Hydroclimatic challenges and opportunities for Africa: Beyond the Paris Agreement

Luigi Piemontese, Ingo Fetzer, Johan Rockström and Fernando Jaramillo

Stockholm Resilience Centre, Stockholm University

Africa: the hotspot

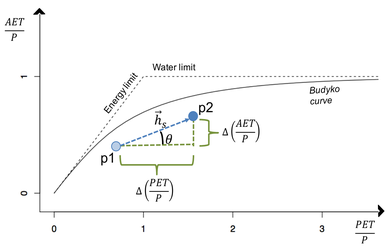
Africa is the main hotspot of **future population growth and climate change**, expecting **to affect water resources availability** leading to **sever social and environmental problems**.

The consequences of the Paris Agreement for African water resources have not been addressed in a comprehensive way (mainly analysis if changes in runoff).

Analysis of climate forecasts

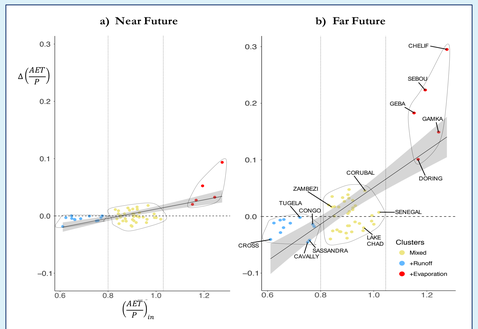
We investigate two development pathways (**Paris Agreement** and **BaU**) using forecast of precipitation (P), temperature (T) and evaporation (AET) from 19 climate models within the CMIP5 project (Coupled model intercomparison).

We calculate hydroclimatic shifts in terms of changes in **PET/P** – the ratio of potential evapotranspiration to precipitation – and **AET/P** – the ratio of actual evapotranspiration to precipitation – within the Budyko framework.



Business as Usual hydroclimatic scenario

Unequal precipitation partitioning



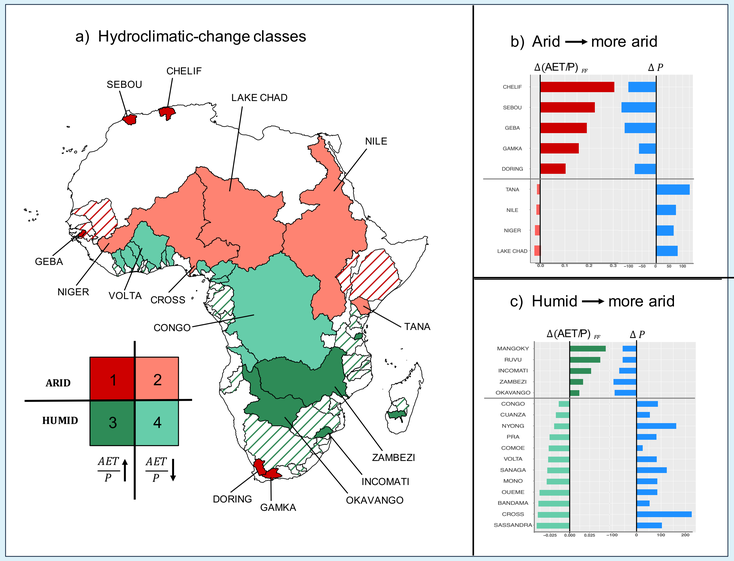
Change in AET/P against initial evaporative ratios (AET/Pin) in a) near future (2010–2039) and (b) far future (2070–2099). Linear regression with 95% confidence interval and 3-cluster K-mean analysis.

Increase evaporation in dry basins

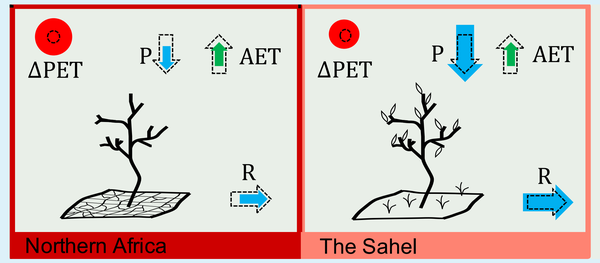
Increase in runoff in wet basins

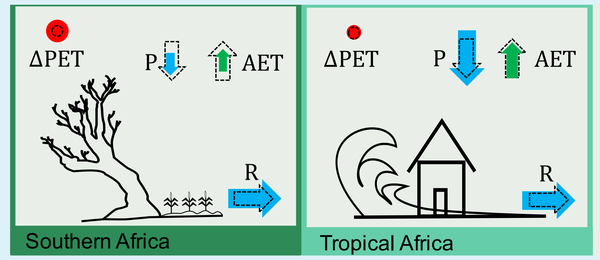
This trend in contrast to the Budyko framework, where basins with low initial AET/P are more likely to experience larger increase in AET/P.

Hydroclimate–change classes

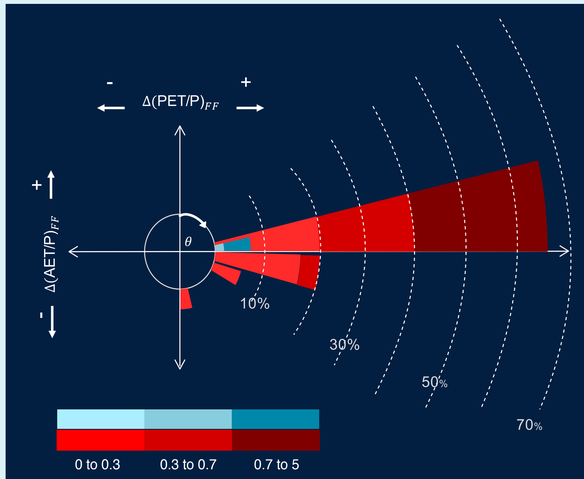


Effects on water resources





Results: Two dissimilar hydroclimatic scenarios



Future Hydroclimatic change in terms of combined changes in PET/P (horizontal axes) and AET/P (vertical axes) for 53 basins from the 30-year average 1960–1989 to 2070–2099 in the **BAU** and the **PA** scenarios. Only the statistically relevant changes are considered ($p < 0.05$ with a two-tailed t test).

Business as Usual

- **96%** of the basins show a shift in hydroclimatic conditions.
- The aridity (PET/P) increases in all these basins

Paris Agreement

- **7%** of the basins **increase in aridity**
- **no significant change in AET/P**.

What are the social–ecological implications?