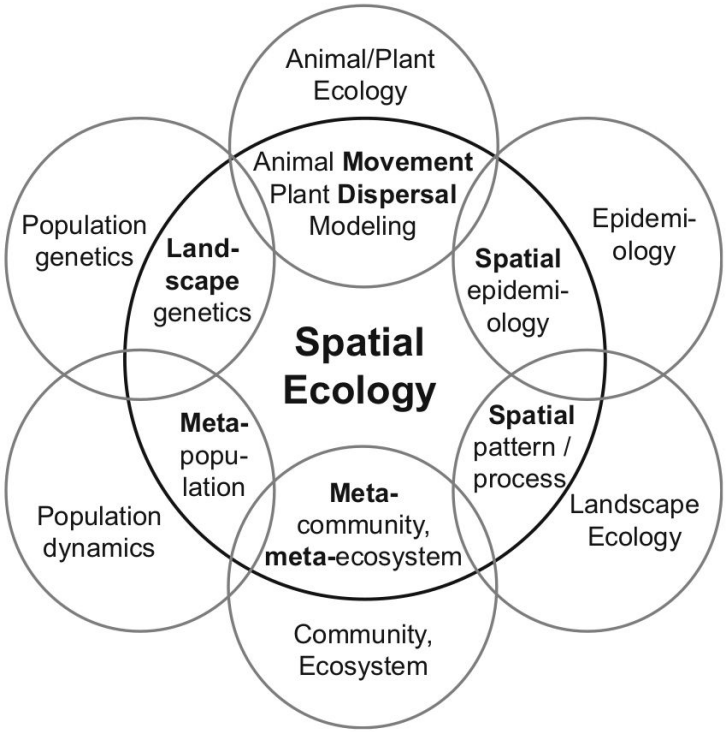
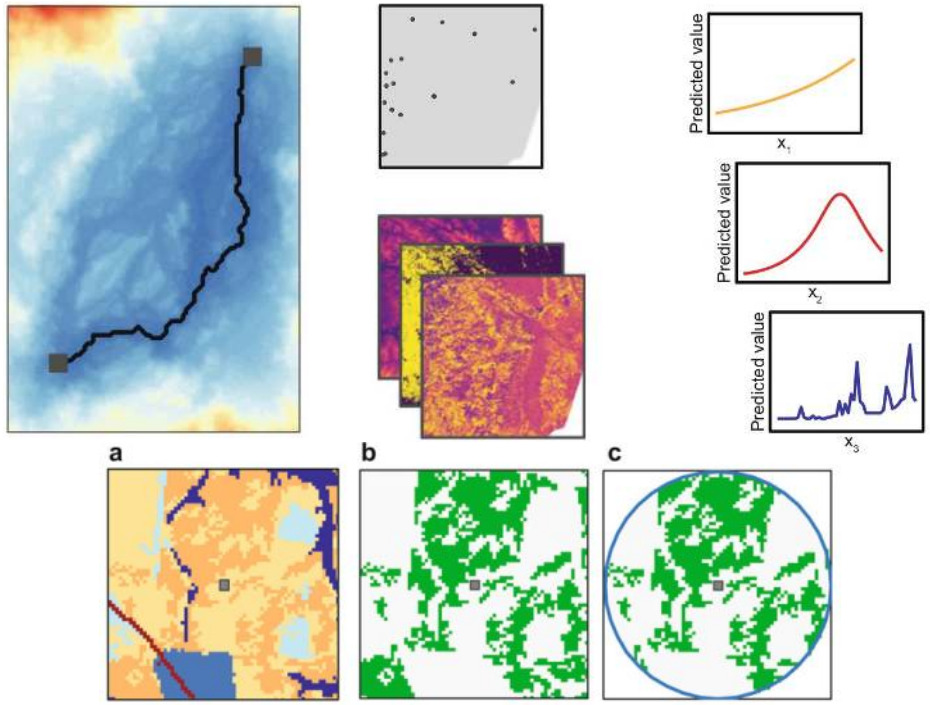
Aplicações da Cartografia para a Ecologia Espacial





Maurício Vancine
UNESP - Rio Claro/SP
Lab. Ecologia Espacial e Conservação (LEEC)
02/04/2021

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

unesp
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, ...]

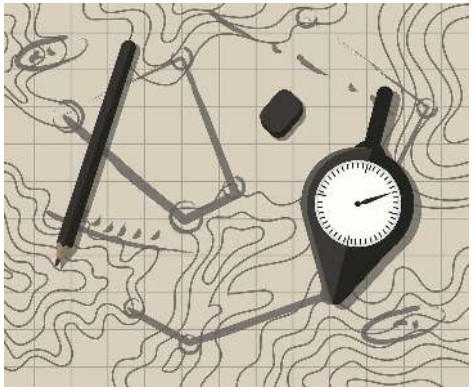
Contato e informações

mauricio.vancine@gmail.com
@mauriciovancine
mauriciovancine.github.io

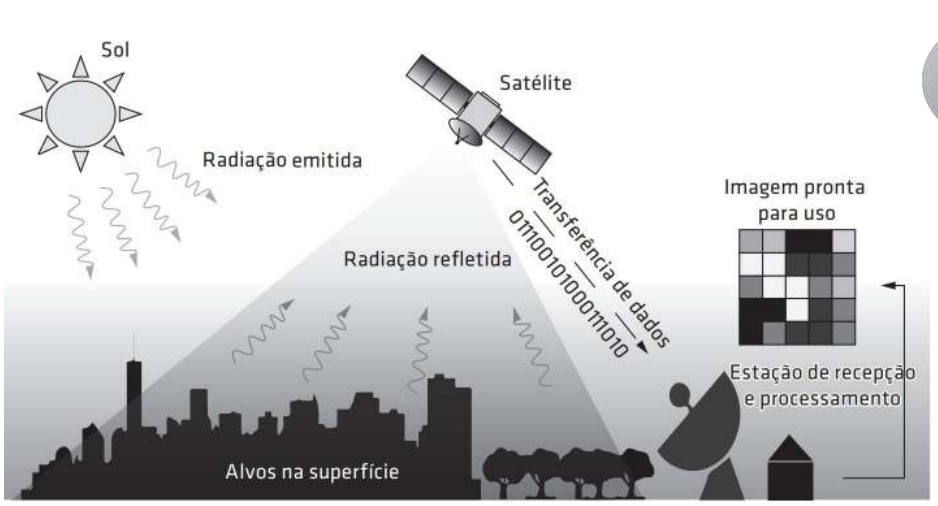
2. Cartografia

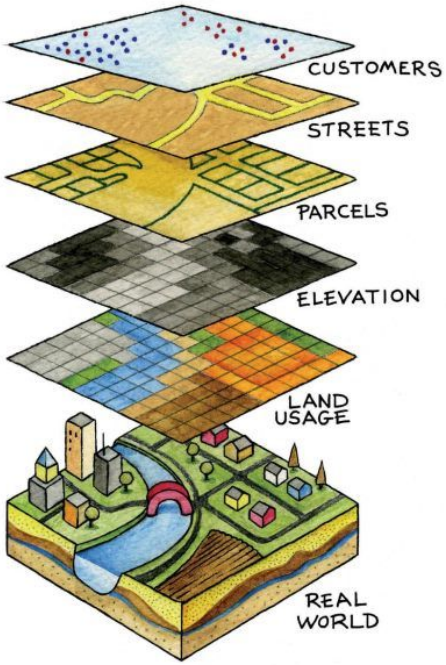
Cartografia

Geoprocessamento



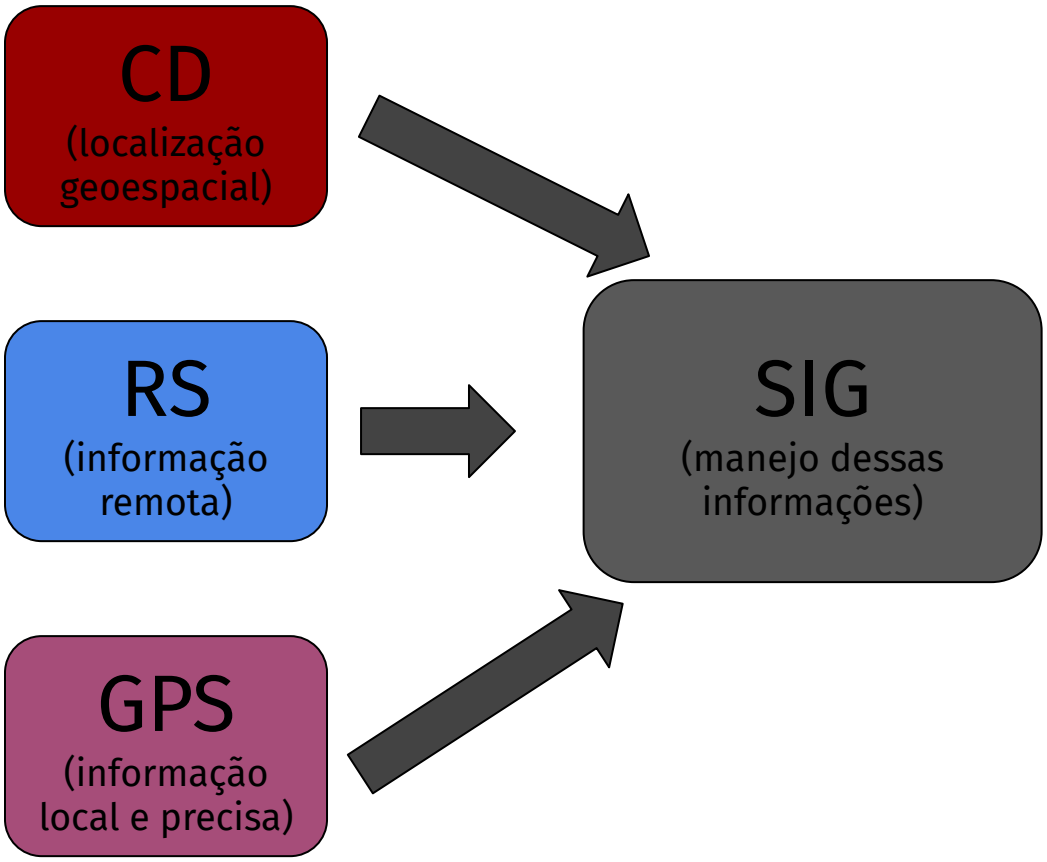
1. Cartografia [digital] (CD)
2. Sensoriamento Remoto (RS)
3. *Global Positioning System* (GPS)
4. Sistemas de Informações Geográficas (SIG)





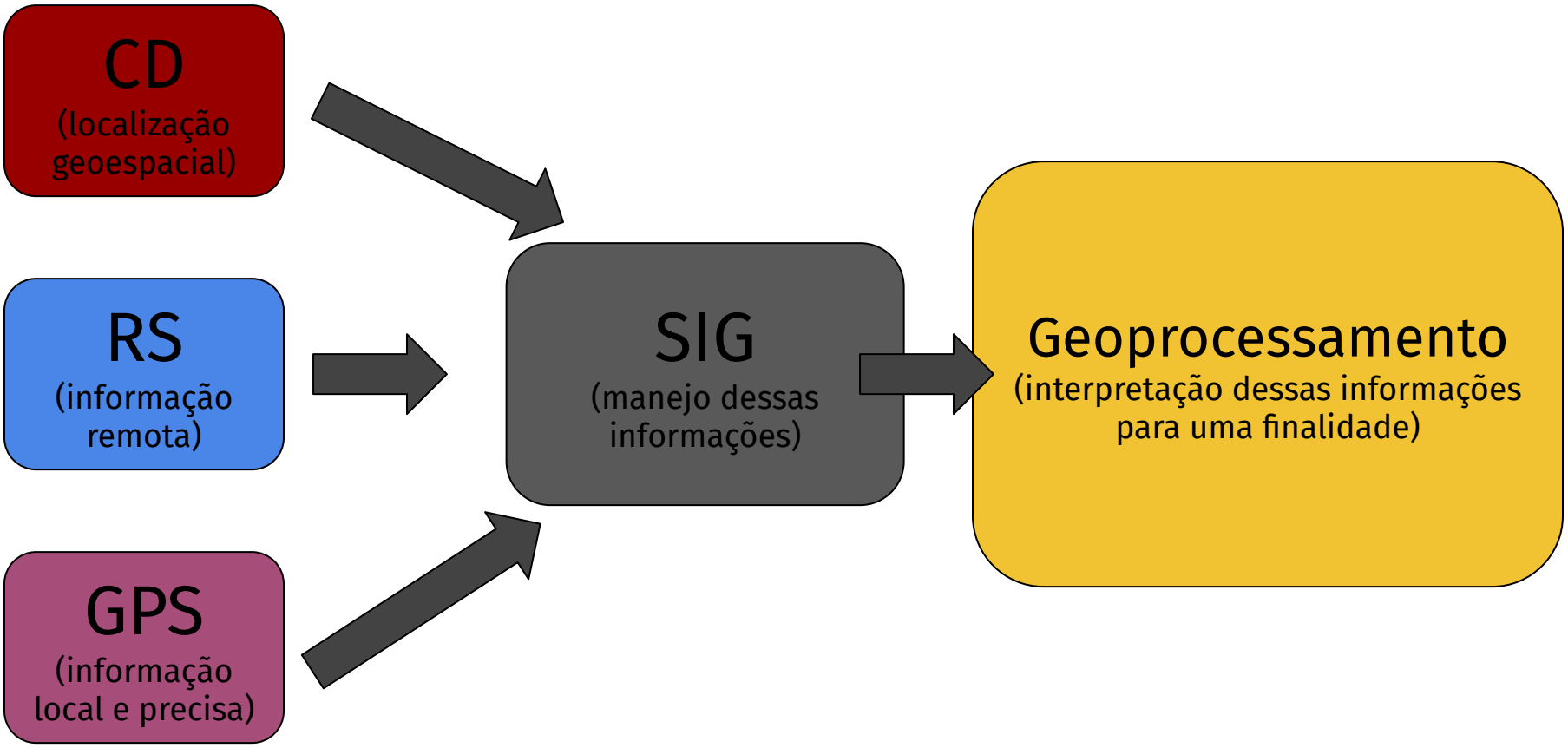
Cartografia

Gerar informações para tomada de decisões



Cartografia

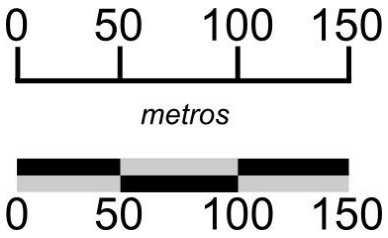
Gerar informações para tomada de decisões

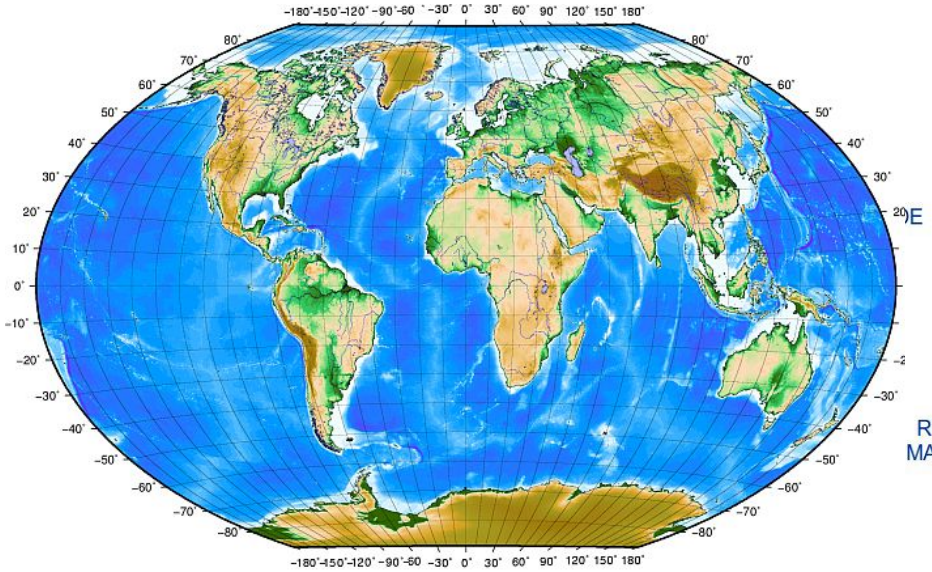


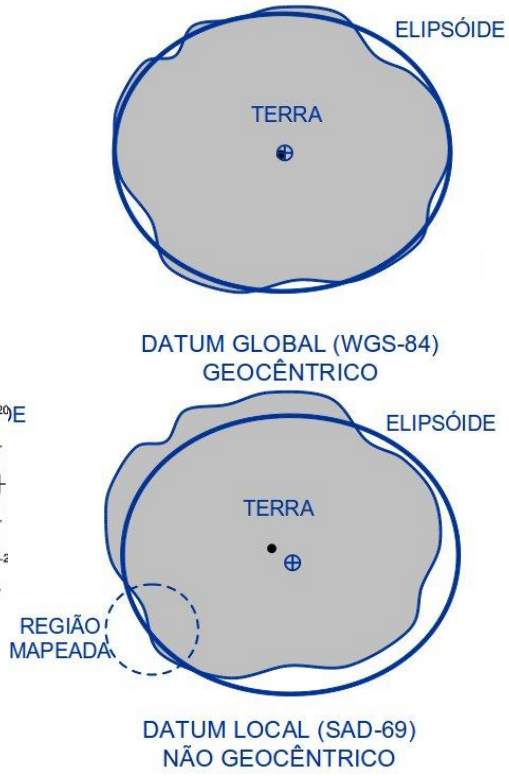
Cartografia

Conceitos em cartografia

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

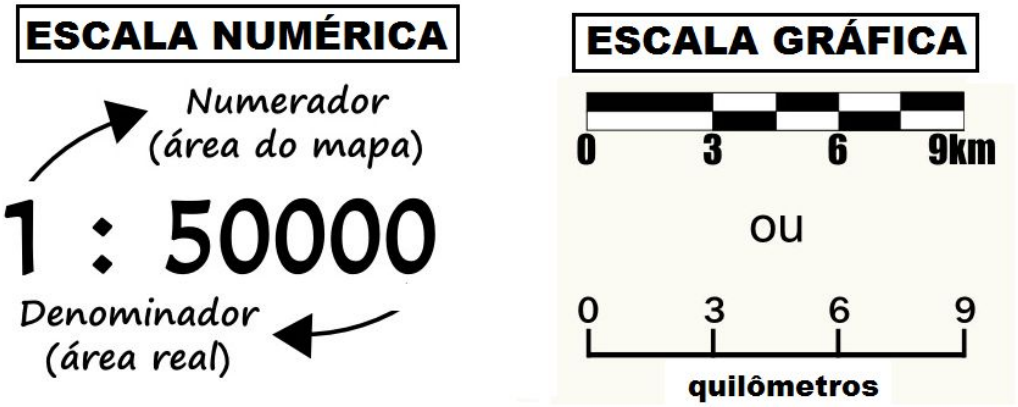


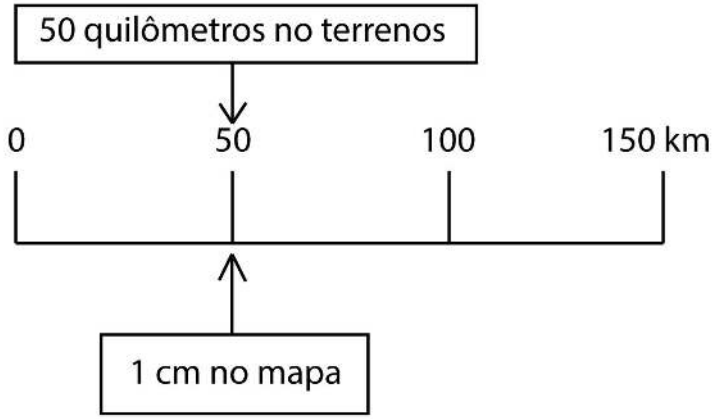




Cartografia

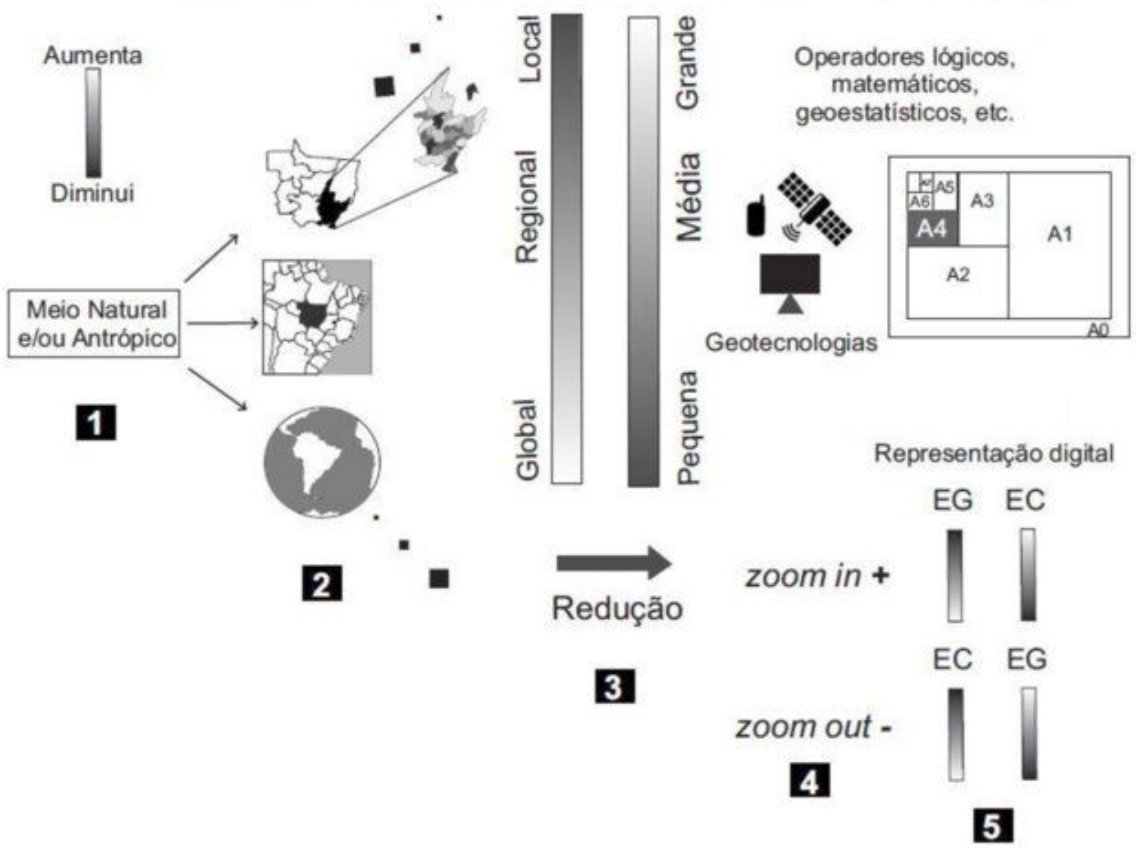
Escala





Escala

Escala Geográfica (EG) x Escala Cartográfica (EC)

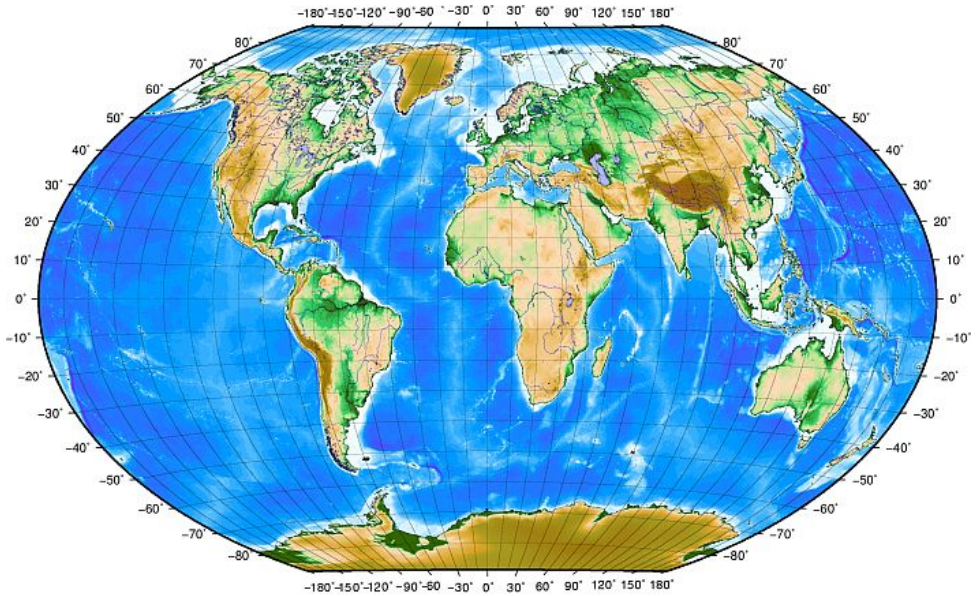


Fonte: GUIRRA, A. P. M. (2017)

Cartografia

Sistemas referência de coordenadas (SRC)

Geográficos (graus)

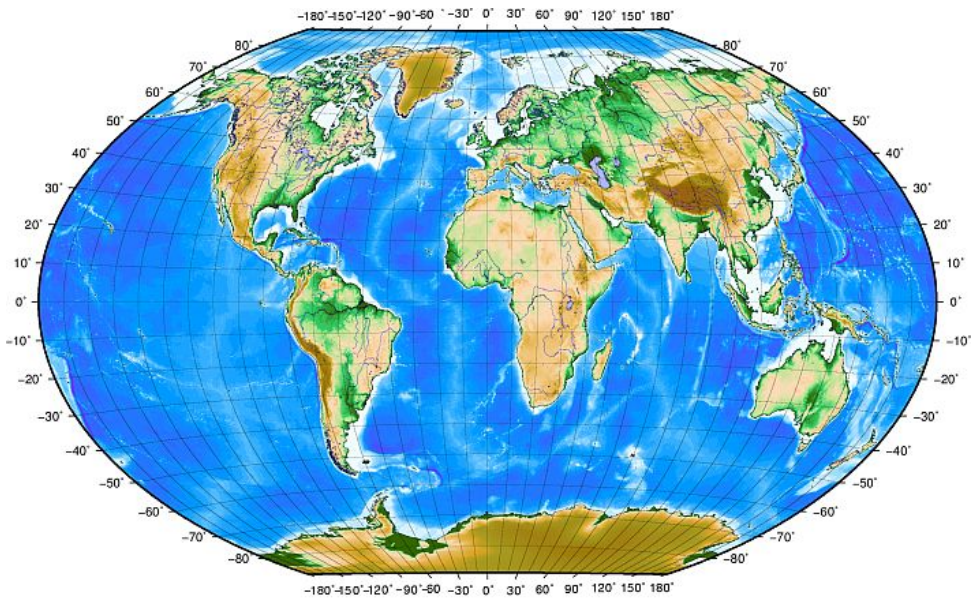


https://docs.qgis.org/3.4/pt_BR/docs/gentle_gis_introduction/coordinate_reference_systems.html

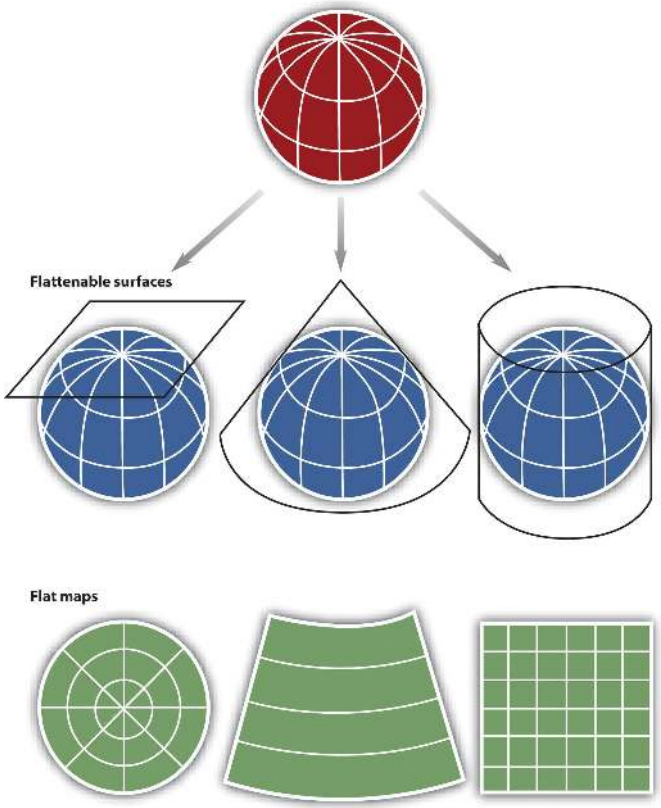
Cartografia

Sistemas referência de coordenadas (SRC)

Geográficos (graus)



Projetados (metros)



https://docs.qgis.org/3.4/pt_BR/docs/gentle_gis_introduction/coordinate_reference_systems.html

Cartografia

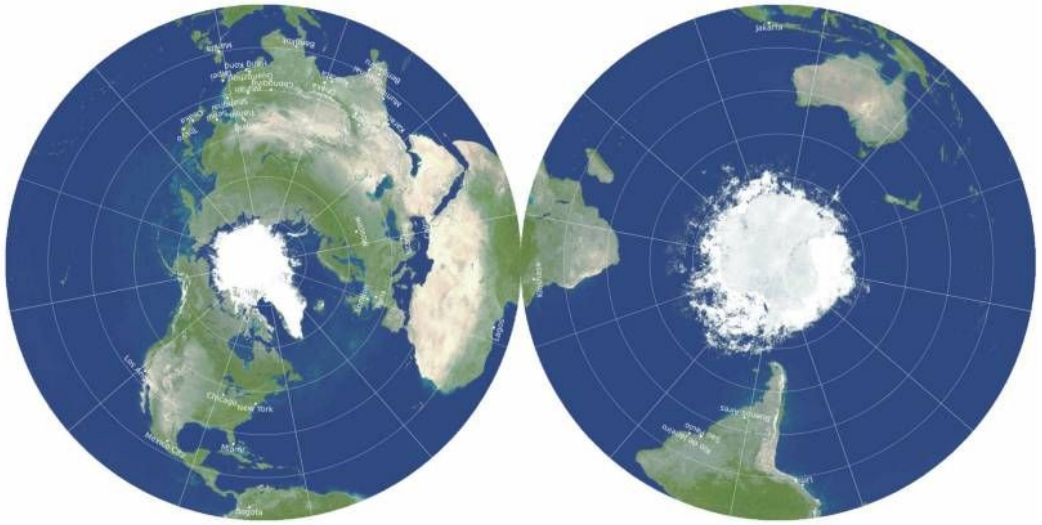
Nova projeção com menos distorções possível

Flat Maps that improve on the Winkel Tripel

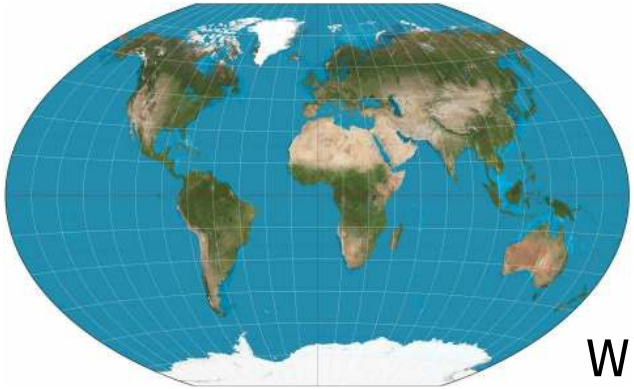
J. Richard Gott III[1], David M. Goldberg[2], and Robert J. Vanderbei[3]

Distorções:

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



Gott, Goldberg e Vanderbei

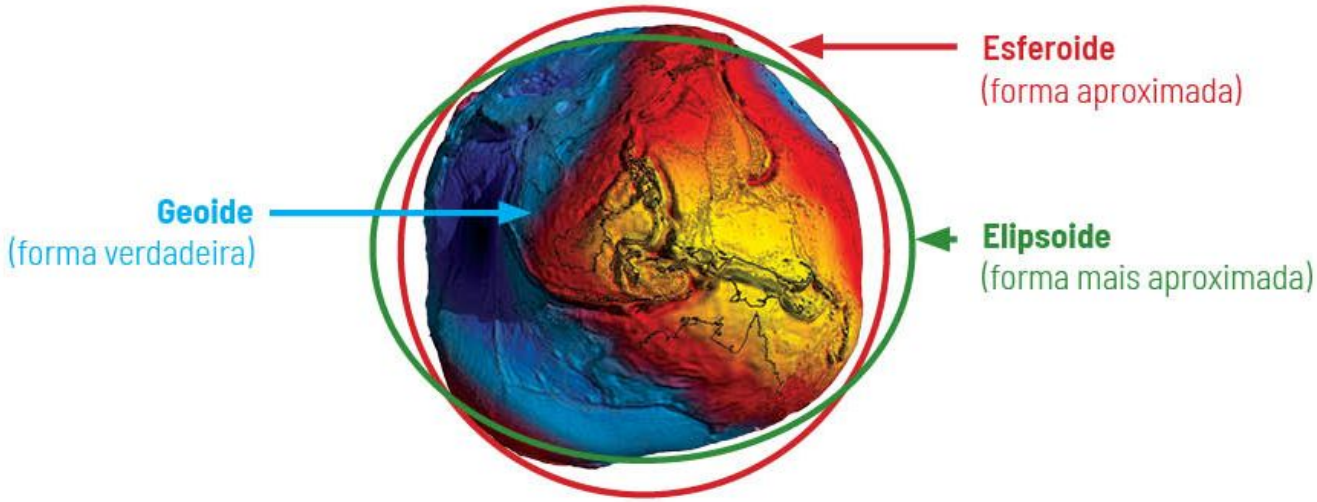


Winkel Tripel

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

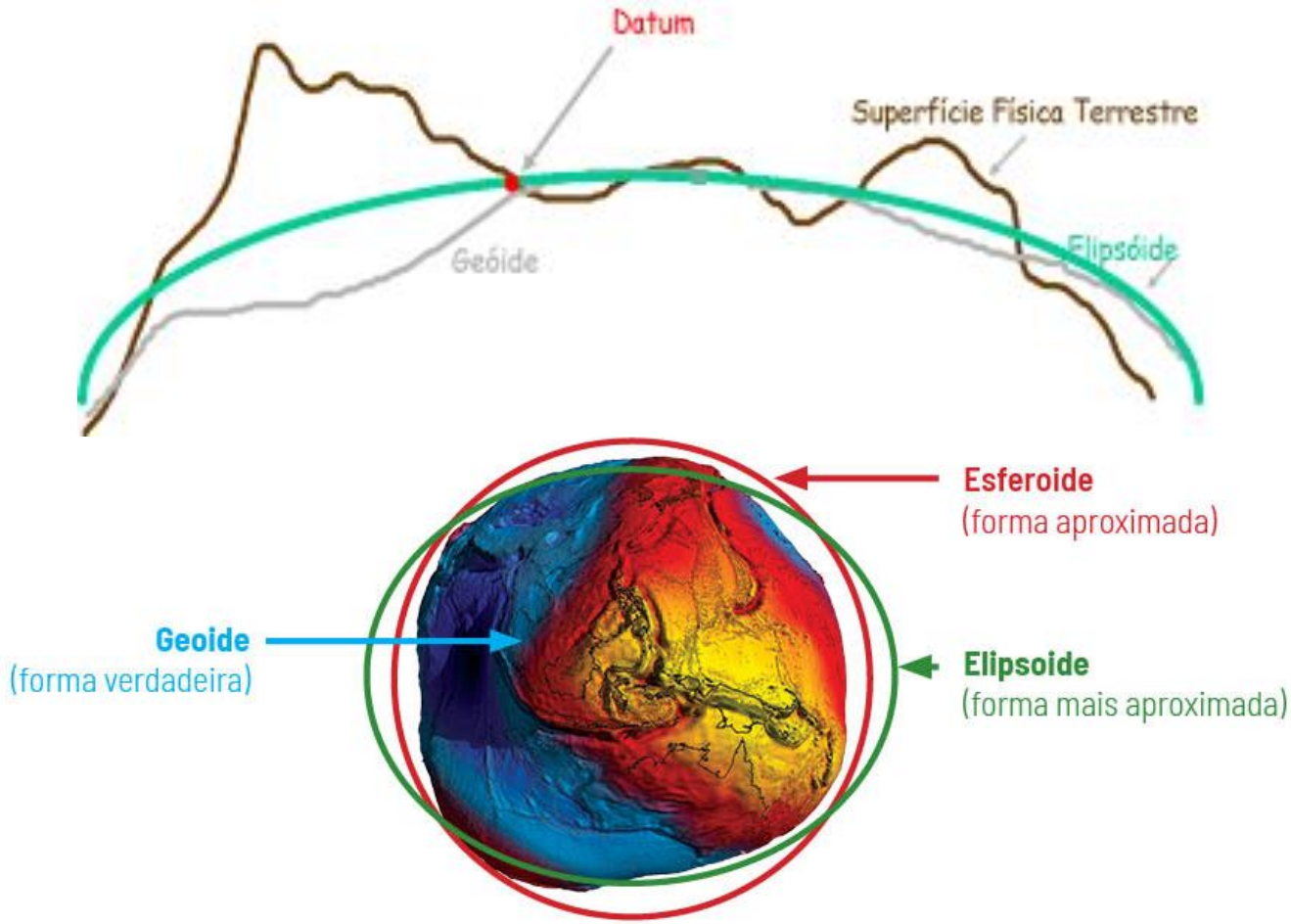
Cartografia

Datum



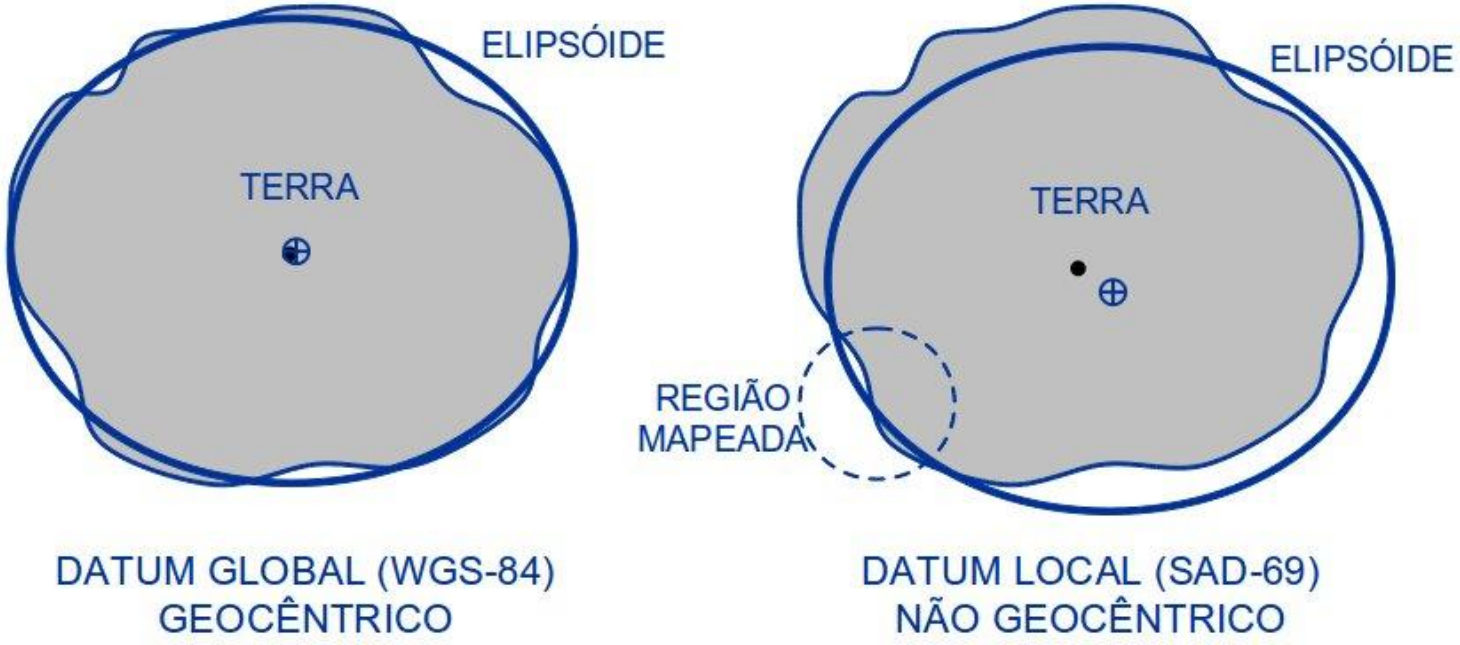
Cartografia

Datum



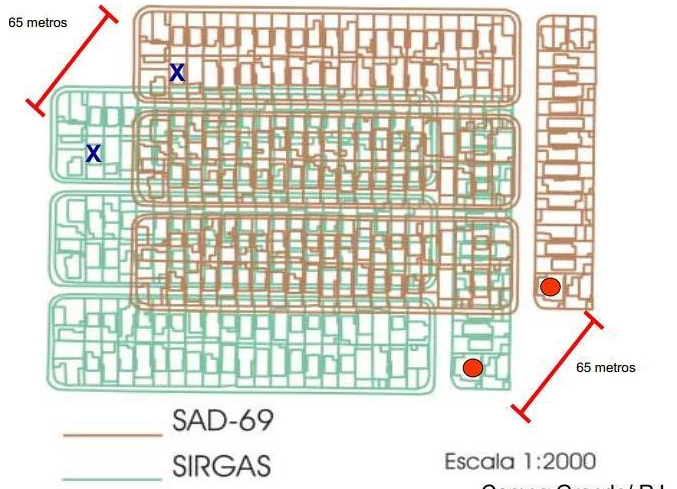
Cartografia

Datum

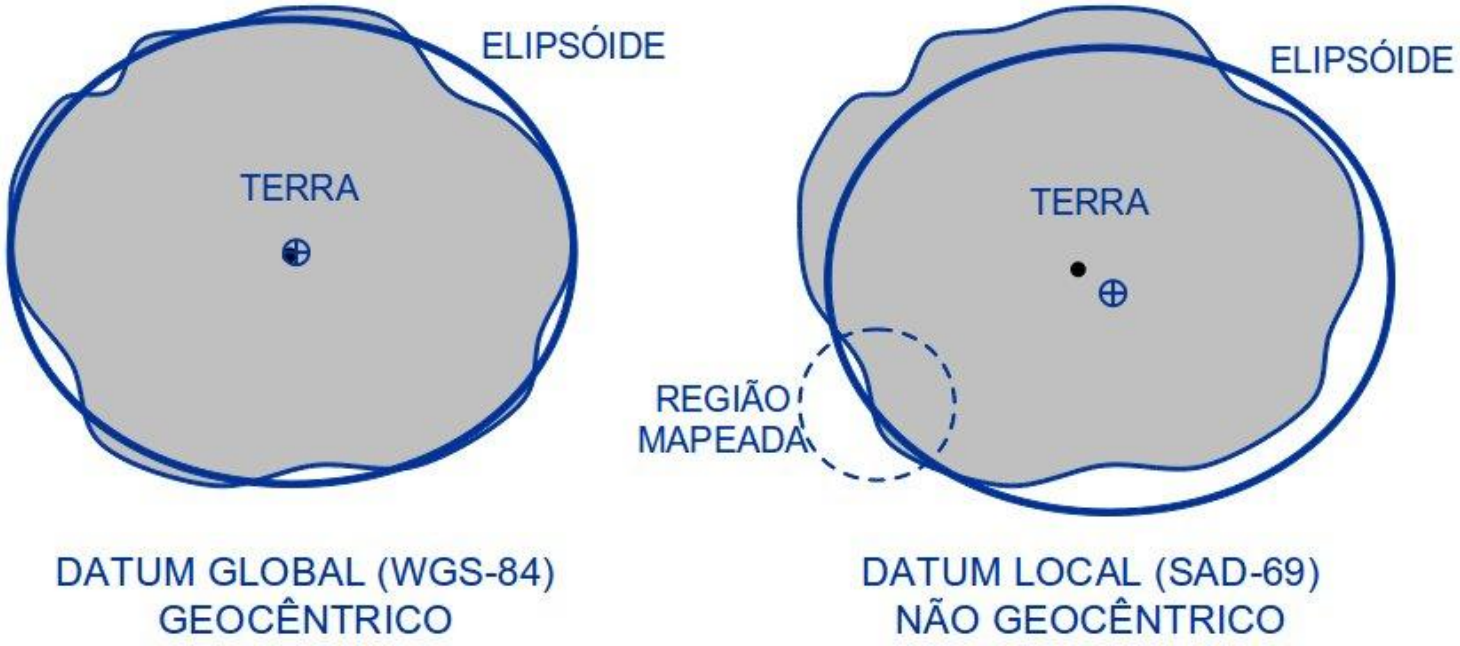


Cartografia

Datum

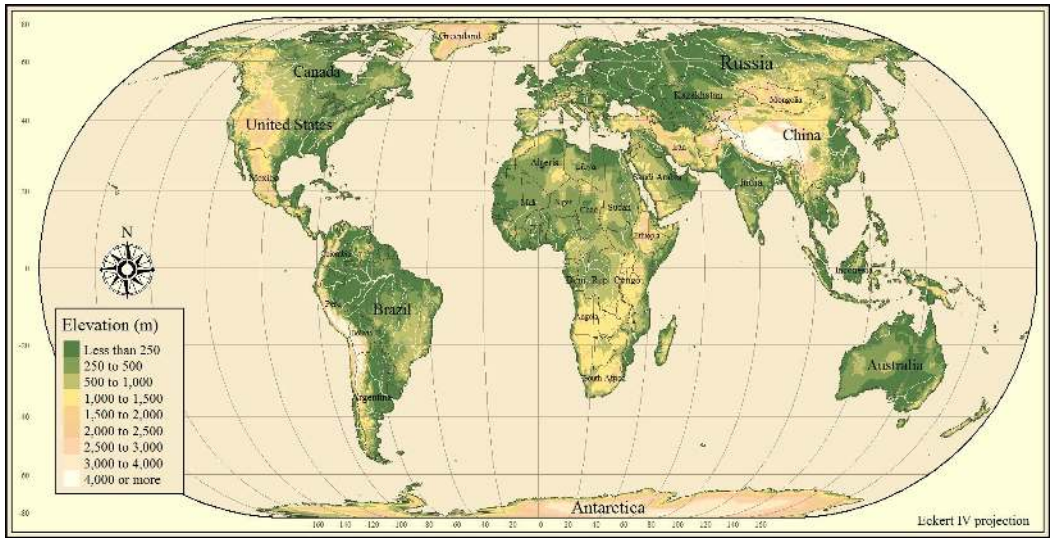


Campo Grande/ RJ



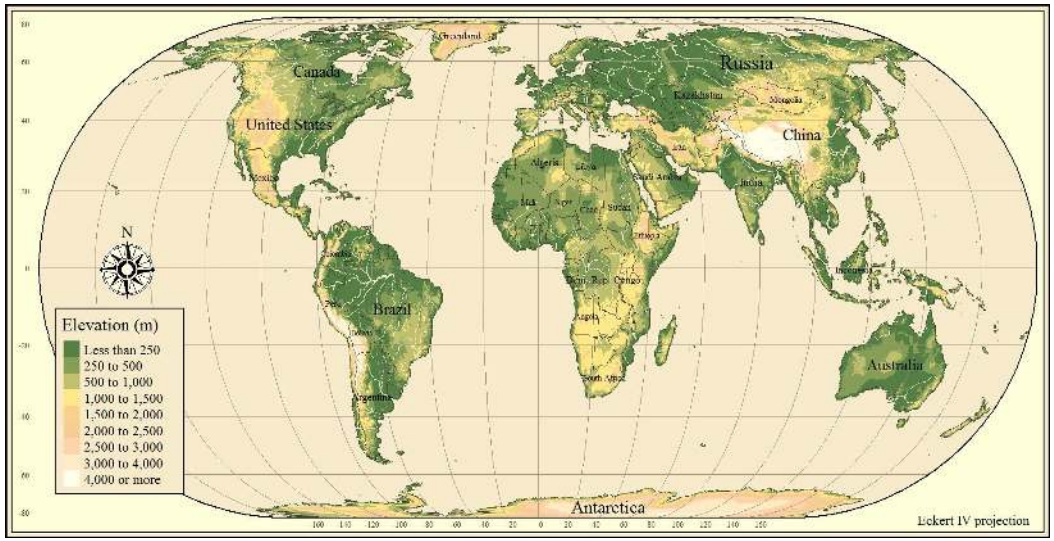
Cartografia

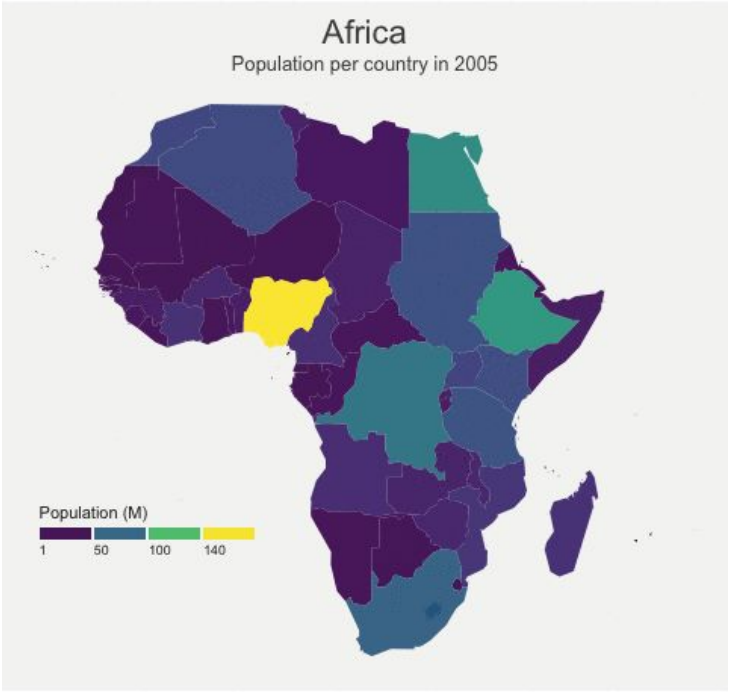
Tipos de mapas



Cartografia

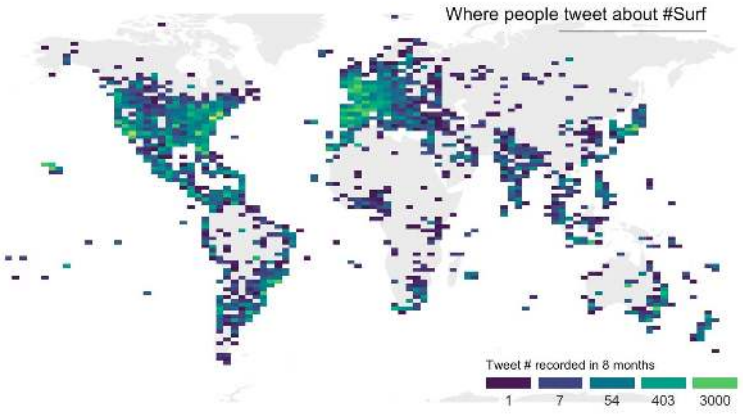
Tipos de mapas

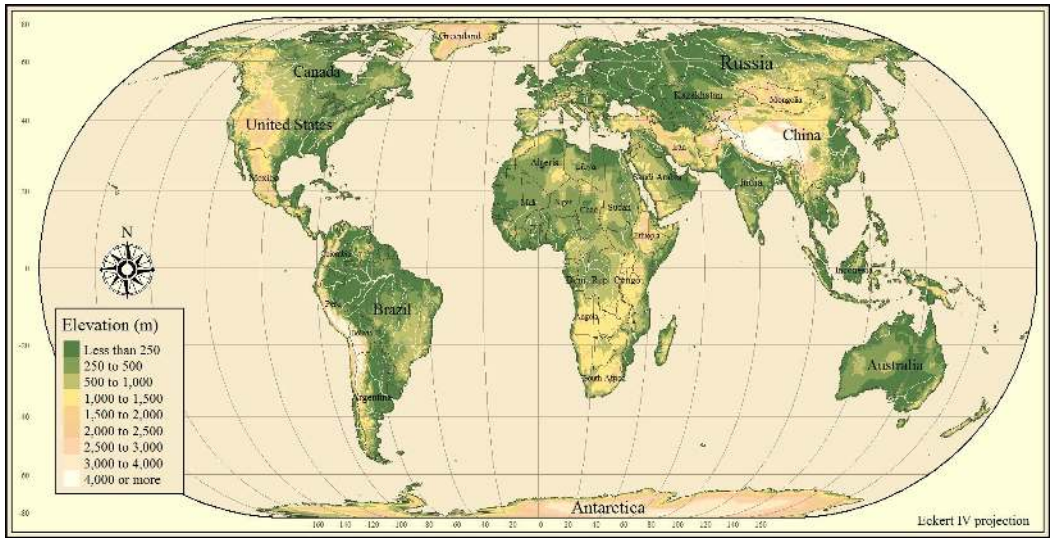


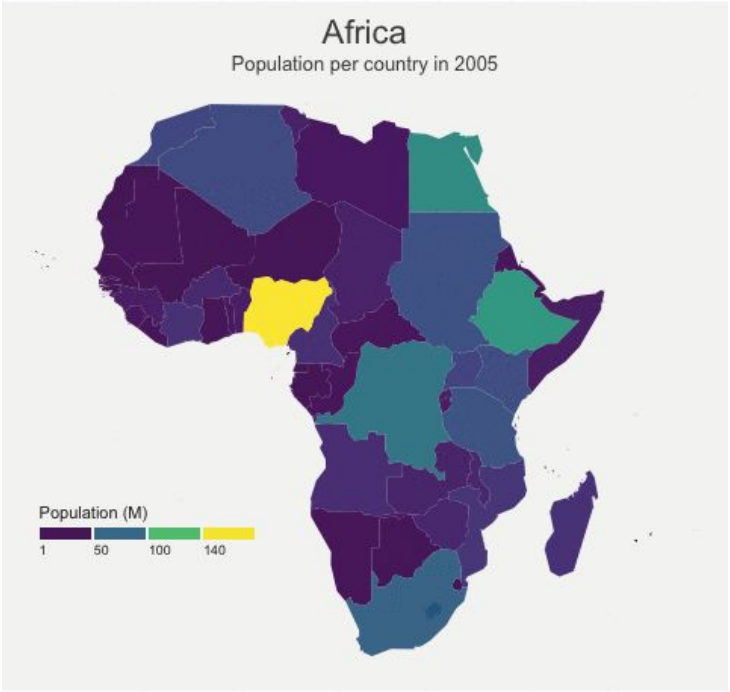


Cartografia

Tipos de mapas

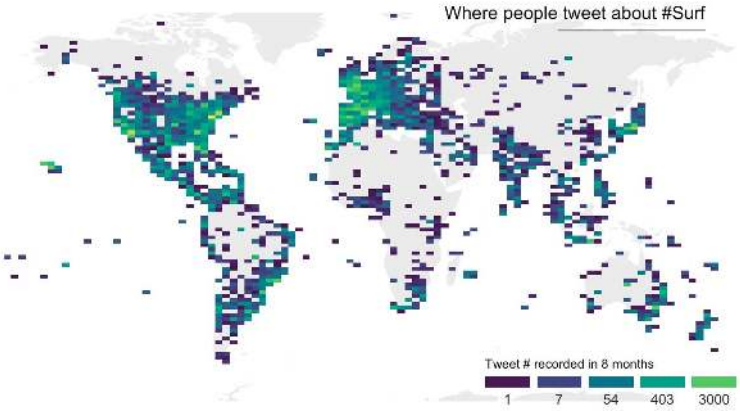


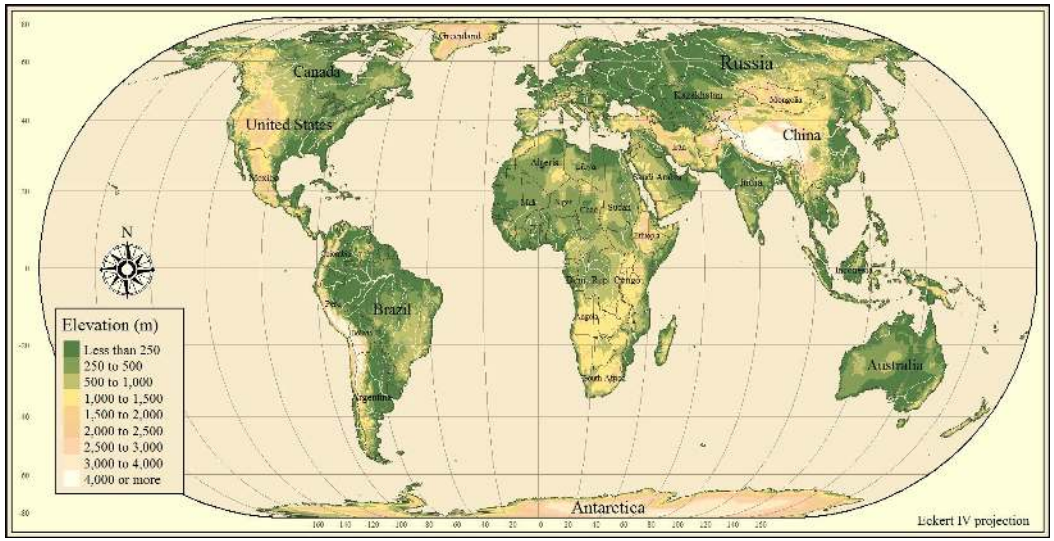


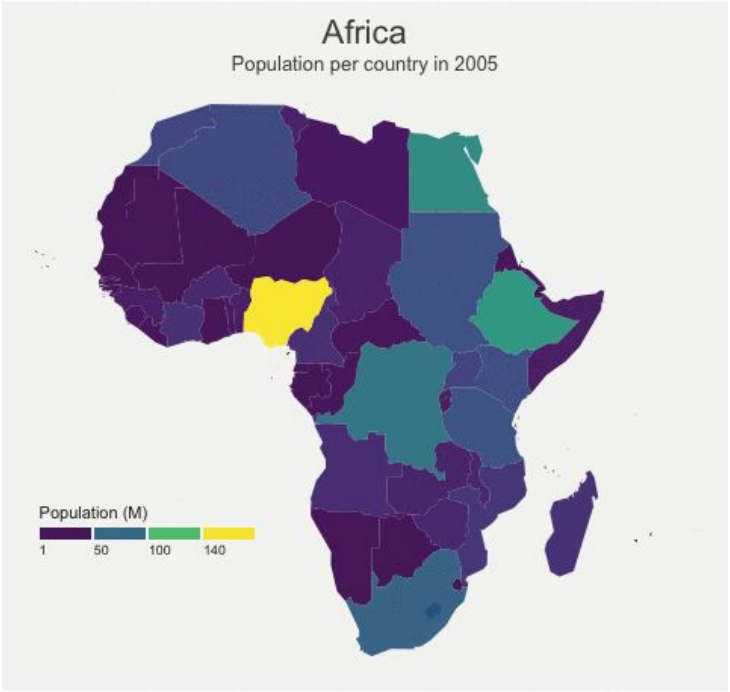


Cartografia

Tipos de mapas

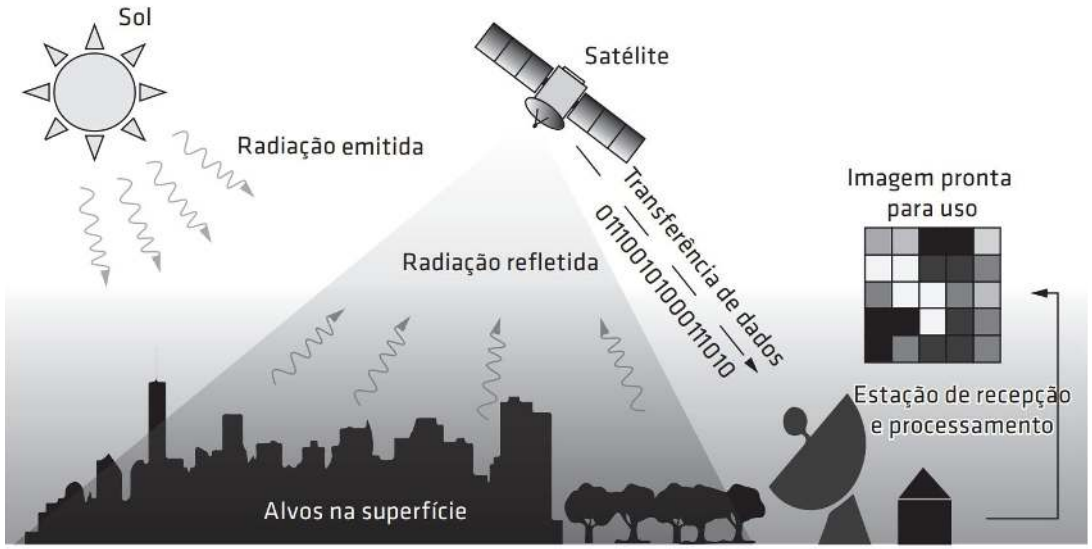






Cartografia

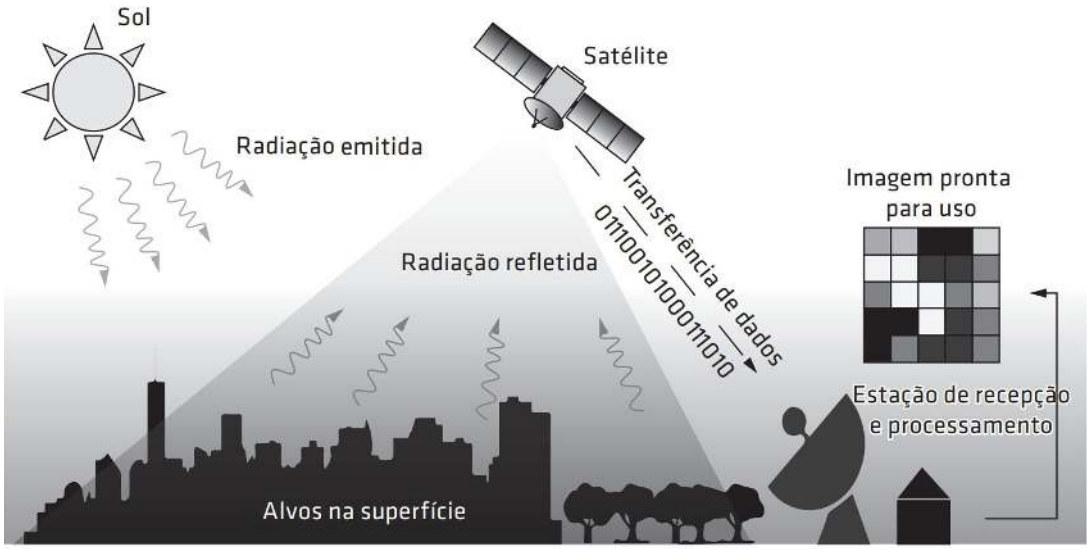
Sensoriamento Remoto

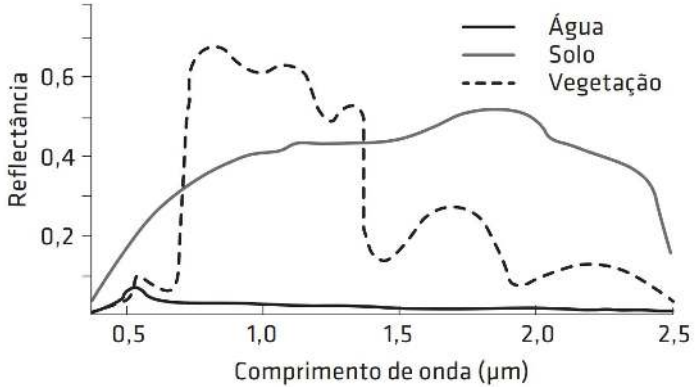


Zanotta et al. (2019)

Cartografia

Sensoriamento Remoto



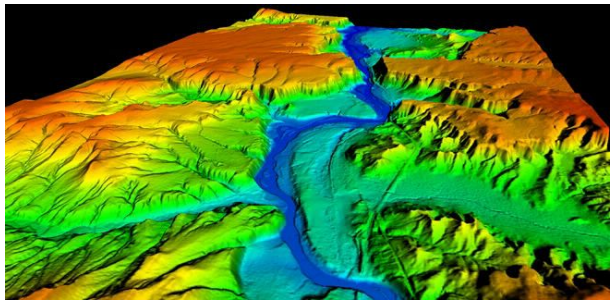


		Reflectância		
		*P*x1	*P*x2	*P*x3
Bandas do sensor	B_1	16%	7%	12%
	B_2	20%	6%	14%
	B_3	27%	17%	8%
	B_4	33%	47%	0%
	B_5	48%	35%	0%
	B_7	49%	18%	0%

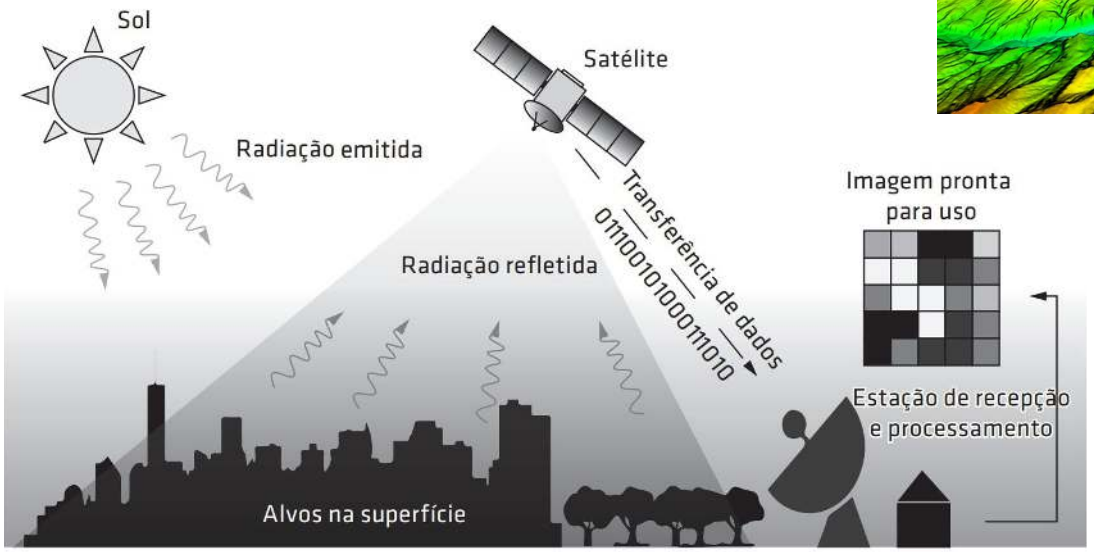
Zanotta et al. (2019)

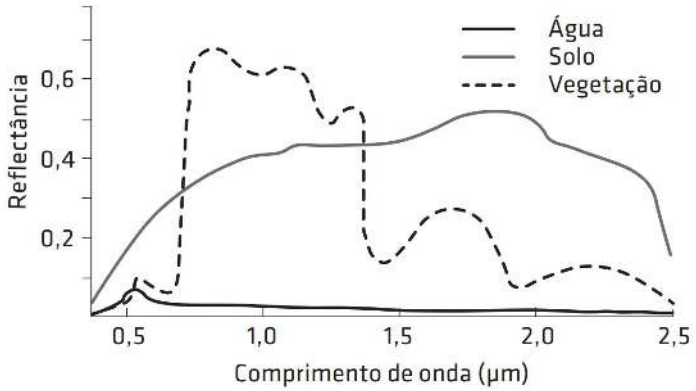
Cartografia

Sensoriamento Remoto



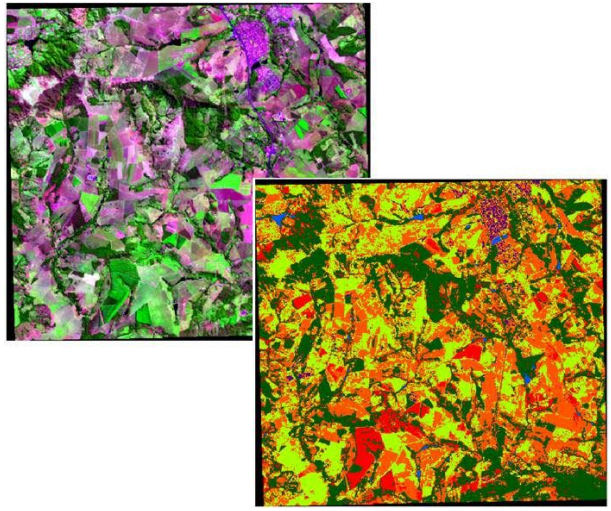
Modelo Digital de Elevação Zanotta et al. (2019)





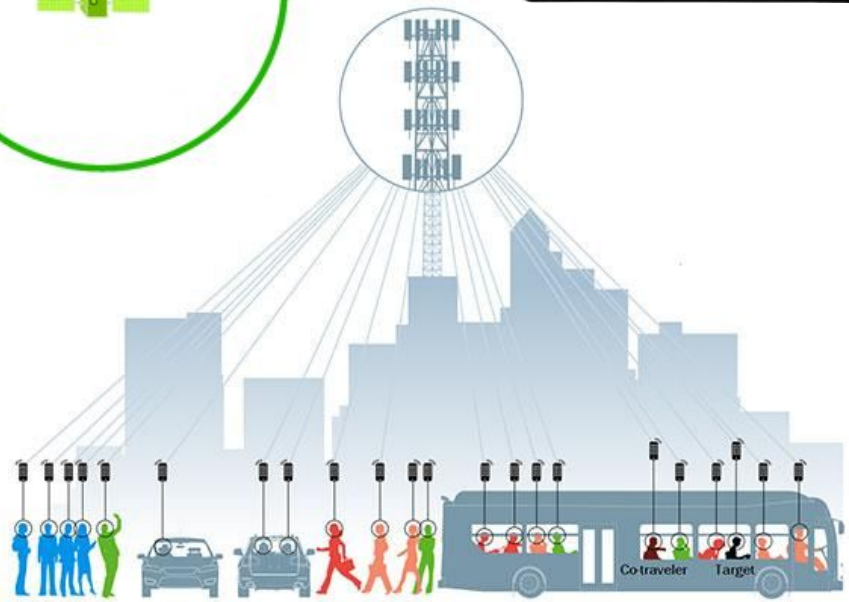
		Reflectância		
		*P*x1	*P*x2	*P*x3
Bandas do sensor	B_1	16%	7%	12%
	B_2	20%	6%	14%
	B_3	27%	17%	8%
	B_4	33%	47%	0%
	B_5	48%	35%	0%
	B_7	49%	18%	0%

Segmentação e Classificação



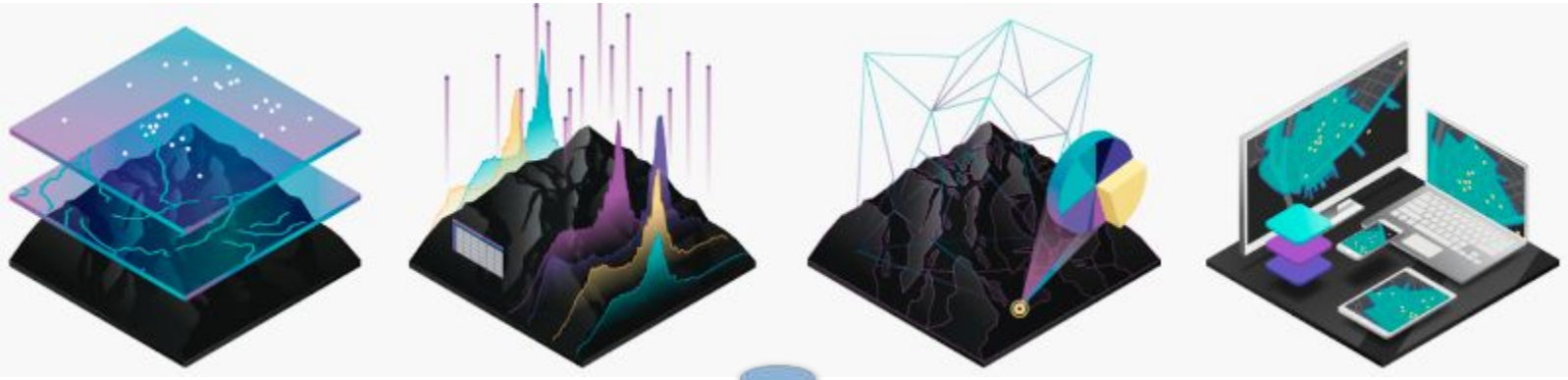
Cartografia

Global Positioning System (GPS)



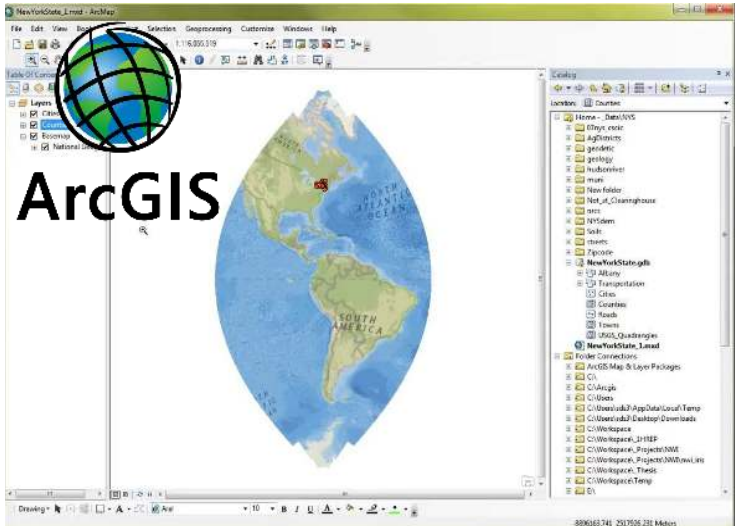
Cartografia

Sistemas de Informação Geográfica (SIG)



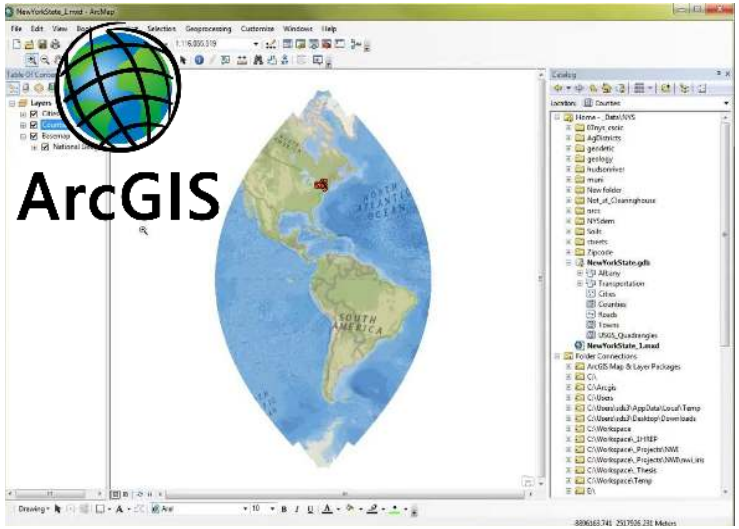
Cartografia

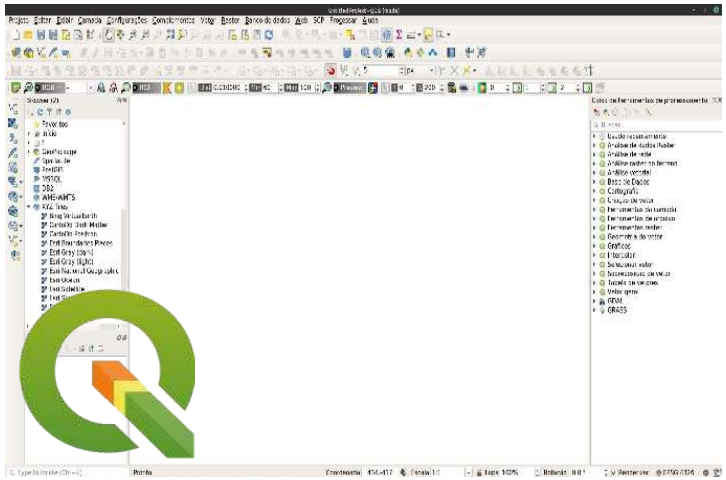
Sistemas de Informação Geográfica (SIG)



Cartografia

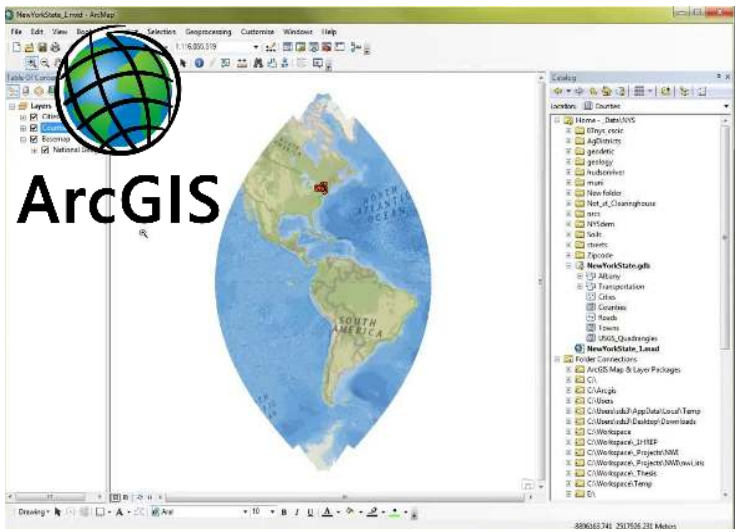
Sistemas de Informação Geográfica (SIG)

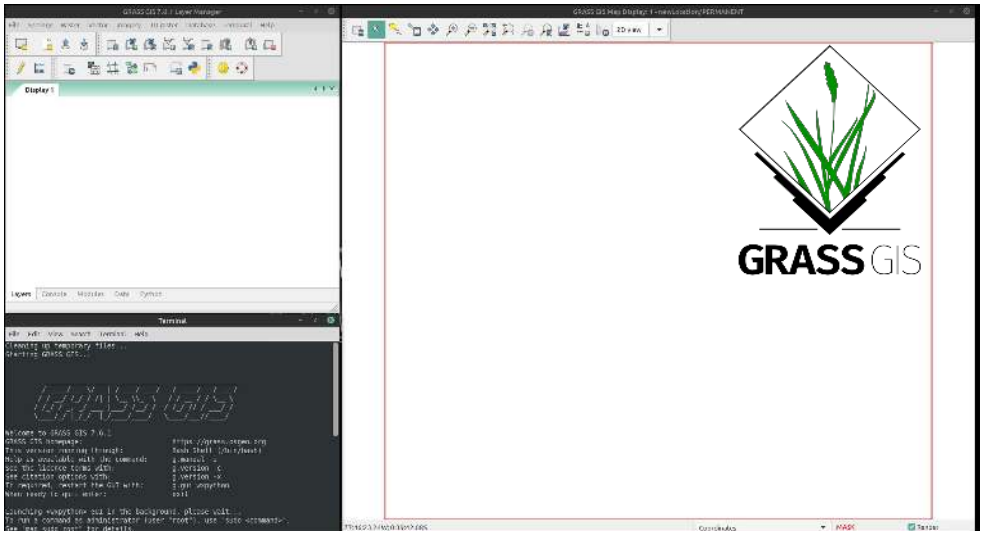


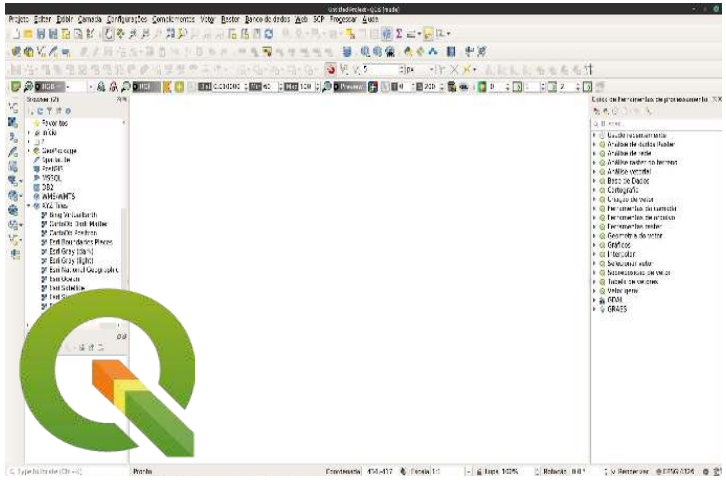


Cartografia

Sistemas de Informação Geográfica (SIG)

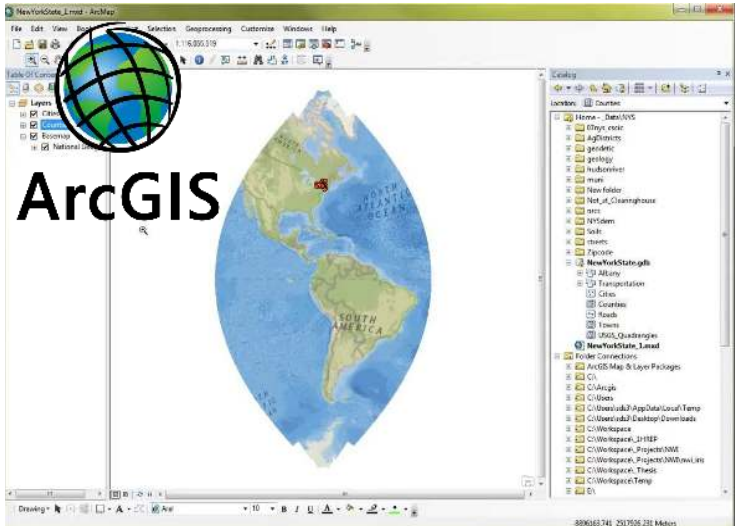


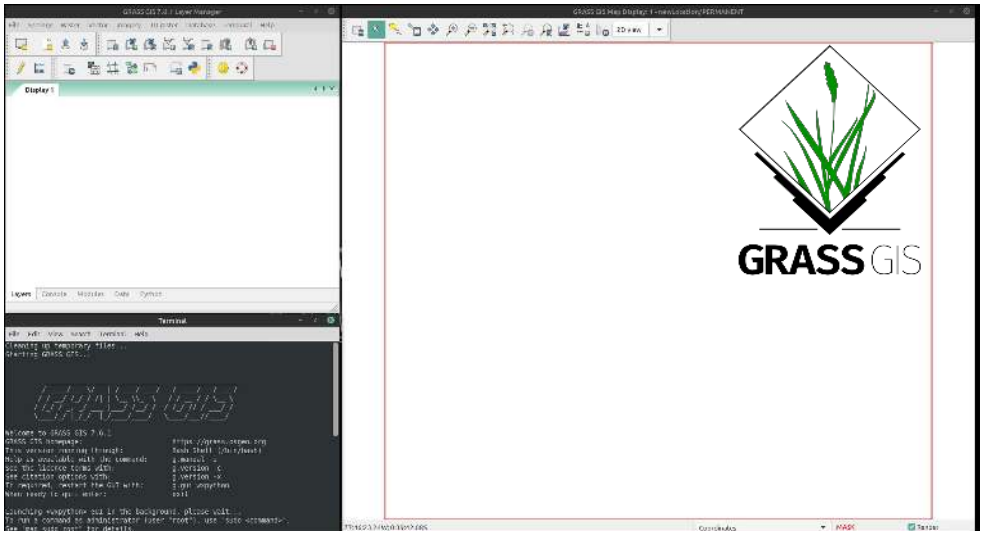


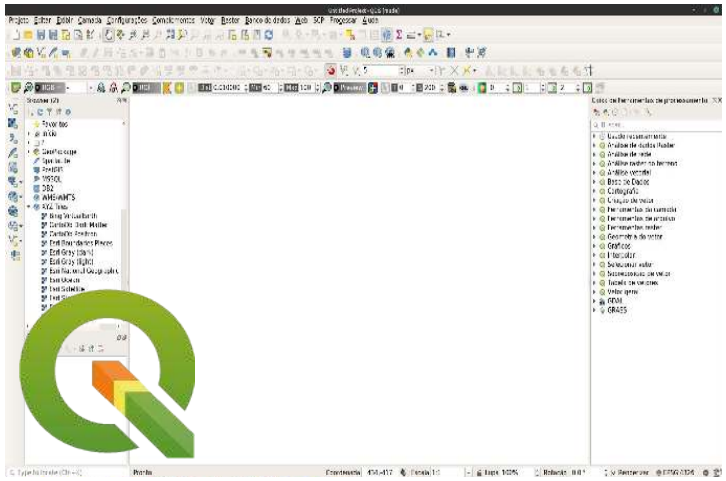


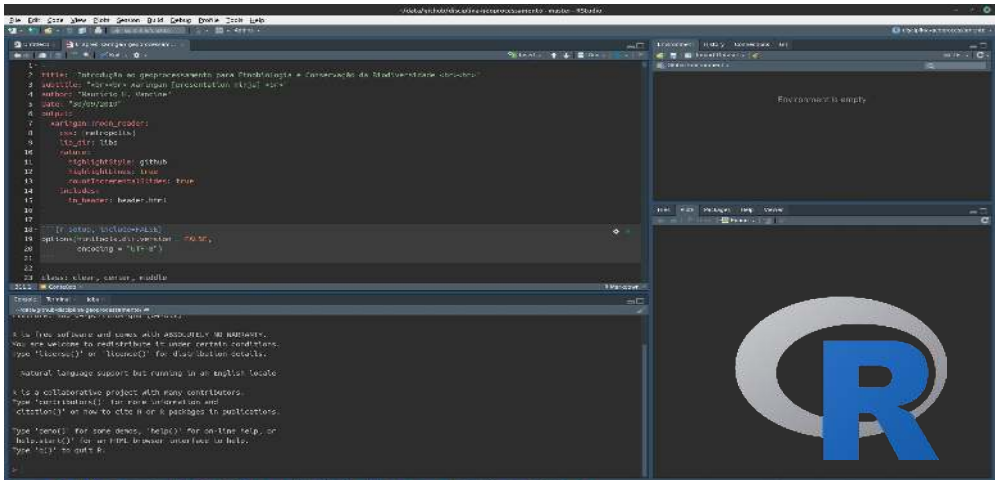
Cartografia

Sistemas de Informação Geográfica (SIG)



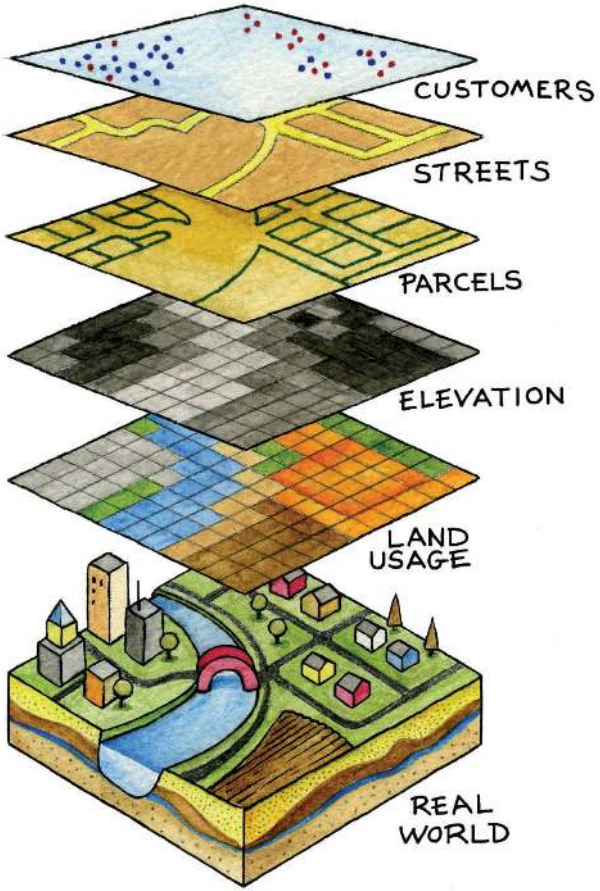




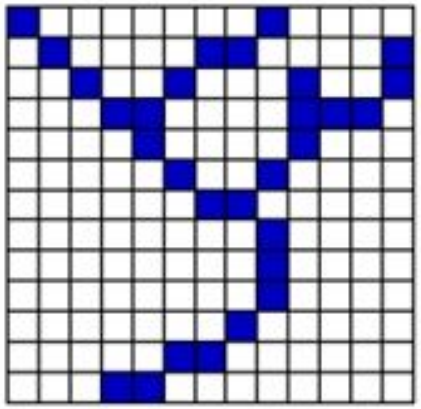


Cartografia

Formatos dos arquivos: Vetor e Raster



Vector



Raster

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

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

Cartografia

Extensão dos arquivos

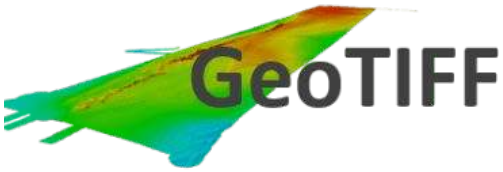
Vetor

Raster

Shapefile

GeoTiff

GeoPackage



SHP DBF SHX PRJ

Cartografia

Extensão dos arquivos

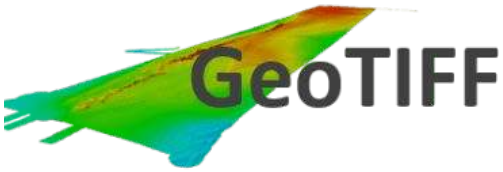
Vetor

Raster

Shapefile

GeoTiff

GeoPackage



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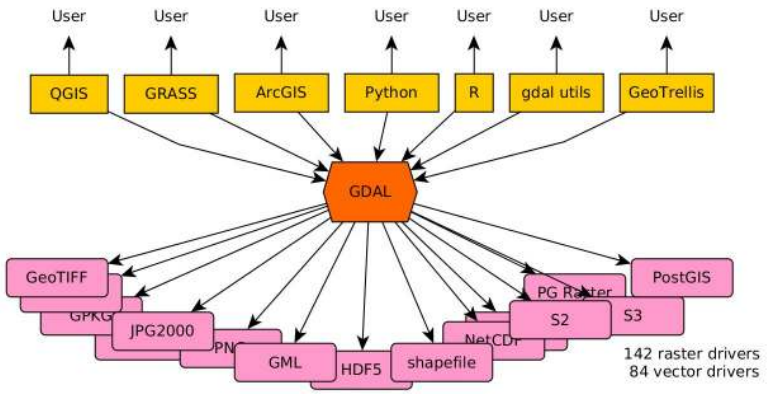
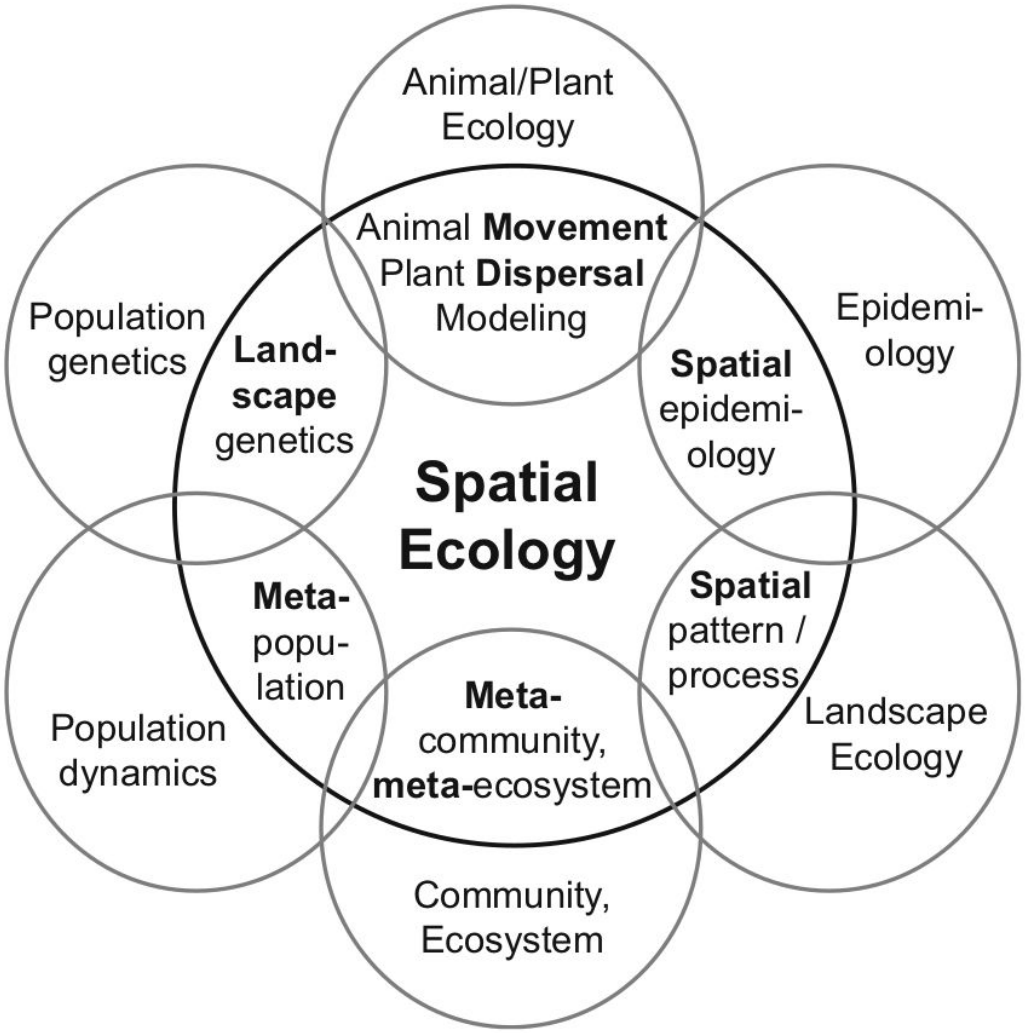
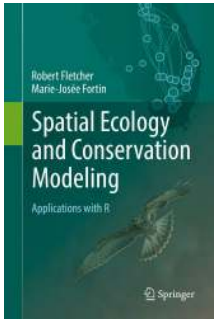


3. Ecologia Espacial

Ecologia Espacial

Definição

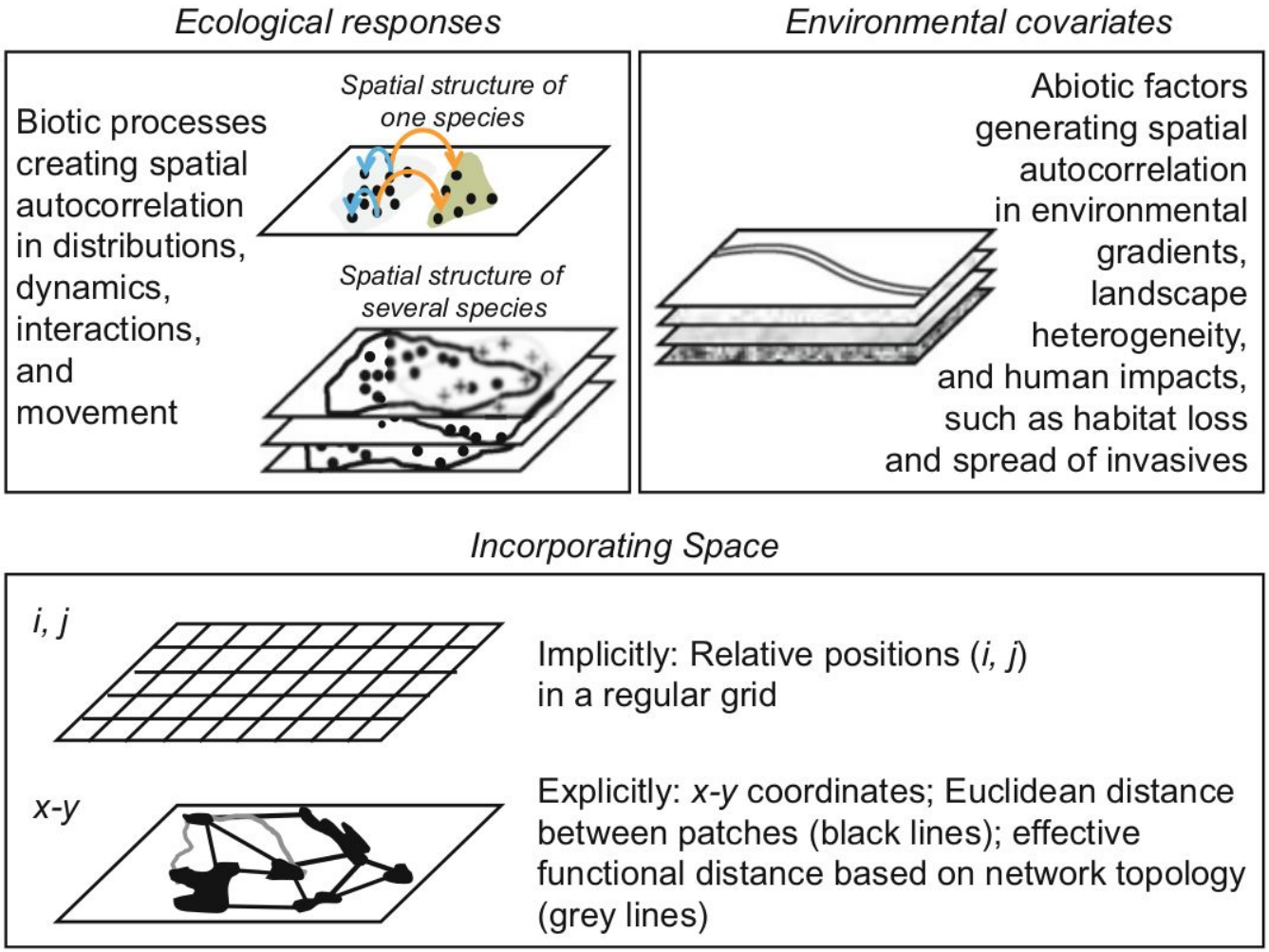


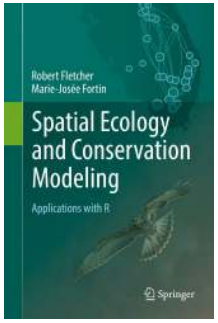


Fletcher & Fortin (2018)

Ecologia Espacial

Definição

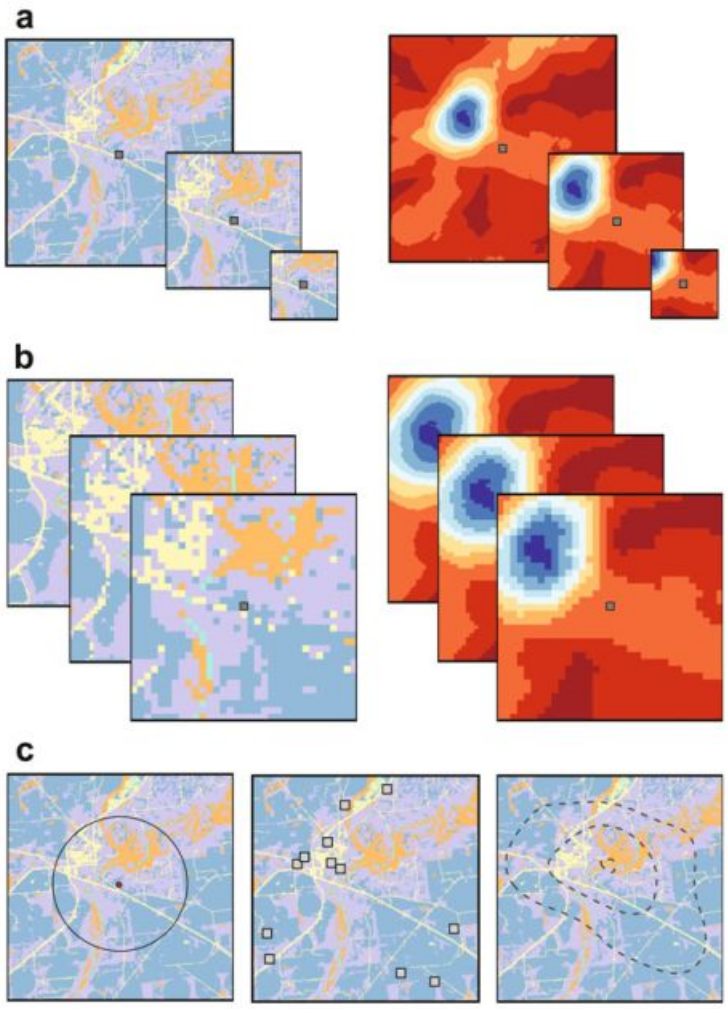


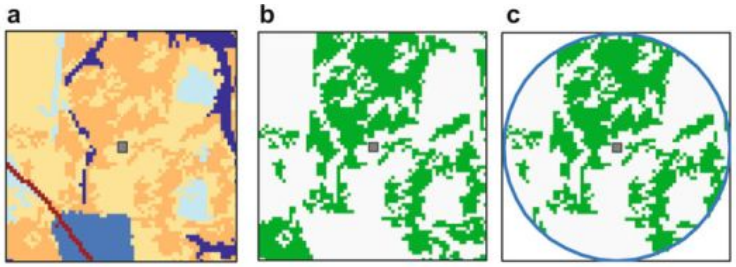


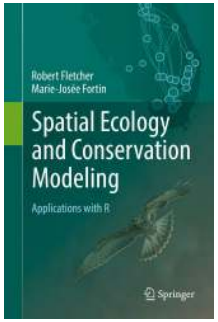
Fletcher & Fortin (2018)

Ecologia Espacial

Escalas



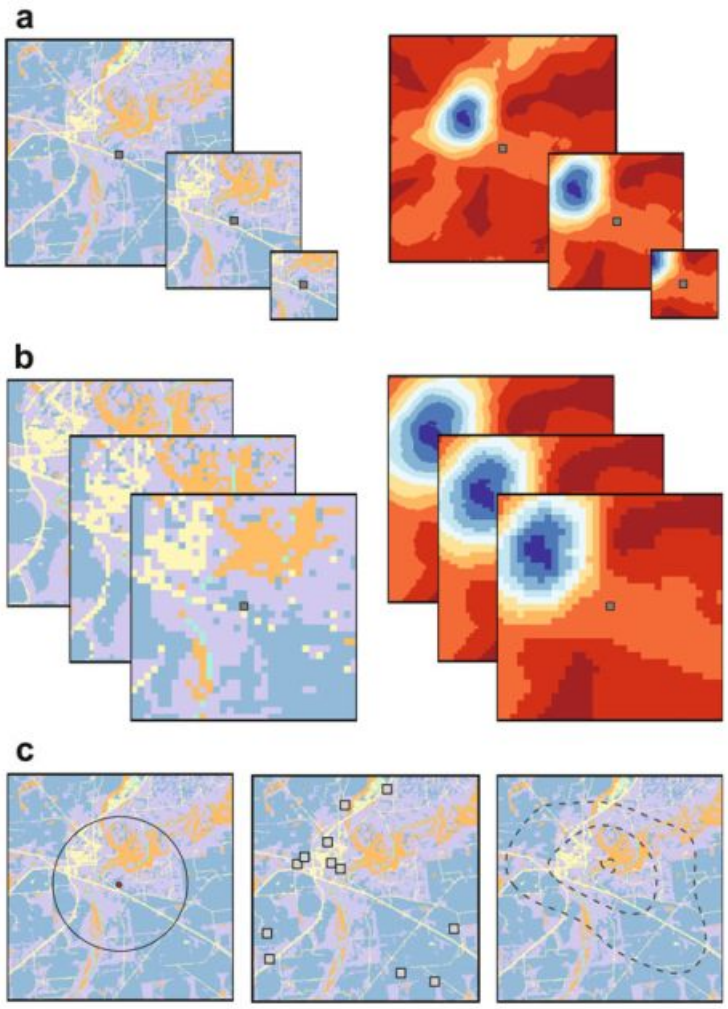


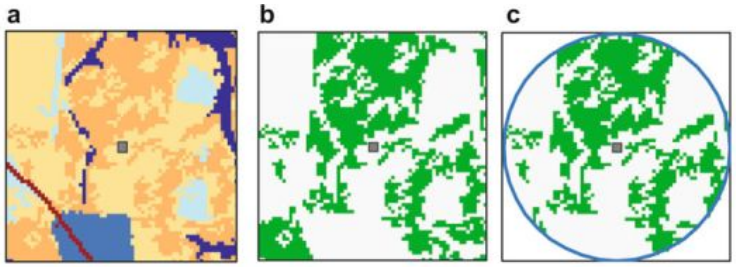


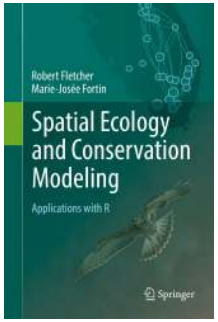
Fletcher & Fortin (2018)

Ecologia Espacial

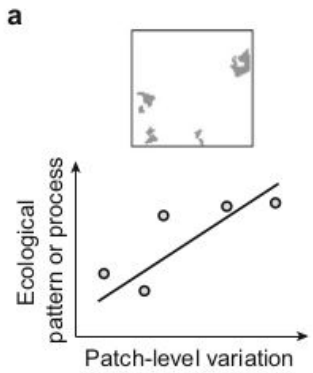
Escalas

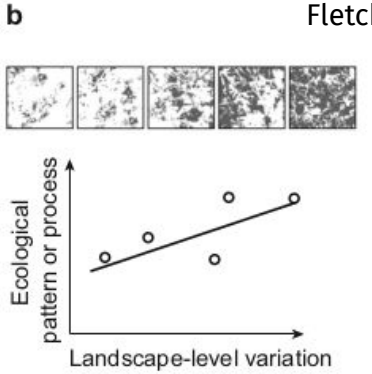


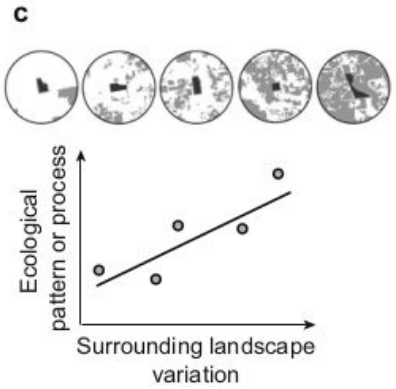


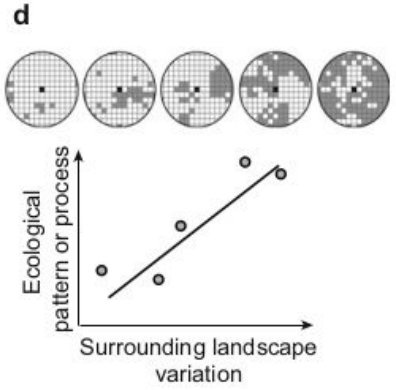


Fletcher & Fortin (2018)



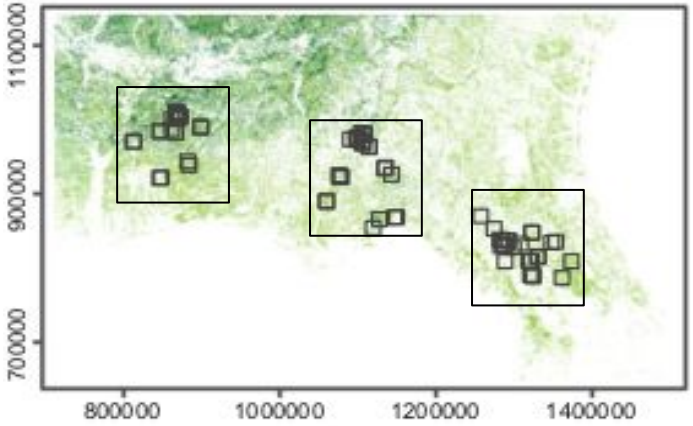


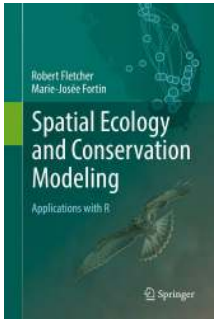




Ecologia Espacial

Ecologia da Paisagem

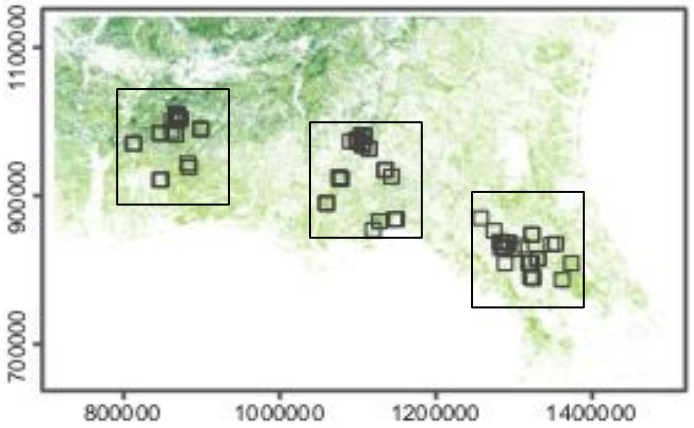


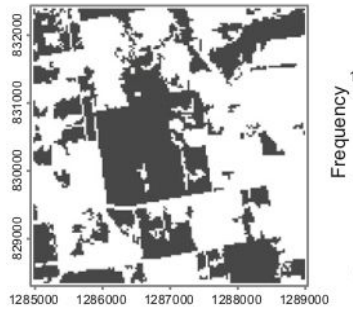


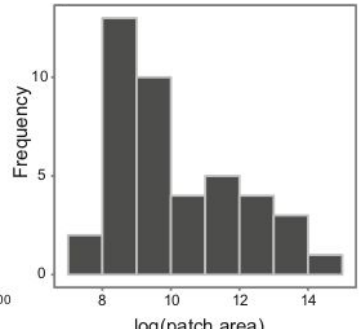
Fletcher & Fortin (2018)

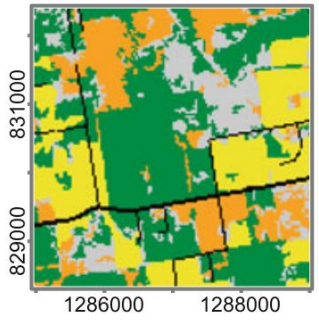
Ecologia Espacial

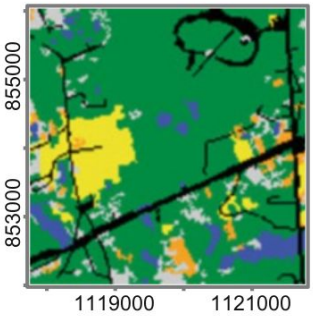
Ecologia da Paisagem

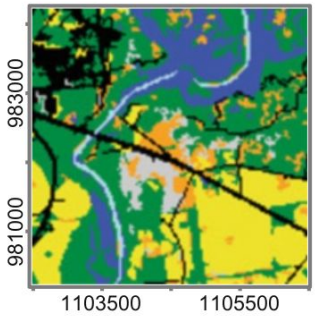




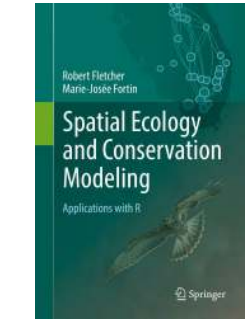








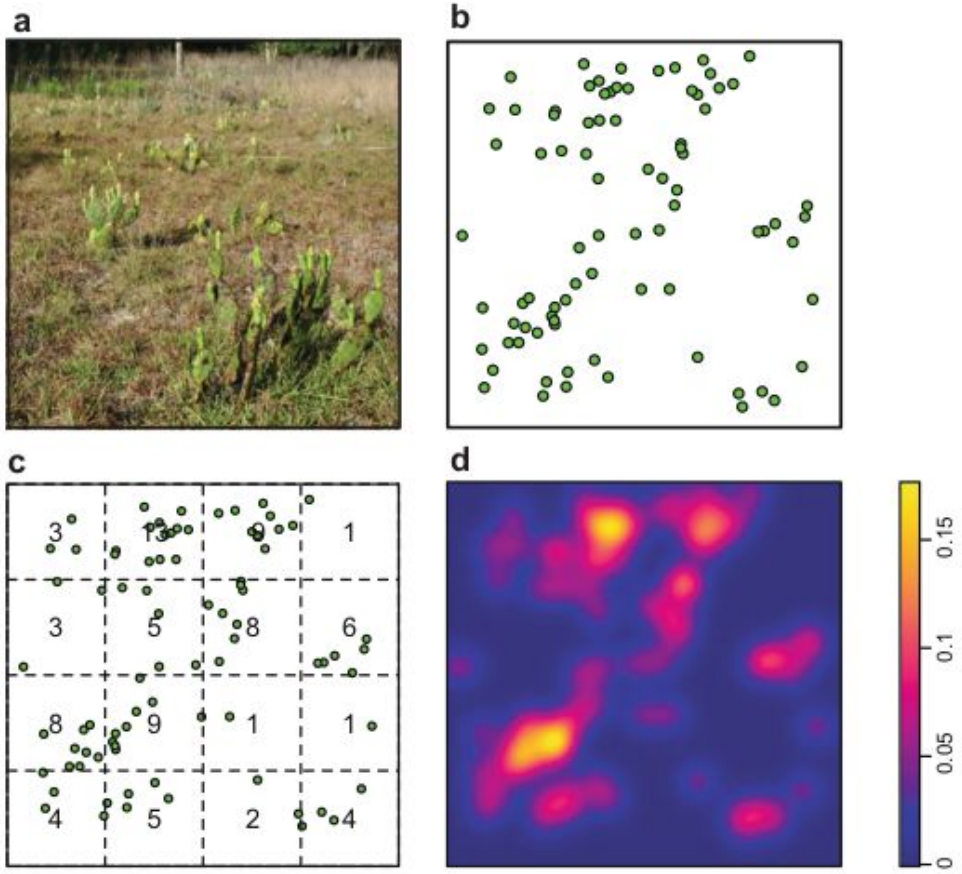
Metric type	Metric	Landscape a	Landscape b	Landscape c
Patch	Number of patches	166	174	232
	Largest patch index	0.189	0.439	0.108
Edge	Total edge	181081	180540	227220
	Edge density	0.011	0.011	0.014
Aggregation	Aggregation index	84.6	84.5	80.0
	Percentage of like adjacencies	83.9	83.9	79.2
	Contagion	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

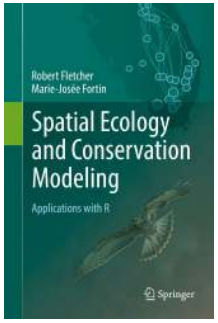


Fletcher & Fortin (2018)

Ecologia Espacial

Processos pontuais e autocorrelação espacial

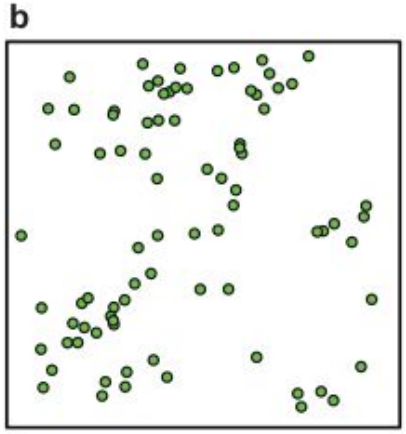


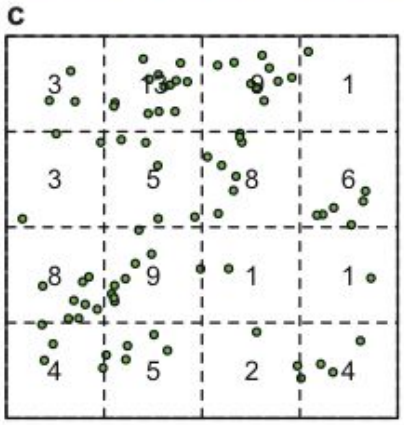


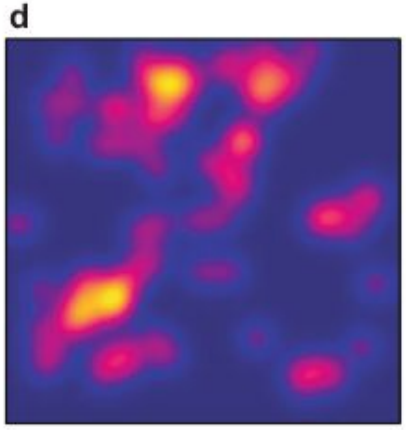
Fletcher & Fortin (2018)

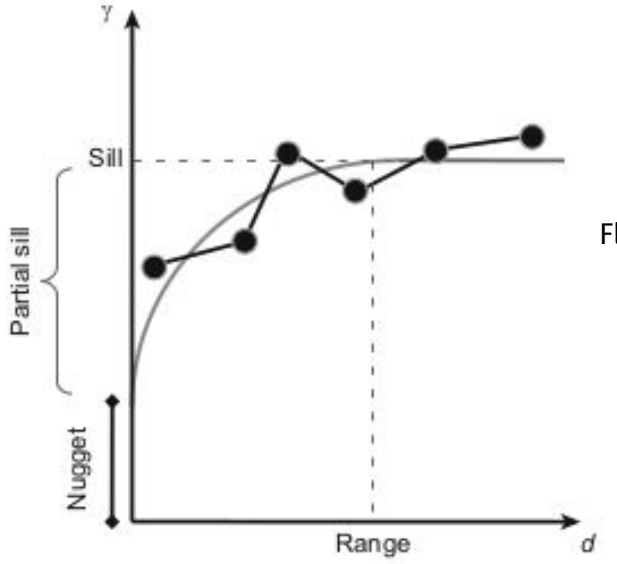
Ecologia Espacial

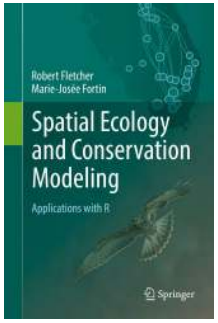
Processos pontuais e autocorrelação espacial



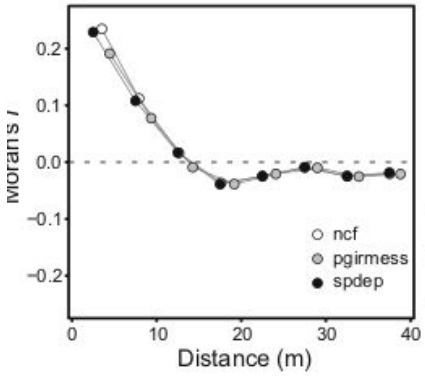


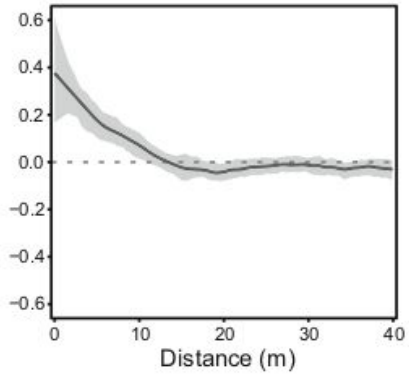






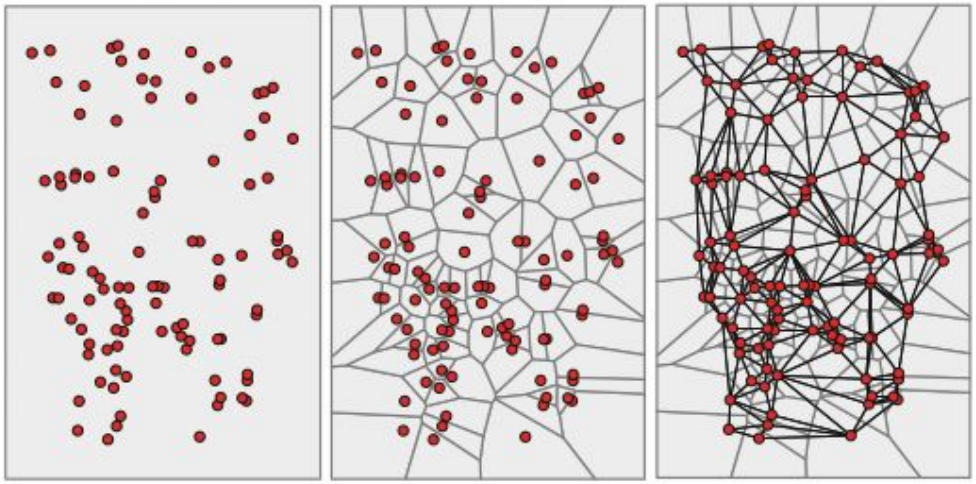
Fletcher & Fortin (2018)

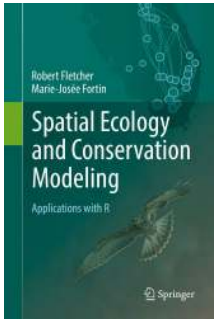




Ecologia Espacial

Dependência espacial

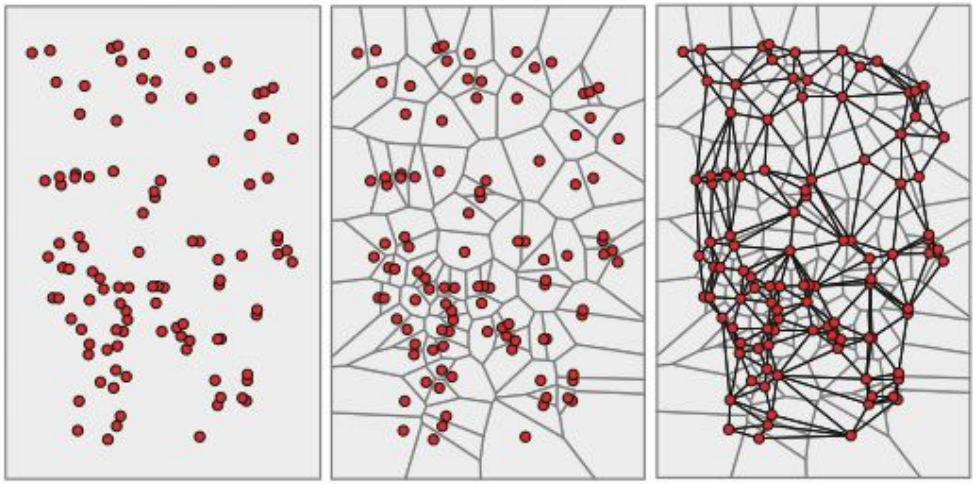


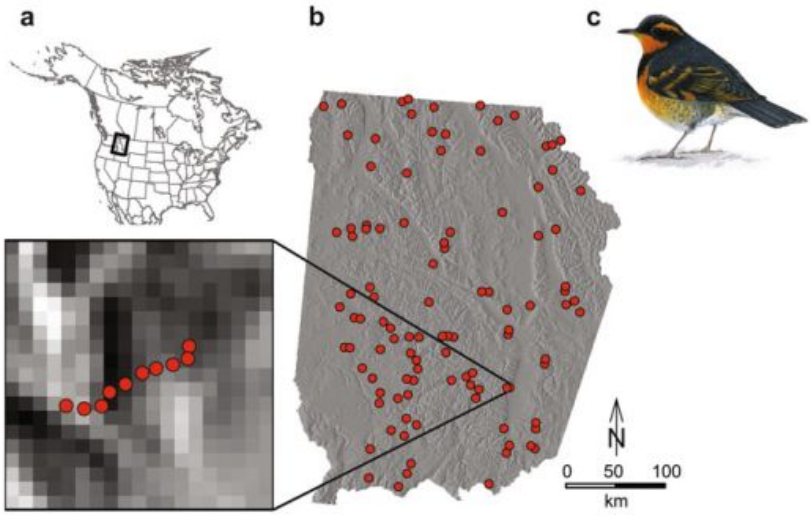


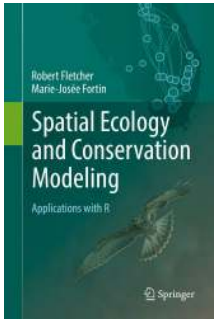
Fletcher & Fortin (2018)

Ecologia Espacial

Dependência espacial



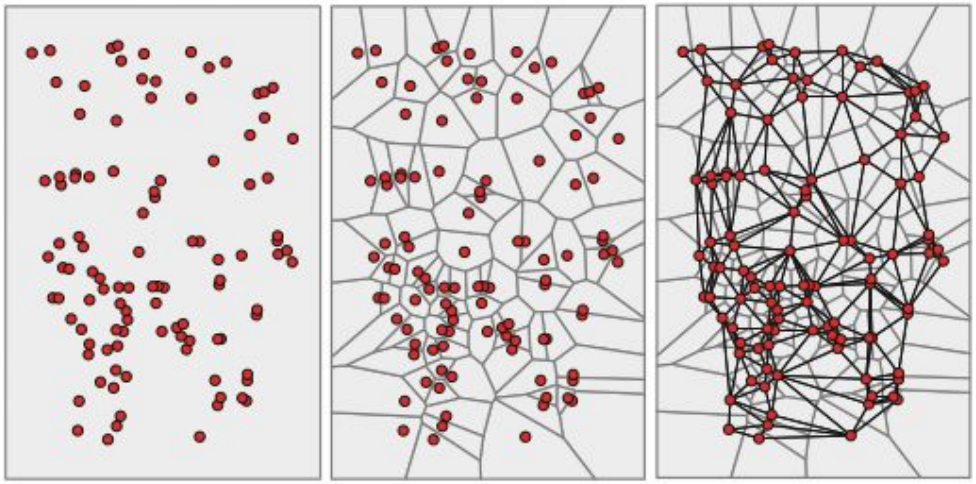


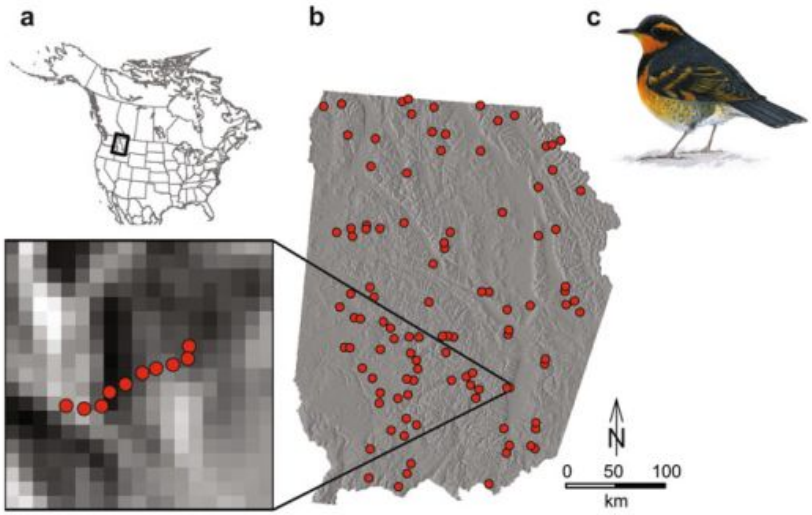


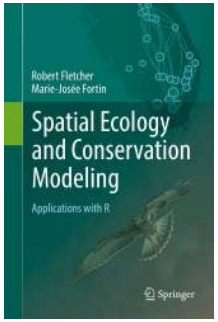
Fletcher & Fortin (2018)

Ecologia Espacial

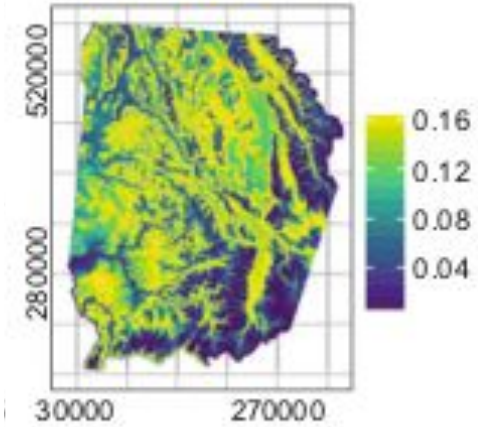
Dependência espacial

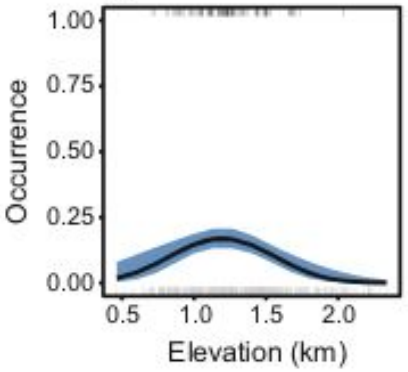


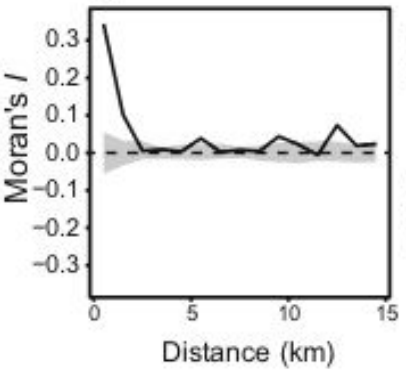




Fletcher & Fortin (2018)

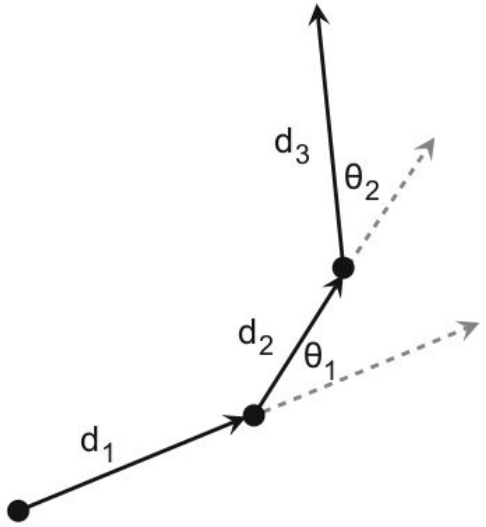


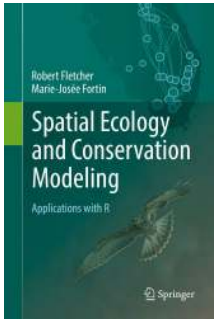




Ecologia Espacial

Ecologia do movimento

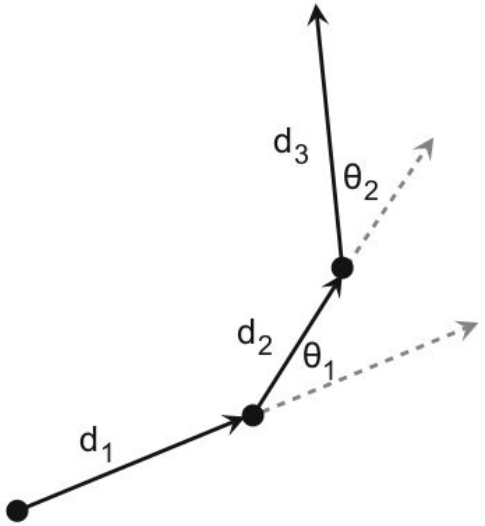


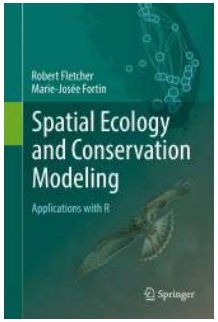


Fletcher & Fortin (2018)

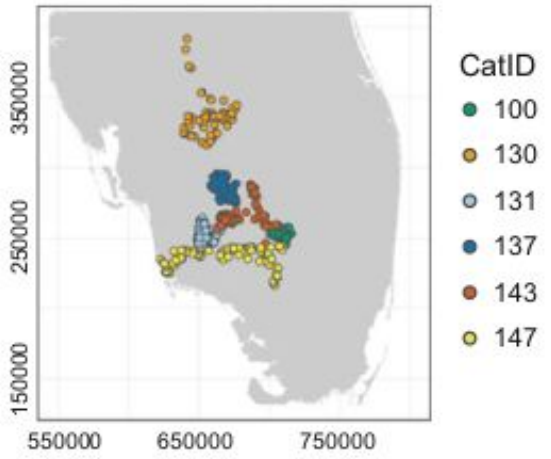
Ecologia Espacial

Ecologia do movimento



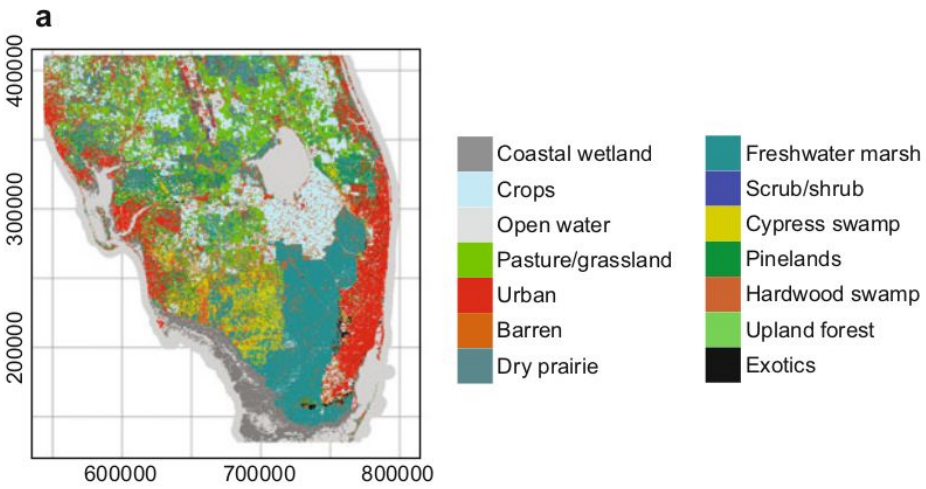


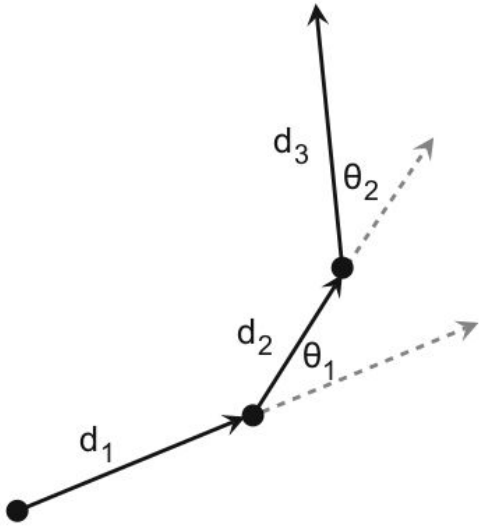
Fletcher & Fortin (2018)

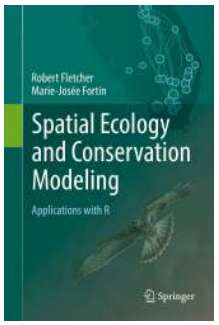


Ecologia Espacial

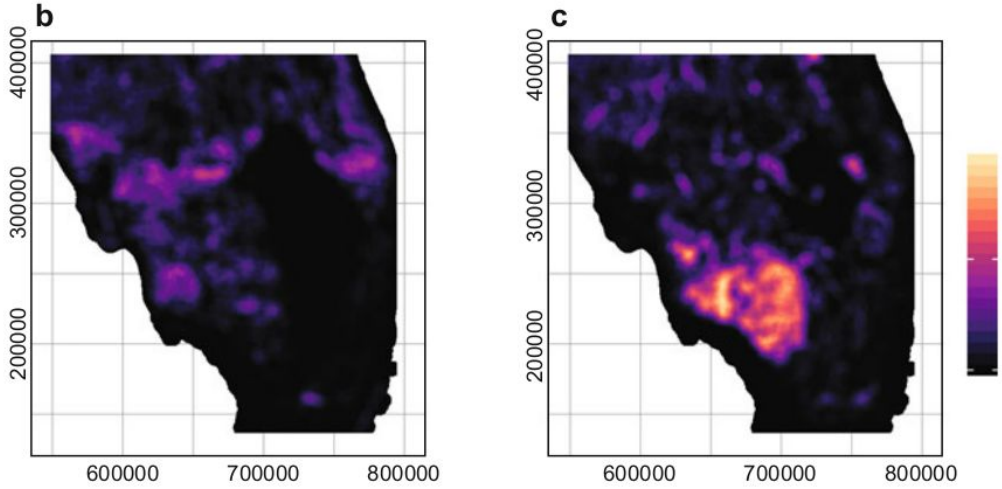
Ecologia do movimento

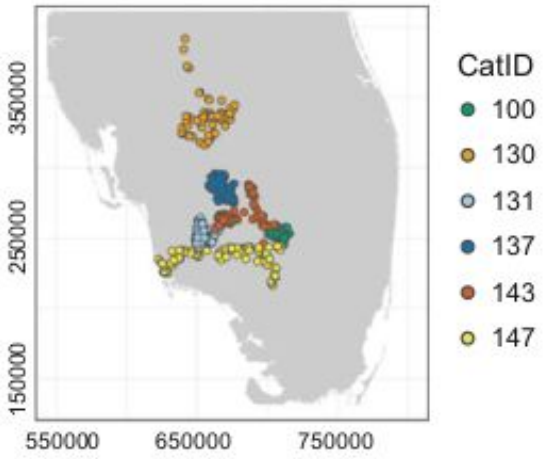






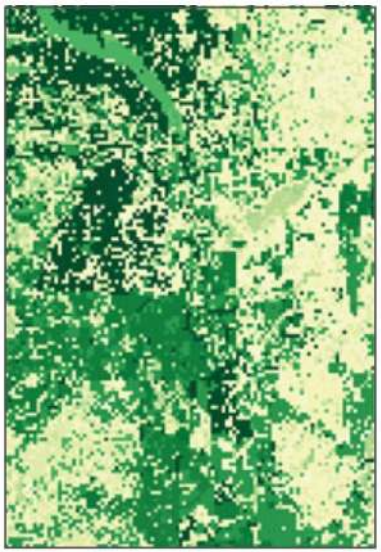
Fletcher & Fortin (2018)

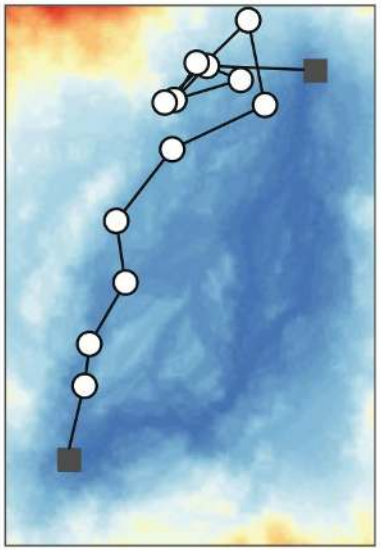


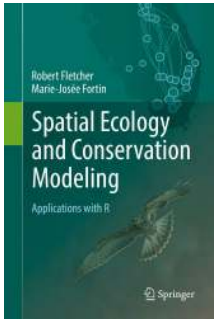


Ecologia Espacial

Corredores ecológicos



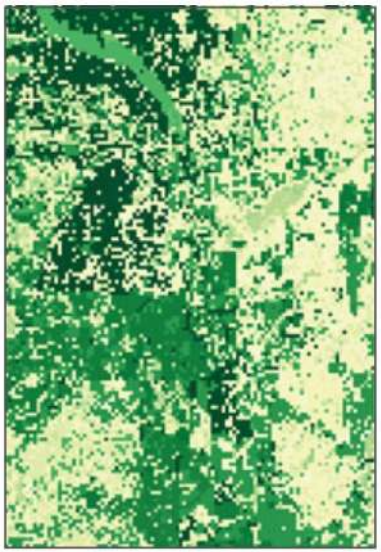


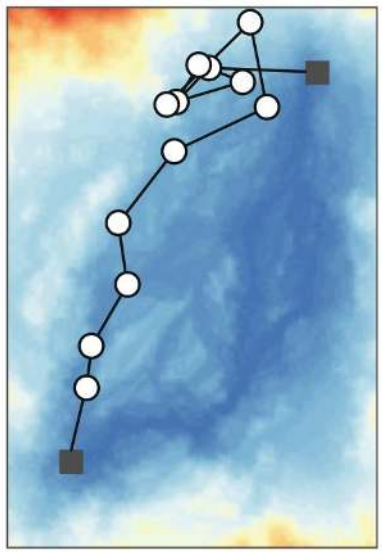


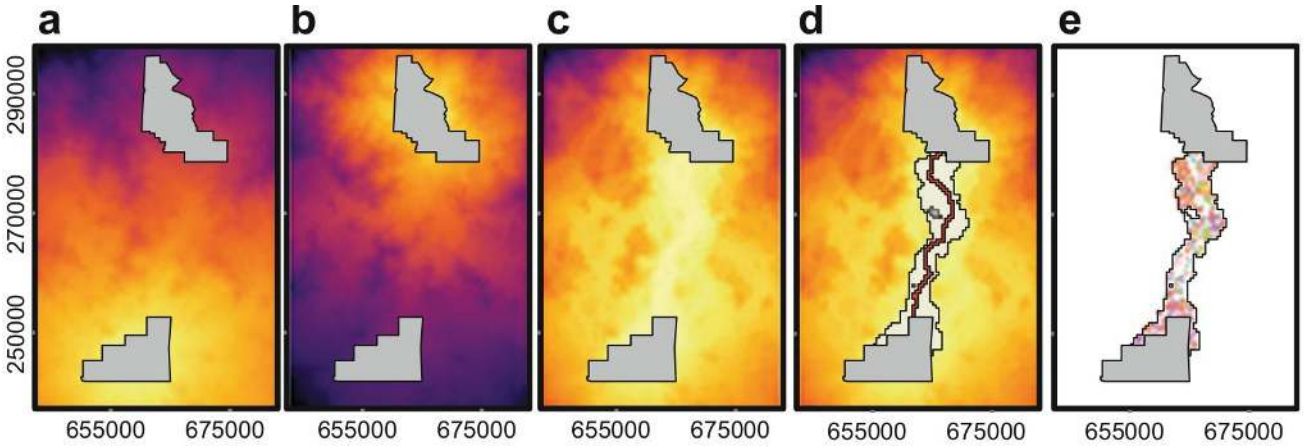
Fletcher & Fortin (2018)

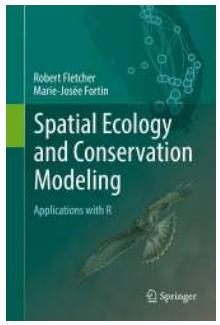
Ecologia Espacial

Corredores ecológicos

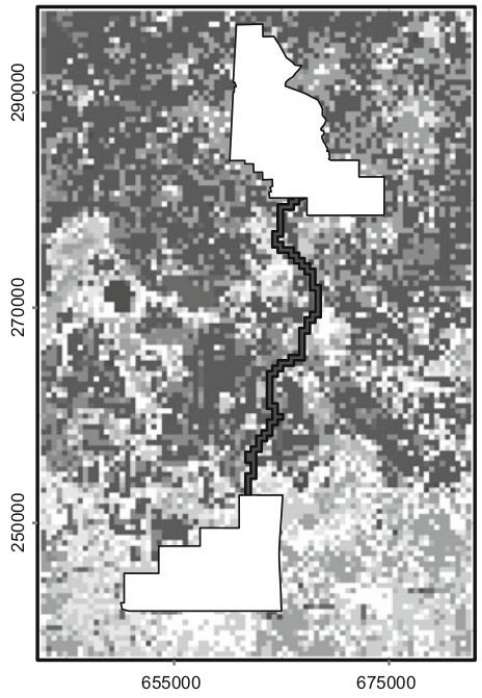






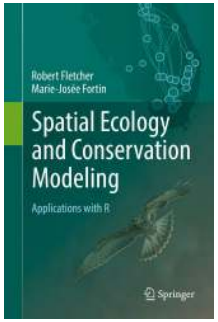


Fletcher & Fortin (2018)

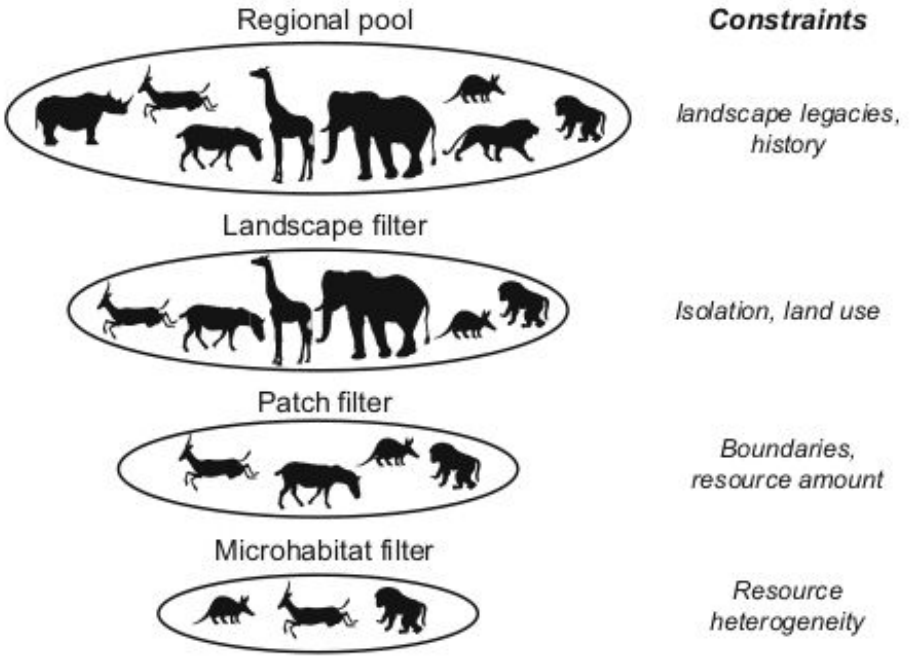


Ecologia Espacial

Padrões de comunidades

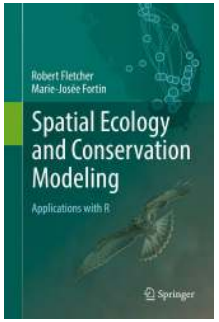


Fletcher & Fortin (2018)

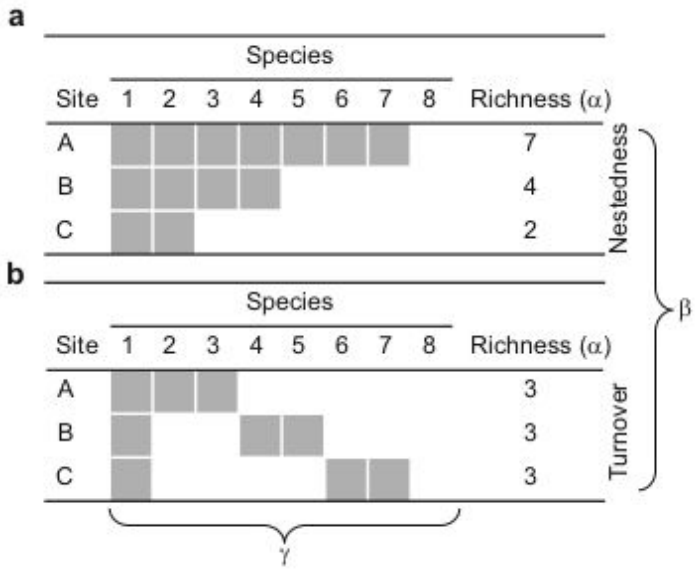


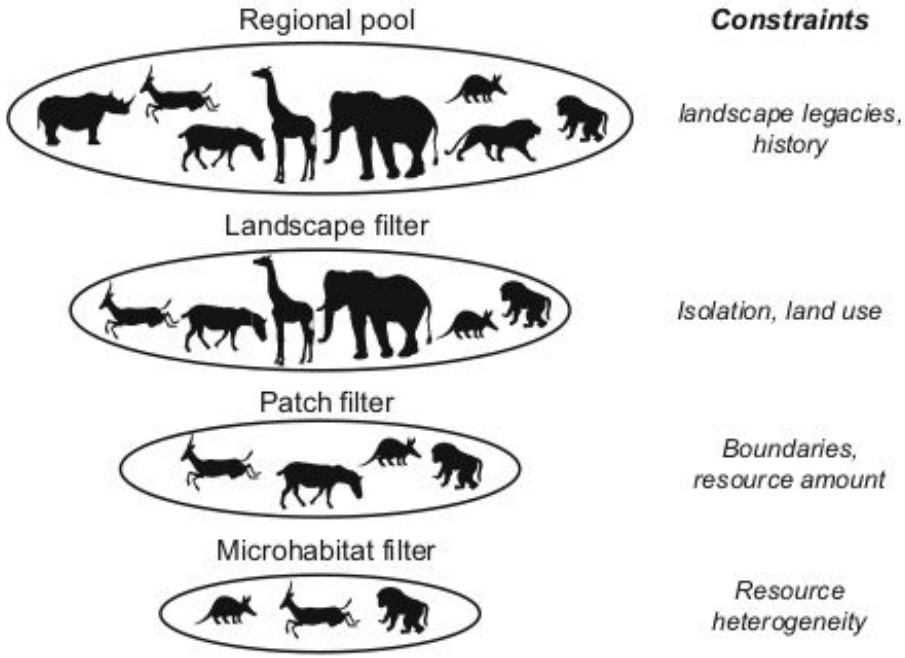
Ecologia Espacial

Padrões de comunidades



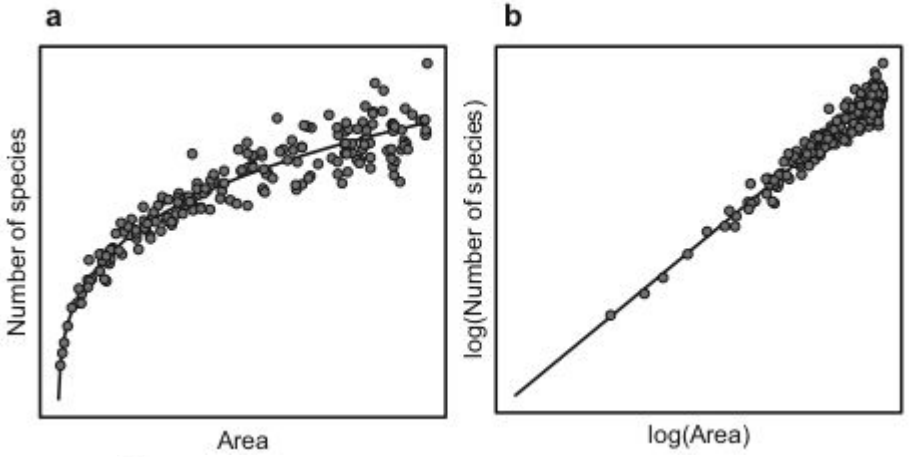
Fletcher & Fortin (2018)

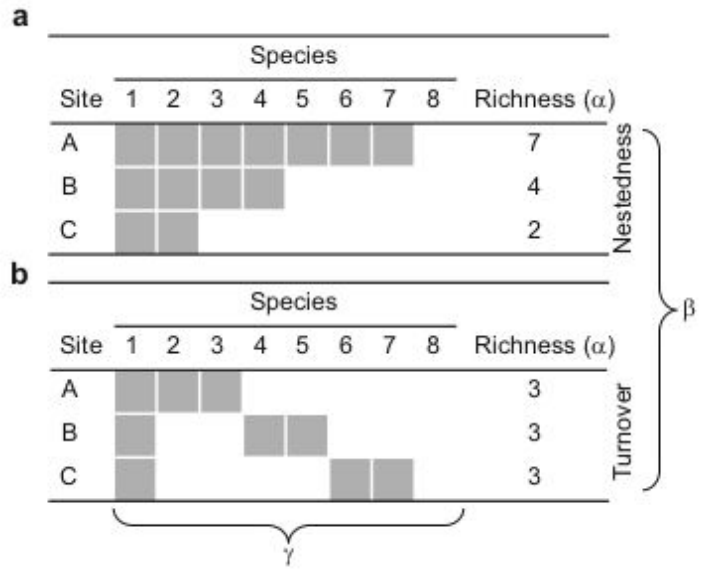


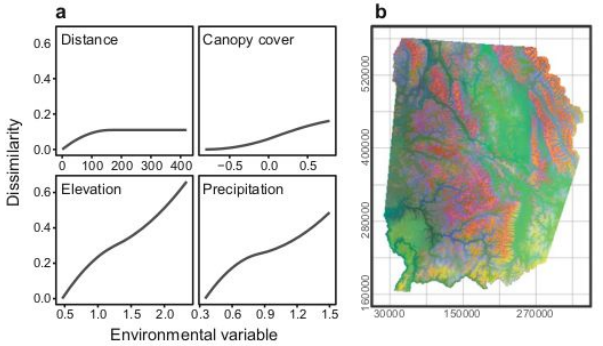


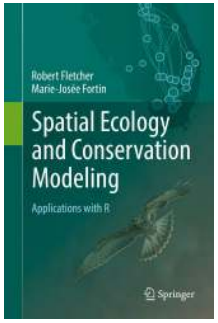
Ecologia Espacial

Padrões de comunidades

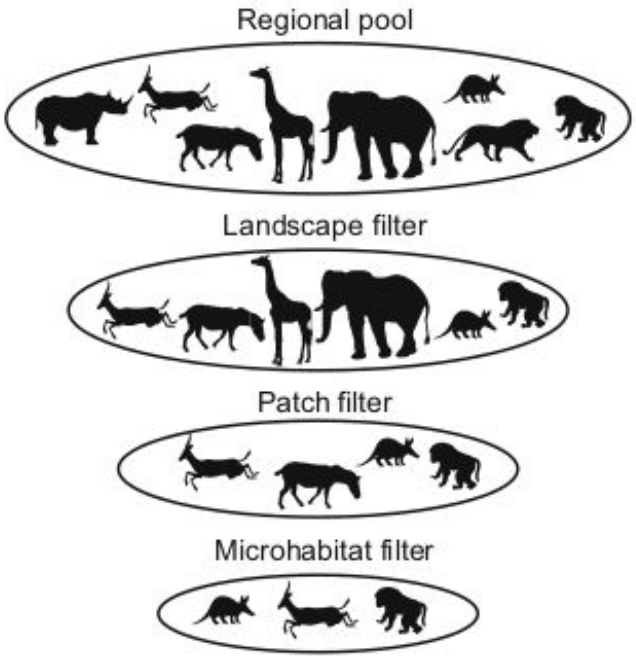








Fletcher & Fortin (2018)



Constraints

landscape legacies, history

Isolation, land use

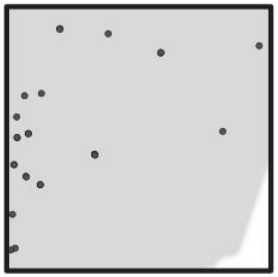
Boundaries, resource amount

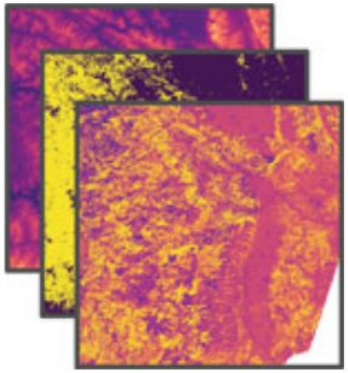
Resource heterogeneity

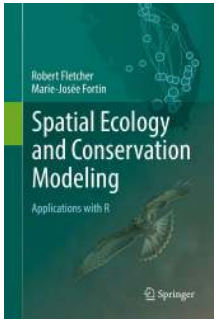
Ecologia Espacial

Distribuição de espécies

Data:
species and environment



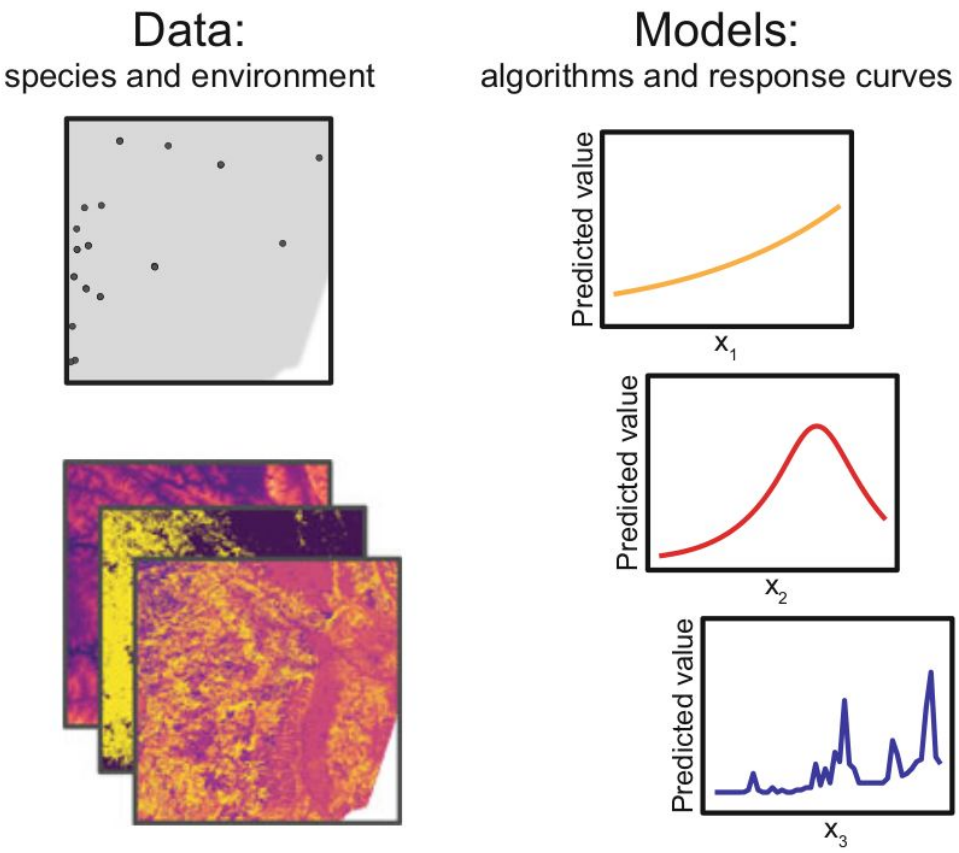


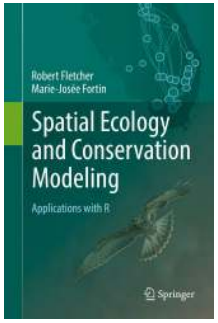


Fletcher & Fortin (2018)

Ecologia Espacial

Distribuição de espécies

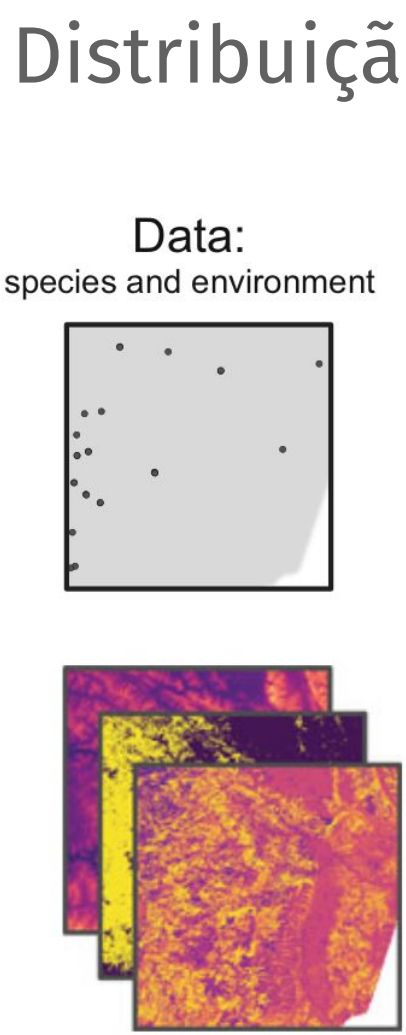


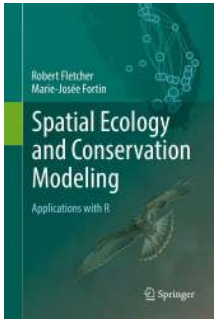


Fletcher & Fortin (2018)

Ecologia Espacial

Distribuição de espécies





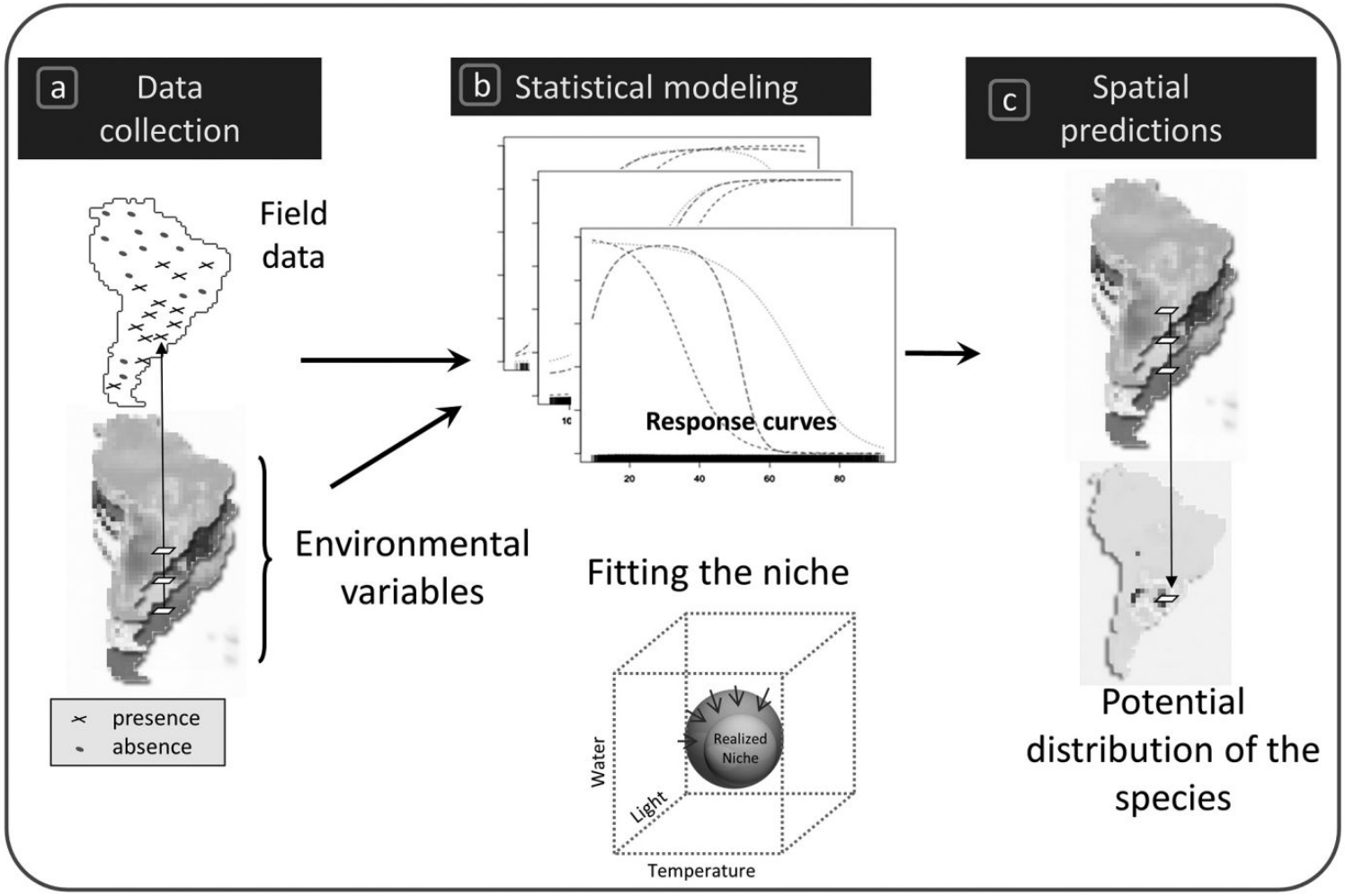
Fletcher & Fortin (2018)

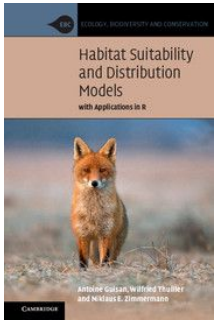
Notaram a **Cartografia** como um **componente essencial** no entendimento de padrões espaciais em **Ecologia Espacial**?

4. Modelagem de Distribuição de Espécies (SDMs)

Modelos de Distribuição de Espécies (SDMs)

Visão geral

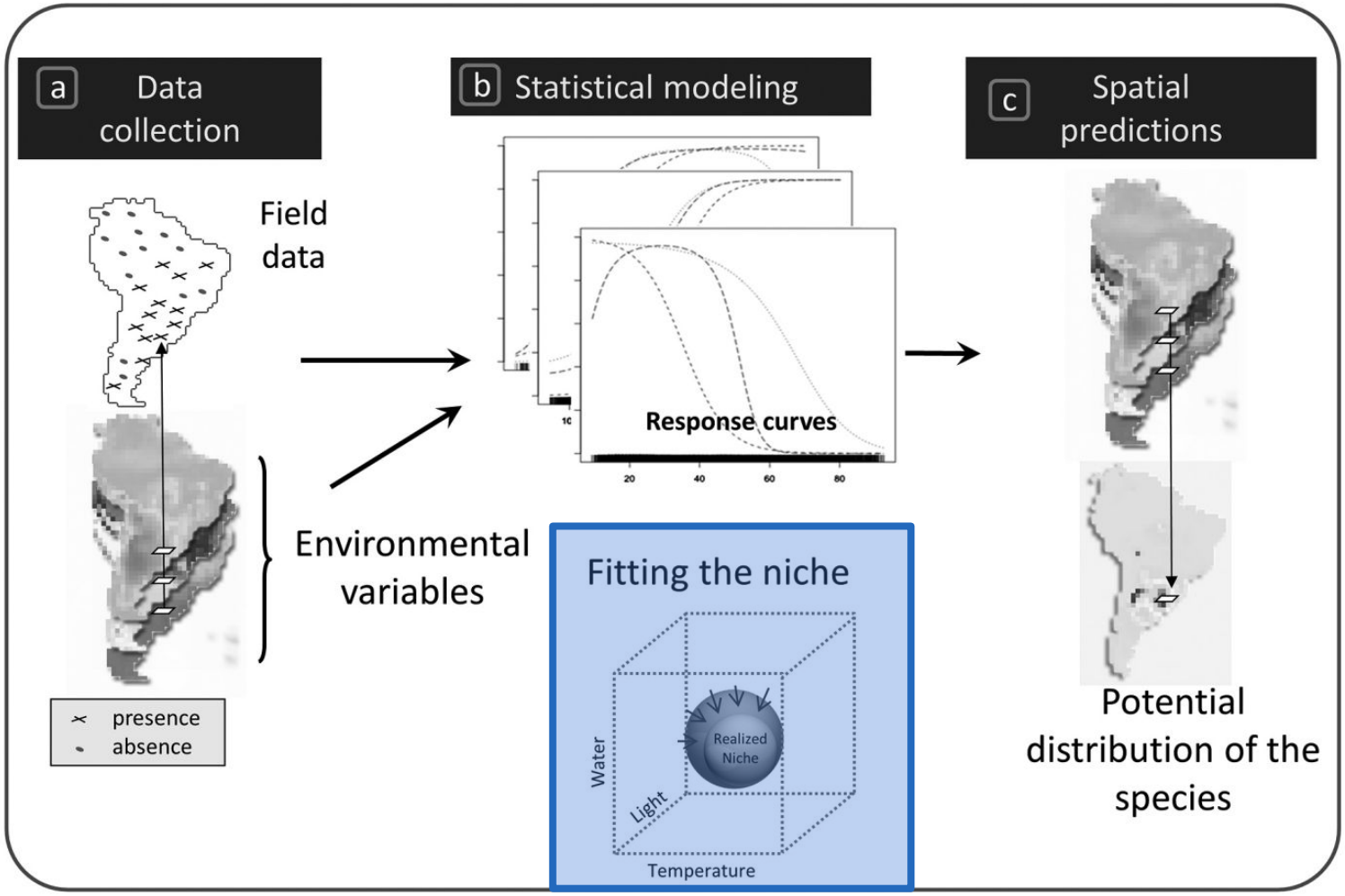


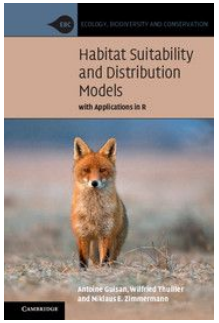


Guisan et al. (2017)

Modelos de Distribuição de Espécies (SDMs)

Visão geral





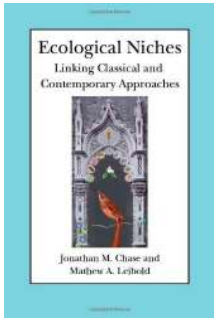
Guisan et al. (2017)

5. Nicho ecológico e distribuição das espécies

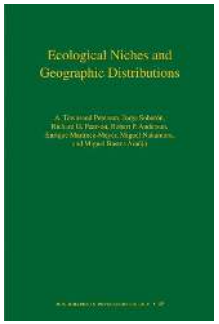
O que determina a distribuição das espécies?

Espaço Geográfico (G)

G



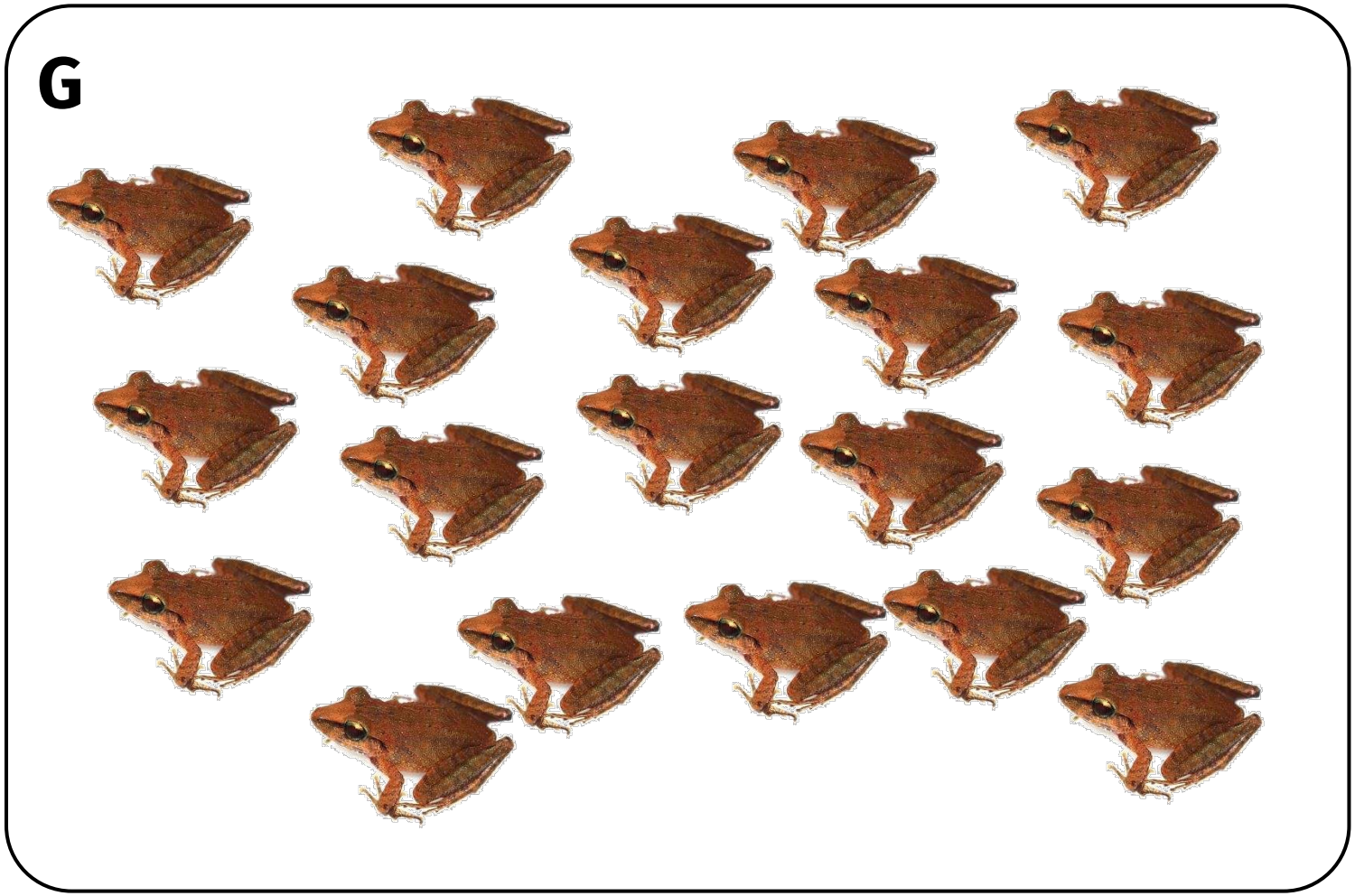
Chase & Leibold (2003)

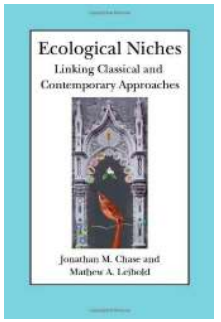


Peterson et al. (2011)

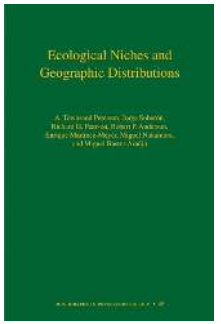
O que determina a distribuição das espécies?

Espaço Geográfico (G)





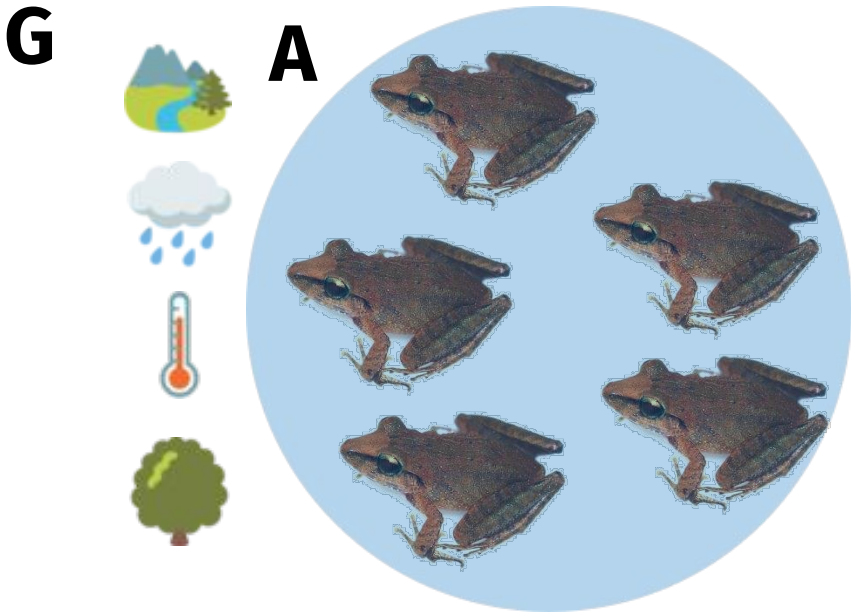
Chase & Leibold (2003)

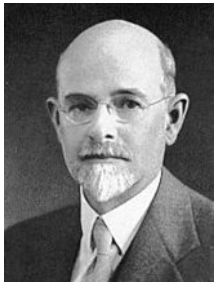


Peterson et al. (2011)

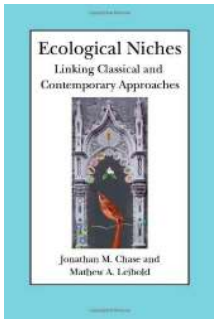
O que determina a distribuição das espécies?

Condições Abióticas (A)

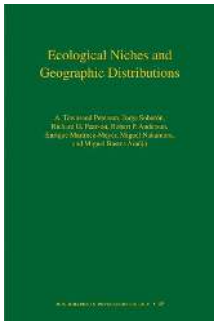




Joseph Grinnell (1917)
Requerimentos ambientais “condições climáticas”



Chase & Leibold (2003)



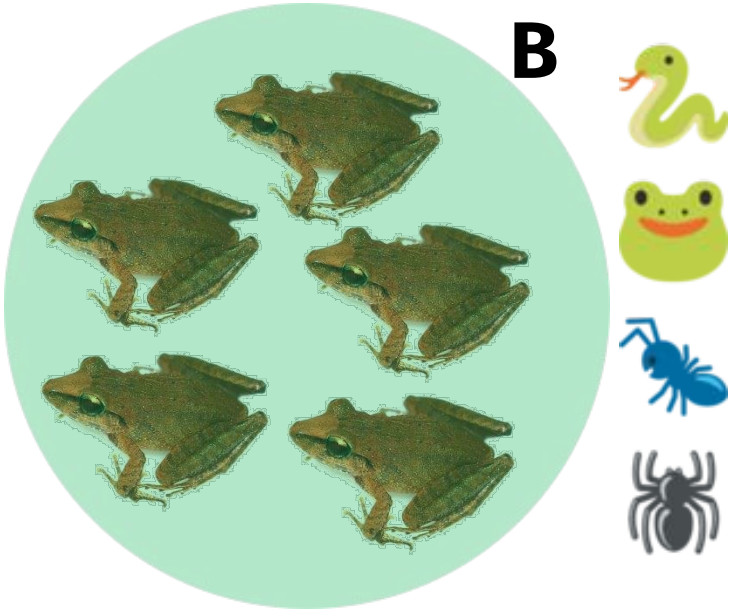
Peterson et al. (2011)

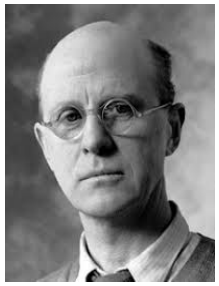
O que determina a distribuição das espécies?

Condições Bióticas (B)

G

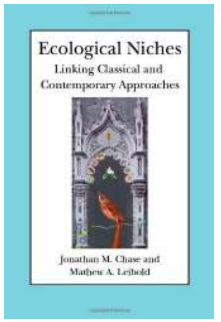
B



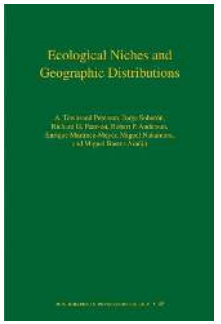


Charles Elton (1927)

Papel funcional dos organismos “impacto”



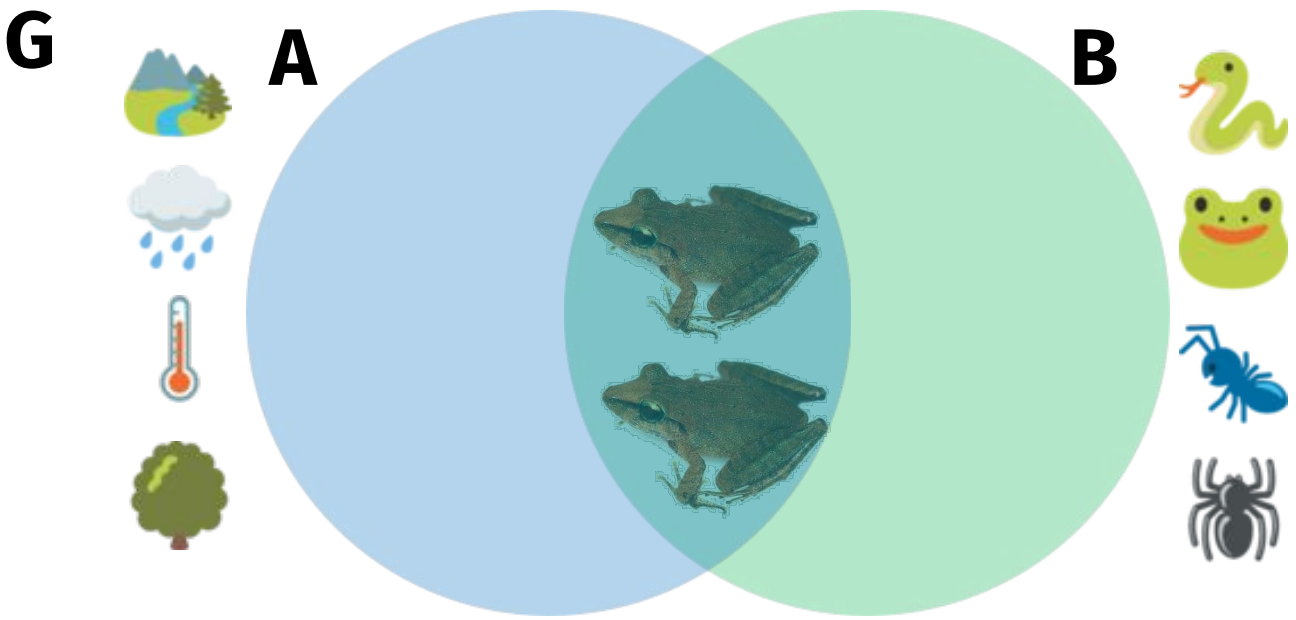
Chase & Leibold (2003)

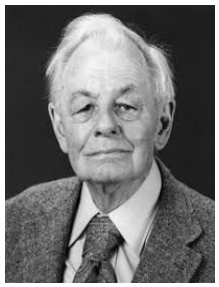


Peterson et al. (2011)

O que determina a distribuição das espécies?

Relação entre condições abióticas e bióticas



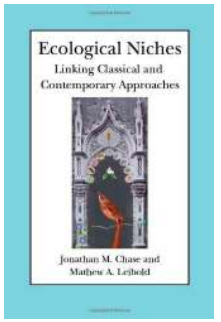


George E. Hutchinson (1957)

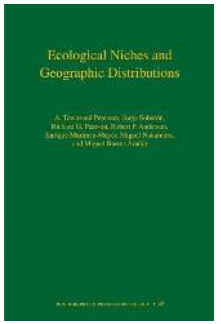
Requerimentos ambientais (**Nicho Fundamental**)

+

Requerimentos biológicos (**Nicho Realizado**)



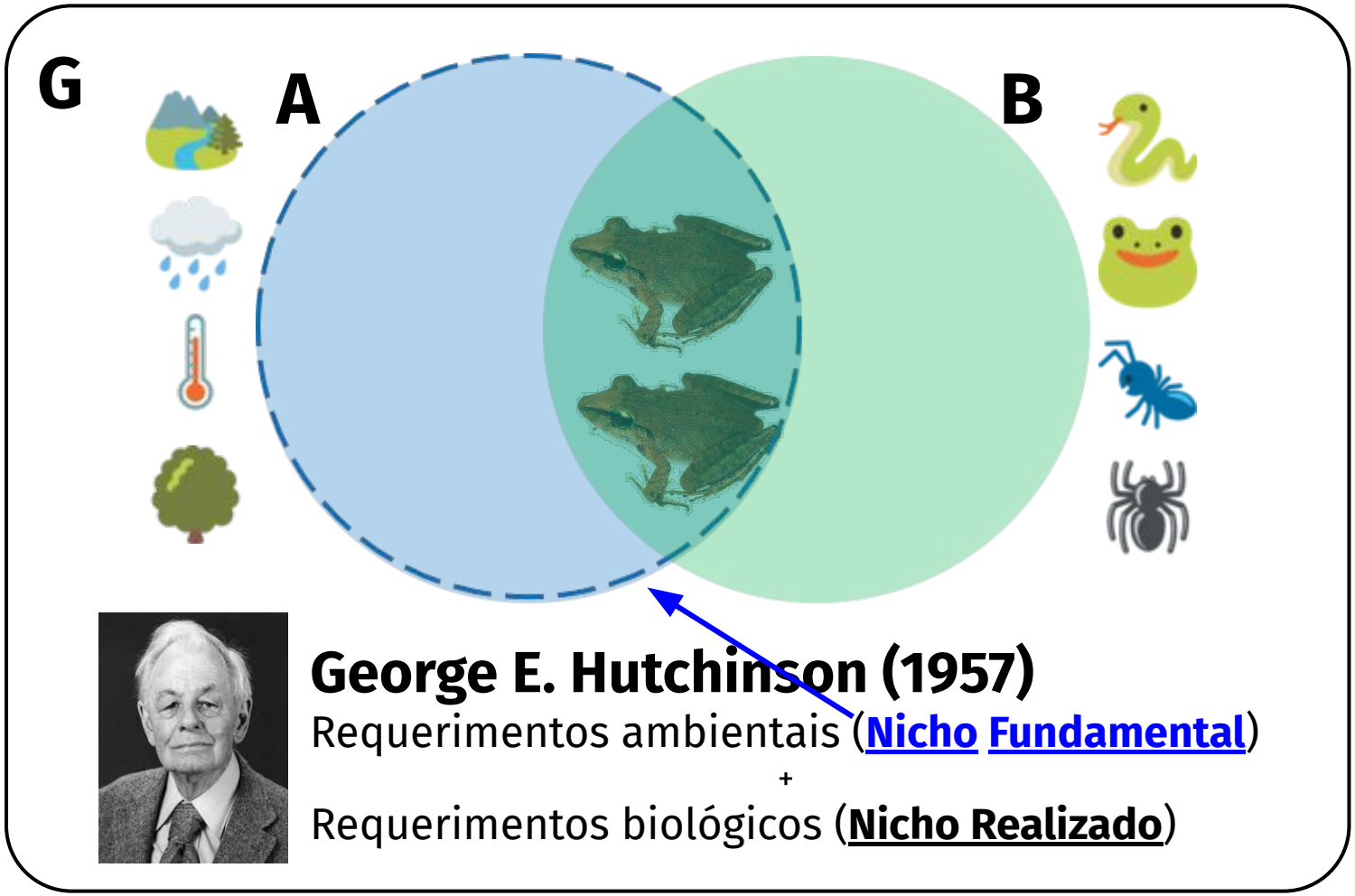
Chase & Leibold (2003)



Peterson et al. (2011)

O que determina a distribuição das espécies?

Nicho Fundamental

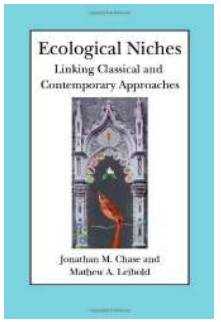


George E. Hutchinson (1957)

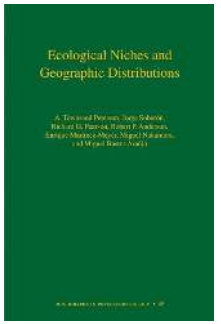
Requerimentos ambientais (**Nicho Fundamental**)

+

Requerimentos biológicos (**Nicho Realizado**)



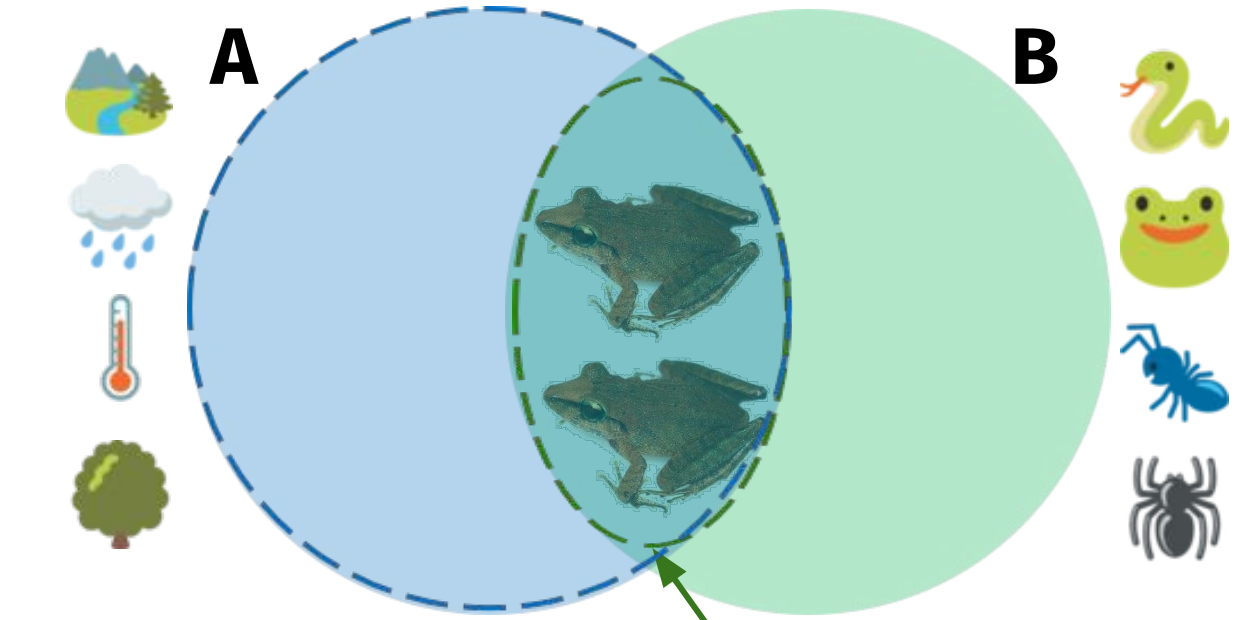
Chase & Leibold (2003)

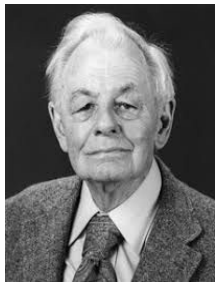


Peterson et al. (2011)

O que determina a distribuição das espécies?

Nicho Realizado



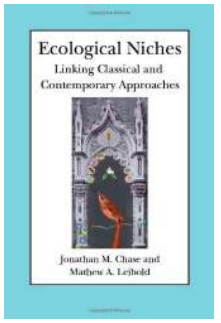


George E. Hutchinson (1957)

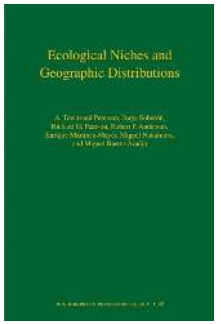
Requerimentos ambientais (Nicho Fundamental)

+

Requerimentos biológicos (Nicho Realizado)



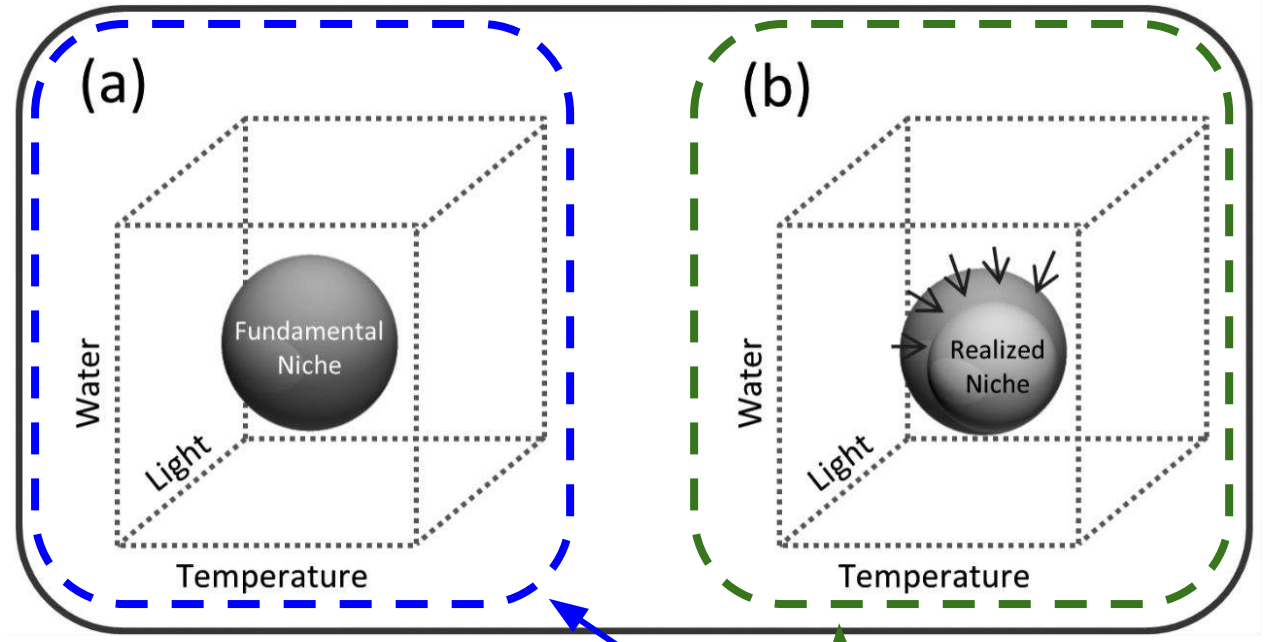
Chase & Leibold (2003)

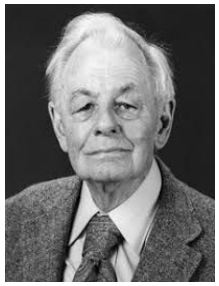


Peterson et al. (2011)

O que determina a distribuição das espécies?

Hipervolume n-dimensional



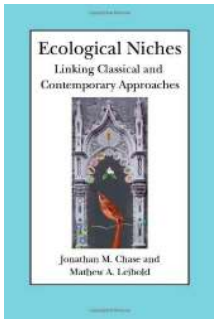


George E. Hutchinson (1957)

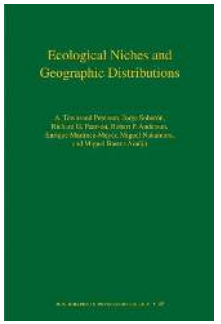
Requerimentos ambientais (**Nicho Fundamental**)

+

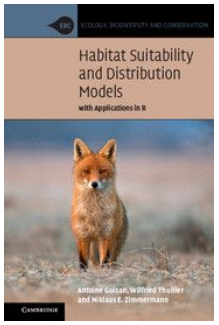
Requerimentos biológicos (**Nicho Realizado**)



Chase & Leibold (2003)



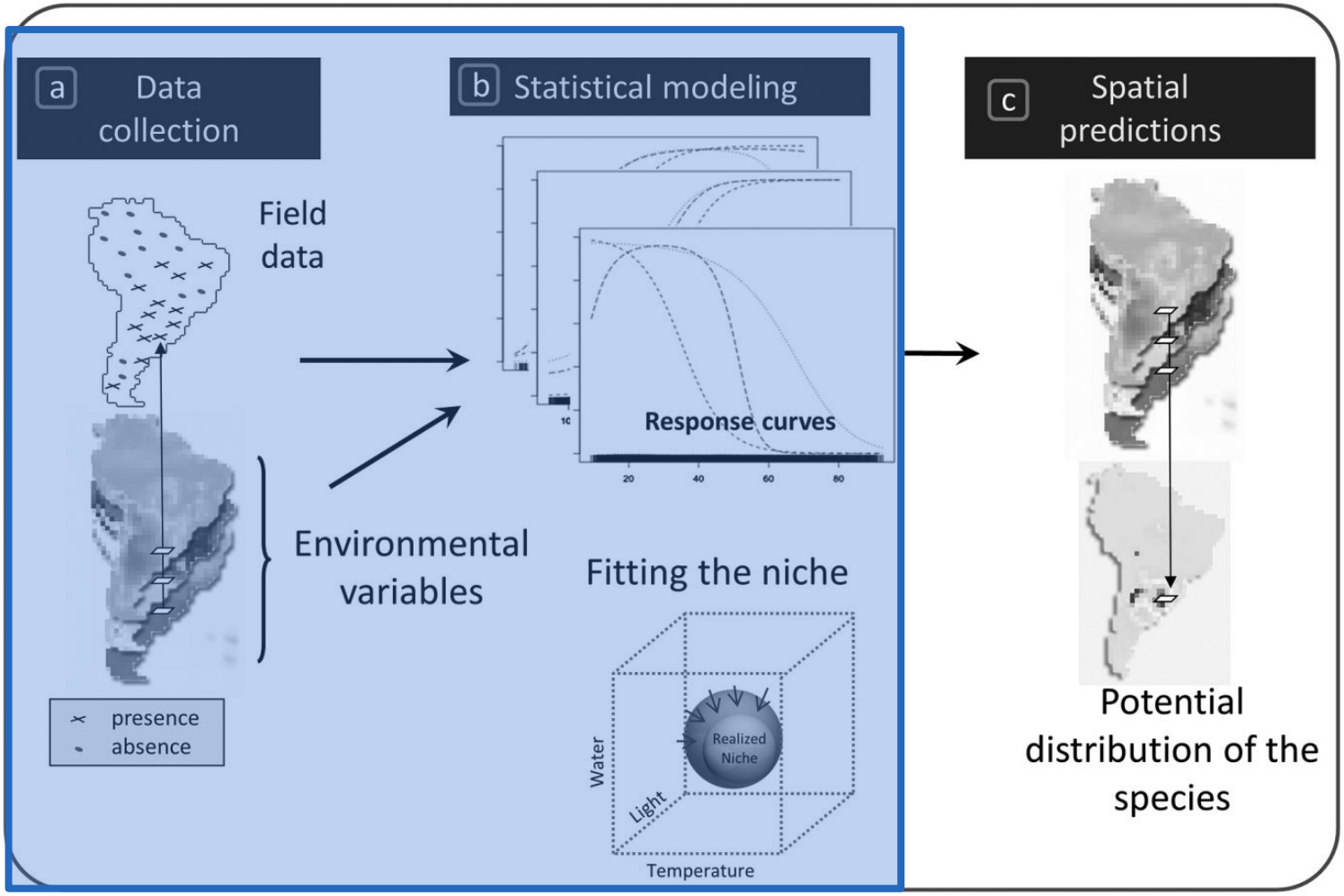
Peterson et al. (2011)

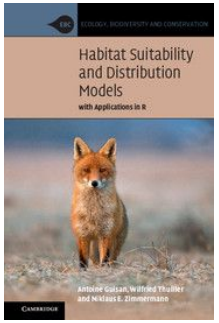


Guisan et al. (2017)

Modelos de Distribuição de Espécies (SDMs)

Visão geral



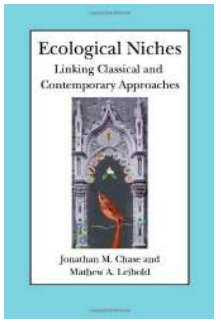


Guisan et al. (2017)

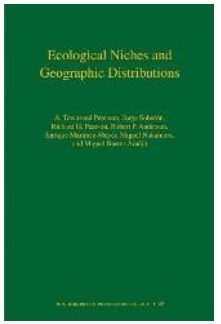
Modelos de Distribuição de Espécies (SDMs)

Ocorrências

Espaço geográfico (G)



Chase & Leibold (2003)

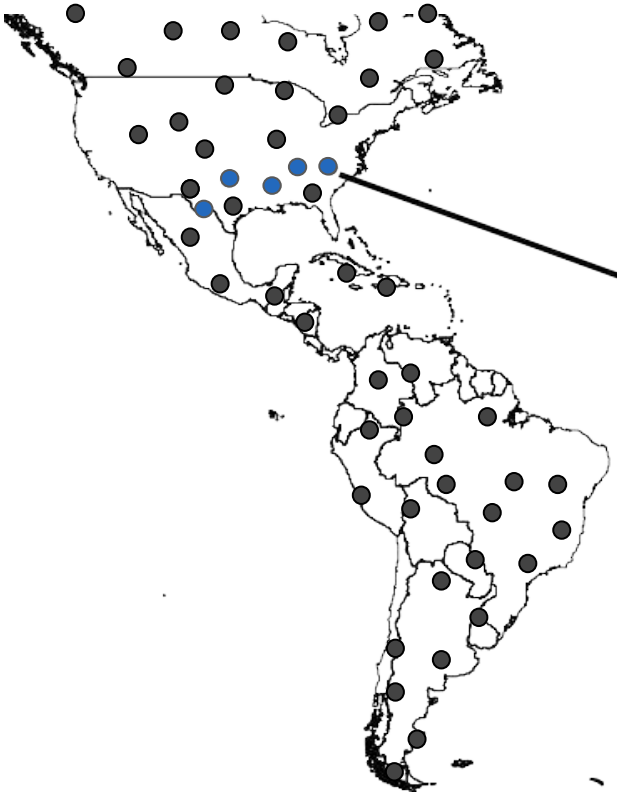


Peterson et al. (2011)

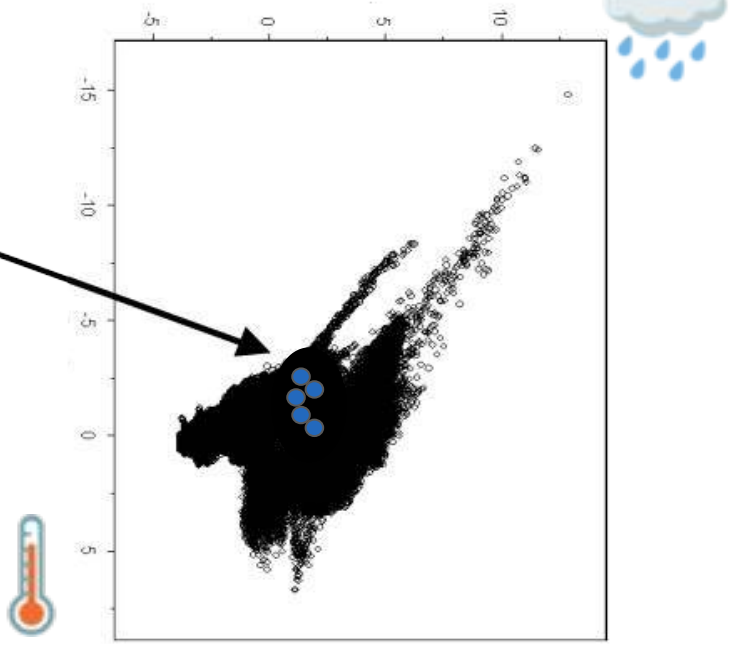
Modelos de Distribuição de Espécies (SDMs)

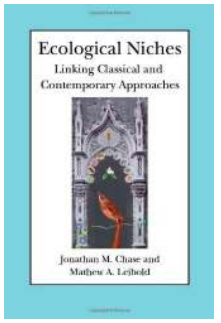
Condições ambientais

Espaço geográfico (G)

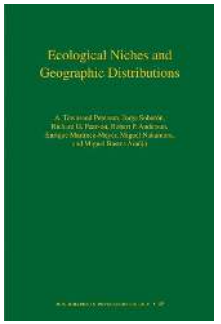


Espaço ambiental (E)





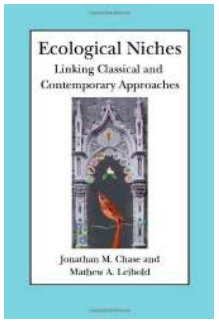
Chase & Leibold (2003)



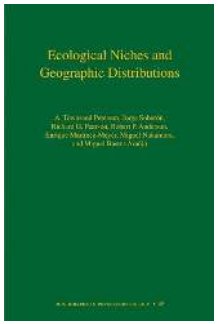
Peterson et al. (2011)

Modelos de Distribuição de Espécies (SDMs)

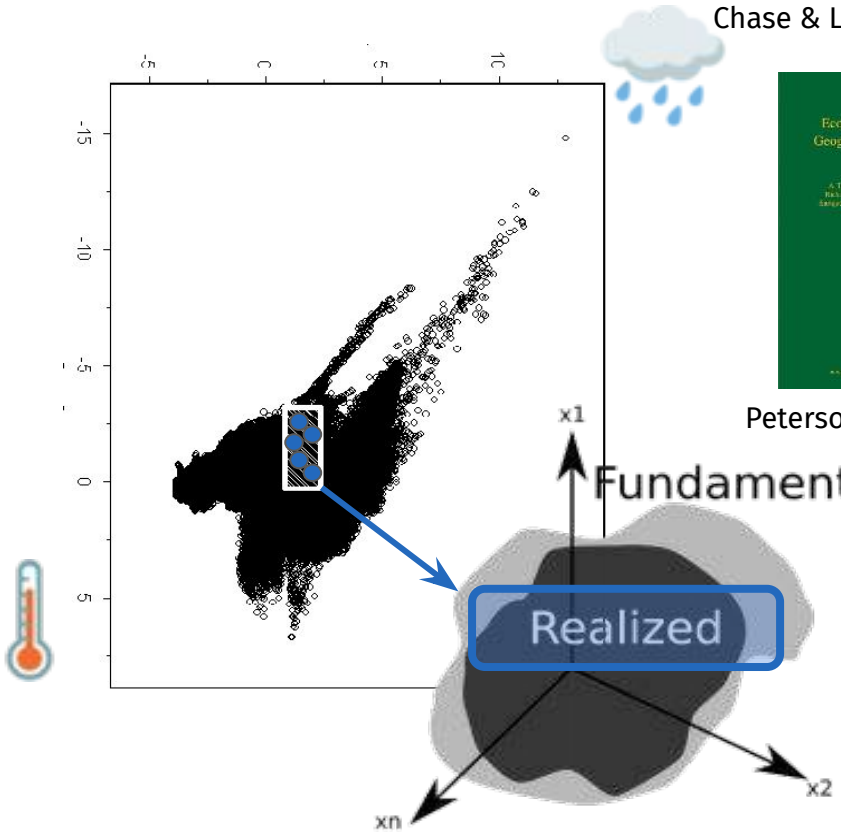
Estimativa do nicho realizado



Chase & Leibold (2003)



Peterson et al. (2011)

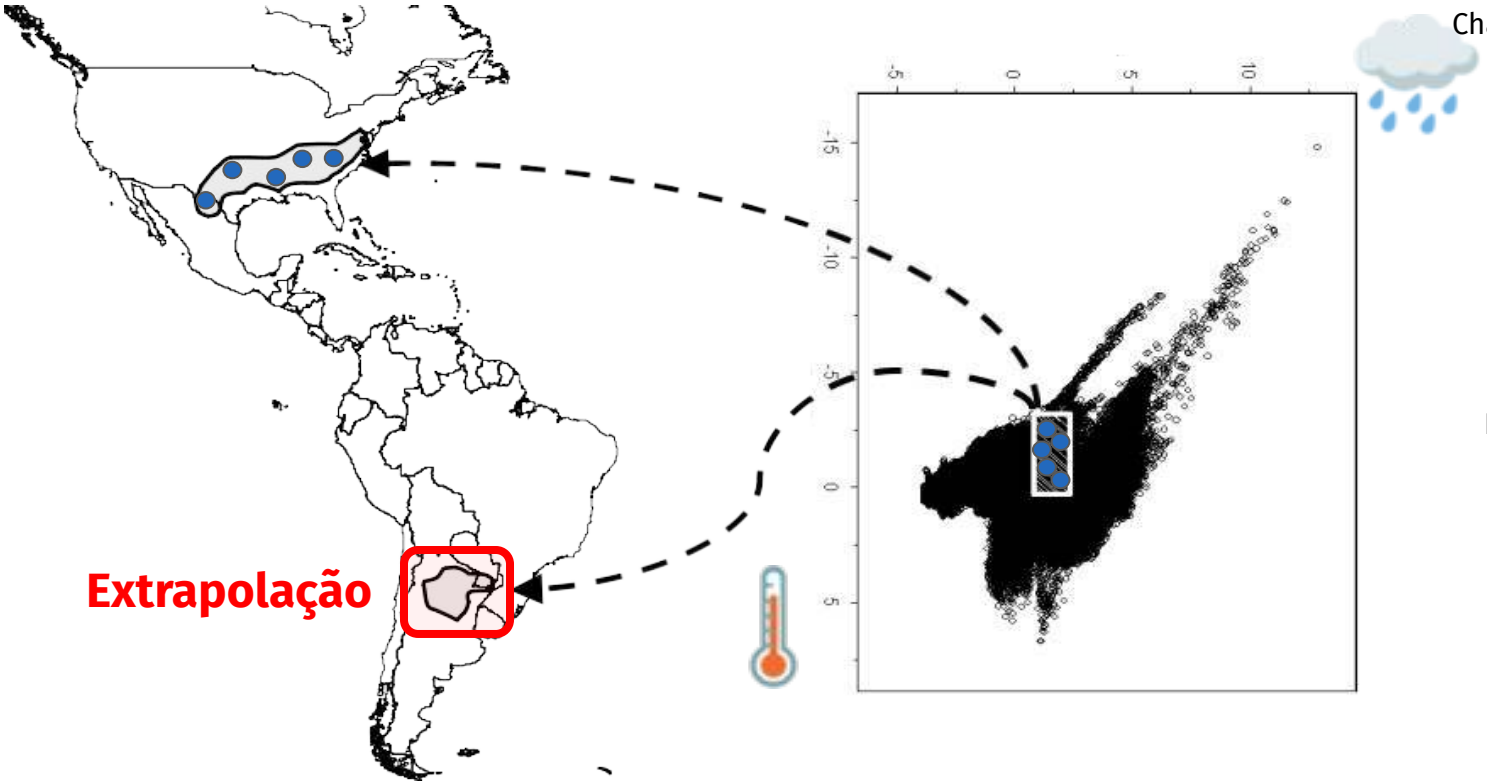


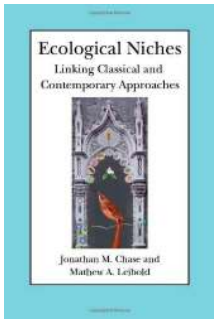
Modelos de Distribuição de Espécies (SDMs)

Predição do nicho realizado estimado

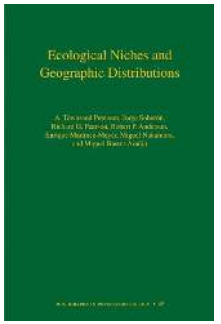
Espaço geográfico (G)

Espaço ambiental (E)





Chase & Leibold (2003)

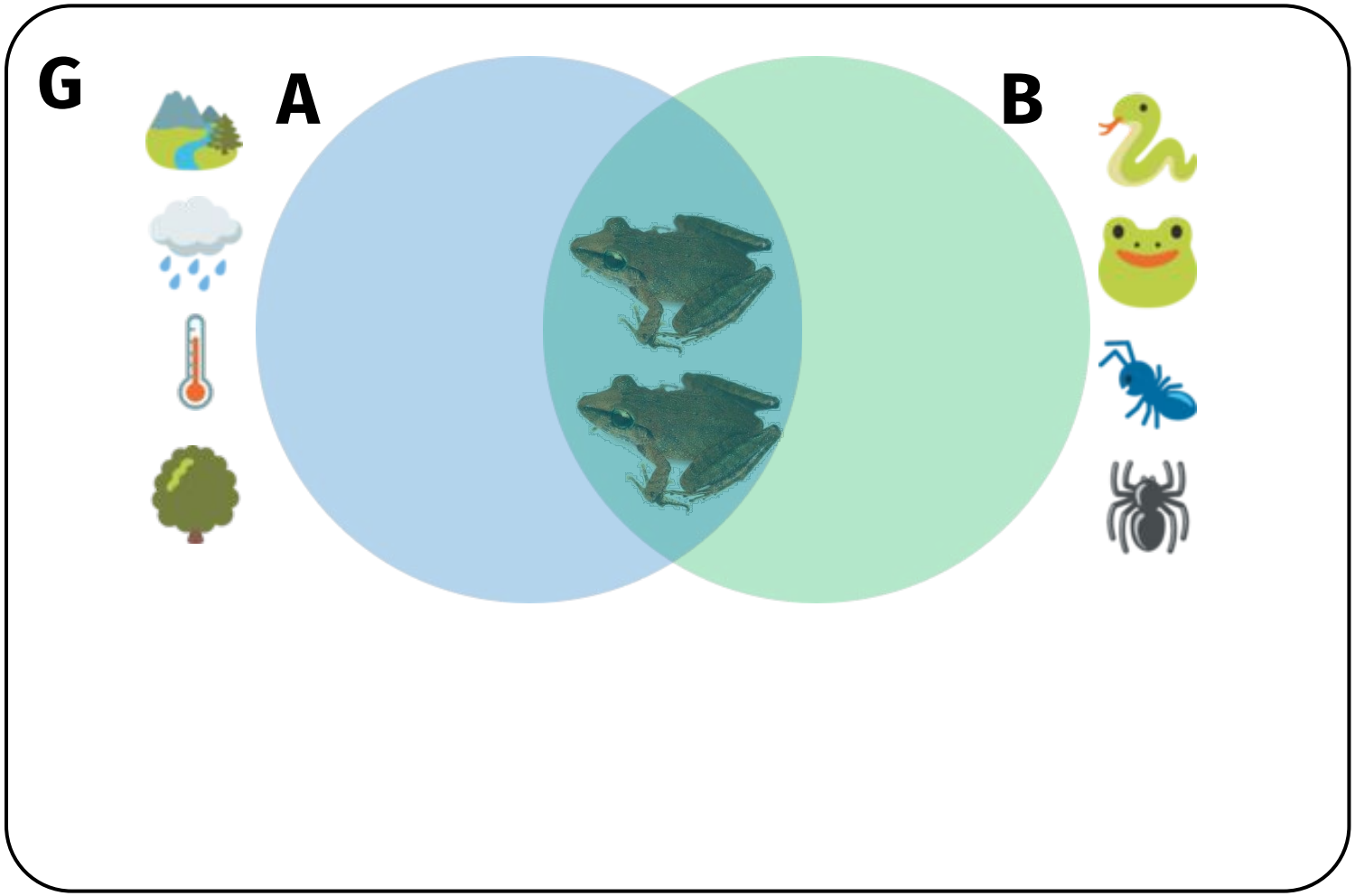


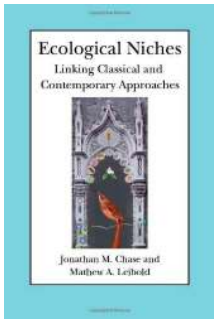
Peterson et al. (2011)

E como contornar essa **extrapolação**?

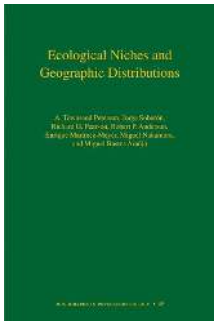
O que determina a distribuição das espécies?

Nicho Ecológico





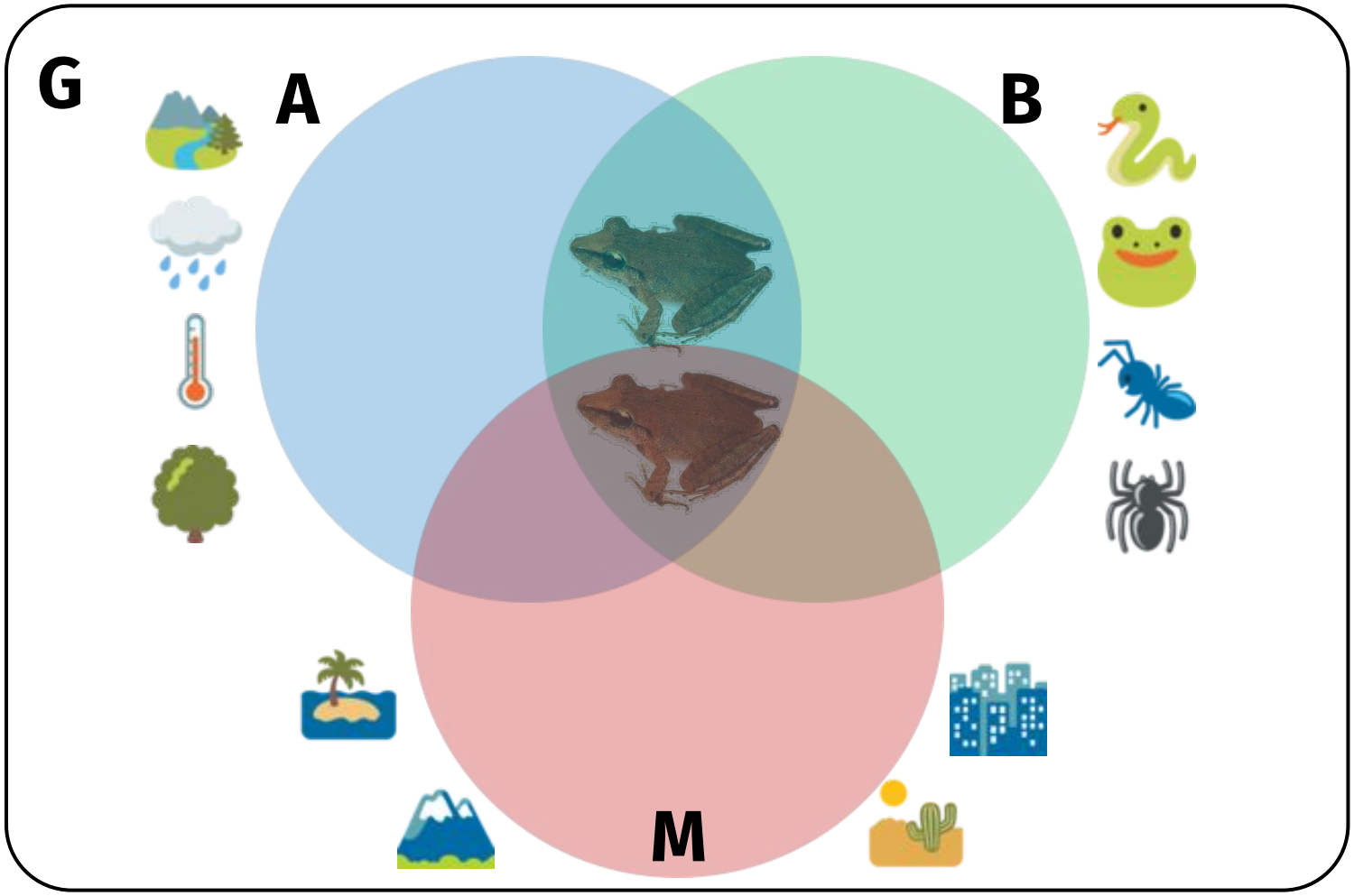
Chase & Leibold (2003)

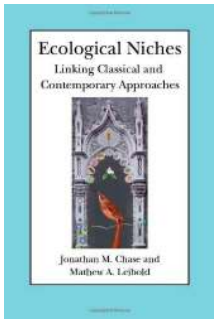


Peterson et al. (2011)

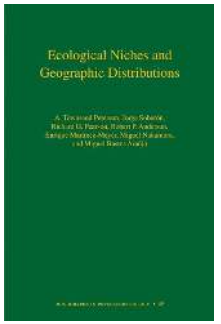
O que determina a distribuição das espécies?

Nicho Ecológico limitado pelo **movimento**





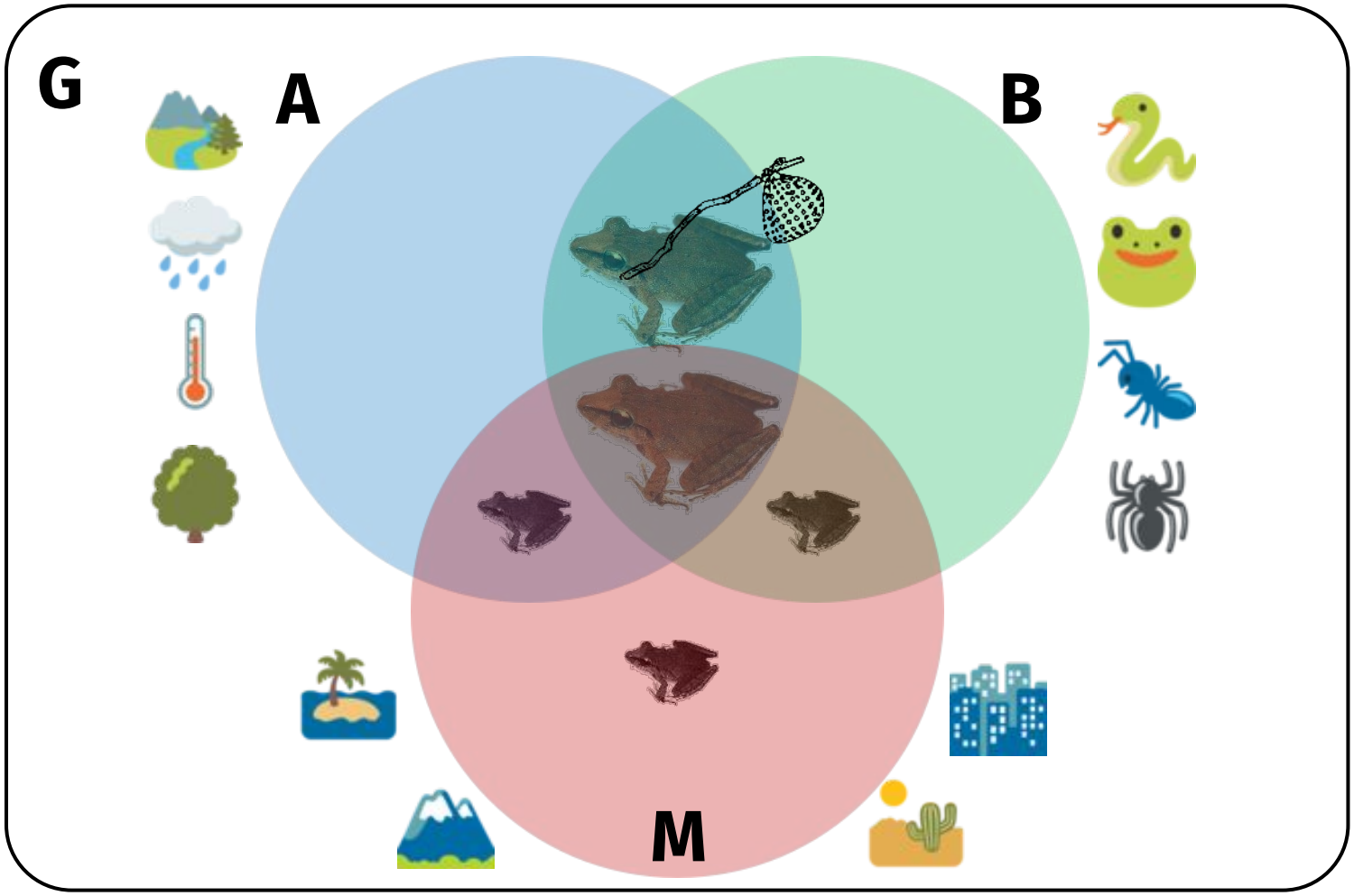
Chase & Leibold (2003)

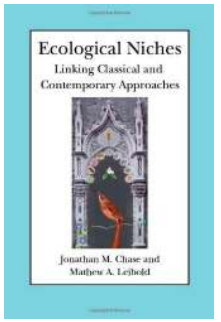


Peterson et al. (2011)

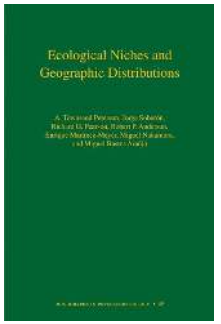
O que determina a distribuição das espécies?

Populações fonte e ralo (*source-sink*)





Chase & Leibold (2003)



Peterson et al. (2011)

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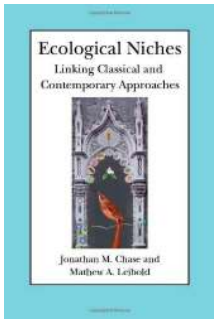
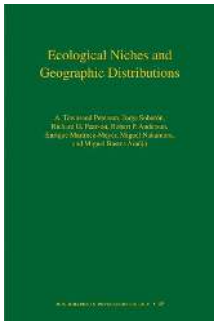


Chase & Leibold (2003)

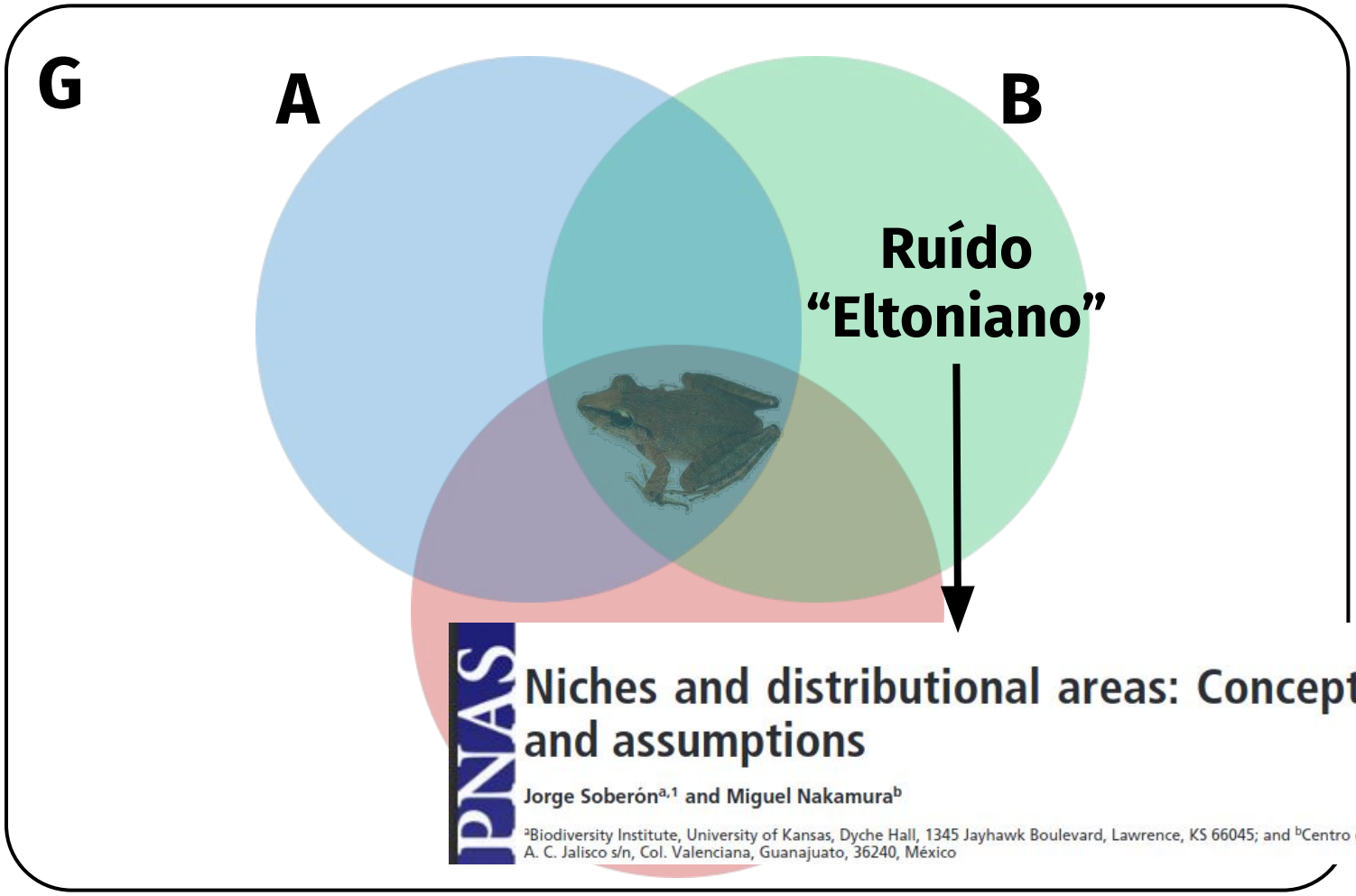


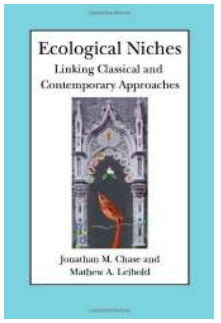
Peterson et al. (2011)

E as **interações bióticas**?

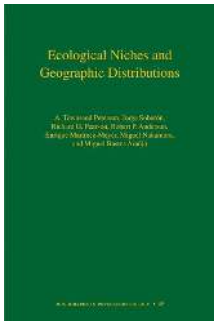
O que determina a distribuição das espécies?

Interações bióticas “ignoradas”





Chase & Leibold (2003)



Peterson et al. (2011)

PNAS

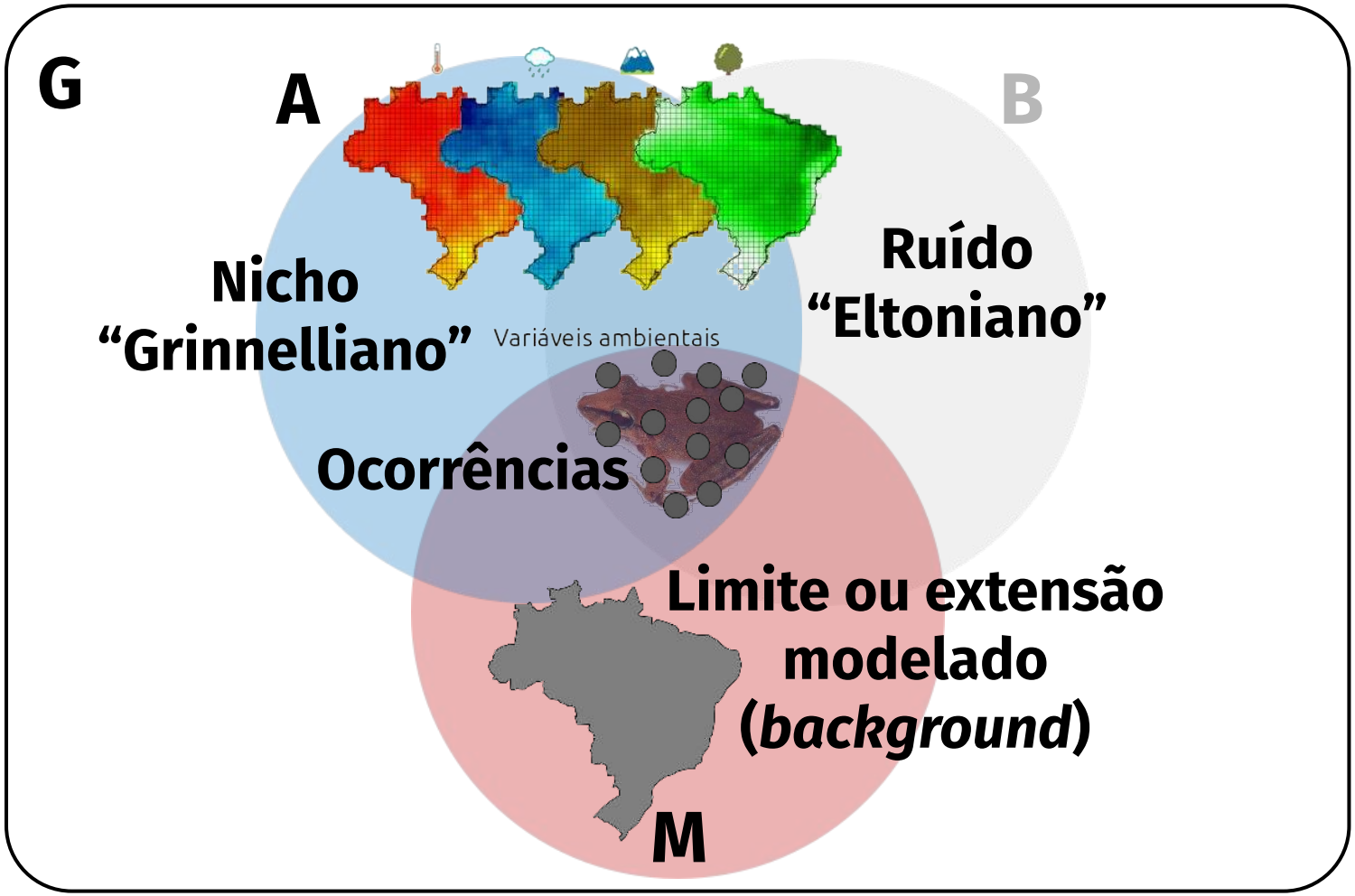
Niches and distributional areas: Concepts, methods, and assumptions

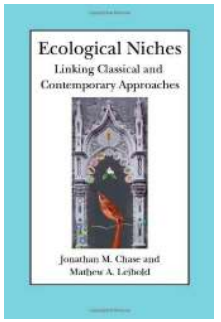
Jorge Soberón[a,1] and Miguel Nakamura[b]

[a]Biodiversity Institute, University of Kansas, Dyche Hall, 1345 Jayhawk Boulevard, Lawrence, KS 66045; and [b]Centro de Investigación en Matemáticas, A. C. Jalisco s/n, Col. Valenciana, Guanajuato, 36240, México

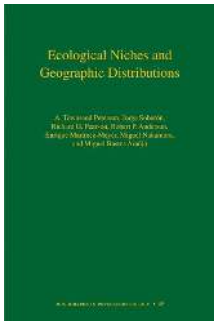
O que determina a distribuição das espécies?

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 Brischoux[4] | Monica Papeş[5]

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

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ORIGINAL RESEARCH | Open Access

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

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

Carsten F. Dormann[1] | Maria Bobrowski[2] | D. Matthias Dehling[3] | David J. Harris[4] | Florian Hartig[1,5] | Heike Lischke[6] | Marco D. Moretti[7] | Jörn Pagel[8] | Stefan Pinkert[9] | Matthias Schleuning[10] | Susanne I. Schmidt[11] | Christine S. Sheppard[8] | Manuel J. Steinbauer[12,13] | Dirk Zeuss[14] | Casper Kraan[15,16]

Biotic interactions and climate in species distribution modelling

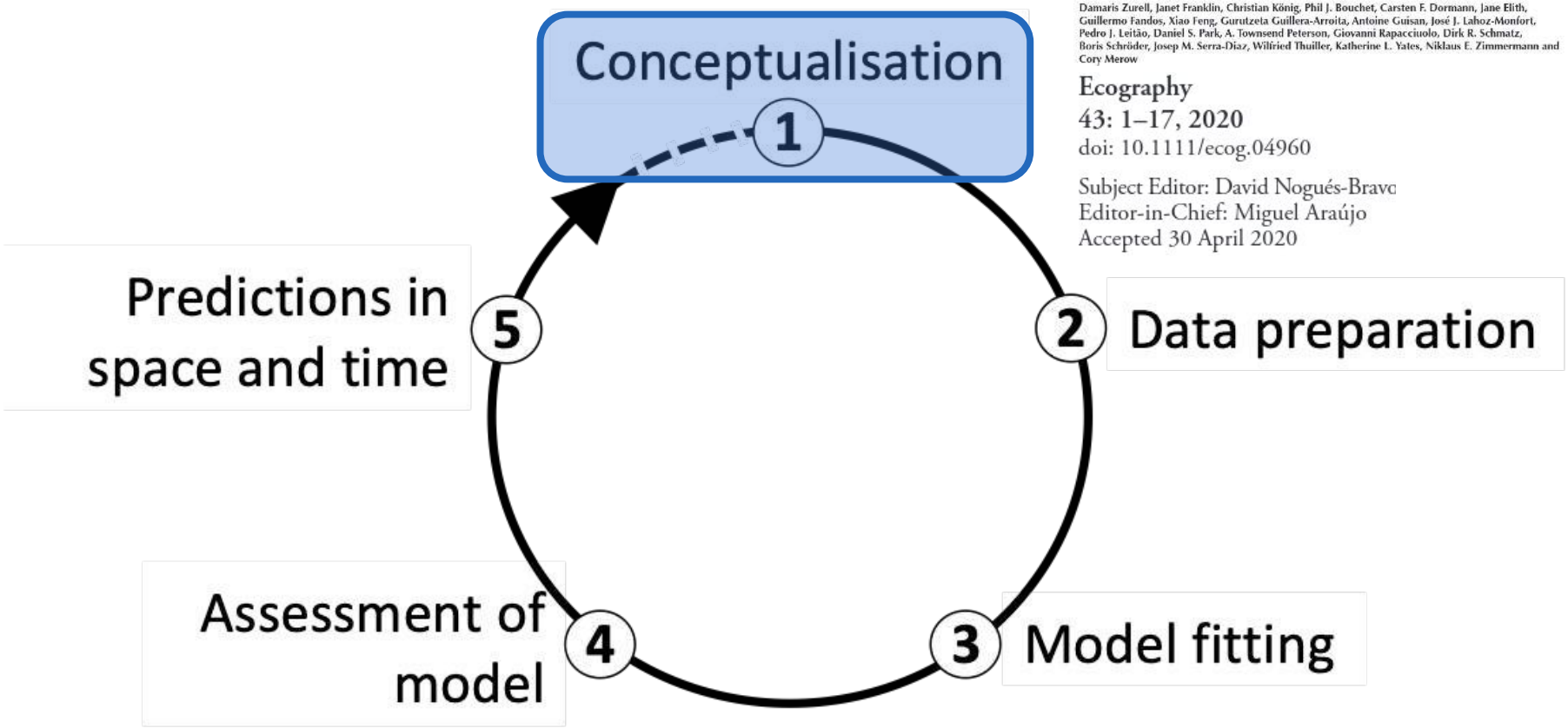
Daniel P. Bebber, Sarah J. Gurr

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. Schmatz, Boris Schröder, Josep M. Serra-Diaz, Wilfried Thuiller, Katherine L. Yates, Niklaus E. Zimmermann and Cory Merow

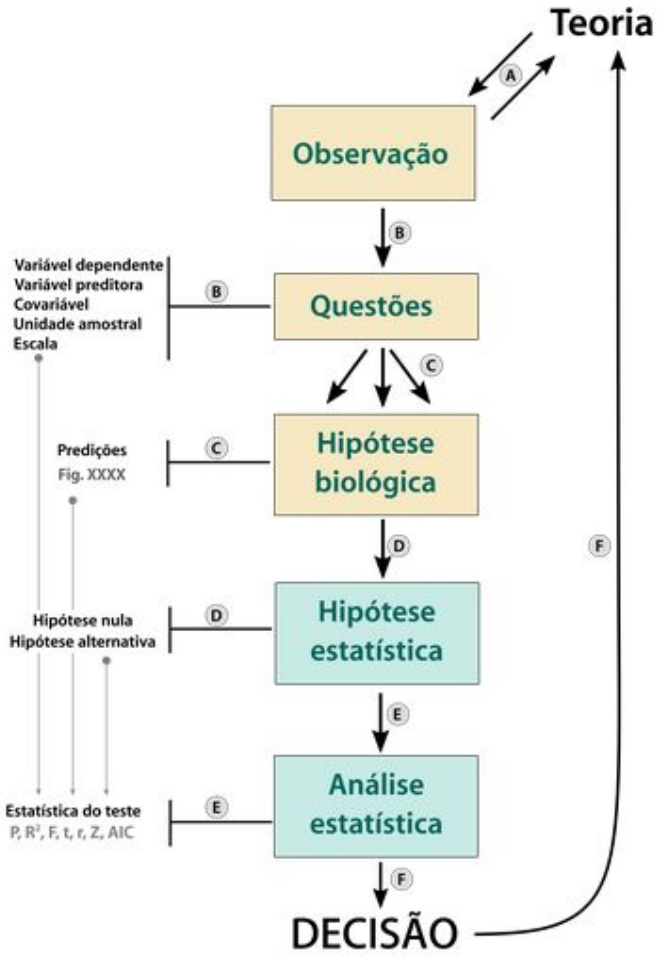
Ecography
43: 1–17, 2020
doi: 10.1111/ecog.04960

Subject Editor: David Nogués-Bravo
Editor-in-Chief: Miguel Araújo
Accepted 30 April 2020

https://doi.org/10.1111/ecog.04960

1. Conceitualização

Perguntas associadas à distribuição das espécies

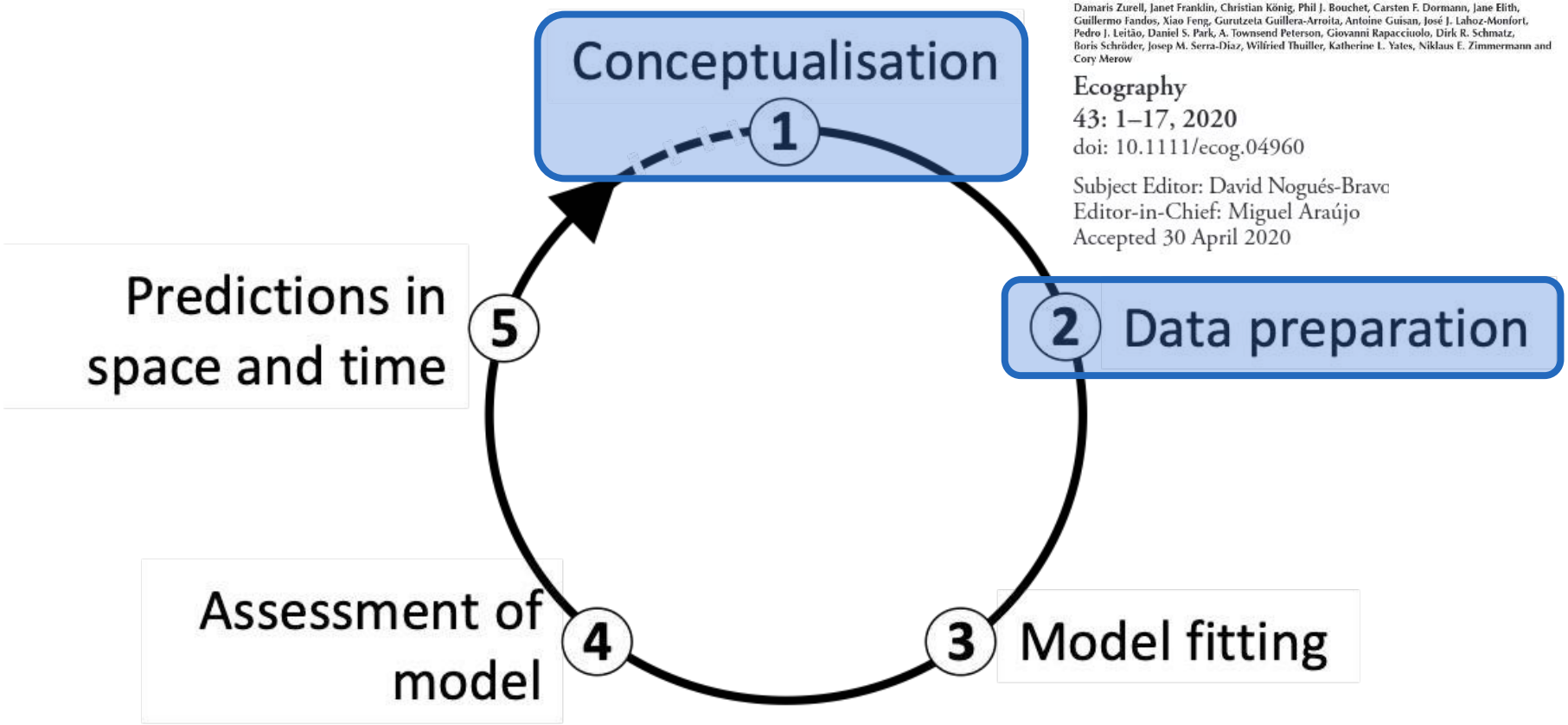


Temas

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



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Review and synthesis

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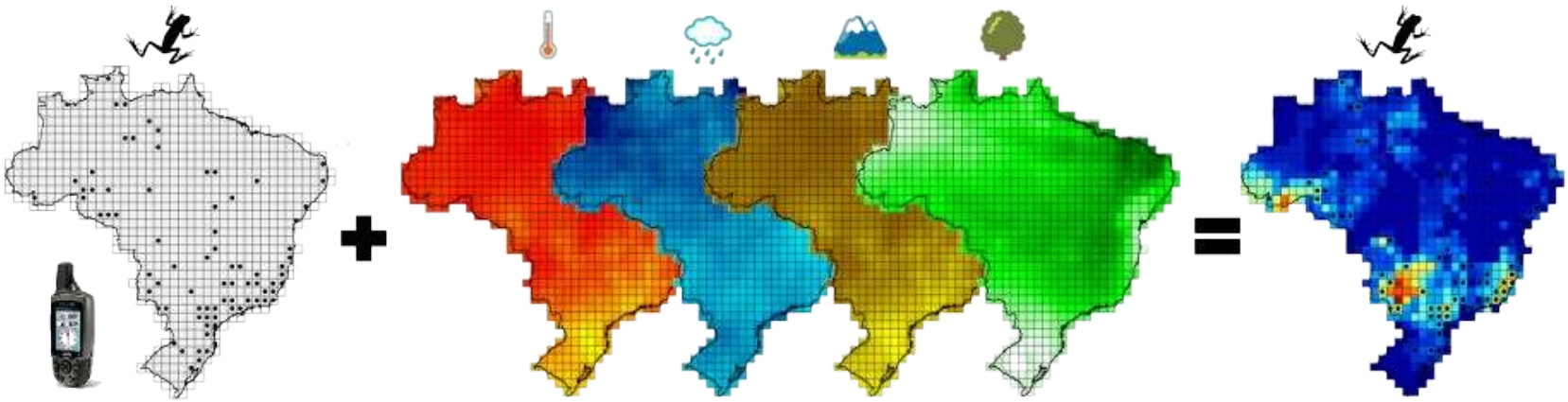
2. Preparação dos dados

Dados de entrada e saída



"Ocorrências"

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

Variáveis ambientais

variaveis
temperatura
precipitação
relevo

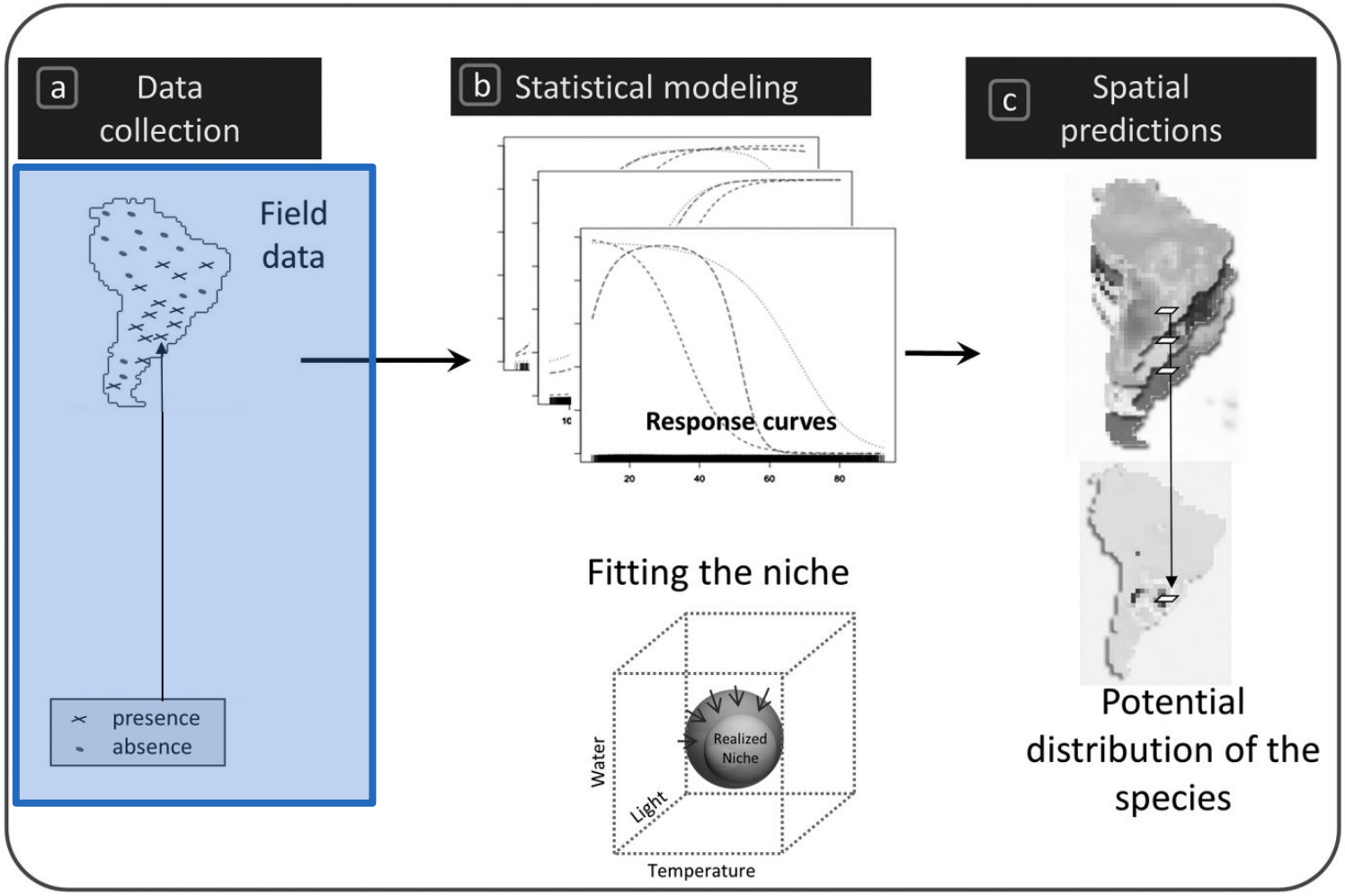
Adequabilidade

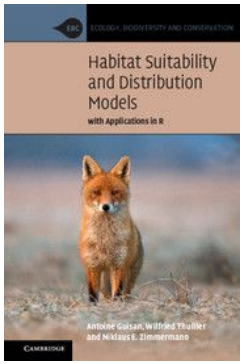
valores
0
até
1

Ocorrências

2. Preparação dos dados

Ocorrências





Guisan et al. (2017)

2. Preparação dos dados

Fontes

1. Coletas em campo

2. Preparação dos dados

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

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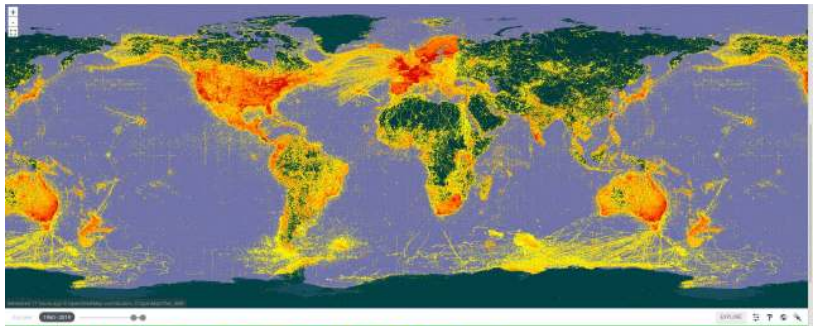
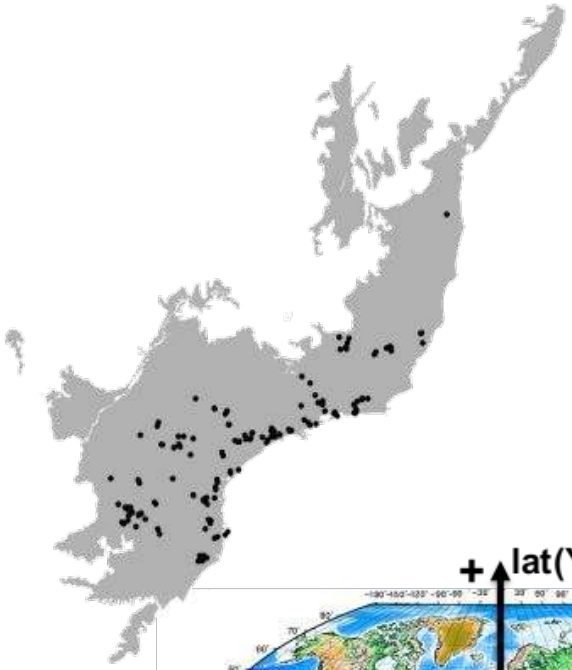
5. Banco de dados (GBIF, SpeciesLink, ...)

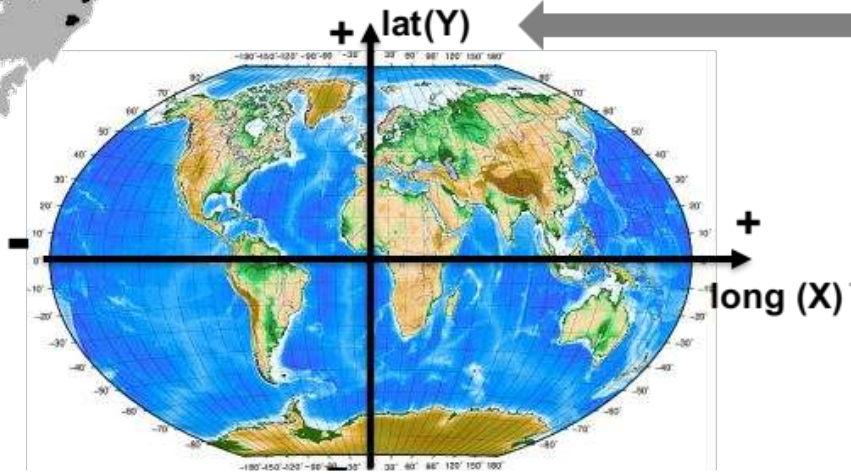


2. Preparação dos dados

Formato

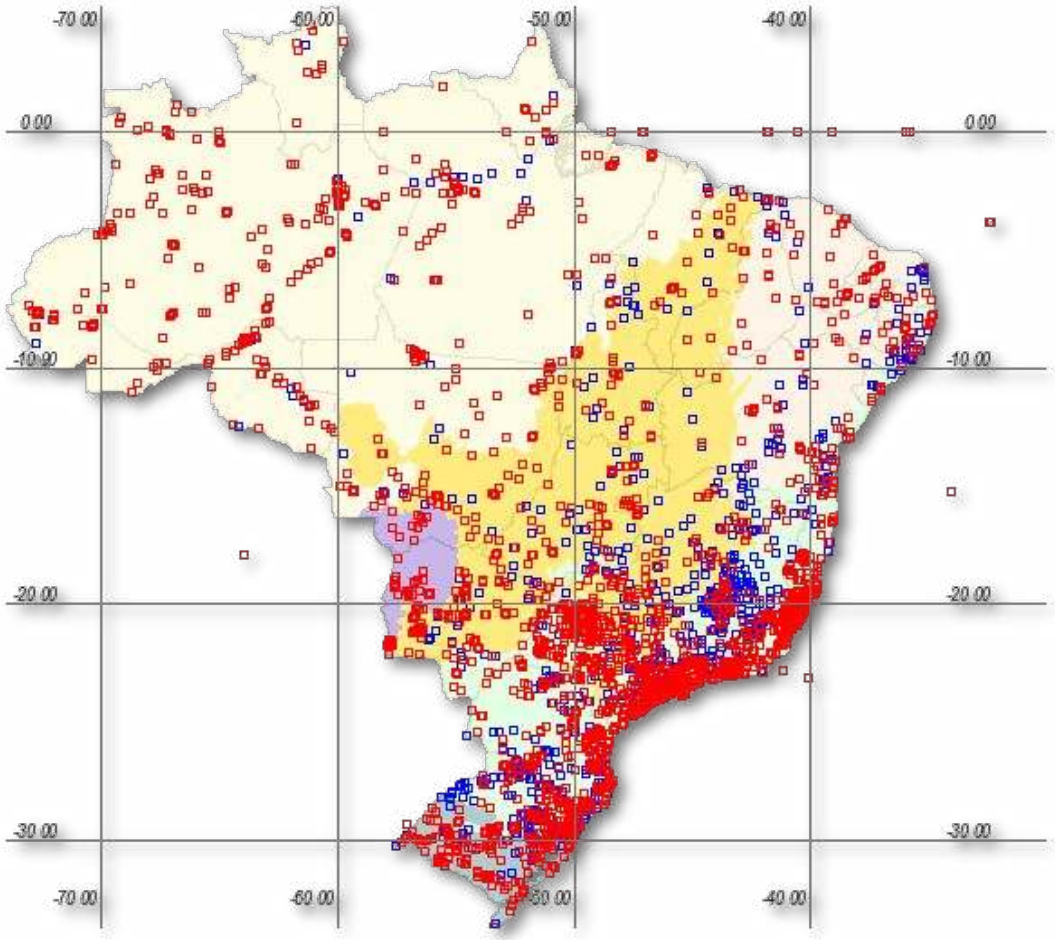


especie	longitude	latitude
haddadus_binotatus	-39.858889	-18.716111
haddadus_binotatus	-41.184722	-20.603611
haddadus_binotatus	-45.069722	-23.430278
haddadus_binotatus	-40.071944	-19.391111
haddadus_binotatus	-47.549722	-24.700278
haddadus_binotatus	-39.280278	-14.785833



2. Preparação dos dados

Viés de amostragem



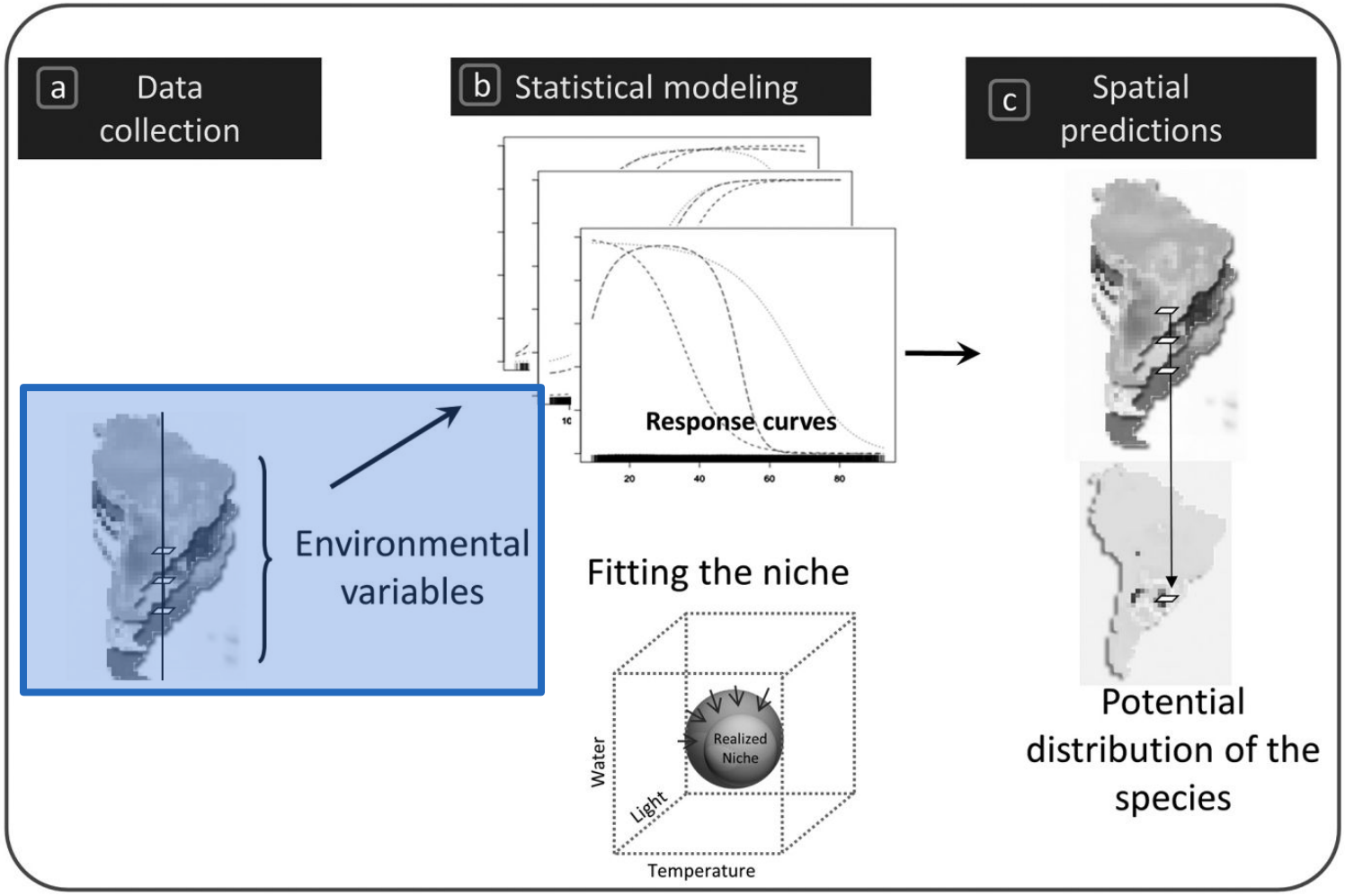
Boana faber

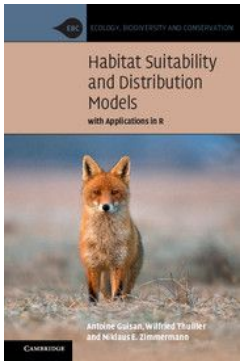
speciesLink

Variáveis ambientais

2. Preparação dos dados

Variáveis

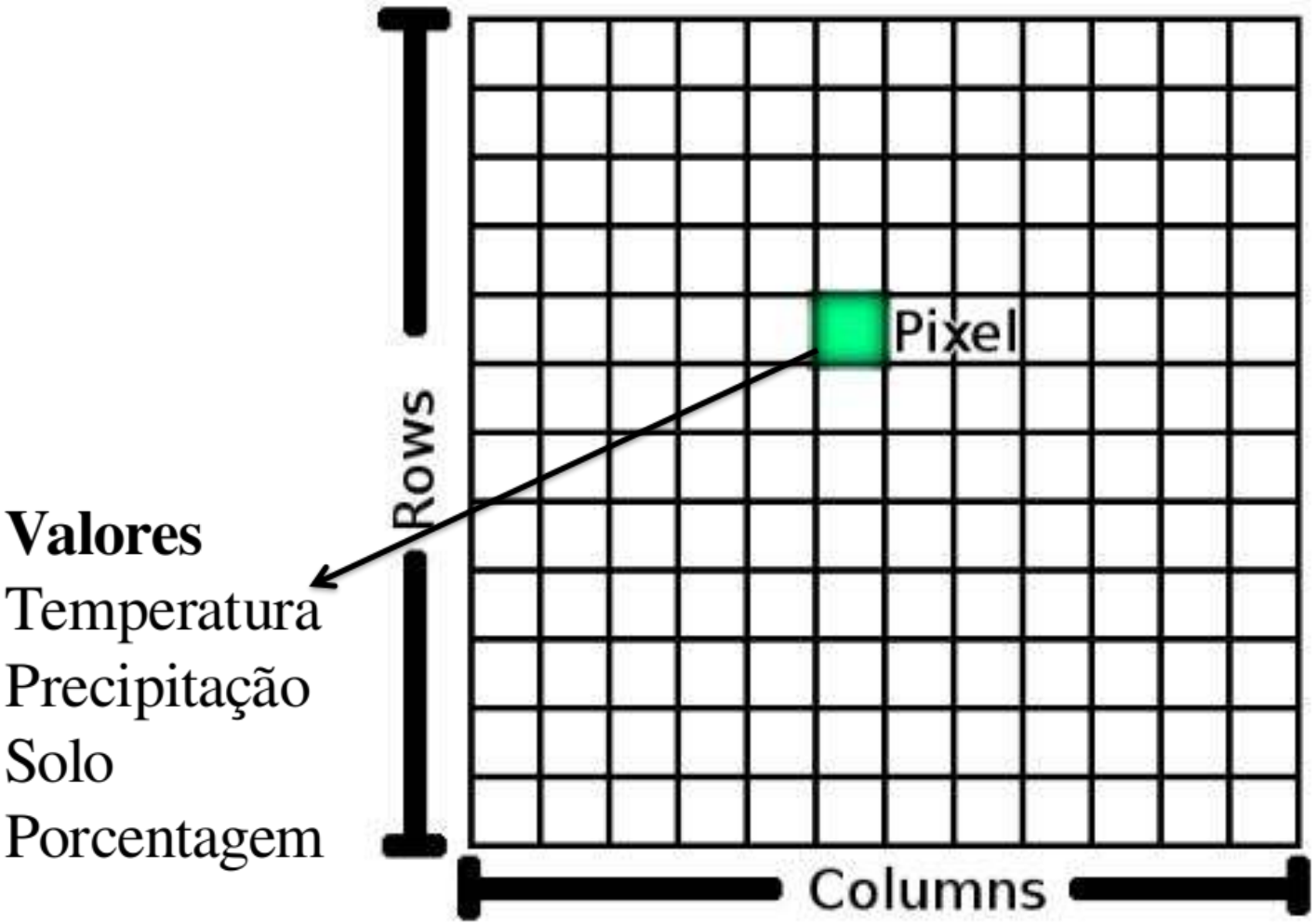




Guisan et al. (2017)

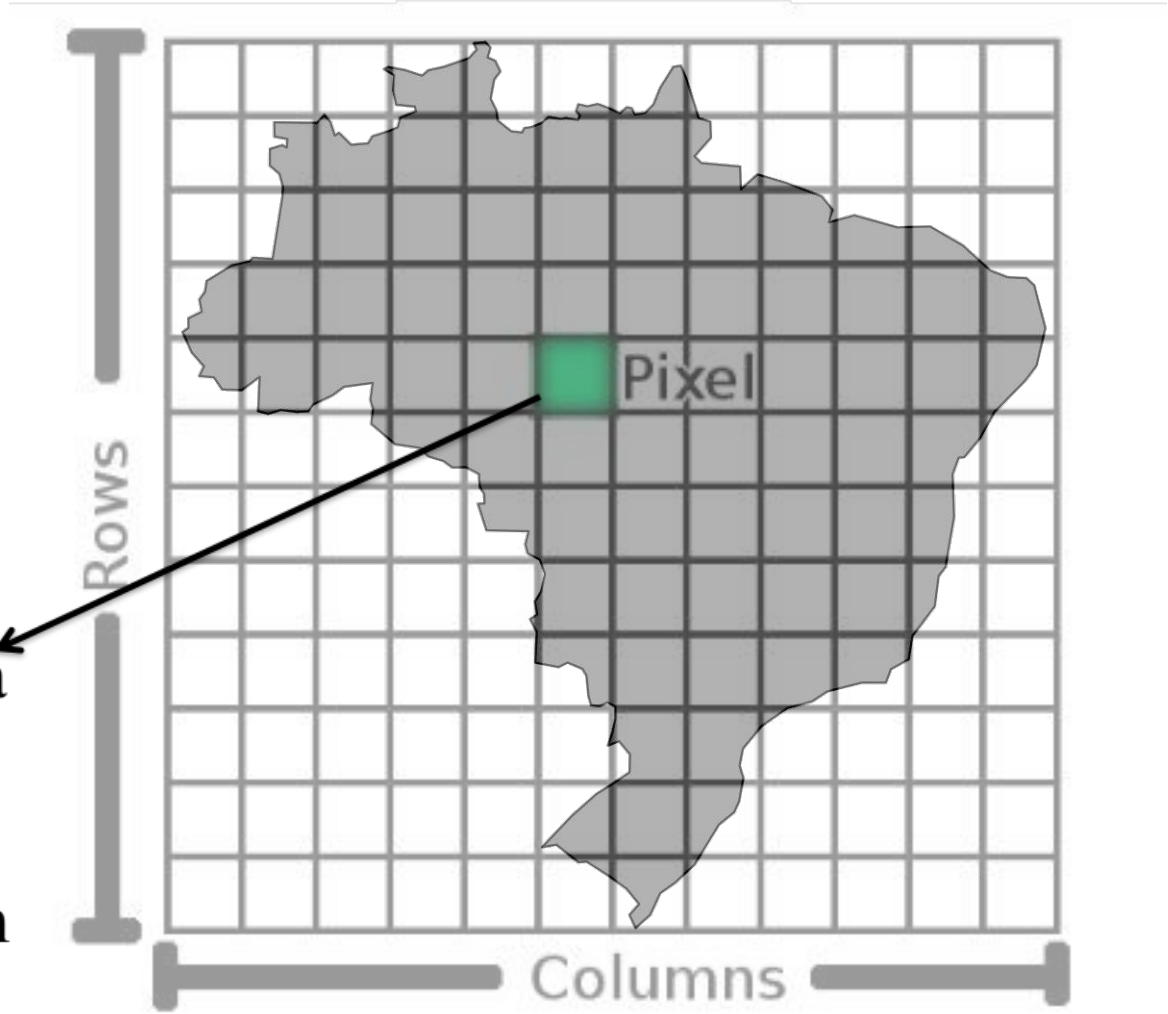
2. Preparação dos dados

Raster - Extensão e resolução



2. Preparação dos dados

Raster - Extensão e resolução



Valores
Temperatura
Precipitação
Solo
Porcentagem

2. Preparação dos dados

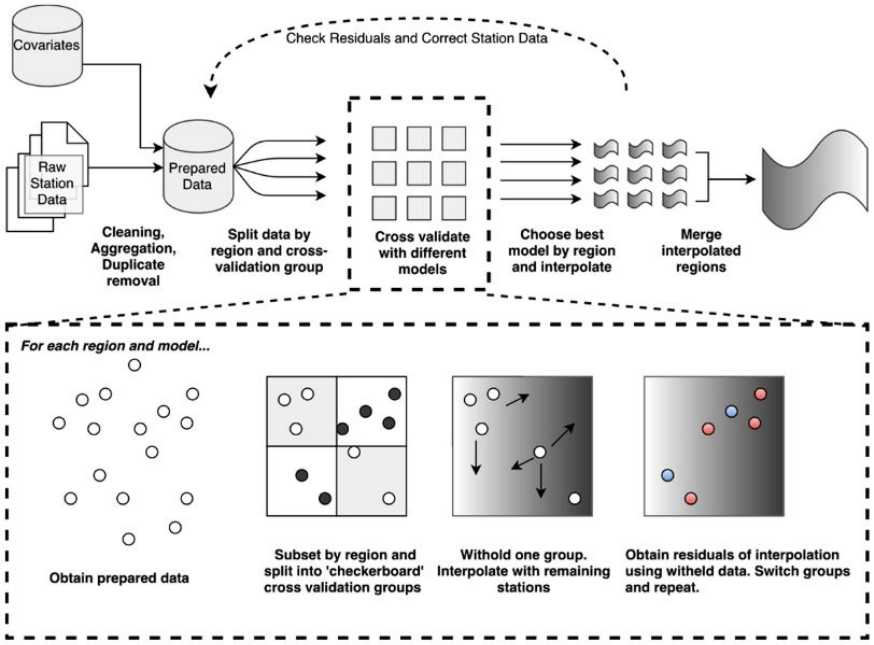
Raster - Interpolação

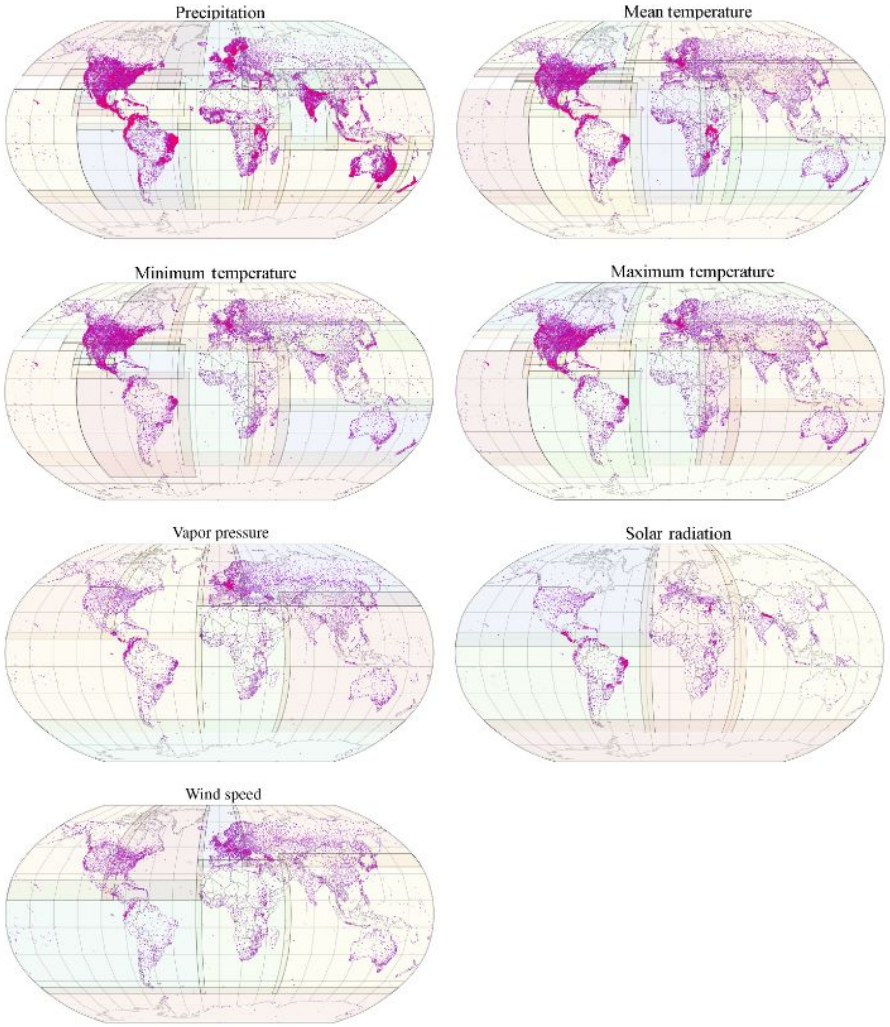
INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. (2017)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.5086

RMetS
Royal Meteorological Society

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*

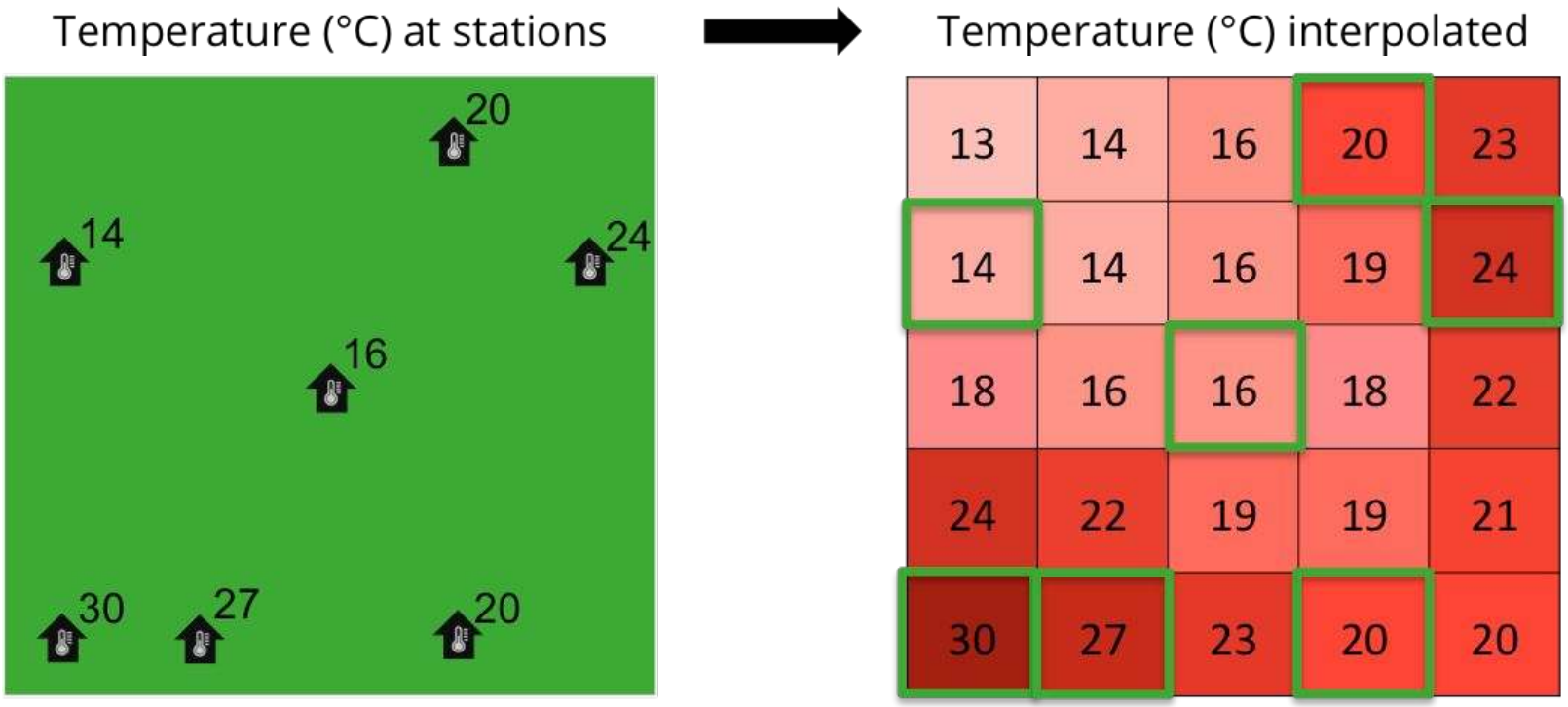




2. Preparação dos dados

Raster - Interpolação

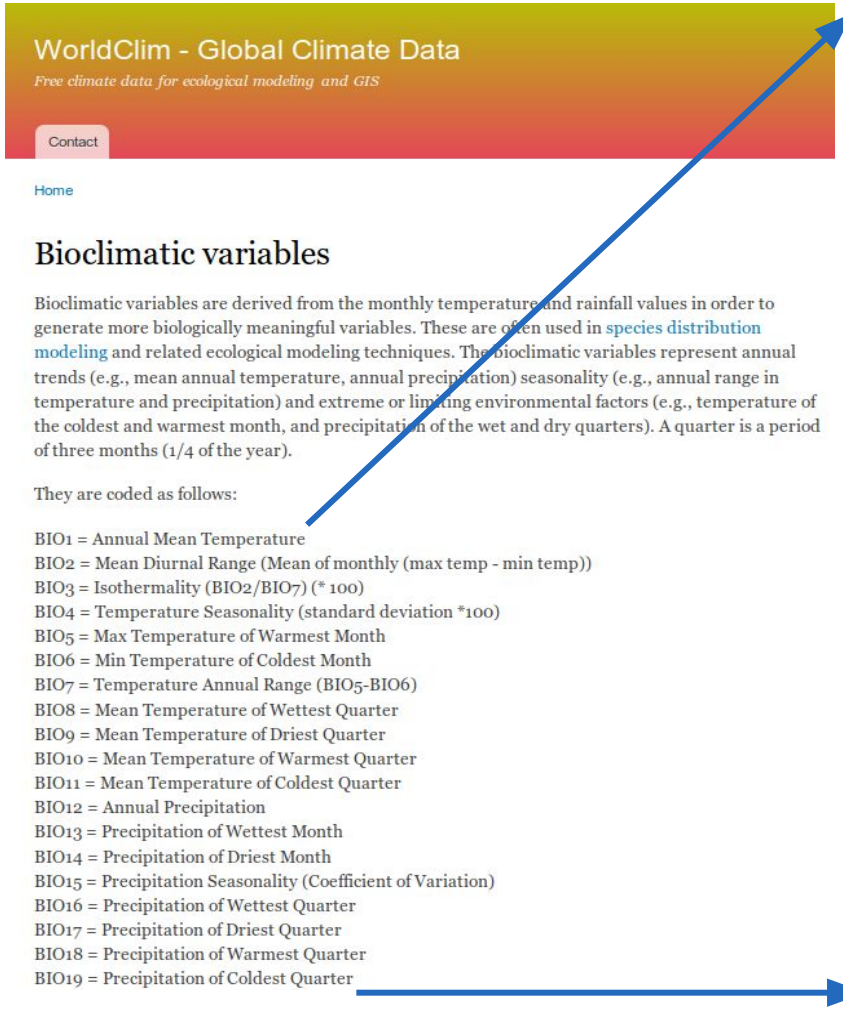
https://support.bccvl.org.au/support/home



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

2. Preparação dos dados

WorldClim - Bioclimáticas



BIO01 = Temperatura média anual
BIO02 = Variação Diurna Média de Temperatura (Média mensal (Tmax-Tmin))
BIO03 = Isotermalidade ((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

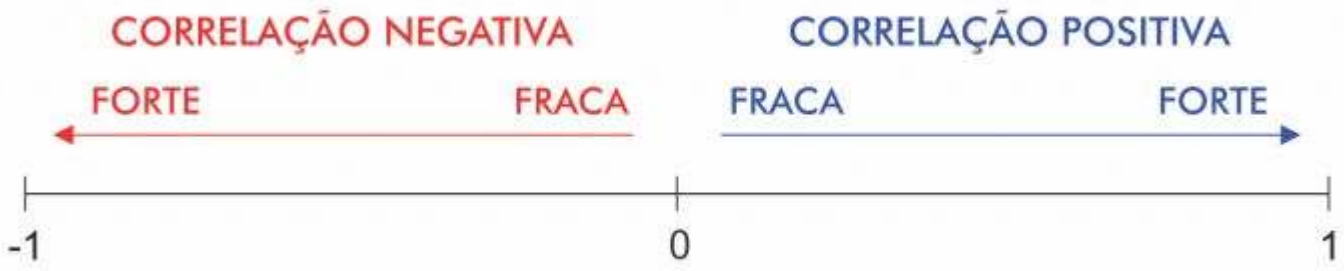
Temperatura

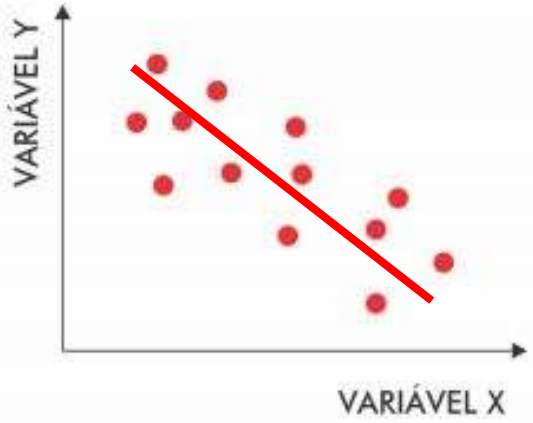
BIO12 = Precipitação Anual
BIO13 = Precipitação do mês mais chuvoso
BIO14 = Precipitação do mês mais seco
BIO15 = Sazonalidade da Precipitação (coeficiente de variação)
BIO16 = Precipitação do trimestre mais chuvoso
BIO17 = Precipitação do trimestre mais seco
BIO18 = Precipitação do trimestre mais quente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

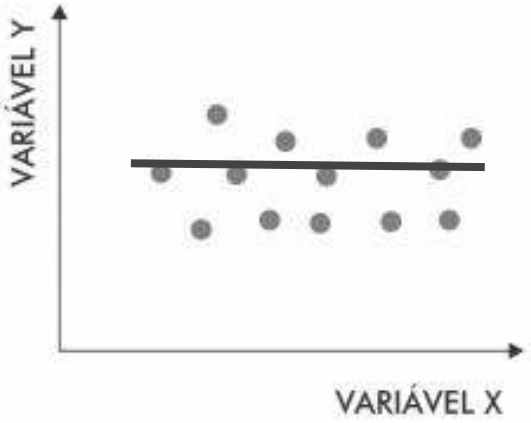
Precipitação

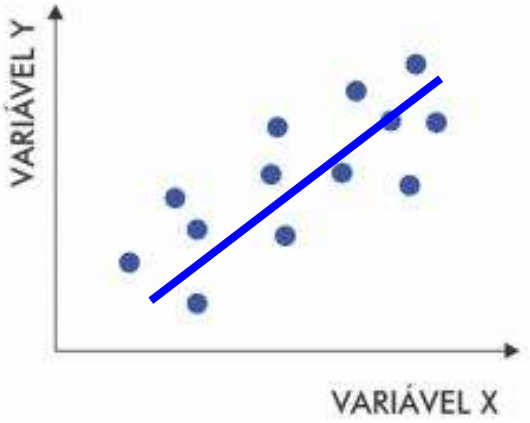
2. Preparação dos dados

Colinearidade - Correlação



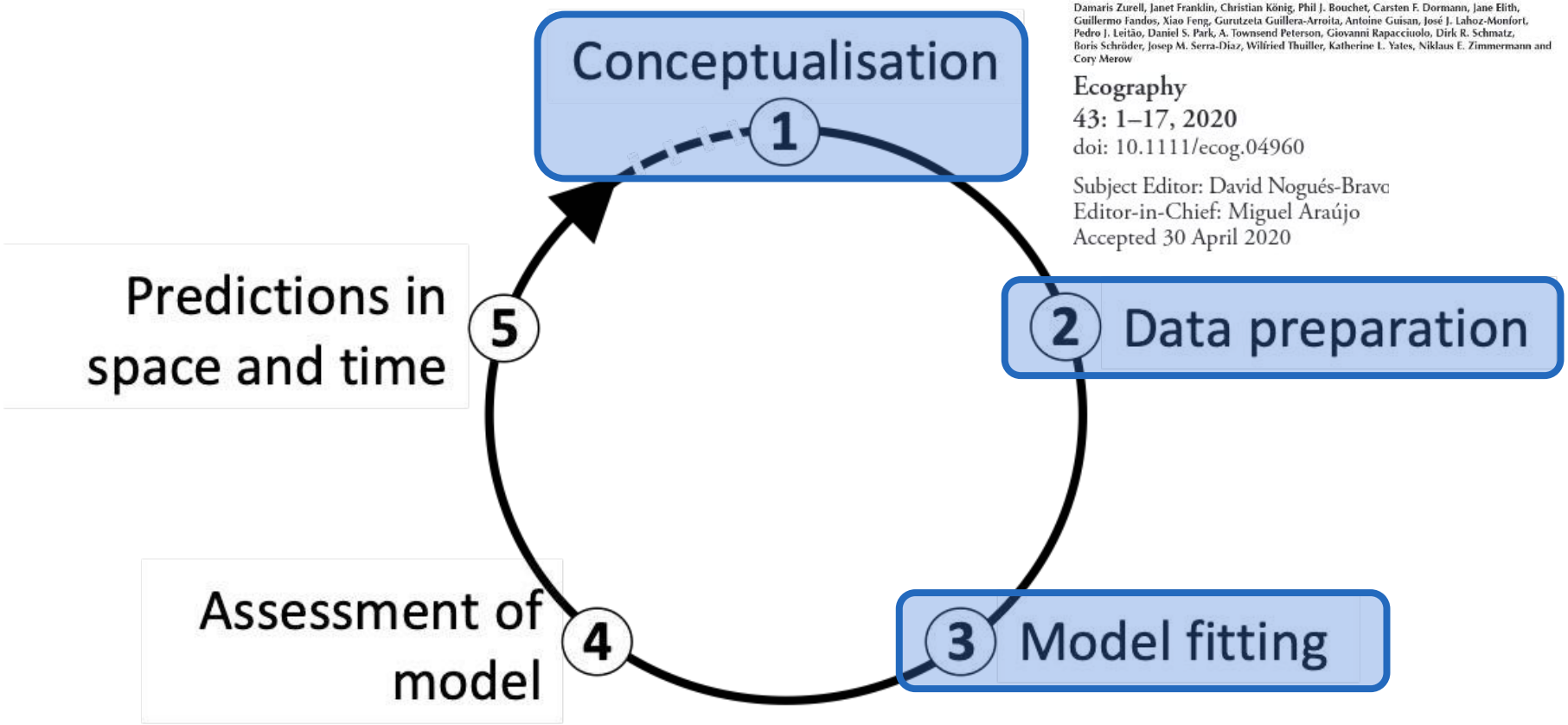






SDM passo a passo

Passos de construção dos SDMs



ECOGRAPHY

Review and synthesis

A standard protocol for reporting species distribution models

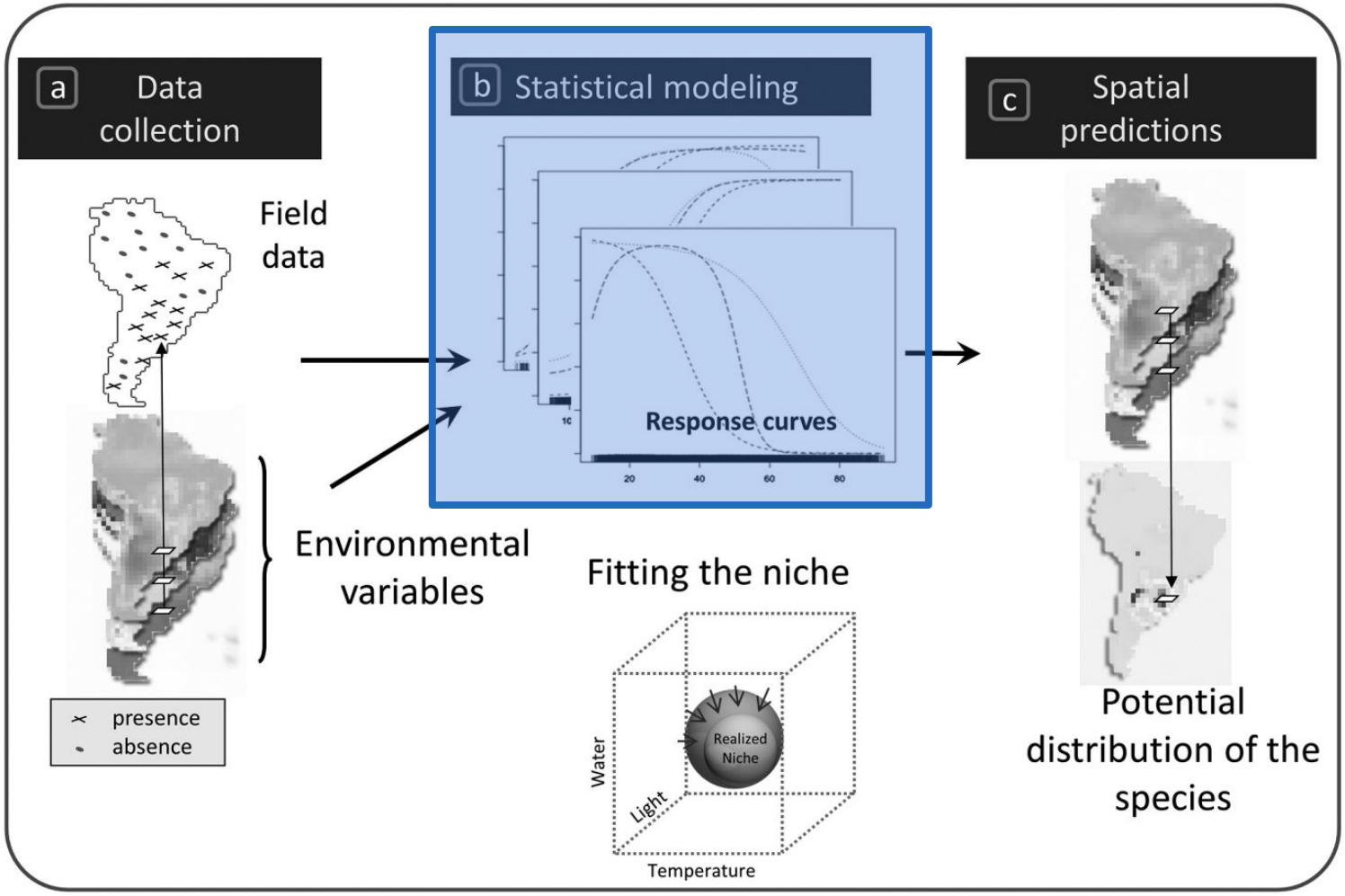
Damaris Zurell, Janet Franklin, Christian König, Phil J. Bouchet, Carsten F. Dormann, Jane Elith, Guillermo Fandos, Xiao Feng, Gurutzeta Guillera-Arroita, Antoine Guisan, José J. Lahoz-Monfort, Pedro J. Leitão, Daniel S. Park, A. Townsend Peterson, Giovanni Rapacciuolo, Dirk R. Schmatz, Boris Schröder,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

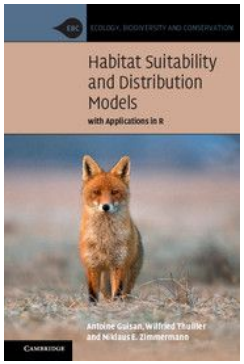
Ecography
43: 1–17, 2020
doi: 10.1111/ecog.04960

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

Aquário

Bioclim

Dist. Euclidiana

Dist. Mahalanobis

Domain (dist. Gower)

ENFA (ecological niche factor analysis)

Presença/Background

GARP (genetic algoritm 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)

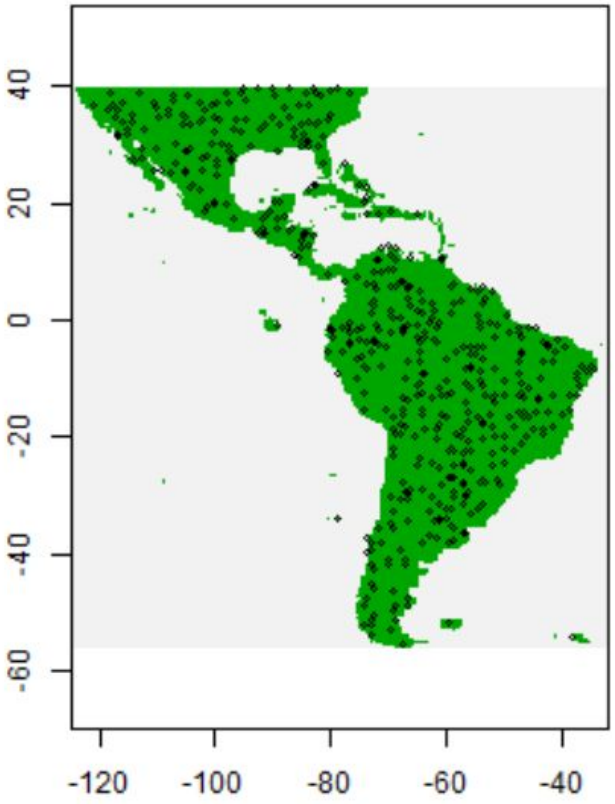
NNET (neural networks)

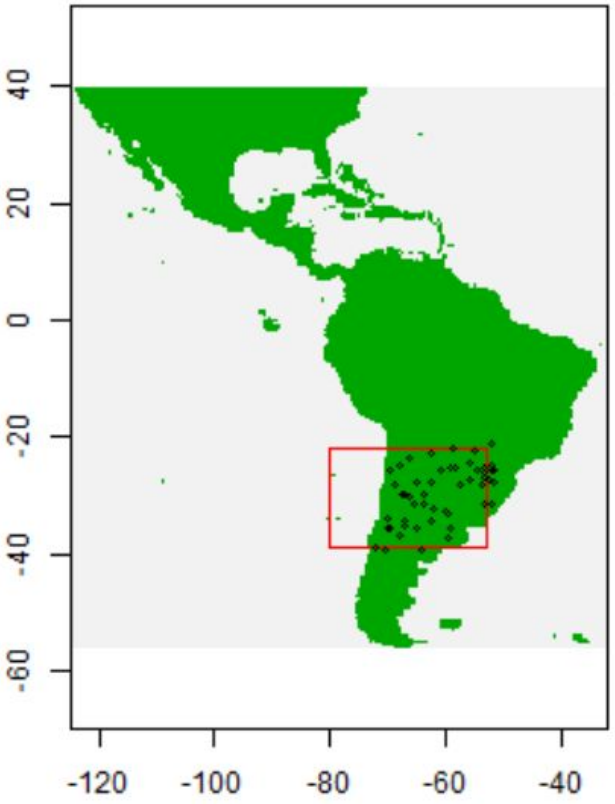
→ ANN (artificial neural networks)

3. Ajuste dos modelos

Pseudo-ausência

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

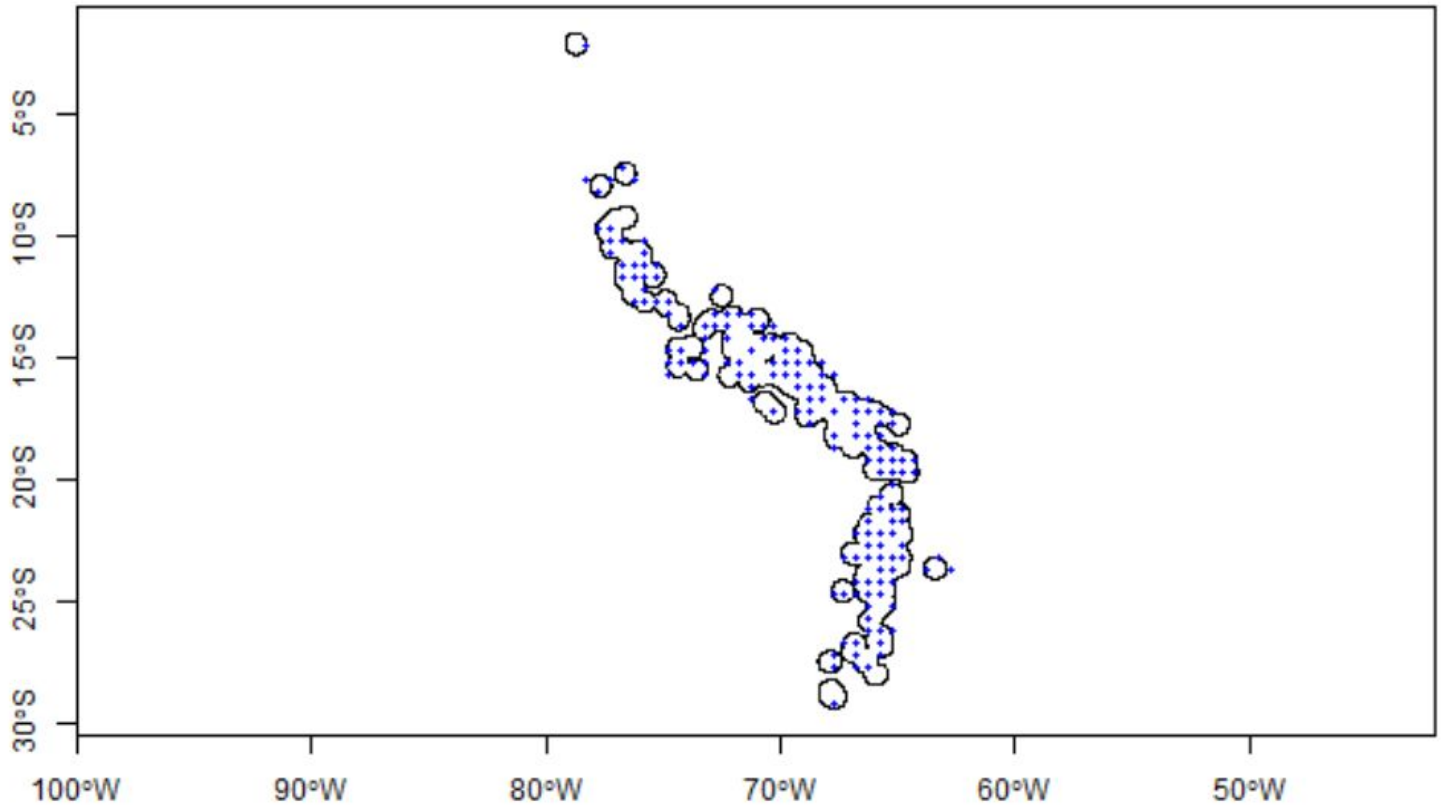




3. Ajuste dos modelos

Pseudo-ausência

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



3. Ajuste dos modelos

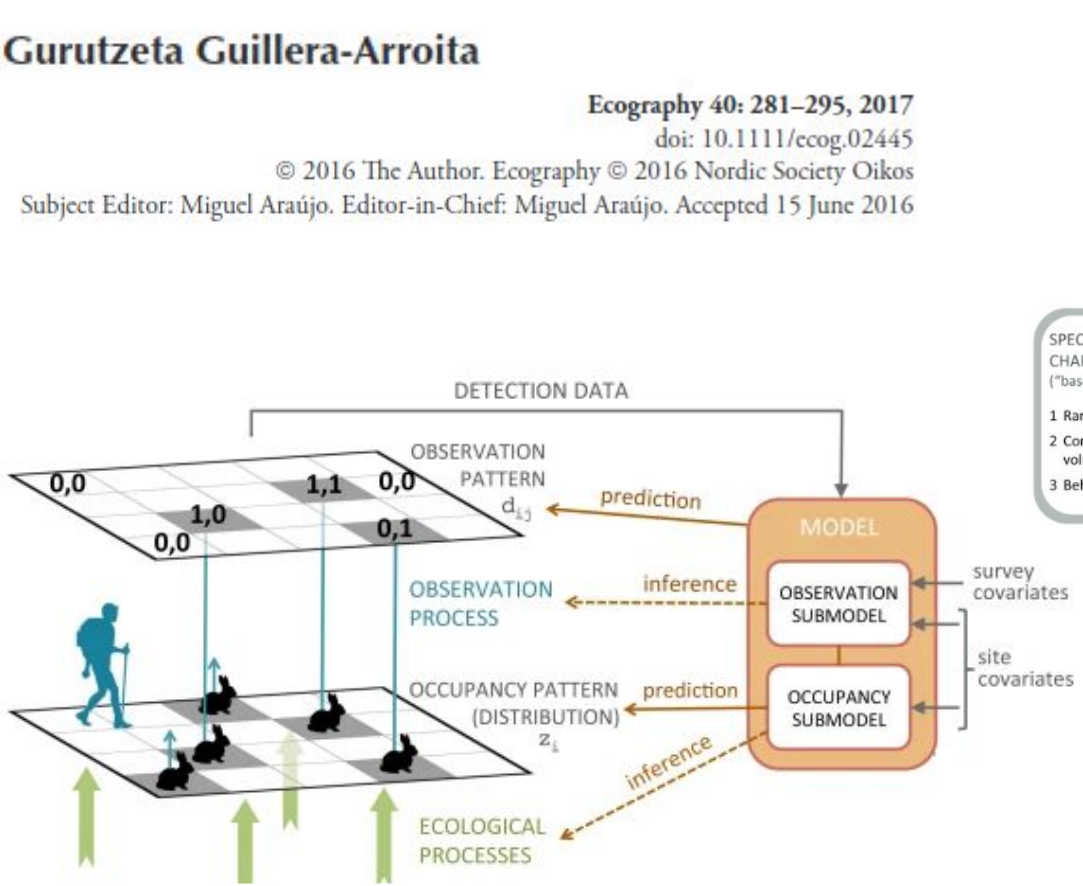
Ausência “real” (modelos de ocupação)

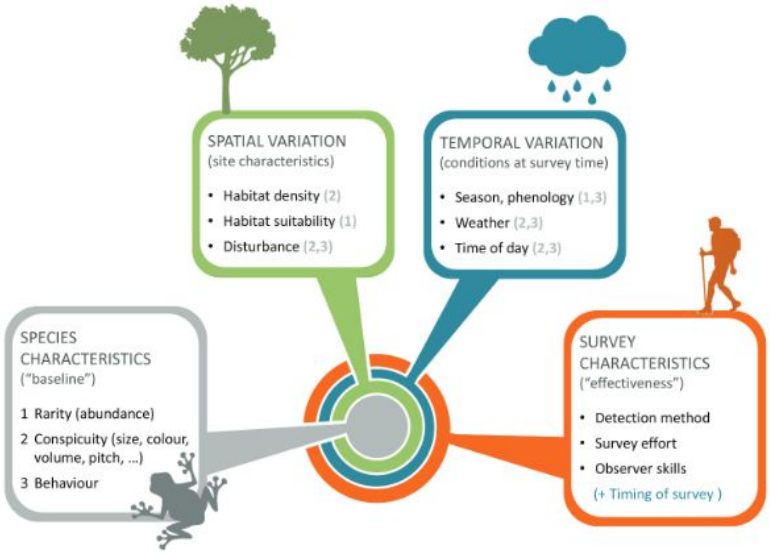
Modelling of species distributions, range dynamics and communities under imperfect detection: advances, challenges and opportunities

Gurutzeta Guillera-Arroita

Ecography 40: 281–295, 2017
doi: 10.1111/ecog.02445

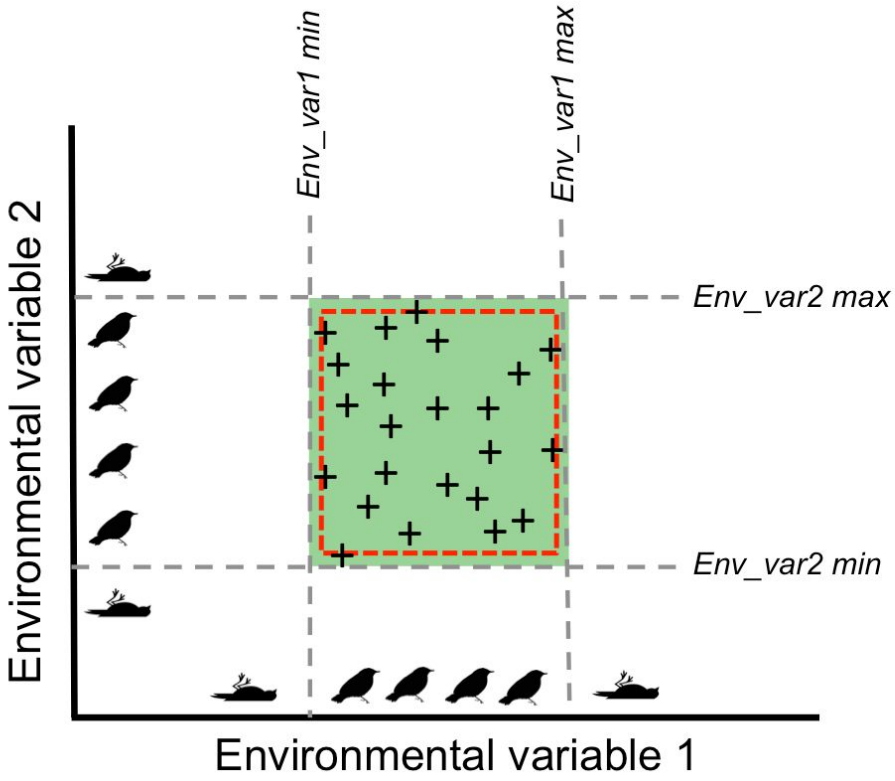
Subject Editor: Miguel Araújo. Editor-in-Chief: Miguel Araújo. Accepted 15 June 2016



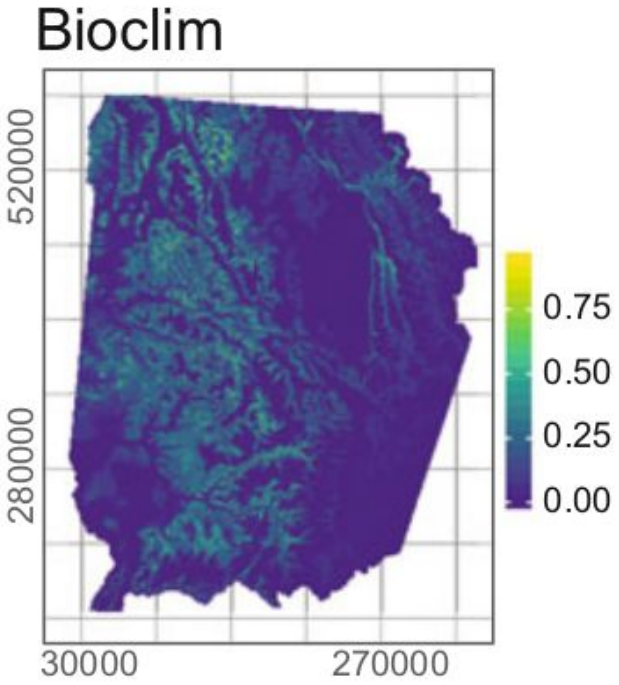


3. Ajuste dos modelos

BIOCLIM - Envelope Climático



Lima-Ribeiro &
Diniz-Filho (2013)



bccvl

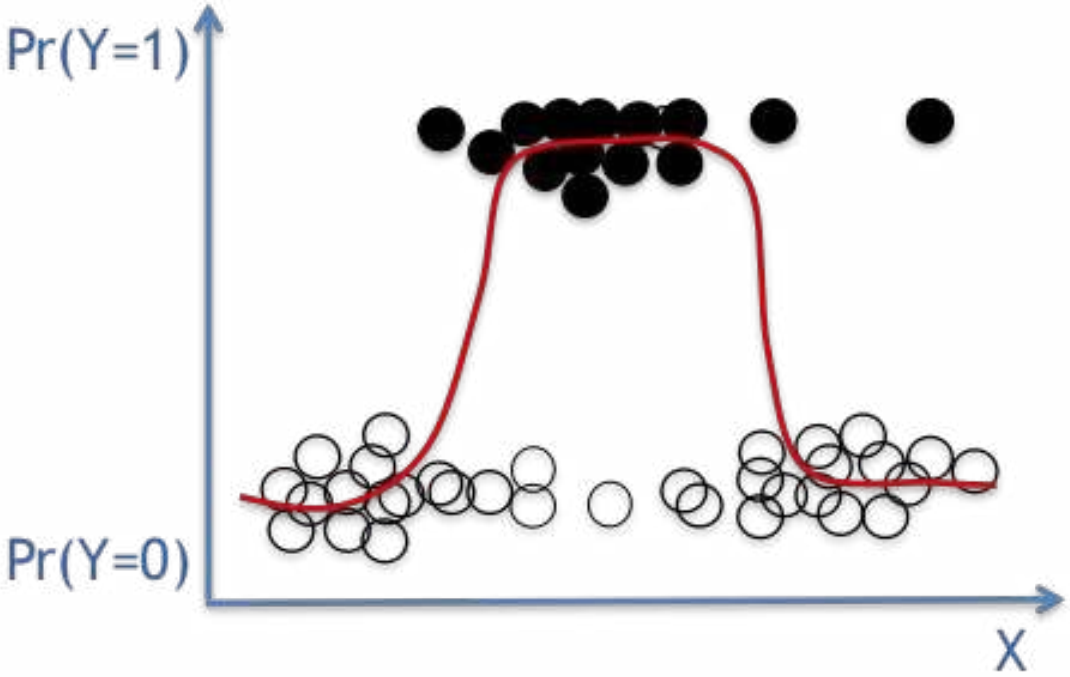
https://support.bccvl.org.au/support/home

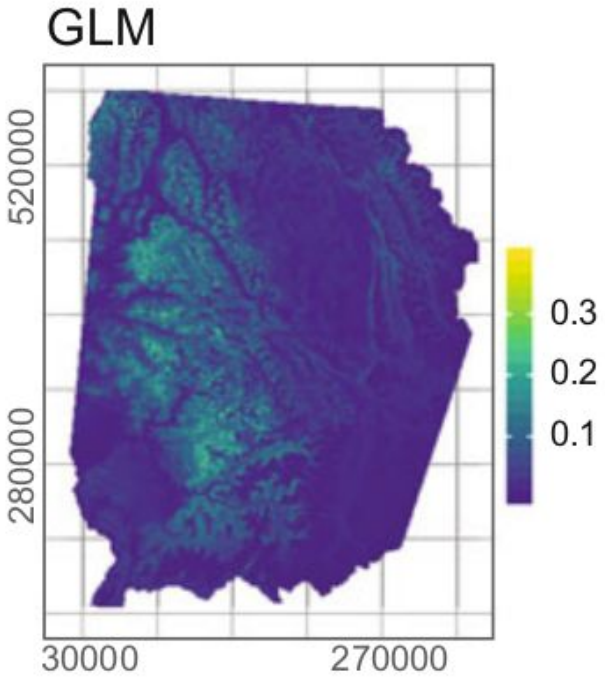
3. Ajuste dos modelos

Generalized Linear Models (GLM)

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

Lima-Ribeiro &
Diniz-Filho (2013)



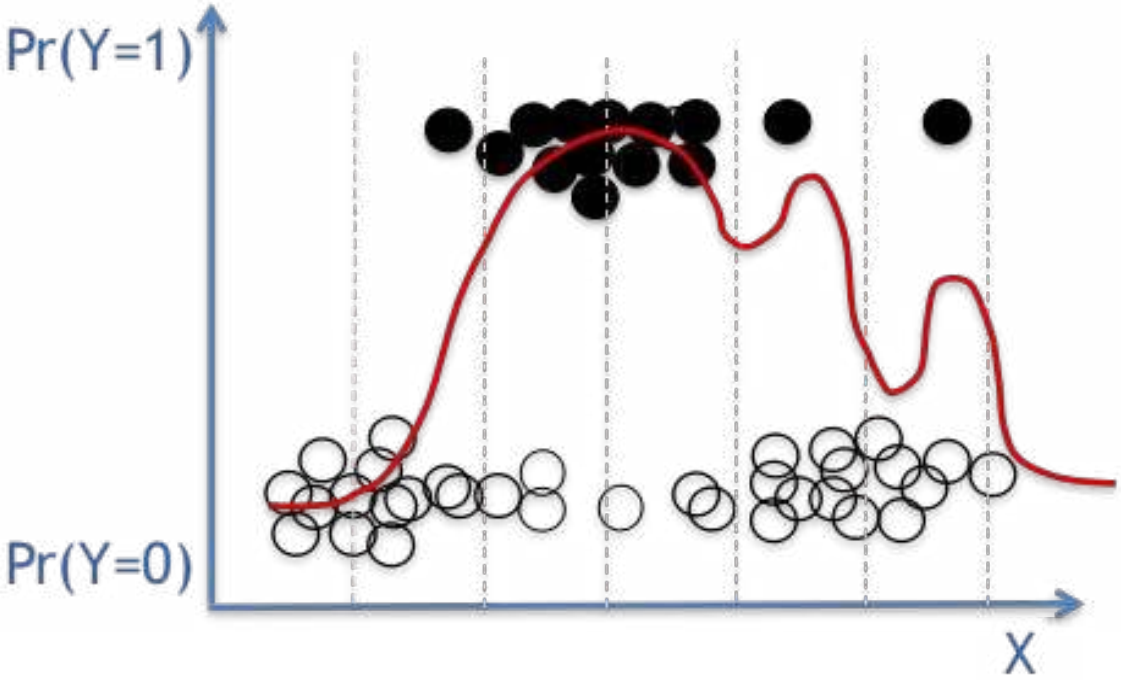


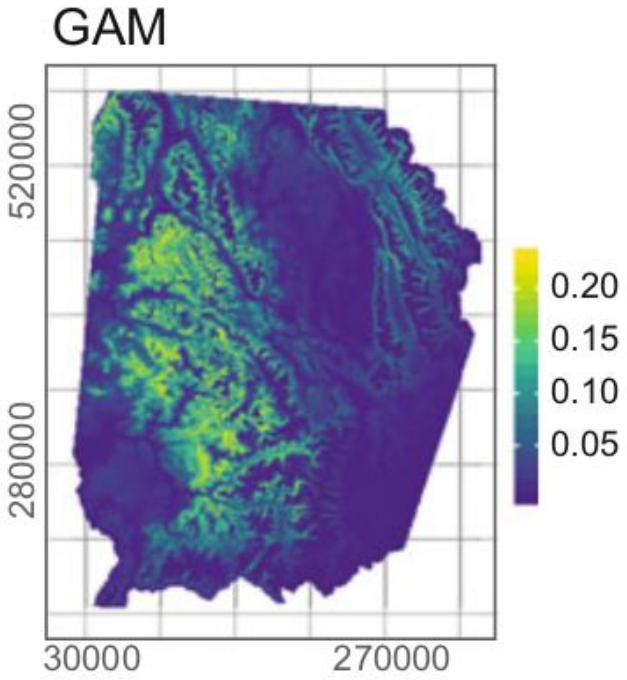
3. Ajuste dos modelos

Generalized Linear Models (GLM)

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

Lima-Ribeiro &
Diniz-Filho (2013)

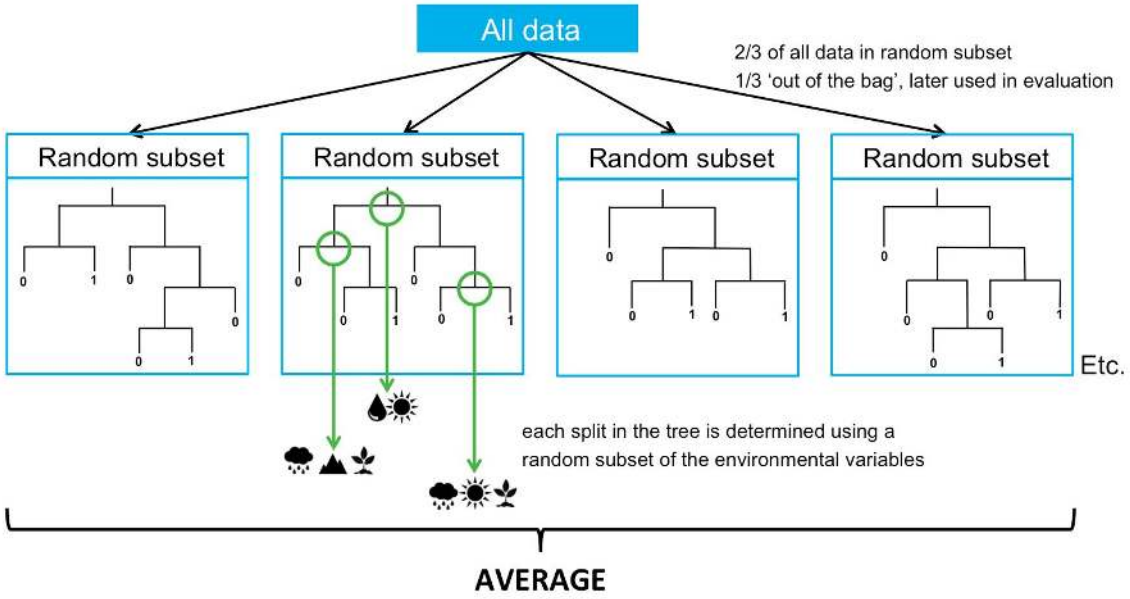




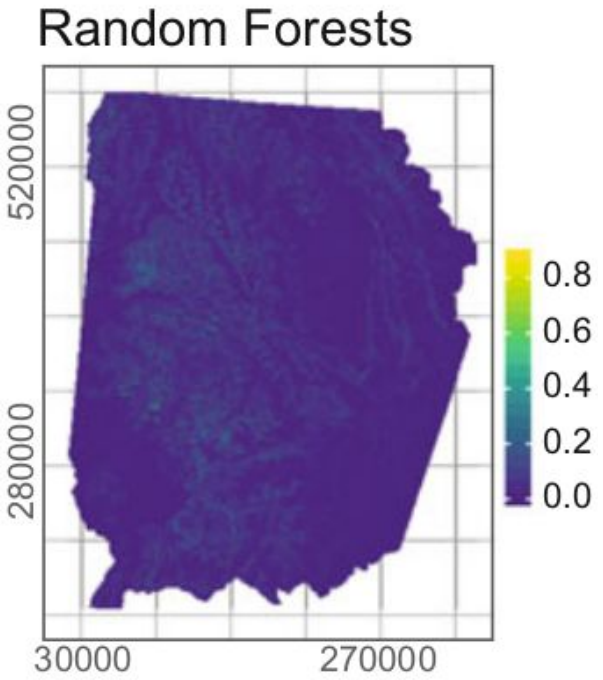
3. Ajuste dos modelos

Random Forest

Lima-Ribeiro &
Diniz-Filho (2013)



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



bccvl

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

3. Ajuste dos modelos

Maximum Entropy (MaxEnt)

Lima-Ribeiro &
Diniz-Filho (2013)

ECOGRAPHY

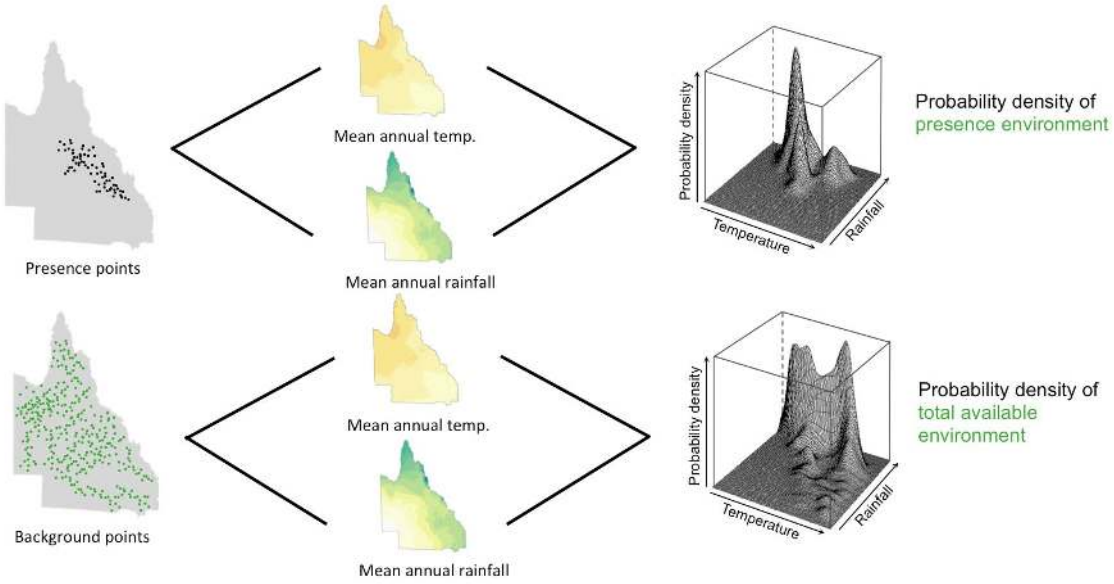
A JOURNAL OF SPACE AND TIME IN ECOLOGY

Software note | Free Access

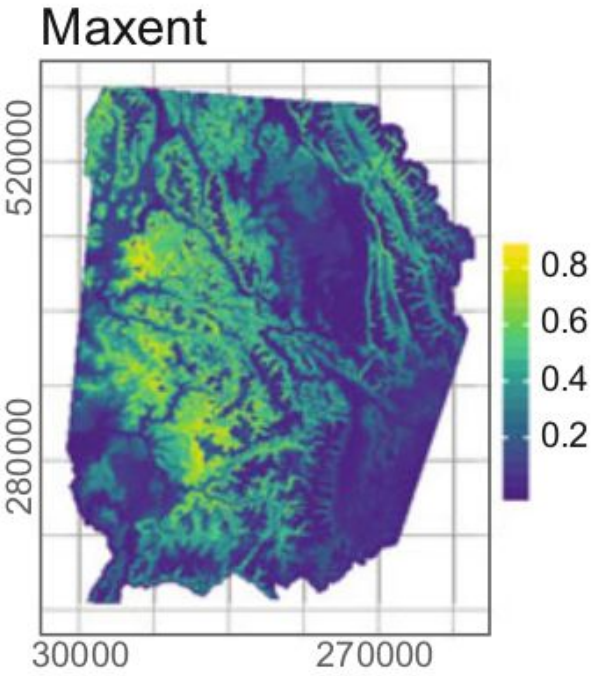
Opening the black box: an open-source release of Maxent

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

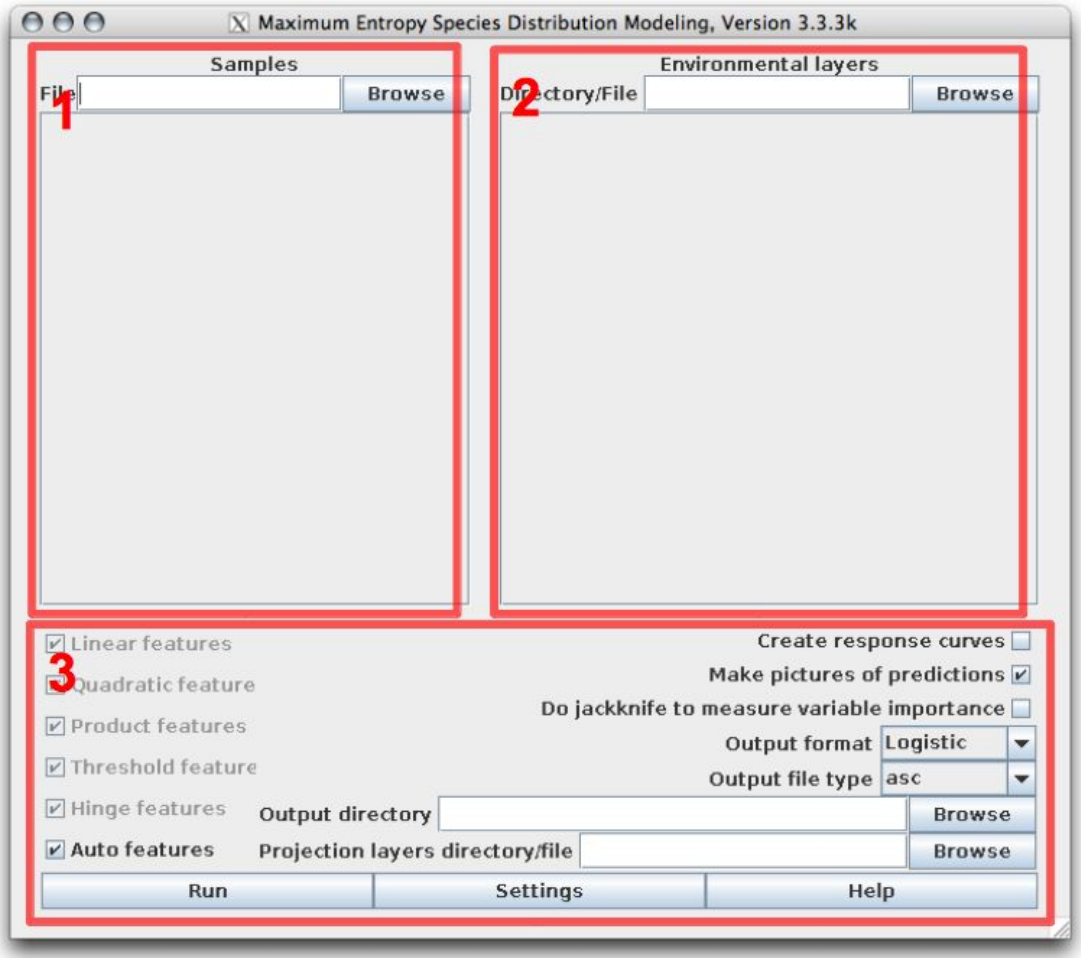


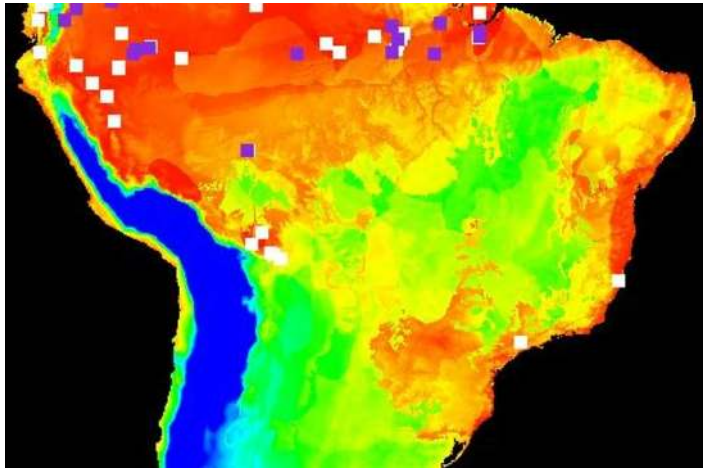
Adapted from Elith et al. (2011) *A statistical explanation of MaxEnt for ecologists*. Diversity and Distributions, 17, 43-57.

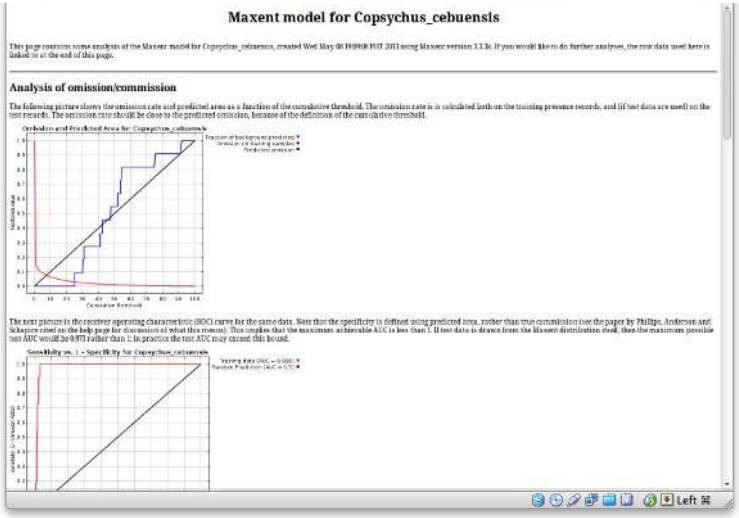


3. Ajuste dos modelos

Maximum Entropy (MaxEnt)

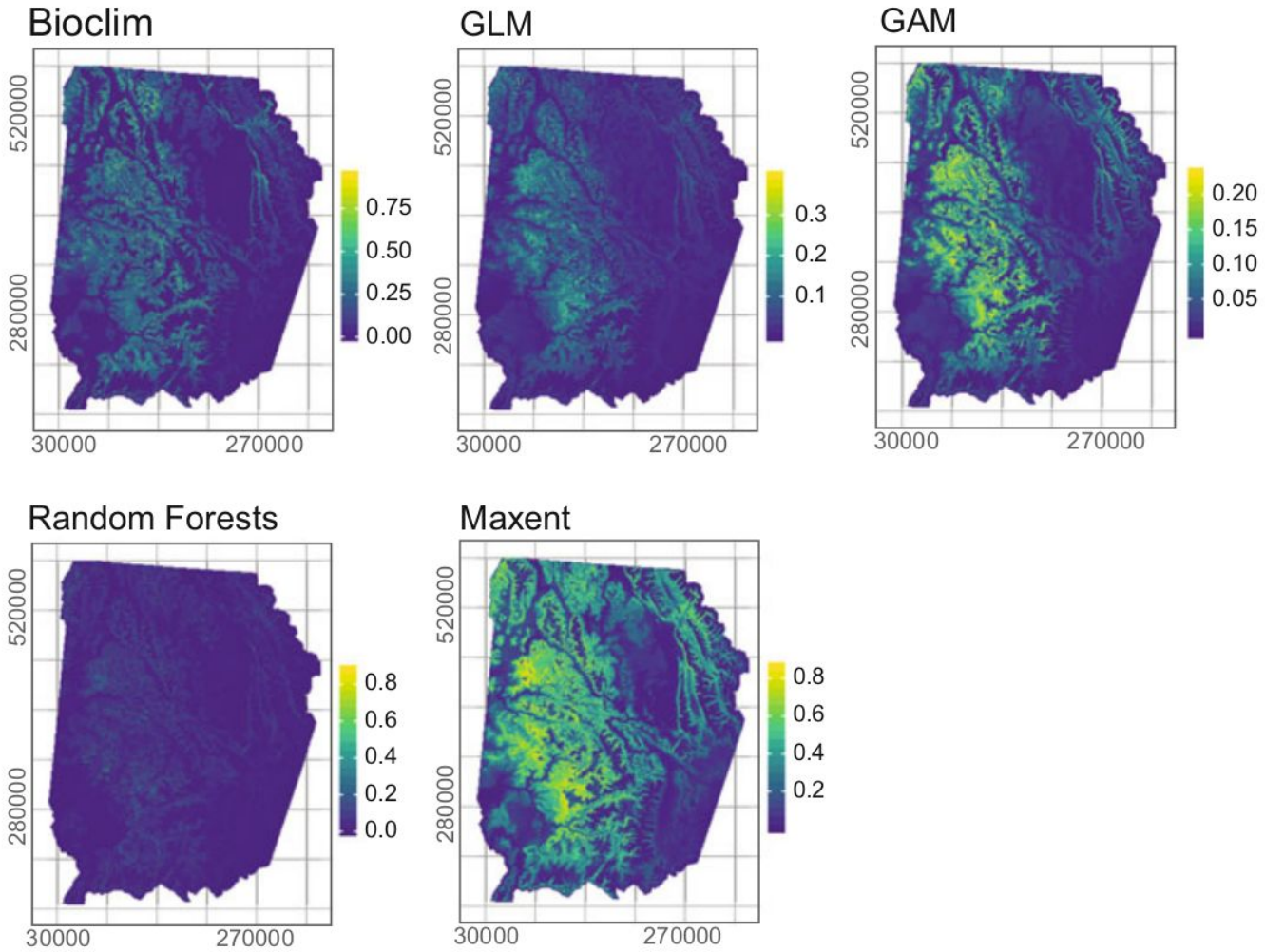






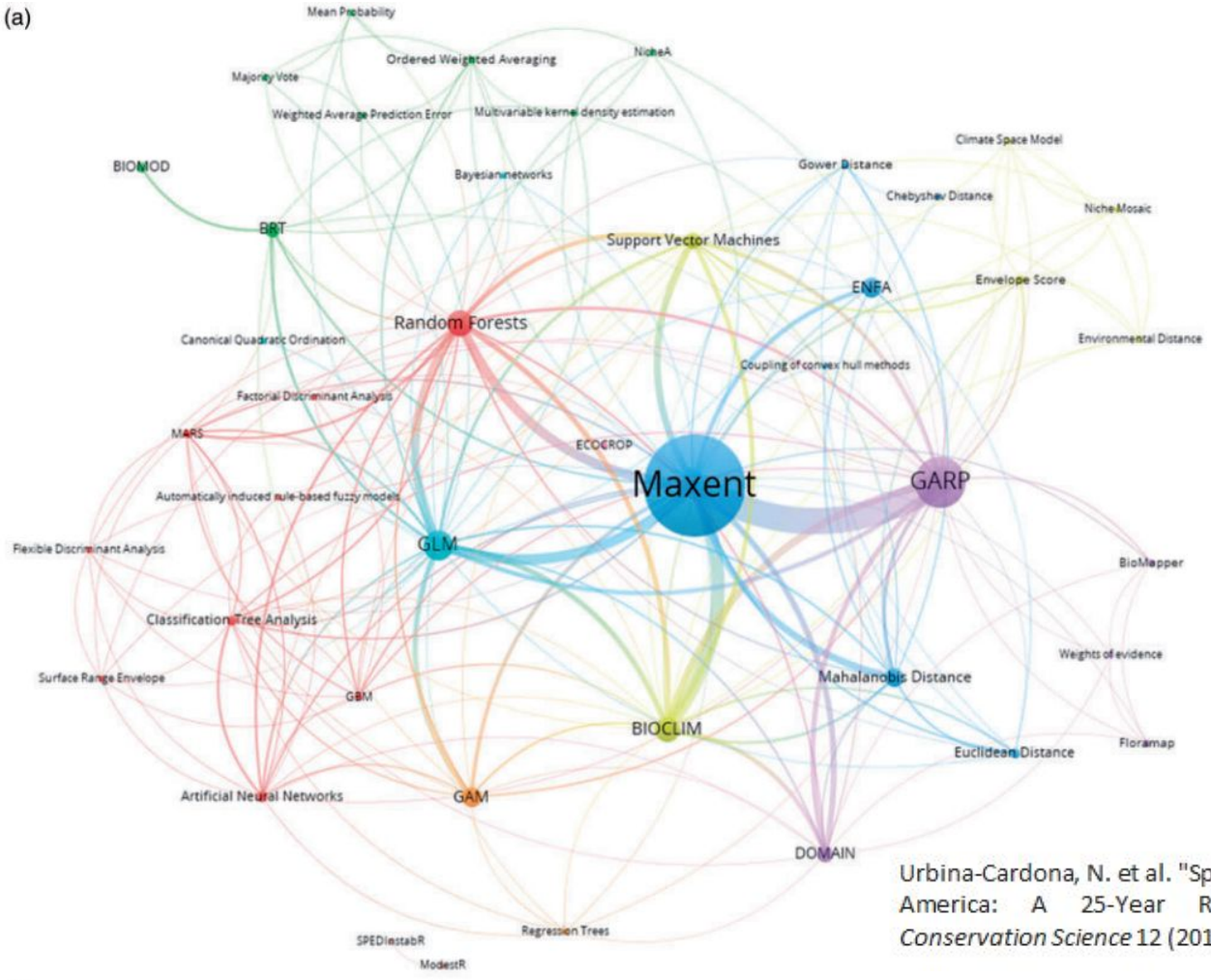
3. Ajuste dos modelos

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

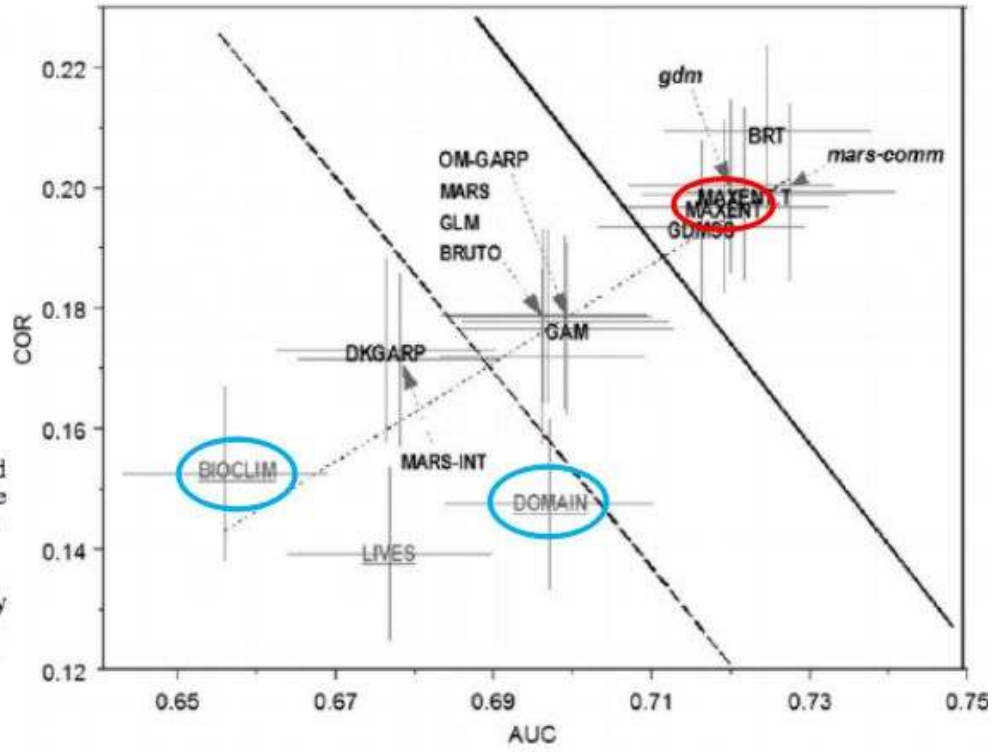


Fig. 3. Mean AUC vs mean correlation (COR) for modelling methods, summarised across all species. The grey bars are standard errors estimated in the GLMM (see Appendix), reflecting variation for an average species in an average region. The labels are broad classifications of the methods: grey underlined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

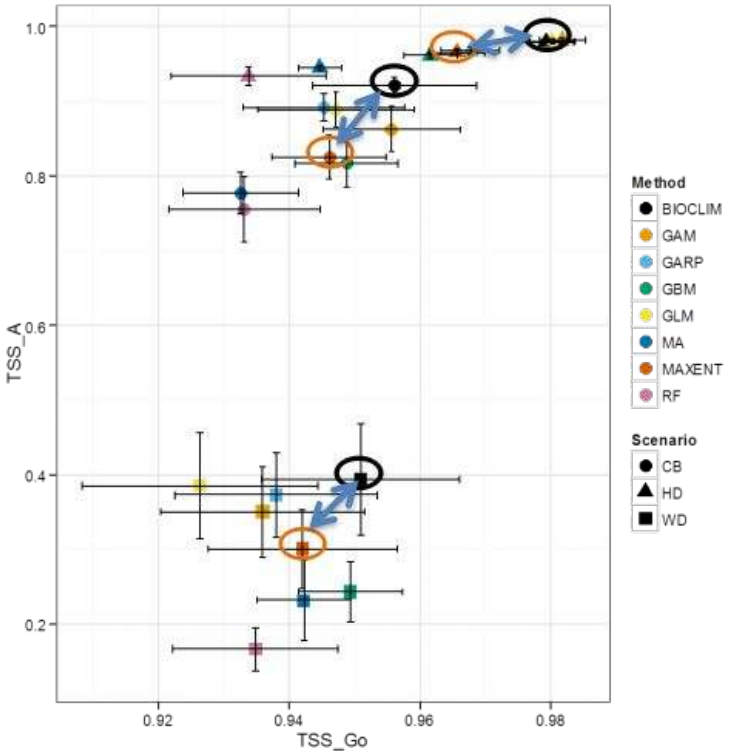
3. Ajuste dos modelos

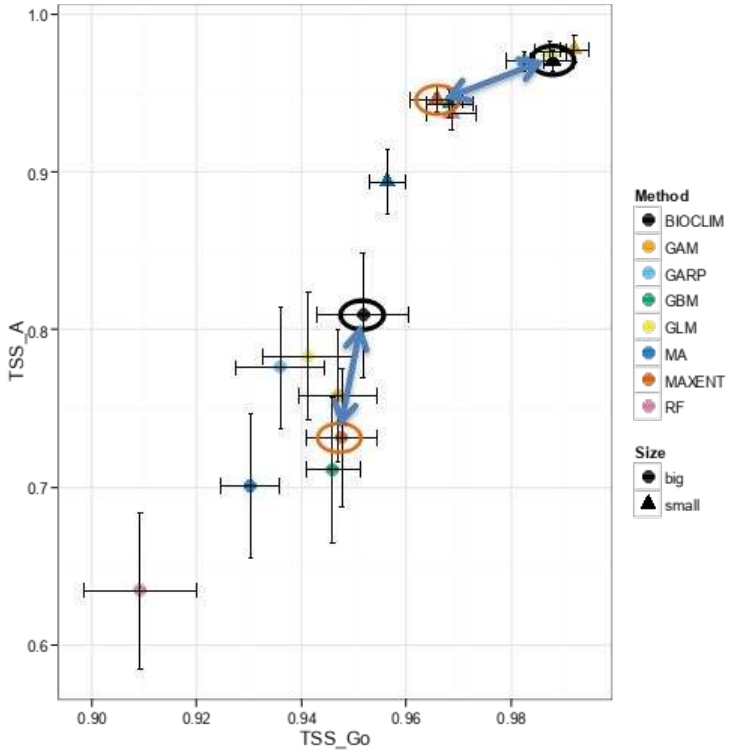
Consenso *(Ensemble)*

Methods in Ecology and Evolution
BRITISH ECOLOGICAL SOCIETY
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





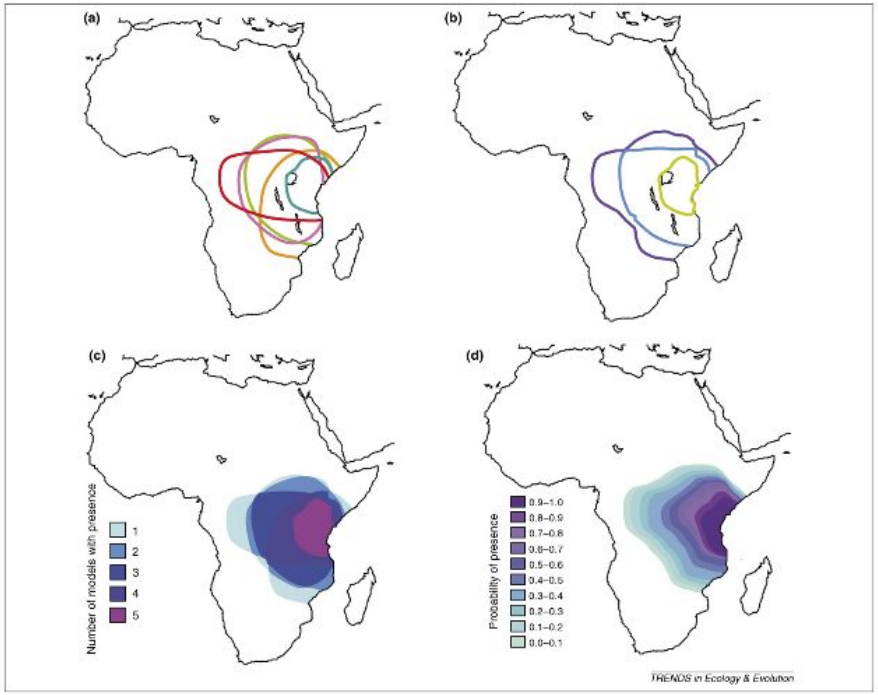
3. Ajuste dos modelos

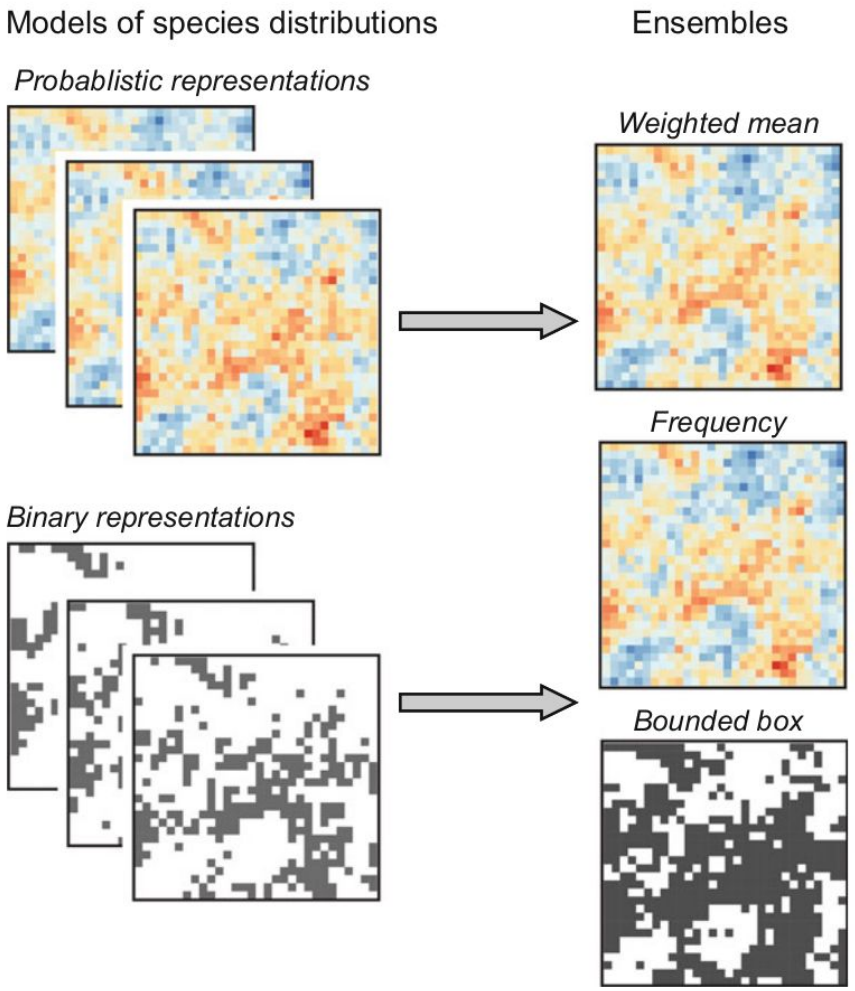
Consenso *(Ensemble)*

Review TRENDS in Ecology and Evolution Vol.22 No.1

Ensemble forecasting of species distributions

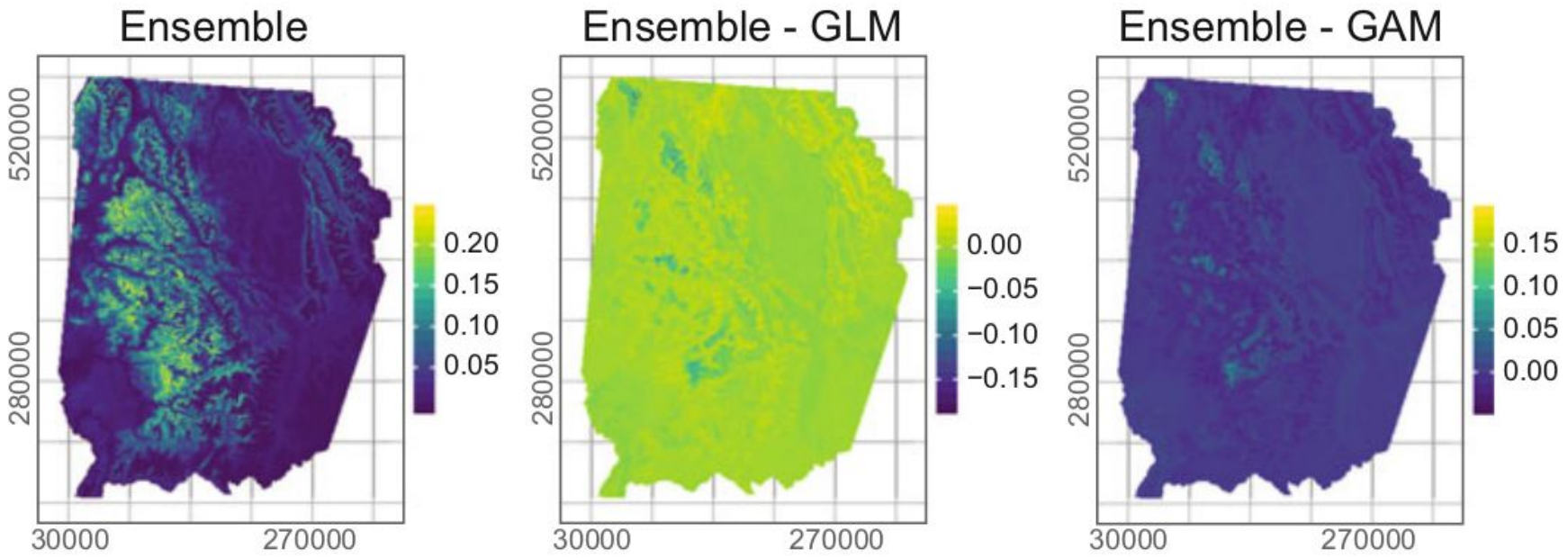
Miguel B. Araújo[1] and Mark New[2]





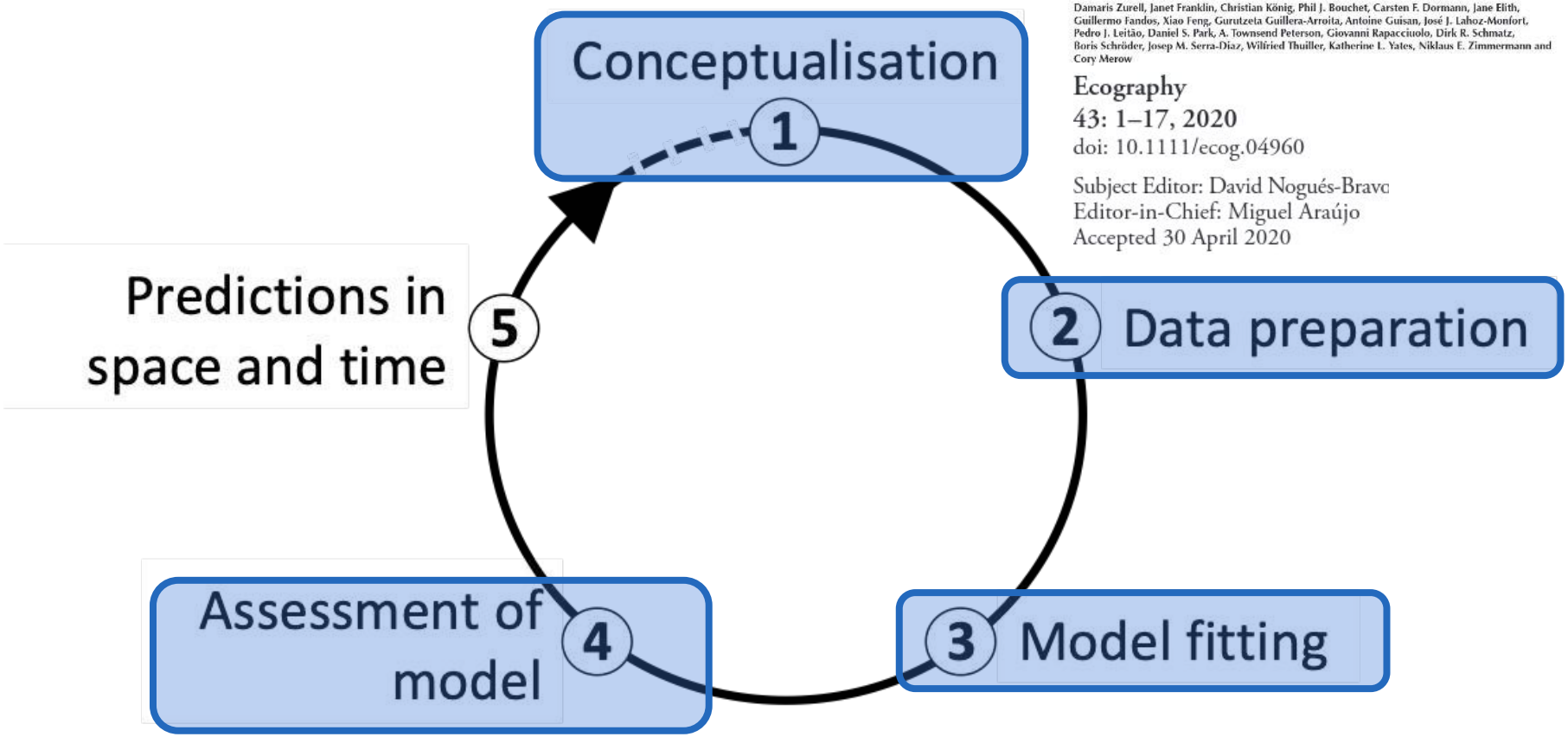
3. Ajuste dos modelos

Consenso *(Ensemble)*



SDM 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. Schmatz, Boris Schröder, Josep M. Serra-Diaz, Wilfried Thuiller, Katherine L. Yates, Niklaus E. Zimmermann and Cory Merow

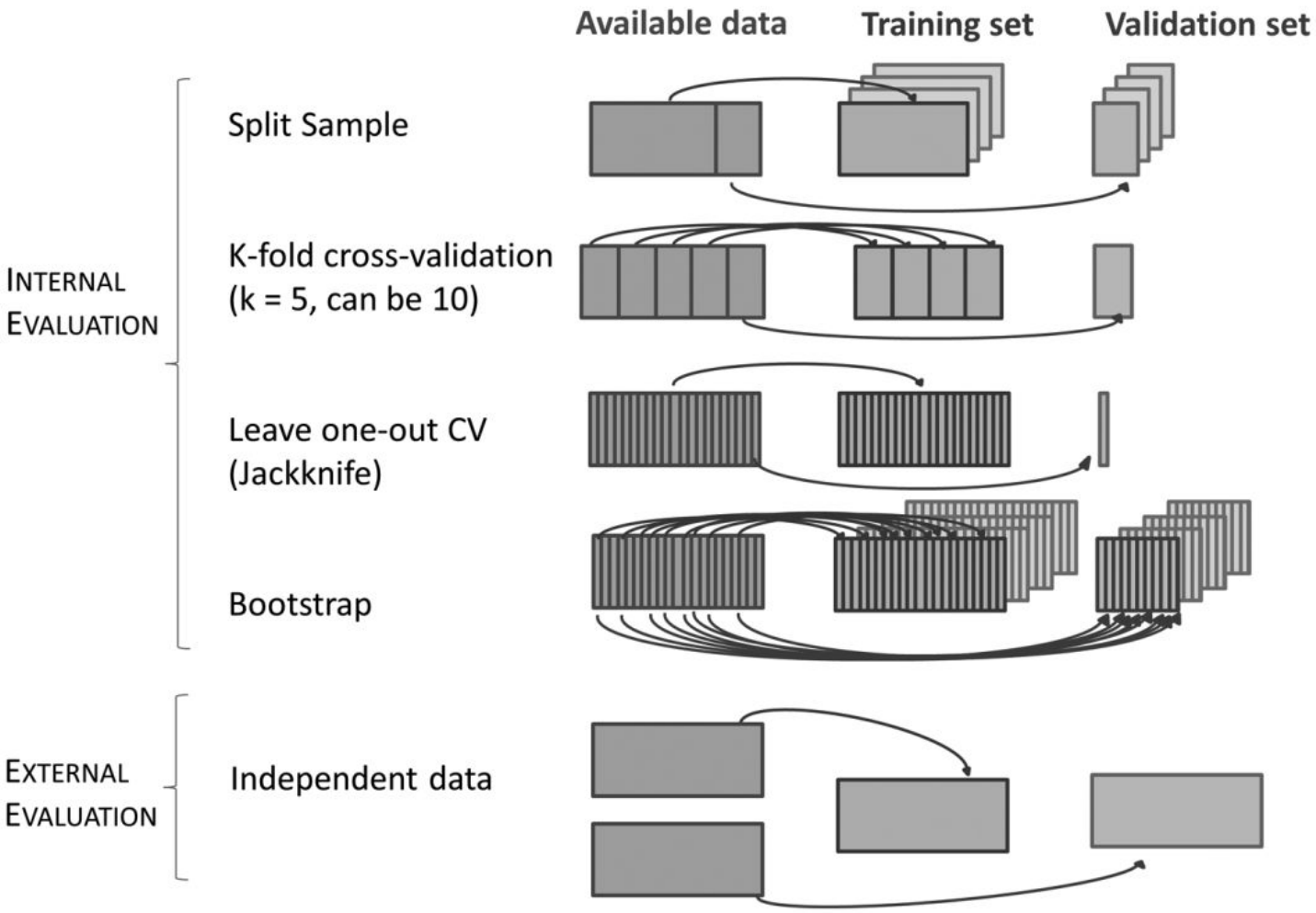
Ecography
43: 1–17, 2020
doi: 10.1111/ecog.04960

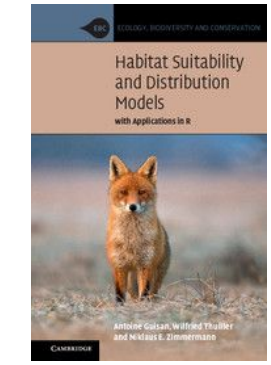
Subject Editor: David Nogués-Bravo
Editor-in-Chief: Miguel Araújo
Accepted 30 April 2020

Como saber se meu modelo se **aproxima da realidade**?

4. Avaliação dos modelos

Tipos de avaliação

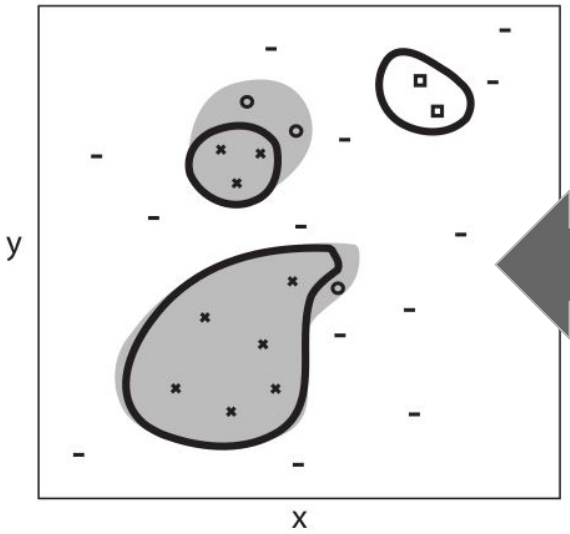


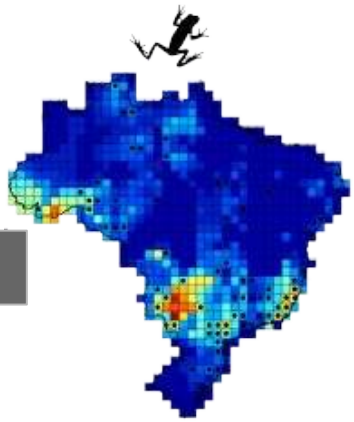


Guisan et al. (2017)

4. Avaliação dos modelos

Como saber se o modelo acerta a realidade?





Adequabilidade

valores
0
até
1

Occupied distributional area, G_O

Areas predicted by an ecological niche model

× True positive

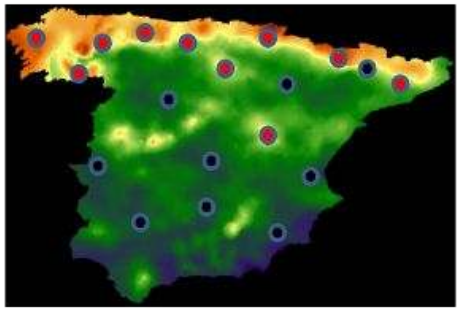
– True negative

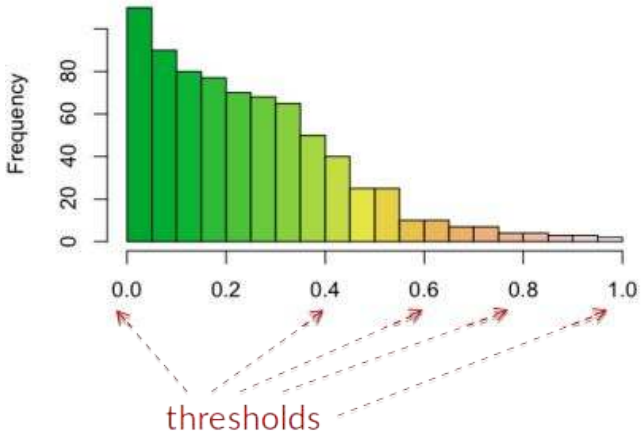
o False negative

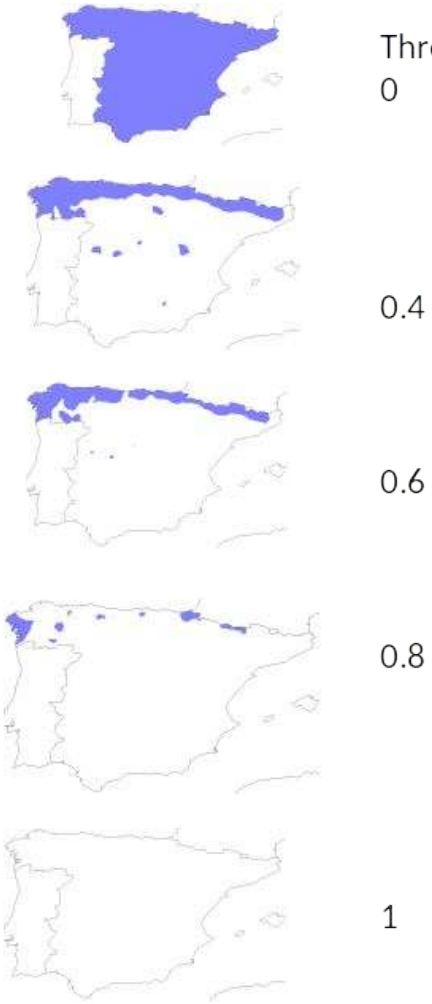
□ False positive

4. Avaliação dos modelos

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

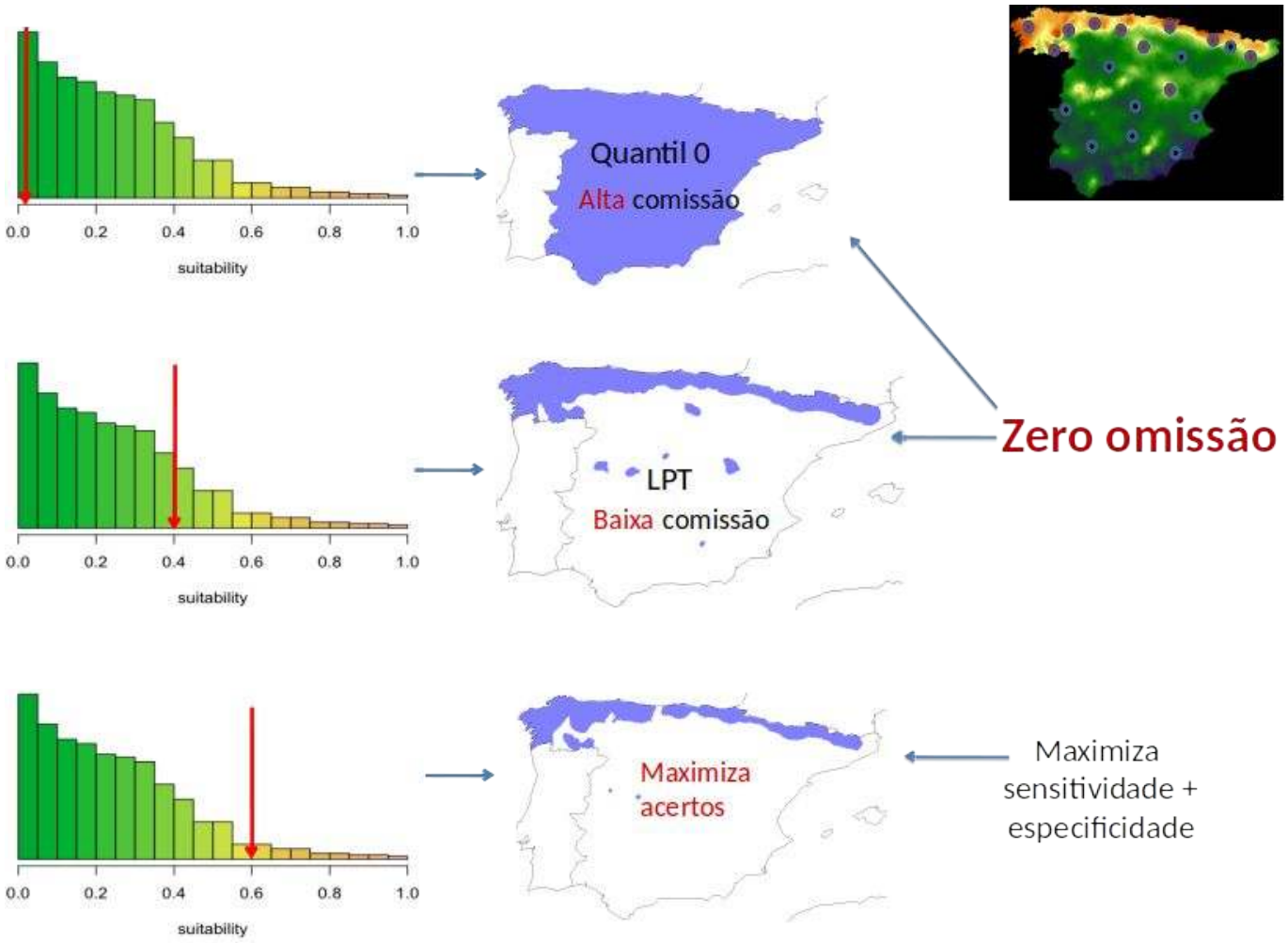






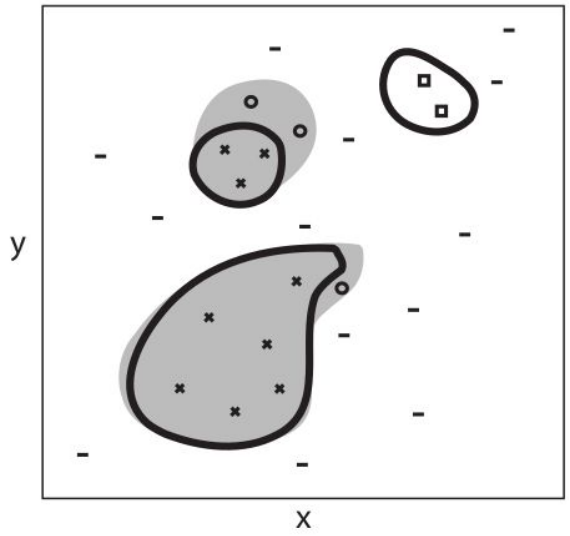
4. Avaliação dos modelos

Limiares (*Thresholds*)



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

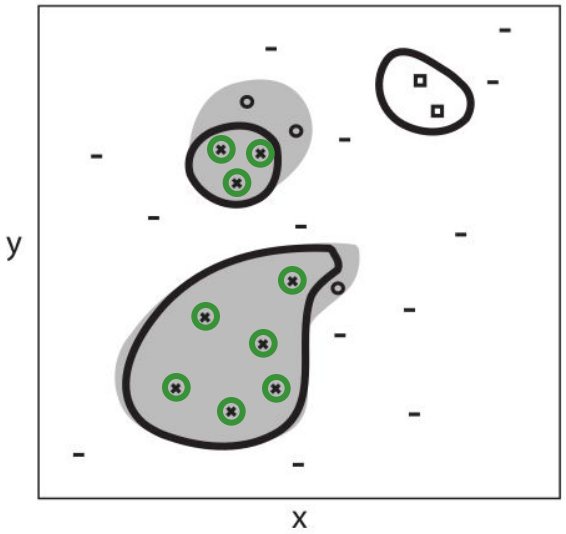
o False negative

□ 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**

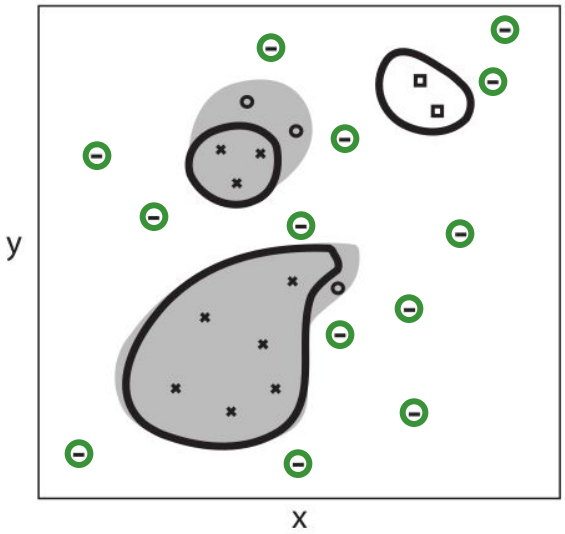


		Observation	
		Present	Absent
Prediction	Present	X True positive	False positive
	Absent	False negative	True negative

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

4. Avaliação dos modelos

Matriz de confusão - para os **dados de teste**



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

Occupied distributional area, G_O

Areas predicted by an ecological niche model

× True positive

– True negative

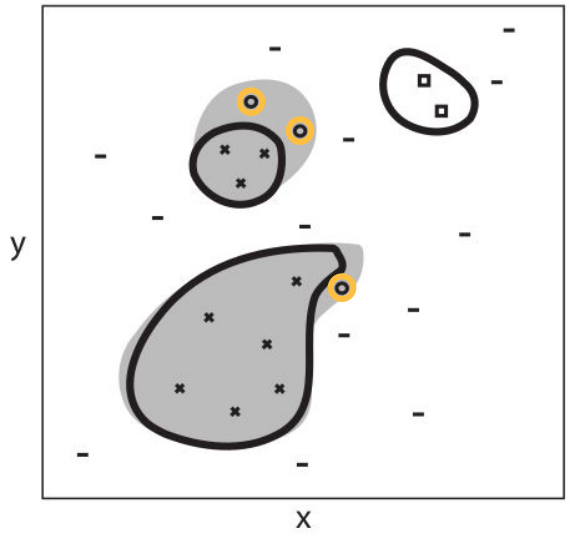
o False negative

□ False positive

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

4. Avaliação dos modelos

Matriz de confusão - para os **dados de teste**



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

Occupied distributional area, G_O

Areas predicted by an ecological niche model

× True positive

– True negative

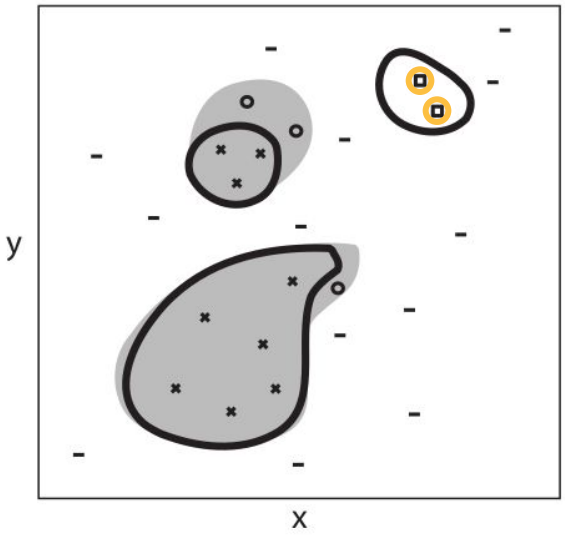
o False negative

□ False positive

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

4. Avaliação dos modelos

Matriz de confusão - para os **dados de teste**



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

Occupied distributional area, G_O

Areas predicted by an ecological niche model

× True positive

– True negative

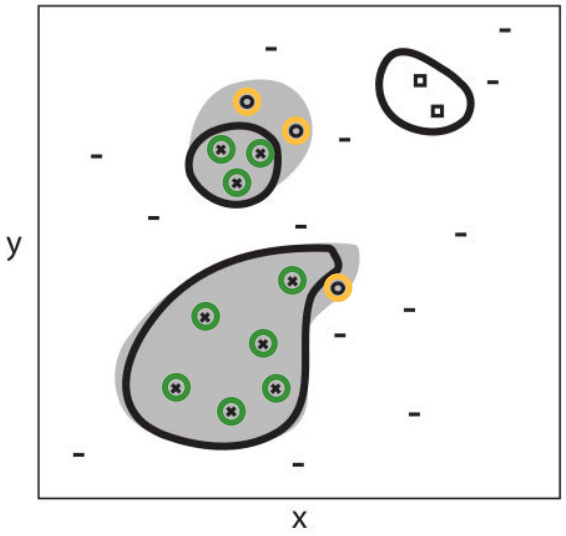
o False negative

□ False positive

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

4. Avaliação dos modelos

Matriz de confusão - para os **dados de teste**



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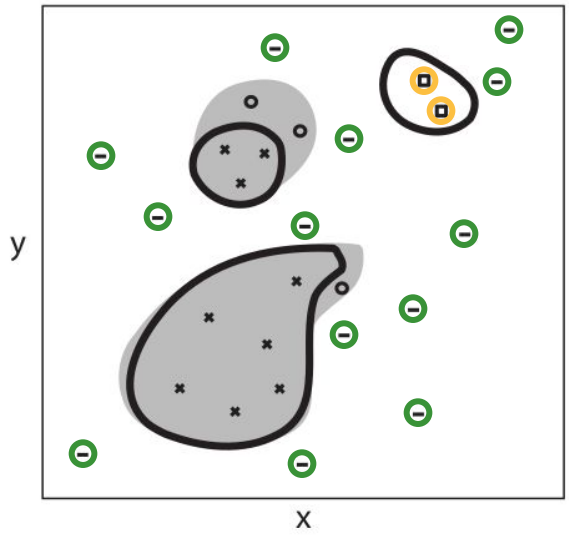
		Observation: Present	Observation: Absent
Prediction	Present	True positive	False positive
Prediction	Absent	False negative	True negative

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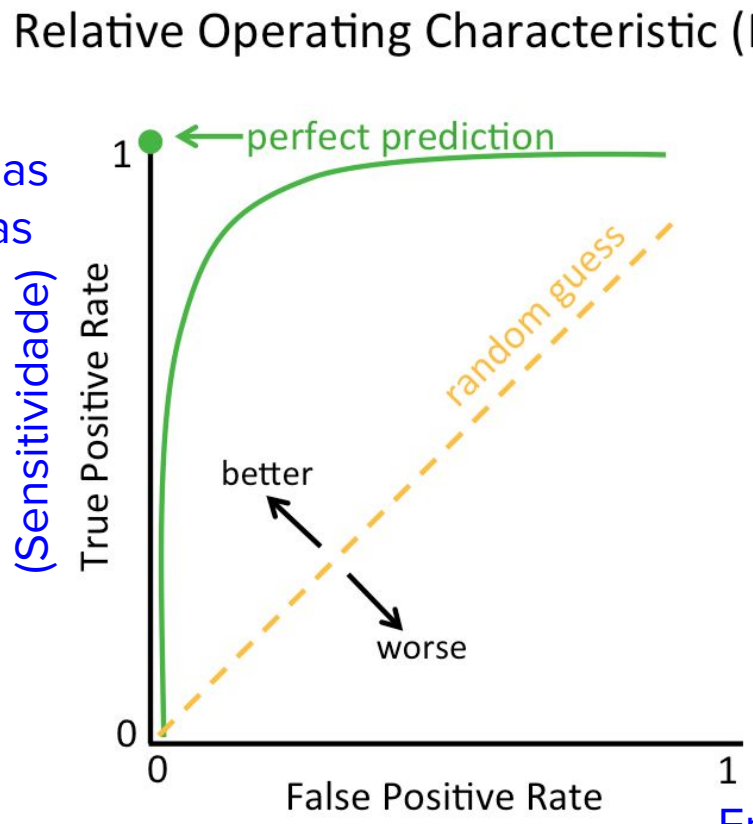
		Observation: Present	Observation: Absent
Prediction	Present	True positive	False positive
Prediction	Absent	False negative	True negative

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

4. Avaliação dos modelos

Curva ROC



Acertos das presenças (Sensitividade)

(Especificidade - 1) Erro das ausências

AUC = area under the curve

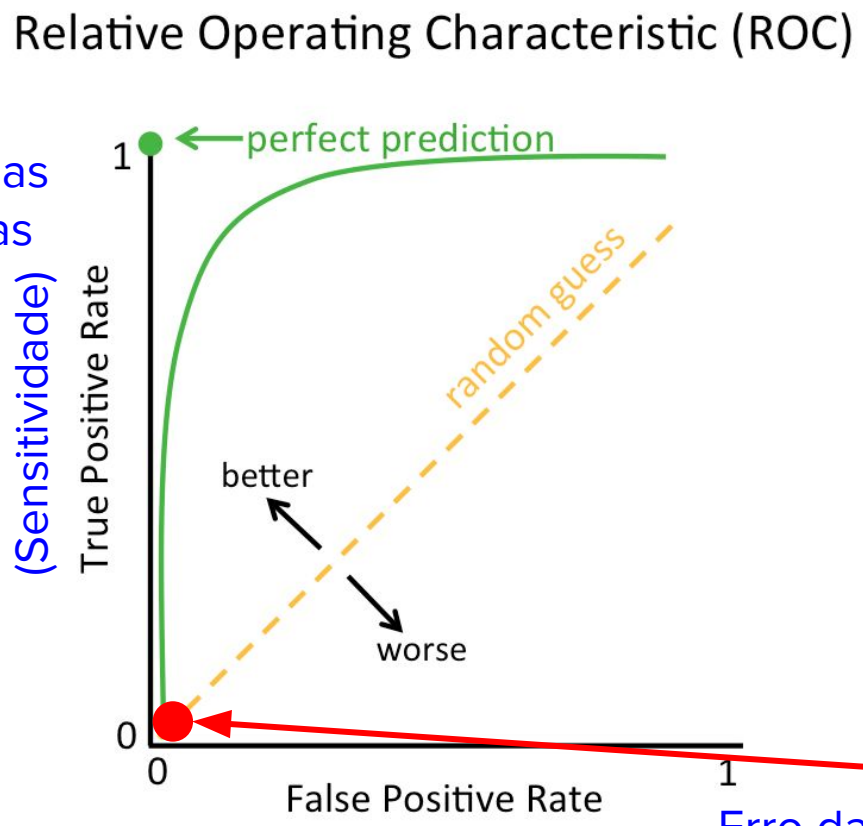
0.5-0.7 = poor model performance

0.7-0.9 = moderate

> 0.9 = excellent

4. Avaliação dos modelos

Curva ROC



Acertos das presenças

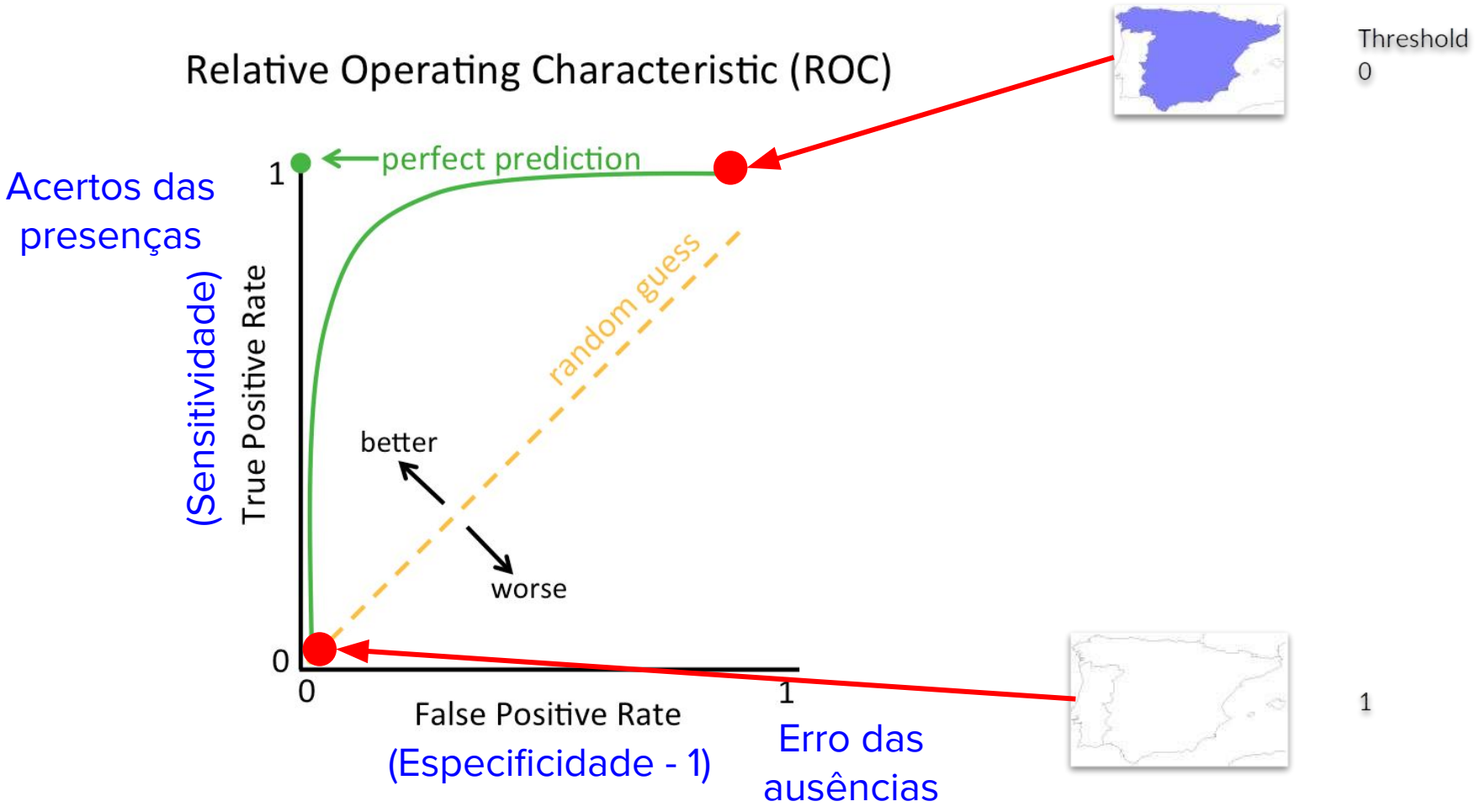
(Sensitividade)

(Especificidade - 1)

Erro das ausências

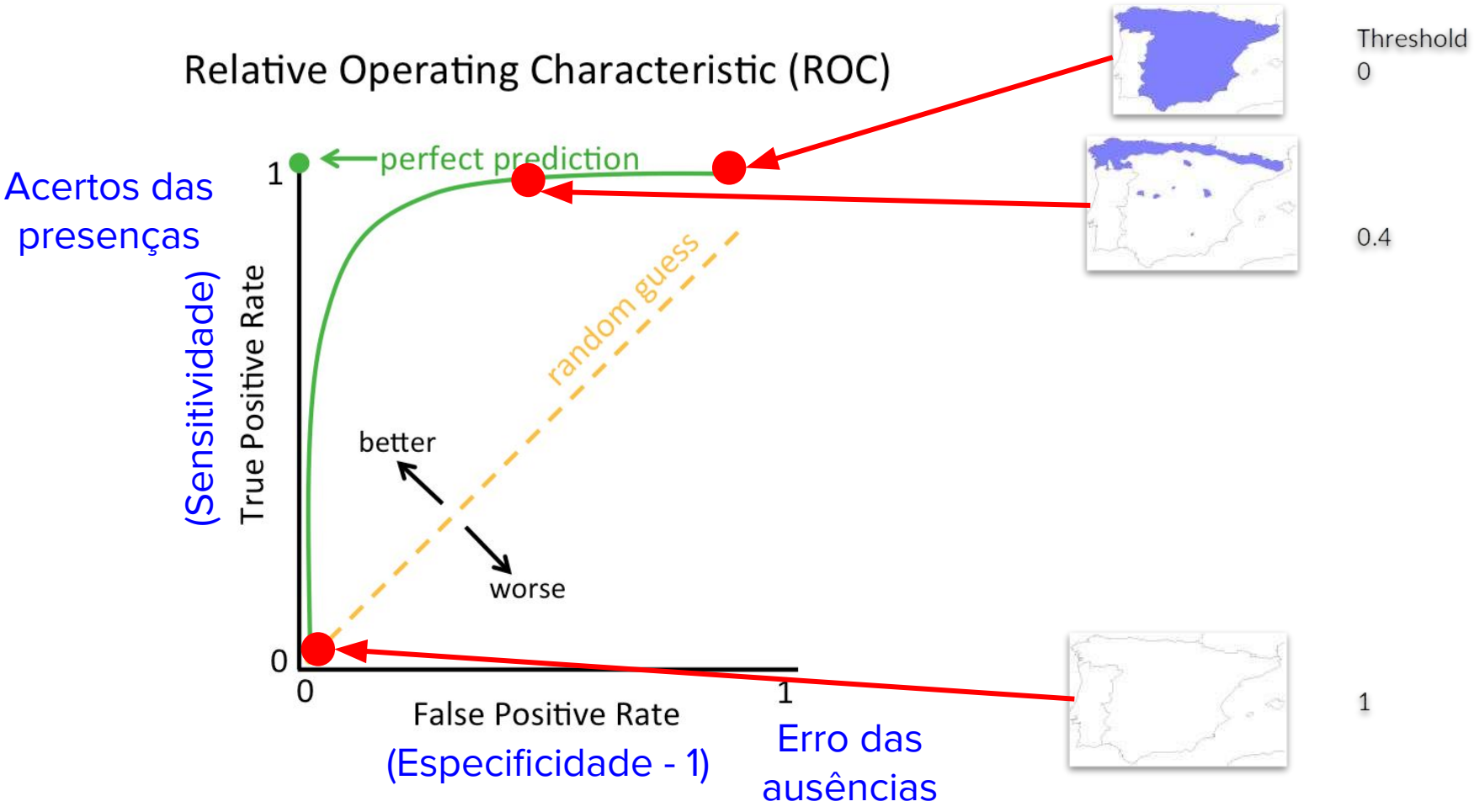
4. Avaliação dos modelos

Curva ROC



4. Avaliação dos modelos

Curva ROC



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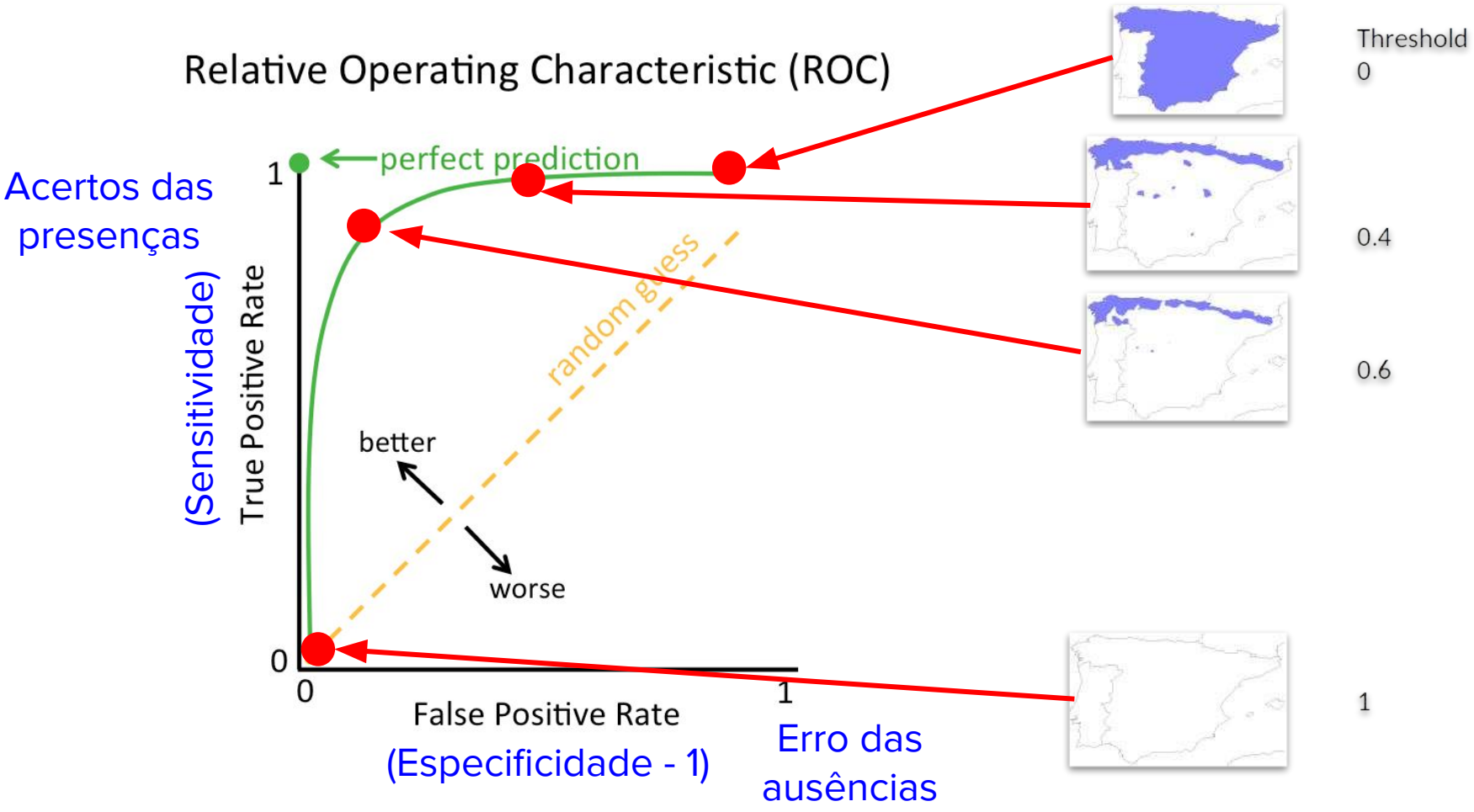
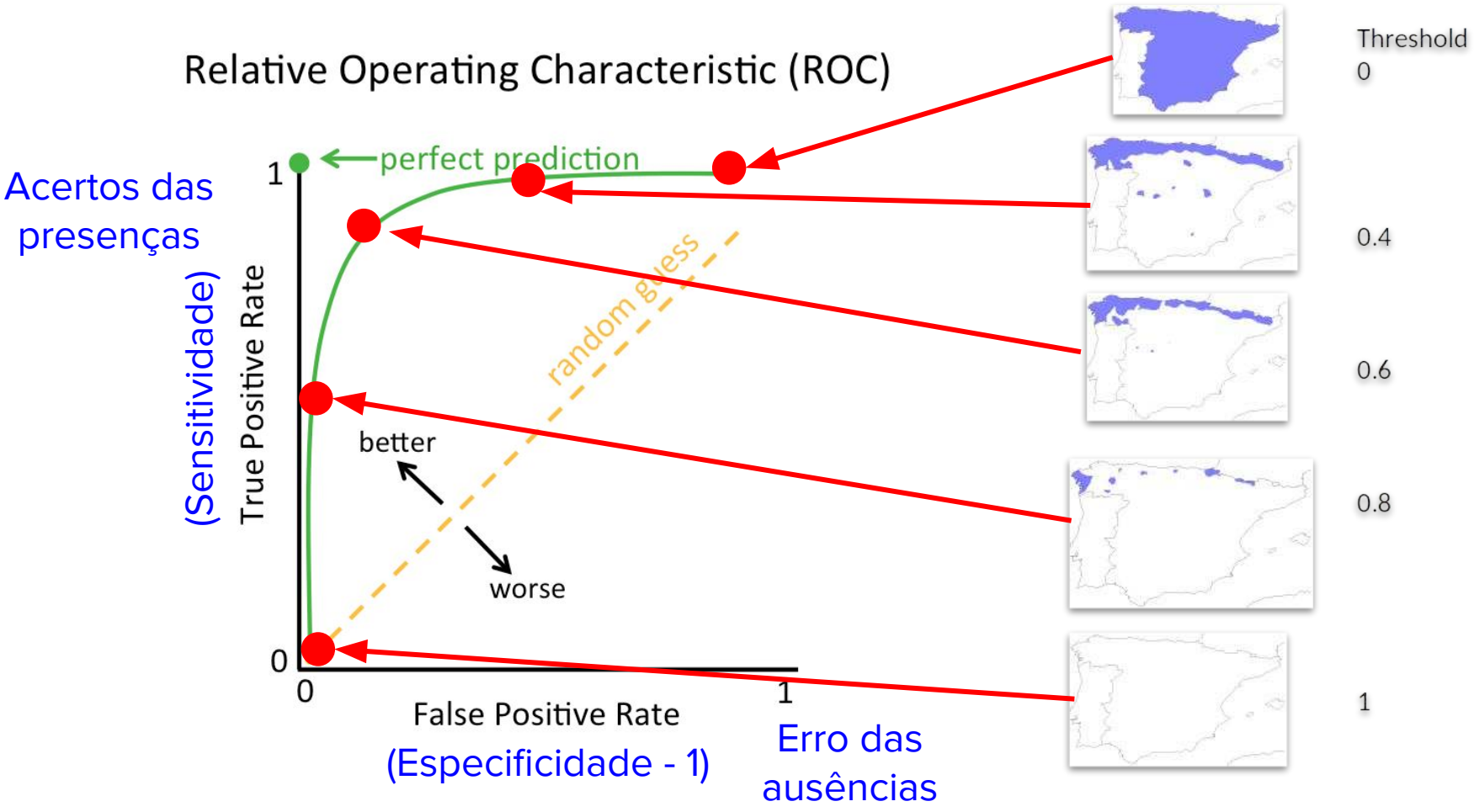
Curva ROC



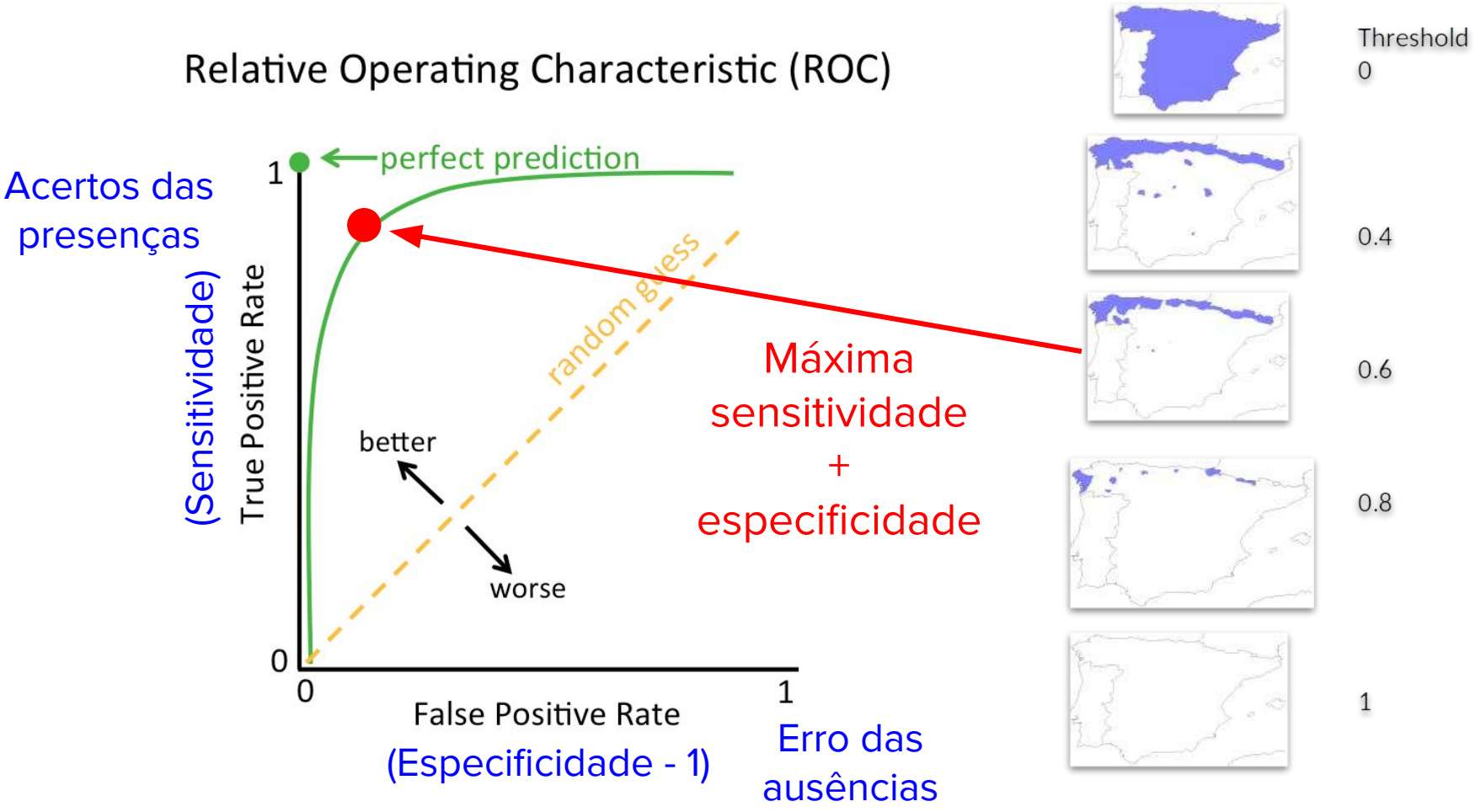
4. Avaliação dos modelos

Curva ROC



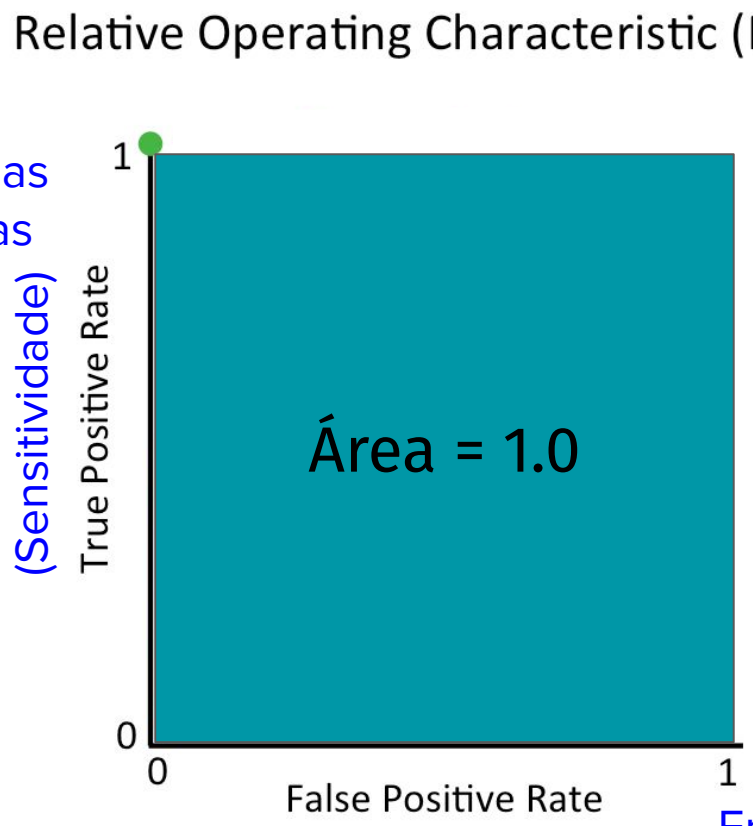
4. Avaliação dos modelos

Curva ROC



4. Avaliação dos modelos

AUC



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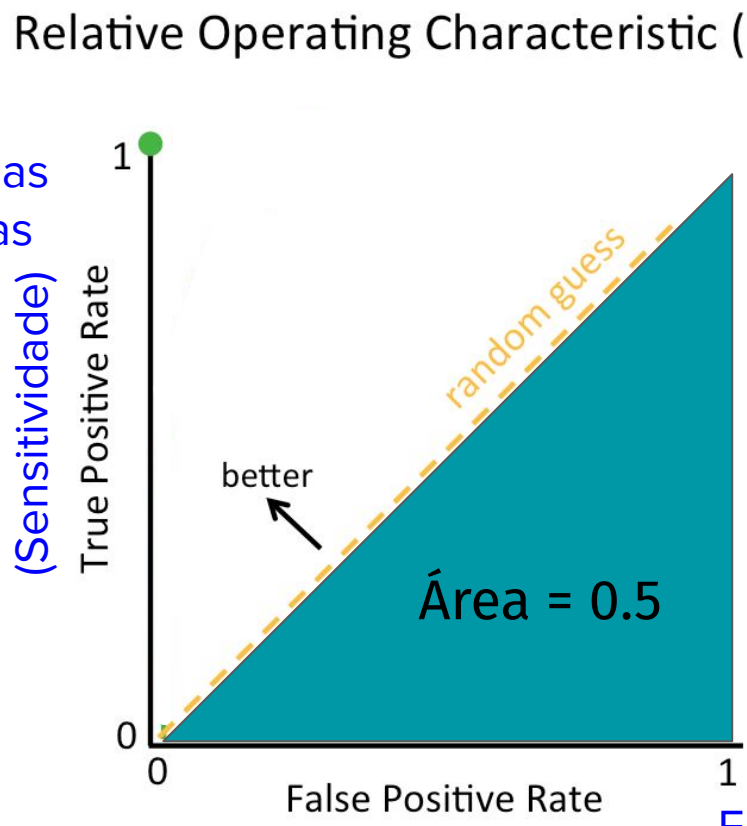
4. Avaliação dos modelos

AUC



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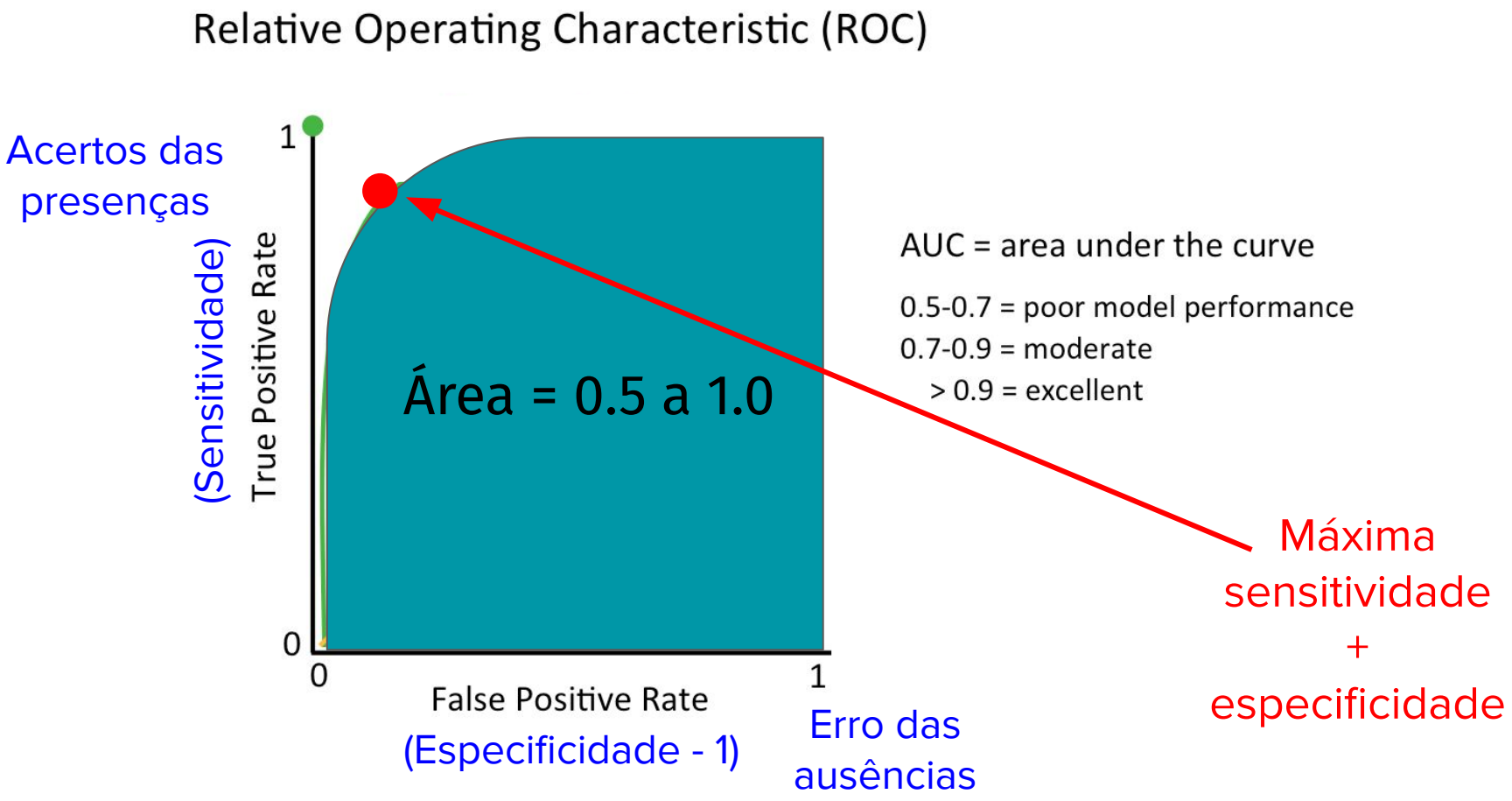
4. Avaliação dos modelos

AUC



4. Avaliação dos modelos

TSS (*True skill statistic*)

Número de sucessos menos o número de sucessos aleatórios

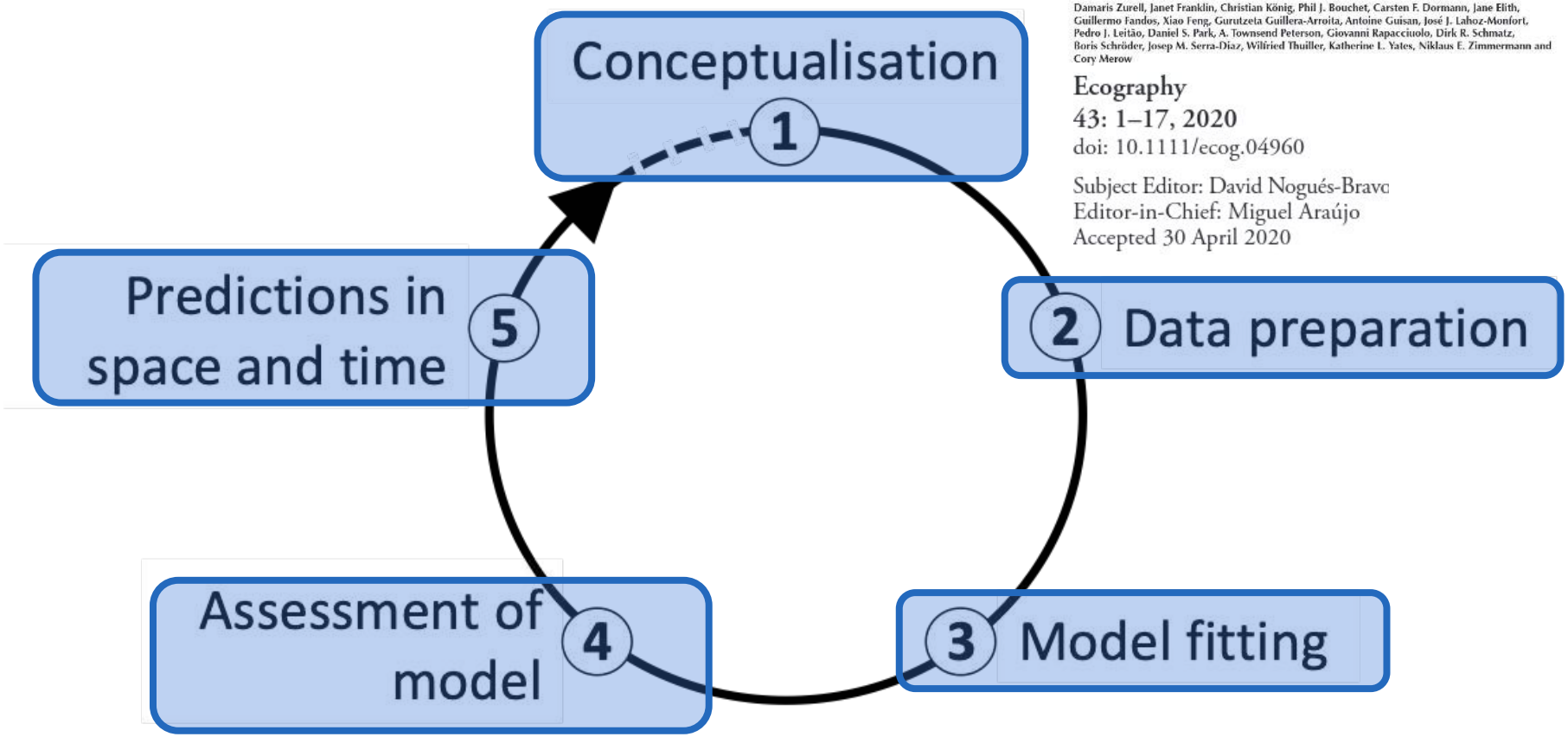
Varia de -1 to 1. Valores próximos a 0 modelos não diferentes do aleatórios

Depende de um valor de corte (*threshold*)

TSS = sensitividade + especificidade - 1

SDM passo a passo

Passos de construção dos SDMs



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Ecography
43: 1–17, 2020
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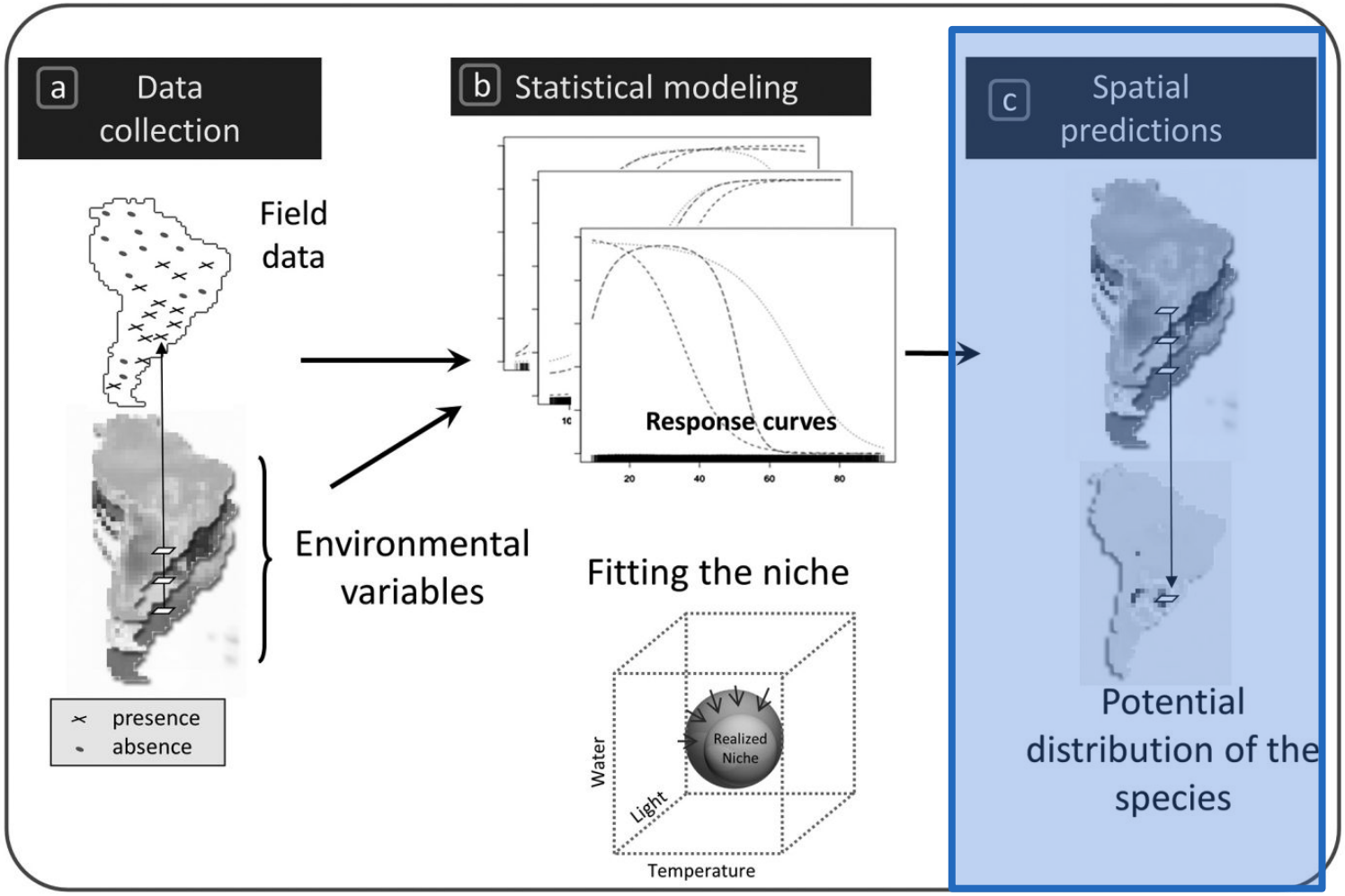
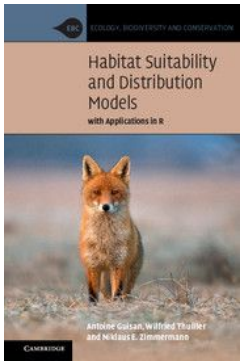
Subject Editor: David Nogués-Bravo
Editor-in-Chief: Miguel Araújo
Accepted 30 April 2020

Modelos de Distribuição de Espécies (SDMs)

Predições (espaço e no tempo)

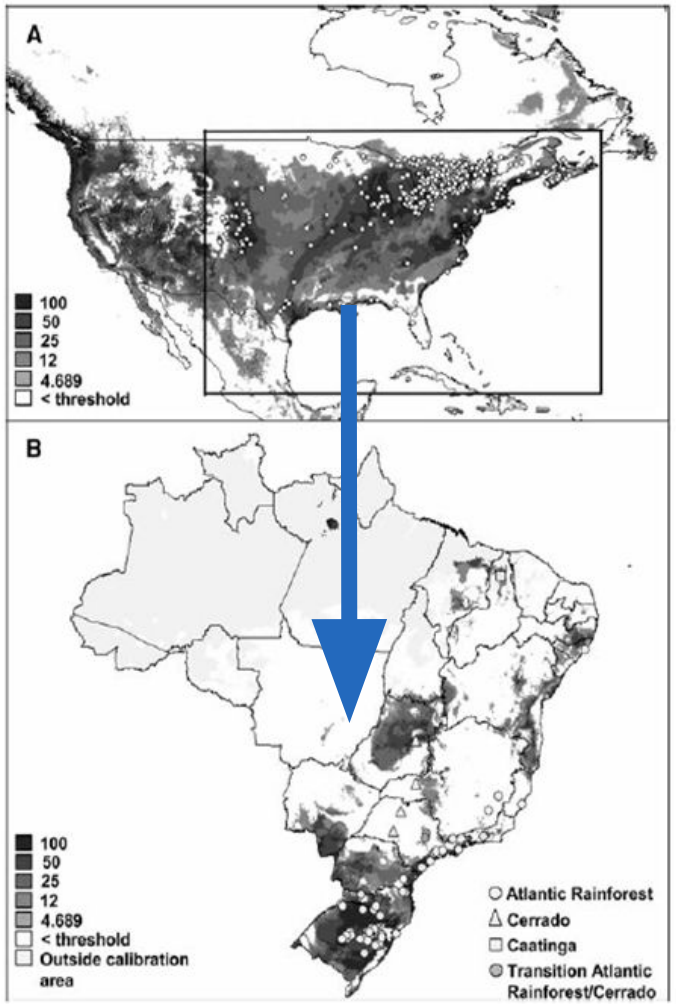




Guisan et al. (2017)

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

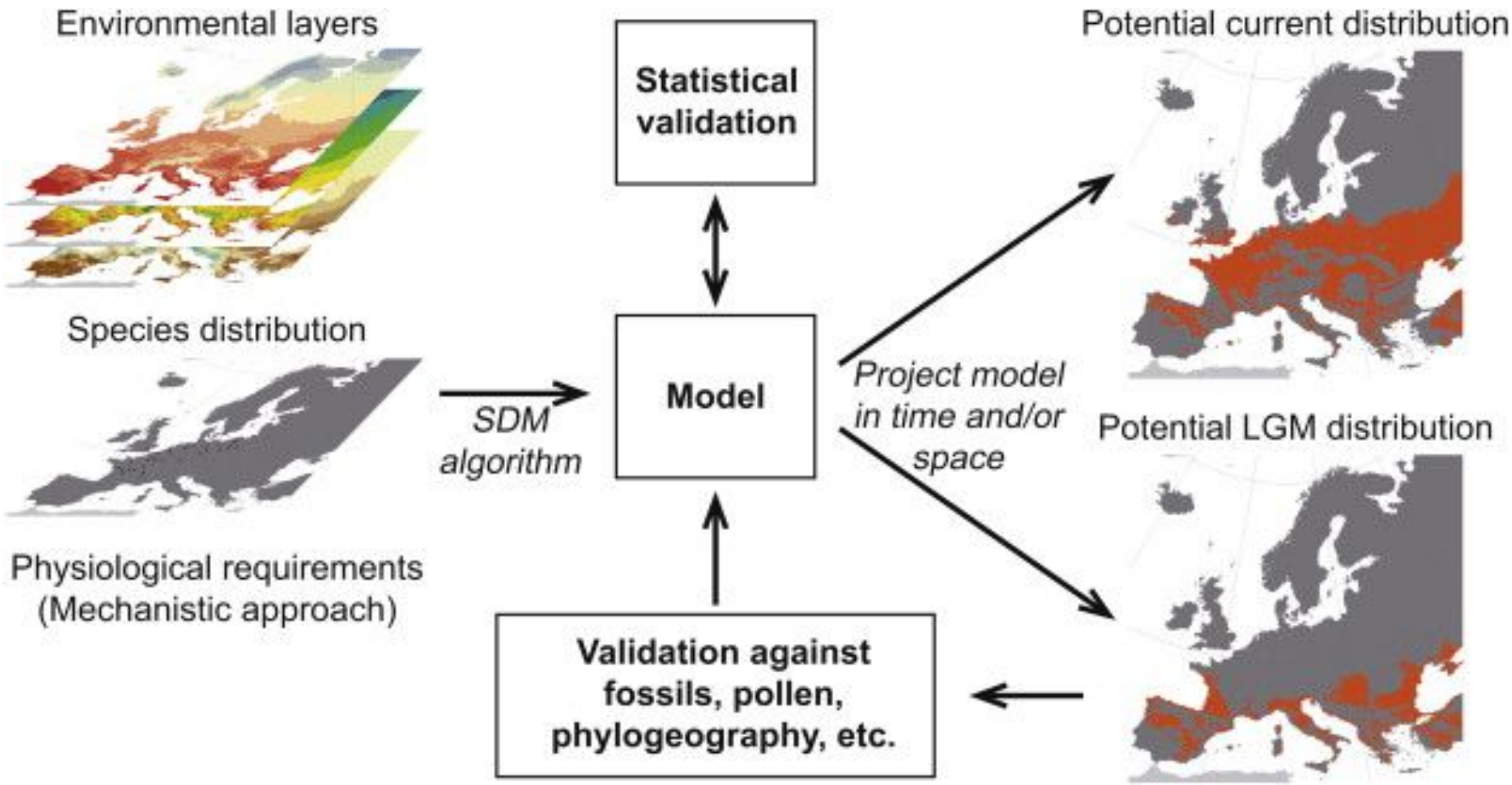
João G. R. Giovanelli · Célio F. B. Haddad · João Alexandrino

Foto: Carl D. Howe

Giovanelli et al., 2008. Biological Invasions

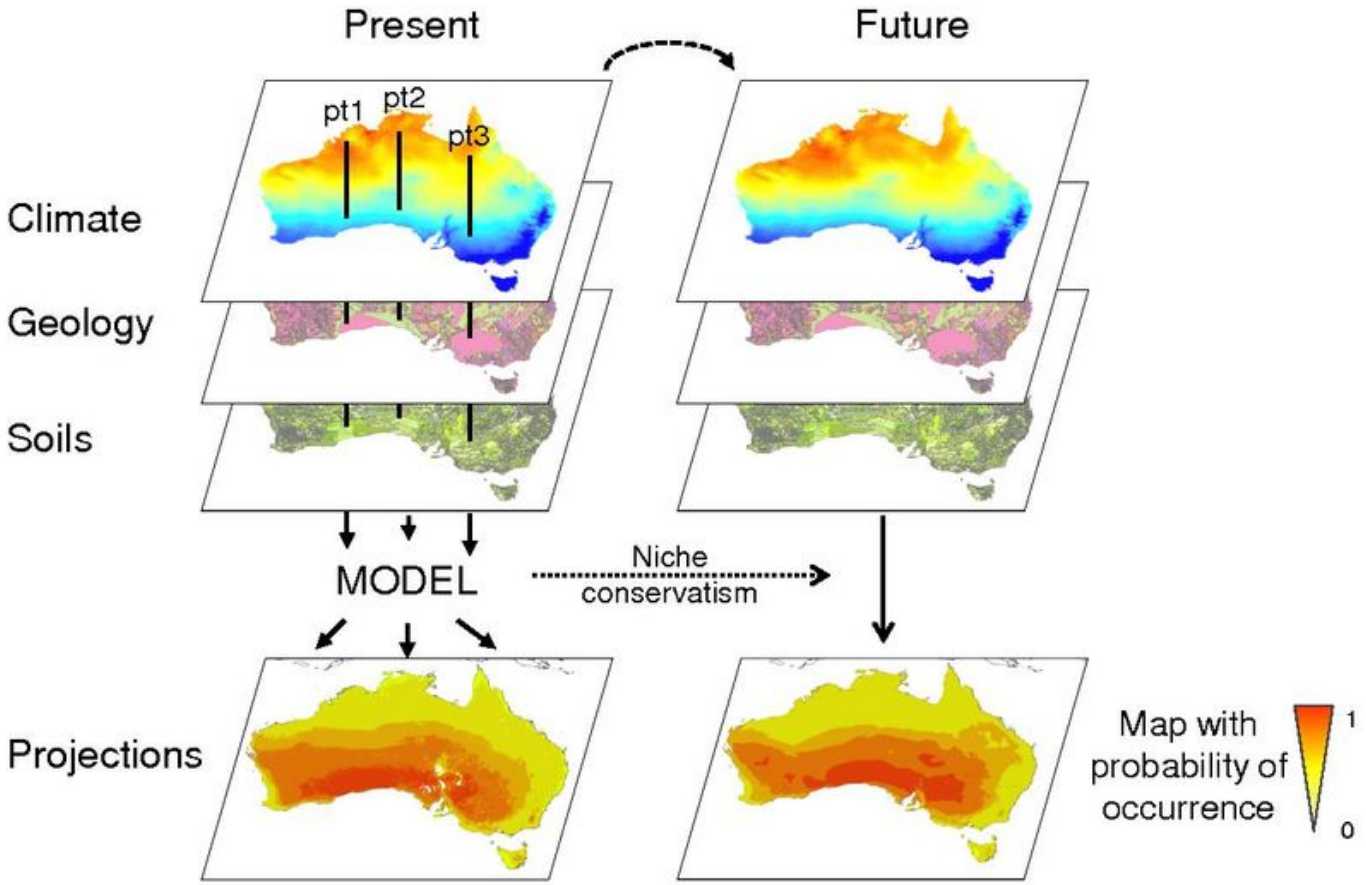
Modelos de Distribuição de Espécies (SDMs)

Tempo - passado



Modelos de Distribuição de Espécies (SDMs)

Tempo - futuro

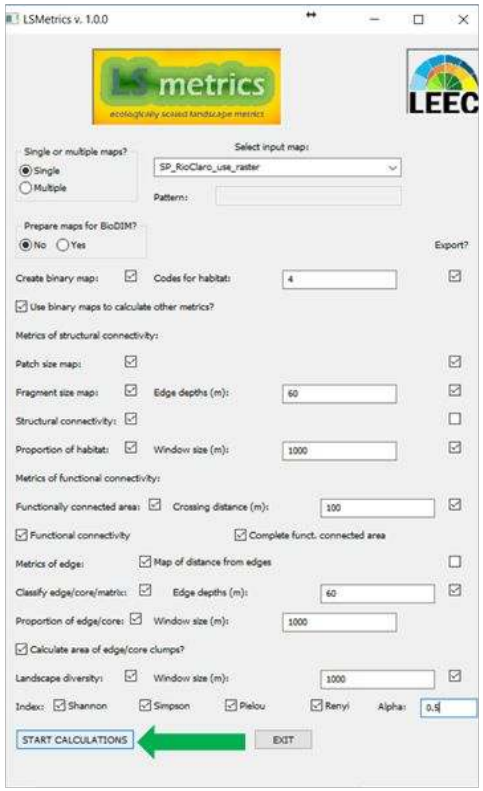


7. Aplicações

Cálculo de métricas de paisagem

LSMetrics - Landscape Metrics

Bernardo Niebuhr



LS metrics
ecologically scaled landscape metrics

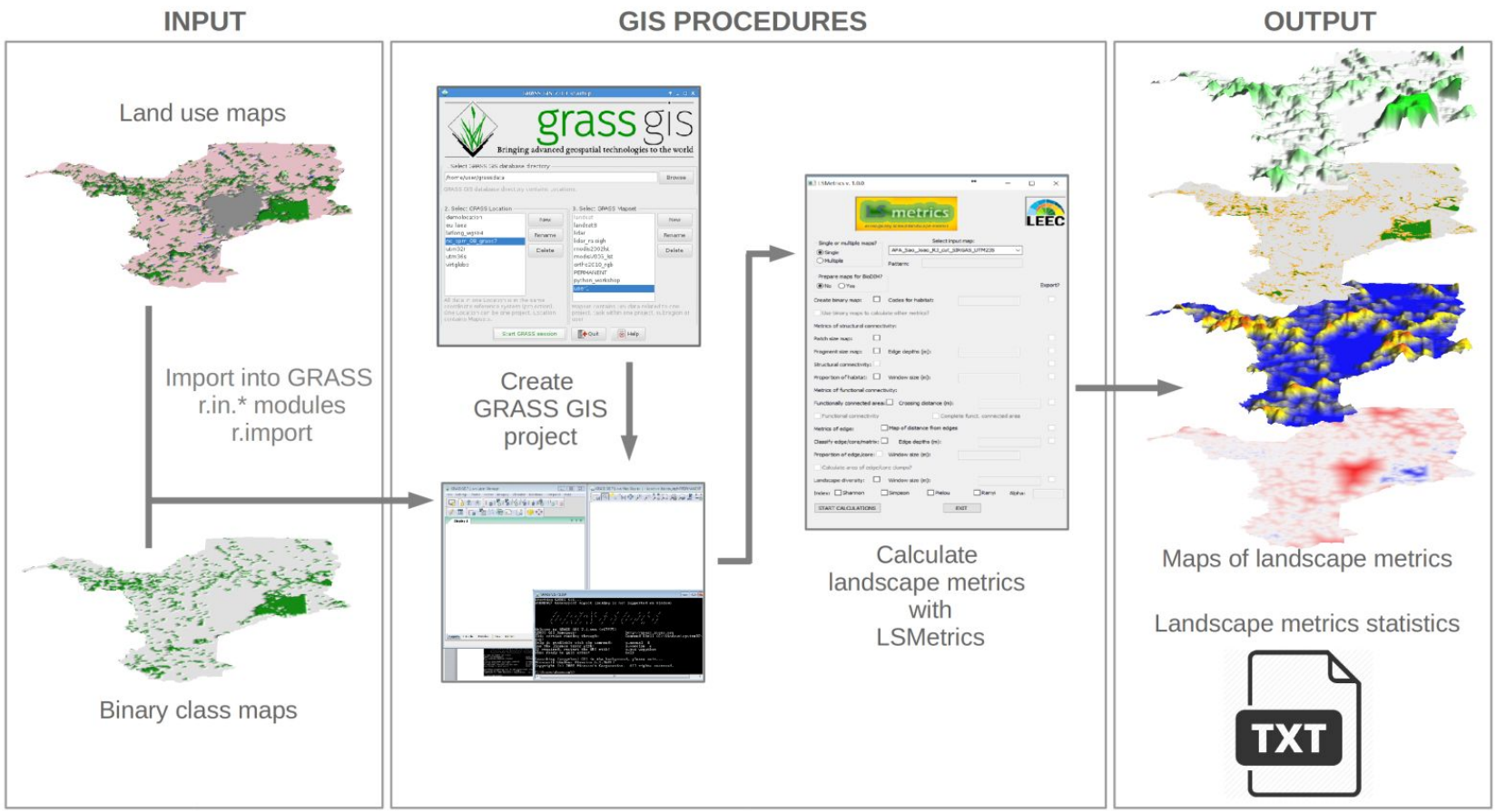
Prof. Milton Cezar Ribeiro

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

Cálculo de métricas de paisagem

LSMetrics - Landscape Metrics



https://github.com/LEEClab/LS_METRICS

Corredores ecológicos

LSCorridors - Landscape Corridors

Methods in Ecology and Evolution | BRITISH ECOLOGICAL SOCIETY

Application | Free Access

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

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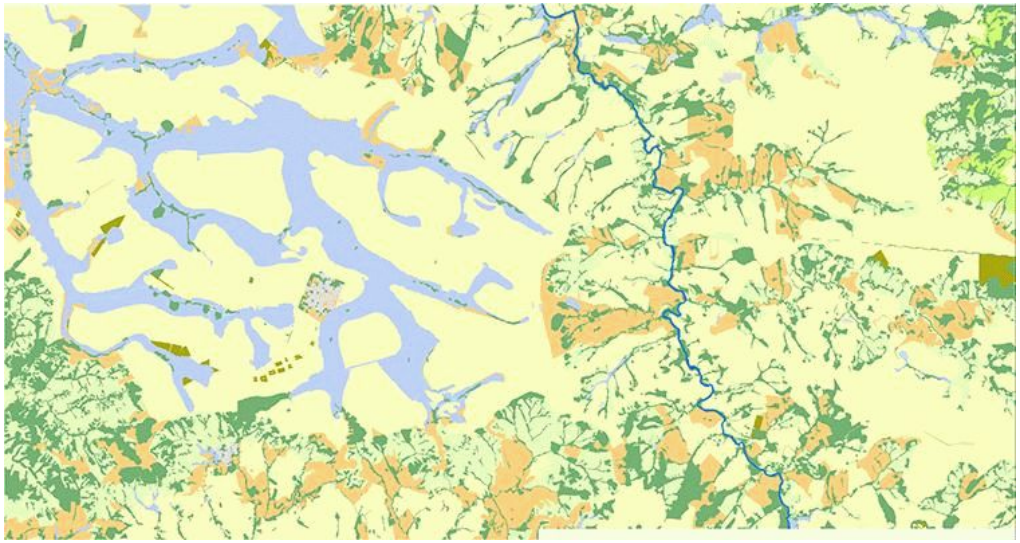

https://doi.org/10.1111/2041-210X.12750

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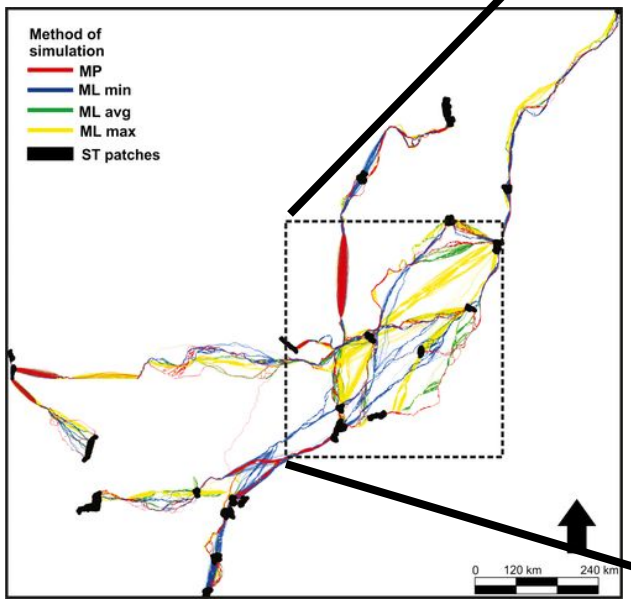
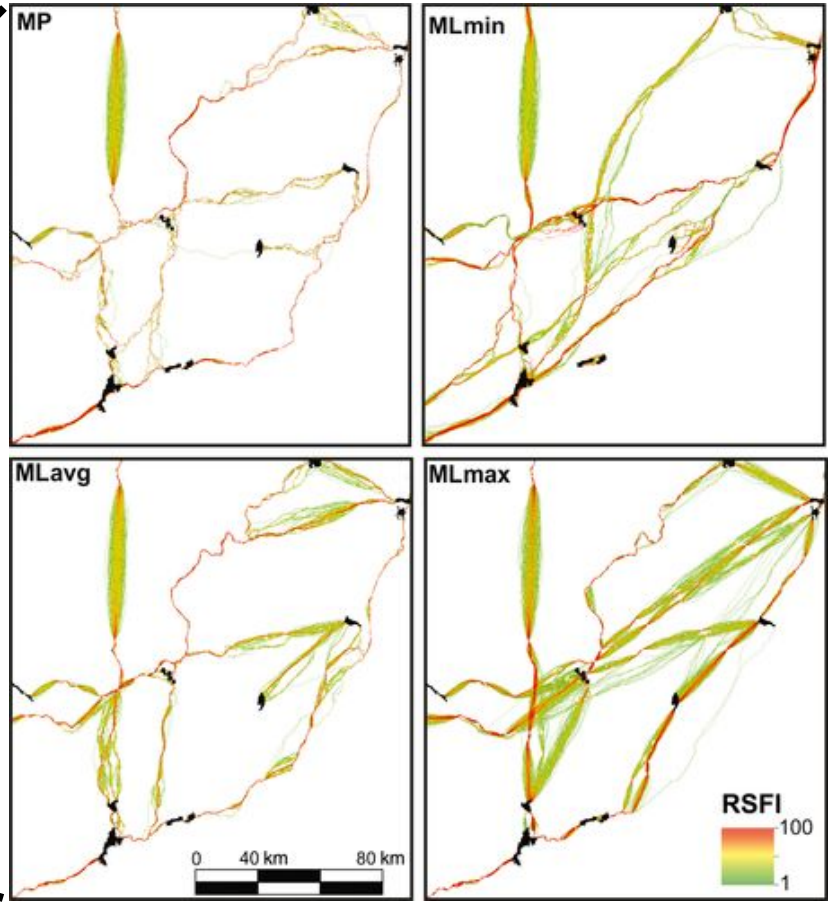




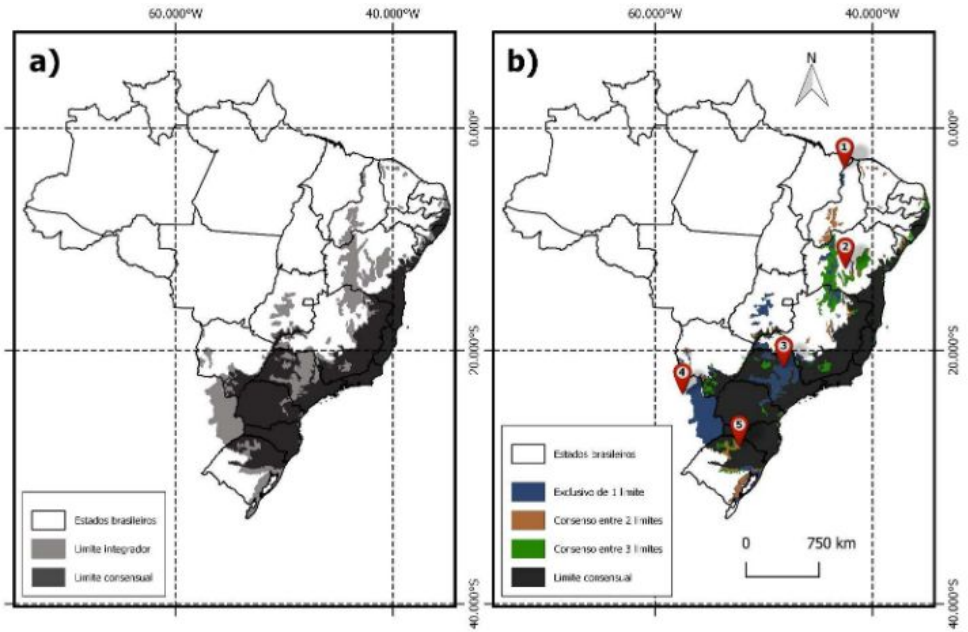
https://doi.org/10.1111/2041-210X.12750

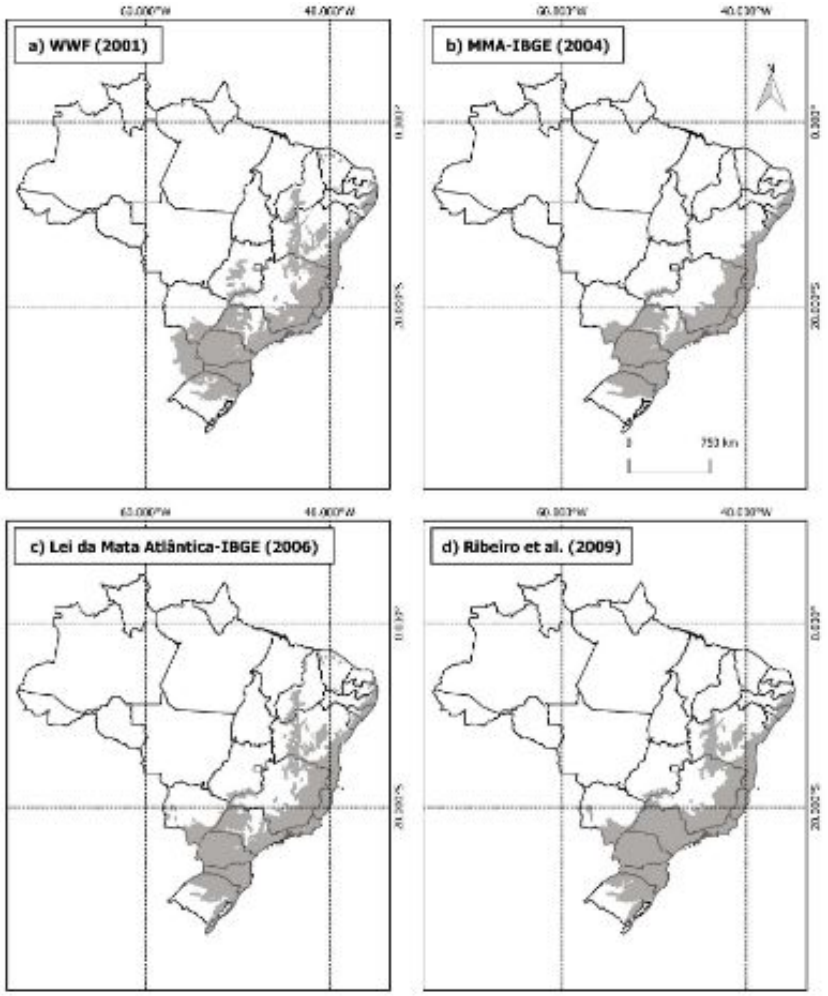
Limites da Mata Atlântica

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 Vancine[1], Rodrigo Bernardo[1,2], Júlia Emi Faria Oshima[1], Thadeu Sobral-Souza[1,3], Vinicius Rodrigues Tonetti[1], Bernardo Brandão Niebuhr[1] & Milton Cezar Ribeiro[1]*





https://doi.org/10.4257/oeco.2018.2203.09

Comunidades de anfíbios da Mata Atlântica

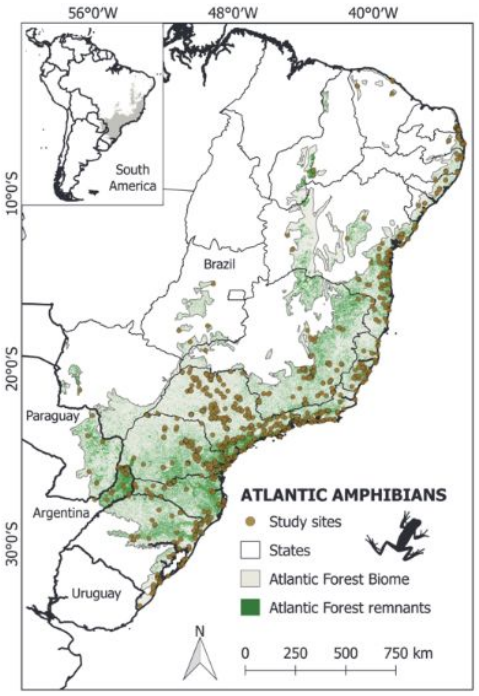
ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA

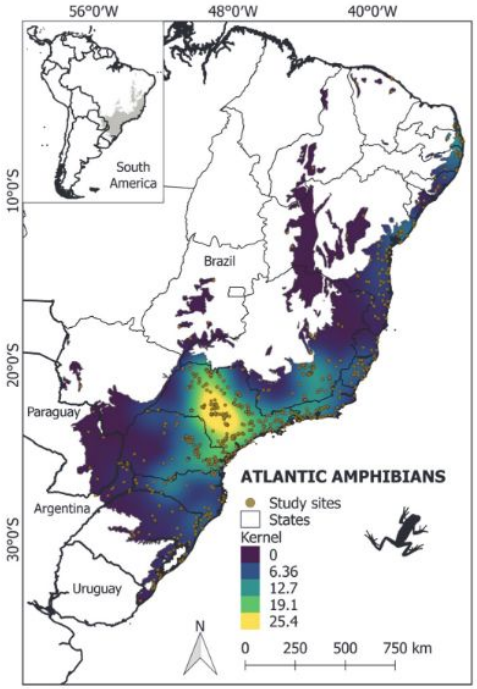
Data Papers | Free Access

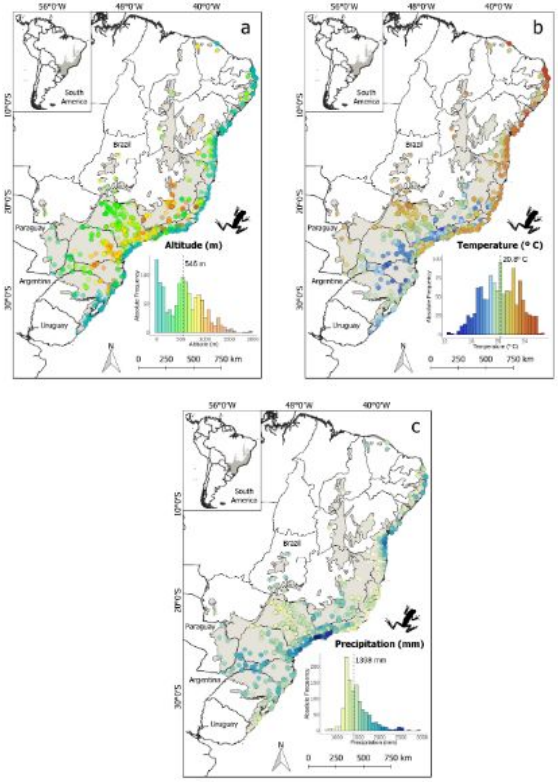
ATLANTIC AMPHIBIANS: a data set of amphibian communities from the Atlantic Forests of South America

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







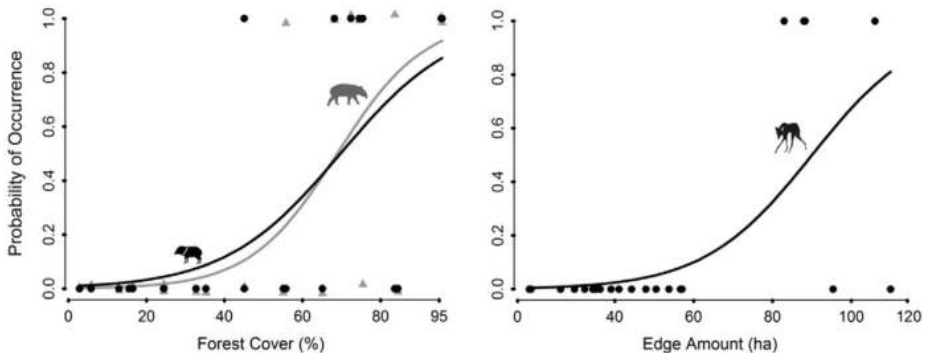
https://doi.org/10.1002/ecy.2392

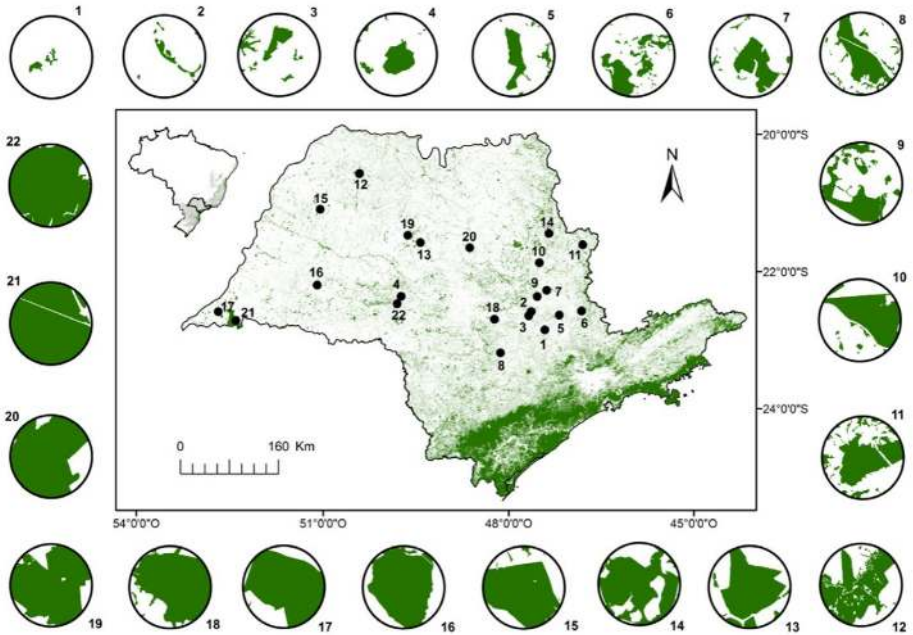
Diversidade de mamíferos em paisagens de SP

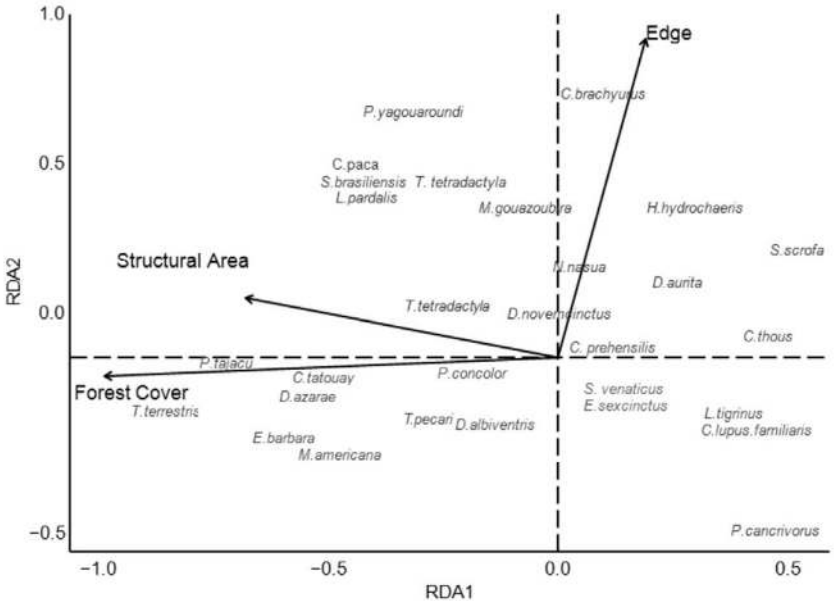
Biological Conservation
Volume 210, Part A, June 2017, Pages 352-359

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]







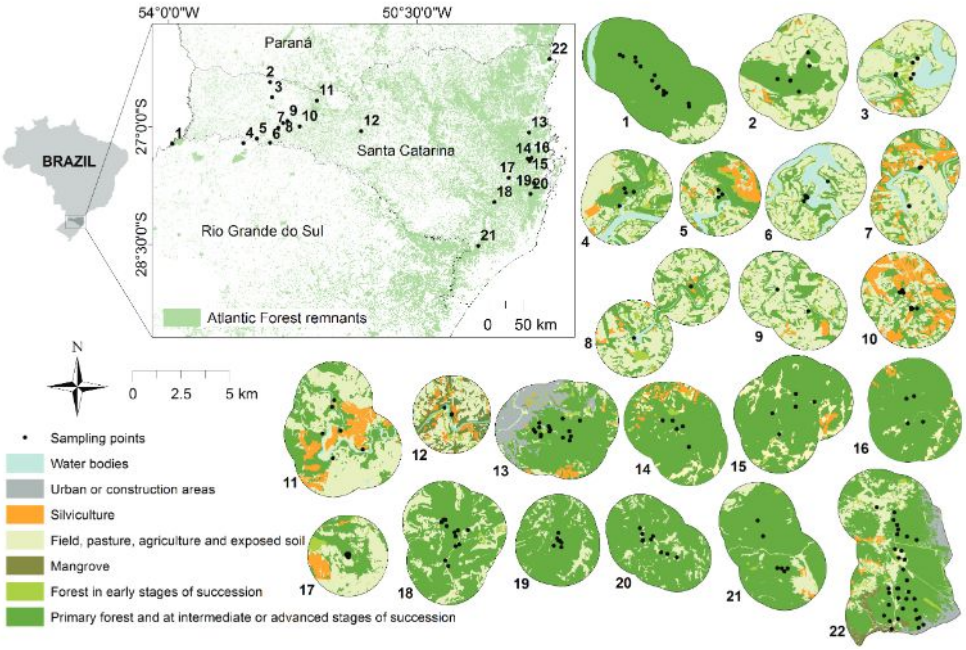
https://doi.org/10.1016/j.biocon.2017.02.033

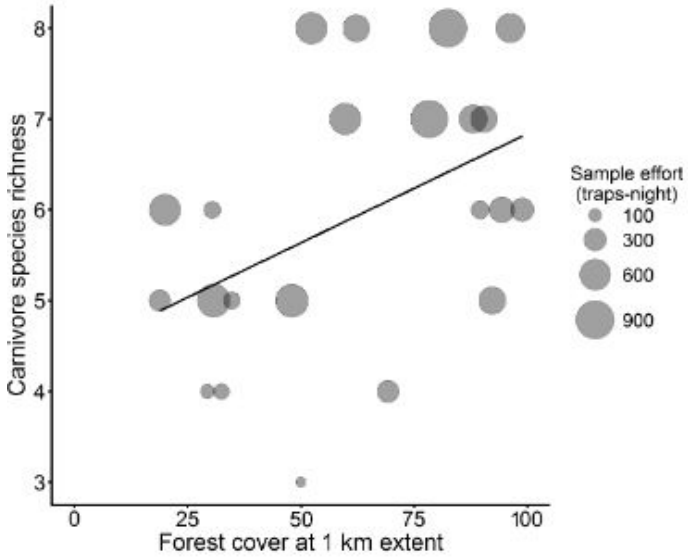
Diversidade de mamíferos em paisagens de SC

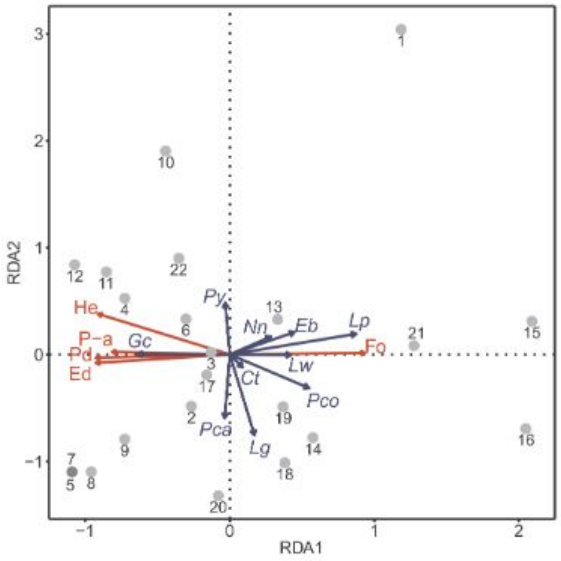
Journal of Mammalogy, 98(6):1721–1731, 2017
DOI:10.1093/jmammal/gyx103
Published online October 9, 2017

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

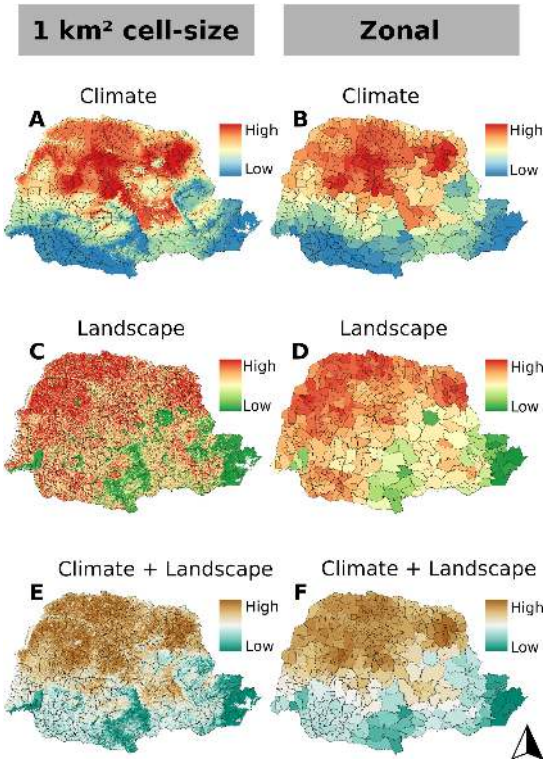
Áreas de transmissão *Trypanosoma cruzi* no PR

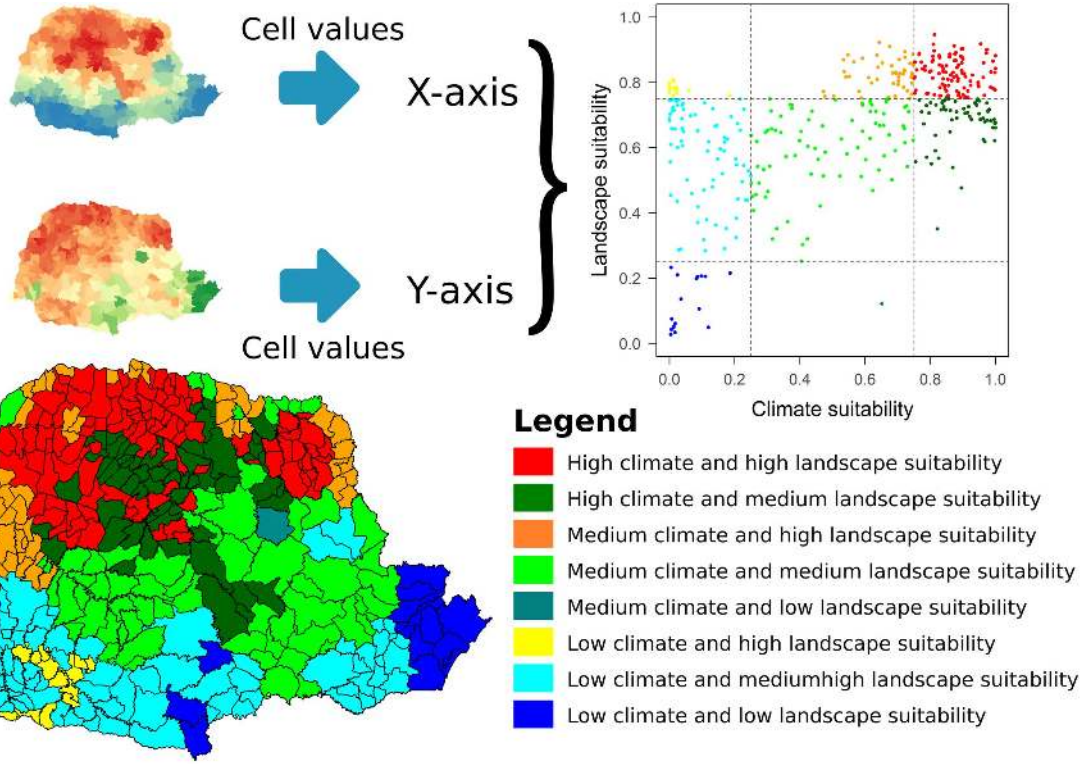
PLOS | NEGLECTED TROPICAL DISEASES

RESEARCH ARTICLE

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

Andréia Mantovani Ferro e Silva[1], Thadeu Sobral-Souza[2], Maurício Humberto Vancine[2], Renata Lara Muylaert[2], Ana Paula de Abreu[1], Sandra Marisa Pelloso[1,3], Maria Dalva de Barros Carvalho[1,4], Luciano de Andrade[1,4], Milton Cezar Ribeiro[2], Max Jean de Ornelas Toledo[1,5]*





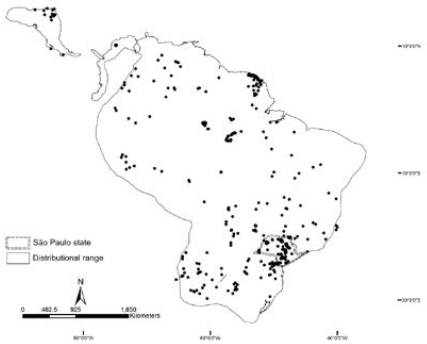
https://doi.org/10.1371/journal.pntd.0006907

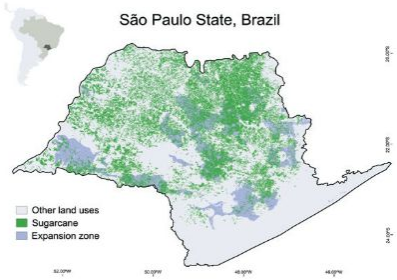
Expansão da cana sobre o tamanduá em SP

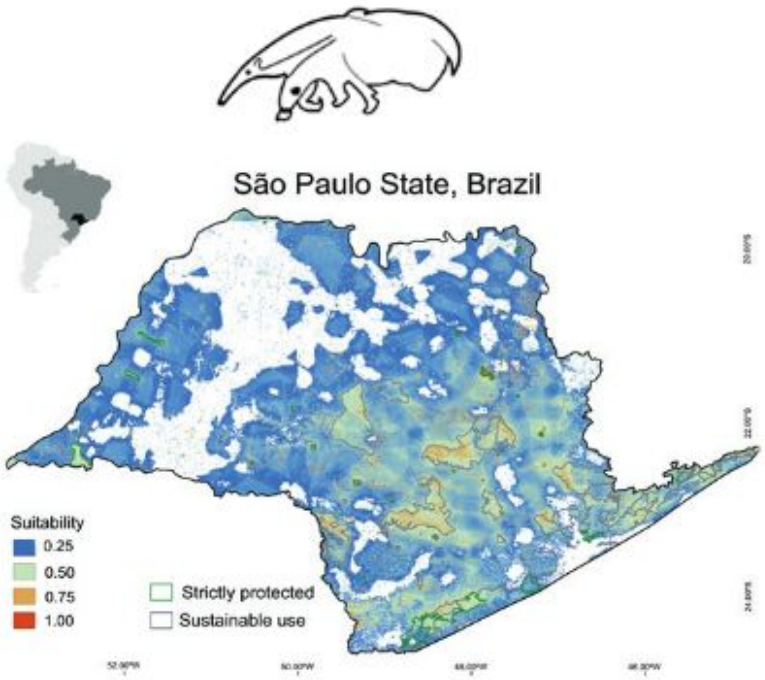
Journal of Mammalogy, 100(2):435–444, 2019
DOI:10.1093/jmammal/gyz042
Published online 18 March 2019

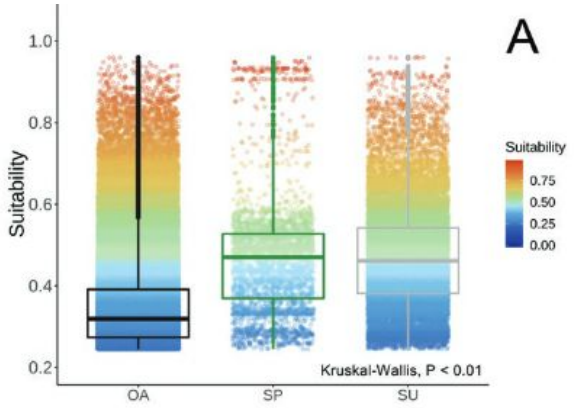
Land-use changes and the expansion of biofuel crops threaten the giant anteater in southeastern Brazil

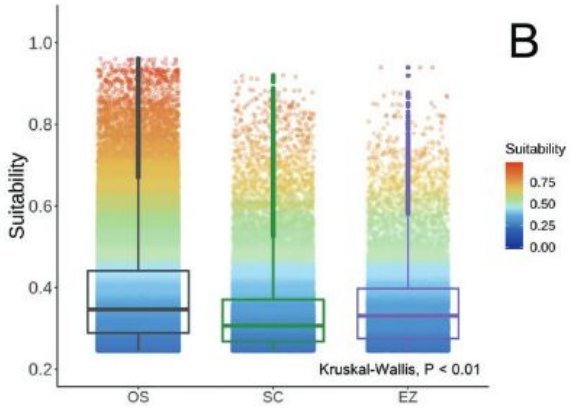
Alessandra Bertassoni,*,[•] Rômulo Theodoro Costa, Jéssica Abonizio Gouvea, Rita de Cassia Bianchi, John Wesley Ribeiro, Maurício Humberto Vancine, and Milton Cezar Ribeiro











https://doi.org/10.1093/jmammal/gyz042

Mineração sobre anuros e aves na Serra Espinhaço

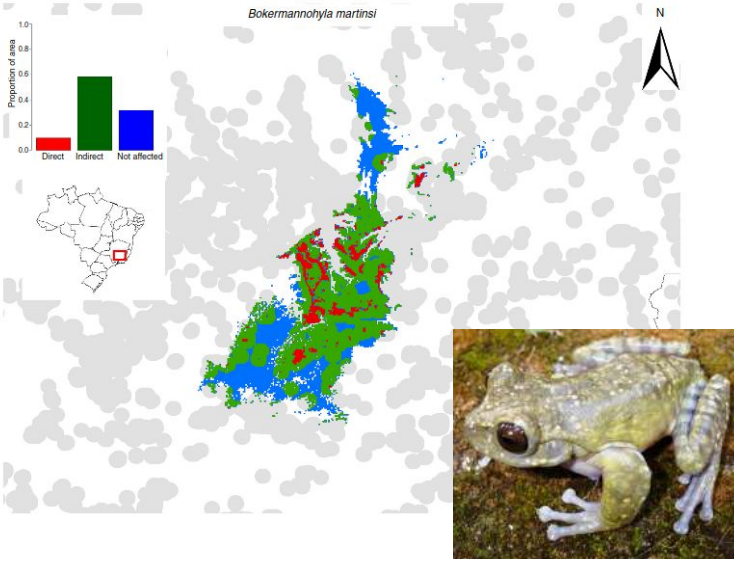
ELSEVIER

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

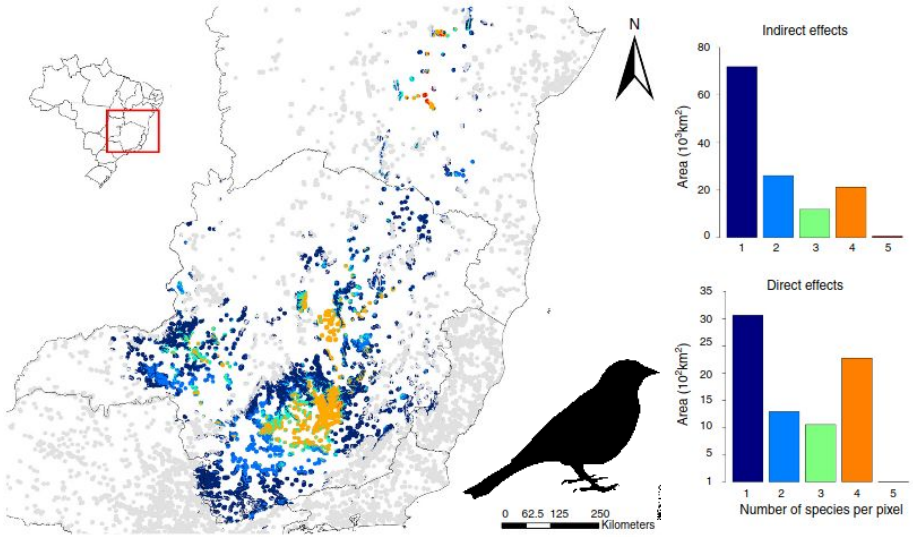
Research Letters

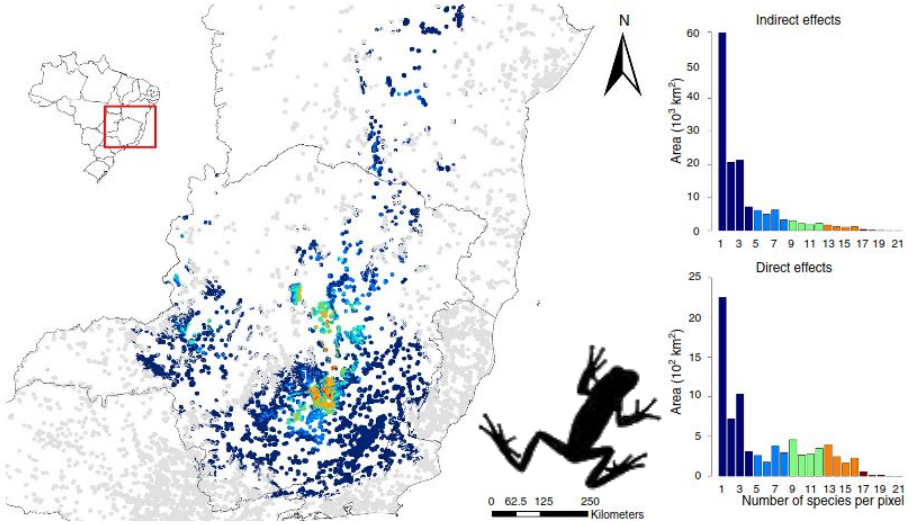
Impacts of mining activities on the potential geographic distribution of eastern Brazil mountaintop endemic species

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]



Bokermannohyla martinsi





https://doi.org/10.1016/j.pecon.2017.07.005

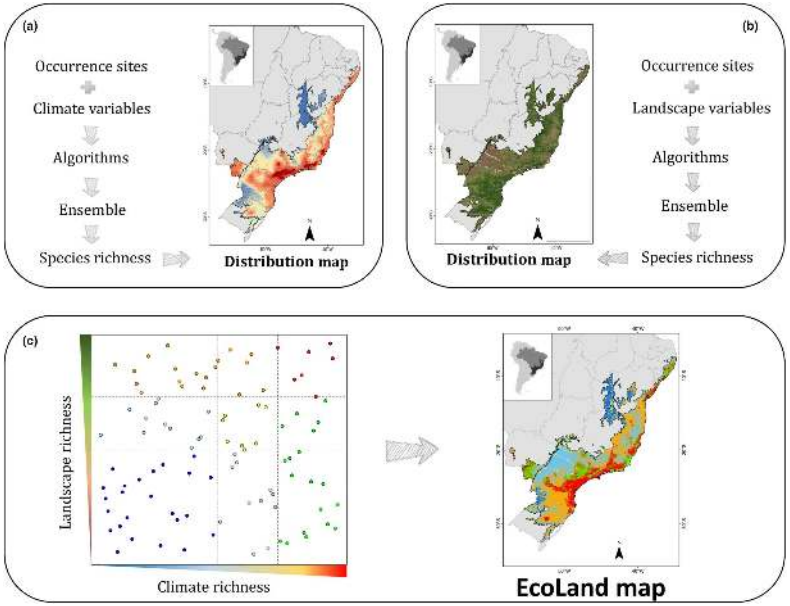
Clima, paisagem e riqueza de borboletas na MA

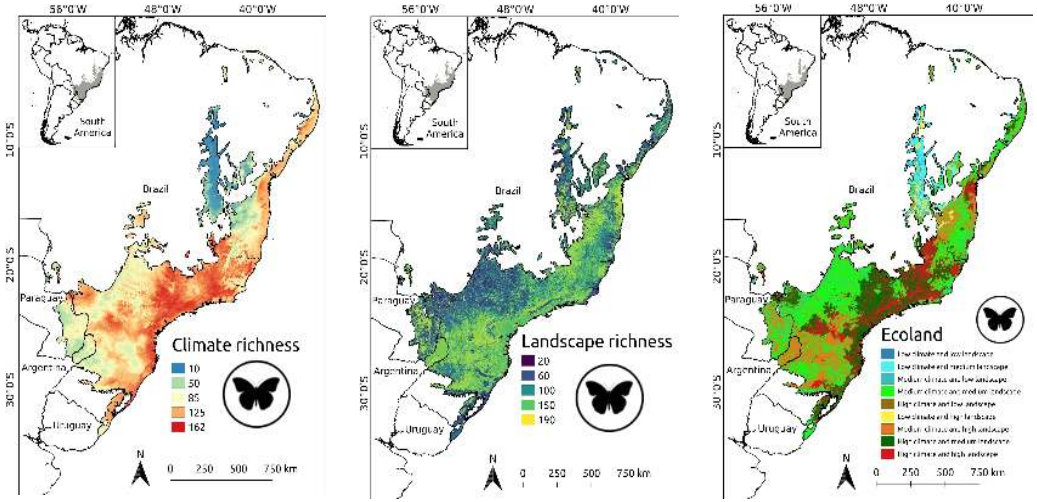
Diversity and Distributions Open Access
A Journal of Conservation Biogeography

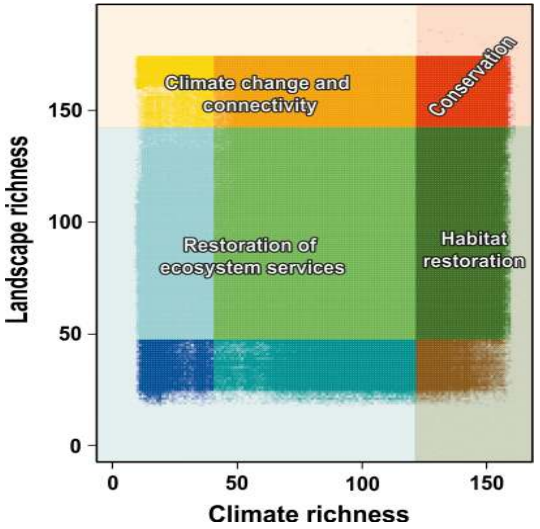
BIODIVERSITY RESEARCH | Open Access

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







https://doi.org/10.1111/ddi.13007

Paisagem e interações animal-planta na MA

Diversity and Distributions Open Access
A Journal of Conservation Biogeography

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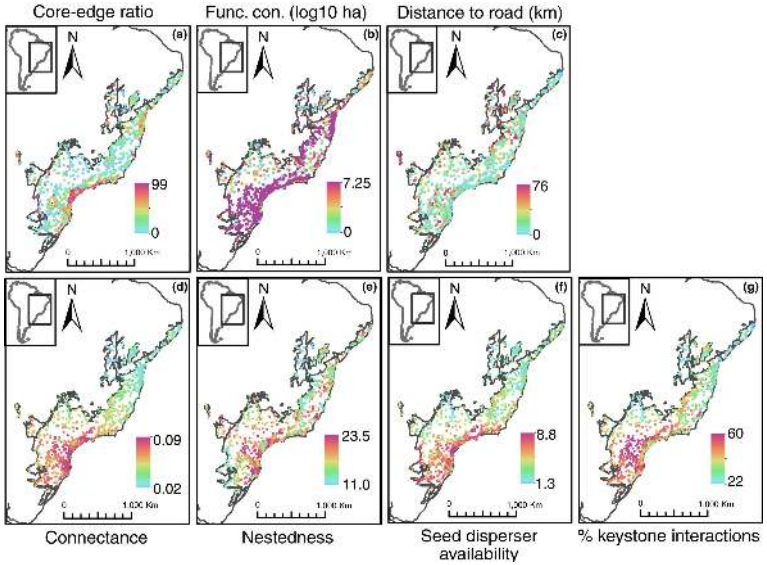
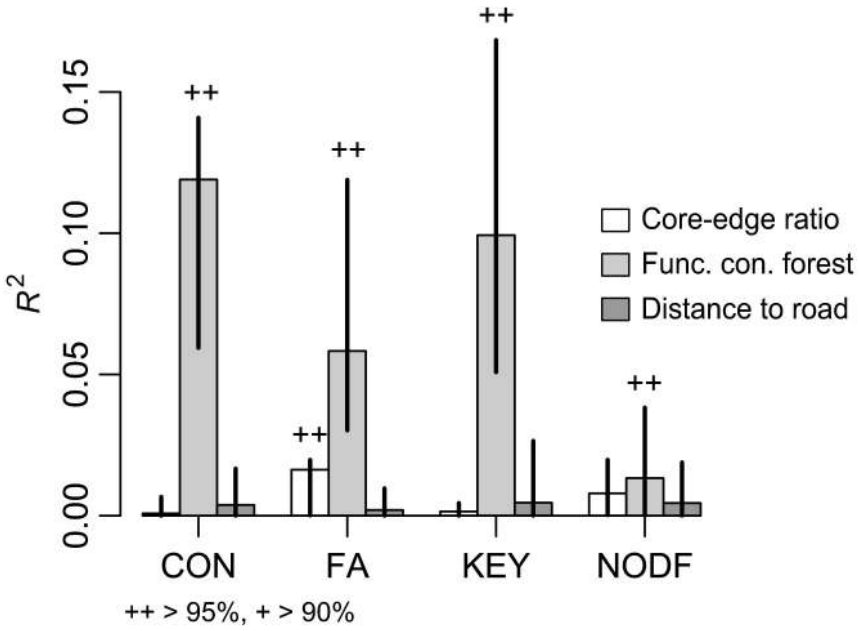
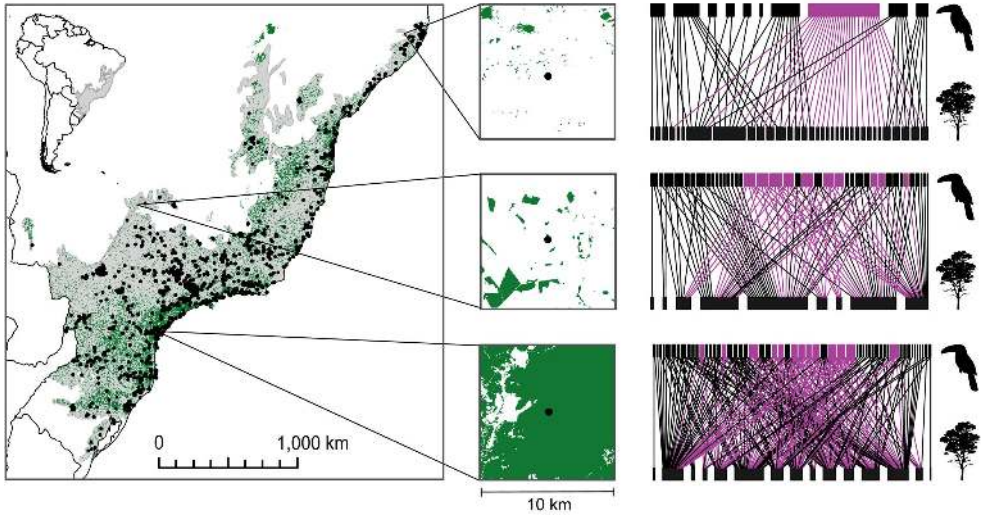
Fragmented tropical forests lose mutualistic plant–animal interactions

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







https://doi.org/10.1111/ddi.13010

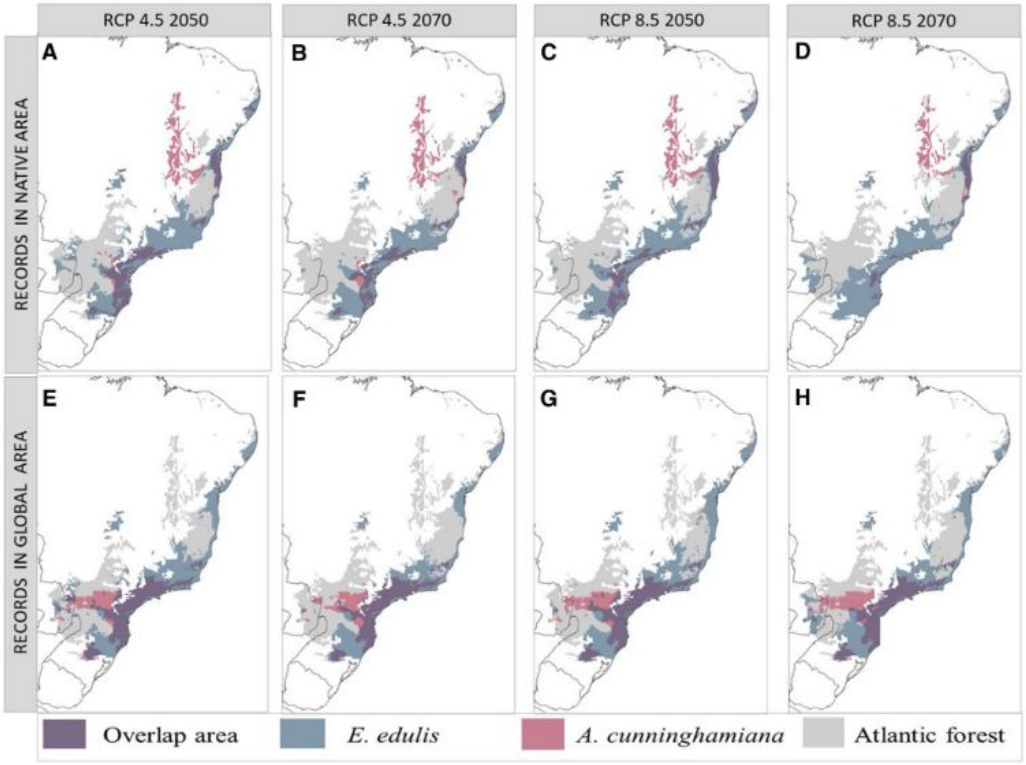
Interação de palmeira nativa e invasora na MA

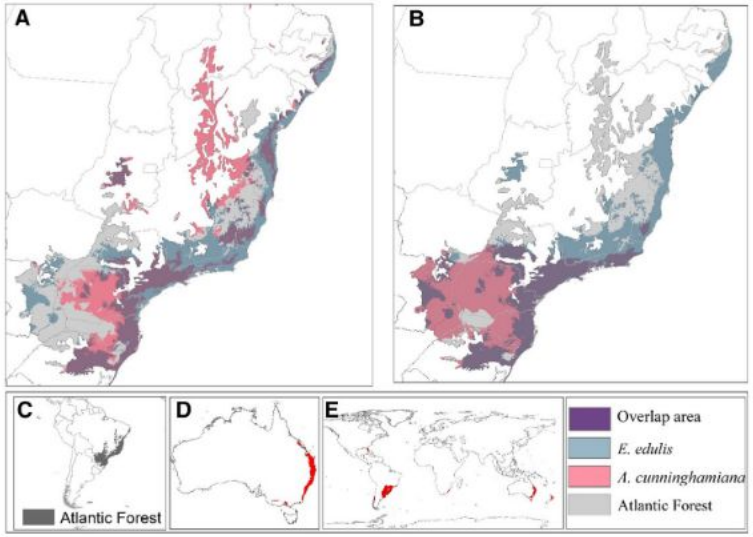
Environmental niche and functional role similarity between invasive and native palms in the Atlantic Forest

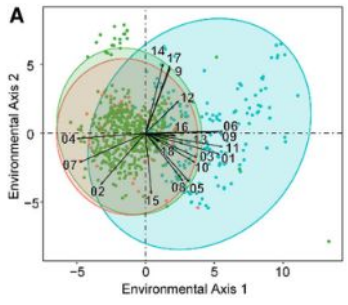
Carolina Bello ✉, Ana Laura P. Cintra, Elisa Barreto, Maurício Humberto Vancine, Thadeu Sobral-Souza, Catherine H. Graham & Mauro Galetti

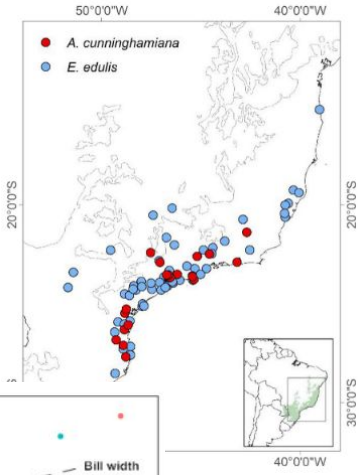
Biological Invasions (2020) | Cite this article

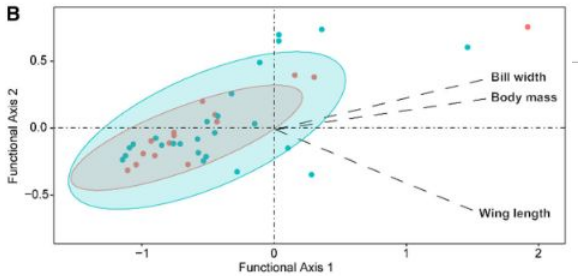
884 Accesses | 7 Altmetric | Metrics











https://doi.org/10.1007/s10530-020-02400-8

Zonas de hibridização potencial de saguis no BR

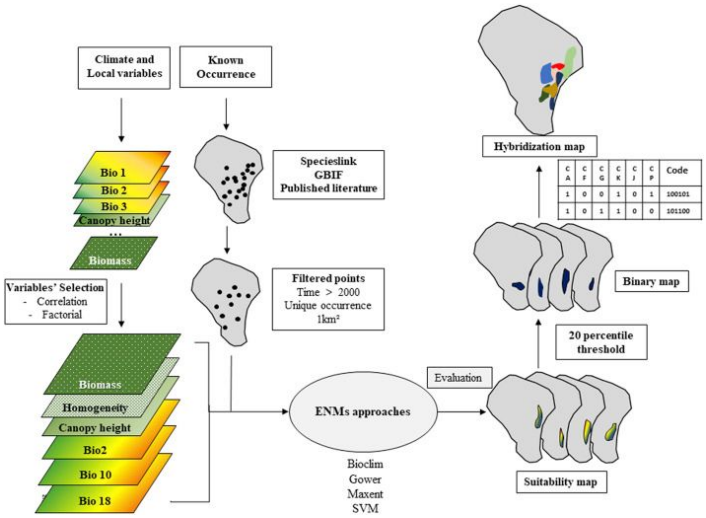
ELSEVIER

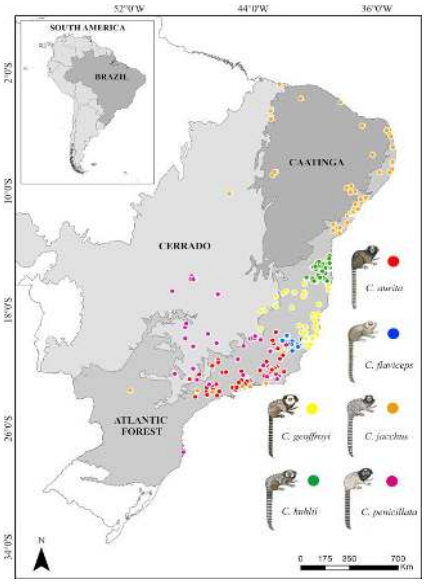
Global Ecology and Conservation

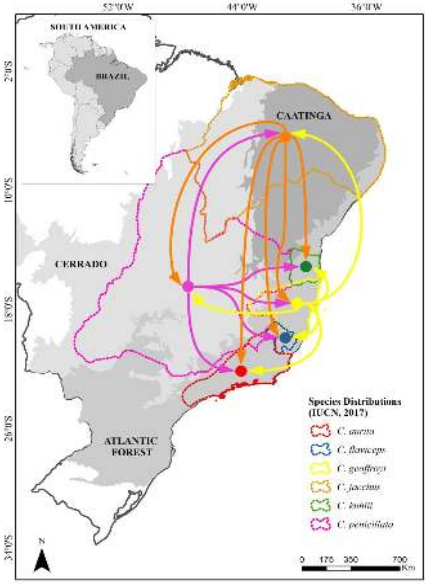
Volume 20, October 2019, e00706

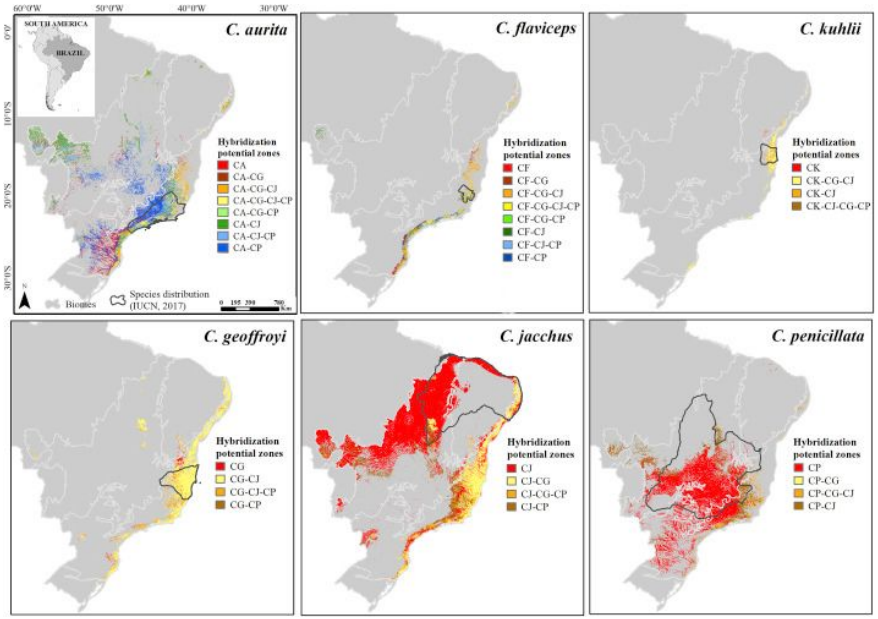
Predicting the potential hybridization zones between native and invasive marmosets within Neotropical biodiversity hotspots

Andreia 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]









https://doi.org/10.1016/j.gecco.2019.e00706

Eficiência das áreas protegidas da AM e MA

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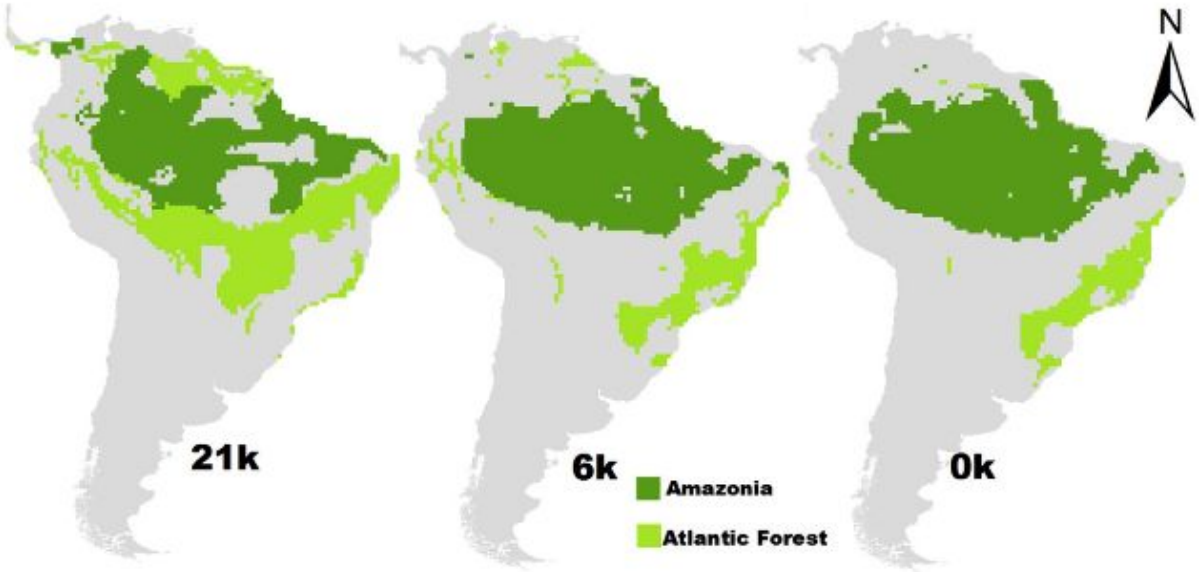
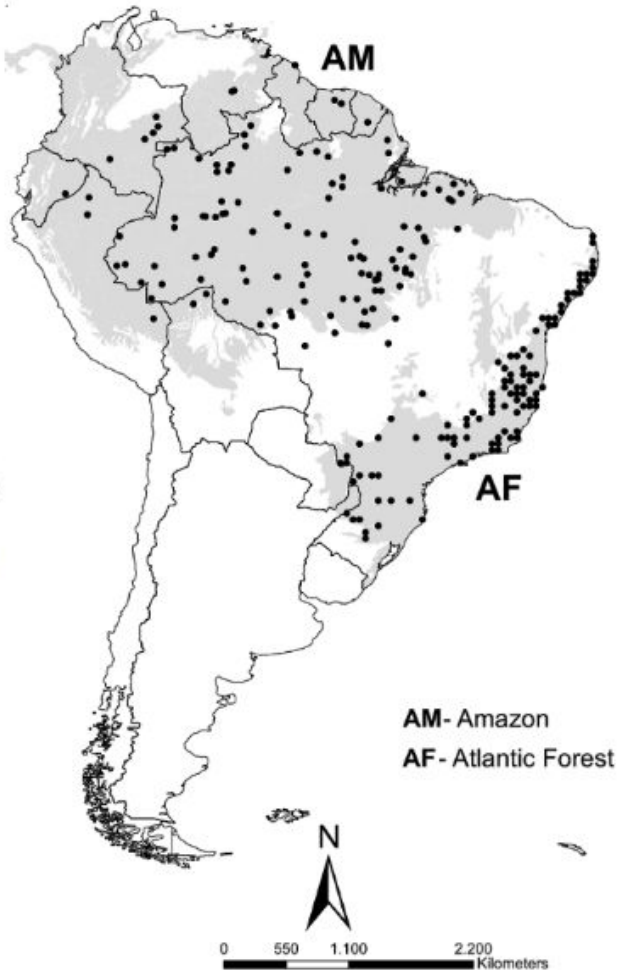
Efficiency of protected areas in Amazon and Atlantic Forest conservation: A spatio-temporal view

Thadeu Sobral-Souza[a,b,*], Maurício Humberto Vancine[a], Milton Cezar Ribeiro[a], Matheus S. Lima-Ribeiro[c]





https://doi.org/10.1016/j.actao.2018.01.001

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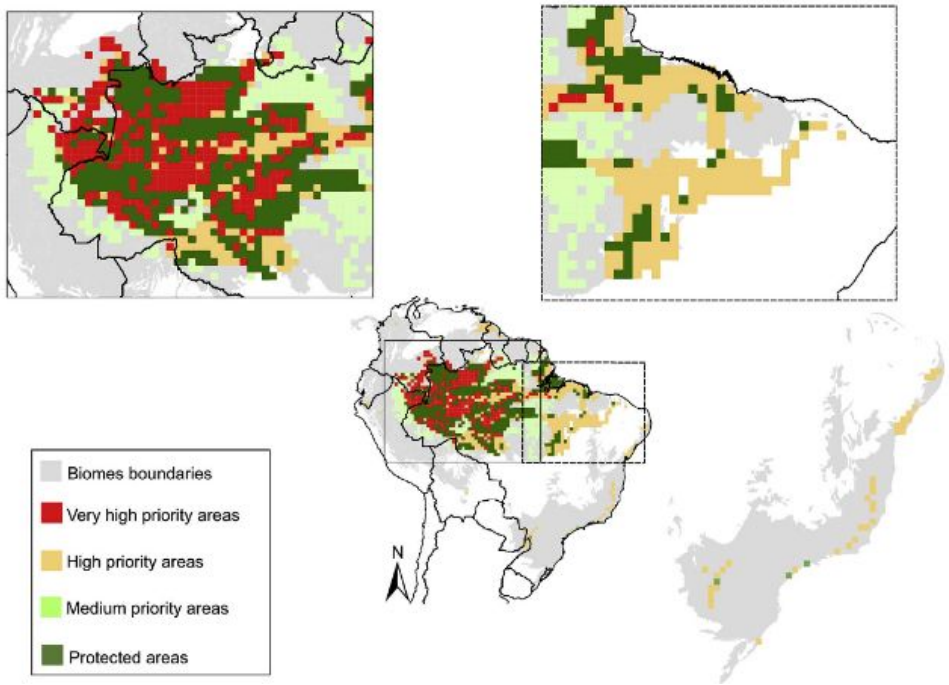

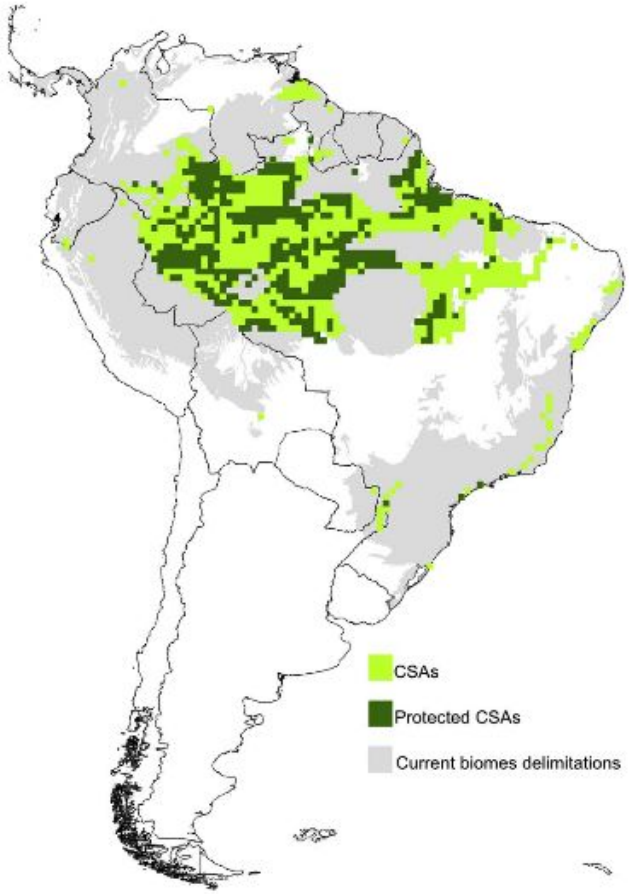

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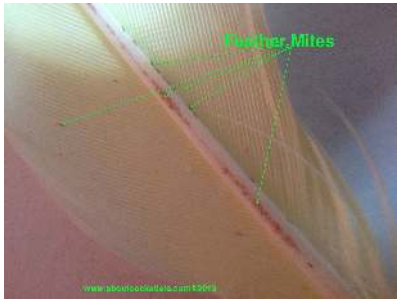
Predição de ácaros em penas de aves no mundo

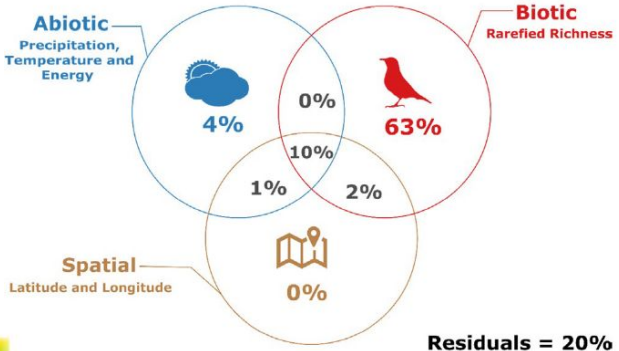
Diversity and Distributions Open Access — A Journal of Conservation Biogeography

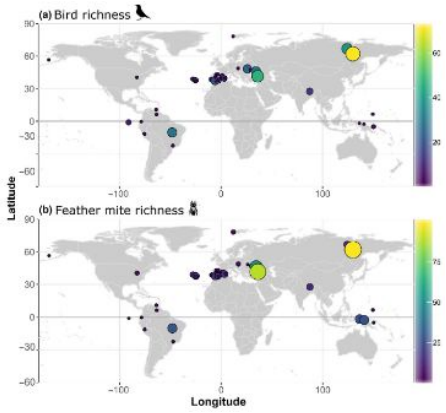
BIODIVERSITY RESEARCH | Open Access

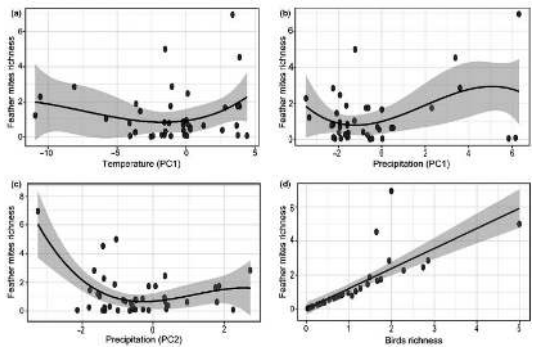
Host diversity outperforms climate as a global driver of symbiont diversity in the bird-feather mite system

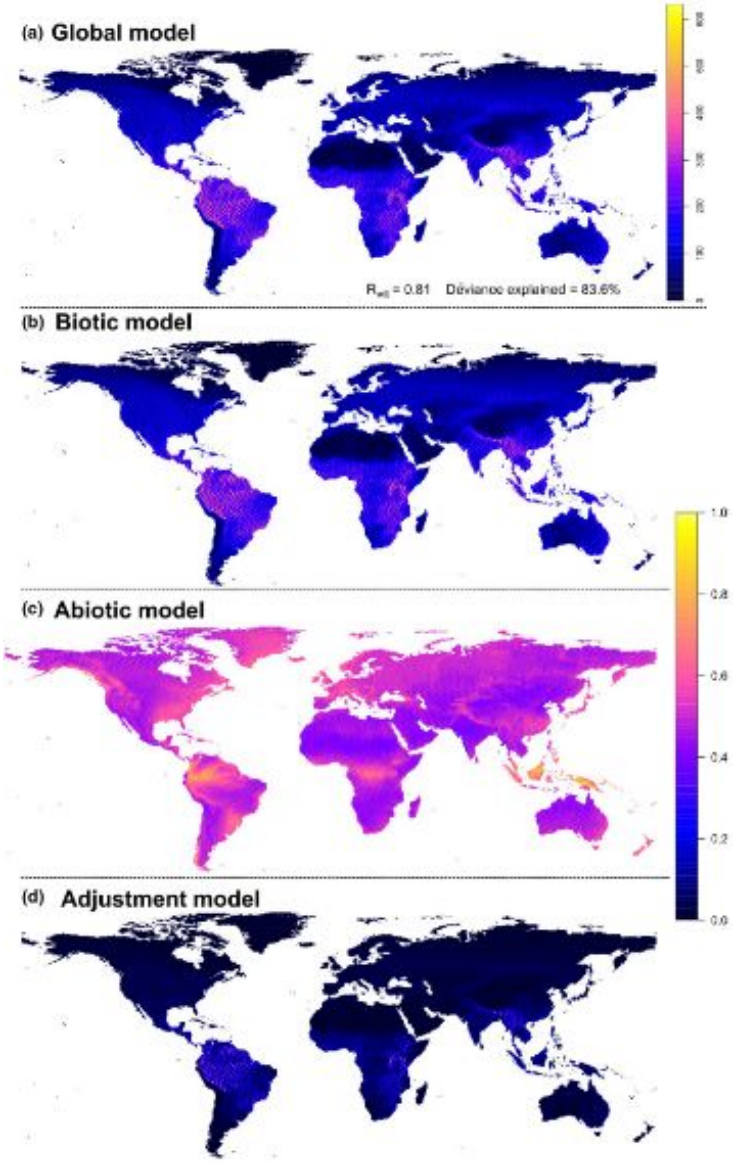
Reginaldo A. F. Gusmão, Fabio A. Hernandes, Maurício H. Vancine, Luciano N. Naka, Jorge Doña, Thiago Gonçalves-Souza







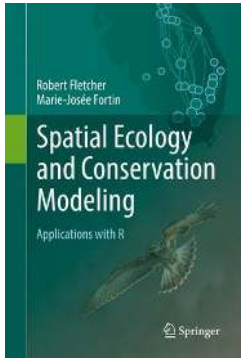




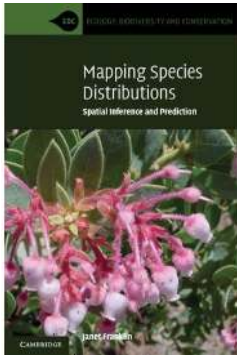
https://doi.org/10.1111/ddi.13201

Mais informações

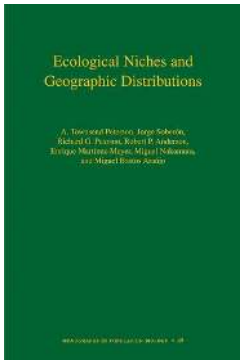
Livros



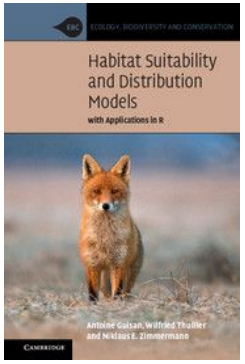
Fletcher and Fortin (2018)



Franklin (2009)

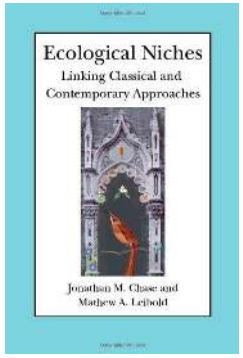


Peterson et al. (2011)

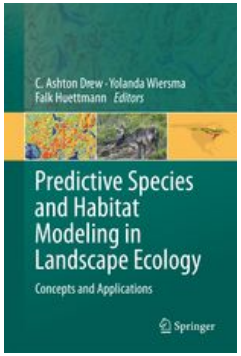


Guisan et al. (2017)

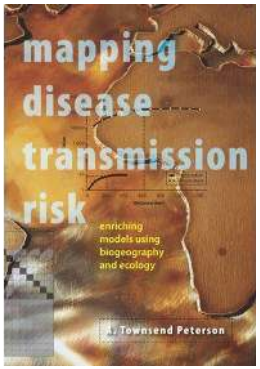
Lima-Ribeiro & Diniz-Filho (2013)



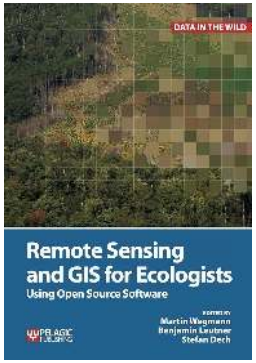
Chase & Leibold (2003)



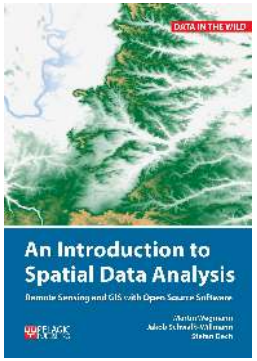
Drew et al. (2011)



Peterson (2014)



Wegmann et al. (2016)

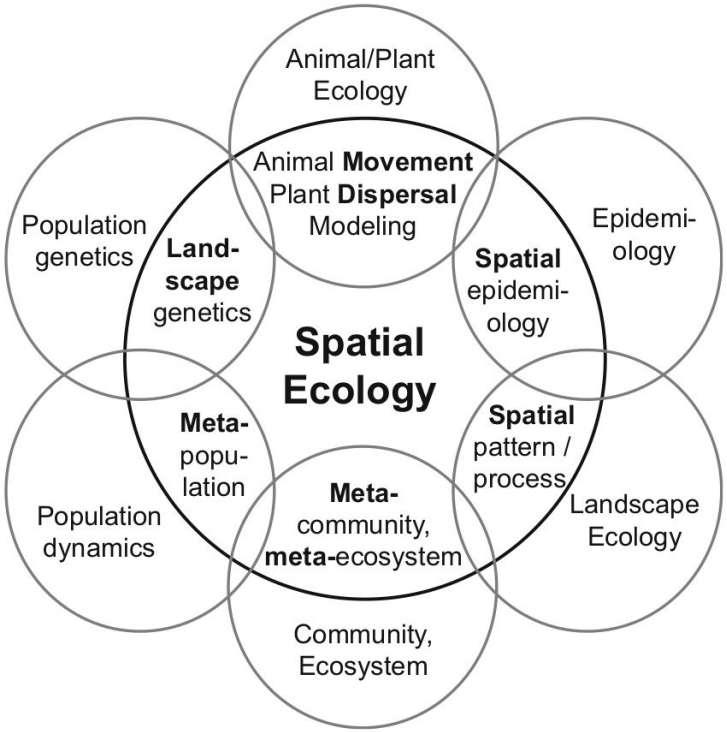


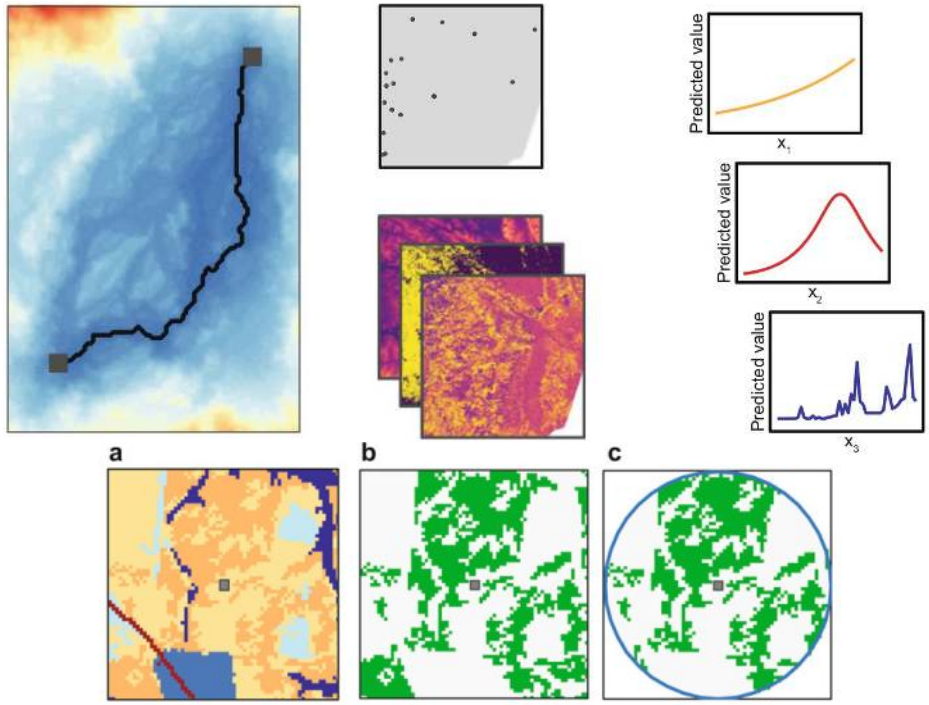
Wegmann et al. (2020)

Porque se nada mudar
Se nada for feito
Abril será pior que Março
E Maio pior que Abril
O Ponto de Não Retorno se aproxima do Brasil
Não podemos permitir que isso aconteça
É hora de gritar
Gritar ainda mais alto
#BASTA

https://brasil.elpais.com/brasil/2021-03-31/miguel-nicolelis-estamos-a-poucas-semanas-de-um-ponto-de-nao-retorno-na-crise-da-covid-19.html

Aplicações da Cartografia para a Ecologia Espacial





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02/04/2021

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