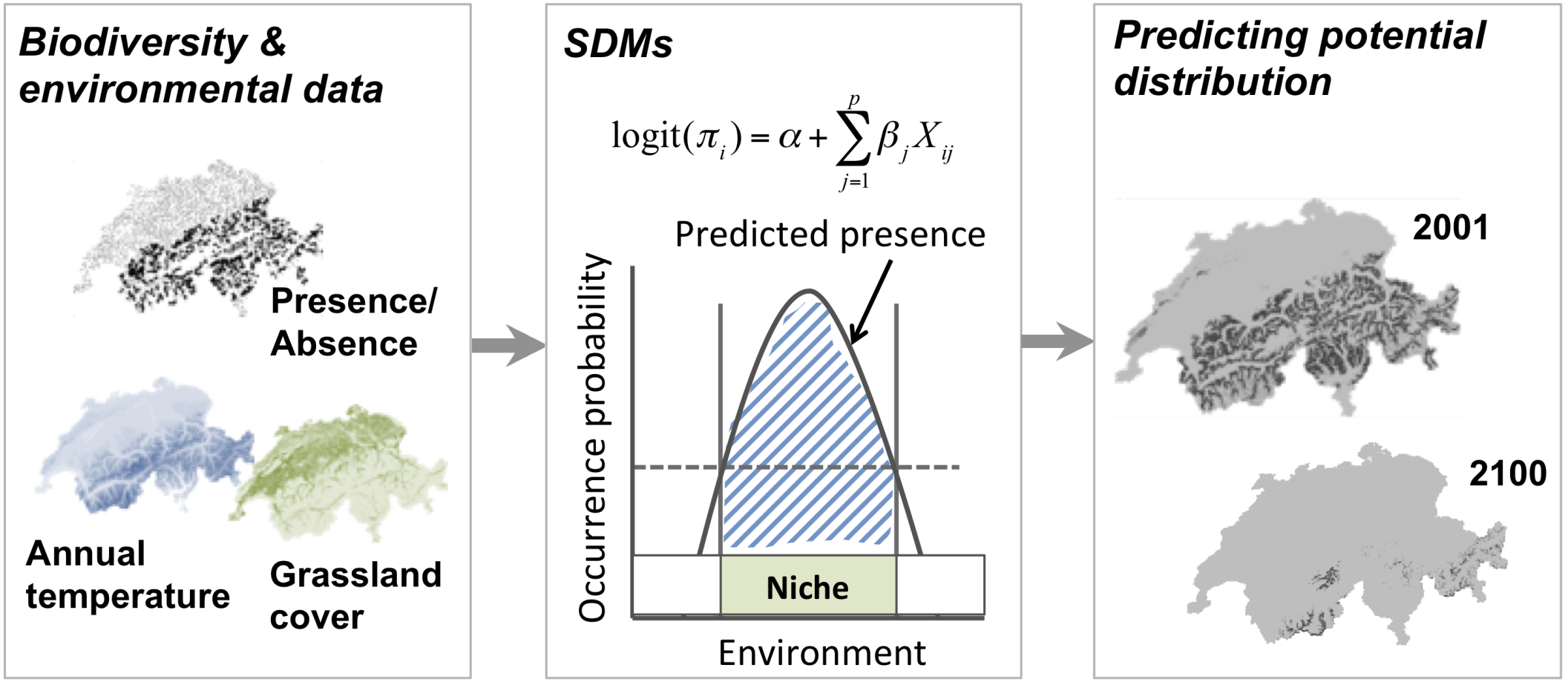


Dormann et al., 2011

World of SDMs



Our goal: build simple correlative SDM



Zurell, 2022

Questions?

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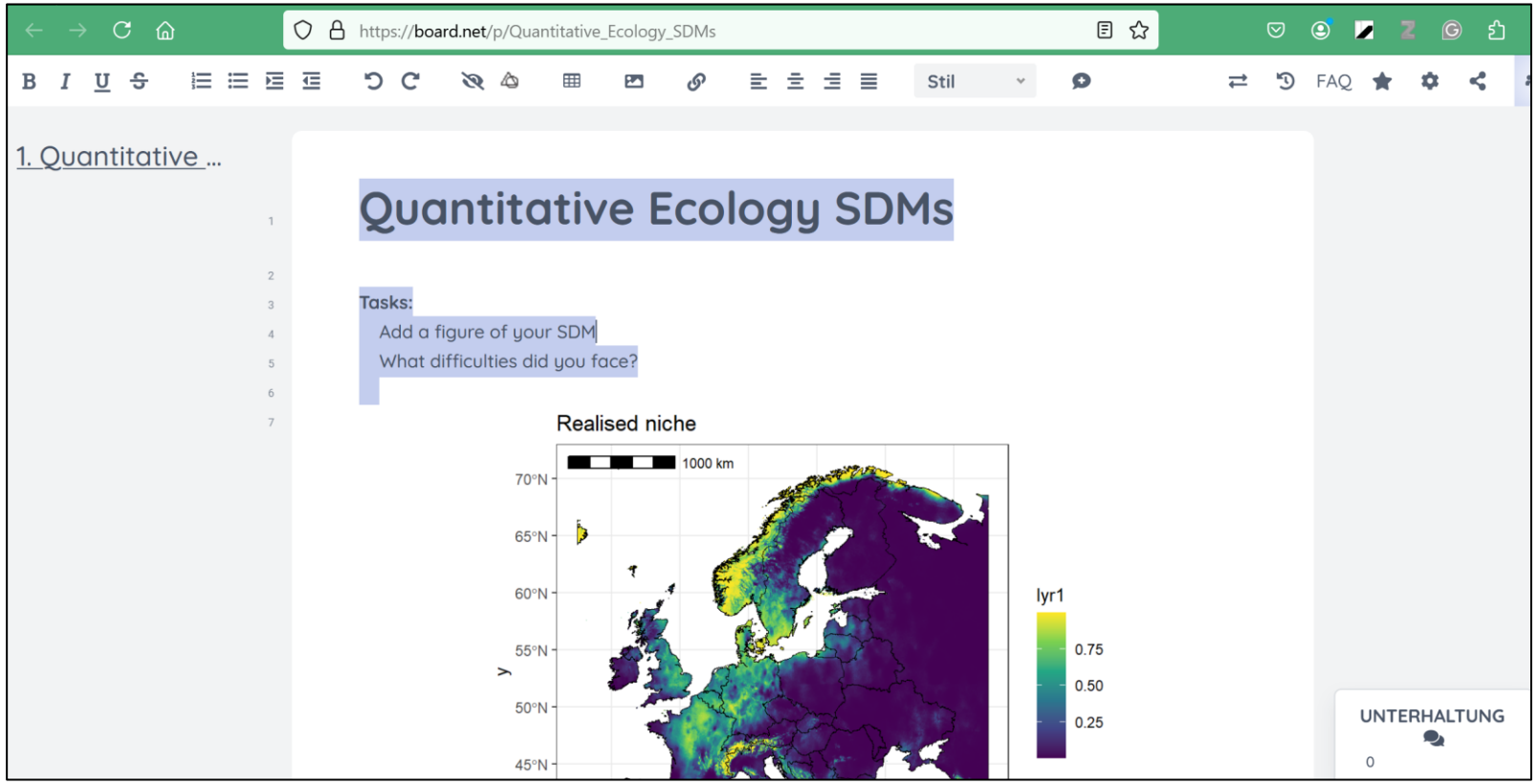
5 minutes activity break?

4. SDMs in R (live coding together)

Your turn!

4. SDMs in R (live coding together)

Your SDMs



https://board.net/p/Quantitative_Ecology_SDMs

Pros cons correlative SDMs

Think per share

1. Take **5 minutes** to think about the pros and cons of correlative SDMs **individually**.
2. Take **10 minutes** to discuss the topic in **groups of 2-3 people**.
3. Share your results in the **plenary**

Please note down your group results in the following etherpad:

https://board.net/p/Quantitative_Ecology_SDMs_pros_cons

Tutorials

- **A very brief introduction to species distribution models in R** by Jeff Oliver: https://jcoliver.github.io/learn-r/011-species-distribution-models.html
- **Introduction to species distribution modelling (SDM) in R** by Damaris Zurell: https://damariszurell.github.io/SDM-Intro/
- **Downloading and cleaning GBIF data with R** by A.M. Barbosa: https://www.r-bloggers.com/2021/03/downloading-and-cleaning-gbif-data-with-r/
- **Accessing, handling, and referencing open biodiversity data using the Global Biodiversity Information Facility (GBIF)** by Eric Kusch: https://www.erikkusch.com/courses/gbif/
- Joint Species Distribution Modeling in R with Hmsc: https://earthlab.colorado.edu/blog/joint-species-distribution-modeling-r-hmsc

R packages

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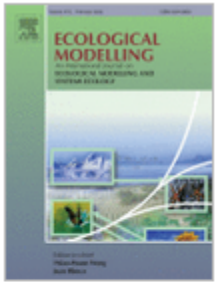
Ecological Modelling

Volume 476, February 2023, 110242



A curated list of R packages for ecological niche modelling

Neftalí Sillero [a], João Carlos Campos [a], Salvador Arenas-Castro [b], A.Márcia Barbosa [a]

Sillero, 2023

Questions?

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Thank you!

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