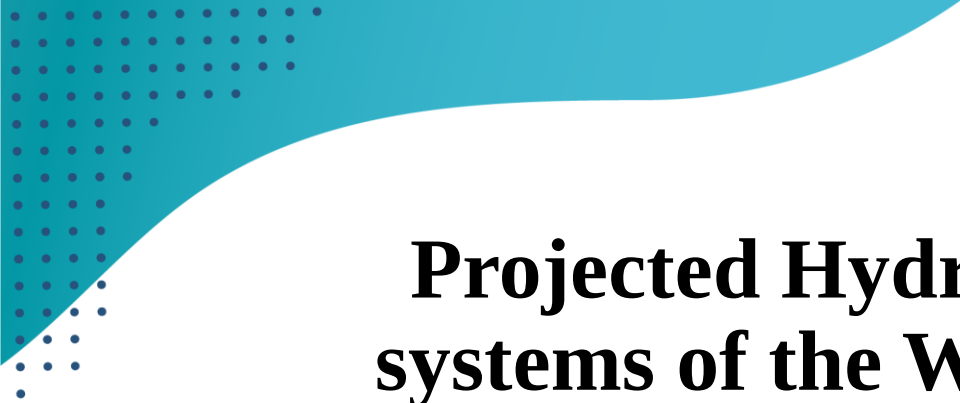




Projected Hydrology and water resources systems of the Wabi Shebele, Genale-Dawa, and Omo-Turkana basins

Haileyesus Belay Lakew, 2023

Introduction and Methodology

Basins

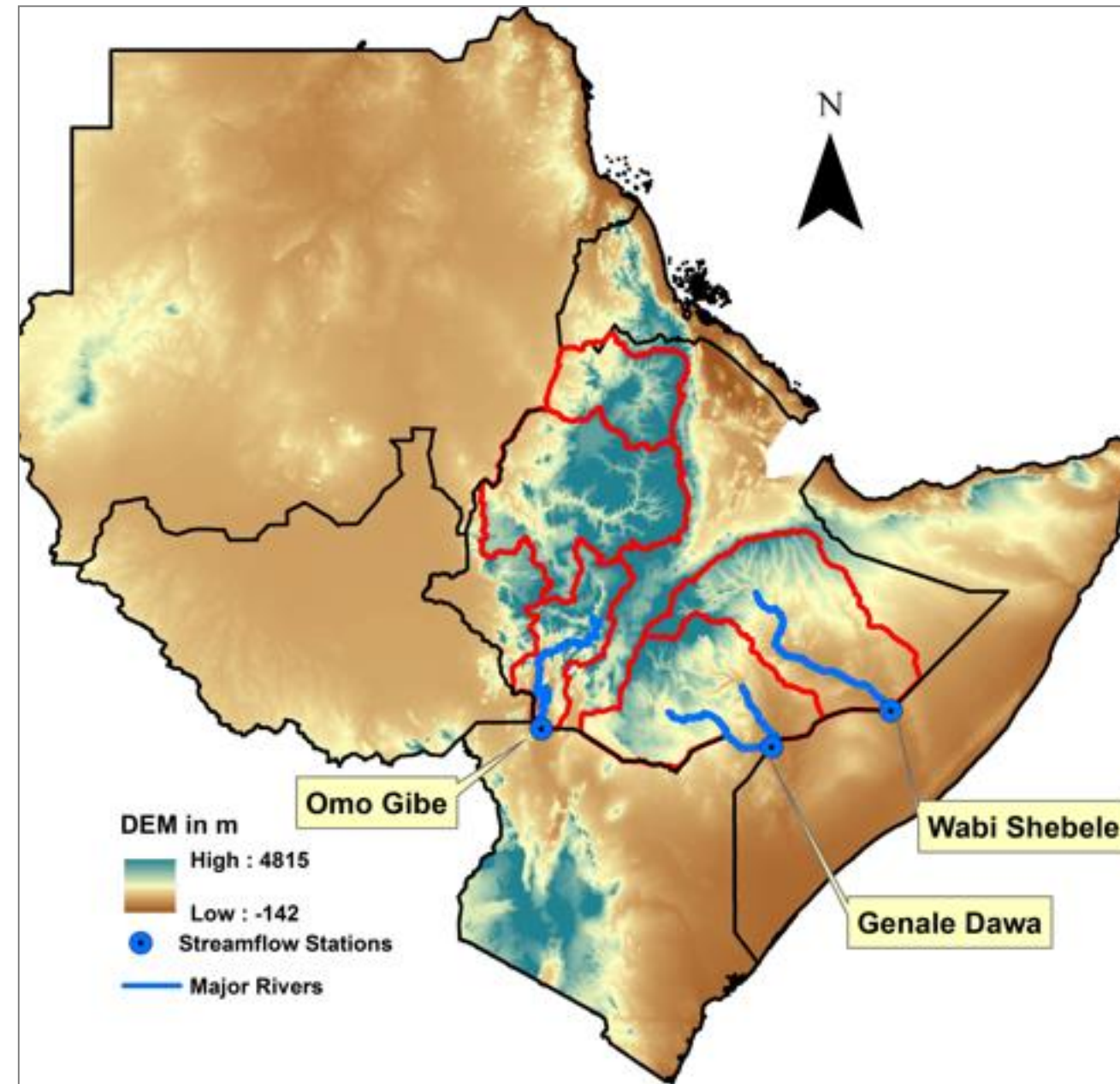
- **OMO Gibe** (79,000Km²), (Ethiopia and Kenya)
 - 73% highland, flow=**16.6BCM**
- **Genale Dawa** (171,042km²), (Ethiopia and Somalia)
 - 51% highland, flow =**4.9BCM**
- **Wabi Shebele** (202,697km²), (Ethiopia and Somalia)
 - 41% highland, flow=**4.6BCM**

CMIP6 Climate Models (SSP2-4.5 and SSP5-8.5)

- EC-Earth-CC (Europe, 0.7°*0.7°)
- GFDL-ESM (USA, 1.3°*1°)
- INM-CMS-0 (Russia, 2°*1.5°)
- MRI-ESM2-0 (Japan, 1.125°*1.125°)
- NorESM2-MM (Norway, 0.94°*1.25°)
 - Base period (1981-2010) and Projected (2041-2070)

CREST hydrological Model

- ✓ Fully distributed hydrological model (Monthly)
- ✓ Calibration (1981-2000) and validation (2001-2010)
 - Using CHIRPS & measured flow
 - 3 calibrations and 108 simulations
- ✓ Simulation (2041-2070)

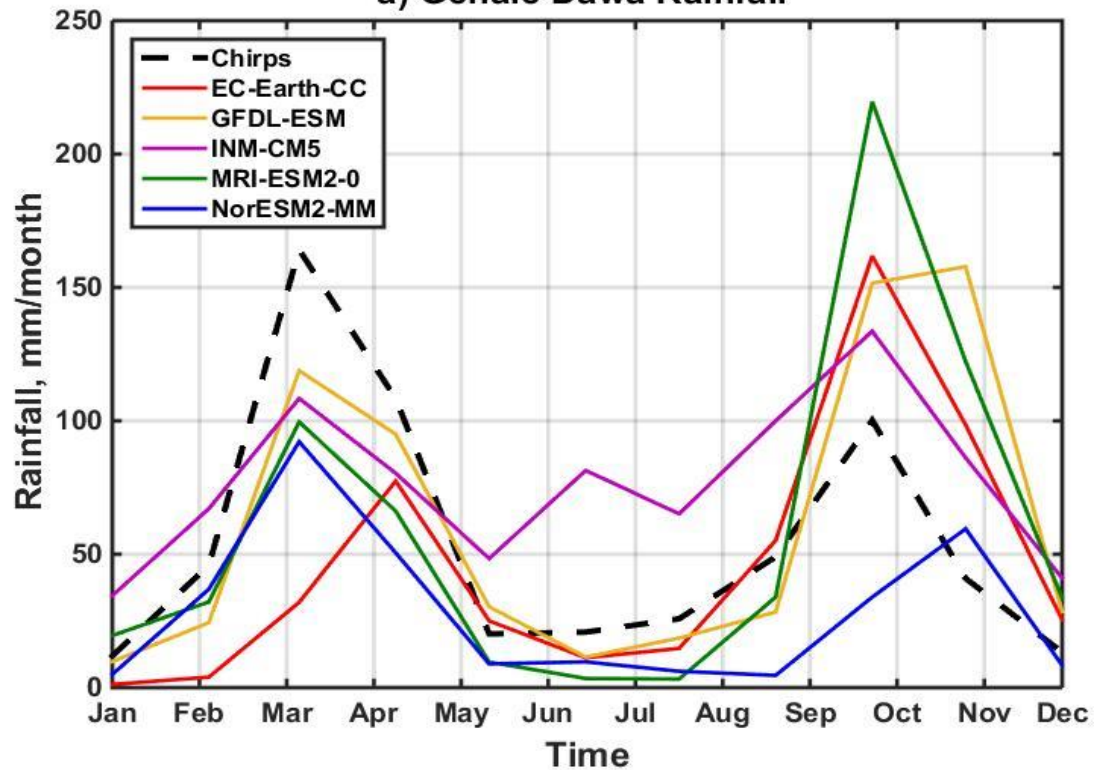


Projected Rainfall for the 2050's

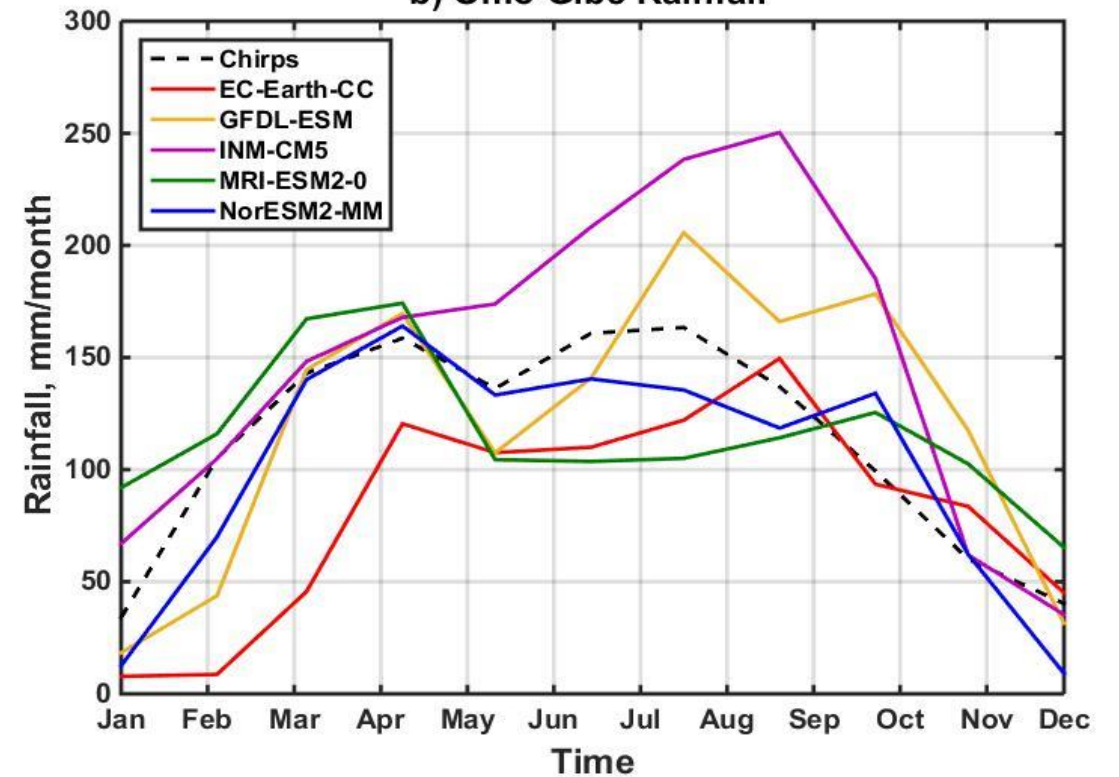
The rainfall change

- **Genale Dawa** (+8%)
- **Omo Gibe** (+5%)
- **Wabi Shebele** (+8%)

a) Genale Dawa Rainfall



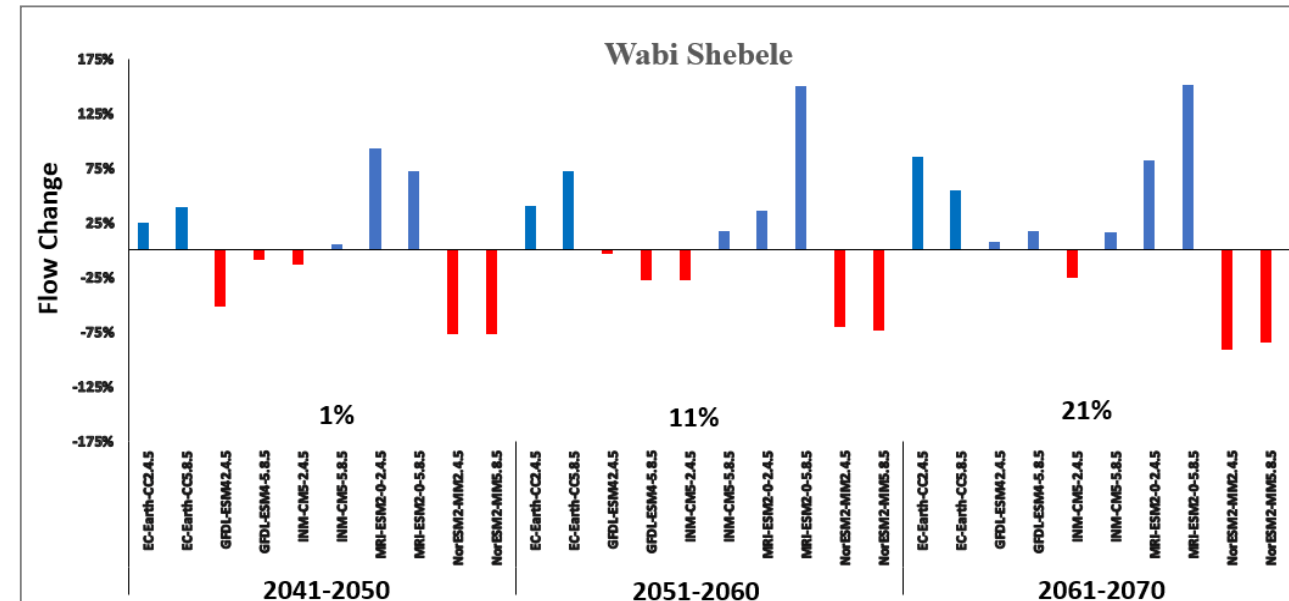
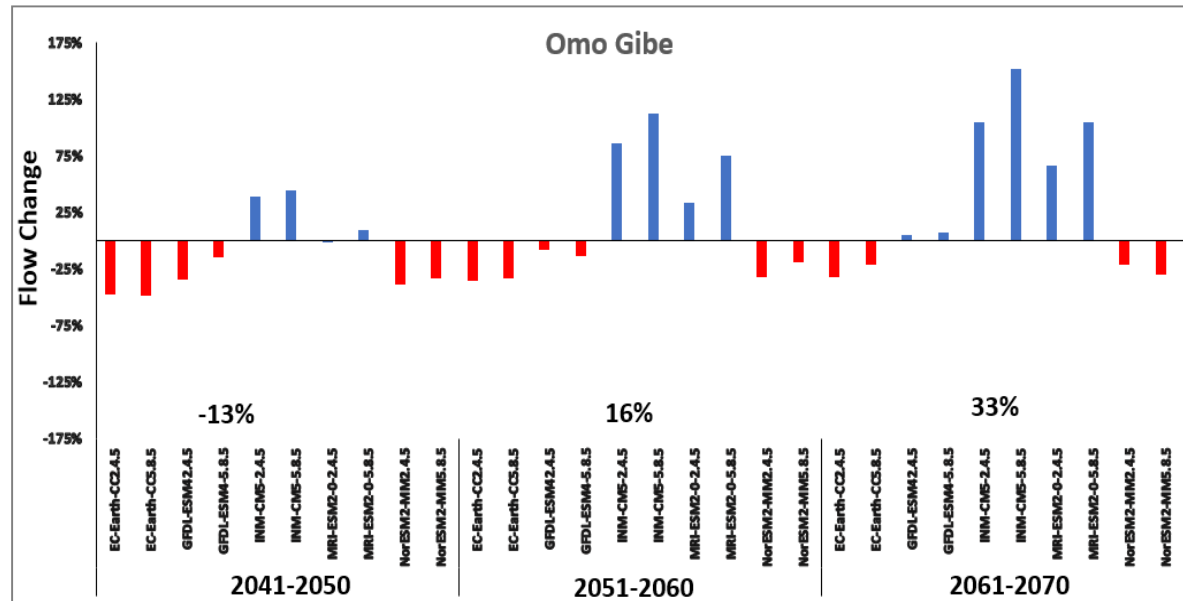
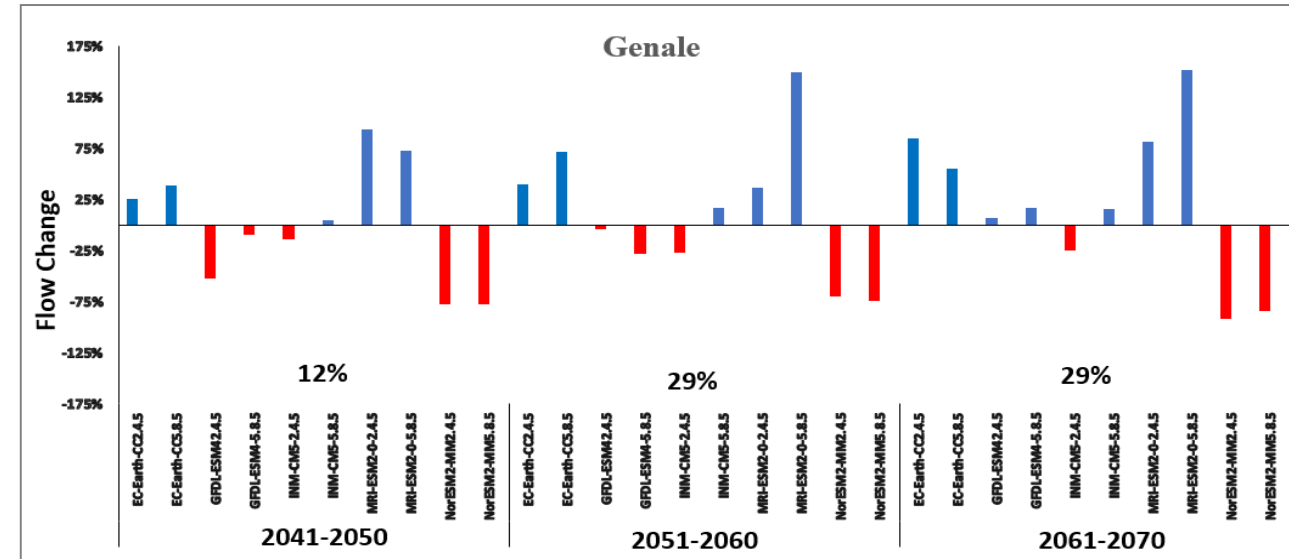
b) Omo Gibe Rainfall



Projected annual streamflow for the 2050's

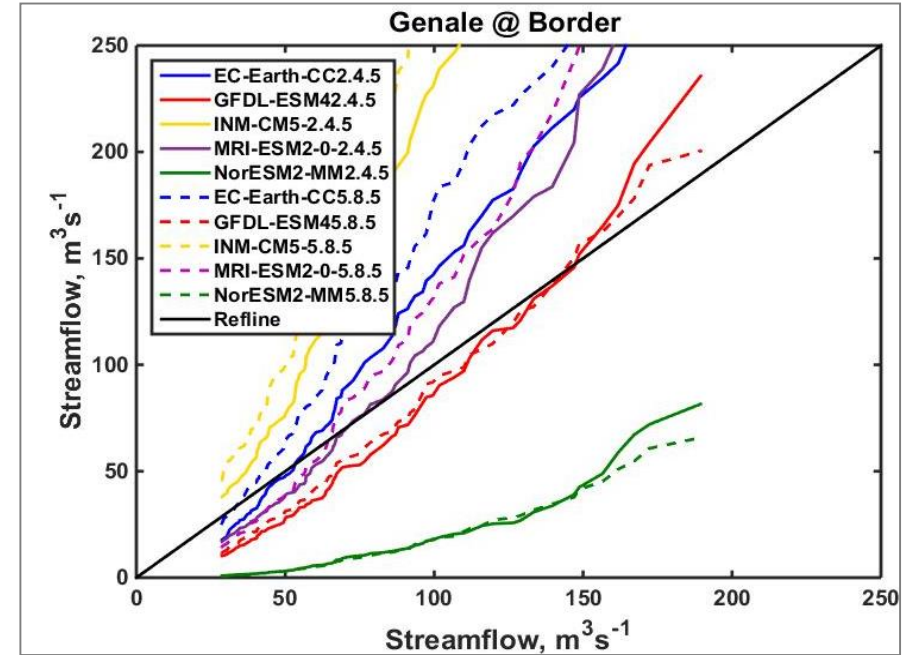
The *Streamflow* changes

- Genale Dawa (+23%)
- Omo Gibe (+12%)
- Wabi Shebele (+11%)



QQ plot streamflow analysis

- There are higher high-flow projections in the 2050's with respect to the base period.
- There are differences among basins in terms of streamflow projection distribution.
- High flows have high variation.
- Low flows have low variation.

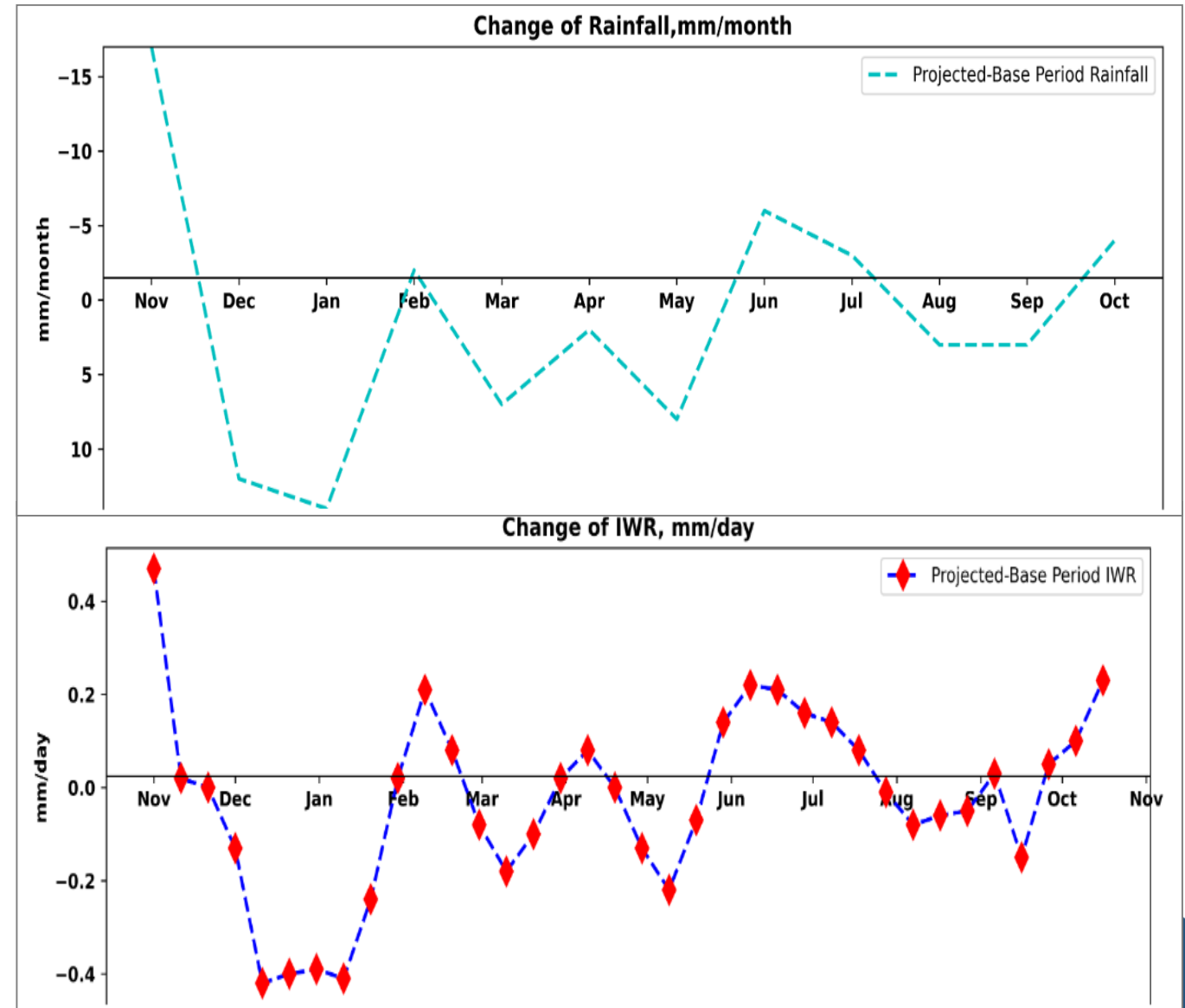
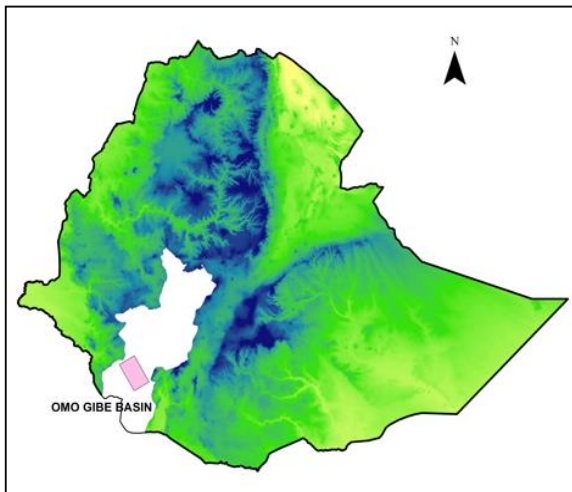


Irrigation Water Requirement (IWR)

IWR

Ensemble **rainfall** and **Temperature** taken for the specific location

- Crop type **Sugarcane**
- Current IWR = **5.74mm/day**
- Projected IWR= **5.71mm/day**
- Difference IWR = **-0.03mm/day**
- Less irrigation water demand.



• Summary of the Study

- ❑ The ensemble rainfall increases from **5%** to **8%** for transboundary basins (2041-2070).
- ❑ The ensemble simulated flow shows an increment from **11%** to **23%** (2041-2070).
- ❑ The QQ shows that there is a high increment in the **monthly maximum flow**.
- ❑ There is *less irrigation water requirement* (**0.03mm/day**) for the projected period of 2041-2070 (low lad of Omo Gibe basin)

Limitations of the study

- Projected PET remained constant as baseline (**CREST**).
- **LULC** is assumed constant.
- The resolutions of the Climate models are **coarse** to capture detailed rainfall situations in the complex Ethiopian topography.

Implications

- Increased rainfall projection might support better water **availability** and supply.
- Better rainfall projection in Ethiopian highlands can support different sectors (e.g. Agriculture, Energy-production).
- Increased high-flow projection might lead to potential **flooding** if the highlands are not well protected with watershed management.