# Scanning Climate Change Impacts on Water Resources of the Largest African River Basins


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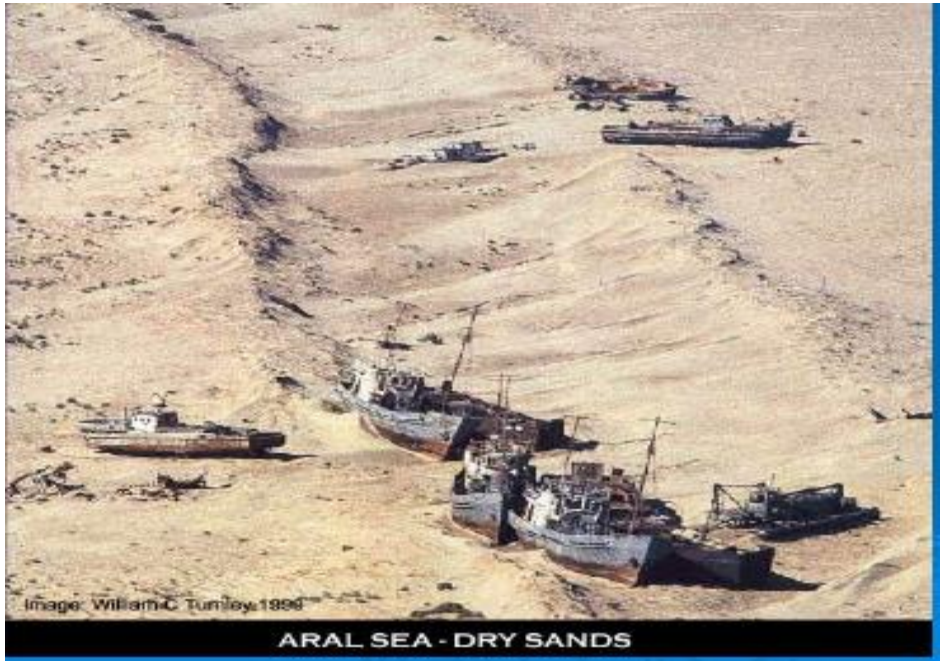
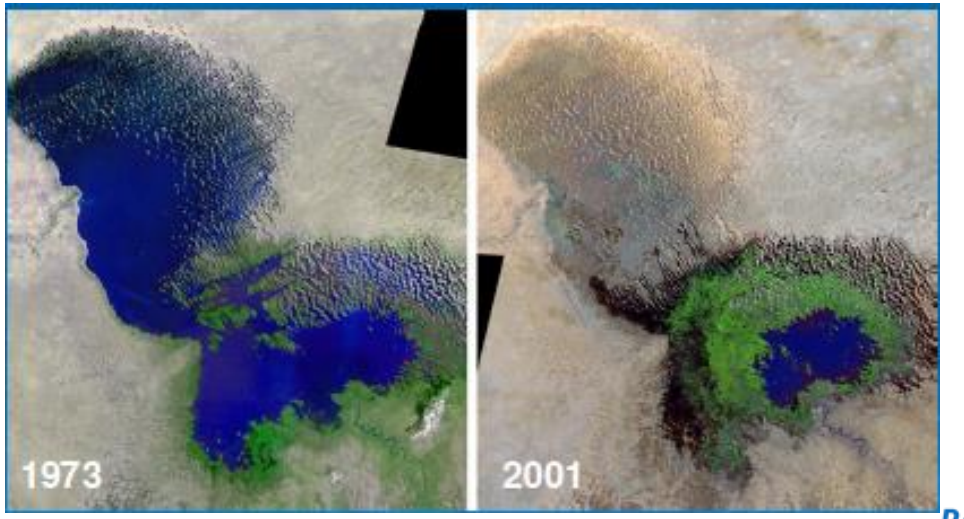
# Prelude

- **Climate change** (CC) grasps much scientific attentions nowadays. However, predictions in CC remained a controversial issue, especially the water-related ones
- **Climate prediction/forecast** is an attempt to produce a future estimate of the actual evolution of the climate using a predetermined state of climate (initial conditions)
- **Climate projection** is a conditional simulated response of a given climate system to a scenario(s) of future emission . This normally reads with confidence
- **Emission scenario** is a plausible representation of the future development of emission of potentially radiatively active substance based on assumed driving forces, e.g. socioeconomic development. The result is concentration scenarios used as input to a climate model to compute climate projections



- Climate projections showed high uncertainty due to:
  - ✓GCM configuration
  - ✓emission scenario,
  - ✓Scale, especially the temporal
  - ✓observational datasets, and
  - ✓Model parameterizations, e.g. unresolved processes like cloud formation and aerosols, etc
- Ultimately, the adoption of adaptation projects (a decision-making dependent) gets very low
- Use of an **Ensemble** approach may provide a solution to characterize **uncertainty**

# Ensemble

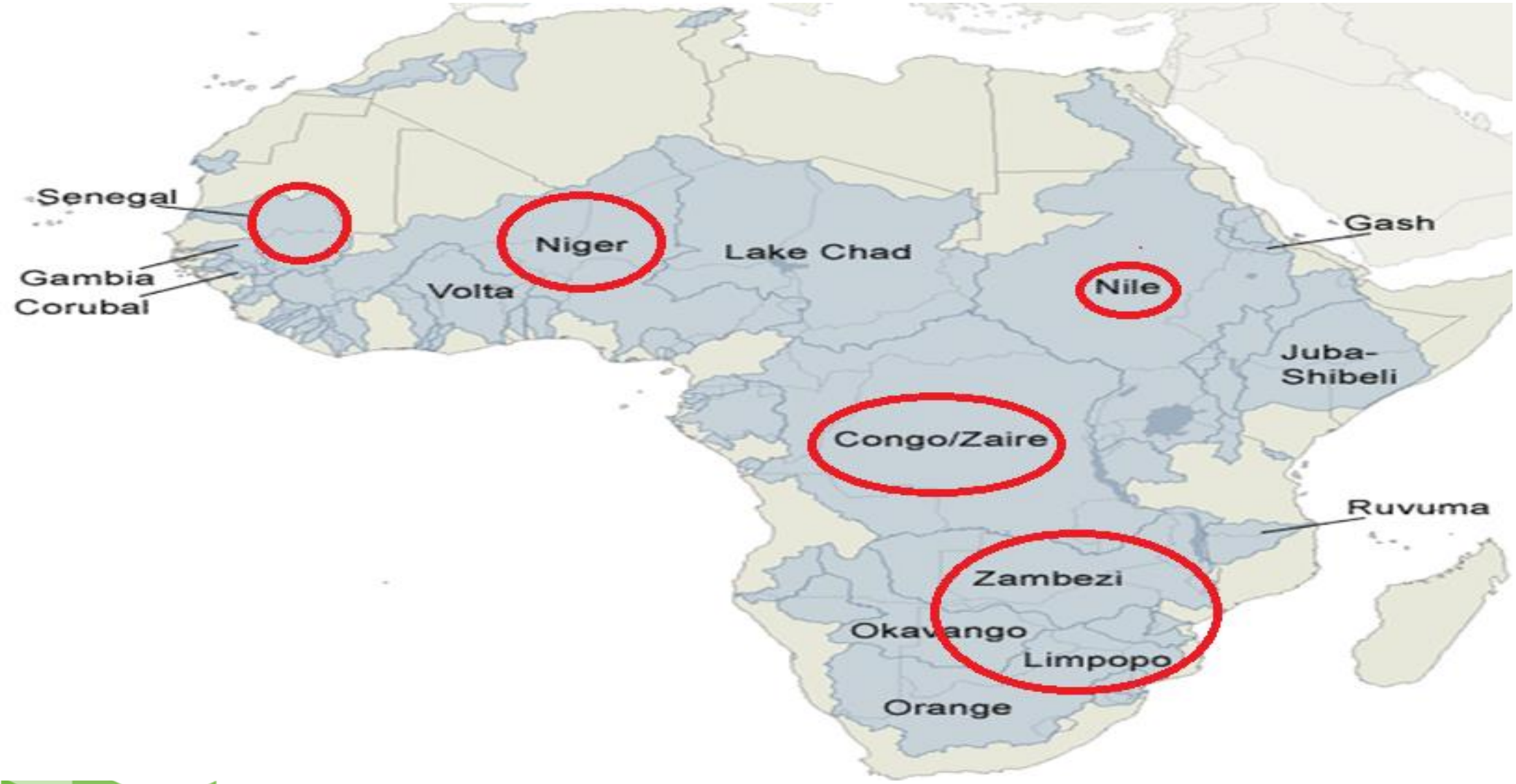
1. Related to a given model internal structure/parameters,
2. Related to range of models (different modeling centers)…multi-model ensemble

- Ensemble represents a new resource for studying the range of plausible climate responses to a given forcing.
- The multi-model filters out biases of individual models and only retains errors that are generally pervasive.

# Objectives

1. Quantify and compare the Climate change projection signals in five African river basins (Nile, Senegal & Volta, Niger, Congo, and Zambezi & Limpopo);
2. List the hotspots of CC-related research issues in Africa, especially to mid-career researchers.
3. Fill the gap in climate change adaptation process

# Studied basins



# Methodology

- **Ensemble results of 61** papers (2008-2017).
- Emphasis given to:

1. Emission scenarios used,
2. Applied climate change model(s),
3. Prediction's time windows,
4. Historical baseline,
5. Applied hydrological model(s),
6. Predicted trends in temperature, rainfall, runoff, flows and reference evapotranspiration ($ET_o$),
7. Land use/cover in the hydrological modelling,
8. Methods used for estimating $ET_o$.

- **Trends** : **increasing**, **decreasing** and **uncertain**.
- The increasing trend implies a pure increasing trend (all predictions > 0) and the opposite holds true for the decreasing trend (all predictions <0). In cases where the projection indicates simultaneously increasing and decreasing trends, then this trend is assigned as uncertain.
- The percents of consent mong trends were then estimated for each basin.
- The considerations of land use in hydrological modelling was assigned to "**0** or **1**"

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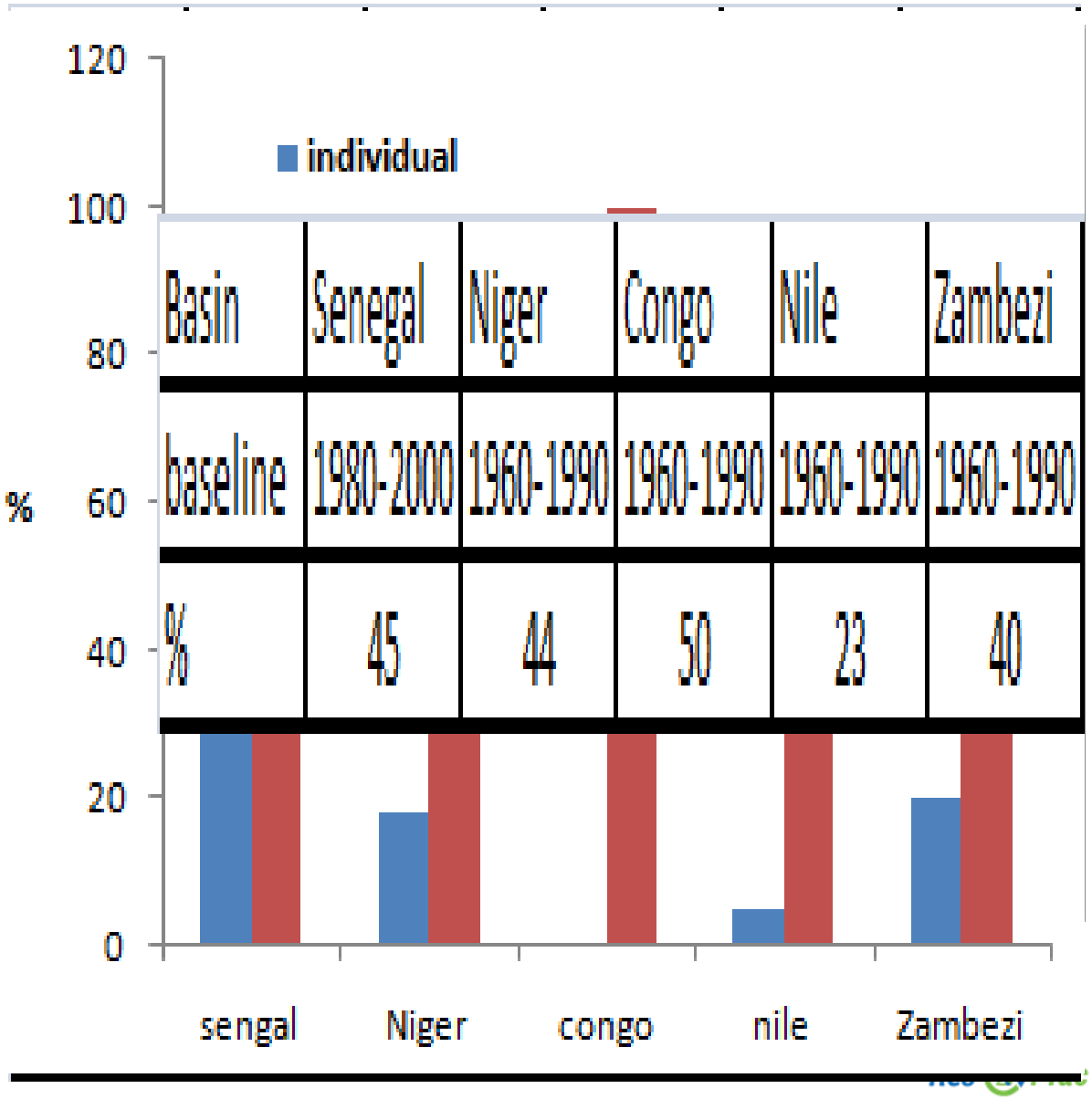
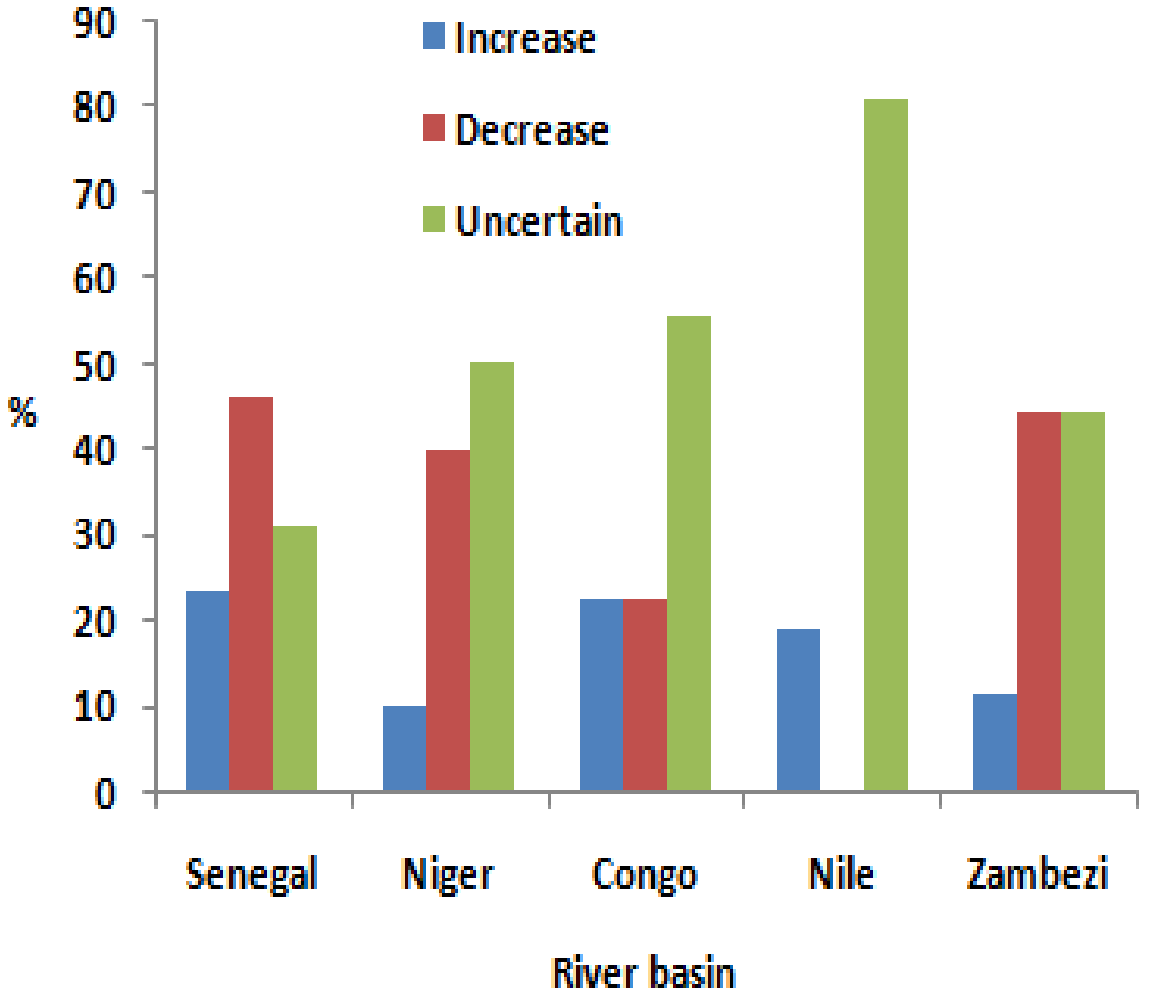
# Results

- The Nile basin has the dominant share in the reviewed papers
- High tendency for using unmitigated future emission pathways
- Ensemble GCMs models dominates
- several baselines exist. the period 1960-1990 is



# Cont'd

- Increasing trends in temperature are dominant
- Uncertain trends in rainfall, except in the Senegal & Volta
- 19 hydrological models applied (conceptual and semi-distributed types).
- SWAT has the lion's share (50% for Congo, 36% for Senegal, 30% for Niger, and 18% for the Nile), whilst the CLiRun model dominates in



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- All basins experienced **decreased Runoffs**
- This large consent is missing in rivers' flow
- little considerations given to change in land use/cover in predicting climate change
- Increasing trends in $ET_o$,
- HG is dominantly used

90

| | sengal | niger | congo | Nile | zambezi |
|---|---|---|---|---|---|
| PM | 67 | 0 | 0 | 33 | 33 |
| HG | 33 | 100 | 100 | 56 | 33 |
| WB | 0 | 0 | 0 | 11 | 0 |
| Priestley- | 0 | 0 | 0 | 0 | 33 |

River basin

- We trust in CC models because of their physical basis and they perfectly predict the current weather and climate conditions.
- Parameterization is open area for further studies
- Expenditure on climate change adaptation plan is limited by the uncertainty associates with CC projections
- Ensemble increases the robustness of CC predictions, however cautions should be taken in its weighting process
- Lacking of observational datasets contributes largely to regional uncertainty in Africa. There is a need for experimental studies like HAPEX
- Further Synthetic studies are needed

- Runoff and River flow are two different hydrological terms, however many studies have interchangeably used them.
- most of the African rivers experienced human interventions (e.g. dams), which should be considered in calibrating and configuring hydrological models
- Authors and reviewers should fully consider the proper use of the term ET.

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As researchers or practitioners what are the possible interactions/collaboration with practitioners resp. researchers to improve/upscale your activities

# Industry-Research nexus

## What are the potential aspects of the research that can be transformed into practice?

1. Improving parameterization e.g. cloud.
2. Downscaling (spatially and temporally).
3. Incorporating more processes into the models,  e.g. land surface interactions, aerosols, etc.
4. Characterization of Uncertainty

# Thank you
# (Shukran) شكرا
# جزيلا