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ORGANIZING TO ADVANCE SOLUTIONS IN THE SAHEL

Climate Change in the Sahel: Potential Impacts of Afforestation

Babatunde J. Abiodun, PhD

Climate System Analysis Group (CSAG)
Department Environmental and Geographical Science
University of Cape Town (South Africa)

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West African Monsoon (WAM) and the Sahel

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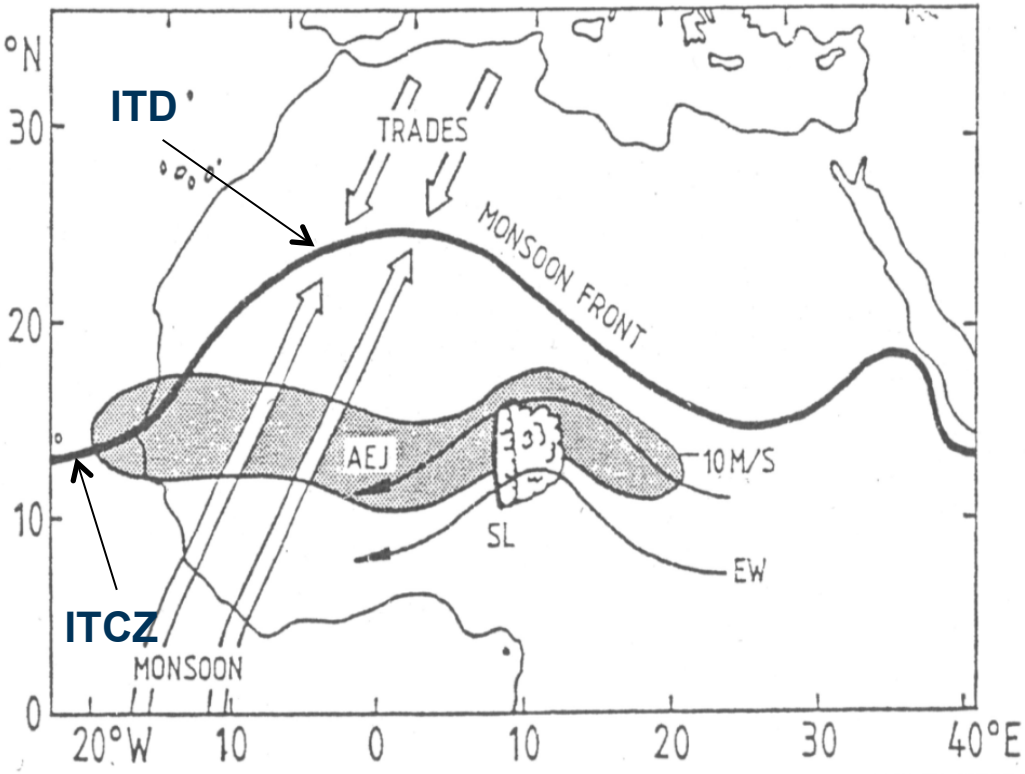
WAM is a regional seasonal prevailing wind that lasts for months.

It is caused by Land-Ocean temperature contrast

The winter monsoon produces clear weather

The summer monsoon produces precipitation



Monthly variation of monsoon system over West Africa

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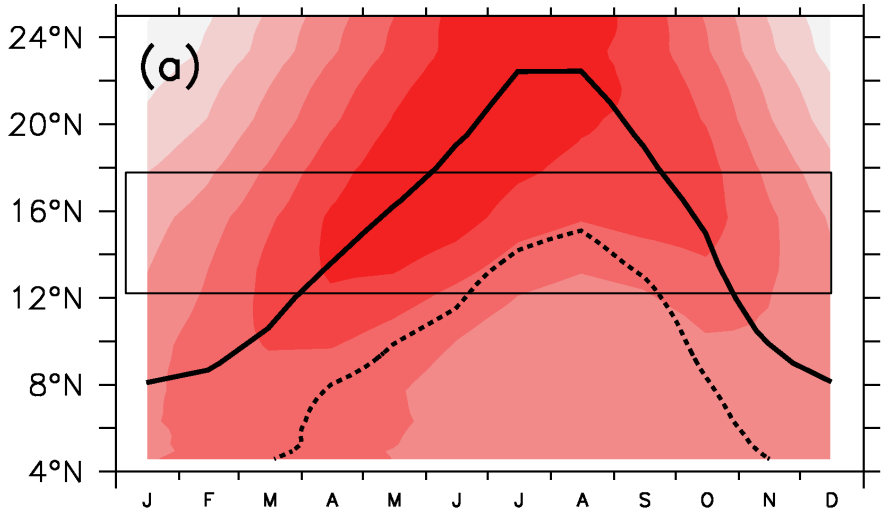
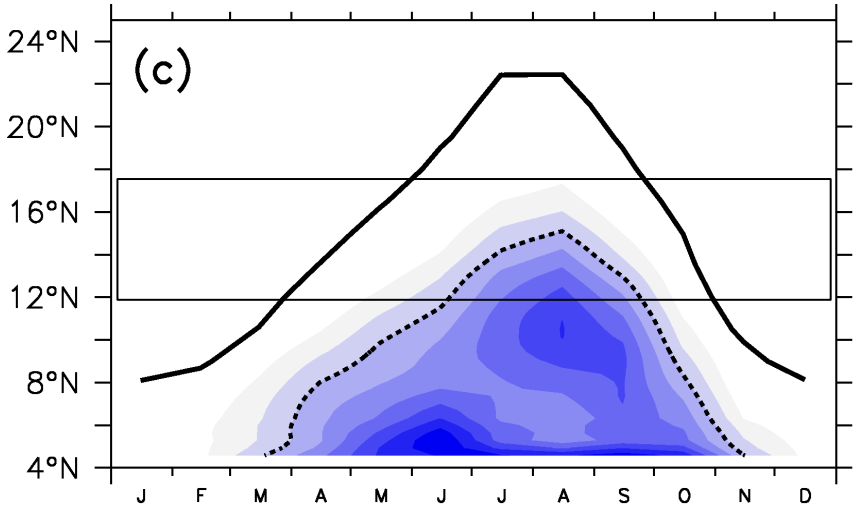
Temperature



Rainfall



Economic Importance of West African Monsoon

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Monsoon precipitation is directly tied to food production in Sahel.

Monsoon's arrival dates are eagerly watched by government planners and agronomists to determine the optimal dates for plantings.

Proper forecasting of location and quantity of precipitation from monsoon is crucial to maintaining food stocks.

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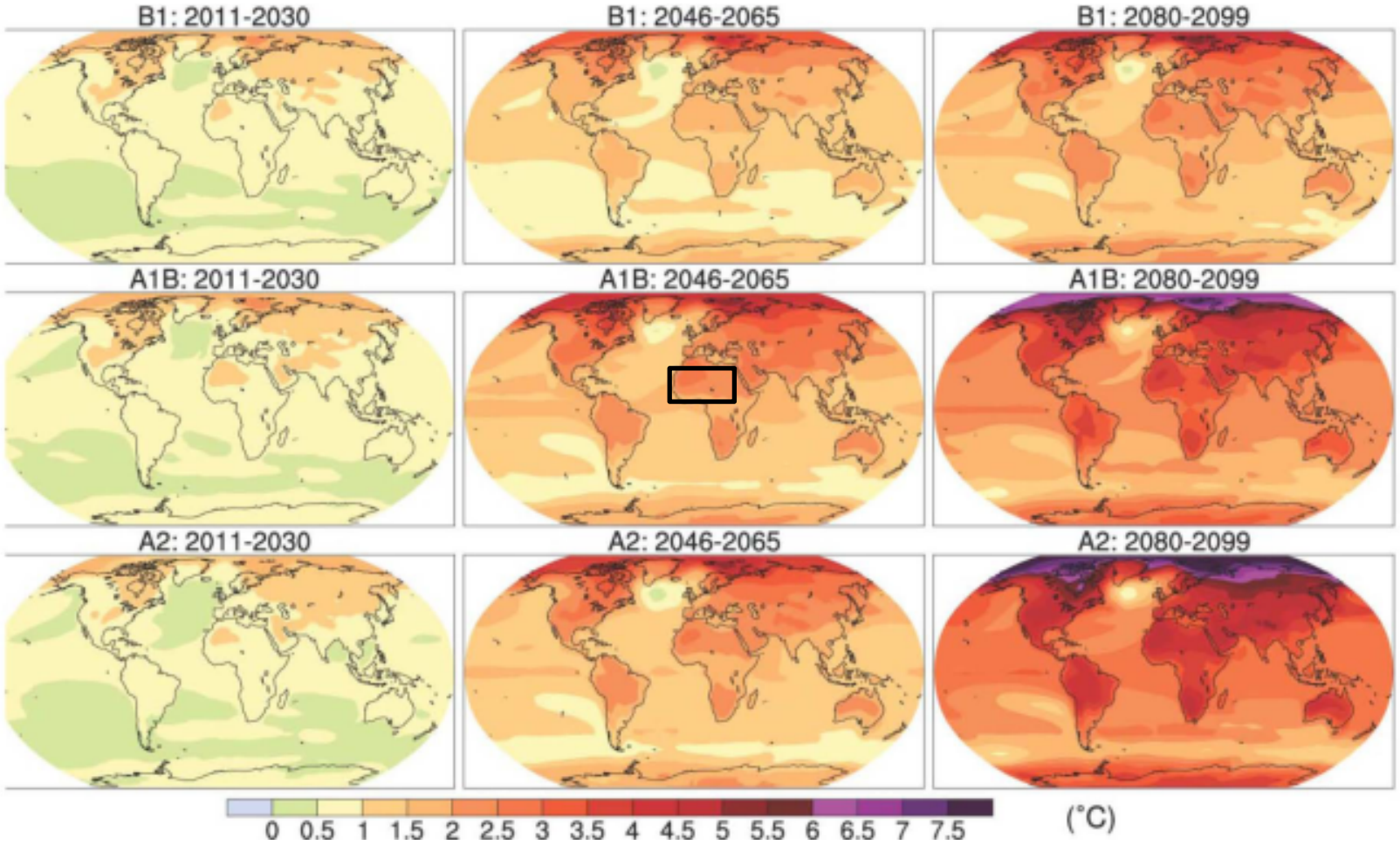
Section 1

Motivation

Multi-model mean of annual mean surface warming (surface air temperature change (°C) for scenarios B1 (top), A1B (middle) and A2 (bottom), and three Anomalies are relative to the average of the period 1980 to 1999



In each case, greater warming over most land areas is evident. Over the ocean, warming is relative large in the Arctic and along the equator in the eastern Pacific with less warming over the North Atlantic and the Southern Ocean.

Impacts of Climate Change in the Sahel

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Questions on geo-engineering approaches of mitigation

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- Can these options work?
- Can they be carried out with a reasonable cost?
- What are the side effects of implementing them?

Using afforestation to mitigate local climate in West Africa: Not a new idea!

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Brook (1928)

- Bind blowing sand
- Increase in precipitation (1% -2%)

Otterma (1974, 1977)

- Control convective precipitation

Enger & Tjernstron (1991)

- "Forest planting in semiarid, initially irrigated with aquifer water, may increase the precipitation so much that it would ultimately eliminate the need for further irrigations"

Afforestation in West Africa: Important Questions to be considered ?

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- How will the afforestation affect West African Monsoon system in future, and what are the consequences on the regional climate?
- Where are the best locations for afforestation in West Africa?

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Section 2

Research Method: Numerical Experiments

Numerical Experiments: Model Set-up

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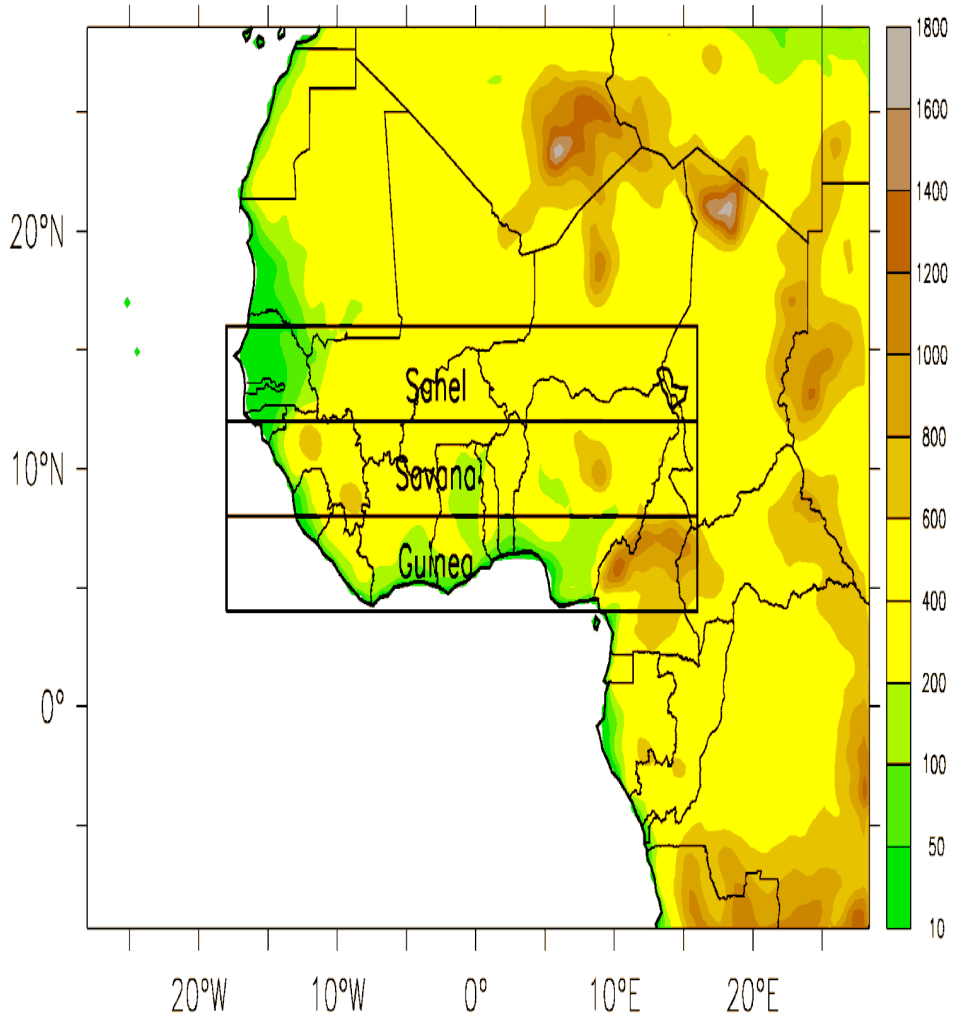
- Regional Climate Model (RegCM3, ICTP)
- Domain: (28°W-28°E; 3°S-27°N)
- Resolution: 40 km
- ECHAM5 simulation (data) for initial and boundary conditions
- Two control experiments
  - Present climate (1981-2000)
  - Future climate (2031-2050)



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Section 3

Model Validations

Temperature and Rainfall: 1981-2000

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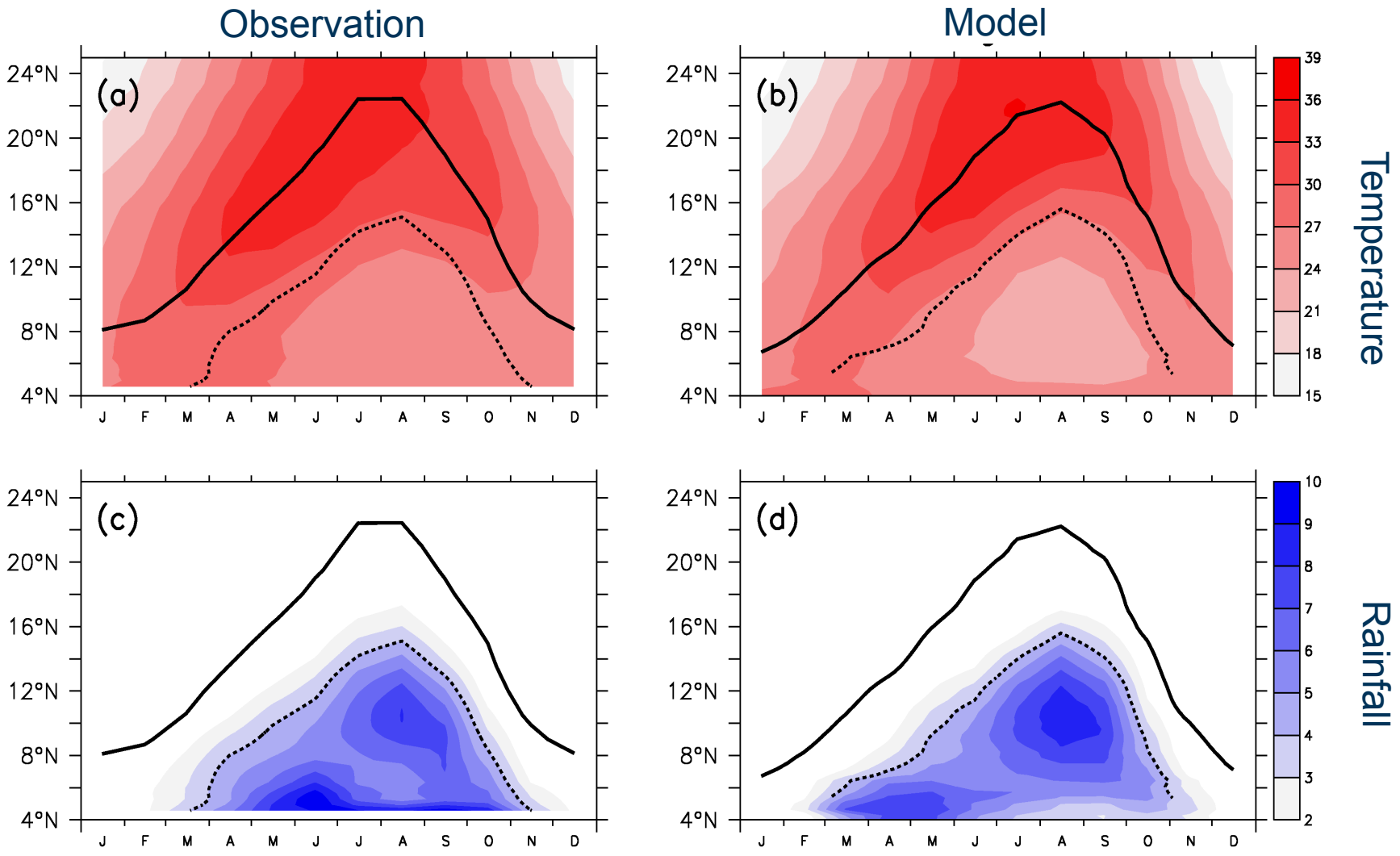

Temperature and Rainfall: June-August (1981-2000)

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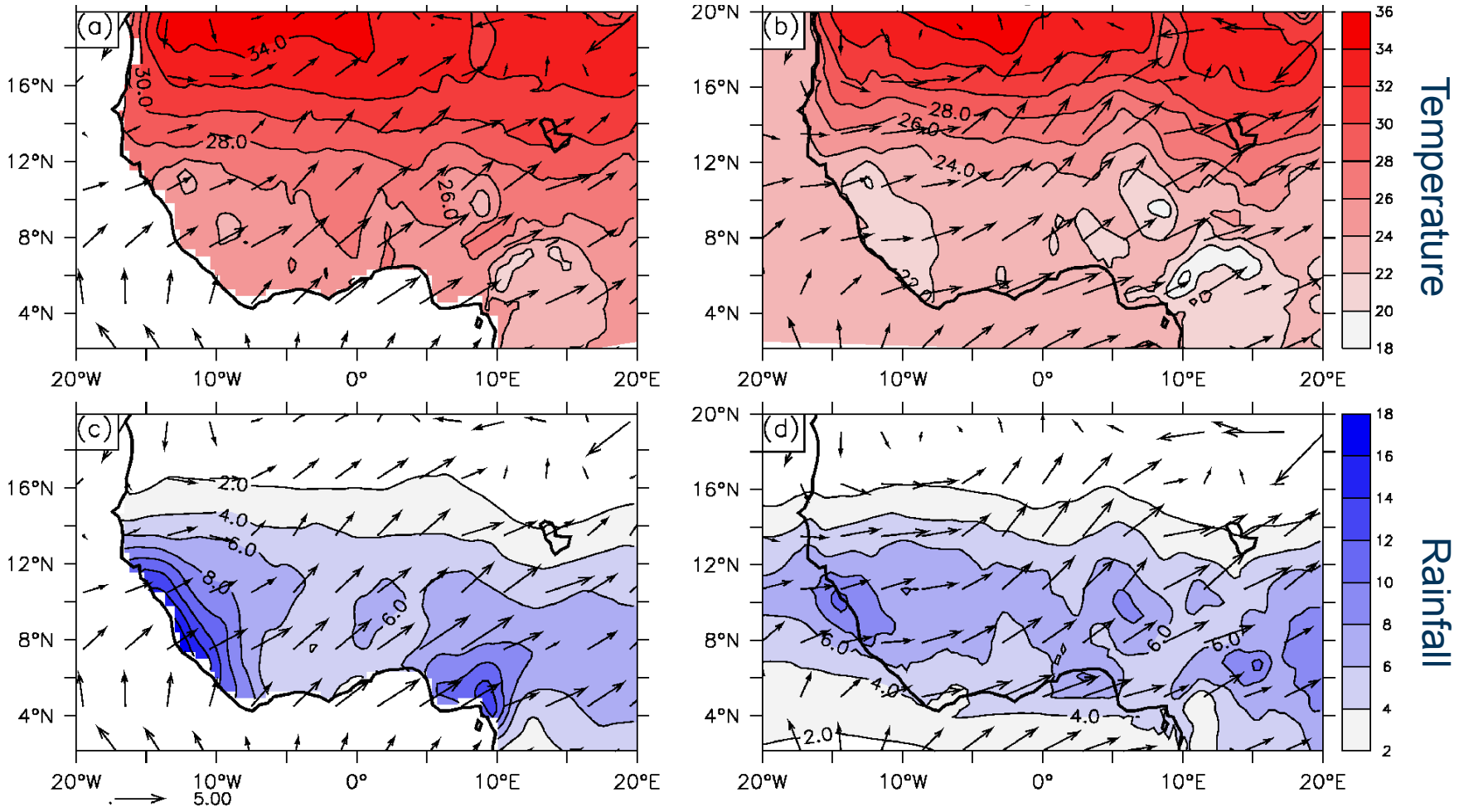
Observation

Model



Section 4

Climate Change Projections over the Sahel

Future Climate Changes: 2031-2050 under A1B scenario

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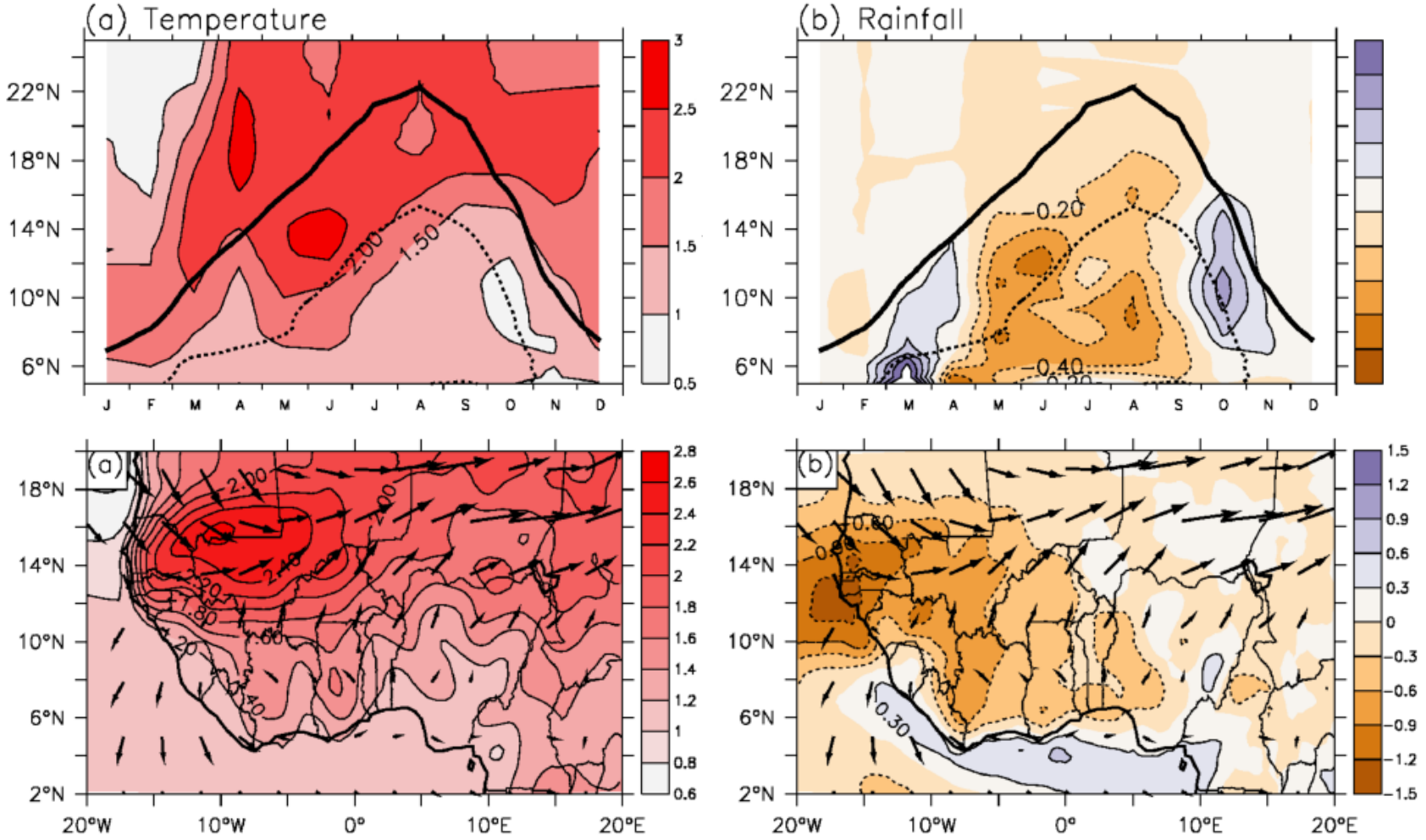

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Section 5

Impacts of Afforestation on Future Climate Change

Afforestation Experiments: Changes in Land Cover Patterns

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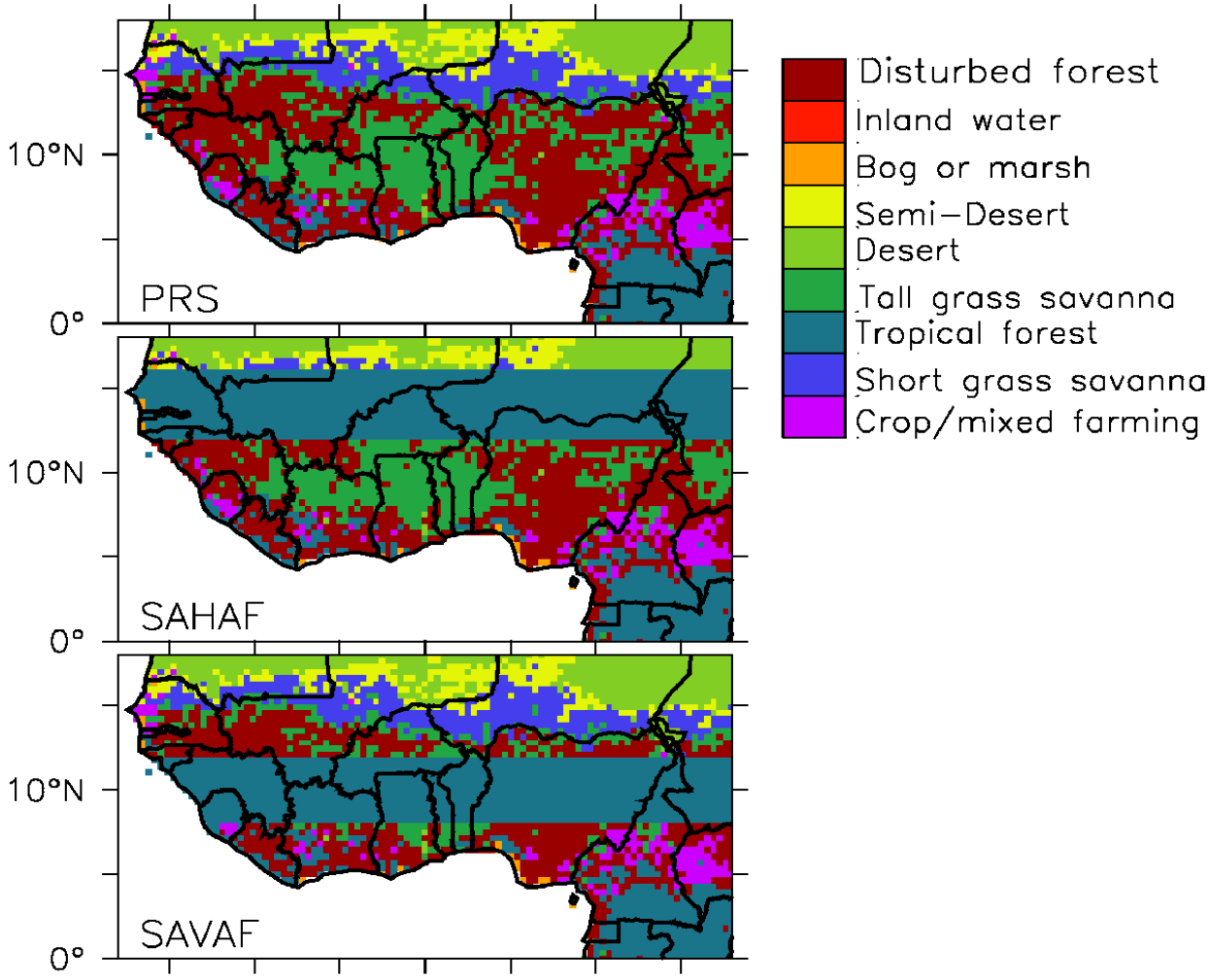

Impacts of Afforestation on Temperature

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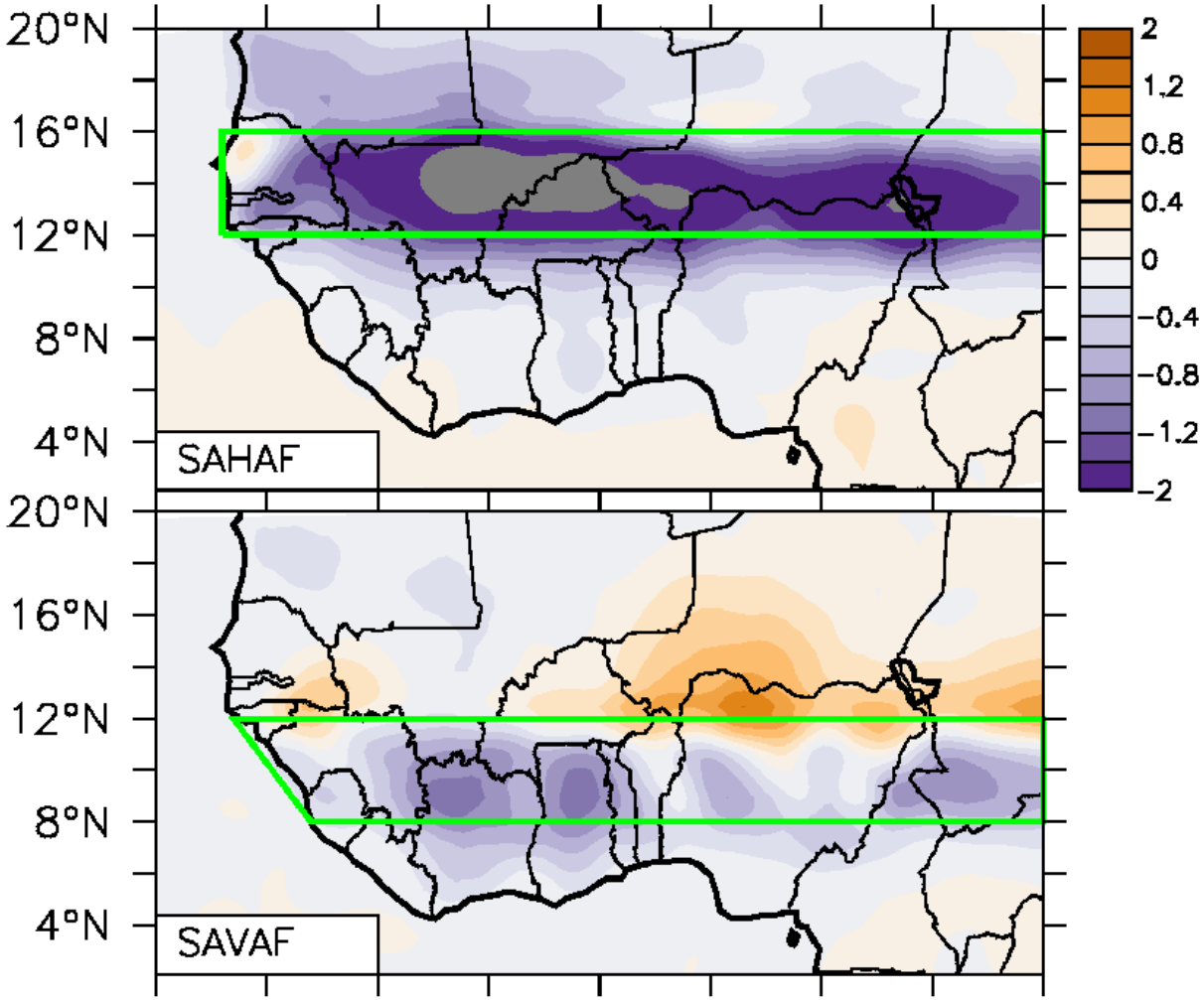

Impacts of Afforestation on Rainfall

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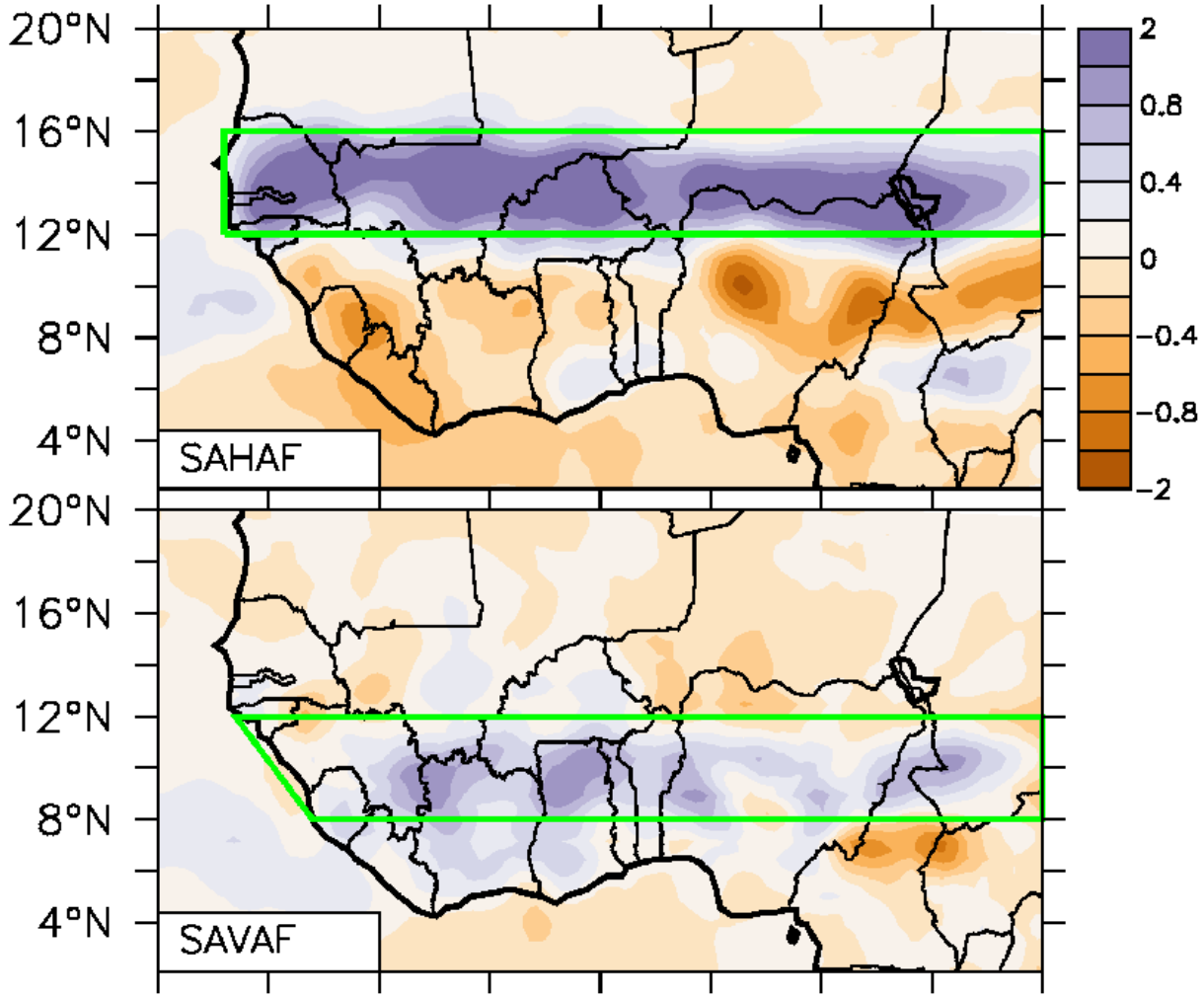

Impacts of Afforestation on Heat Waves

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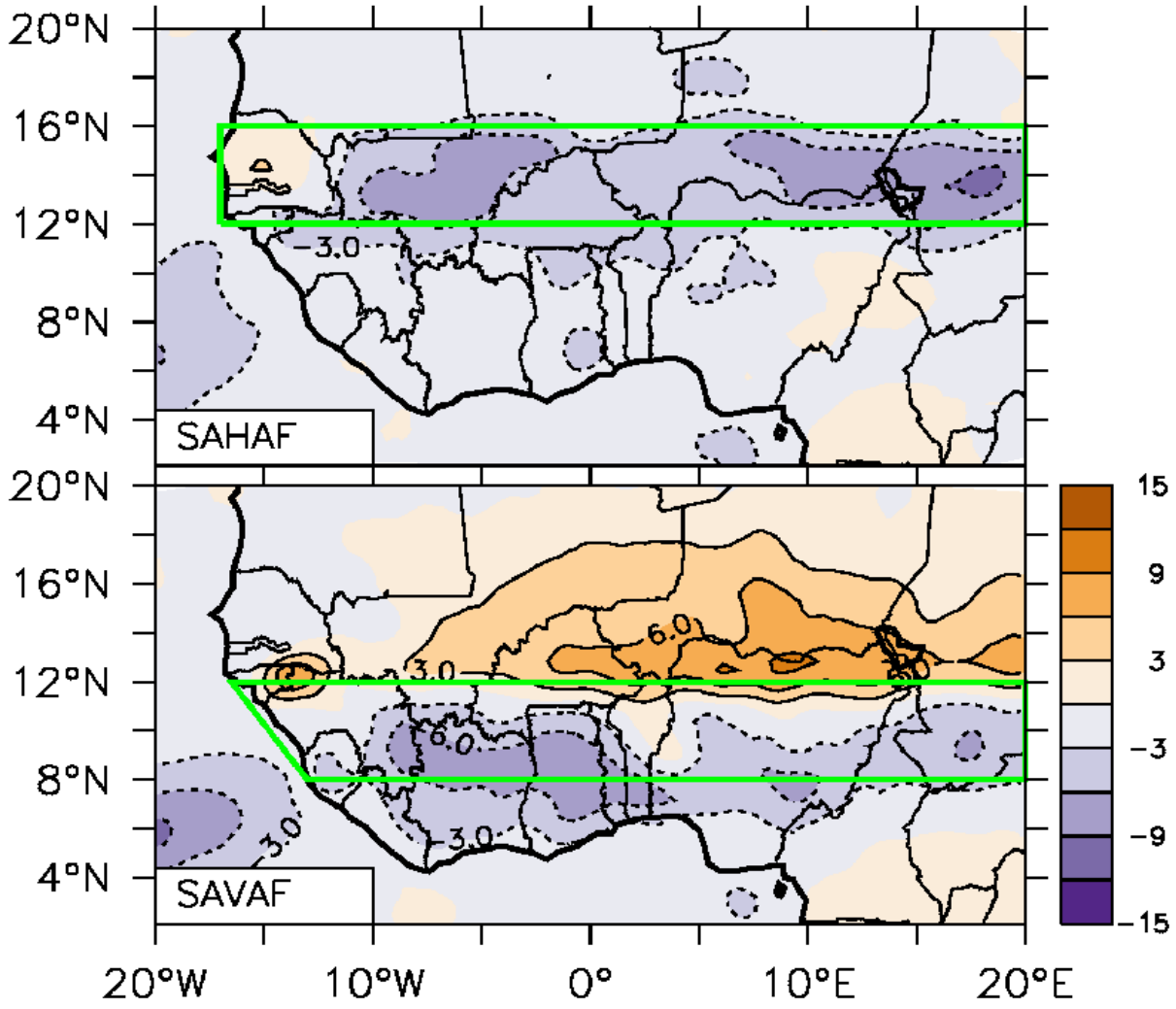

Impacts of Afforestation on Droughts

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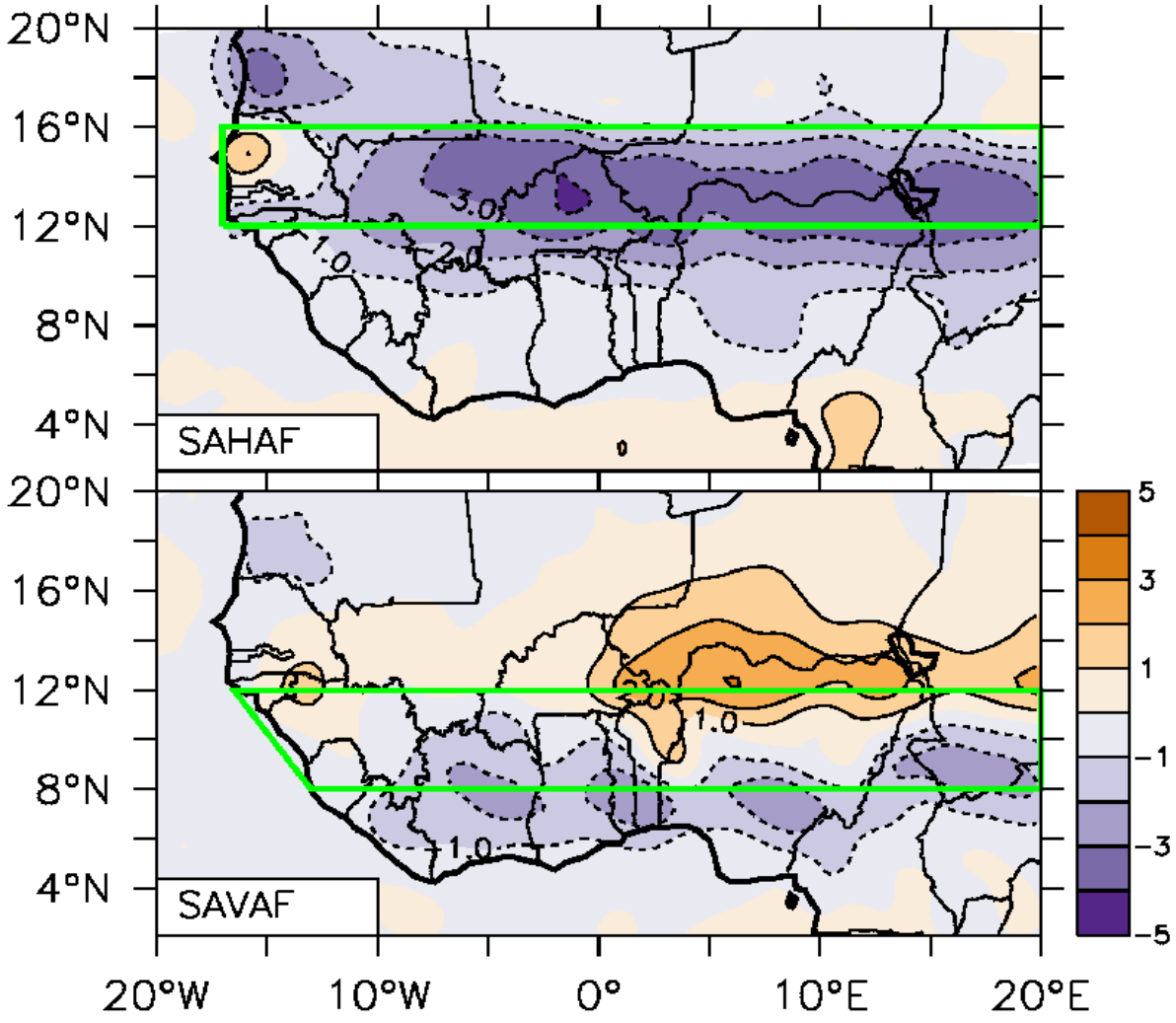

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Section 6

Afforestation in Nigeria

Land cover change experiments

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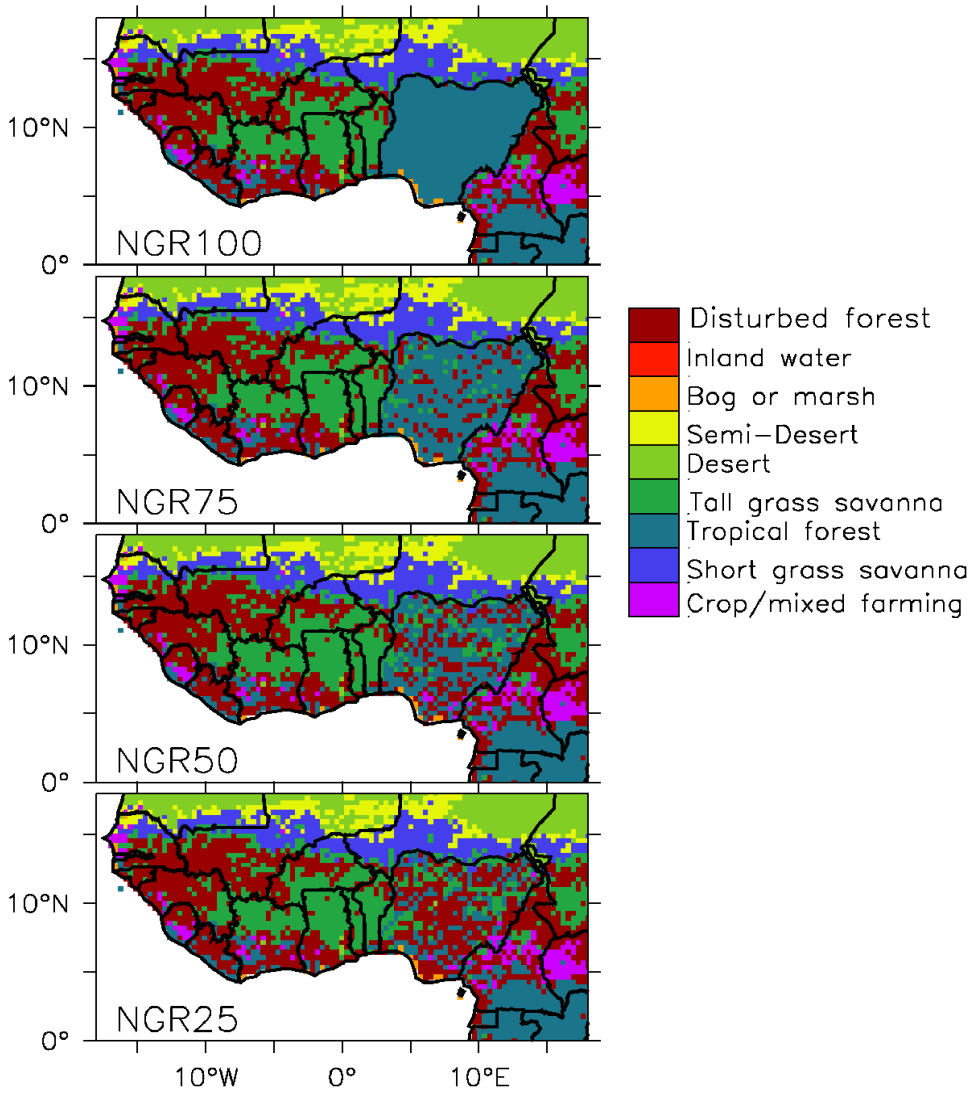

Impacts on climate

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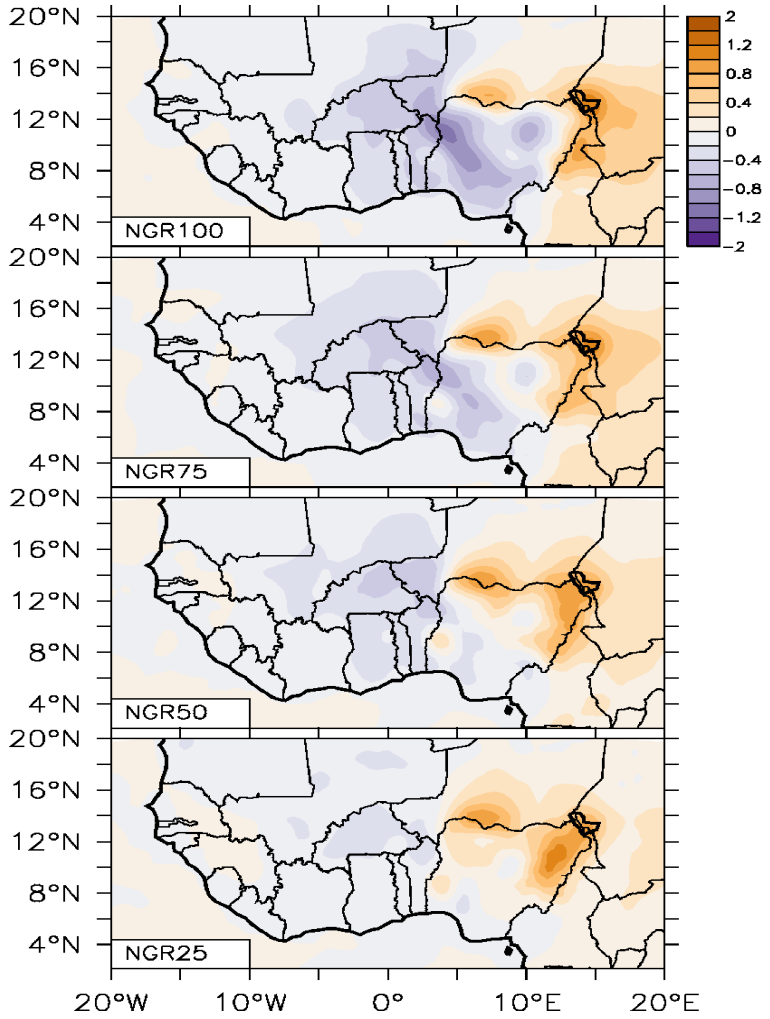
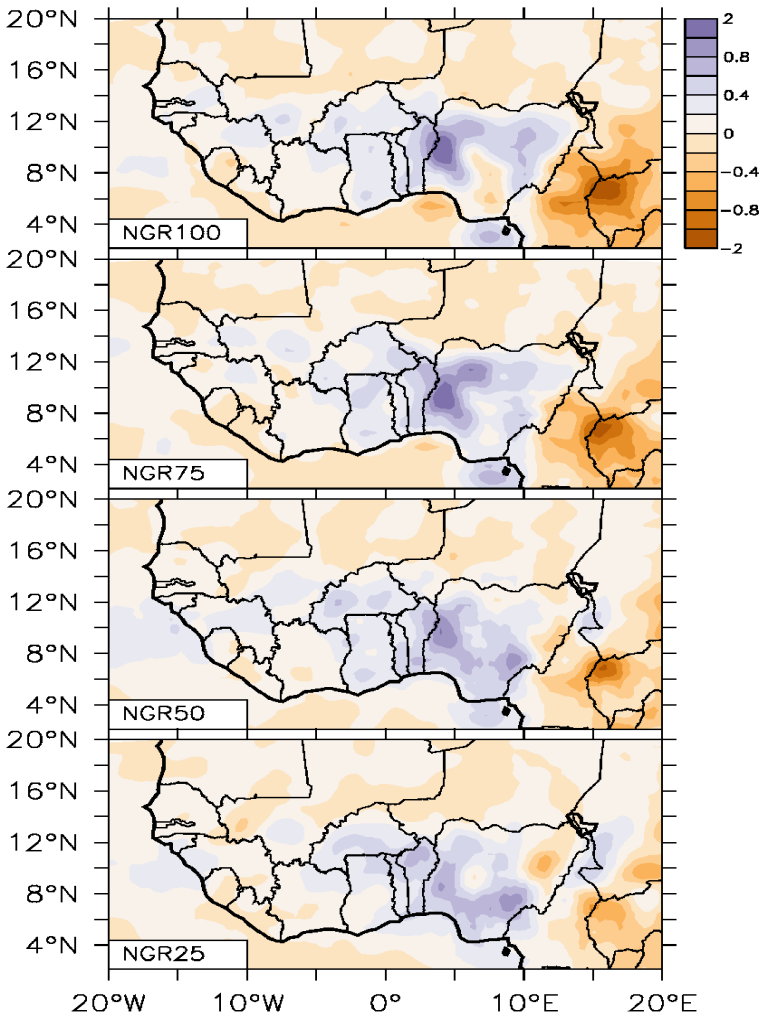
Temperature



Rainfall



Impacts on climate extremes

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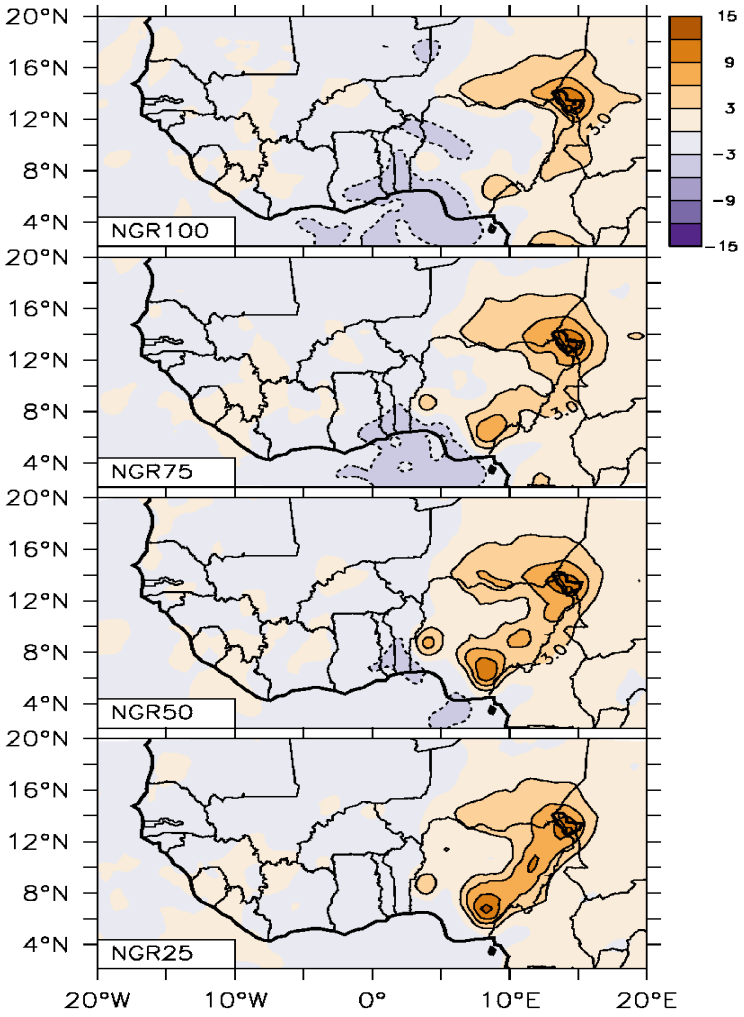
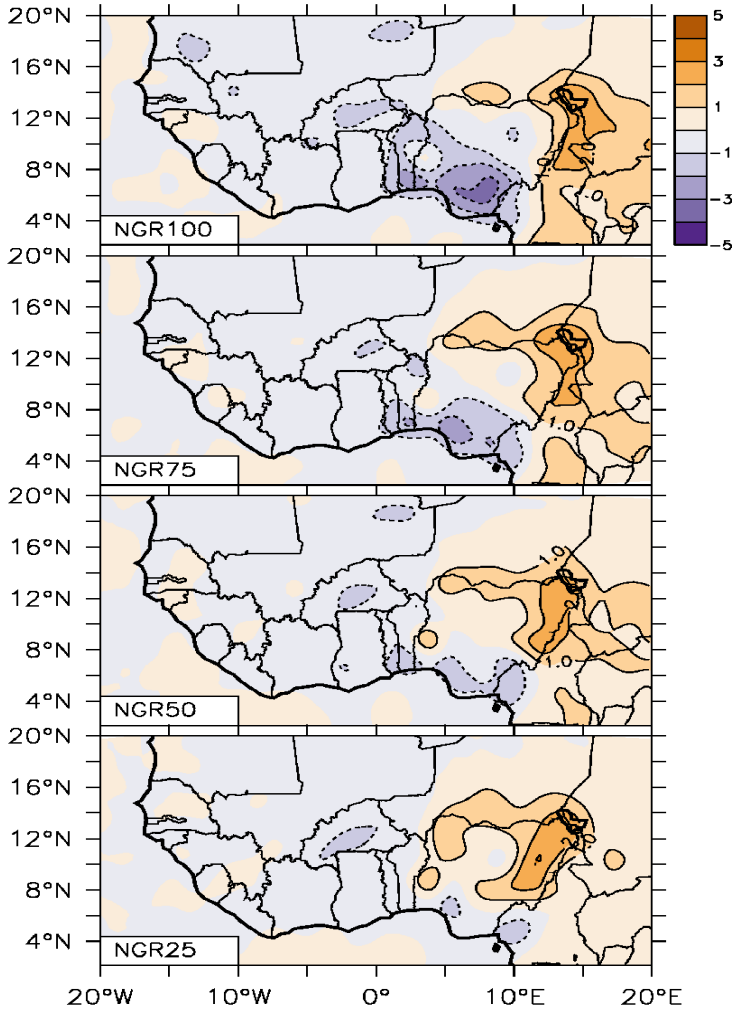
Heat Waves



Droughts



Conclusion

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Afforestation in West Africa could have both positive and negative impacts on the future climate in the Sahel, depending on the location of the afforestation.

Afforestation over the Sahel can reduce the impacts of global warming in Sahel, but afforestation over Savanna can enhance the impacts.

Afforestation in West Africa requires a mutual agreement among the West African countries because the impacts of afforestation do not recognize political boundaries.

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Thank you!