

What are ENM/SDM and why do we use them?

Emilio Berti

The why SDMs

Species Distribution Models (SDMs) are projections of species geographic ranges, i.e. where the species are found.

Among other applications, SDMs are used for:

1. Understand what limits species' distribution.
2. Project how they will change under future climate.
3. Plan conservation and management, e.g. where to establish new protected areas.

A brief history of SDMs

- ▶ 1807: Essay on the Geography of Plants (Humboldt).
- ▶ 1967: The theory of island biogeography (MacArthur & Wilson)
- ▶ 1990s: Infancy of quantitative SDMs.
- ▶ 2000s: SDMs as a recognized field.
- ▶ 2010s: Boom of SDMs.
- ▶ 2020s: Overflow of SDMs.

The basic workflow

Starting from data, to obtain the *projected* distribution of one species:

1. Ecological Niche Model (ENM): Model the ecological requirements of species.
2. SDM: Project these requirements into geographic space.

Always Data \rightarrow ENM \rightarrow SDM.

The basic workflow

Always Data \rightarrow ENM \rightarrow SDM.

Given some data, ENM is a flexible module.

SDM is usually much more constrained: Meta-population dynamics and other spatial processes.

The basic workflow

Always Data \rightarrow ENM \rightarrow SDM.

ENM: Environmental processes. ENM is hard due to data limitations.

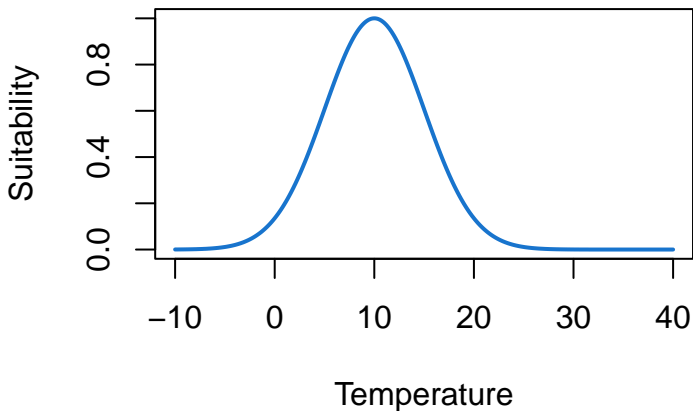
SDM: Spatial processes SDM is hard due to complexity and lack of theory.

Theory Primer

Ecological Niche Modeling (ENM)

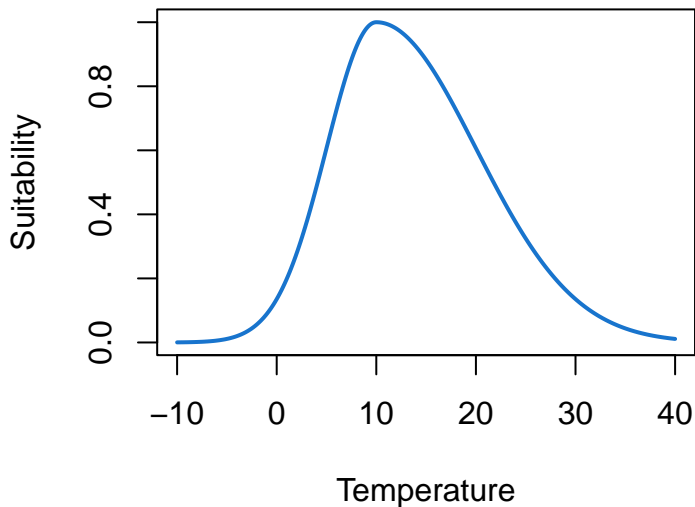
ENM try to reconstruct the ecological (climatic) niche of a species.

Theory suggests the niche must be convex.



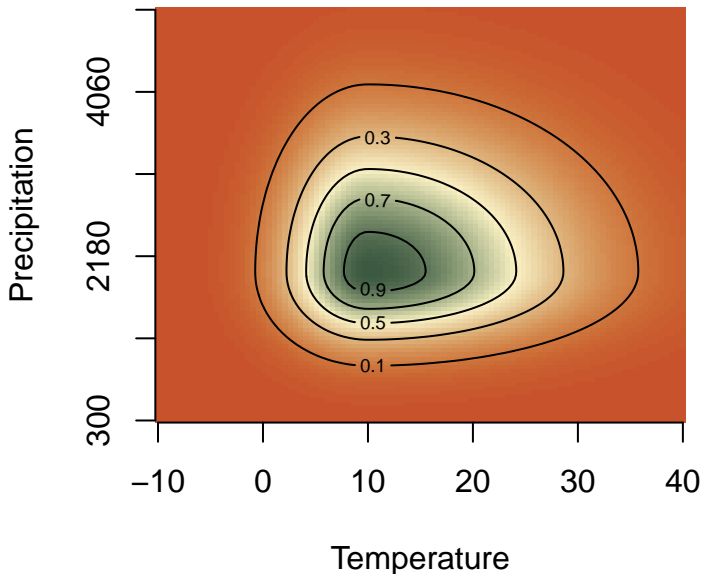
Ecological Niche Modeling (ENM)

Theory suggests the niche must be convex and not symmetrical



Ecological Niche Modeling (ENM)

Example of non-symmetrical, convex 2D niche.



Species Distribution Modeling (SDM)

SDMs project ENMs from an environmental space to a geographical area.

