The fate of African tropical flora under climate change

Gilles Dauby

Deblauwe V., Blach-Overgaard A. , Svenning J-C. Sepulchre P.,

Couvreur T.L.P.

& RAINBIO consortium

Impact of climate change on biodiversity is challenging

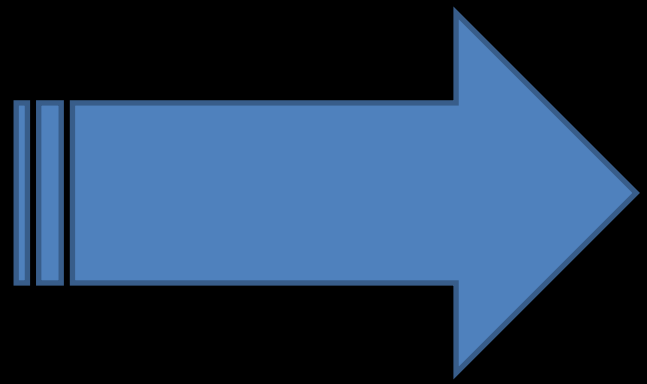
Climate change components

Temperature
Means
Extremes
Variability
Seasonality

Rainfall
Means
Extremes
Variability
Seasonality

Extreme events
Droughts
Fires

Atmospheric [CO2]



Biodiversity components

- Physiology
- Genetics
- Phenology
- Dynamics
- Distribution
- Species interactions
- Community productivity
- Ecosystem services

Adapted from Bellard C. et al. 2012

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  - Means
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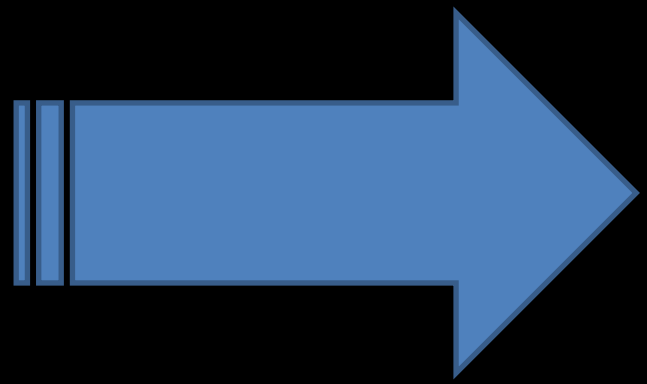

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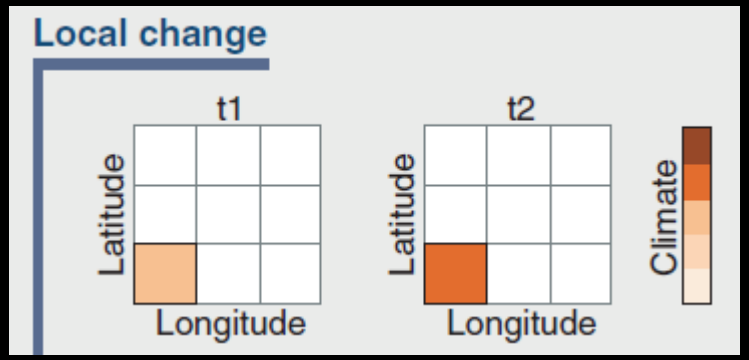
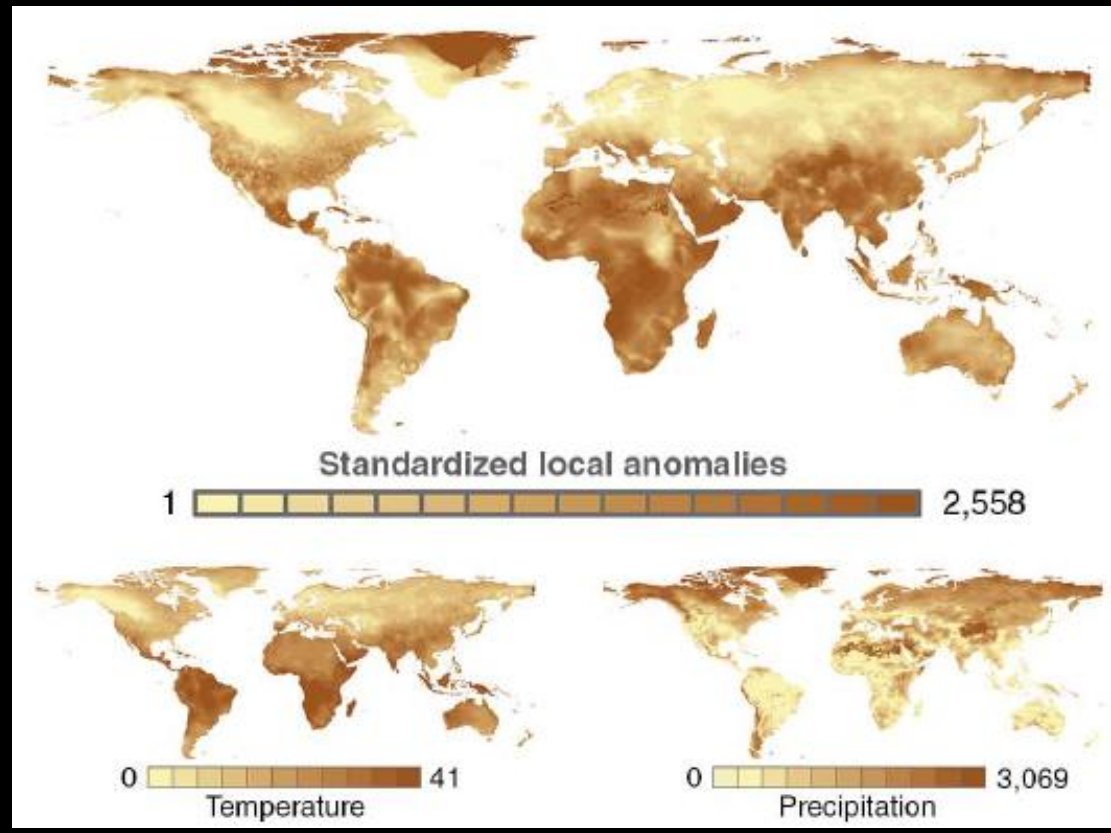
Two widely applied approaches

Two widely applied approaches

1: Characterization of the multiple dimensions of climate change





Garcia R.A. et al. 2012

Two widely applied approaches

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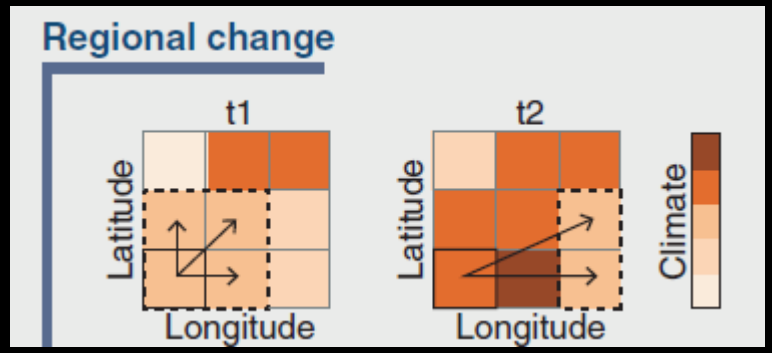
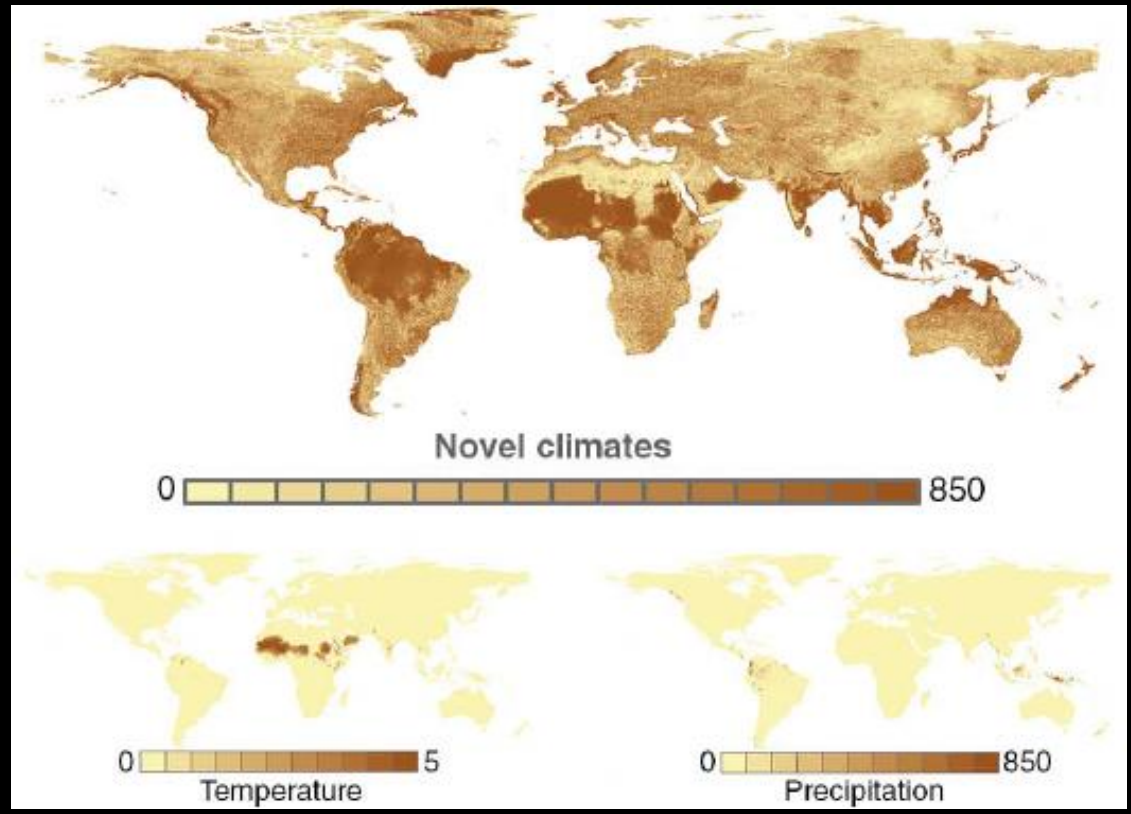




Garcia R.A. et al. 2012

Two widely applied approaches

1: Characterization of the multiple dimensions of climate change

- Easy to implement

  Present-day + projected climates conditions

- Identify the multiple components of CC

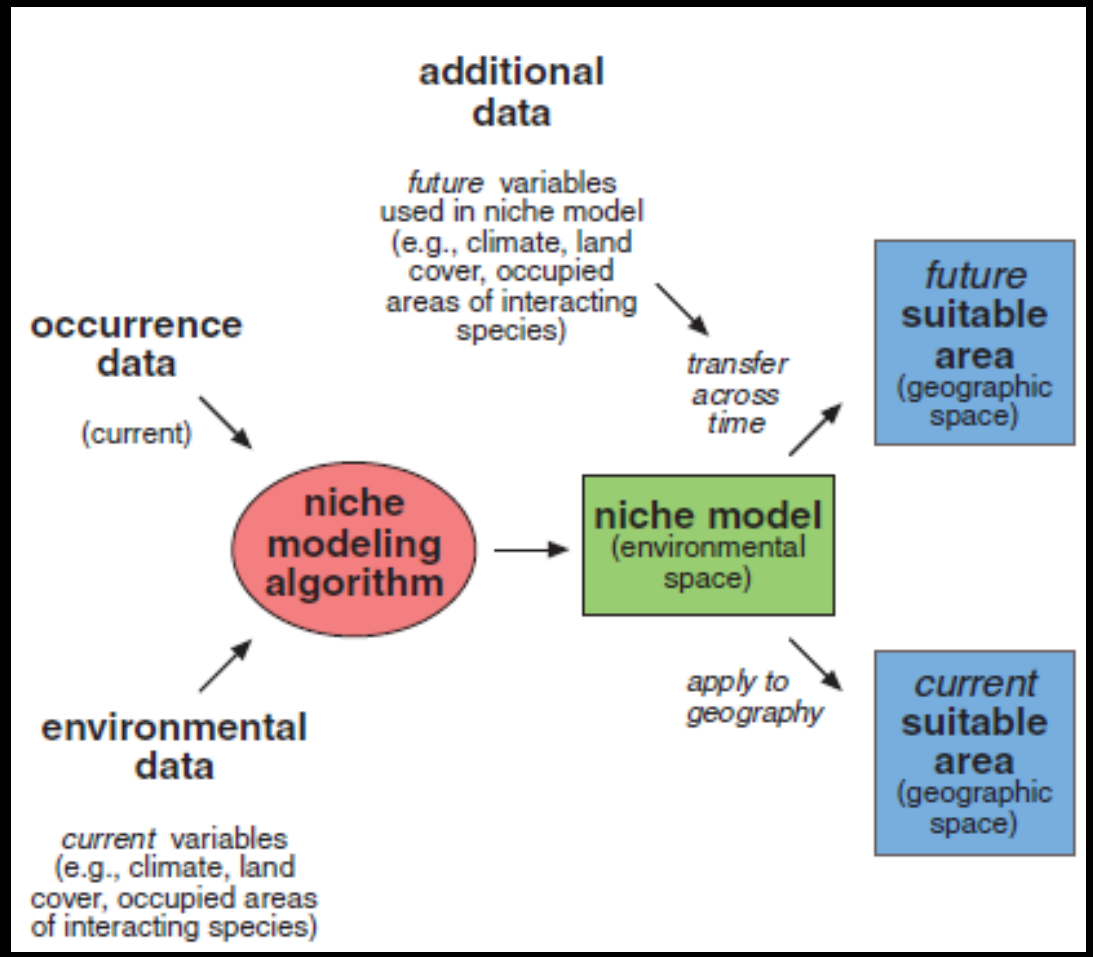
  Each with distinct threats to biodiversity

- *A priori* risk factors

No clue on biodiversity responses

Two widely applied approaches

2: Assessing species suitability dynamics using correlative ecological niche modelling



Anderson R.P. 2013

Two widely applied approaches

2: Assessing species suitability dynamics
using correlative ecological niche modelling

Relatively easy to implement
Potential response of species CC

Correlative models

Projections into new climatic conditions → require extrapolation in conditions not experimented by species

Suitability dynamics → not easy to identify drivers

Two widely applied approaches

1: Climate change dimensions approach

Potential drivers

Novel climates

Complementary

2: Niche model approach

Potential responses

Uncertainty in projections

Goal

Apply this two approaches in parallel

for infering

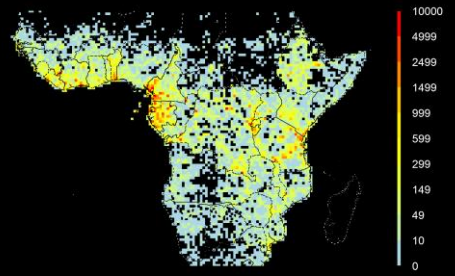
impact of climate change

on the

flora of Tropical Africa

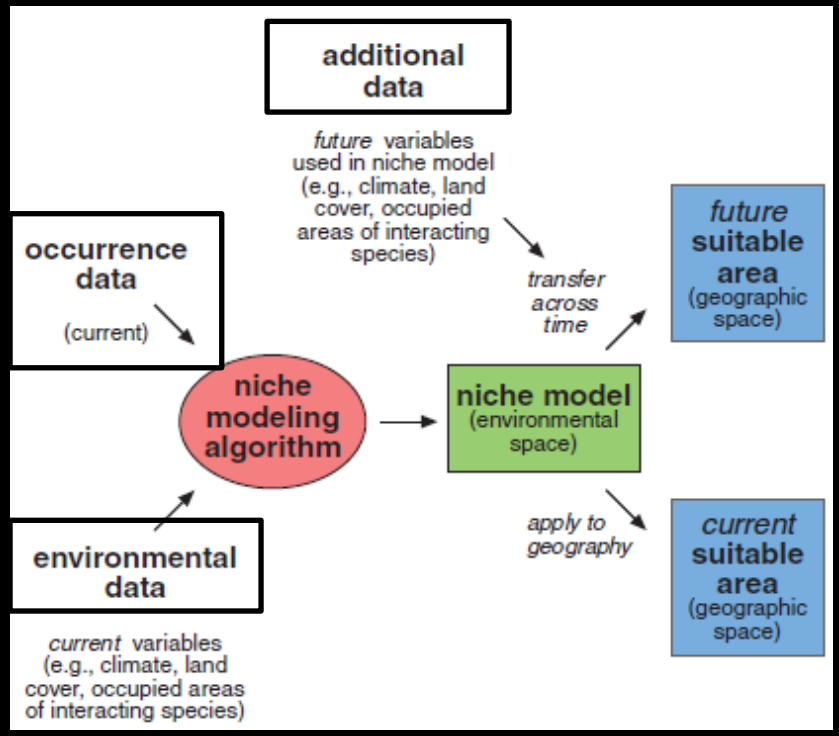
Niche model approach

RAINBIO
database



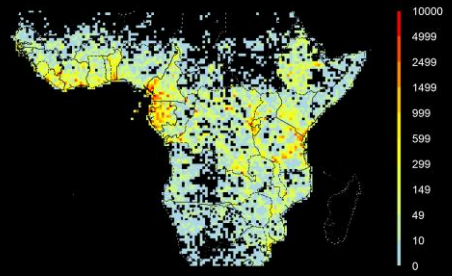
> 600,000 georeferenced records

> 8,000 species



Niche model approach

RAINBIO database



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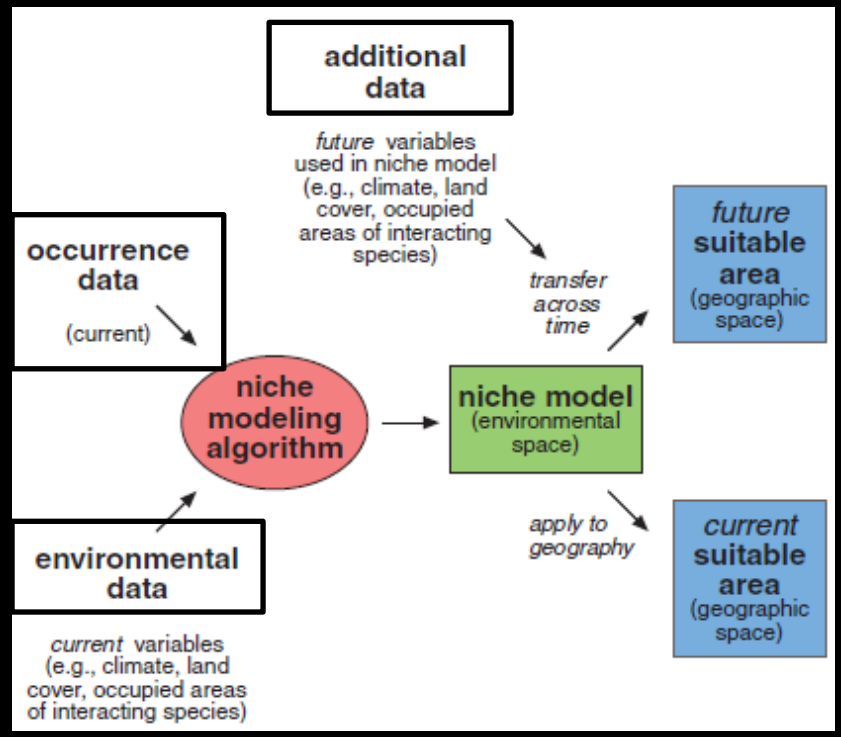
6 climatic predictors

mean annual temperature (wc)
temperature seasonality (wc)
minimum temperature of the coolest month (wc)
rainfall deficit (wc+chirps)
water balance seasonality (wc+chirps)
annual water balance (wc+chirps)



AFRICLIM: high-resolution climate projections for ecological applications in Africa

Philip J. Platts[1]*, Peter A. Omeny[2] and Rob Marchant[1]

Projected climates

- 10 coupled Atmosphere-Ocean General Circulation Models (GCM)
- RCP 4.5 (global mean temperature increase of 1.1° to 2.6°)
- 10’ arc minutes resolution
- [2071-2090] period

6 climatic predictors

mean annual temperature (wc)

temperature seasonality (wc)

minimum temperature of the coolest month (wc)

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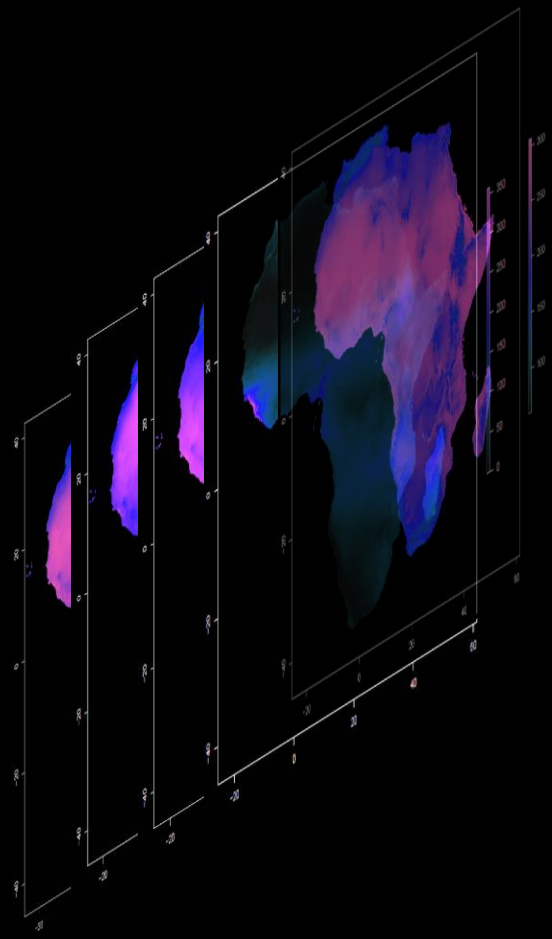


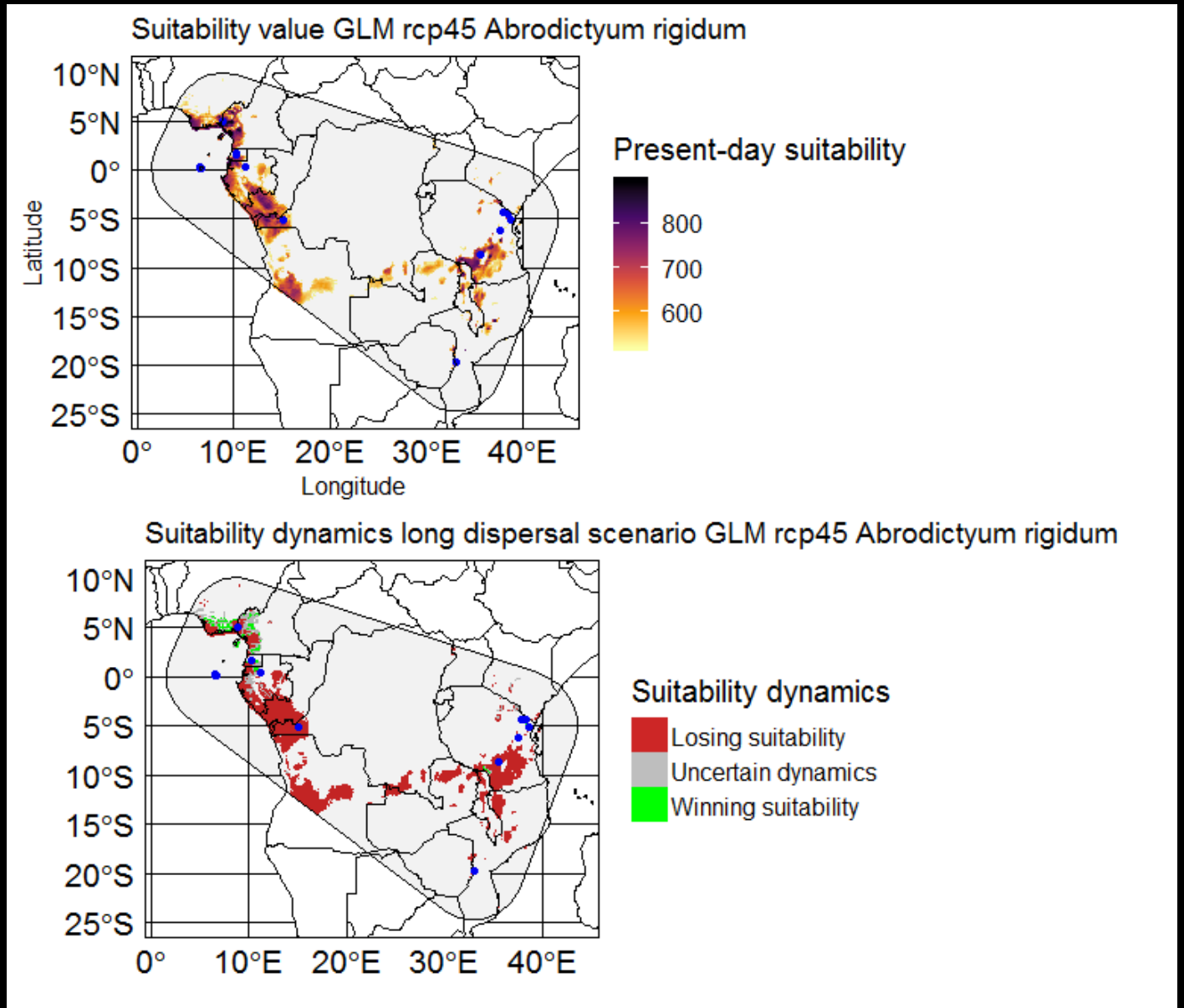
3 algorithms

- MaxEnt
(quadratic+linear)

- GLM
Quadratic and AIC for selecting the best model

- GBM
Generalized Boosted Model

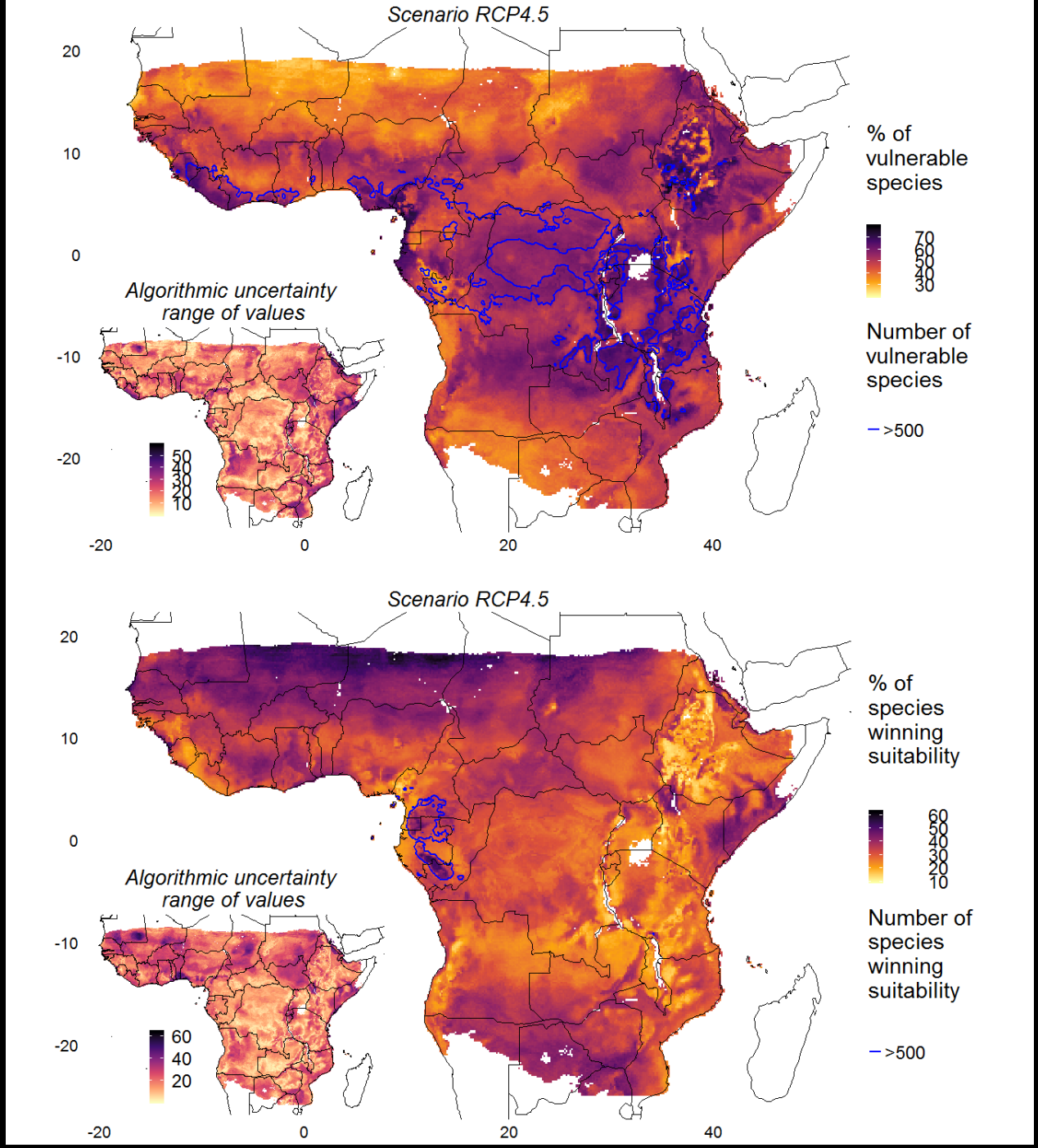
Example with one species



Suitability dynamics

ca. 5000 plant species

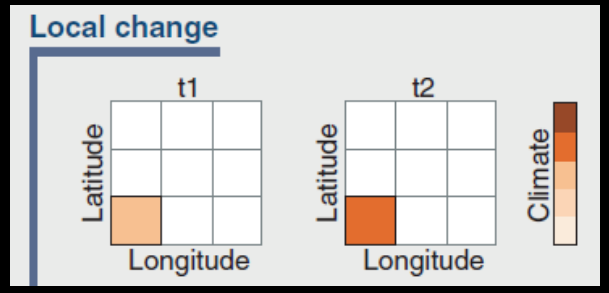
→



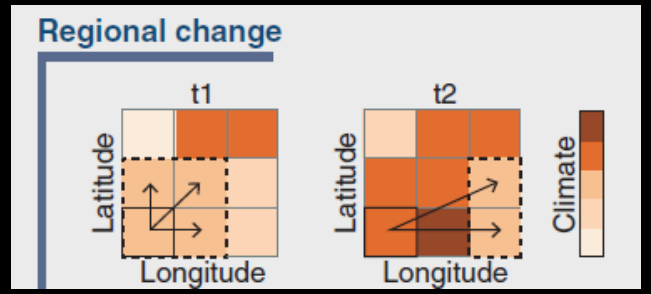
Vulnerability

Winning species

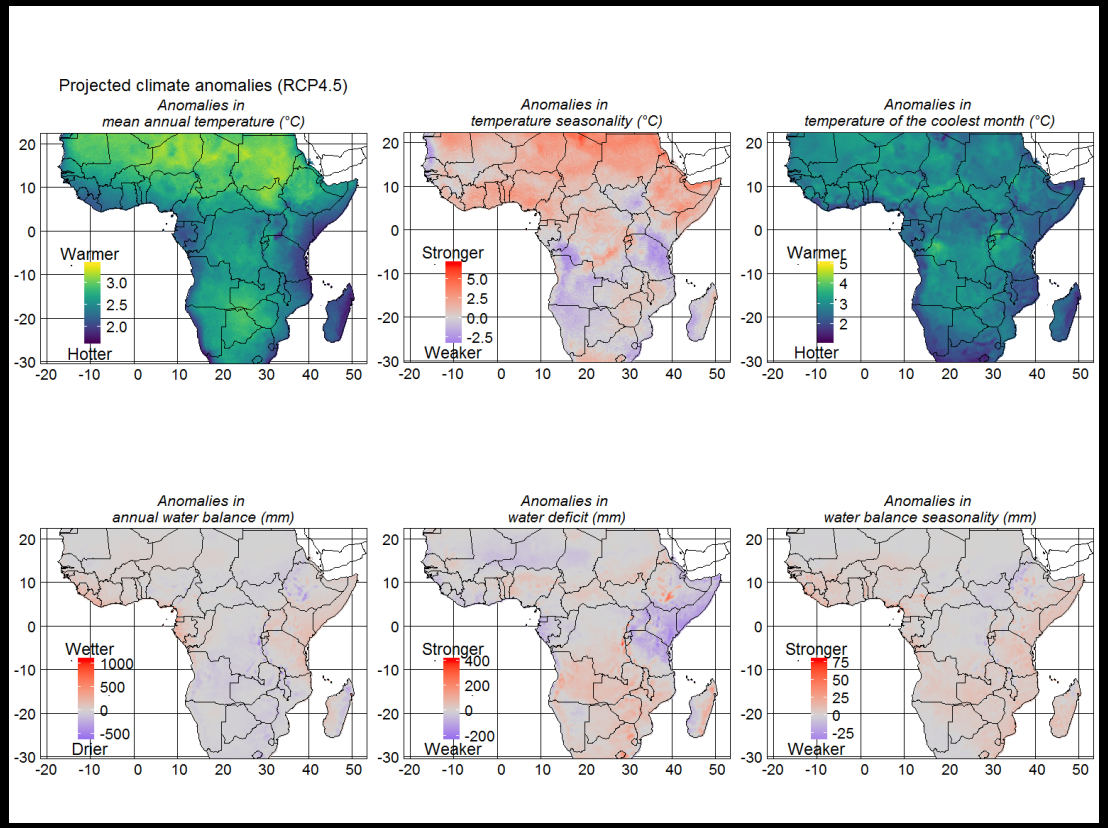
1: Characterization of the multiple dimensions of climate change

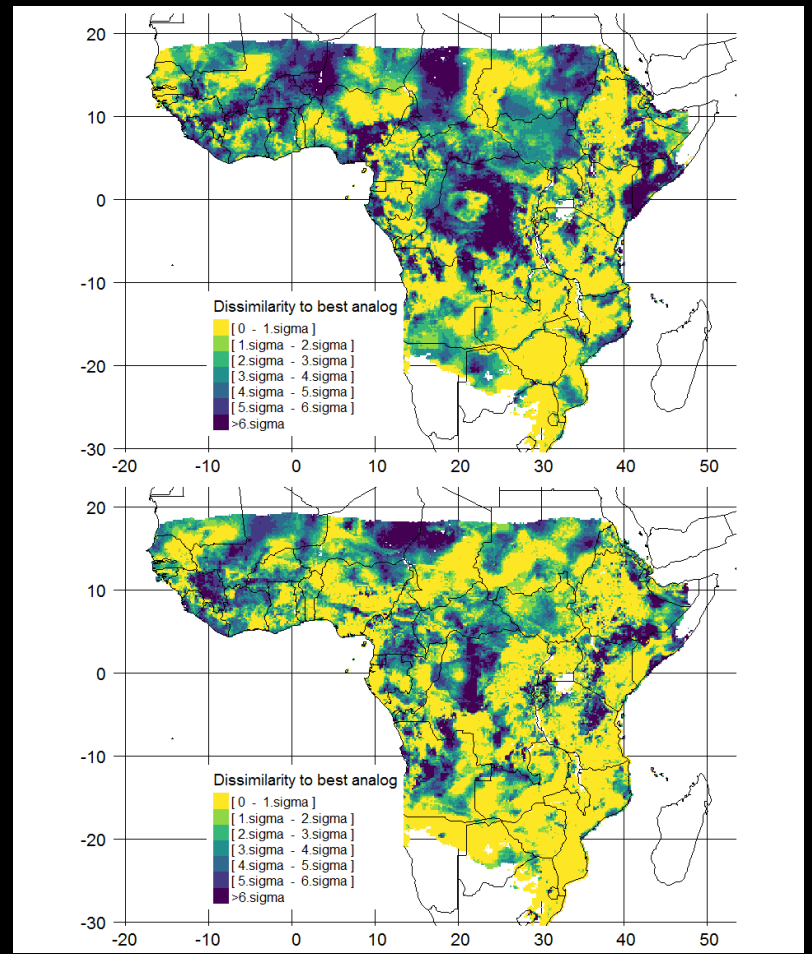


Risk factors



Local anomalies

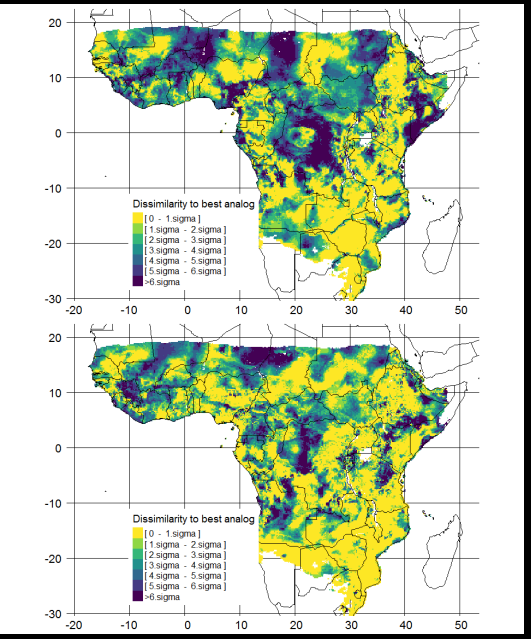




Risk of novel climate

Risk of disappearing climate

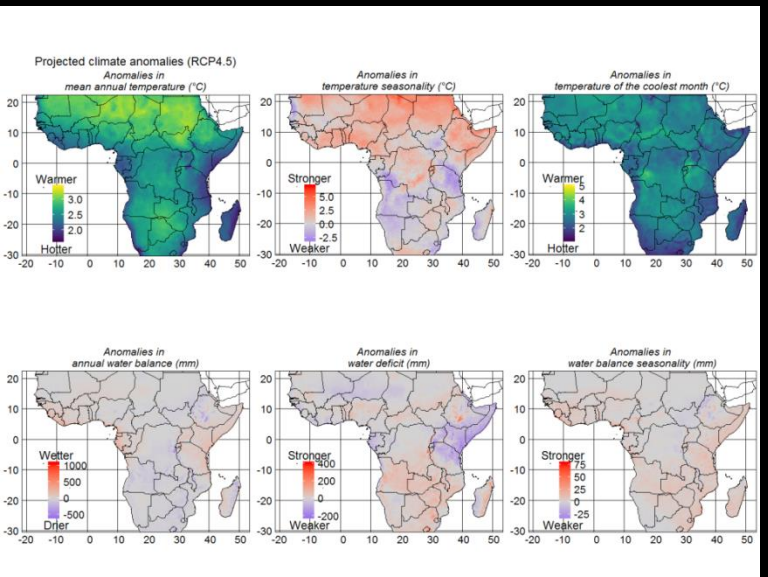
Risk factors



Which factor explain

Vulnerability?

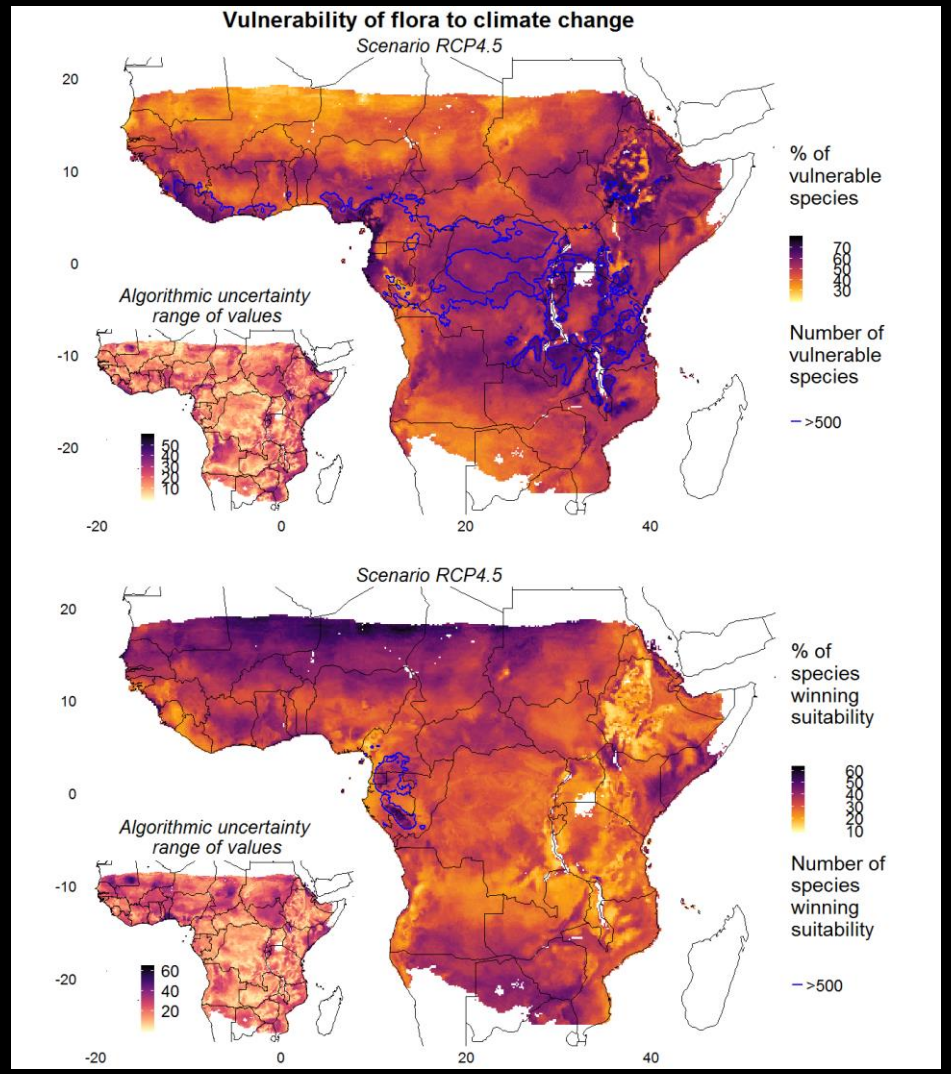
Winning suitability?



Is it temperature anomaly?

Is it novel climate?

Potential responses and uncertainties



For the whole study area →

Only 3 significant positive correlations

Risk factors	*Potential responses and uncertainties*	*Pearson correlation coefficients*
Anomaly in mean annual temperature	Proportion of winners	**0.42**
Risk of novel climate	Proportion of winners	**0.22**
Risk of novel climate	**Range in proportions of winners**	**0.26**

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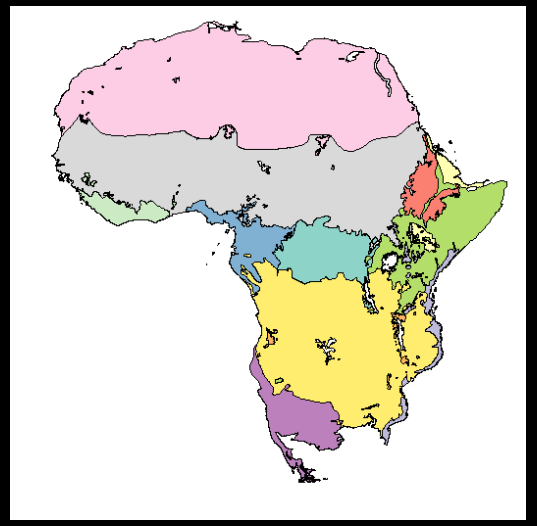
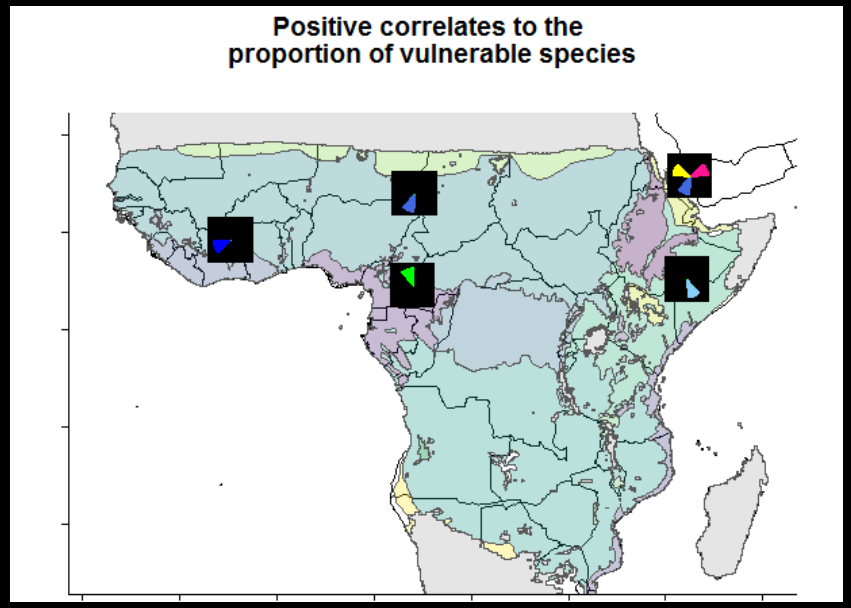
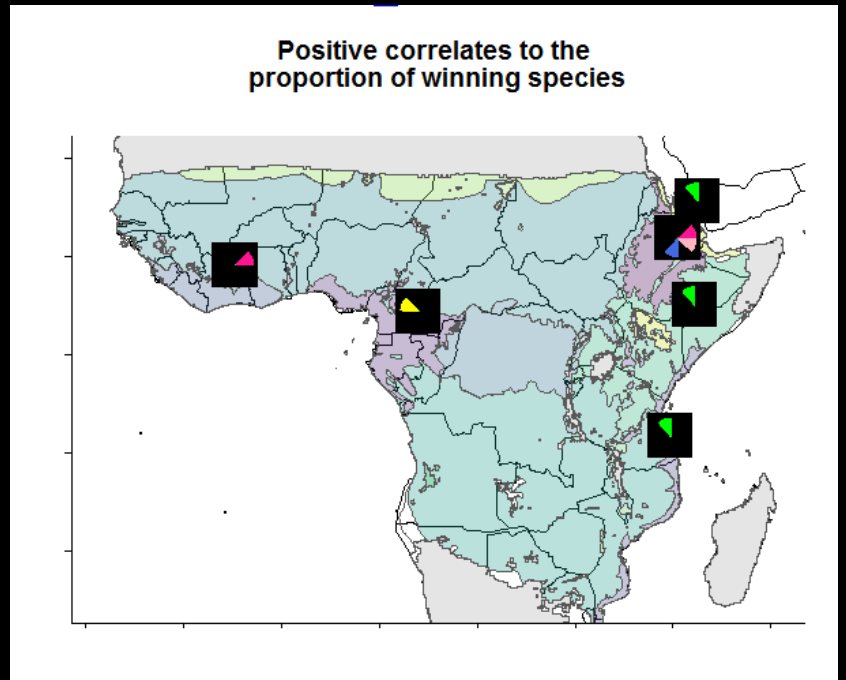
Few significant correlations

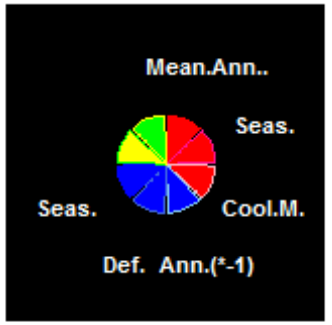
Could drivers differ among regions ?

Correlates at the scale of biogeographical region?









- Disapearing climate
- Novel climate
- Temperature anomalies
- Water balance anomalies

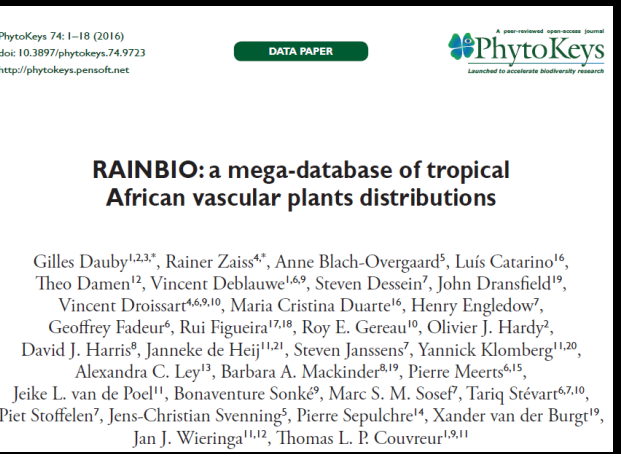
Some conclusions :

Climate change could significantly impact species suitability in nearly all regions

Drivers of suitability dynamics might be different among regions

Algorithmic uncertainty is high in regions with high risk of novel climate

Thanks for your attention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doi: 10.3897/phytokeys.74.9723
http://phytokeys.pensoft.net

DATA PAPER

PhytoKeys
A peer-reviewed open-access journal
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RAINBIO: a mega-database of tropical African vascular plants distributions

Gilles Dauby[1,2,3,*], Rainer Zaiss[4,*], Anne Blach-Overgaard[5], Luís Catarino[16], Theo Damen[12], Vincent Deblauwe[1,6,9], Steven Dessein[7], John Dransfield[19], Vincent Droissart[4,6,9,10], Maria Cristina Duarte[16], Henry Engledow[7], Geoffrey Fadeur[6], Rui Figueira[17,18], Roy E. Gereau[10], Olivier J. Hardy[2], David J. Harris[8], Janneke de Heij[11,21], Steven Janssens[7], Yannick Klomberg[11,20], Alexandra C. Ley[13], Barbara A. Mackinder[8,19], Pierre Meerts[6,15], Jeike L. van de Poel[11], Bonaventure Sonké[9], Marc S. M. Sosef[7], Tariq Stévart[6,7,10], Piet Stoffelen[7], Jens-Christian Svenning[5], Pierre Sepulchre[14], Xander van der Burgt[19], Jan J. Wieringa[11,12], Thomas L. P. Couvreur[1,9,11]


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Exploring the floristic diversity of tropical Africa

larc S. M. Sosef[1*†], Gilles Dauby[2,12,21†], Anne Blach-Overgaard[3], Xander van der Burgt[4], Luís Catarino[5], heo Damen[6], Vincent Deblauwe[2,7,8,22,23], Steven Dessein[1], John Dransfield[4], Vincent Droissart[7,9,20], laria Cristina Duarte[5], Henry Engledow[1], Geoffrey Fadeur[7], Rui Figueira[10,11], Roy E. Gereau[9], Olivier J. Hardy[12], avid J. Harris[13], Janneke de Heij[14,15], Steven Janssens[1], Yannick Klomberg[14,16], Alexandra C. Ley[17], arbara A. Mackinder[4,13], Pierre Meerts[7,18], Jeike L. van de Poel[14], Bonaventure Sonké[8], Tariq Stévart[1,7,9], iet Stoffelen[1], Jens-Christian Svenning[3], Pierre Sepulchre[19], Rainer Zaiss[20], Jan J. Wieringa[6,14] and homas L. P. Couvreur[2,8,14*]

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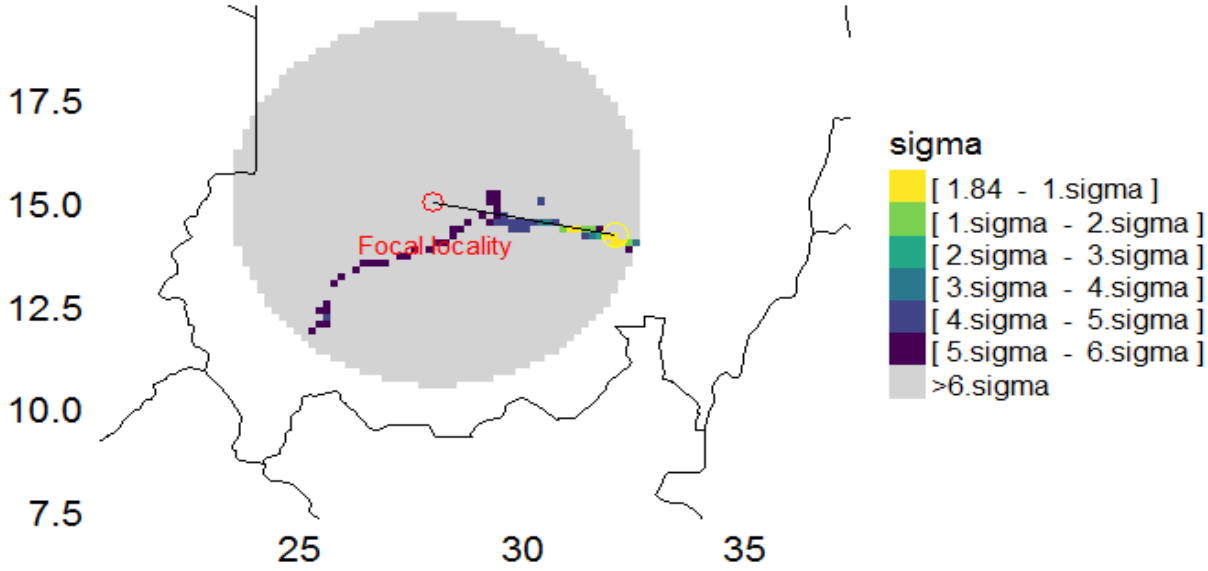
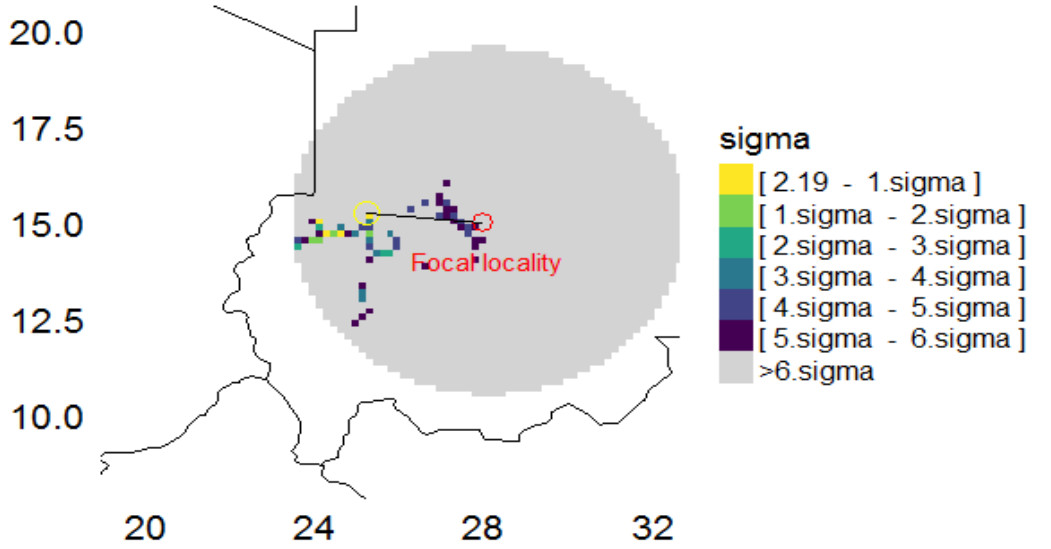


	Nearest analog locality	Focal locality	Difference	Direction
Latitude (dec.deg.)	14.23	15	-0.77	Southern
Longitude (dec.deg)	32.07	28	4.07	Eastern
Spatial distance (km)	NA	NA	447.2	
Elevation (m)	399.3	700.4	301.1	Downhill

Risque de nouveau climat

- Distance climatique entre les conditions climatiques futures du point focal et l'analogue climatique actuelle le plus proche



	Nearest analog locality	Focal locality	Difference	Direction
Latitude (dec.deg.)	15.23	15	0.23	Northern
Longitude (dec.deg)	25.24	28	-2.76	Western
Spatial distance (km)	NA	NA	297.9	
Elevation (m)	1152.7	700.4	-452.2	Uphill

Risque de disparition du climat

- Distance climatique entre les conditions climatiques actuelles du point focal et l'analogue climatique futur le plus proche