WHAT ARE SDM?

Tuesday 3rd, September
Guillaumot Charlène
charleneguillaumot21@gmail.com

OUTLINE OF THE COURSE

What are SDM?	[9:00 – 10:00]
Review of SDM applications	[10:15 – 11:15]
Practice ! Prepare the afternoon exercises	[11:30 – 12:30]
Run a simple SDM, understand SDM outputs	[13:30 – 15:00]
Calibration: the most important you should know	[15:15 – 17:30]
Introduction to different SDM algorithms	[09:00 – 10:00]
Questions and final practice	[10:30 – …]

WHAT ARE SDM?

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SDM: Species Distribution Models

Models that evaluate the probability of a species to be distributed in an environment characterised by its own conditions

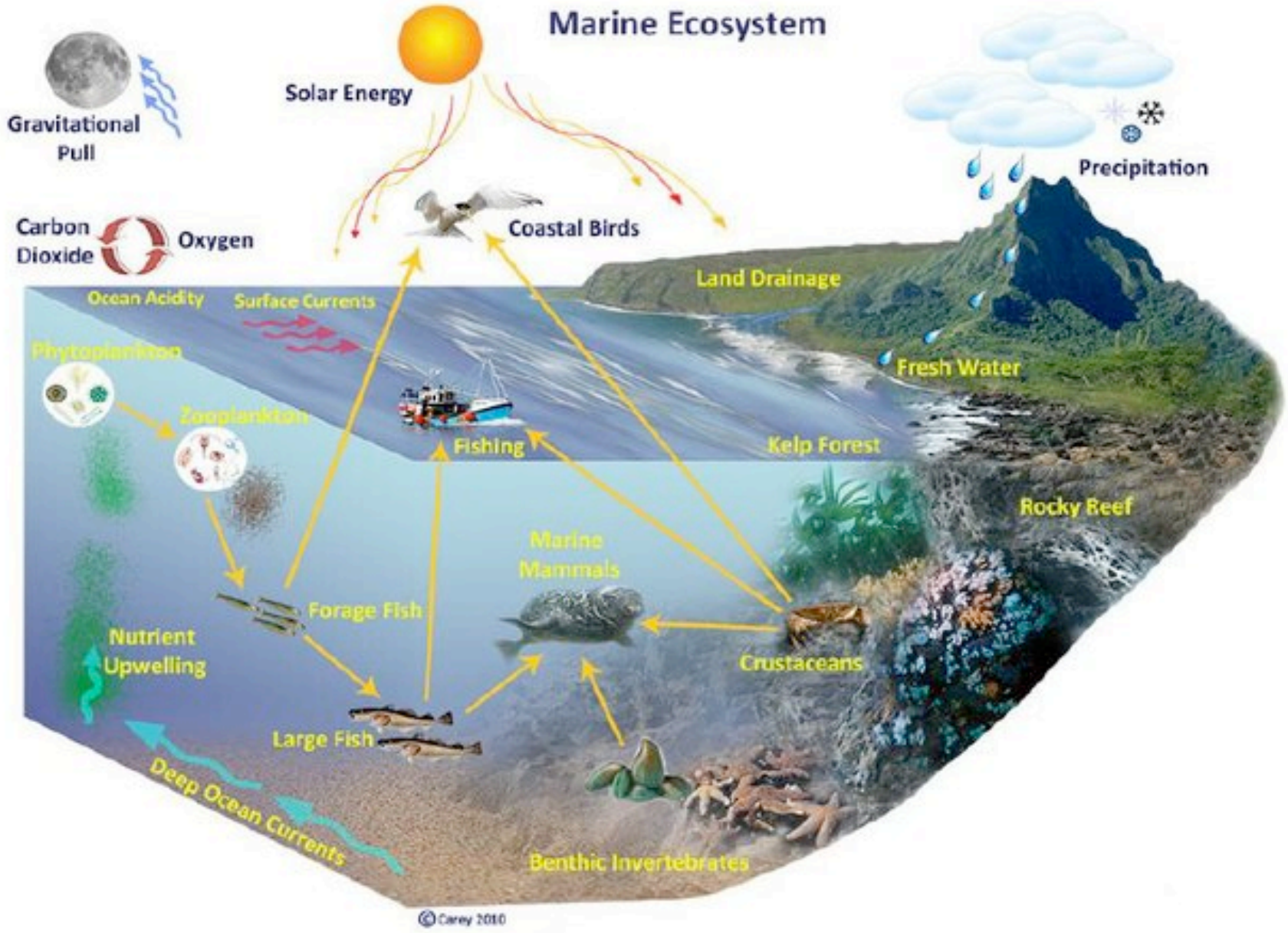
A.K.A. Climate envelope modelling, habitat modelling, environmental/ecological niche modelling

WHY DO WE USE MODELS?

- Simple and fast way to get an idea of the potential distribution of a species
- Models and outputs are generally easy to interpret

But… be careful...models are wrong !

"all models are wrong; some are useful....the practical question is how wrong do they have to be to not be useful » G. Box



Richard et al. 2013 (MariNet)

SPECIES DISTRIBUTION MODELS principle

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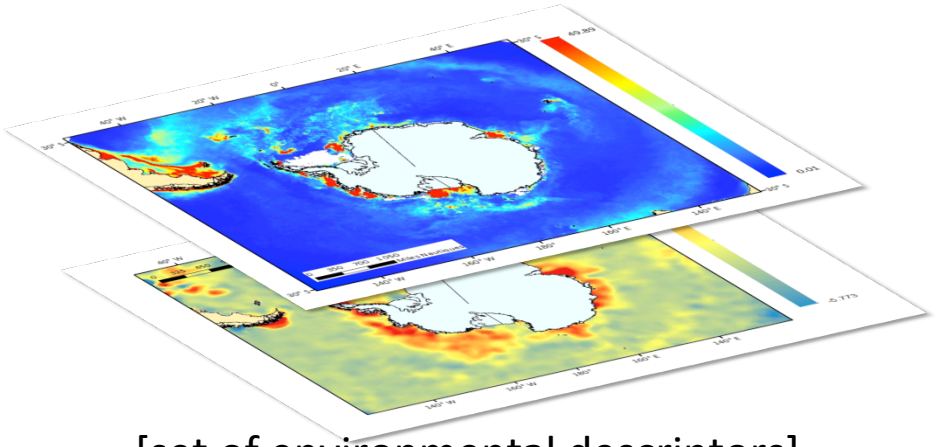
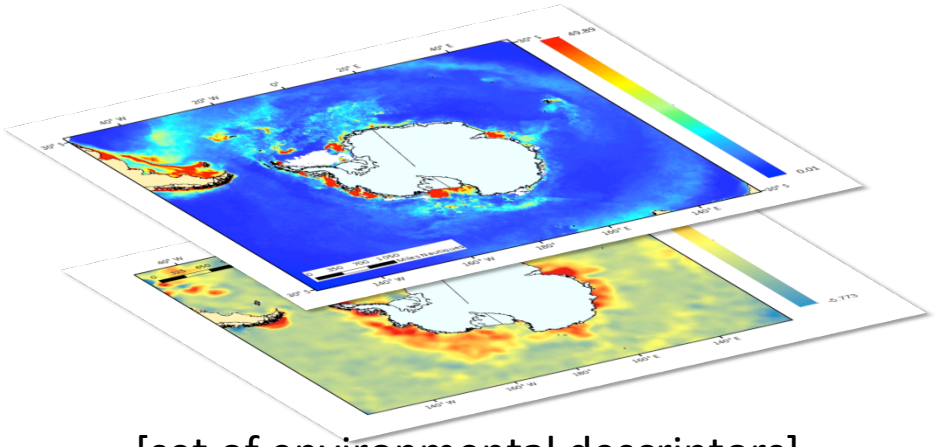


[set of environmental descriptors]

SPECIES DISTRIBUTION MODELS principle



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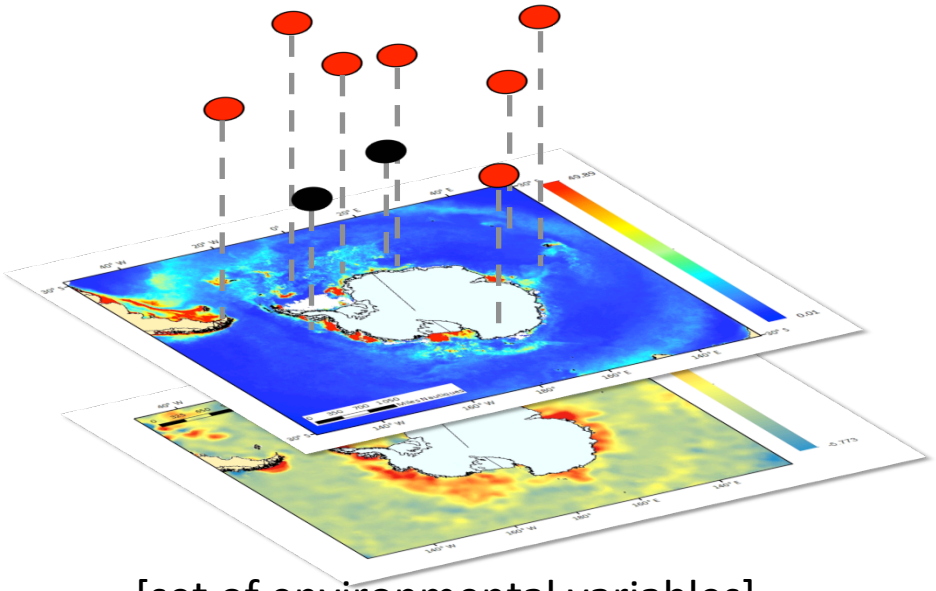
Variables // covariates

SPECIES DISTRIBUTION MODELS principle

[presence + absence records]



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SPECIES DISTRIBUTION MODELS principle

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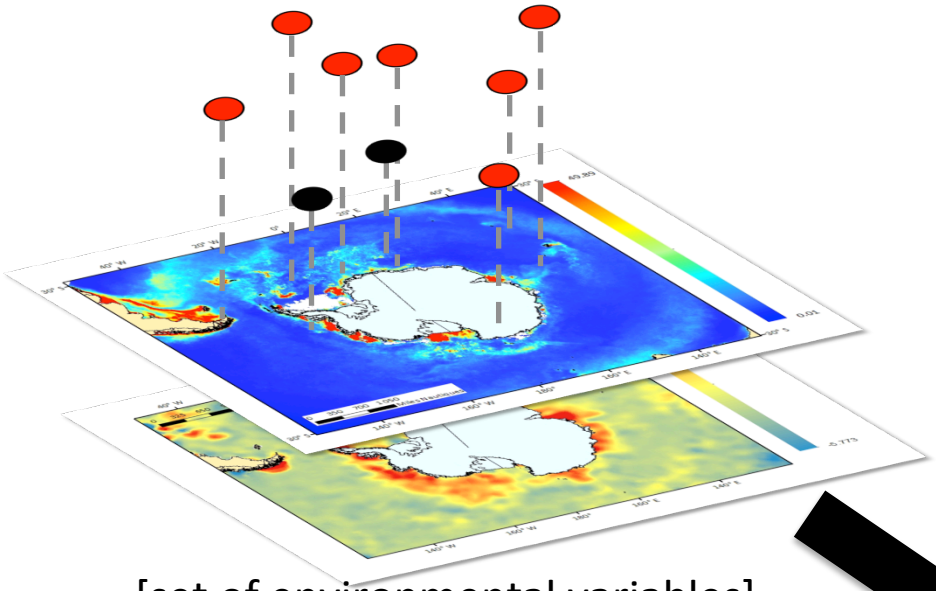
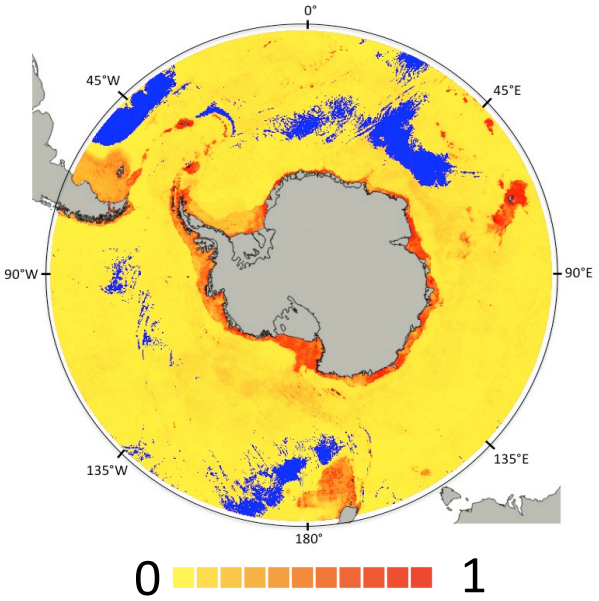


[set of environmental variables]

SDM

[Predicted distribution]



SPECIES DISTRIBUTION MODELS principle

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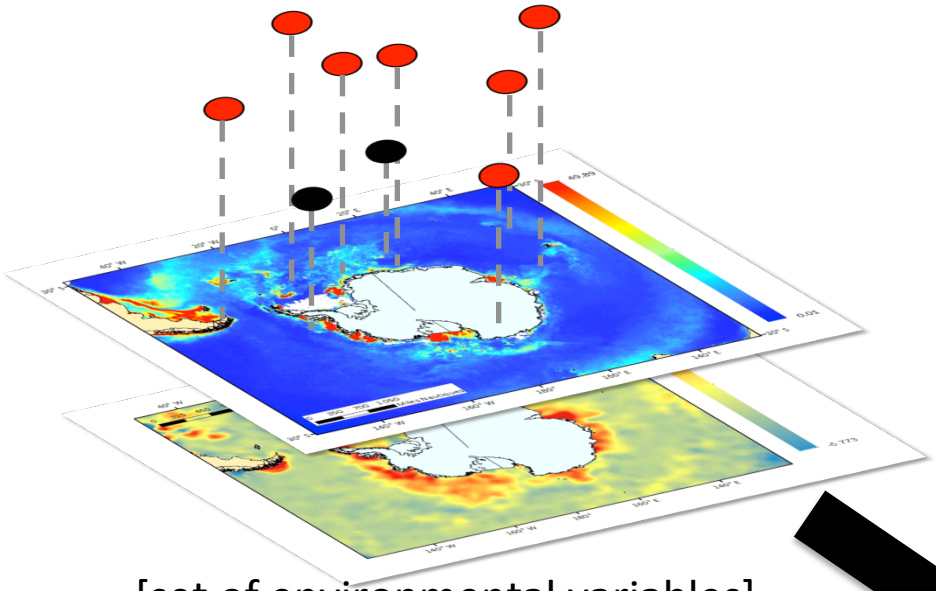

[set of environmental variables]

Presence / absence?	Layer 1 e.g. Depth	Layer 2 e.g. T°	Layer 3 e.g. Salinity
1	-351	0.2	32.4
1	-150	-1.4	32.1
0	-1053	-2	32.8
1	-3042	0.3	31.9
…	…	…	…

SDM

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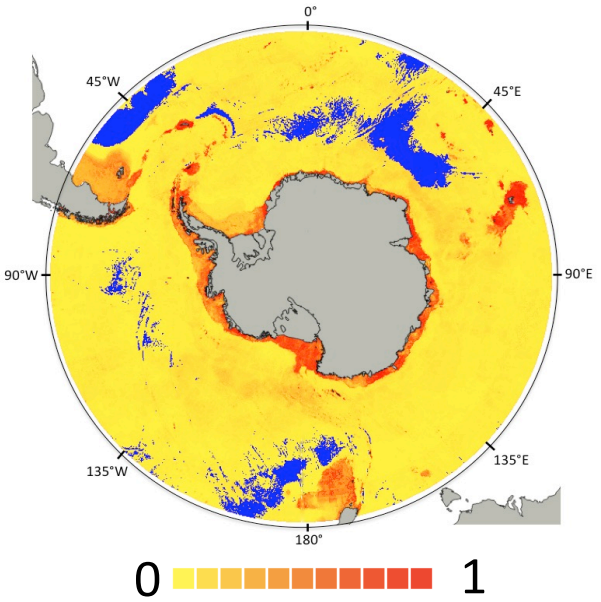


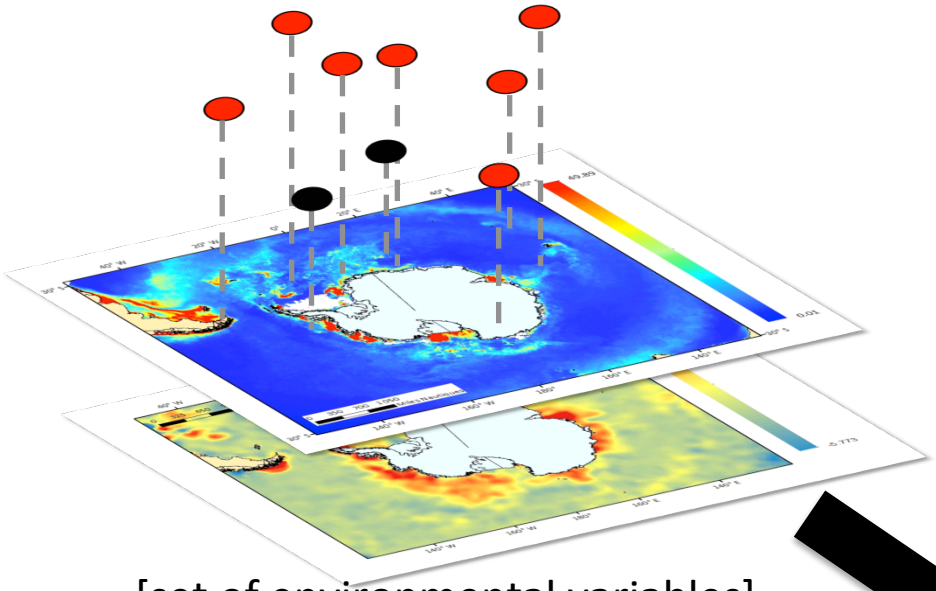
Y ~ f(X)

Y = P/A records
X = Environmental covariates (descriptors)

Function could be linear / non-linear

SPECIES DISTRIBUTION MODELS principle

[presence + absence records]



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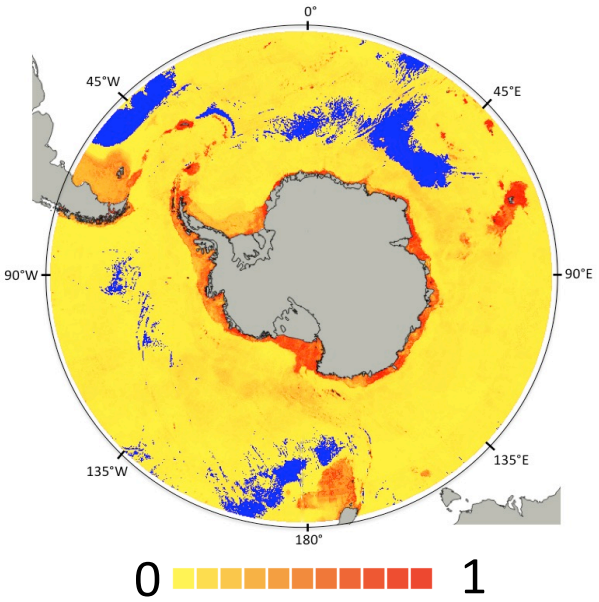

- Statistical / correlative relationship
- Easy to compute
- Several algorithms = several ways of relating occurrence & envi. covariates

SPECIES DISTRIBUTION MODELS principle

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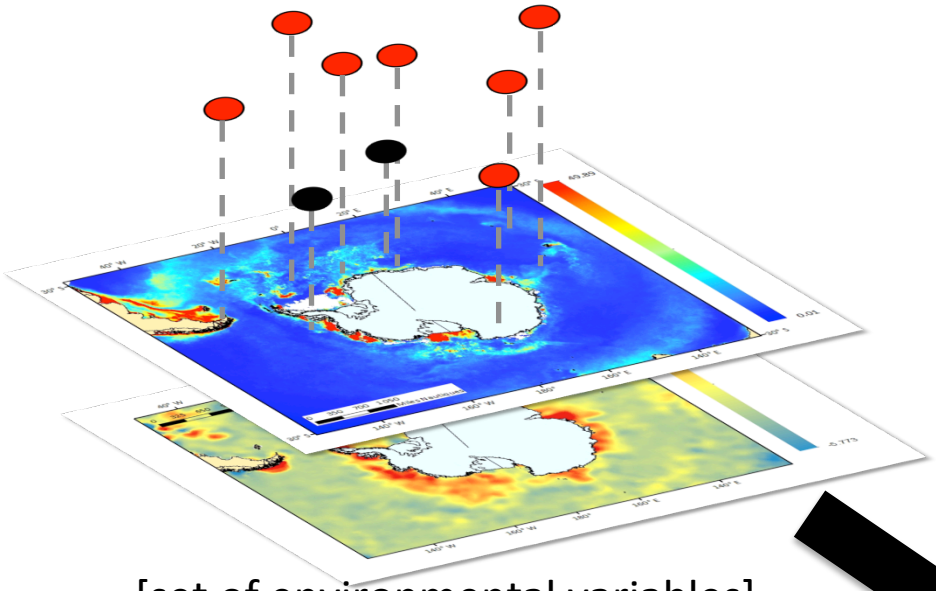

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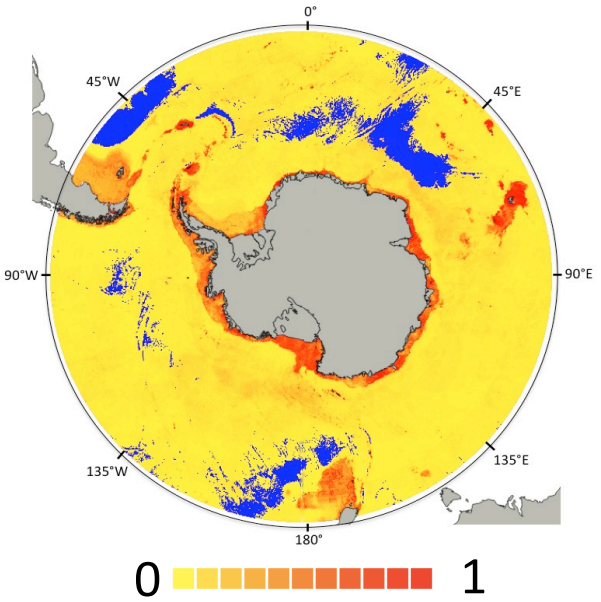
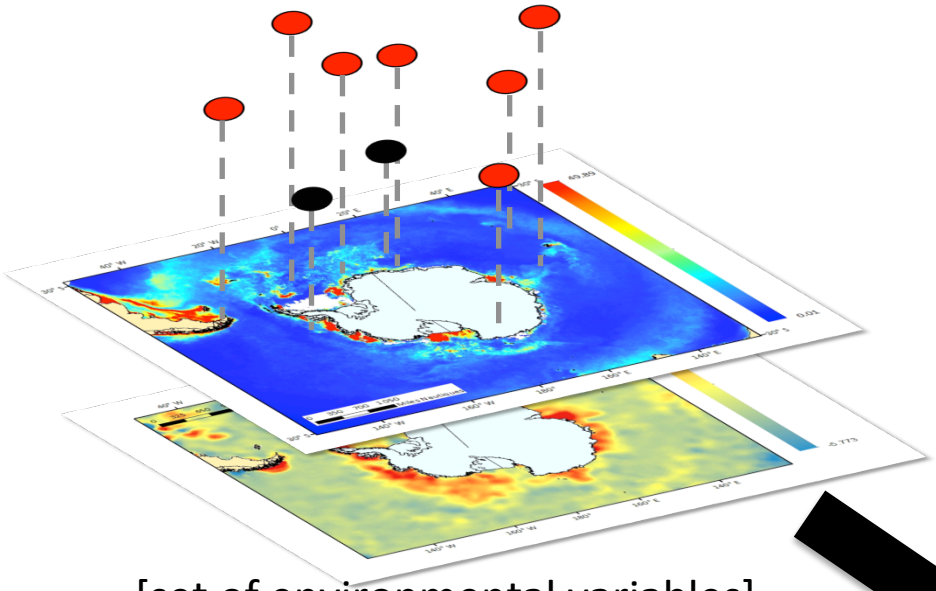


INPUTS

- Presence + absence data
- Presence-only data + background
- Abundance data

SPECIES DISTRIBUTION MODELS principle

[presence + absence records]



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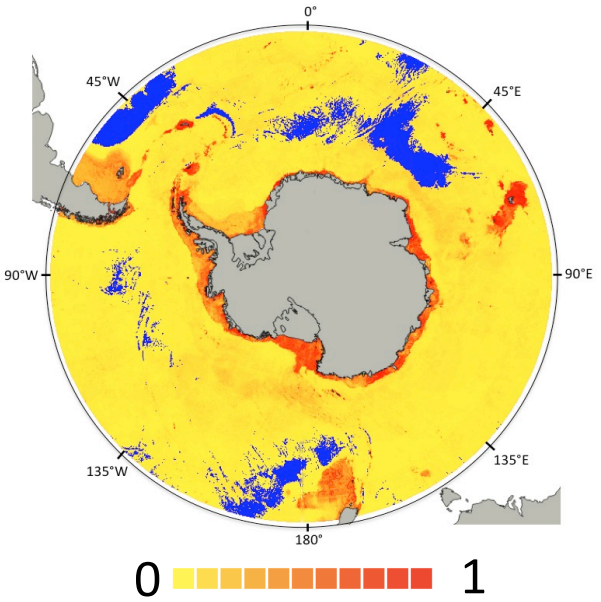


OUTPUTS

- Map of probabilities of distribution
- Lot of other things ! (see this afternoon!)

INTRODUCTIVE LITERATURE

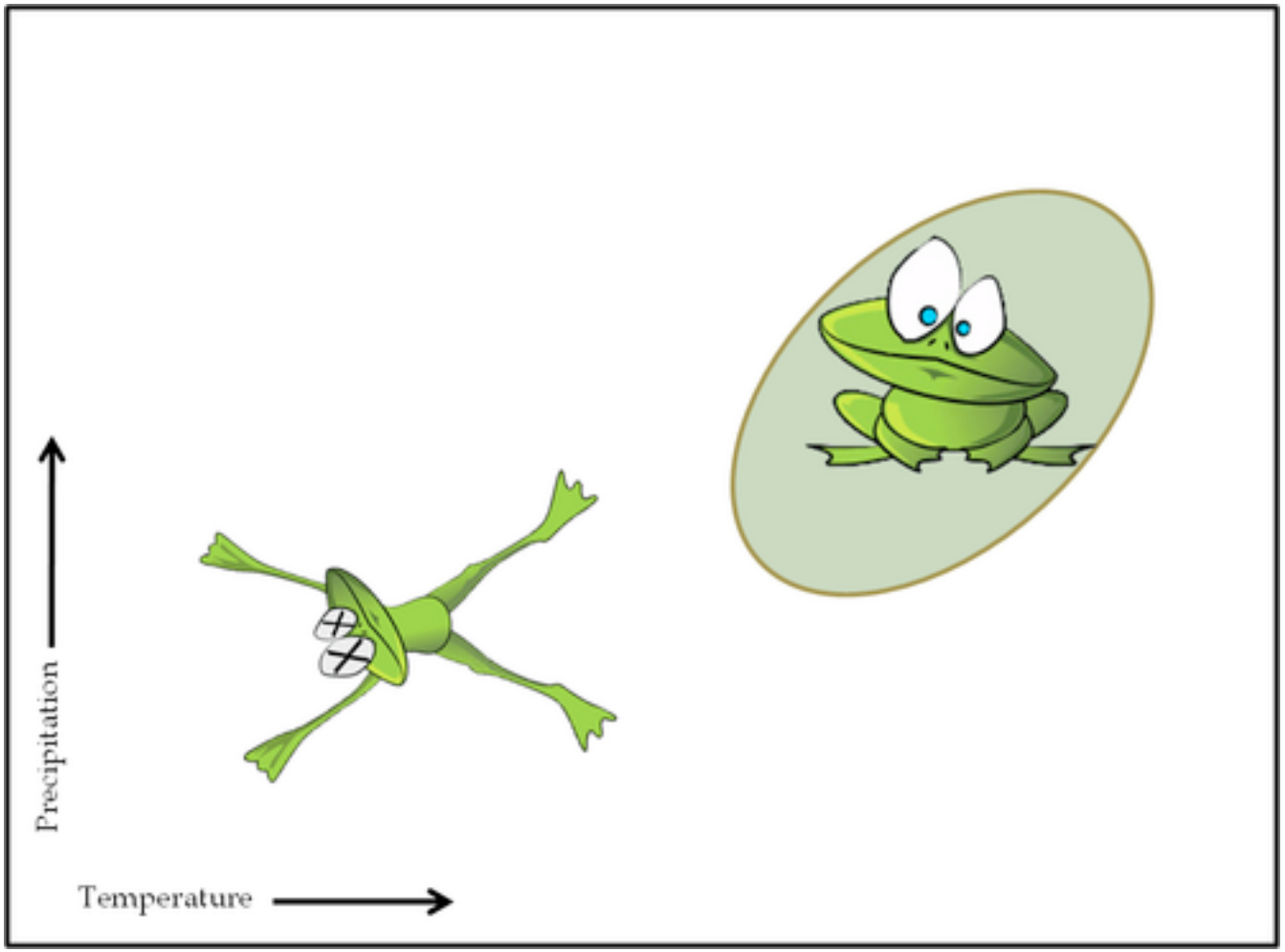
- Elith et al. 2006
- Araujo & Guisan 2006
- Elith & Leathwick 2009
- Guisan & Zimmermann 2000
- Peterson 2011

[all the publications in https://github.com/SCAR/EGABIcourse19/Literature]

Have also a look at 'dismo', 'raster', 'biomod' R packages -> functions and tutorials

** A very good tutorial for SDMs in R can be found at:
https://rspatial.org/sdm/index.html

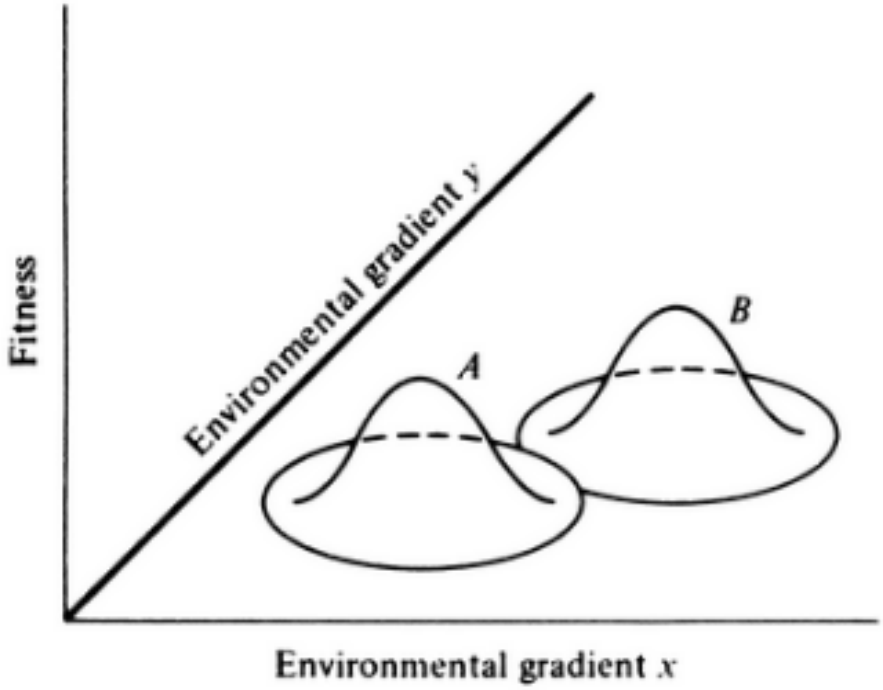
RELATIONSHIP TO NICHE THEORY

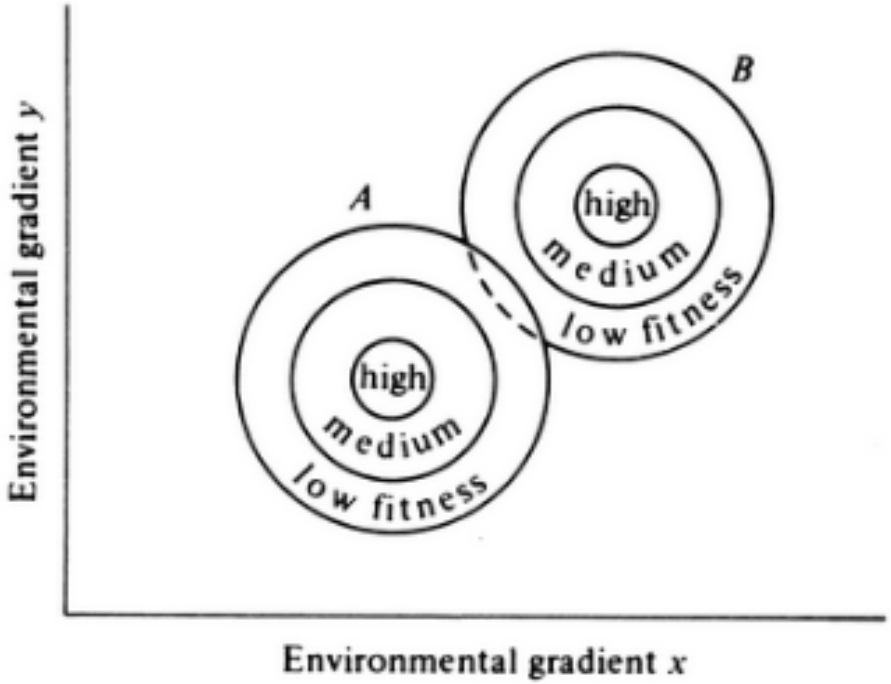


How do you define an ecological niche?

Ecological niche:

All conditions that enable the species to exist indefinetly





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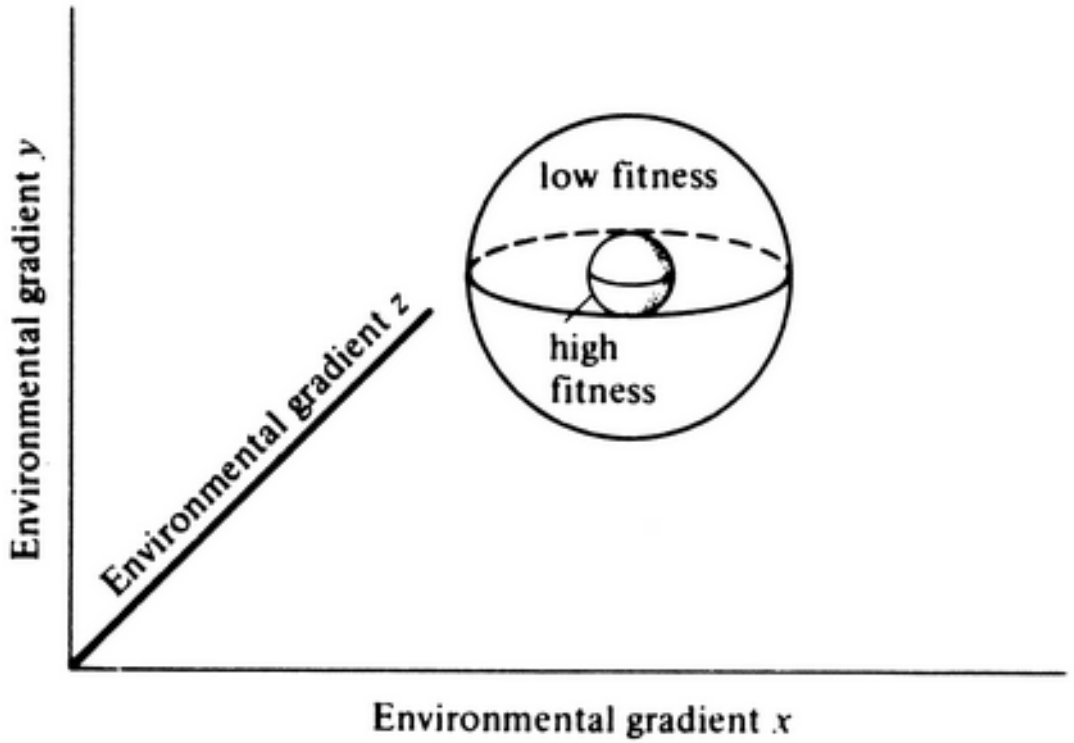
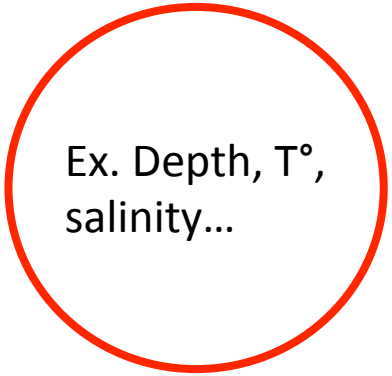


Relationship to niche theory…several theories !

Grinnell (1917)



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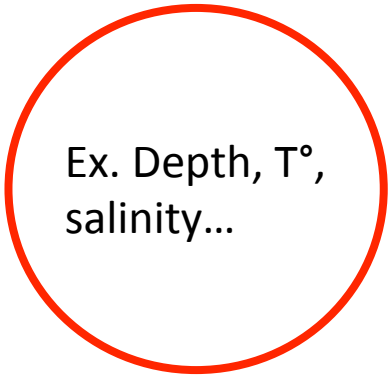

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BIOTIC INTERACTIONS

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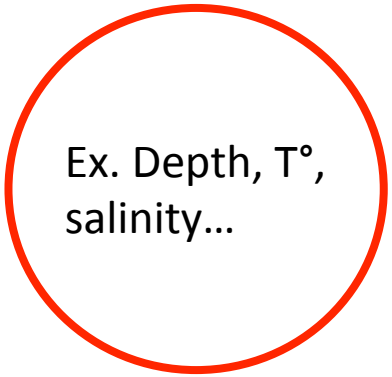

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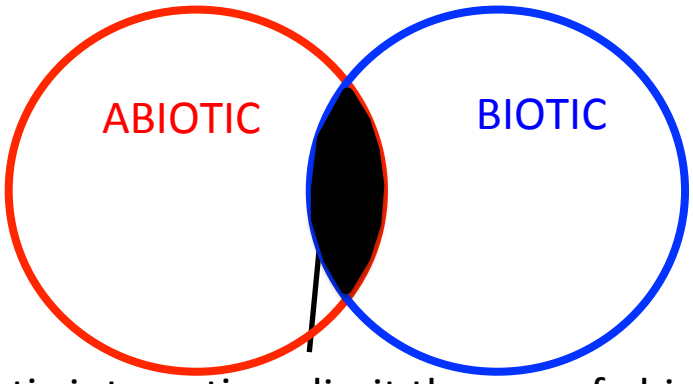

Biotic interactions limit the use of abiotic

Relationship to niche theory…several theories !

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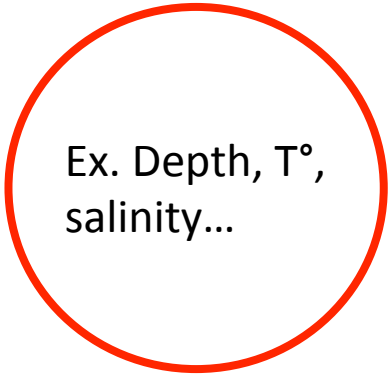

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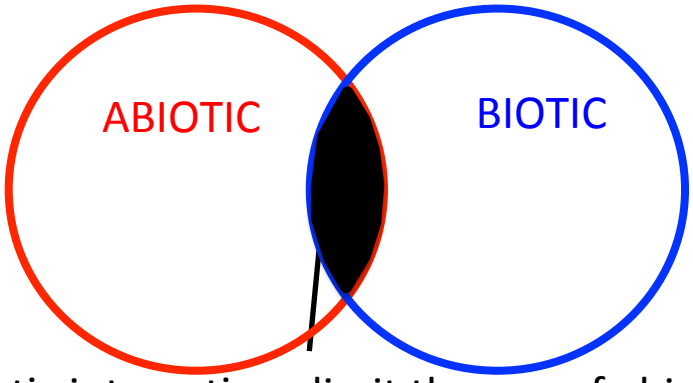
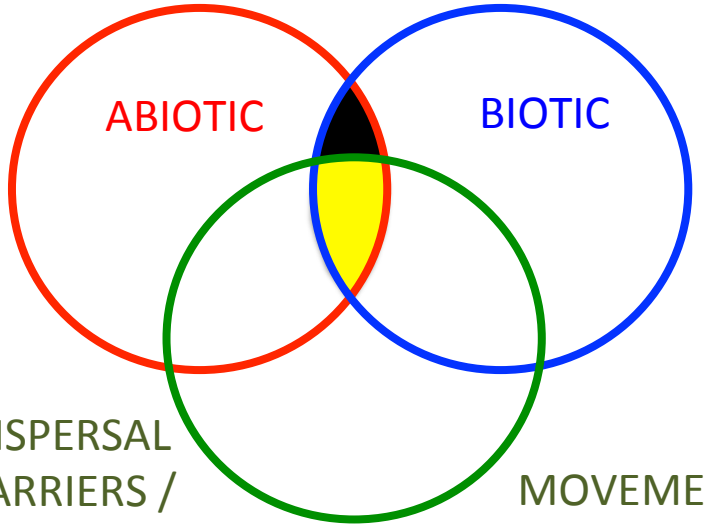


Biotic interactions limit the use of abiotic

Soberon & Peterson (2005)



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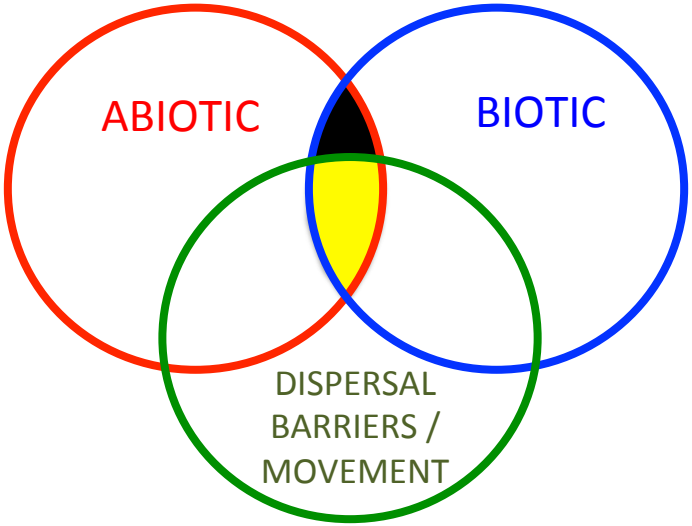
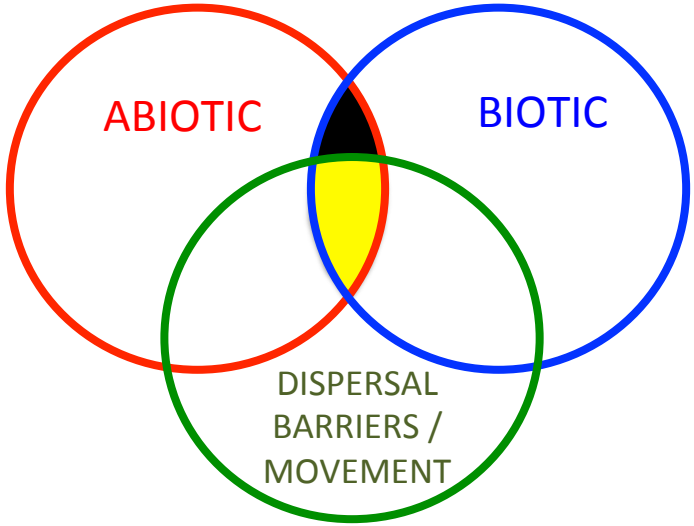


SDM ??

Calibrated on presence data

-> areas where the species is actually present

-> ABIOTIC + BIOTIC + MOVEMENT impacts



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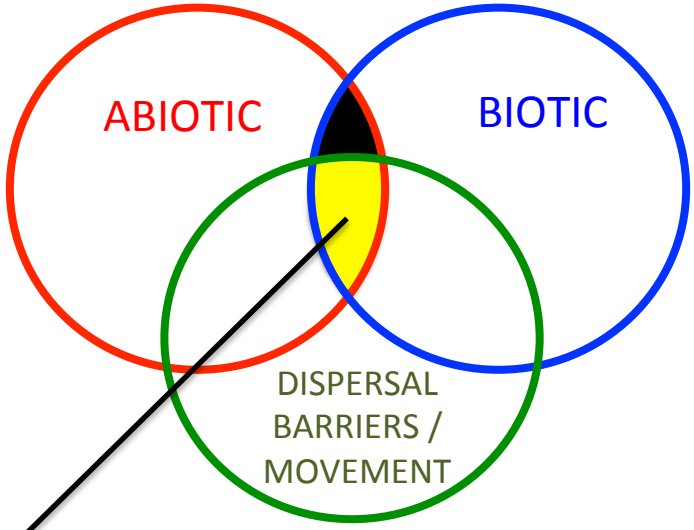
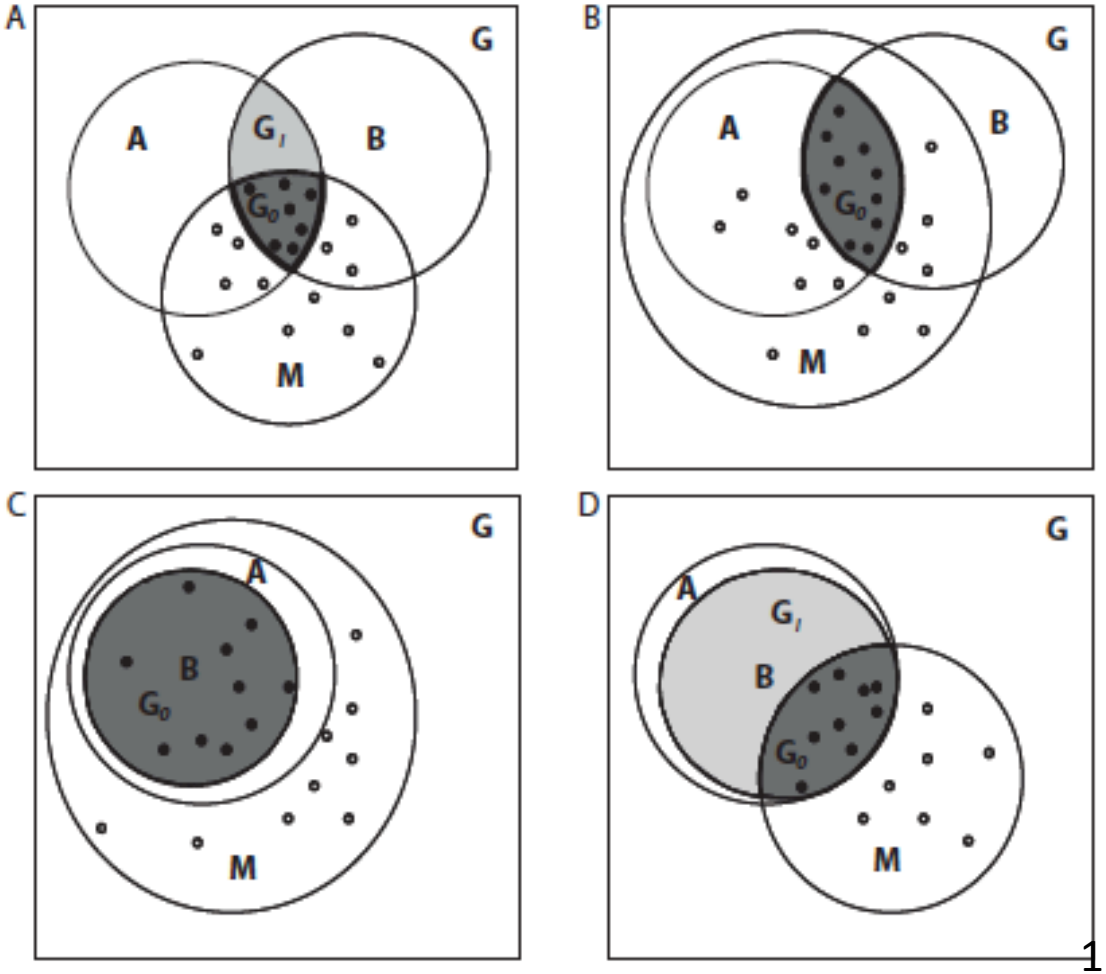


What the SDM actually models !

= realised niche

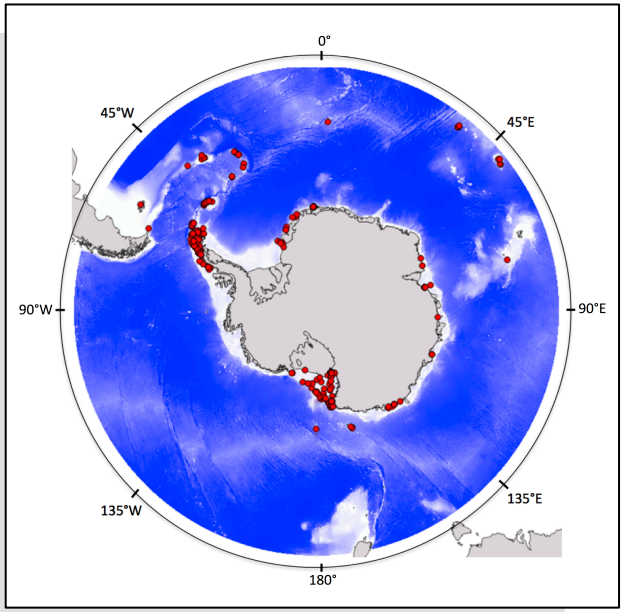
Theory is not that simple….
Several ways of representing the BAM diagram...



Peterson et al. (2011)

DRAWBACKS

• Definition of the occupied space of presence records strongly dependent of the sampling effort + spatial scale



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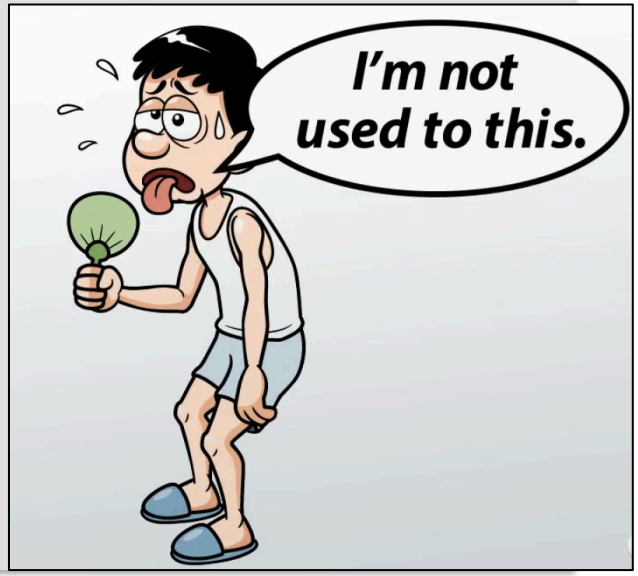

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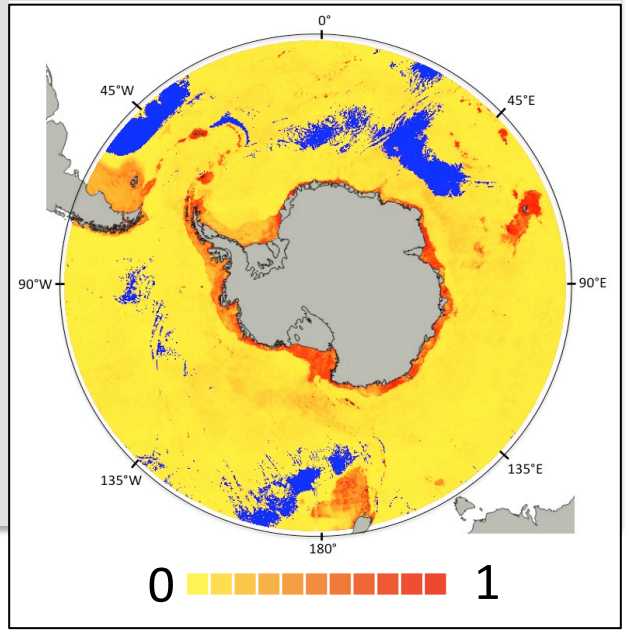

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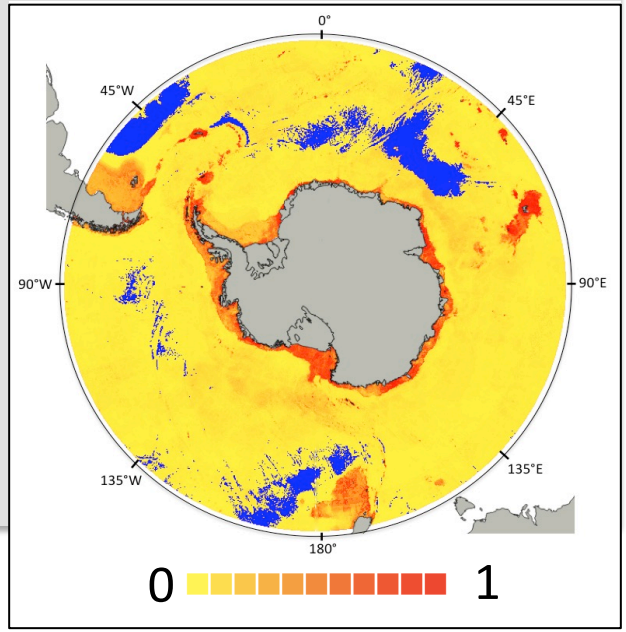

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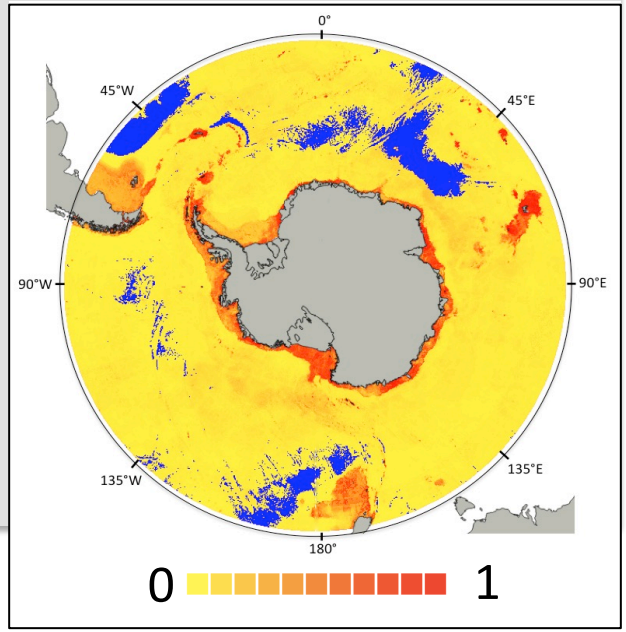

TAKE HOME MESSAGE :

BE CAREFUL WITH YOUR INTERPRETATIONS !

ADVANTAGES… !

- Enable to simply and quickly describe the species niche with occurrence records (simple information to get)
- Some softwares are user friendly and can help quickly provide results
- Enable to make predictions in space and time
- Results easy to interprete

Questions ?

Discussion

1) What kinds of questions can we answer with species distribution models?

2) Can you think of any examples of when SDMs have made a positive impact on conservation?

3) Can you think of examples of how SDMs have been used to study potential impacts of climate change?

4) If you have ever read a paper that used SDMs, how accessible (easy to understand) were the methods? Did they include their code?

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COMPUTERS ON !

➔ Have a look at the provided literature

➔Have a look at youtube tutorials to explain SDMs