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Global warming beyond 1.5–2^{0}C multiplies the rainforests' tipping risk

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Climate Change | Energy | Pollution | Policy & Economics | Oceans | Biodiversity | Conservation | Solutions

CLIMATE CHANGE

Amazon Rainforest Tipping Point is Closer Than Ever, Data Shows

BY OLIVIA LAI | AMERICAS | MAR 9TH 2022 | 2 MINS

NDTV | LIVE TV | LATEST | INDIA | VIDEO | OPINION | CITIES | WORLD | EDUCATION | OFFBEAT | FEATUR

Amazon Rainforest Close To Tipping Point, Damage Could Trigger "Dieback": Study

In recent years, widespread deforestation and burning of agriculture has taken its toll on the Amazon rainforest.

The Guardian

Amazon near tipping point of switching from rainforest to savannah - study

Climate crisis and logging is leading to shift from canopy rainforest to open grassland

nature

NEWS FEATURE | 25 February 2020

When will the Amazon hit a tipping point?

Scientists say climate change, deforestation and fires could cause the world's largest rainforest to dry out. The big question is how soon that might happen.

Ignacio Amigo

SCIENTIFIC AMERICAN
CLIMATE CHANGE

Amazon Rain Forest Nears Dangerous 'Tipping Point'

It is losing its ability to recover from disturbances such as drought, wildfire and human development, researchers say

By Chelsea Harvey, E&E News on March 8, 2022

‘Tipping’ refers to the significant **reorganization** of a system’s structure and functions

Rainforest tipping refers to changes in the dense-canopy structure of forests to one that mimics an open-canopy structure similar to savanna

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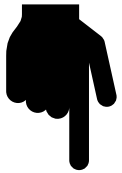
How resilient are forest ecosystems to future climate change?

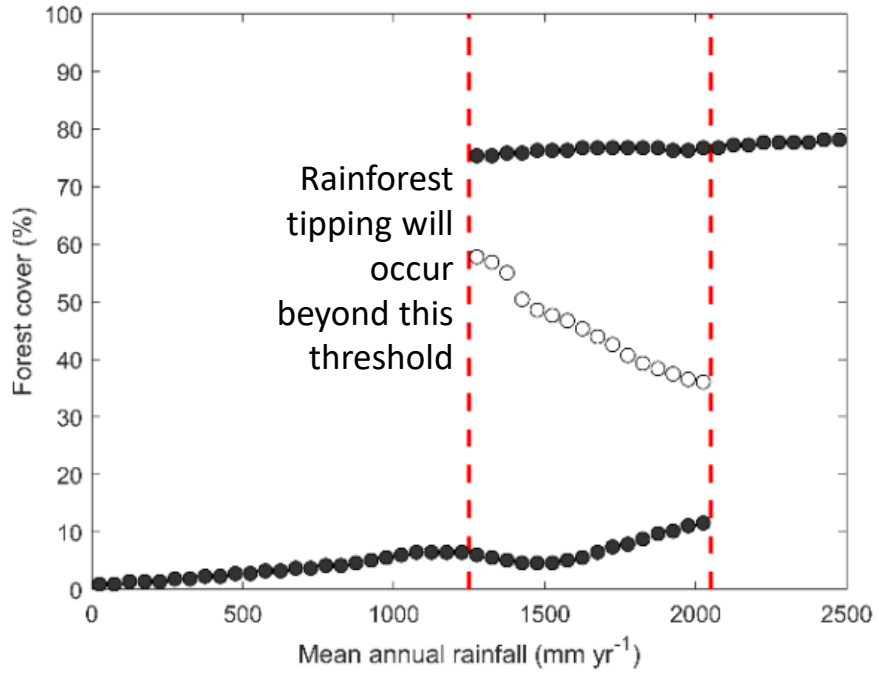



Complex ecohydrological dynamics remain **challenging to incorporate** in the Earth System Models (ESMs) due to our limited understanding of Earth System processes



This **limits** ESM's capacity to simulate tipping points as an **emergent property** of the system (*i.e., properties that emerge due to multiple interactions between several system components, and is not the property of an individual component*)

We have depended on **empirical evidence** to **simulate** rainforest tipping



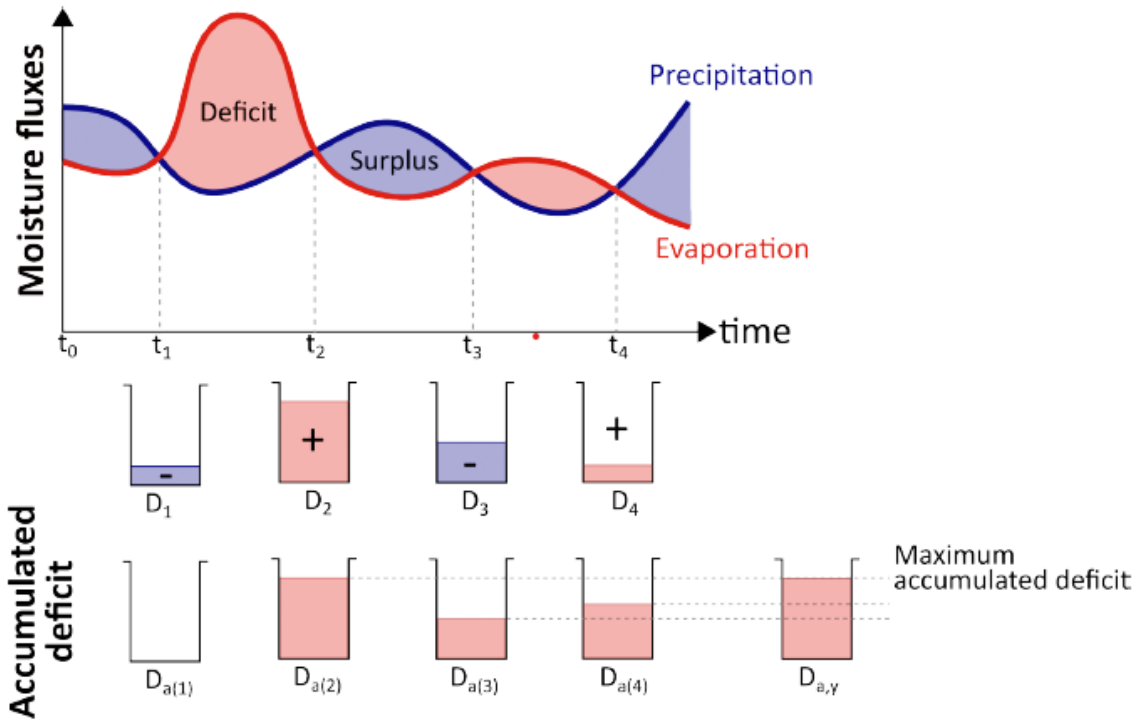
Previous studies have projected tipping using

thresholds based **on empirically constructed stability landscape** derived from the mean annual precipitation and tree cover data

the **magnitude and duration of water-deficit** experienced by the vegetation also affect them at the local scale is not accounted by mean annual precipitation

from Staal et al. 2020 (Nat. Comm.)

Root zone storage capacity (S_r)



S_r represents the **maximum volume of water per unit area within reach of plant roots for transpiration** *(this is water that ecosystem store from periods when water is surplus in its unsaturated zone of the soil, which we refer to root zone)*

Assumption: Ecosystem do not invest more than necessary to bridge the water-deficit experienced by the vegetation

adapted from Wang-Erlandsson et al. 2016 (HESS)

Environmental Research Letters

LETTER

Rootzone storage capacity reveals drought coping strategies along rainforest-savanna transitions

Chandrakant Singh[1,2,3,6], Lan Wang-Erlandsson[1,2], Ingo Fetzer[1,2], Johan Rockström[4] and Ruud van der Ent[3,5]

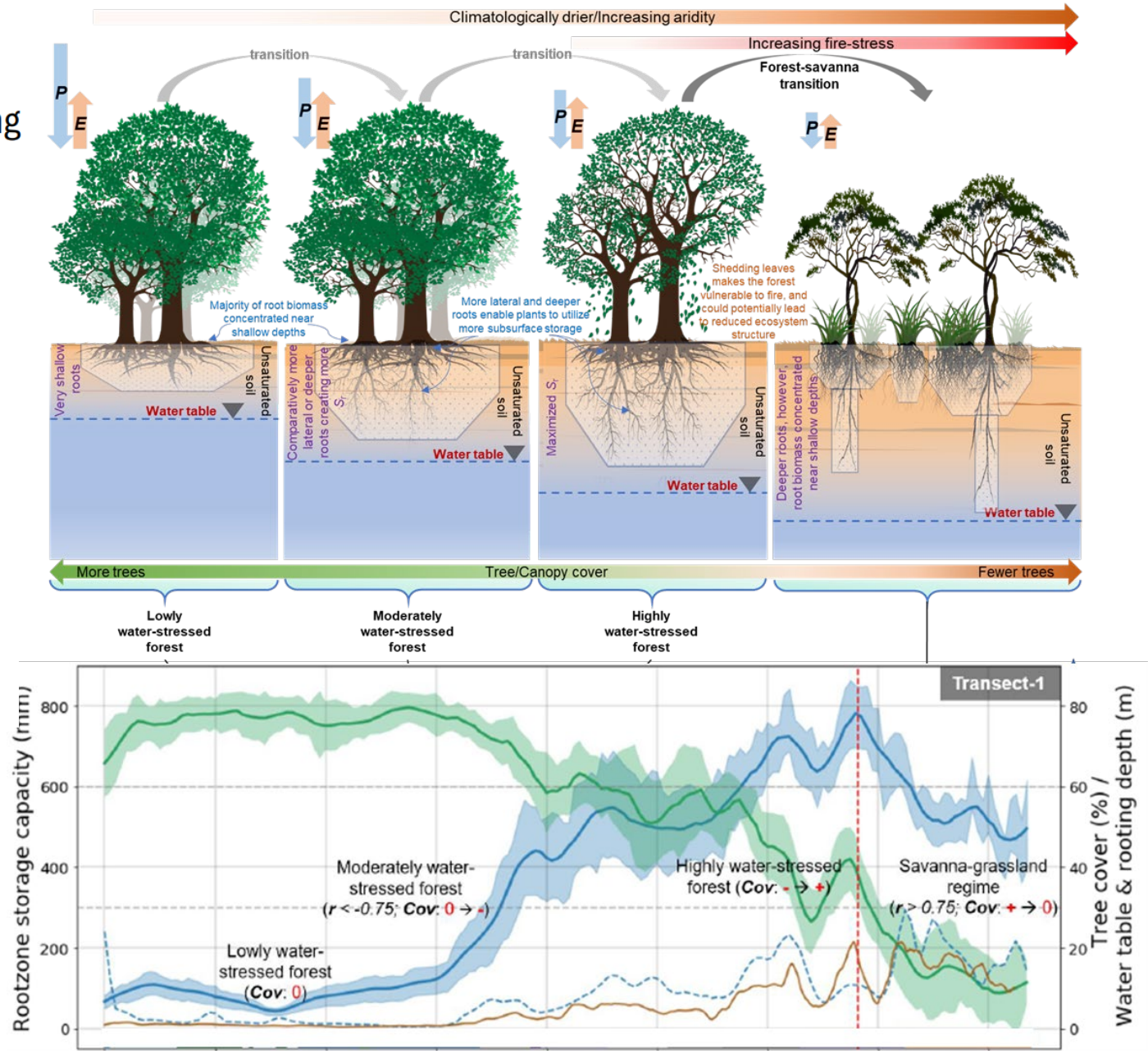
DOI: 10.1111/gcb.16115

RESEARCH ARTICLE

Global Change Biology WILEY

Hydroclimatic adaptation critical to the resilience of tropical forests

Chandrakant Singh[1,2] | Ruud van der Ent[3,4] | Lan Wang-Erlandsson[1,2] | Ingo Fetzer[1,2]



Background	Research question/gap	**Method**	Results and discussion

Environmental Research Letters

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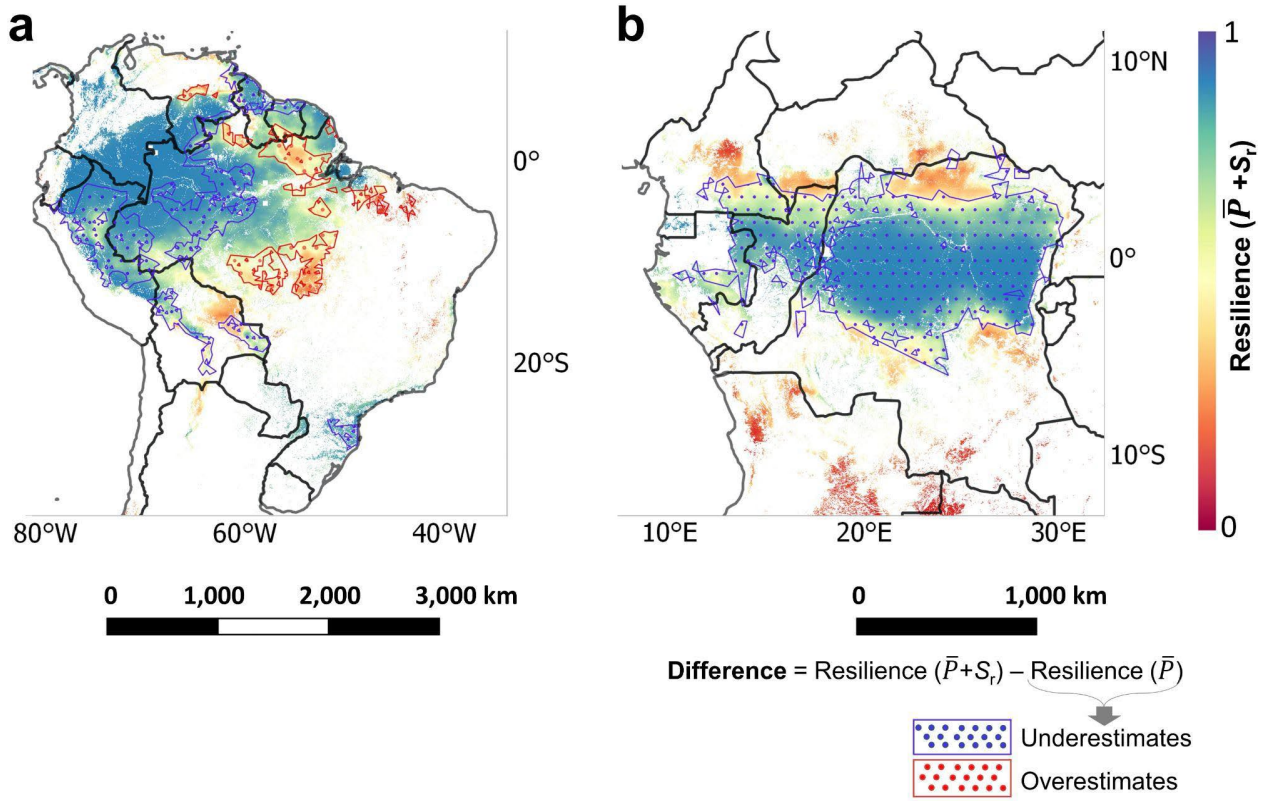


	South America		Africa	
Variables	AIC	BIC	AIC	BIC
$\overline{P} + S_r$	501772.33	501806.75	249156.25	249191.01
S_r	582170.43	582193.38	257513.09	257536.26
$\overline{P}$	638263.45	638286.40	454887.59	454910.76

a-c is defined for one ESM

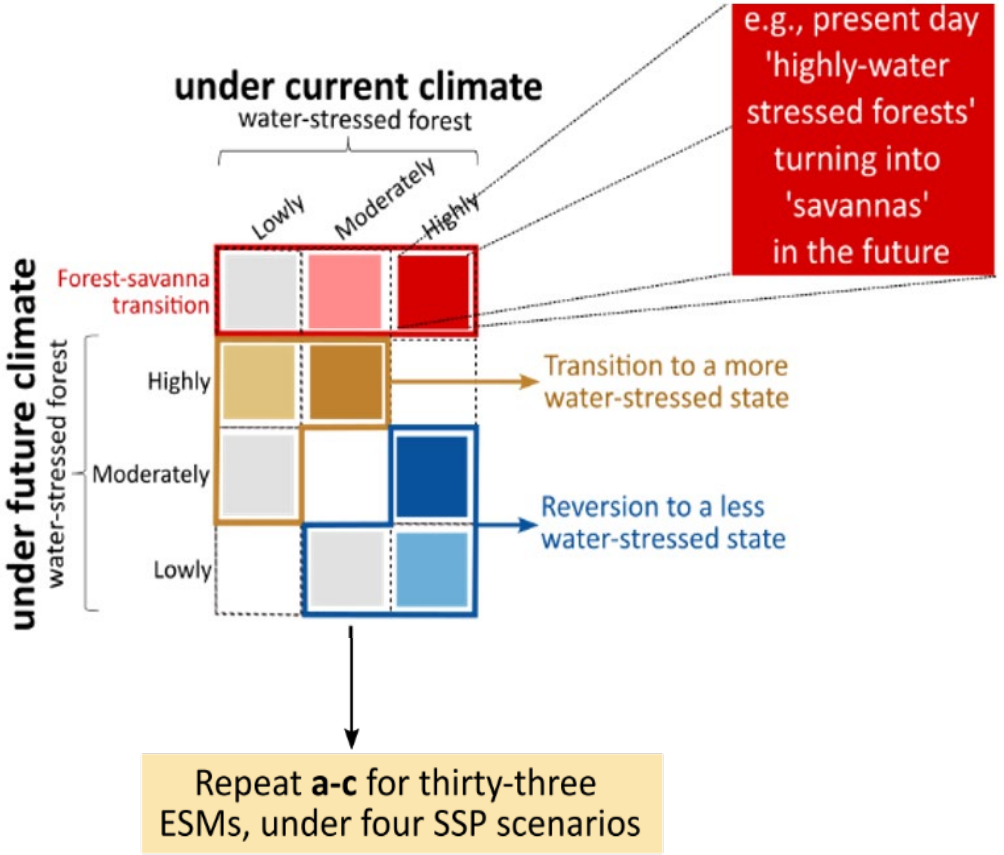
a **Classifying terrestrial ecosystems under current climate**

as *lowly*, *moderately* and *highly* water-stressed forests

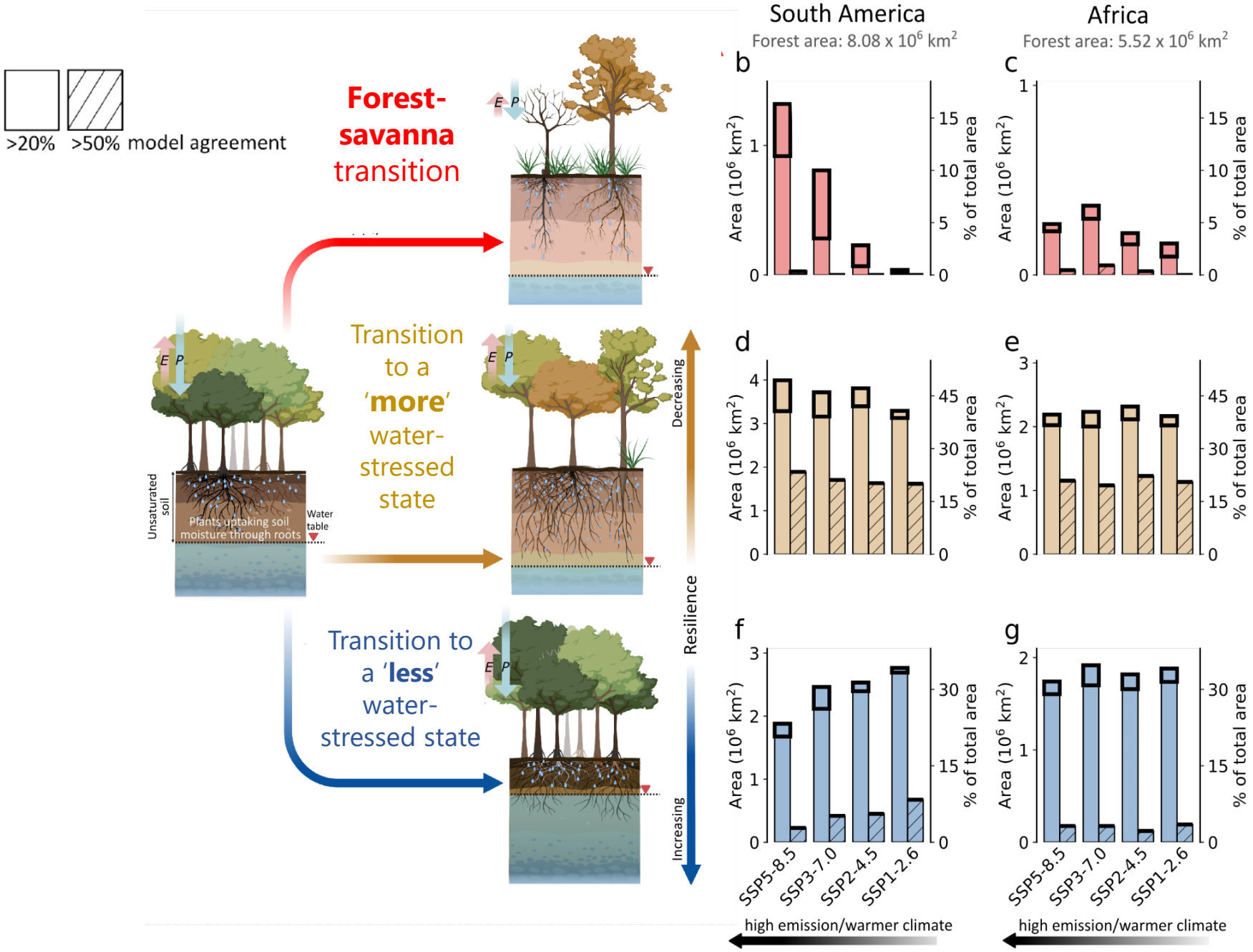
b **Classifying terrestrial ecosystems under future climate**

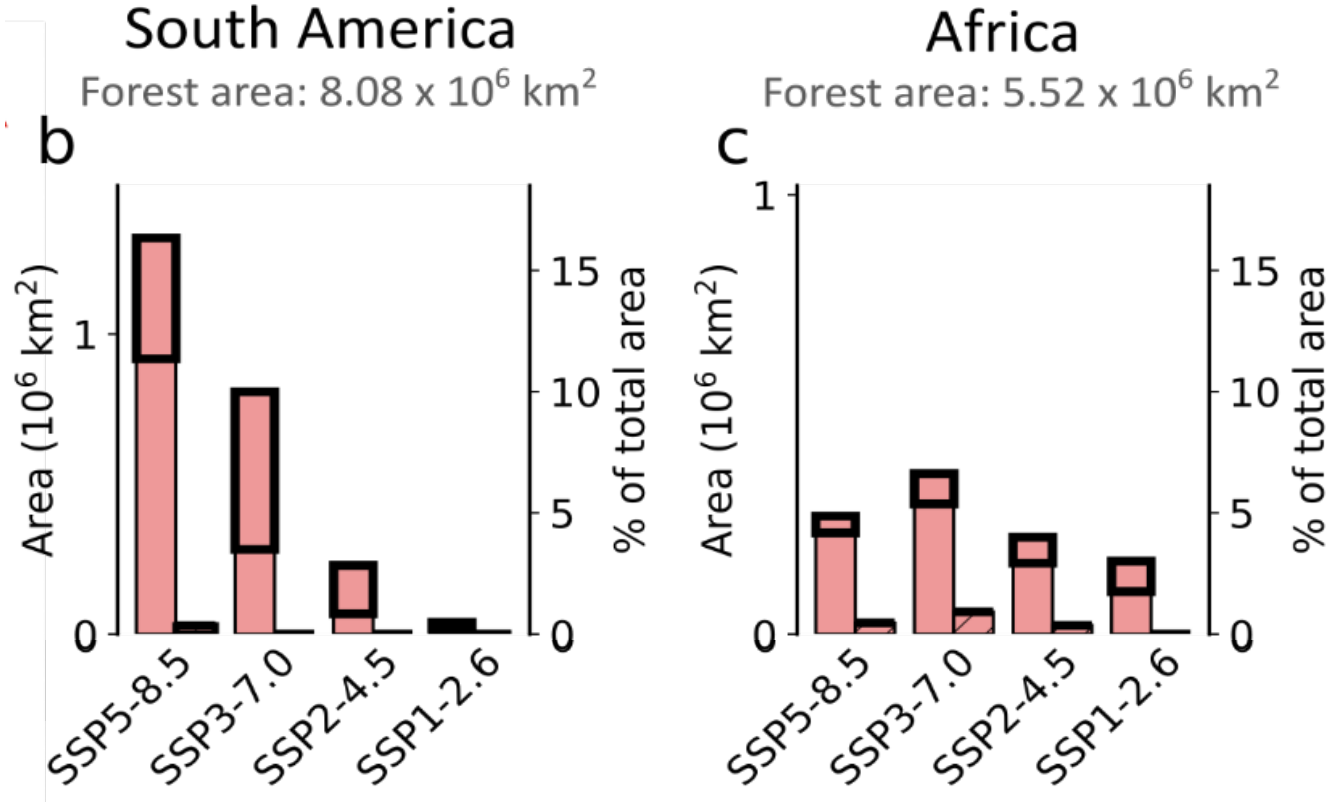
as *lowly*, *moderately*, *highly* water-stressed forests and *savanna*

c **Analysing potential transitions based on current and future classifications**



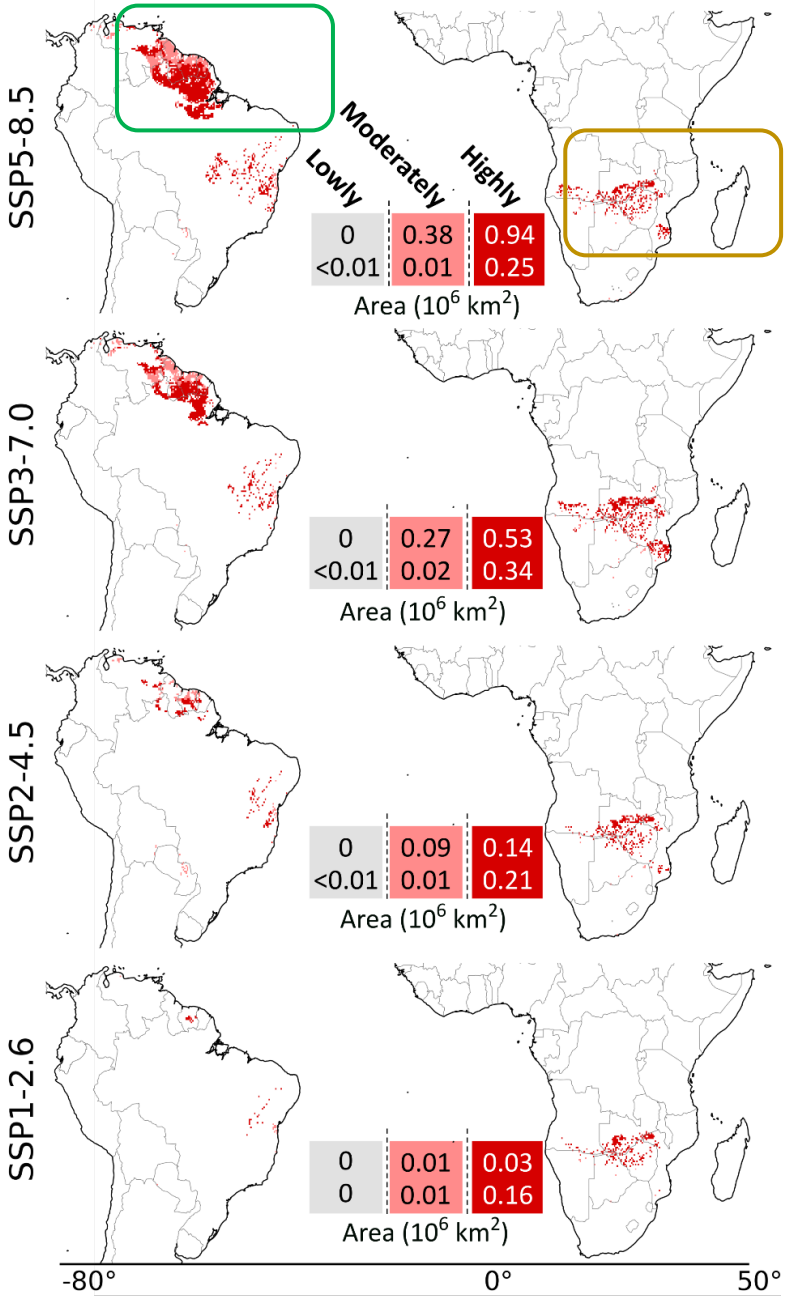
Assumption: Vegetation is in equilibrium with its climate

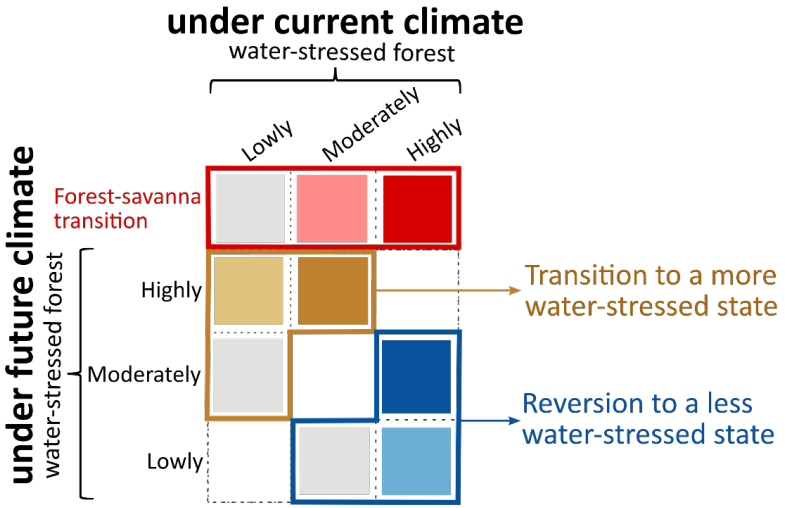

>20%
>50% model agreement
Forest-savanna transition
Transition to a 'more' water-stressed state
Transition to a 'less' water-stressed state
E P
Unsaturated soil
Plants uptaking soil moisture through roots
Water table
Decreasing
Resilience
Increasing
South America
Forest area: 8.08 x 10^6 km^2
Africa
Forest area: 5.52 x 10^6 km^2
b
c
d
e
f
g
Area (10^6 km^2)
% of total area
SSP5-8.5
SSP3-7.0
SSP2-4.5
SSP1-2.6
high emission/warmer climate



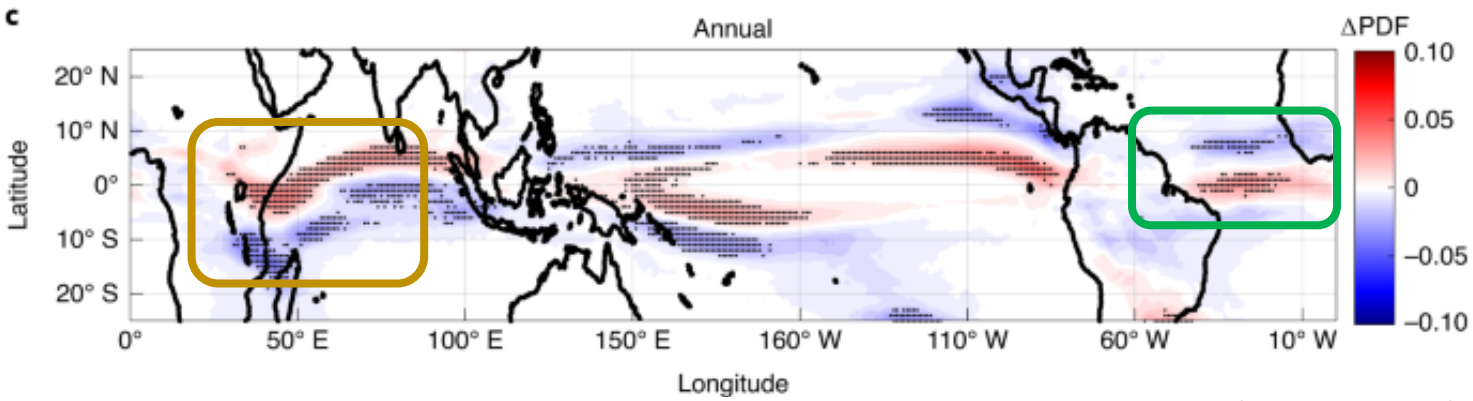
For Amazon, these risks increase **1.5-6 times** relative to its immediate lower warming scenario, whereas, for Congo, the risk growth is 0.7-1.65 times

Forest-savanna transition





Intertropical convergence zone (ITCZ)



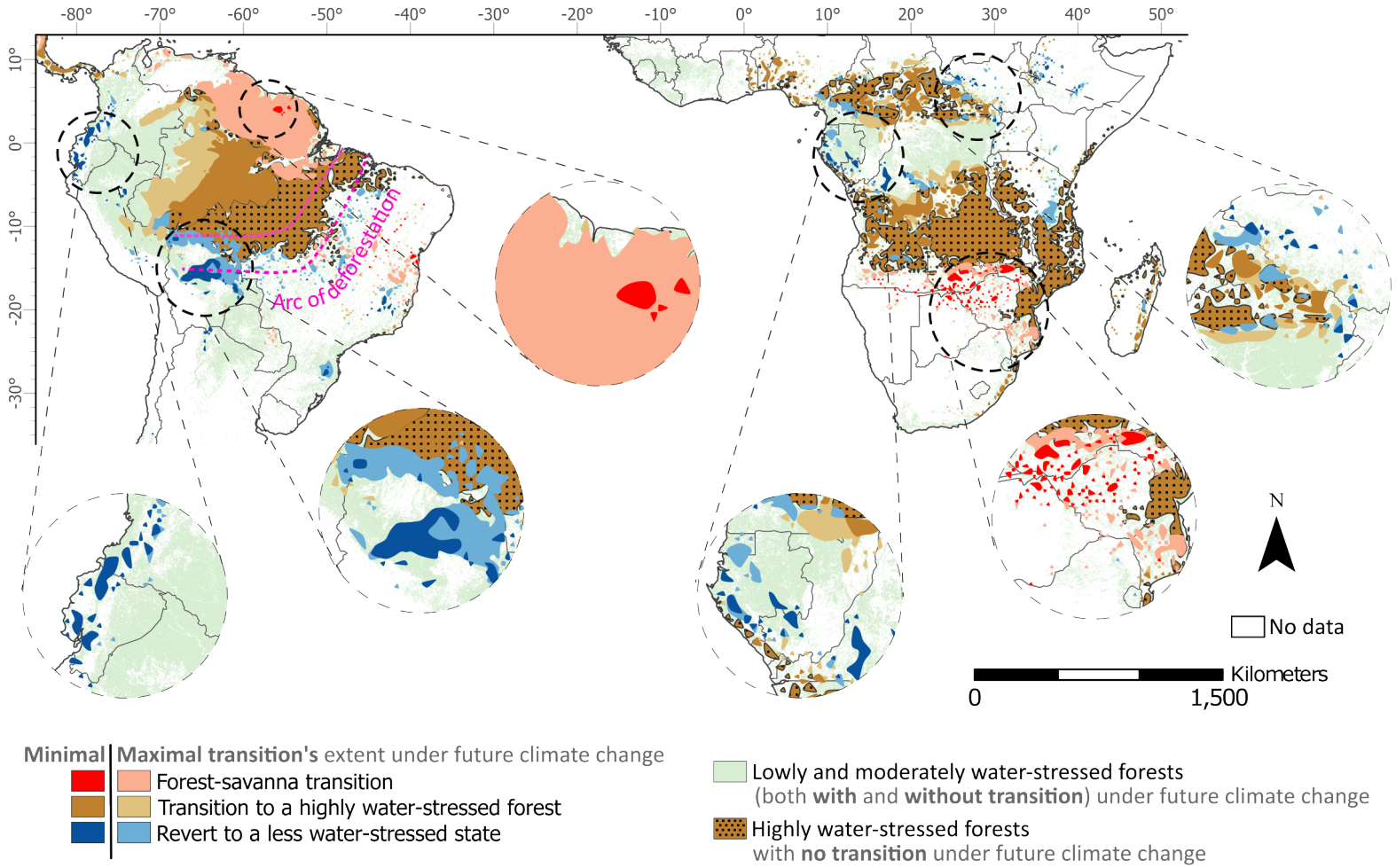
Mamalakis et al., 2021 (Nat. Clim. Change)

Take home message:

Forest-to-savanna transition risks **increase non-linearly** with each degree of warming

Although some transitions are locked-in, **vast majority of potential transition can still be influenced** by steering across different climate change scenarios.

Restricting temperature change below 1.5-2^{0}C warming, we **minimize tipping risk** and **maximize ecosystem recovery**



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Thank you

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