



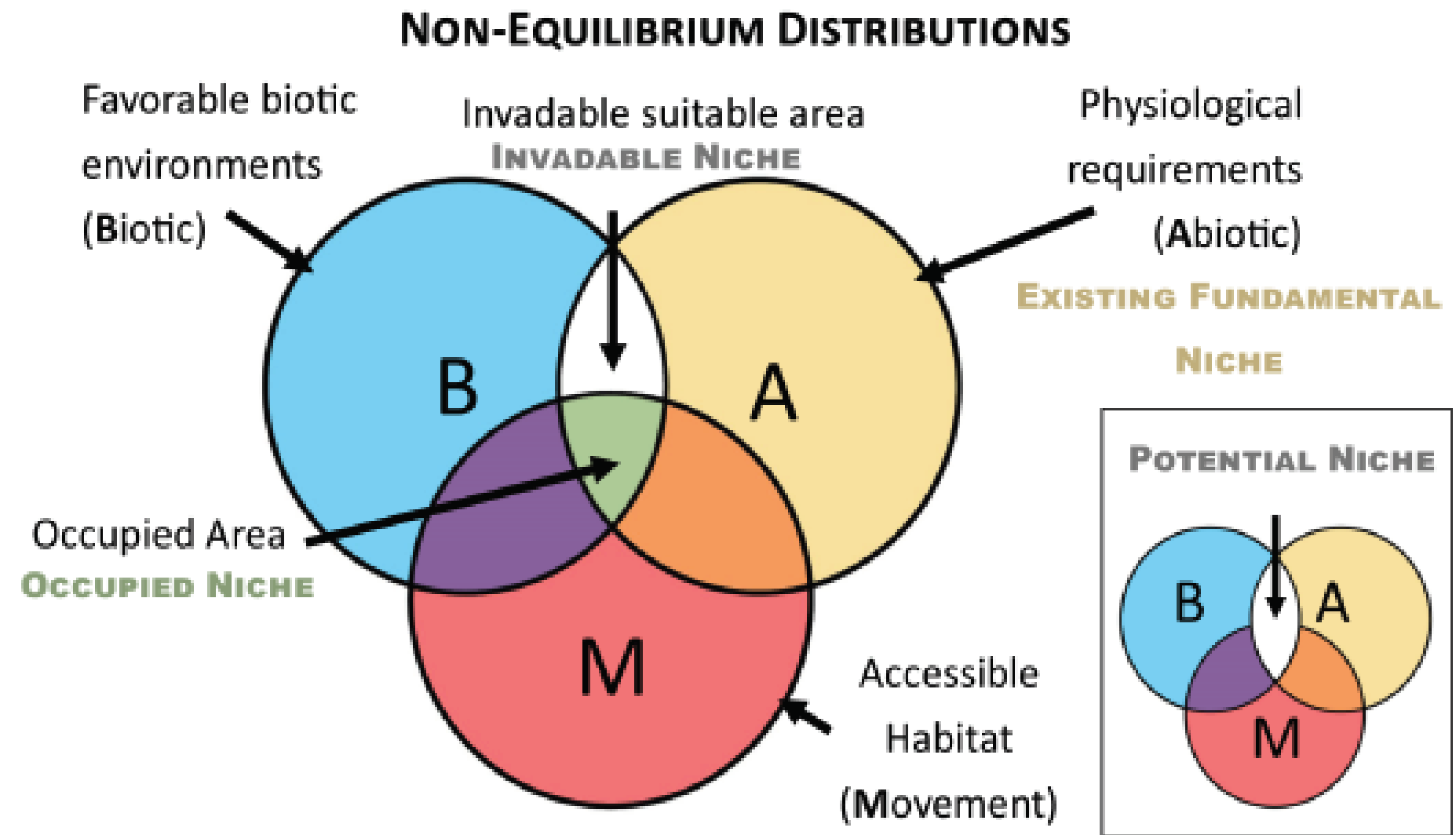
ACCESSIBLE AREA + VARIABLE SELECTION

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1. Defining Accessible Area

- Accessible area can be defined based on:
 - species ecology
 - dispersal ability
 - geographical barriers
- **Accessible area (M)** defines where a species *could* have dispersed to, given geography and history.



Brown and Carnaval. 2019. A tale of two niche: methods, concepts, and evolution. *Frontiers of Biogeography*.

1.The Role of the Accessible Area (M) in ENM

The crucial role of the accessible area in ecological niche modeling and species distribution modeling

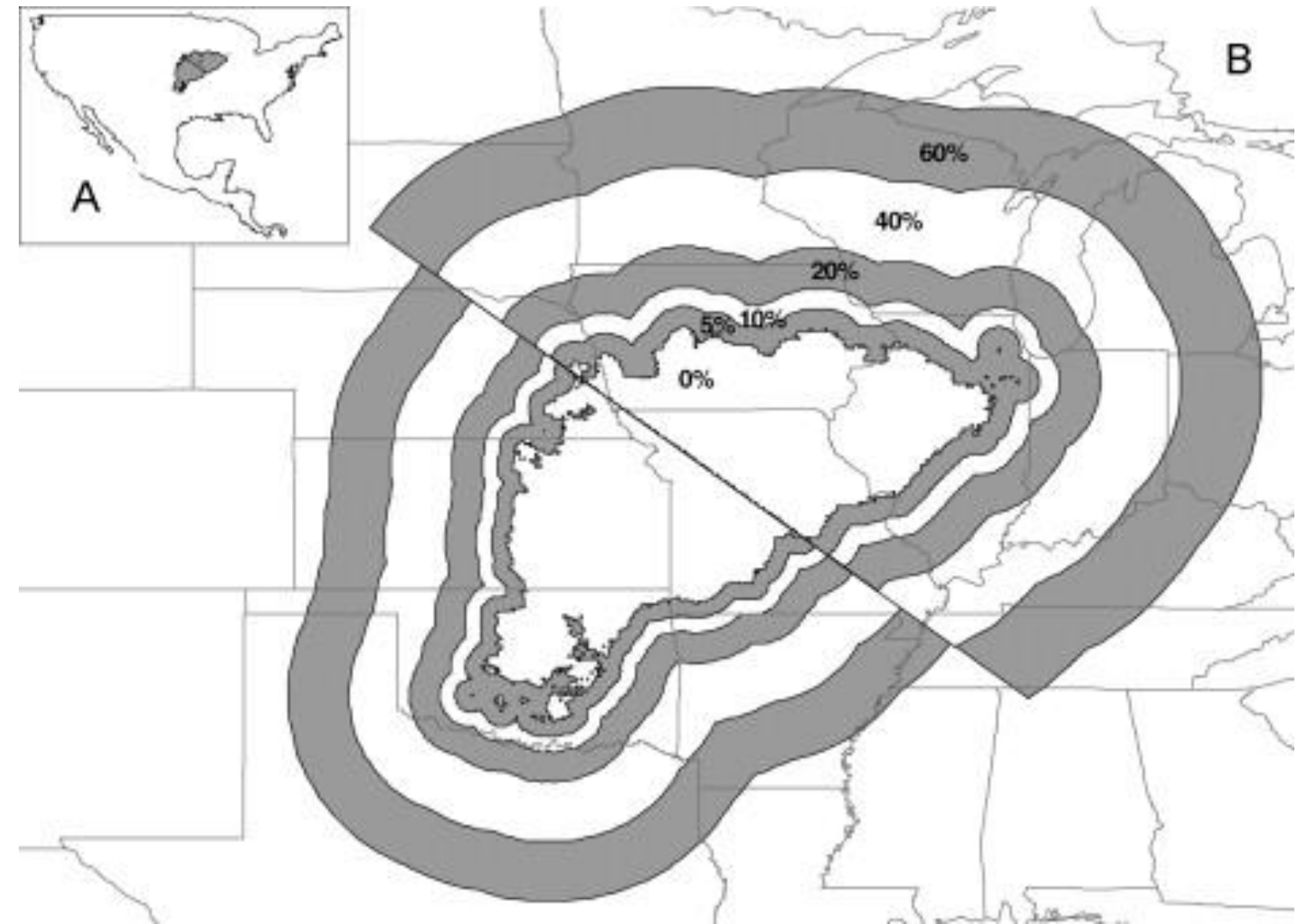
Narayani Barve ^a, Vijay Barve ^{a, 1}, Alberto Jiménez-Valverde ^{a, 1}, Andrés Lira-Noriega ^a, Sean P. Maher ^{a, 2}, A. Townsend Peterson ^a  , Jorge Soberón ^a, Fabricio Villalobos ^b

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- Add a buffer around the species distribution to capture potential movement.

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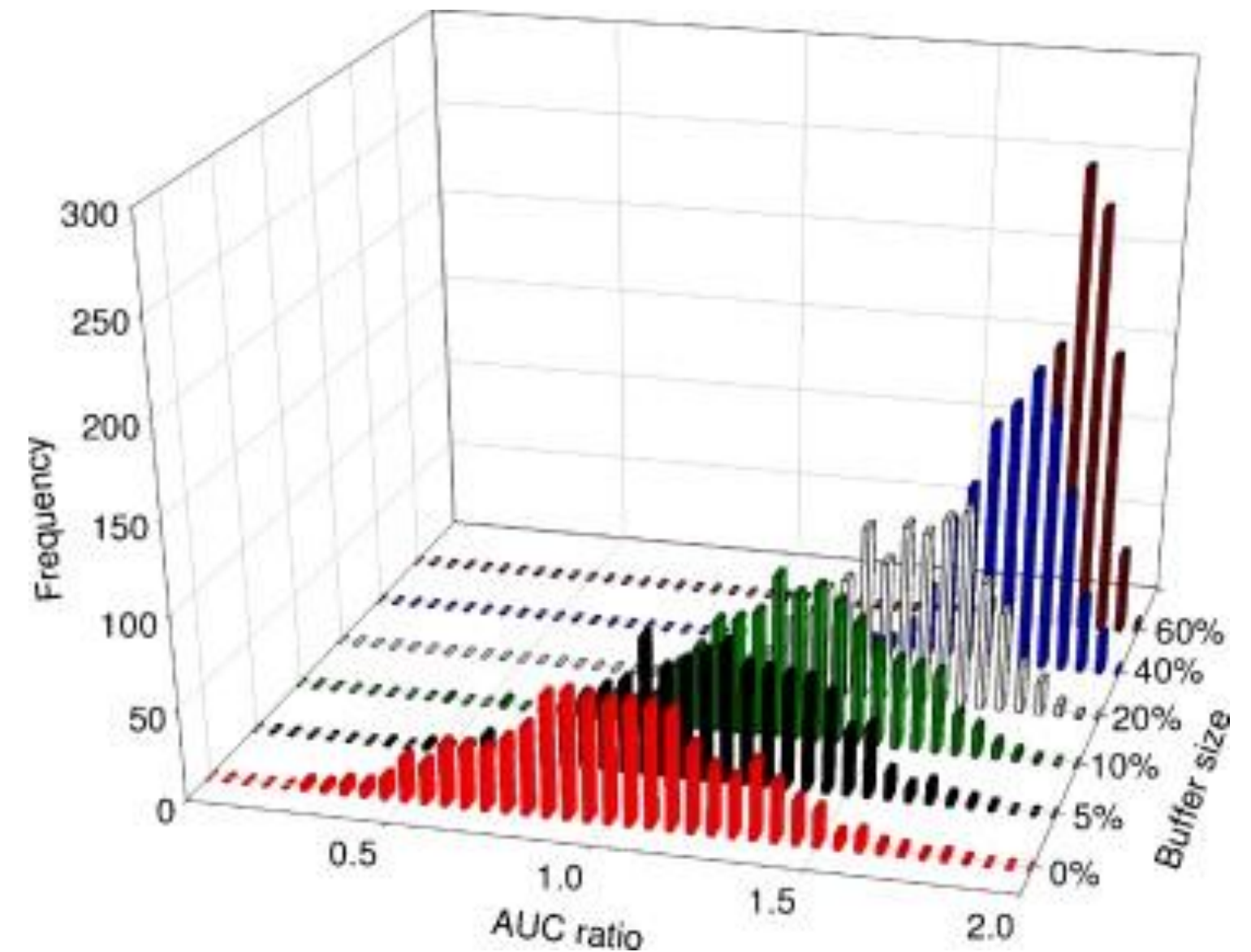
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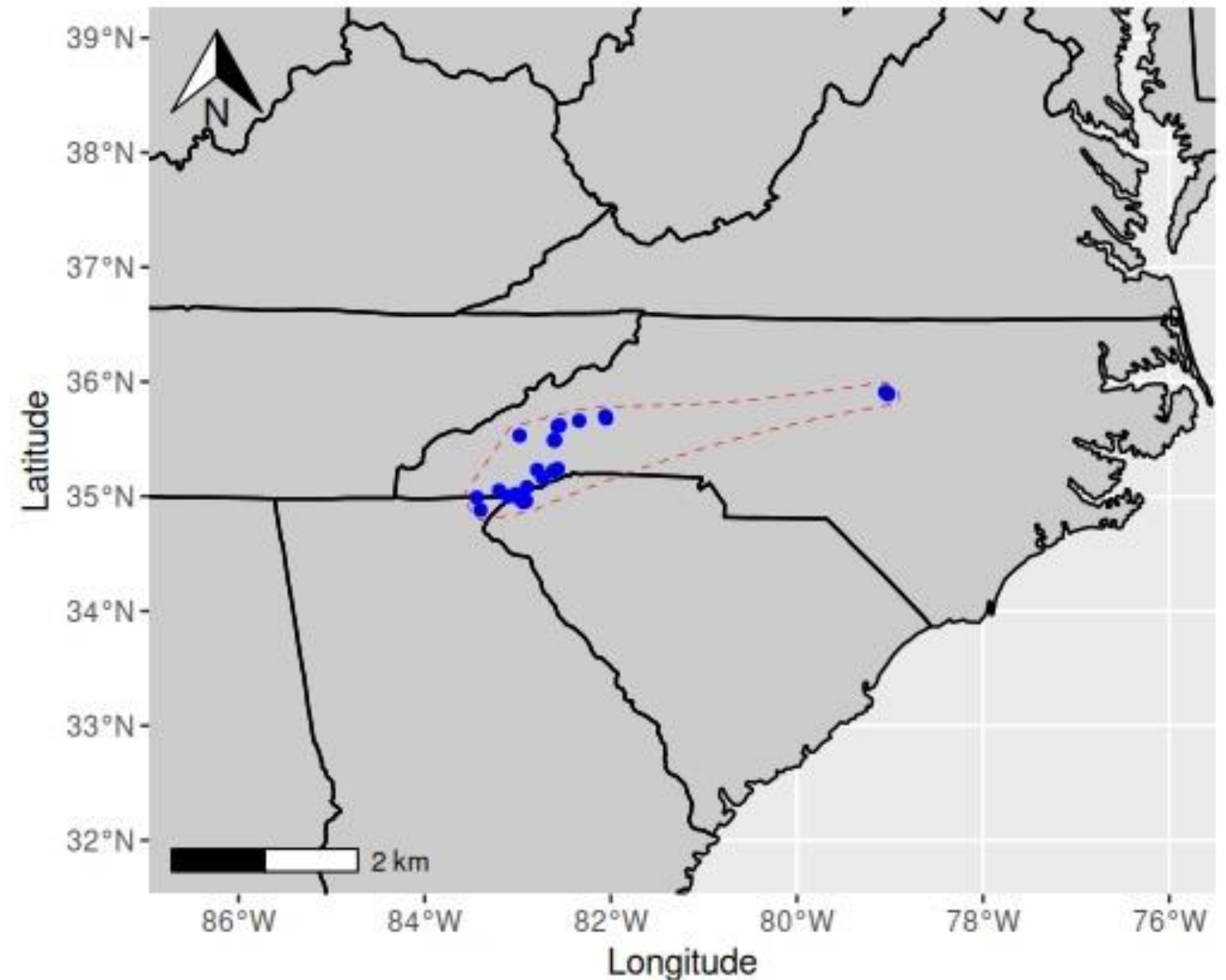
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- More area, AUC increased.
- Higher model significance as buffer size increased.

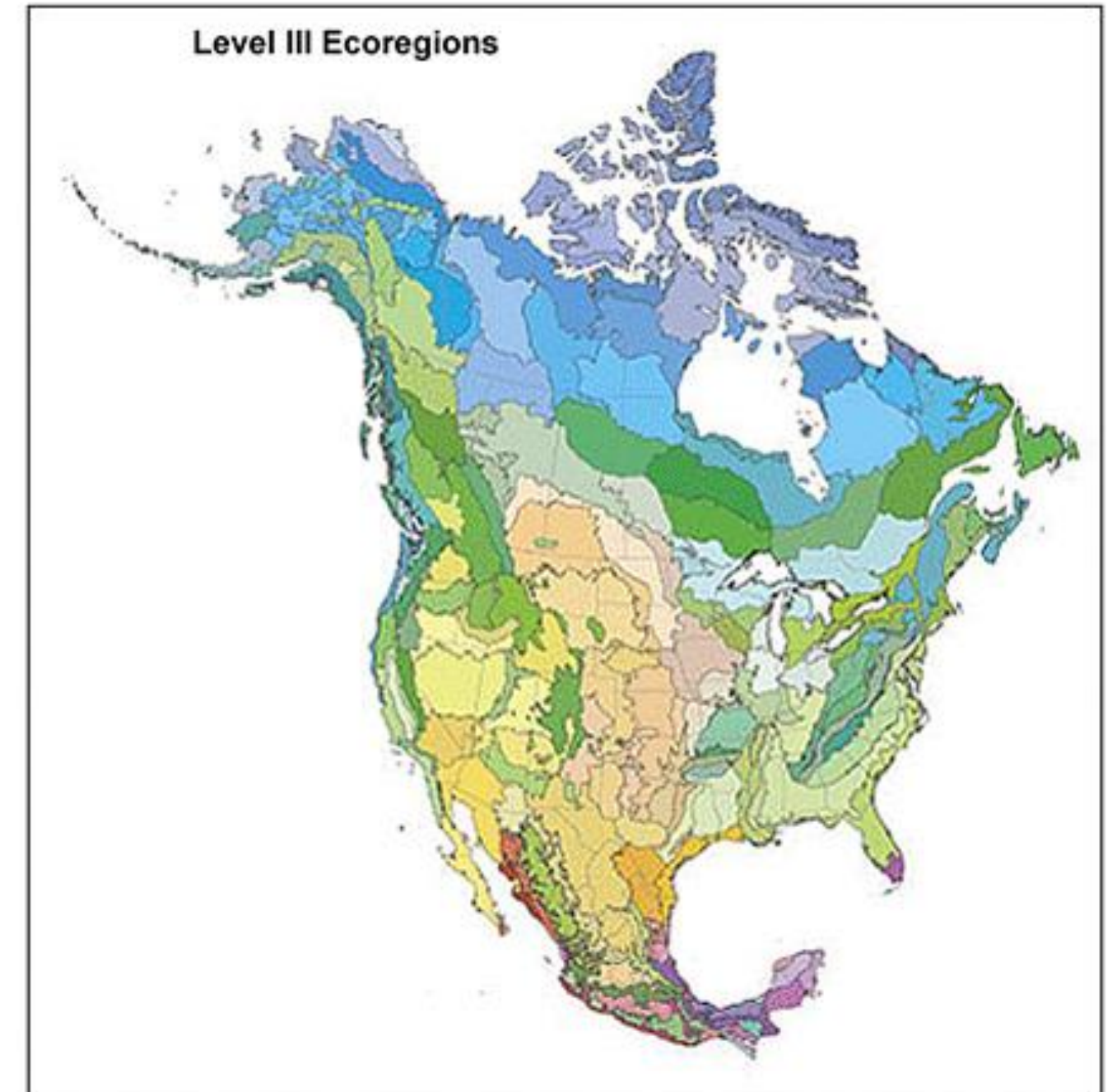
1. Defining the Accessible Area in Practice

1. **Create spatial boundary around species occurrences.**
2. Create a Spatial Buffer around occurrence boundary.
 - Measure pairwise distances between species occurrences.
 - Extract the 80th percentile distance as a buffer radius.
3. Obtain gridded abiotic data layers.
4. Crop layers to the shared accessible area.
5. Select layers for ecological niche modeling.



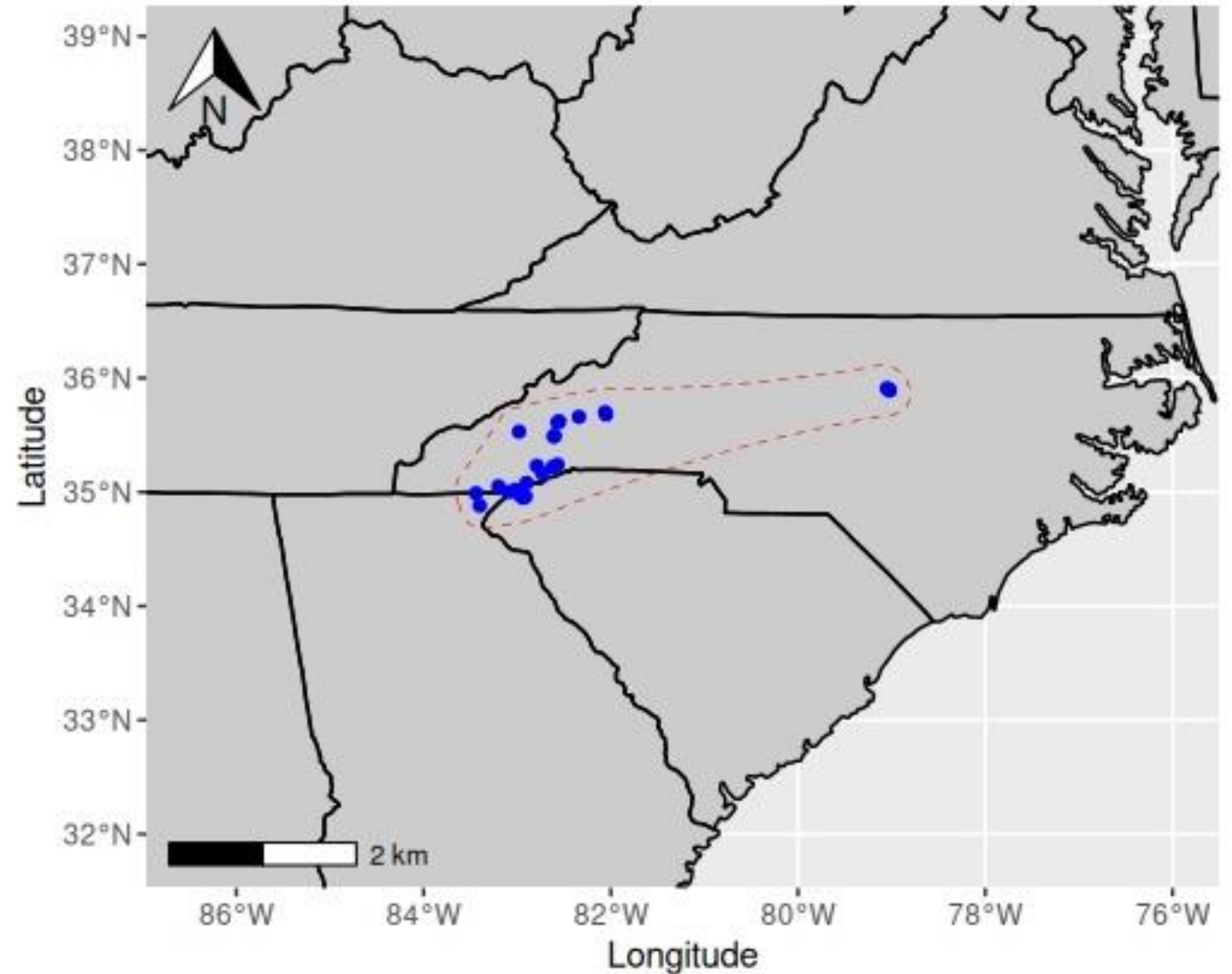
1. Multiple ways to create species boundaries

- **Convex Hull** - Encloses all points in the smallest convex polygon.
 - Equivalent to the boundary formed by stretching a rubber band around the outermost points.
- **Alpha Hull** - A flexible, concave boundary estimator controlled by an alpha value.
 - Captures non-convex patterns and gaps in occurrence data (e.g., disjunct populations, island distributions). <- we do this today
- **Ecoregions** - Identify clear distributional boundaries and ecoregions using the World Wildlife Fund Terrestrial Ecoregions (see Rautsaw et al. 2022).
- **Point-based** - Defines species' accessible area directly from occurrence coordinates.
 - Constructs boundaries (e.g., convex or alpha hulls) and buffers using the spatial structure of the occurrence points (see Melton et al. 2022).

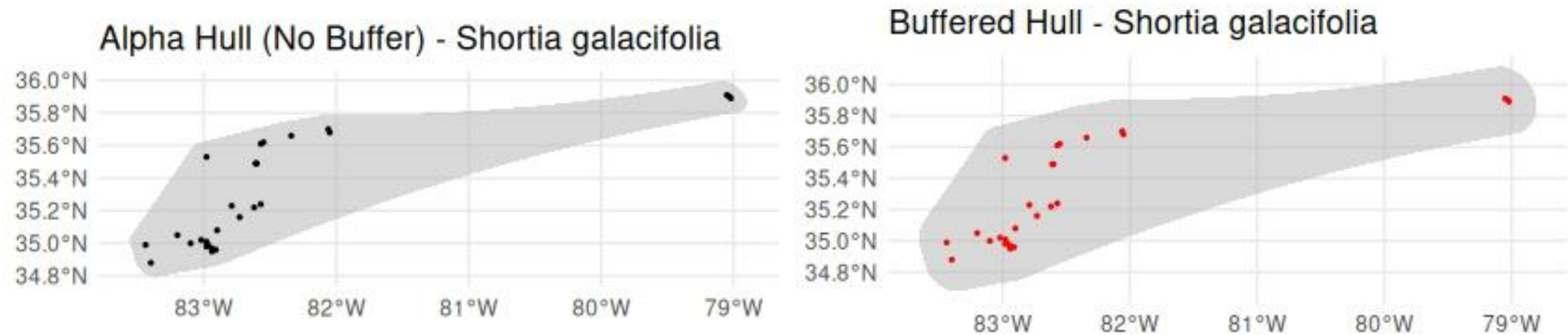


1. Defining the Accessible Area in Practice

1. Create spatial boundary around species occurrences.
- 2. Creating a Spatial Buffer Around Occurrence Alpha Hull**
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1. Defining the Accessible Area in Practice



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1. Creating a Spatial Buffer Around Occurrence

Convex Hull

→ Measure pairwise distances between species occurrences.

→ Extract the 80th percentile distance as a buffer radius.

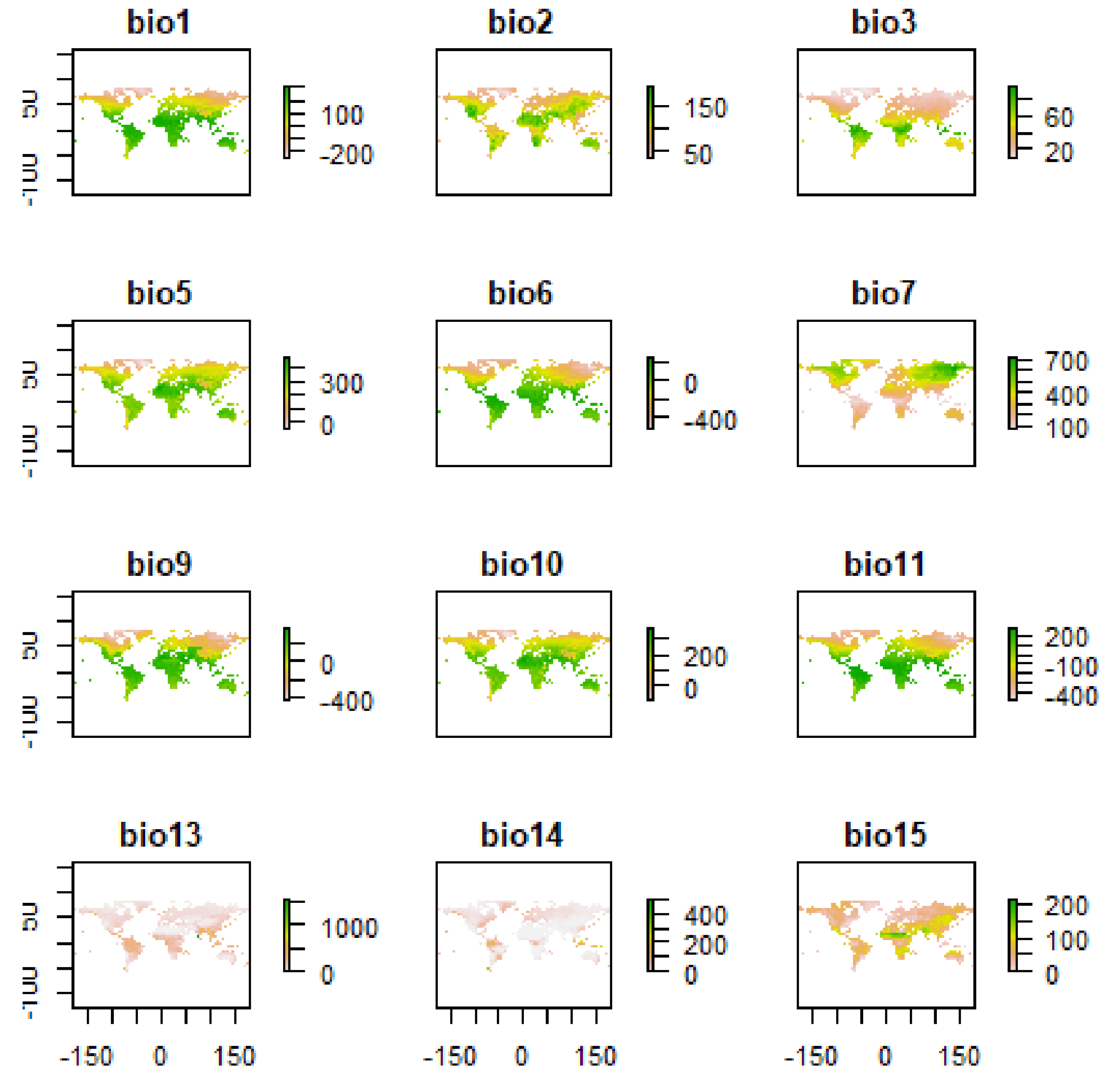
2. Obtain gridded abiotic data layers.

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4. Select layers for ecological niche modeling.

WorldClim - Global Climate Data

Free climate data for ecological modeling and GIS



1. Defining the Accessible Area in Practice

1. Creating a Spatial Buffer Around Occurrence

Convex Hull

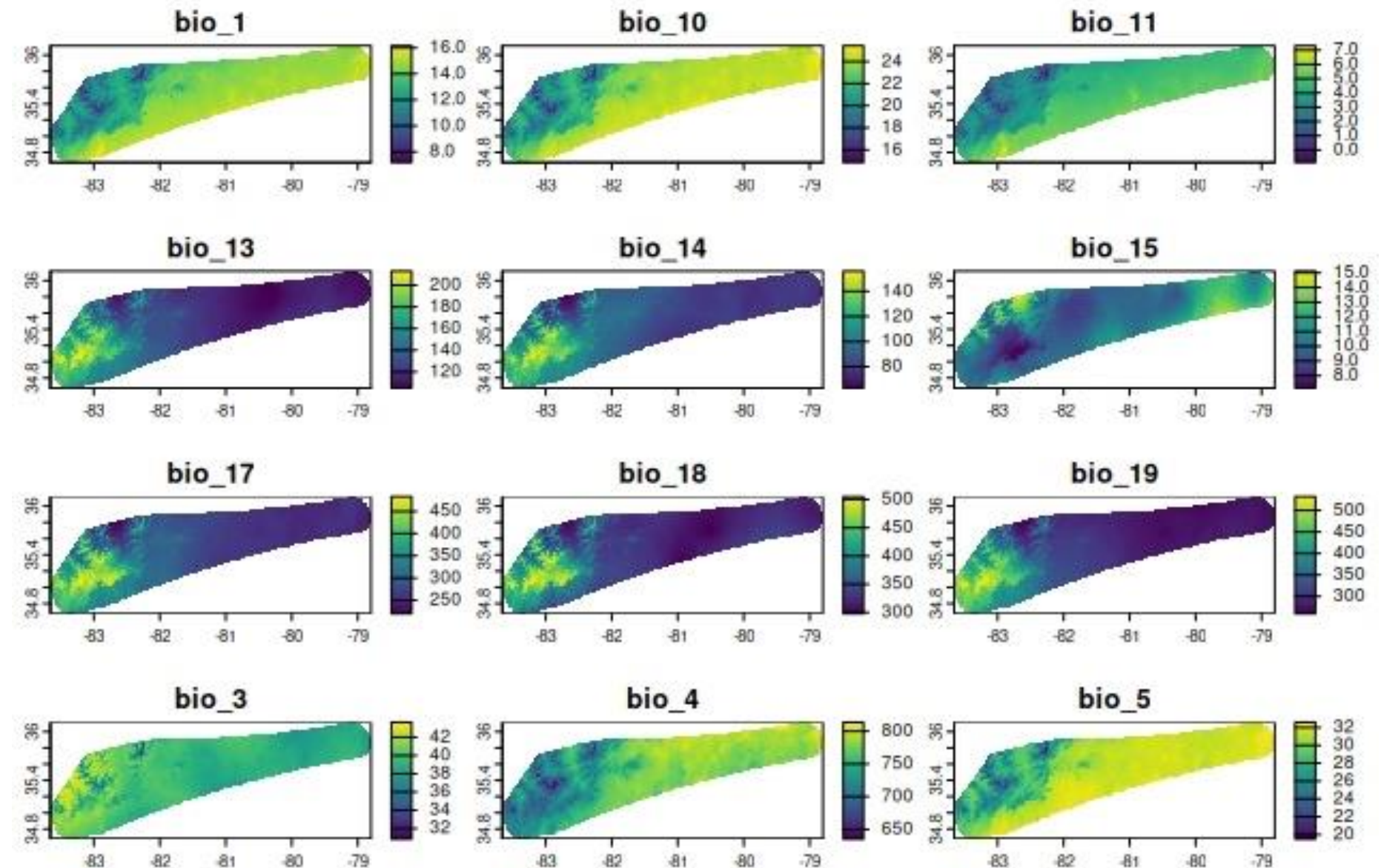
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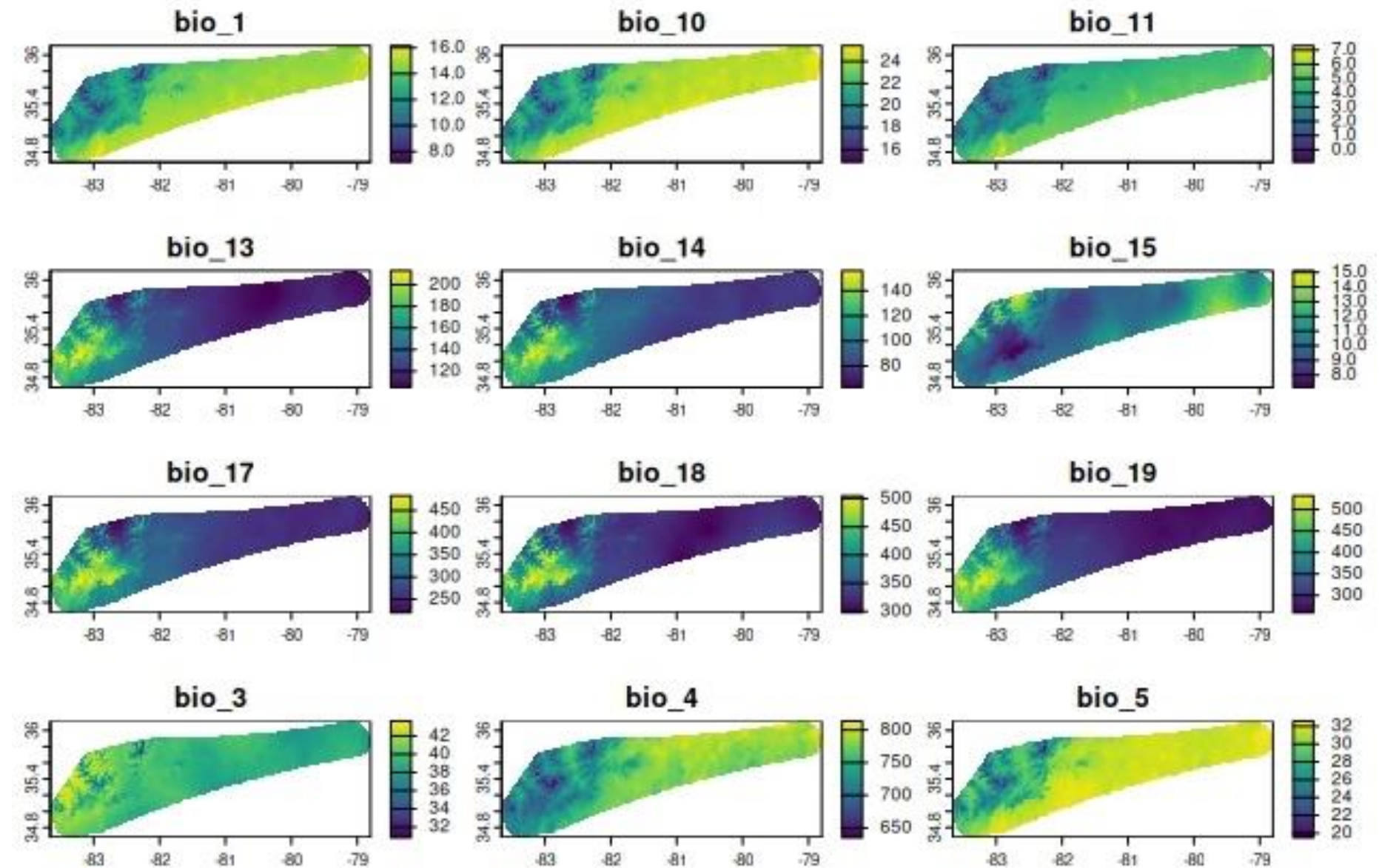
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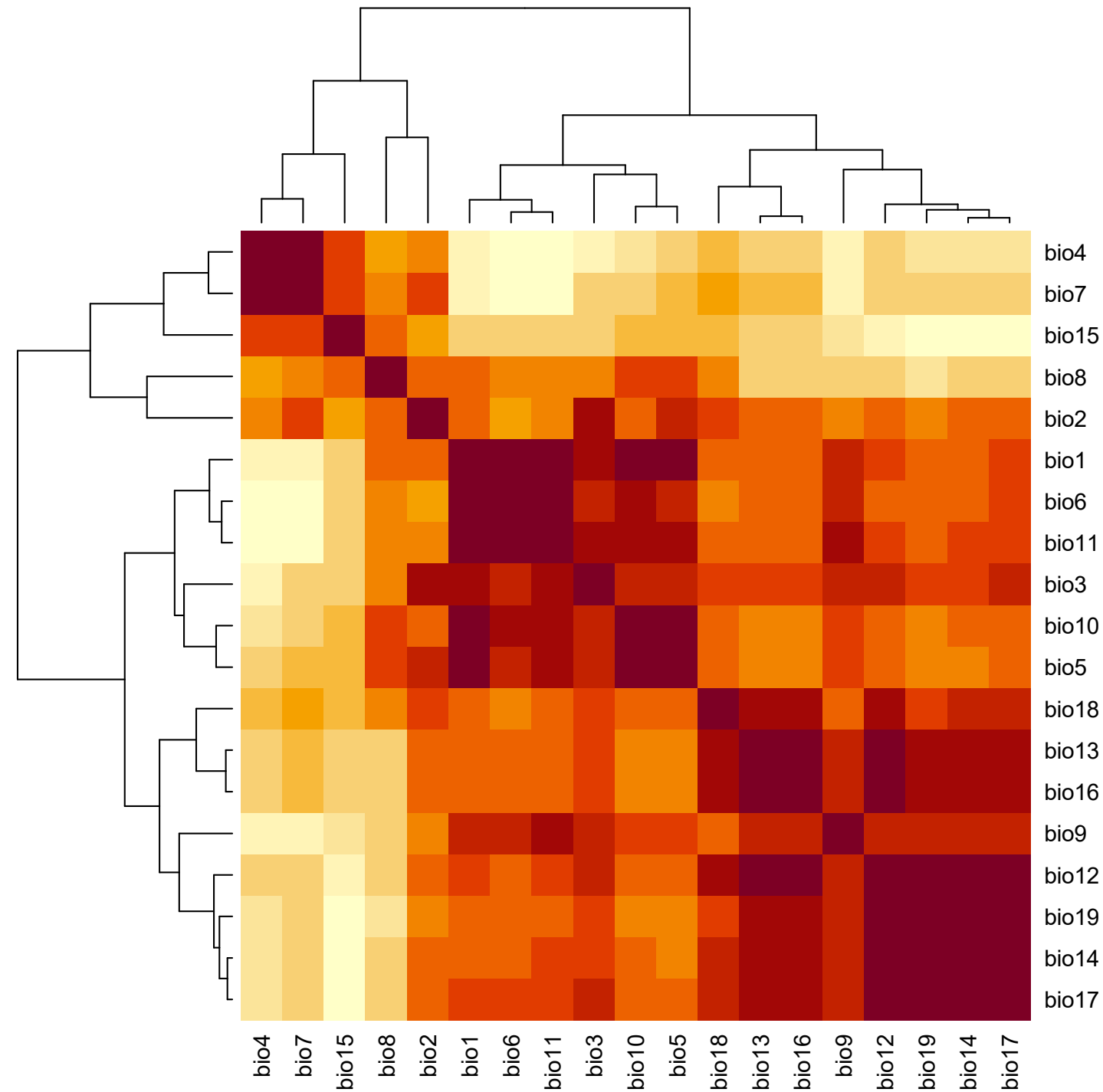
4. Select layers for ecological niche modeling.



2. Select layers for ecological niche modeling

Method	Threshold	Purpose
PCA	PC1 + PC2 = ~95%	Reduces variables to axis
Pearson correlation	Removes variables $> 0.80 $	Removes correlated variables
Variable Inflation Factor	Removes variables > 10	Removes multicollinear variables

2. Select layers for ecological niche modeling



Layers used in ENM
development

bio2

bio3

bio5

bio7

bio8

bio9

bio15

bio18

bio19

- Pearsons correlation

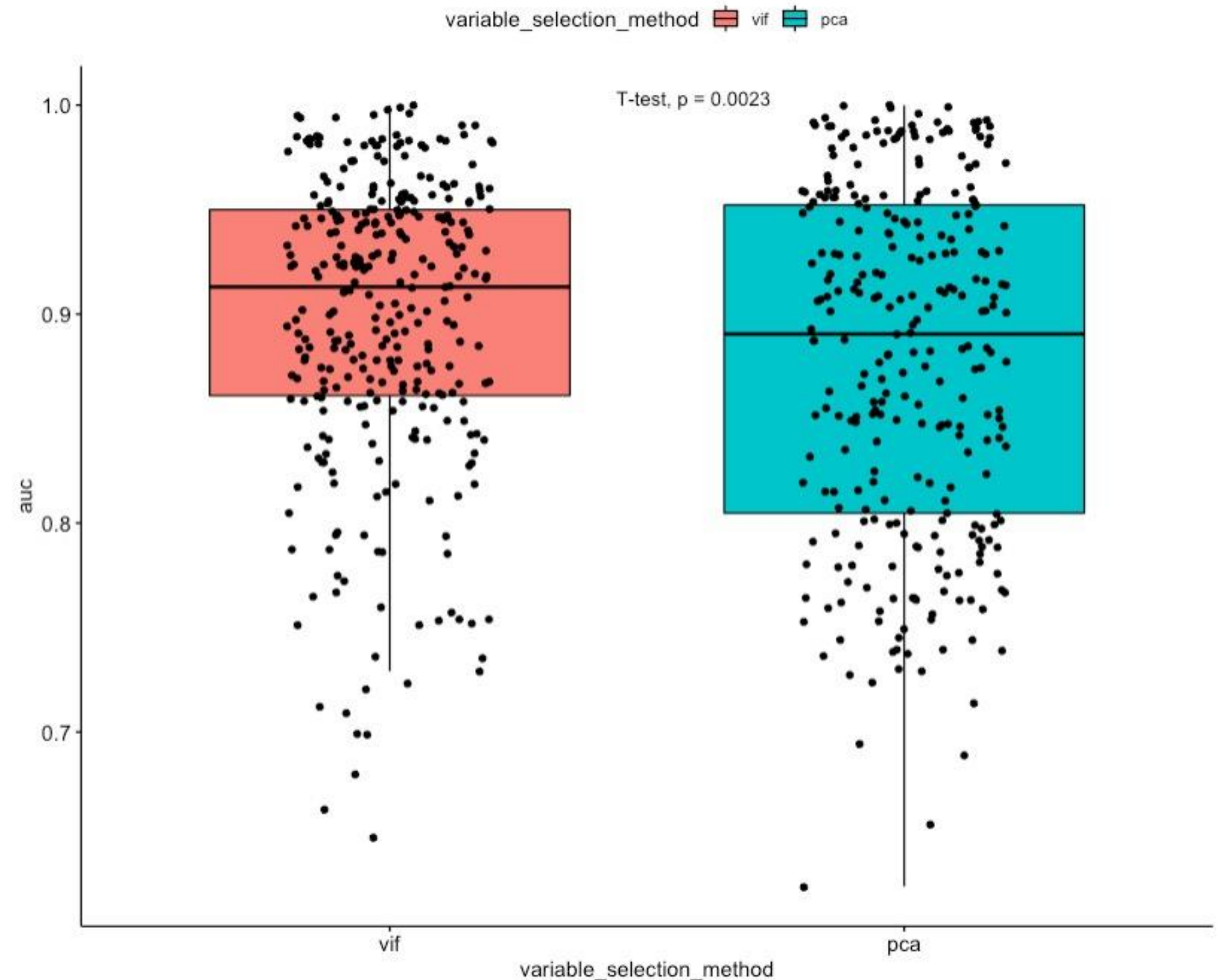
- A correlation test is performed on all 19 BioClim layers.

- Removes variables $> |0.80|$

2. Select layers for ecological niche modeling

PCA vs VIF with permutation

- AUC was significantly higher in models generated using the VIF method
- Based on 109 species in the subfamily Crotalinae (Viperidae)
- PCA with 75% collinearity cutoff, each variable contribution had to be >5%.
- $VIF < 10$, permutation importance > 1%



3. Activity

- Define the accessible area (M) for each species, crop WorldClim layers accordingly, and select environmental variables using Variance Inflation Factor (VIF) analysis.

