

CMIP6 based climate projections analysis for East Africa and the Nile basin

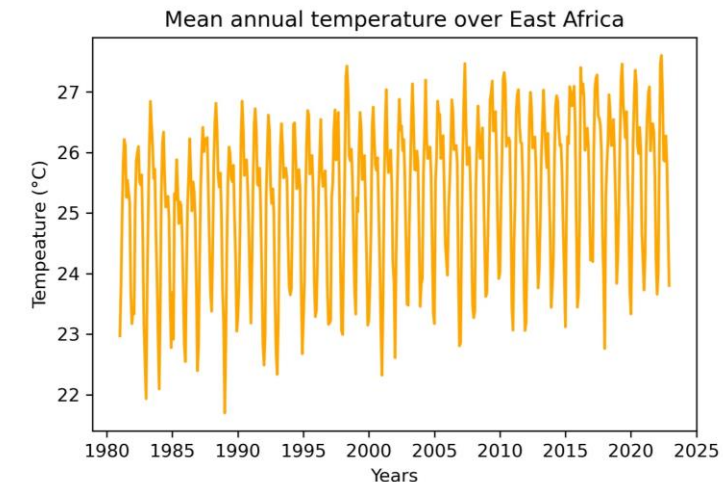
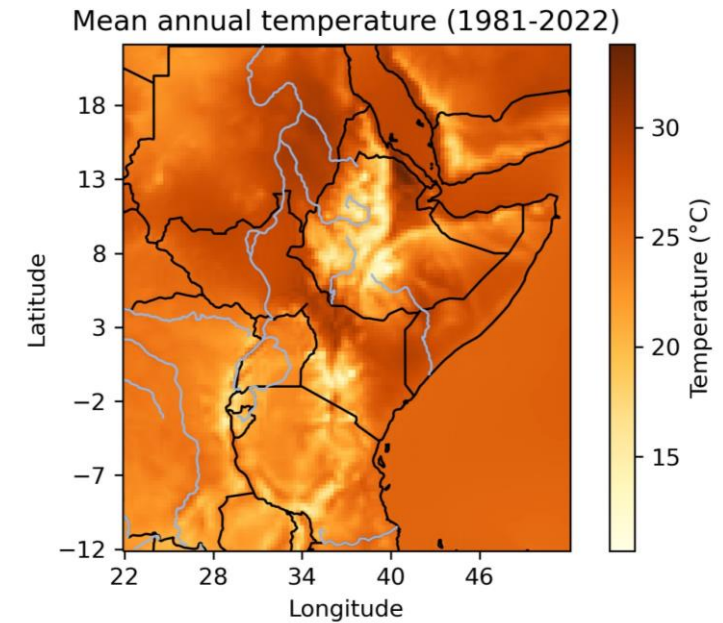
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The 7th Nile Basin Development Forum

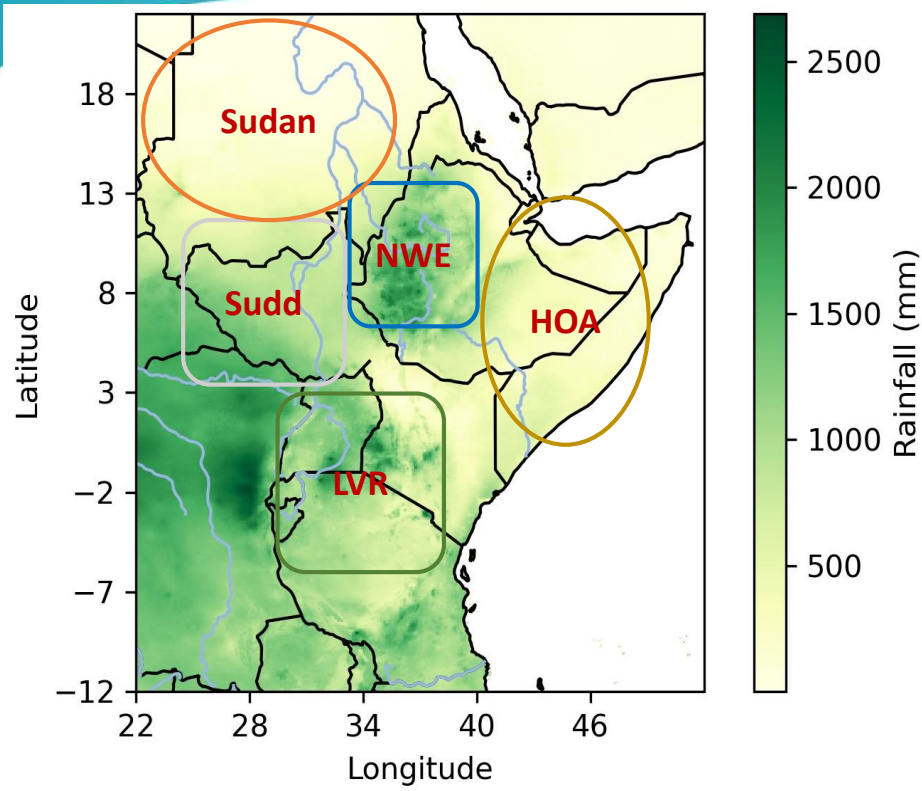
17 October 2023

Overarching context

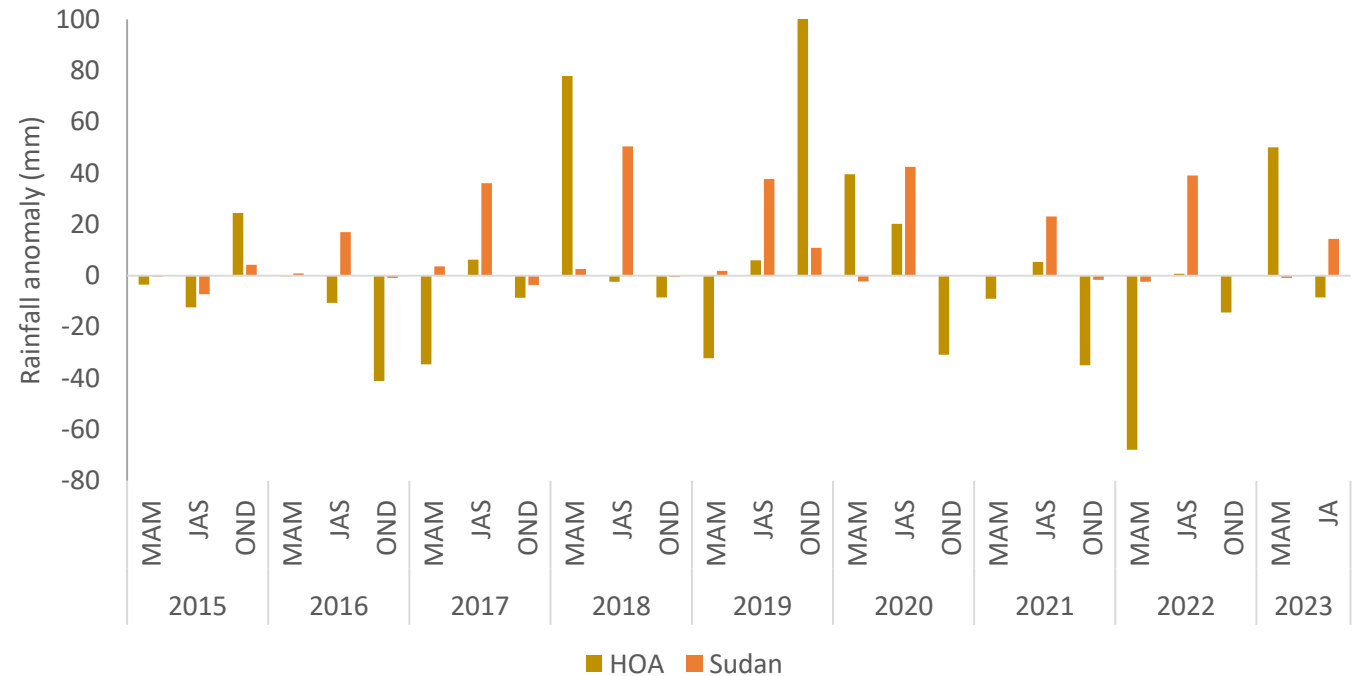
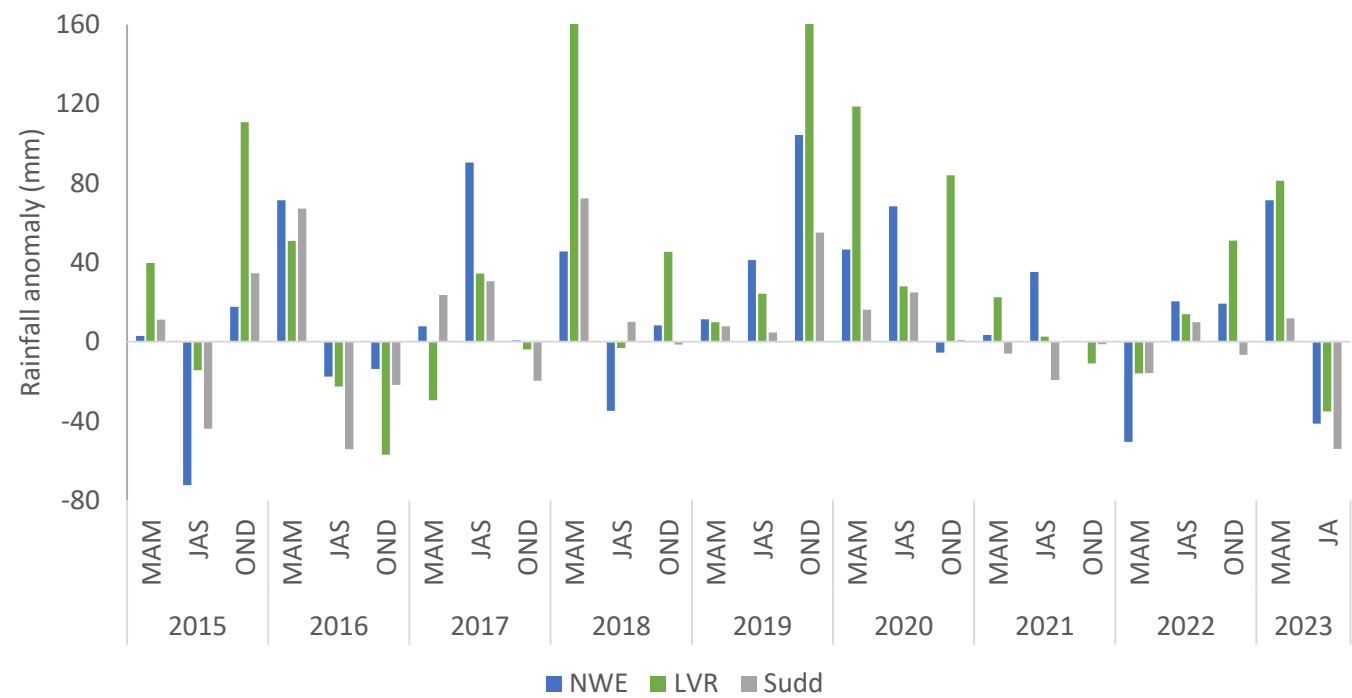
- The East African region:
 - Relying on subsistence rain-fed agriculture and pastoralism
 - Low adaptive capacity → Vulnerability to climate shocks
- Observed increase in the frequency of hydrological extremes, droughts and floods.
 - Food and water insecurity, conflict, and migration are some of the dire implications of climate change on the region's population.
- Global climate change signals as per WMO
 - The top three warmest years were 2016, 2019, and 2020
 - Similar trend in the East Africa region
- Why do we need to consistently analyse climate data and its implications?
 - Limited data and information exist for the region
 - Climate models are updated regularly – with some improvement from previous generations
 - Therefore, there is a need to better understand the status of change with updated models
- For this analysis IWMI used IPCC's CMIP6 generation models to analyse projected changes in the East African region.



Rainfall anomaly



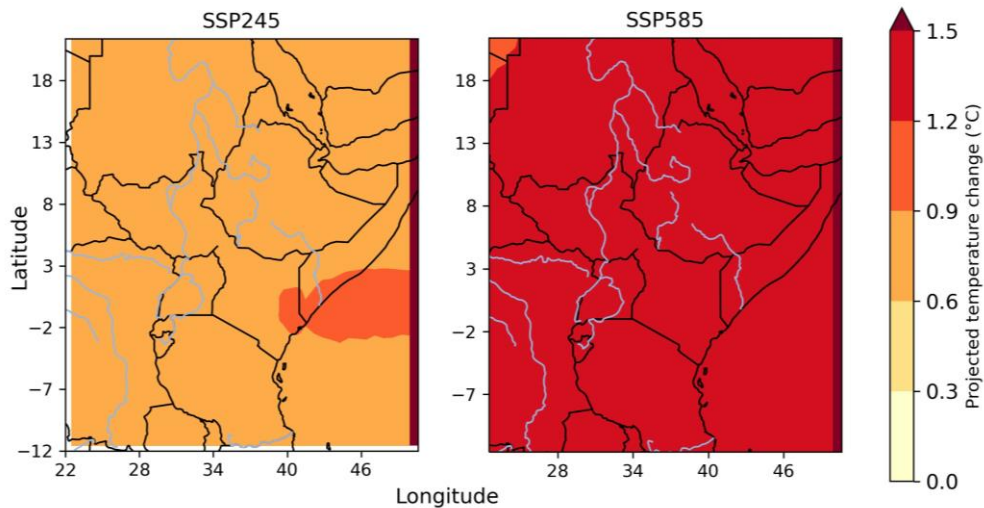
- Anomaly estimated with respect to 1981-2010 using CHIRPS rainfall data
- Consecutive rainy seasons with low rainfall in the Horn of Africa – led to droughts
- MAM 2018 & OND 2019 – high rainfall anomaly – led to floods
- What drives such changes – large-scale atmospheric and oceanic drivers
 - In 2015-2016 – a strong El Niño event
 - In 2020-2022 – unusually consecutive La Nina years



Annual temperature projection: scope and results

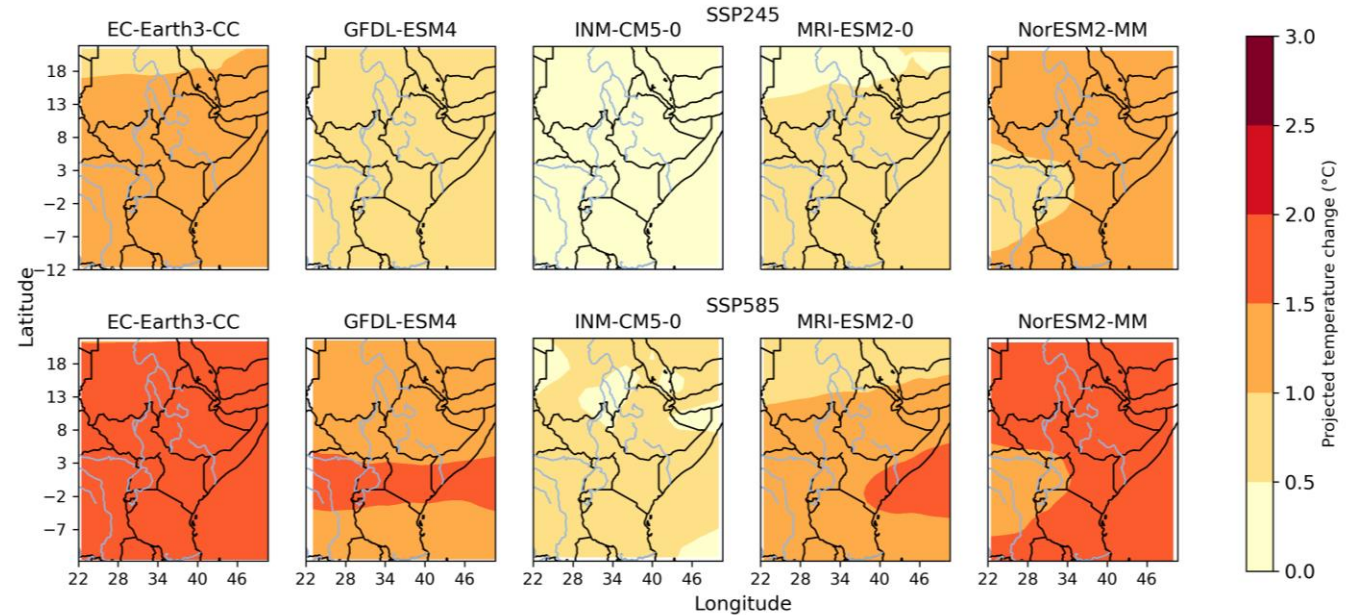
- Used five GCMs and two scenarios
- Historical 1981-2010
- Future period 2041-2070 (the 2050s)

Annual ensemble mean temperature change for the 2050s



- Annual ensemble results – increasing temperature projection
- Under SSP 245 scenario – up to 0.9°C
- Under SSP 585 scenario – up to 1.5°C

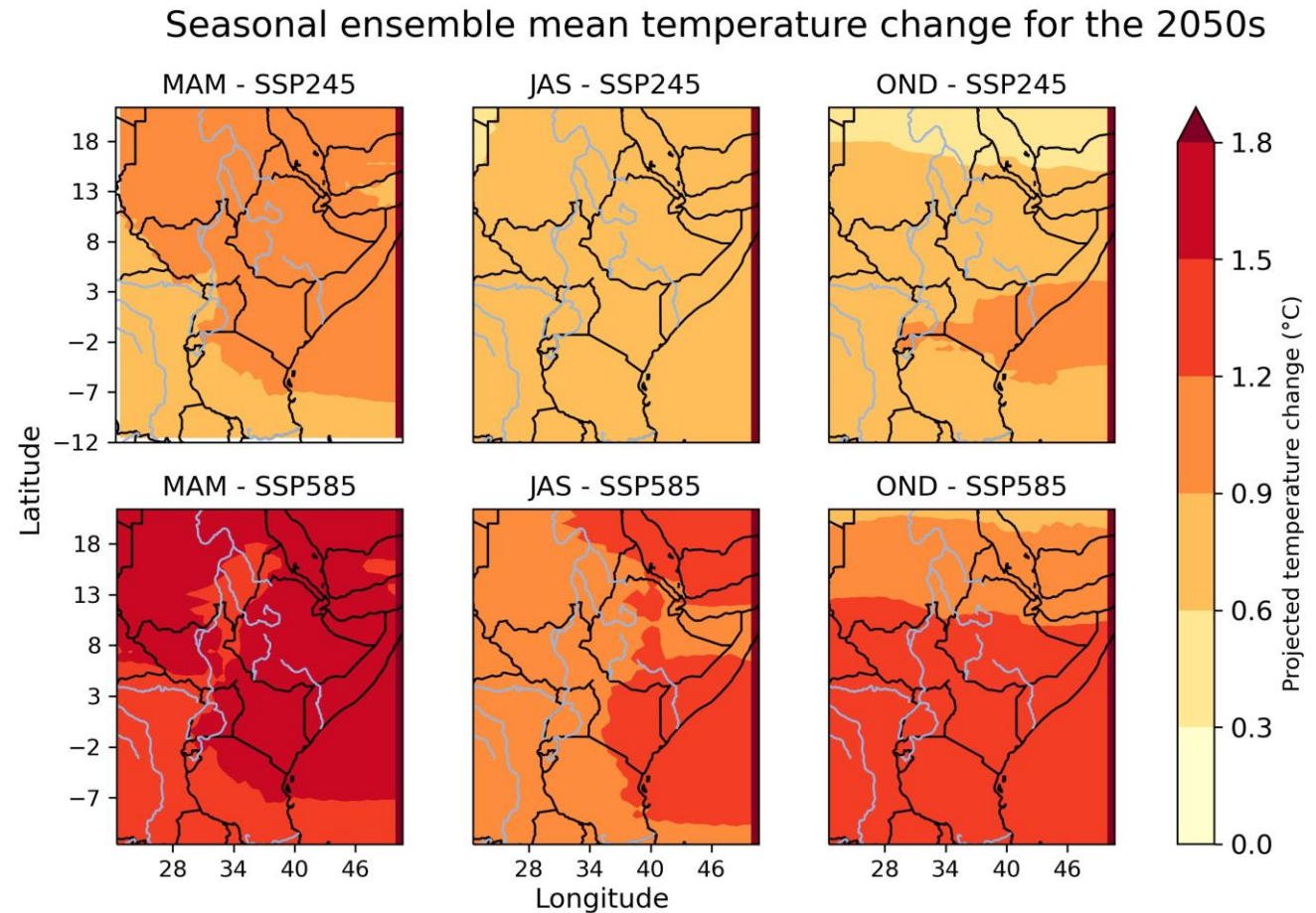
Annual temperature change for the 2050s under two scenarios



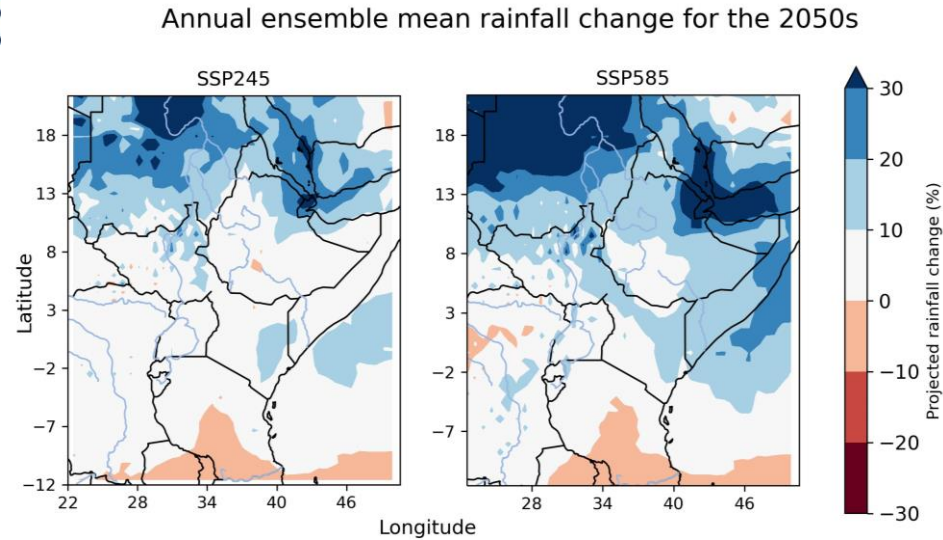
- GCMs have consistent signal – increase in temperature
- GCMs have diverse projections in terms of magnitude
 - The lowest increase is by INM-CM5 => 0.5 °C

Seasonal mean temperature projections

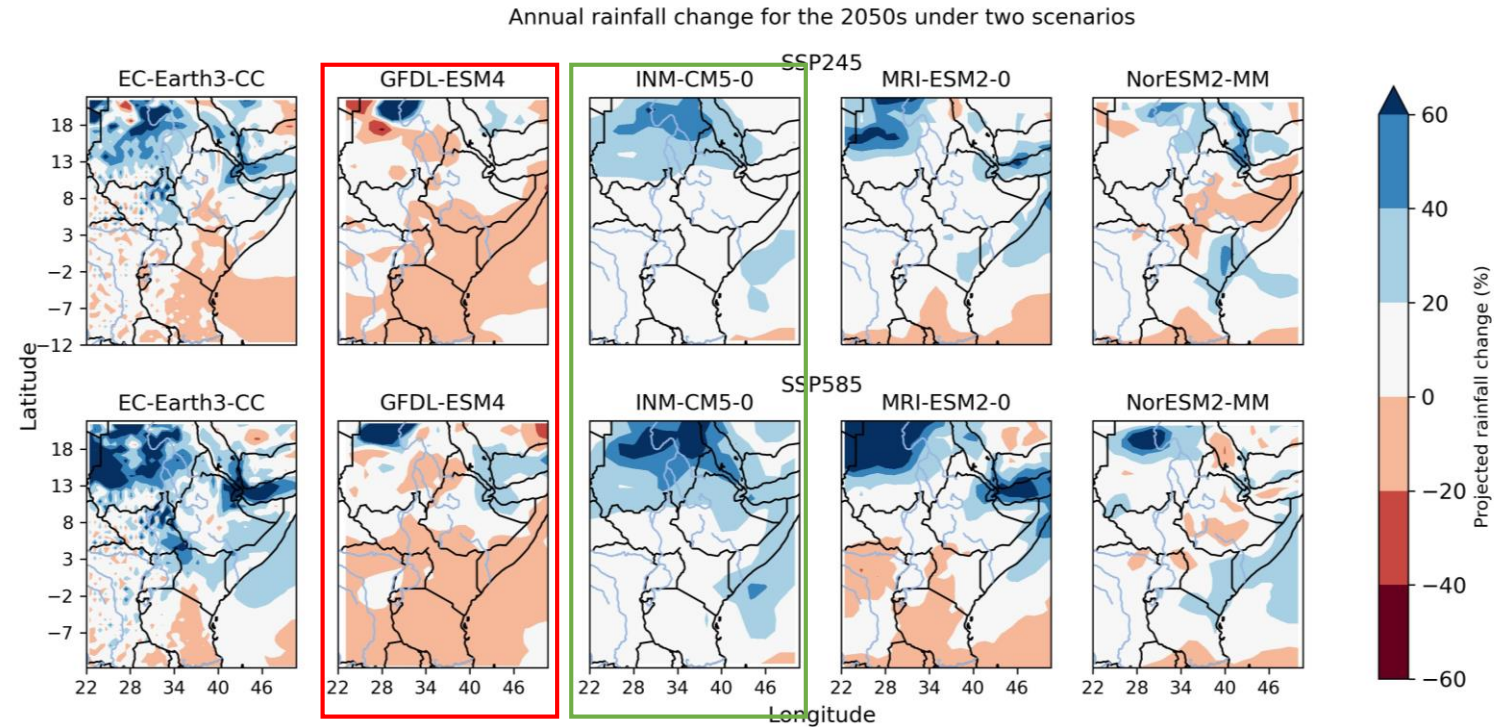
- The three main rainfall seasons are considered
 - MAM and OND for bi-modal rainfall regions
 - JAS for uni-modal rainfall regions
- The MAM season has higher increasing temperature projection than other seasons
 - The SSP-585 scenario shows a higher temperature increase – can be more than 1.5°C in MAM and 1.2°C in OND
- The Ethiopian highlands temperature increase is in the range of 0.6–0.9°C for the main rainy season, JAS



Annual rainfall projections: scope and results



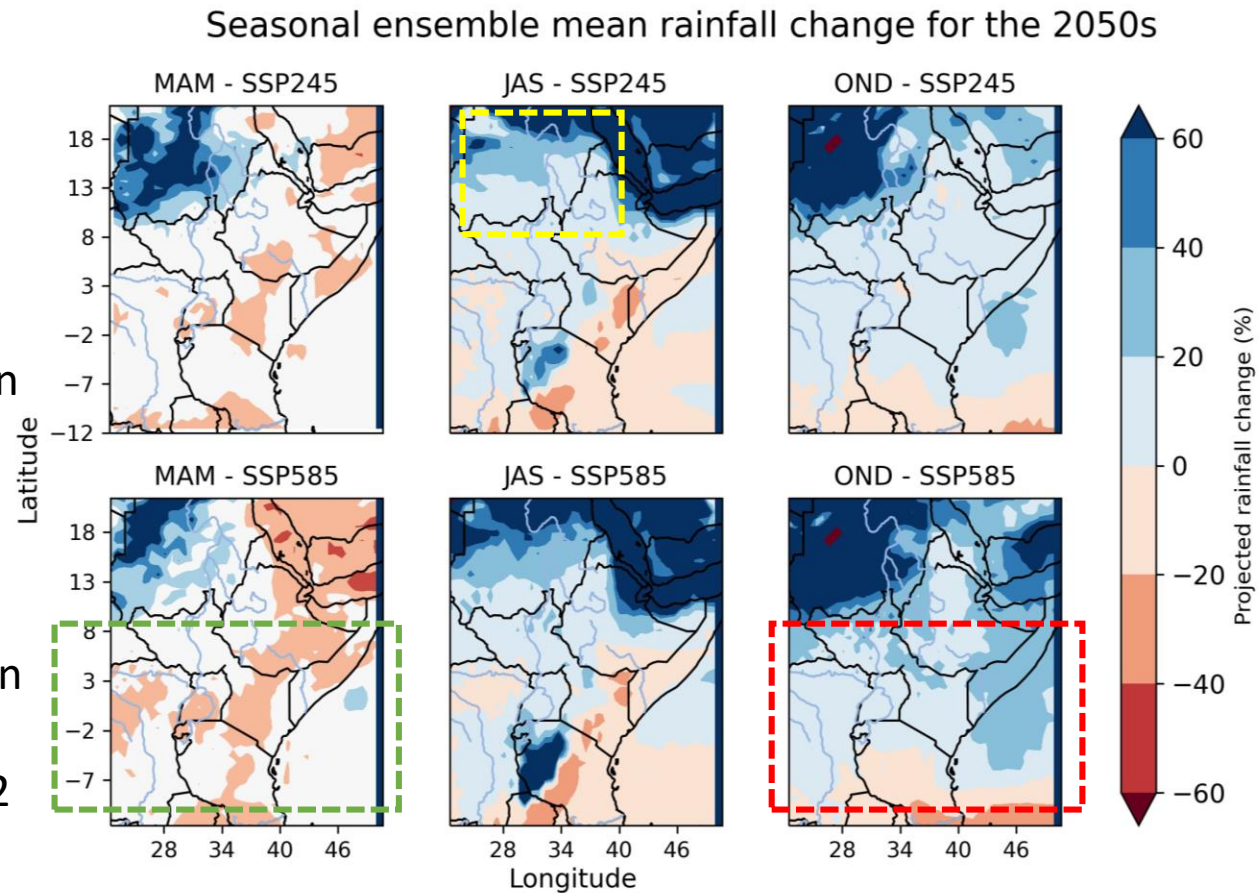
- Annual ensemble results – mostly increasing rainfall projection for the 2050s
- Up to 10% increase under SSP 245 in most areas except in Sudan (can reach up to 30%)
- SSP 585 scenario shows higher rainfall projection in all climate models



- GCMs have diverse projections – a range of possibilities with equal likelihood
 - GFDL-ESM4 has the driest projection => -20%
 - INM-CM5 has the wettest projection => +40%

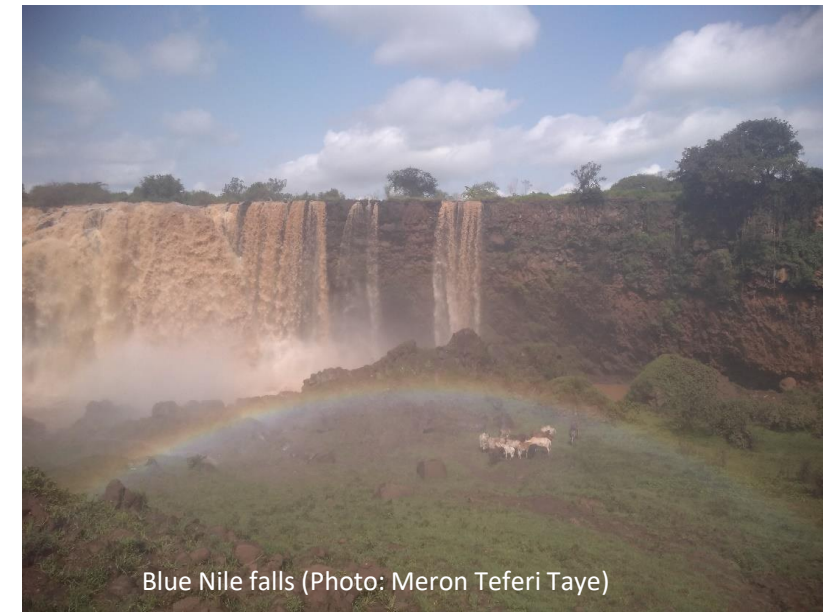
Seasonal rainfall projections

- Green and red boxes => bi-modal rainfall regions
- Yellow box => uni-modal rainfall regions
- The OND season has a higher increasing rainfall projection than other seasons
- The SSP-585 scenario shows higher rainfall projections than the SSP-245 scenario
- OND might become the main rainy season than MAM for the bi-modal rainfall regions
 - MAM rainfall was declining until 2017 but recovered in 2018 and 2020
 - OND rainfall showed an increasing trend up until 2022
- The Ethiopian highlands are projected to obtain up to 20% increase in rainfall during the main rainy season, JAS. Useful for more water availability.



Implications of climate change projections

- Higher rainfall projections are good news in terms of the potential for more water availability.
- OND season is projected to be wetter and less hot than MAM season – potentially OND might become the main rainy season
- MAM season is projected to be drier and hotter than OND season.
 - How does this impact livelihoods or communities that depend on this rainfall?
 - Can rainfed agriculture be sustainable under these conditions?
 - Will the cropping calendar and crop types change?
- Not all models project similar directions of rainfall – some project increase, and others decrease – all with potential equal likelihood
 - Indicating the need for risk-based planning and management
 - Improved practices on better water management, disaster risk prevention, and improving livelihoods are required
- Co-development/ co-production of knowledge on climate and water is important
 - Continuously updated data is needed for decision-makers
 - Interested institutes may come together in a consortium to build up-to-date new insights and new tools





International Water
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Thank you

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