Troisième Conférence scientifique Internationale sur le Changement Climatique en Afrique de l'Ouest et au Sahel (CICC2024)

Du 09 au 11 Septembre 2024
Hôtel Bravia, Niamey, Niger

Assessing the Impacts of Climate Change on Rainfed Maize Production in Burkina Faso, West Africa

By

Moussa WAONGO[1], Amadou COULIBALY[1] and Seydou B. TRAORE[1]

[1]AGRHYMET Regional Centre

OUTLINE

INTRODUCTION

DATA AND METHODS

RESULTS

SUMMARY AND CONCLUSION

CONTEXT 1/2

- ✓ IPCC AR6 predicts that temperatures across West Africa will increase by 2° C to 5 ° C by the end of the 21st century under high-emission scenarios.
- ✓ rainfall will become more variable, with some regions experiencing increased rainfall and others facing declines, resulting in frequent flooding and drought
- ✓ The Sahel region in West Africa may experience more intense and frequent drought and flood events; compounded with the most significant temperature rises
- ✓ Sahel region: the majority of the population relies on rainfed agriculture. Climate change, along with challenges related to climate variability, will amplify the vulnerability of the population

CONTEXT 2/2

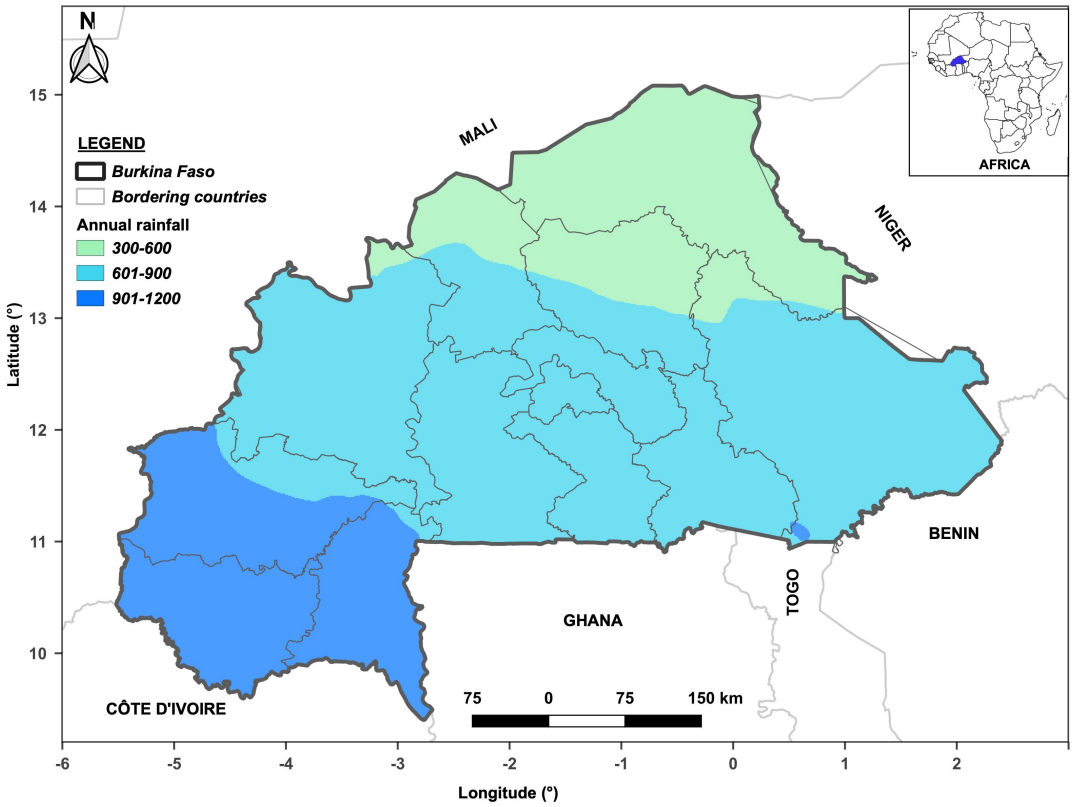
- ✓ High rainfall variability and extreme weather events can lead to crop failure or reduced yields. Impacts will also vary for crops and regions based on a complex interaction of changes in precipitation, temperature and [CO_2]

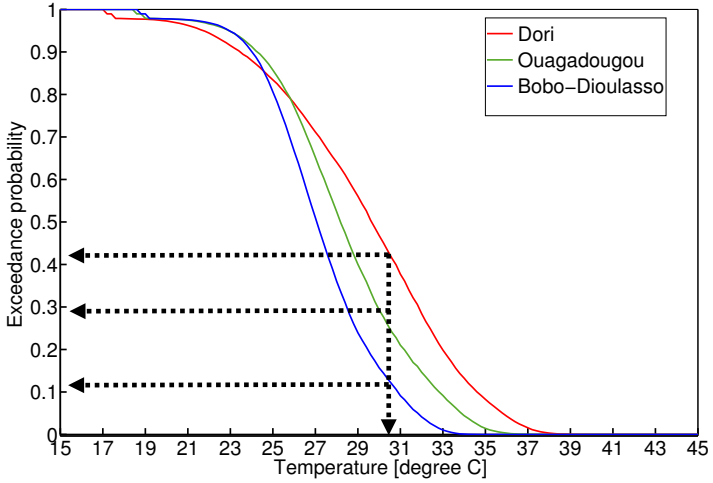
- ✓ To capture these complex interactions of climate variables more effectively, there is a need for comprehensive climate-crop modeling that offers valuable insights for agricultural management, research, and policy-making related to climate change

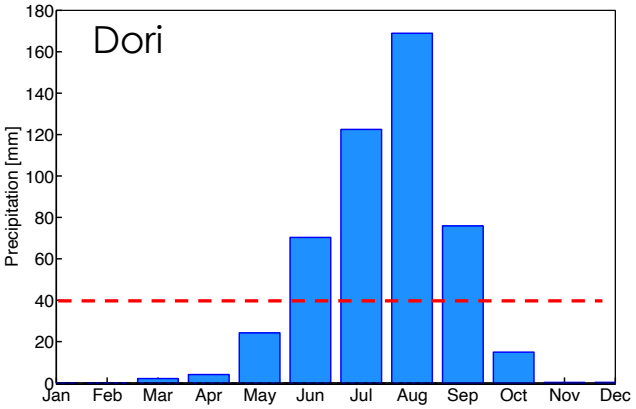
- ✓ In this context, assessing the impact of climate change on crop production using CMIP6 data based on the new set of Shared Socioeconomic Pathways (SSP) scenarios is valuable for planning and policy development in the agricultural sector.

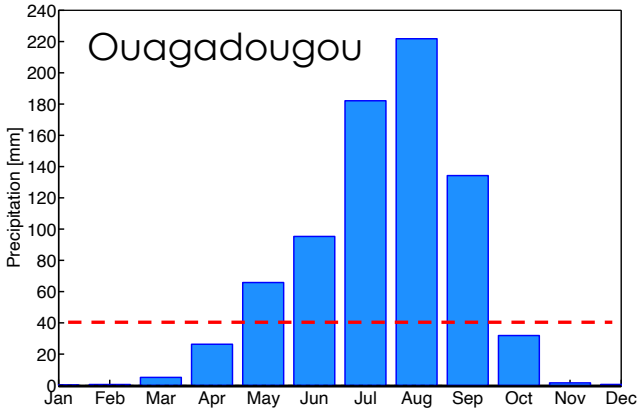
DATA AND METHODS

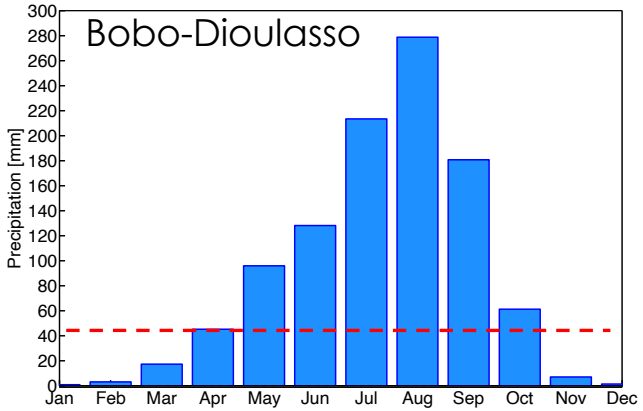
Study area











BF's food production rely strongly on rainfed agricultural and involve about 80% of the population, main source of income for the rural population. The staple crop production is subsistence-oriented and predominantly consists of sorghum, millet and maize .

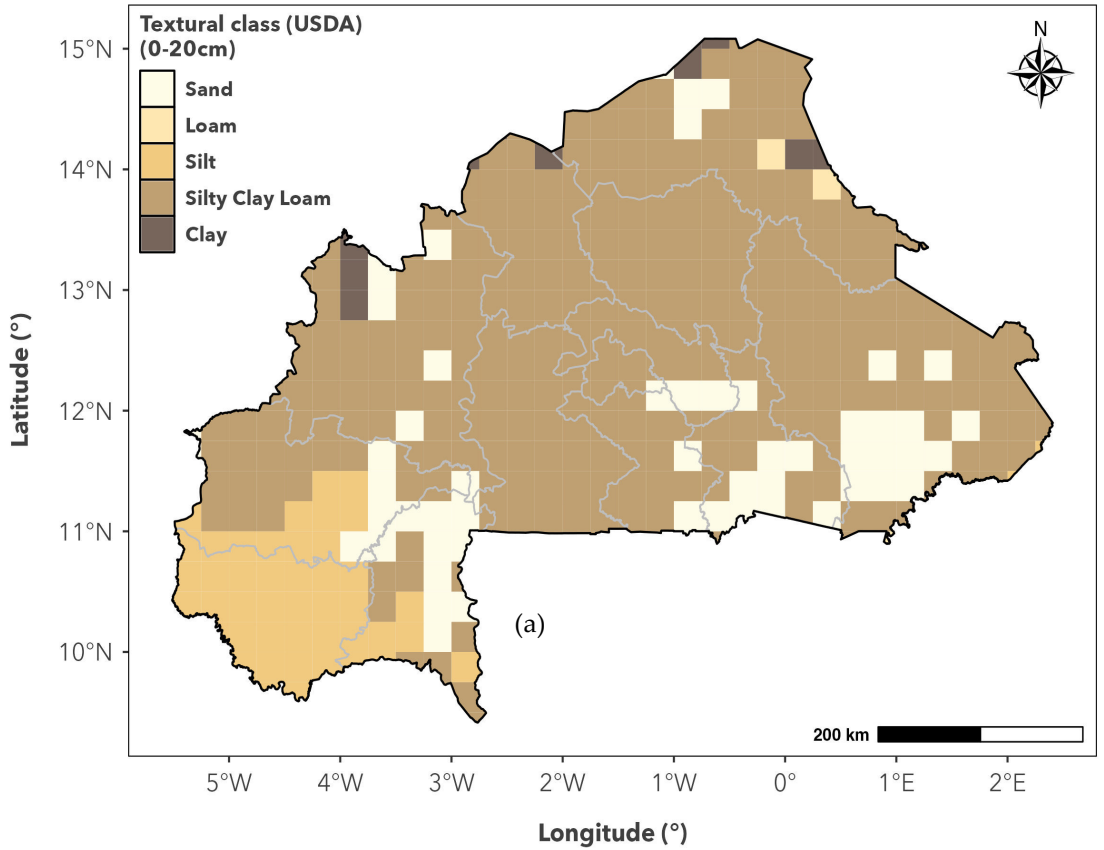
DATA AND METHODS

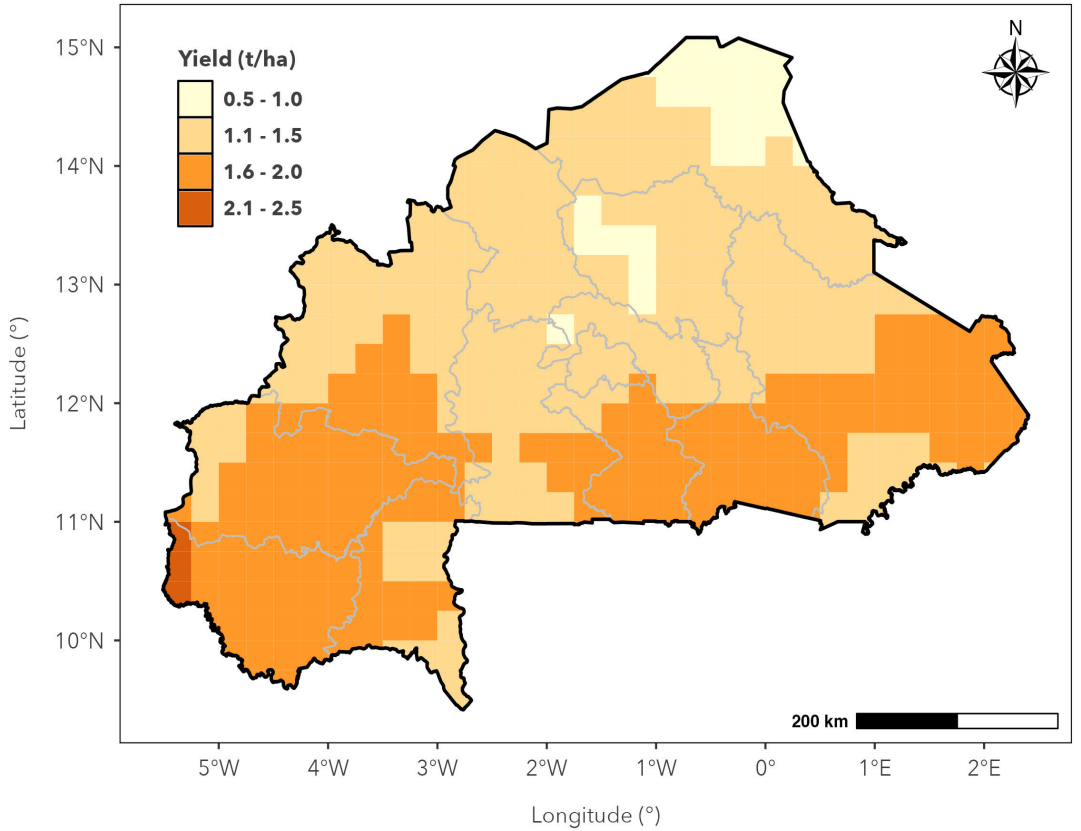
Climate data (NEX-GDDP-CMIP6)

GCMs	Reference	Emission Pathways		
	Historical	SSP2-4.5	SSP5-8.5	
ACCESS-CM2	1985–2014	2016–2075	2016–2075	pcp, Tmin, Tmax, Radiation, HRmean, Wind
ACCESS-ESM1-5				
CMCC-ESM2				
CanESM5				
GISS-E2-1-G				
HadGEM3-GC31-LL				
MIROC-ES2L				
MIROC6				
MPI-ESM1-2-HR				
MPI-ESM1-2-LR				
MRI-ESM2-0				
NorESM2-LM				
NorESM2-MM				
TaiESM1				
UKESM1-0-LL				

DATA AND METHODS

Gridded Soil data and Observed Maize yield (average)





6 soil layers from HWSD v2.0 : first soil layer (0–20cm)

Gridded average maize yield over the period 2009–2020

HWSD v2

DATA AND METHODS

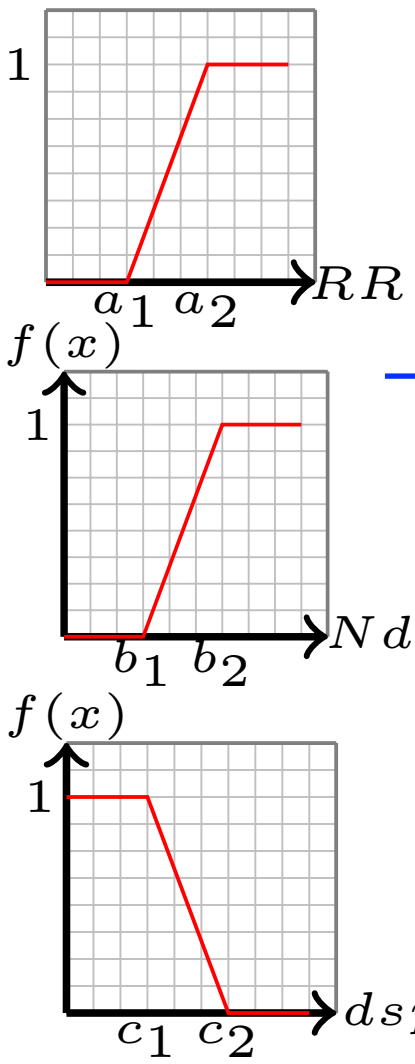
Management and Maize phenology (INERA-BF)

Type	Parameter	Minimum value	Maximum value
Crop	Growing period length	80 days	120 days
	Base temperature	8	12
	Upper temperature	30	35
	Number of plants	25000 plants/ha	45000 plants/ha
	Length of building up of Harvest Index	20 days	40 days
	Reference Harvest Index (HIo)	20%	45%
Management [a]	Soil fertility rate	20%	80%
	Relative cover of weed	10%	80%
	Planting date	May 1st	July 31

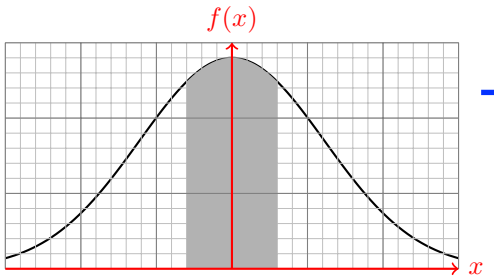
DATA AND METHODS

Yield Simulation Approach

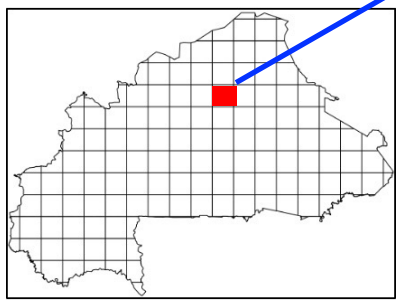
Waongo et al., 2014



Planting dates based on Fuzzy Logic approach



A time window for simulation



OBSERVATIONS

1. Climate (Tx,Tn,pcp,ET,$[CO_2]$)
2. Management (weed, fertilizer)
3. Maize yield

GCMs

Historical (1985-2014) | SSP2-4.5 (2016-2075) | SSP5-8.5 (2016-2075)

Calibration

AquaCrop model + GA approach

Soil

1. PCP
2. Tn , Tx
3. ET
4. $[CO_2]$

Location-specific parameters

1. Maize crop
2. Crop management

Maize yield simulations (AquaCrop)

Assessing maize yield responses

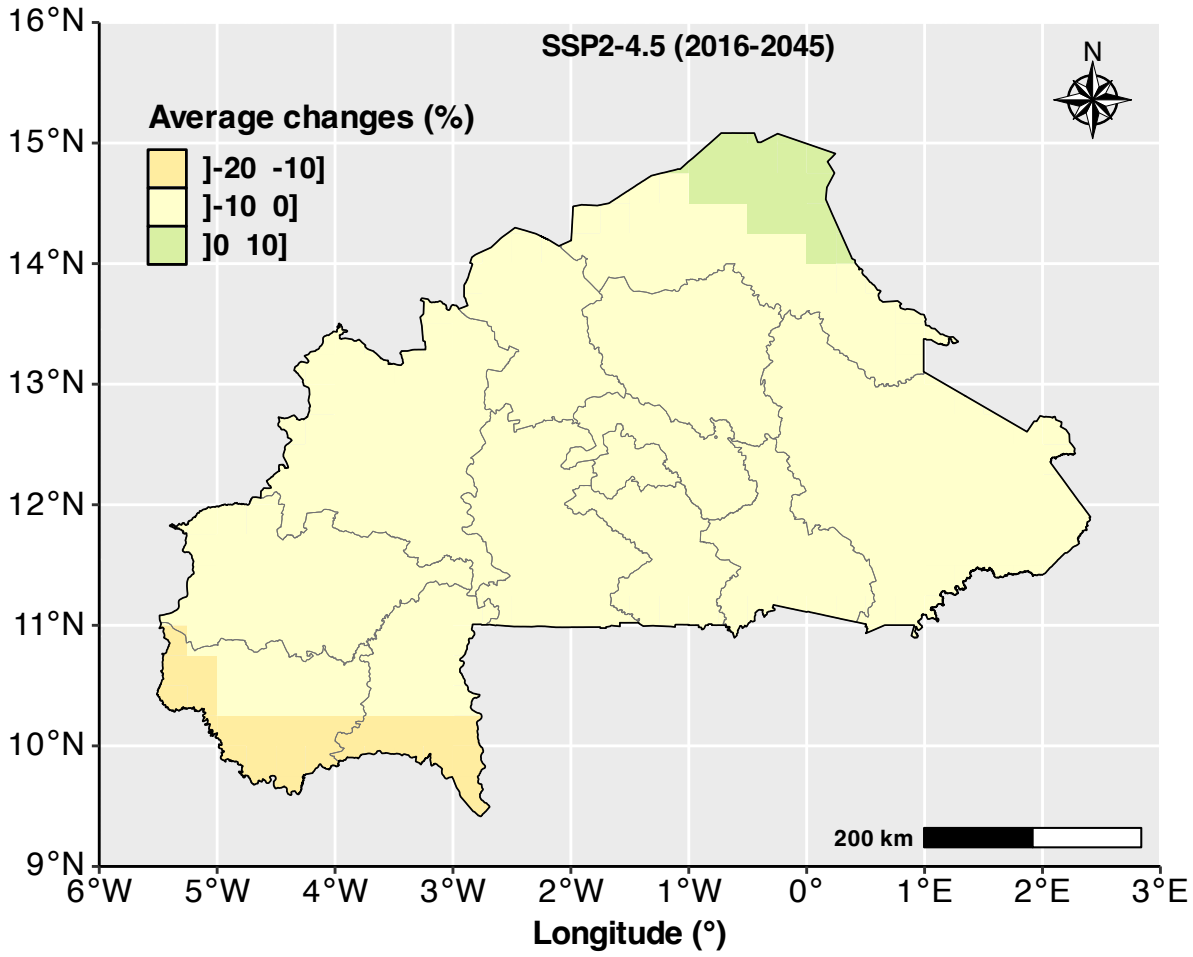
Statistics on simulated yield ($Yield_{SSP}$ vs $Yield_{historical}$)

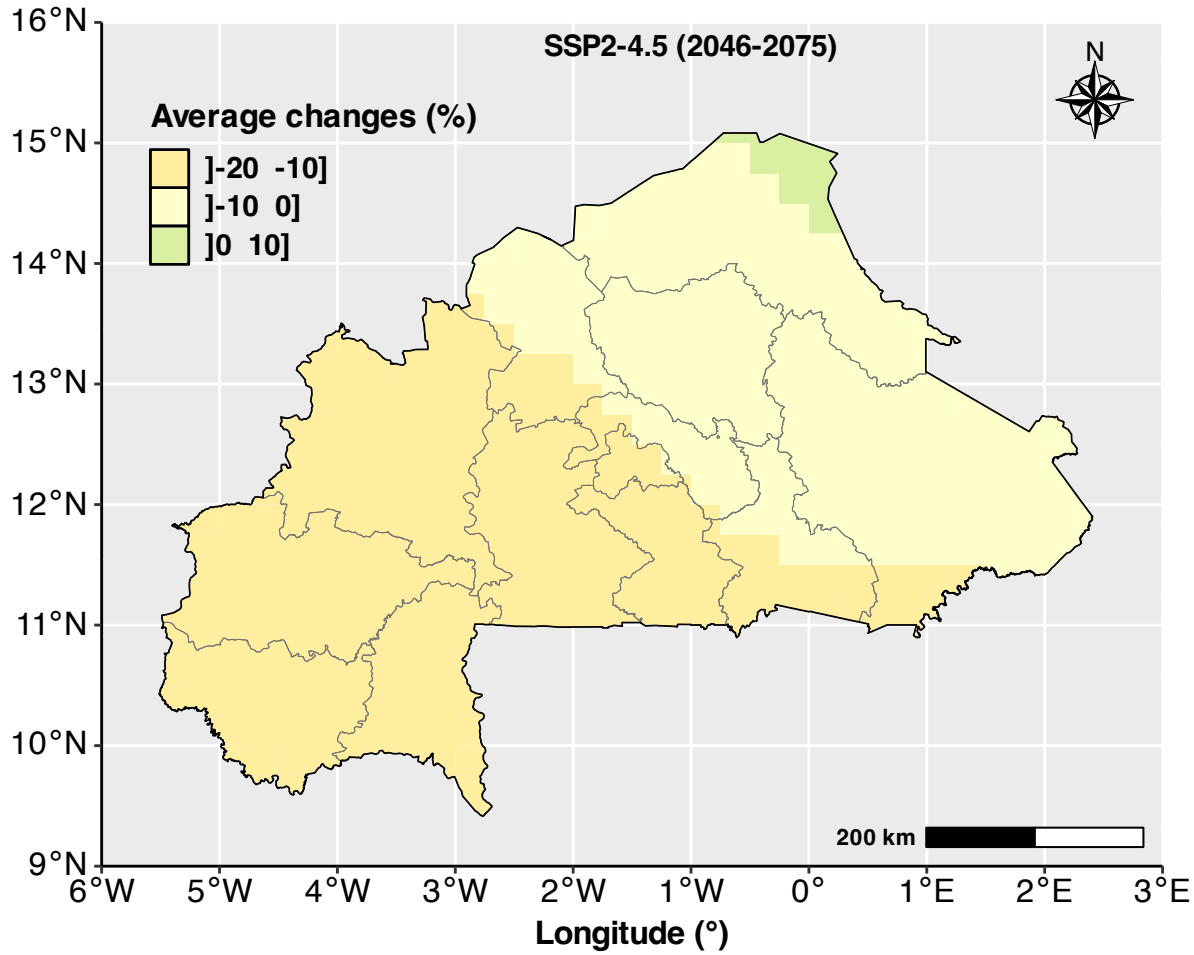
Waongo et al., 2024 (under peer review)

pcp: precipitation, Tn,Tx: minimum and maximum temperature, ET: evaptranspiration, $[CO_2]$: carbone dioxide concentration

RESULTS

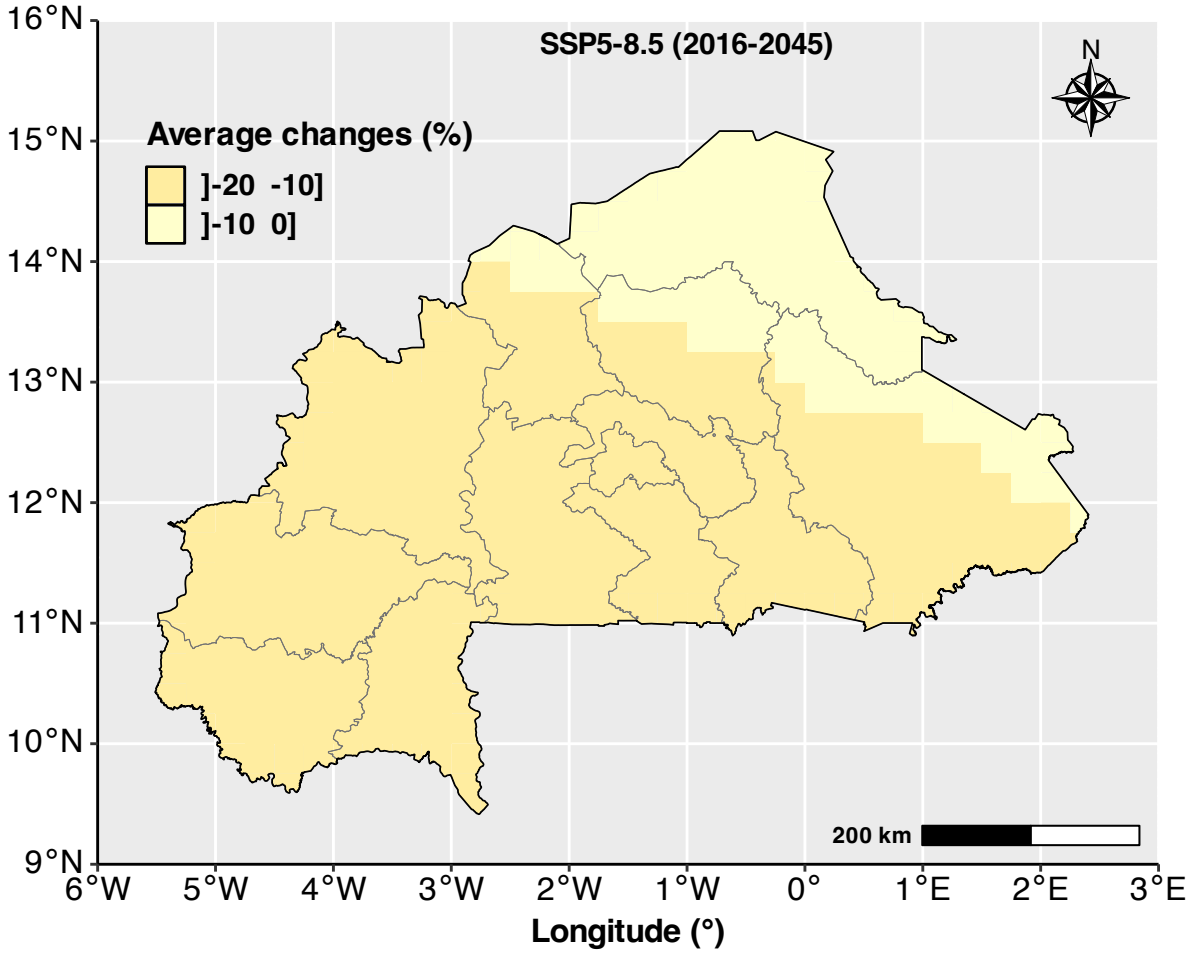
Precipitation changes : SSP2-4.5

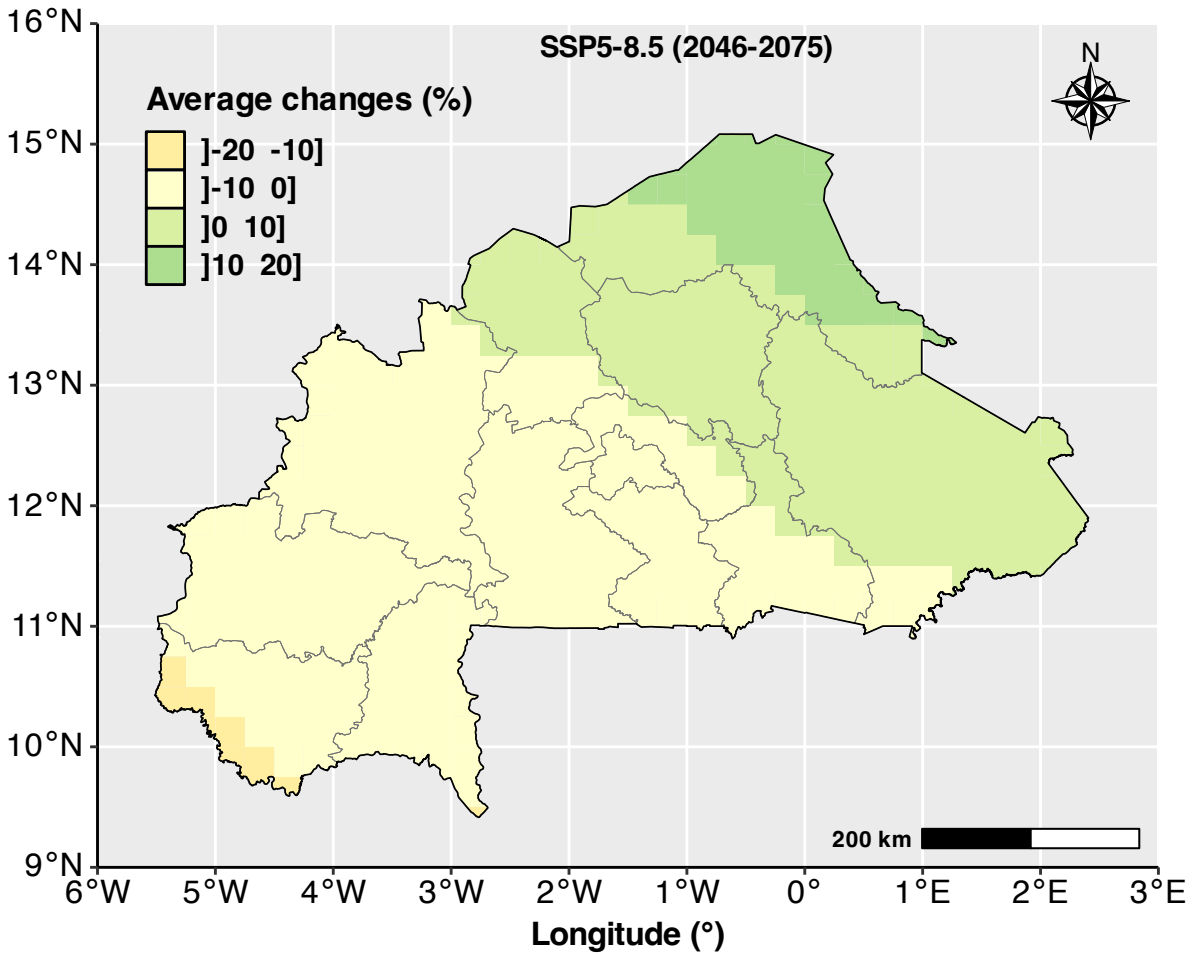




Projected annual mean precipitation changes from 15 GCMs (Ensemble Mean).

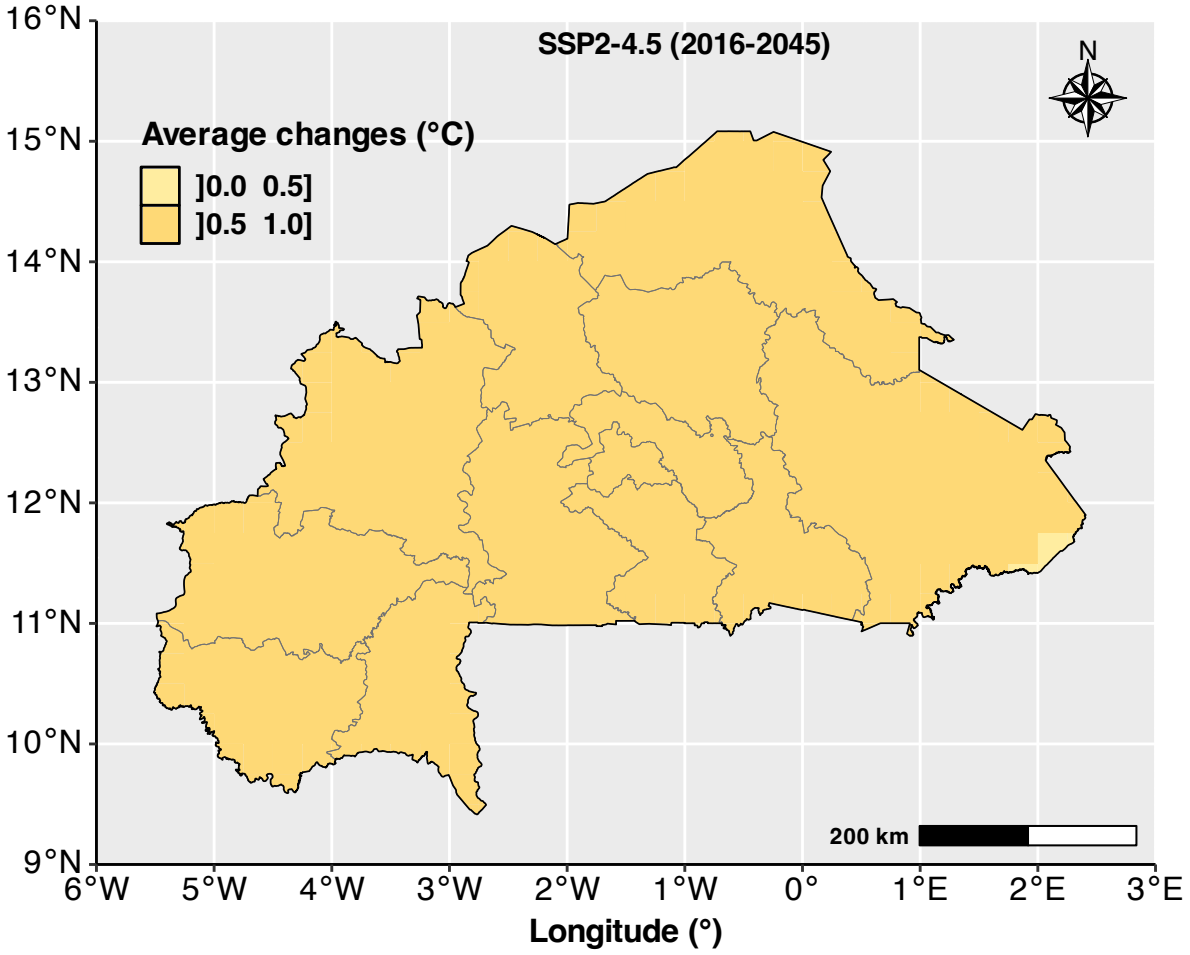
Precipitation changes : SSP5-8.5

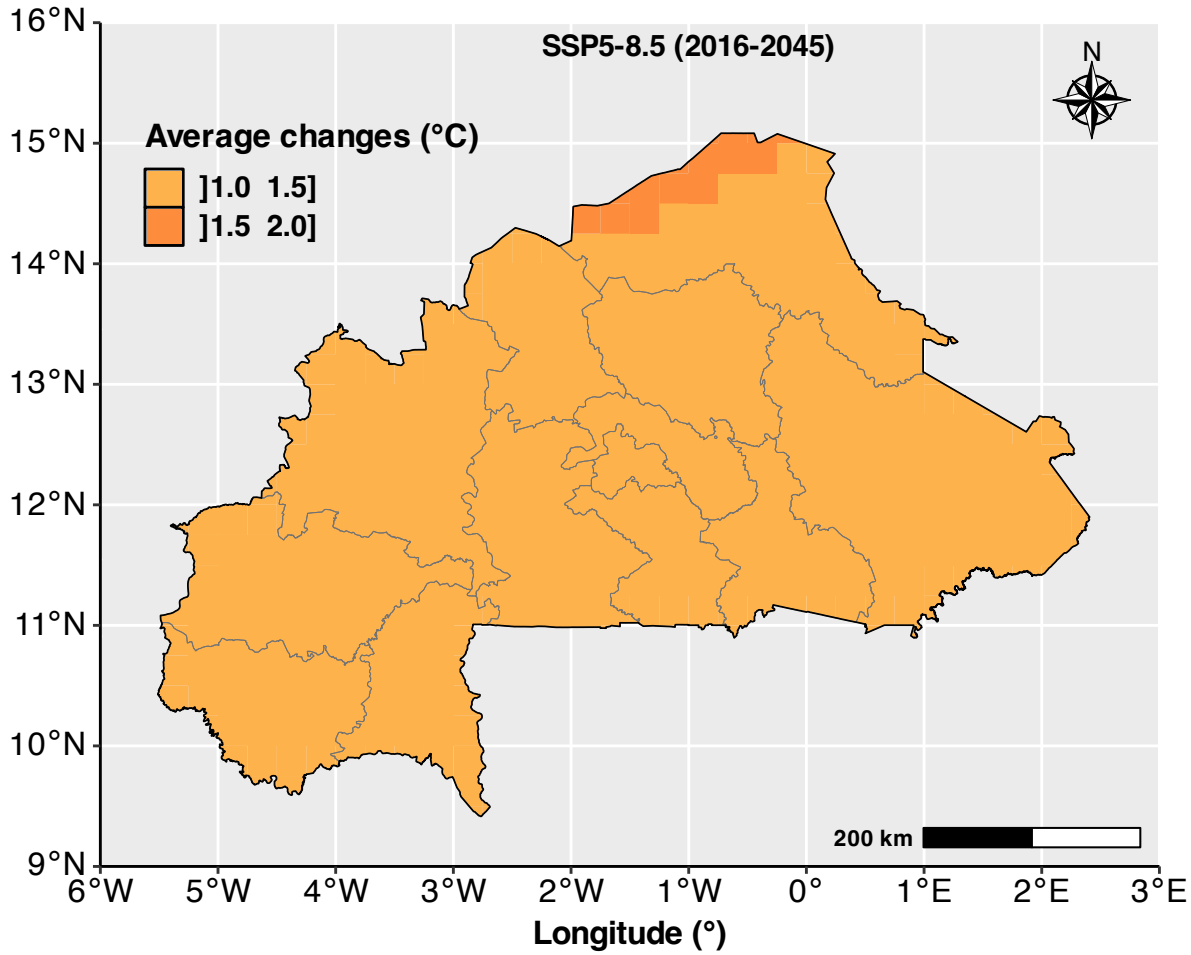




Projected annual mean precipitation changes from 15 GCMs (Ensemble Mean).

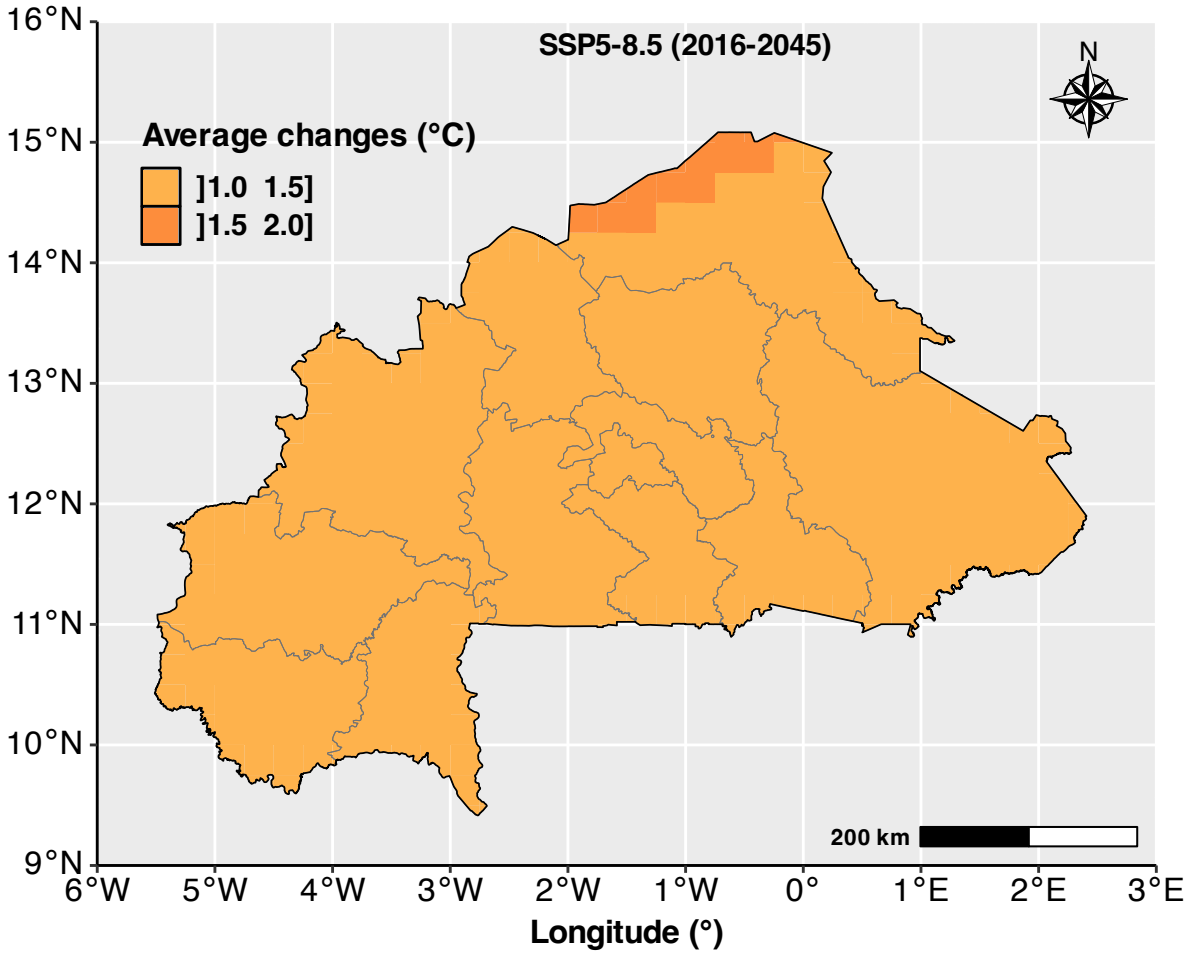
Temperature Changes : SSP2-4.5

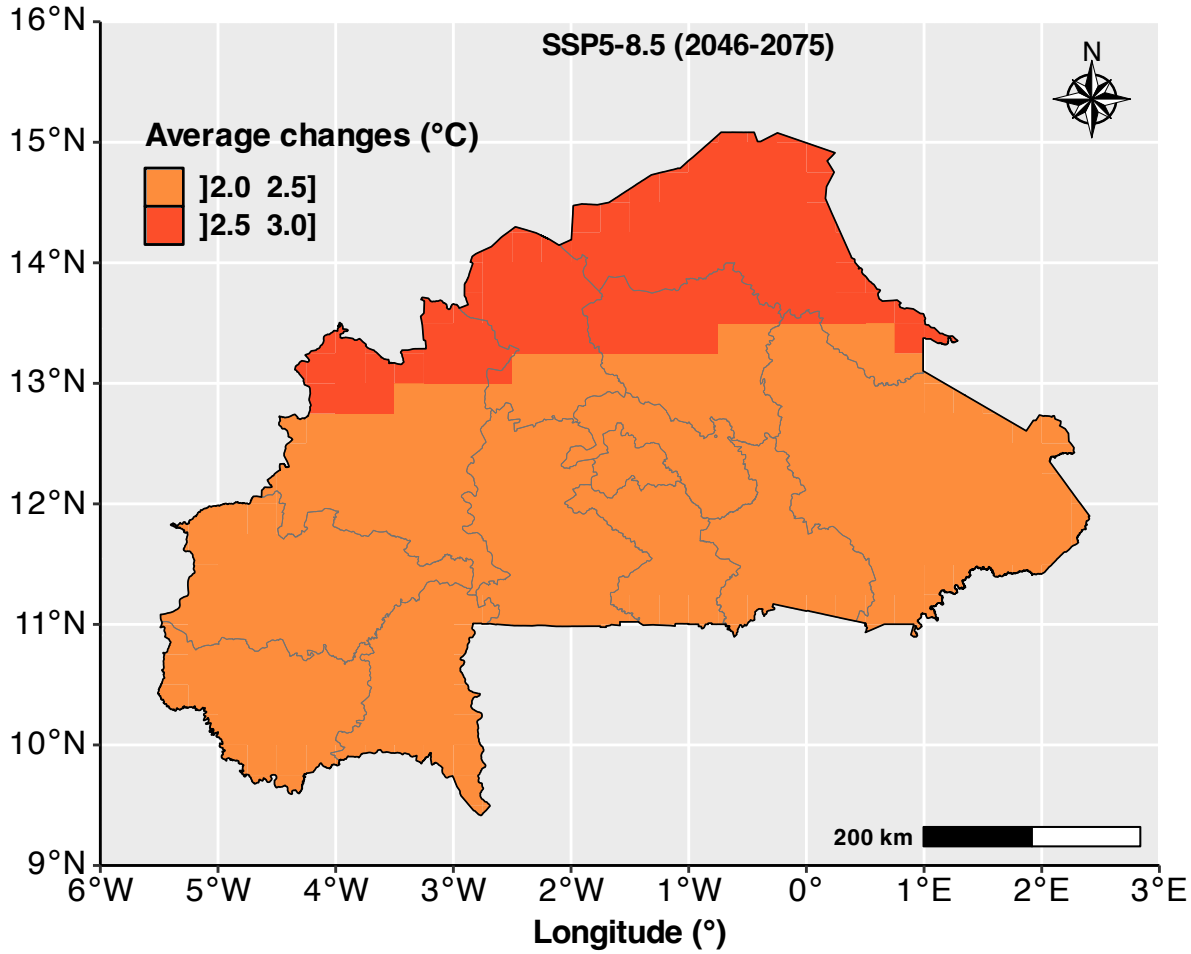




Projected annual mean temperature changes from 15 GCMs (Ensemble Mean)

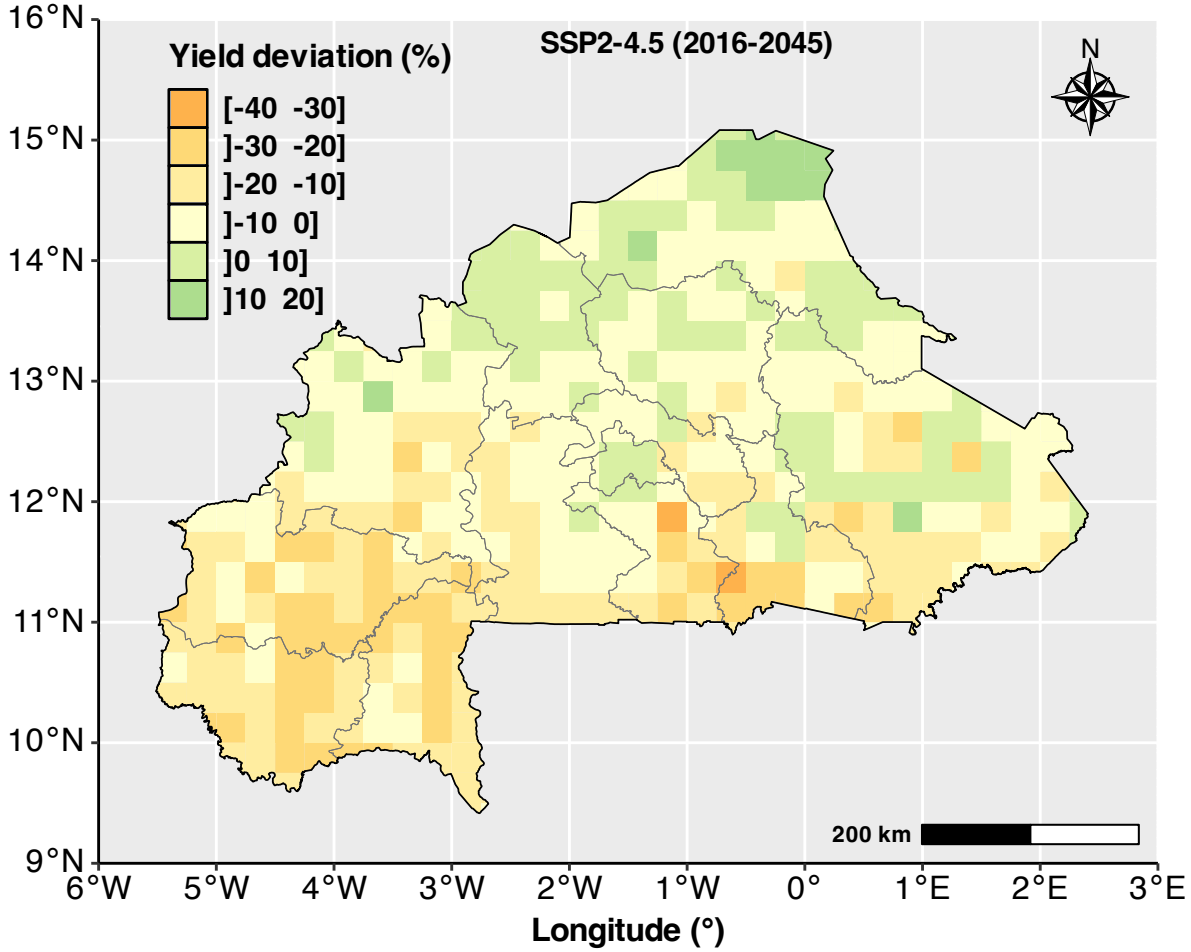
Temperature Changes : SSP5-8.5

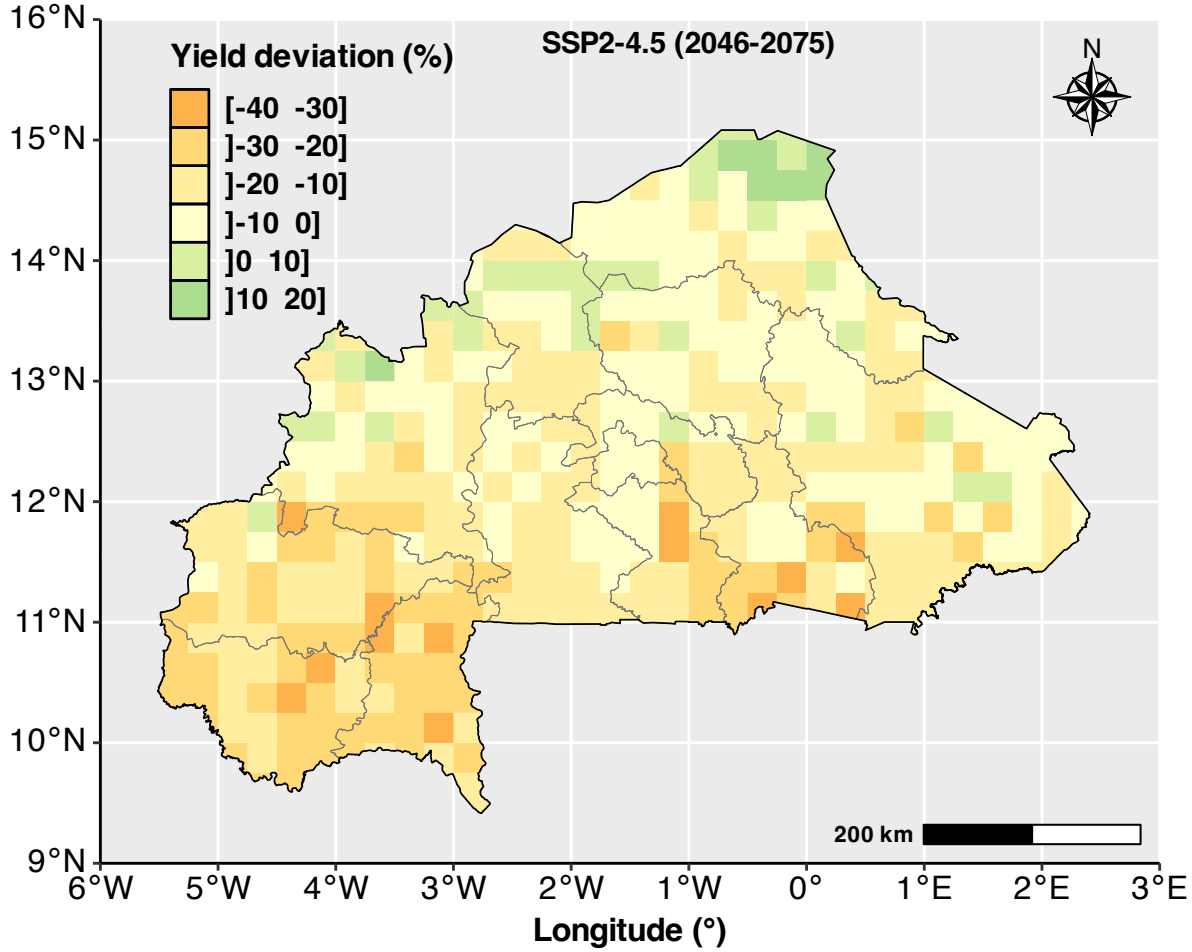




Projected annual mean temperature changes from 15 GCMs (Ensemble Mean).

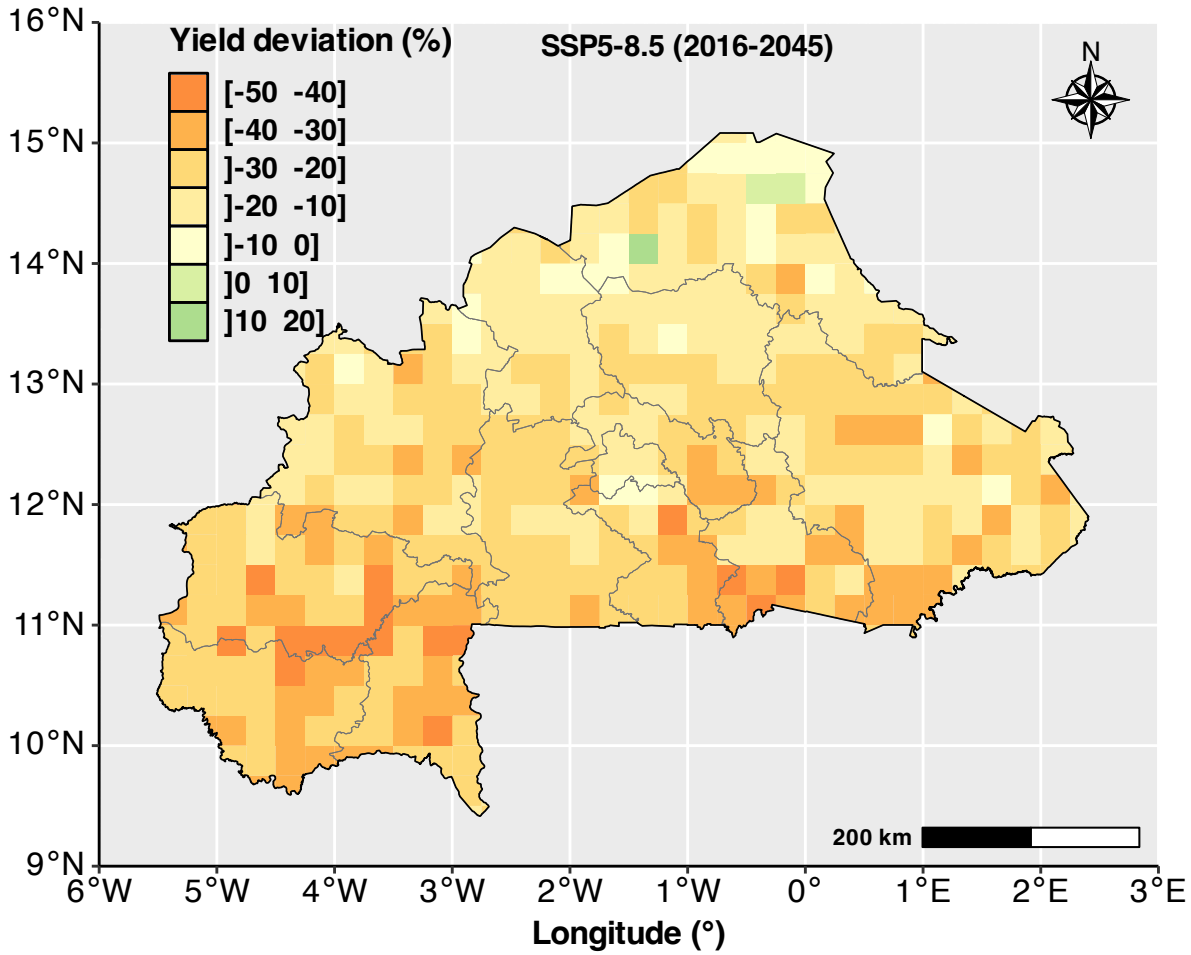
Maize Yield Changes : SSP2-4.5

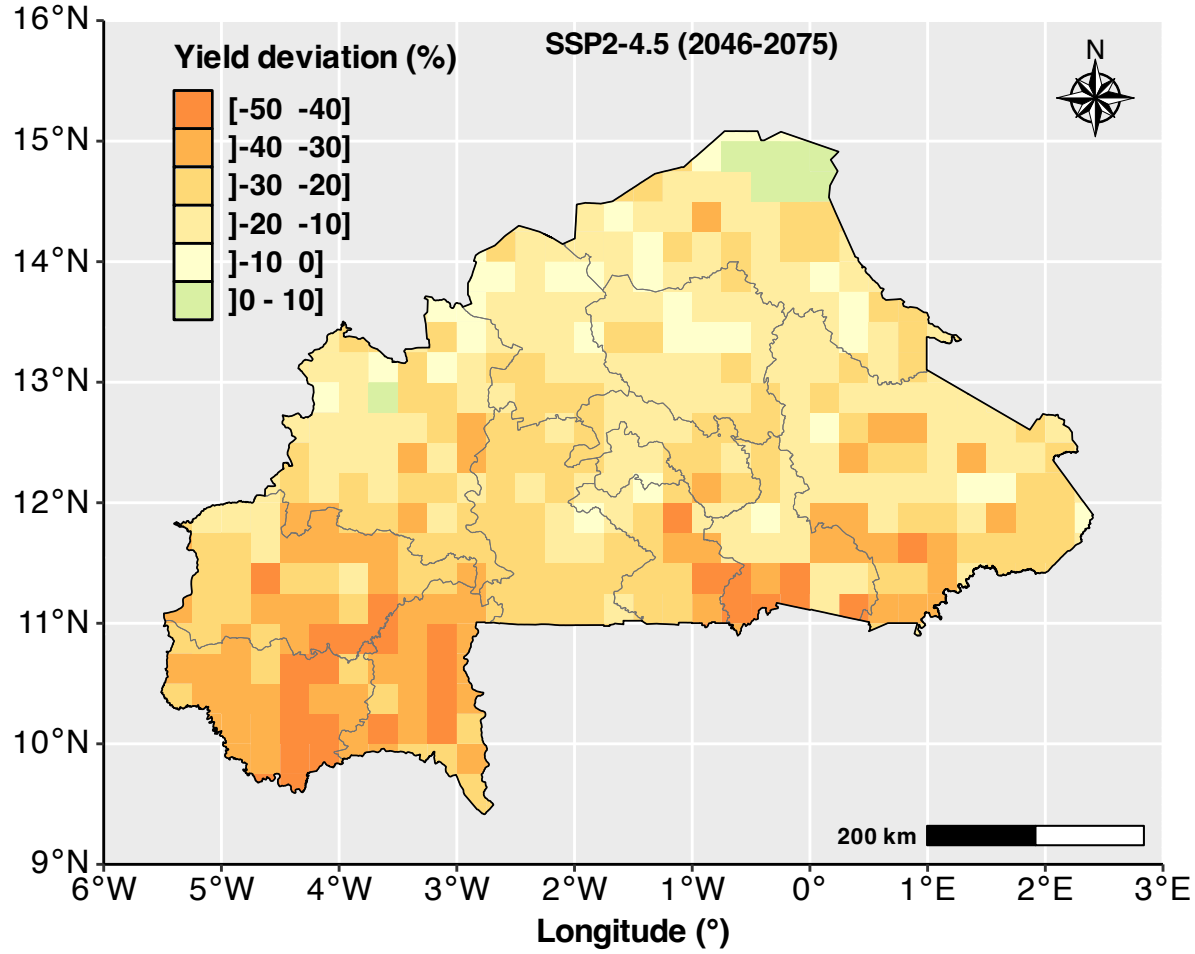




Projected Maize yield changes from 15 GCMs (Ensemble Mean).

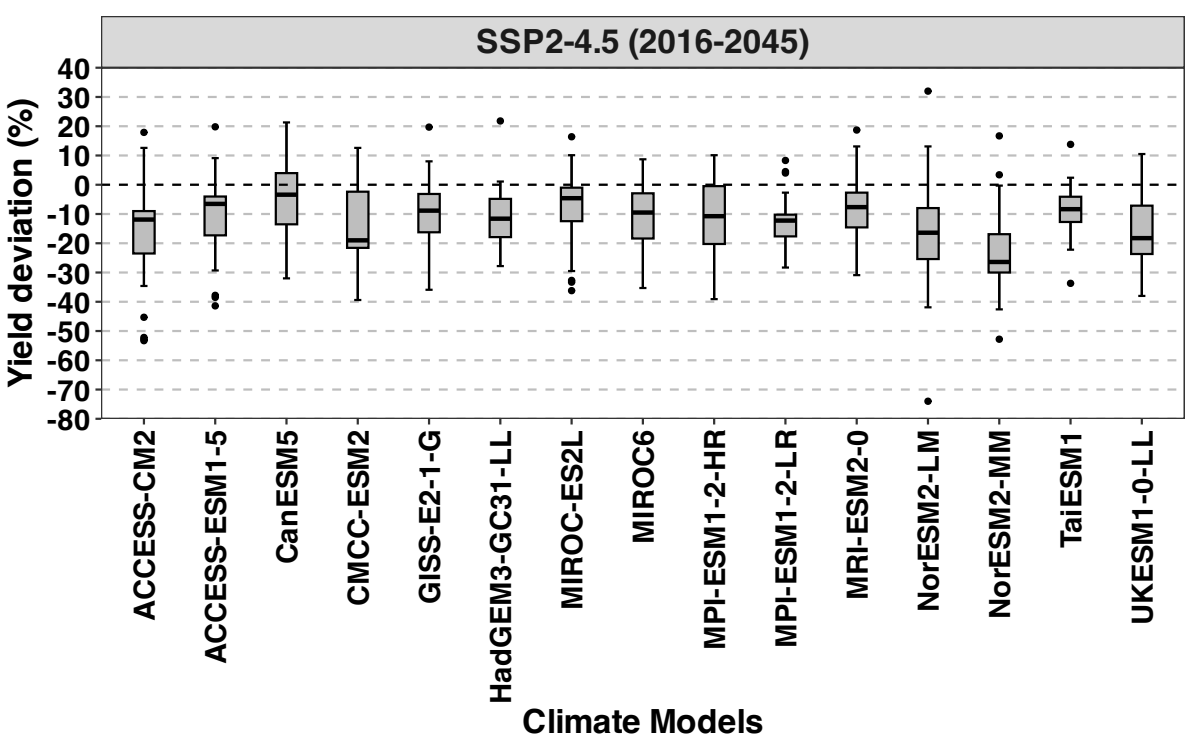
Maize Yield Changes : SSP5-8.5

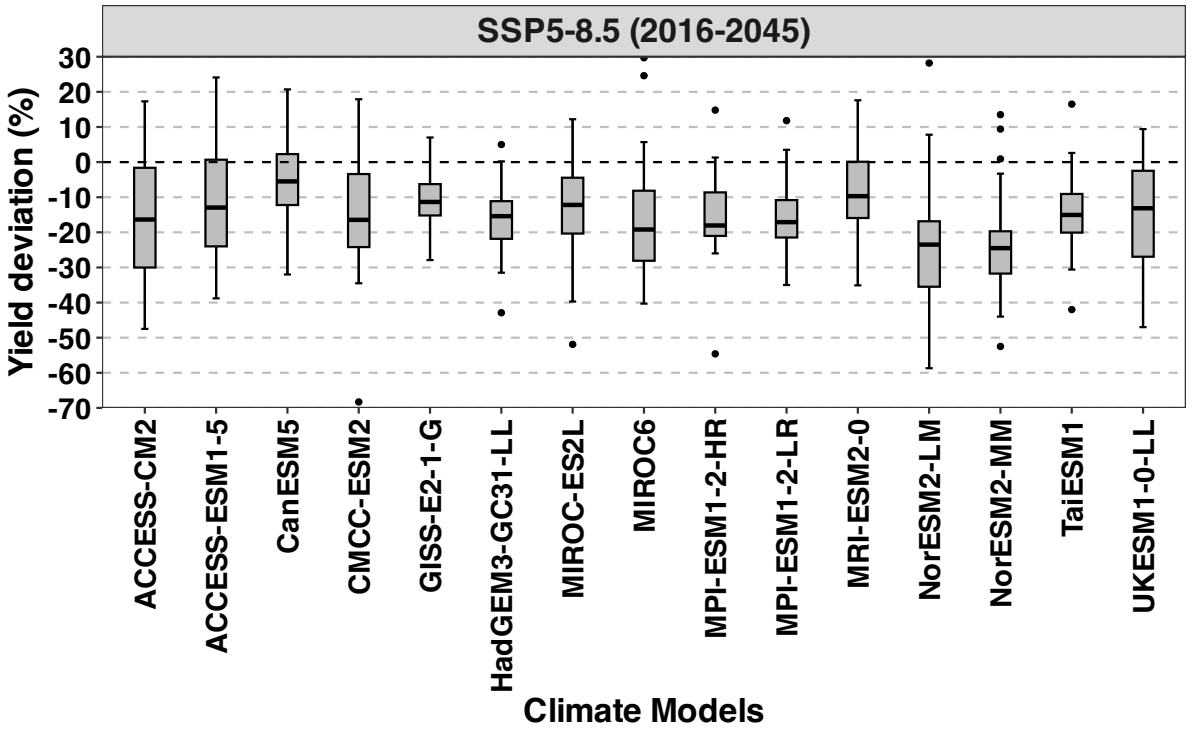




Projected Maize yield changes from 15 GCMs (Ensemble Mean)

Maize Yield Changes : SSP2-4.5 and SSP5-8.5





Variability of maize yield changes from 15 GCMs

SUMMARY AND CONCLUSION

- ✓ Significant changes in both temperature and precipitation patterns across BF, with a projected increase in mean temperature by 0.5-3° C across BF and a decrease in precipitation particularly affecting the key agricultural zone in the southwest

- ✓ Yield simulations indicate a substantial decrease in projected maize yields across the country, with reductions reaching up to 20% in the southwestern agricultural regions, under the SSP5-8.5 scenario

- ✓ It is crucial to develop and prioritize proactive adaptation strategies to enhance the resilience of farming communities in the face of these changing environmental conditions.

- ✓ Integrate a multi-crop modeling and ensemble Crop Models approach and explore a wider range of adaptation options on local scale to capture the magnitude of uncertainties.

CILSS

AGRHYMET

2024

CONFÉRENCE SCIENTIFIQUE INTERNATIONALE SUR LE CHANGEMENT CLIMATIQUE • NIAMEY (NIGER)

Thank you for your attention !