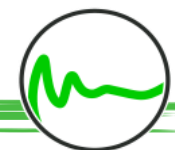


Welcome to the Science School on Quantitative Ecology!

Species Distribution Modelling I & II

Dr. Anna Walentowitz

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biogeografie
uni bayreuth

Bayceer
Bayreuth Center of Ecology
and Environmental Research

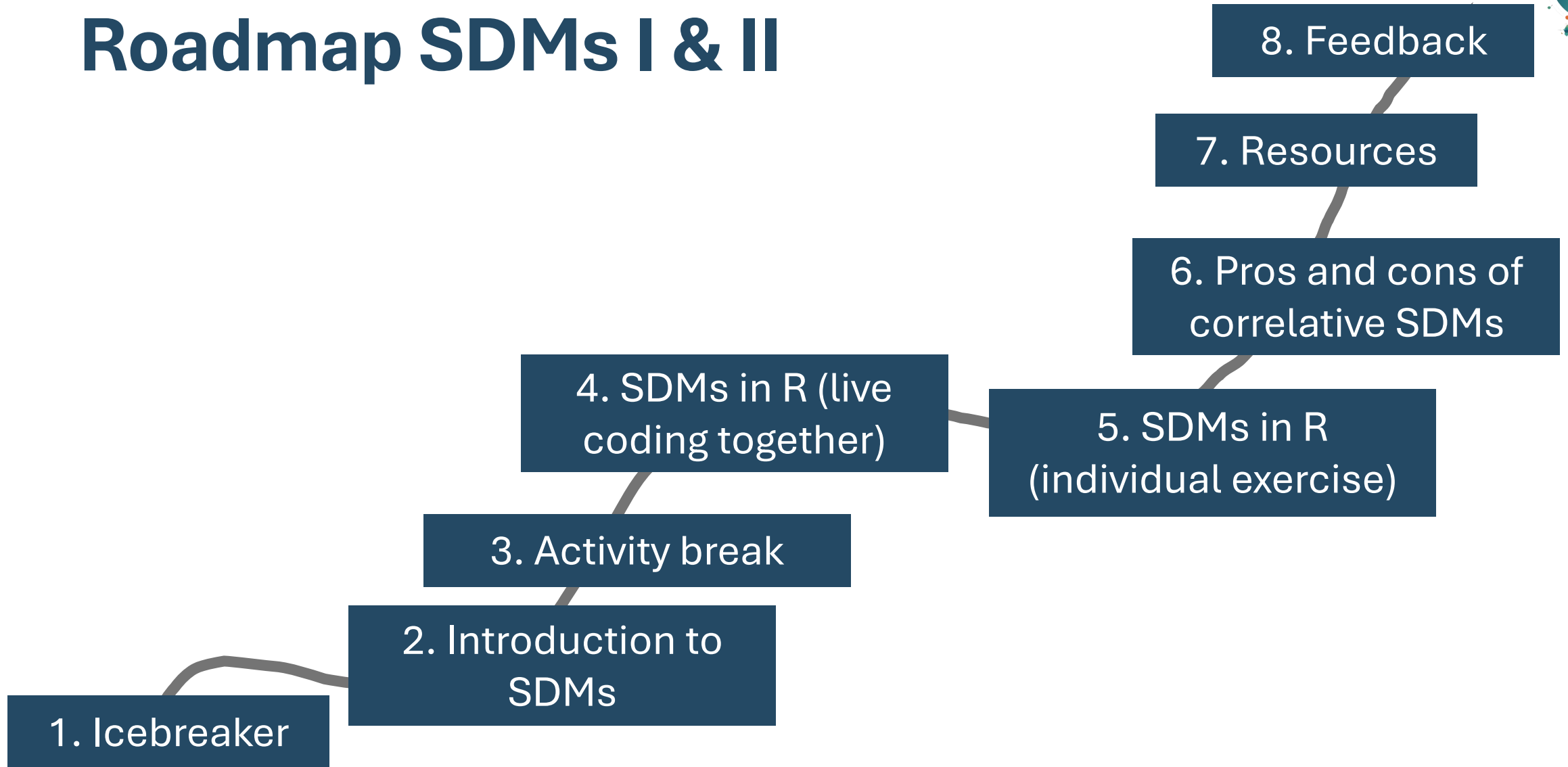


Aims of SDM I & II

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

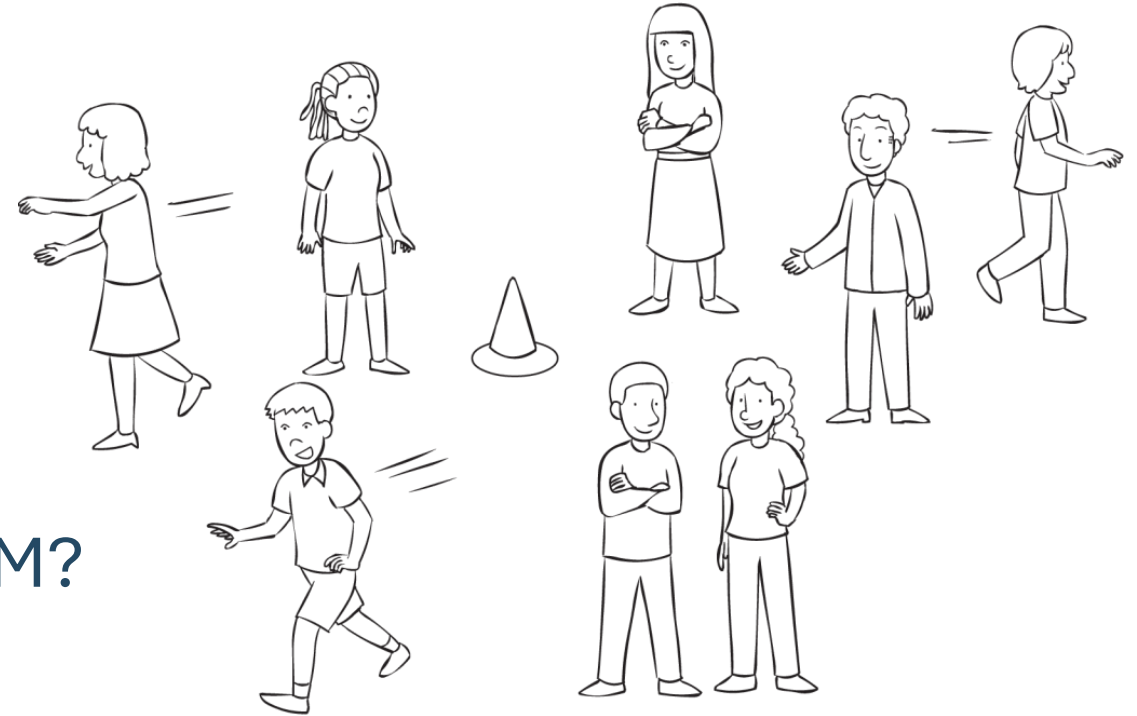




Icebreaker – group map

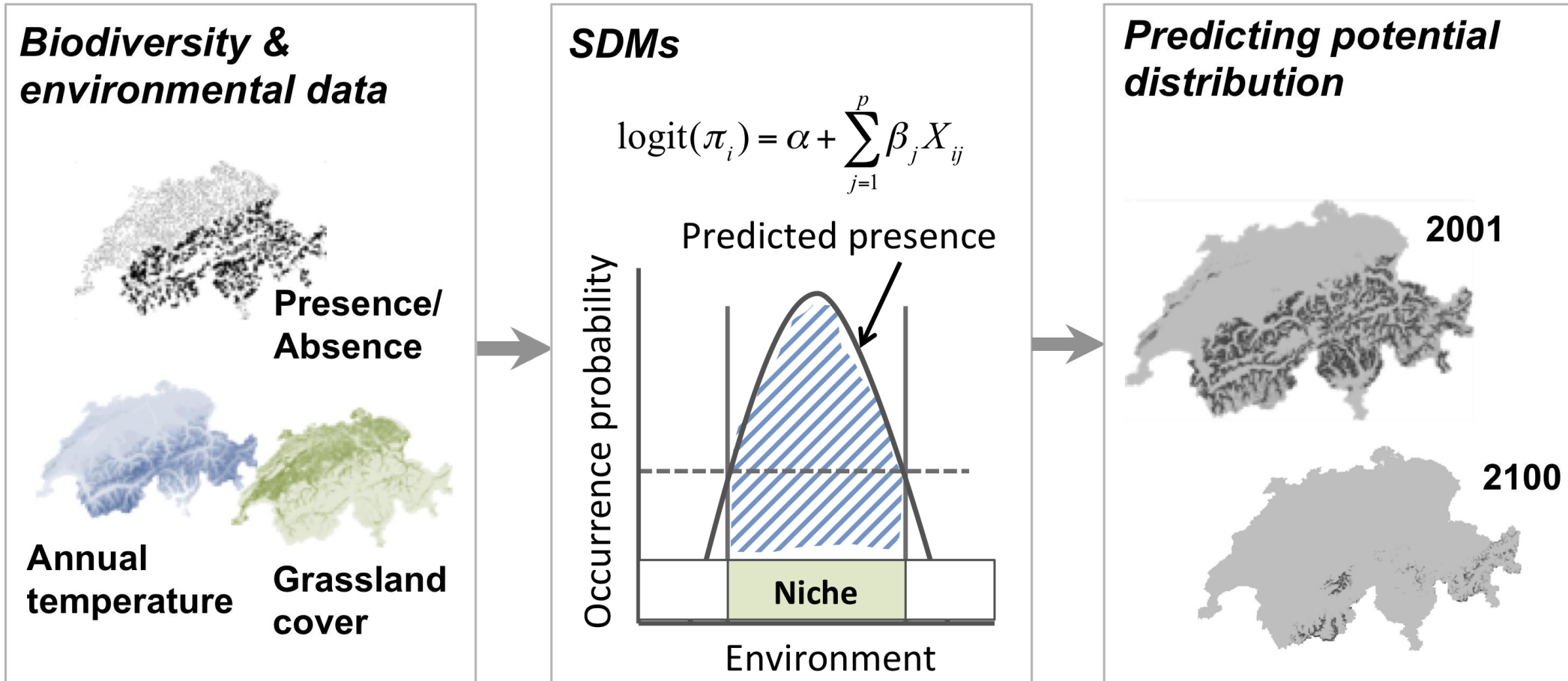
Activity: move in the room

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





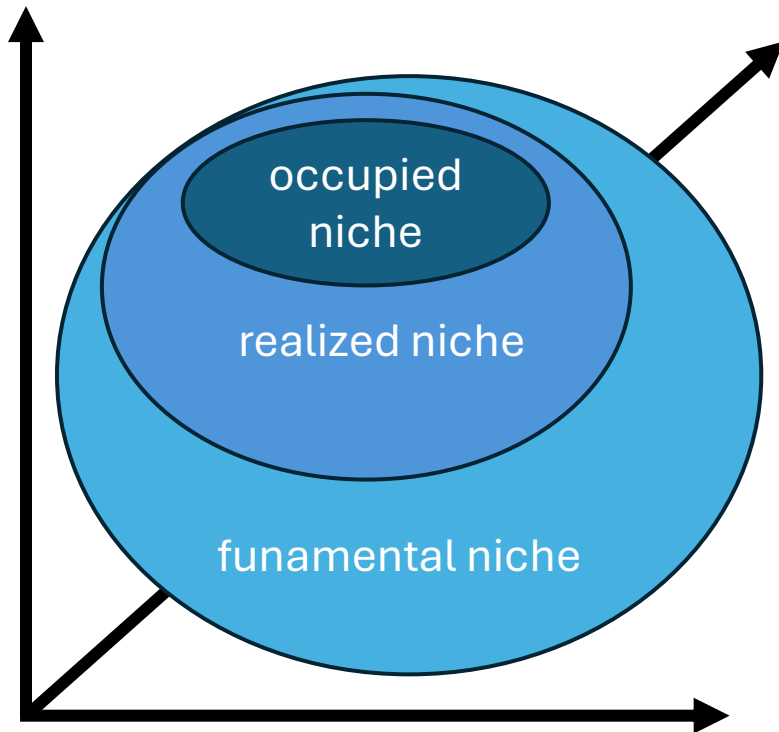
Main components of a SDM (correlative)



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



2. Introduction to SDMs

The variability of SDMs - examples

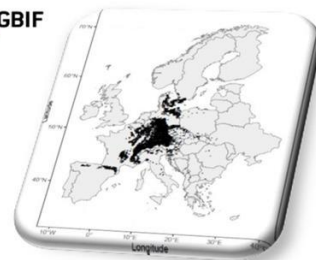
Predicting into the future

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

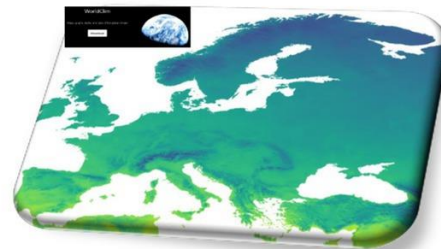


Species distribution modelling (ensemble approach)

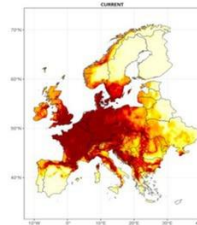
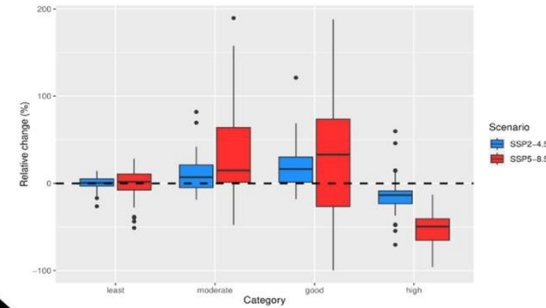
Occurrence records from GBIF database



Bioclimatic variables from WorldClim database

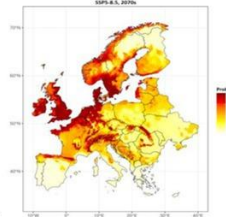


Climatic suitability is predicted to decrease in the future



strong northward shift

changes depend on biogeographic attributes of species



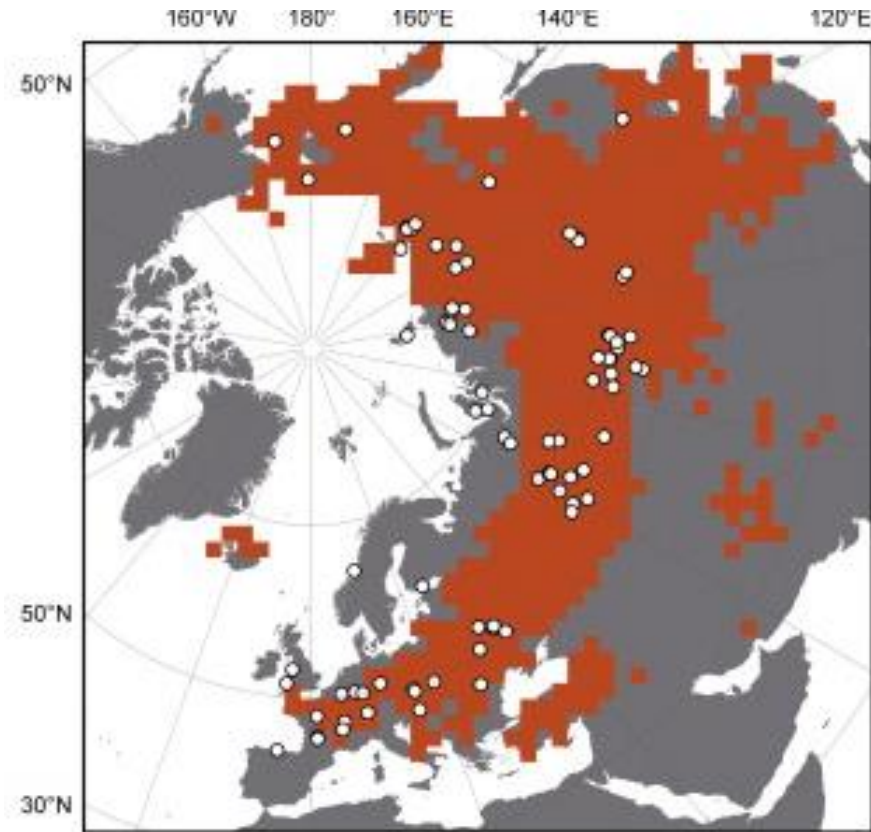
- Climatic suitability for European beech forest herbs under climate change

Kermavnar et al., 2023



The variability of SDMs - examples

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

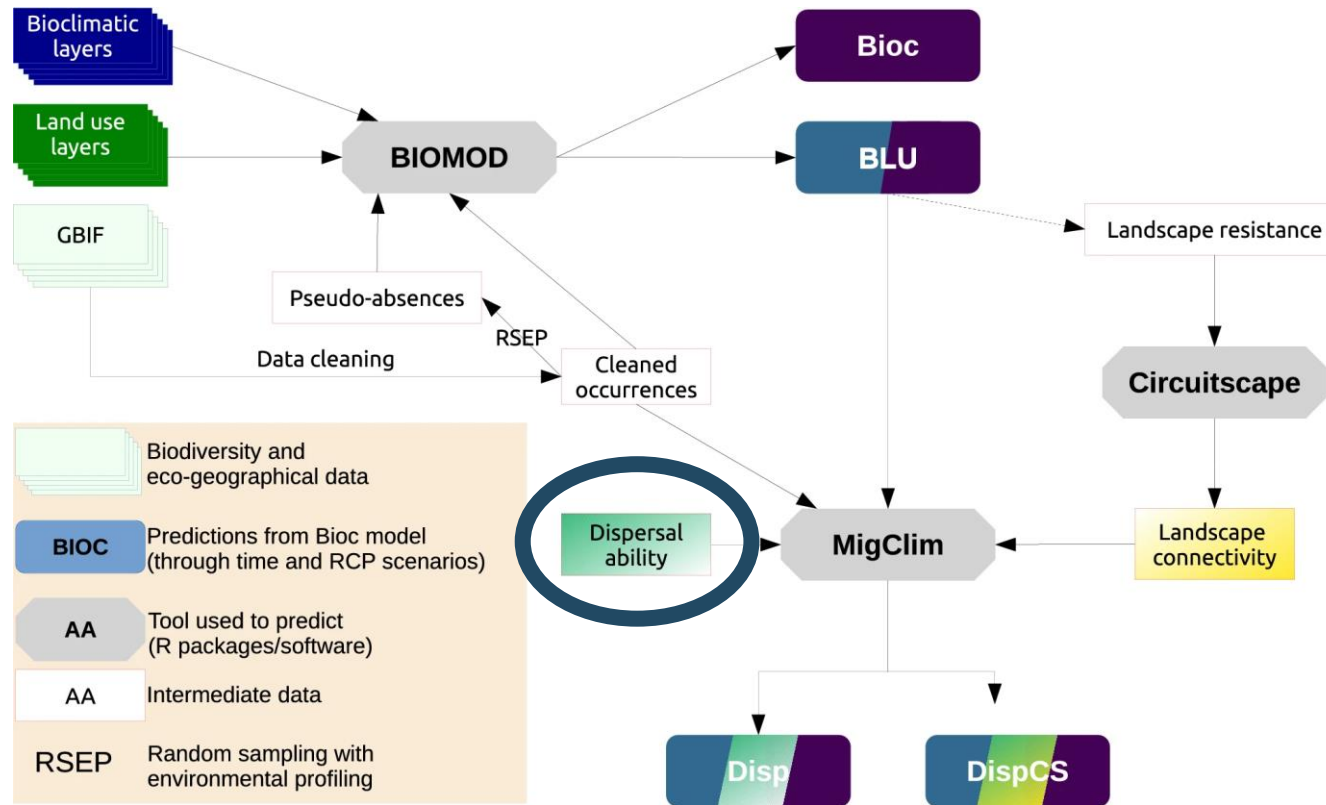


2. Introduction to SDMs

The variability of SDMs - examples

Including dispersal

- Predictions of SDM in predatory arthropods in Europe

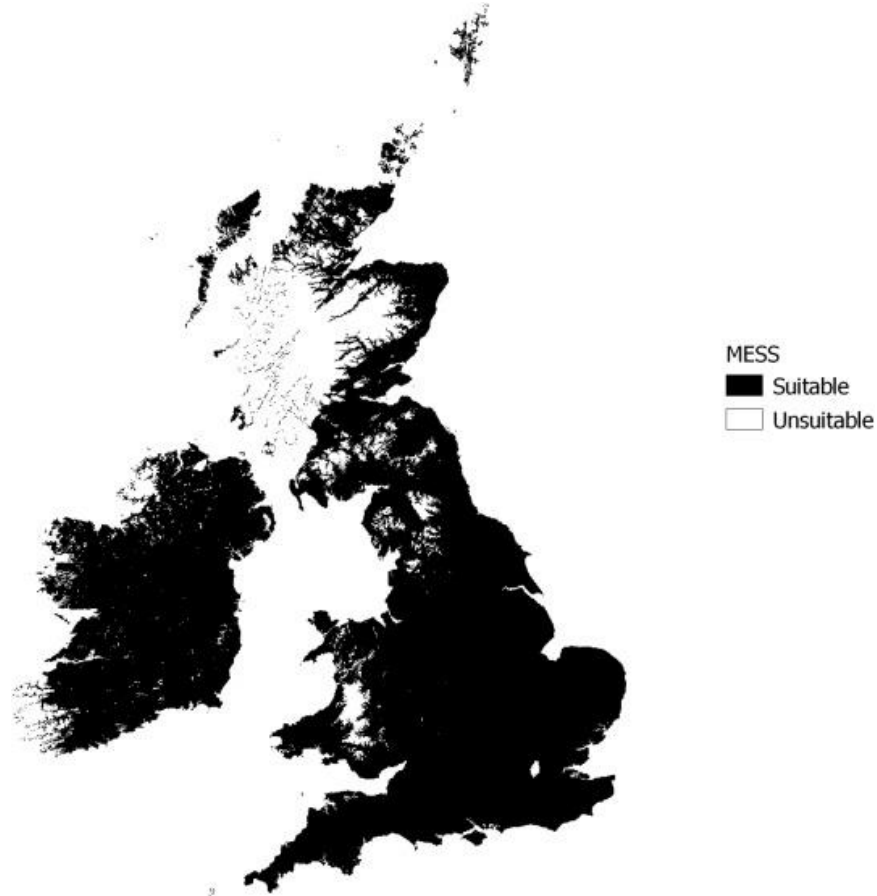


Monsimet et al., 2020



The variability of SDMs - examples

invasive species distribution model (iSDM)



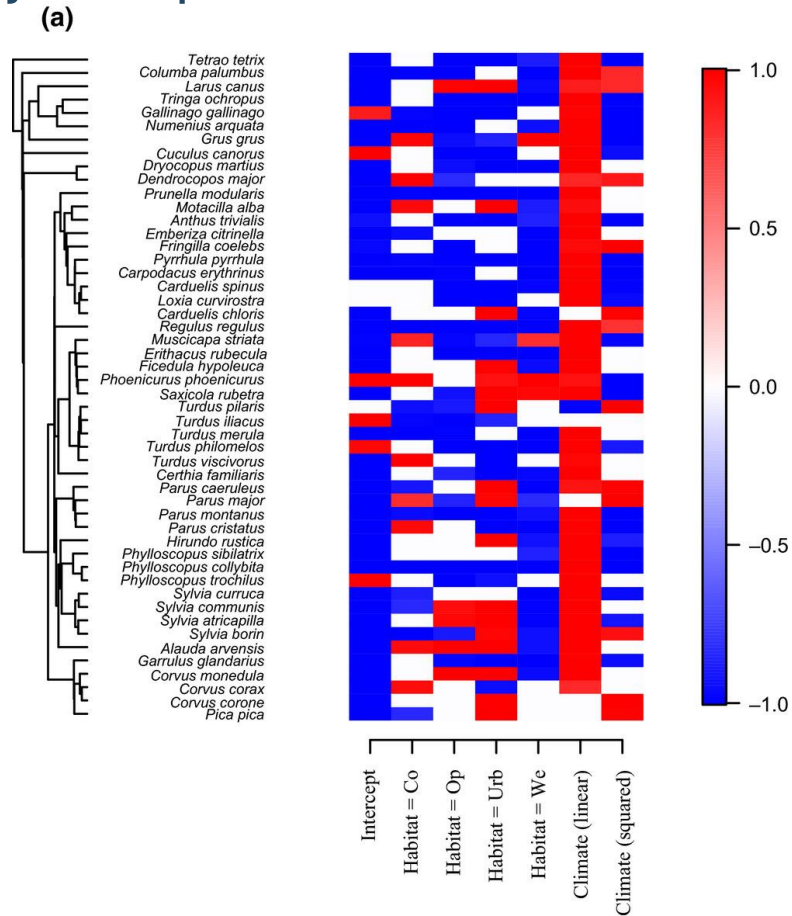
- Predicting the range of muntjac deer in Britain and Ireland
- Incorporation of non-equilibrium bias and survey effort in presence-only iSDM



2. Introduction to SDMs

The variability of SDMs - examples

joint species distribution model (jSDM)



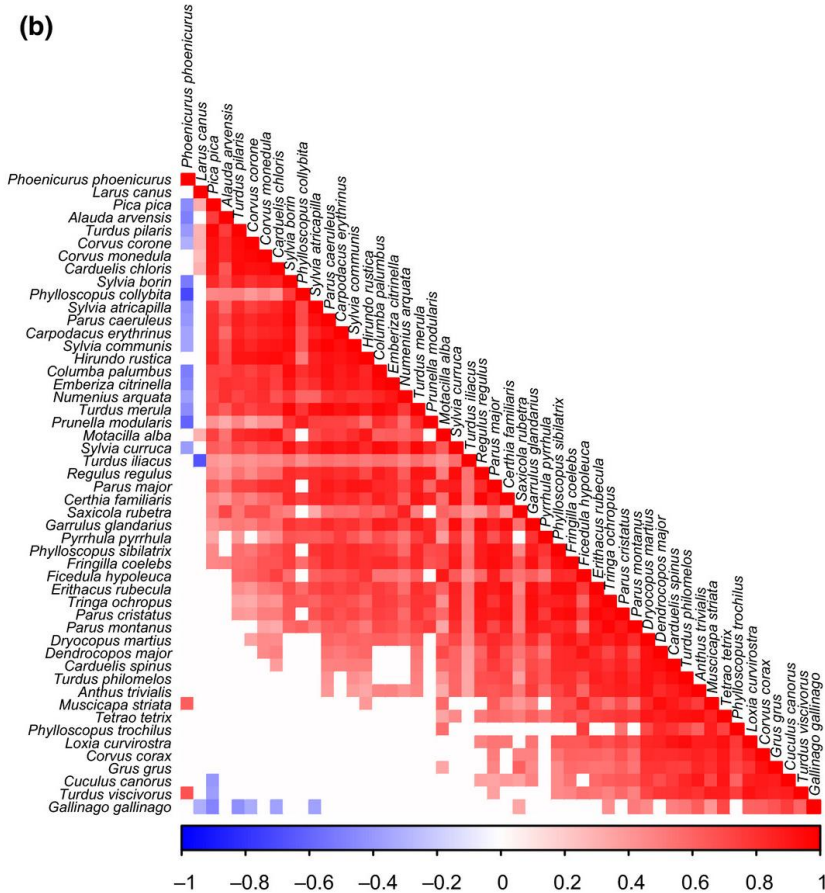
Include species responses to environmental covariates...



The variability of SDMs - examples

jSDM

(b)



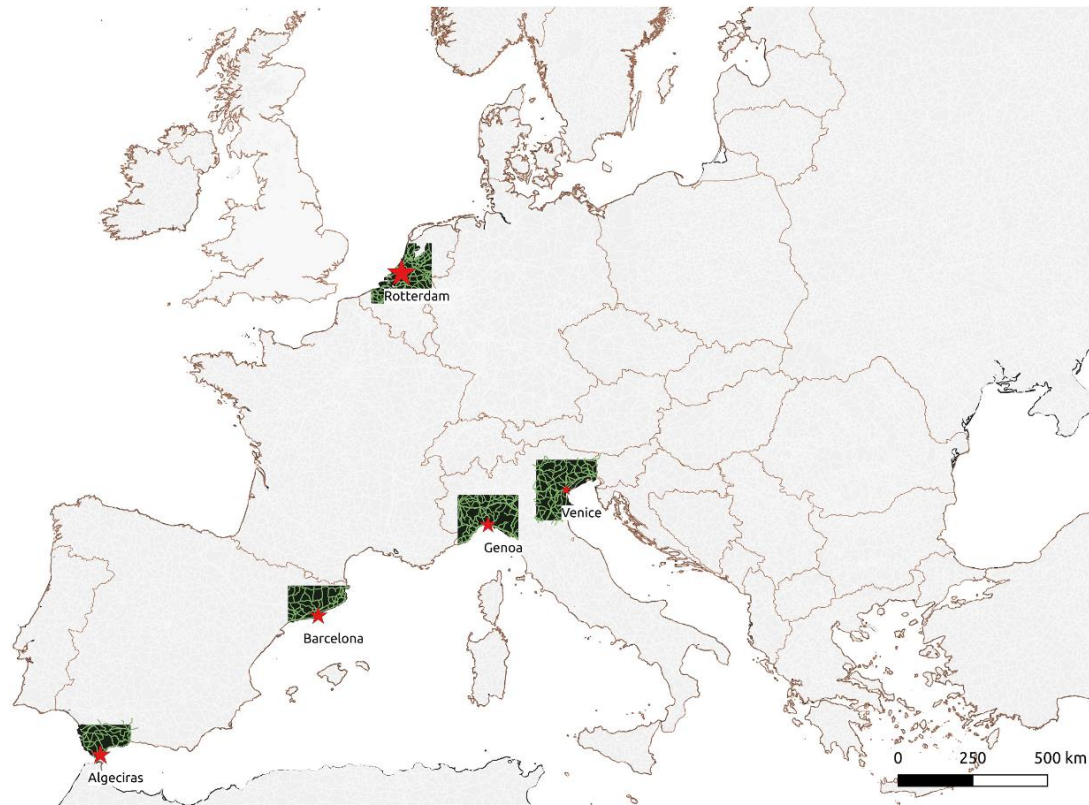
... and species' associations based on residuals.



2. Introduction to SDMs

The variability of SDMs - examples

process-based model



Aedes aegypti



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

Ae. aegypti is a potential vector of yellow fever.

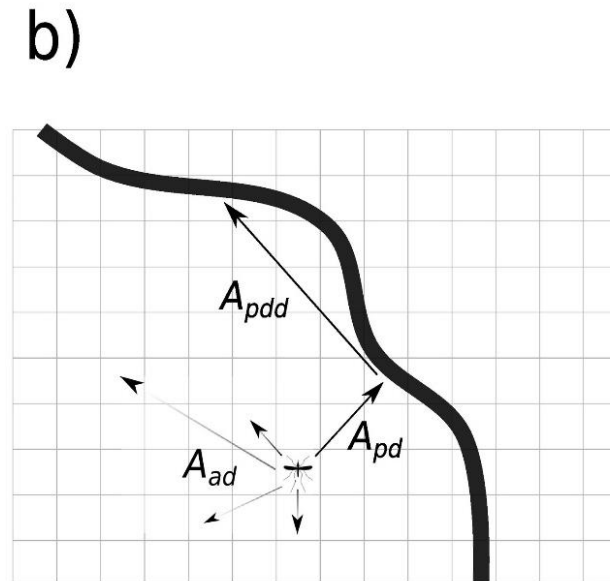
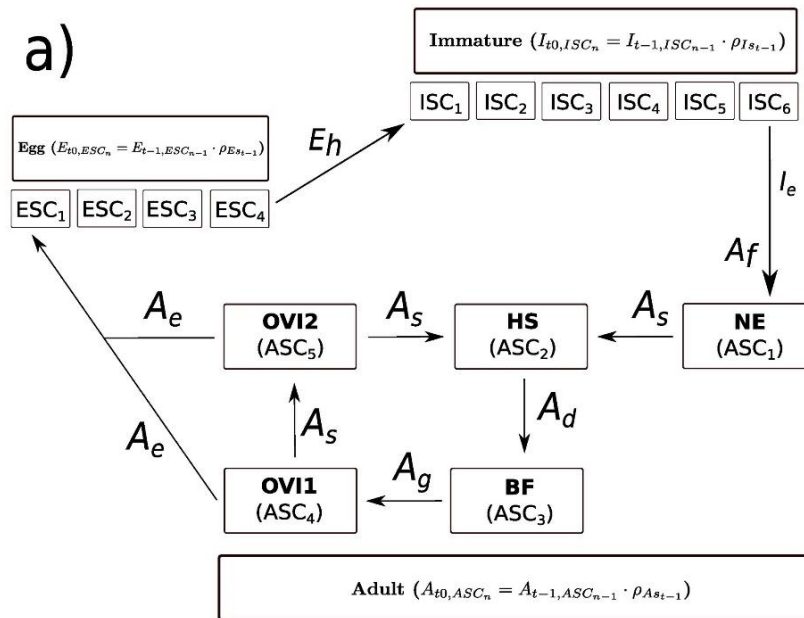
Da Re et al., 2021



2. Introduction to SDMs

The variability of SDMs - examples

process-based model



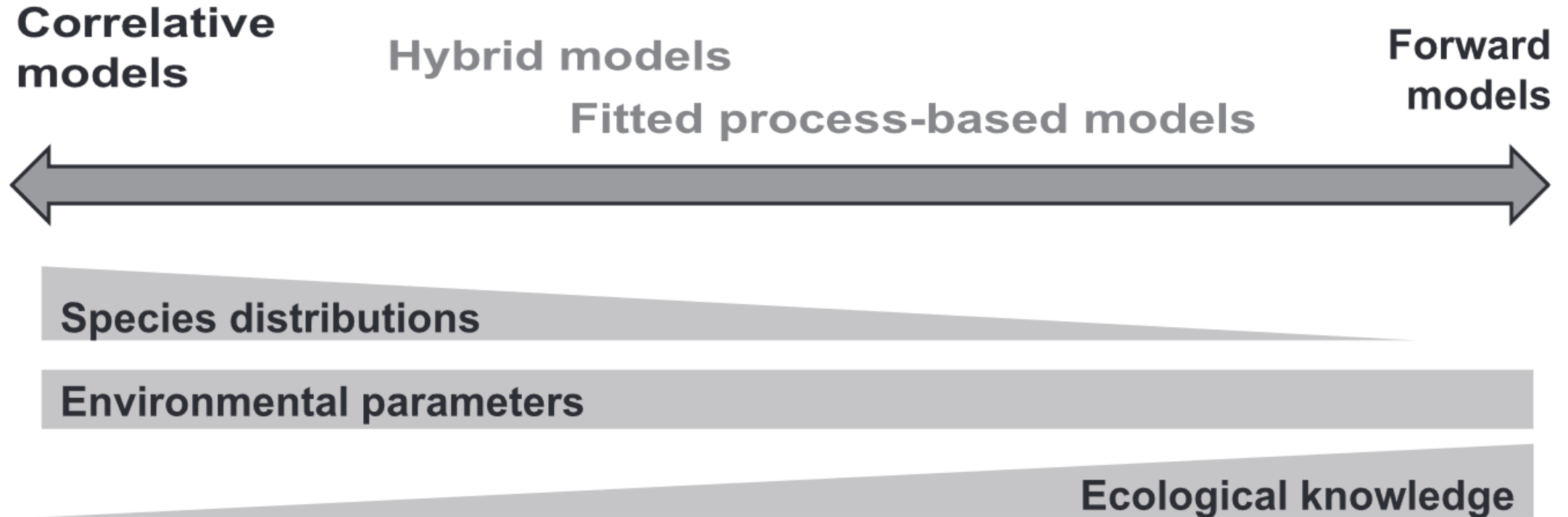
Modeling the life cycle...

... and dispersal.

Da Re et al., 2021



Correlative vs. process-based models

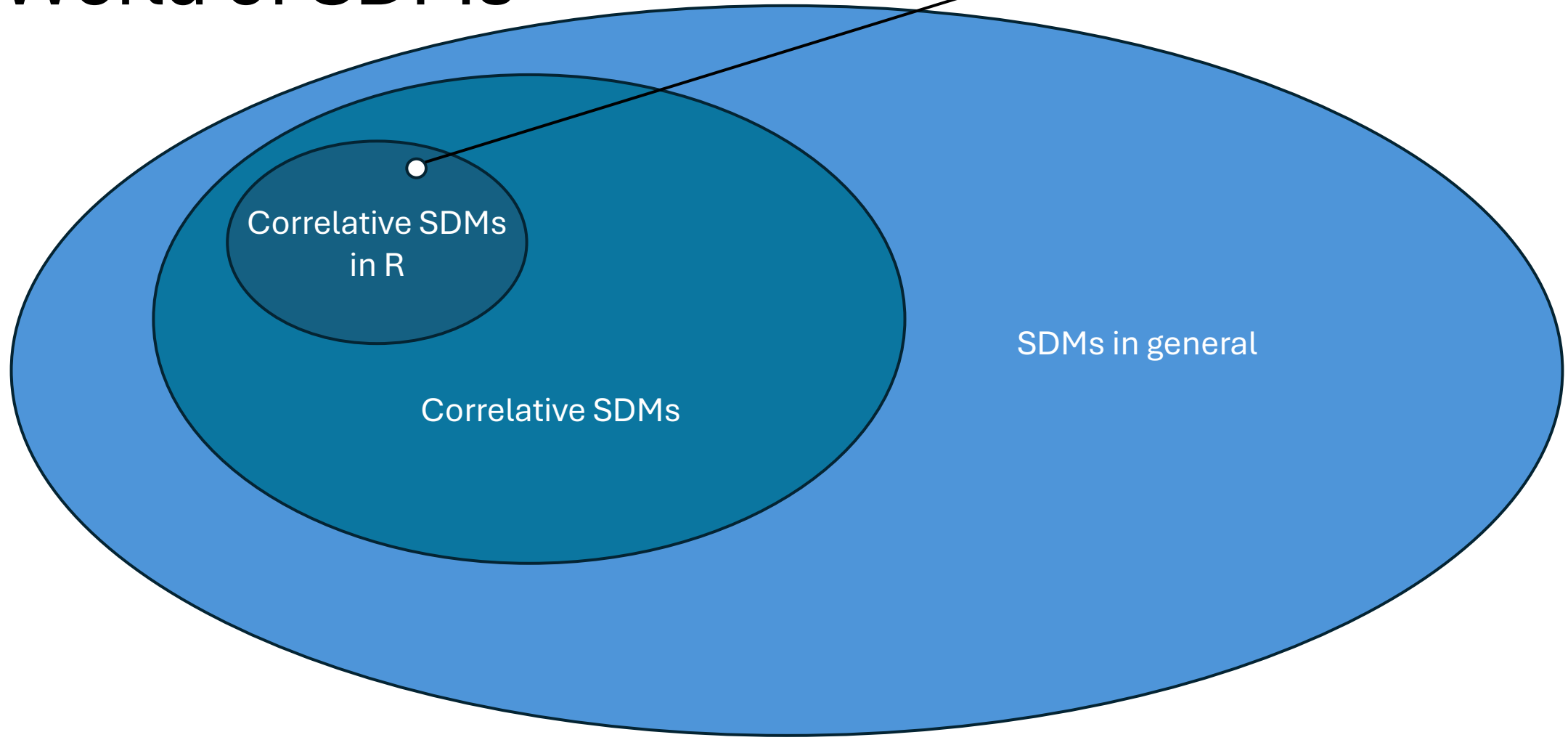


Dormann et al., 2011



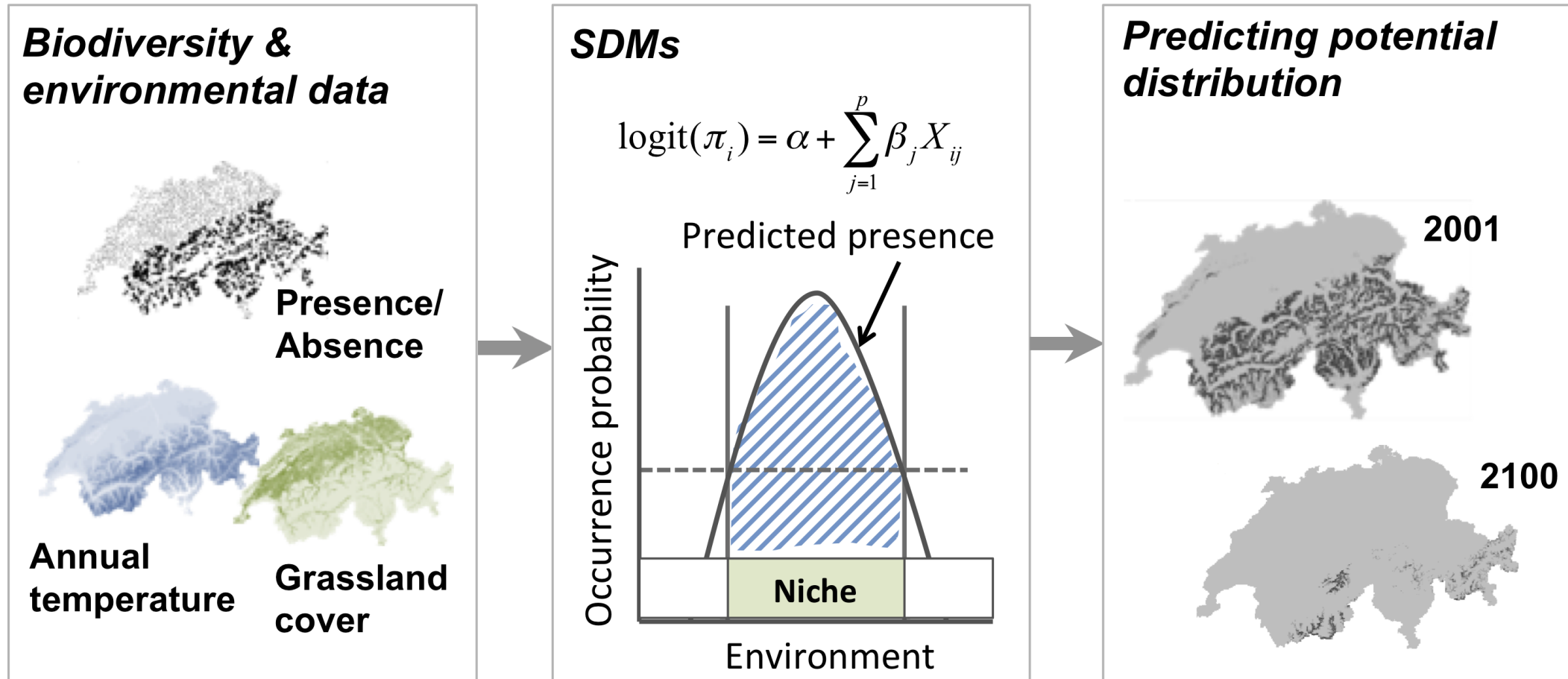
World of SDMs

What we will cover today





Our goal: build simple correlative SDM



Zurell, 2022

Questions?



5 minutes activity break?



ARE YOU READY
TO MOVE?

4. SDMs in R (live coding together)

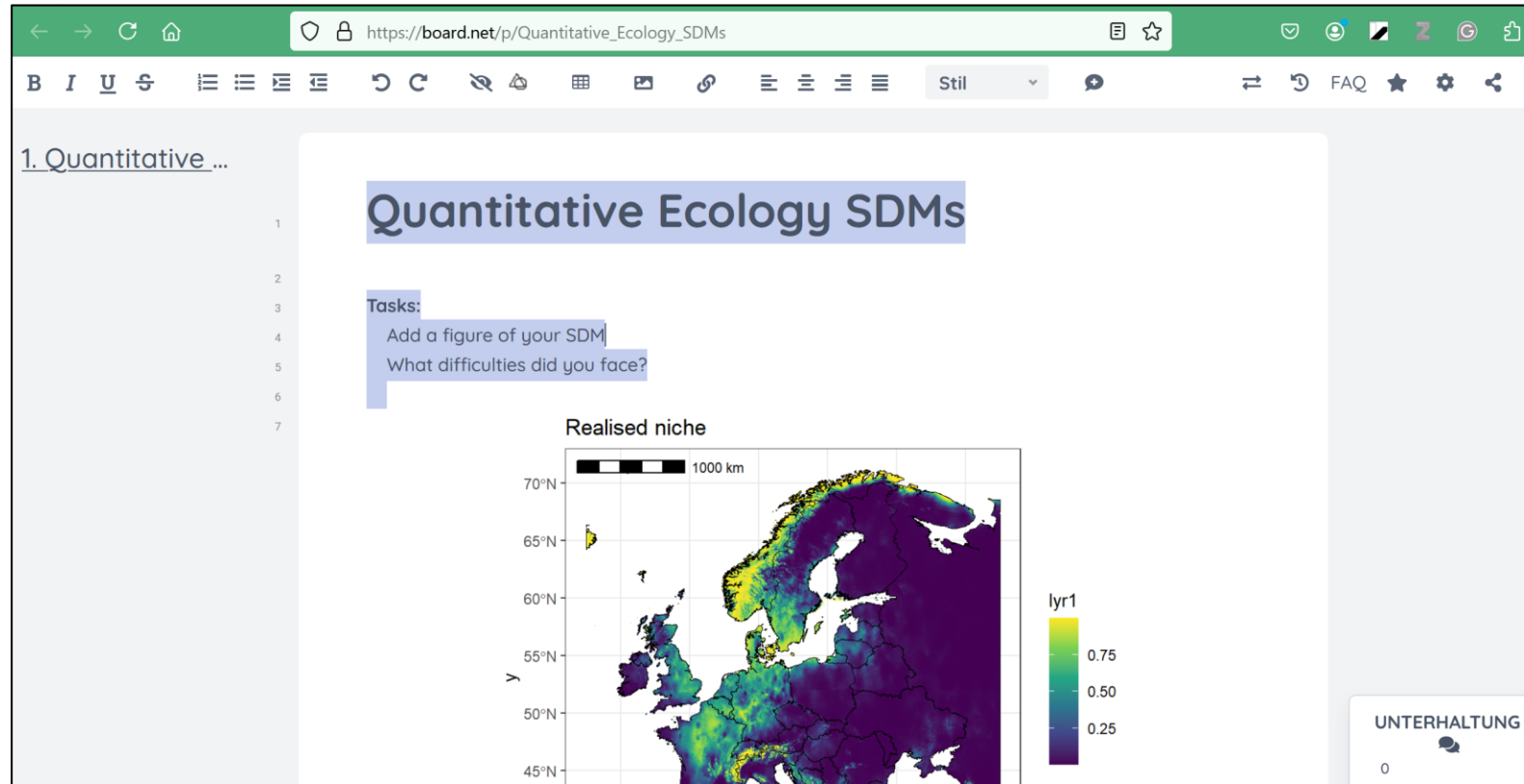


You  turn!



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

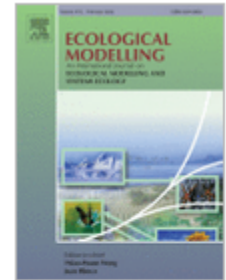
- **A very brief introduction to species distribution models in R** by Jeff Oliver: <https://jcoliver.github.io/learn-r/011-species-distribution-models.html>
- **Introduction to species distribution modelling (SDM) in R** by Damaris Zurell: <https://damariszurell.github.io/SDM-Intro/>
- **Downloading 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





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?



Thank you!