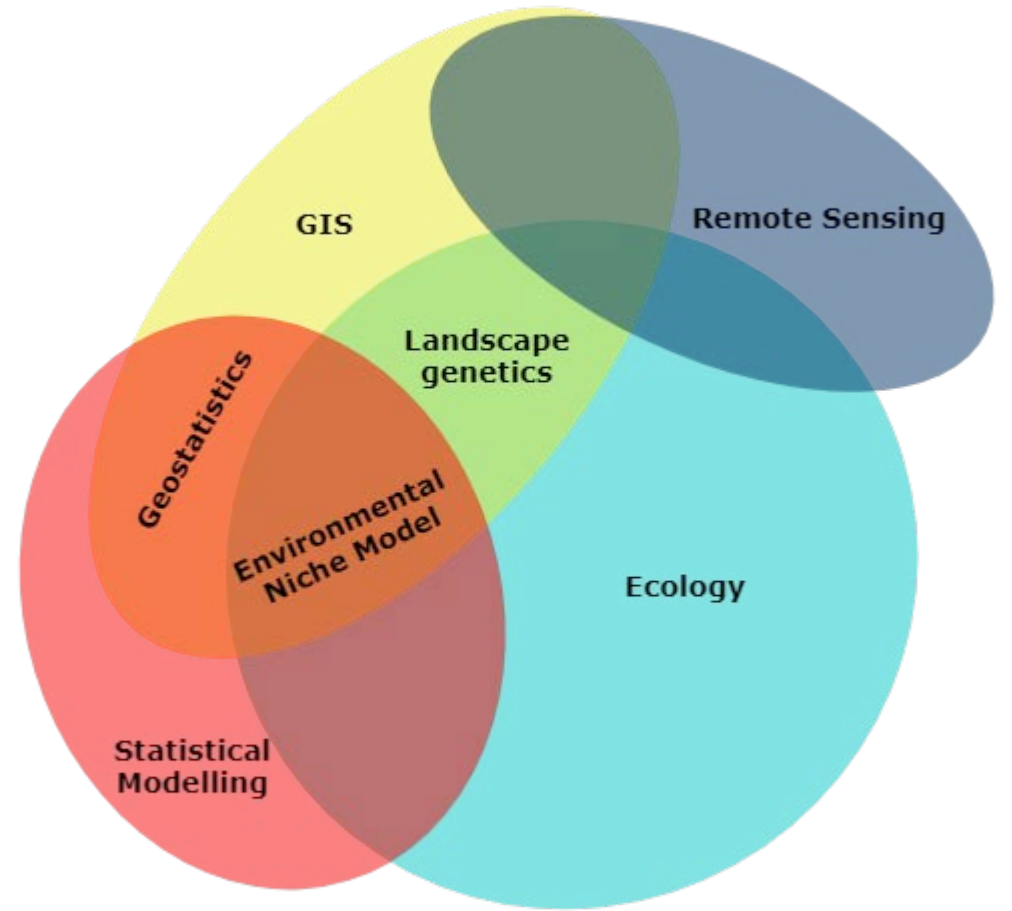
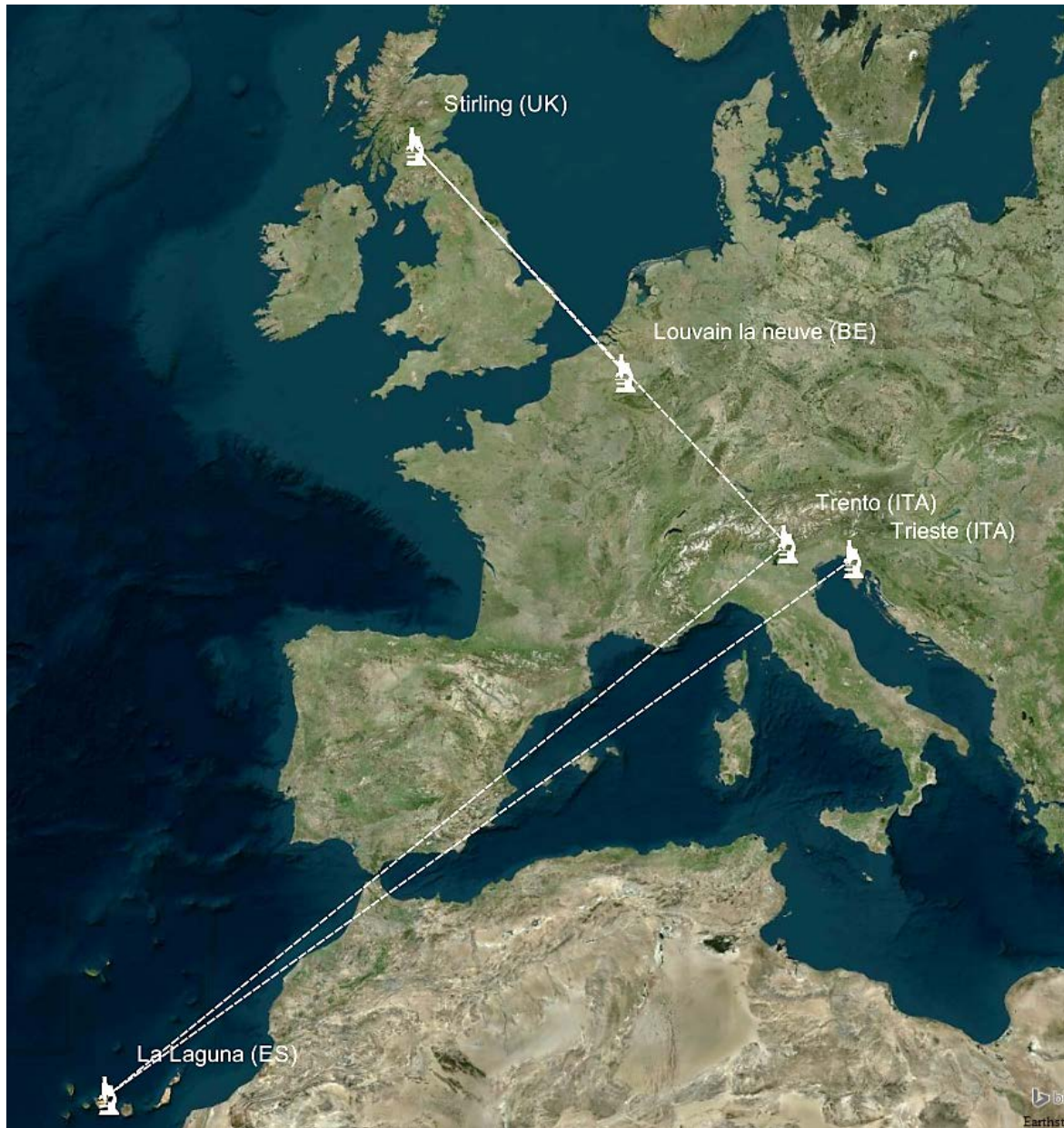




L'uso dei sistemi informativi geografici per la mappatura delle Specie Aliene Invasive

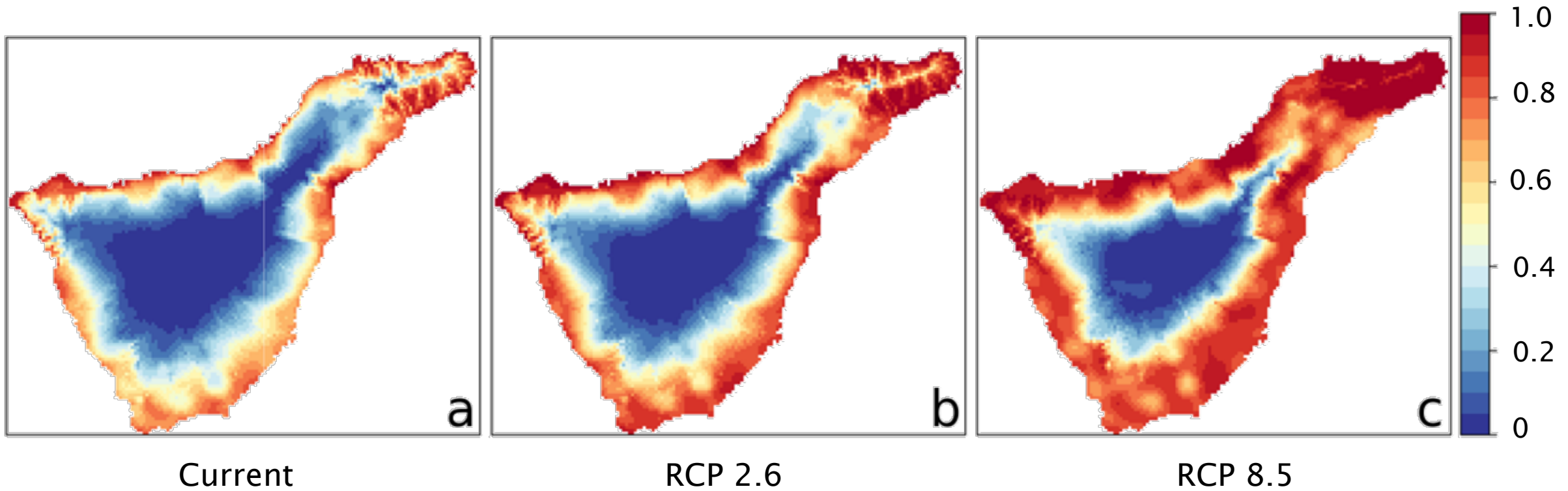
Daniele Da Re

FRS-FNRS research fellow presso UCLouvain



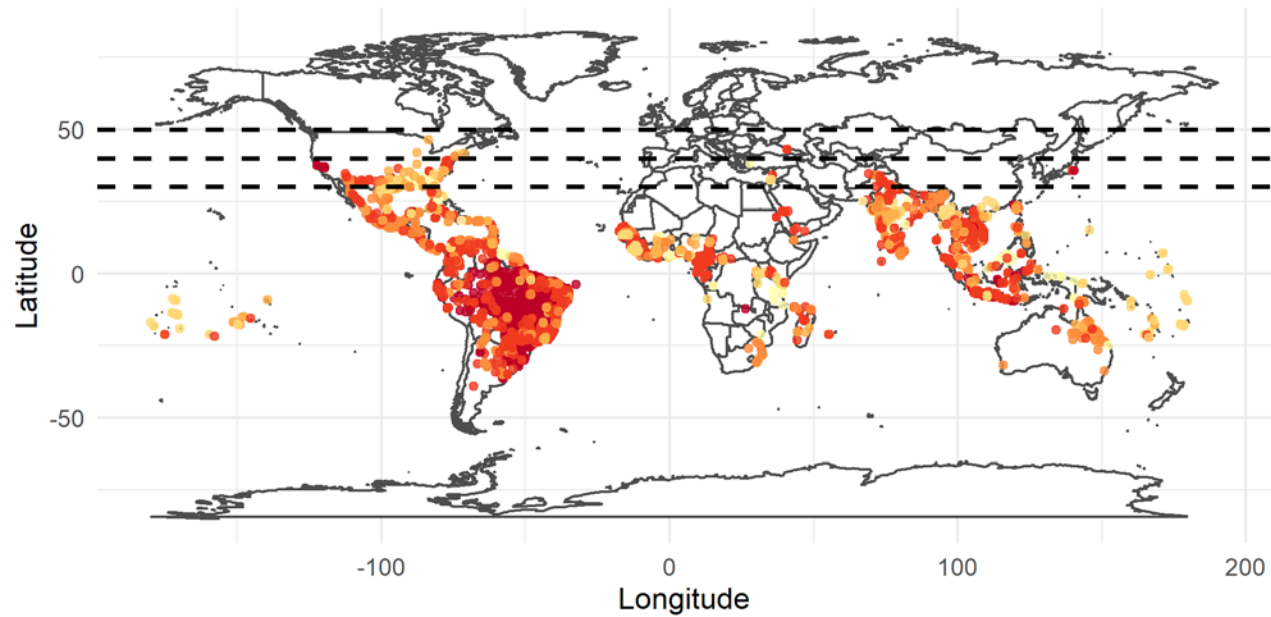
Mi occupo di: invasioni Biologiche, specie aliene invasive, epidemiologia spaziale

Pennisetum setaceum Habitat suitability index

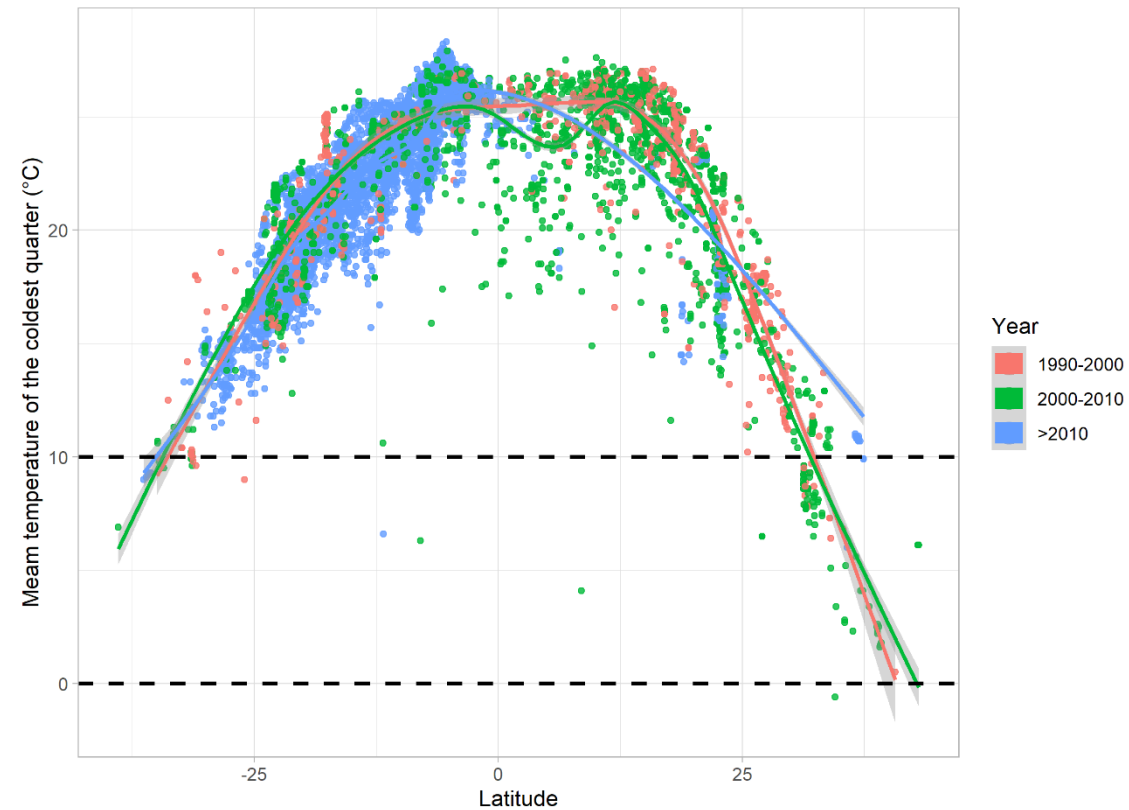
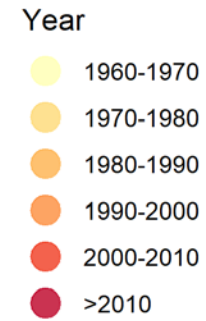


0 = not suitable habitat; 1 = suitable habitat

Current *Aedes aegypti* distribution



Data Source: CHELSA, Dryad



Data Source: CHELSA, Dryad



Land & Water



Overview

Water

Land

Databases & Software

News

Events

Resources

Sustainable Land
Management

Land assessment &
impacts

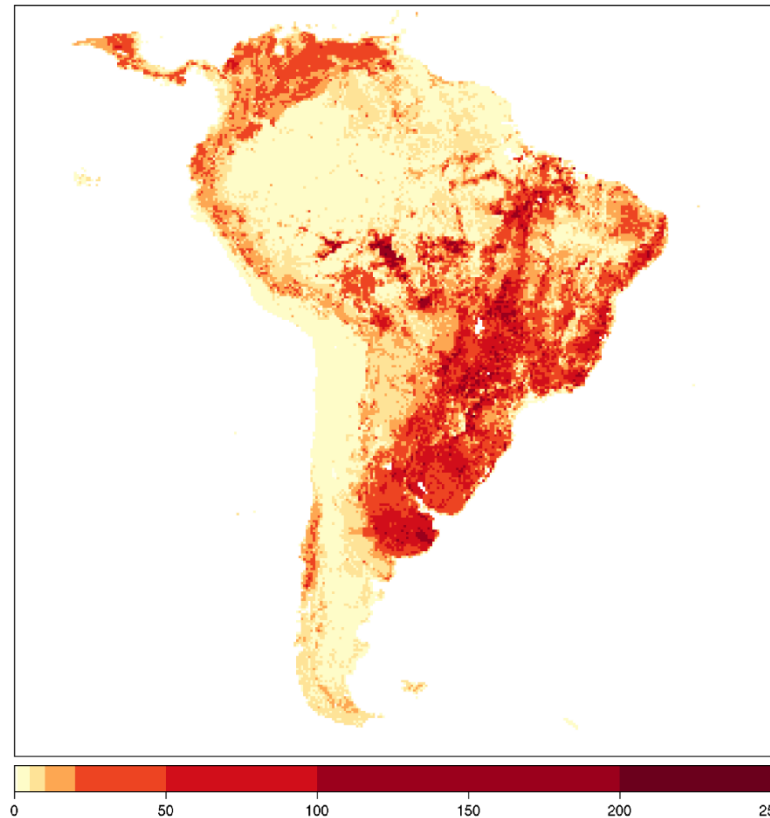
Land governance and
planning

Land Policy

Land resources planning

Gridded Livestock of the World (GLW3)

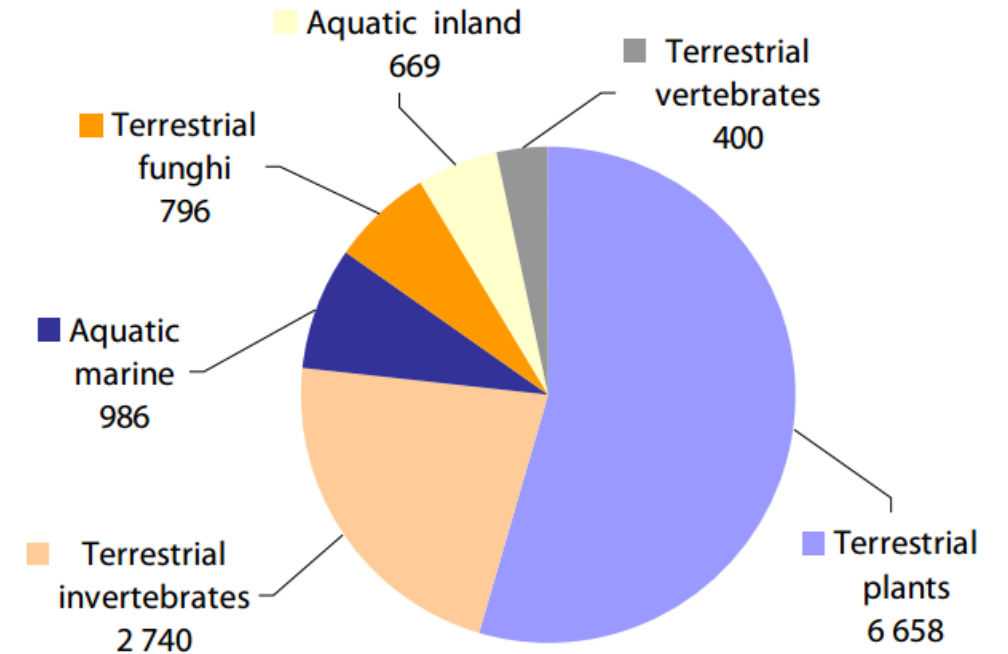
Cattle Mean Density 2000-2010



Invasioni biologiche

Più di 12 000 specie aliene!

Alien species in Europe (2012)



Data source: [DAISIE](#) (Delivering Alien Invasive Species Inventories for Europe), research project funded by the European Commission, and the Centre for Ecology and Hydrology ([CEH](#)).

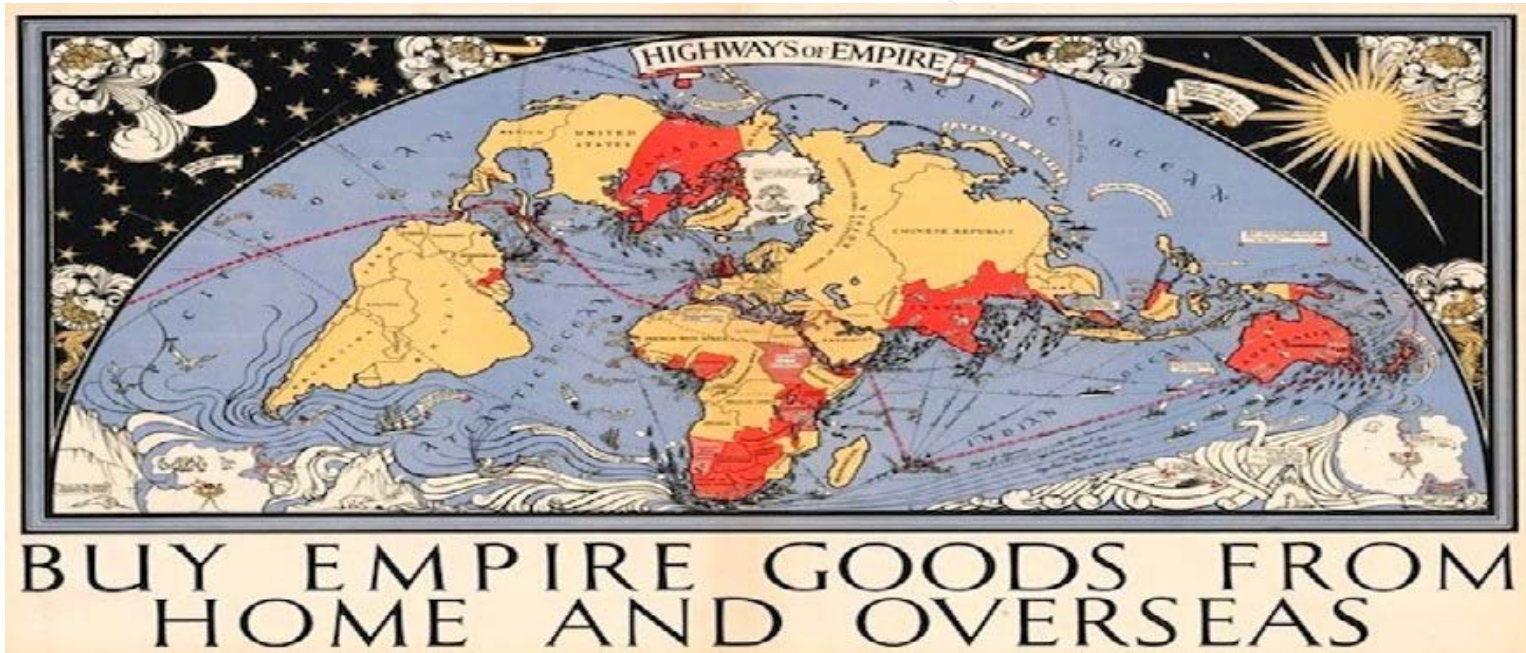
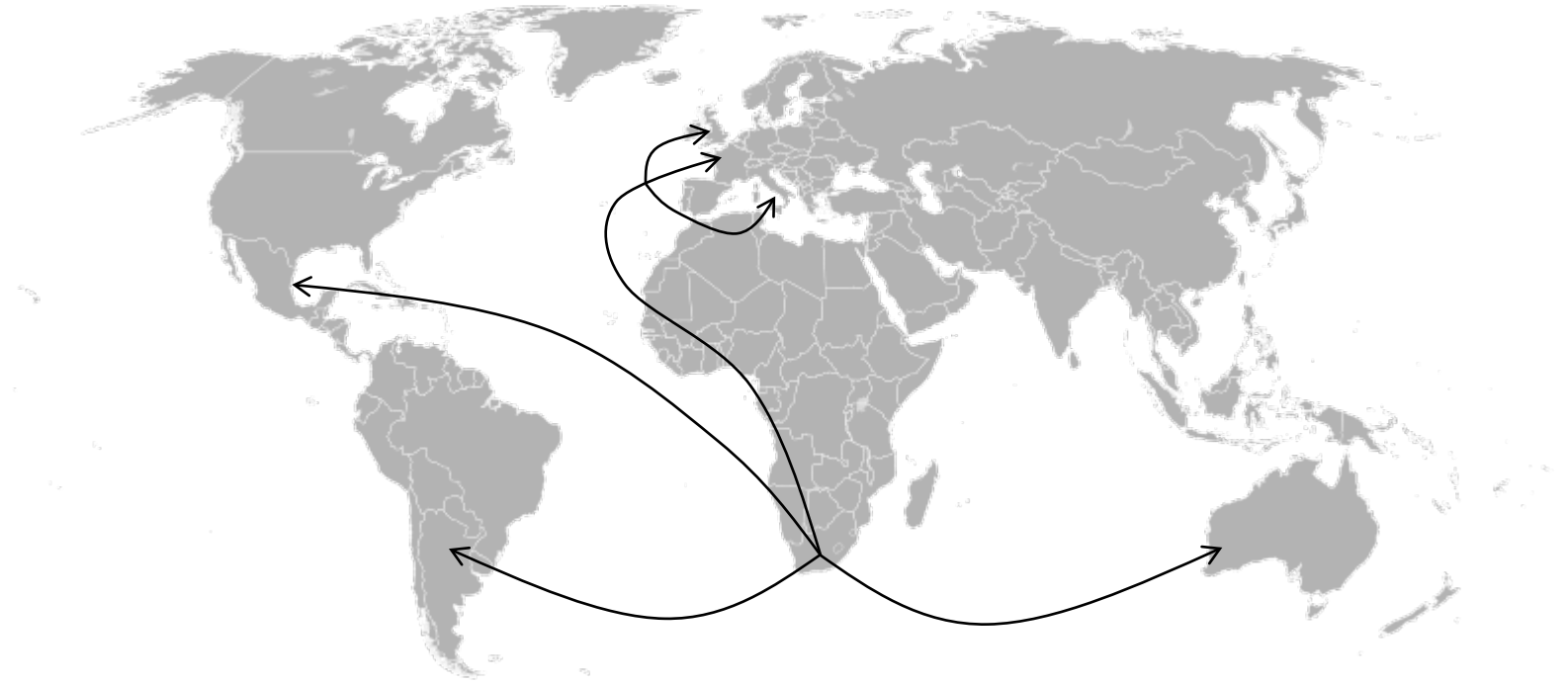


"Before invasive species, the only things I could grow were weeds and mildew."

Senecio inaequidens

- Origine: praterie sudafricane
- Specie erbacea
- Perenne
- Riproduzione sessuale e vegetativa
- Specie plastica



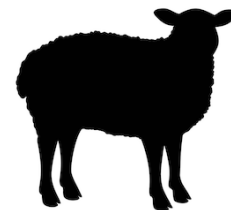
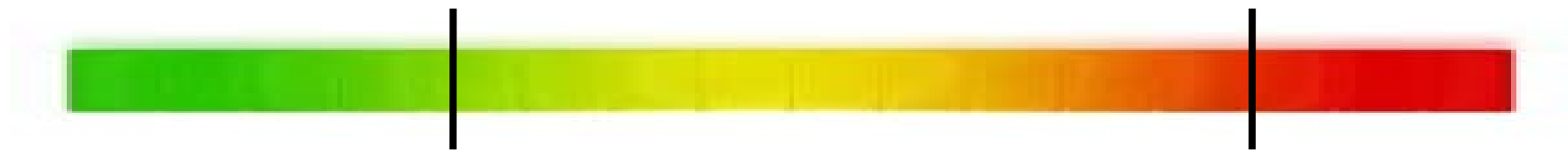


Quali sono gli impatti di *S. inaequidens* ?



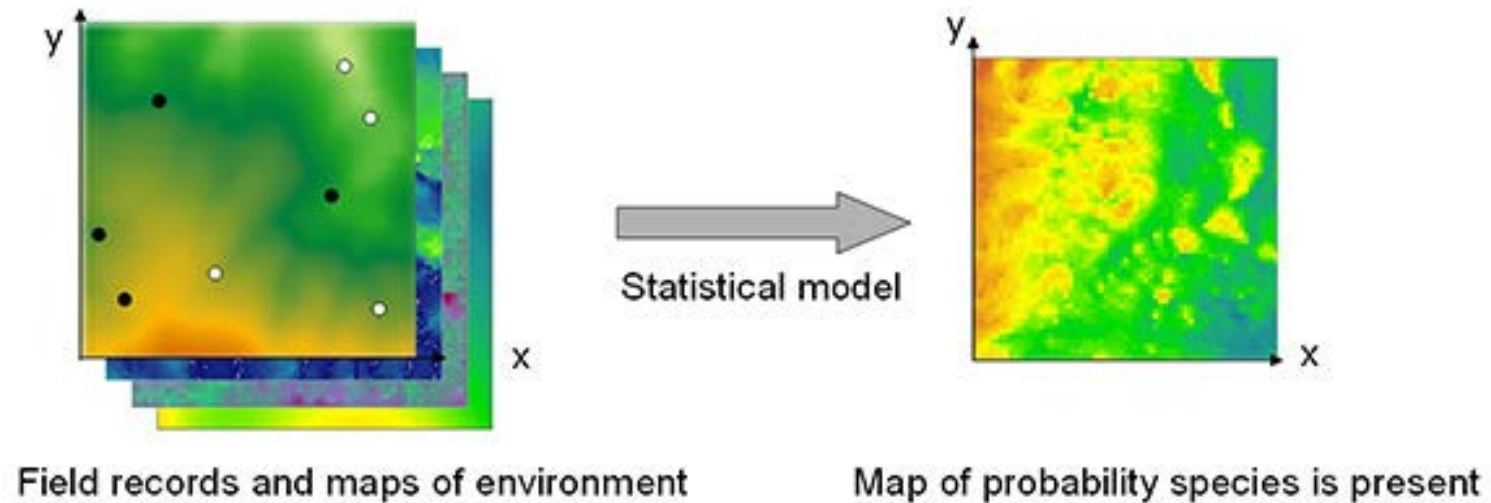
Aree rurali

Praterie + pascoli + terre arabili



Che fare?

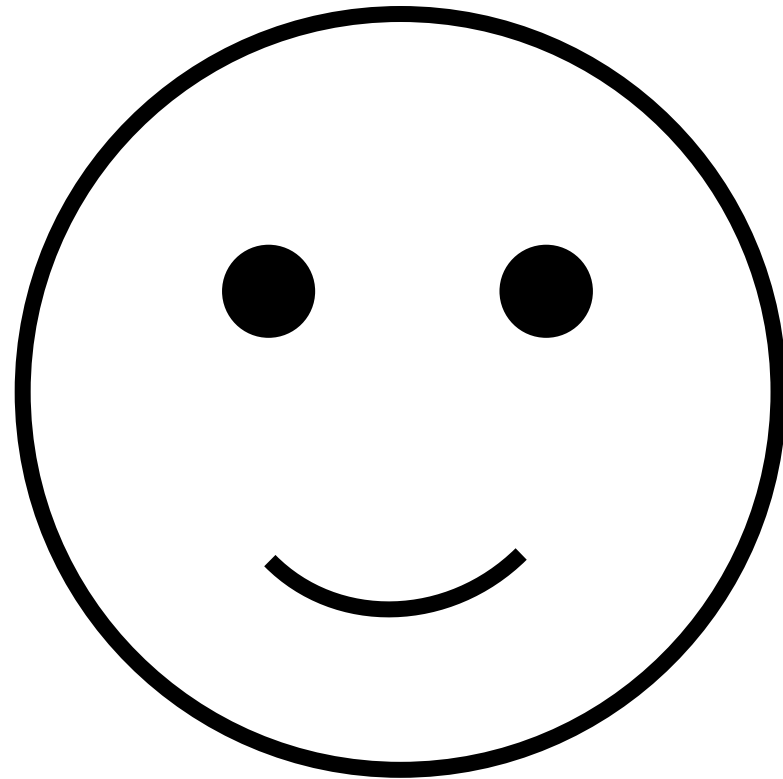
Un aiuto ci viene offerto dagli SDMs.

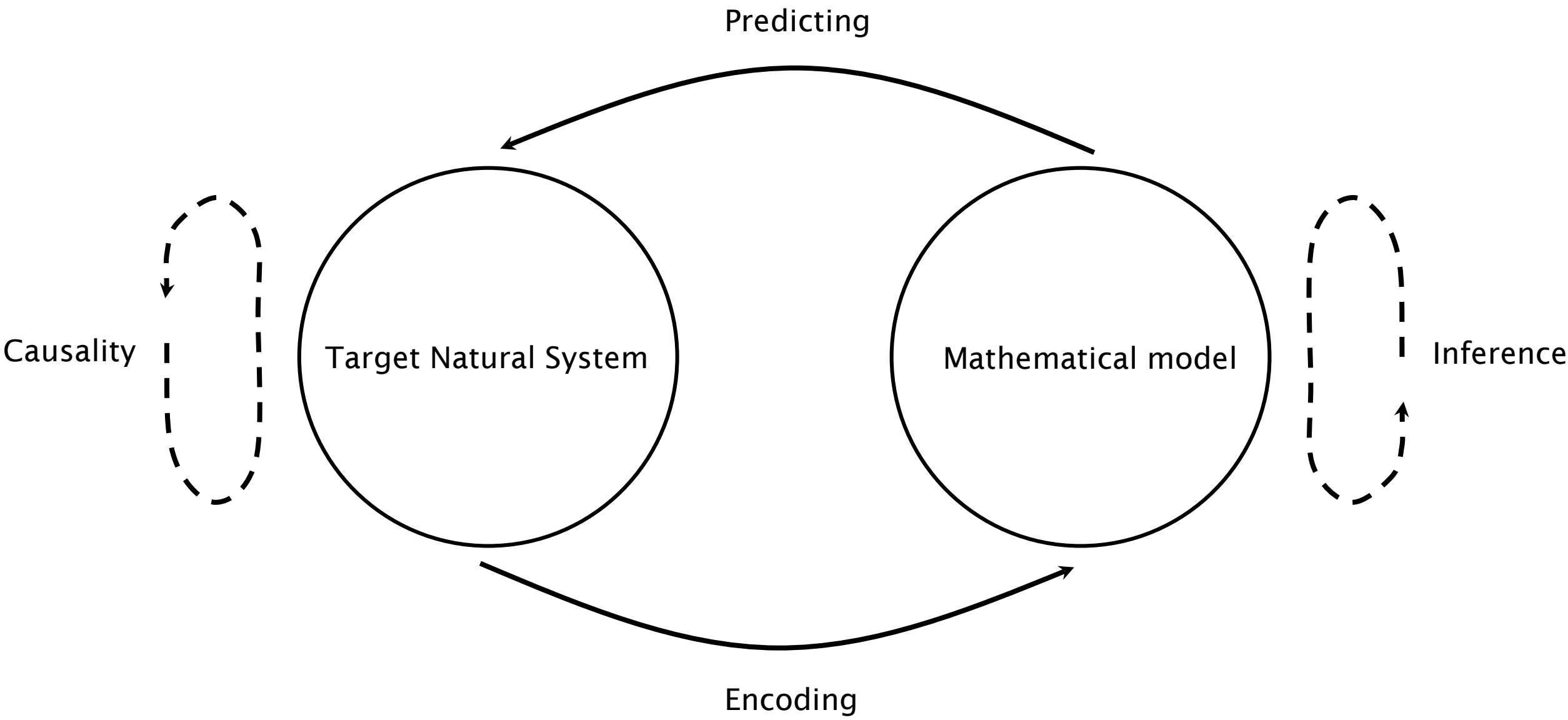


Costruire un SDMs necessita un approccio multidisciplinare.

Che cos'è un modello?

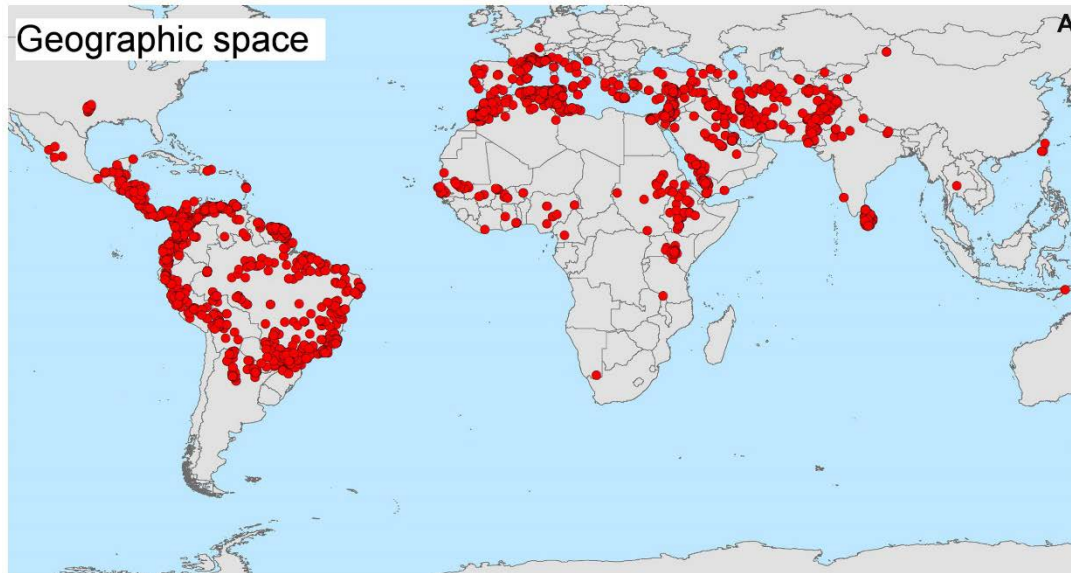
Una delle possibili rappresentazioni di un Sistema Naturale





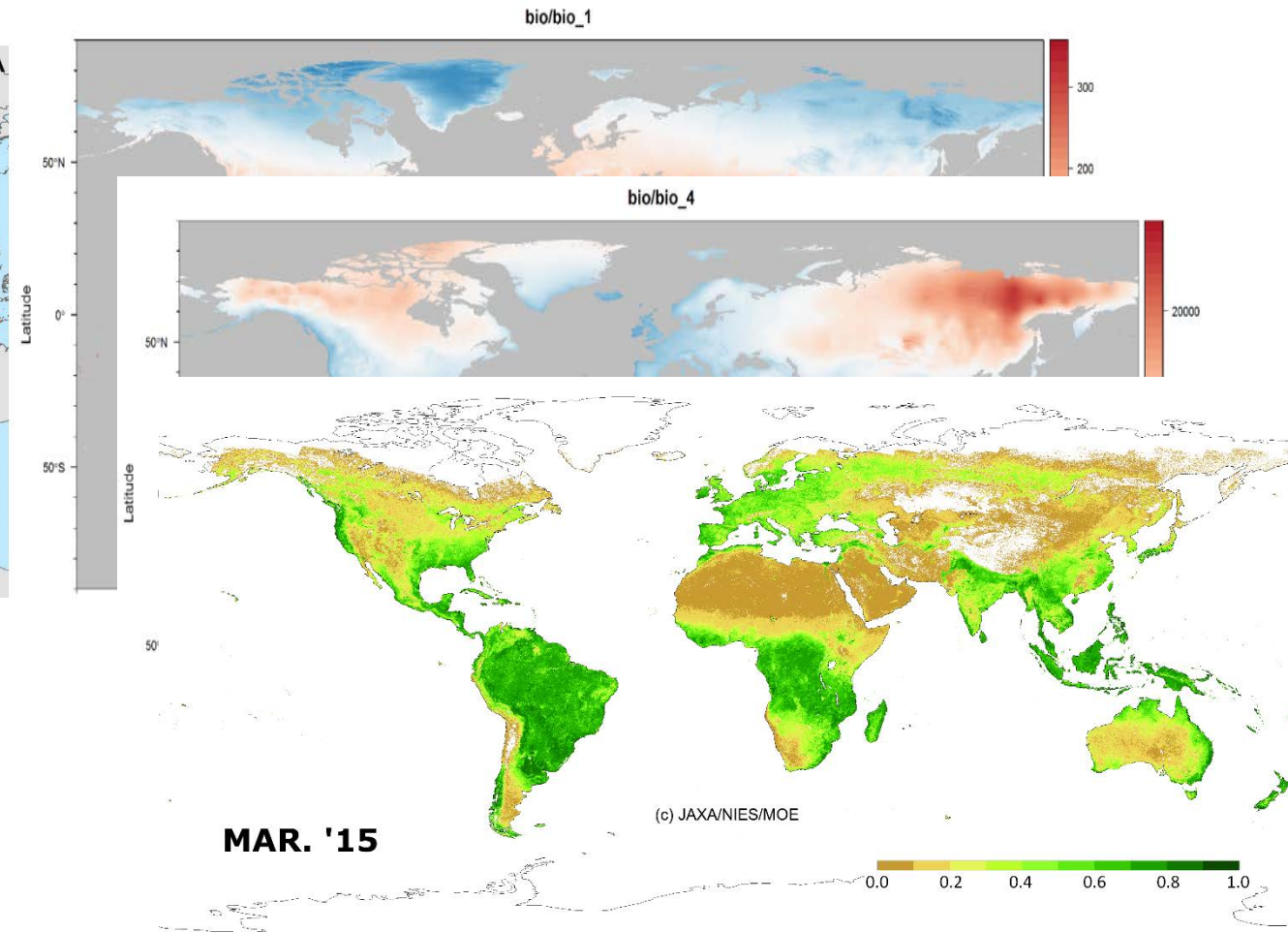
Species Distribution Models

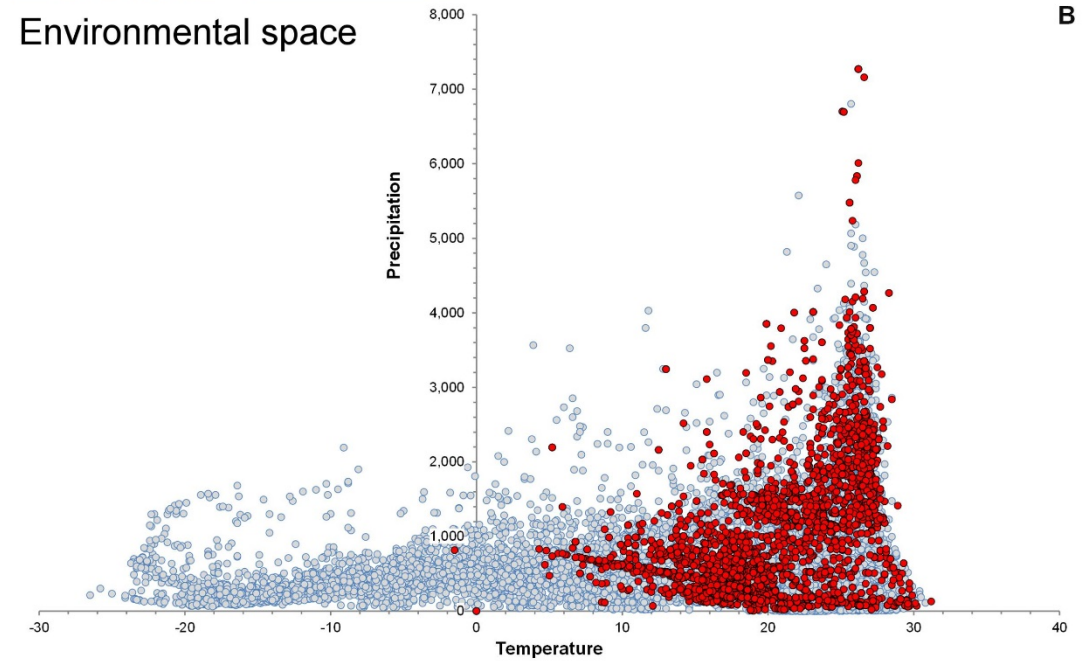
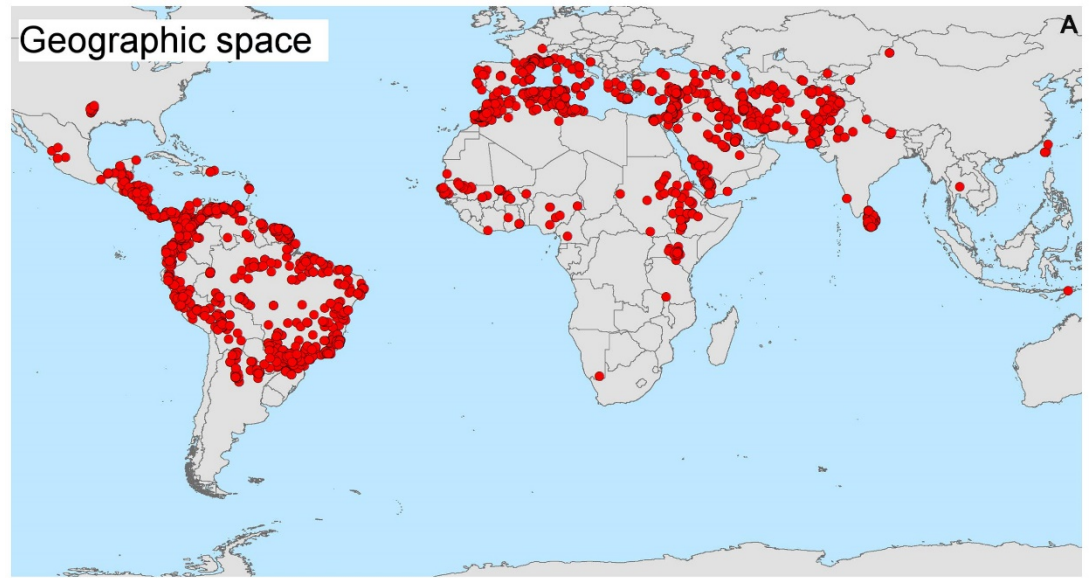
Occorrenze geo-riferite



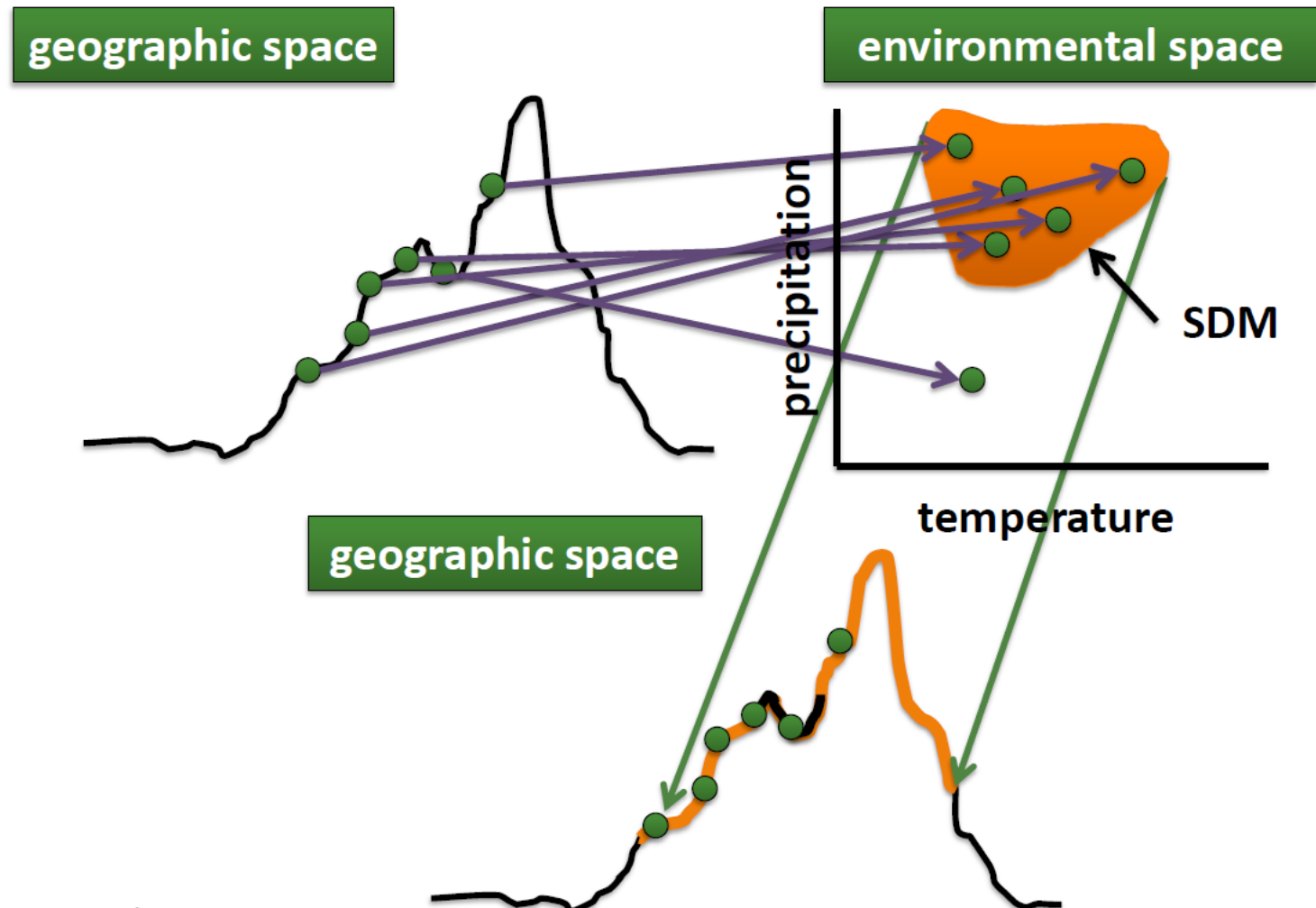
Anche da remote sensing

Predittori

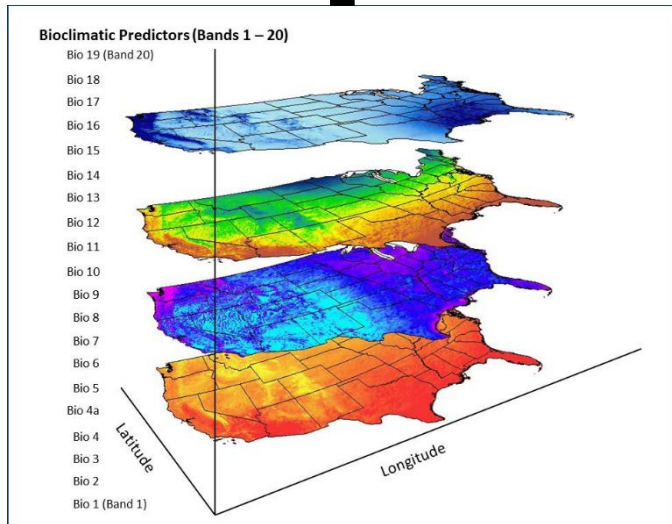
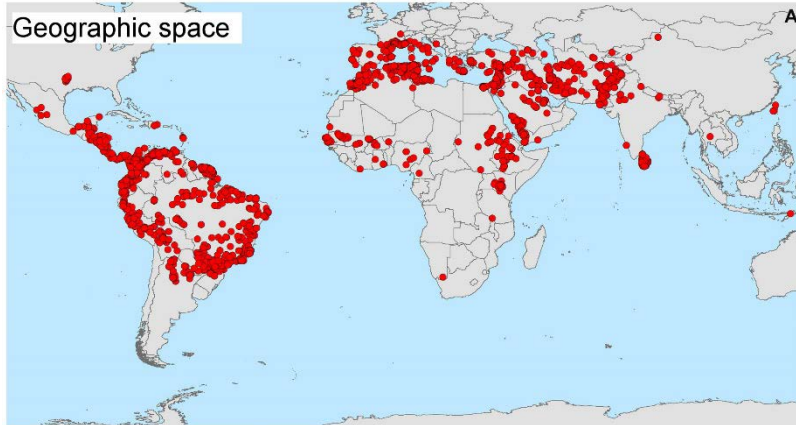




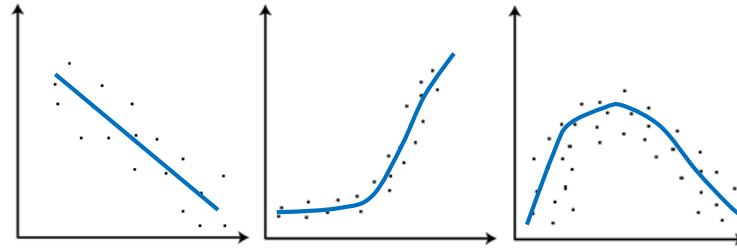
Che cosa fa un modello?



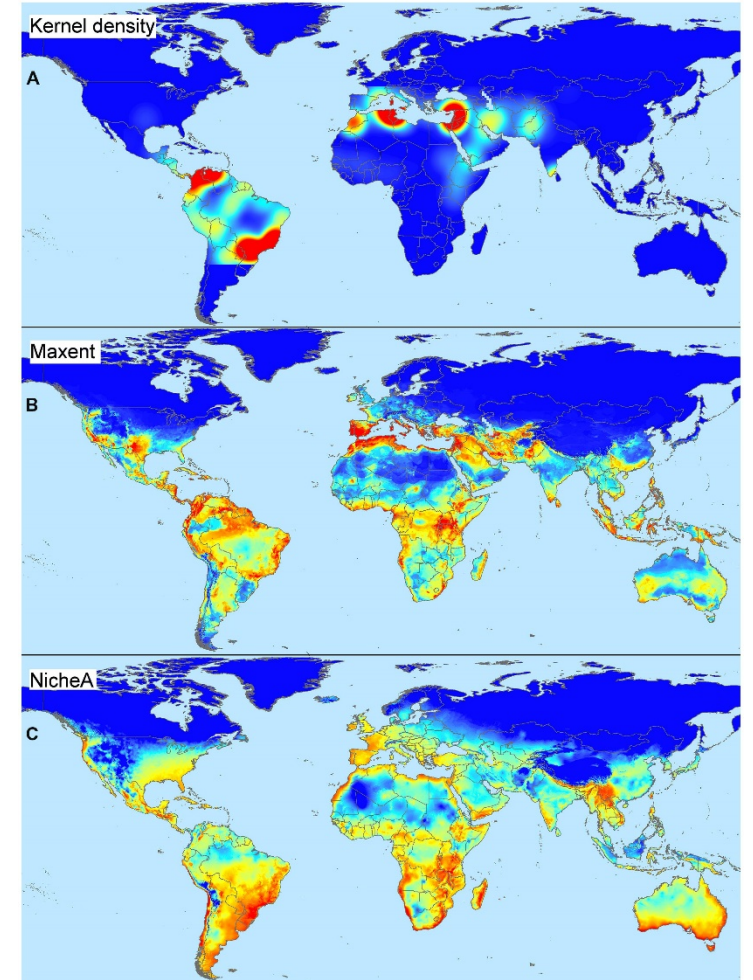
Differenti modelli hanno differenti assunti



Modeled species response function



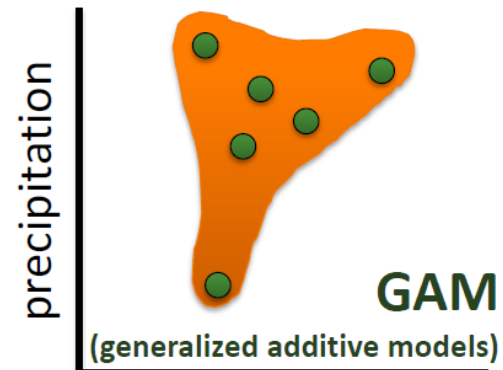
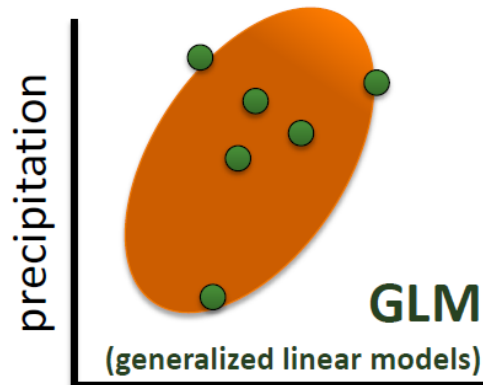
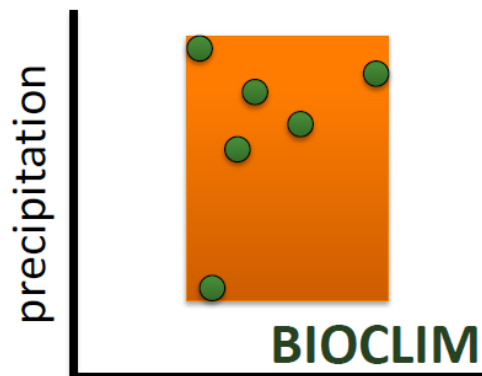
Species Distribution Model



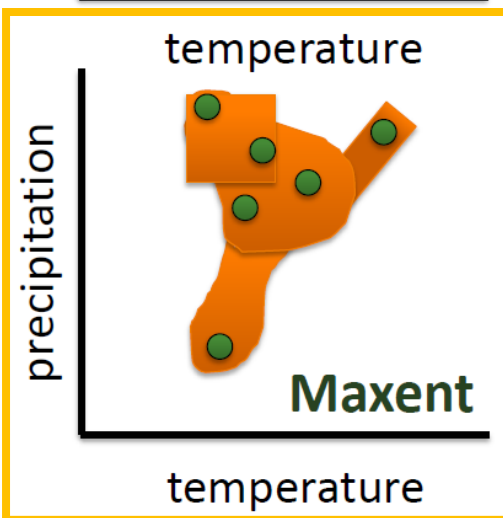
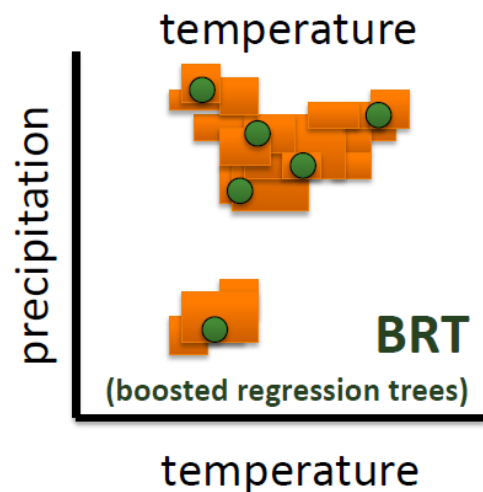
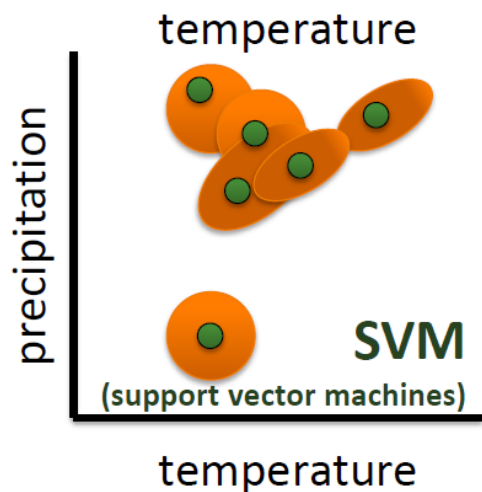
Suitable habitat

Gli algoritmi maggiormente utilizzati come SDMs

Modelli frequentisti



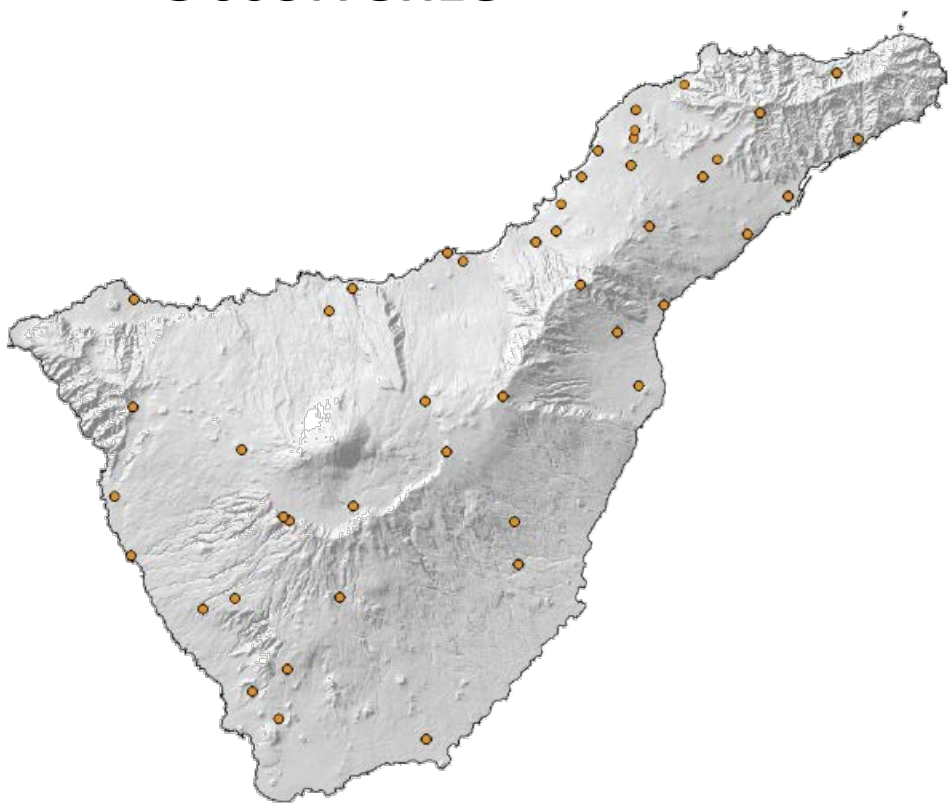
Machine learning



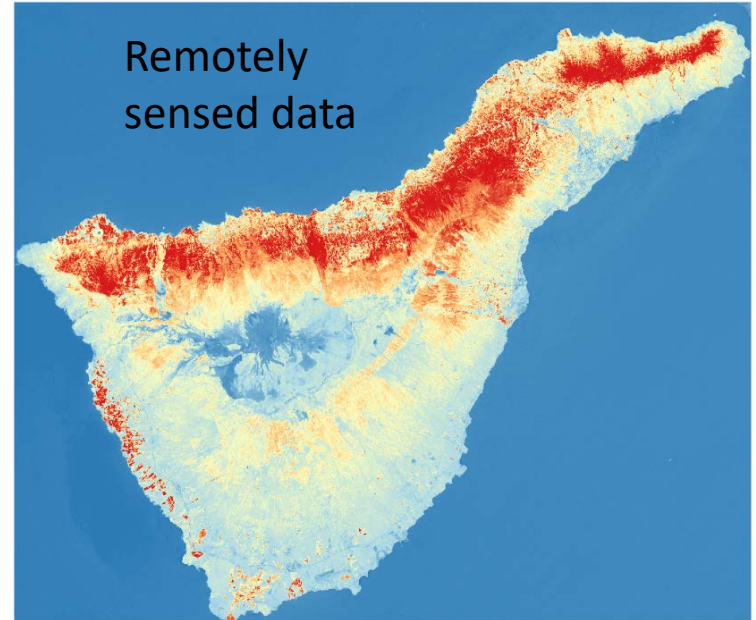
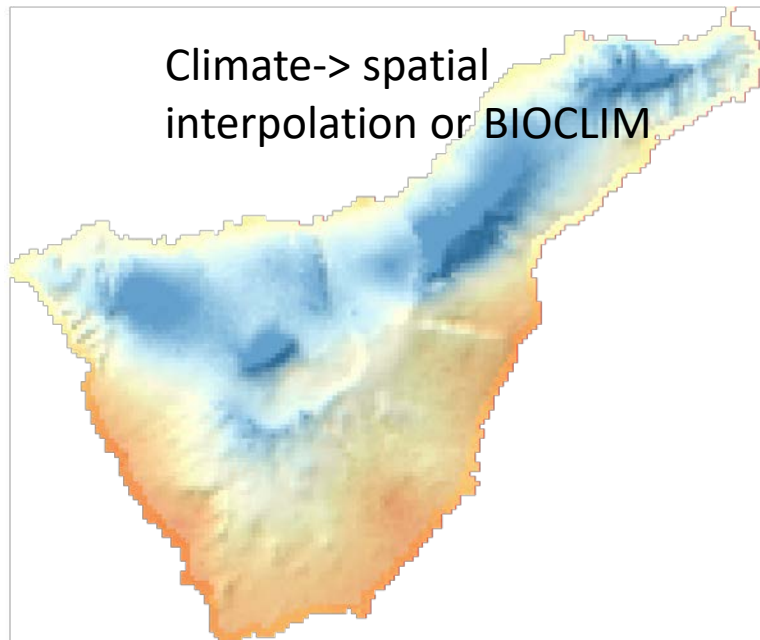
Workflow per sviluppare un SDMs

- Variabile di risposta: osservazioni riguardanti la specie, presenza-assenza, presence-only, abbondanze
- Un set di predittori
- Uno o più modelli

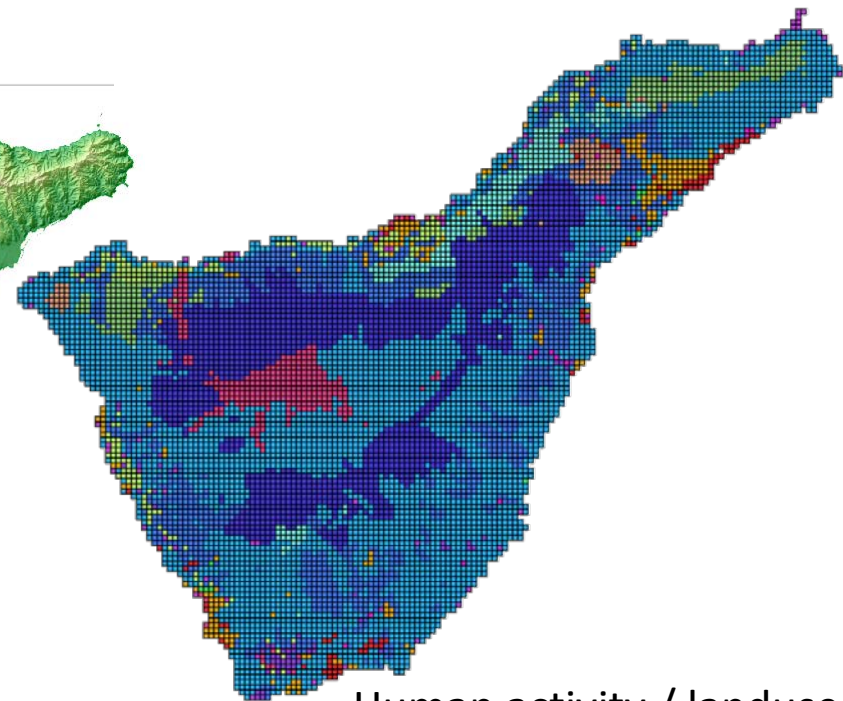
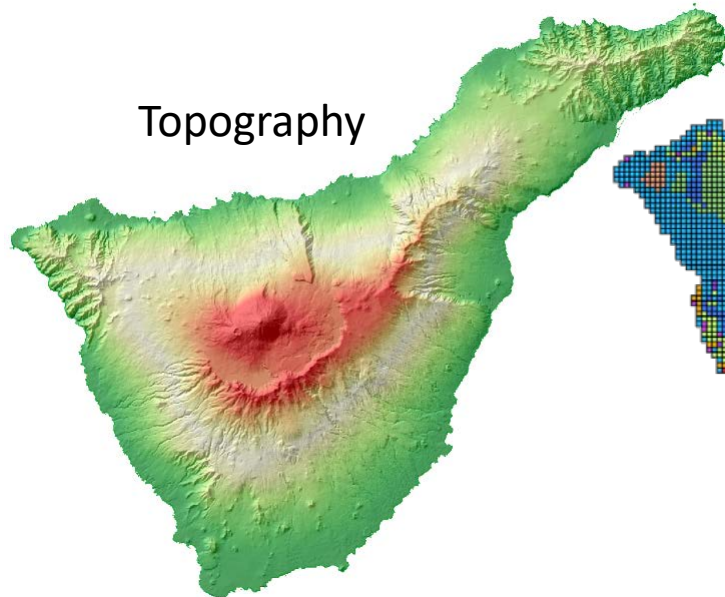
Occorrenze



Predittori



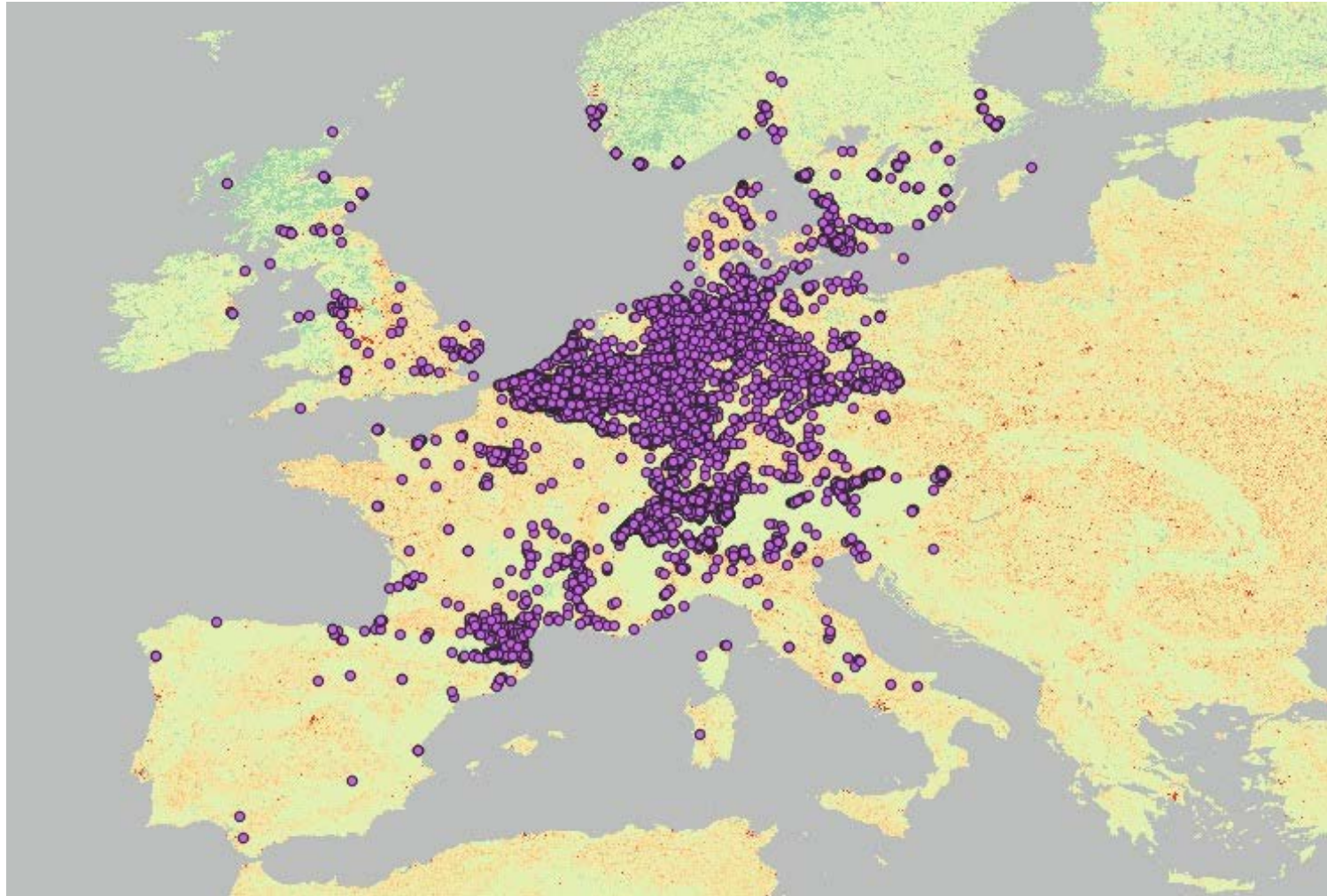
Topography



Human activity / landuse

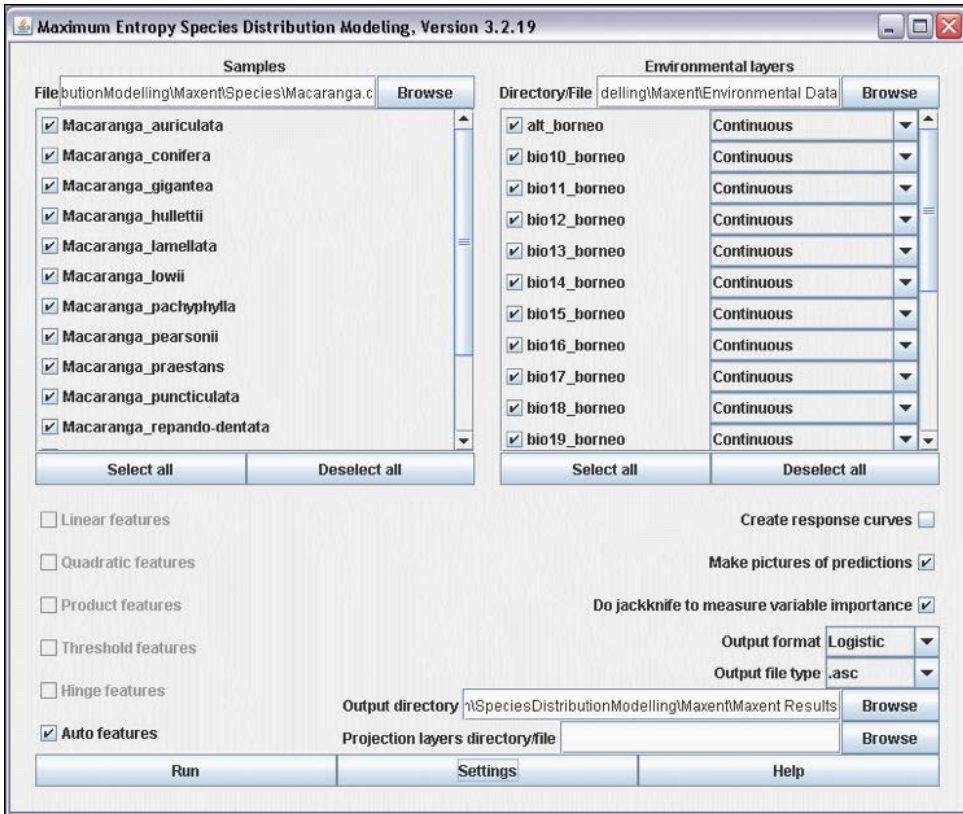
*Cominciamo a giocare con
queste variabili in QGIS*

Ora che abbiamo tutto pronto,
proviamo a fare un modello!



*Creiamo il nostro primo
modello con Maxent*

Maxent software



Uno degli SDMs più popolari.

La sua fama è principalmente dovuta a:

- Utilizza solo dati di presenza (occurrenze, PO)
- Generalmente più performante di altri metodi
- Ha una bella GUI, facile da usare

Phillips et al. 2006

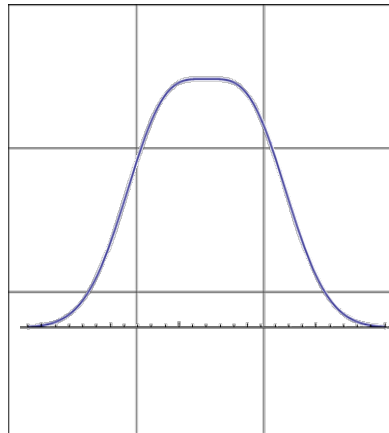
Come funziona Maxent?

The best approach is to ensure that the approximation satisfies any constraints on the unknown distribution that we are aware of, and that subject to those constraints, the distribution should have maximum entropy
(Maximum-Entropy principle, Jaynes, 1957).

Maxent is a general-purpose method for making predictions or inferences from incomplete information
(Jaynes, 1957).

In poche parole...

1. Obiettivo: fare inferenza su una distribuzione (nel nostro caso la distribuzione dell'habitat di una specie) partendo da informazioni incomplete
2. Maximum Entropy = probability distribution of maximum entropy (closest to uniform)
3. Trovare la distribuzione più uniforme, date le limitazioni dovute alle informazioni parziali che abbiamo (presenza della specie e variabili ambientali)



Maxent cerca di **predire** la distribuzione dell'**habitat di una specie** basandosi su come

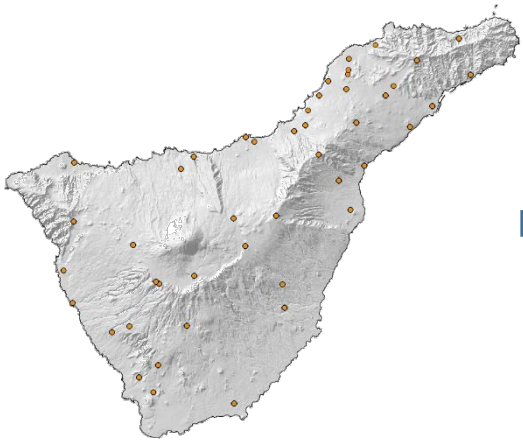
L'ambiente in cui una **specie** è **presente**

SI RELAZIONA

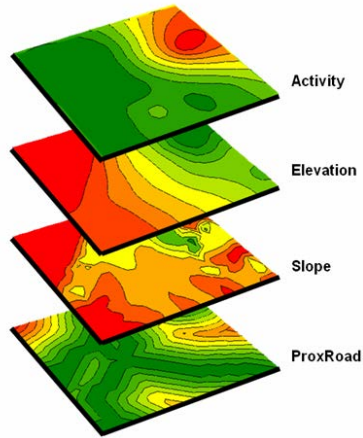
All'ambiente di tutta **l'area di studio**

How Maxent (sw) works

Presence locations

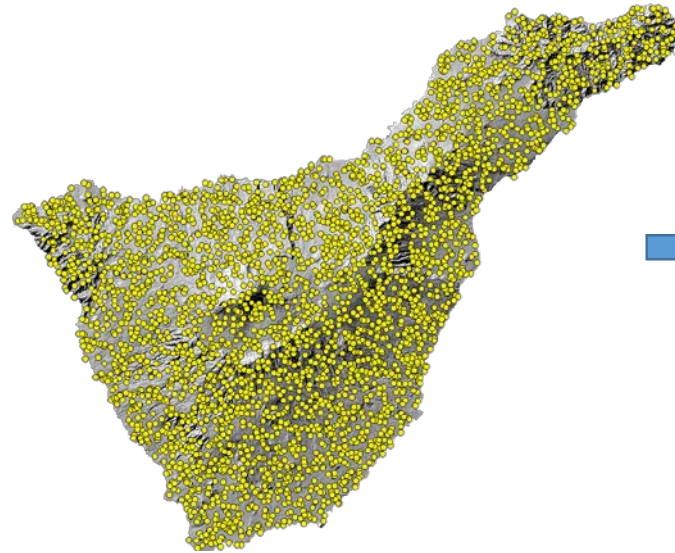


Environmental covariates for each landscape gridcell

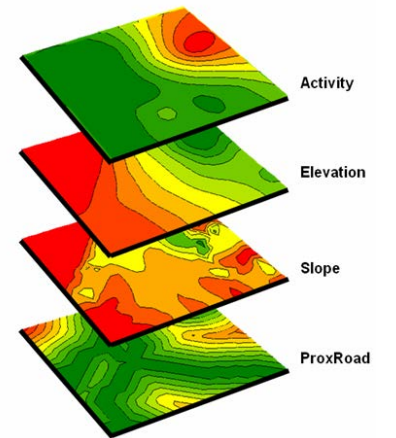


VS

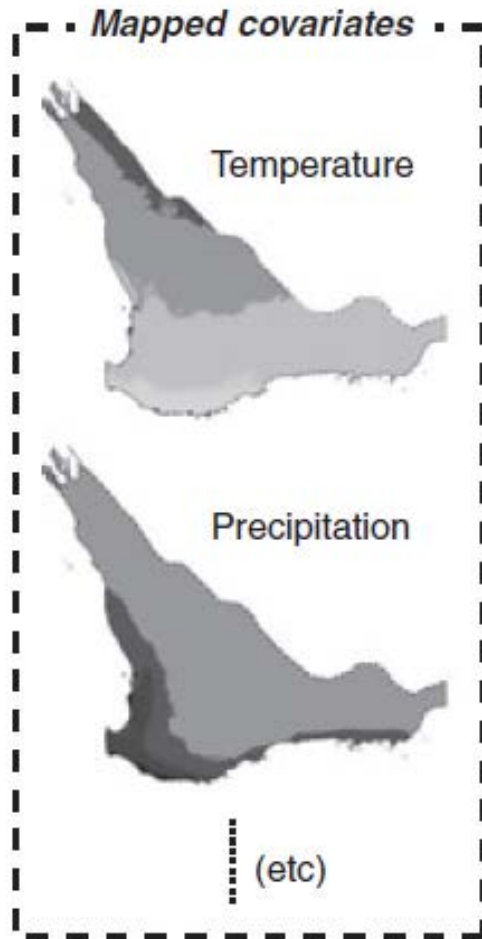
Background locations



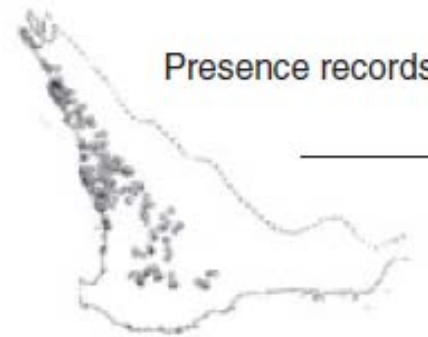
Environmental covariates for each landscape gridcell



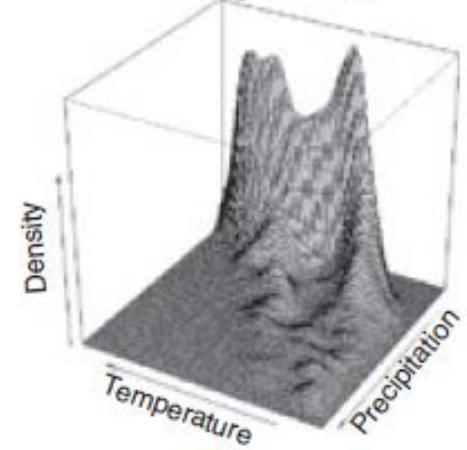
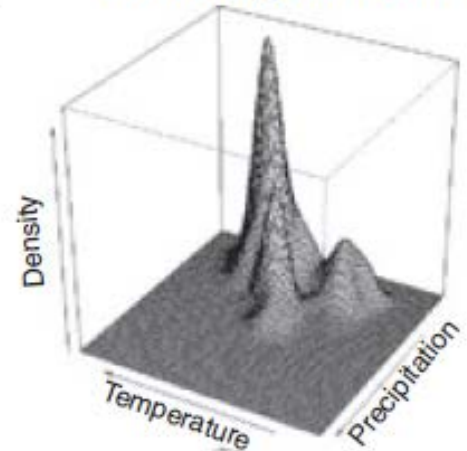
Densities






Sample at locations →



Probability densities



Esempio




T=10 	T=10	T=10
T=20 	T=20	T=20
T=30 	T=30	T=30

- Mean annual temperature measured in each cell

- 3 observed presences

- Mean temp of presence locations = $(10+20+30)/3 = 20$

- What is the flattest distribution over all 9 grid cells that has a mean temp of 20?

T=10 p=1/9 	T=10 p=1/9	T=10 p=1/9
T=20 p=1/9 	T=20 p=1/9	T=20 p=1/9
T=30 p=1/9 	T=30 p=1/9	T=30 p=1/9

- Constraint 1: avg. T= 20

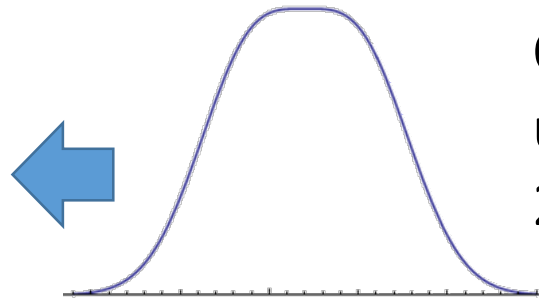
- Constraint 2:

$$\sum_{i=1}^{i=9} p_i = 1$$

p_i =relative probability
of observing the species
in cell i.

- What is the flattest
distribution over all 9 grid
cells that has a mean
temp of 20?

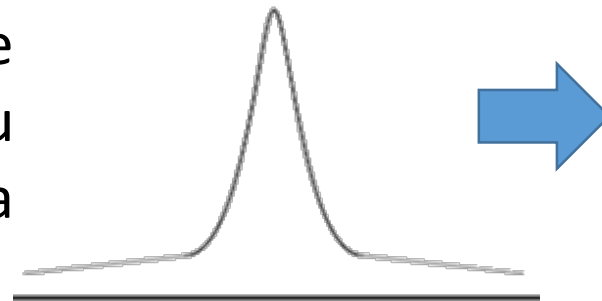
T=10	T=10	T=10
p=1/18	p=1/18	p=1/18
T=20	T=20	T=20
p=2/9	p=2/9	p=2/9
T=30	T=30	T=30
p=1/18	p=1/18	p=1/18



Questa è la distribuzione predetta più uniforme, considerando una T_{media} di 20°C.

MA...

Altre distribuzioni possono essere consistenti date queste limitazioni, ma non sono le più uniformi e quindi non hanno la Maximum Entropy

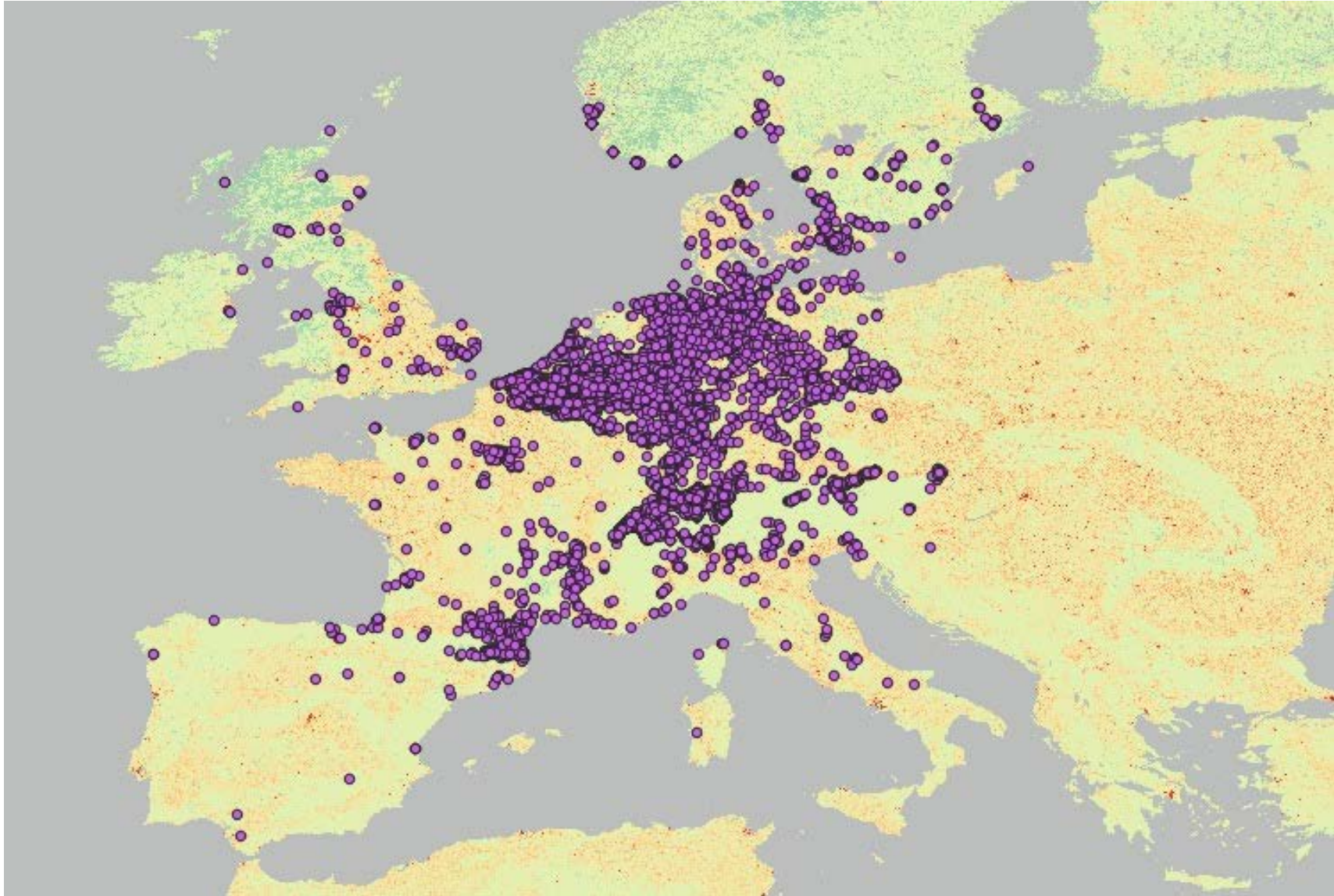


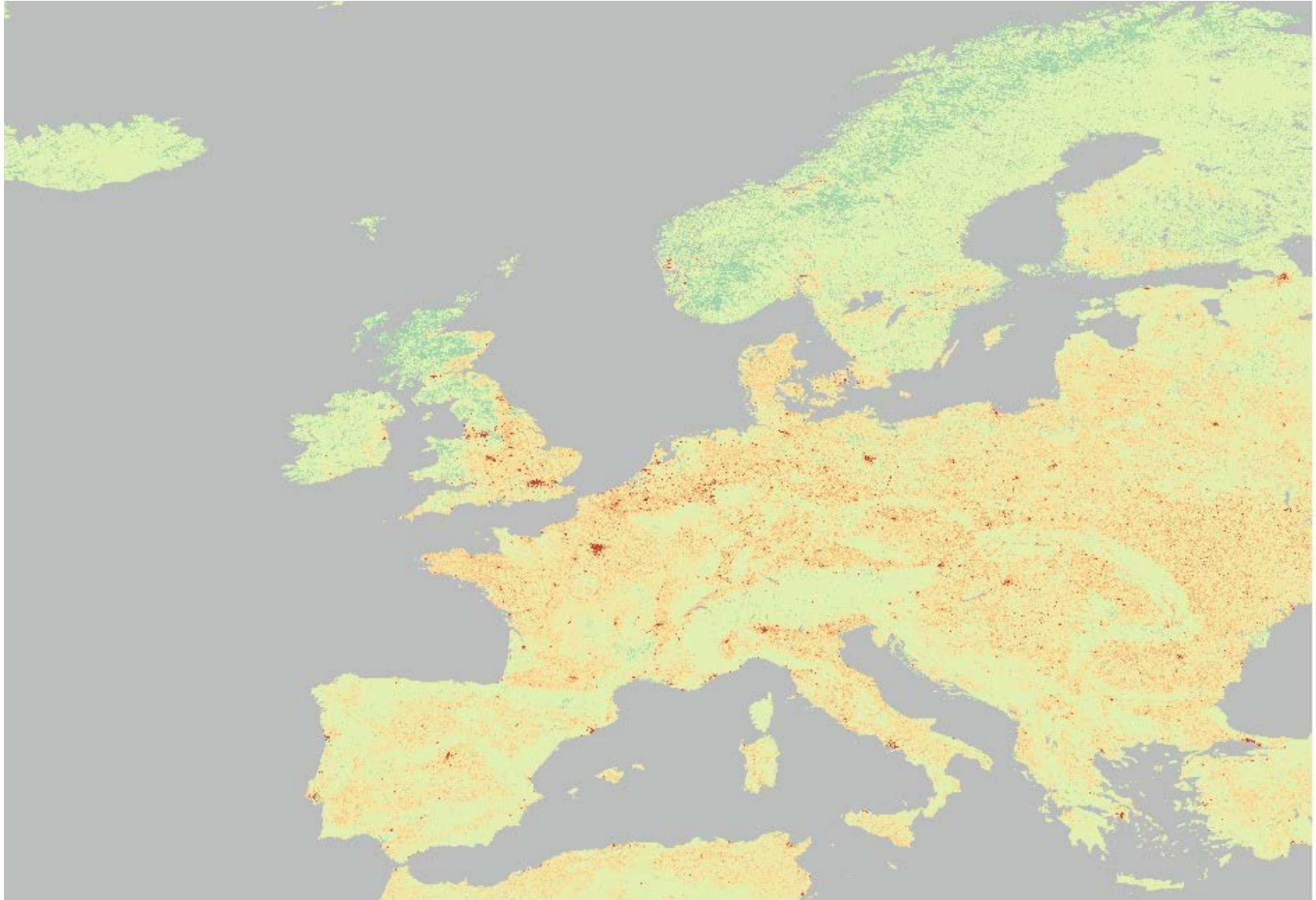
T=10	T=10	T=10
p=0	p=0	p=0
T=20	T=20	T=20
p=1/3	p=1/3	p=1/3
T=30	T=30	T=30
p=0	p=0	p=0

IS EVERYTHING CLEAR?



A scala Europea





Tips and Tricks (se siete appassionati)

- Fare esperienza con la OSGeoShell, per sfruttare i comandi GDAL da linea di comando
- Imparare R o Python
- Ricordarsi che utilizziamo dei modelli, i loro output sono interpretazioni della realtà basata su degli assunti

Grazie per l'attenzione!

daniele.dare@uclouvain.be