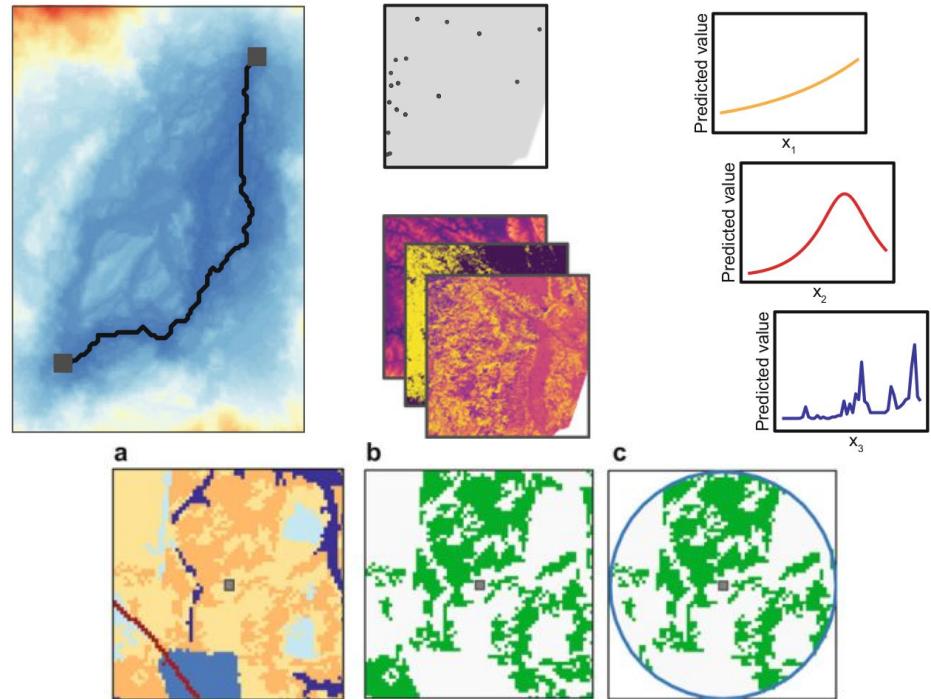
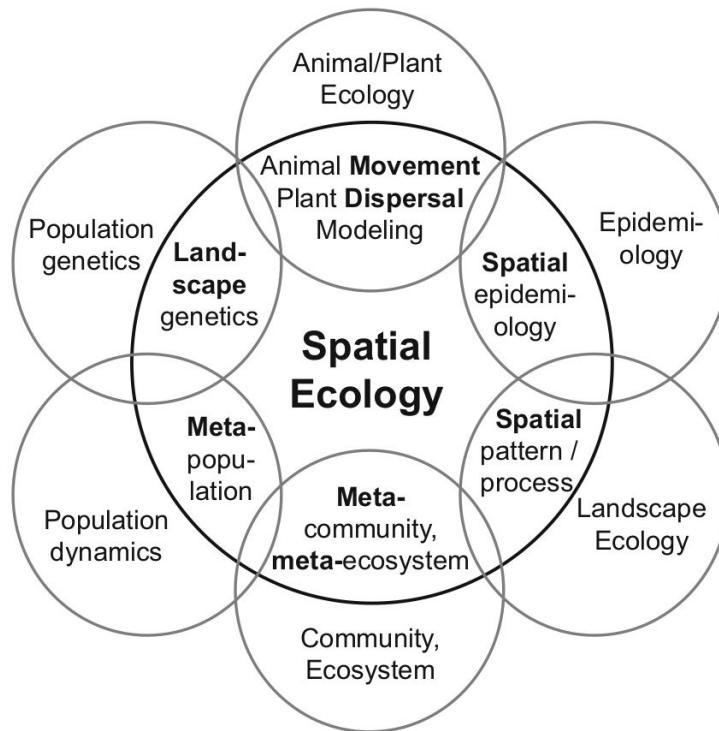


Aplicações da Cartografia para a Ecologia Espacial



Maurício Vancine

UNESP - Rio Claro/SP

Lab. Ecologia Espacial e Conservação (LEEC)

02/04/2021

unesp



Palestra

Tópicos

1. Apresentações
2. Cartografia
3. Ecologia Espacial
4. Modelagem de Distribuição de Espécies - *Species Distribution Modeling (SDMs)*
5. Nicho Ecológico e Distribuição de Espécies
6. SDMs passo a passo
7. Aplicações

1. Apresentações

Maurício Vancine

Ecólogo (2014) | Mestre em Zoologia (2018) |
Doutorando em Ecologia (2020-?)

Pesquisa

Ecologia Espacial (Ecologia da Paisagem)

Ecologia Quantitativa (SDM e JSDM)

Ecologia de Anfíbios



UNIVERSIDADE ESTADUAL PAULISTA
“JÚLIO DE MESQUITA FILHO”



Prof. Milton Ribeiro



Prof. Célio Haddad



Maurício Vancine

Ecólogo (2014) | Mestre em Zoologia (2018) |
Doutorando em Ecologia (2020-?)

Pesquisa

Ecologia Espacial (Ecologia da Paisagem)
Ecologia Quantitativa (SDM e JSDM)
Ecologia de Anfíbios

Especialidades

Modelagem de Distribuição de Espécies (SDMs)
Análise de Dados Ecológicos e Geoprocessamento
Open source [R, QGIS, GRASS GIS, Linux, Libreoffice, ...]

Contato e informações

-  mauricio.vancine@gmail.com
-  @mauriciovancine
-  [mauriciovancine.github.io](https://github.com/mauriciovancine)



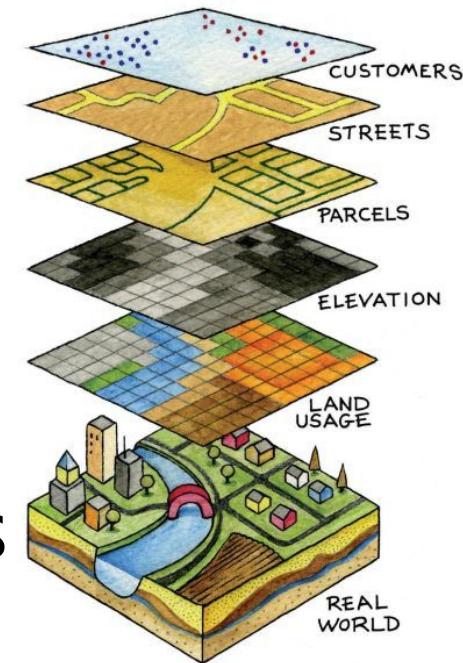
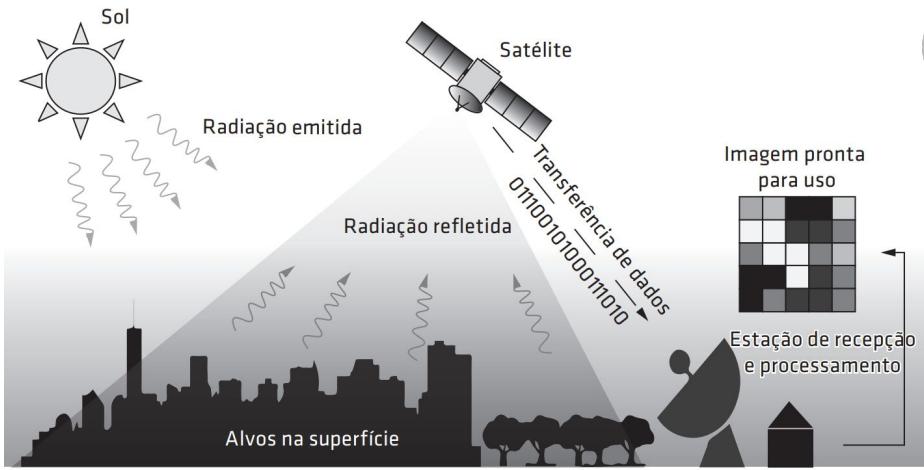
UNIVERSIDADE ESTADUAL PAULISTA
“JÚLIO DE MESQUITA FILHO”

2. Cartografia

Cartografia

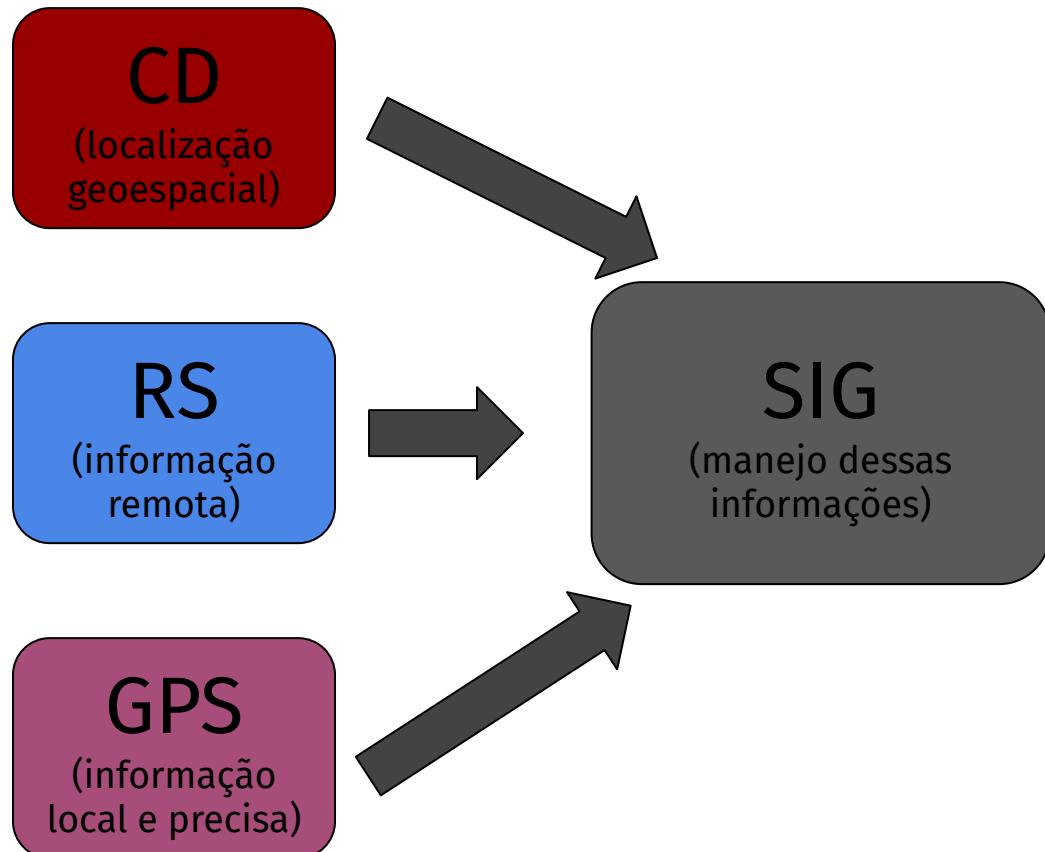
Geoprocessamento

1. Cartografia [digital] (CD)
2. Sensoriamento Remoto (RS)
3. *Global Positioning System* (GPS)
4. Sistemas de Informações Geográficas (SIG)



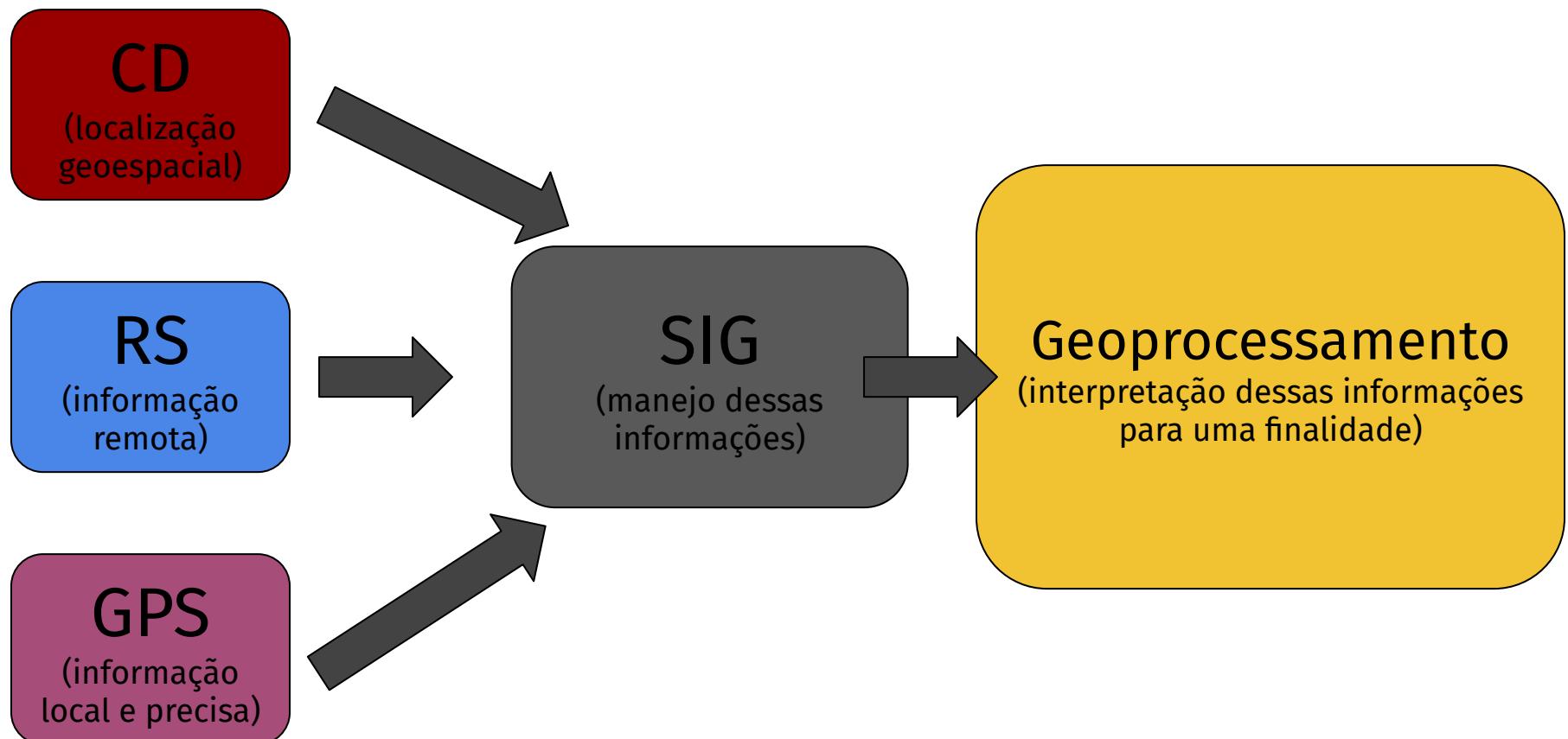
Cartografia

Gerar informações para tomada de decisões



Cartografia

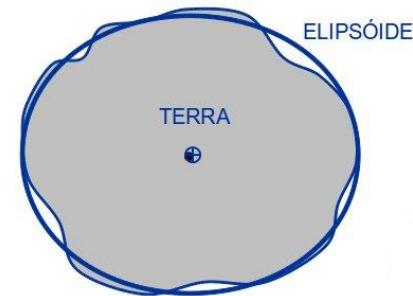
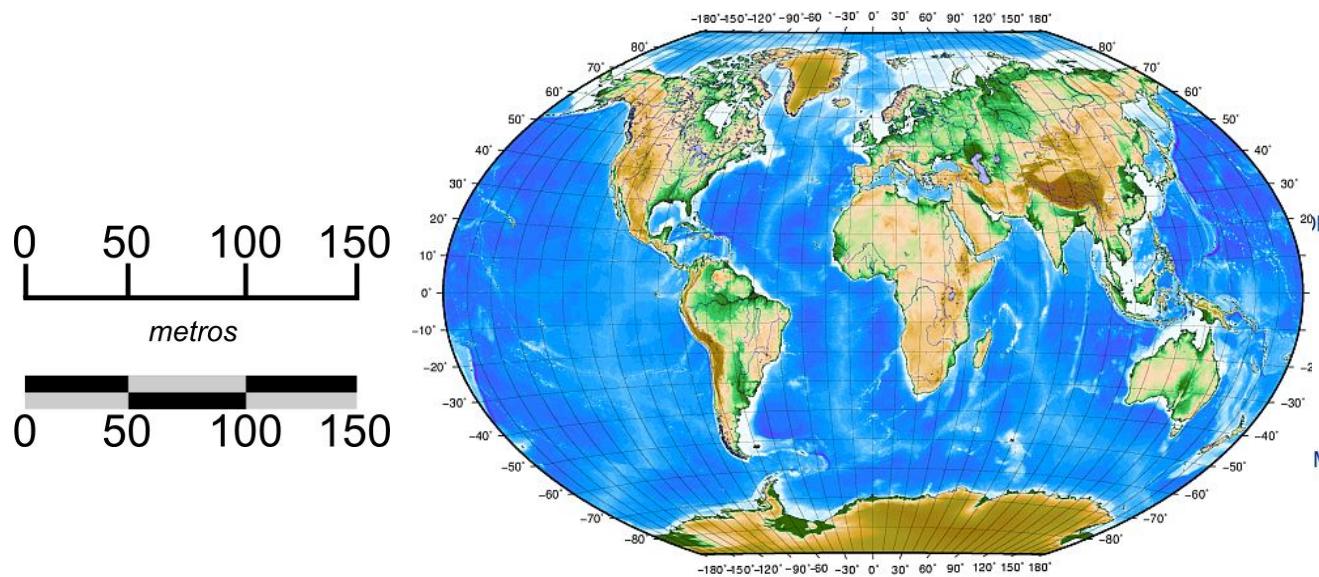
Gerar informações para tomada de decisões



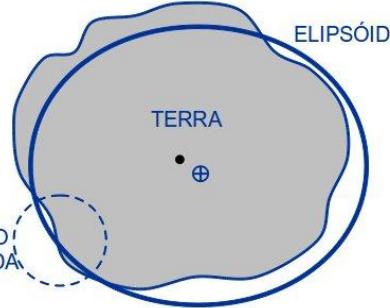
Cartografia

Conceitos em cartografia

1. Escala
2. Sistema de referência de coordenadas
3. Datum
4. Tipos de mapas



DATUM GLOBAL (WGS-84)
GEOCÊNTRICO



DATUM LOCAL (SAD-69)
NÃO GEOCÊNTRICO

Cartografia

Escala

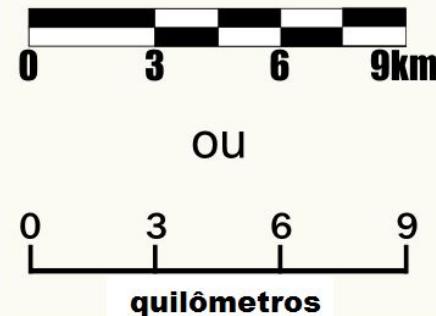
ESCALA NUMÉRICA

*Numerador
(área do mapa)*

1 : 50000

*Denominador
(área real)*

ESCALA GRÁFICA



50 quilômetros no terreno

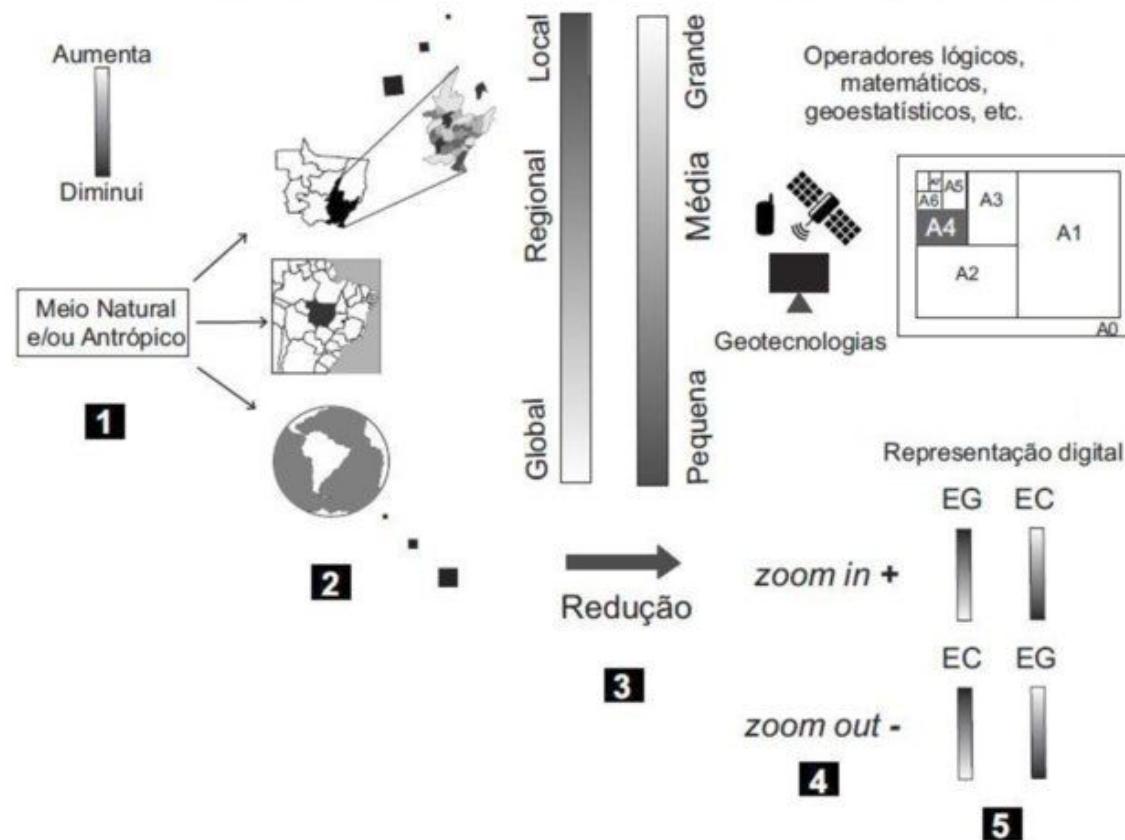
0 50 100 150 km

1 cm no mapa

Cartografia

Escala

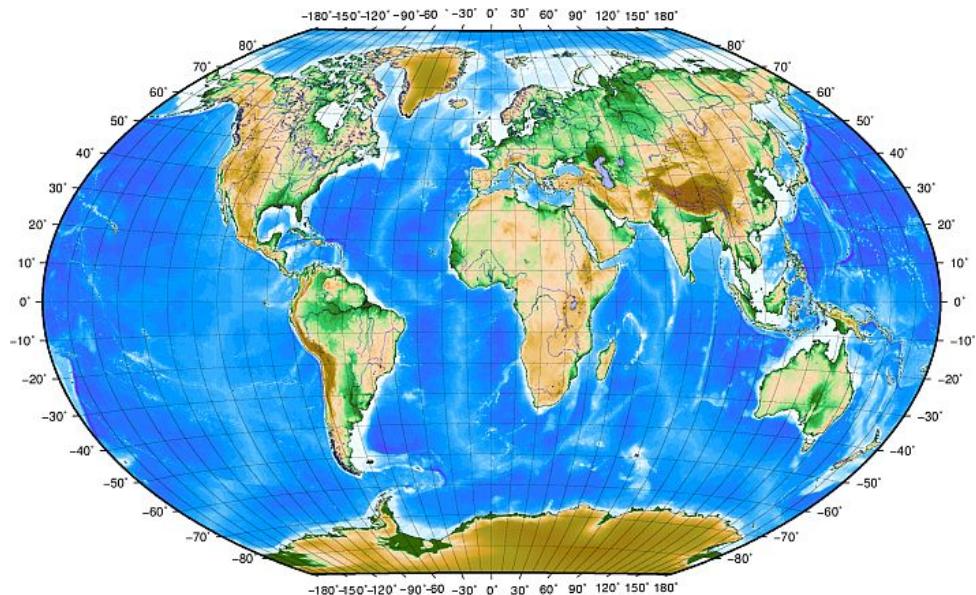
Escala Geográfica (EG) x Escala Cartográfica (EC)



Cartografia

Sistemas referência de coordenadas (SRC)

Geográficos (graus)

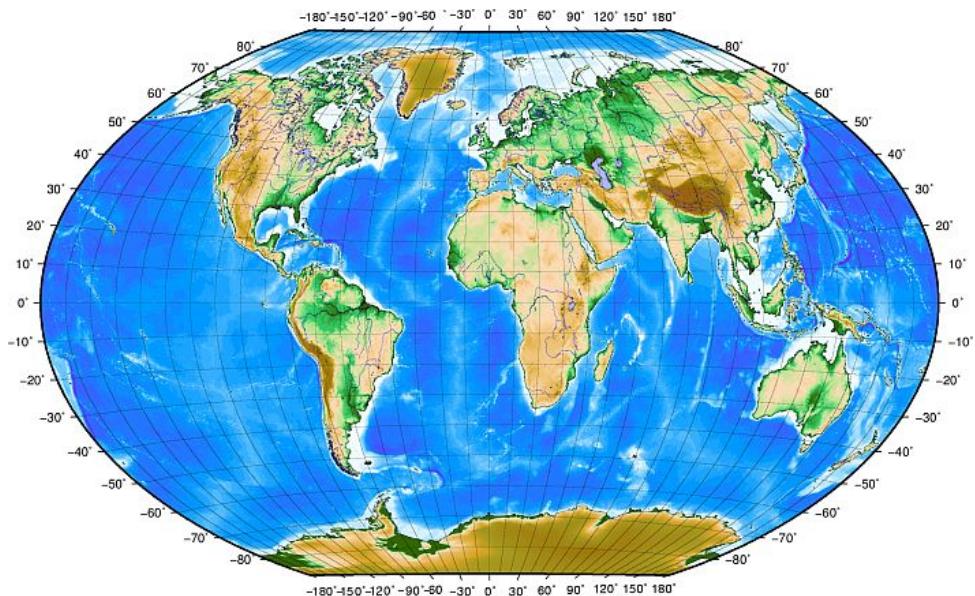


https://docs.qgis.org/3.4/pt_BR/docs/gentle_gis/introduction/coordinate_reference_systems.html

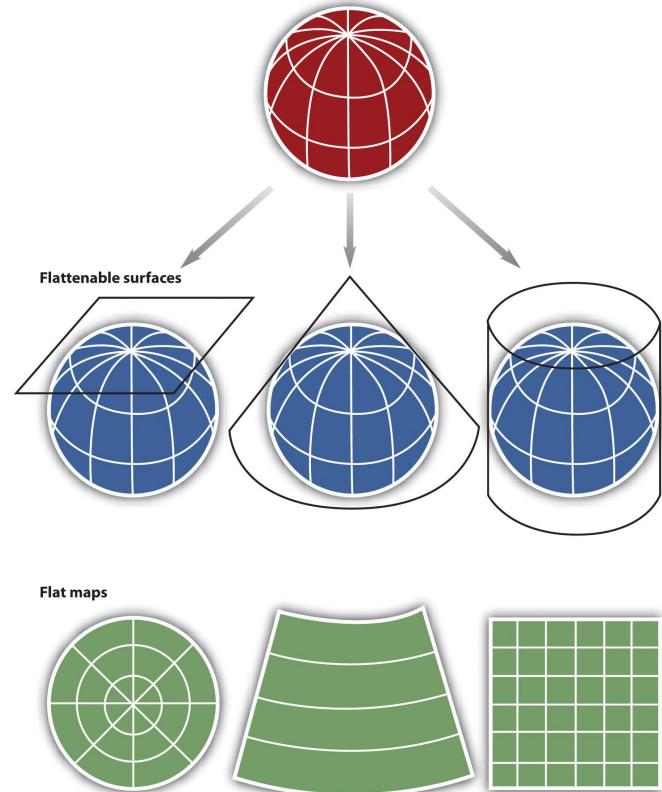
Cartografia

Sistemas referência de coordenadas (SRC)

Geográficos (graus)



Projetados (metros)



Cartografia

Nova projeção com menos distorções possível

Flat Maps that improve on the Winkel Tripel

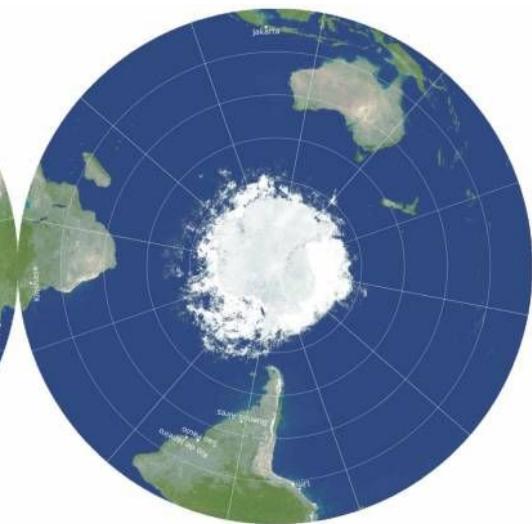
J. Richard Gott III¹, David M. Goldberg², and Robert J. Vanderbei³

Distorções:

1. formas locais
2. áreas
3. distâncias
4. flexão ou curvatura
5. assimetria
6. lacunas de continuidade



Winkel Tripel

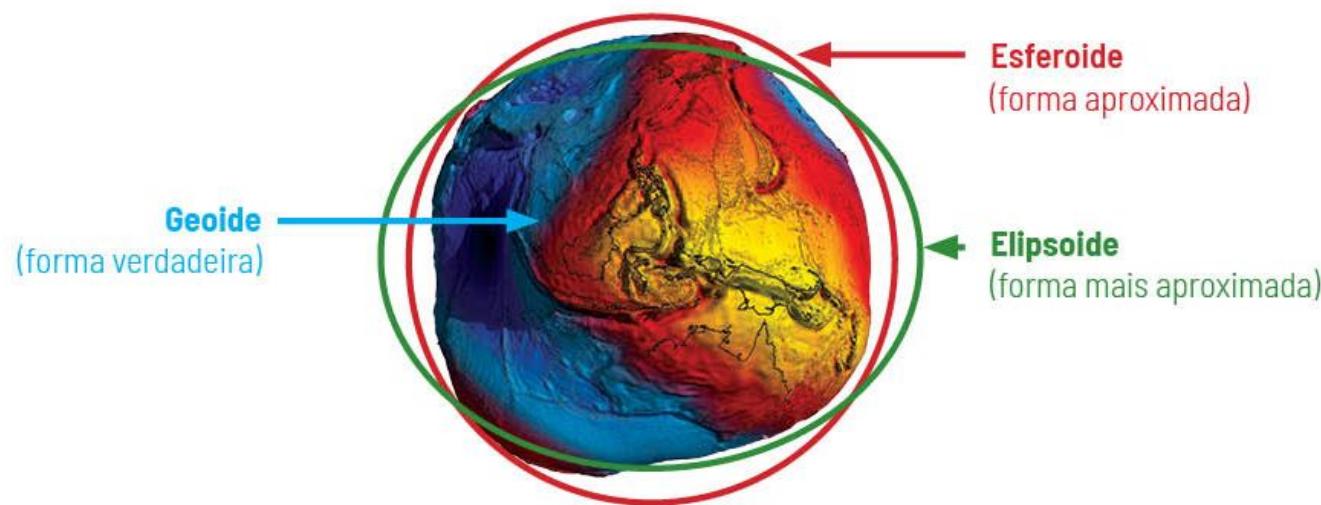


Gott, Goldberg e
Vanderbei

<https://arxiv.org/pdf/2102.08176v1.pdf>

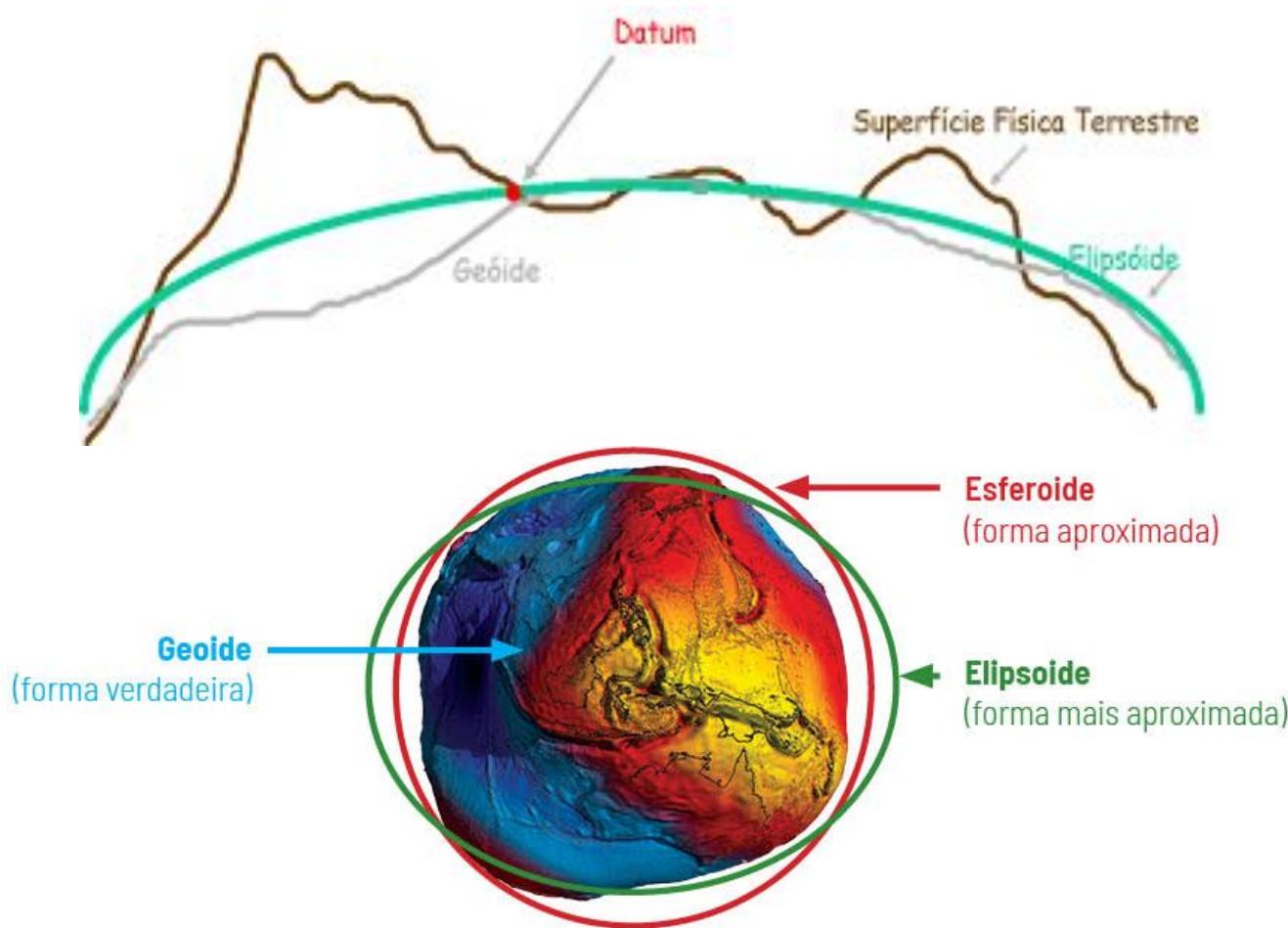
Cartografia

Datum



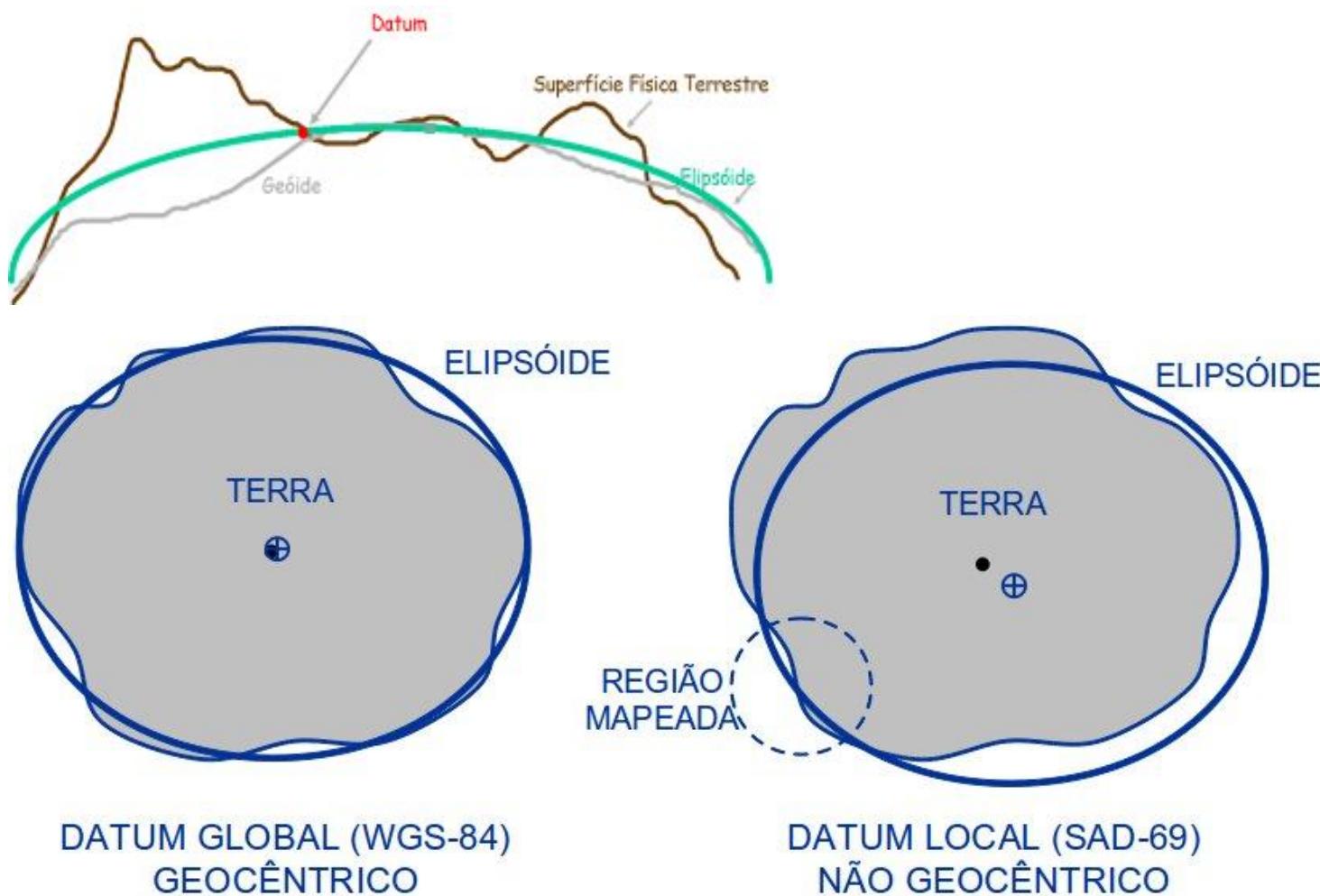
Cartografia

Datum



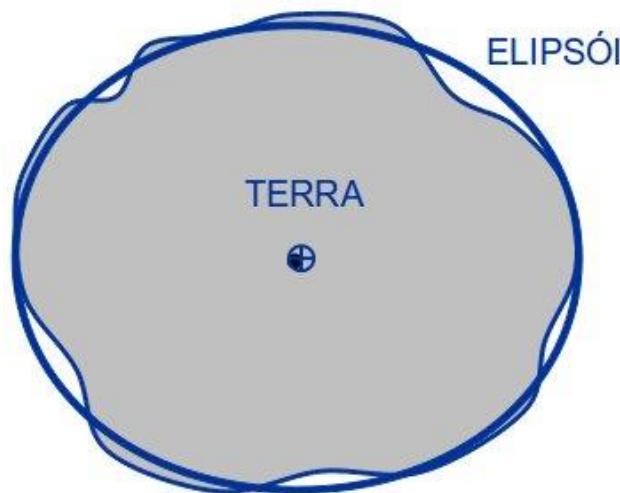
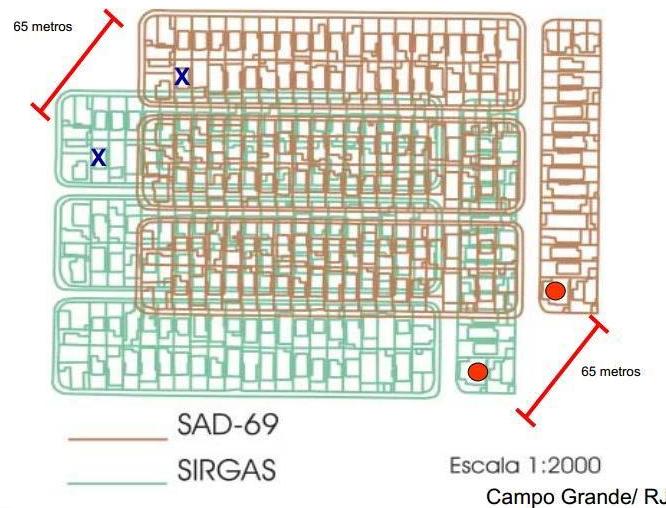
Cartografia

Datum

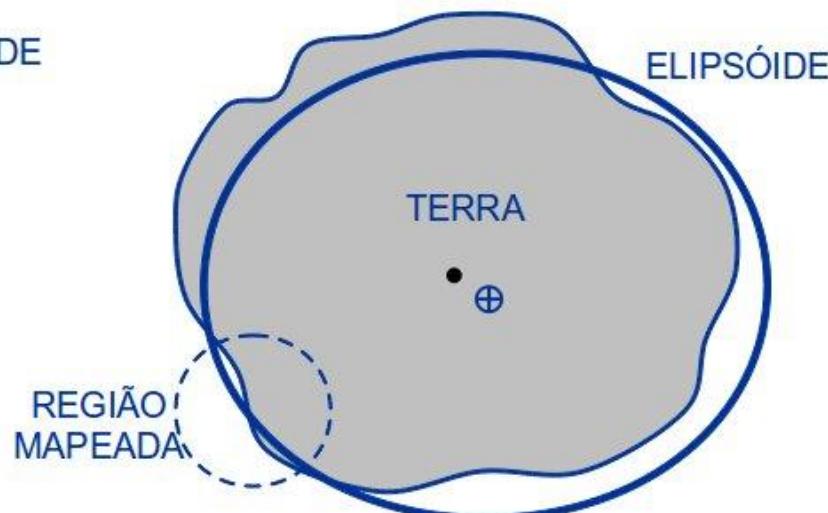


Cartografia

Datum



DATUM GLOBAL (WGS-84)
GEOCÊNTRICO



DATUM LOCAL (SAD-69)
NÃO GEOCÊNTRICO

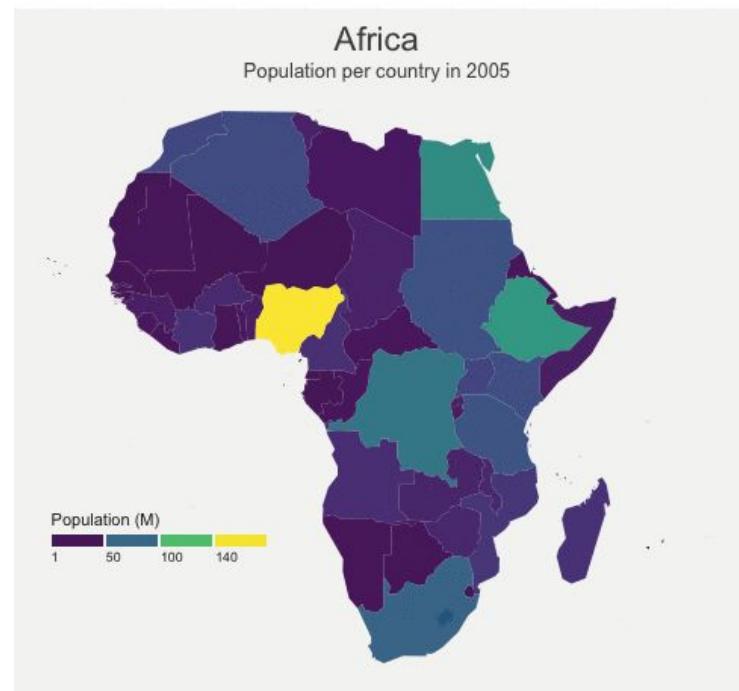
Cartografia

Tipos de mapas



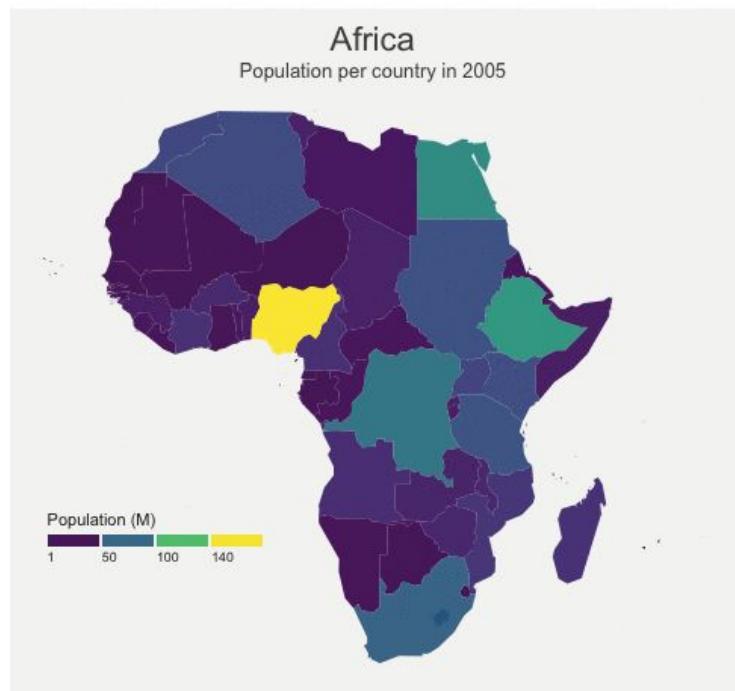
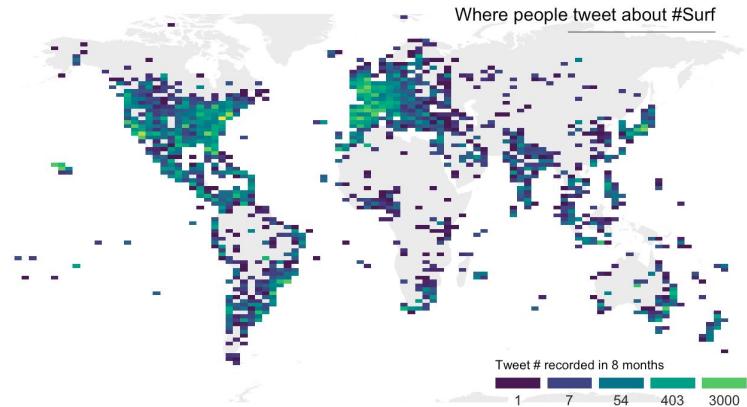
Cartografia

Tipos de mapas



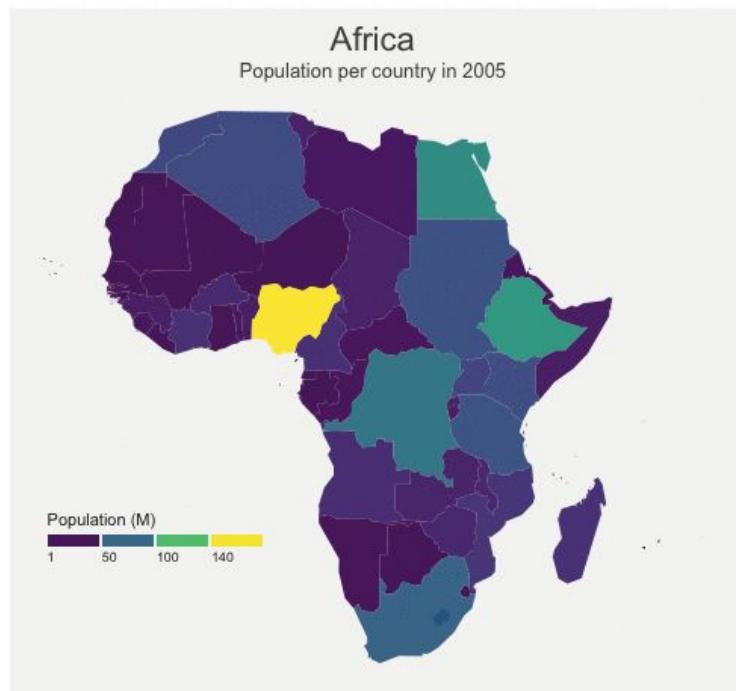
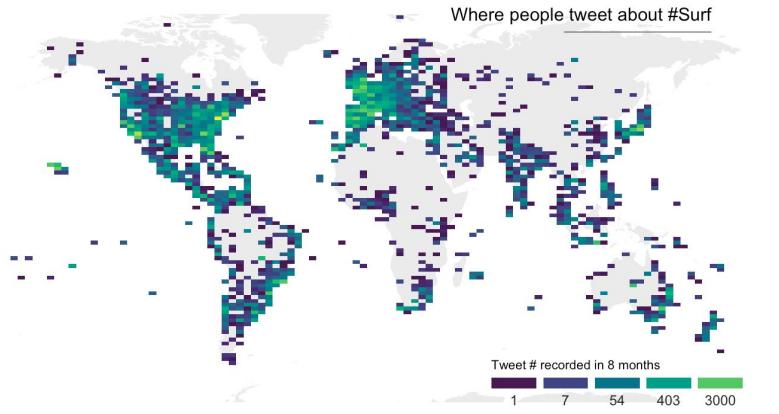
Cartografia

Tipos de mapas



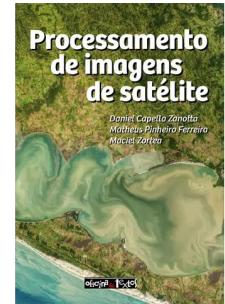
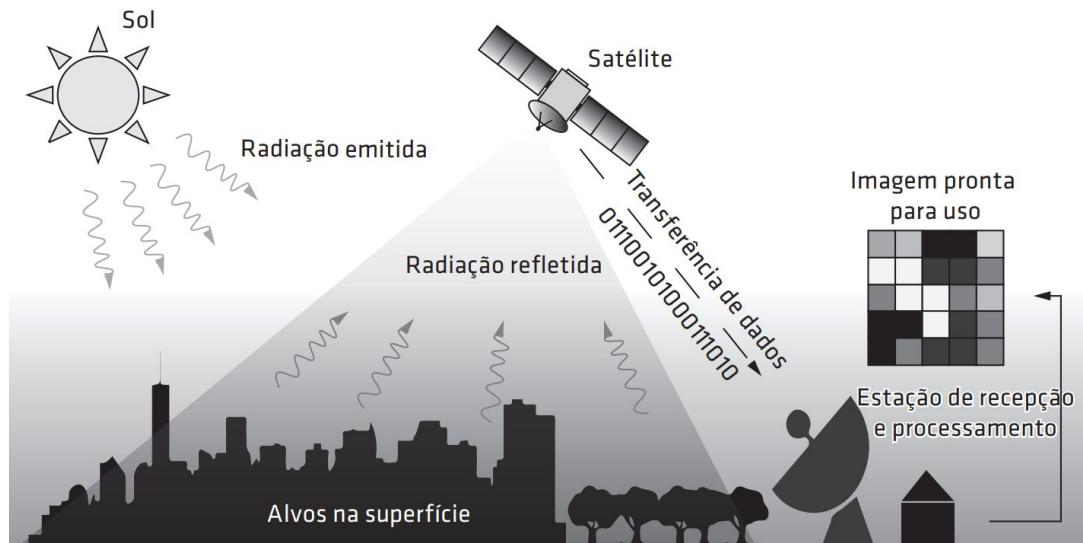
Cartografia

Tipos de mapas



Cartografia

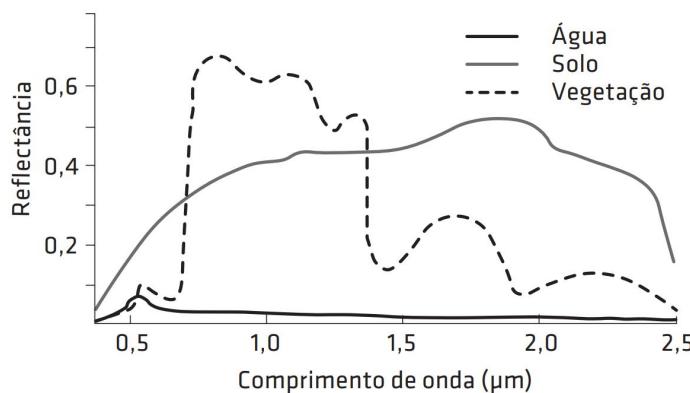
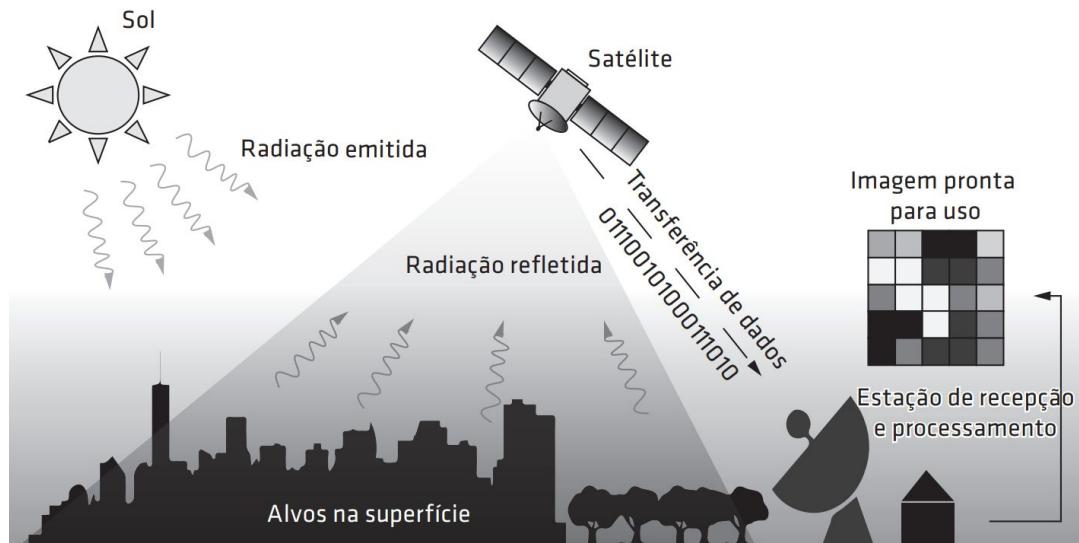
Sensoriamento Remoto



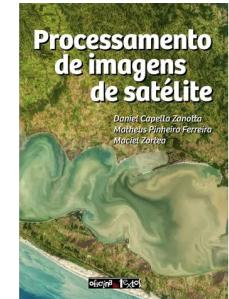
Guisan et al. (2017)

Cartografia

Sensoriamento Remoto

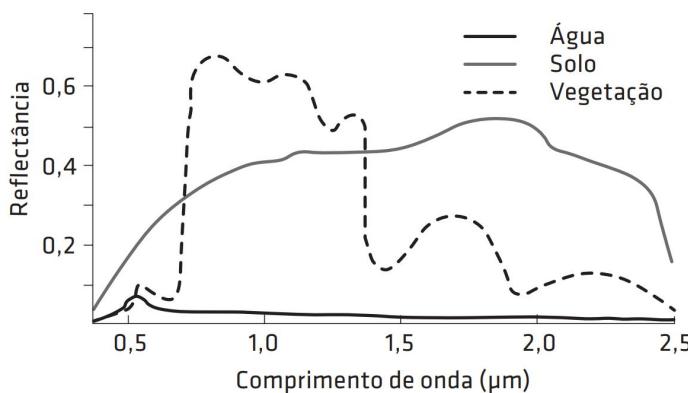
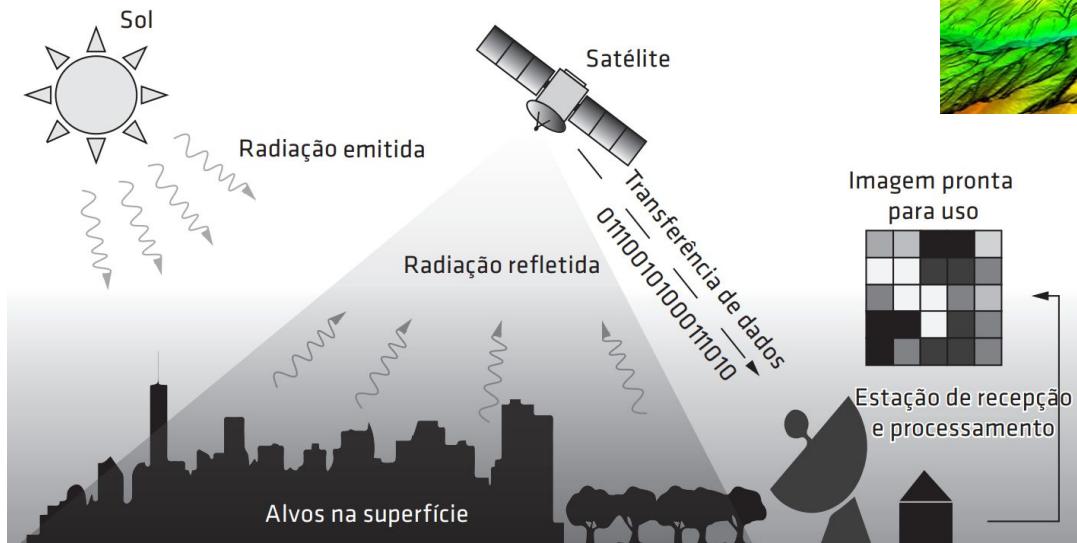


Bandas do sensor	Reflectância		
	Px1	Px2	Px3
B ₁	16%	7%	12%
B ₂	20%	6%	14%
B ₃	27%	17%	8%
B ₄	33%	47%	0%
B ₅	48%	35%	0%
B ₇	49%	18%	0%

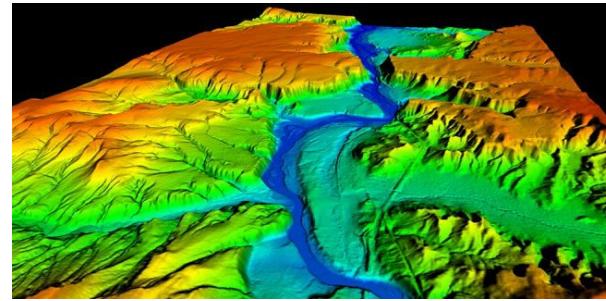


Cartografia

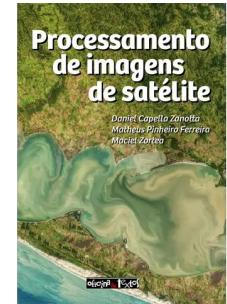
Sensoriamento Remoto



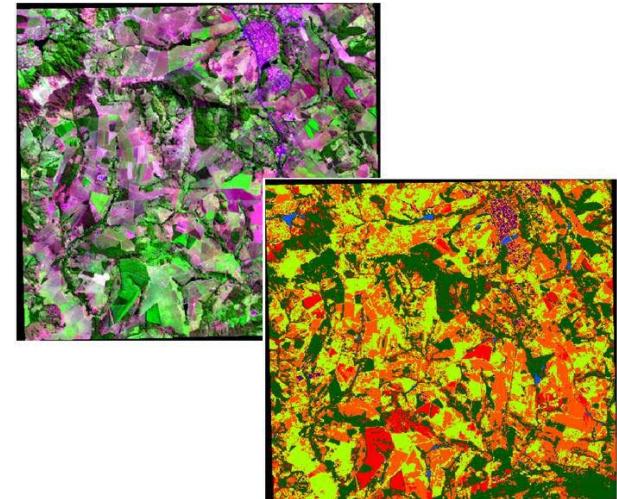
Bandas do sensor	Reflectância		
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B ₅	48%	35%	0%
B ₇	49%	18%	0%



Modelo Digital de Elevação
Guisan et al. (2017)

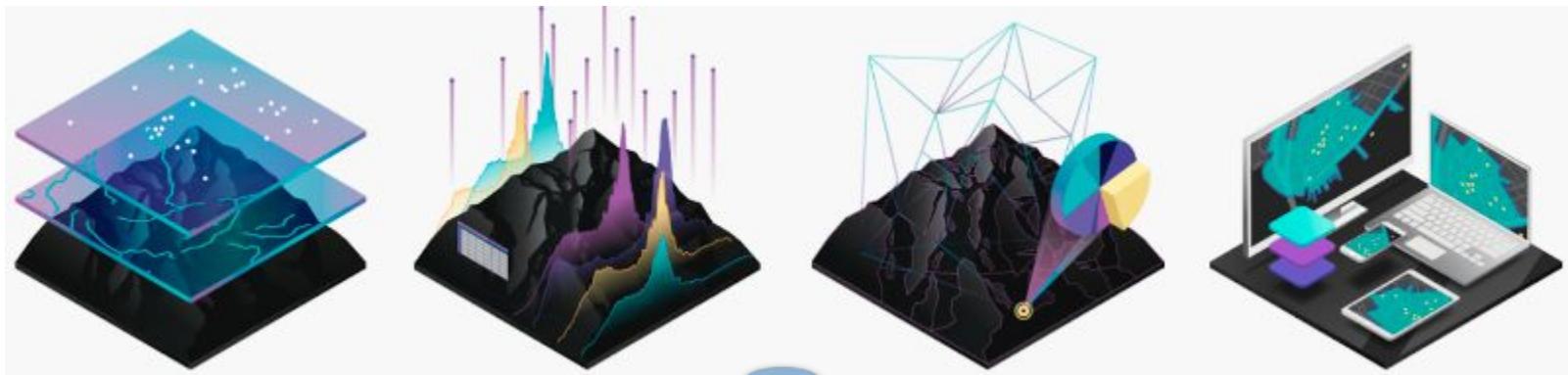


Segmentação e Classificação



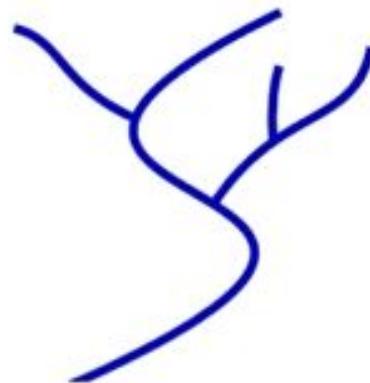
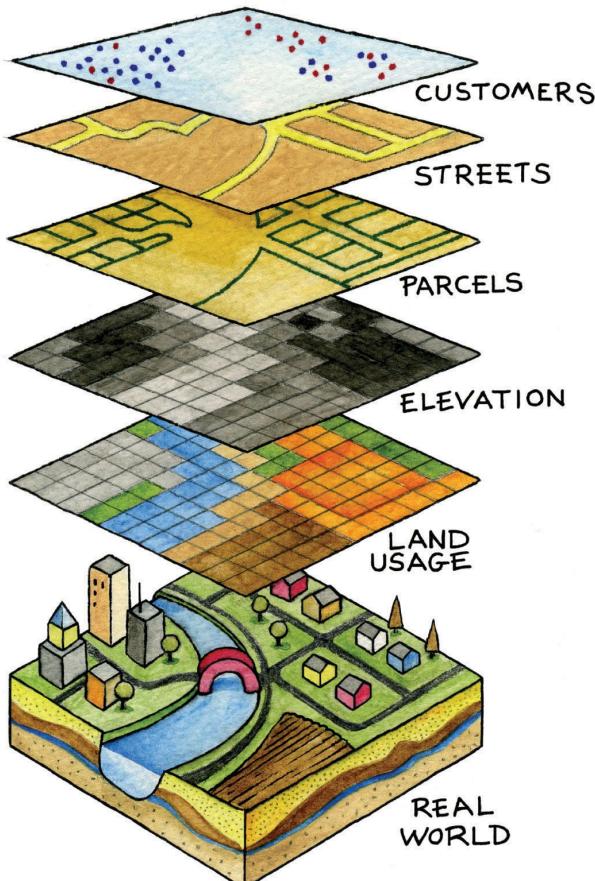
Cartografia

Sistemas de Informação Geográfica (SIG)

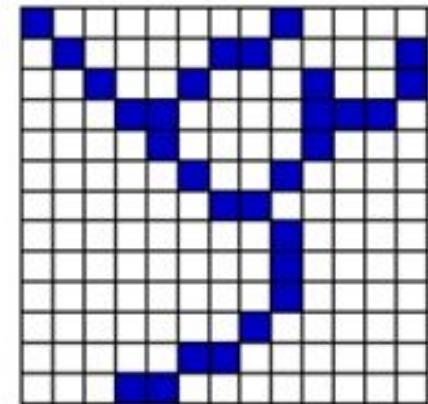


Cartografia

Formatos dos arquivos: Vetor e Raster



Vector



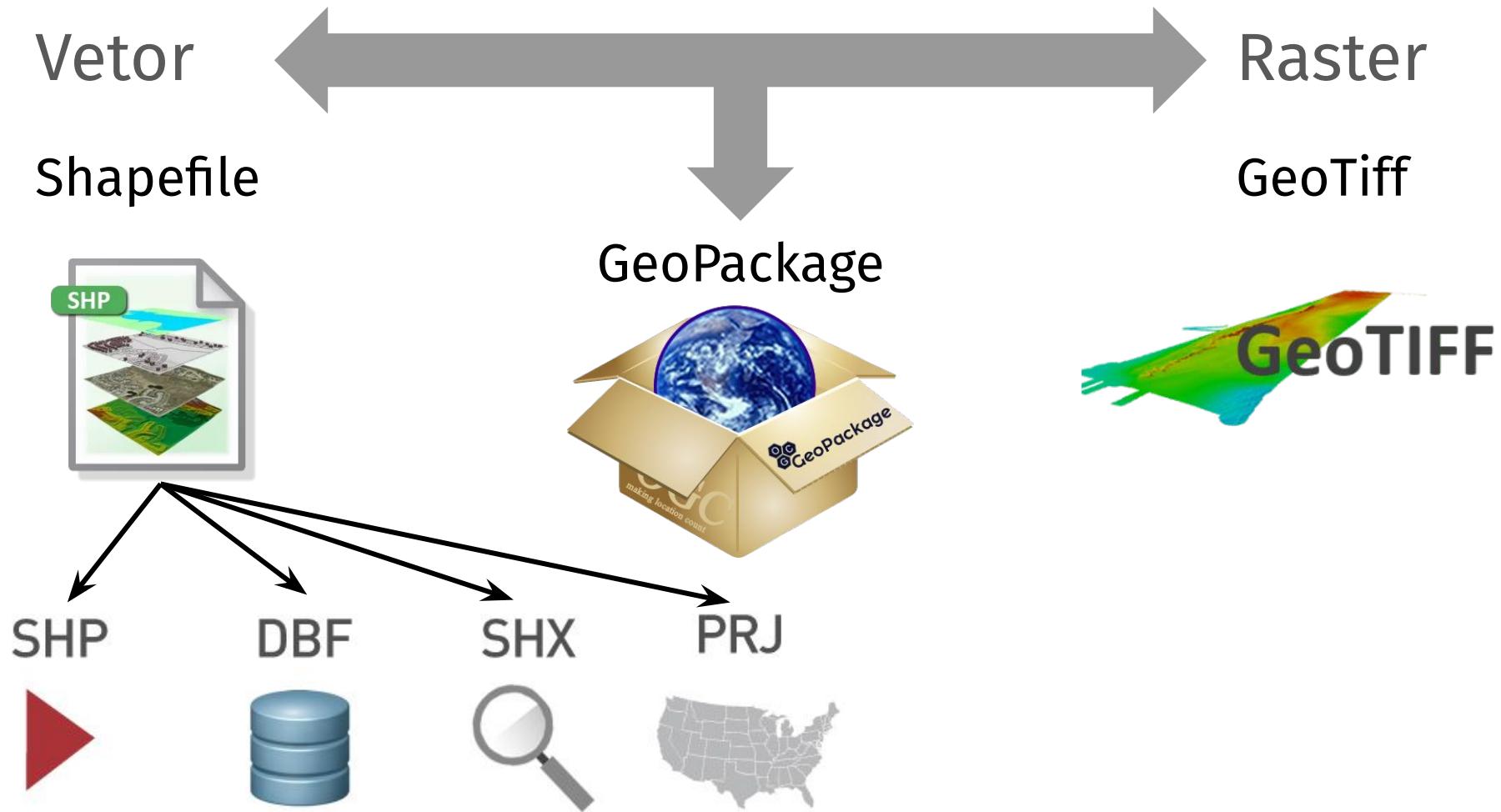
Raster

https://saylordotorg.github.io/text_essentials-of-graphic-information-systems/index.html

<https://mgimond.github.io/Spatial/feature-representation.html>

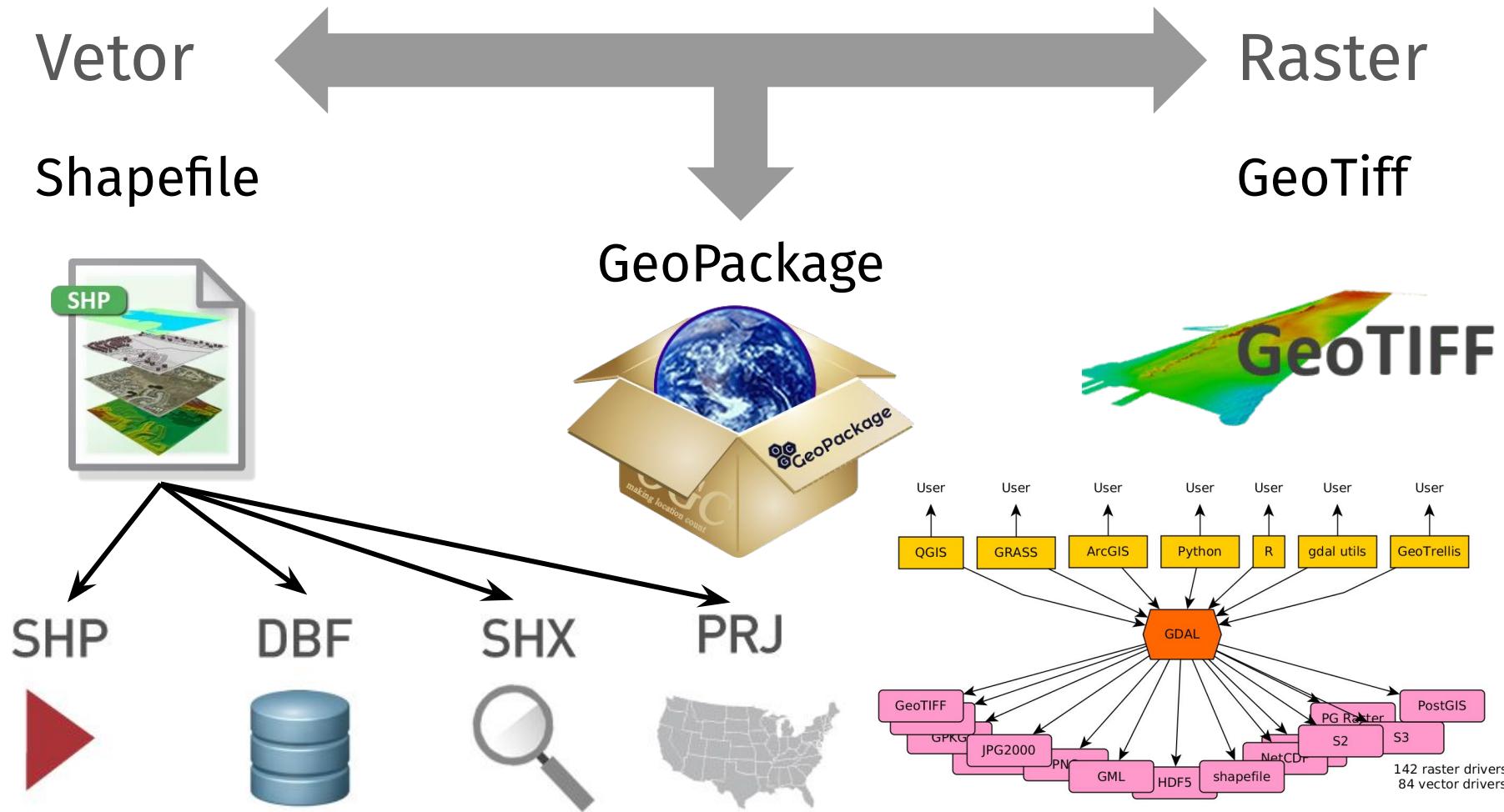
Cartografia

Extensão dos arquivos



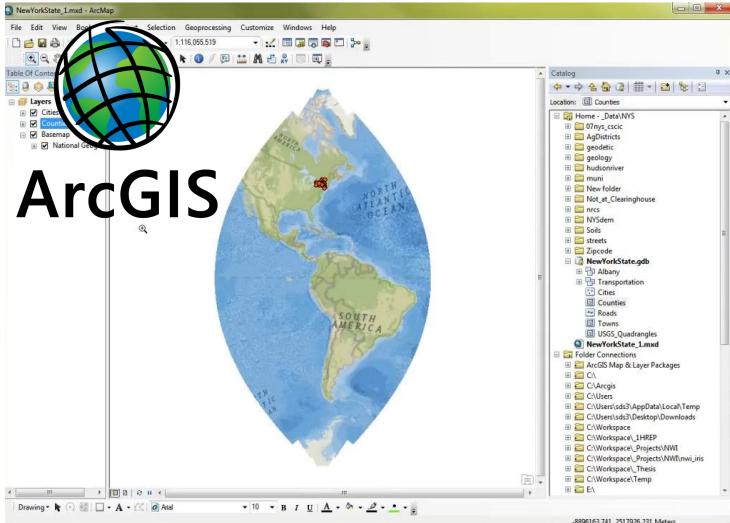
Cartografia

Extensão dos arquivos



Cartografia

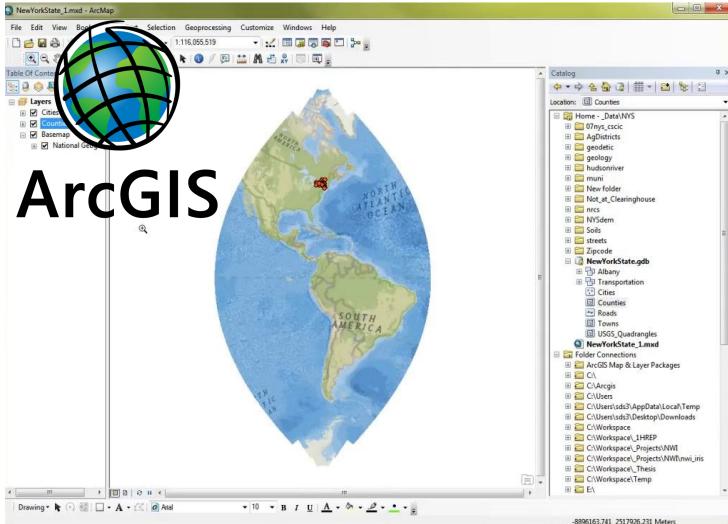
Sistemas de Informação Geográfica (SIG)



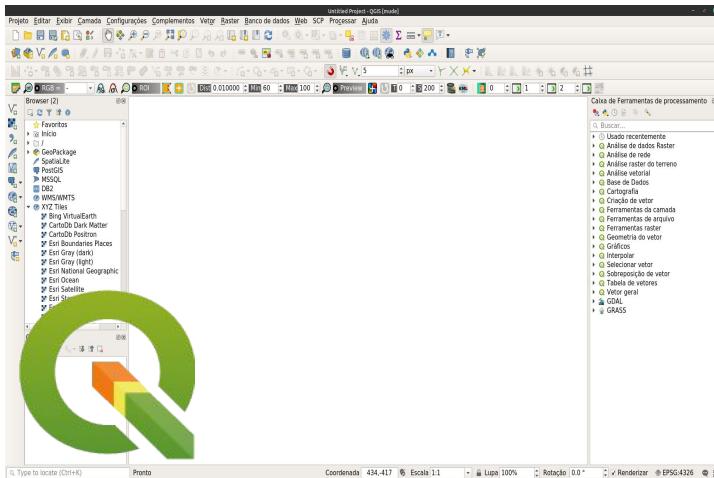
ArcGIS

Cartografia

Sistemas de Informação Geográfica (SIG)

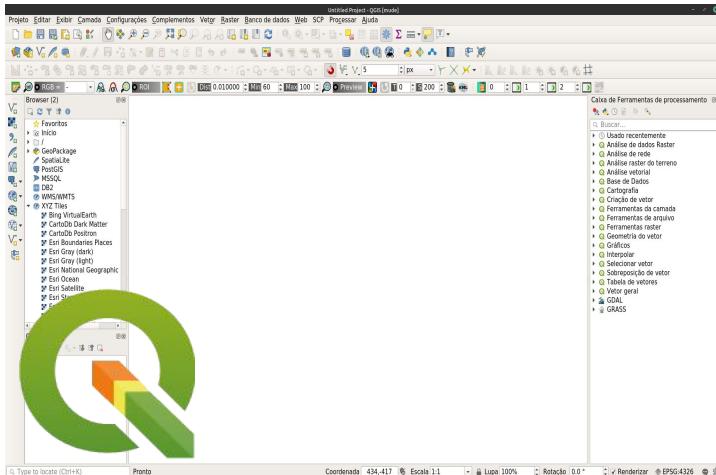
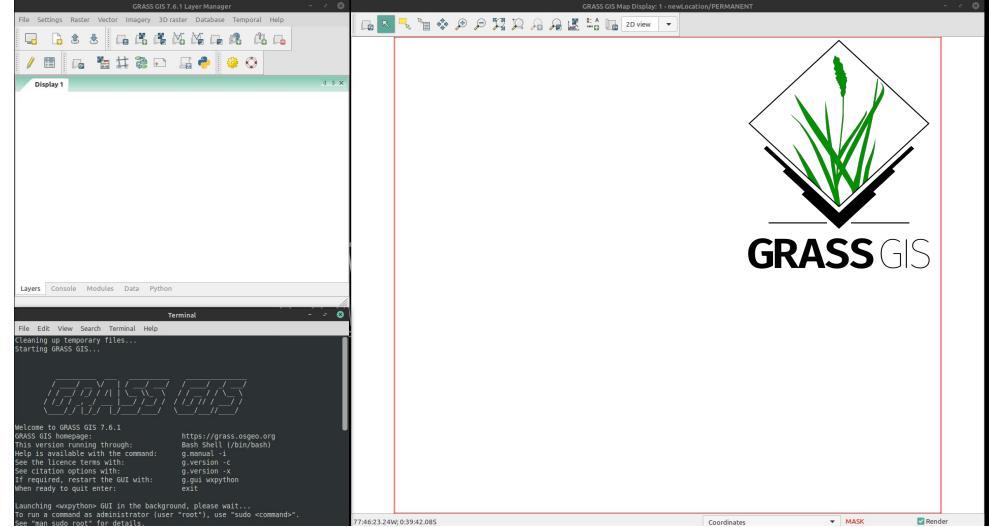
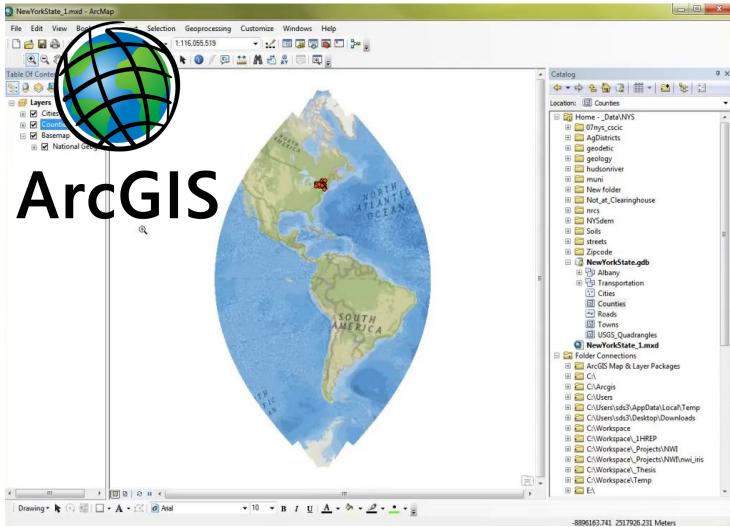


ArcGIS



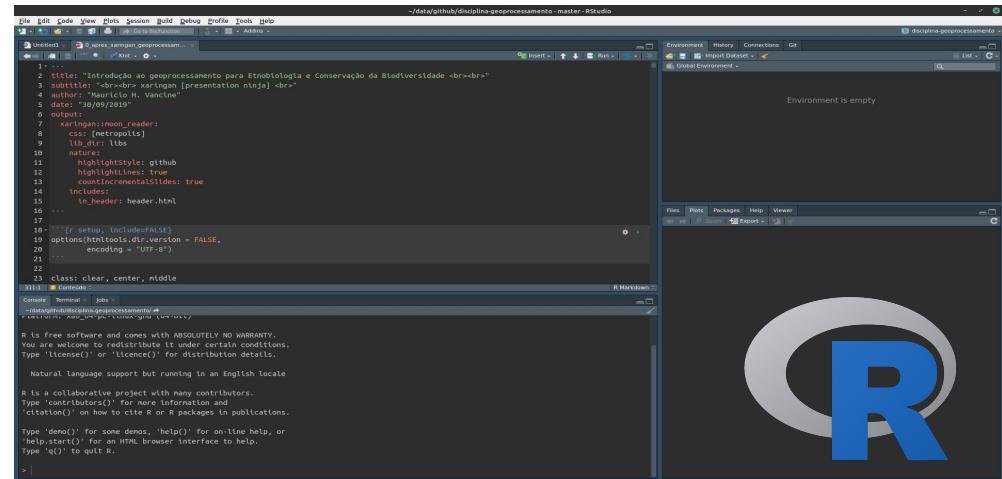
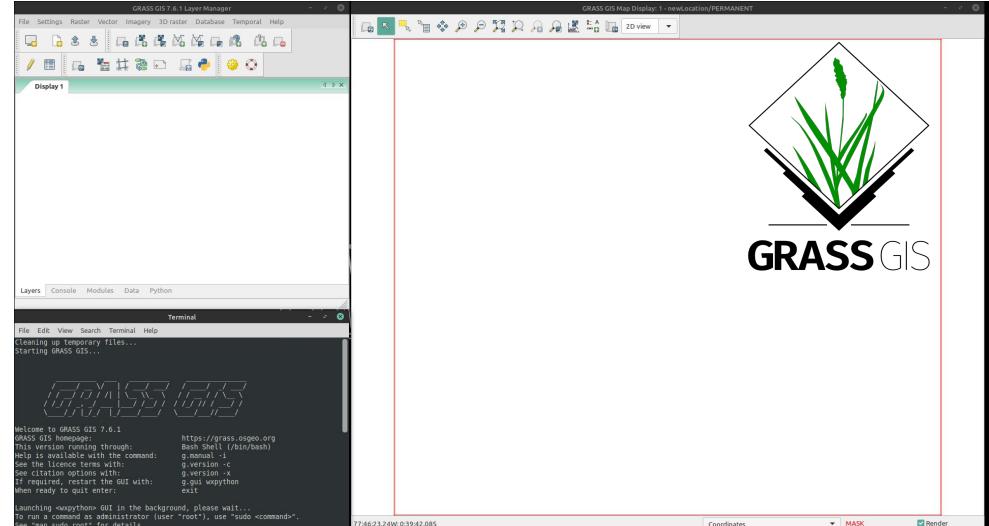
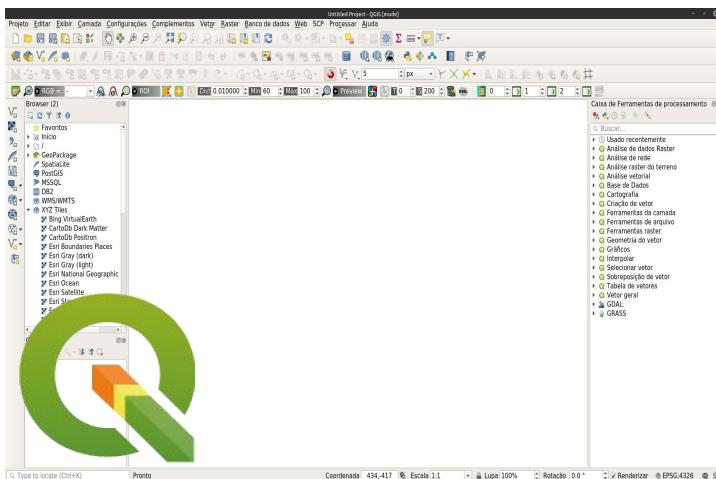
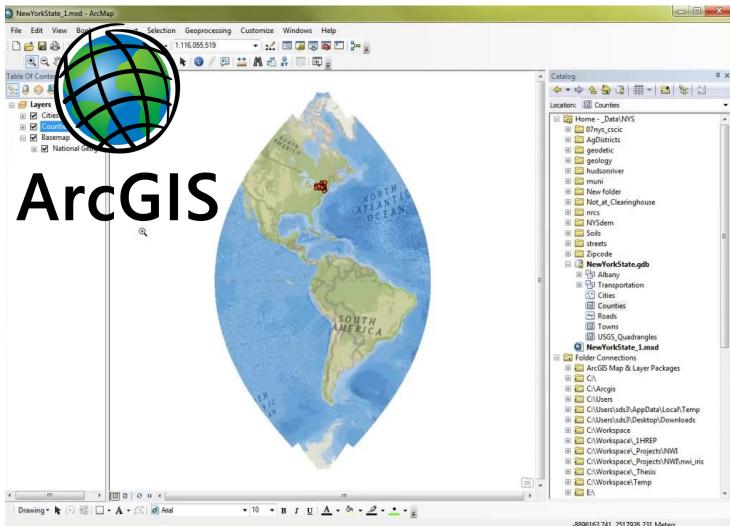
Cartografia

Sistemas de Informação Geográfica (SIG)



Cartografia

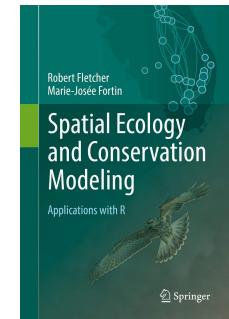
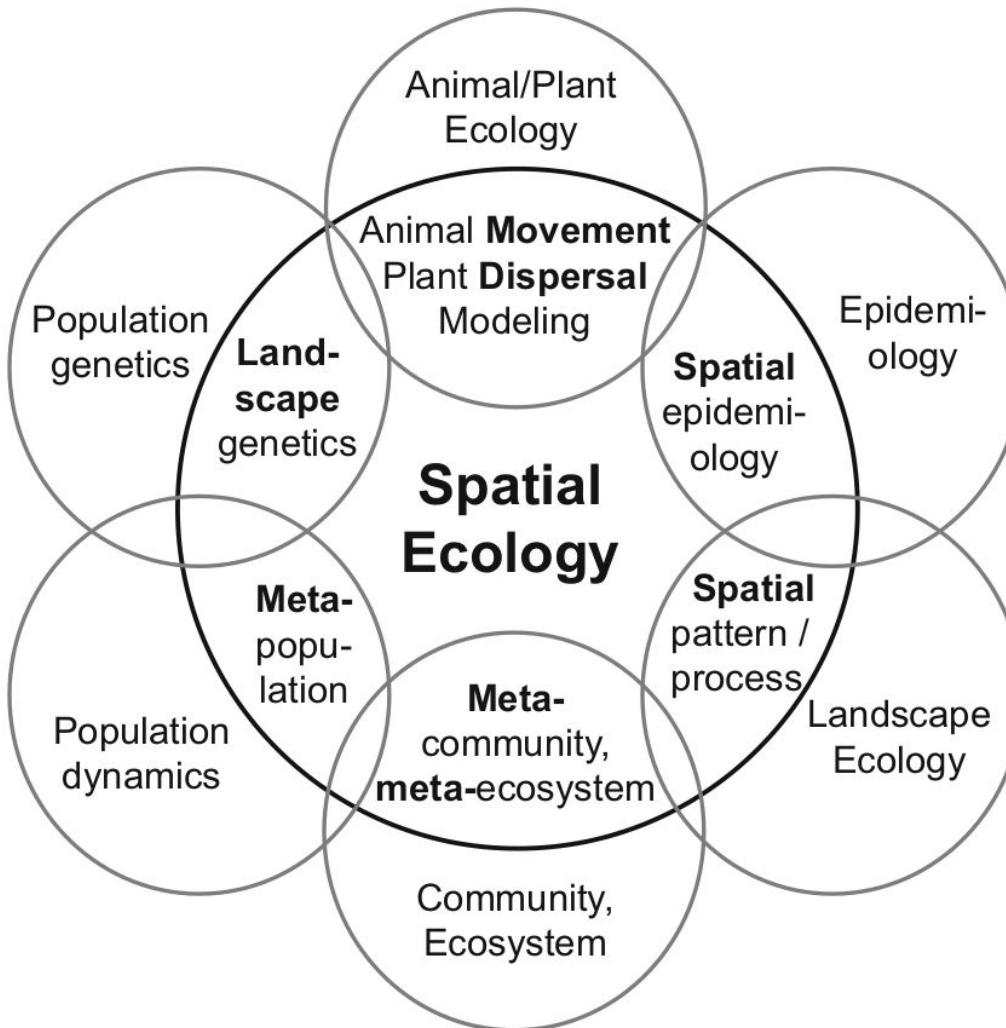
Sistemas de Informação Geográfica (SIG)



3. Ecología Espacial

Ecologia Espacial

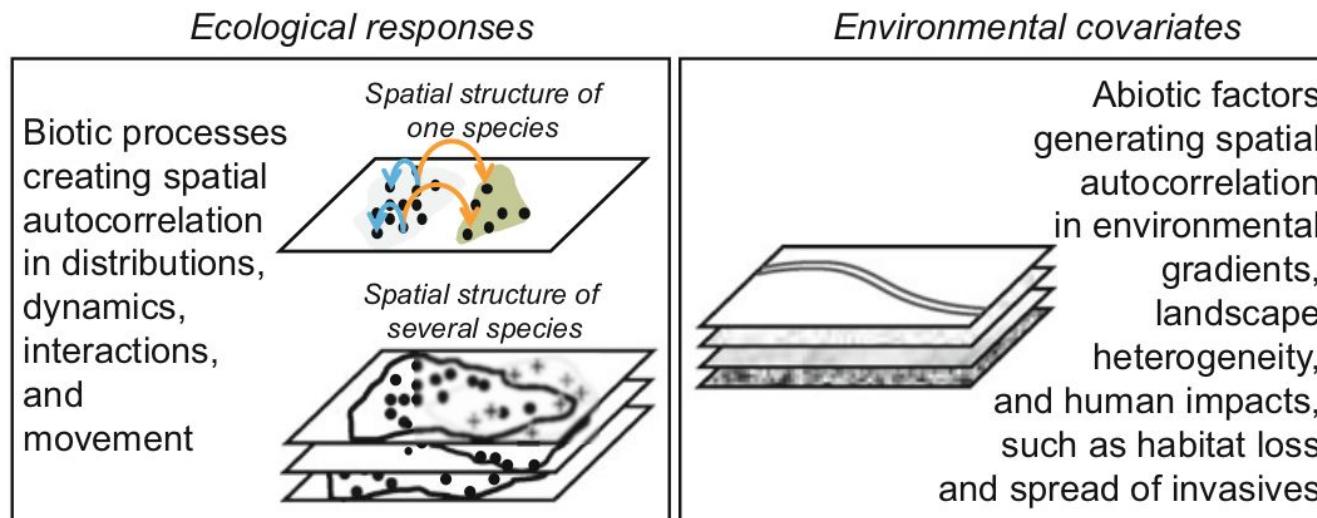
Definição



Fletcher & Fortin (2018)

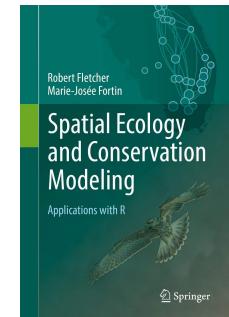
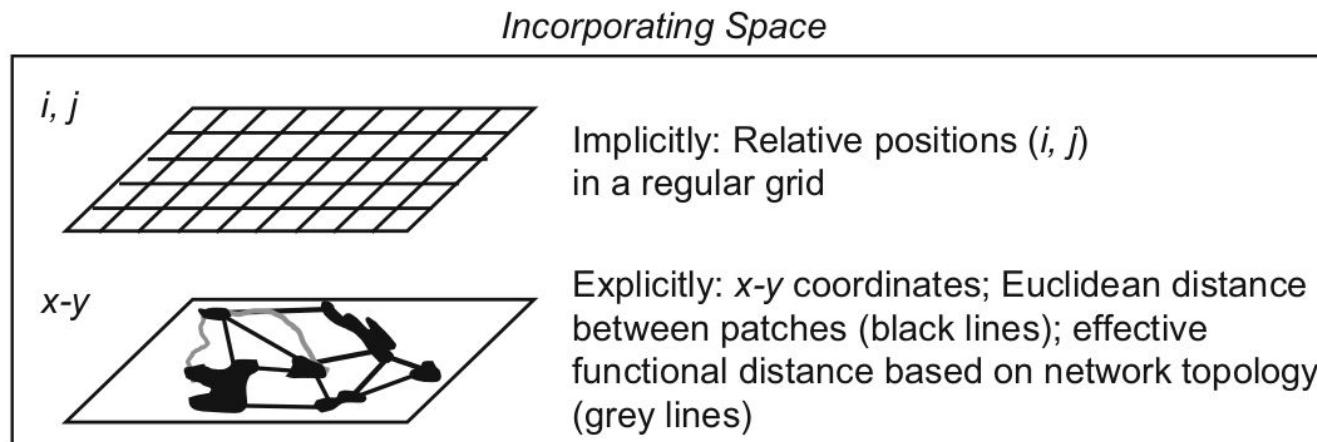
Ecologia Espacial

Definição



Environmental covariates

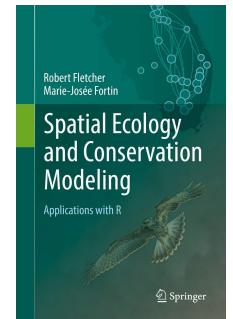
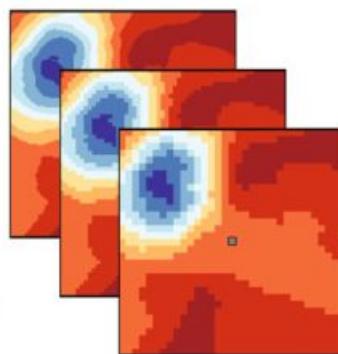
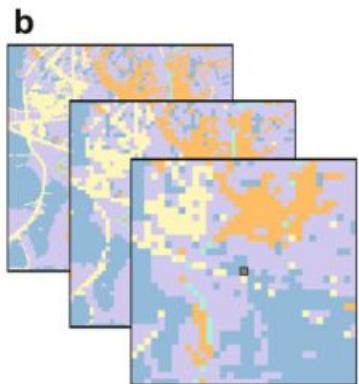
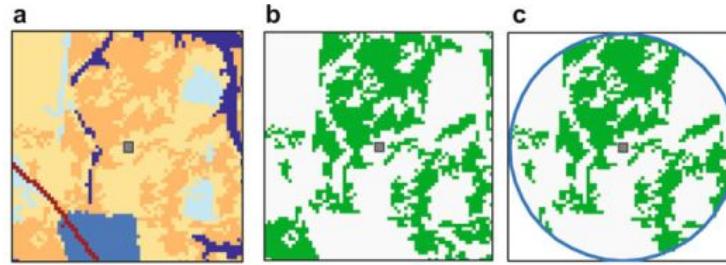
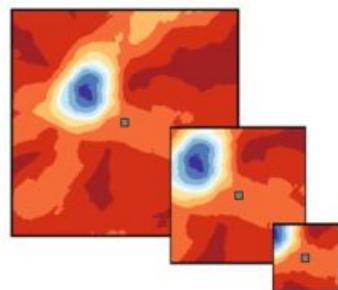
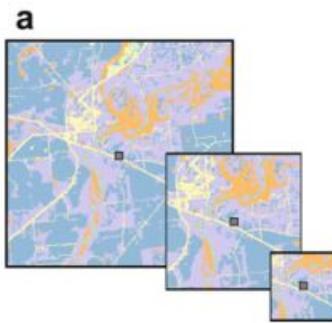
Abiotic factors generating spatial autocorrelation in environmental gradients, landscape heterogeneity, and human impacts, such as habitat loss and spread of invasives



Fletcher & Fortin (2018)

Ecología Espacial

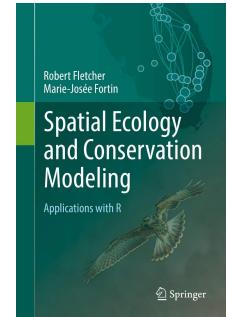
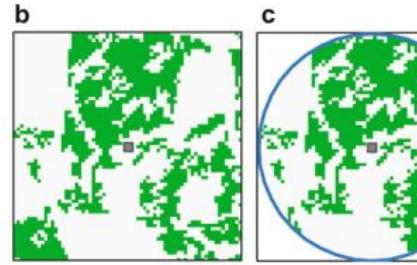
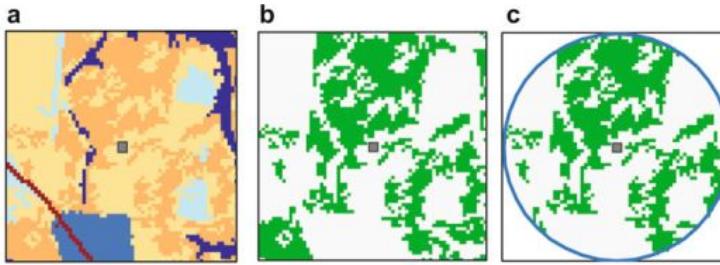
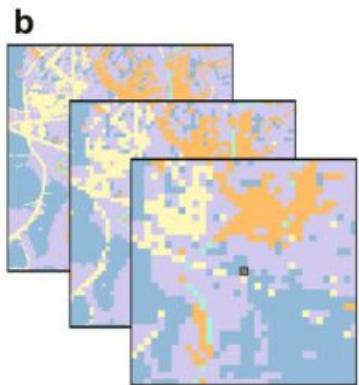
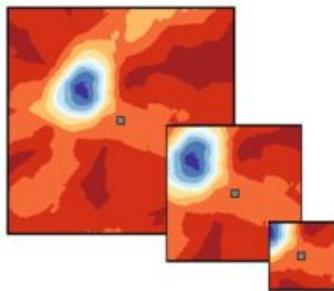
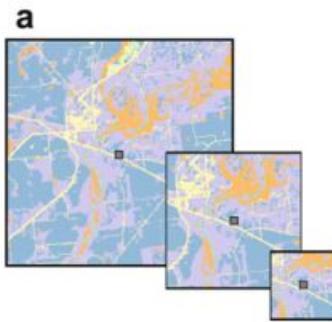
Escalas



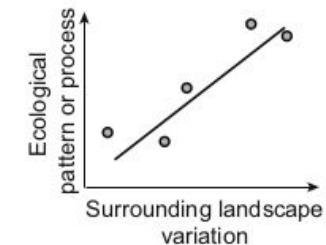
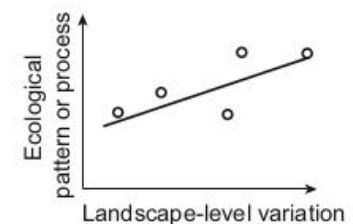
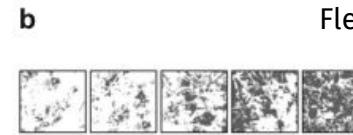
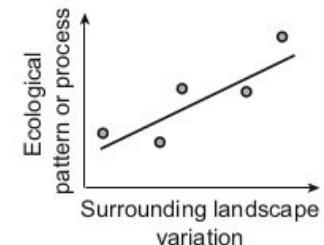
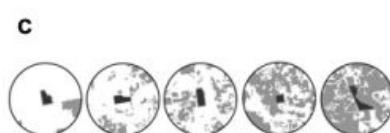
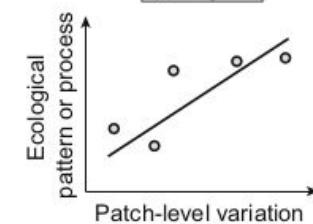
Fletcher & Fortin (2018)

Ecología Espacial

Escalas

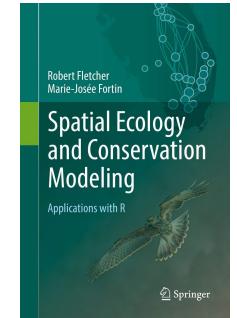


Fletcher & Fortin (2018)

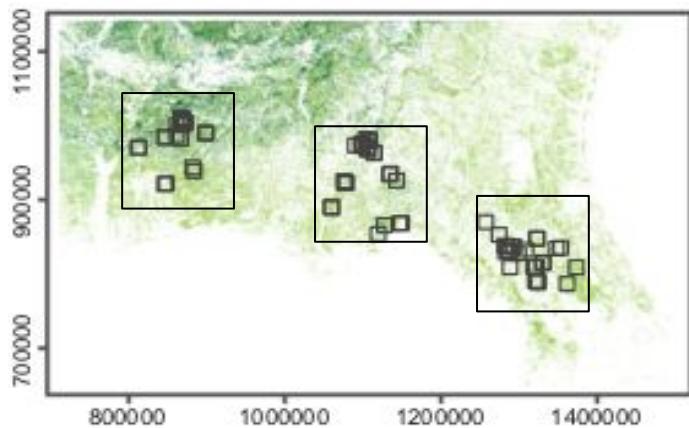


Ecología Espacial

Ecología da Paisagem

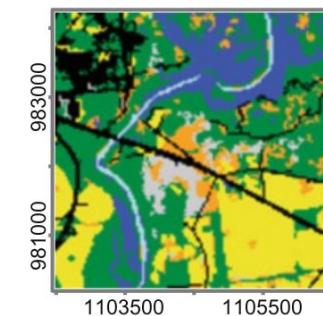
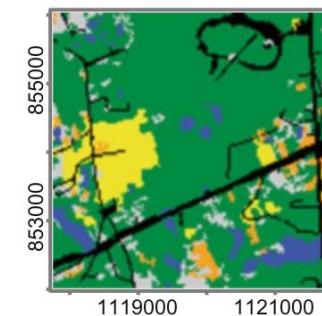
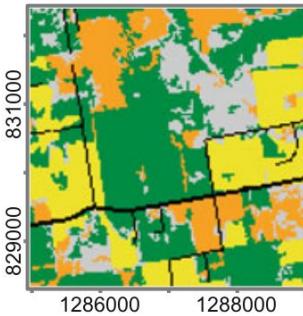
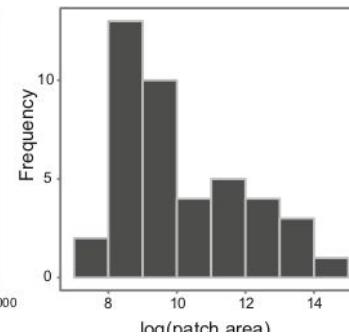
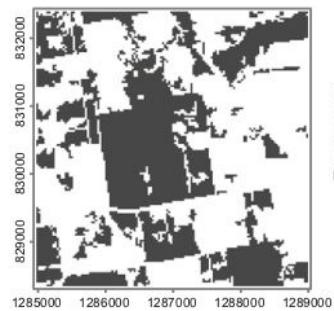


Fletcher & Fortin (2018)



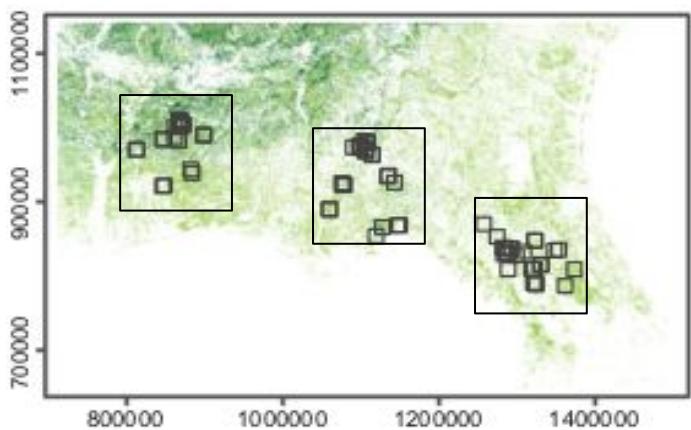
Ecología Espacial

Ecología da Paisagem

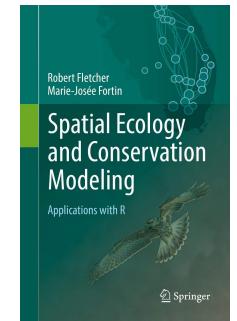


Land cover

- Forest
- Developed
- Agriculture
- Grassland
- Open
- Wetland
- Water



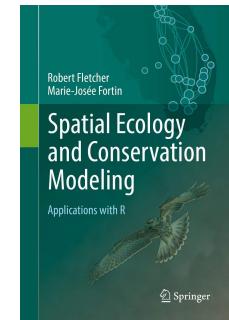
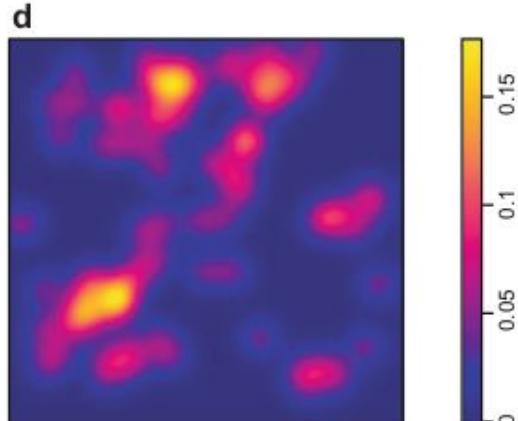
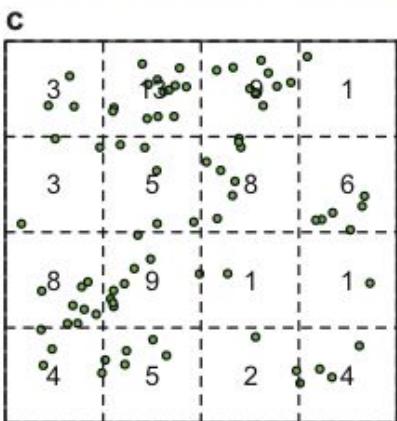
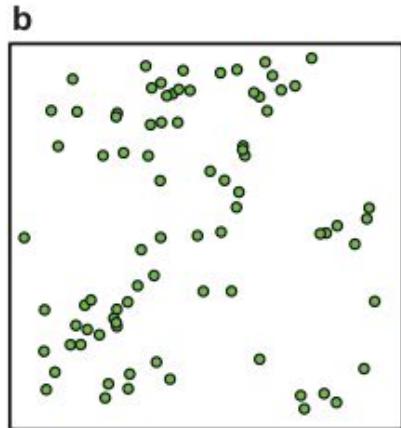
Metric type	Metric	Landscape a	Landscape b	Landscape c
Patch	Number of patches	166	174	232
	Largest patch index	0.189	0.439	0.108
Edge	Total edge	181081	180540	227220
	Edge density	0.011	0.011	0.014
Aggregation	Aggregation index	84.6	84.5	80.0
	Percentage of like adjacencies	83.9	83.9	79.2
	Contagion	0.337	0.471	0.282
Diversity	Land-cover richness	6	7	7
	Shannon diversity	1.41	1.17	1.16
	Shannon evenness	0.79	0.60	0.83



Fletcher & Fortin (2018)

Ecologia Espacial

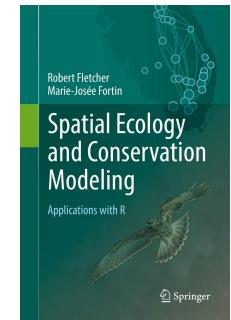
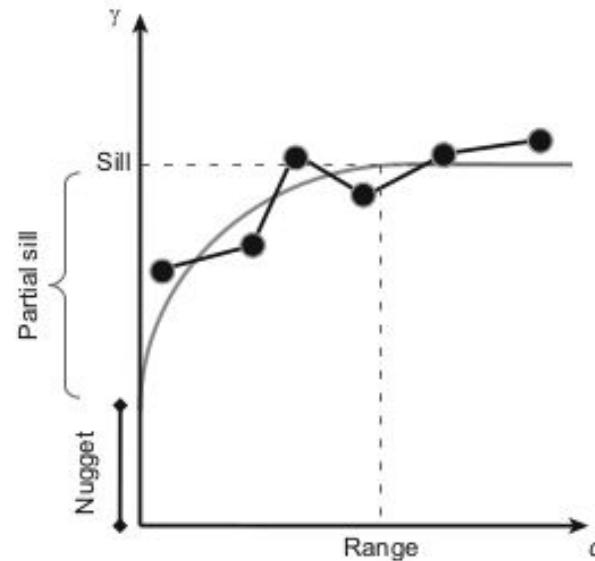
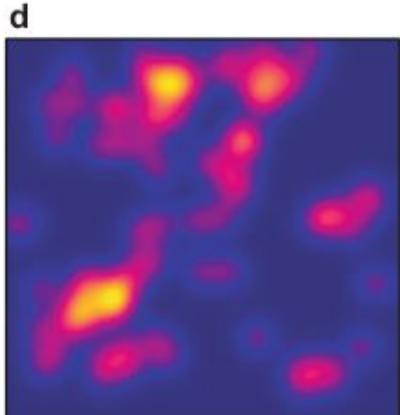
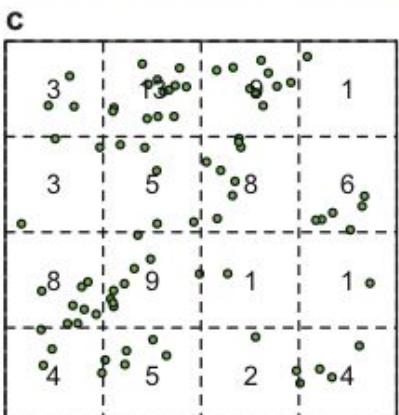
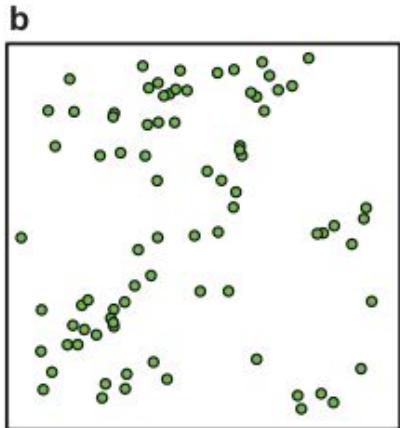
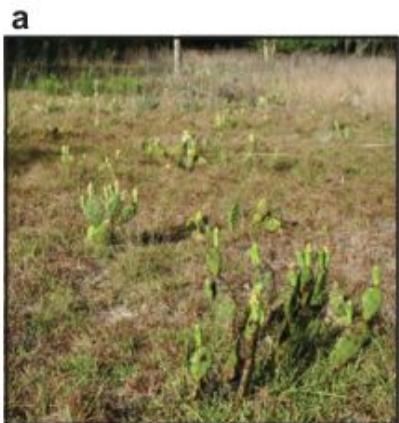
Processos pontuais e autocorrelação espacial



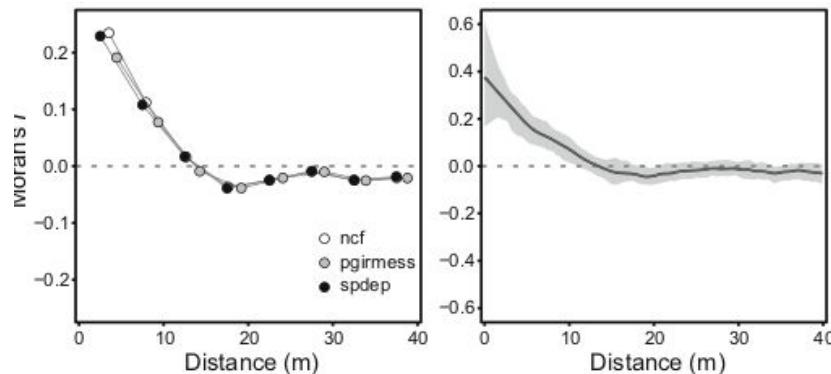
Fletcher & Fortin (2018)

Ecologia Espacial

Processos pontuais e autocorrelação espacial

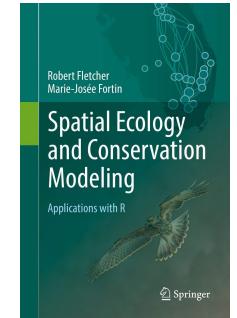
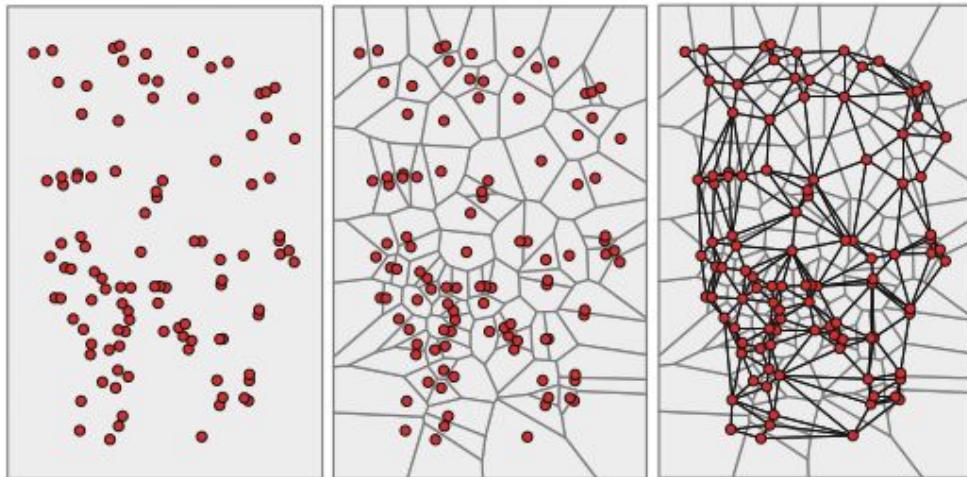


Fletcher & Fortin (2018)



Ecologia Espacial

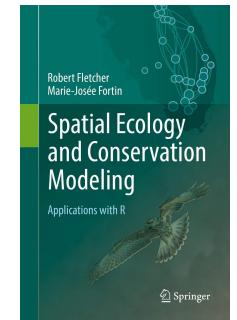
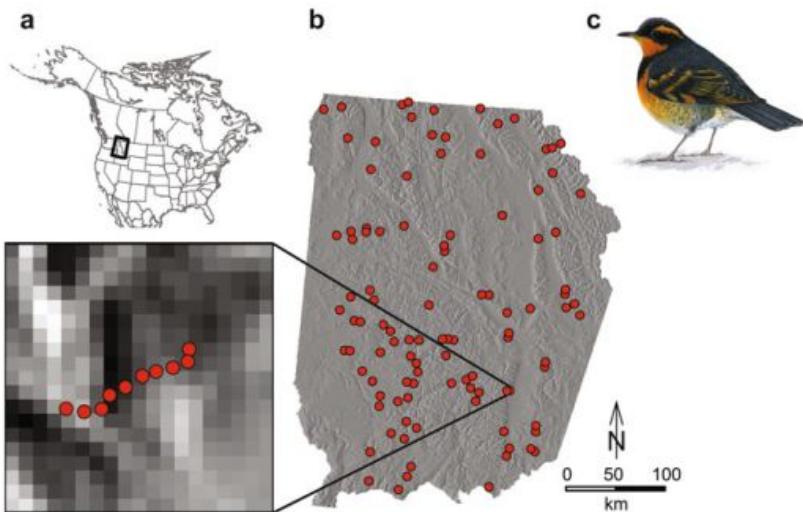
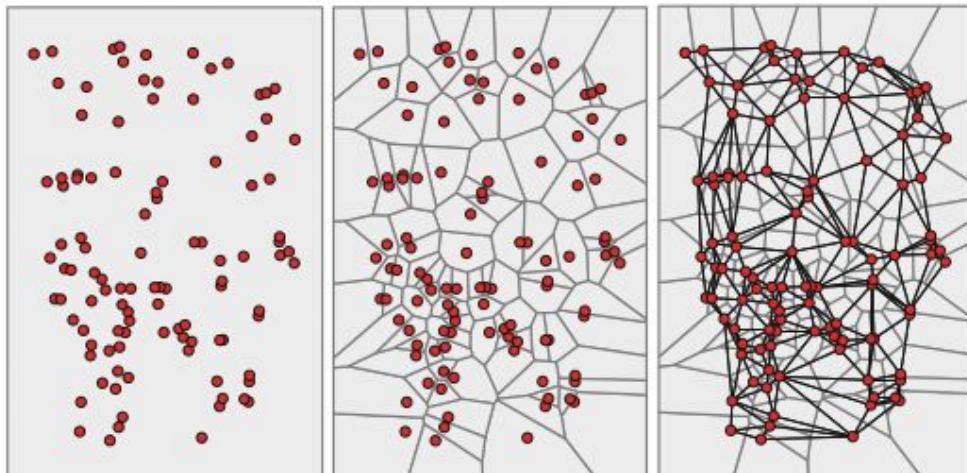
Dependência espacial



Fletcher & Fortin (2018)

Ecología Espacial

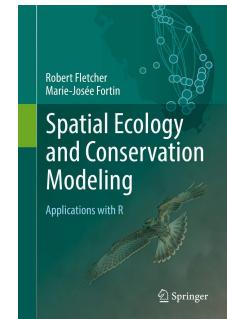
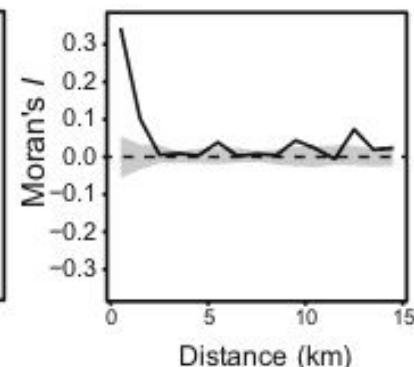
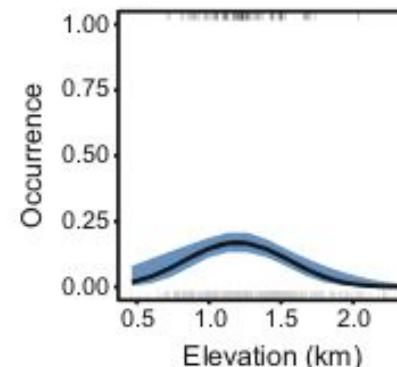
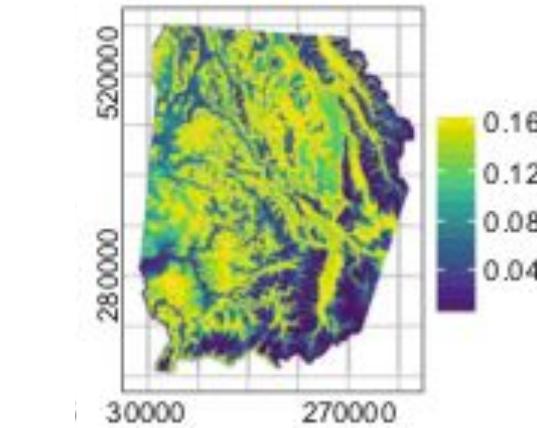
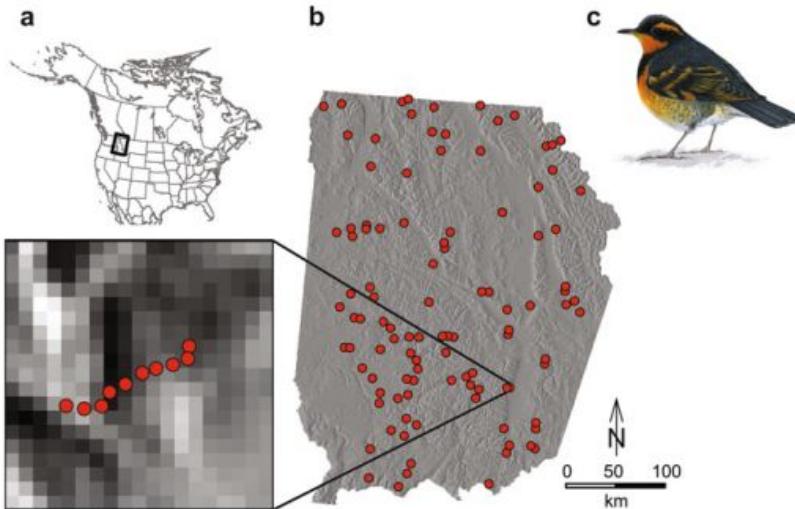
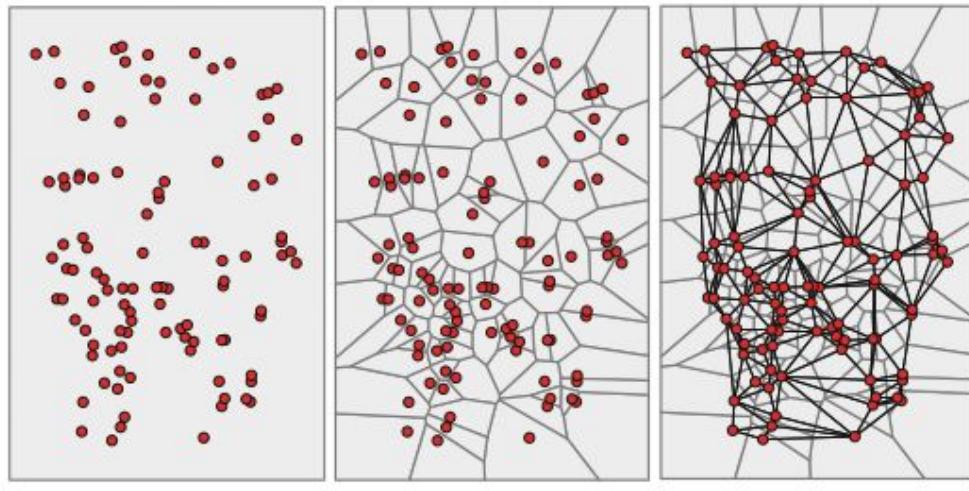
Dependência espacial



Fletcher & Fortin (2018)

Ecologia Espacial

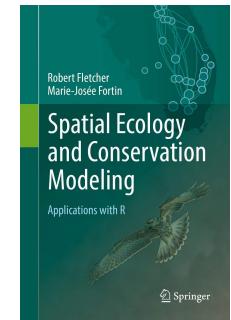
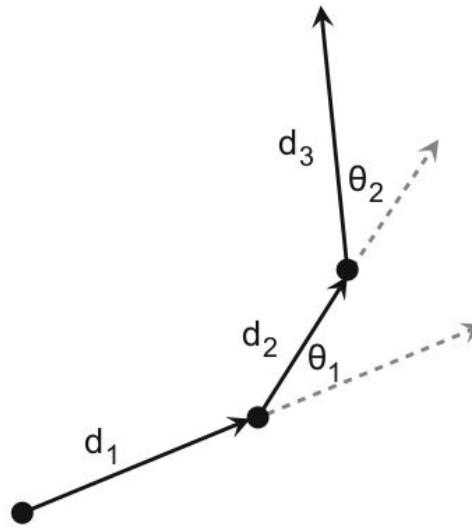
Dependência espacial



Fletcher & Fortin (2018)

Ecologia Espacial

Ecologia do movimento

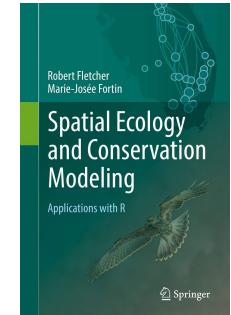
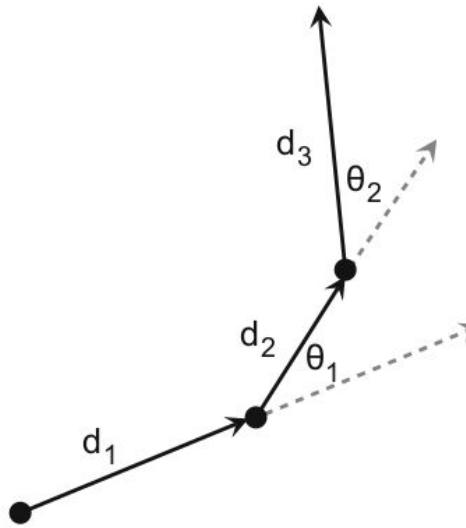


Fletcher & Fortin (2018)

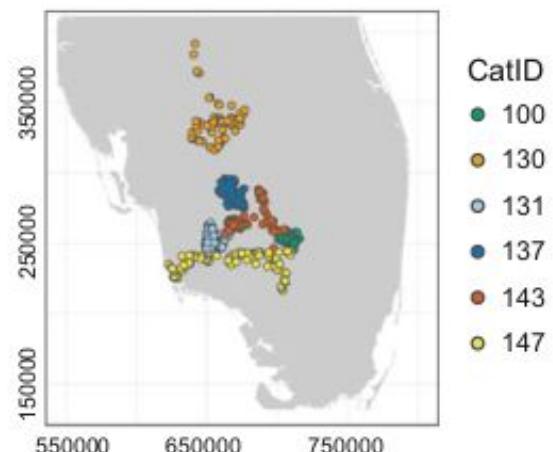
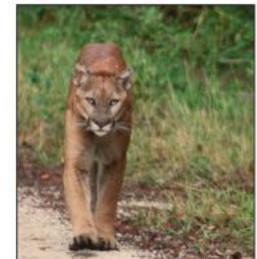


Ecologia Espacial

Ecologia do movimento

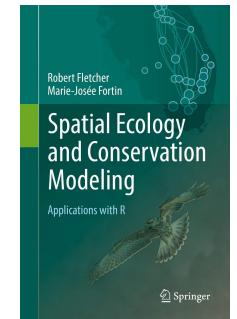
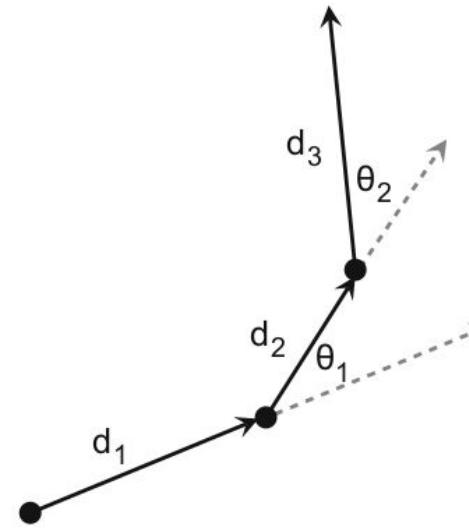
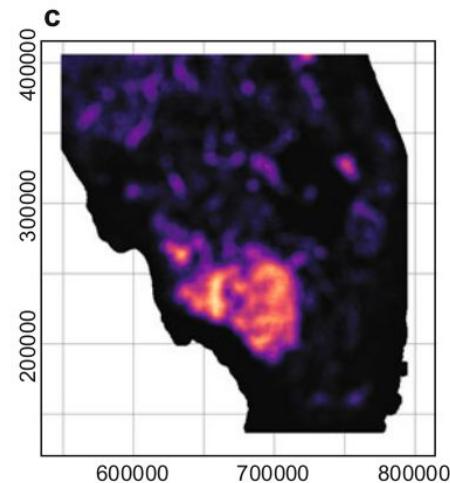
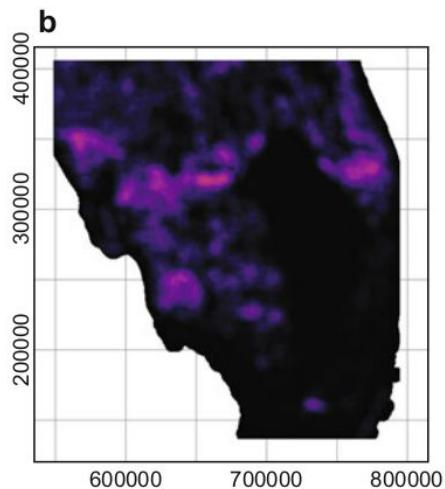
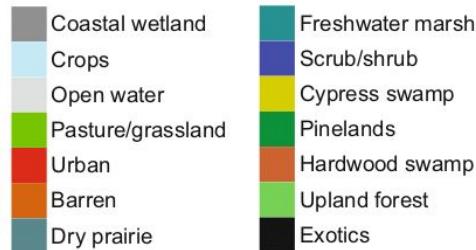
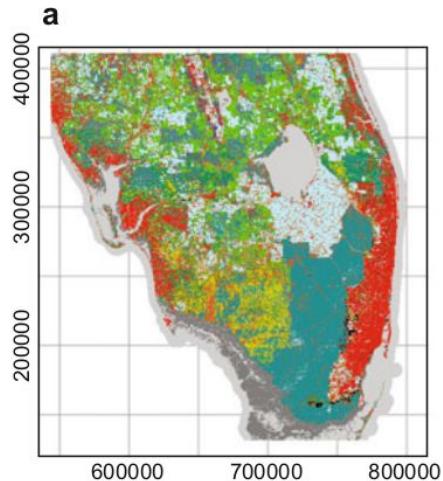


Fletcher & Fortin (2018)

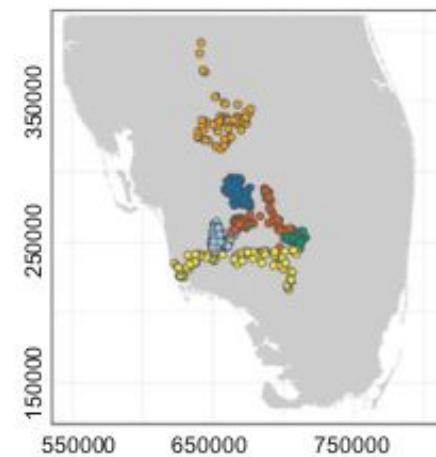
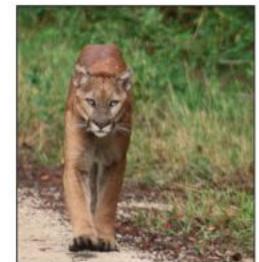


Ecología Espacial

Ecología do movimiento



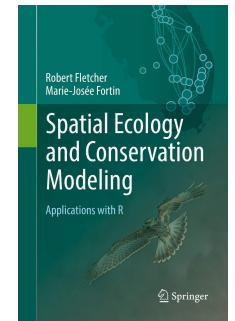
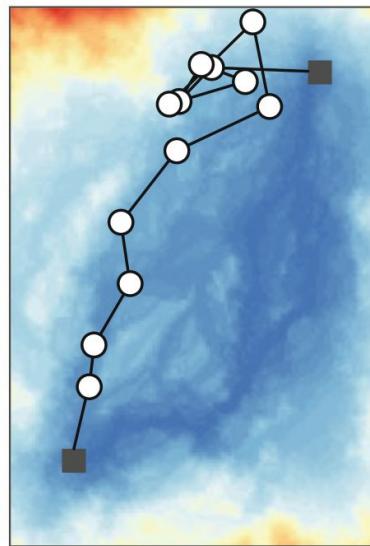
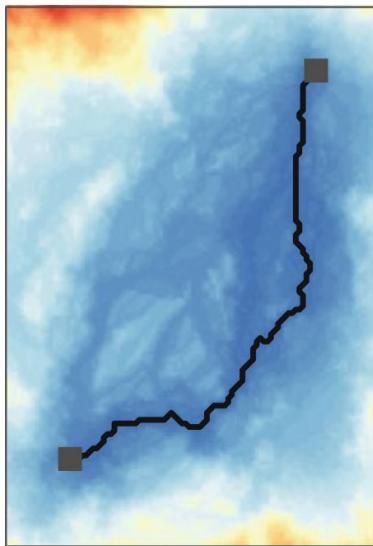
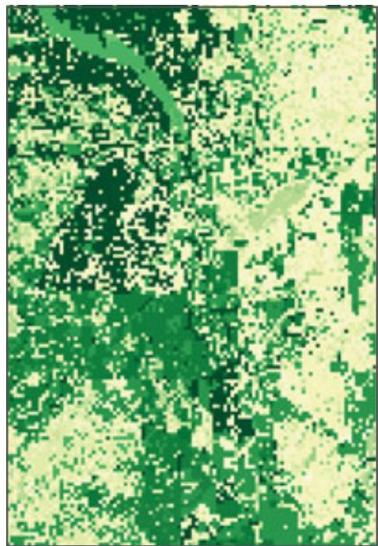
Fletcher & Fortin (2018)



- CatID
- 100
 - 130
 - 131
 - 137
 - 143
 - 147

Ecología Espacial

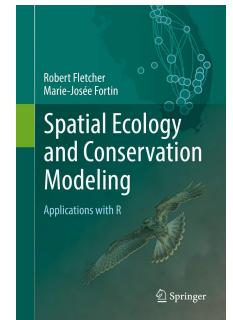
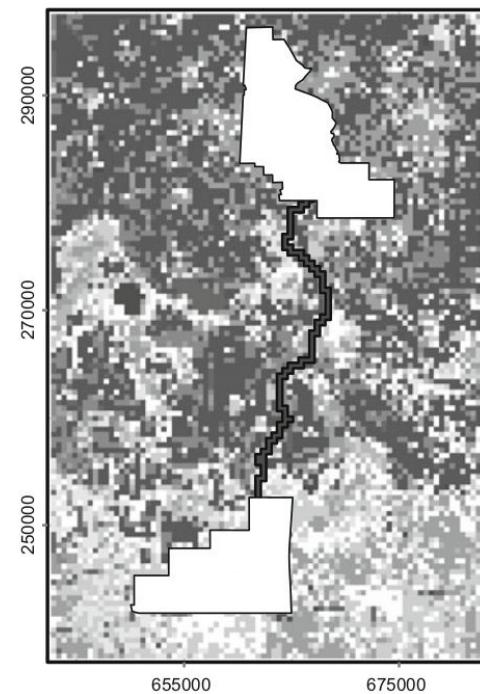
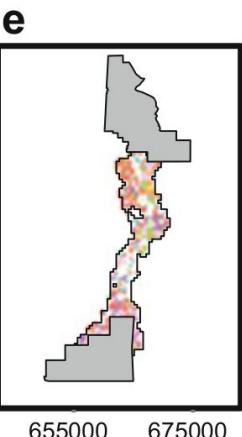
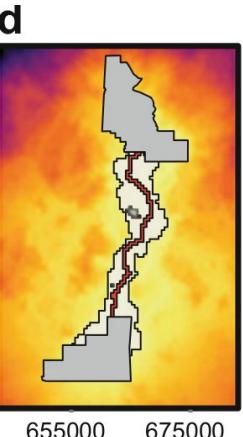
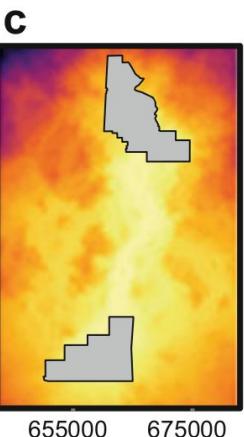
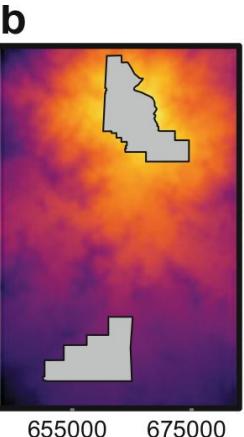
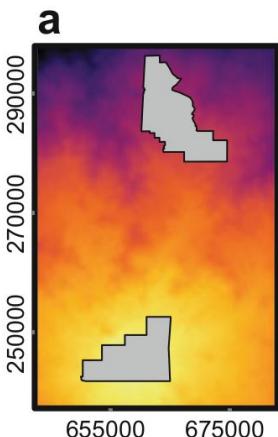
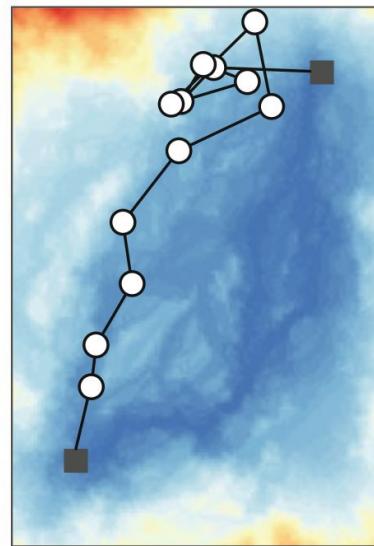
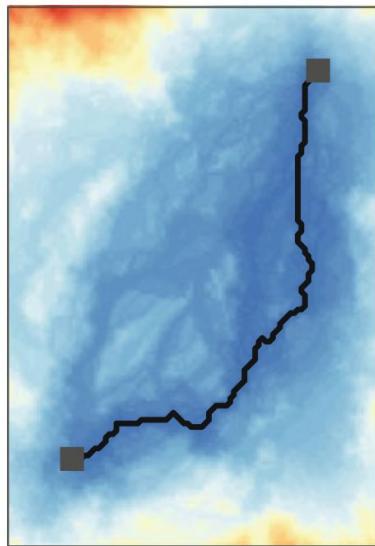
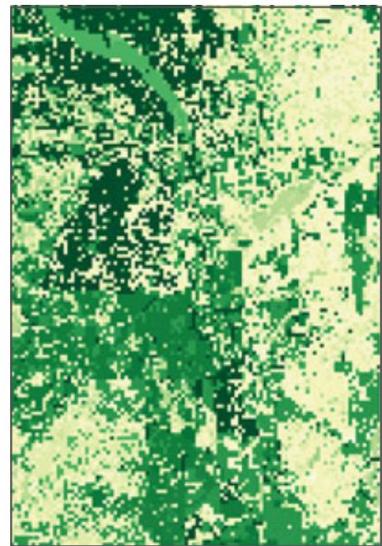
Corredores ecológicos



Fletcher & Fortin (2018)

Ecología Espacial

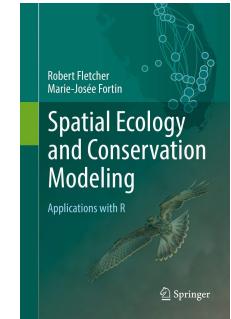
Corredores ecológicos



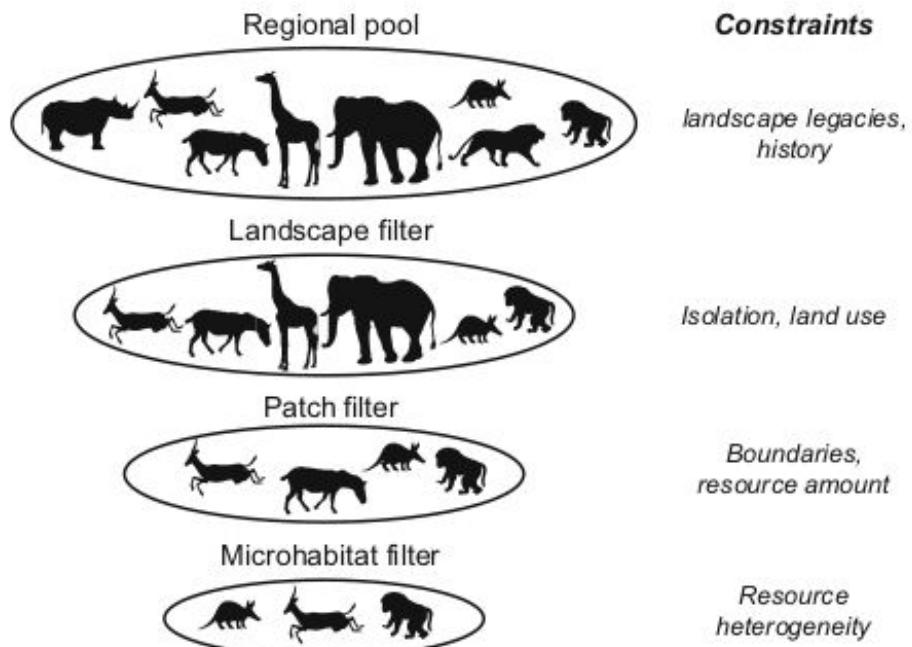
Fletcher & Fortin (2018)

Ecologia Espacial

Padrões de comunidades

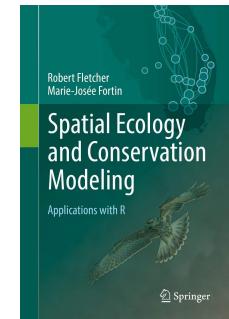


Fletcher & Fortin (2018)

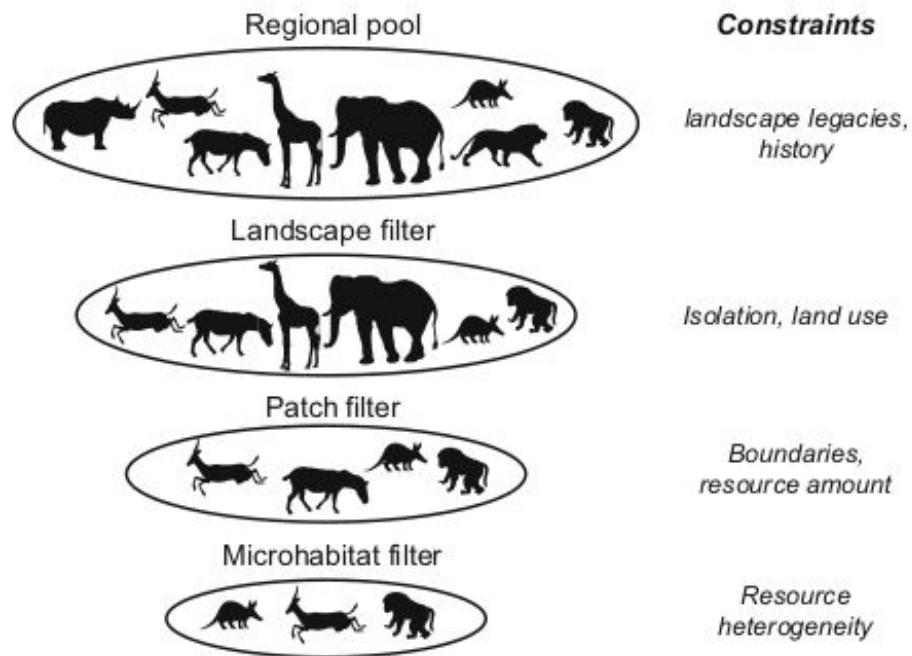
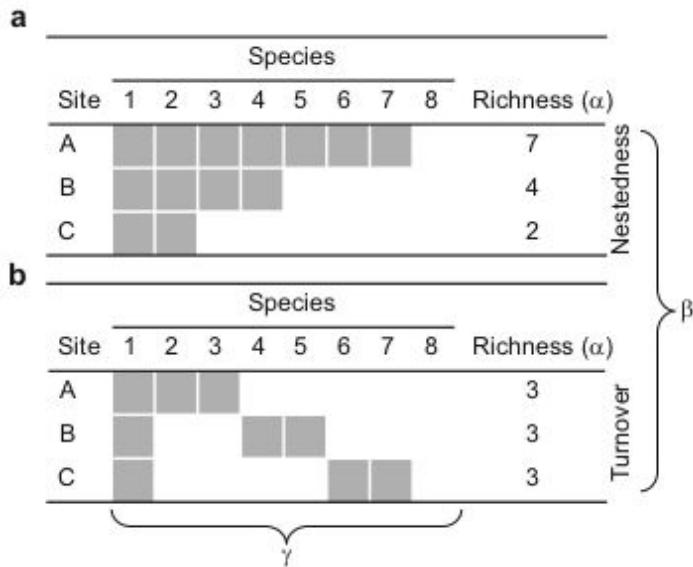


Ecología Espacial

Padrões de comunidades

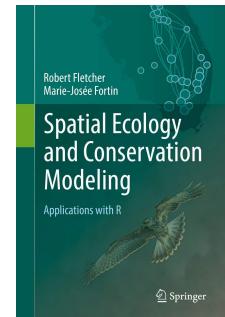
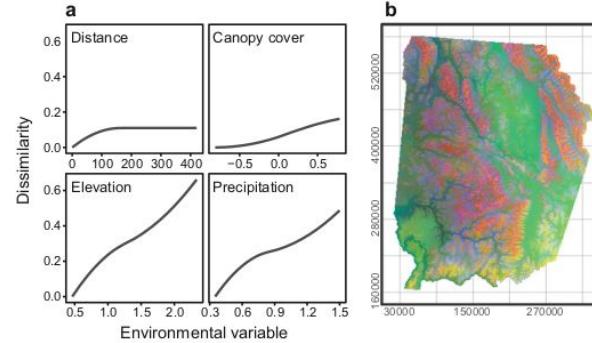
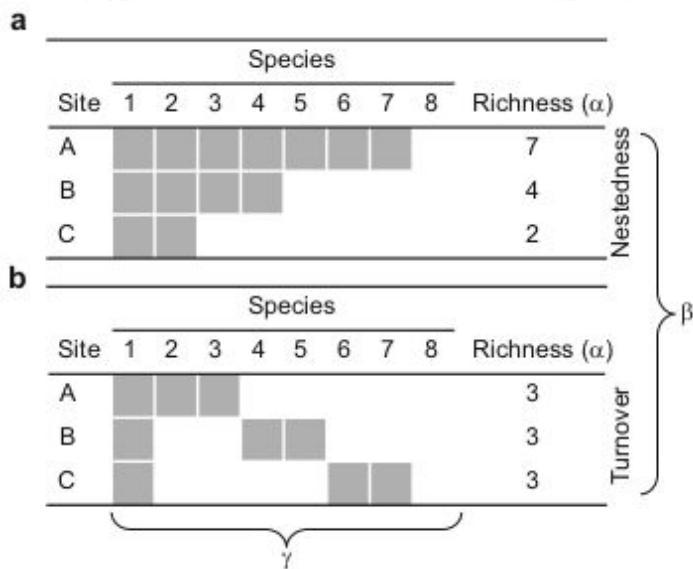
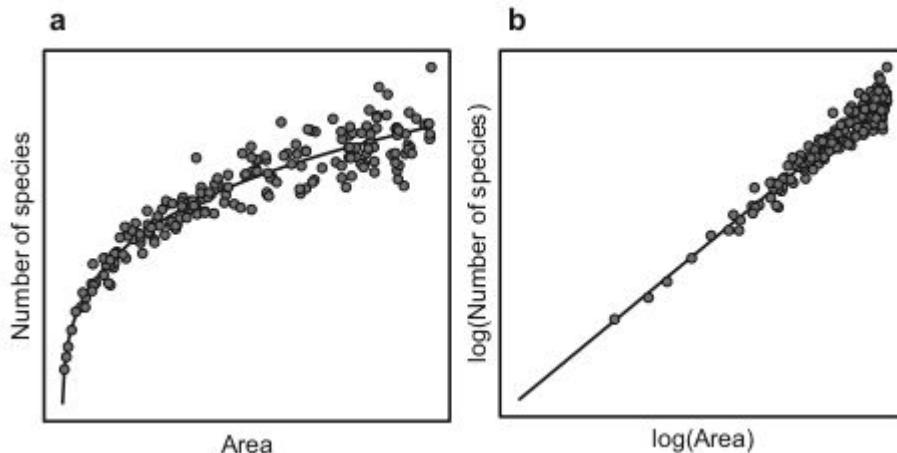


Fletcher & Fortin (2018)



Ecología Espacial

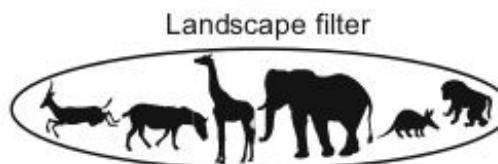
Padrões de comunidades



Fletcher & Fortin (2018)



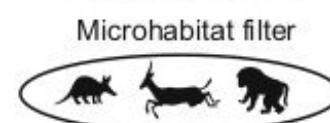
landscape legacies,
history



Isolation, land use



Boundaries,
resource amount

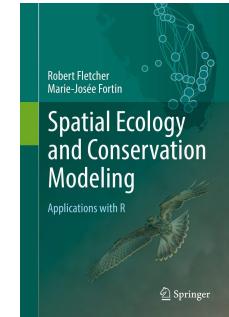
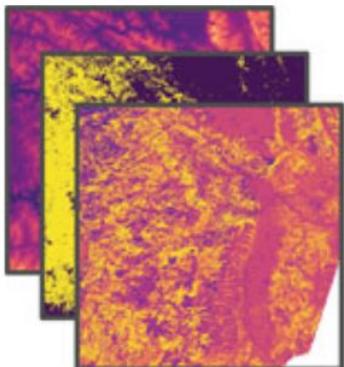


Resource
heterogeneity

Ecologia Espacial

Distribuição de espécies

Data:
species and environment

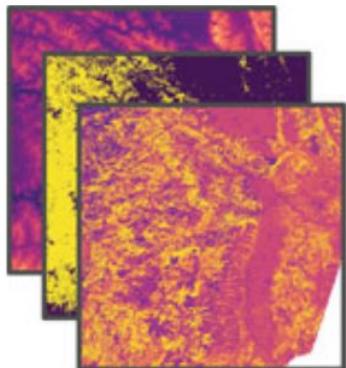
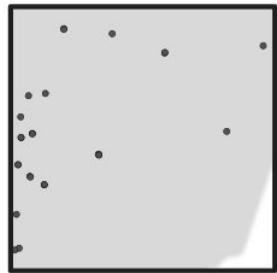


Fletcher & Fortin (2018)

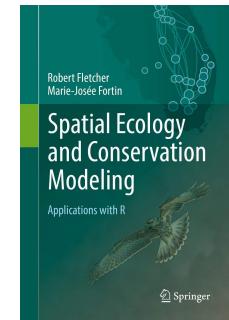
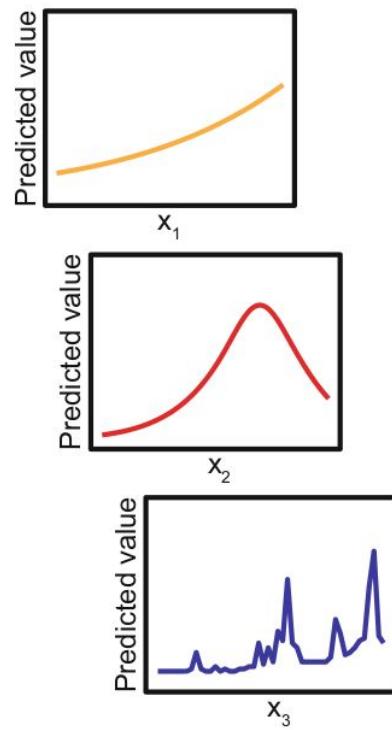
Ecologia Espacial

Distribuição de espécies

Data:
species and environment



Models:
algorithms and response curves

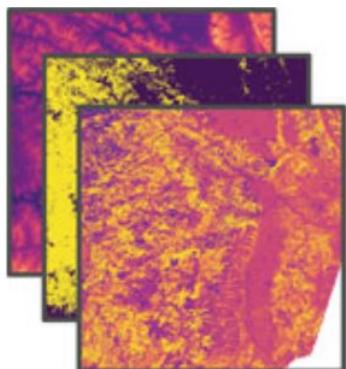
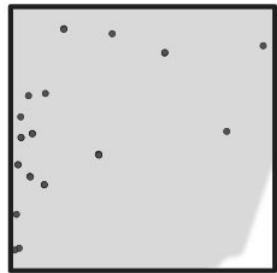


Fletcher & Fortin (2018)

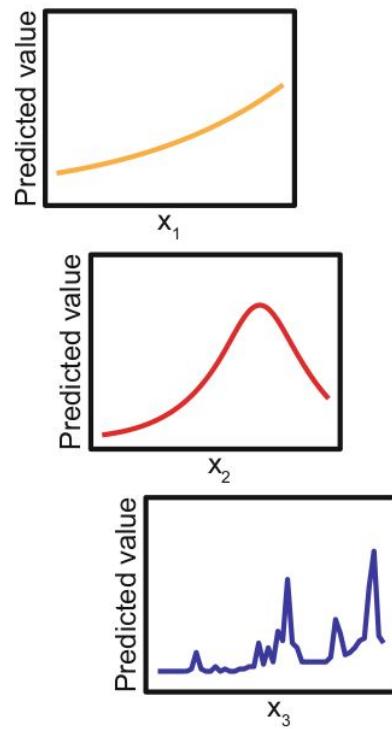
Ecologia Espacial

Distribuição de espécies

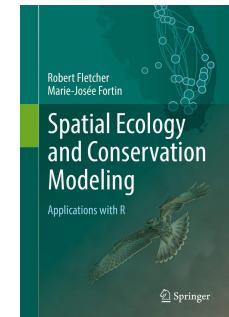
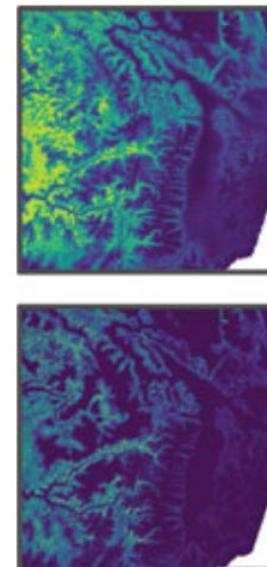
Data:
species and environment



Models:
algorithms and response curves



Predicted distribution:
current, past and/or future



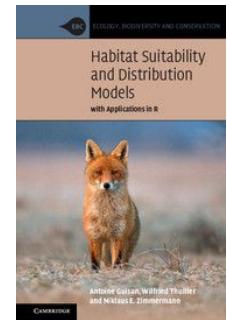
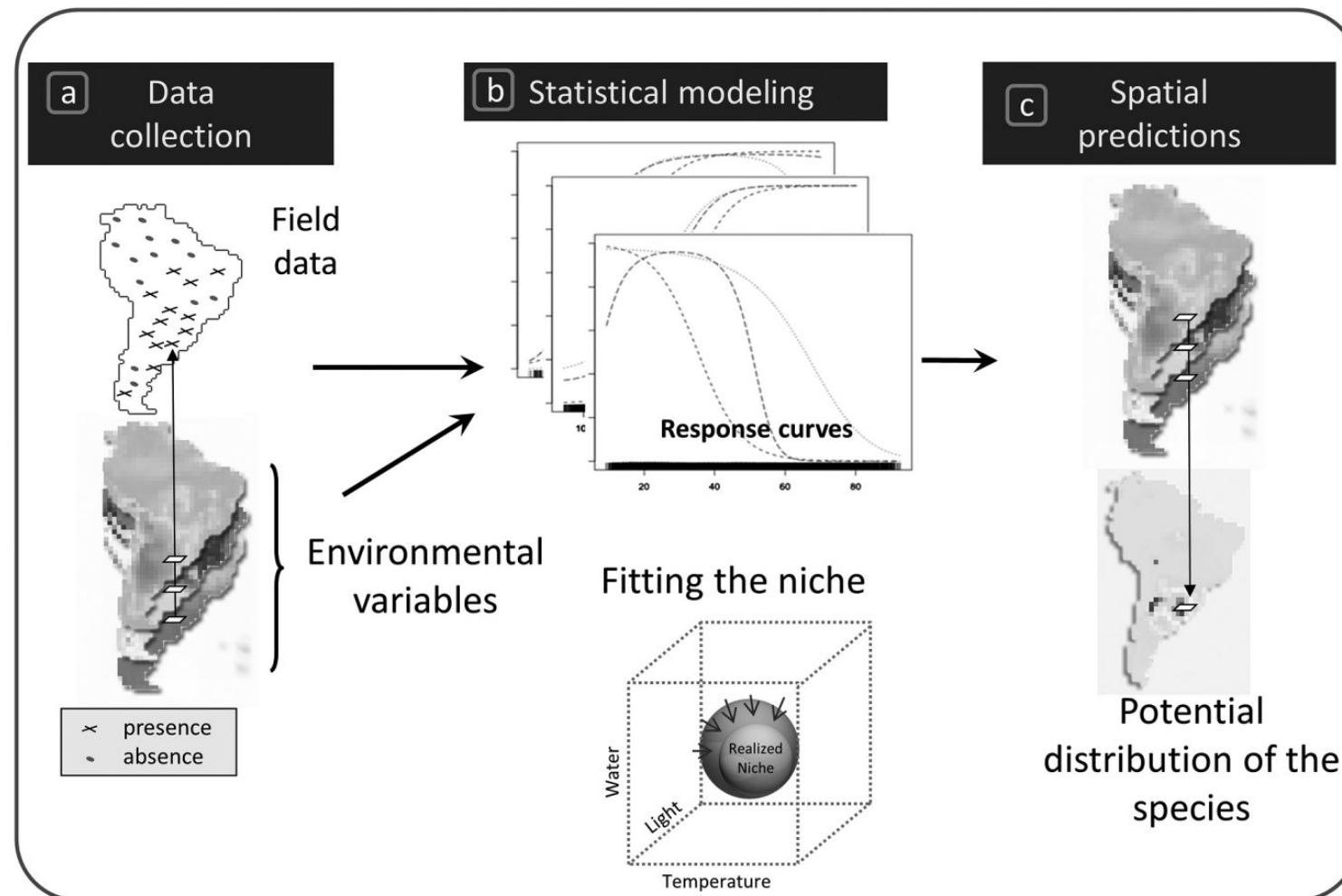
Fletcher & Fortin (2018)

Notaram a Cartografia como um
componente essencial no
entendimento de padrões
espaciais em Ecologia Espacial?

4. Modelagem de Distribuição de Espécies (SDMs)

Modelos de Distribuição de Espécies (SDMs)

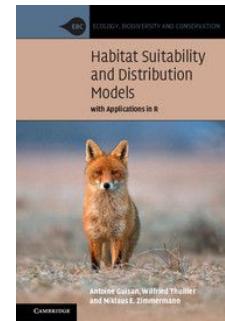
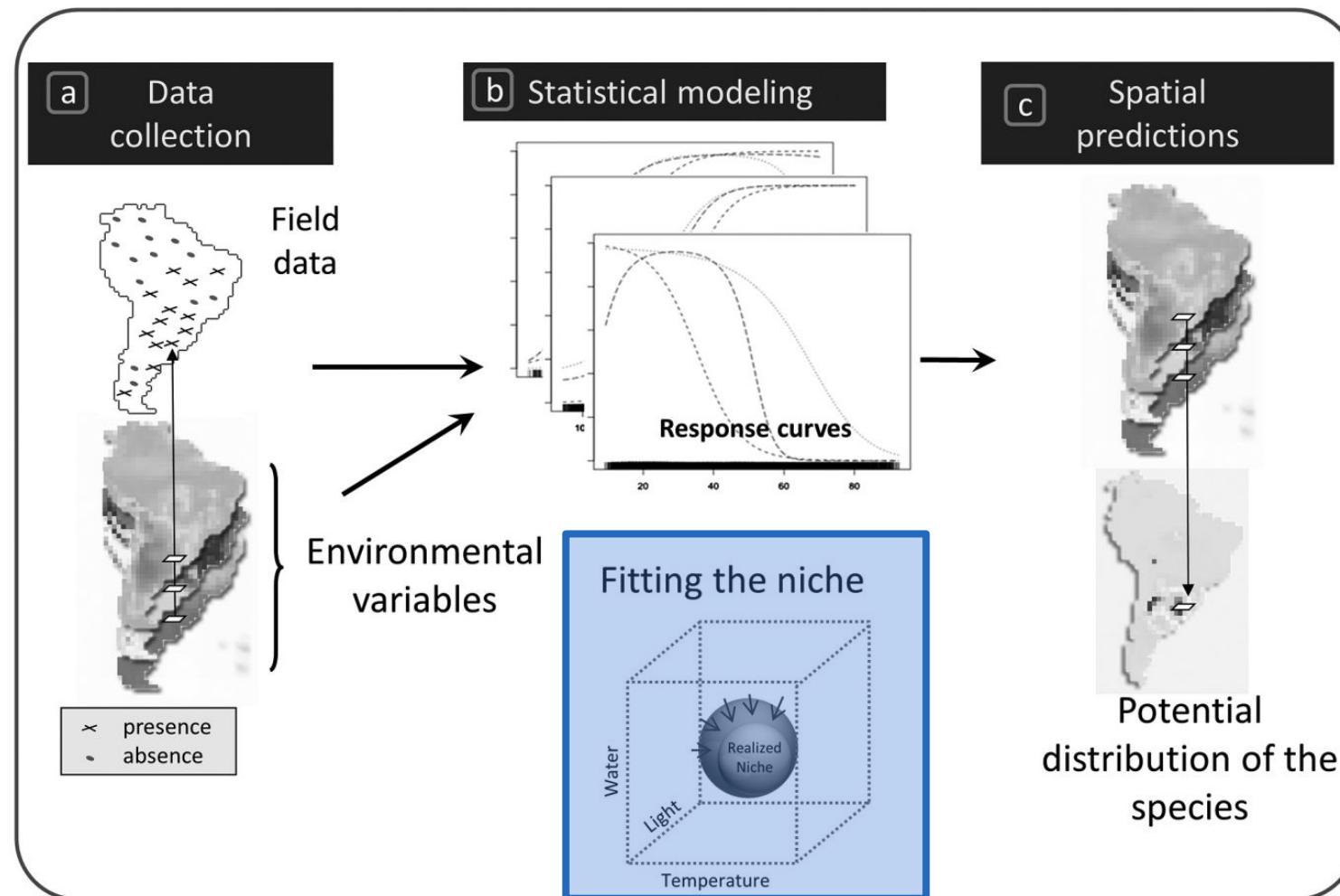
Visão geral



Guisan et al. (2017)

Modelos de Distribuição de Espécies (SDMs)

Visão geral



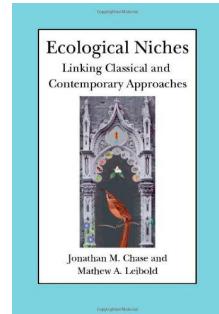
Guisan et al. (2017)

5. Nicho ecológico e distribuição das espécies

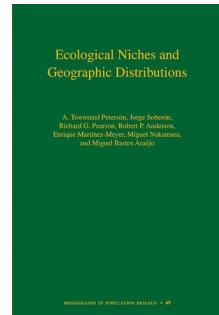
O que determina a distribuição das espécies?

Espaço Geográfico (G)

G



Chase & Leibold (2003)

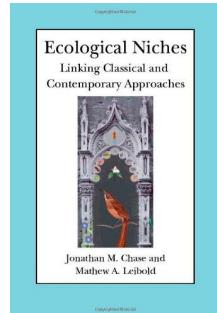


Peterson et al. (2011)

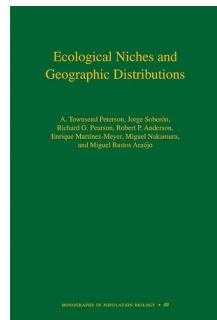
O que determina a distribuição das espécies?

Espaço Geográfico (G)

G



Chase & Leibold (2003)



Peterson et al. (2011)

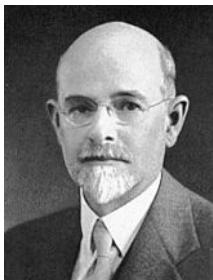
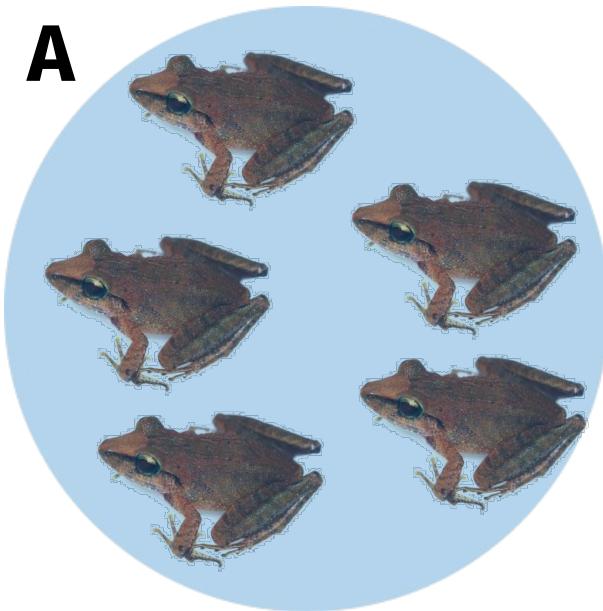
O que determina a distribuição das espécies?

Condições Abióticas (A)

G

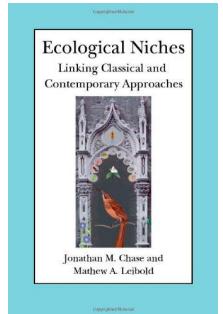


A

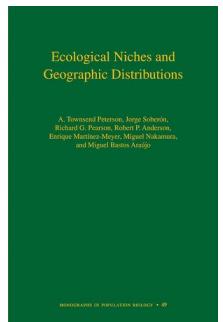


Joseph Grinnell (1917)

Requerimentos ambientais “condições climáticas”



Chase & Leibold (2003)

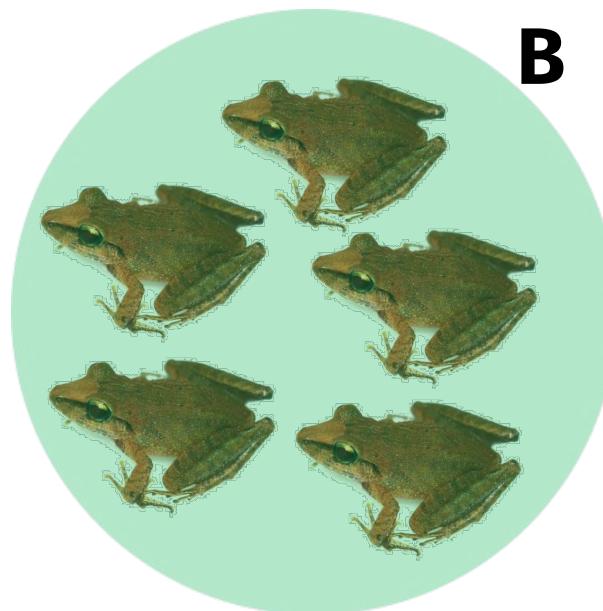


Peterson et al. (2011)

O que determina a distribuição das espécies?

Condições Bióticas (B)

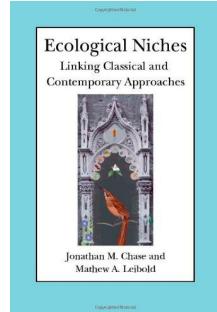
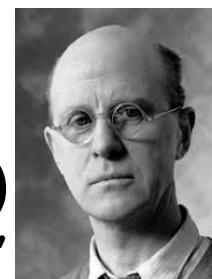
G



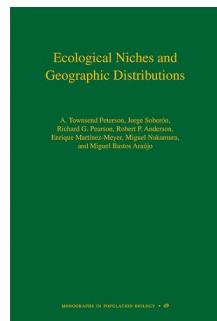
B



Charles Elton (1927)
Papel funcional dos organismos “impacto”



Chase & Leibold (2003)



Peterson et al. (2011)

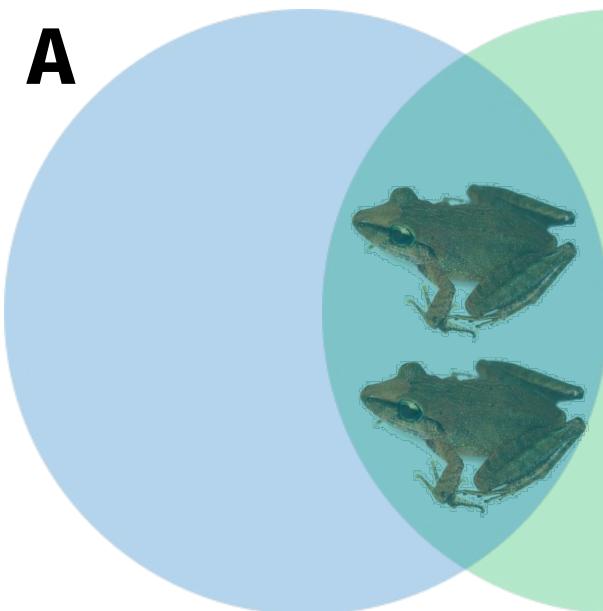
O que determina a distribuição das espécies?

Relação entre condições abióticas e bióticas

G



A



B

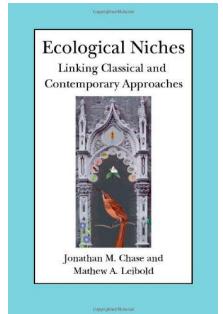


George E. Hutchinson (1957)

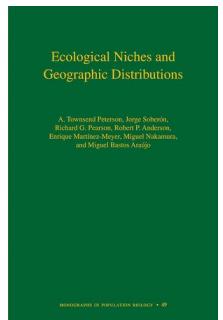
Requerimentos ambientais (Nicho Fundamental)

+

Requerimentos biológicos (Nicho Realizado)



Chase & Leibold (2003)



Peterson et al. (2011)

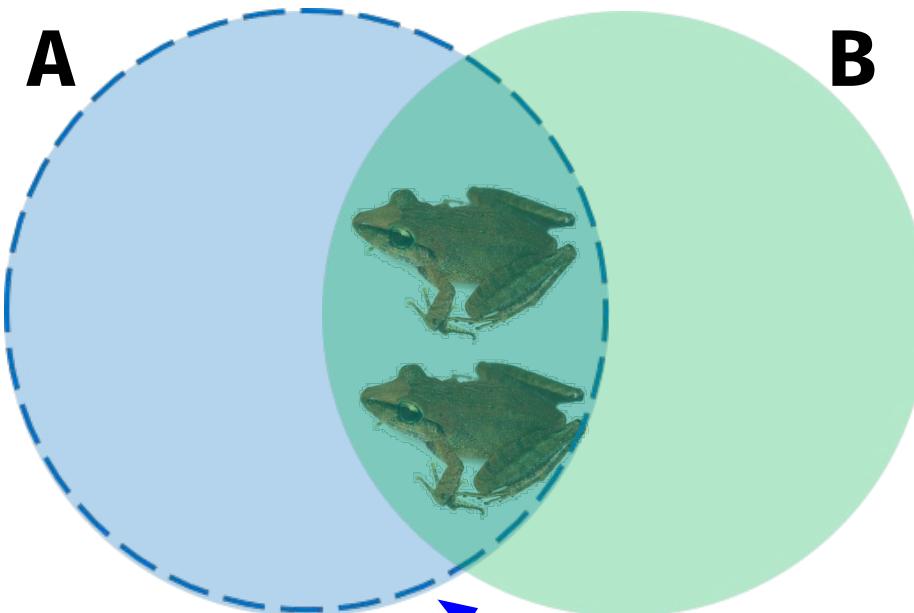
O que determina a distribuição das espécies?

Nicho Fundamental

G



A



B

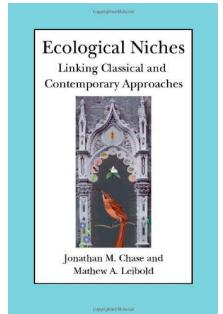


George E. Hutchinson (1957)

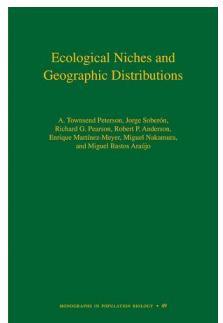
Requerimentos ambientais (Nicho Fundamental)

+

Requerimentos biológicos (Nicho Realizado)



Chase & Leibold (2003)



Peterson et al. (2011)

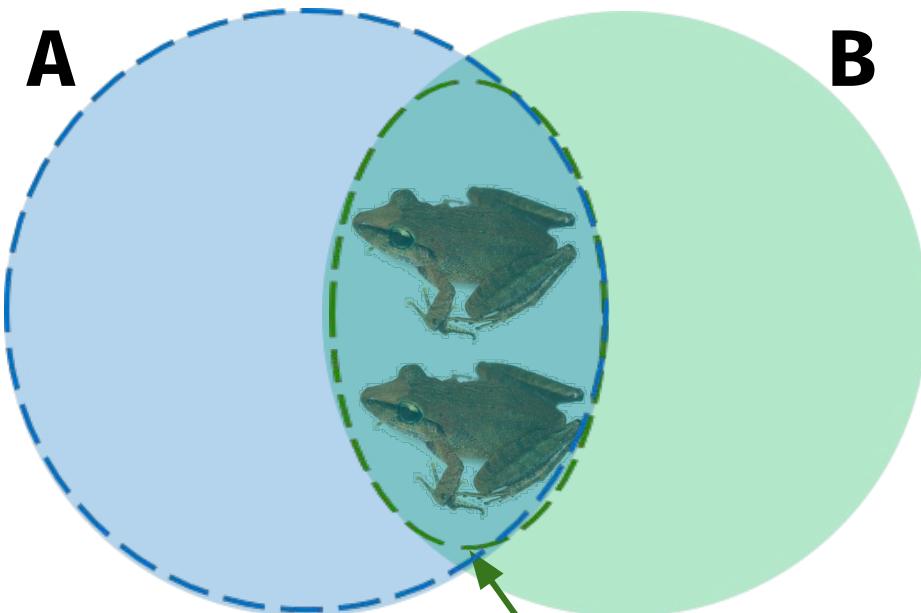
O que determina a distribuição das espécies?

Nicho Realizado

G



A



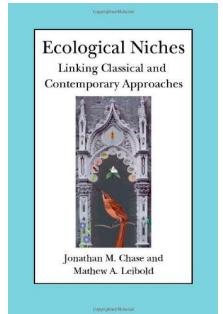
B



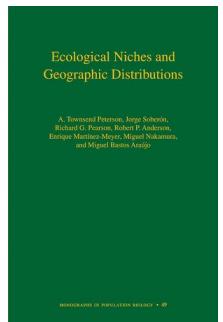
George E. Hutchinson (1957)

Requerimentos ambientais ([Nicho Fundamental](#))

+
Requerimentos biológicos ([Nicho Realizado](#))



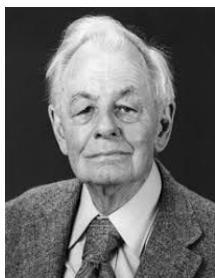
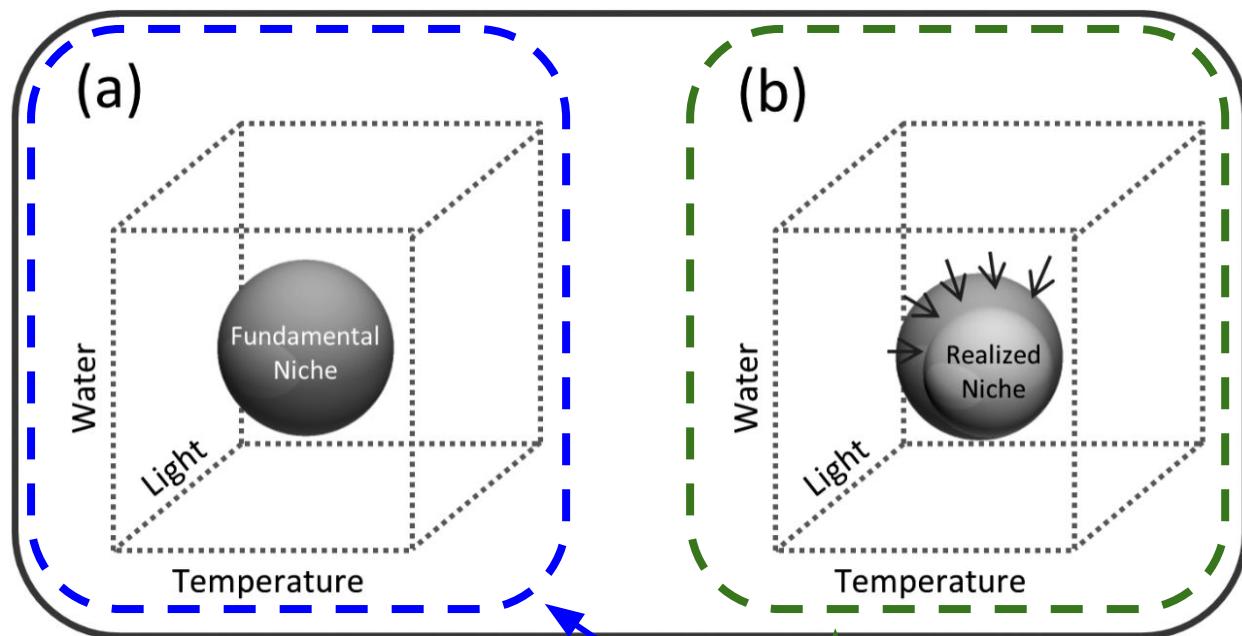
Chase & Leibold (2003)



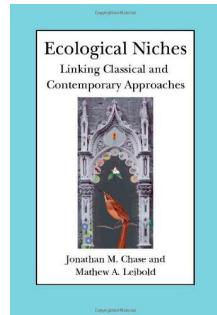
Peterson et al. (2011)

O que determina a distribuição das espécies?

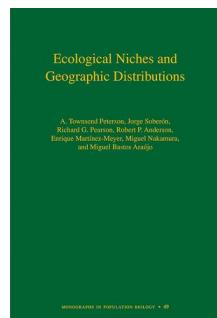
Hipervolume n-dimensional



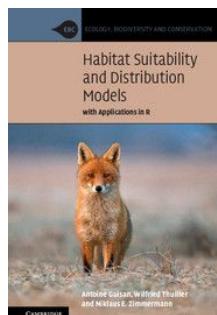
George E. Hutchinson (1957)
Requerimentos ambientais (Nicho Fundamental)
+
Requerimentos biológicos (Nicho Realizado)



Chase & Leibold (2003)



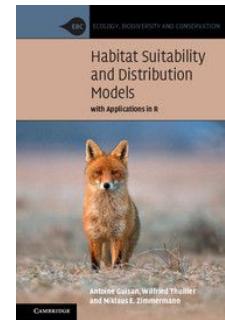
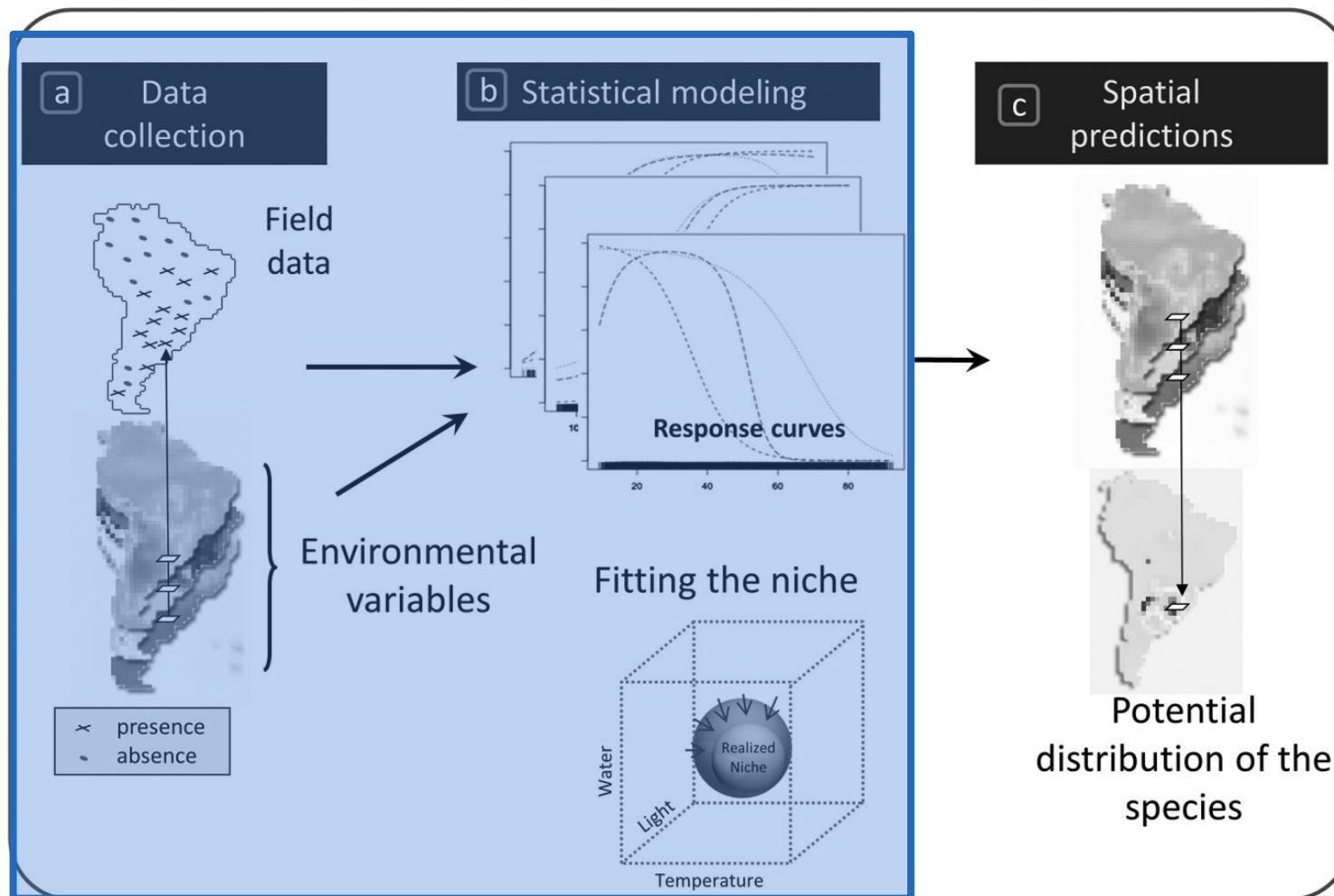
Peterson et al. (2011)



Guisan et al. (2017)

Modelos de Distribuição de Espécies (SDMs)

Visão geral

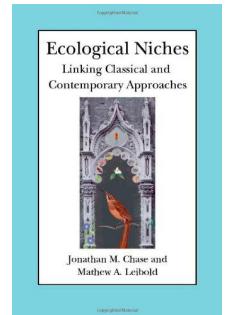


Guisan et al. (2017)

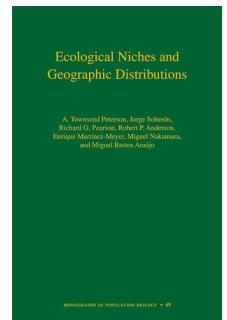
Modelos de Distribuição de Espécies (SDMs)

Ocorrências

Espaço geográfico (G)



Chase & Leibold (2003)

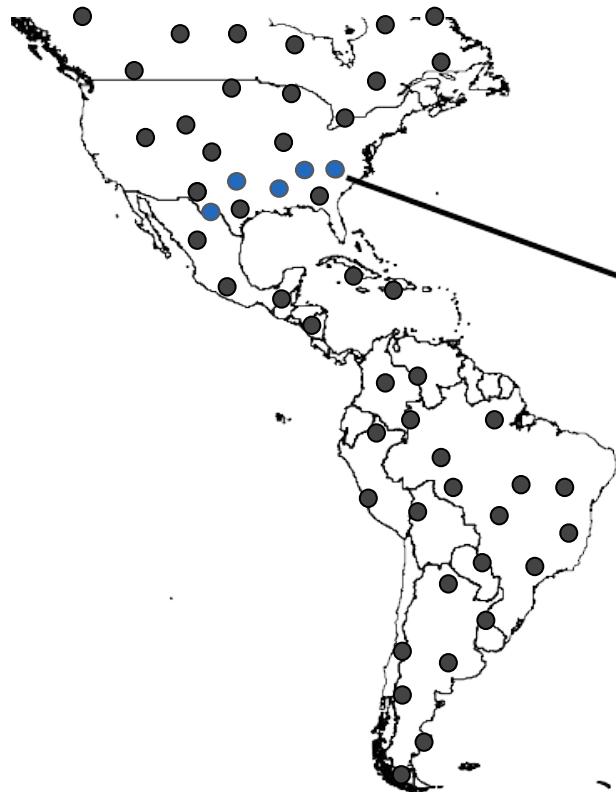


Peterson et al. (2011)

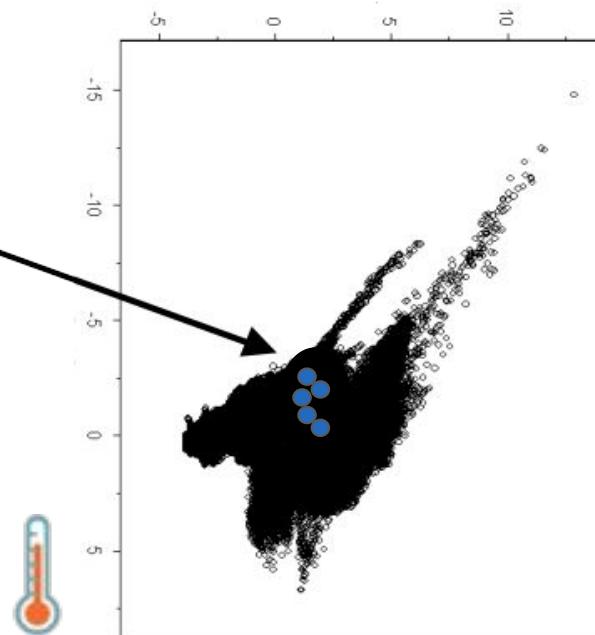
Modelos de Distribuição de Espécies (SDMs)

Condições ambientais

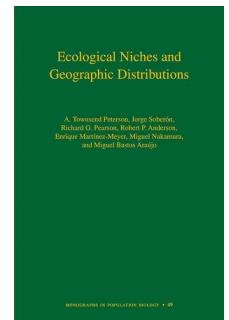
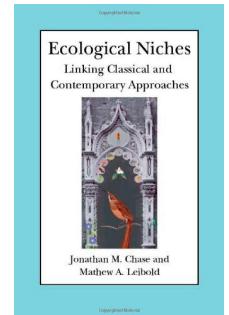
Espaço geográfico (G)



Espaço ambiental (E)



Chase & Leibold (2003)

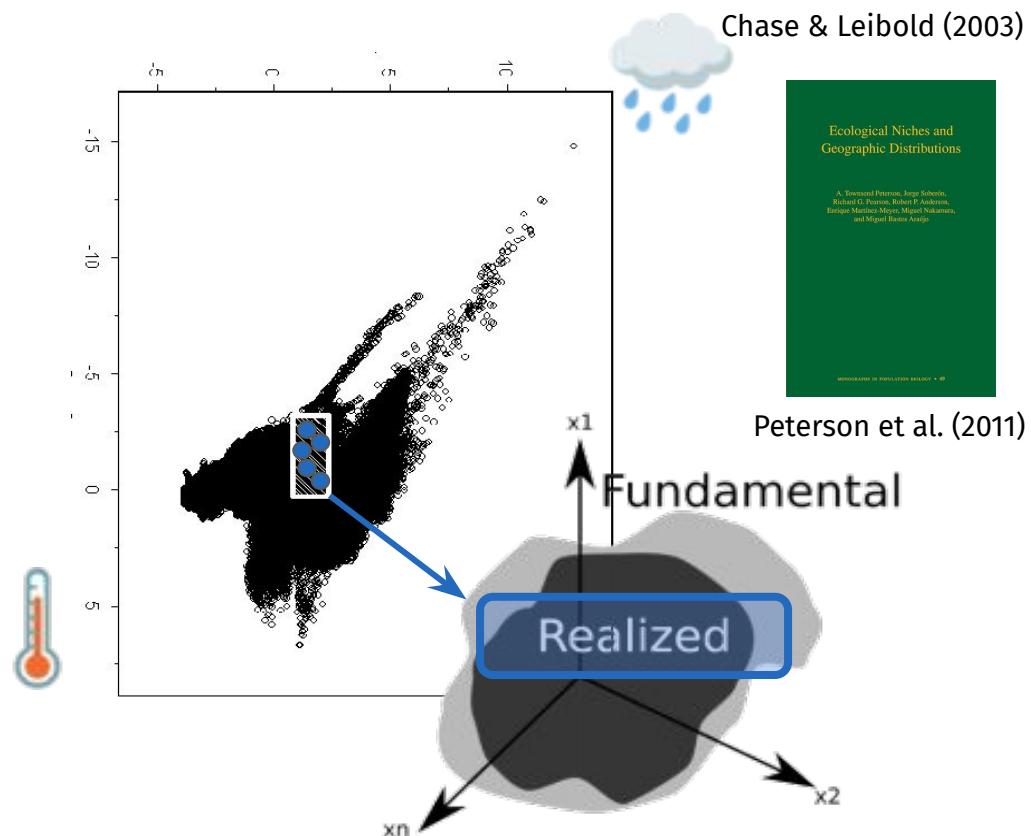


Peterson et al. (2011)

Modelos de Distribuição de Espécies (SDMs)

Estimativa do nicho realizado

Espaço ambiental (E)



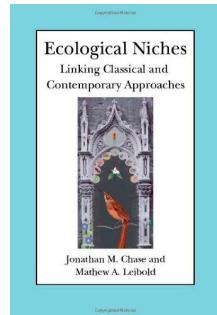
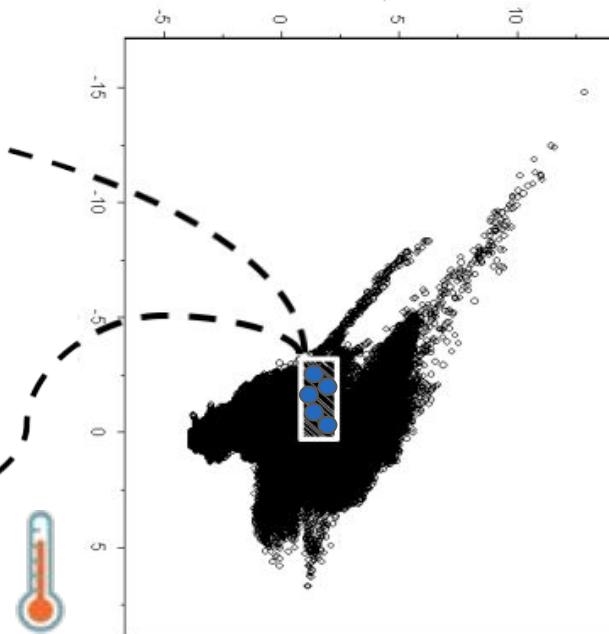
Modelos de Distribuição de Espécies (SDMs)

Predição do nicho realizado estimado

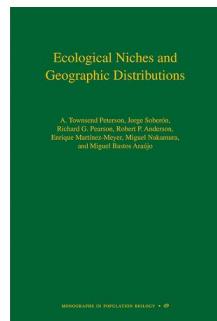
Espaço geográfico (G)



Espaço ambiental (E)



Chase & Leibold (2003)

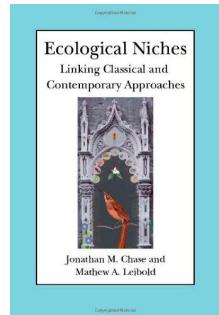
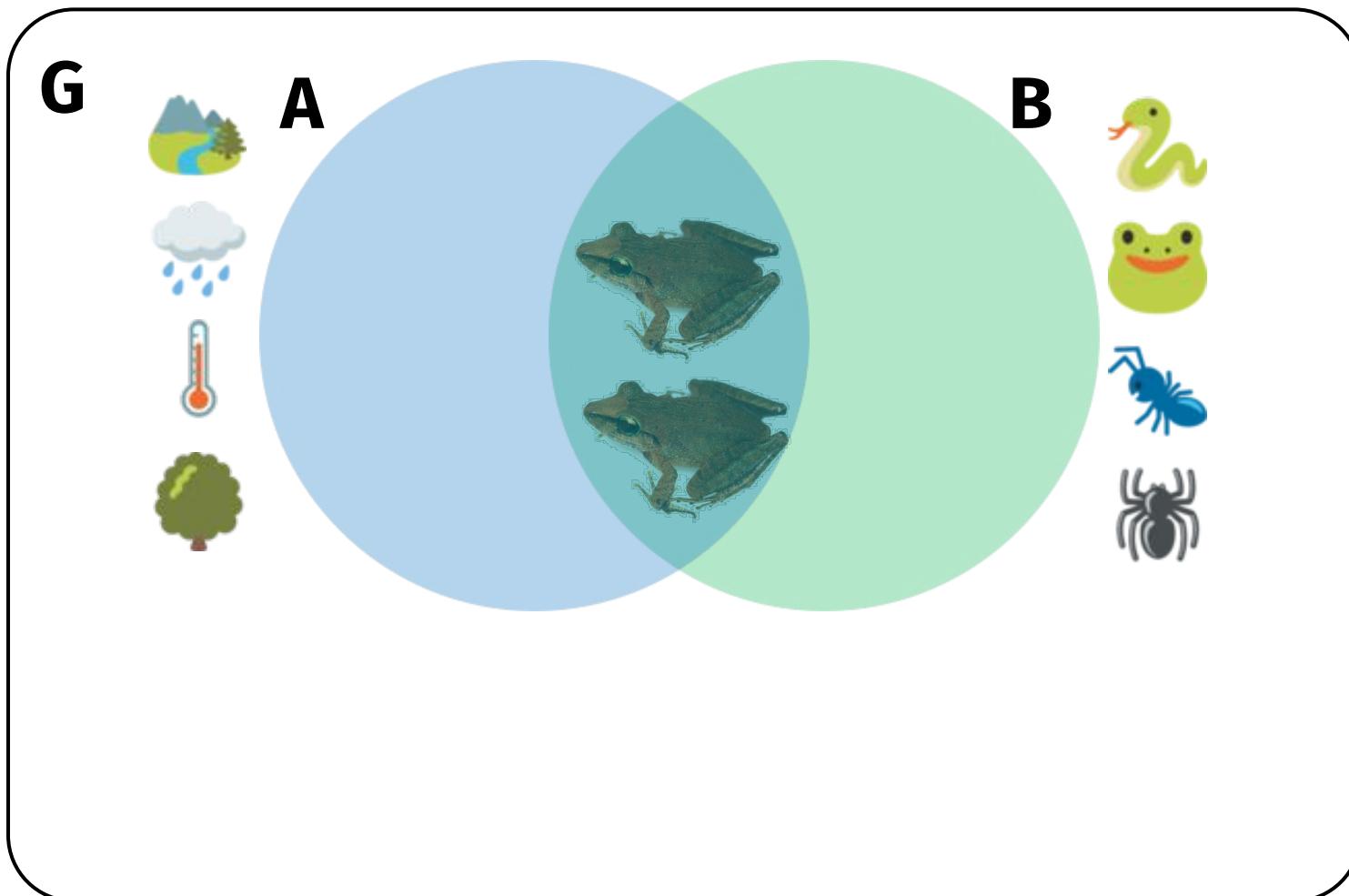


Peterson et al. (2011)

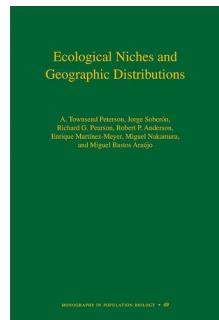
E como contornar essa
extrapolação?

O que determina a distribuição das espécies?

Nicho Ecológico



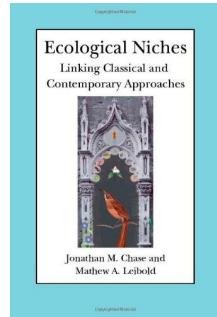
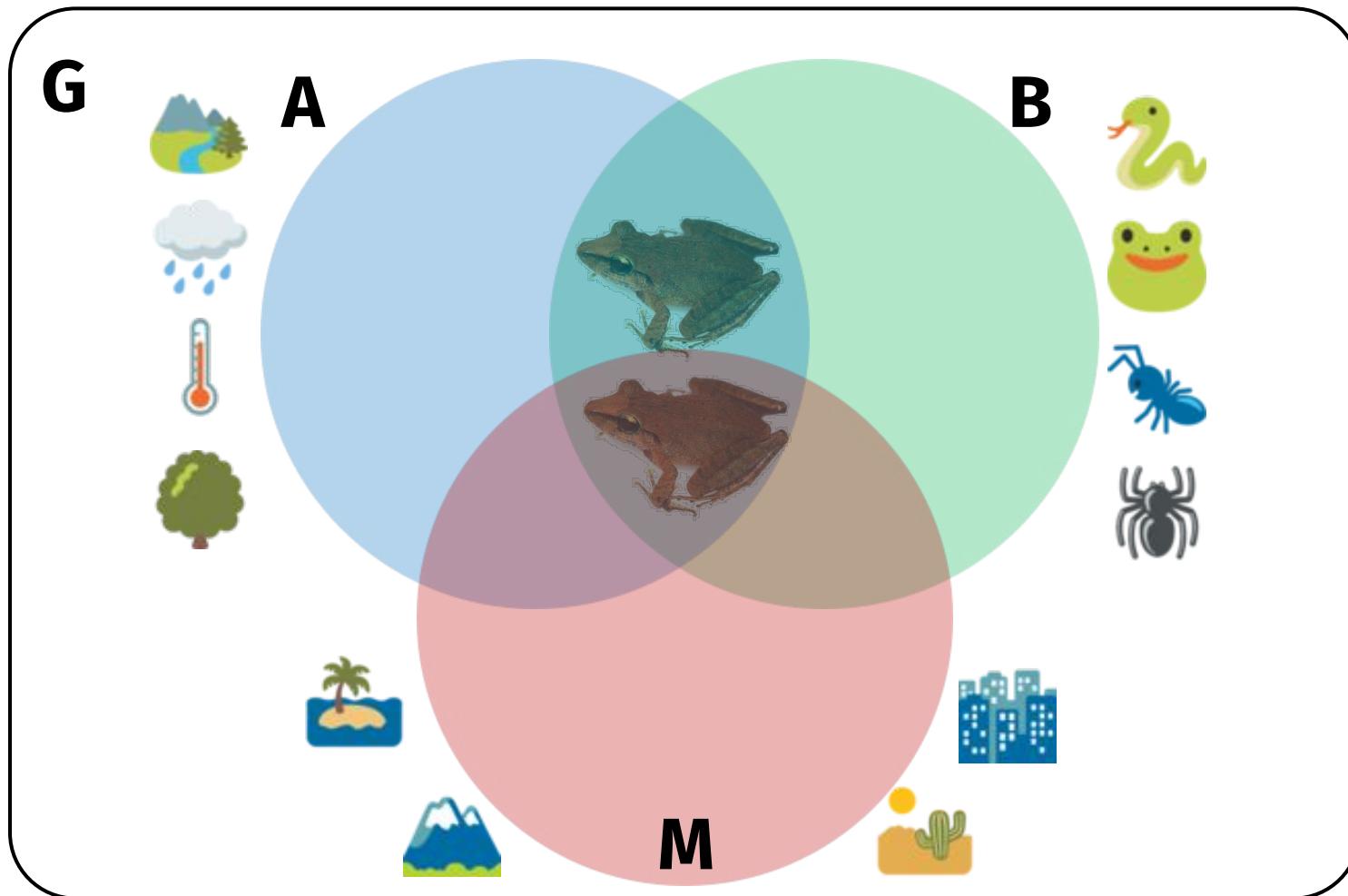
Chase & Leibold (2003)



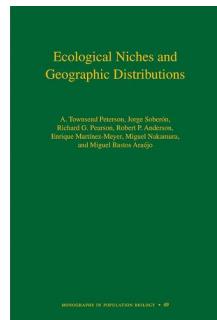
Peterson et al. (2011)

O que determina a distribuição das espécies?

Nicho Ecológico limitado pelo movimento



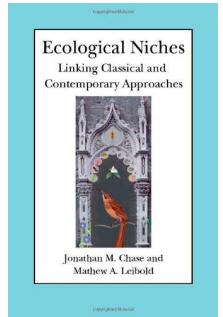
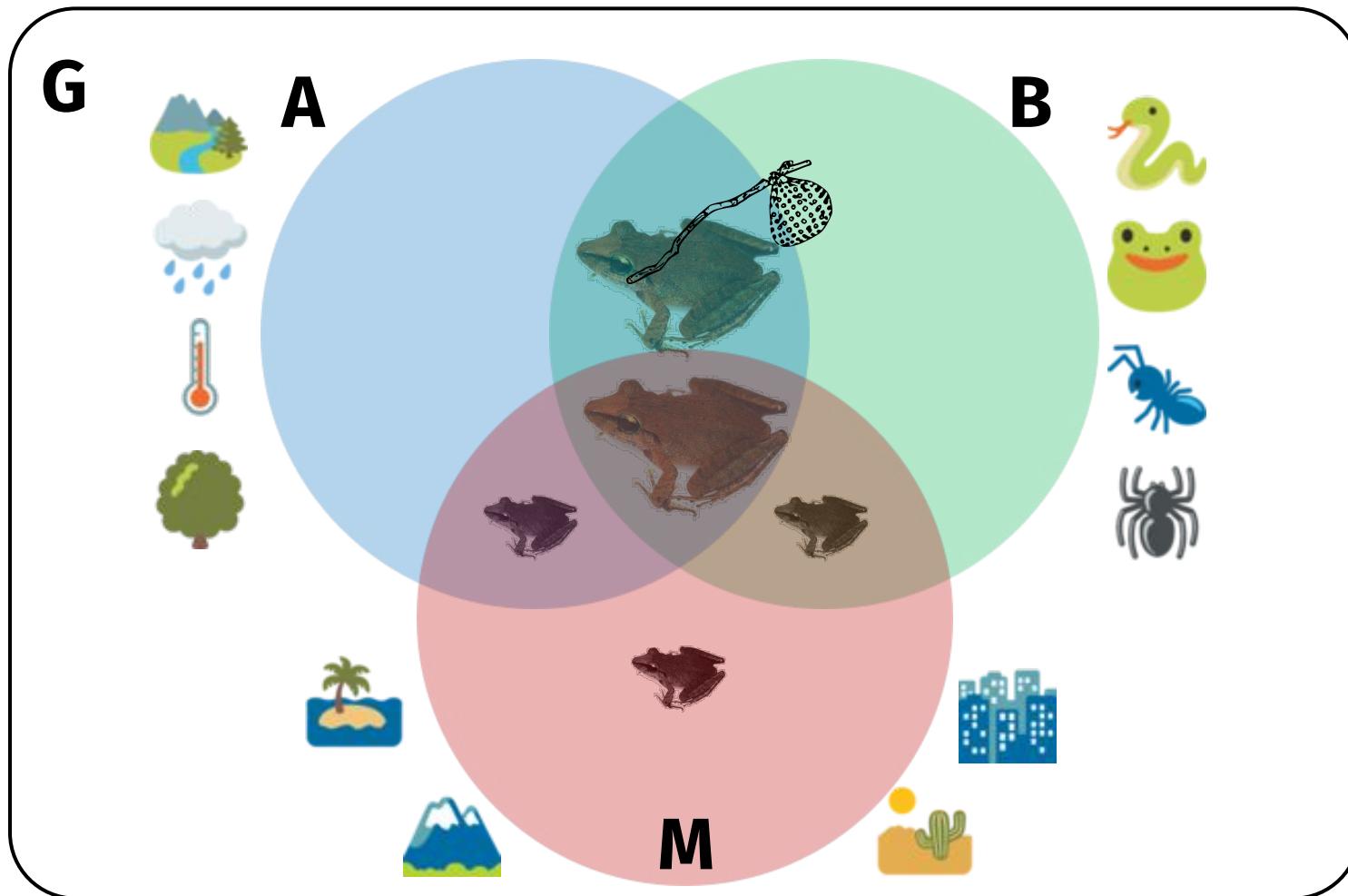
Chase & Leibold (2003)



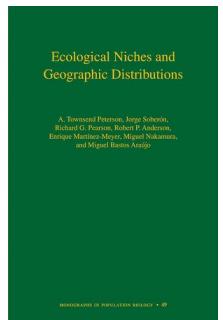
Peterson et al. (2011)

O que determina a distribuição das espécies?

Populações fonte e ralo (source-sink)



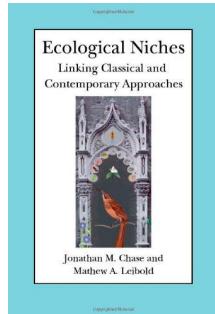
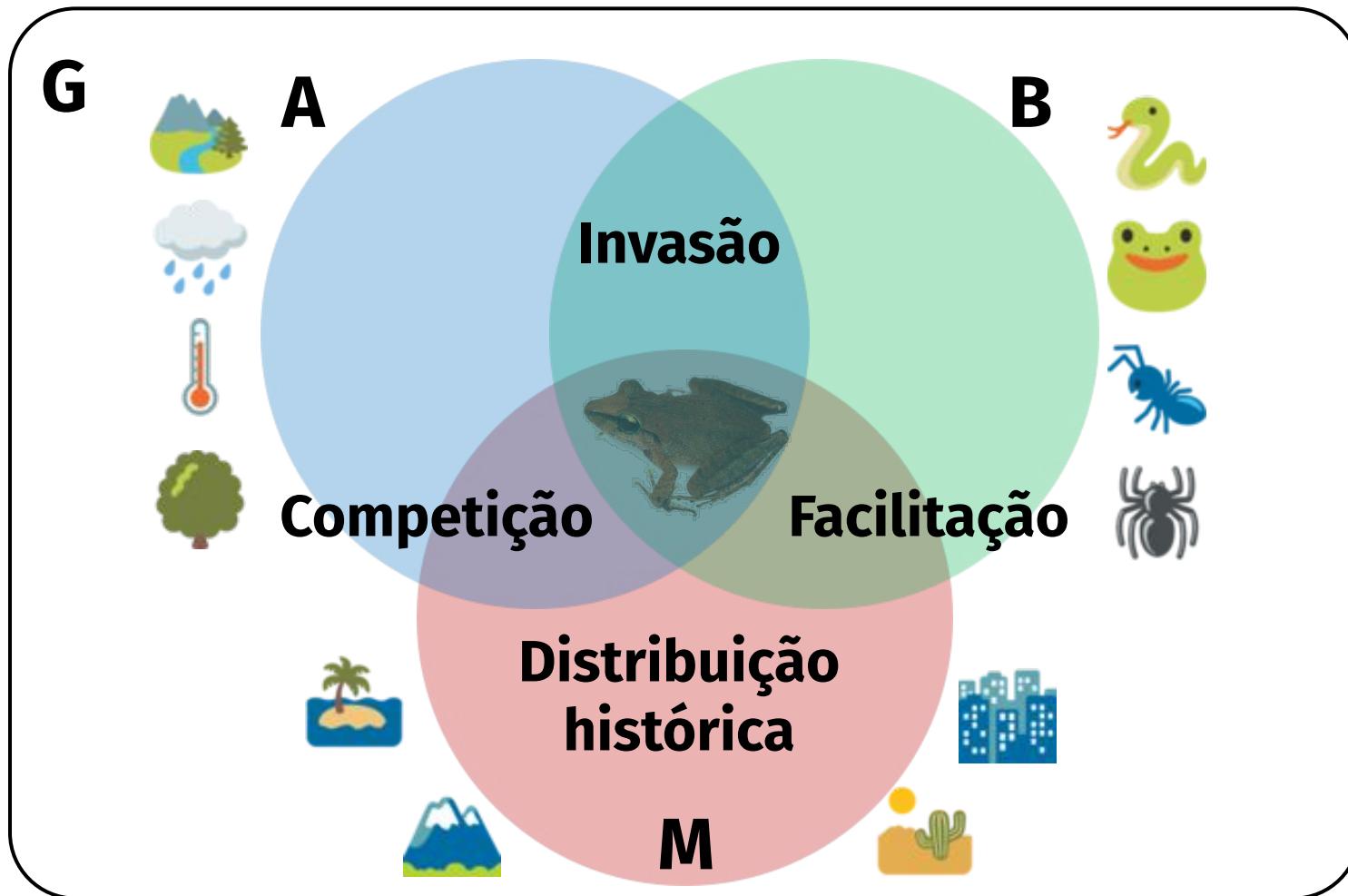
Chase & Leibold (2003)



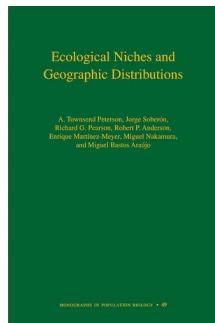
Peterson et al. (2011)

O que determina a distribuição das espécies?

Populações fonte e ralo (*source-sink*)



Chase & Leibold (2003)



Peterson et al. (2011)

E as interações bióticas?

O que determina a distribuição das espécies?

Interações bióticas “ignoradas”

G

A

B

**Ruído
“Eltoniano”**

PNAS

Niches and distributional areas: Concepts, methods, and assumptions

Jorge Soberón^{a,1} and Miguel Nakamura^b

^aBiodiversity Institute, University of Kansas, Dyche Hall, 1345 Jayhawk Boulevard, Lawrence, KS 66045; and ^bCentro de Investigación en Matemáticas, A. C. Jalisco s/n, Col. Valenciana, Guanajuato, 36240, México

Ecological Niches
Linking Classical and Contemporary Approaches
Jonathan M. Chase and Mathew A. Leibold

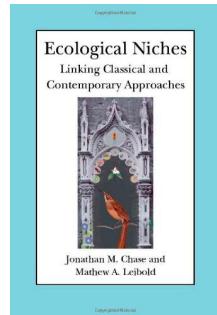
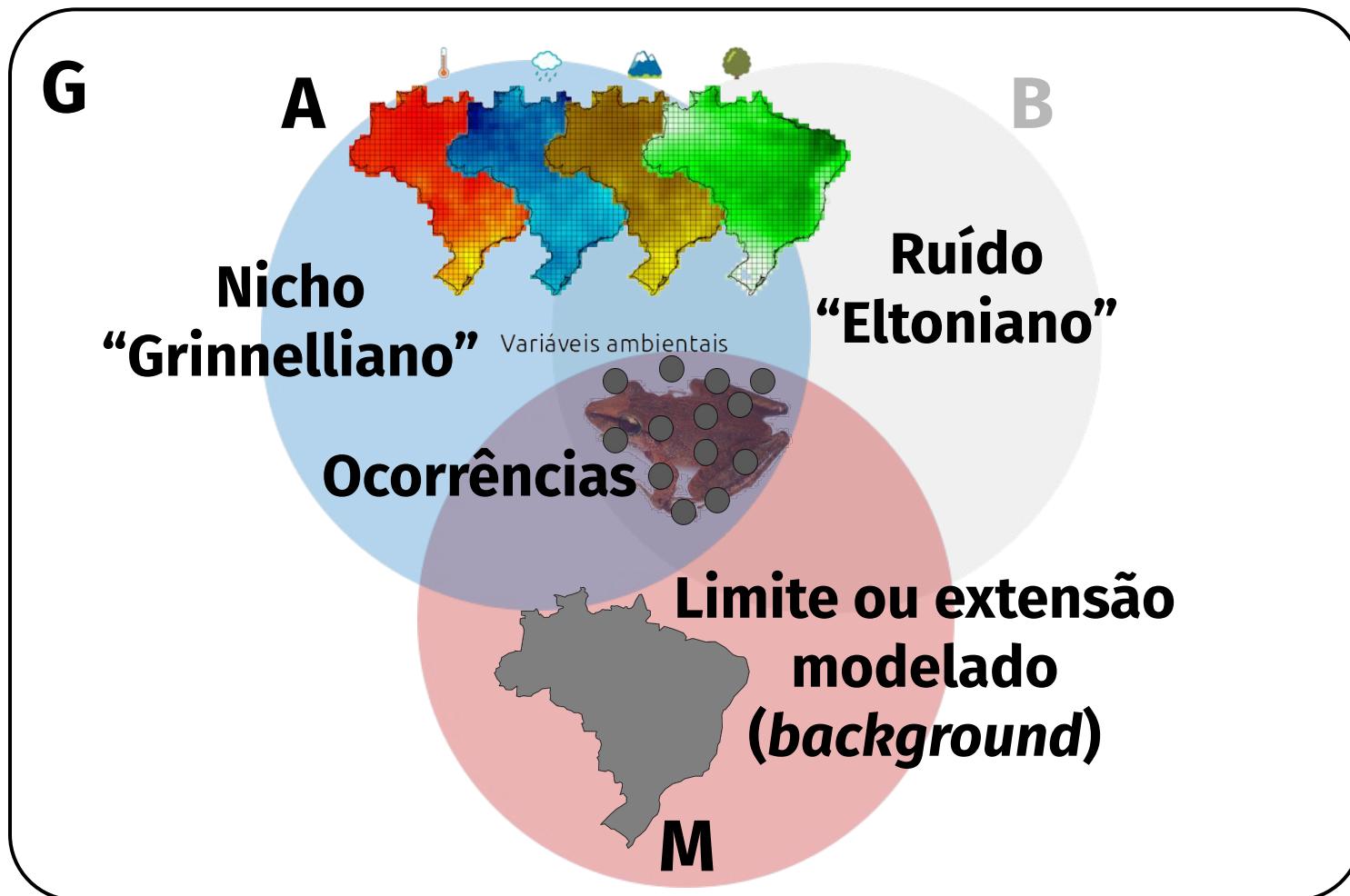
Chase & Leibold (2003)

Ecological Niches and Geographic Distributions
A. Townsend Peterson, Jorge Soberón, Enrique Martínez-Meyer, Miguel Nakamura, and Miguel Bisbal Arango

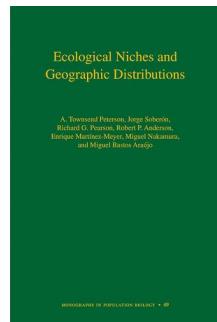
Peterson et al. (2011)

O que determina a distribuição das espécies?

Estimativa do nicho Grinnelliano realizado



Chase & Leibold (2003)



Peterson et al. (2011)

Área em desenvolvimento

Como inserir as interações bióticas nos SDMs?

RESEARCH PAPER

WILEY Journal of Biogeography

Using biotic interactions in broad-scale estimates of species' distributions

Iulian Gherghel^{1,2,3}  | François Brischoux⁴ | Monica Papes⁵

BIOLOGICAL REVIEWS

Cambridge Philosophical Society

 Open Access

The role of biotic interactions in shaping distributions and realised assemblages of species: implications for species distribution modelling

Mary Susanne Wisz , Julien Pottier, W. Daniel Kissling, Loïc Pellissier, Jonathan Lenoir, Christian F. Damgaard, Carsten F. Dormann, Mads C. Forchhammer, John-Arvid Grytnes ... See all authors 

Journal of Biogeography



Original Article  Full Access

The importance of biotic interactions in species distribution models: a test of the Eltonian noise hypothesis using parrots

Carlos B. de Araújo , Luiz Octavio Marcondes-Machado, Gabriel C. Costa

Ecology and Evolution

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ORIGINAL RESEARCH   

Effects of biotic interactions on modeled species' distribution can be masked by environmental gradients

William Godsoe , Janet Franklin, F. Guillaume Blanchet

RESEARCH REVIEWS

WILEY Global Ecology and Biogeography

A Journal of
Macroecology

Biotic interactions in species distribution modelling: 10 questions to guide interpretation and avoid false conclusions

Carsten F. Dormann¹  | Maria Bobrowski² | D. Matthias Dehling³ | David J. Harris⁴ | Florian Hartig^{1,5} | Heike Lischke⁶ | Marco D. Moretti⁷  | Jörn Pagel⁸ | Stefan Pinkert⁹  | Matthias Schleuning¹⁰ | Susanne I. Schmidt¹¹  | Christine S. Sheppard⁸  | Manuel J. Steinbauer^{12,13}  | Dirk Zeuss¹⁴  | Casper Kraan^{15,16} 

Biotic interactions and climate in species distribution modelling

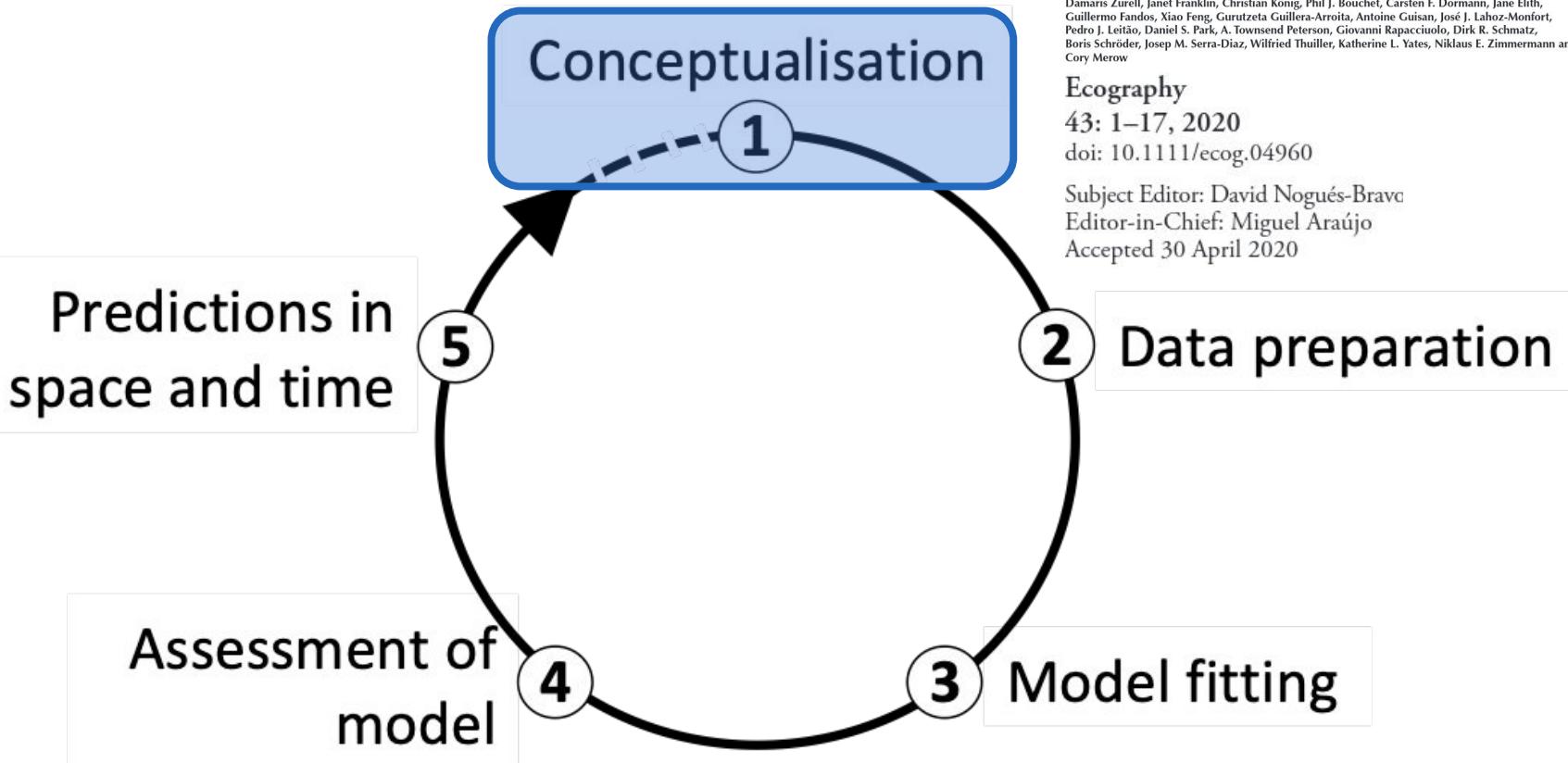
Daniel P. Bebber,  Sarah J. Gurr

doi: <https://doi.org/10.1101/520320>

6. SDMs passo a passo

SDMs passo a passo

Passos de construção dos SDMs



ECOGRAPHY

Review and synthesis

A standard protocol for reporting species distribution models

Damaris Zurell, Janet Franklin, Christian König, Phil J. Bouchet, Carsten F. Dormann, Jane Elith, Guillermo Fandos, Xiao Feng, Gurutzeta Guillera-Arroita, Antoine Guisan, José J. Lahoz-Monfort, Pedro J. Leitão, Daniel S. Park, A. Townsend Peterson, Giovanni Rapacciuolo, Dirk R. Schmactz, Boris Schröder, Josep M. Serra-Díaz, Wilfried Thuiller, Katherine L. Yates, Niklaus E. Zimmermann and Cory Merow

Ecography

43: 1–17, 2020

doi: 10.1111/ecog.04960

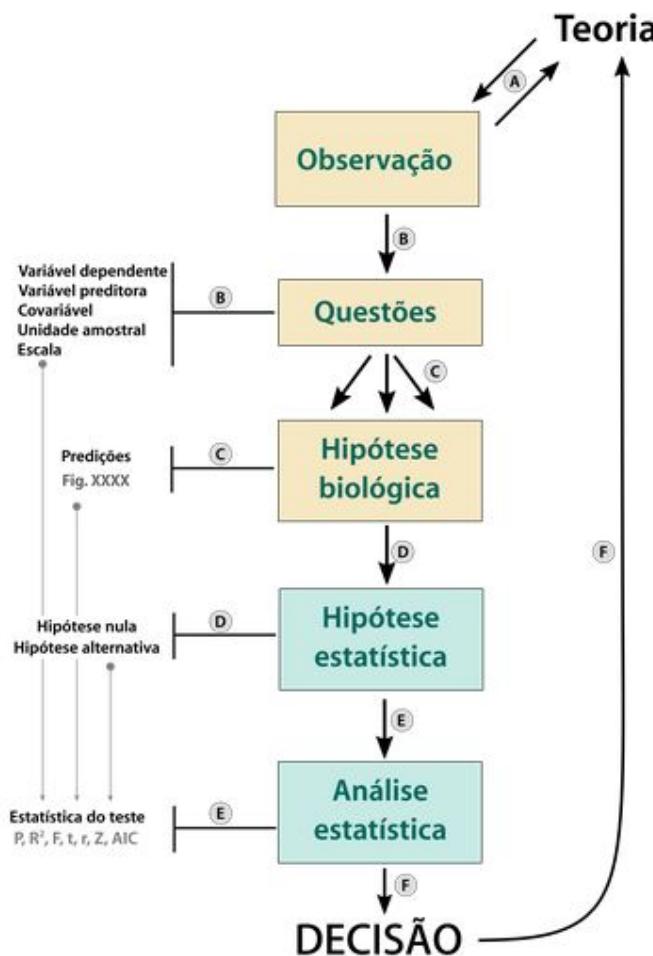
Subject Editor: David Nogués-Bravo

Editor-in-Chief: Miguel Araújo

Accepted 30 April 2020

1. Conceitualização

Perguntas associadas à distribuição das espécies



Temas

1. Distribuição de espécies
2. Padrões de diversidade
3. Mudanças climáticas (passado e futuro)
4. Invasão de espécies
5. Transmissão de doenças
6. Interações entre espécies
7. Processos de extinção
8. Conservação-evolução de nicho
9. Estabelecer refúgios climáticos
10. Estabelecimento e eficiência de áreas protegidas

SDMs passo a passo

Passos de construção dos SDMs

ECOGRAPHY

Review and synthesis

A standard protocol for reporting species distribution models

Damaris Zurell, Janet Franklin, Christian König, Phil J. Bouchet, Carsten F. Dormann, Jane Elith, Guillermo Fandos, Xiao Feng, Gurutzeta Guillera-Arroita, Antoine Guisan, José J. Lahoz-Monfort, Pedro J. Leitão, Daniel S. Park, A. Townsend Peterson, Giovanni Rapacciuolo, Dirk R. Schmactz, Boris Schröder, Josep M. Serra-Díaz, Wilfried Thuiller, Katherine L. Yates, Niklaus E. Zimmermann and Cory Merow

Ecography

43: 1–17, 2020

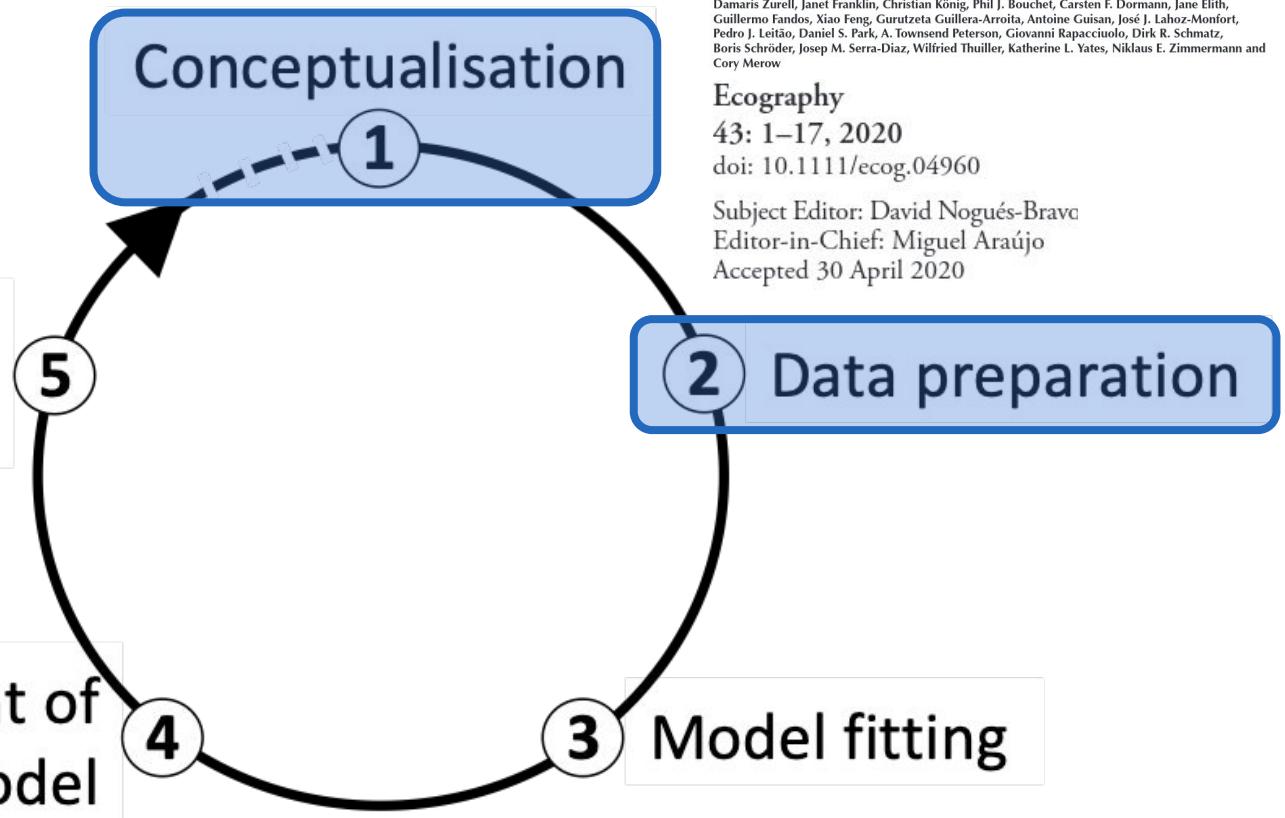
doi: 10.1111/ecog.04960

Subject Editor: David Nogués-Bravo

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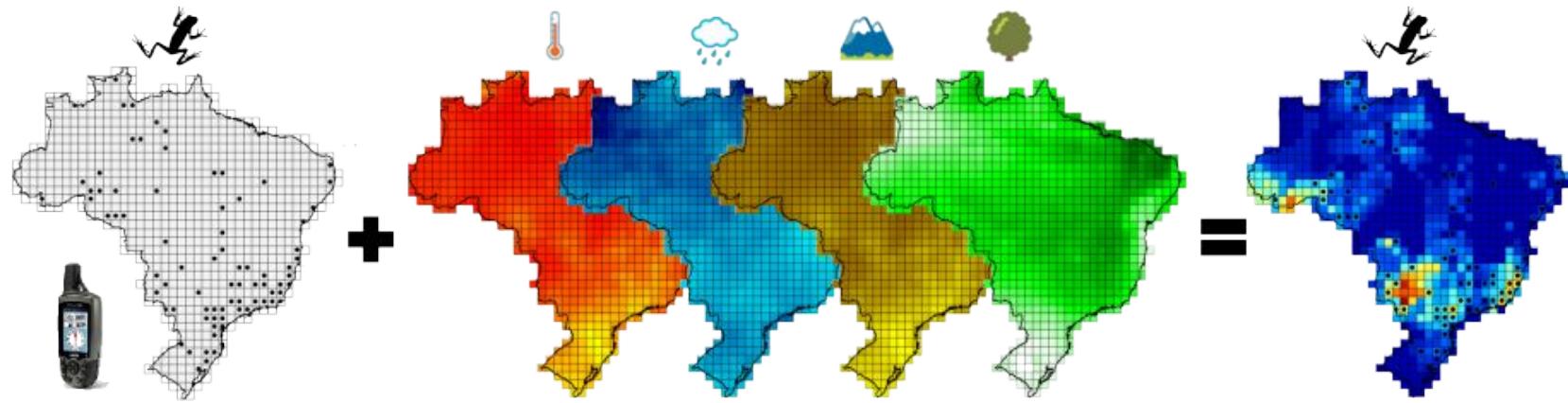
Accepted 30 April 2020

Predictions in
space and time



2. Preparação dos dados

Dados de entrada e saída



"Ocorrências"

Variáveis ambientais

Adequabilidade

species	lon	lat
sp1	-40.2	-23.4
sp1	-38.8	-20.3
sp1	-43.3	-19.9

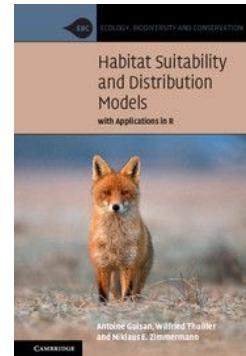
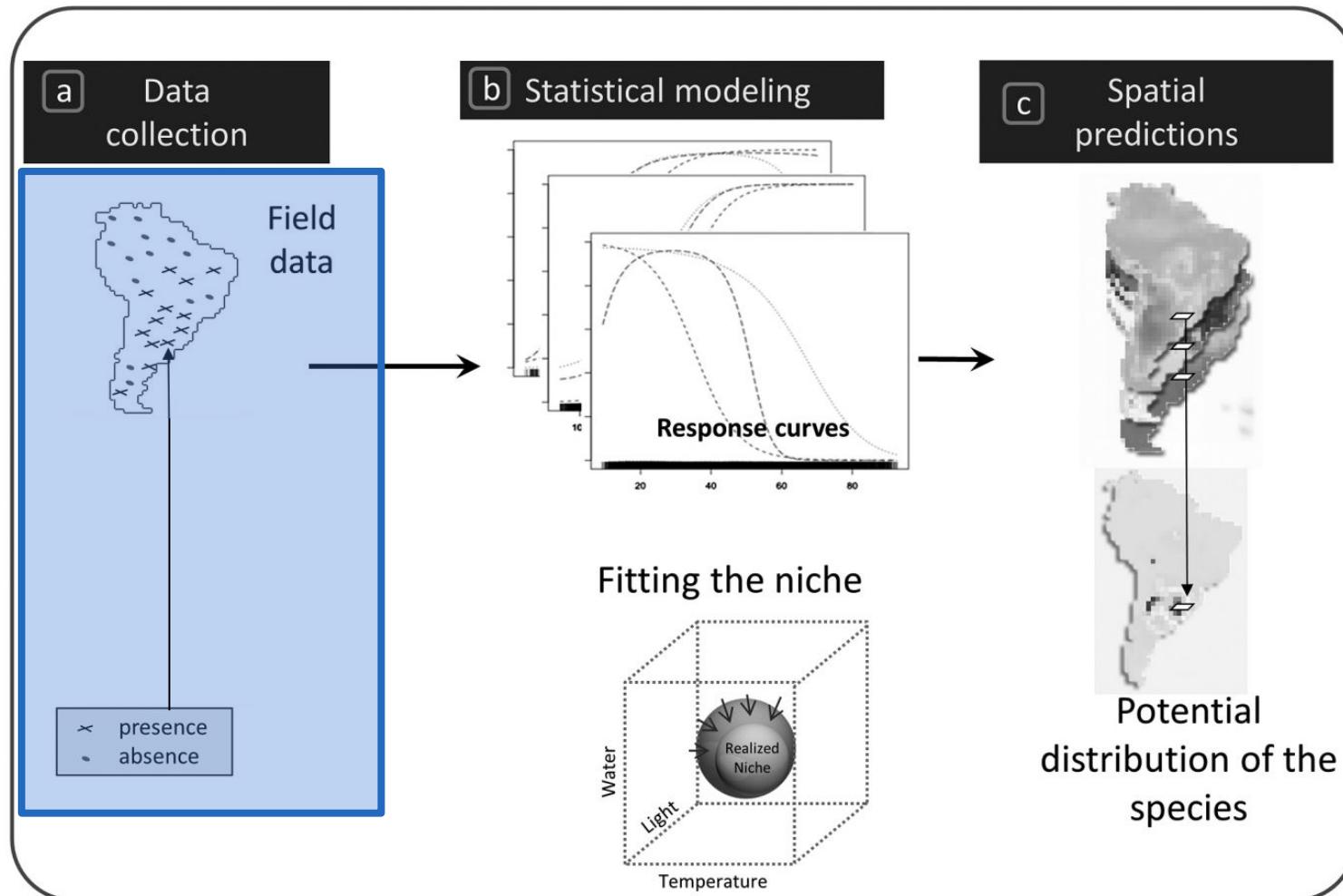
variaveis
temperatura
precipitação
relevo

valores
0
até
1

Ocorrências

2. Preparação dos dados

Ocorrências



Guisan et al. (2017)

2. Preparação dos dados

Fontes

1. Coletas em campo



2. Preparação dos dados

Fontes

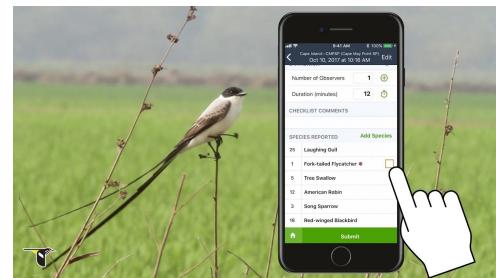
1. Coletas em campo
2. Literatura (artigos, data papers, ...)



2. Preparação dos dados

Fontes

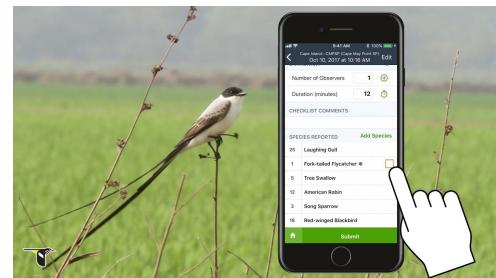
1. Coletas em campo
2. Literatura (artigos, data papers, ...)
3. Naturalistas e ciência cidadã (e-Bird, iNaturalist, ...)



2. Preparação dos dados

Fontes

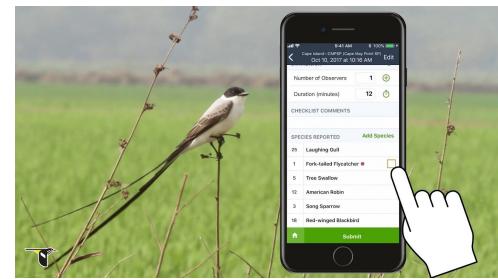
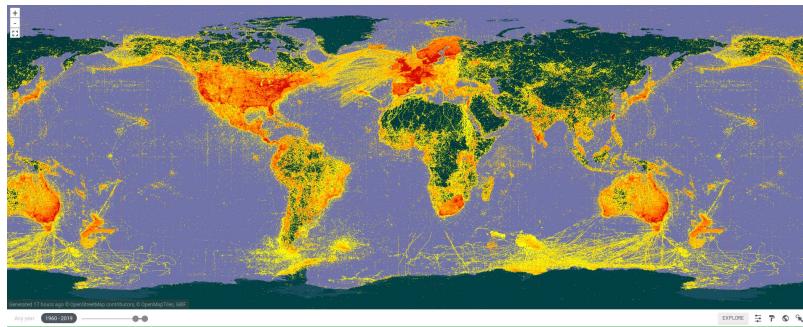
1. Coletas em campo
2. Literatura (artigos, data papers, ...)
3. Naturalistas e ciência cidadã (e-Bird, iNaturalist, ...)
4. Coleções científicas e museus (Museu Nacional, MZUSP, CFBH, ...)



2. Preparação dos dados

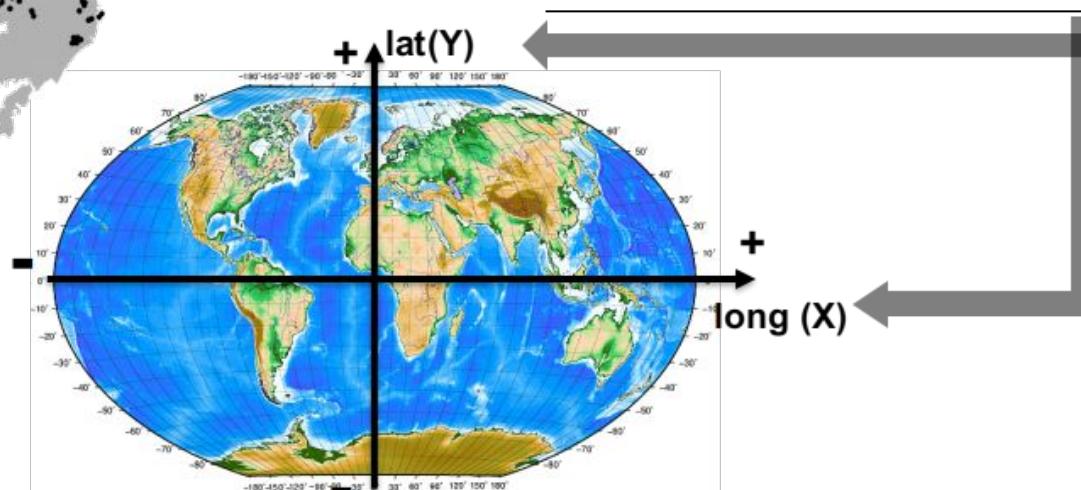
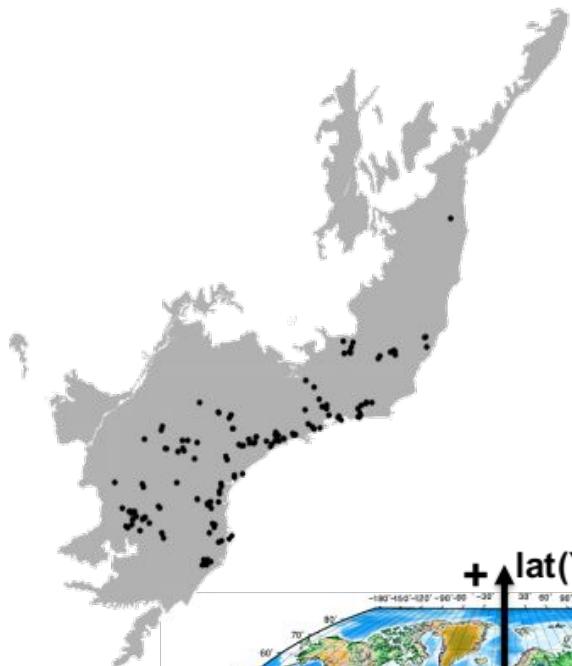
Fontes

1. Coletas em campo
2. Literatura (artigos, data papers, ...)
3. Naturalistas e ciência cidadã (e-Bird, iNaturalist, ...)
4. Coleções científicas e museus (Museu Nacional, MZUSP, CFHB, ...)
5. Banco de dados (GBIF, SpeciesLink, ...)



2. Preparação dos dados

Formato

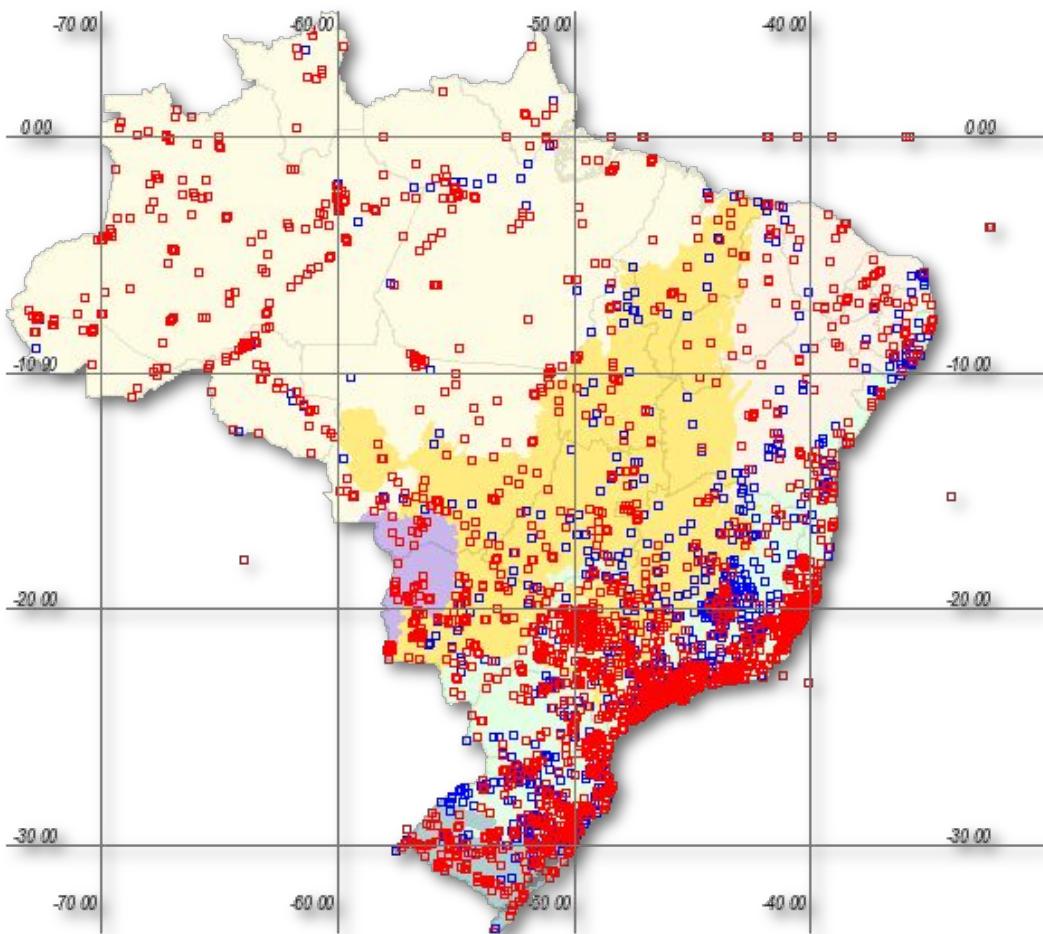


especie	longitude	latitude
<i>haddadus binotatus</i>	-39.858889	-18.716111
<i>haddadus binotatus</i>	-41.184722	-20.603611
<i>haddadus binotatus</i>	-45.069722	-23.430278
<i>haddadus binotatus</i>	-40.071944	-19.391111
<i>haddadus binotatus</i>	-47.549722	-24.700278
<i>haddadus binotatus</i>	-39.280278	-14.785833



2. Preparação dos dados

Viés de amostragem



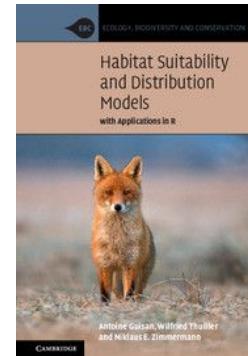
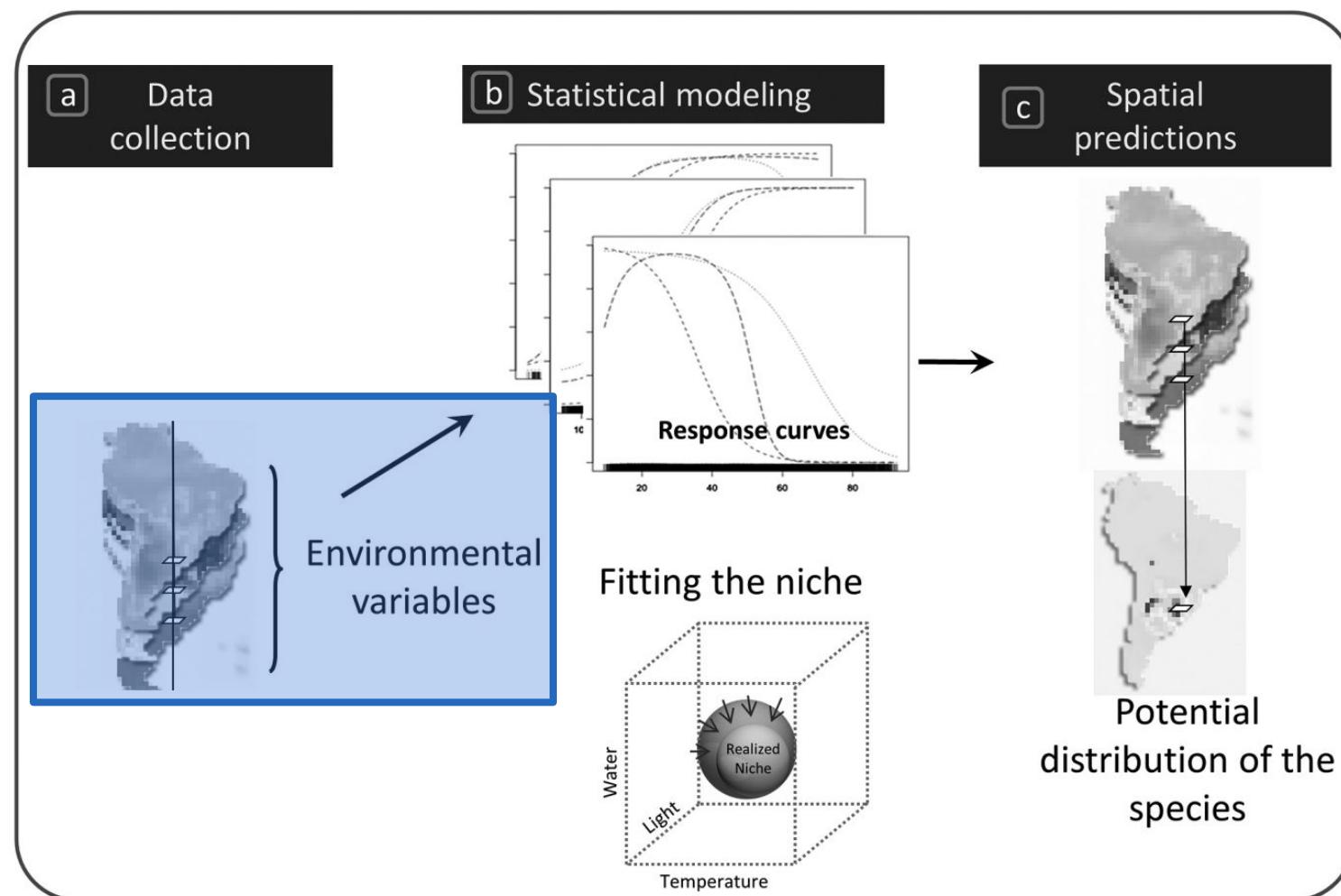
Boana faber

species link

Variáveis ambientais

2. Preparação dos dados

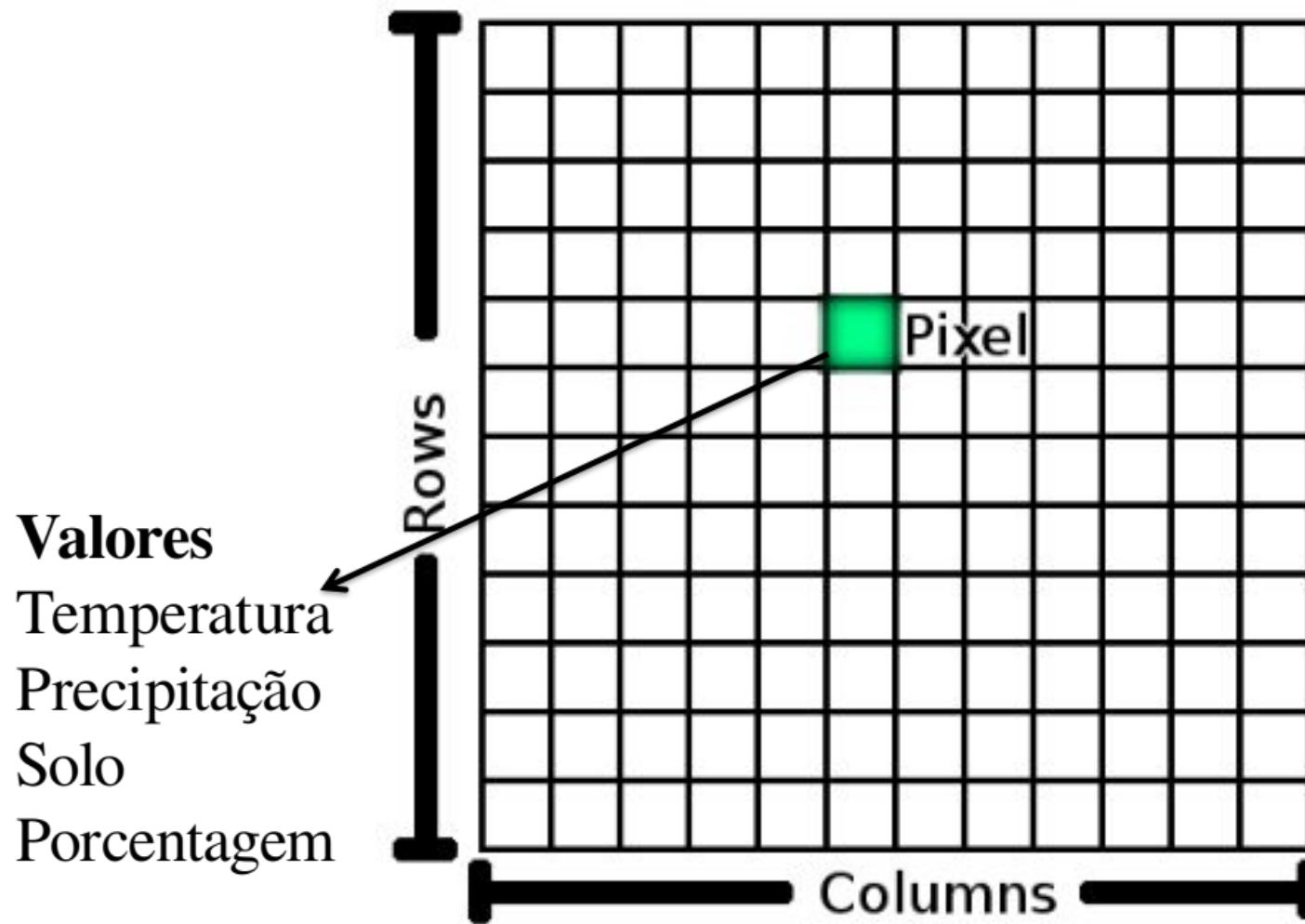
Variáveis



Guisan et al. (2017)

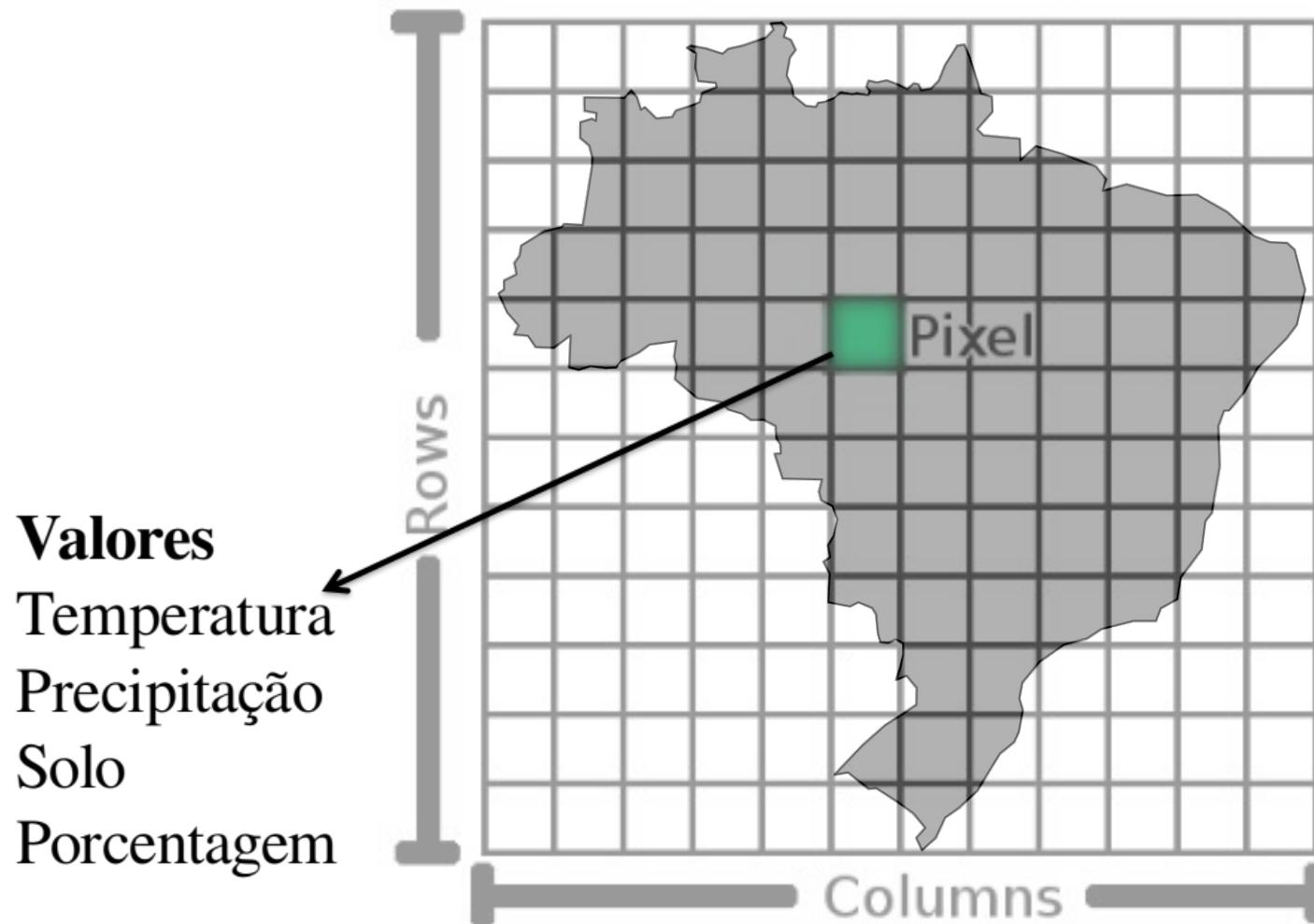
2. Preparação dos dados

Raster - Extensão e resolução



2. Preparação dos dados

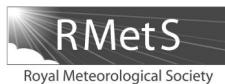
Raster - Extensão e resolução



2. Preparação dos dados

Raster - Interpolação

INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. (2017)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.5086

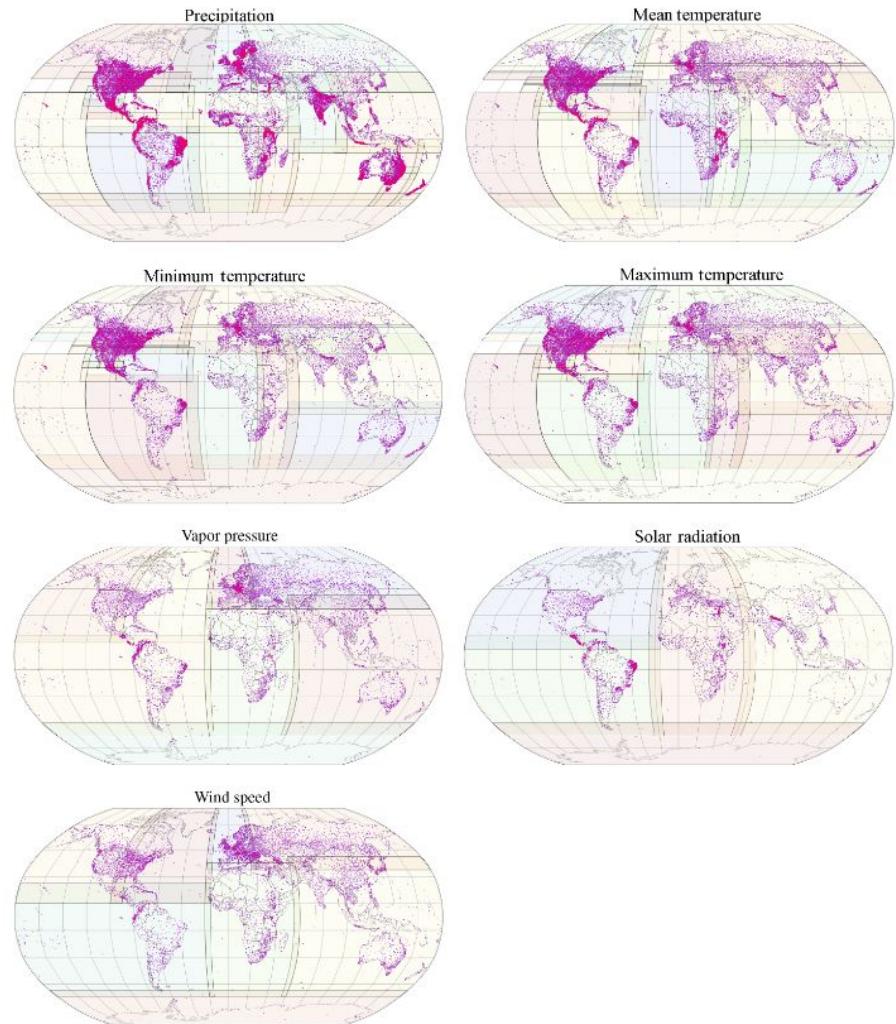
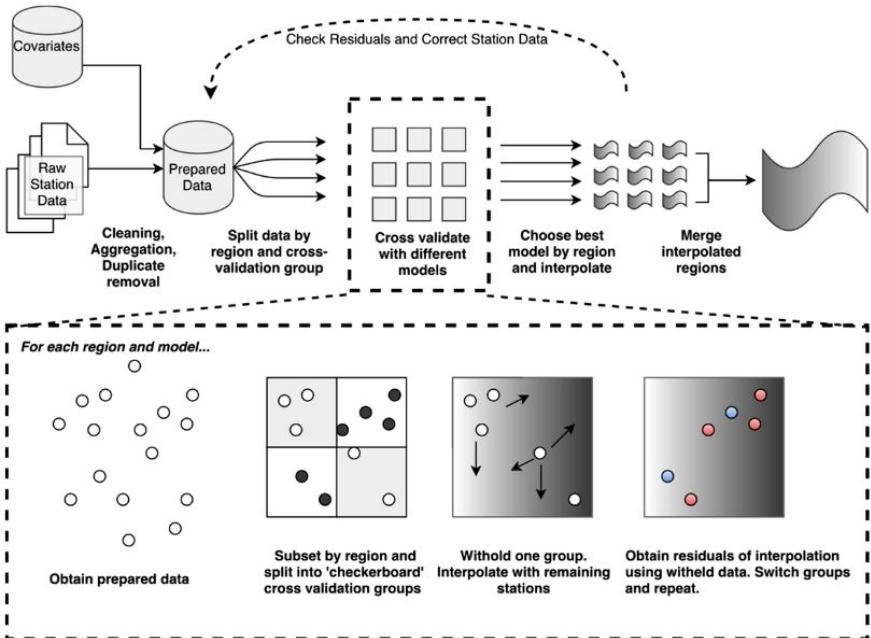


WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas

Stephen E. Fick^{a*} and Robert J. Hijmans^b

^a Department of Plant Sciences, University of California, Davis, CA, USA

^b Department of Environmental Science and Policy, University of California, Davis, CA, USA

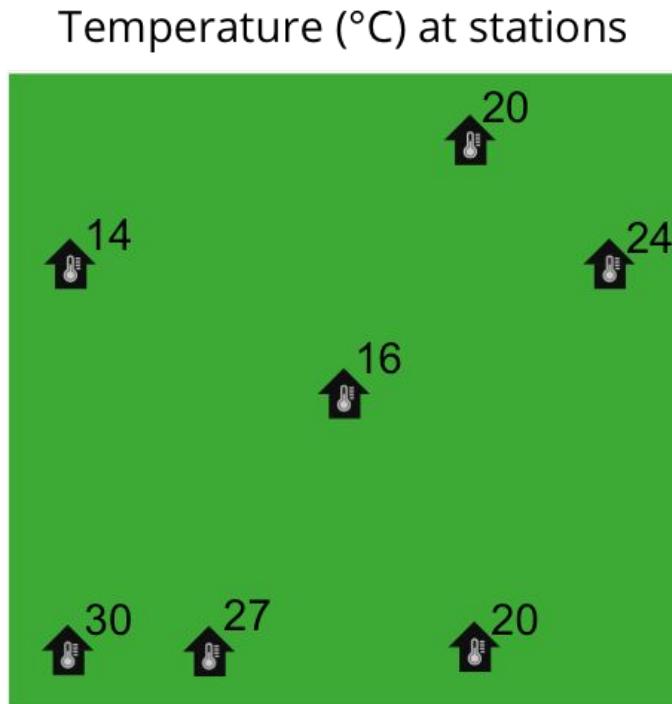


2. Preparação dos dados

Raster - Interpolação



<https://support.bccvl.org.au/support/home>



Temperature ($^{\circ}\text{C}$) interpolated

A 5x5 grid of colored cells representing interpolated temperature values. The colors range from light red (low values) to dark red (high values). Some cells are outlined in green, highlighting specific data points or cells of interest.

13	14	16	20	23
14	14	16	19	24
18	16	16	18	22
24	22	19	19	21
30	27	23	20	20

Adapted from http://planet.botany.uwc.ac.za/nisl/GIS/spatial/chap_1_11.h

2. Preparação dos dados

WorldClim - Bioclimáticas

WorldClim - Global Climate Data
Free climate data for ecological modeling and GIS

Contact

Home

Bioclimatic variables

Bioclimatic variables are derived from the monthly temperature and rainfall values in order to generate more biologically meaningful variables. These are often used in **species distribution modeling** and related ecological modeling techniques. The bioclimatic variables represent annual trends (e.g., mean annual temperature, annual precipitation) seasonality (e.g., annual range in temperature and precipitation) and extreme or limiting environmental factors (e.g., temperature of the coldest and warmest month, and precipitation of the wet and dry quarters). A quarter is a period of three months (1/4 of the year).

They are coded as follows:

BIO1 = Annual Mean Temperature
BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp))
BIO3 = Isothermality (BIO2/BIO7) (* 100)
BIO4 = Temperature Seasonality (standard deviation *100)
BIO5 = Max Temperature of Warmest Month
BIO6 = Min Temperature of Coldest Month
BIO7 = Temperature Annual Range (BIO5-BIO6)
BIO8 = Mean Temperature of Wettest Quarter
BIO9 = Mean Temperature of Driest Quarter
BIO10 = Mean Temperature of Warmest Quarter
BIO11 = Mean Temperature of Coldest Quarter
BIO12 = Annual Precipitation
BIO13 = Precipitation of Wettest Month
BIO14 = Precipitation of Driest Month
BIO15 = Precipitation Seasonality (Coefficient of Variation)
BIO16 = Precipitation of Wettest Quarter
BIO17 = Precipitation of Driest Quarter
BIO18 = Precipitation of Warmest Quarter
BIO19 = Precipitation of Coldest Quarter

BIO01 = Temperatura média anual
BIO02 = Variação Diurna Média de Temperatura (Média mensal (Tmax-Tmin))
BIO03 = Isothermalidade ((BIO2/BIO7) (* 100))
BIO04 = Sazonalidade da Temperatura (desvio padrão * 100)
BIO05 = Temperatura máxima do mês mais quente
BIO06 = Temperatura mínima do mês mais frio
BIO07 = Amplitude térmica anual (BIO5-BIO6)
BIO08 = Temperatura média do trimestre mais úmido
BIO09 = Temperatura média do trimestre mais seco
BIO10 = Temperatura média do trimestre mais quente
BIO11 = Temperatura média do trimestre mais frio

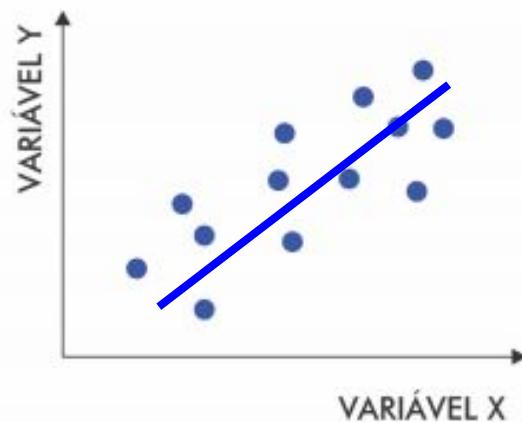
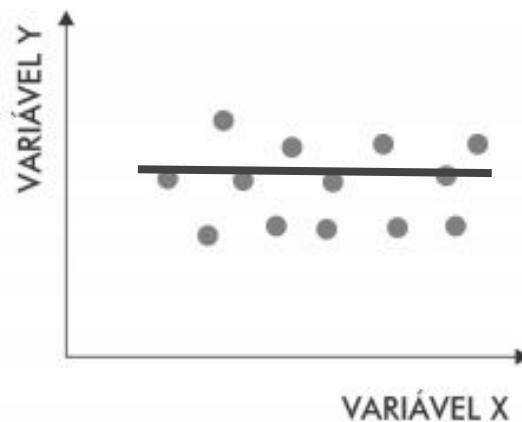
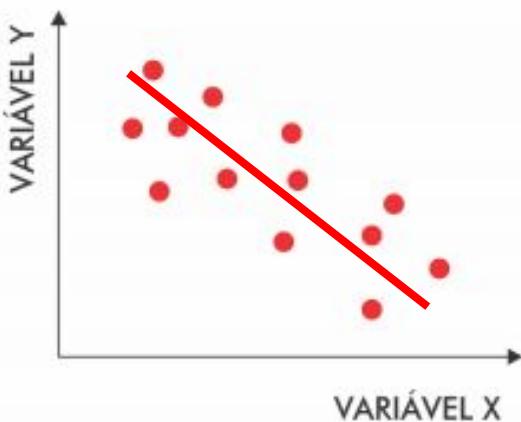
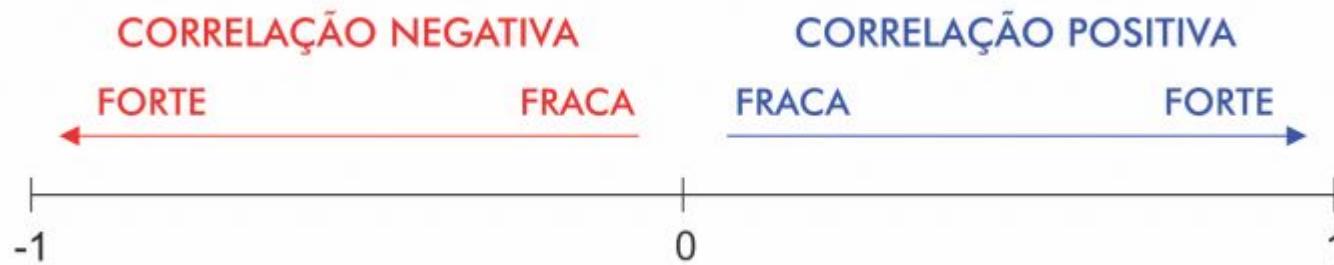
Temperatura

BIO12 = Precipitação Anual
BIO13 = Precipitação do mês mais chuvoso
BIO14 = Precipitação do mês mais seco
BIO15 = Sazonalidade da Precipitação (coeficiente de variação)
BIO16 = Precipitação do trimestre mais chuvoso
BIO17 = Precipitação do trimestre mais seco
BIO18 = Precipitação do trimestre mais quente
BIO19 = Precipitação do trimestre mais frio

Precipitação

2. Preparação dos dados

Colinearidade - Correlação

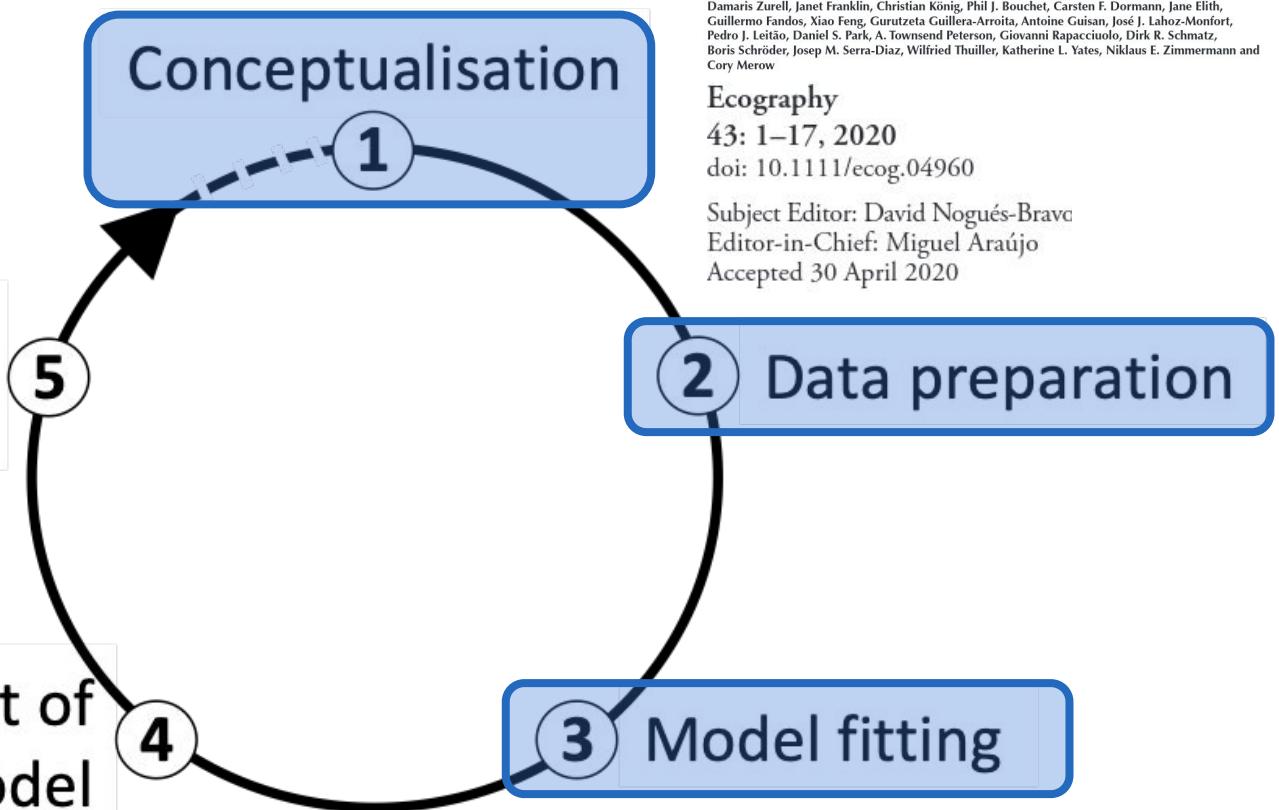


SDM passo a passo

Passos de construção dos SDMs

Predictions in space and time

Assessment of model



ECOGRAPHY

Review and synthesis

A standard protocol for reporting species distribution models

Damaris Zurell, Janet Franklin, Christian König, Phil J. Bouchet, Carsten F. Dormann, Jane Elith, Guillermo Fandos, Xiao Feng, Gurutzeta Guillera-Arroita, Antoine Guisan, José J. Lahoz-Monfort, Pedro J. Leitão, Daniel S. Park, A. Townsend Peterson, Giovanni Rapacciuolo, Dirk R. Schmaltz, Boris Schröder, Josep M. Serra-Díaz, Wilfried Thuiller, Katherine L. Yates, Niklaus E. Zimmermann and Cory Merow

Ecography

43: 1–17, 2020

doi: 10.1111/ecog.04960

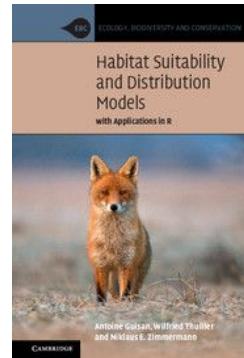
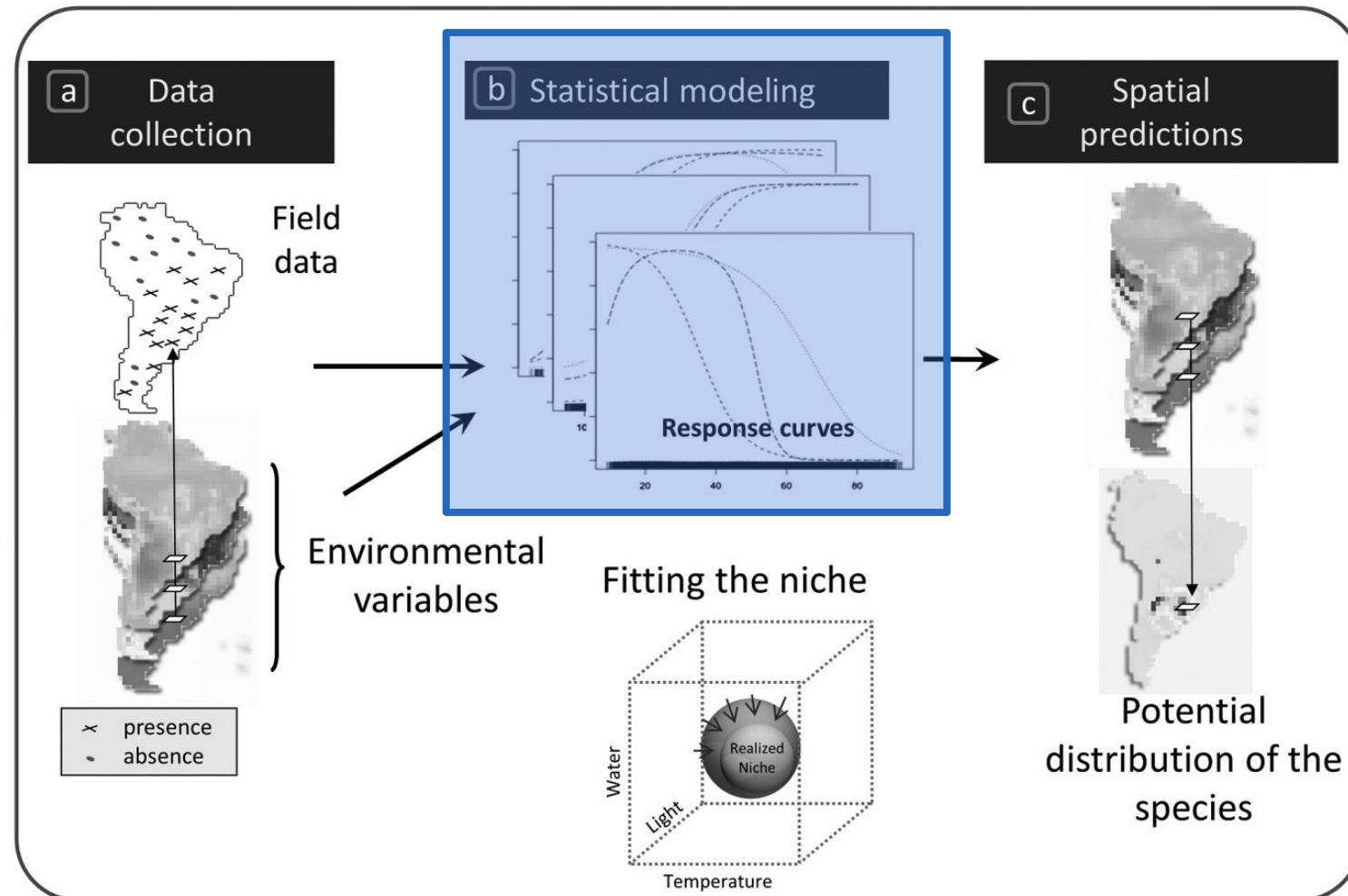
Subject Editor: David Nogués-Bravo

Editor-in-Chief: Miguel Araújo

Accepted 30 April 2020

3. Ajuste dos modelos

Algoritmos estimam o nicho realizado



Guisan et al. (2017)

Ajuste dos modelos

Muitos tipos de algoritmos



Lima-Ribeiro &
Diniz-Filho (2013)

Apenas presença

Bioclim
Dist. Euclidiana
Dist. Mahalanobis
Domain (dist. Gower)
ENFA (ecological niche factor analysis)

Aquário

Presença/Background

GARP (genetic algorithm for rule-set production)
Maxent (maximum entropy)
SVM (support vector machine)

Aprendizado de Máquina
(*machine learning*)
“cofre”

Presença/Ausência

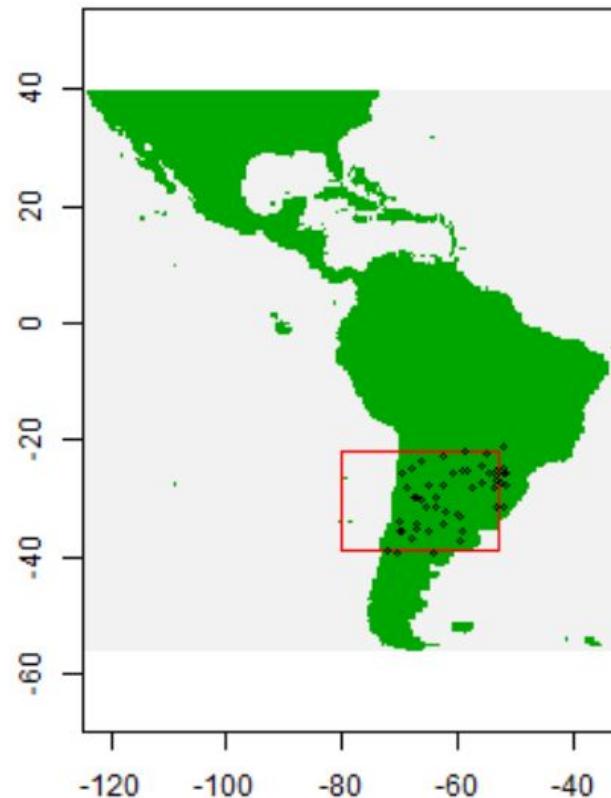
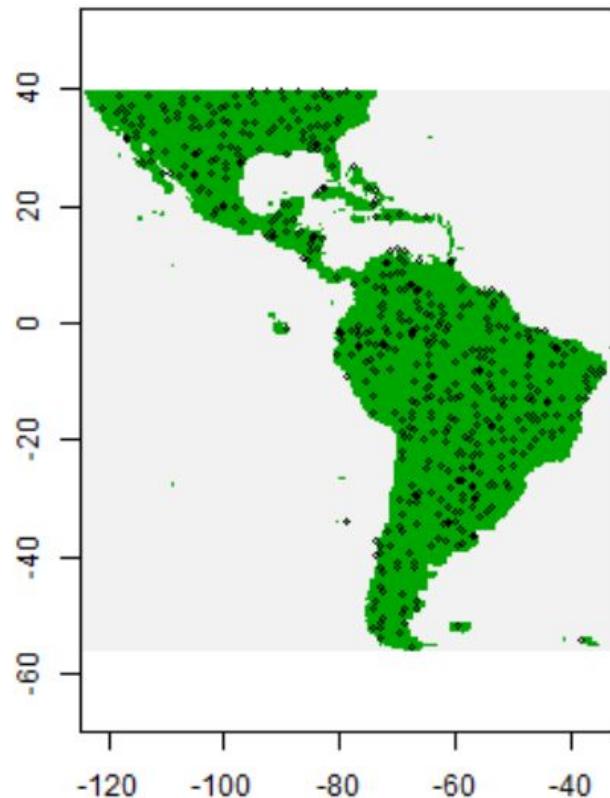
Estatístico (“turbina”)
GLMz (generalized linear model)
GAM (generalized additive model)
FDA (flexible discriminant analysis)
MARS (multivariate adaptive reg. splines)

BRT (boosted regression trees)
→ GBM (gradient boosting machine)
CART (classification and regression trees)
RDNFOR (random forest)
NNET (neural networks)
→ ANN (artificial neural networks)

3. Ajuste dos modelos

Pseudo-ausência

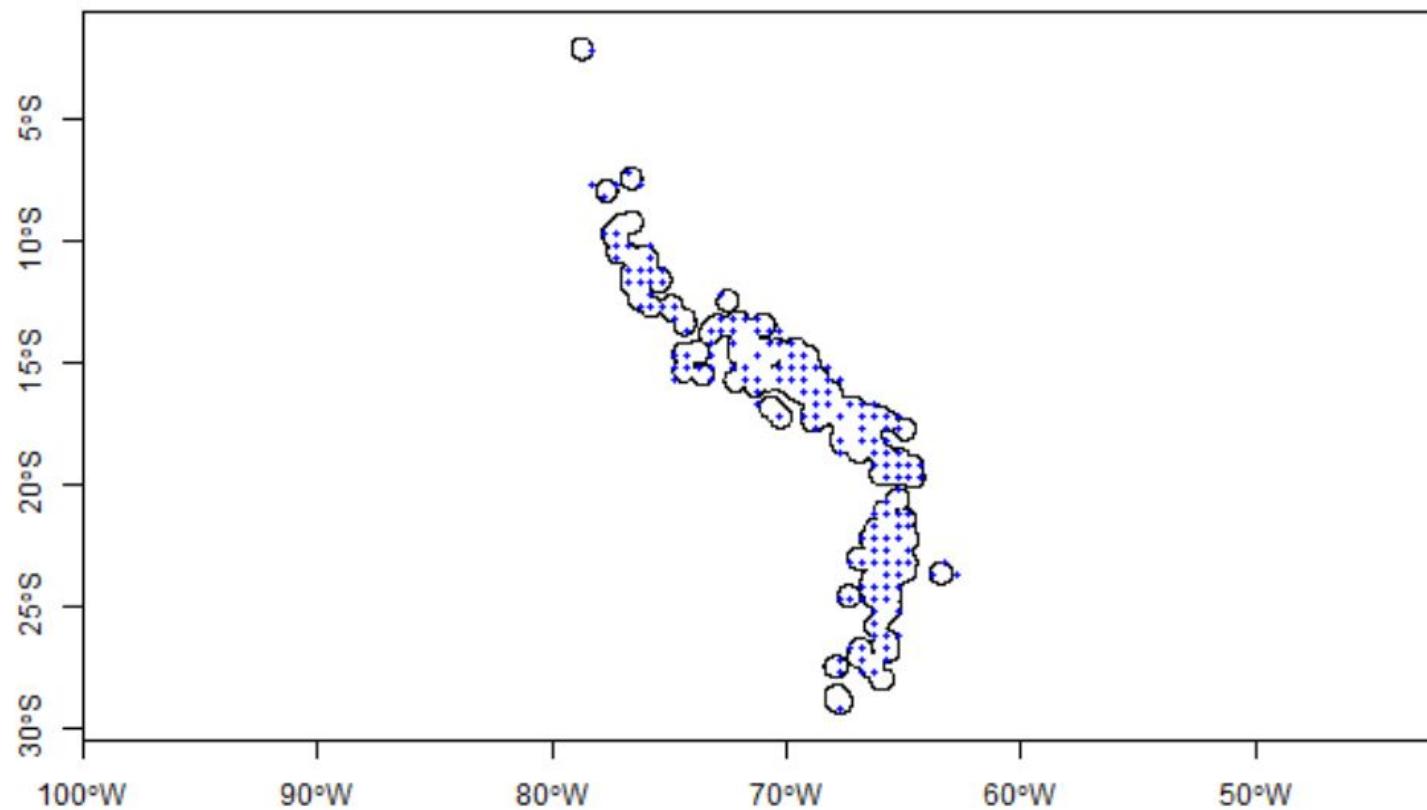
Sorteio de **pontos aleatórios** (sem **padrão espacial**) para serem considerados como **ausência verdadeira**



3. Ajuste dos modelos

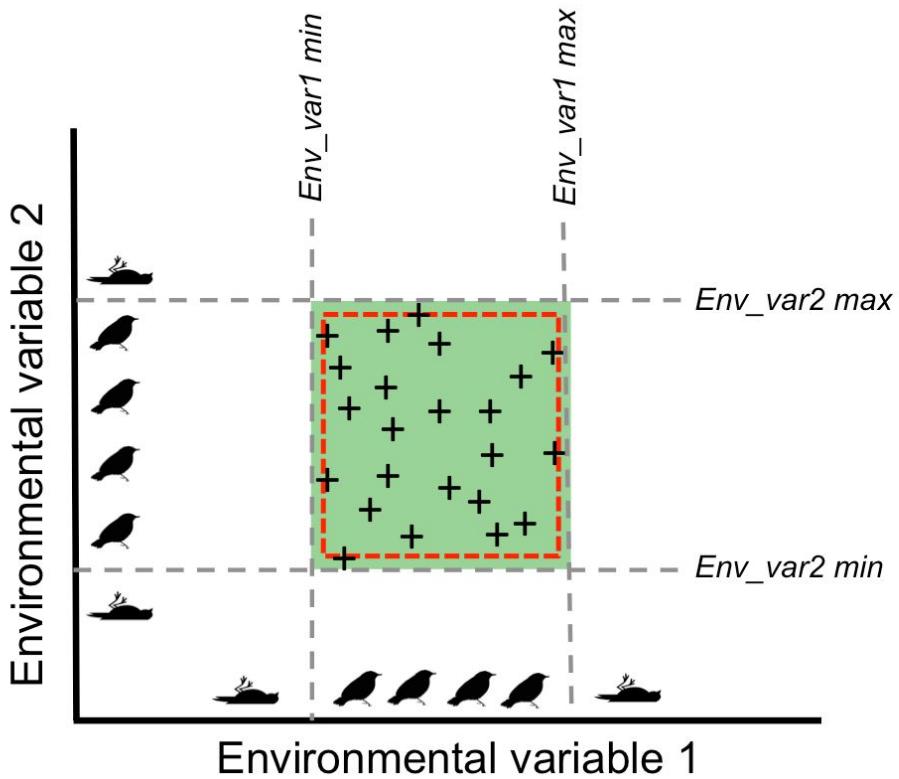
Pseudo-ausência

Sorteio de **pontos aleatórios** (com **padrão espacial**) para serem considerados como **ausência verdadeira**

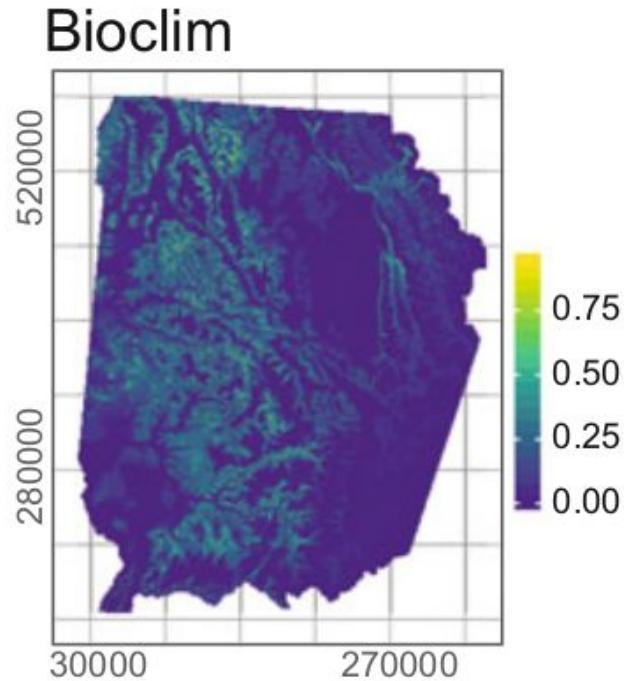


3. Ajuste dos modelos

BIOCLIM - Envelope Climático



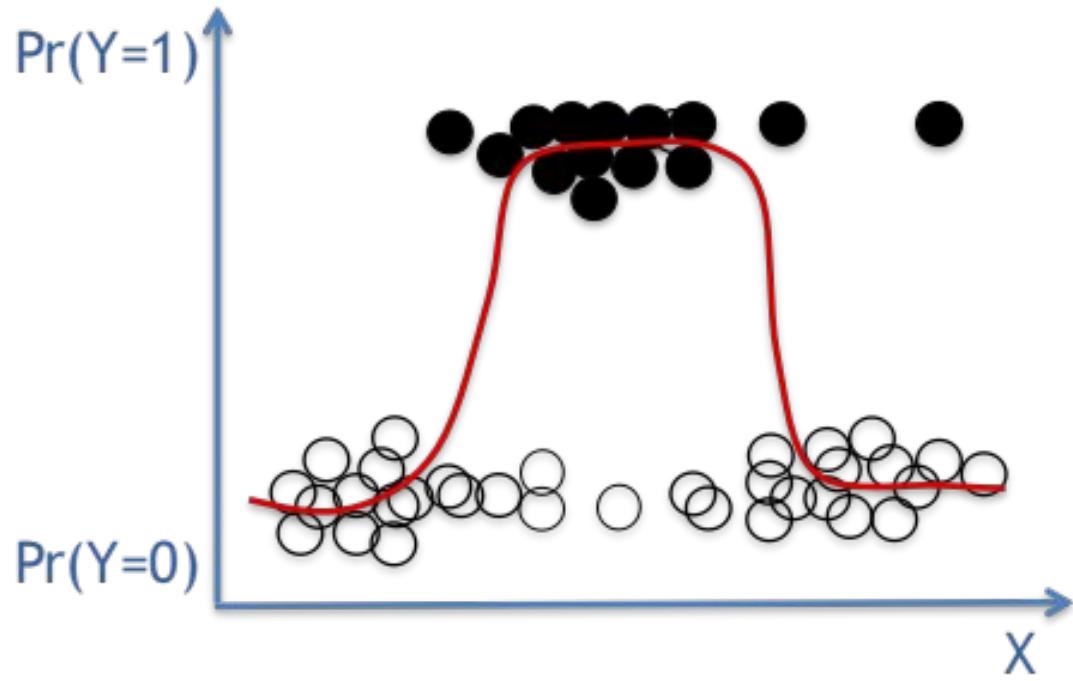
Lima-Ribeiro &
Diniz-Filho (2013)



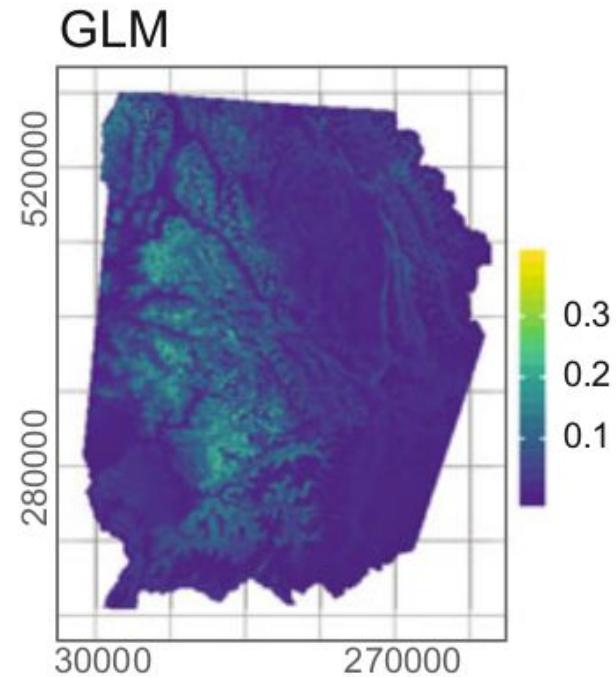
3. Ajuste dos modelos

Generalized Linear Models (GLM)

$$y = \frac{e^{ax+b}}{1 + e^{ax+b}}$$



Lima-Ribeiro &
Diniz-Filho (2013)

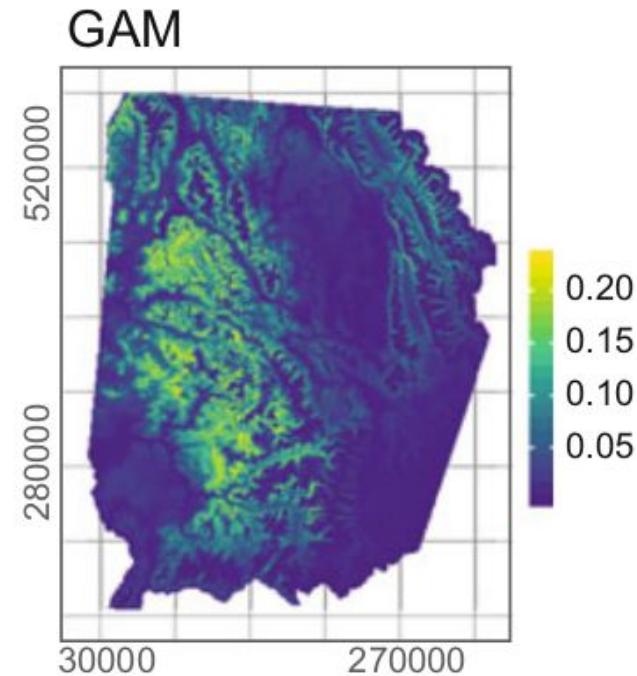
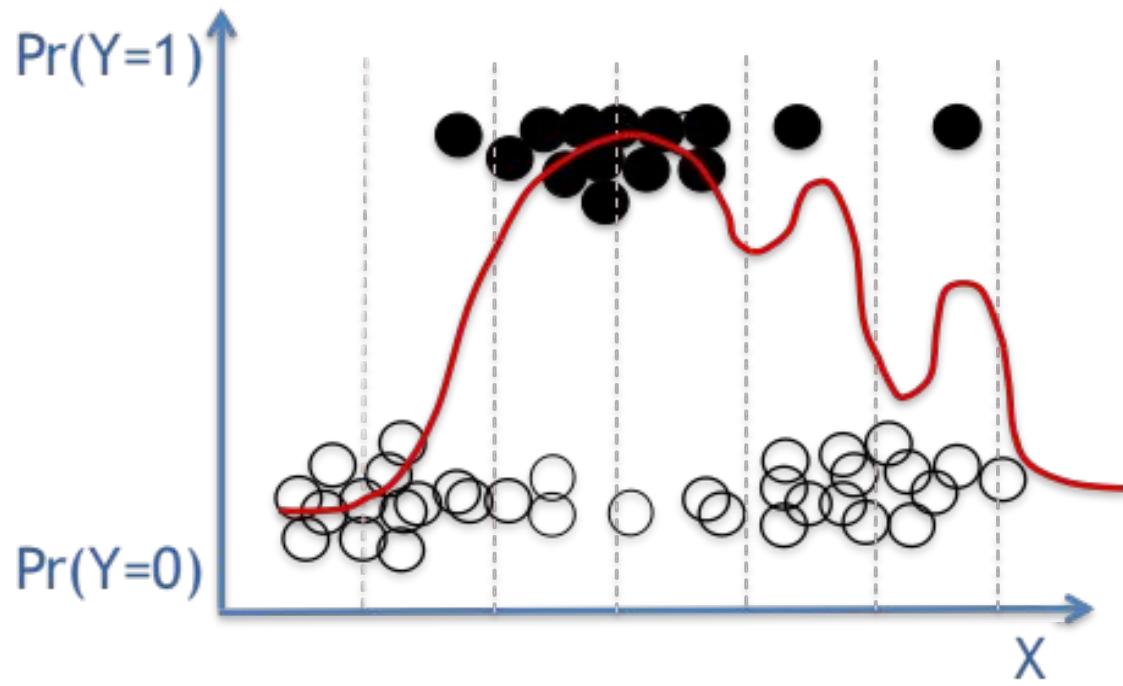


3. Ajuste dos modelos

Generalized Linear Models (GLM)

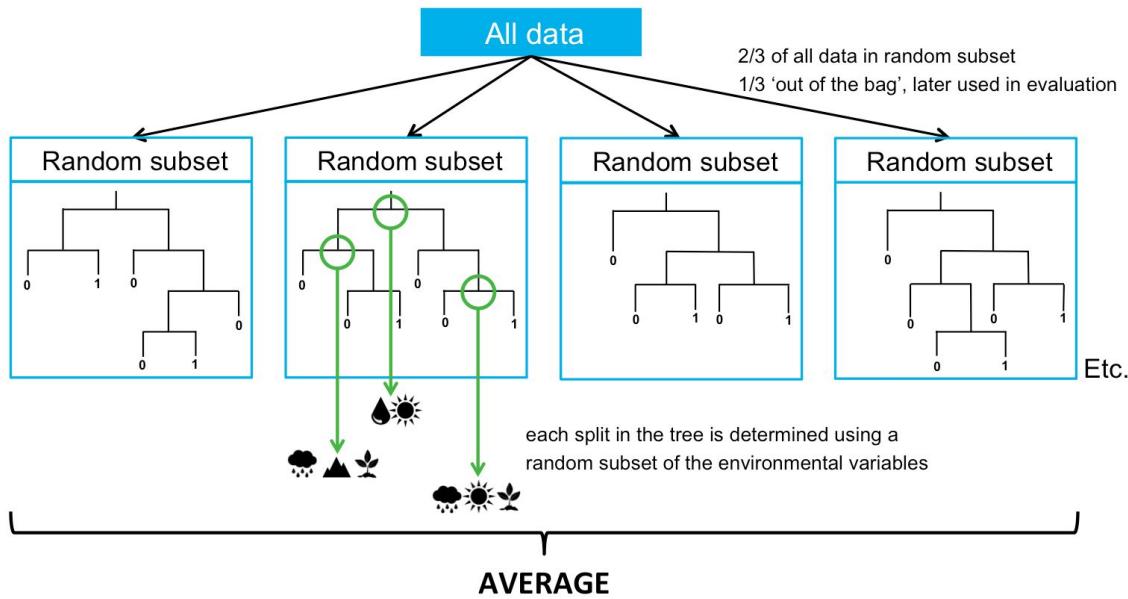
$$g(\mu_i) = \alpha + \beta_1 x_i + \beta_2 x_i^2 + \beta_3 x_i^3 + \dots + \beta_n x_i^n$$

Lima-Ribeiro &
Diniz-Filho (2013)



3. Ajuste dos modelos

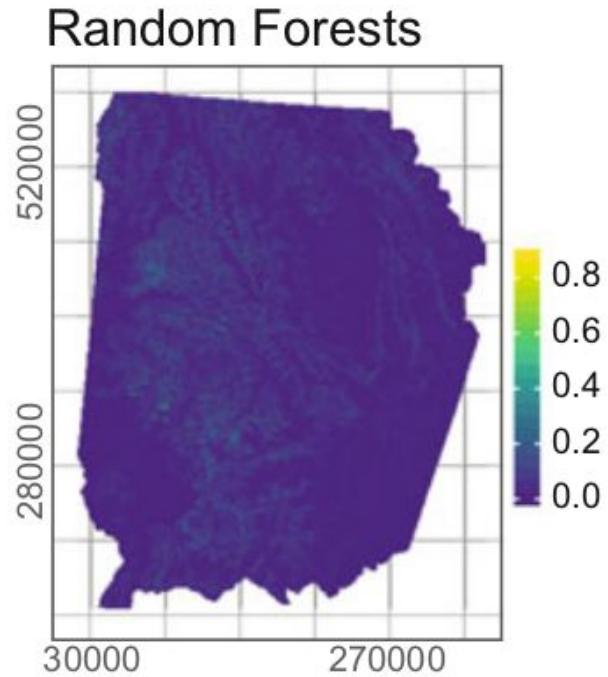
Random Forest



> find the set of predictor variables that produce the strongest classification model



Lima-Ribeiro &
Diniz-Filho (2013)



3. Ajuste dos modelos

Maximum Entropy (MaxEnt)

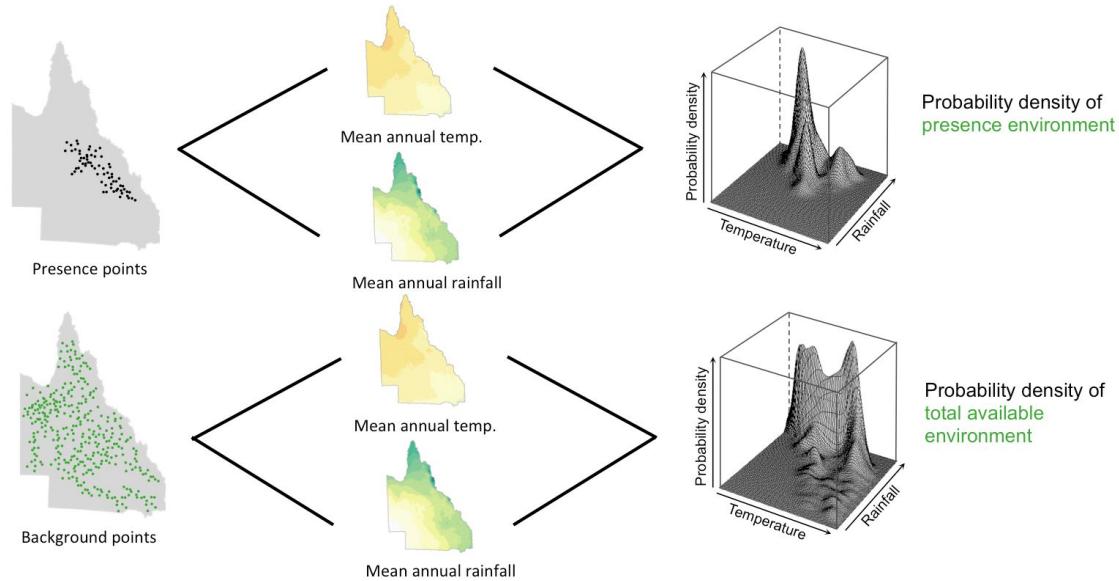


Software note | Free Access |

Opening the black box: an open-source release of Maxent

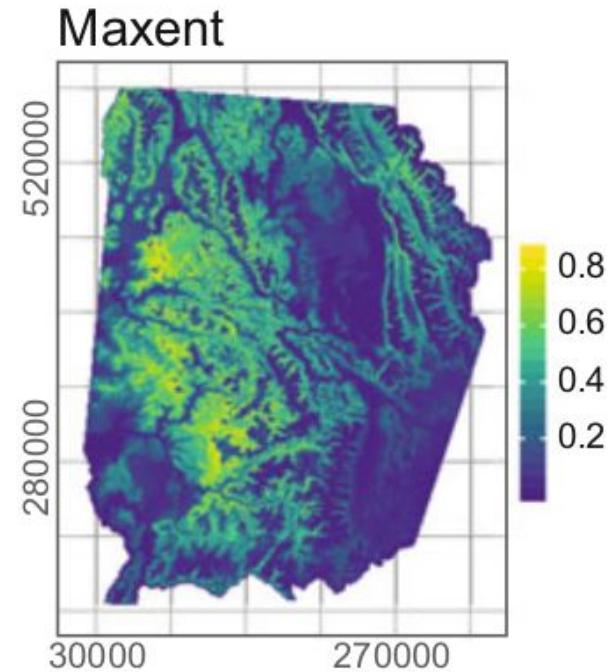
Steven J. Phillips , Robert P. Anderson, Miroslav Dudík, Robert E. Schapire, Mary E. Blair

First published: 21 March 2017 | <https://doi.org/10.1111/ecog.03049> | Citations: 419



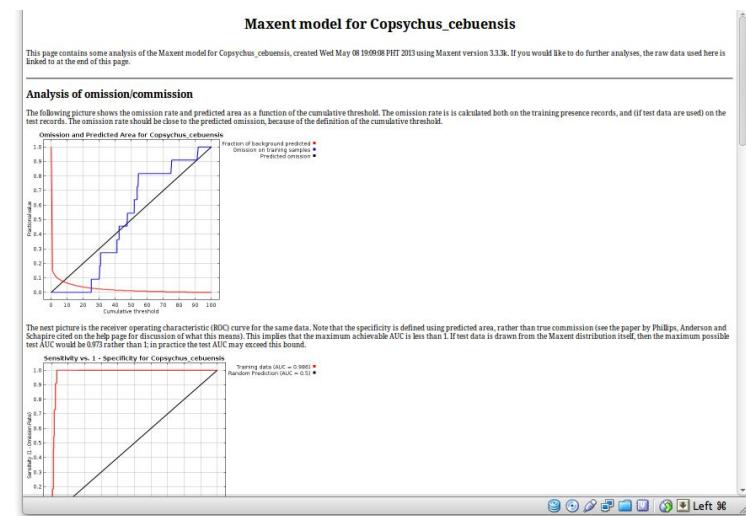
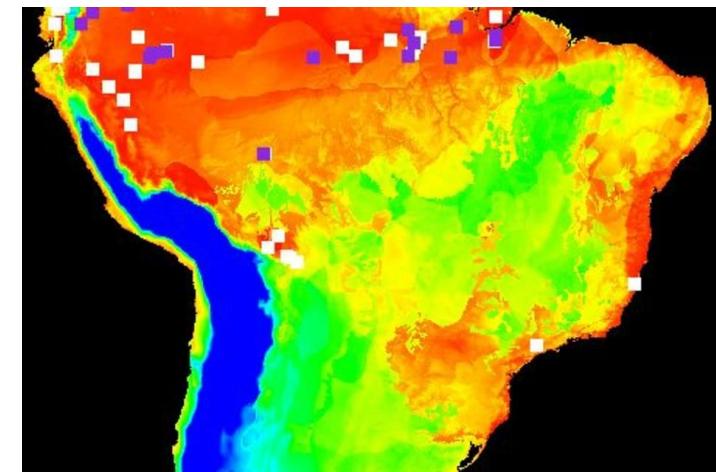
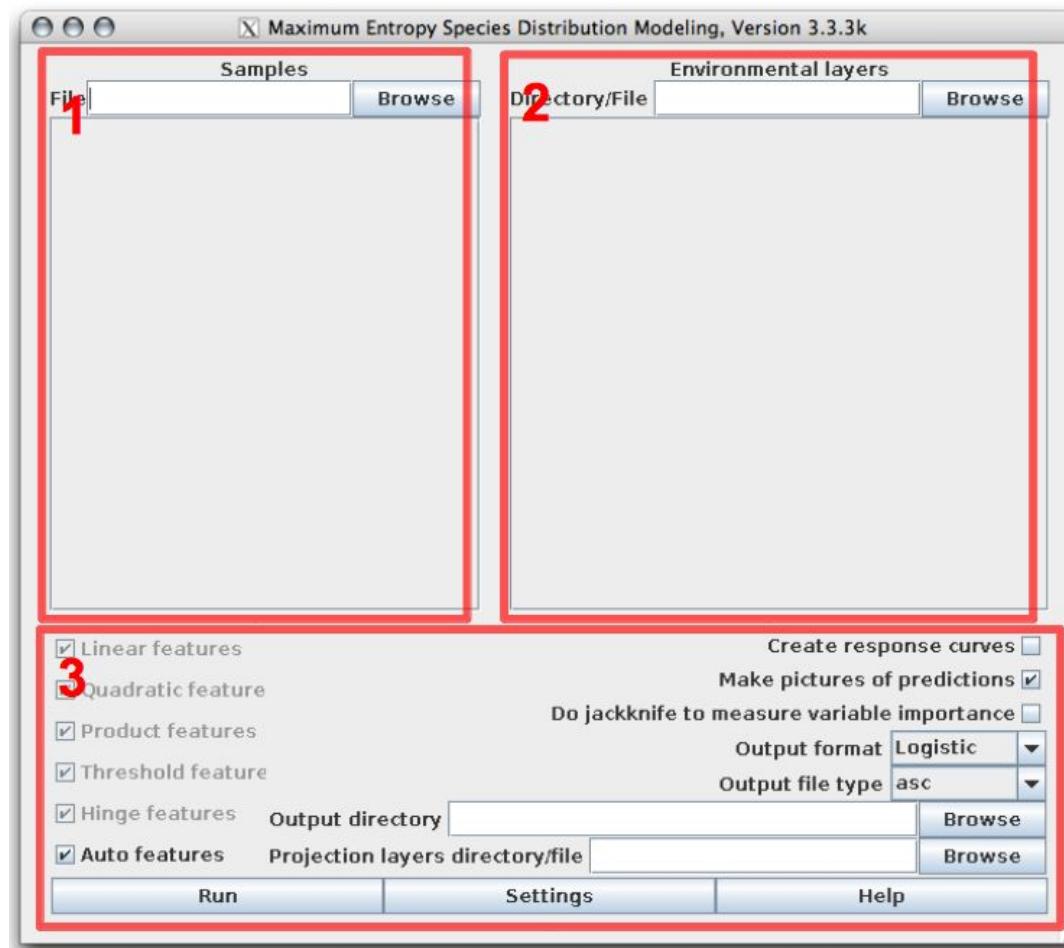
Adapted from Elith et al. (2011) *A statistical explanation of MaxEnt for ecologists*. Diversity and Distributions, 17, 43-57.

Lima-Ribeiro & Diniz-Filho (2013)



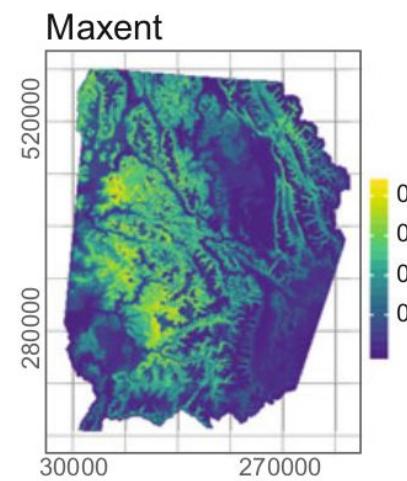
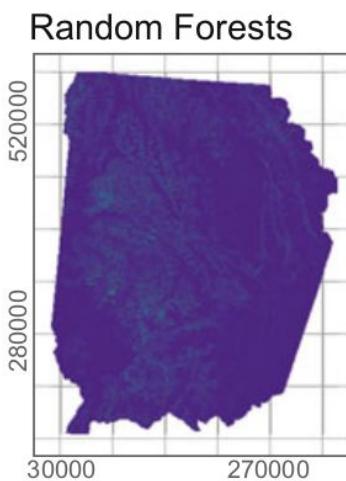
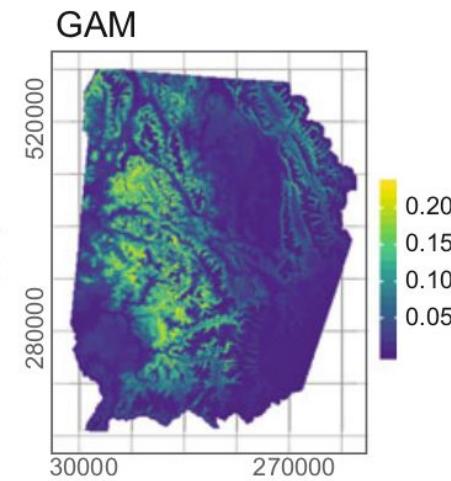
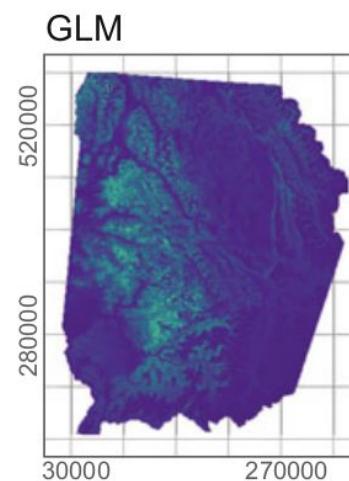
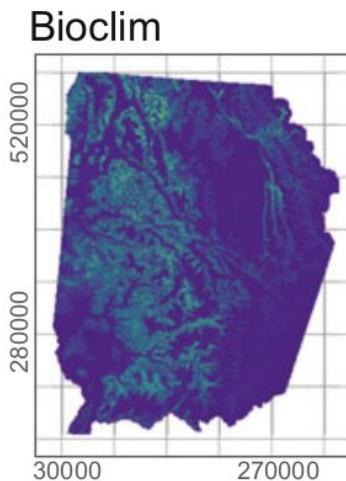
3. Ajuste dos modelos

Maximum Entropy (MaxEnt)



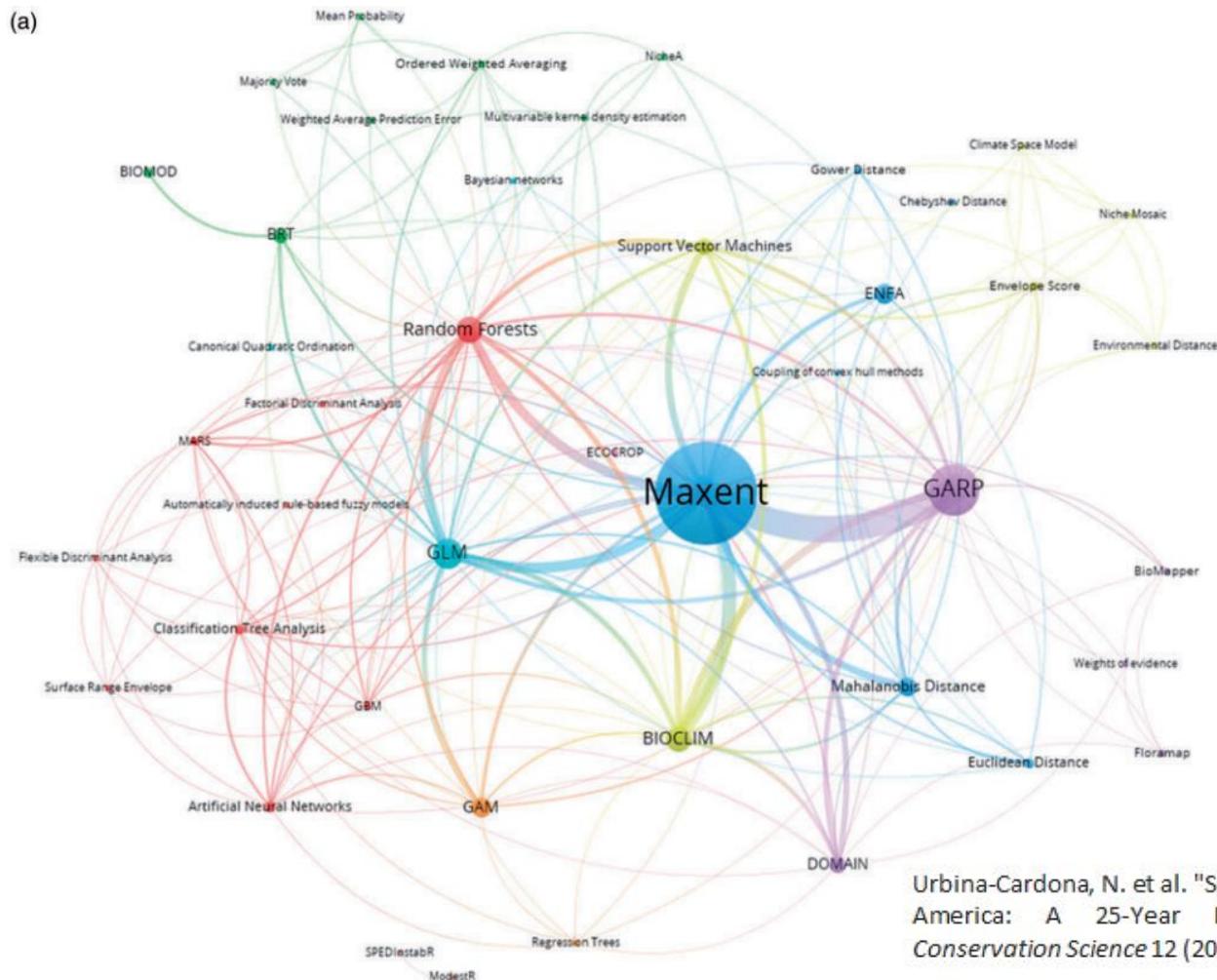
3. Ajuste dos modelos

Qual algoritmo usar?



3. Ajuste dos modelos

Melhor e mais utilizado algoritmo (MaxEnt)



Urbina-Cardona, N. et al. "Species Distribution Modeling in Latin America: A 25-Year Retrospective Review." *Tropical Conservation Science* 12 (2019).

3. Ajuste dos modelos

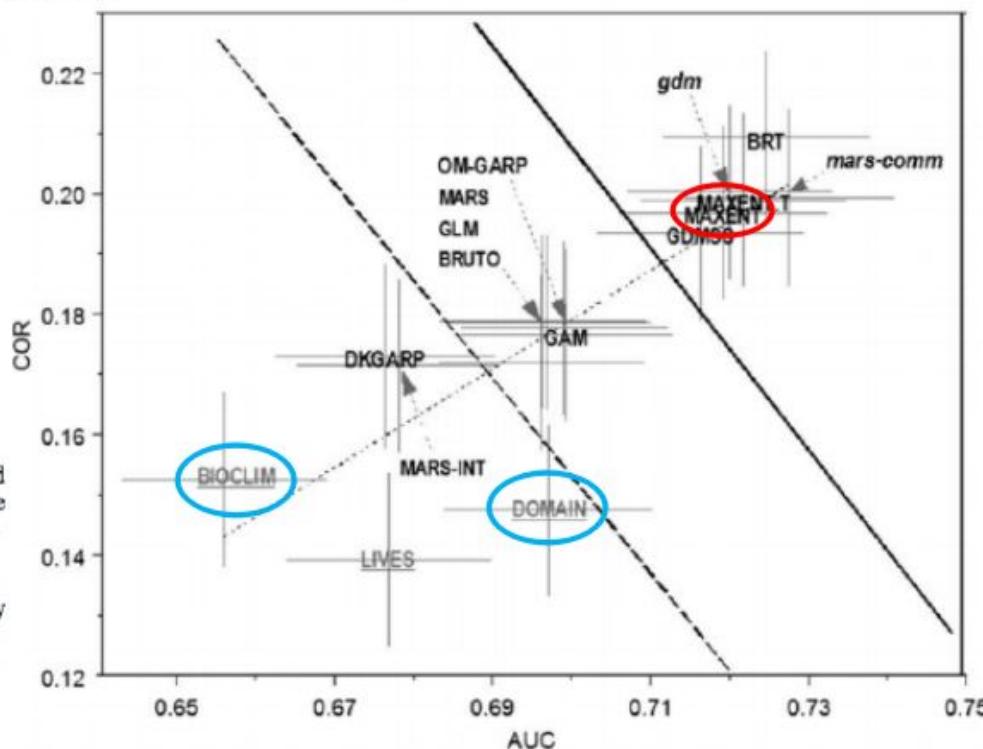
Melhor e mais utilizado algoritmo (MaxEnt)

Novel methods improve prediction of species' distributions from occurrence data

Jane Elith*, Catherine H. Graham*, Robert P. Anderson, Miroslav Dudík, Simon Ferrier, Antoine Guisan, Robert J. Hijmans, Falk Huettmann, John R. Leathwick, Anthony Lehmann, Jin Li, Lucia G. Lohmann, Bette A. Loiselle, Glenn Manion, Craig Moritz, Miguel Nakamura, Yoshinori Nakazawa, Jacob McC. Overton, A. Townsend Peterson, Steven J. Phillips, Karen Richardson, Ricardo Scachetti-Pereira, Robert E. Schapire, Jorge Soberón, Stephen Williams, Mary S. Wisz and Niklaus E. Zimmermann

ECOGRAPHY 29: 129–151, 2006

Fig. 3. Mean AUC vs mean correlation (COR) for modelling methods, summarised across all species. The grey bars are standard errors estimated in the GLMM (see Appendix), reflecting variation for an average species in an average region. The labels are broad classifications of the methods: grey underlined = only use presence data, black capitals = use presence and background samples, black lower case italics = community methods.



3. Ajuste dos modelos

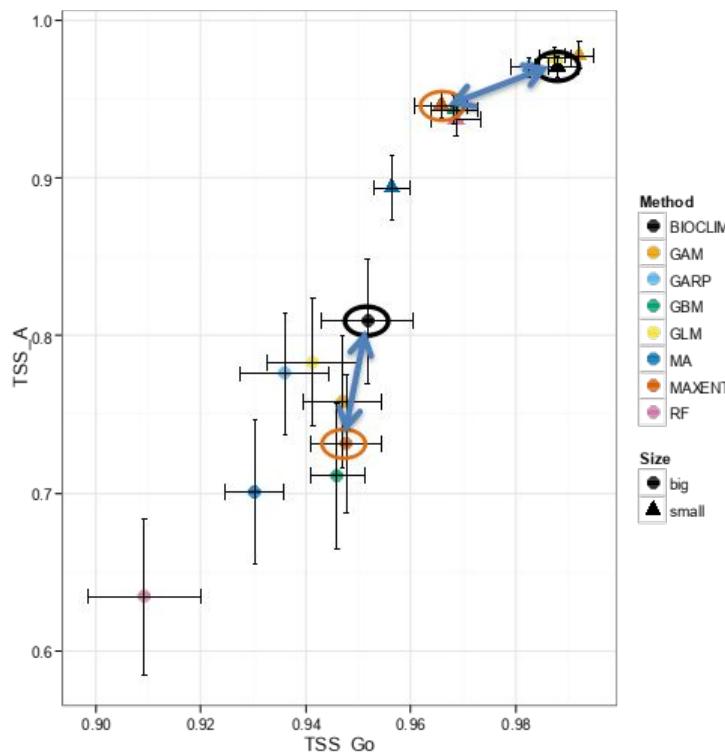
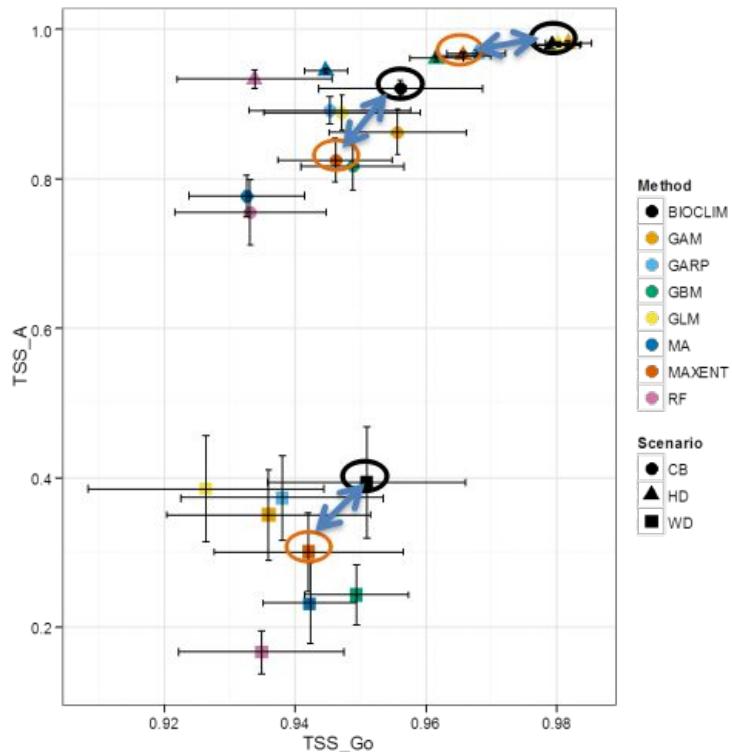
Consenso (*Ensemble*)

Methods in Ecology and Evolution 

Research Article |  Free Access

No silver bullets in correlative ecological niche modelling:
insights from testing among many potential algorithms
for niche estimation

Huijie Qiao, Jorge Soberón, Andrew Townsend Peterson 



3. Ajuste dos modelos

Consenso (*Ensemble*)

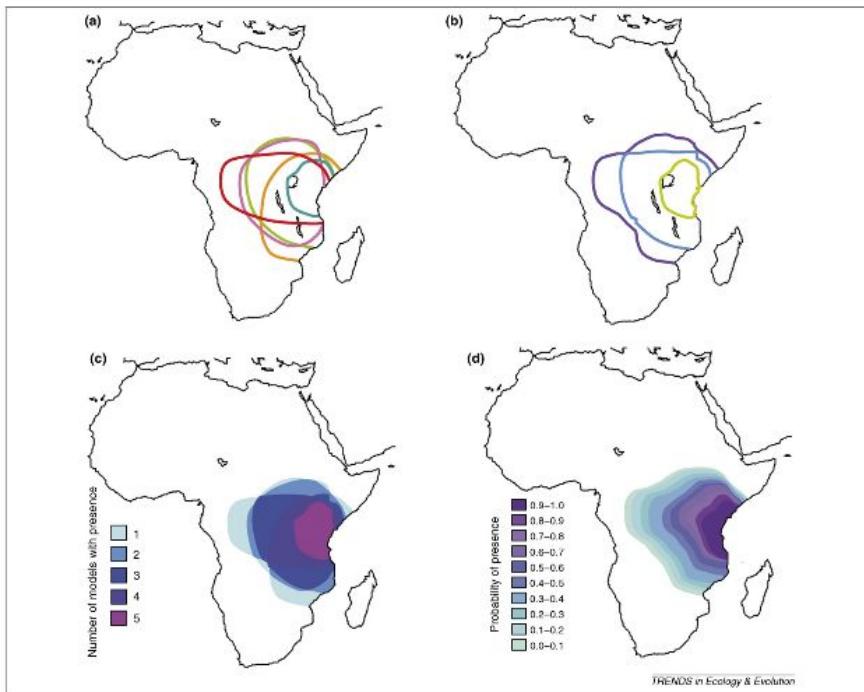


Review

TRENDS in Ecology and Evolution Vol.22 No.1

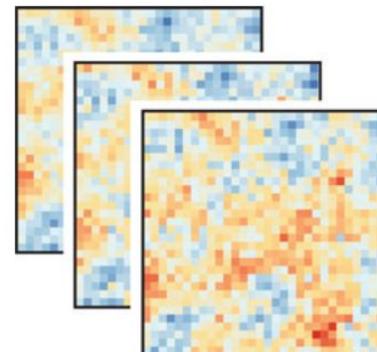
Ensemble forecasting of species distributions

Miguel B. Araújo¹ and Mark New²



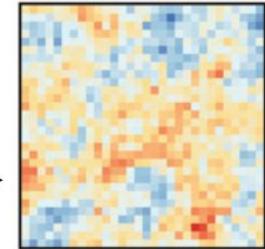
Models of species distributions

Probabilistic representations



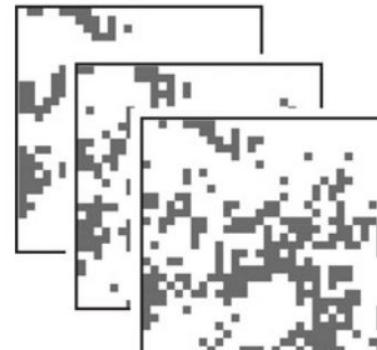
Ensembles

Weighted mean



Frequency

Binary representations

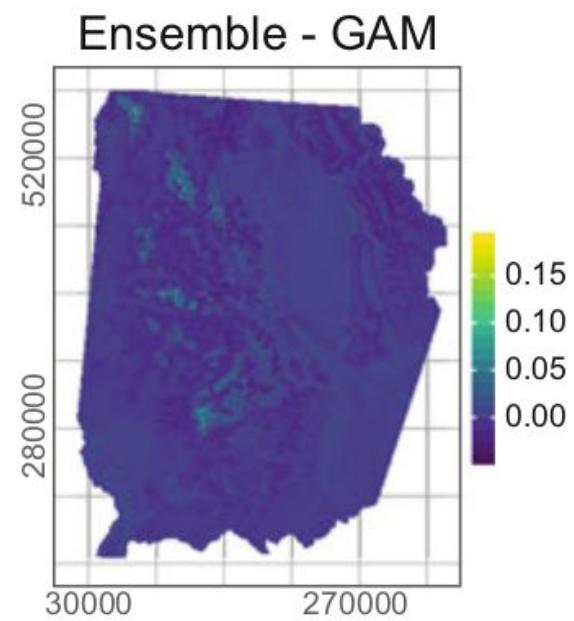
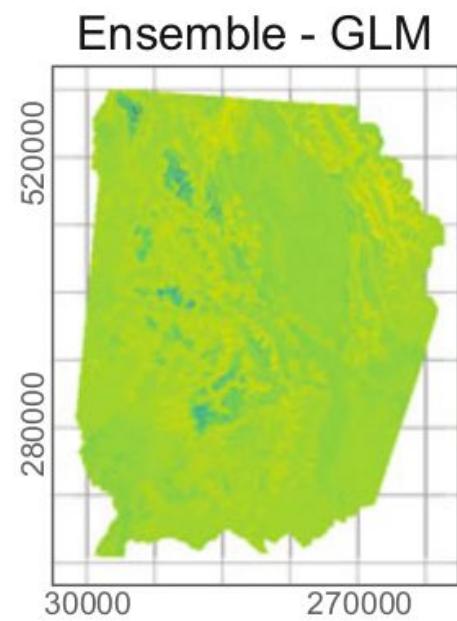
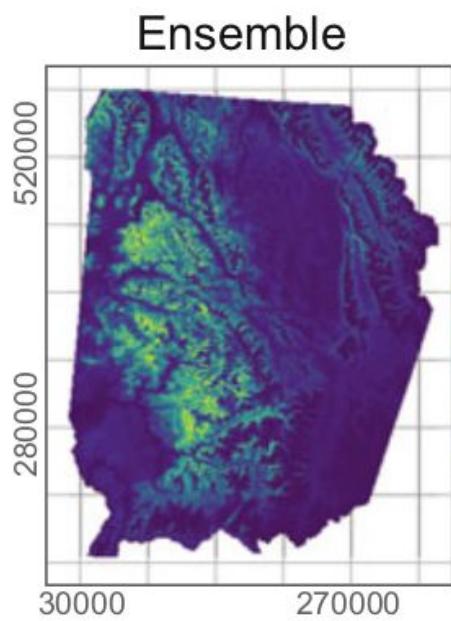


Bounded box



3. Ajuste dos modelos

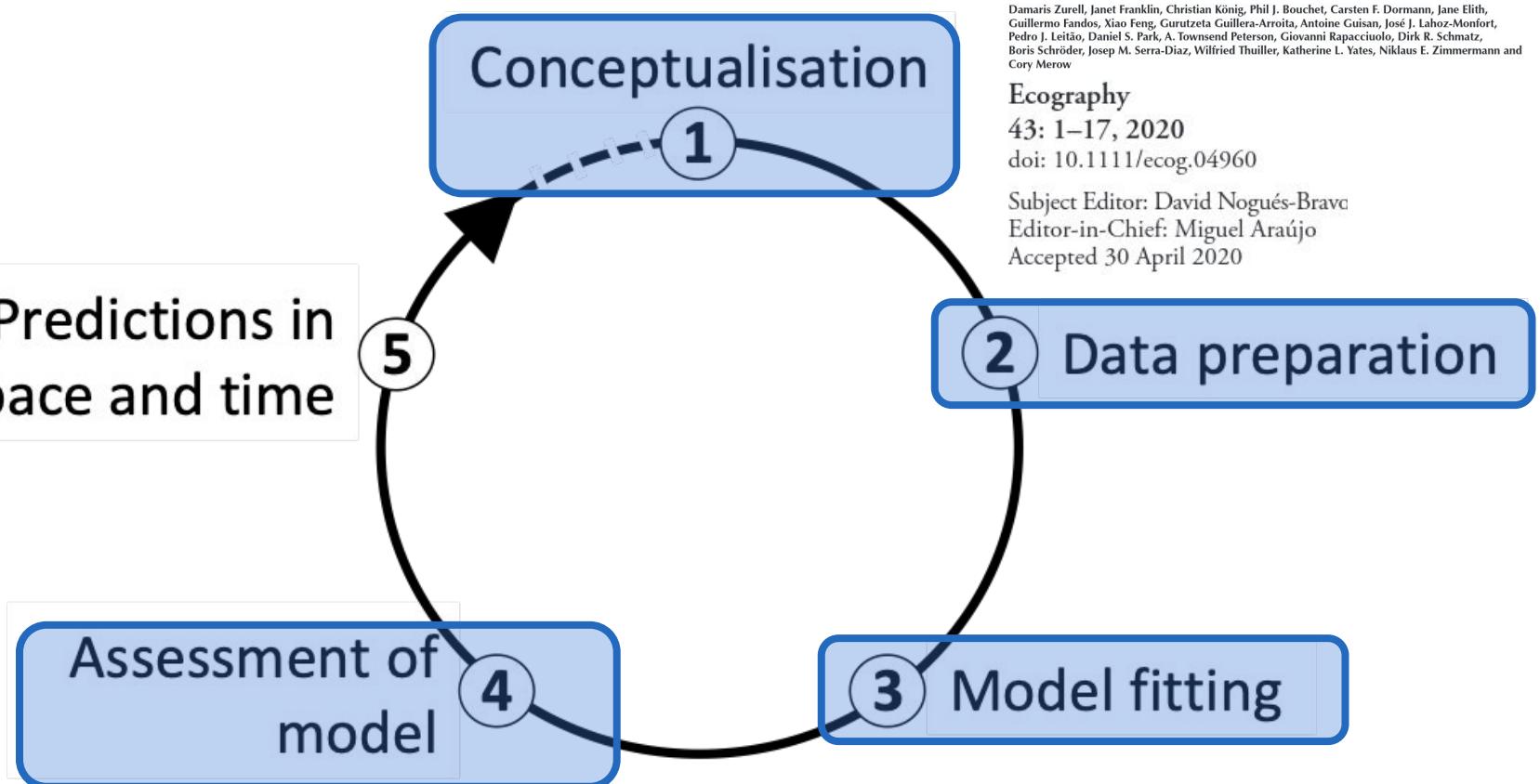
Consenso (*Ensemble*)



SDM passo a passo

Passos de construção dos SDMs

Predictions in space and time



ECOGRAPHY

Review and synthesis

A standard protocol for reporting species distribution models

Damaris Zurell, Janet Franklin, Christian König, Phil J. Bouchet, Carsten F. Dormann, Jane Elith, Guillermo Fandos, Xiao Feng, Gurutzeta Guillera-Arroita, Antoine Guisan, José J. Lahoz-Monfort, Pedro J. Leitão, Daniel S. Park, A. Townsend Peterson, Giovanni Rapacciuolo, Dirk R. Schmaltz, Boris Schröder, Josep M. Serra-Díaz, Wilfried Thuiller, Katherine L. Yates, Niklaus E. Zimmermann and Cory Merow

Ecography

43: 1–17, 2020

doi: 10.1111/ecog.04960

Subject Editor: David Nogués-Bravo

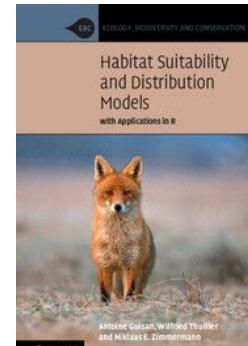
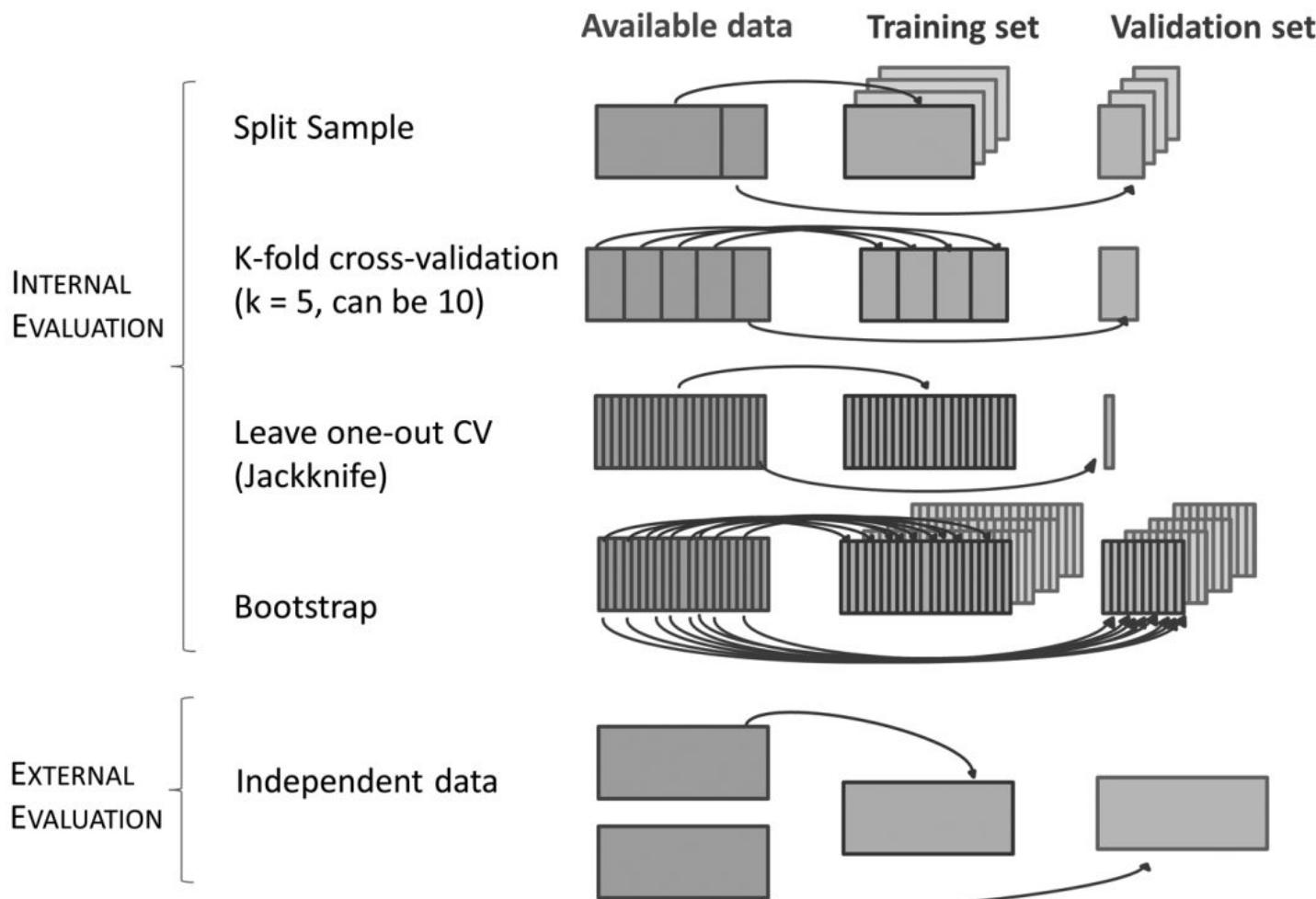
Editor-in-Chief: Miguel Araújo

Accepted 30 April 2020

Como saber se meu modelo se
aproxima da realidade?

4. Avaliação dos modelos

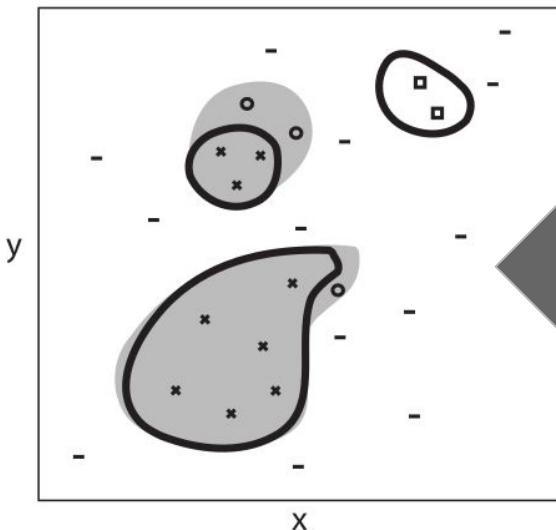
Tipos de avaliação



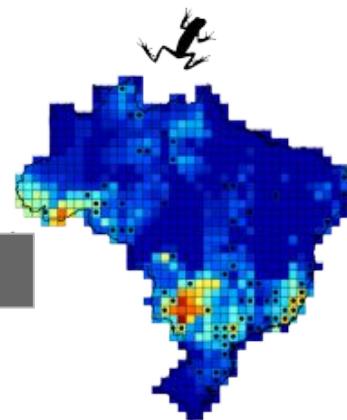
Guisan et al. (2017)

4. Avaliação dos modelos

Como saber se o modelo acerta a realidade?



- Occupied distributional area, G_O
- Areas predicted by an ecological niche model
 - ✗ True positive
 - True negative
 - False negative
 - False positive

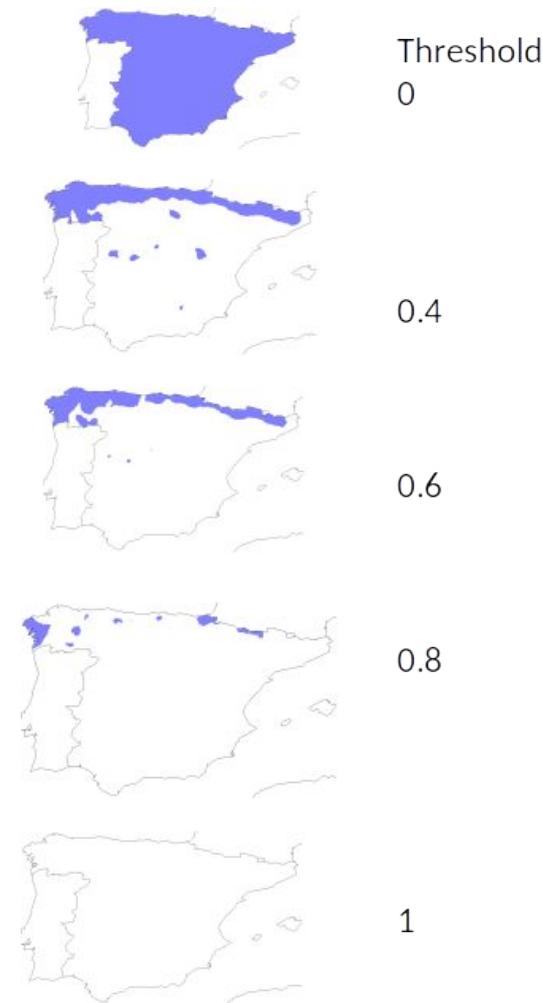
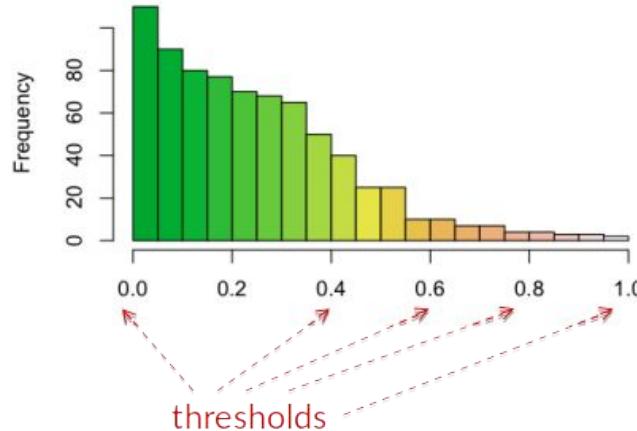
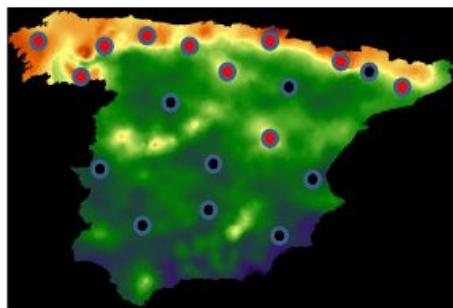


Adequabilidade

valores
0
até
1

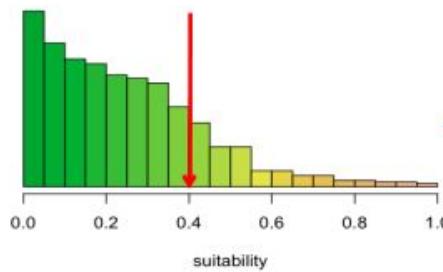
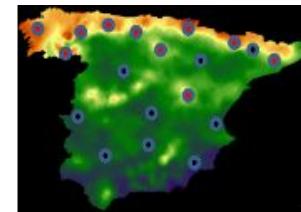
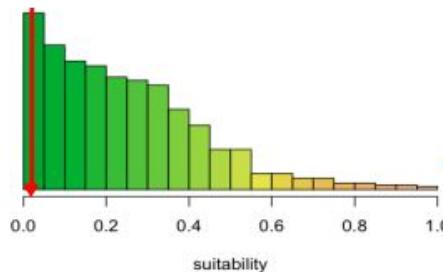
4. Avaliação dos modelos

Límiates (*Thresholds*) - transformar em 1 e 0

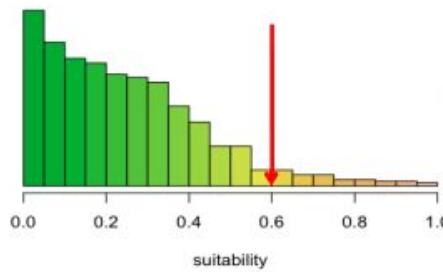


4. Avaliação dos modelos

Limiariares (*Thresholds*)



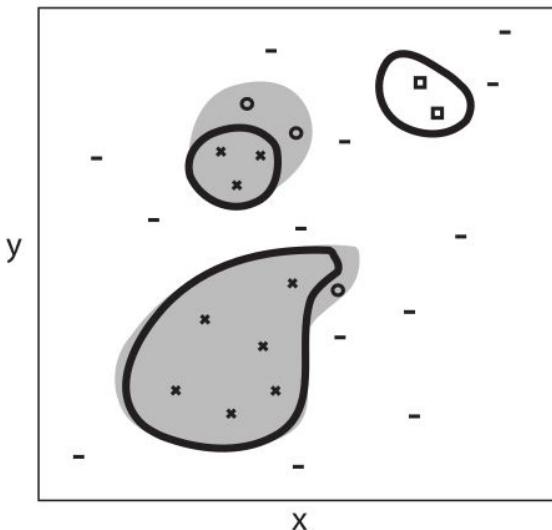
Zero omissão



Maximiza
sensitividade +
especificidade

4. Avaliação dos modelos

Matriz de confusão - para os dados de teste



● Occupied distributional area, G_O

○ Areas predicted by an ecological niche model

✗ True positive

- True negative

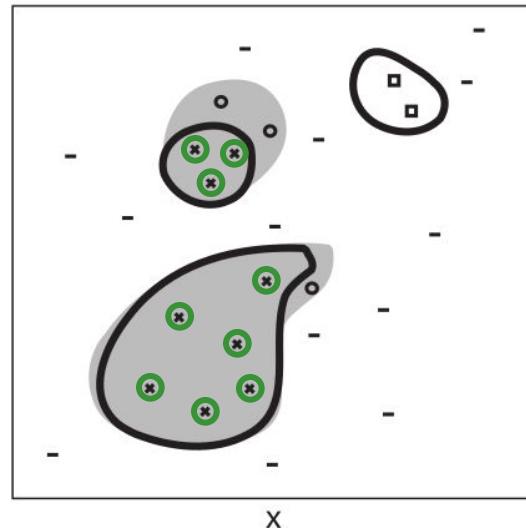
○ False negative

□ False positive

		Observation	
		Present	Absent
Prediction	Present	True positive	False positive
	Absent	False negative	True negative

4. Avaliação dos modelos

Matriz de confusão - para os dados de teste



● Occupied distributional area, G_O

○ Areas predicted by an ecological niche model

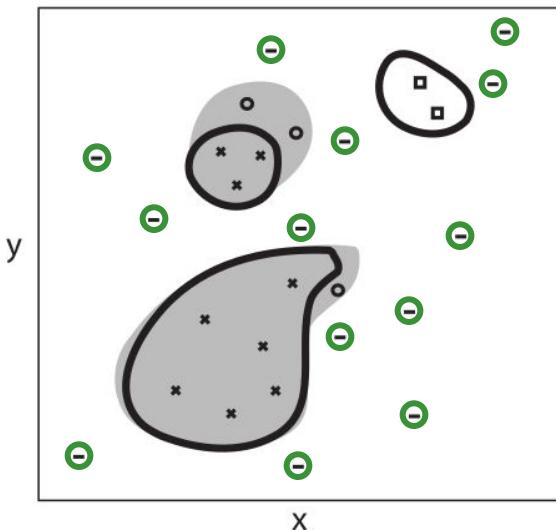
- ✗ True positive
- True negative
- False negative
- ◻ False positive

		Observation	
		Present	Absent
Prediction	Present	True positive	False positive
	Absent	False negative	True negative

Ocorrência que o modelo previu
como **presença (acerto)**

4. Avaliação dos modelos

Matriz de confusão - para os dados de teste



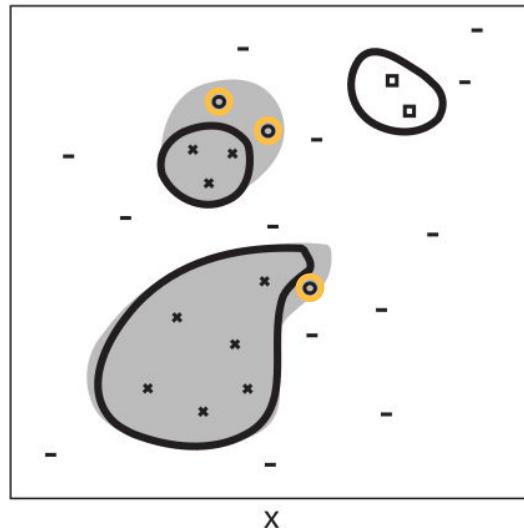
- Occupied distributional area, G_O
- Areas predicted by an ecological niche model
 - ✗ True positive
 - True negative
 - False negative
 - + False positive

		Observation	
		Present	Absent
Prediction	Present	True positive	False positive
	Absent	False negative	True negative

Pseudo-ausência que o modelo previu como **ausência (acerto)**

4. Avaliação dos modelos

Matriz de confusão - para os dados de teste



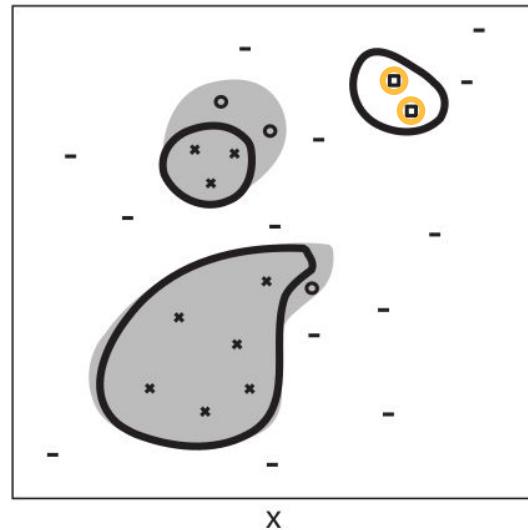
- Occupied distributional area, G_O
- Areas predicted by an ecological niche model
 - ✗ True positive
 - True negative
 - False negative
 - ◻ False positive

		Observation	
		Present	Absent
Prediction	Present	True positive	False positive
	Absent	○ False negative	True negative

Ocorrência que o modelo previu
como ausência (erro de omissão)

4. Avaliação dos modelos

Matriz de confusão - para os dados de teste



● Occupied distributional area, G_o

○ Areas predicted by an ecological niche model

✗ True positive

- True negative

○ False negative

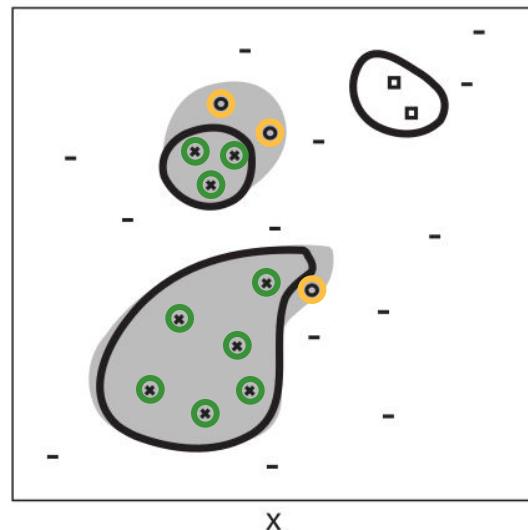
◻ False positive

		Observation	
		Present	Absent
Prediction	Present	True positive	False positive
	Absent	False negative	True negative

Pseudo-ausência que o modelo previu
como **presença (erro de comissão)**

4. Avaliação dos modelos

Matriz de confusão - para os dados de teste



- Occupied distributional area, G_O
- Areas predicted by an ecological niche model
 - ✗ True positive
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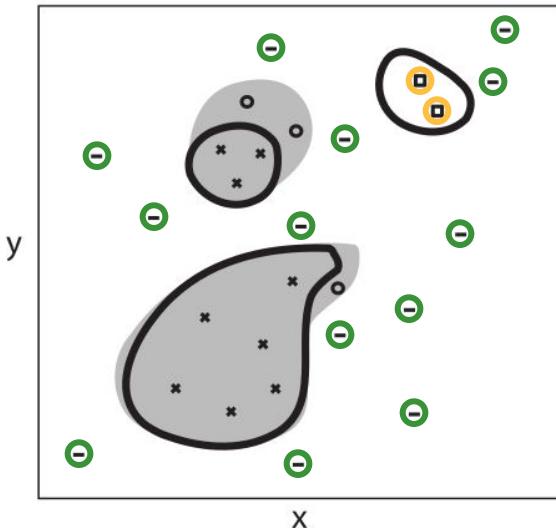
		Observation	
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**Sensitividade: presenças corretas
total de presenças**

4. Avaliação dos modelos

Matriz de confusão - para os dados de teste



- Occupied distributional area, G_O
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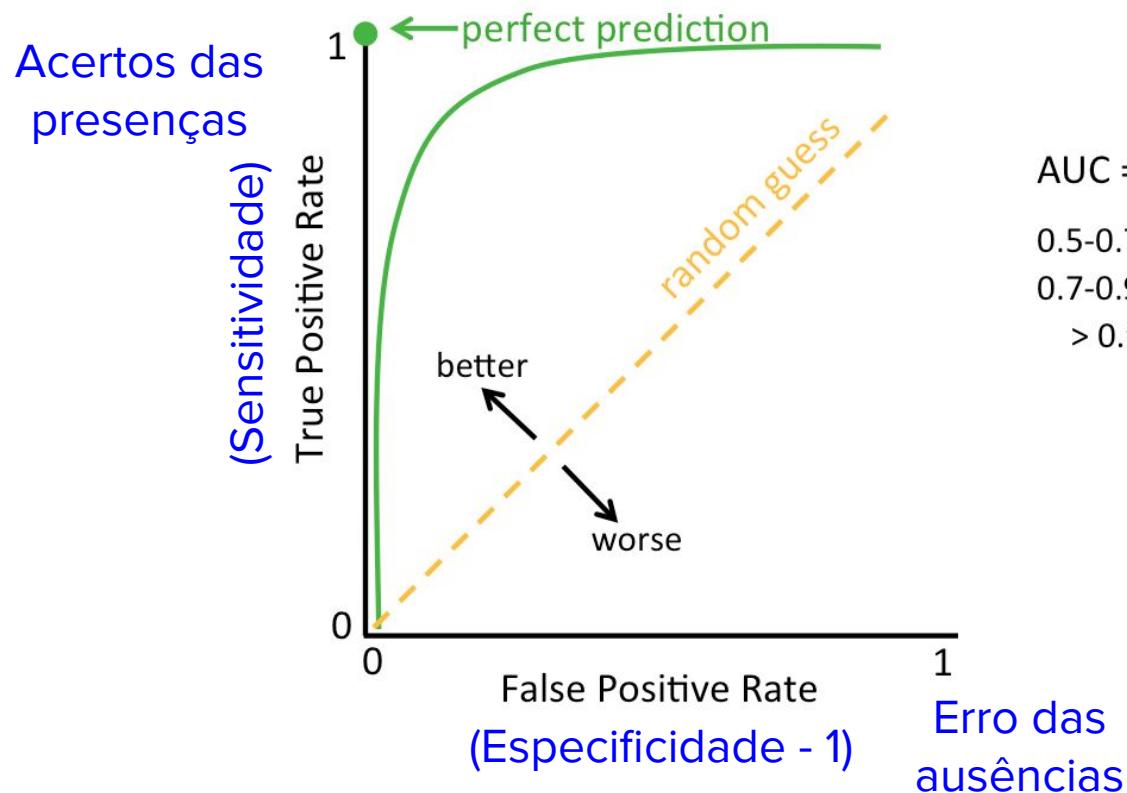


**Especificidade: pseudo-ausências corretas
total de pseudo-ausências**

4. Avaliação dos modelos

Curva ROC

Relative Operating Characteristic (ROC)



AUC = area under the curve

0.5-0.7 = poor model performance

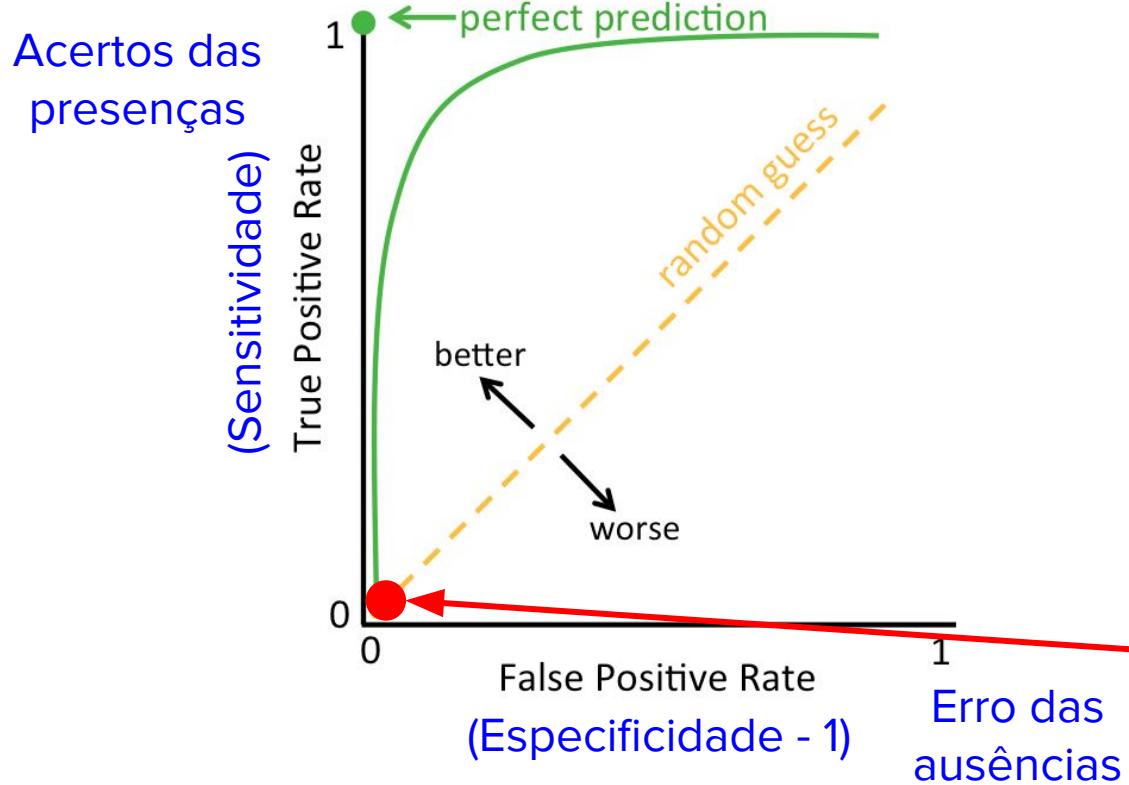
0.7-0.9 = moderate

> 0.9 = excellent

4. Avaliação dos modelos

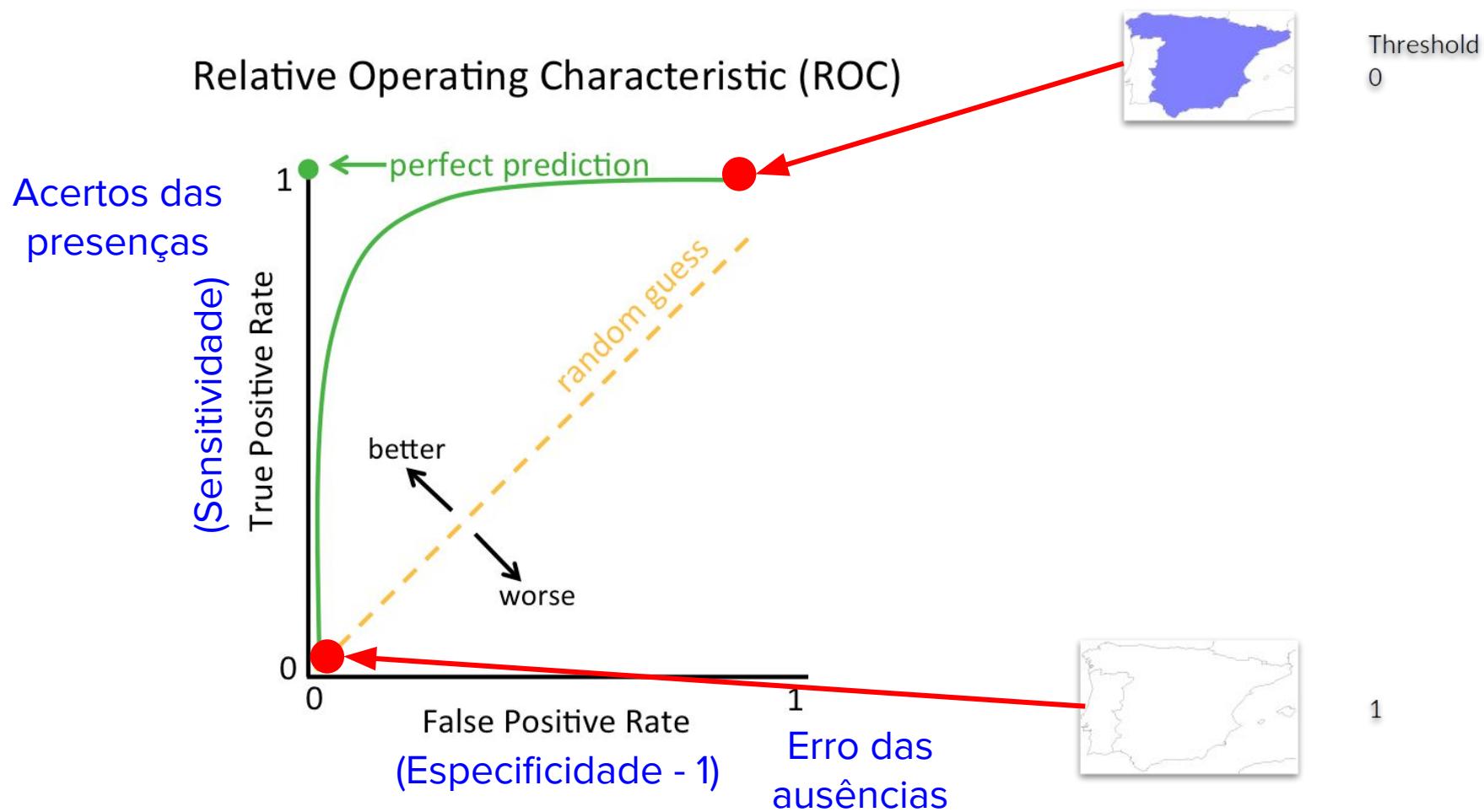
Curva ROC

Relative Operating Characteristic (ROC)



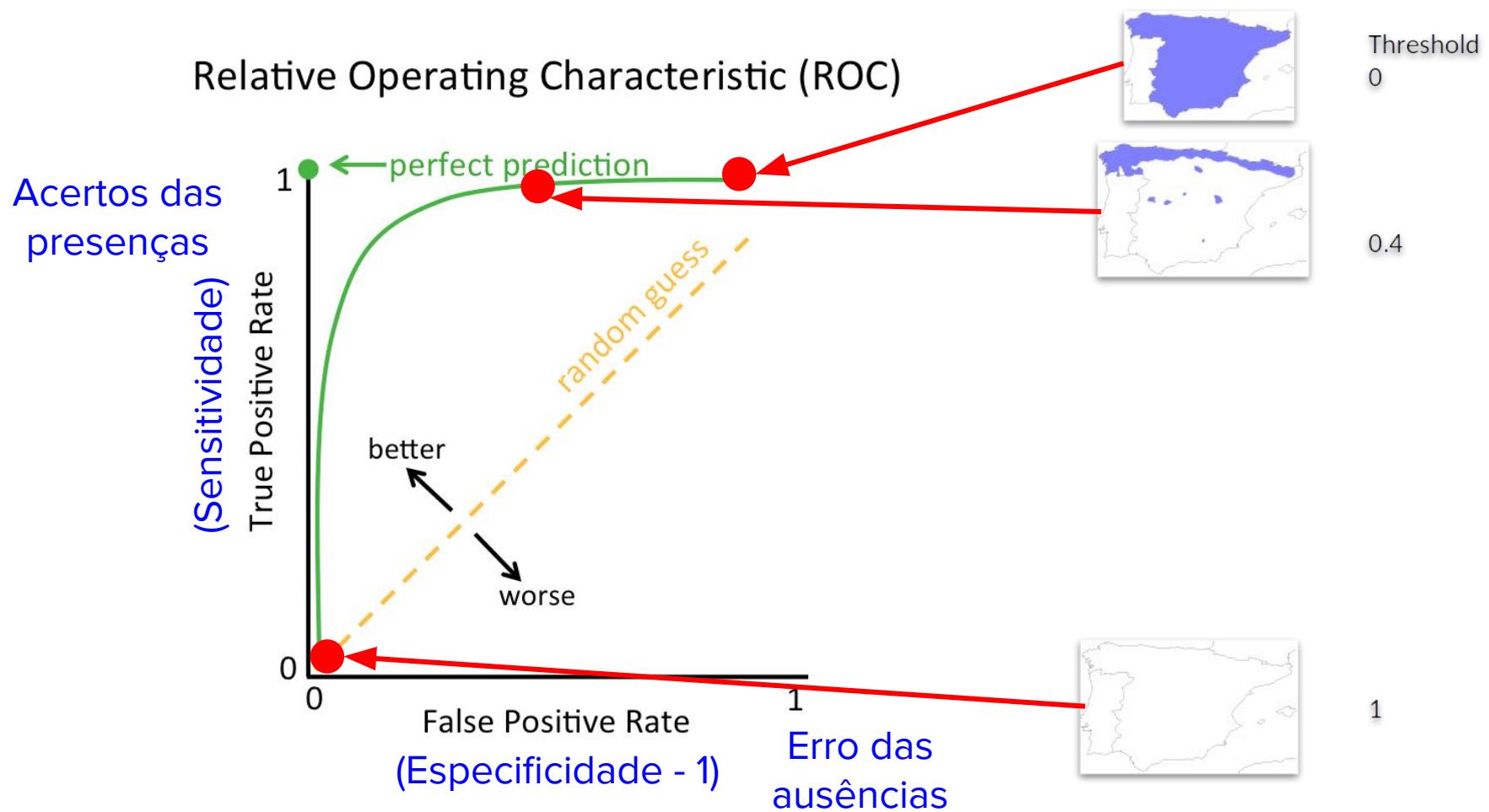
4. Avaliação dos modelos

Curva ROC



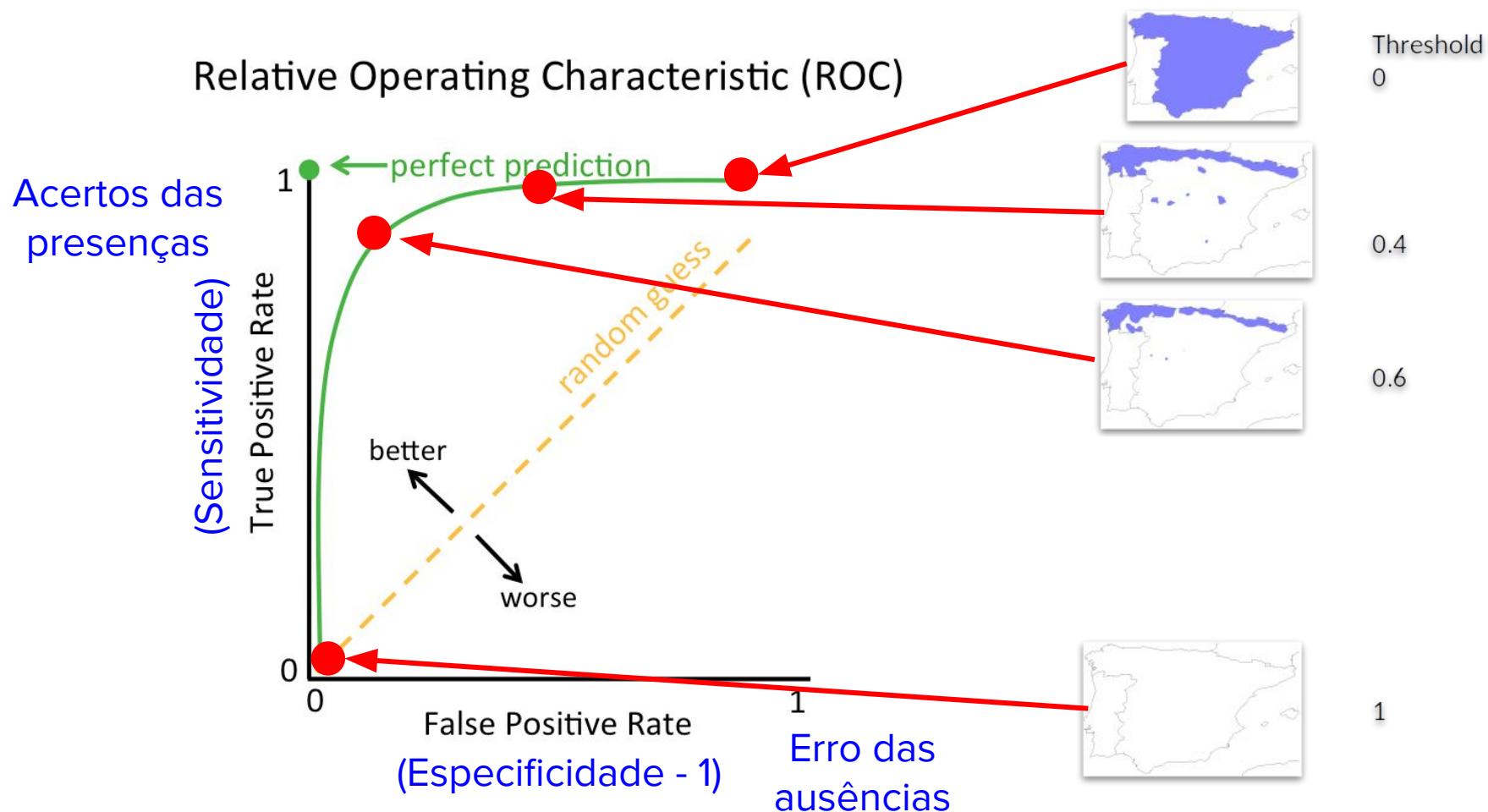
4. Avaliação dos modelos

Curva ROC



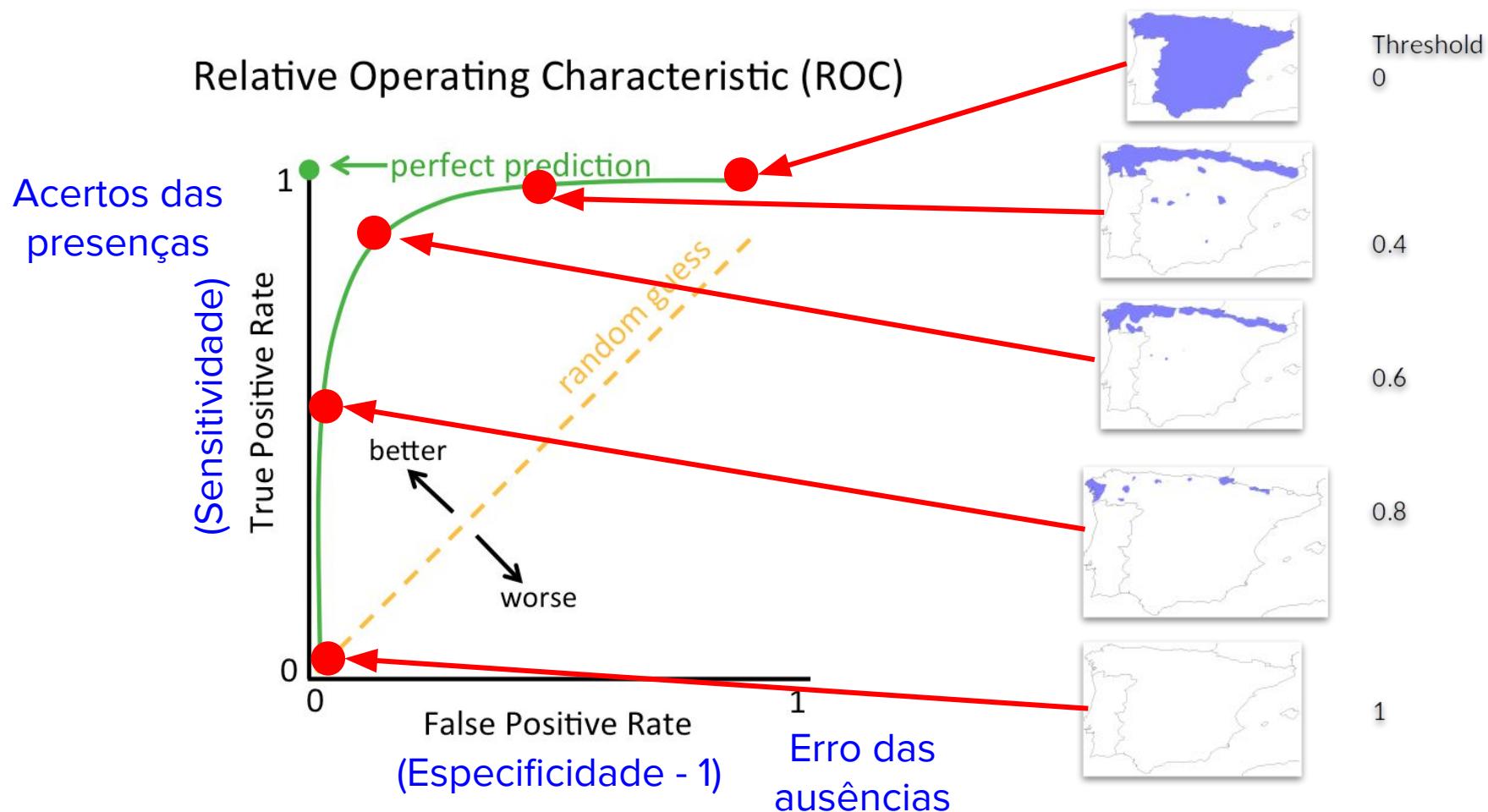
4. Avaliação dos modelos

Curva ROC



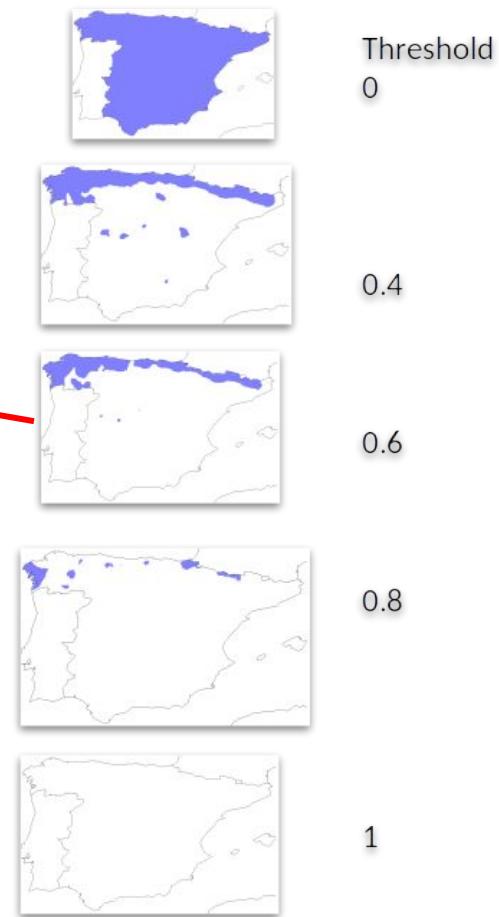
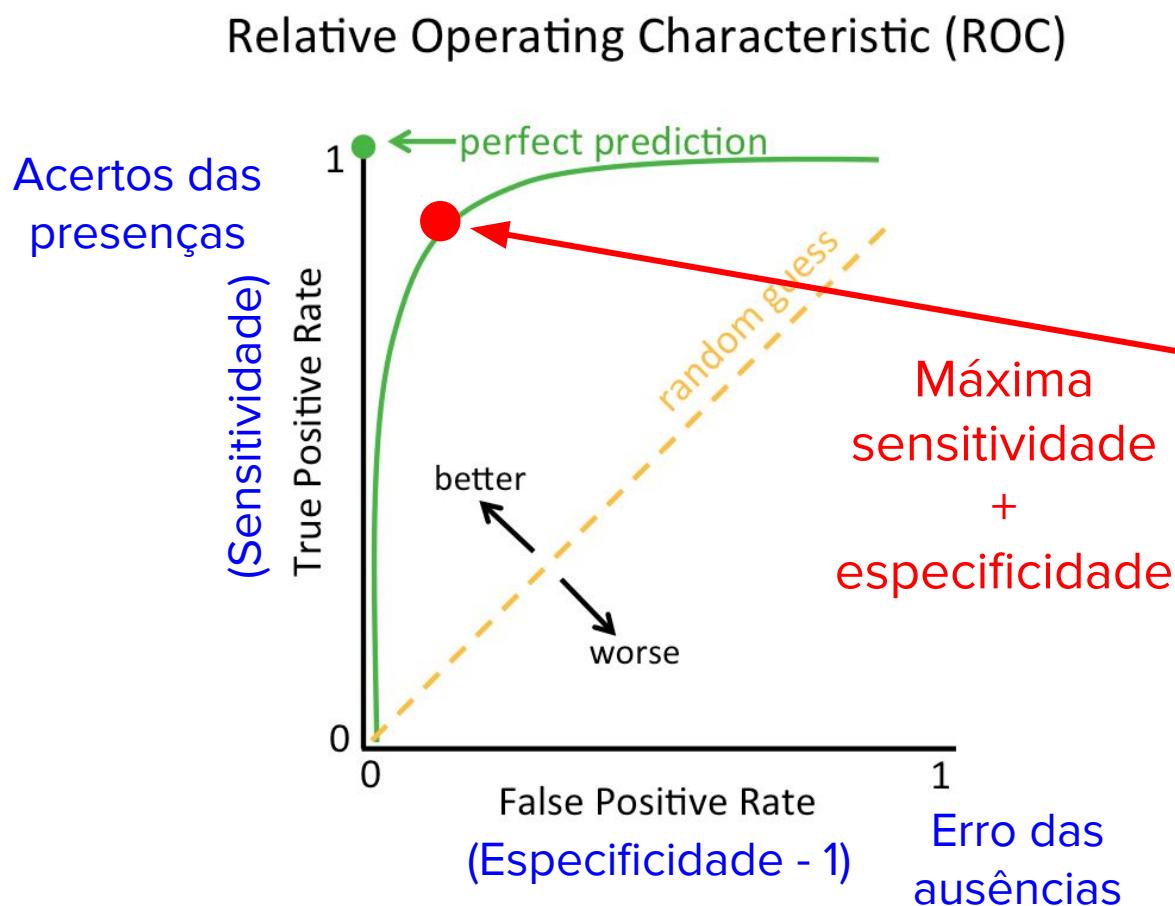
4. Avaliação dos modelos

Curva ROC



4. Avaliação dos modelos

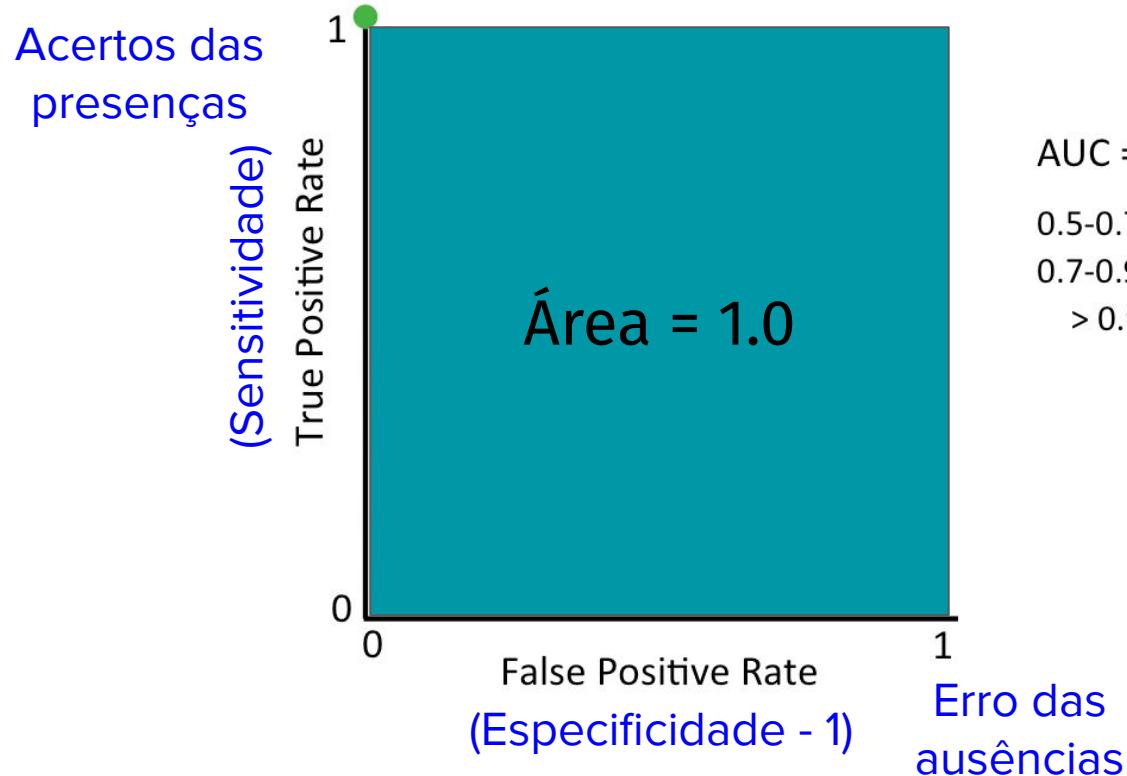
Curva ROC



4. Avaliação dos modelos

AUC

Relative Operating Characteristic (ROC)



AUC = area under the curve

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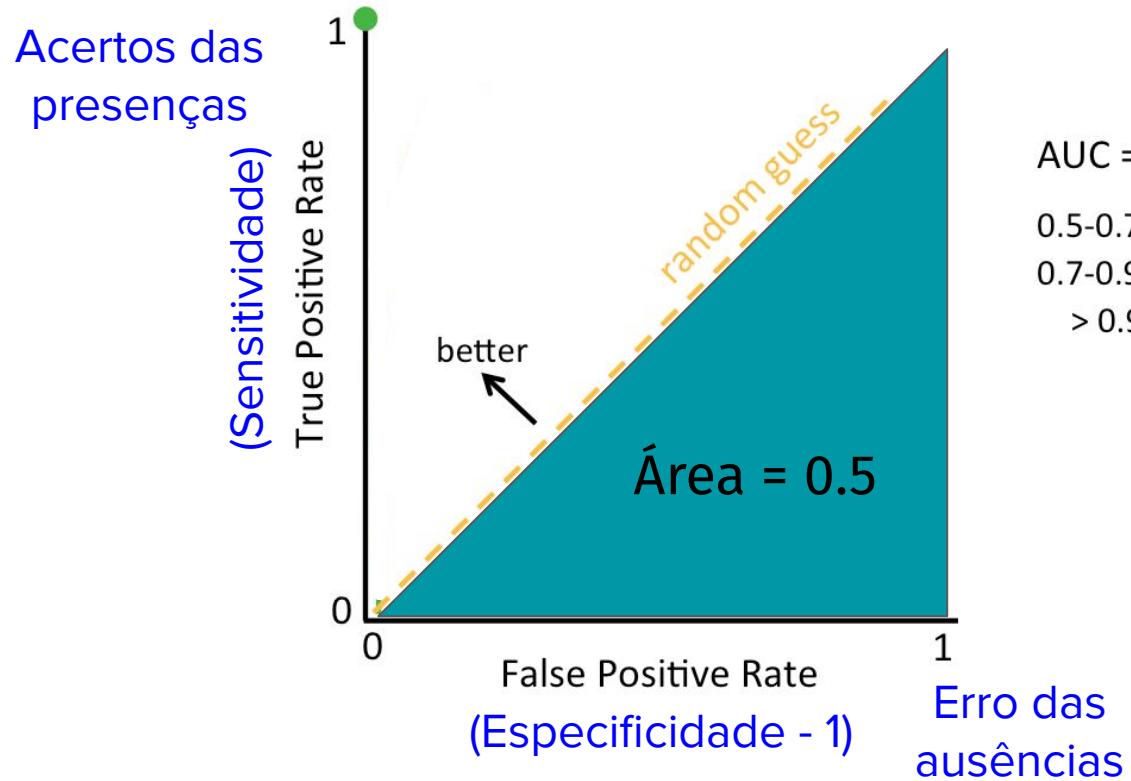
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4. Avaliação dos modelos

AUC

Relative Operating Characteristic (ROC)



AUC = area under the curve

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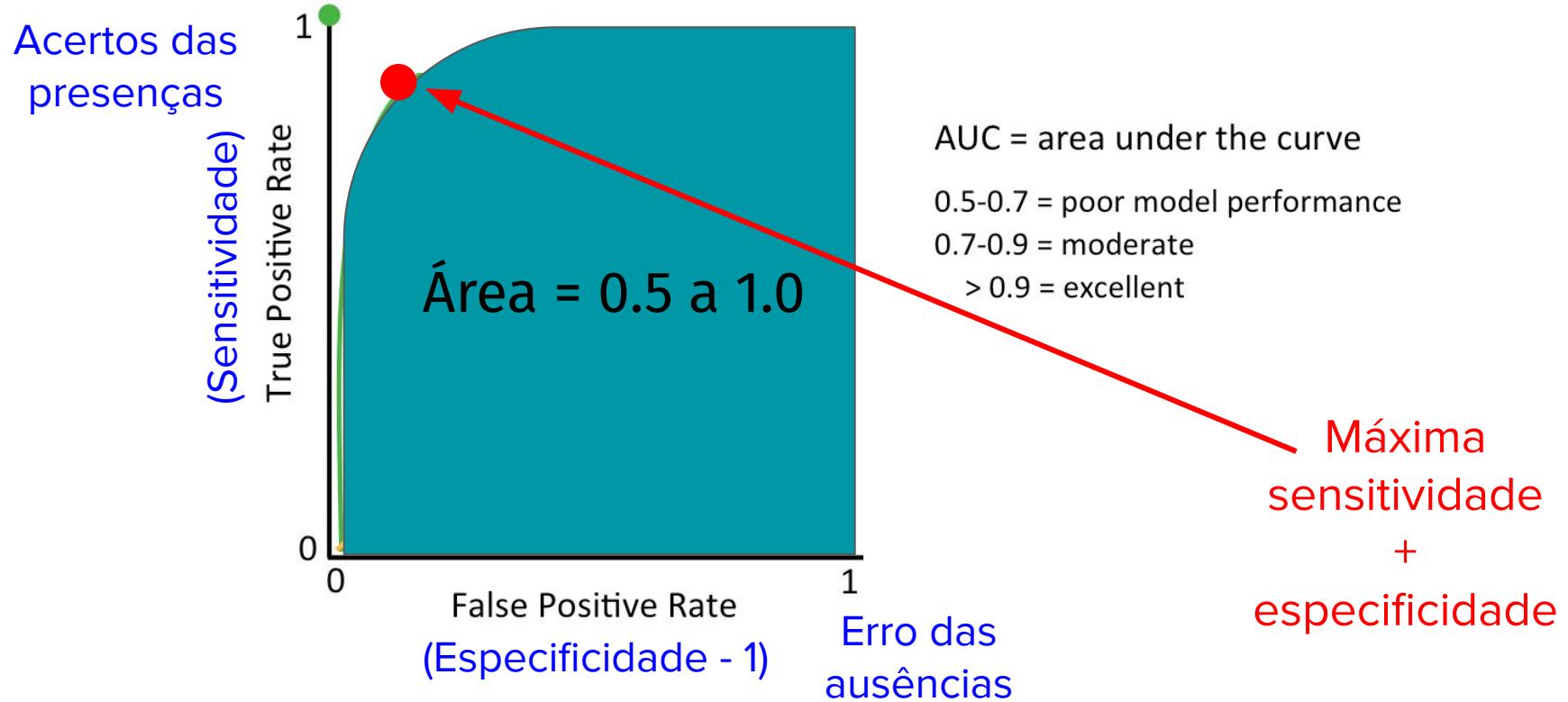
0.7-0.9 = moderate

> 0.9 = excellent

4. Avaliação dos modelos

AUC

Relative Operating Characteristic (ROC)



4. Avaliação dos modelos

TSS (*True skill statistic*)

Número de sucessos menos o número de sucessos aleatórios

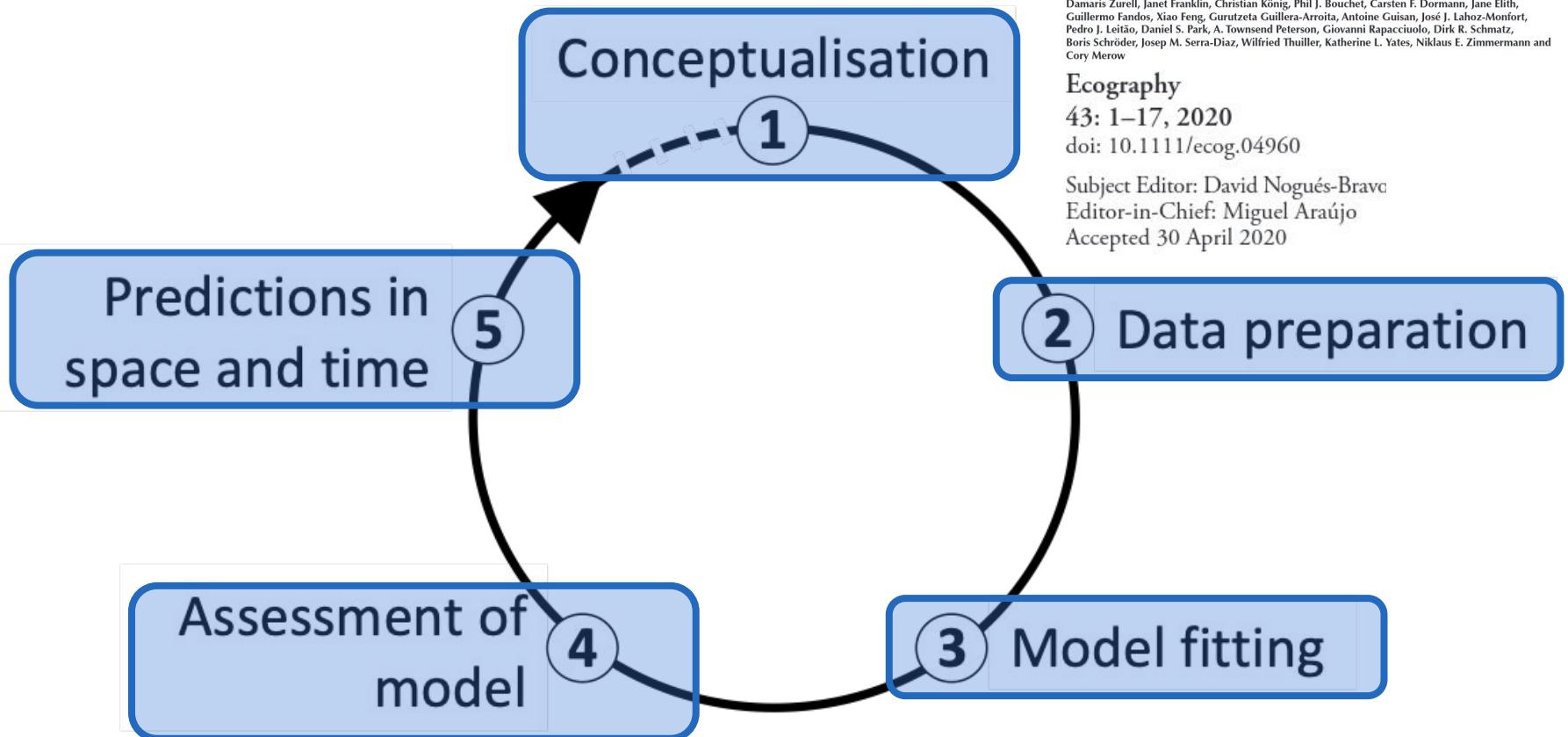
Varia de -1 to 1. Valores próximos a 0 modelos não diferentes do aleatórios

Depende de um valor de corte (*threshold*)

$$\text{TSS} = \text{sensitividade} + \text{especificidade} - 1$$

SDM passo a passo

Passos de construção dos SDMs



ECOGRAPHY

Review and synthesis

A standard protocol for reporting species distribution models

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Ecography

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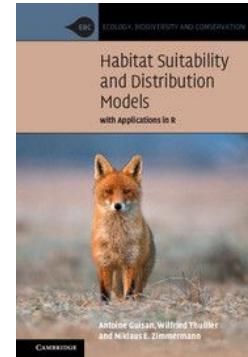
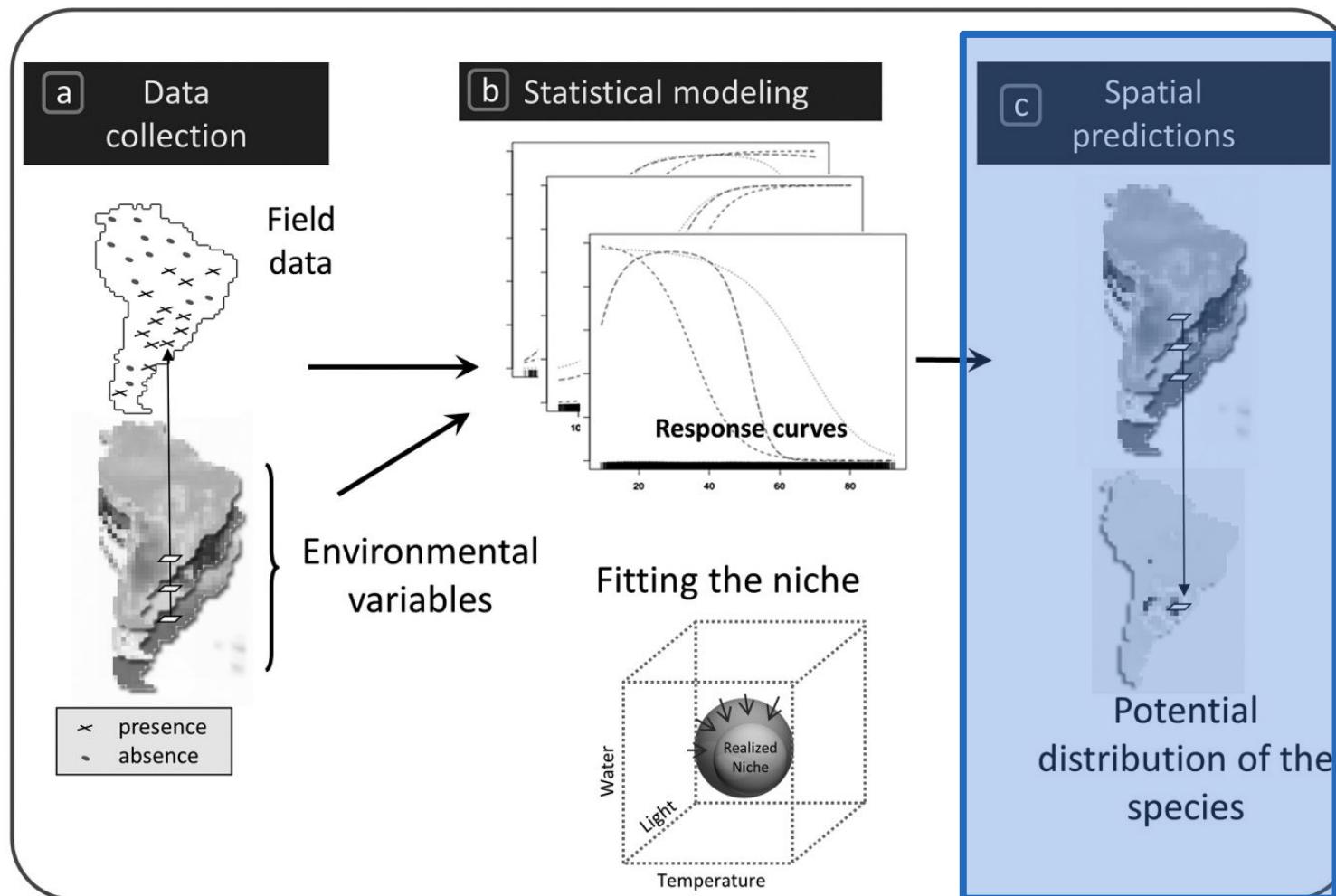
Subject Editor: David Nogués-Bravo

Editor-in-Chief: Miguel Araújo

Accepted 30 April 2020

Modelos de Distribuição de Espécies (SDMs)

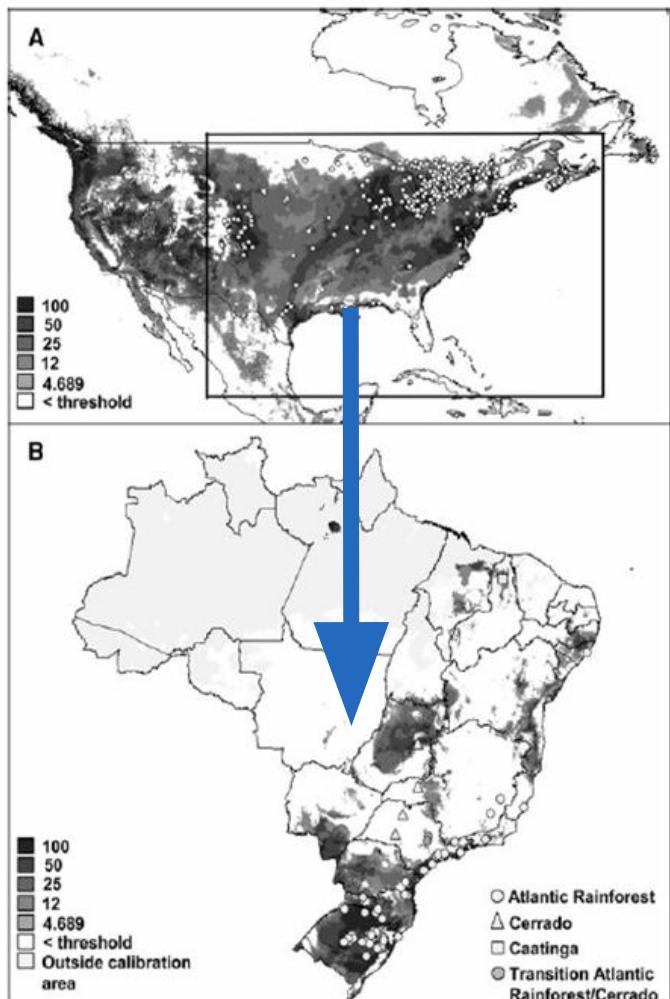
Predições (espaço e no tempo)



Guisan et al. (2017)

Modelos de Distribuição de Espécies (SDMs)

Espaço - Espécies invasoras



Biol Invasions
DOI 10.1007/s10530-007-9154-5

ORIGINAL PAPER

Predicting the potential distribution of the alien invasive American bullfrog (*Lithobates catesbeianus*) in Brazil

João G. R. Giovanelli · Célio F. B. Haddad ·
João Alexandrino

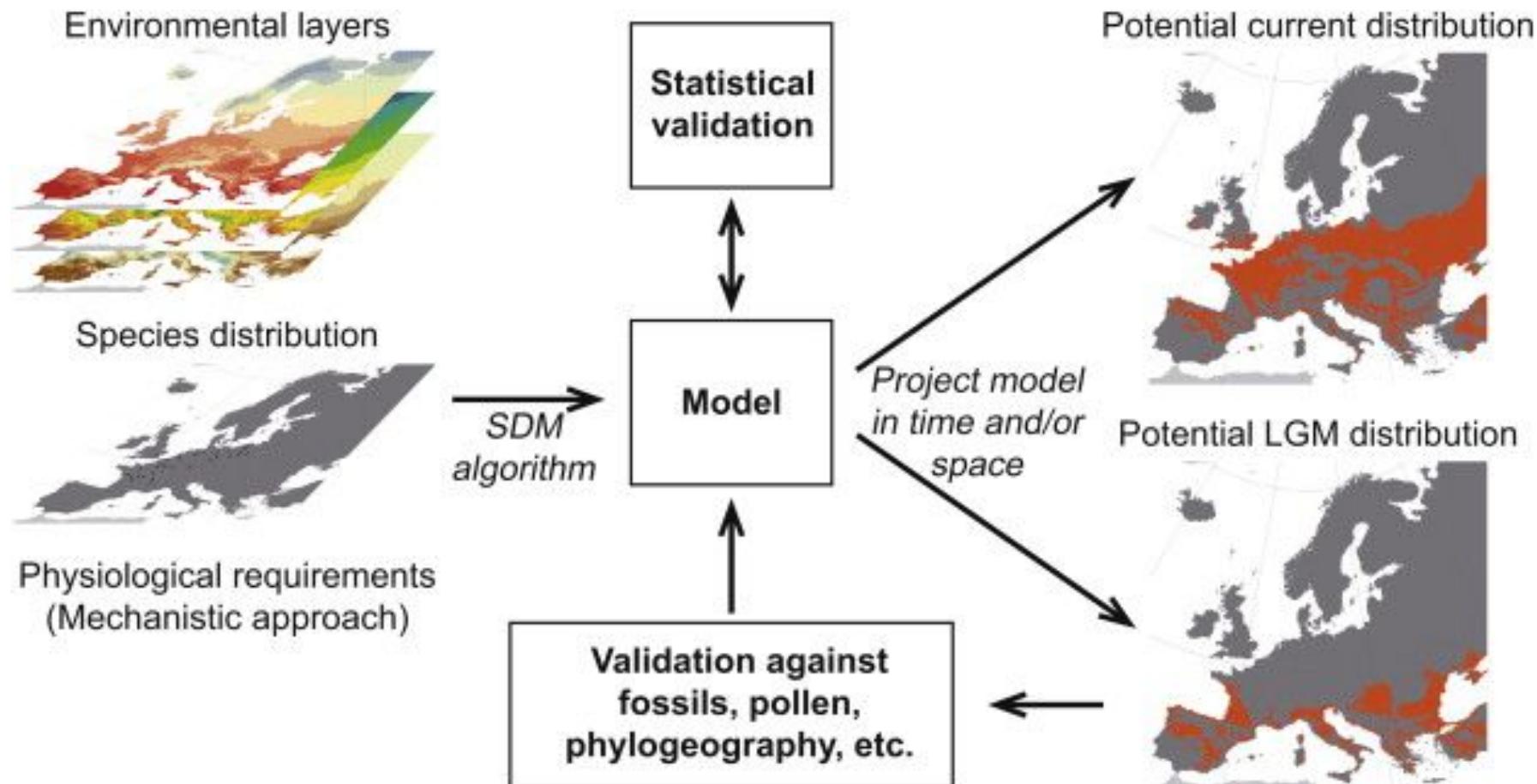


Foto: Carl D. Howe

Giovanelli et al., 2008. Biological Invasions

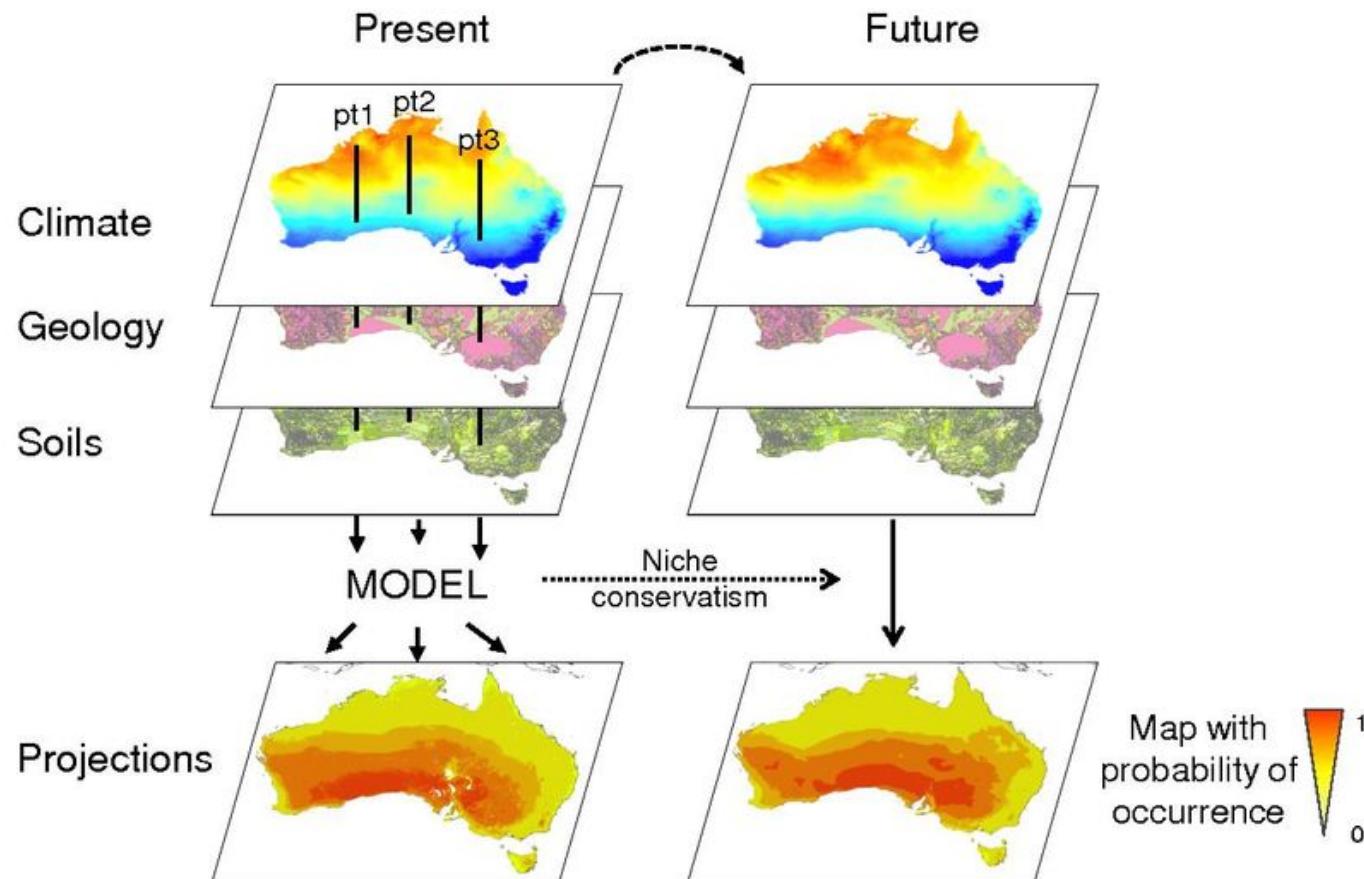
Modelos de Distribuição de Espécies (SDMs)

Tempo - passado



Modelos de Distribuição de Espécies (SDMs)

Tempo - futuro



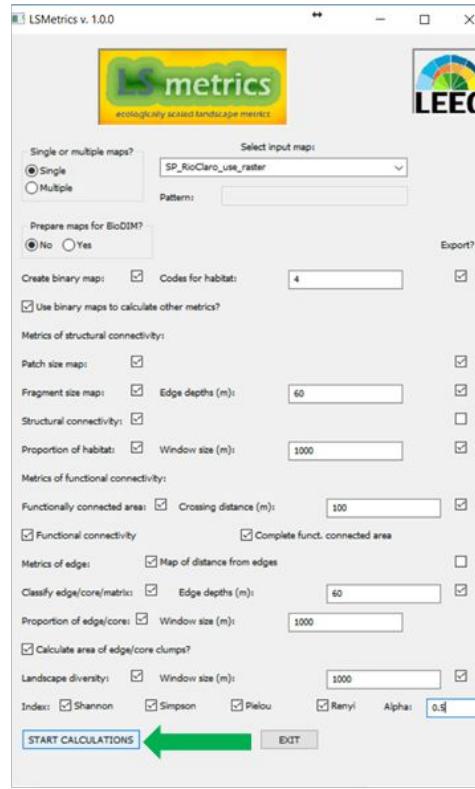
7. Aplicações

Cálculo de métricas de paisagem

LSMetrics - Landscape Metrics



Bernardo Niebuhr



Niebuhr, B. B. S.; Martello, F.; Ribeiro, J. W.; Vancine, M. H.; Muylaert, R. L.; Campos, V. E. W.; Santos, J. S.; Tonetti, V. R.; Ribeiro, M. C. Landscape Metrics (LSMetrics): a spatially explicit tool for calculating connectivity and other ecologically-scaled landscape metrics. In preparation

https://github.com/LEEClab/LS_METRICS



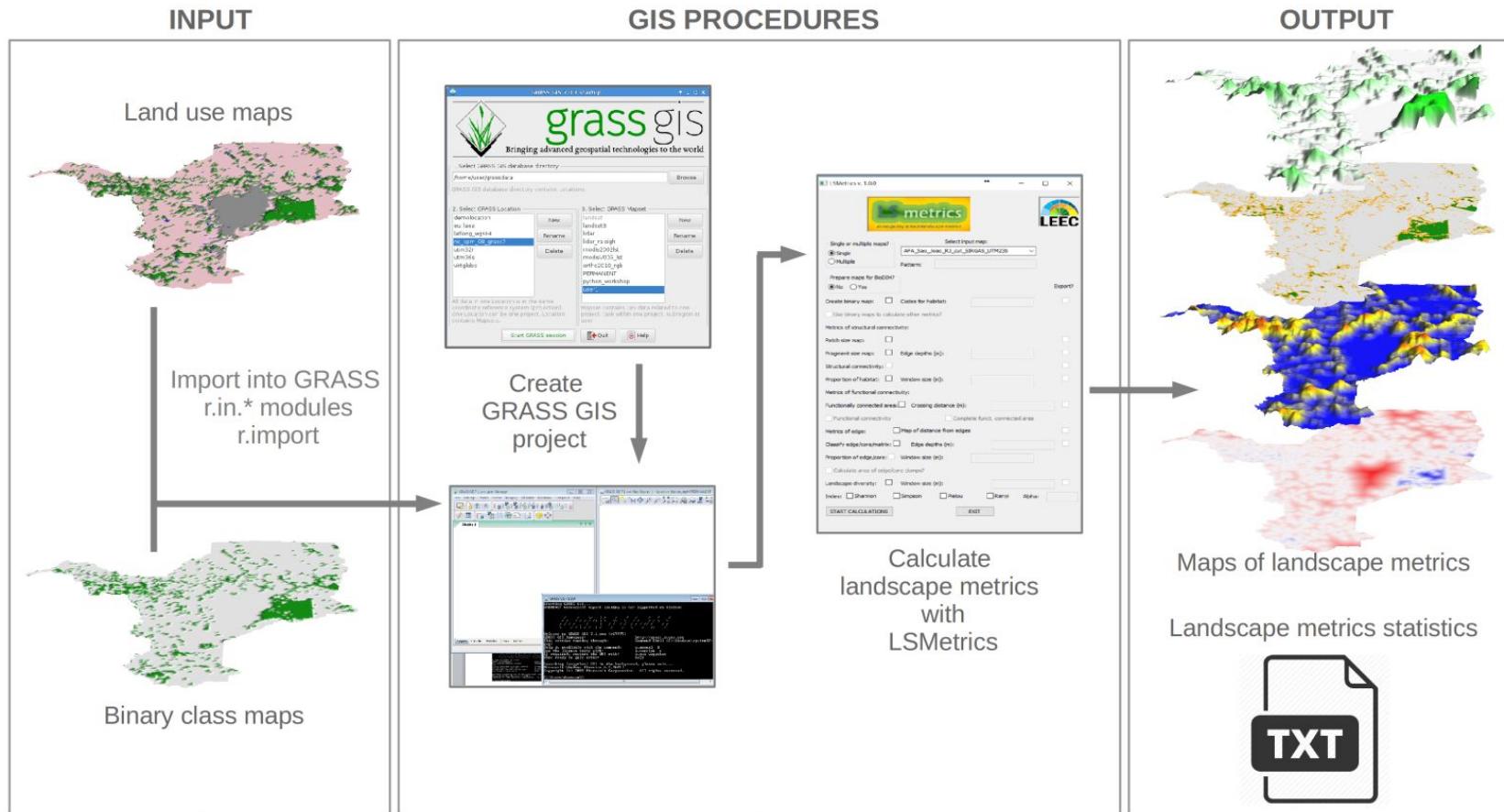
Prof. Milton Cezar Ribeiro



Cálculo de métricas de paisagem



LSMetrics - Landscape Metrics



https://github.com/LEEClab/LS_METRICS

Corredores ecológicos

LSCorridors - Landscape Corridors

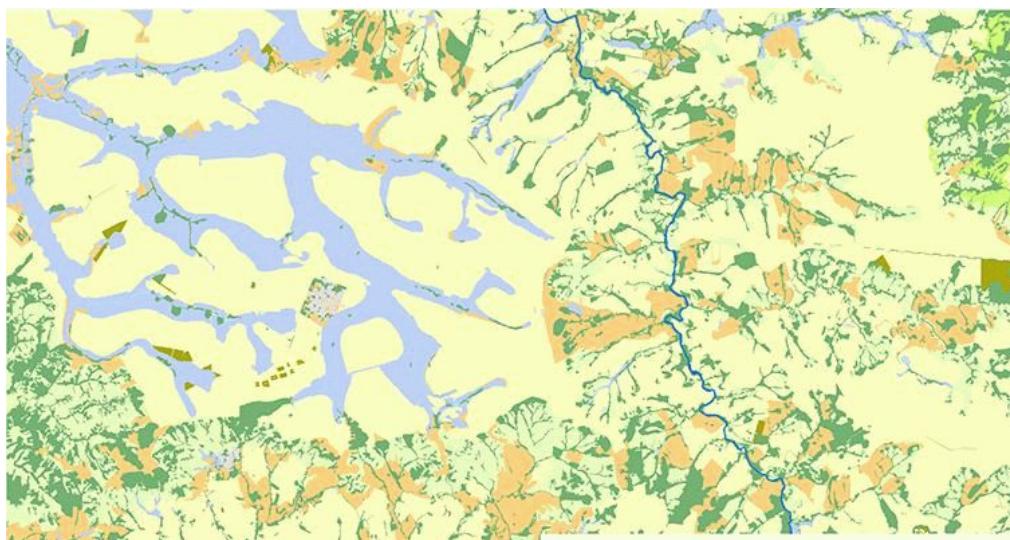


Methods in Ecology and Evolution 

Application |  Free Access |

Landscape Corridors (LSCORRIDORS): a new software package for modelling ecological corridors based on landscape patterns and species requirements

John Wesley Ribeiro, Juliana Silveira dos Santos, Pavel Dodonov, Felipe Martello, Bernardo Brandão Niebuhr, Milton Cezar Ribeiro



LSCorridors v. 1.0

LScorridors
multiple ecological functional corridors

Import Maps:
Resistance Map: Source-Target Map: IMPORT FILES Variability:

Using Maps Already Imported:
Resistance: ST:
Enter a list manually: Ex: 1,2,3,4,... READ LIST TXT COMBINE ALL

Name of output corridor: Proposed name of the map Scale (meters):

Number of Simulations:
Without landscape influence:
MP:
With landscape influence:
MLmin: MLavg: MLmax:

Corredores ecológicos

LSCorridors - Landscape Corridors

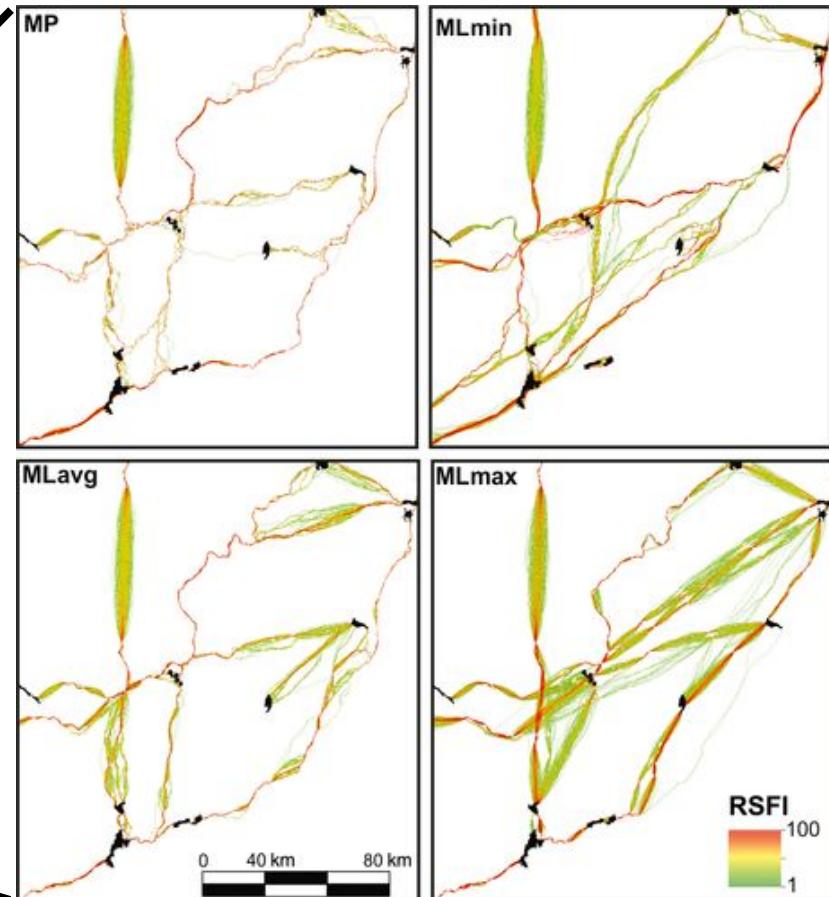
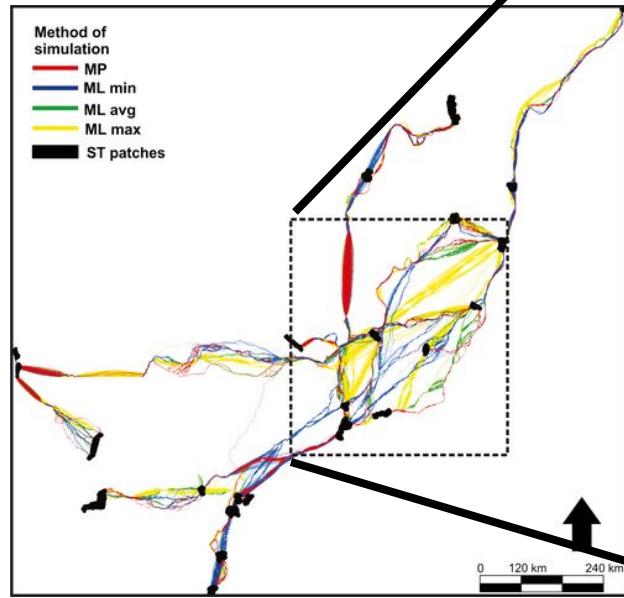


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<https://doi.org/10.1111/2041-210X.12750>

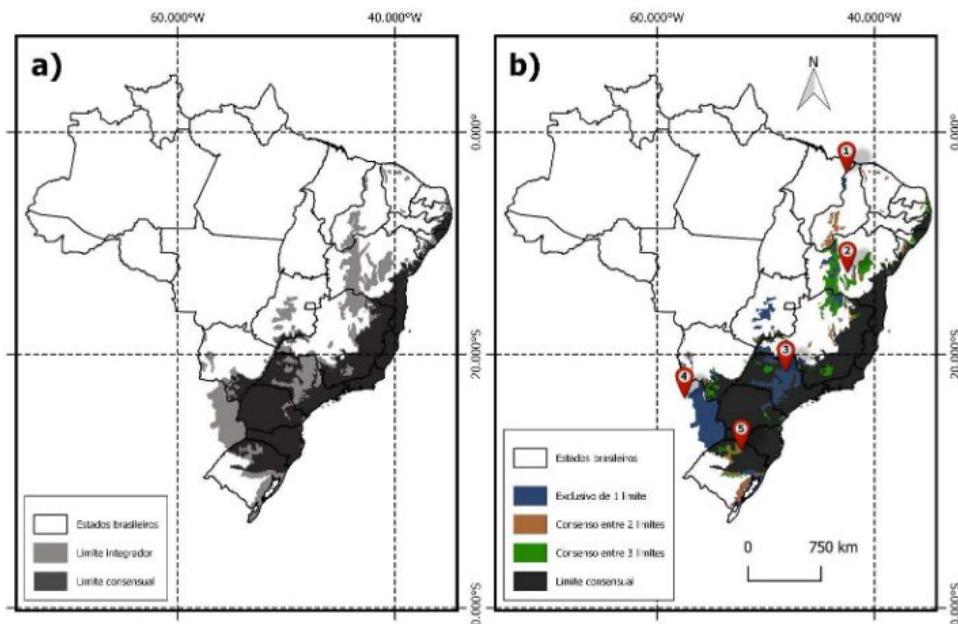
Limites da Mata Atlântica

Oecologia Australis
22(3): 302–311, 2018
10.4257/oeco.2018.2203.09



UMA NOTA SOBRE OS LIMITES TERRITORIAIS DA MATA ATLÂNTICA

Renata Lara Muylaert^{1*}, Maurício Humberto Vancine¹, Rodrigo Bernardo^{1,2},
Júlia Emi Faria Oshima¹, Thadeu Sobral-Souza^{1,3}, Vinicius Rodrigues Tonetti¹,
Bernardo Brandão Niebuhr¹ & Milton Cezar Ribeiro¹



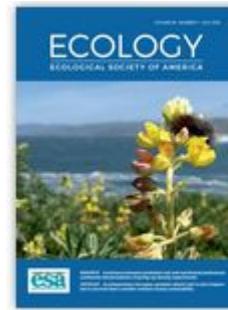
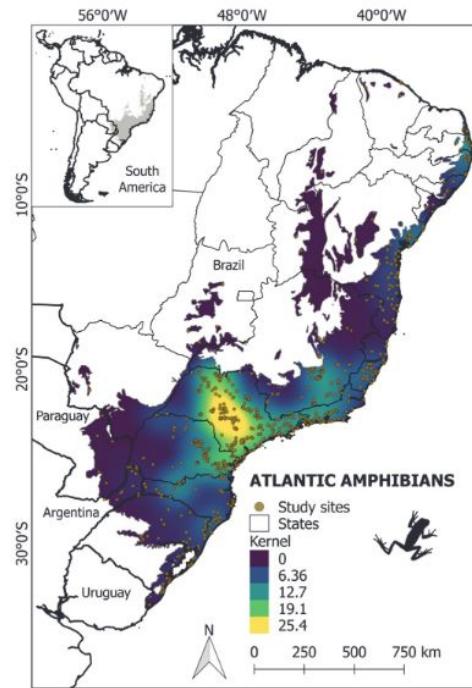
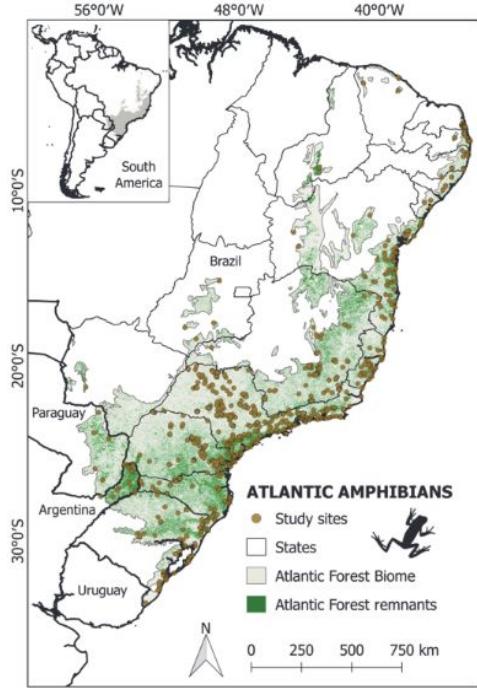
Comunidades de anfíbios da Mata Atlântica



Data Papers | Free Access

ATLANTIC AMPHIBIANS: a data set of amphibian communities from the Atlantic Forests of South America

Maurício Humberto Vancine , Kauã da Silva Duarte, Yuri Silva de Souza, João Gabriel Ribeiro Giovanelli, Paulo Mateus Martins-Sobrinho, Ariel López, Rafael Parelli Bovo, Fábio Maffei ... See all authors

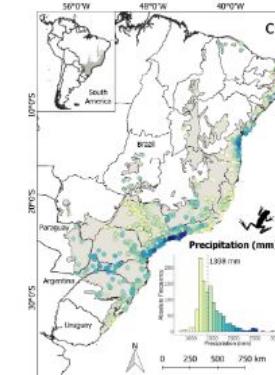
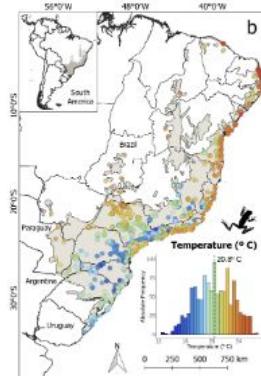
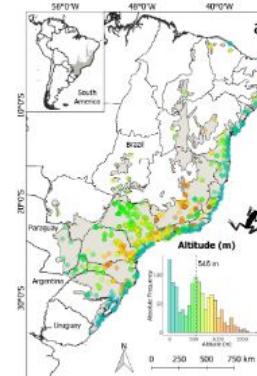


Volume 99, Issue 7

July 2018

Pages 1692-1692

This article also appears in:
ATLANTIC: Data Papers from a biodiversity hotspot



Diversidade de mamíferos em paisagens de SP



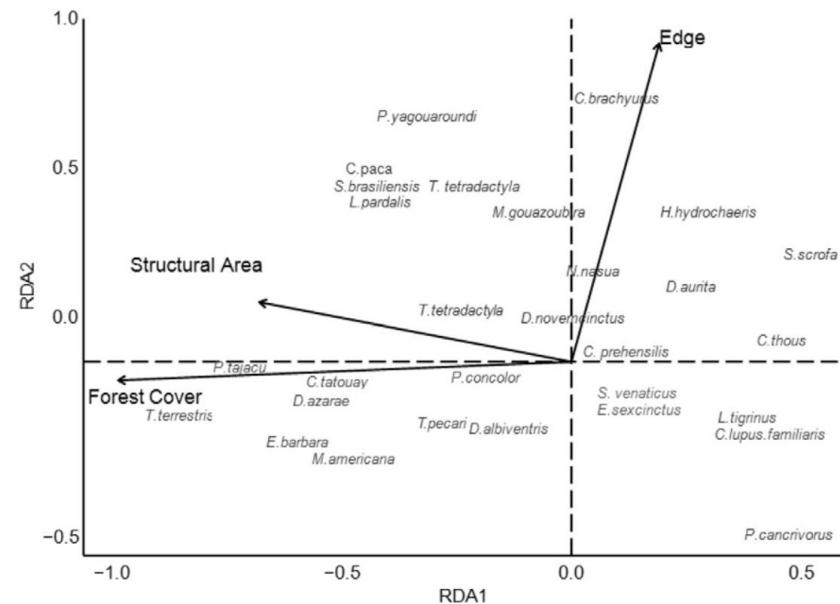
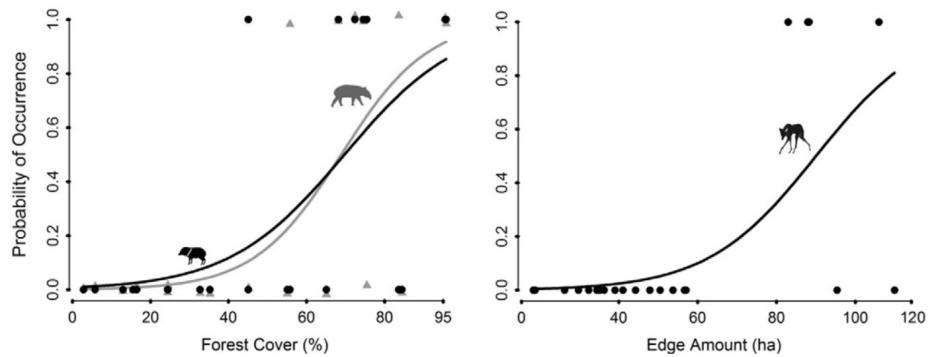
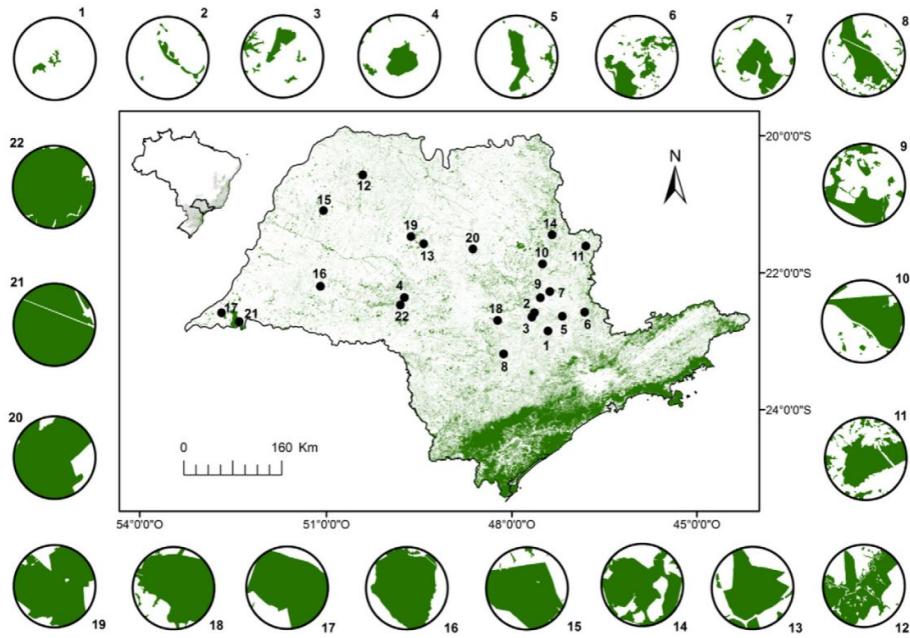
Biological Conservation

Volume 210, Part A, June 2017, Pages 352-359



High mammal species turnover in forest patches immersed in biofuel plantations

Gabrielle Beca ^a, Maurício H. Vancine ^a, Carolina S. Carvalho ^a, Felipe Pedrosa ^a, Rafael Souza C. Alves ^a, Daiane Buscariol ^a, Carlos A. Peres ^b, Milton Cezar Ribeiro ^a, Mauro Galetti ^{a, c}



Diversidade de mamíferos em paisagens de SC



Journal of Mammalogy, 98(6):1721–1731, 2017

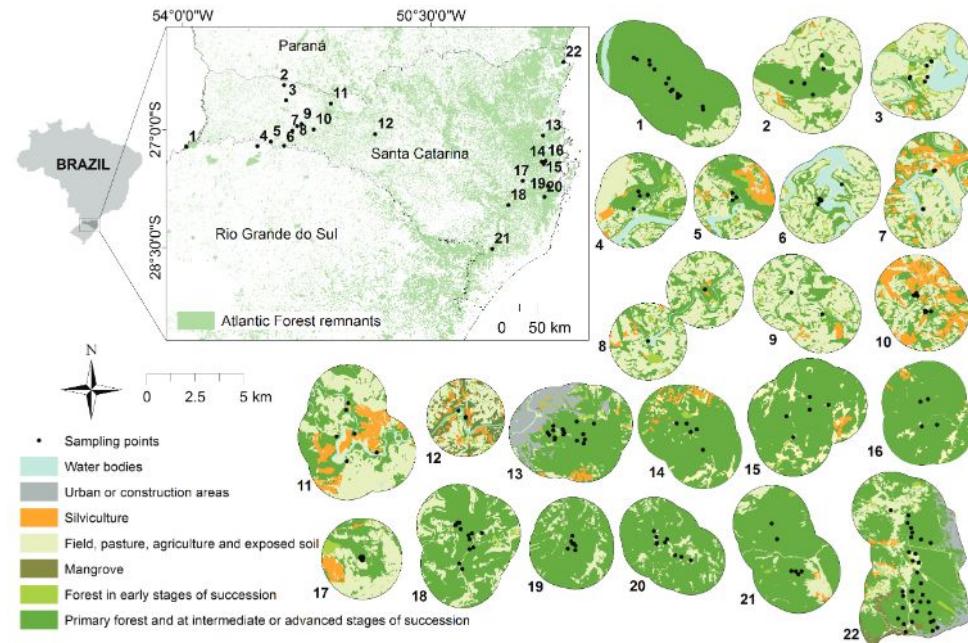
DOI:10.1093/jmammal/gyx103

Published online October 9, 2017

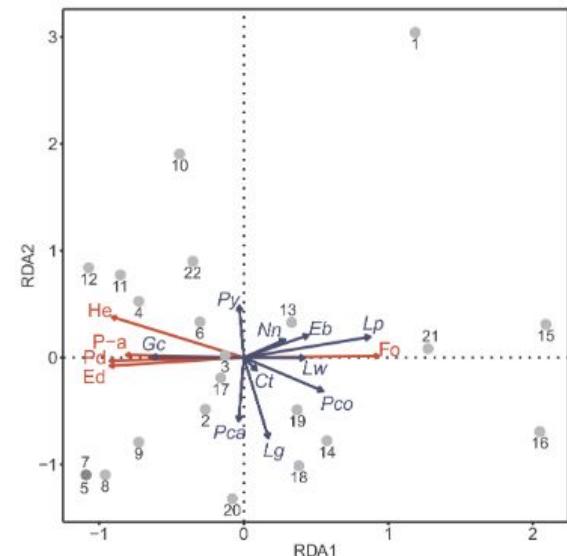
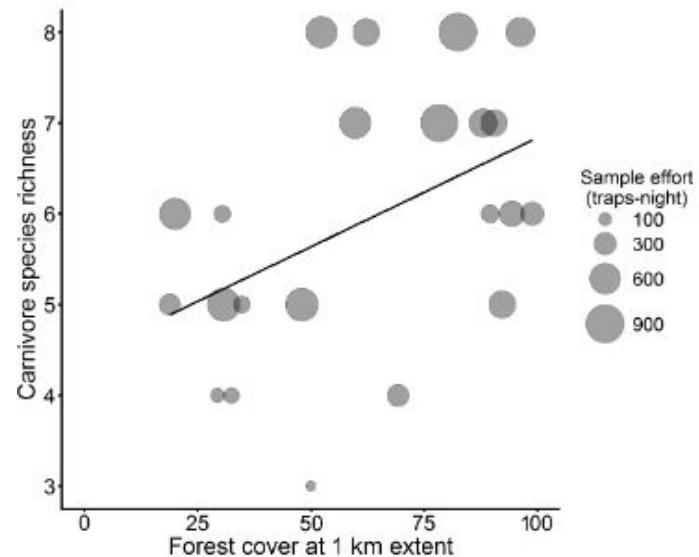


Forest cover influences occurrence of mammalian carnivores within Brazilian Atlantic Forest

ANDRÉ LUIS REGOLIN,* JORGE JOSÉ CHEREM, MAURÍCIO EDUARDO GRAIPEL, JULIANO ANDRÉ BOGONI, JOHN WESLEY RIBEIRO, MAURÍCIO HUMBERTO VANCINE, MARCOS ADRIANO TORTATO, LUIZ GUSTAVO OLIVEIRA-SANTOS, FELIPE MORELI FANTACINI, MICHELI RIBEIRO LUIZ, PEDRO VOLKMER DE CASTILHO, MILTON CEZAR RIBEIRO, AND NILTON CARLOS CÁCERES



<https://doi.org/10.1093/jmammal/gyx103>



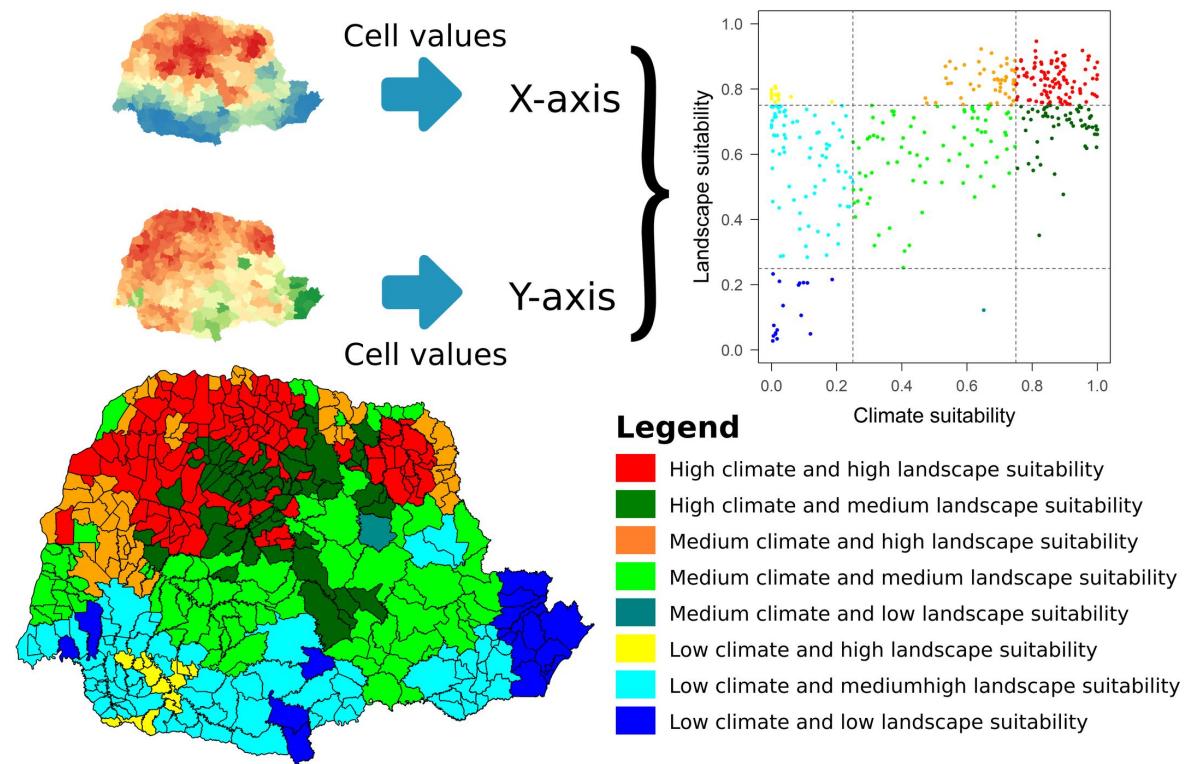
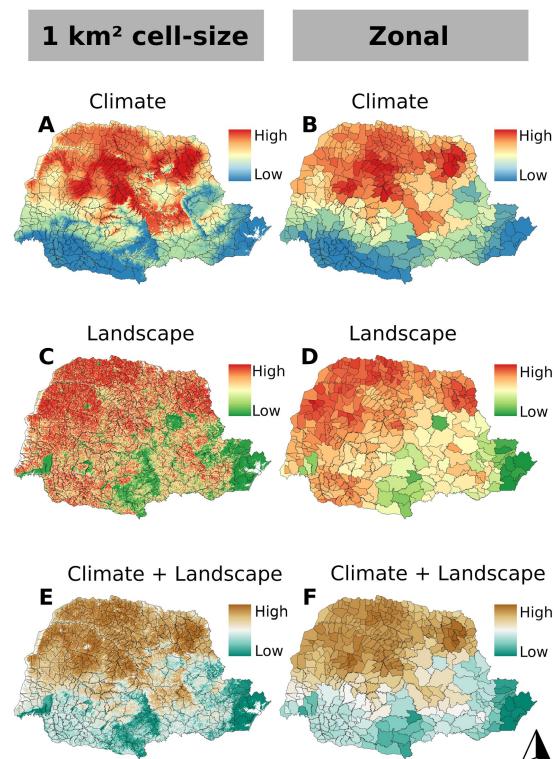
Áreas de transmissão *Trypanosoma cruzi* no PR



RESEARCH ARTICLE

Spatial prediction of risk areas for vector transmission of *Trypanosoma cruzi* in the State of Paraná, southern Brazil

Andréia Mantovani Ferro e Silva¹, Thadeu Sobral-Souza², Maurício Humberto Vancine², Renata Lara Muylaert², Ana Paula de Abreu¹, Sandra Marisa Peloso^{1,3}, Maria Dalva de Barros Carvalho^{1,4}, Luciano de Andrade^{1,4}, Milton Cesar Ribeiro², Max Jean de Ornelas Toledo^{1,5*}



Expansão da cana sobre o tamanduá em SP

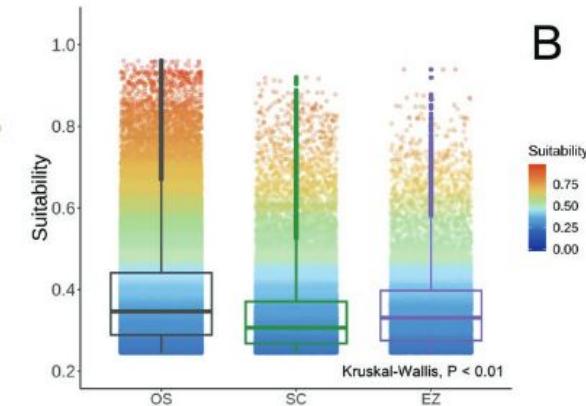
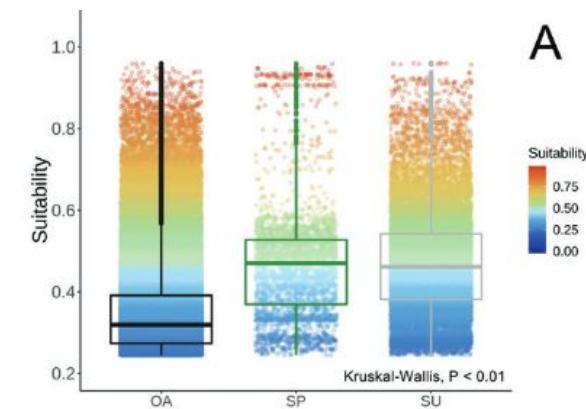
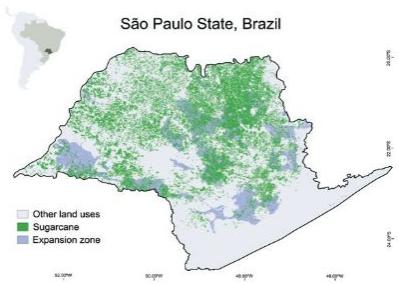
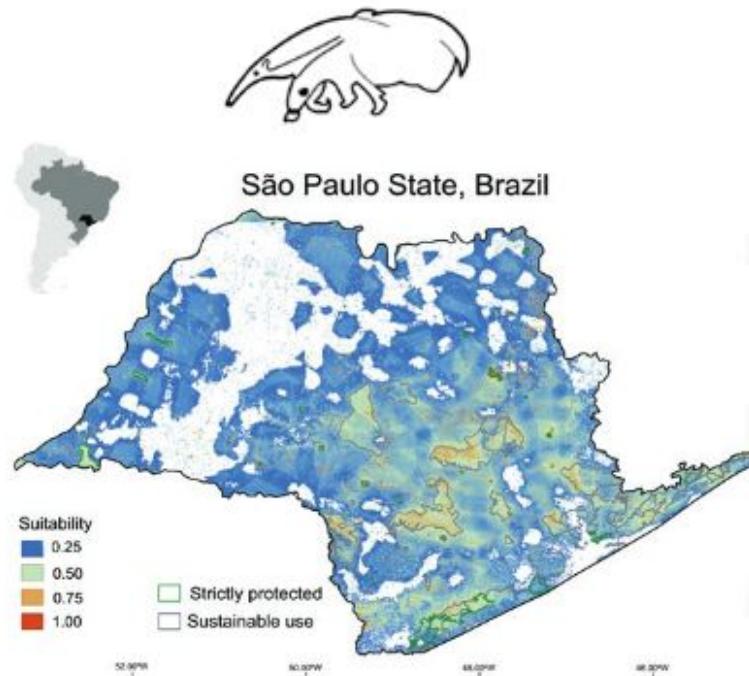
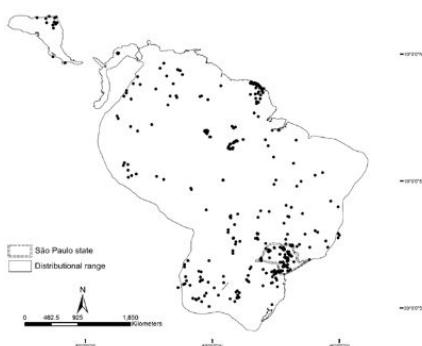


Journal of Mammalogy, 100(2):435–444, 2019
DOI:10.1093/jmammal/gyz042
Published online 18 March 2019



Land-use changes and the expansion of biofuel crops threaten the giant anteater in southeastern Brazil

ALESSANDRA BERTASSONI,^{*•} RÔMULO THEODORO COSTA, JÉSSICA ABONIZIO GOUVEA, RITA DE CASSIA BIANCHI,
JOHN WESLEY RIBEIRO, MAURÍCIO HUMBERTO VANCINE, AND MILTON CEZAR RIBEIRO



Mineração sobre anuros e aves na Serra Espinhaço



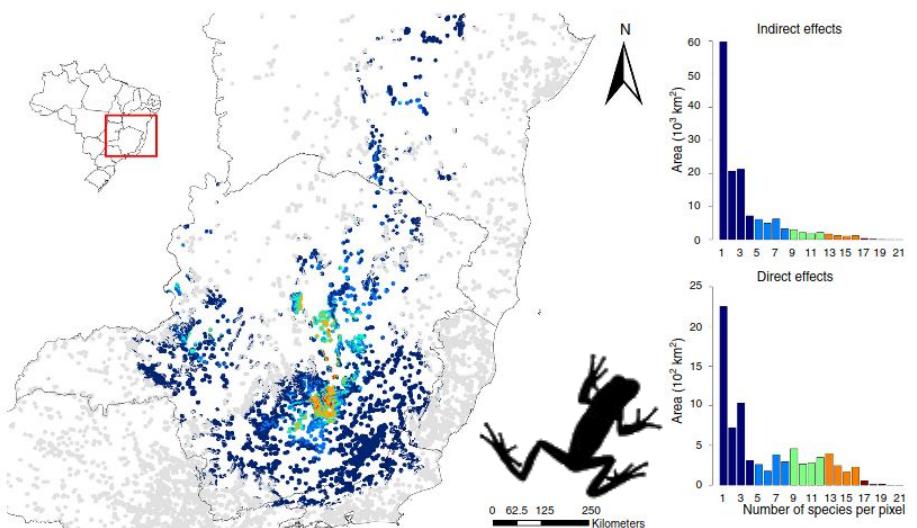
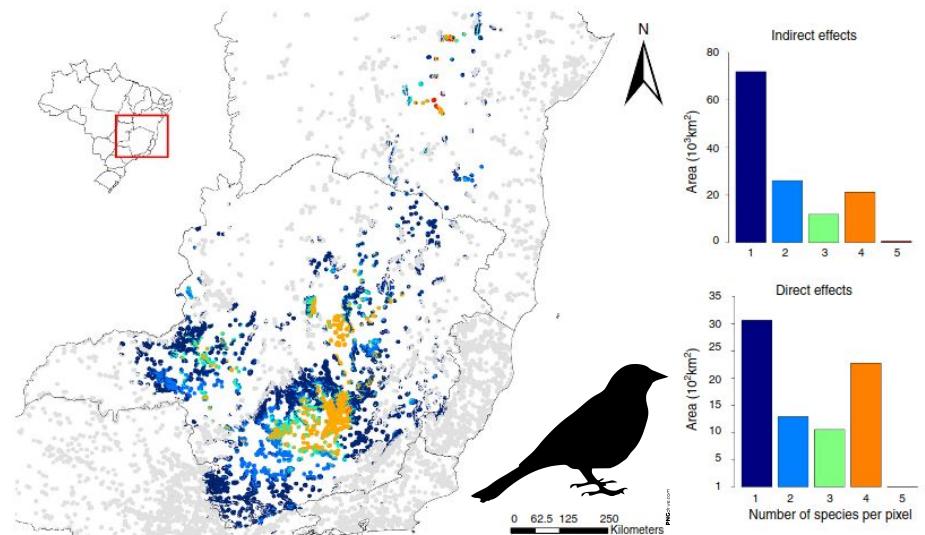
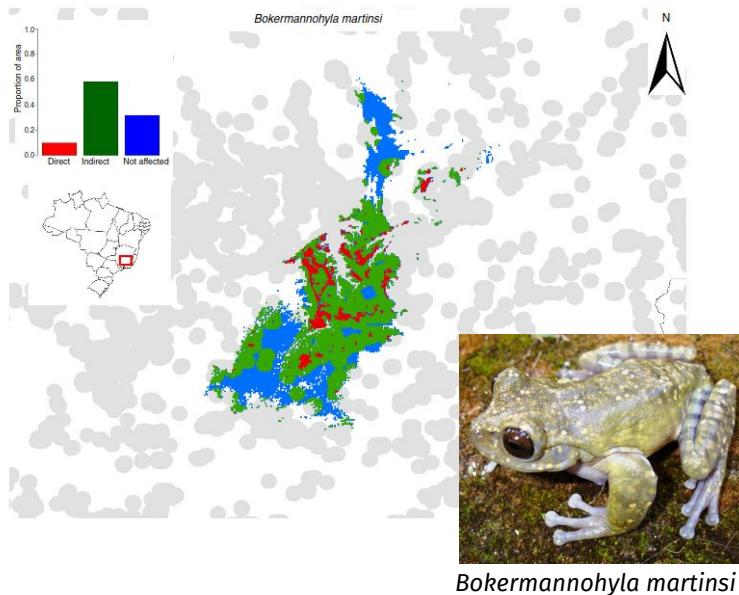
Perspectives in Ecology and Conservation
Volume 15, Issue 3, July–September 2017, Pages 172-178



Research Letters

Impacts of mining activities on the potential geographic distribution of eastern Brazil mountaintop endemic species

João Carlos de Castro Pena ^{a, b, 1}, Fernando Goulart ^c, G. Wilson Fernandes ^{d, e}, Diego Hoffmann ^f, Felipe S.F. Leite ^g, Natália Britto dos Santos ^b, Britaldo Soares-Filho ^c, Thadeu Sobral-Souza ^{h, i}, Maurício Humberto Vancine ^h, Marcos Rodrigues ^a



Clima, paisagem e riqueza de borboletas na MA

Diversity and Distributions

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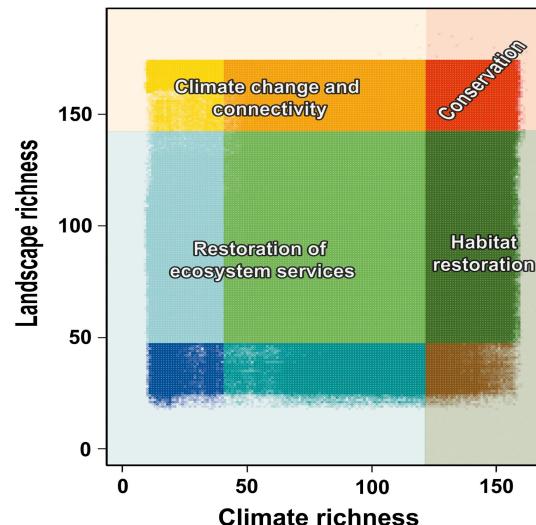
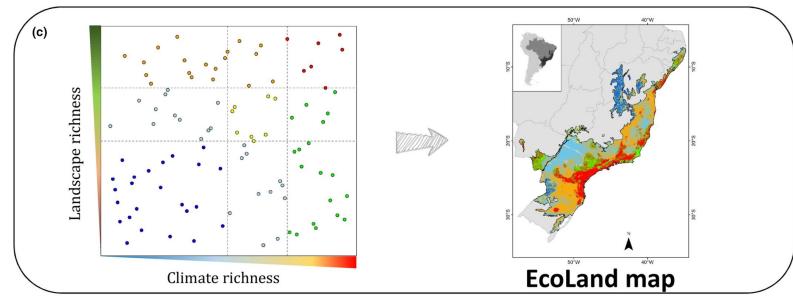
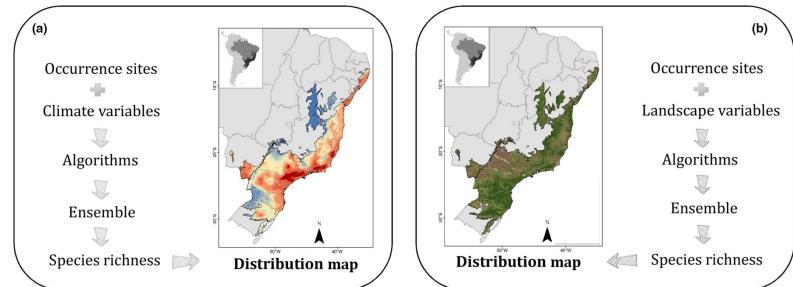
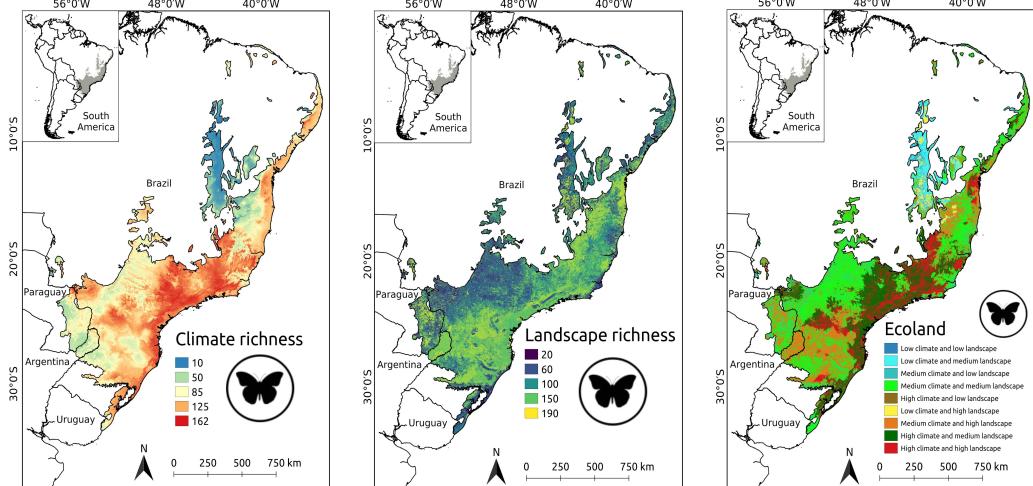
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Effects of landscape modification on species richness patterns of fruit-feeding butterflies in Brazilian Atlantic Forest

Jessie P. Santos ✉, Thadeu Sobral-Souza, Keith S. Brown Jr, Maurício Humberto Vancine, Milton C. Ribeiro, André V. L. Freitas ✉



Paisagem e interações animal-planta na MA

Diversity and Distributions

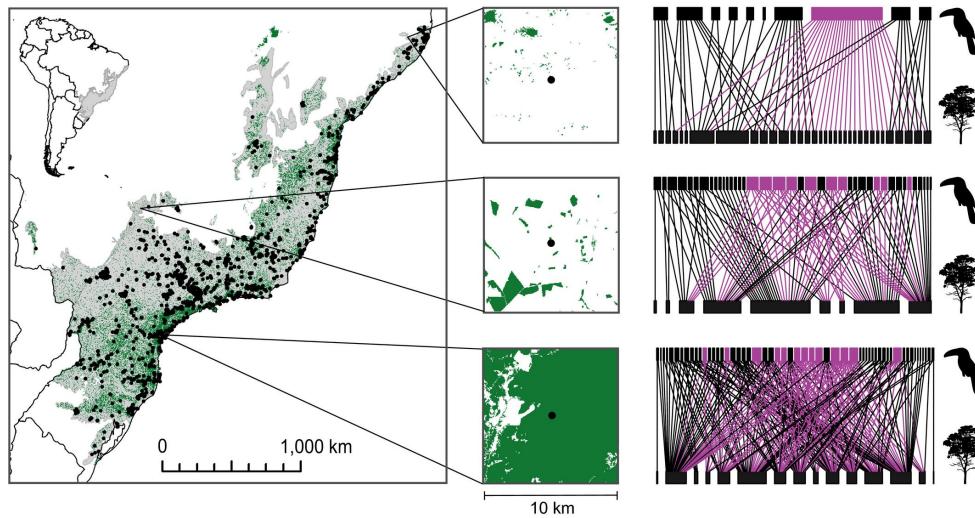
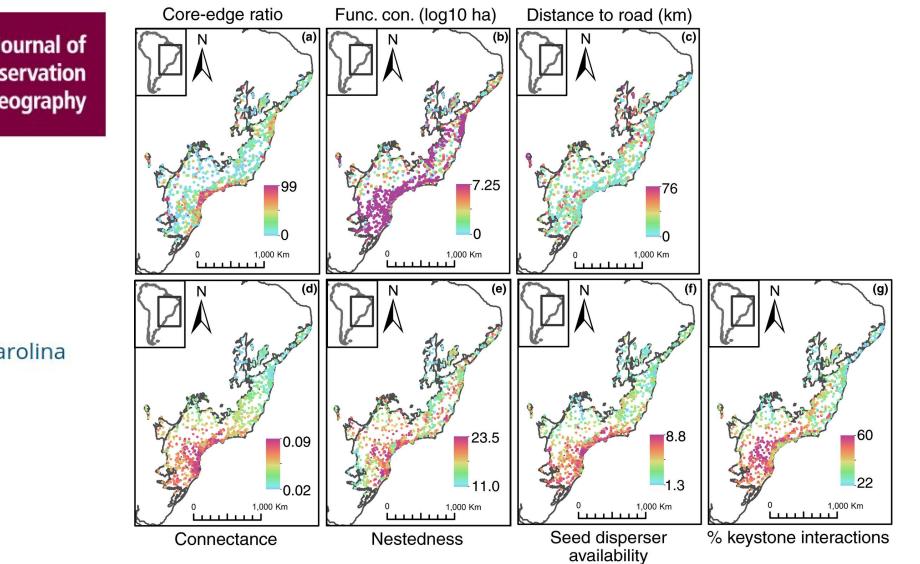
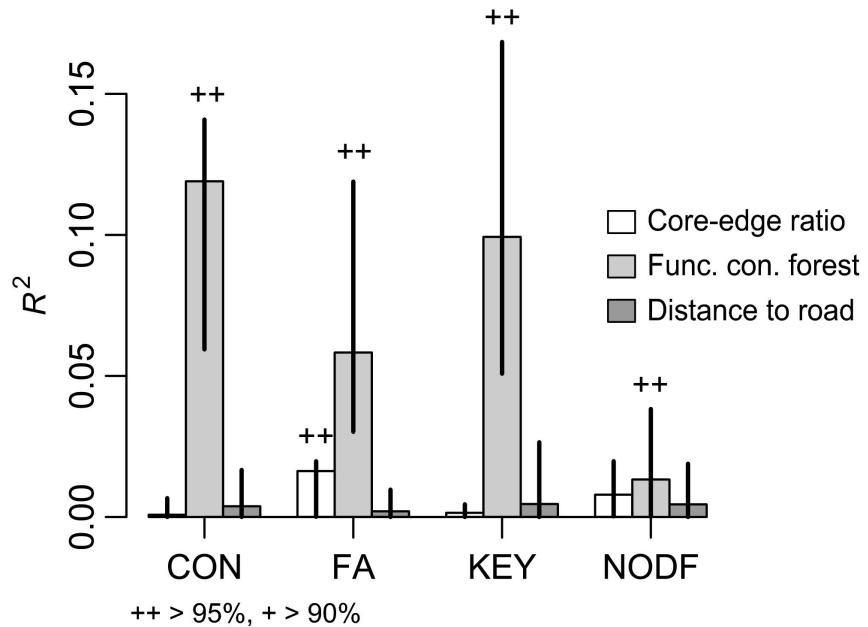
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Fragmented tropical forests lose mutualistic plant-animal interactions

Emma-Liina Marjakangas, Nerea Abrego, Vidar Grøtan, Renato A. F. de Lima, Carolina Bello, Ricardo S. Bovendorp, Laurence Culot, Érica Hasui ... See all authors ▾



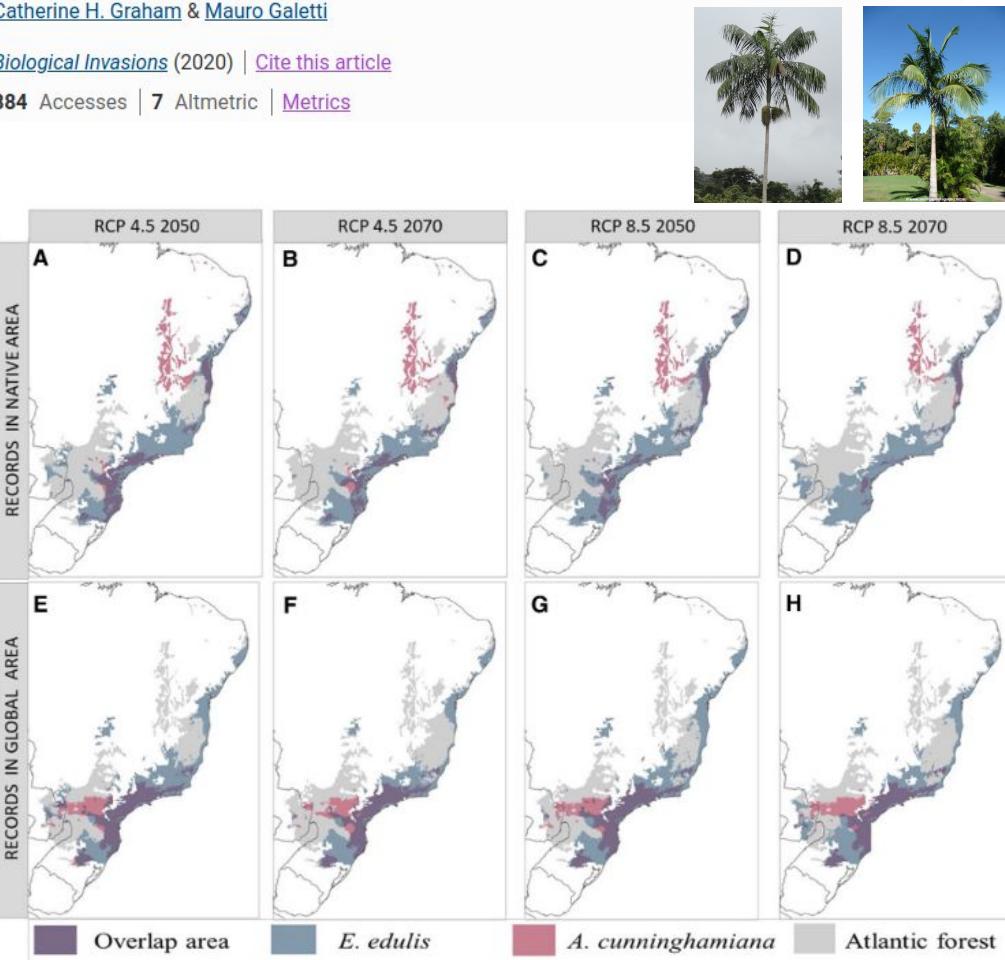
Interação de palmeira nativa e invasora na MA

Environmental niche and functional role similarity
between invasive and native palms in the Atlantic Forest

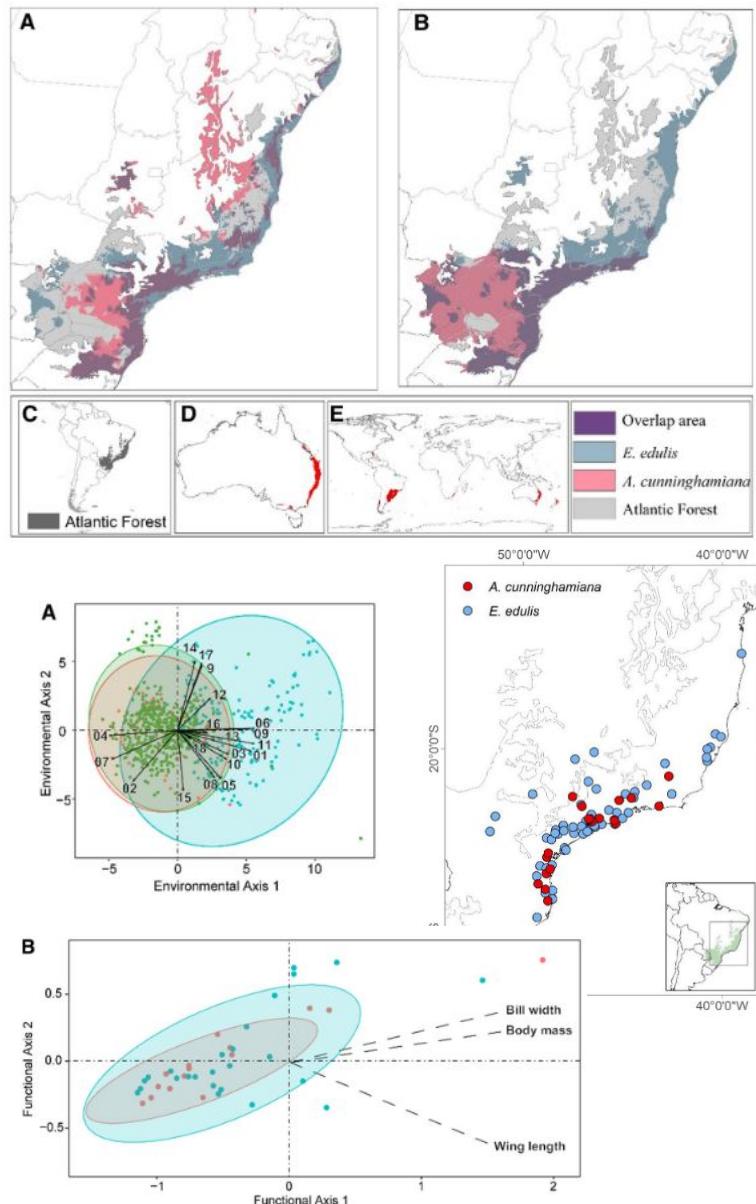
Carolina Bello Ana Laura P. Cintra, Elisa Barreto, Maurício Humberto Vancine, Thadeu Sobral-Souza,
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Biological Invasions (2020) | Cite this article

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Zonas de hibridização potencial de saguis no BR



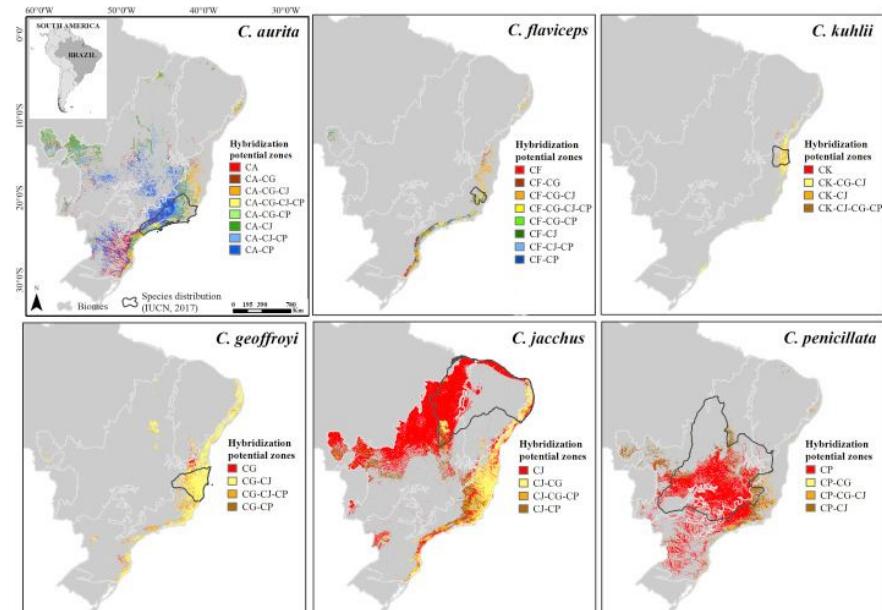
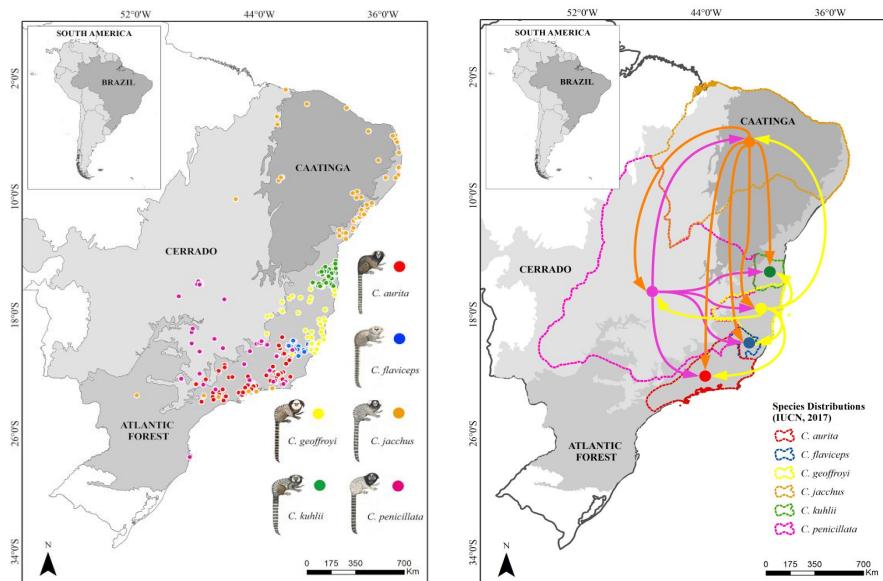
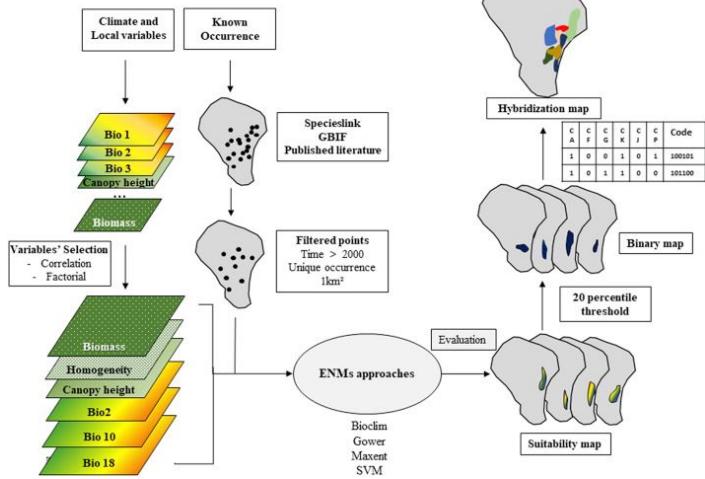
Global Ecology and Conservation

Volume 20, October 2019, e00706



Predicting the potential hybridization zones
between native and invasive marmosets within
Neotropical biodiversity hotspots

Andrea Magro Moraes ^a✉, Maurício Humberto Vancine ^b, Andreza Magro Moraes ^c, Carlos Leandro de Oliveira Cordeiro ^{d, e}, Míriam Plaza Pinto ^f, Adriana Almeida Lima ^f, Laurence Culot ^g, Thiago Sanna Freire Silva ^e, Rosane Garcia Collevatti ^h, Milton Cezar Ribeiro ^a, Thadeu Sobral-Souza ⁱ✉



Eficiência das áreas protegidas da AM e MA



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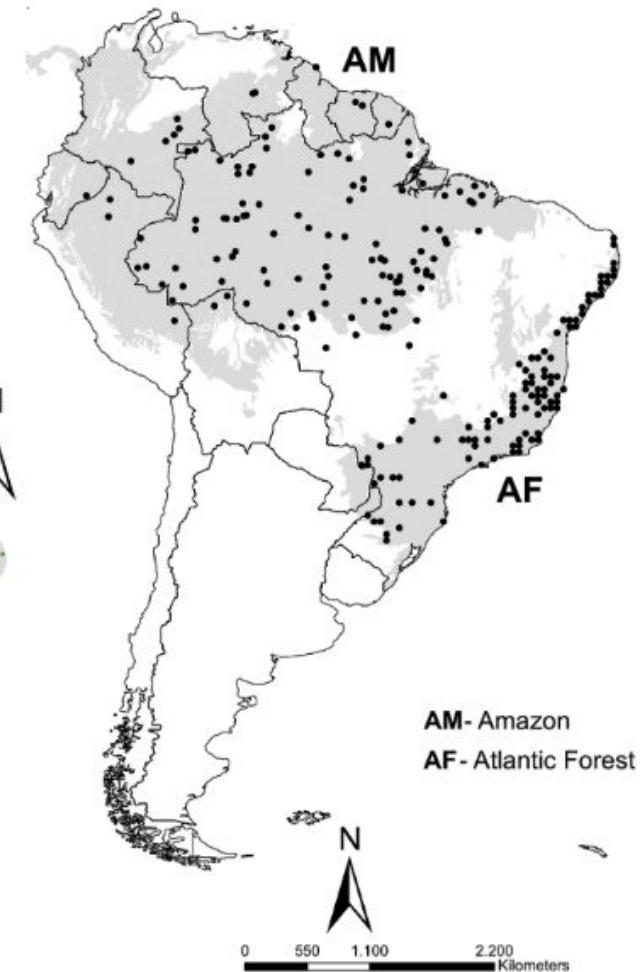
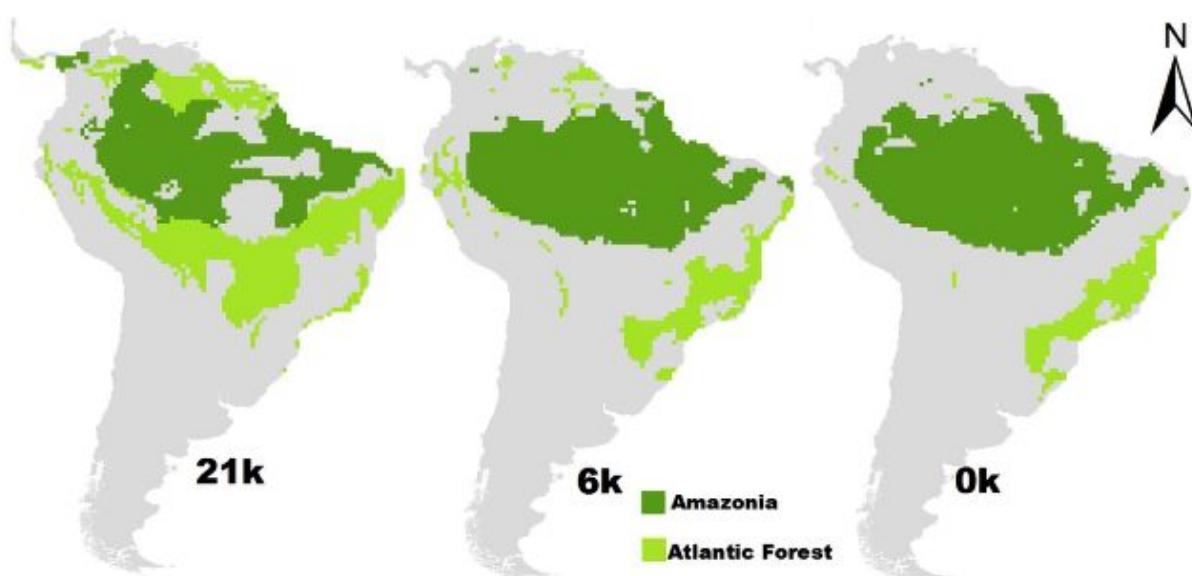


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Efficiency of protected areas in Amazon and Atlantic Forest conservation: A spatio-temporal view

Thadeu Sobral-Souza^{a,b,*}, Maurício Humberto Vancine^a, Milton Cezar Ribeiro^a, Matheus S. Lima-Ribeiro^c

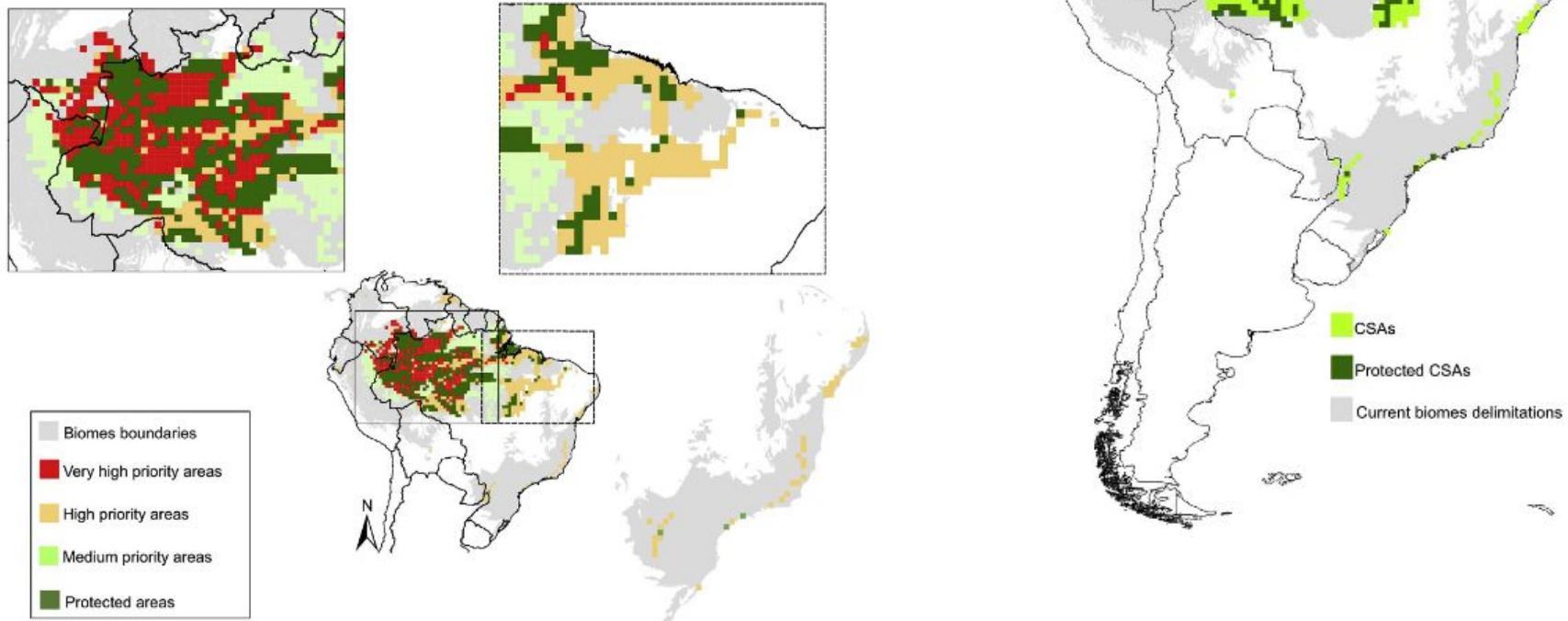


Eficiência das áreas protegidas da AM e MA



Efficiency of protected areas in Amazon and Atlantic Forest conservation: A spatio-temporal view

Thadeu Sobral-Souza^{a,b,*}, Maurício Humberto Vancine^a, Milton Cezar Ribeiro^a, Matheus S. Lima-Ribeiro^c



Predição de ácaros em penas de aves no mundo

Diversity and Distributions

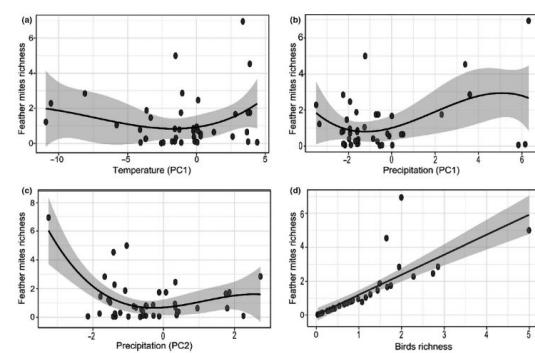
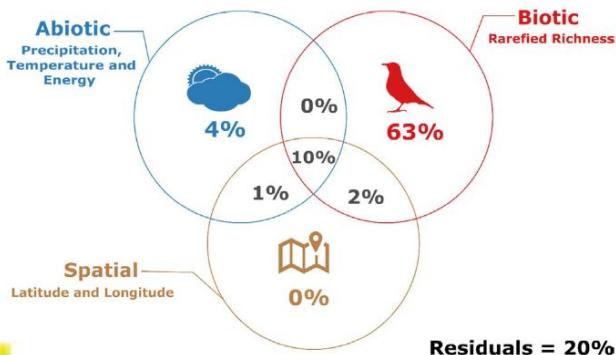
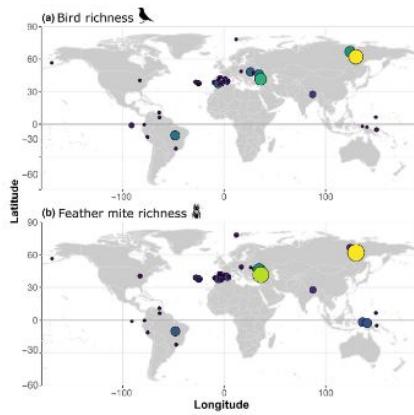
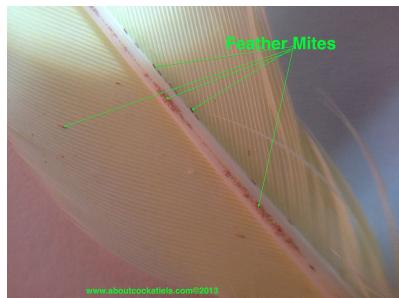
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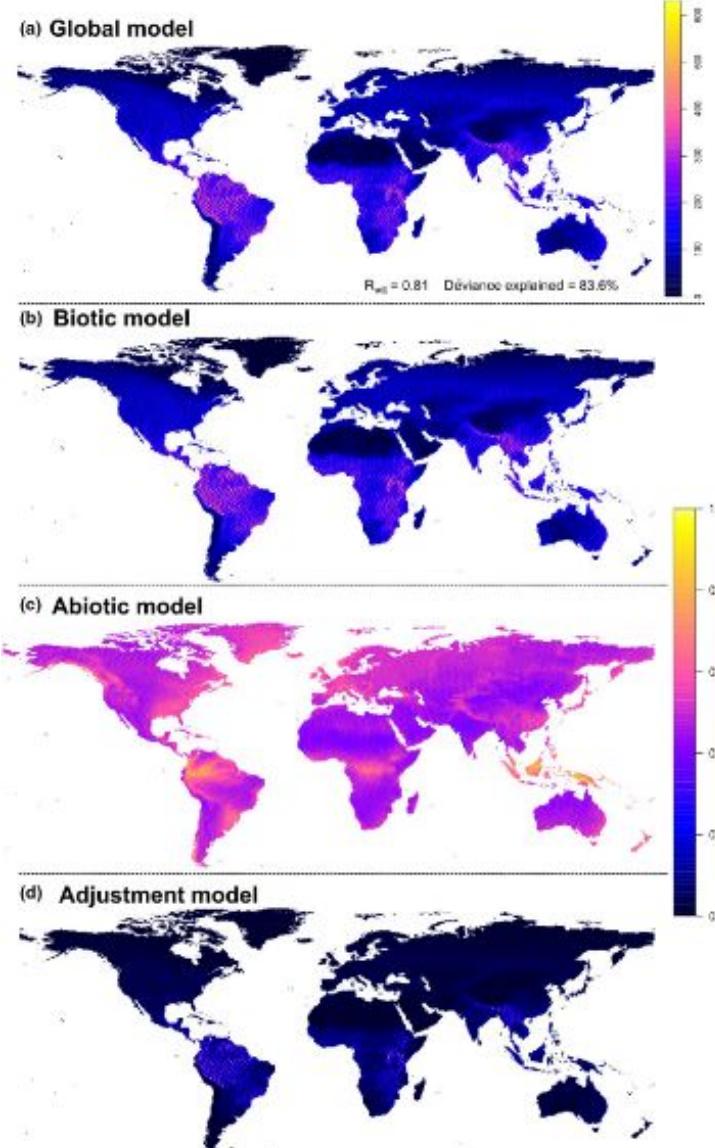
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Host diversity outperforms climate as a global driver of symbiont diversity in the bird-feather mite system

Reginaldo A. F. Gusmão ✉, Fabio A. Hernandes, Maurício H. Vancine, Luciano N. Naka, Jorge Doña, Thiago Gonçalves-Souza ✉

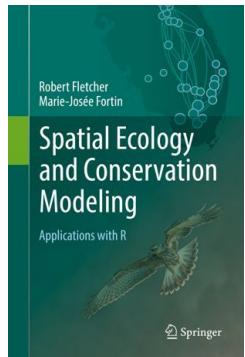


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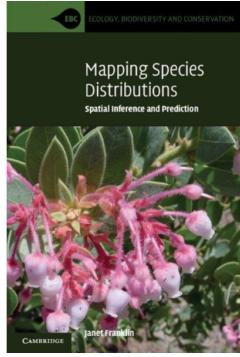


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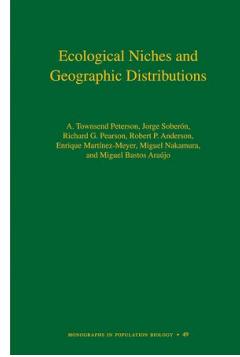
Livros



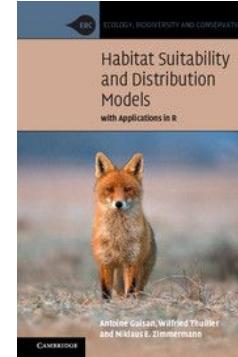
Fletcher and Fortin (2018)



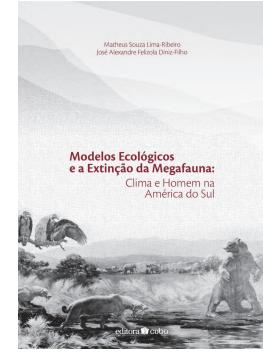
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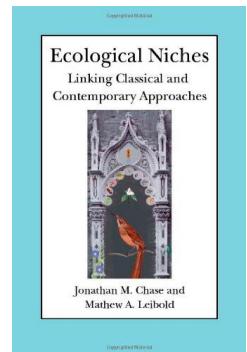
Peterson et al. (2011)



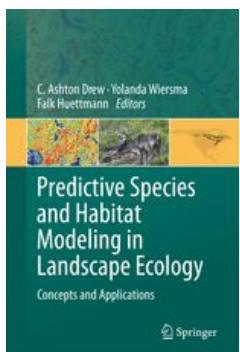
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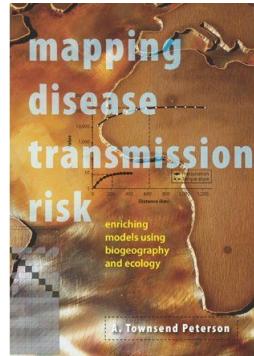
Lima-Ribeiro & Diniz-Filho (2013)



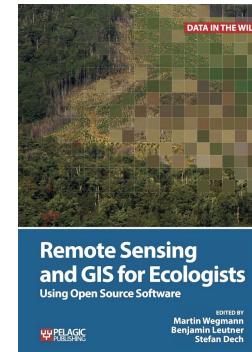
Chase & Leibold (2003)



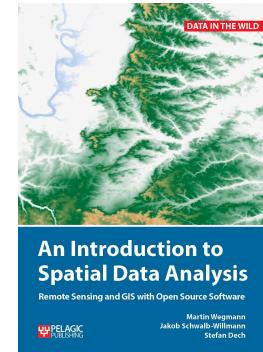
Drew et al. (2011)



Peterson (2014)

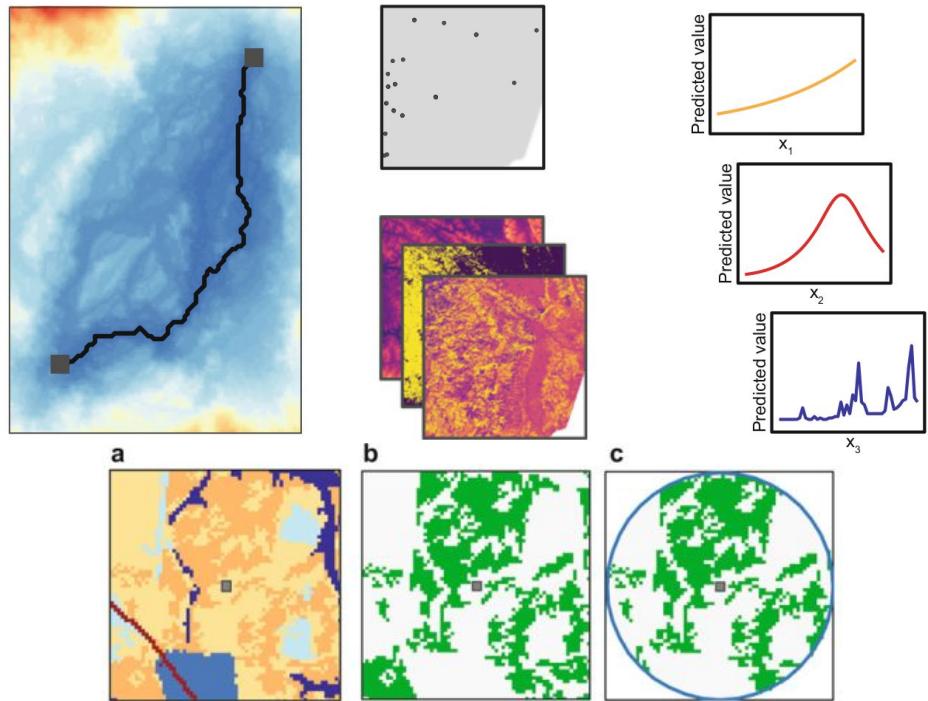
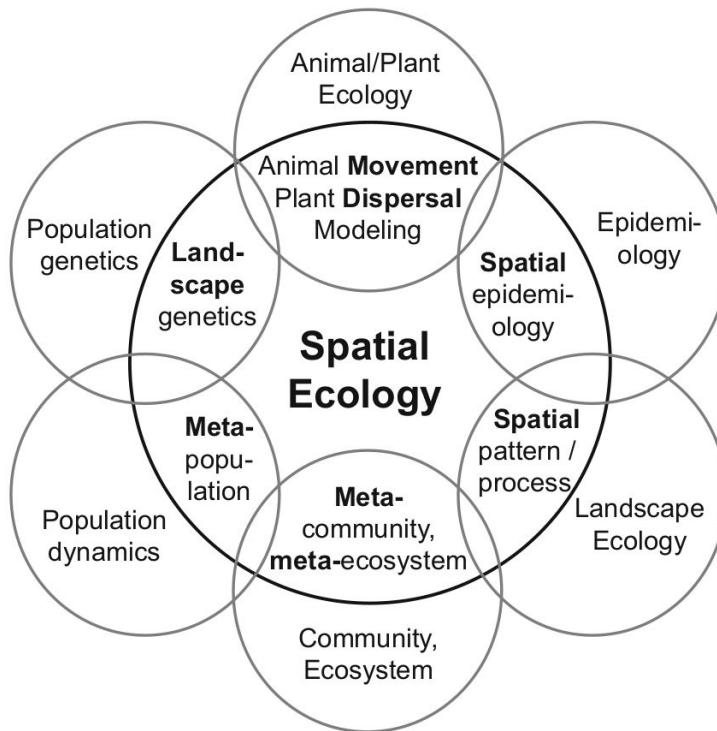


Wegmann et al. (2016)



Wegmann et al. (2020)

Aplicações da Cartografia para a Ecologia Espacial



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Lab. Ecologia Espacial e Conservação (LEEC)

02/04/2021

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