

*Africa Network Media Cafe: WATER and CLIMATE CHANGE*  
*February 15, 2022*

# Water and Climate Change in Africa

## Food for thought

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Contributing Author to IPCC AR6 WG2: Chapter 9  
Contributing Author to the IPCC SR1.5: Chapter 3

# Outline

Climate Change

Climate Change and Water Resources

Case Study: West Africa

Conclusion

# I/ Climate Change

## Climate change

→ Global issue with strong regional implications

■ Refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period, usually decades or longer.

**CCC:** Change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods

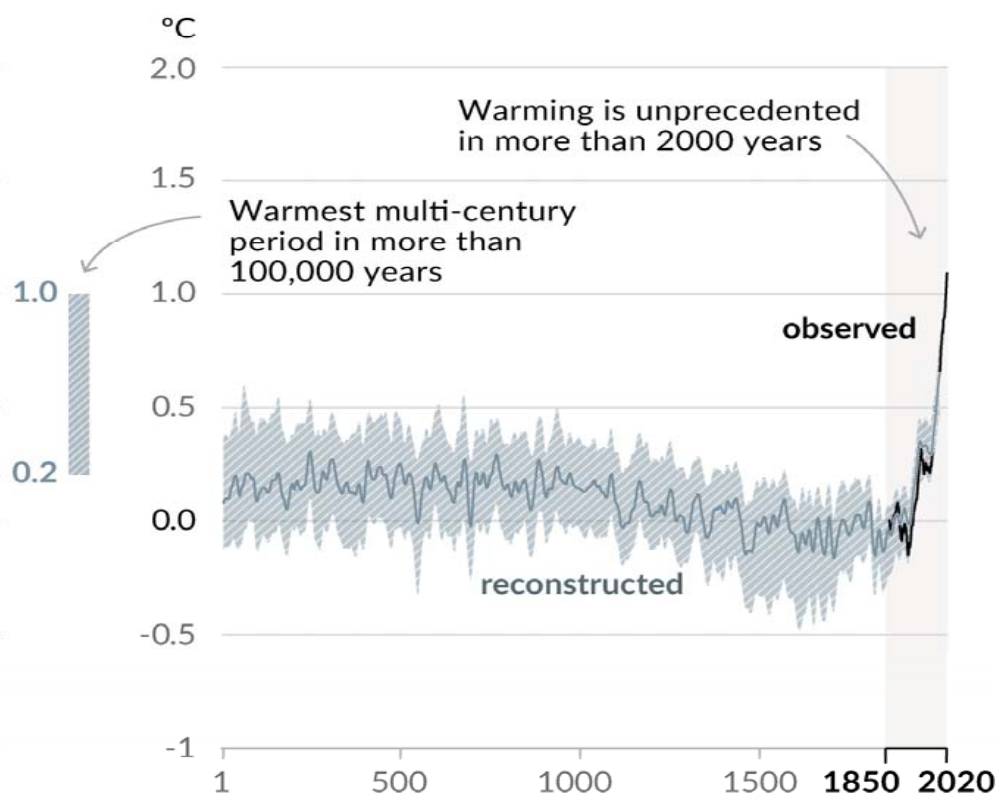
# I/ Climate Change

## Global considerations

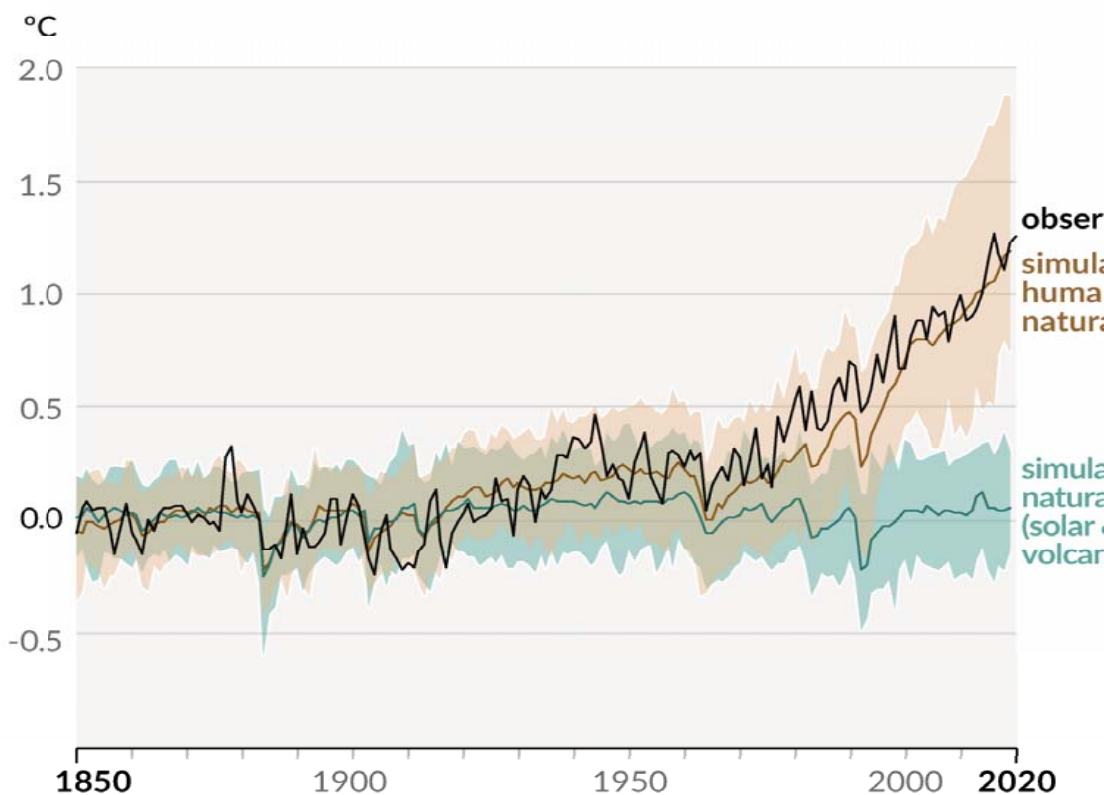
Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

Changes in global surface temperature relative to 1850-1900

a) Change in global surface temperature (decadal average) as **reconstructed** (1-2000) and **observed** (1850-2020)



b) Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and **only natural** factors (both 1850-2020)

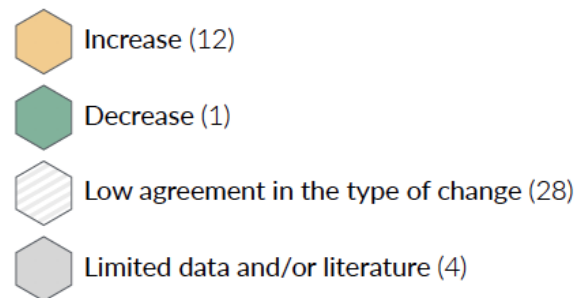


# I/ Climate Change

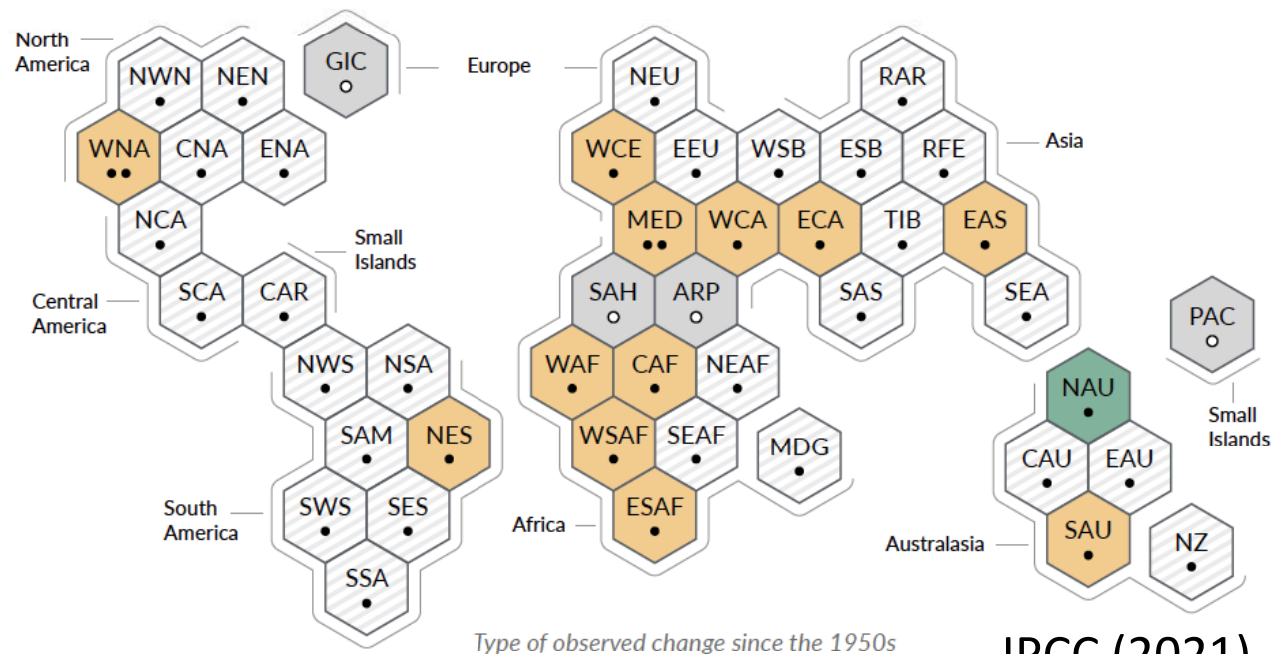
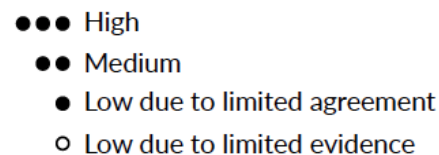
Climate change is already affecting every inhabited region across the globe, with human influence contributing to many observed changes in weather and climate extremes.

c) Synthesis of assessment of observed change in **agricultural and ecological drought** and confidence in human contribution to the observed changes in the world's regions

Type of observed change  
in agricultural and ecological drought



Confidence in human contribution  
to the observed change

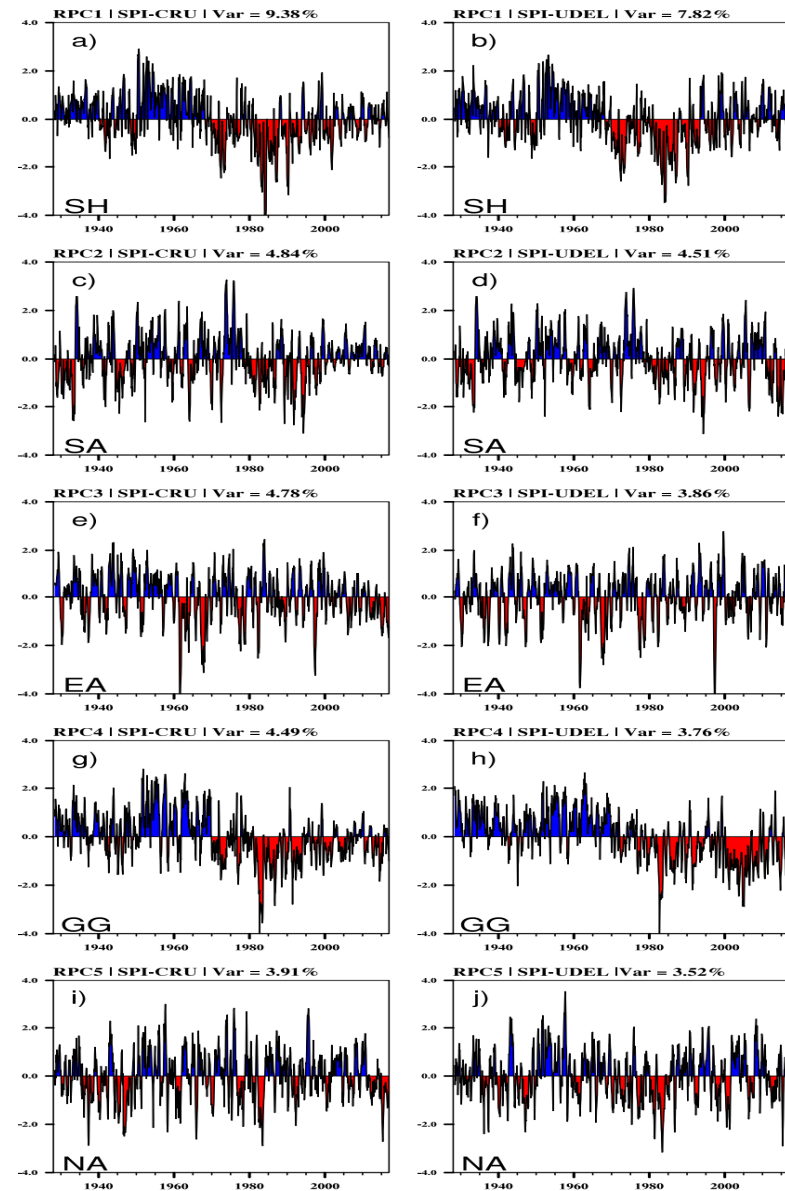
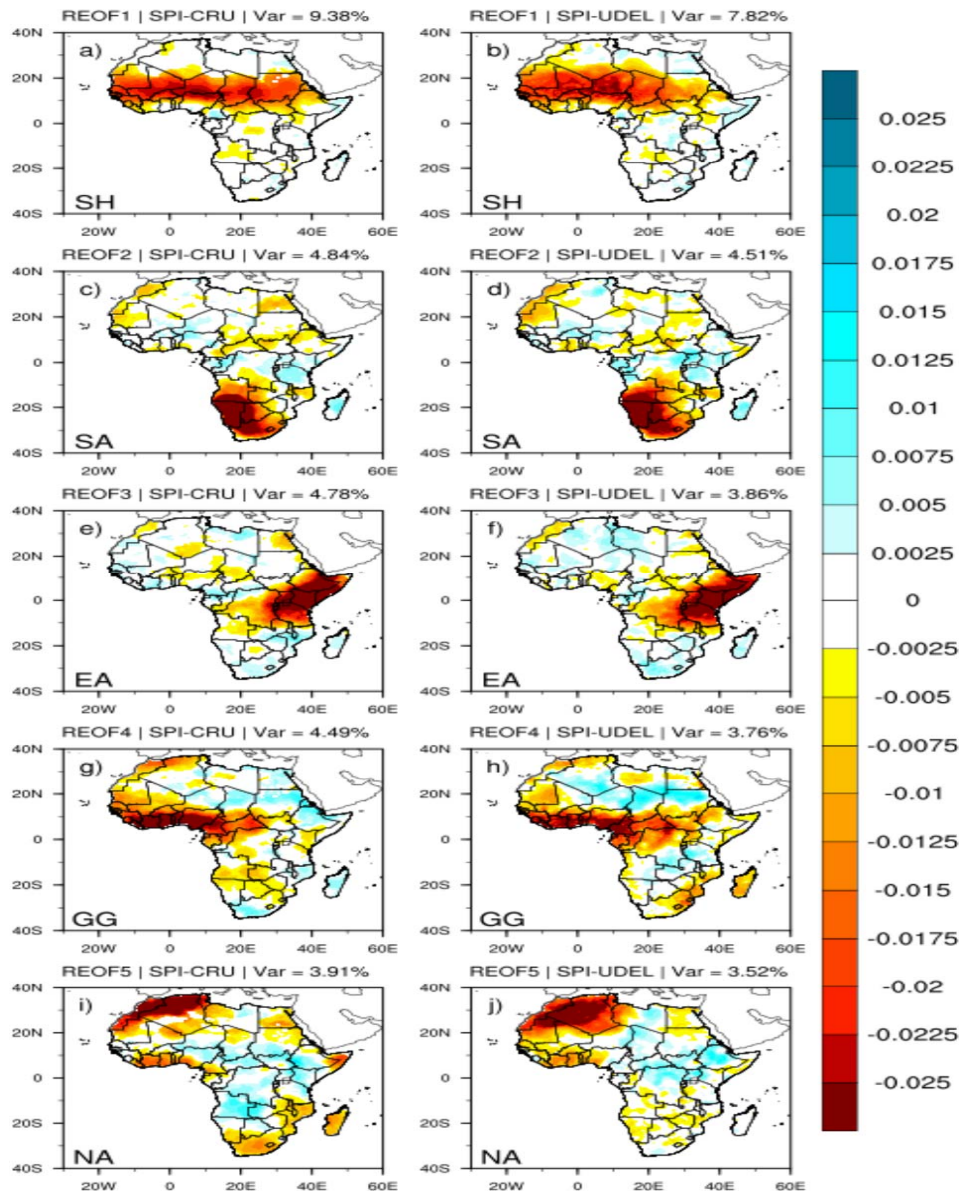


Human-induced climate change has contributed to increases in agricultural and ecological droughts in many regions due to evapotranspiration increases (*medium confidence*).



# I/ Climate Change

ights

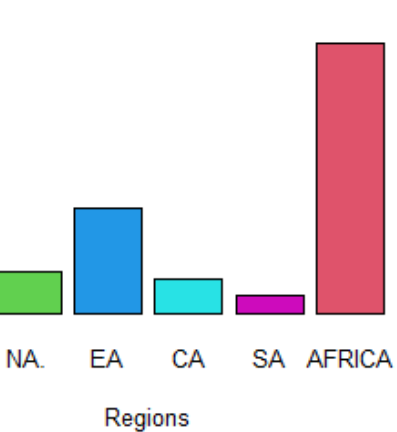


Tall et al.

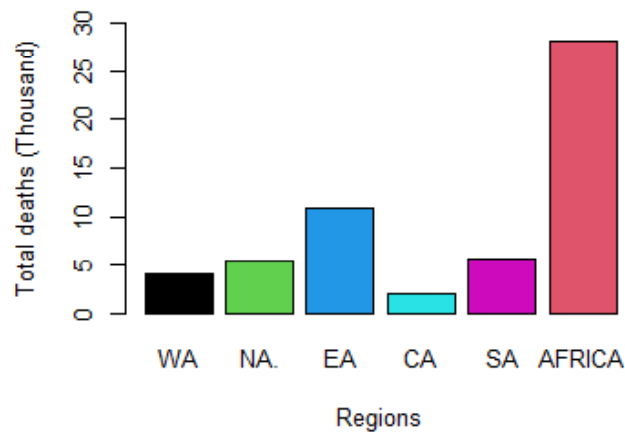
# I/ Climate Change

oods

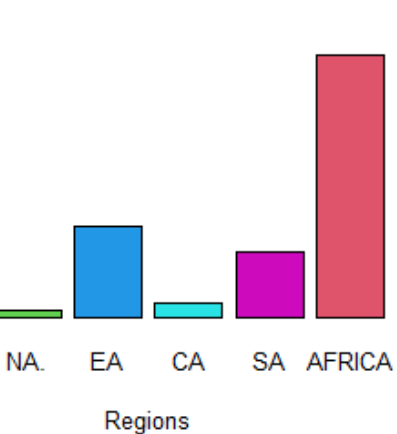
a) Total flood events



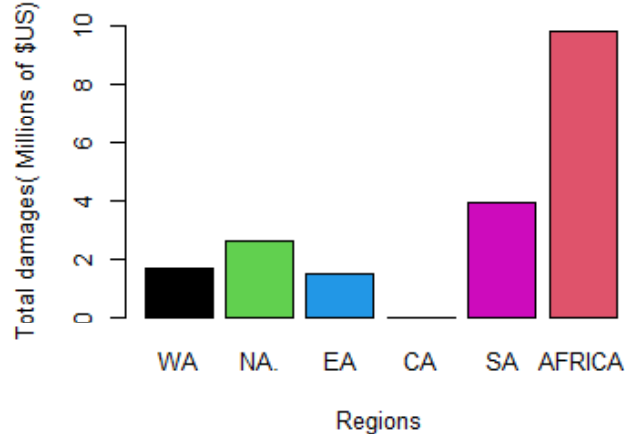
b) Total deaths



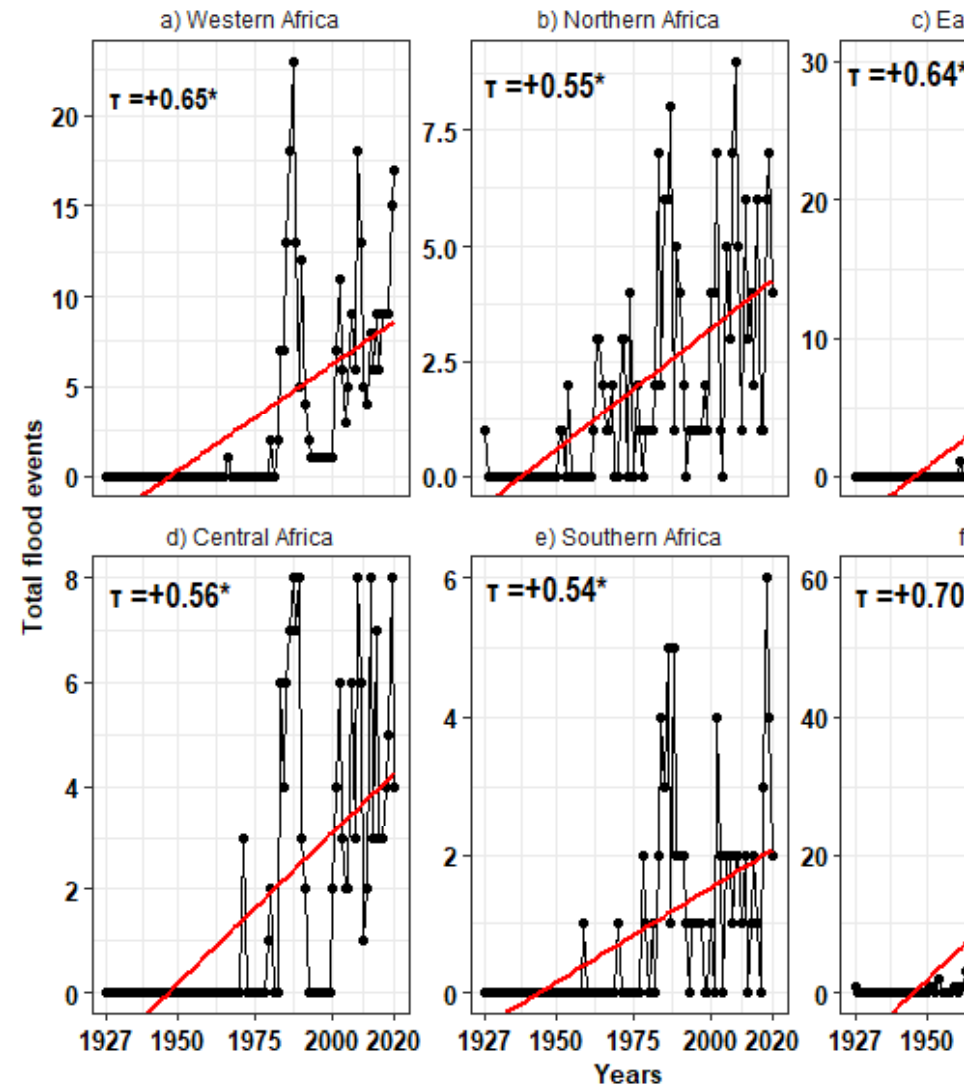
Total affected peoples



d) Total damages



Total flood events between 1927 and 2020



Djanna et al. 2022

# II/ Climate Change and Water Resources

Water resources: sources of water potentially useful for humans

**Rivers**

**Lakes**

**Aquifers**

**Wetlands**





# II/ Climate Change and Water Resources

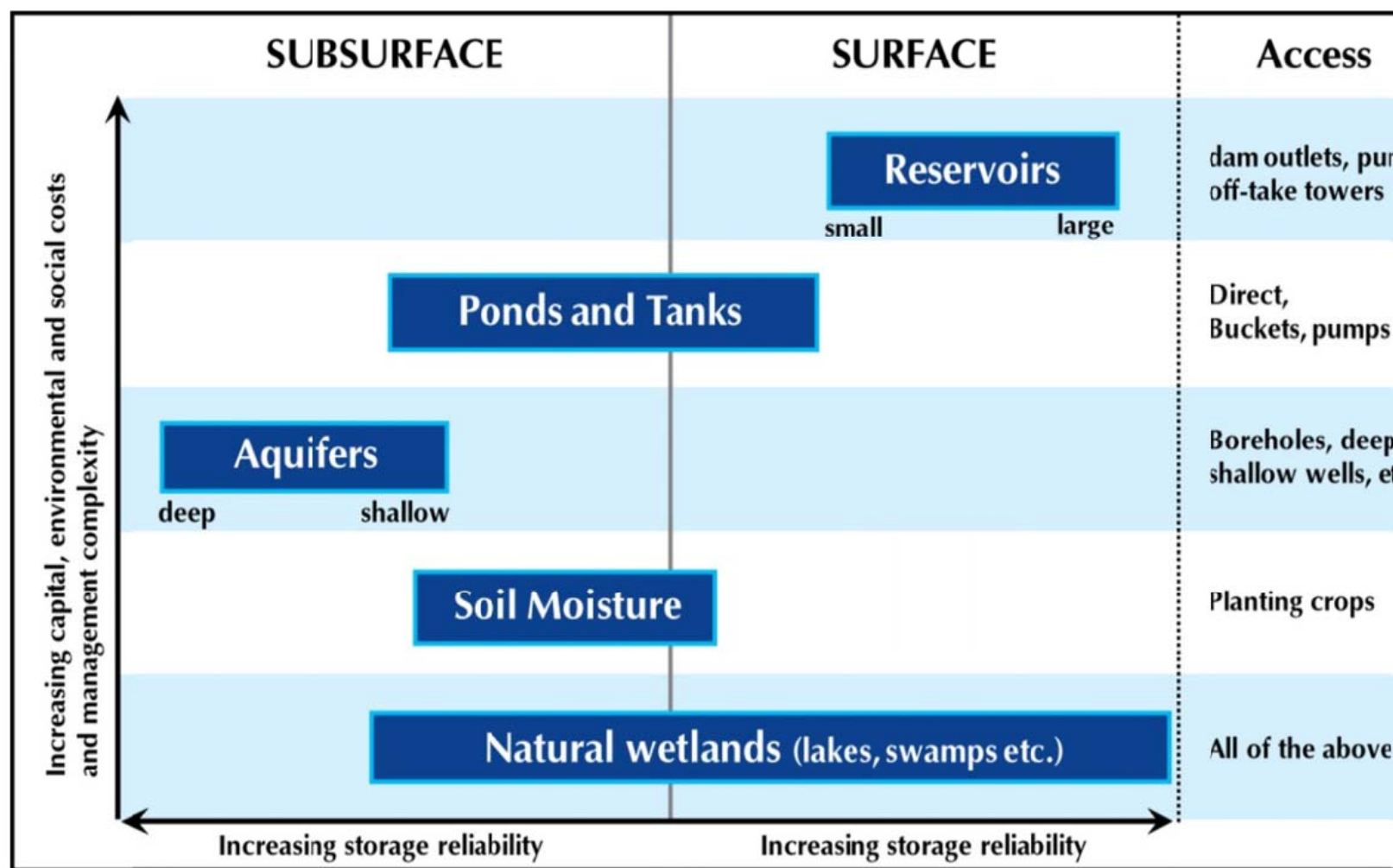
**Water resources:** accessed and used for

domestic

dropower

riculture

dustry



# II/ Climate Change and Water Resources

## Useful Definitions

**Water deficit:** Water deficits occur when water **demand** exceeds **supply**

**Water scarcity:** Lack of supply. It is calculated as the ratio between human water consumption to available water supply in a given area

**Physical scarcity:** unavailability due to physical shortage

**Institutional scarcity:** inaccessibility due to the failure of institutions to ensure a regular supply

**Infrastructure scarcity:** due to a lack of adequate infrastructure

**Water stress:** broader and refers to the inability to meet human and ecological demand for water.

**Water security:** it considers water scarcity, but also water quality, environmental flow, and the accessibility of water.

# II/ Climate Change and Water Resources

## Major components of the Water cycle

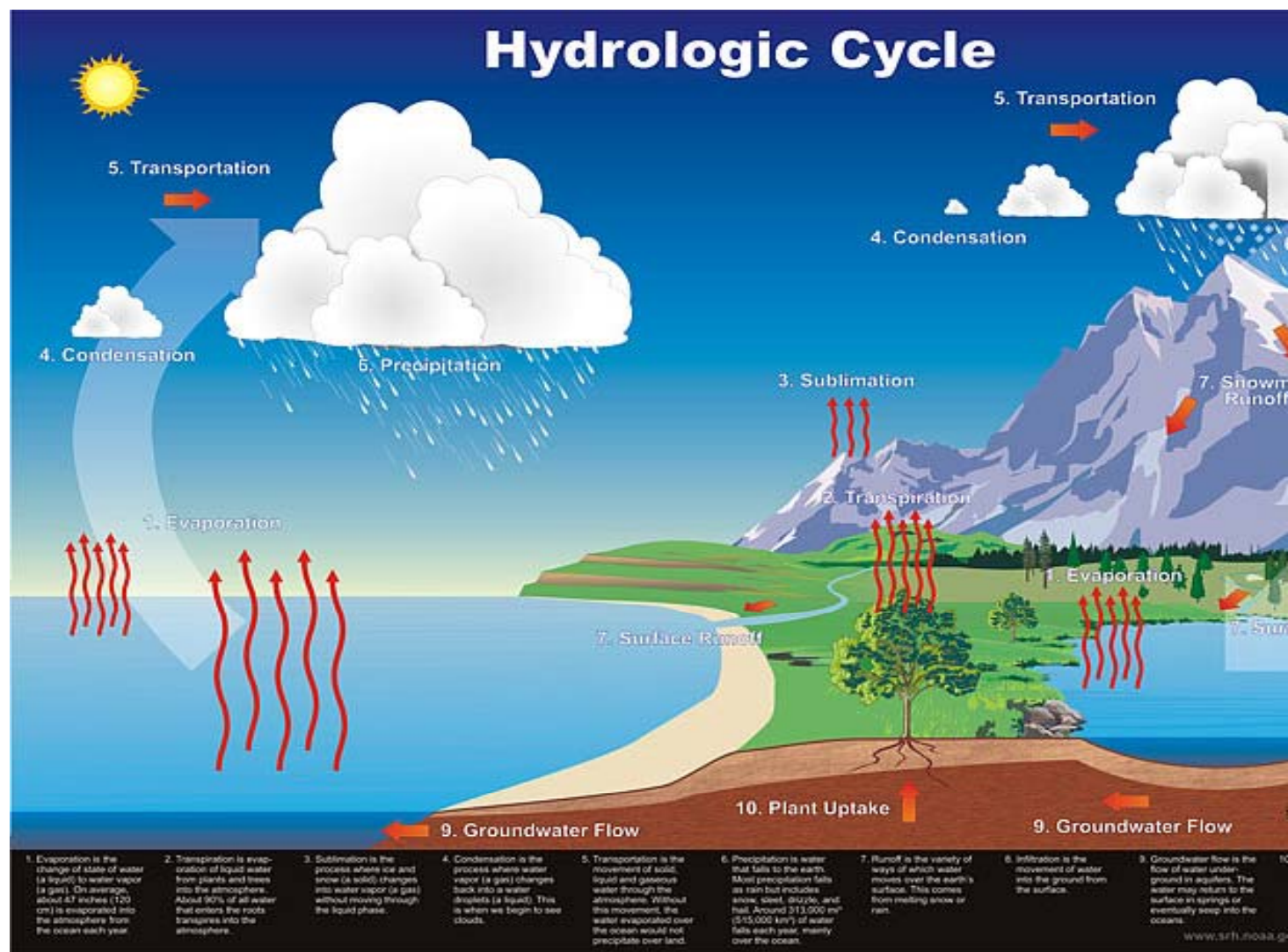
Precipitation

Evaporation &  
Transpiration

Atmospheric transport

Surface runoff and ground  
water flow

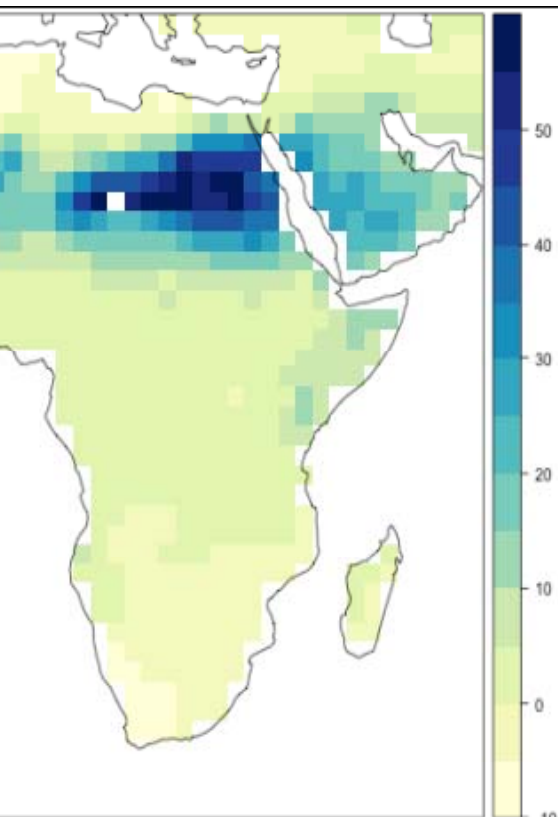
Water reservoir (ocean,  
glacier, soil water,



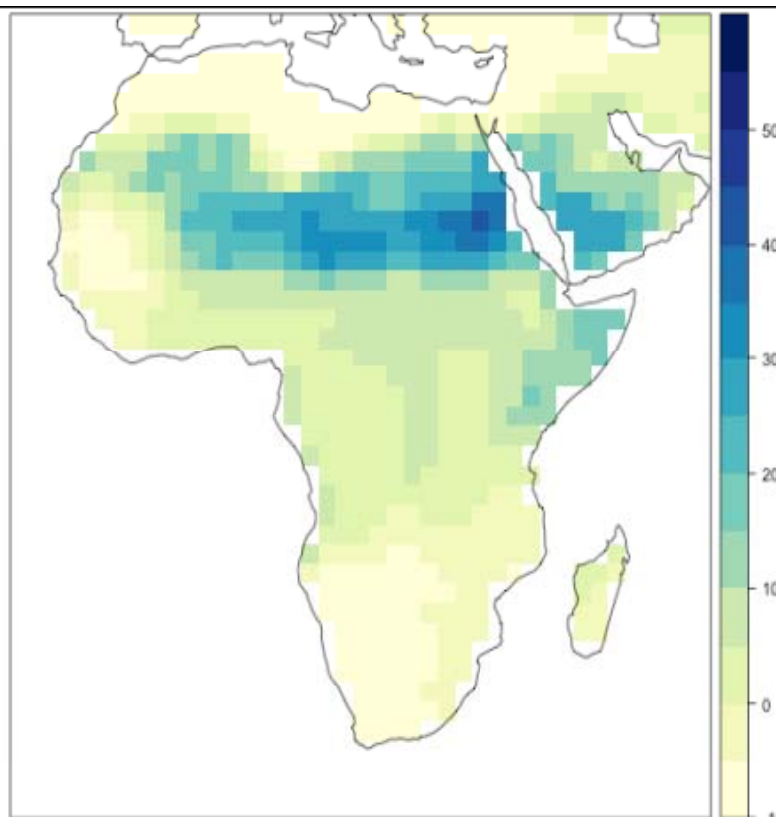
# II/ Climate Change and Water Resources

## Future Precipitation change

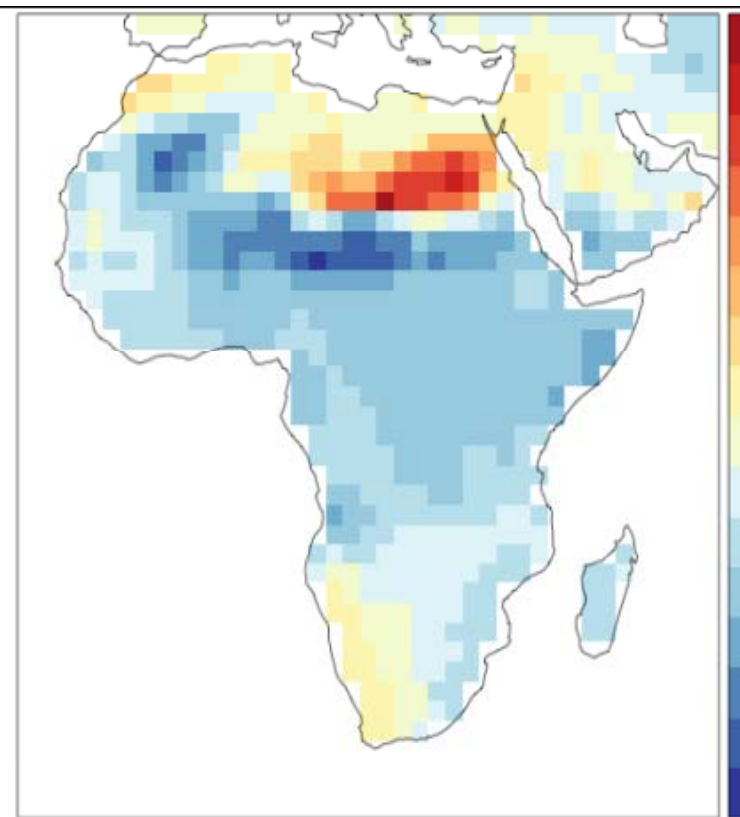
**Near Future**



**Far Future**



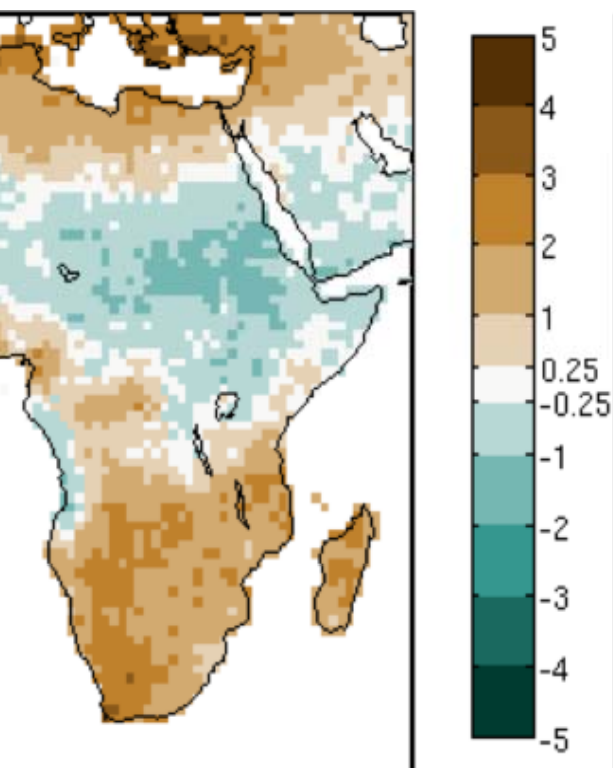
**Diff**



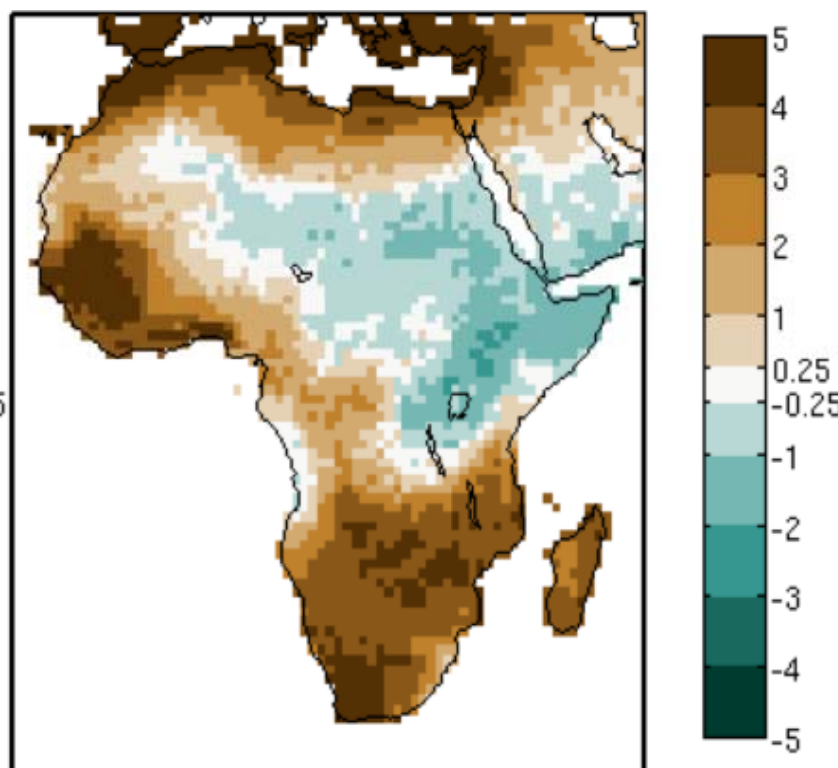
# II/ Climate Change and Water Resources

## Future Drought change

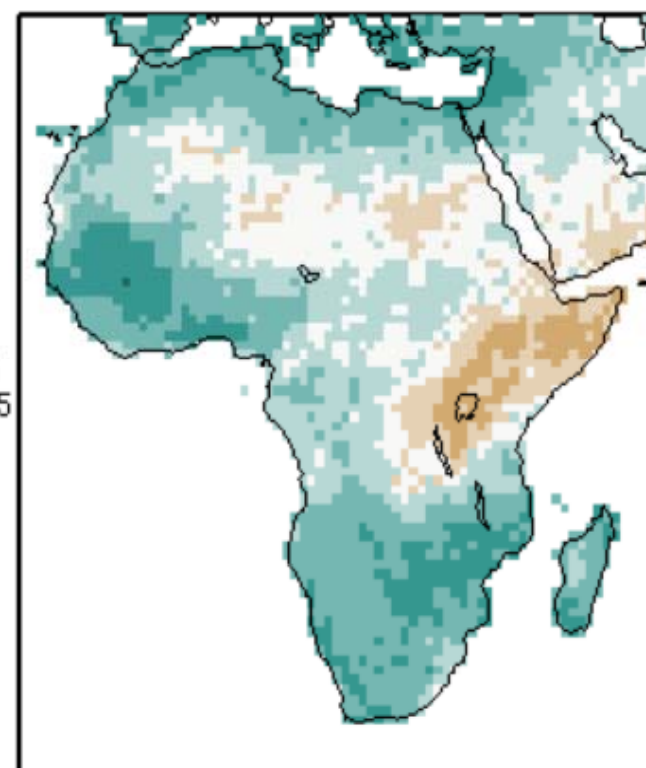
Near Future



Far Future



Diff



**Basins in West Africa, Southern Africa, North Africa and to a lesser extent Central Africa will be more exposed to a decreased freshwater availability**

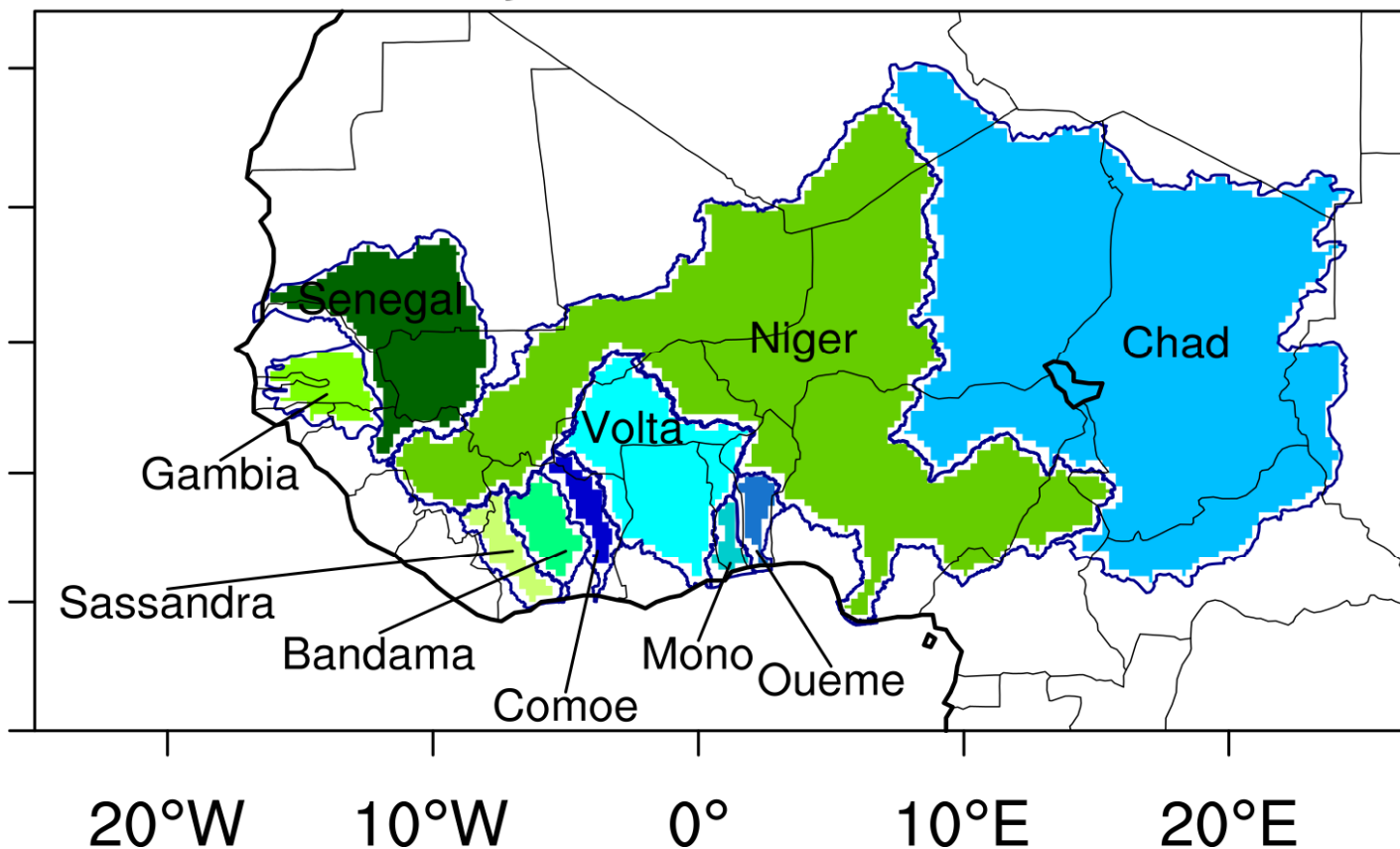


### III/ Case study: West Africa

#### Water Sector: water availability

Considering 10 major river basins

West African Major River Basins



Sylla et al. 2018 (Nature SREP)

- **Crop Water Demand**  
Potential Evap (Hamon  
and Hargreaves)
- **Irrigation water need**  
CWD minus ET
- **Water available:** total  
runoff
- **Basin's potential:**  
runoff minus IWN

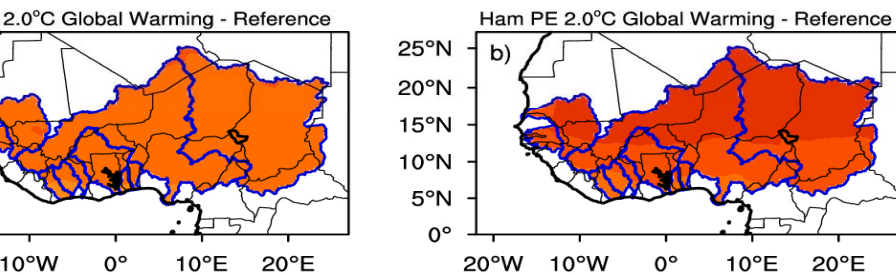
# III/ Case study: West Africa

## Water Sector: Water Availability

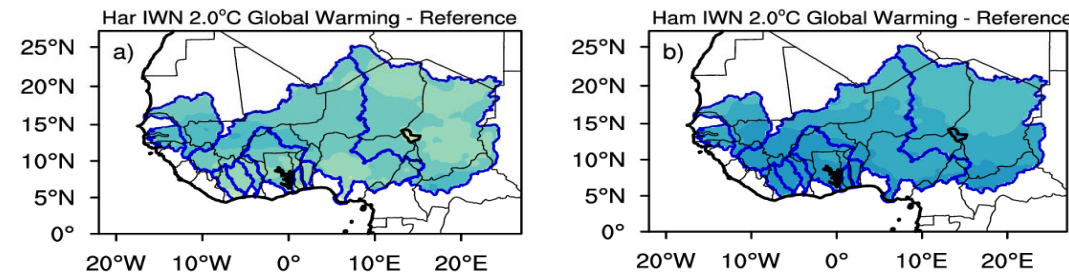
Water for irrigated agriculture (FAO formulation of CWD and IWN)

Stress and statistical significance: Use 2 models of PET and 95%

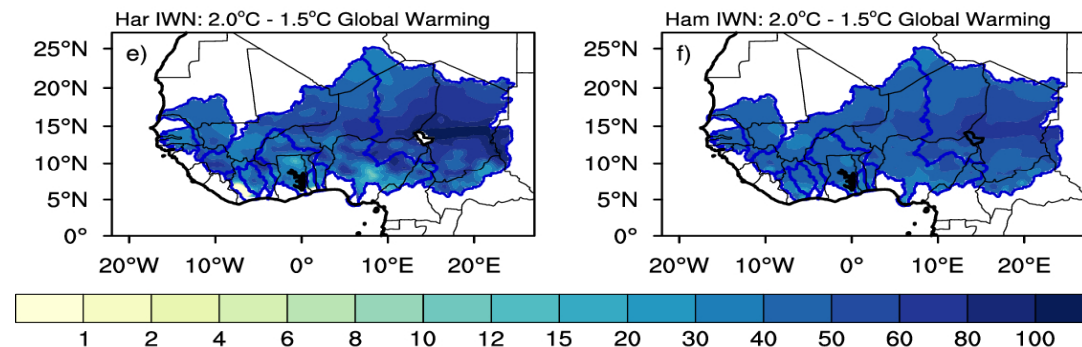
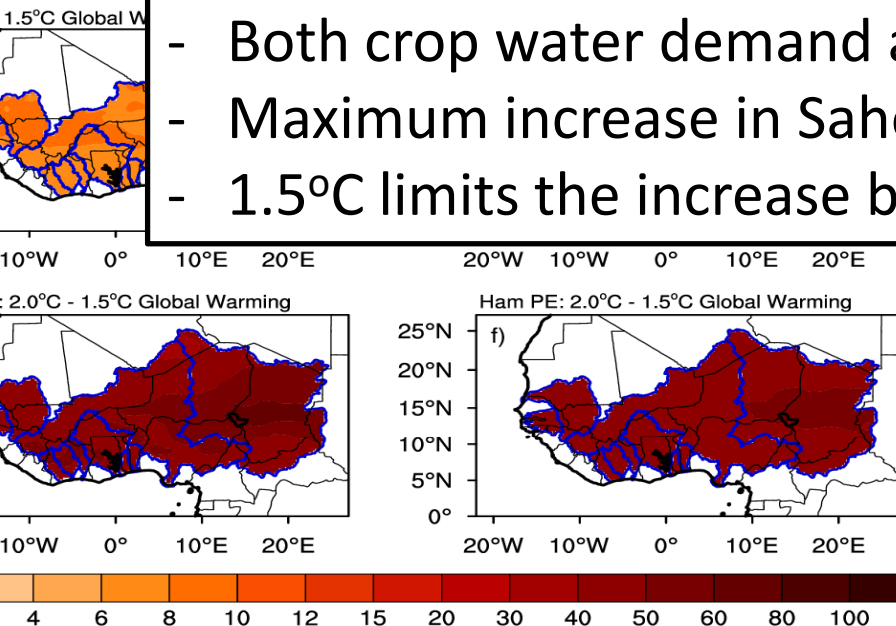
### Crop Water Demand



### Irrigation Water Need



- Both crop water demand and irrigation water need increase
- Maximum increase in Sahelian basins and Gulf of Guinea basins
- 1.5°C limits the increase by up to 60% compared to 2°C

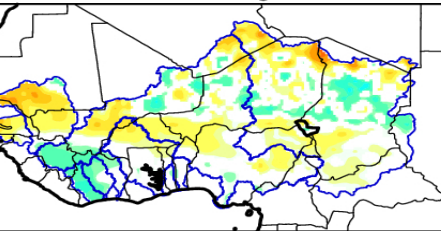


# III/ Case study: West Africa

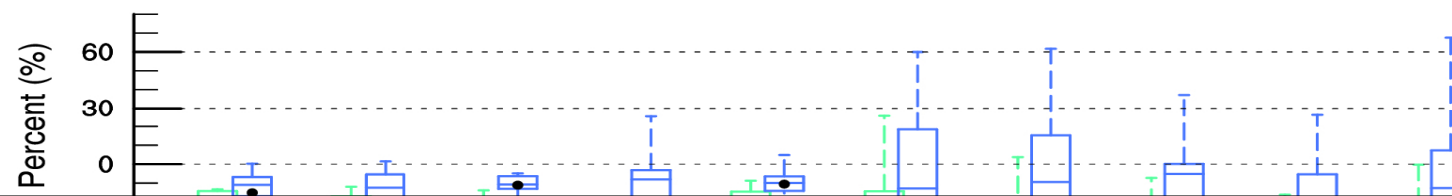
## Water Sector: Water Availability

Water availability Derived: Basin's irrigation potential, ass. uncertainties  
Robustness and statistical significance: Use 2 models of PET and 95%

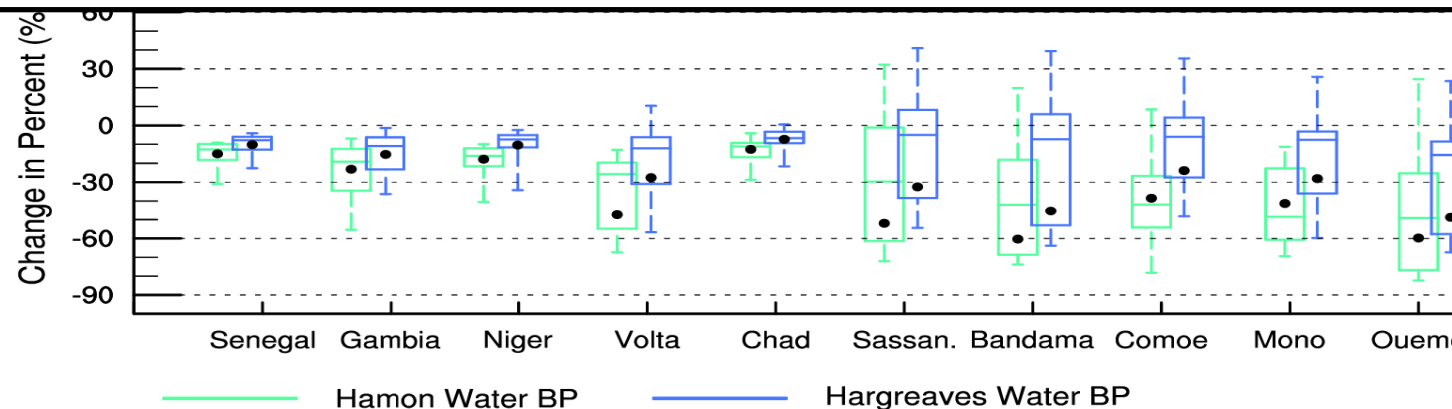
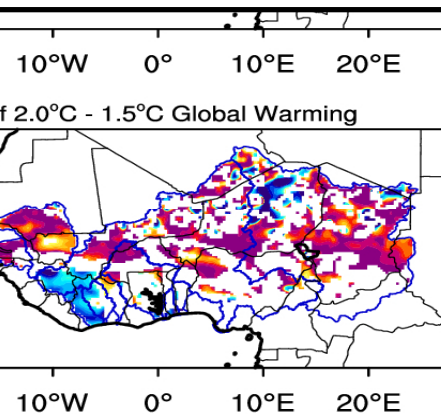
Figure 2.0°C Global Warming - Reference



a) BP: 2.0°C Global Warming - Reference



Water availability cannot overcompensate the IWN →  
Increases the basin's potential to sustain irrigated agriculture around 10% to 50% more  
Most of Guinea's basins will suffer the most  
The difference between the two scenarios can be up to 20%



## IV/ Conclusion

Kenya is blessed with water resources: rivers, lakes, aquifers

Water resources used for Municipal (domestic and hydropower),  
Agricultural (irrigation, livestock and aquaculture) and Industrial  
activities

Increased demography and climate change put a lot of pressure  
on the resources causing water stress

Future climate will induce a substantial decrease in water  
availability

making the basins unable to support sustainable irrigation  
activities

**Thank you for your  
attention**