Vulnerability of tropical moist forests to projected climate changes in Africa

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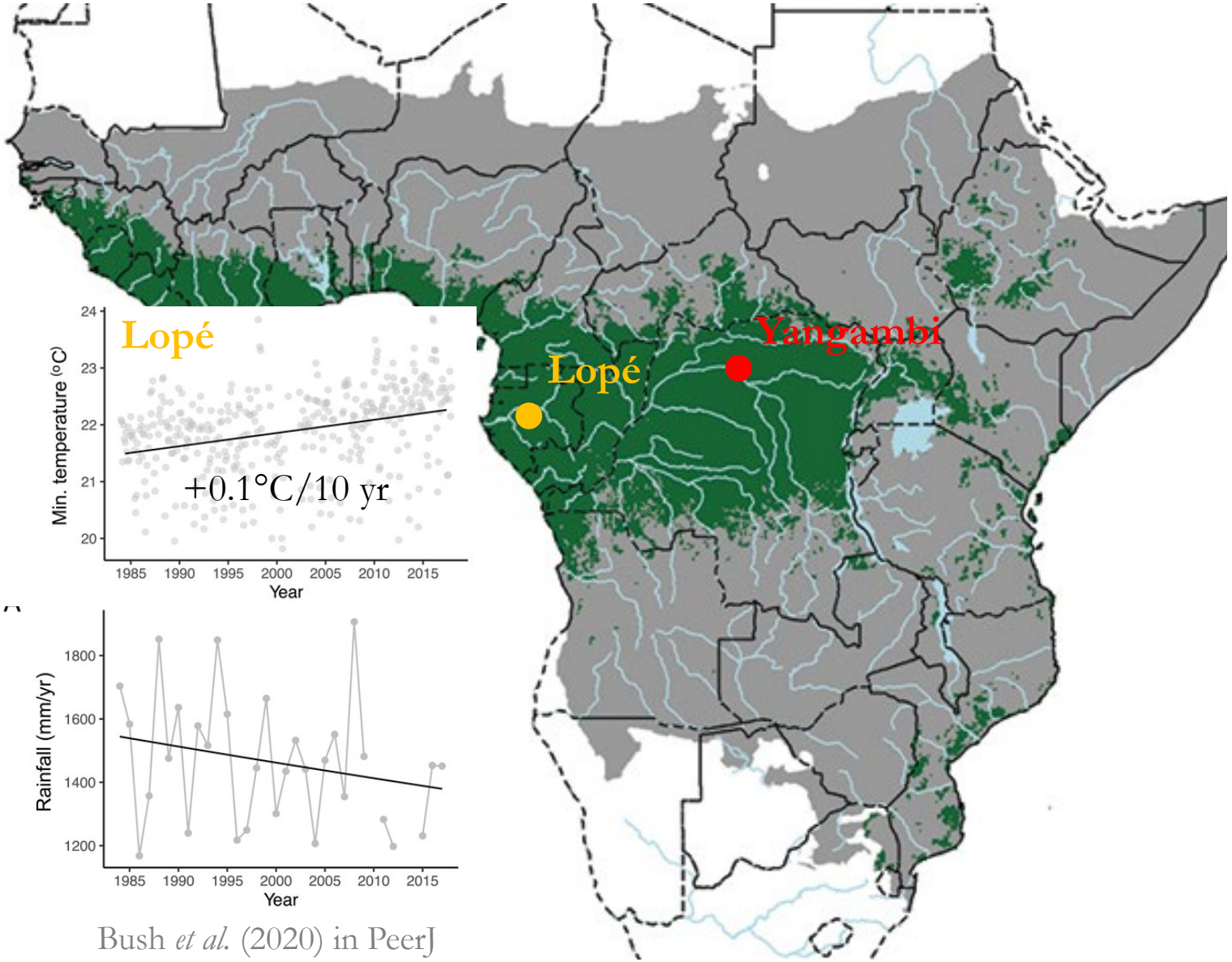
CANOPi

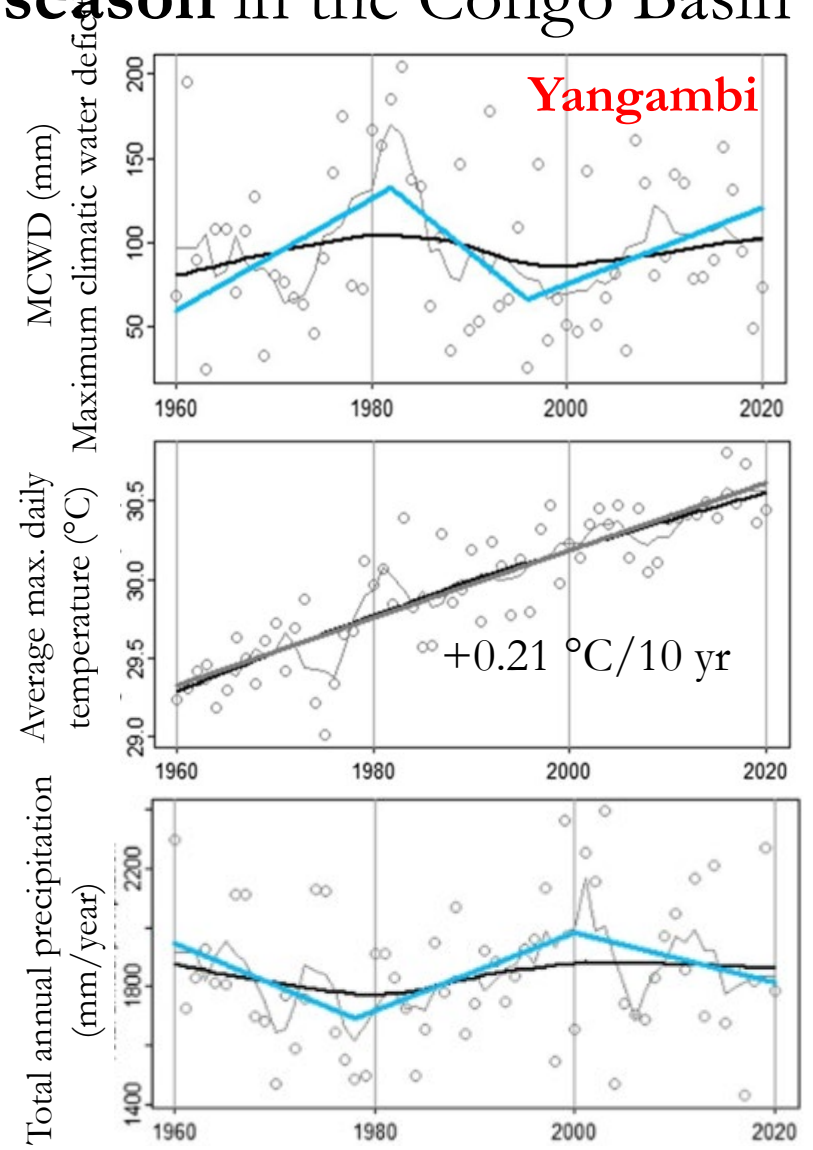
EOS THE EXCELLENCE OF SCIENCE

Introduction

Warming and **intensification of the dry season** in the Congo Basin

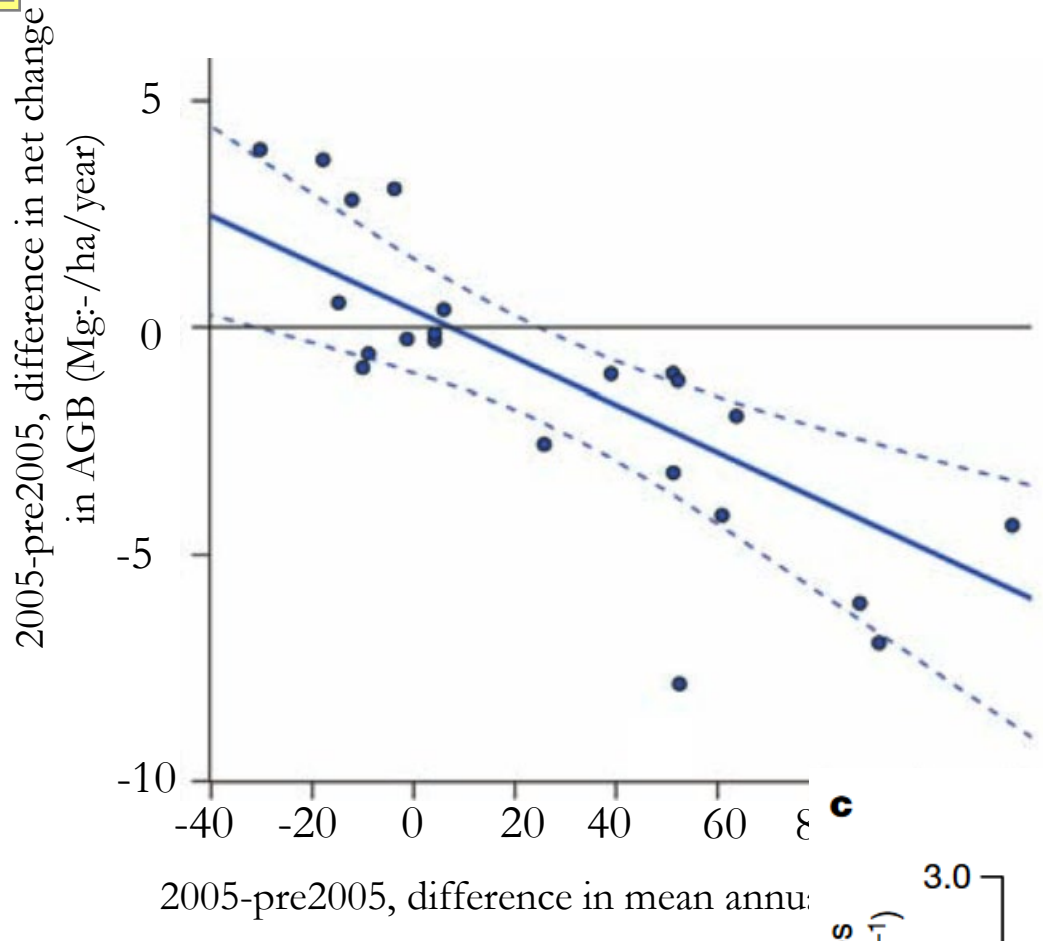


Bush *et al.* (2020) in PeerJ



Kasongo Yakusu *et al.* (2023) in Climate Change

Introduction



Phillips *et al.* (2009) in Science

Amazon :

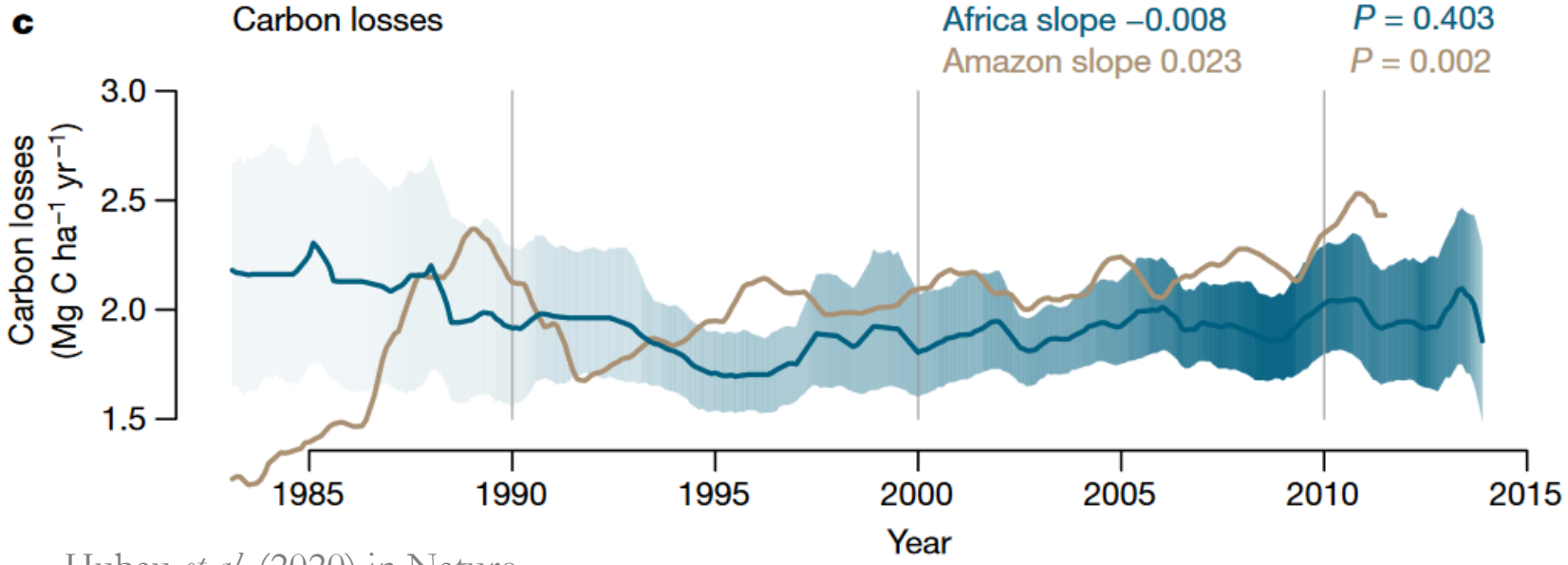
AGB loss after drought – stronger with MCWD

= **Drought induced mortality**

Increase in C losses - decline in C sequestration

Africa : not reported

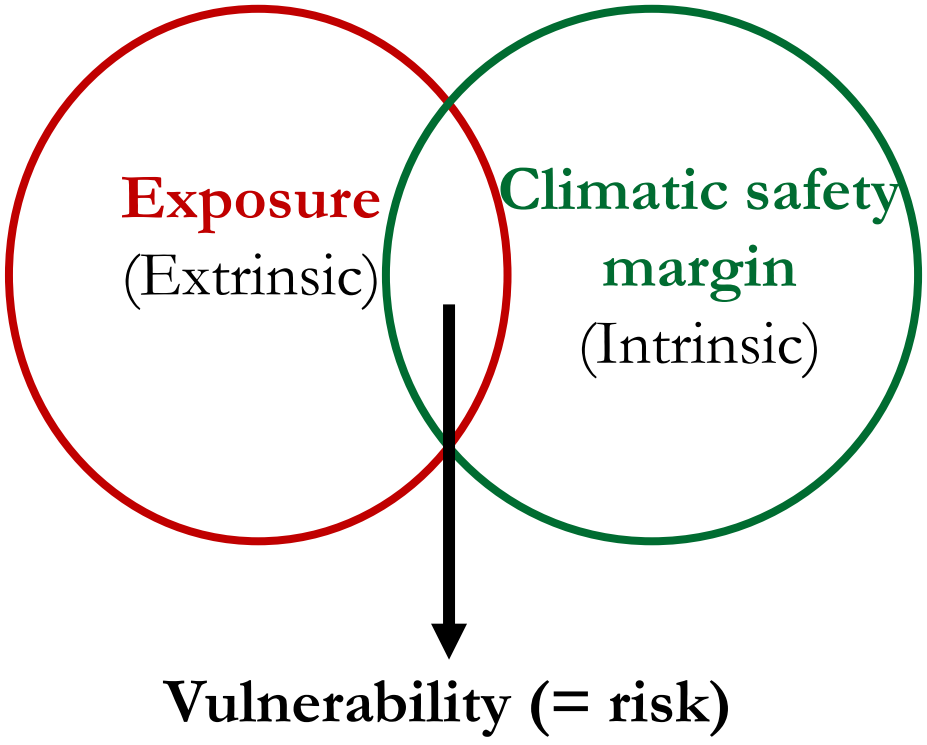
African tree species less vulnerable to drought ?



Hubau *et al.* (2020) in Nature

Objective of study

Assess the **climatic vulnerability** of tropical moist forests across Africa



Gallagher *et al.* (2019) in Scientific Reports
Esperon-Rodriguez *et al.* (2022) in Nature Climate Change

Research questions

(1) What is the **exposure to climate change** in African tropical moist forests ?

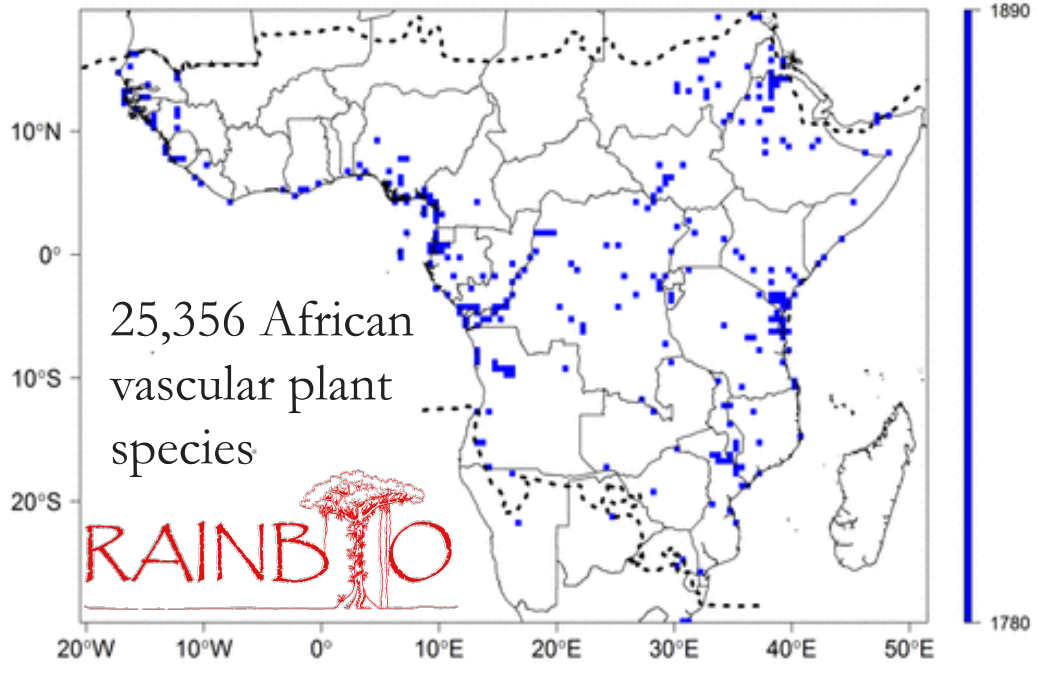
(2) What is the **climatic safety margin** of forest species and communities ?

(3) What is the **climatic risk** encompassed by forest species and communities to projected climate changes ?

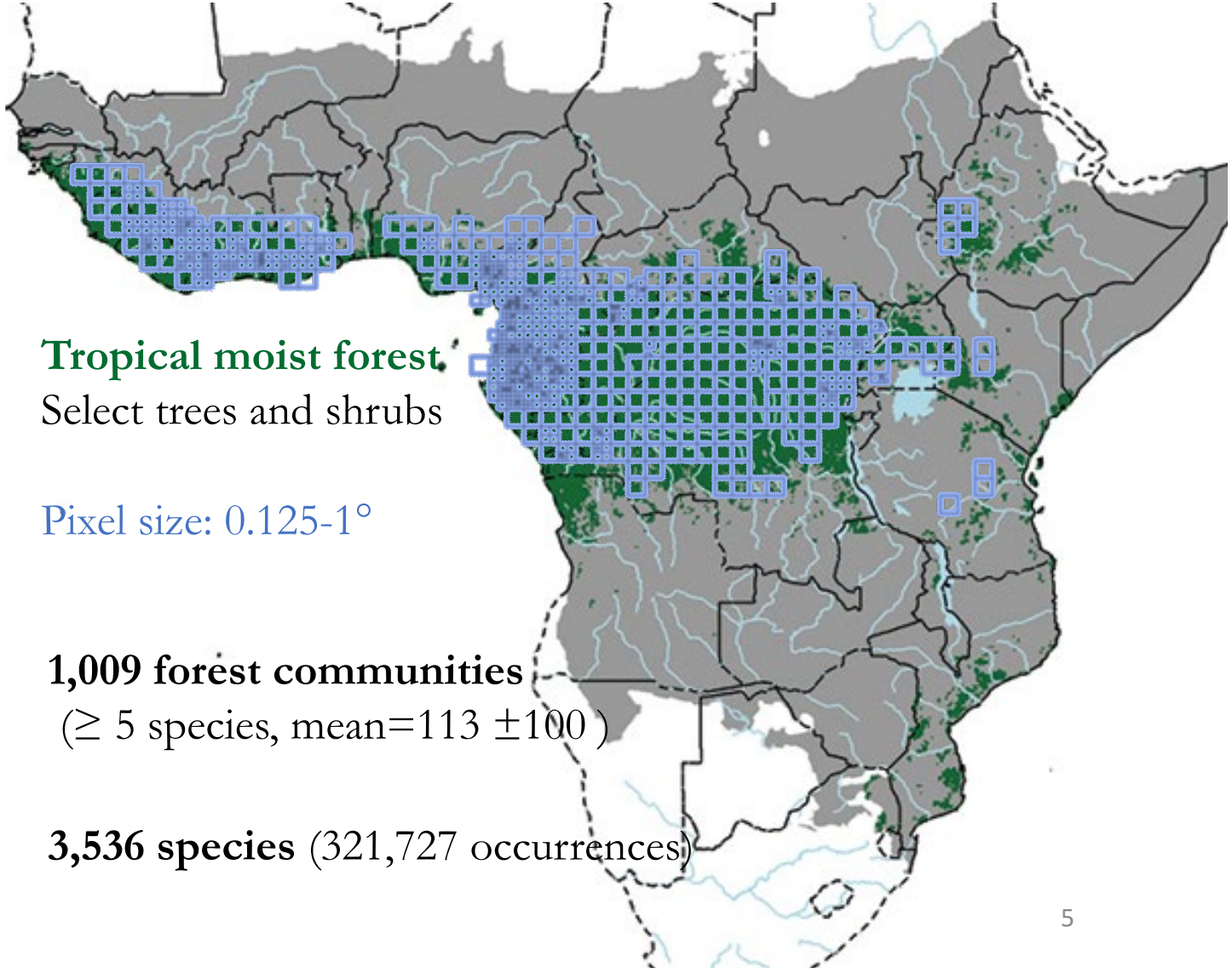
Methods

Species occurrence data and definition of forest communities

Occurrence data



Dauby et *al.* (2016) Phytokeys
Sosef et *al.* (2017)



Tropical moist forest
Select trees and shrubs

Pixel size: 0.125-1°

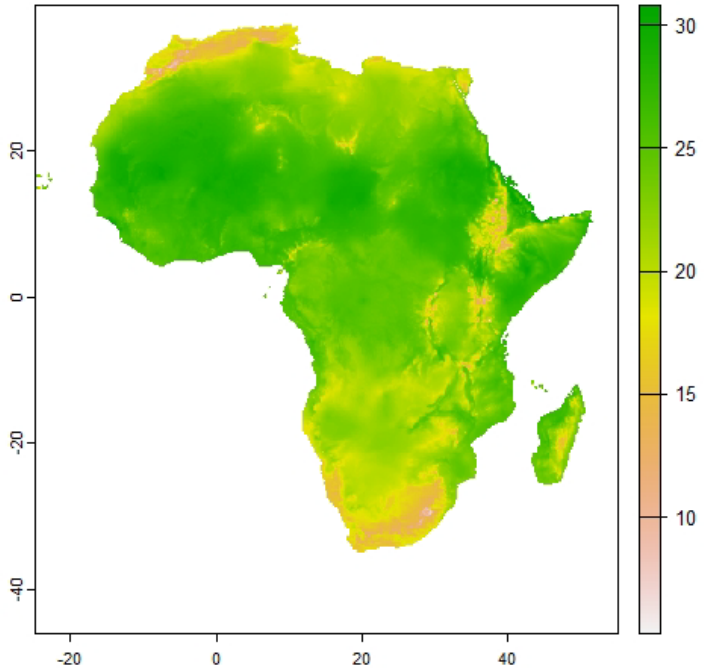
1,009 forest communities
(≥ 5 species, mean=113 ±100)

3,536 species (321,727 occurrences)

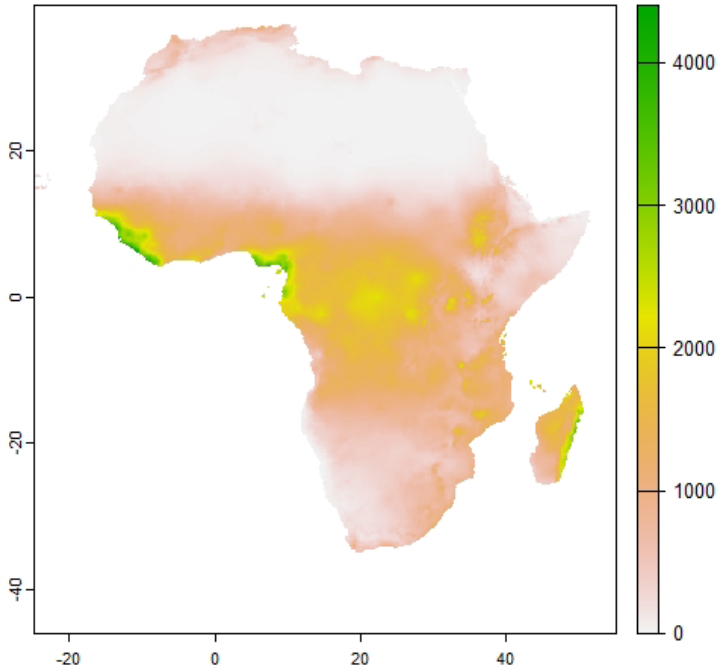
Methods

Climatic data: **Baseline** and **Future** (2080; 5 RCMs; RCP4.5 & RCP8.5)

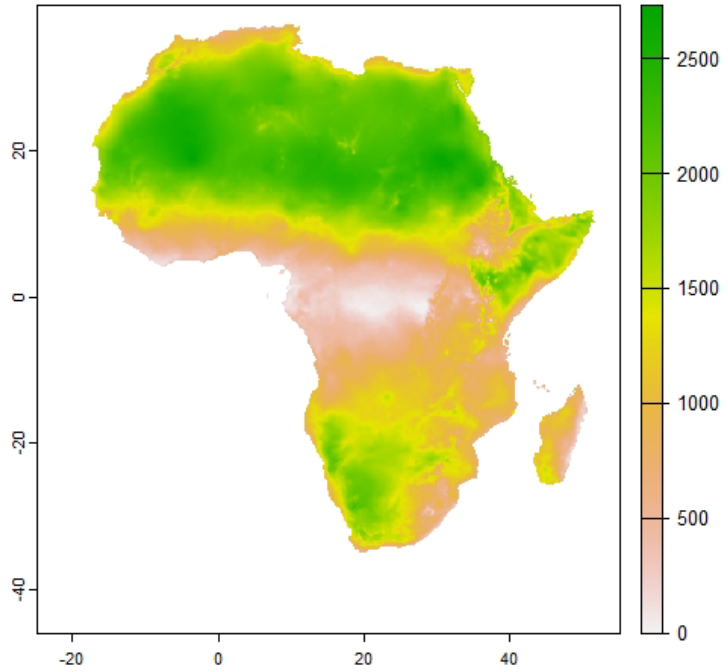
Mean Annual Temperature
(MAT, °C)



Mean Annual Precipitation
(MAP, mm)

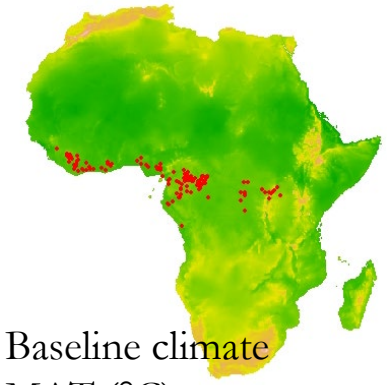


Climatological Water Deficit
(CWD, mm)

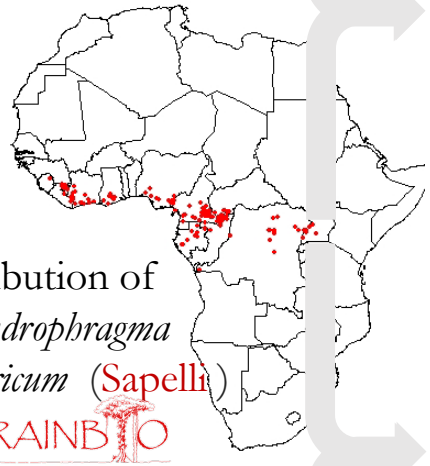


Methods

Species climatic tolerance limits

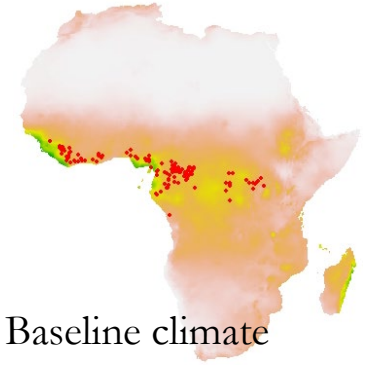


Baseline climate
MAT (°C)

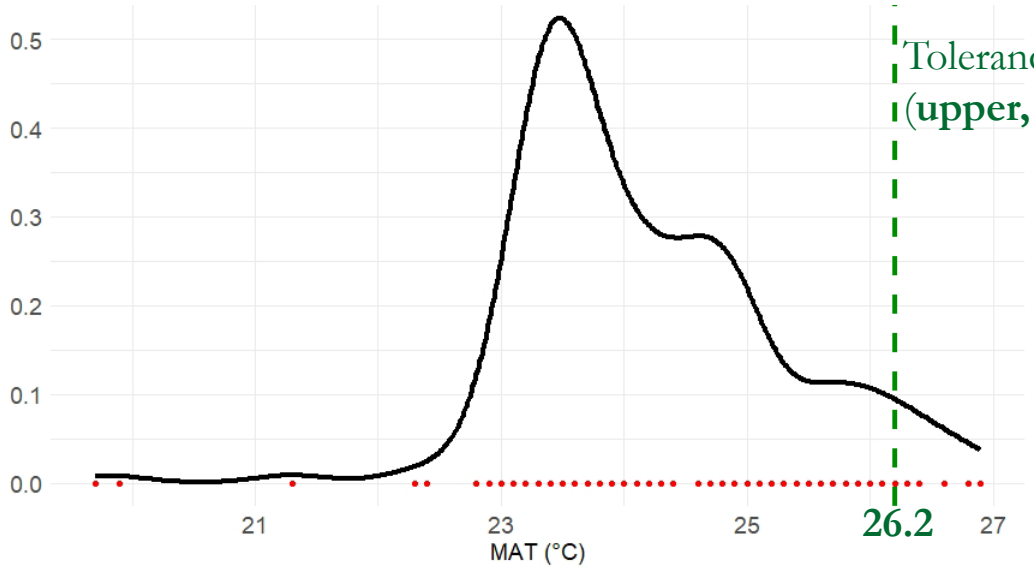


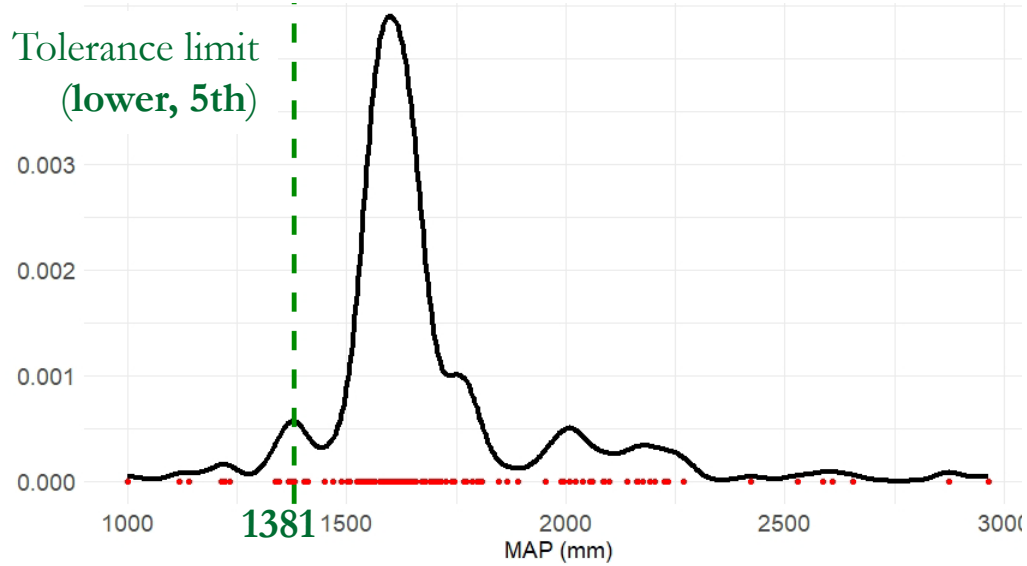
Distribution of
Entandrophragma cylindricum (Sapelli)

RAINBIO

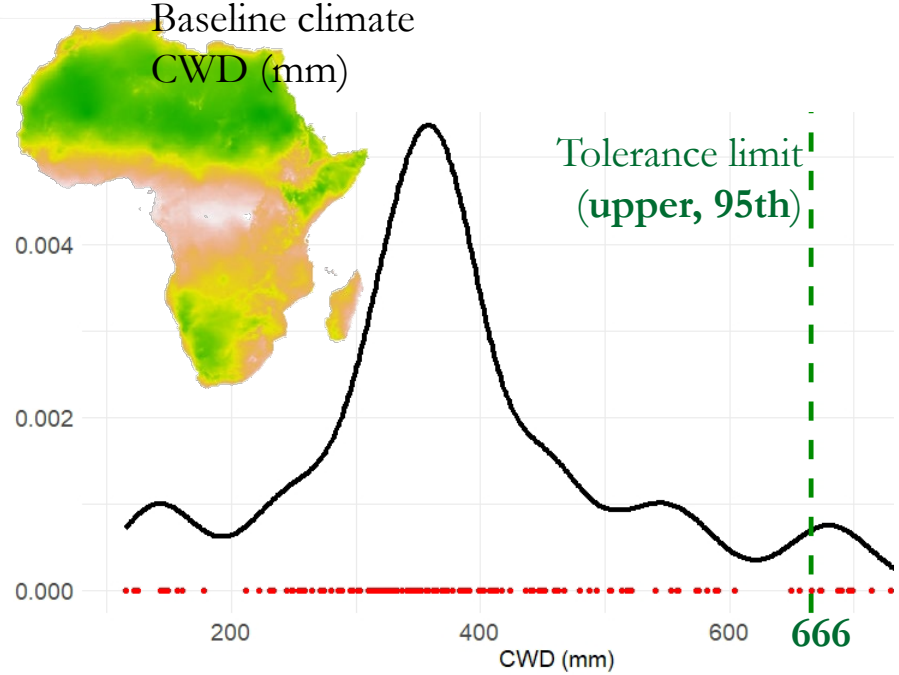


Baseline climate
MAP (mm)



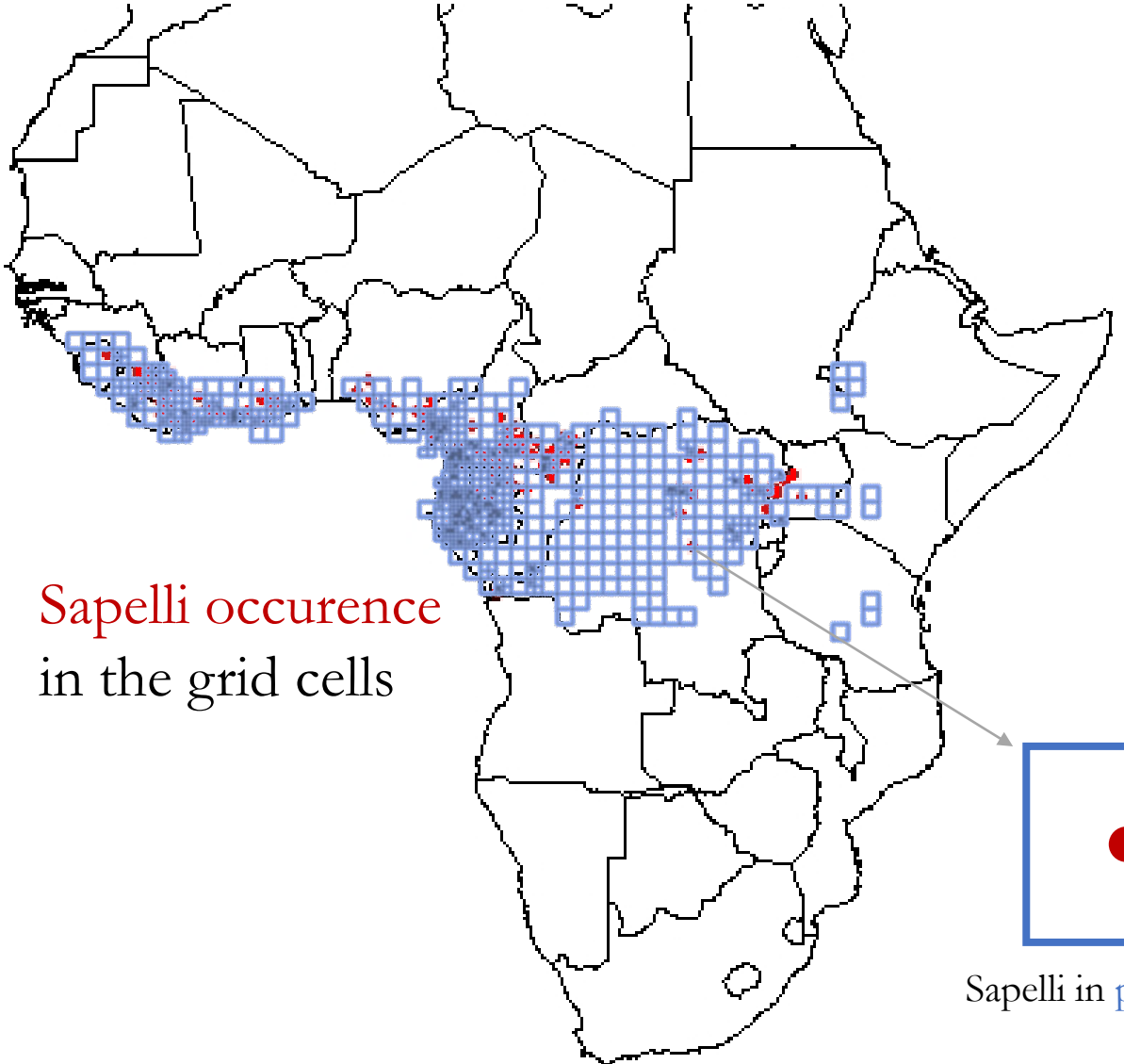


Done for 3,536 trees
and shrub species RAINBIO



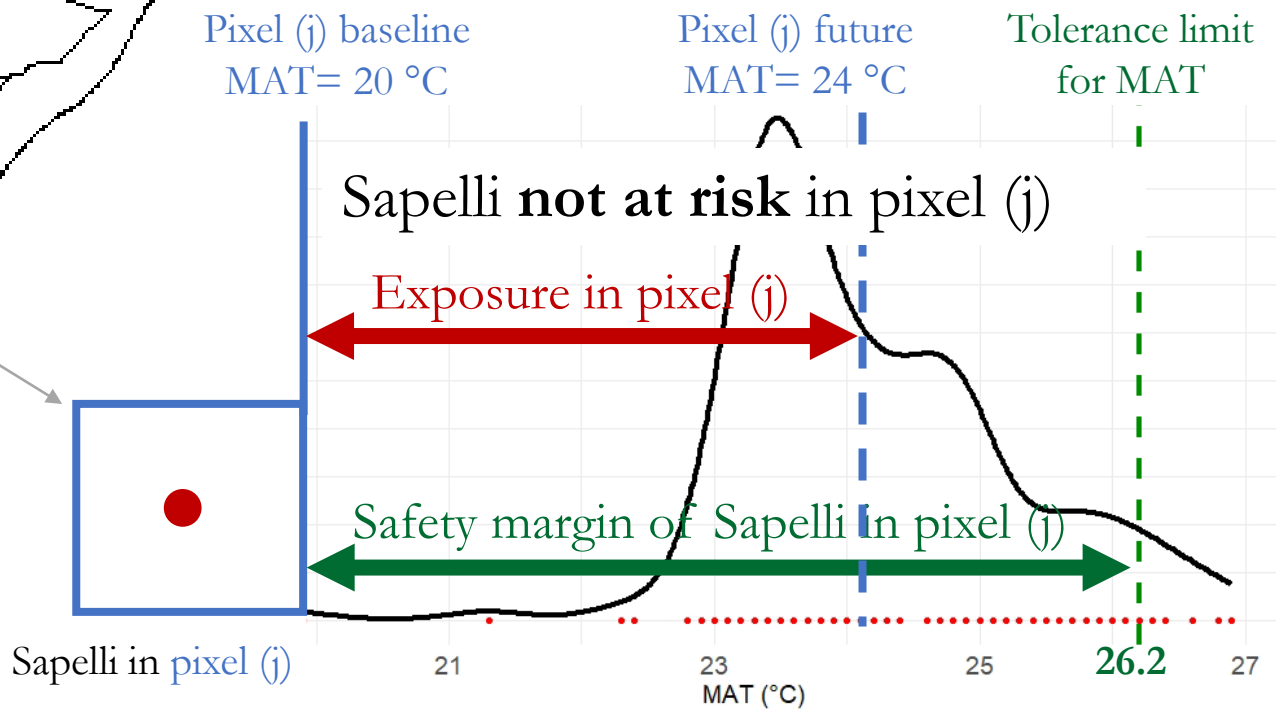
Methods

Analytical framework: **species** level



Sapelli occurence
in the grid cells

Climatic **safety margin**, **exposure** and **risk**
example for MAT



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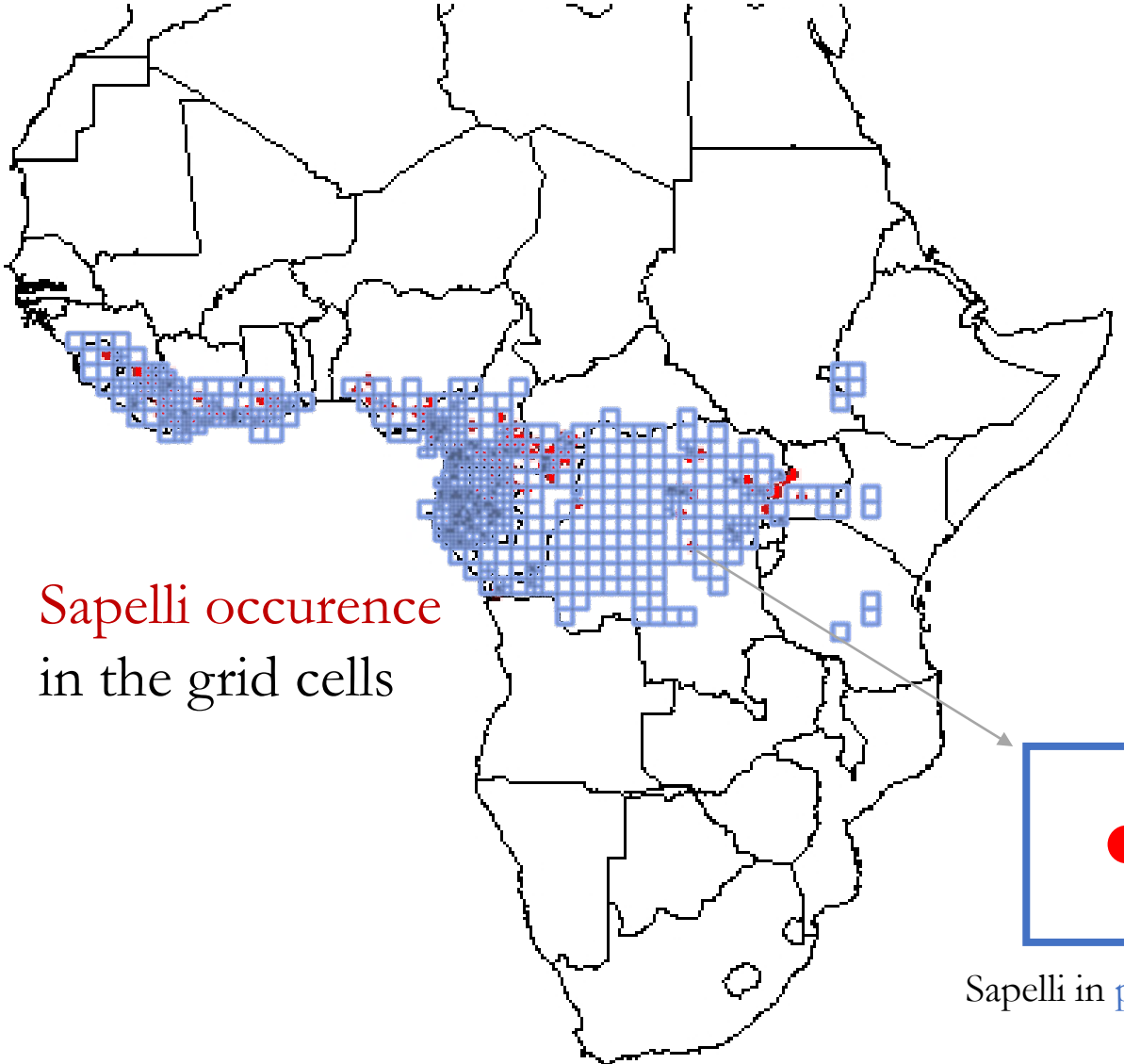

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Climatic **safety margin**, **exposure** and **risk**
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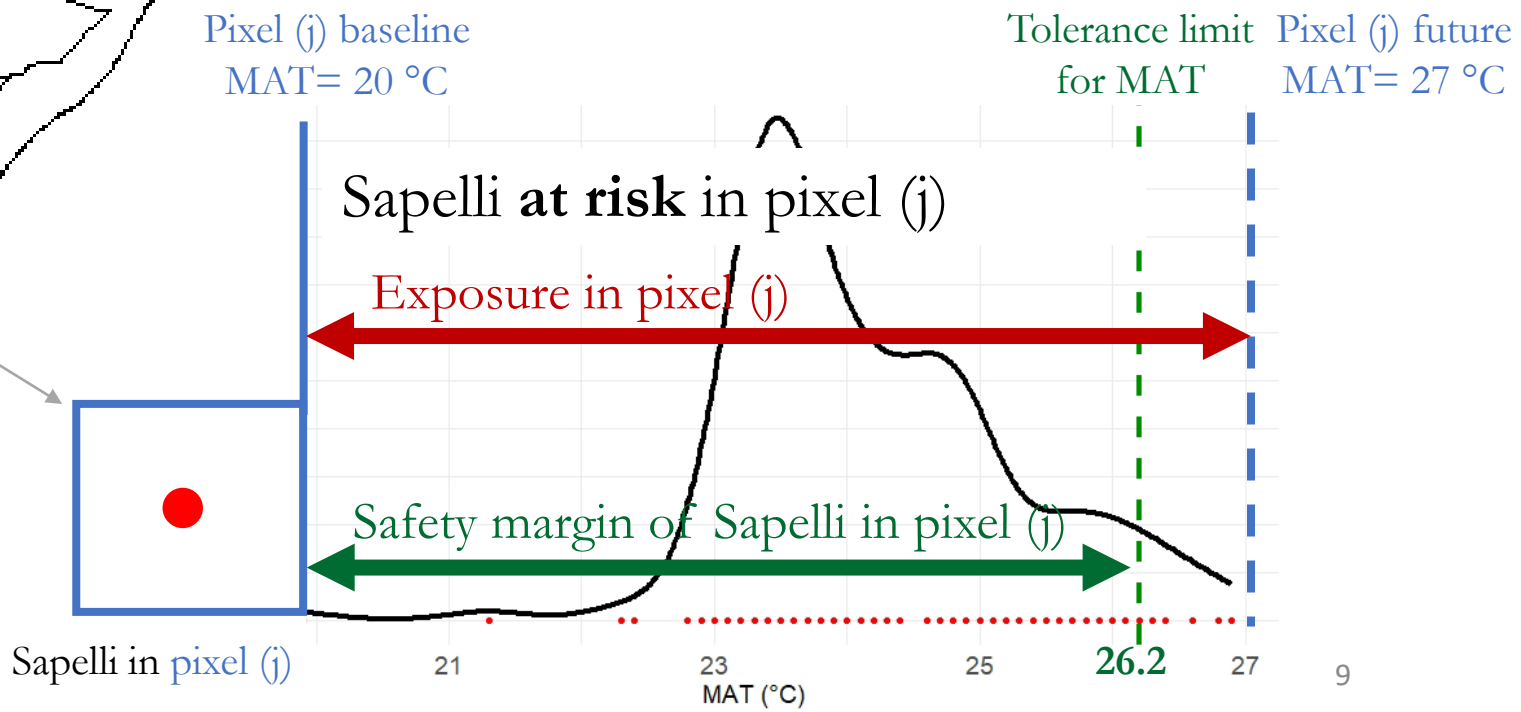
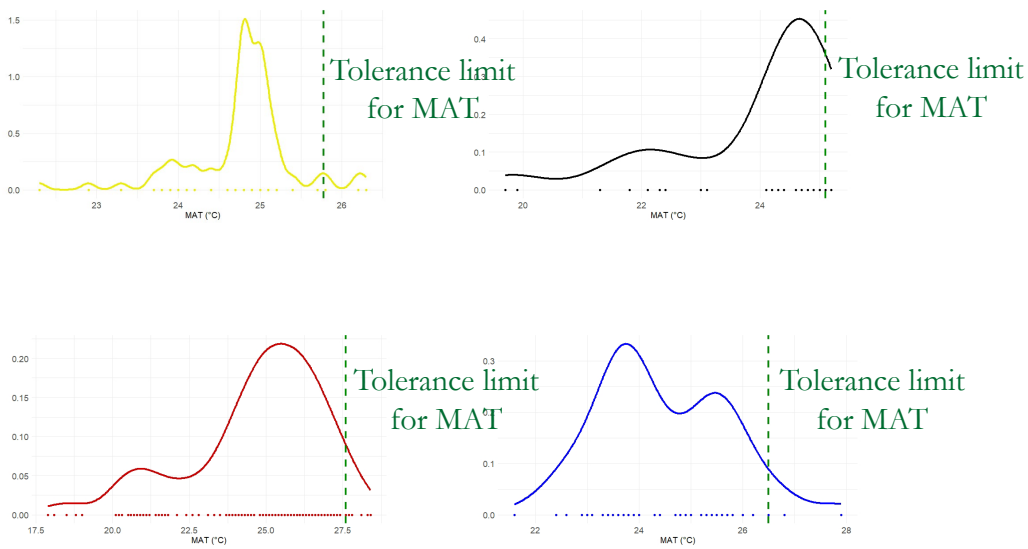


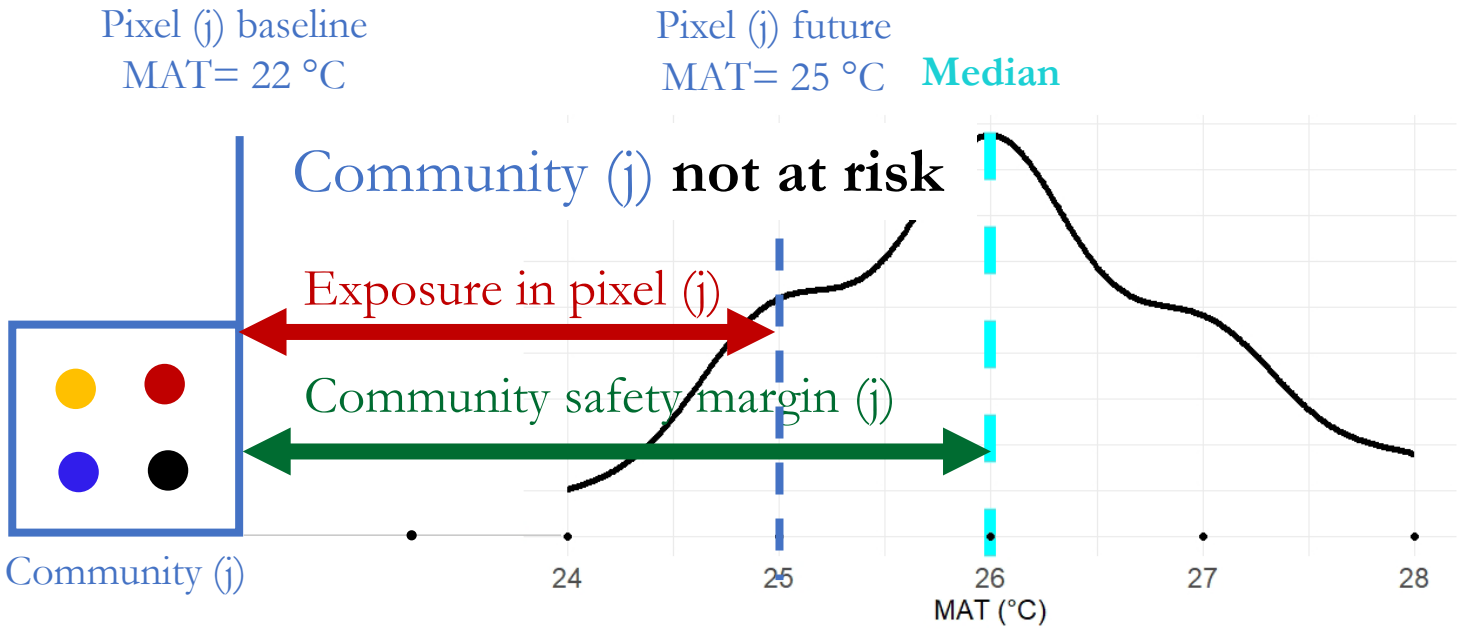
Methods

Analytical framework: **community** level

Species	MAT upper limit
Prioria balsamifera	26
Senna occidentalis	27
Microcos barombiensis	26
Sterculia dawei	25
Median	**26**



Climatic **safety margin**, **exposure** and **risk** example for MAT



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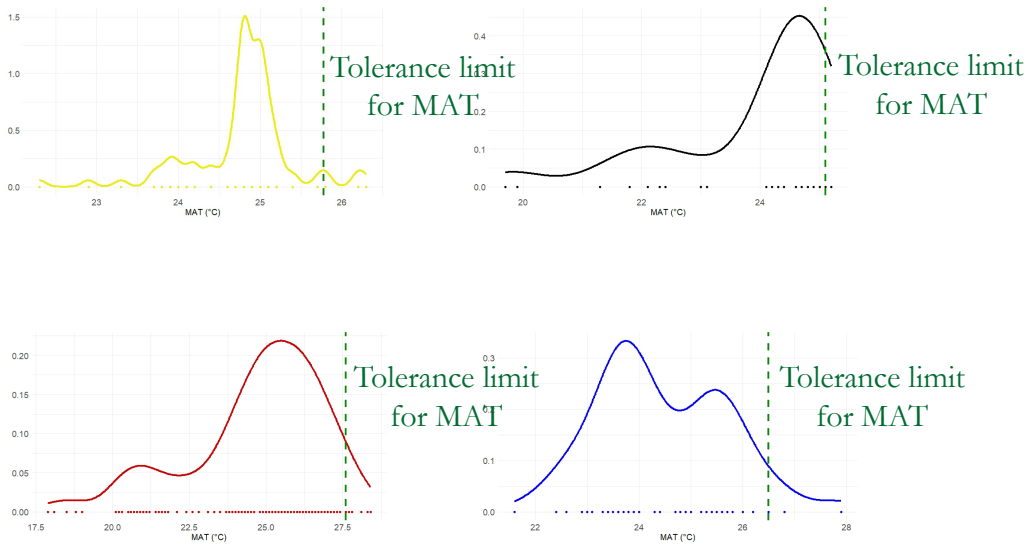
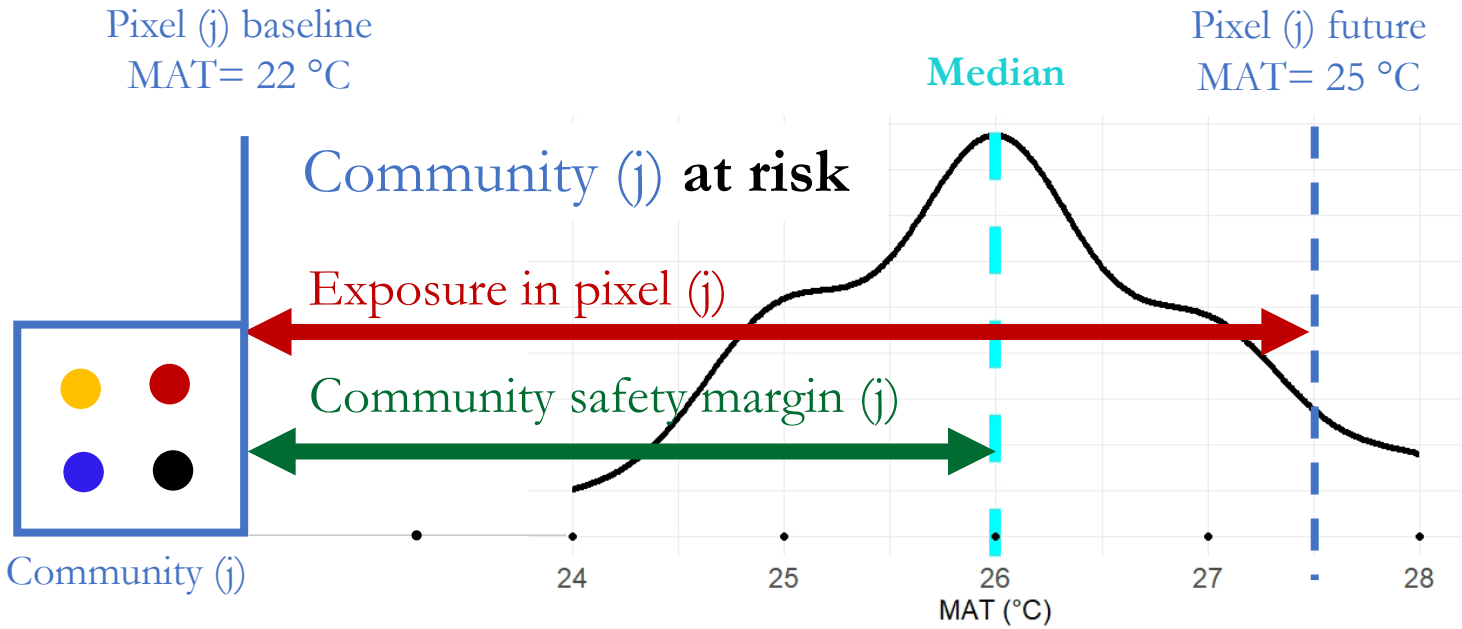


Climatic **safety margin**, **exposure** and **risk** example for MAT

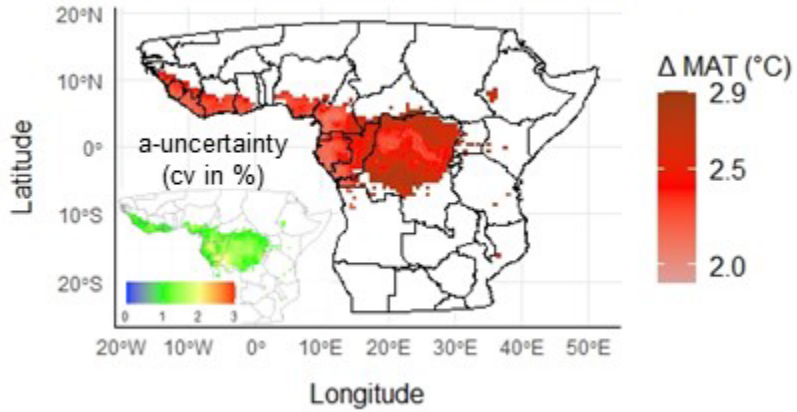


Results

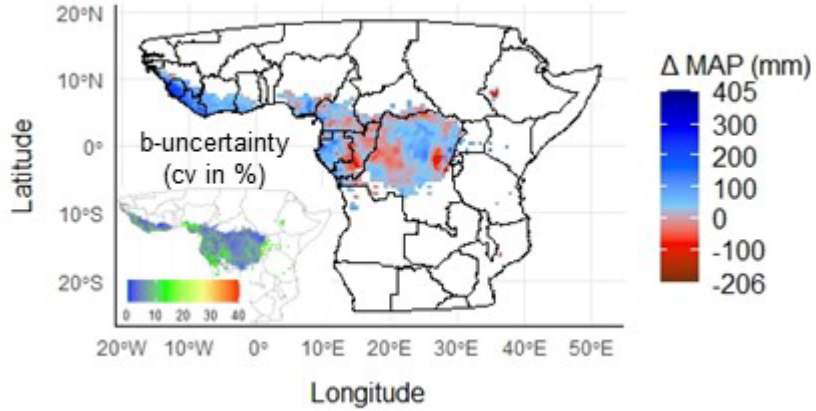
Exposure to climate changes

Widespread increasing temperature and variable rainfall trends with considerable uncertainty

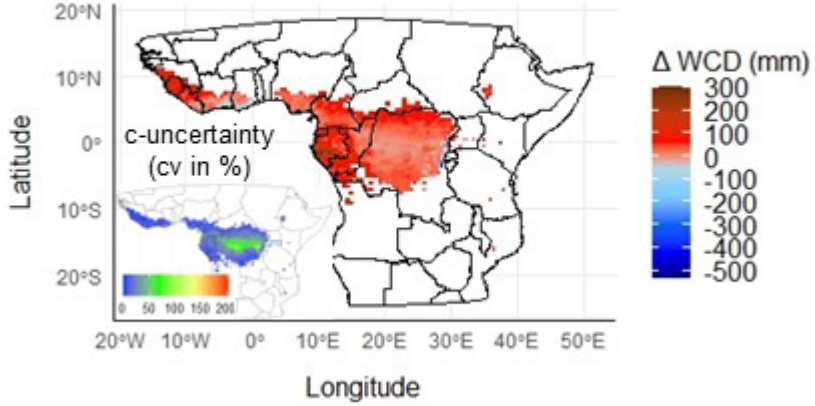
A- Exposure to MAT increase (RCP 4.5 2080)



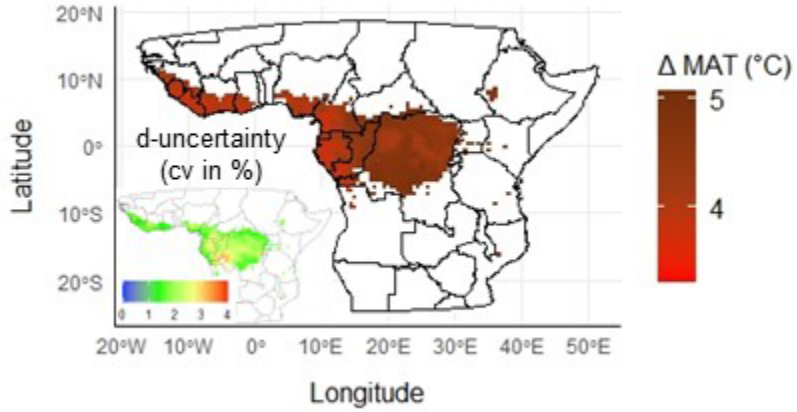
B- Exposure to MAP decrease (RCP 4.5 2080)



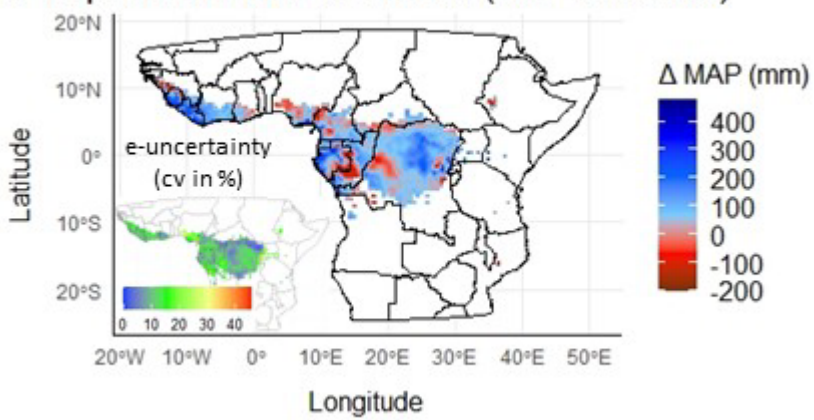
C- Exposure to CWD increase (RCP 4.5 2080)



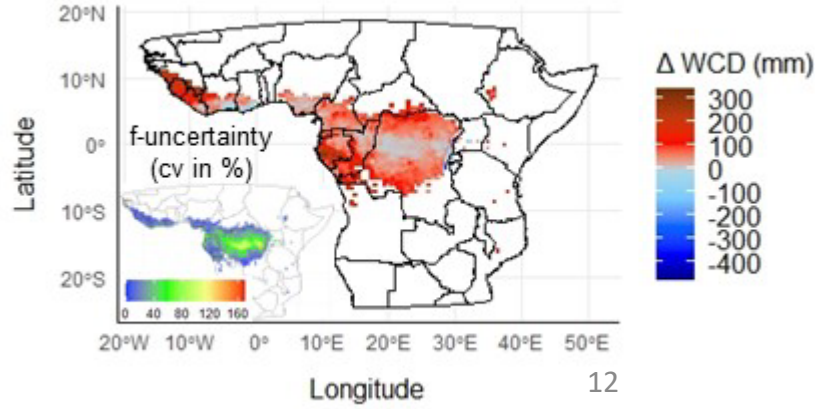
D- Exposure to MAT increase (RCP 8.5 2080)



E- Exposure to MAP decrease (RCP 8.5 2080)

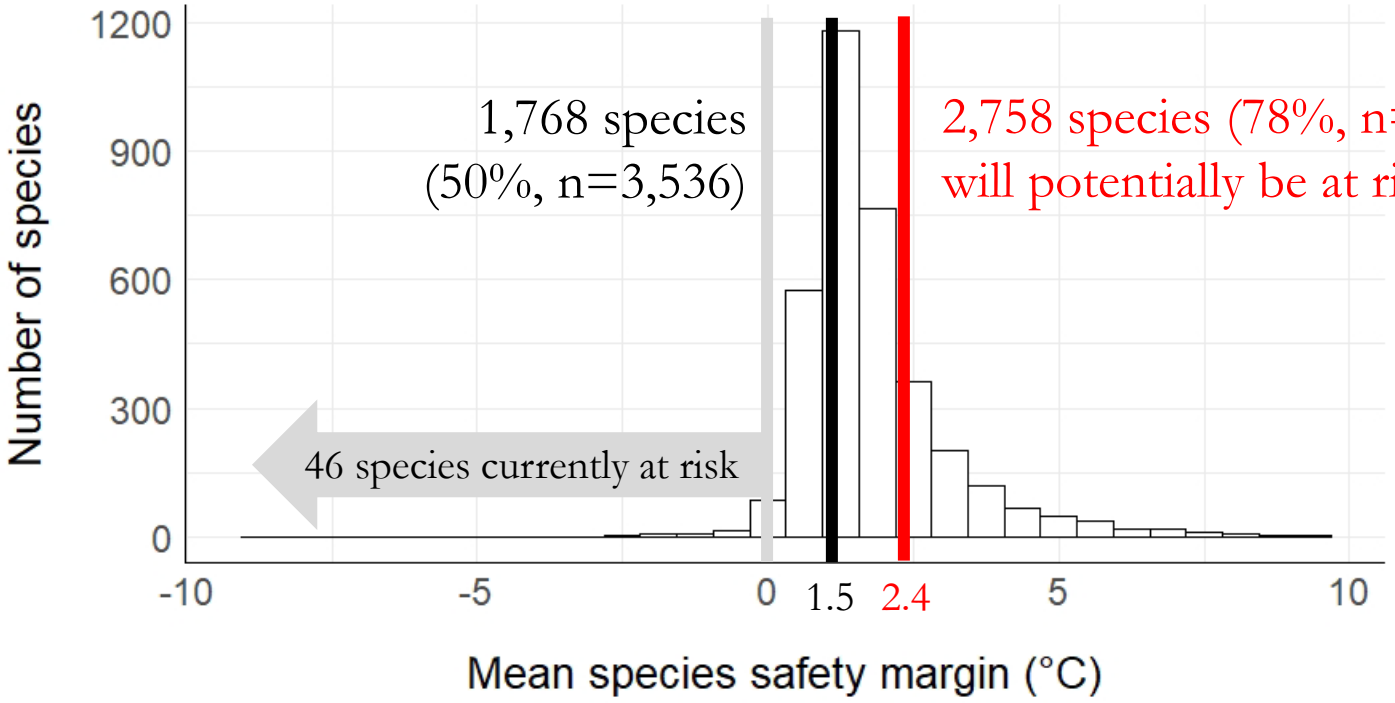


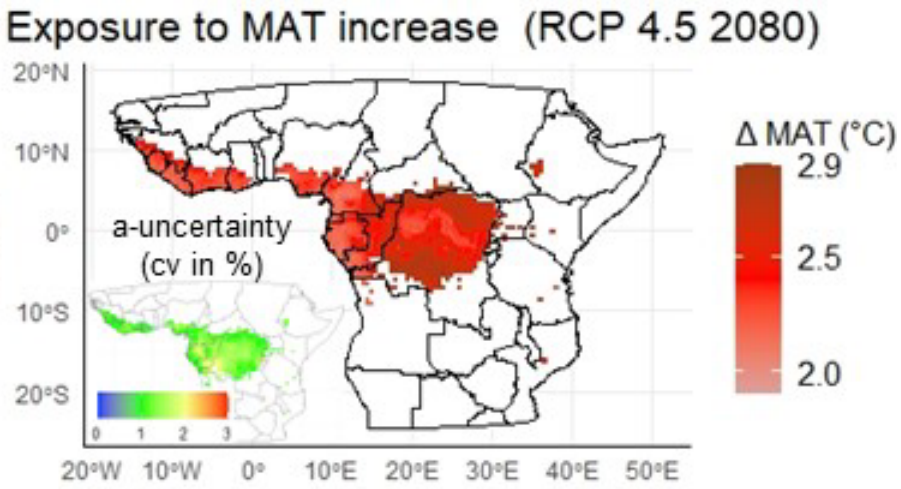
F- Exposure to CWD increase (RCP 8.5 2080)



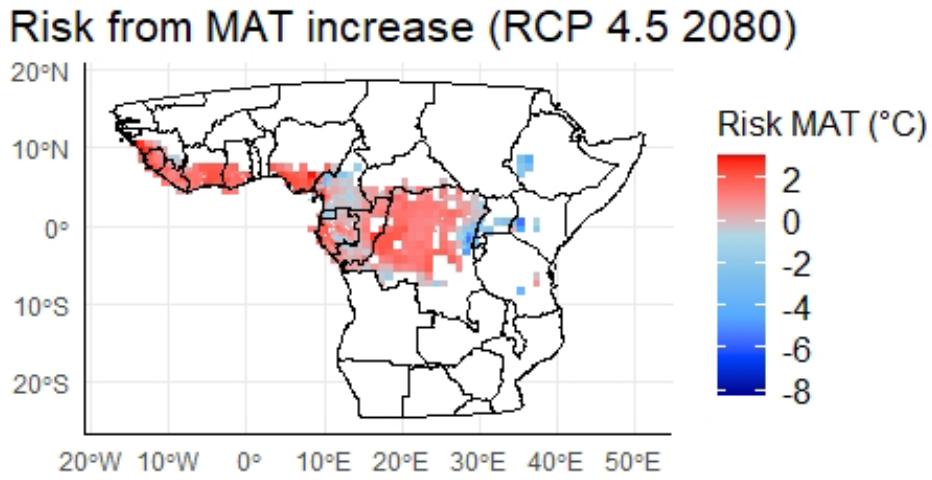
Results

Safety margin and species risk for MAT





Mean exposure = 2.4 ± 0.21°C



At the community level

Take home message

(1) What is the **exposure to climate change** in African tropical moist forests ?

- Widespread increasing temperature and variable rainfall trends with considerable uncertainty

(2) What is the **climatic safety margin** of species and forest communities ?

- Some species are currently exceeding their safety margin for temperature
- Most species have a narrow safety margin for temperature

(3) What is the **climatic risk** encompassed by forest species and communities to projected climate changes ?

- Most forest species and communities are projected to be potentially at risk from rising temperatures

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SESSION

Tropical forest conservation and management under a changing climate

CHAIRS:

Meley Mekonen Rannestad, Norwegian University of Life Sciences
Aster Gebrekirstos, World Agroforestry
Yennie Katarina Bredin, NINA - Norwegian Institute for Nature Research
Thomas Luypaert, Norwegian University of Life Sciences

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