Simulation of climate indices for water resource management

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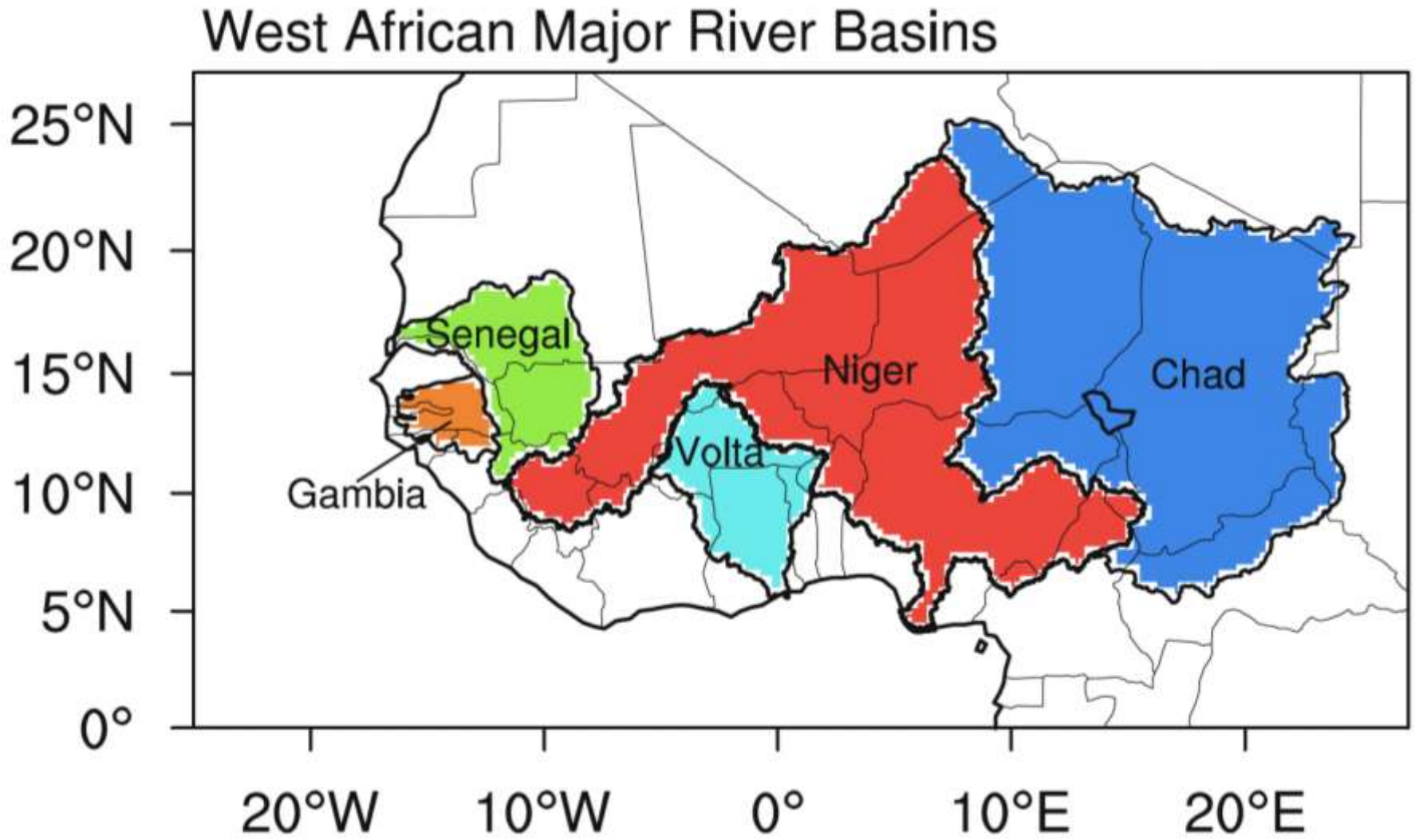
Introduction

- Many changes in the climate system become larger in direct relation to increasing global warming (IPCC 2021).
- Extreme climate events, including heat waves, heavy rainfall, and droughts, are more frequent and severe (IPCC 2021).
- Projected changes in climate variables indicate an increase in the frequency of hydrological extremes (Klutse et al 2018).
- Africa is among the regions where projected change in dangerous heat stress is stronger (IPCC 2021).
- Africa is among the regions where projected change in droughts is stronger (IPCC 2021).

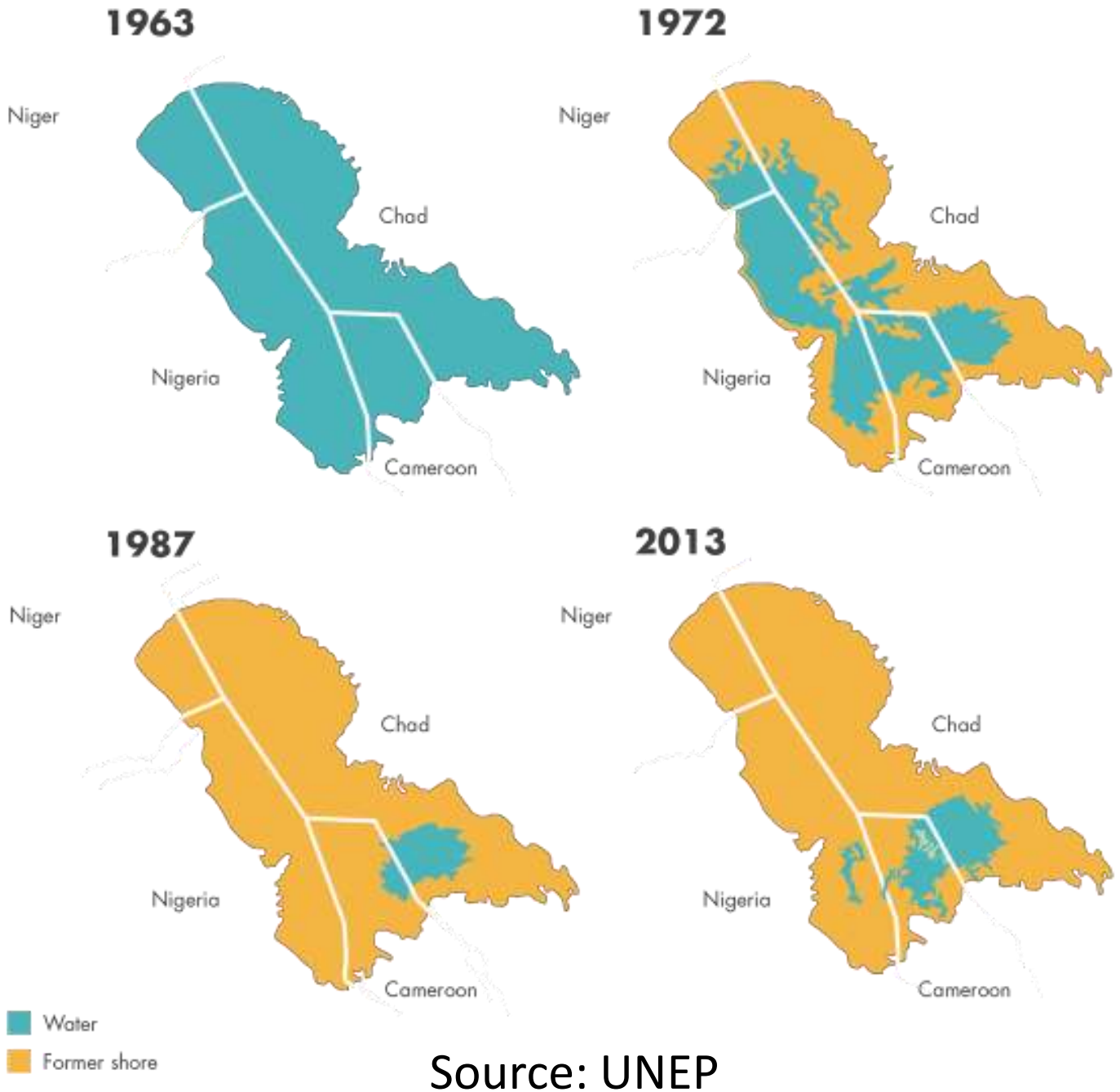
Introduction

- Water on land is a vital resource for West Africa.
- It is mainly used for agricultural (including irrigation, livestock and aquaculture), municipal (including domestic and hydropower) and to some industrial purposes
- The major river basins have undergone strong variability in recent decades leading to an overall increase of water stress
- Incorporating climate change in long-term water resource planning, management and governance is of primary importance for decision makers.

Study domain



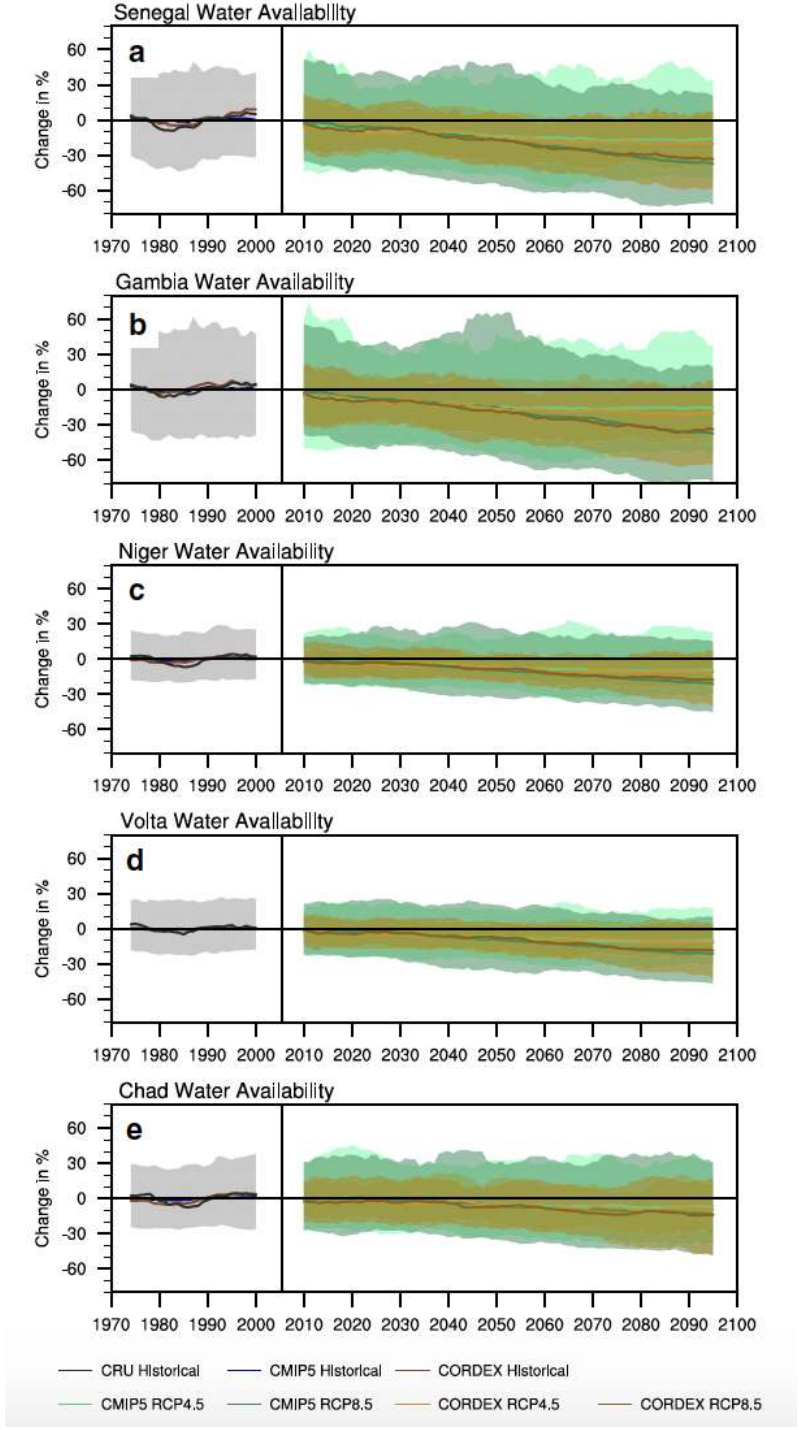
Lake Chad



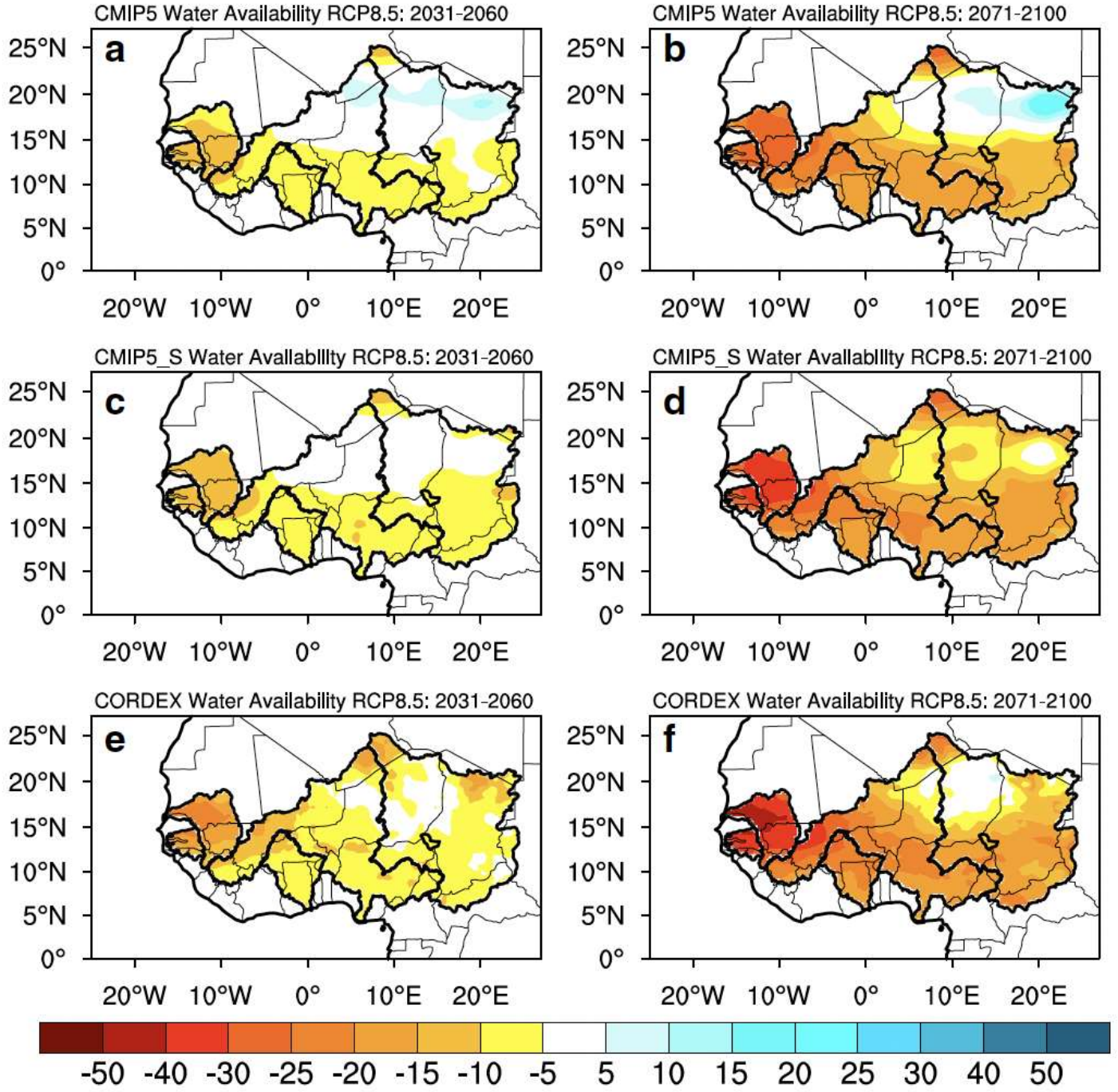
Source: UNEP

Potential water availability index anomalies (with respect to the reference period mean: 1976–2005) for each river basin for the historical and future climate as projected by each multimodel ensemble under RCP4.5 and RCP8.5.

The vertical line denotes the end of the historical period. 10-year running mean is applied to smooth the time series.



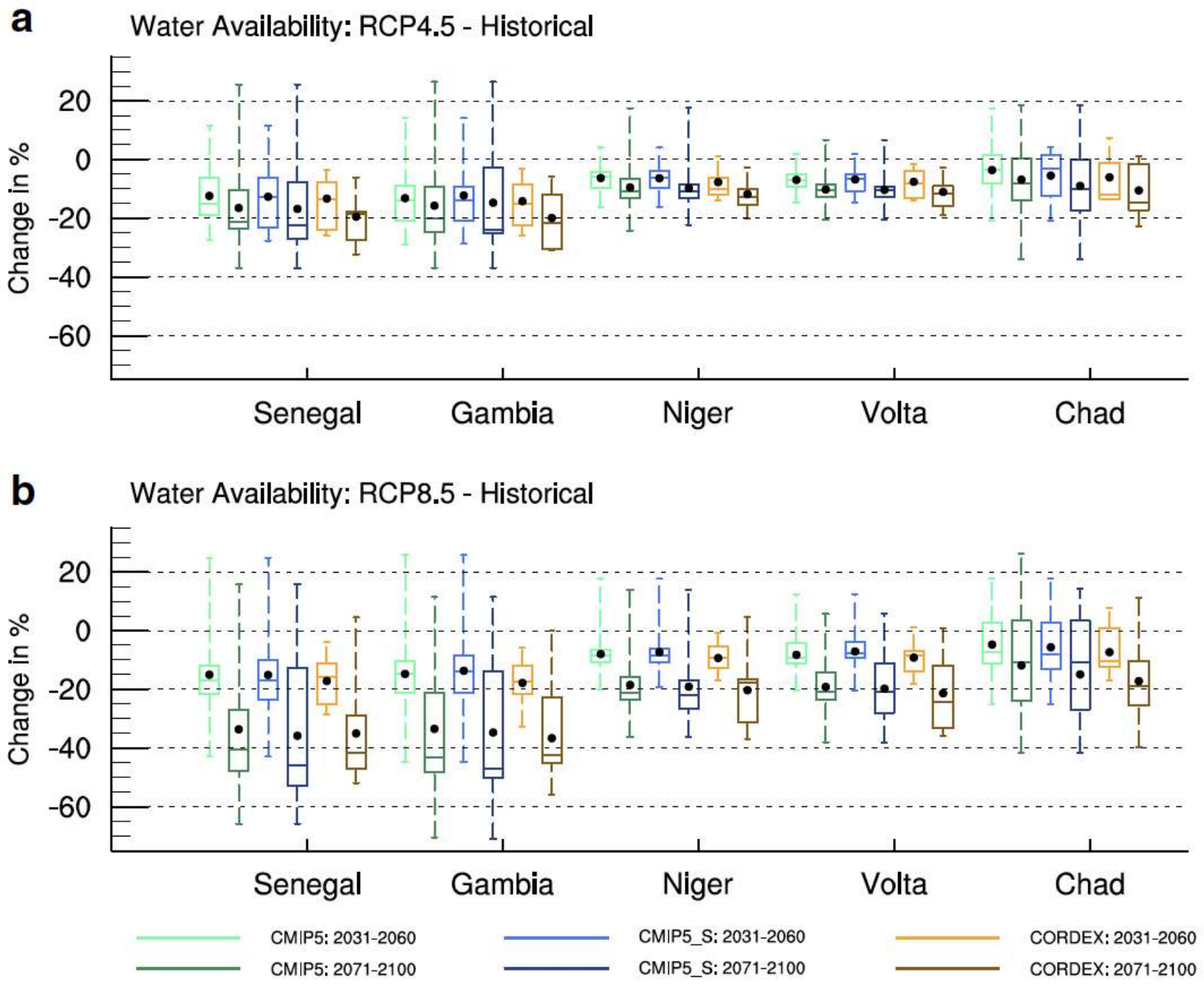
Changes in potential water availability for the RCP8.5.



Changes in potential water availability for RCP4.5 and RCP8.5 for each river basin .

The black dot in each box represents the projected mear change for the specific multimodel ensemble.

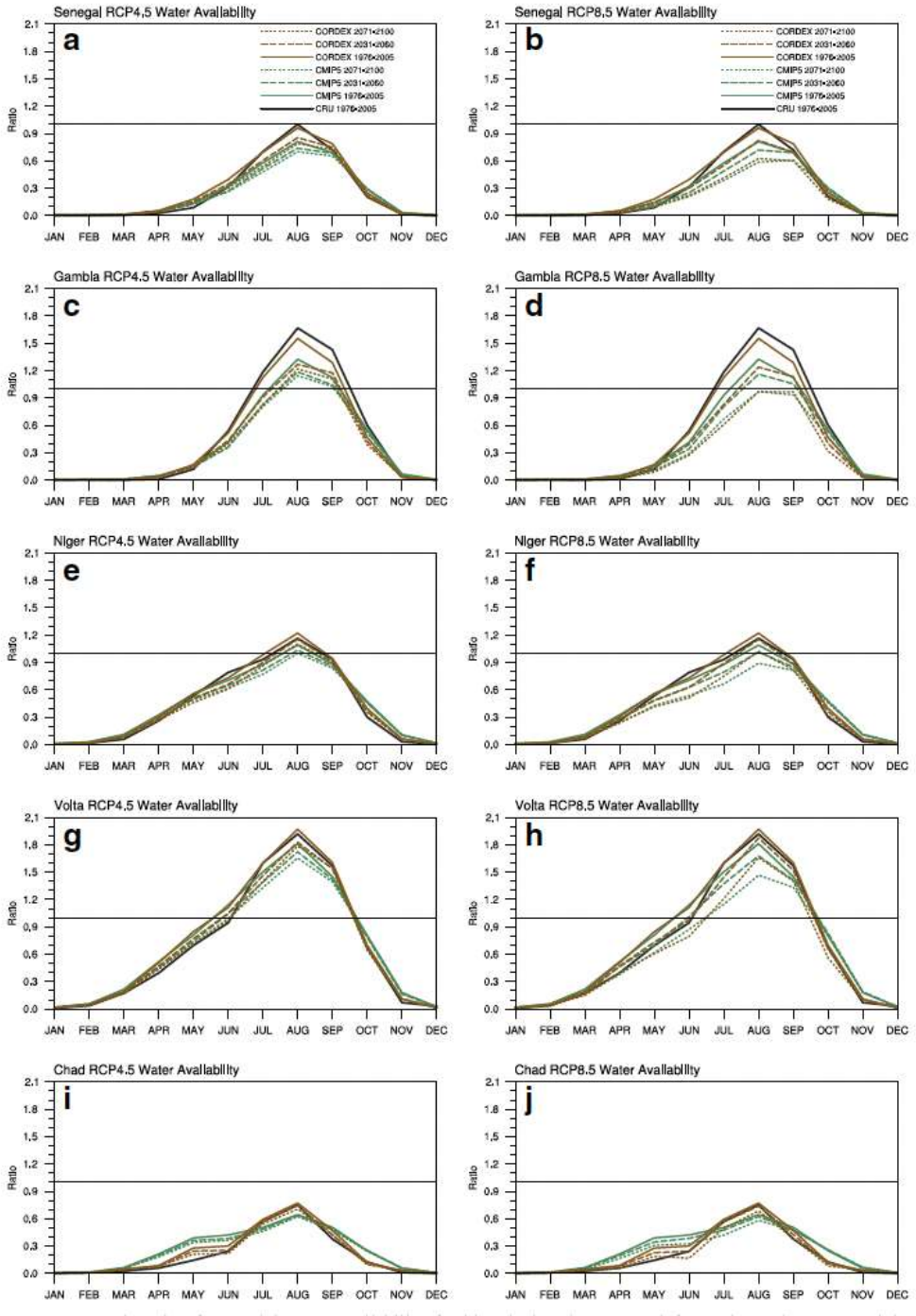
The percentiles depicted in each box are, respectively, the ensemble 95th, 75th, 50th (i.e. the median), 25th an 5th percentiles



Annual cycle of potential water availability for historical and RCP4.5 and RCP8.5 for observation and each of the multimodel ensembles during the near and far future.

The horizontal line indicates where ratio = 1.

Above this line precipitation exceeds potential evapotranspiration



Conclusion

- In a business-as-usual world (i.e. RCP8.5 forcing scenario), GHG forcing combined with strong population growth will amplify the changes along with their consequences.
- Intensified adaptation measures concerted with strong mitigation policies are needed to counter these impacts of climate change.
- With GHG mitigation (i.e. RCP4.5) Gambia and Niger can avoid reaching water deficit
- Senegal and Chad need a stronger response.
- Volta basin presents the most promising situation for adaption in future climate with projected water surplus throughout the twenty-first century but to a lesser extent as the potential water availability still decreases.