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

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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.

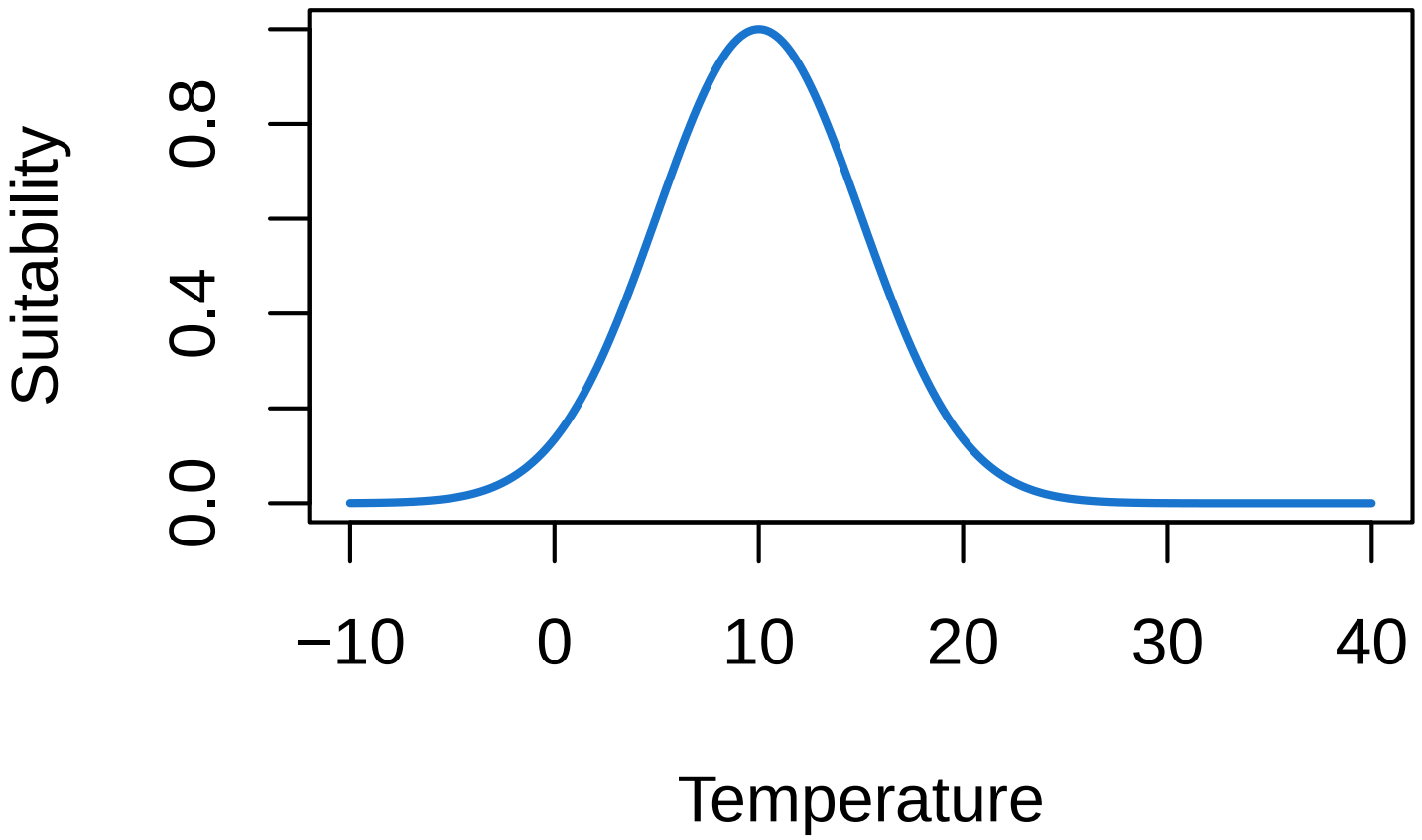
SDM: Spatial processes SDM is hard due to complexity and lack of theory.

Theory Primer

Ecological Niche Modeling (ENM)

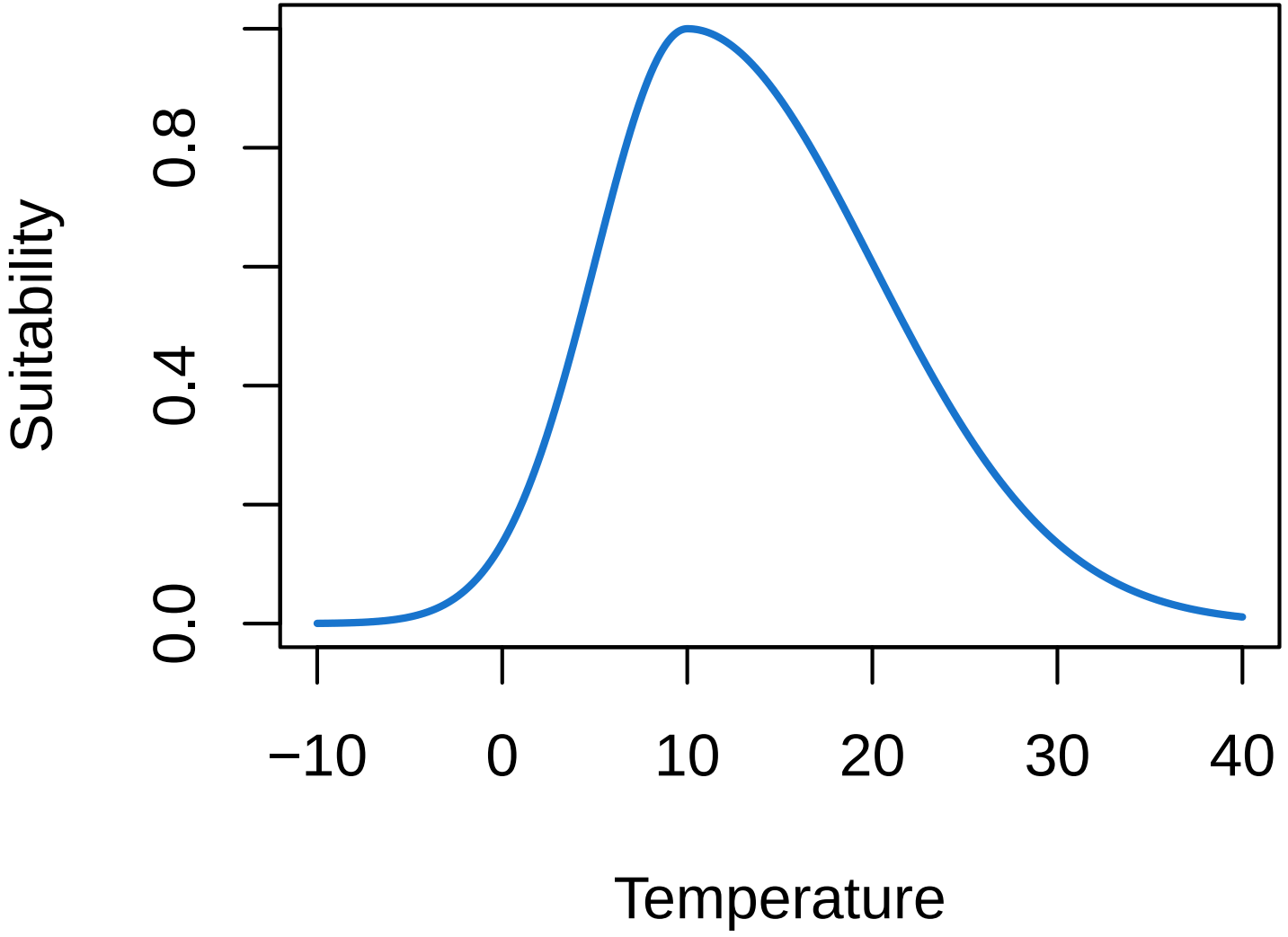
ENM try to reconstruct the ecological (climatic) niche of a species.

Theory suggests the niche must be convex.



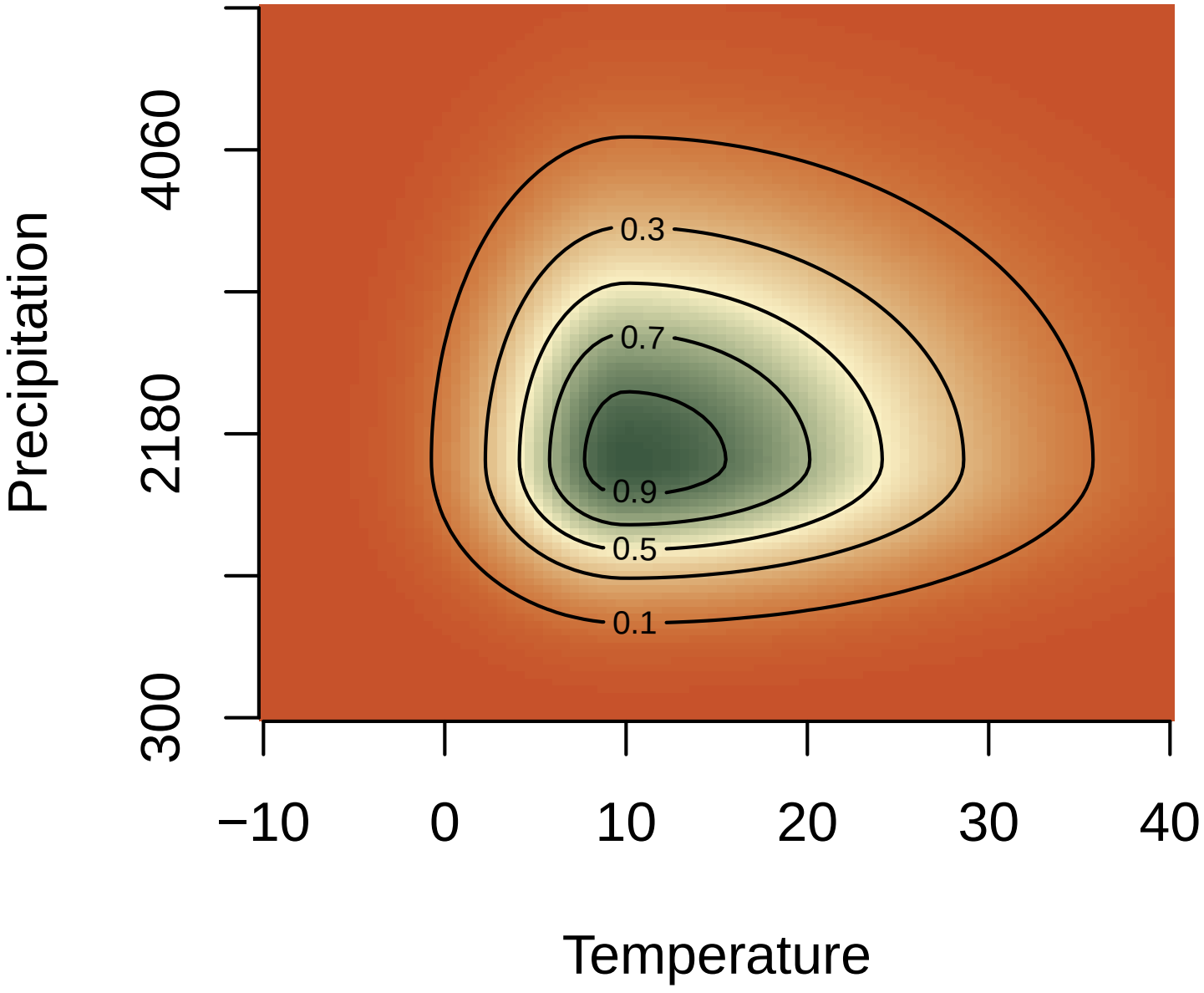
Ecological Niche Modeling (ENM)

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.