OBSERVED CLIMATE TRENDS AND PROJECTION OF FUTURE CLIMATE FOR TANZANIA

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WORKSHOP ON IMPACTS OF CLIMATE CHANGE IN MANAGEMENT OF ROAD ASSETS AND LAUNCH OF E-MONITORING APPLICATION

Bank of Tanzania Academy, Mwanza

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OUTLINE

- Introduction
- Observed Climate Trends In Tanzania
- Climate Projections for Tanzania
- Adaptation to climate change in road construction
- Conclusion

Introduction

- Road Transportation, Infrastructure and Services is most vulnerable to climate due to the nature of how the industry's heavily reliance on manual workers and how road construction companies operate (outdoor).
- Extreme weather events such as flooding, high temperatures and strong winds present physical obstacles to work onsite.
  - ➢high temperatures are dangerous for workers, and they can limit the ability to concentrate
  - ➢ Very low temperature threatens equipment, since it reduces the loading capacity of many components.
  - ➢heavy rains leads to temporary flooding that results closures of construction activities and reduced road/railway access

Introduction cont.....

- Extreme weather increases the variability of weather ➔ roads designed for a particular climate range may fail more quickly.
- Being aware of meteorological parameters of construction site is essential before designing and building roads and bridges.
- These meteorological parameters include:
  - ✓ Amount and type of rainfall,
  - ✓ Temperature,
  - ✓ Humidity,
  - ✓ Wind speed and direction
  - ✓ Detrimental environmental phenomena including heavy showers, strong winds, etc.
  - ✓ fog, and
  - ✓ Sea level rise and coastal flooding on roads

Influence of climate on Road Transportation, Infrastructure and Services

Temperature:

- High temperature may:
  - Soften and expand road pavement➔ create groove and potholes, particularly in high-traffic areas and
  - Place stress on bridge joints
- Can cause many types of vehicles to overheat➔ fast depreciation of tires.

Influence of climate on Road Transportation, Infrastructure and Services

Rainfall

- Heavy rains may result in flooding, which may:
  - ➢ *weaken or wash out the soil and culverts* that support roads, tunnels, and bridges
  - ➢ *delay construction activities*, and *present physical obstacles to work onsite*
  - ➢ *disrupt traffic (Reduced road access)*
  - ➢ *alter moisture balances and influence pavement deterioration*
- Exposure of road infrastructures to flooding events shortens the life expectancy of highways and roads

➔The stress of water to infrastructures may cause severe *damage*, requiring more *frequent maintenance, repairs, and rebuilding of infrastructures*

Climate change and road infrastructures

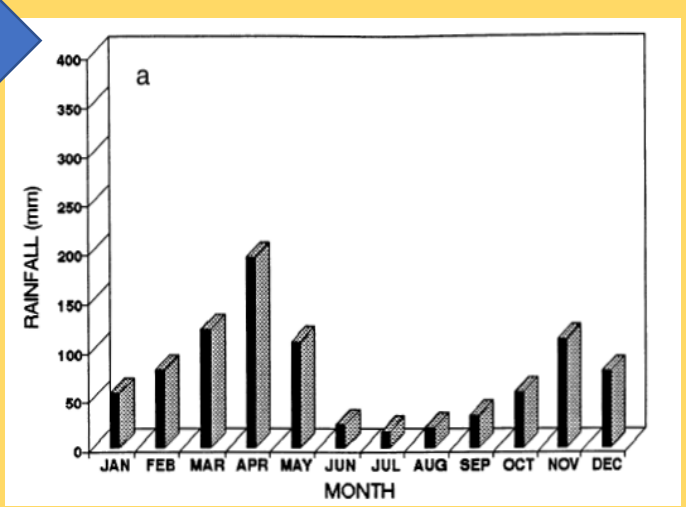
- Road pavement infrastructure is a long-lived investment ➔typically have design lives of 20-40 year.
- Are designed based on moisture and temperature patterns reflecting the history of the local climate.
- With projected climate changes over the next several decades, a pavement could be subjected to very different climatic conditions over the design life.
- Climate change impacts on road pavement will not be equally distributed across the landscape
- Understanding of the localized expected impacts of future climate change could create considerable cost savings in the design, construction, maintenance, and repairs of roads.

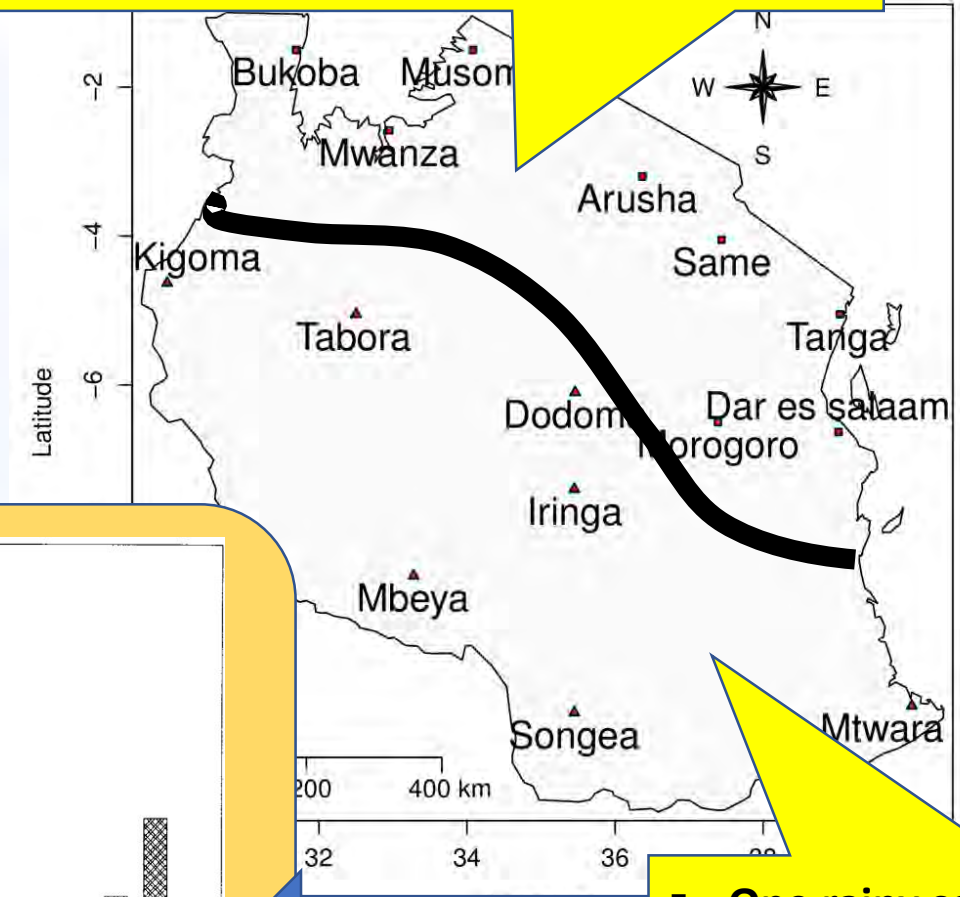
Climate of Tanzania

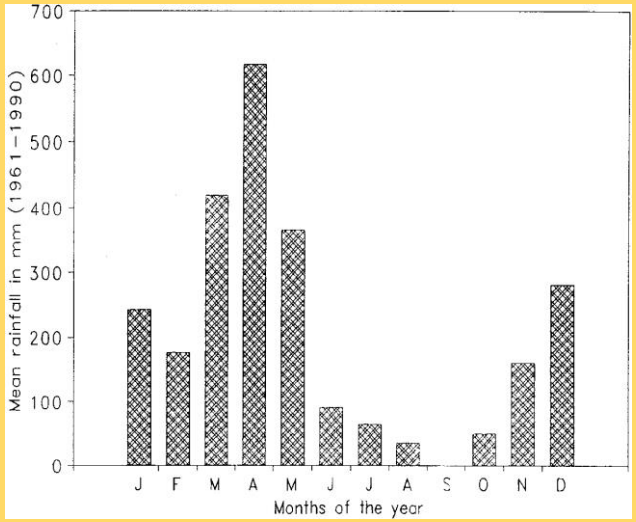
High spatial and temporal variation in precipitation

Hot between **November** and **February** and **cold** between **May** and **August**

Two rainy seasons(Bimodal):
- **MAM and OND**
- **Dry - Jan &Feb and JJA**



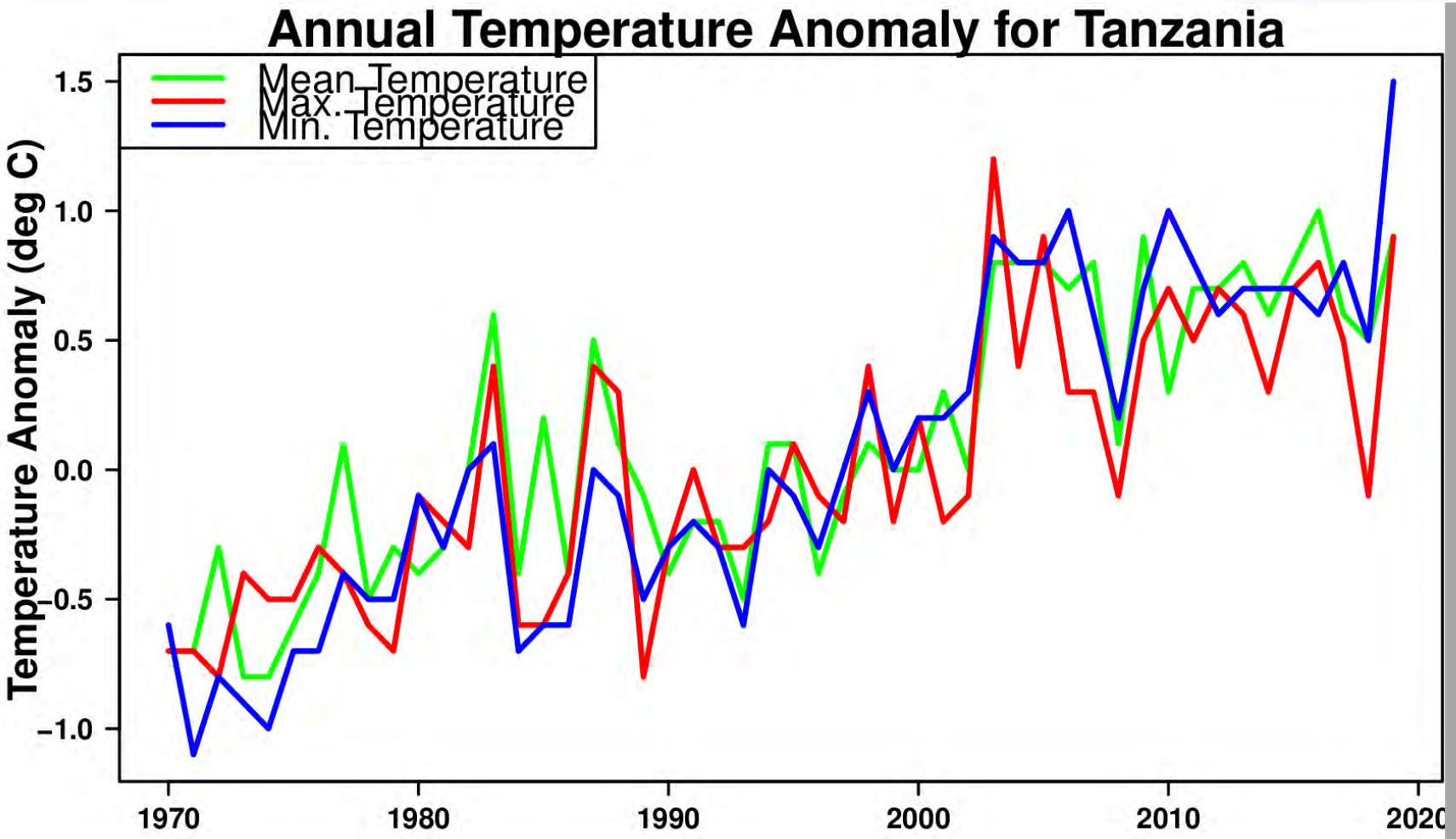




- **One rainy season (Unimodal): NDJFMA**
- **Dry (JJASO)**

Observed Climate Trends In Tanzania

Temperature anomaly in Tanzania (1970-2019)



Country long term average (1981-2010) for :

Mean temperature ➔

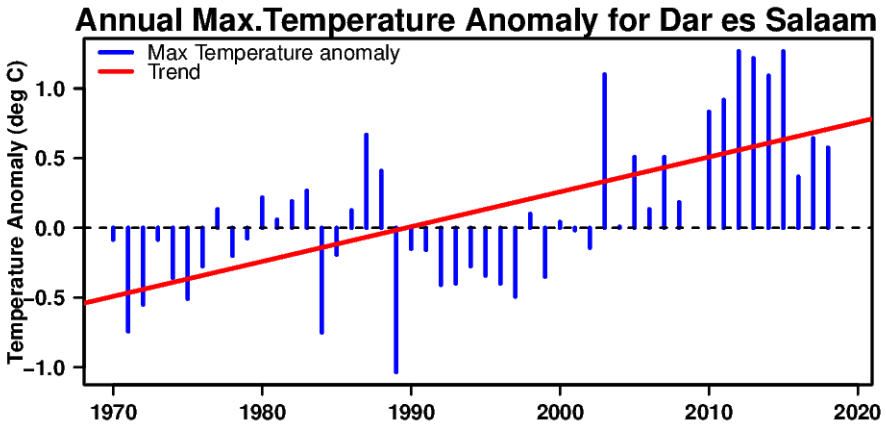
23.2 °C

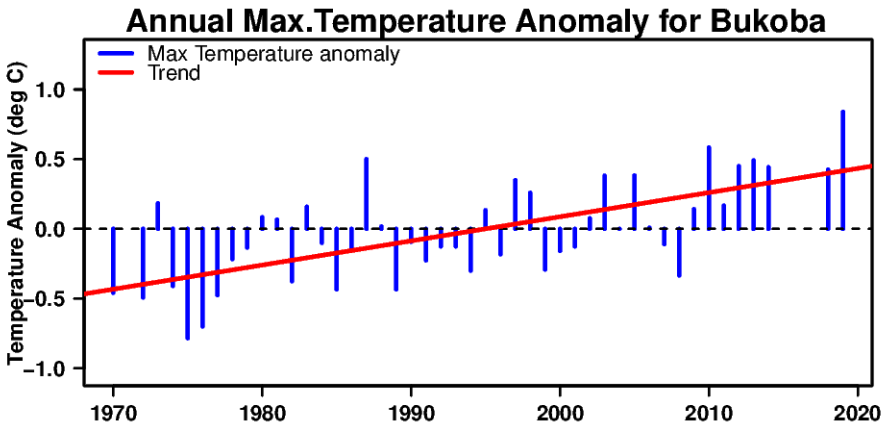
Maximum temperature ➔

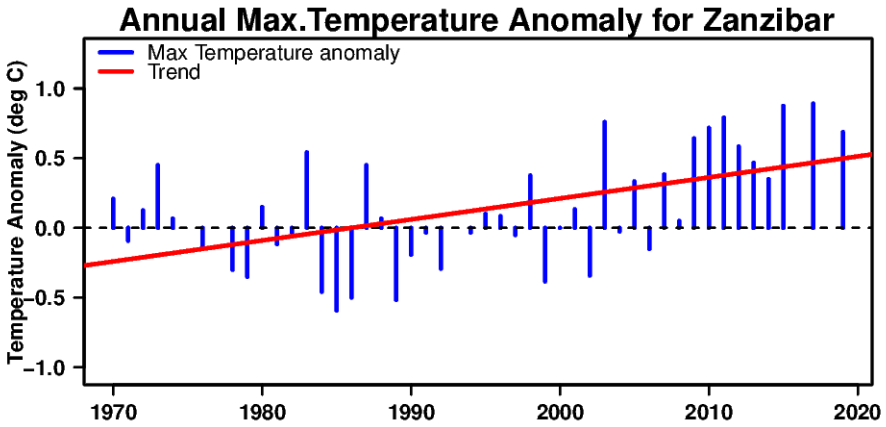
28.4 °C

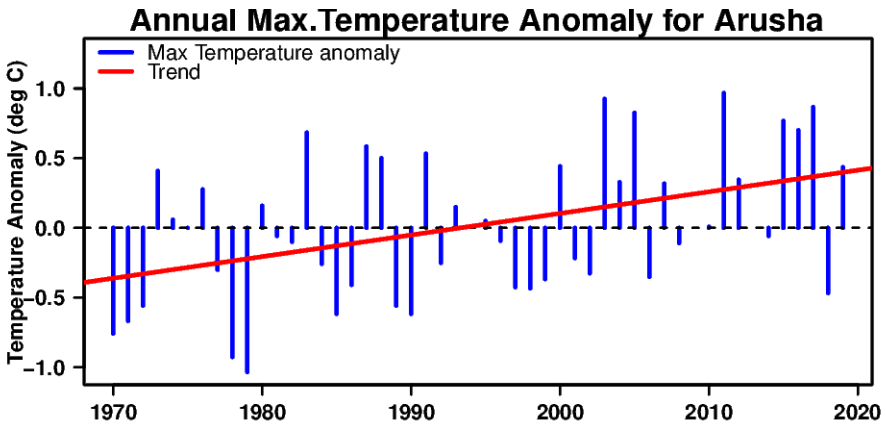
Minimum temperature ➔

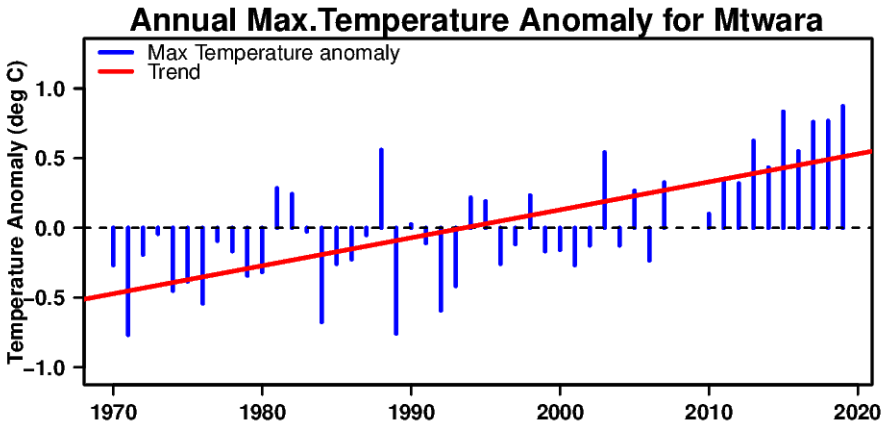
18 °C

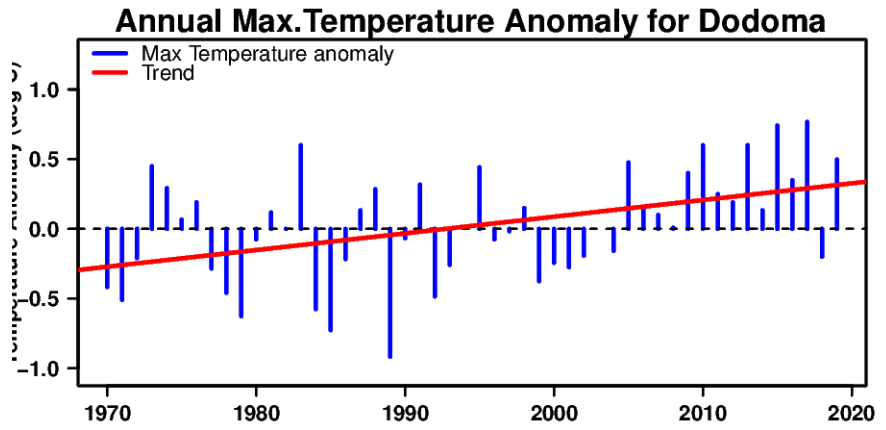










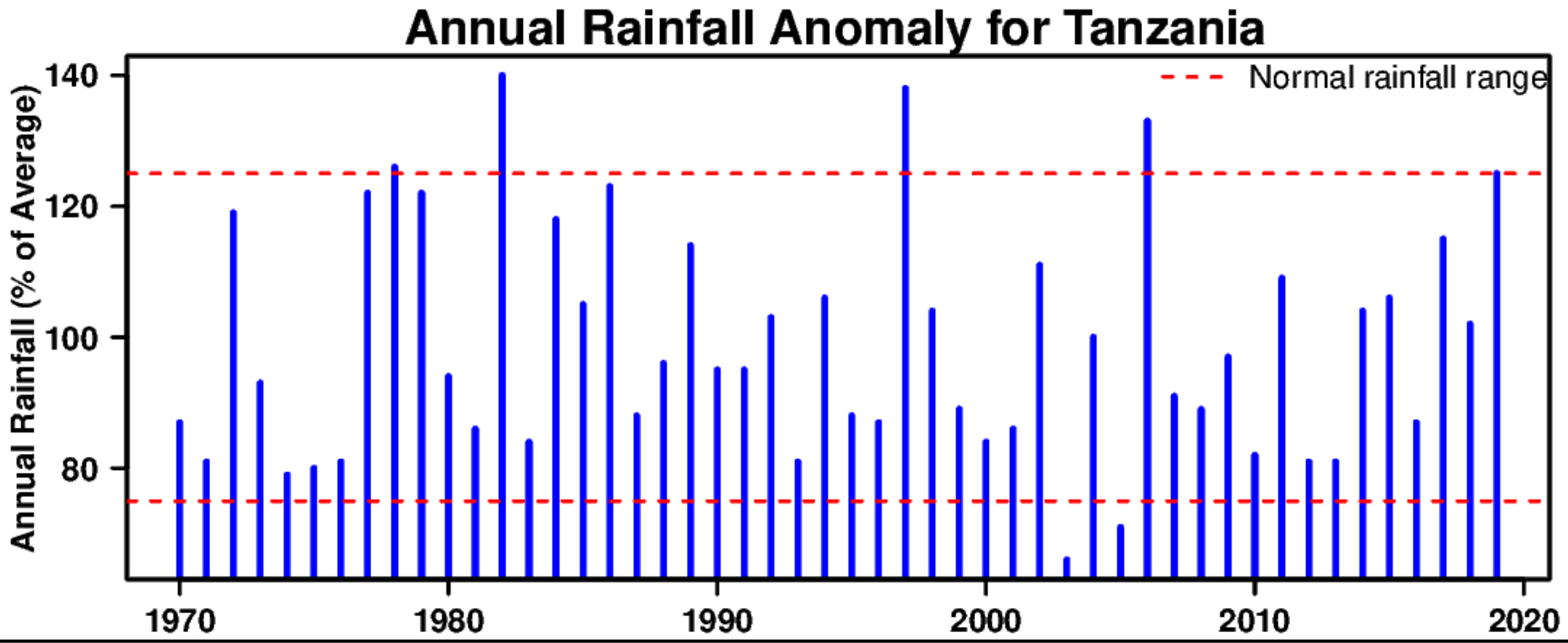


Long term average (1981-2010) of maximum temperature for :

Arusha➔ **25.9 °C**
Bukoba➔ **26 °C**
Zanzibar➔**30.6 °C**
Mtwrara ➔ **30.3 °C**
Dodoma ➔ **29 °C**
DSM ➔ **30.9 °C**

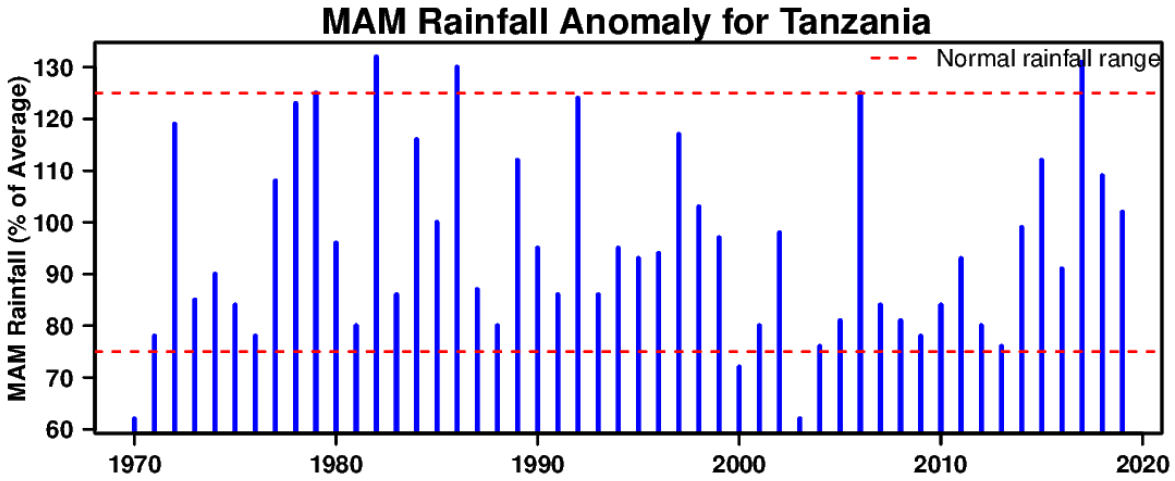
ical Services TMA

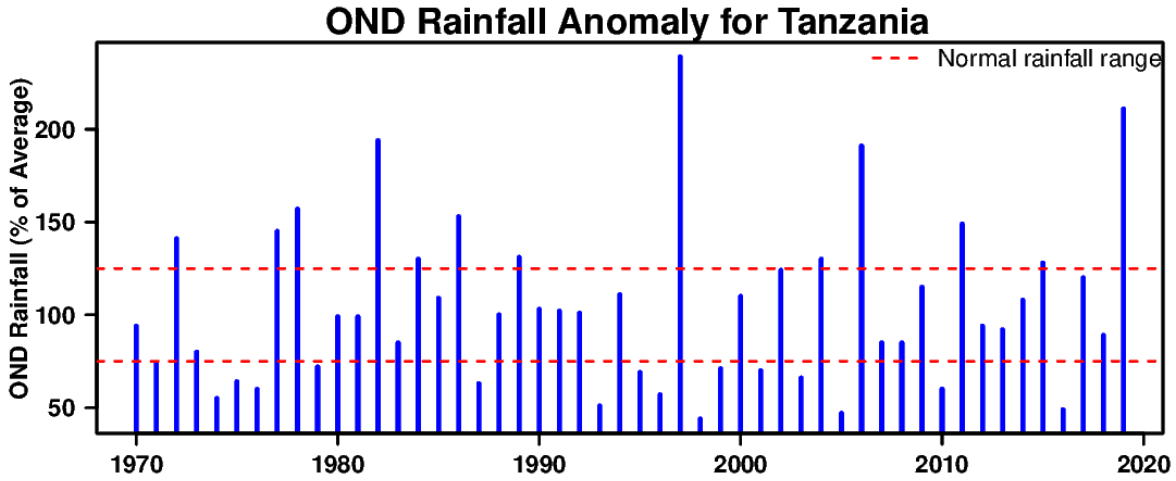
Rainfall anomaly (1970-2019)



Country long term average (1981-2010) for rainfall is : 1025 mm (769 mm -1281 mm)

Seasonal rainfall anomaly (1970-2019)





Country long term average (1981-2010) rainfall for MAM is : 444 mm (333 mm -555 mm)

Country long term average (1981-2010) rainfall for OND is : 279 mm (209 mm -349 mm)

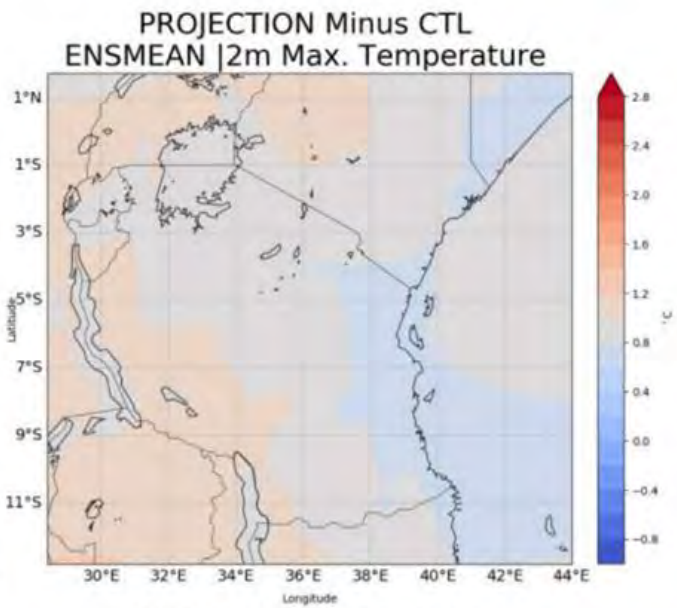
Climate change projections for Tanzania

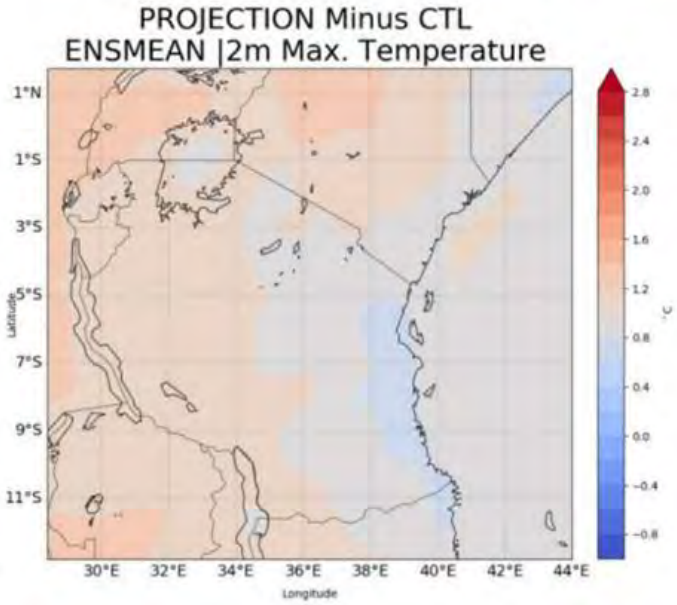
Climate change projections

- **Climate change projection** is the difference between a climate projection and the current climate.
- **Climate projections** are typically presented for a range of plausible pathways, scenarios, or targets that capture the relationships between human choices, emissions, concentrations, and temperature change (**RCP's**)
- The four **RCPs** are numbered according to the change in radiative forcing by 2100: +2.6, +4.5, +6.0 and +8.5 **W/m²**
- **Future climate projections** are most commonly summarized for a given **future scenario** (for example, RCP8.5 or 4.5) over a range of future **climatological time periods** (for example, temperature change in 2040–2079 or 2070–2099 relative to 1980–2009/or any other climate refence).
- **Climate scenario** is often used synonymously with **climate projection**.

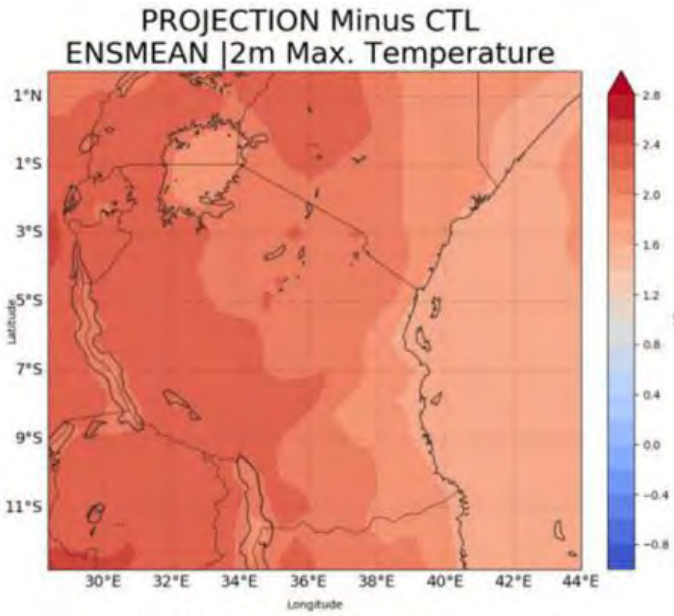
Maximum temperature Projections

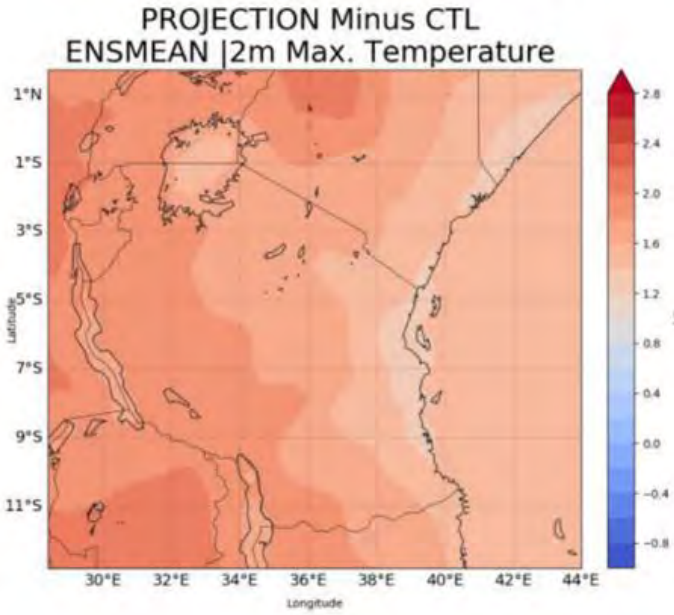
2011-2040



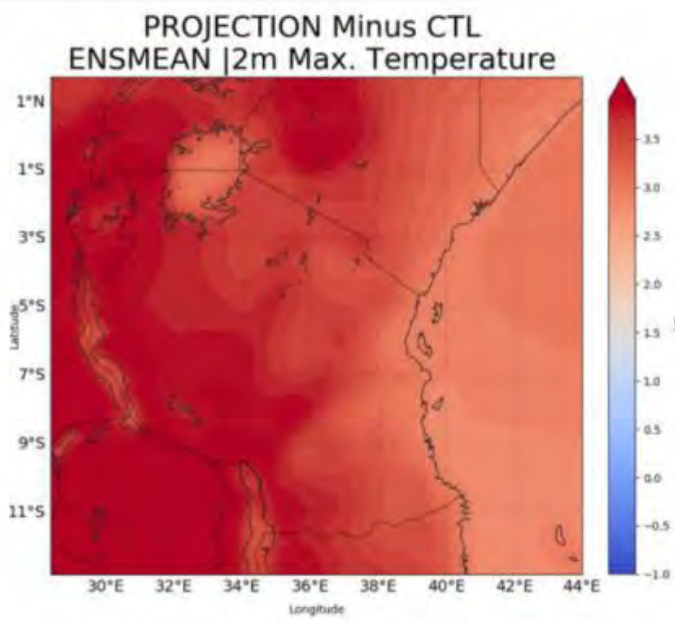


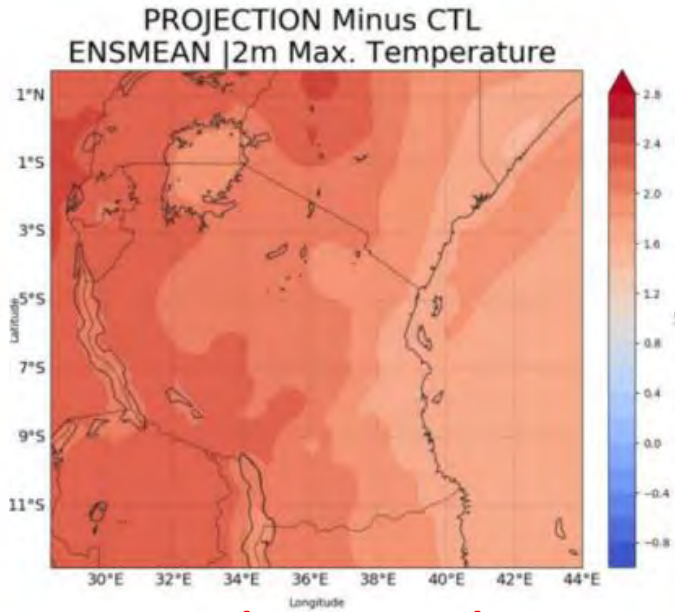
2041-2070





2071-2100





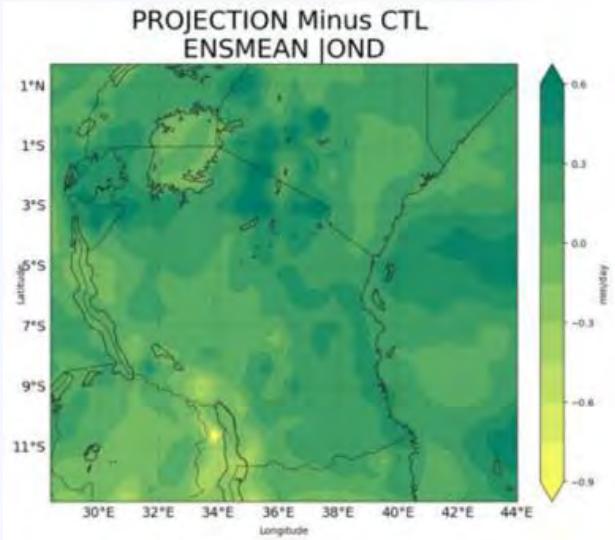
RCP 8.5

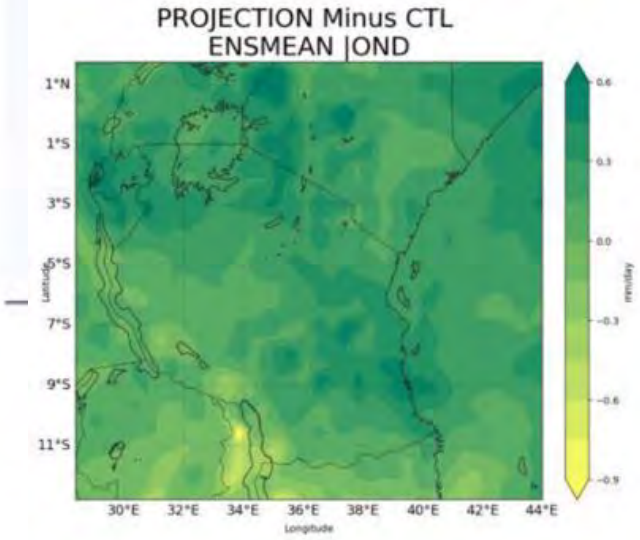
RCP 4.5

Luhunga et. Al. 2018

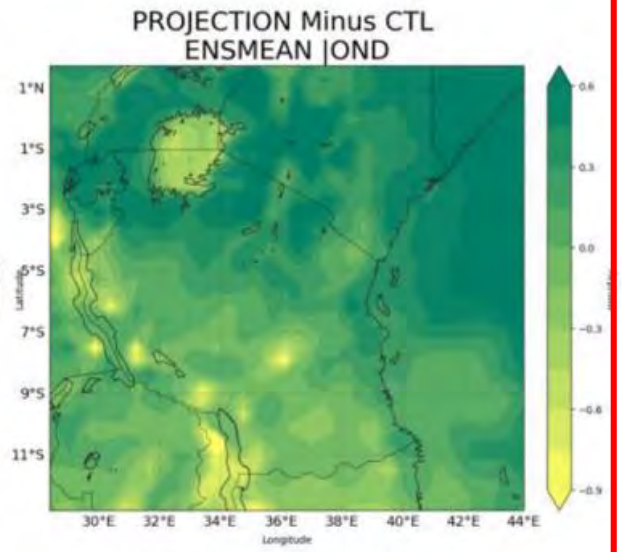
Rainfall Projections (OND)

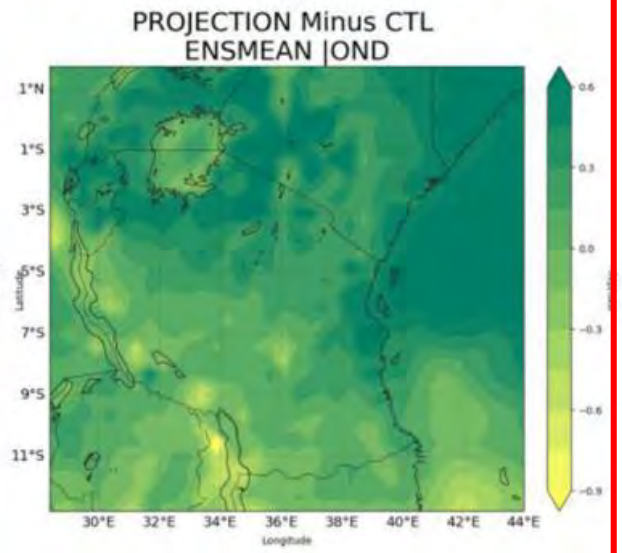
2011-2040



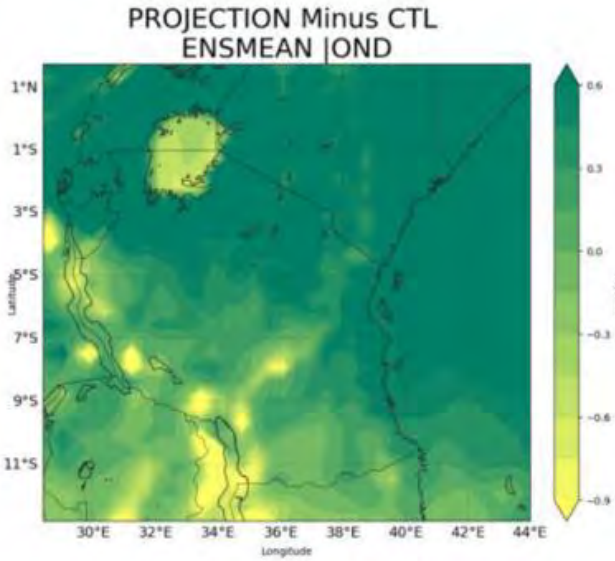


2041-2070

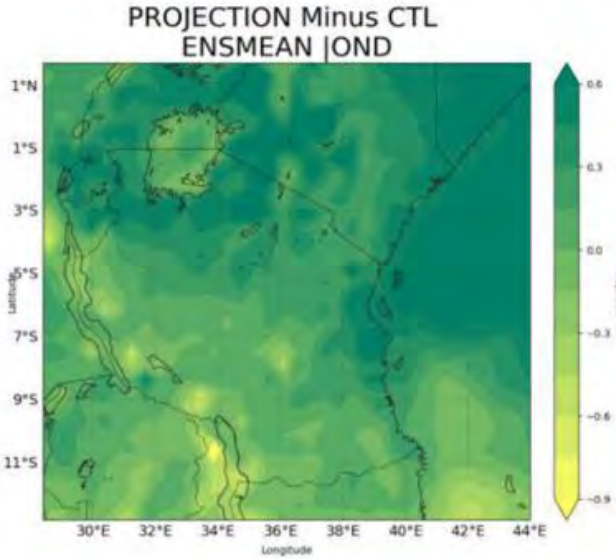




2071-2100



RCP 8.5

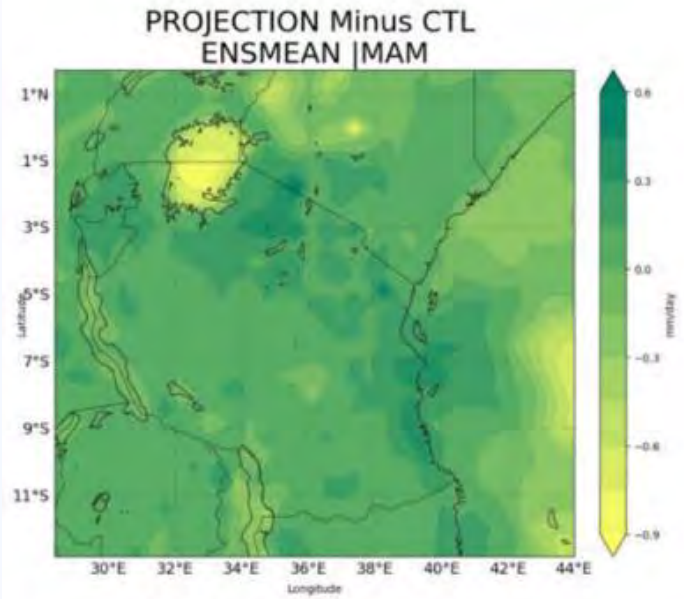


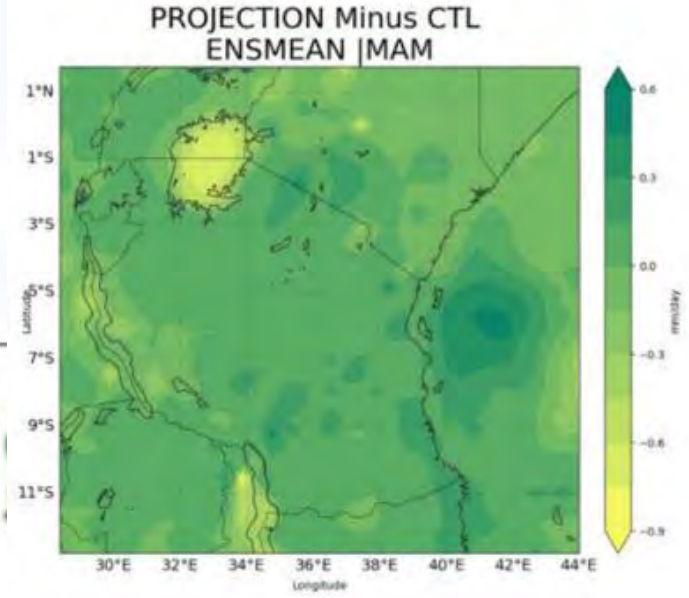
RCP 4.5

Luhunga et. Al. 2018

Rainfall Projections (MAM)

2011-2040





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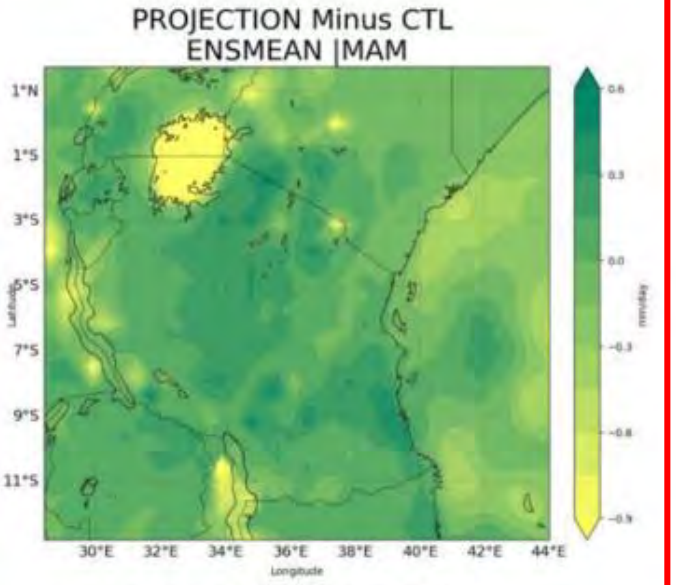

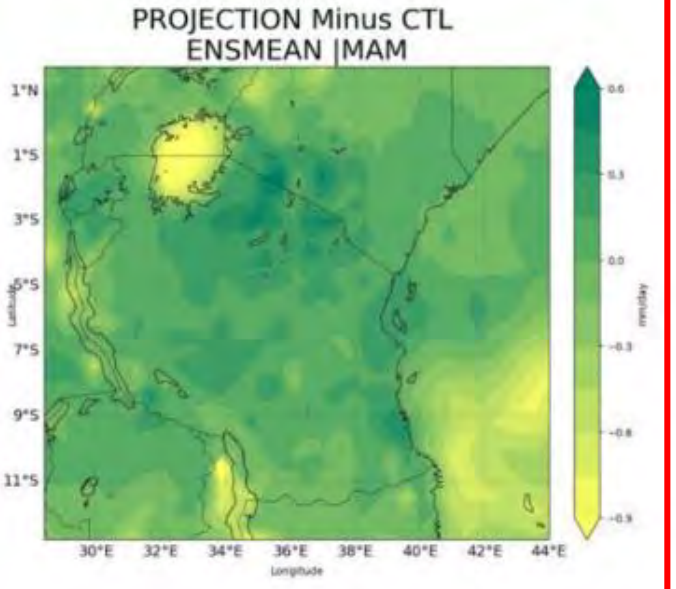

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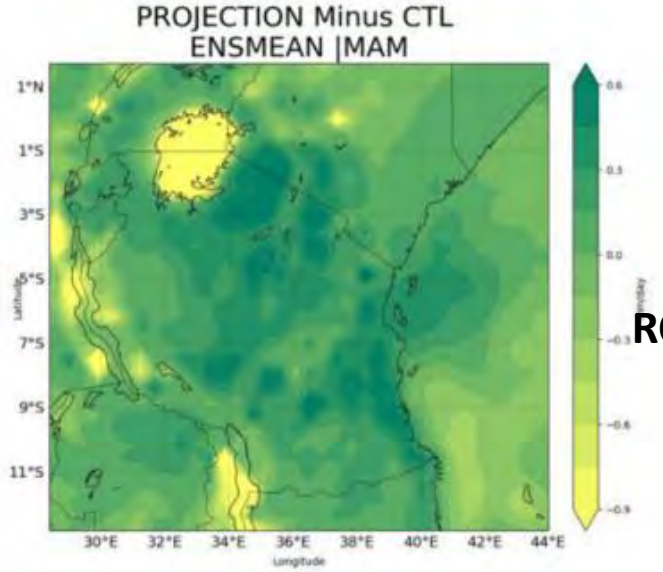

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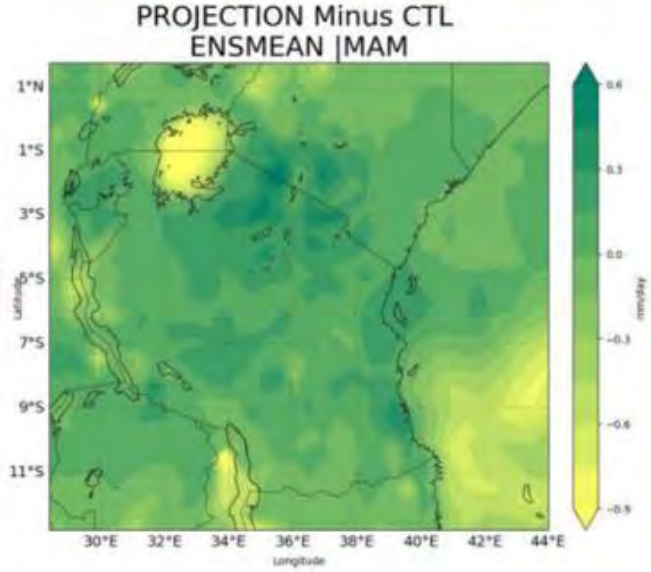
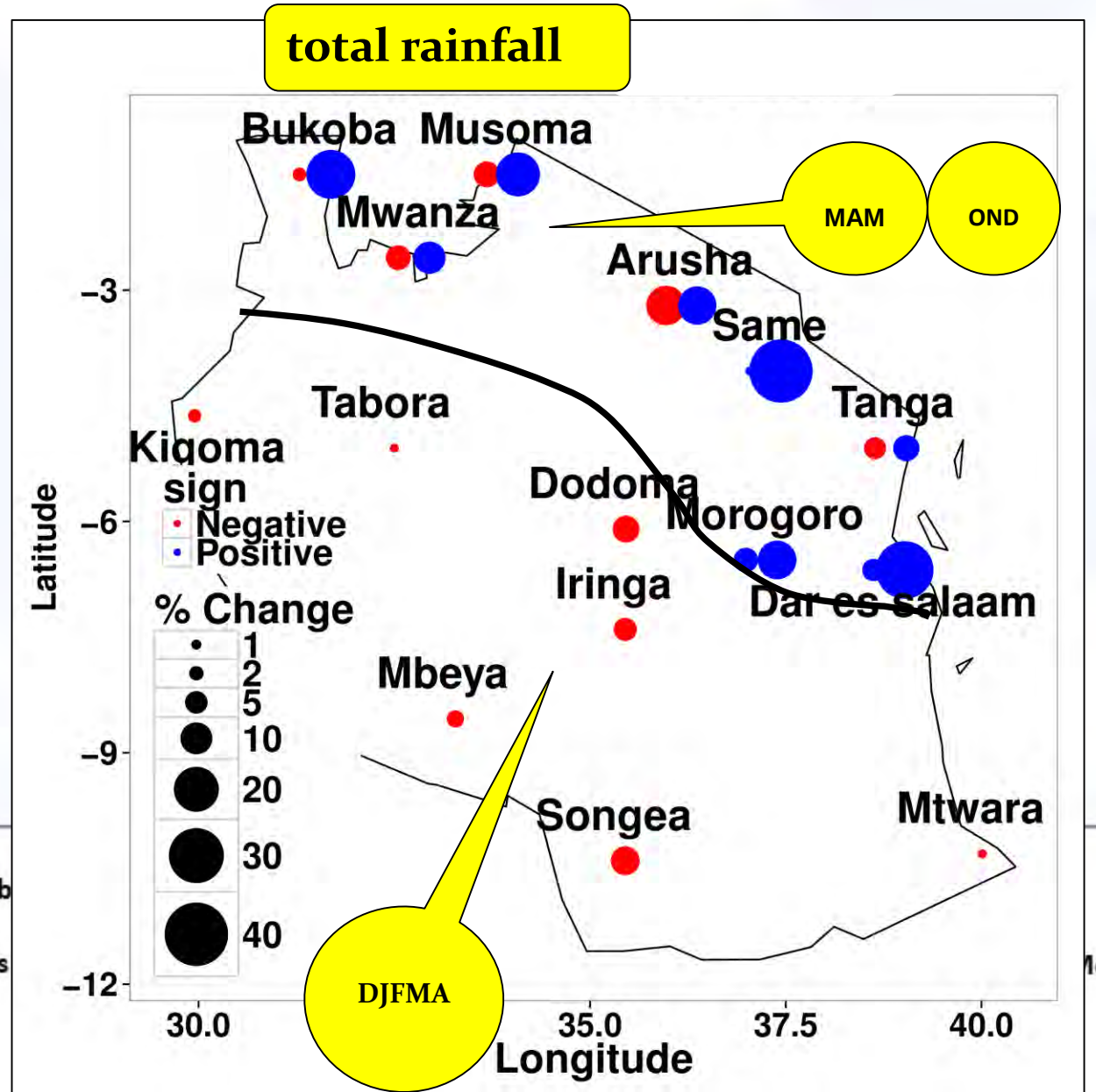


RCP 4.5

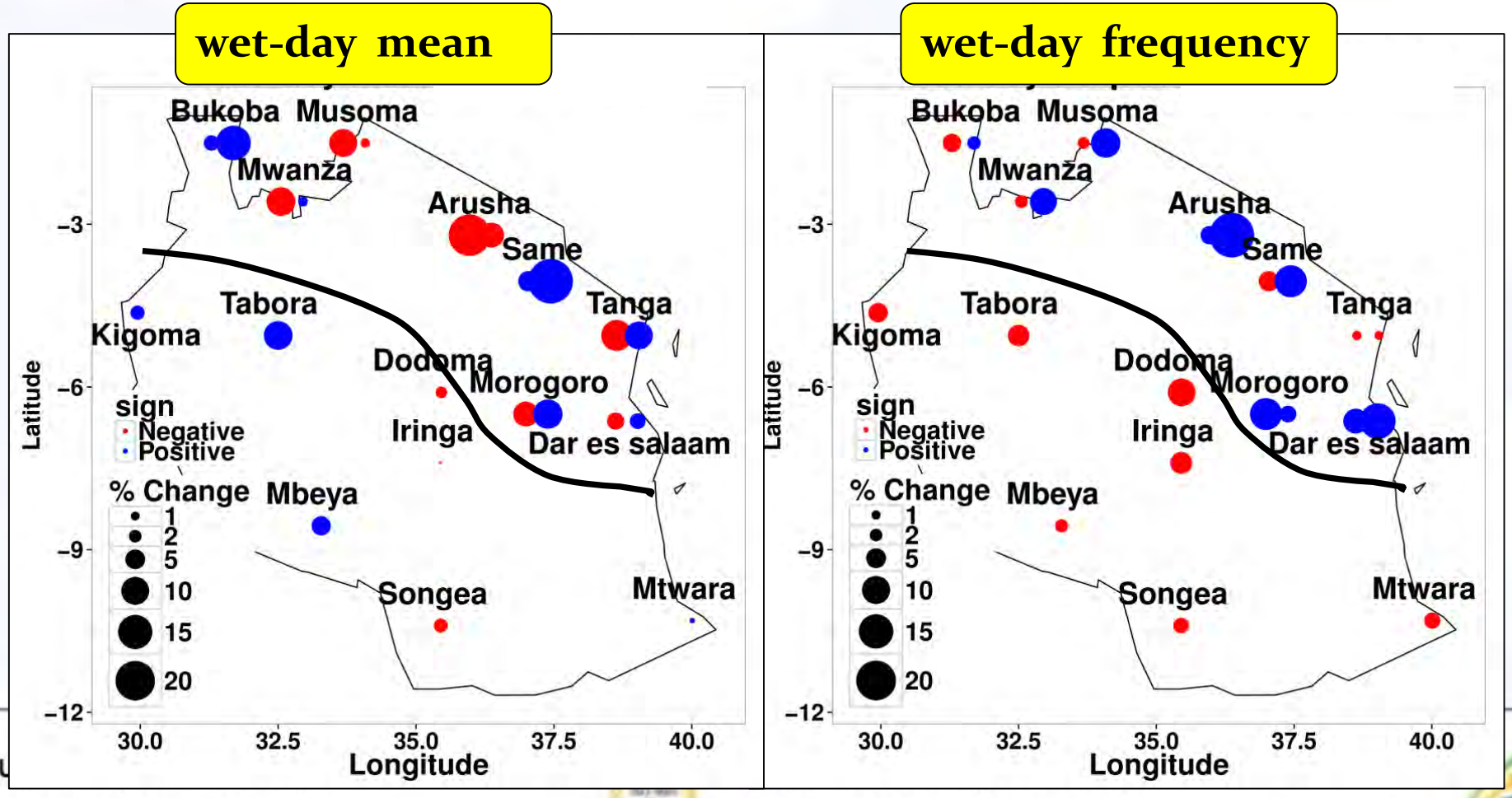
Luhunga et. Al. 2018

Future projections for rainfall (2040-2069): multi-model mean



Mtongori et. Al. 2015

Future projections for rainfall (2040-2069): multi-model mean

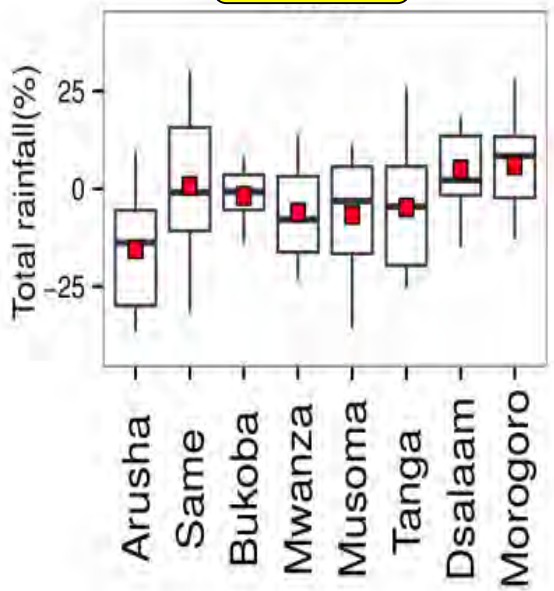


Mtongori et. Al. 2015

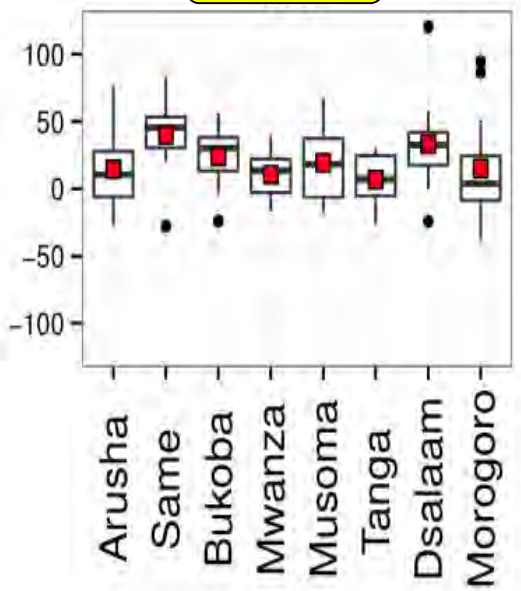
Future projections for rainfall (2040-2069): multi-model individual projections

total rainfall

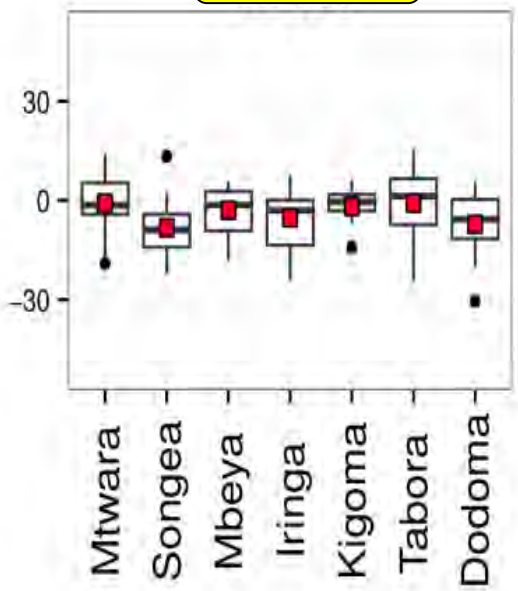
MAM



OND

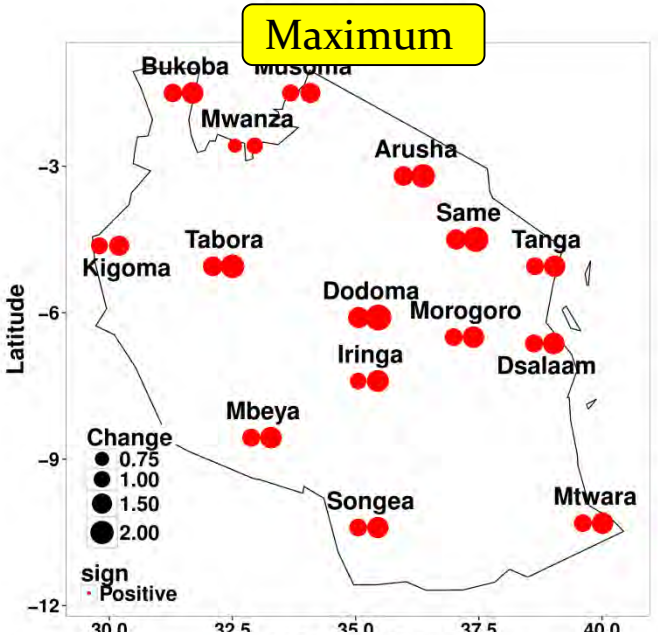


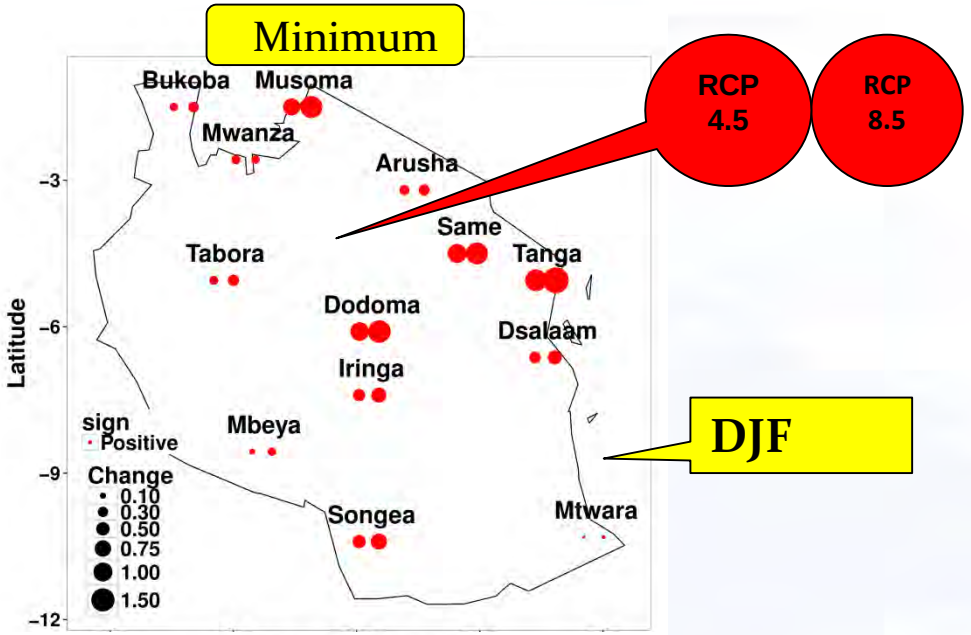
DJFMA



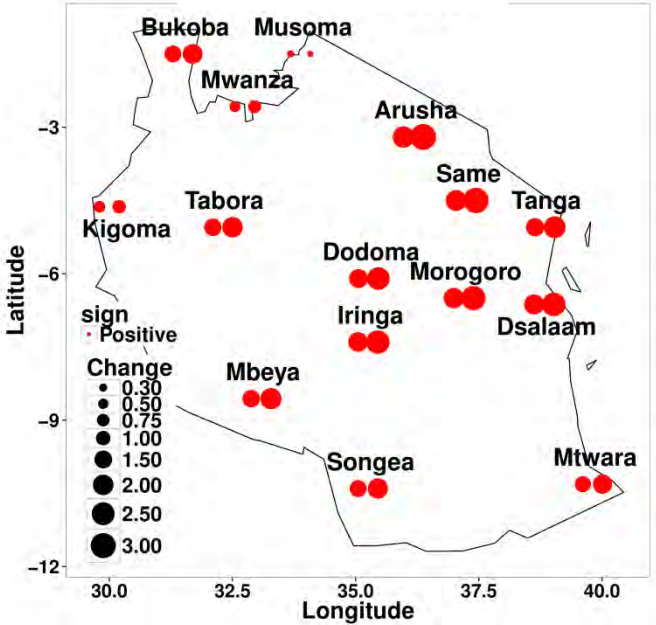
Mtongori et. Al. 2015

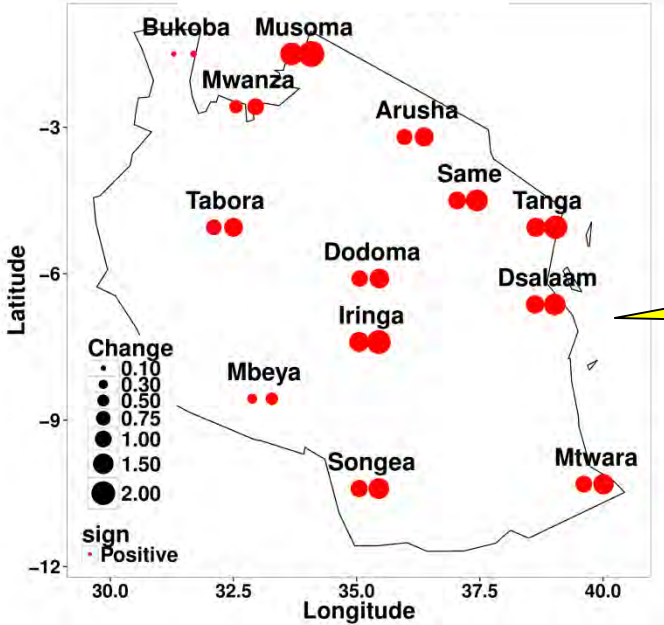
Future projections for temperature (2040-2069): multi-model mean





DJF





MAM

The United R

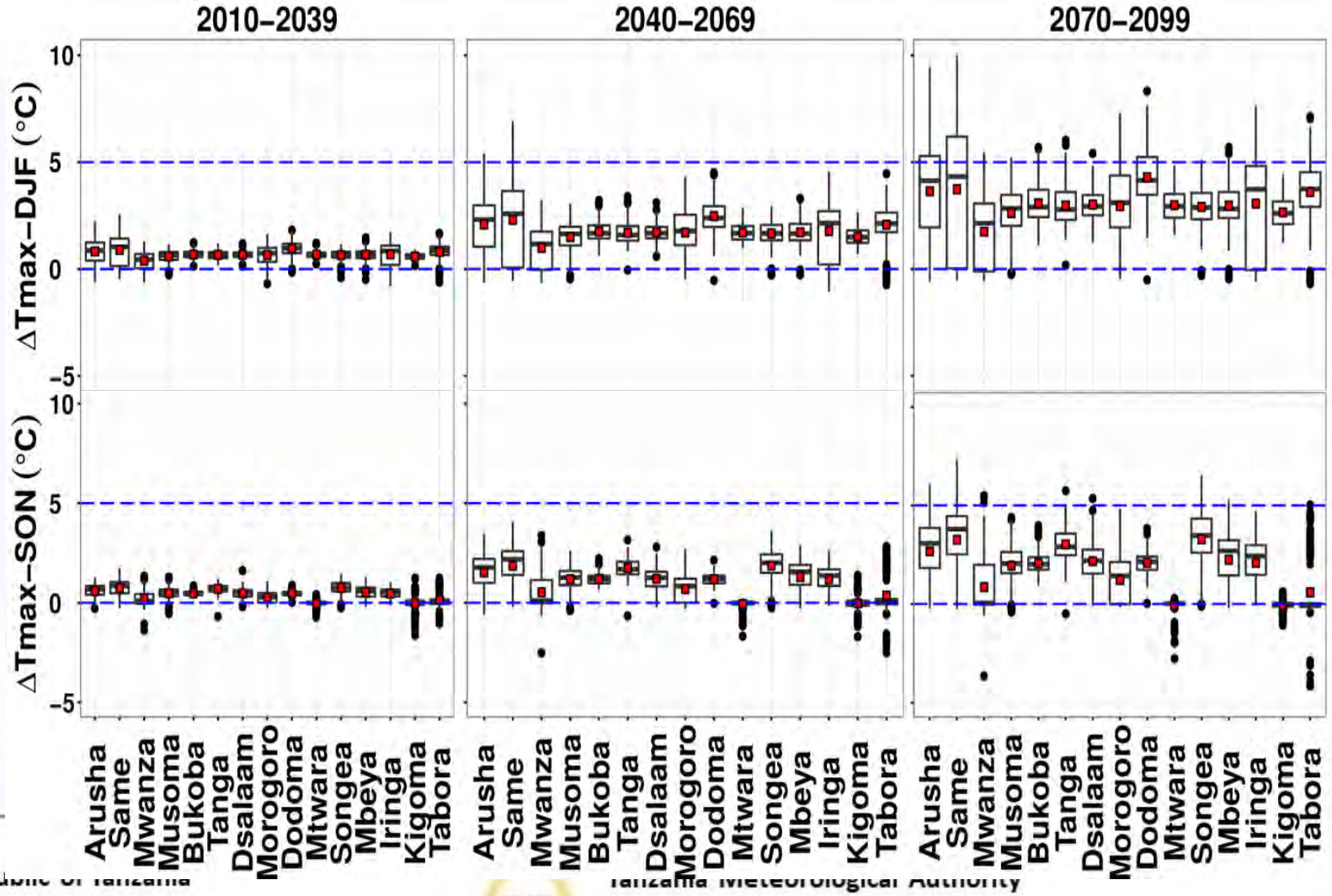
Ministry of V

eorological Services

TMA

Mtongori et. Al. in process

Future projection for maximum temperature multi-model individual projections



The United Republic of Tanzania

Ministry of Works and Transport

Tanzania Meteorological Authority

ISO 9001:2015 Certified in Aviation Meteorological Services

TMA

Mtongori et. Al. in process

SOLUTION:

ADAPTATION TO CLIMATE CHANGE IN ROAD CONSTRUCTION

USE OF METEOROLOGICAL INFORMATION FOR CONSTRUCTION

Weather and climate information for construction industry is crucial for 4 construction stages

A. Planning and designing
B. Procurement and resources mobilization
C. Implementation/construction
D. Post construction – monitoring and maintenance

Tanzania Meteorological Authority Act No 2 of 2019

TMA was established by Tanzania Meteorological Authority Act No 2 of 2019 (Sect 4(1 &2))

- The National Meteorological Service;
- The designated meteorological authority to fulfil the international obligation of the Government under the Convention of International Civil Aviation Organization; and
- The designated National Tsunami Warning Centre.

Tanzania Meteorological Authority Act No 2 of 2019 cont…..

Authority shall deliver (Sect 5)

- public good and
- commercial services in relation to meteorology

- The Authority has to prescribe the weather and climatic requirements for sectoral activities (Sect 21(1&2))
- Road construction is among the sectoral activities that require weather and climate services

Tanzania Meteorological Authority Act No 2 of 2019 (Powers of Authority)

Exclusive powers of Authority (TMA Act (2019) Sect 27)

- on weather forecast and issue of weather warnings to the public and
- to provide meteorological services of safety in nature to various sectors.

  (aviation, marine, agriculture, oil and gas, search and rescue activities in the United Republic and any other sectors as the Minister may prescribe)

THE TANZANIA METEOROLOGICAL AUTHORITY (COST RECOVERY ON METEOROLOGICAL SERVICES) REGULATIONS, 2021

- The Authority (TMA) shall provide the following met services for road construction activities (Reg 14 (1)):-
  a) rainfall amount and intensity;
  b) temperatures and humidity;
  c) the strength and direction of winds;
  d) consecutive wet days and dry days;
  e) site specific weather forecasts/ warnings; and
  f) climatological data and climate projections

THE TANZANIA METEOROLOGICAL AUTHORITY (COST RECOVERY ON METEOROLOGICAL SERVICES) REGULATIONS, 2021 cont.....

- A customer shall use meteorological services for the following construction activities (Reg 14 (2)):-

a) decision basis as regards the implementation of major construction works including erection of a scaffold tower for reduced loss of human life and property;

b) decisions regarding planning, designing and dimensioning of roads and bridges structures;

c) decision on materials and equipment to be used in construction;

d) appropriate and effective timing of construction; and

e) any other related activities

COST RECOVERY ON PROVISION OF METEOROLOGICAL SERVICES

- The Authority shall implement cost recovery for sustainability of meteorological infrastructure to ensure continuity of service delivery. (Reg 4 (1))

- The production cost of providing meteorological service shall comprise of the cost of collecting, analysing, processing, packaging and disseminating the required meteorological observations, data and information. (Reg 4 (2)).

COST RECOVERY ON PROVISION OF METEOROLOGICAL SERVICES

EXISTING CHARGES

1. **Climatological data –** as per formula on data charges (Reg 26)

2. **Certified Meteorological Reports**
   - TZS 300,000/= per report upon request

Maazimio ya mkutano

Mkutano ulikuja na maazimio 12.

Wakandarasi walikubaliana kwa pamoja kwamba huduma za hali ya hewa ni za muhimu katika sekta ya Ujenzi na hivyo kuazimia kwamba Tozo za uchangiaji gharama za utoaji wa huduma mahususi za hali ya hewa kwa ***shughuli za ujenzi zijumuishwe kwenye gharama za mradi (BoQ preliminaries)***

12 hadi 13 Mei, 2022

COST RECOVERY ON PROVISION OF METEOROLOGICAL SERVICES

PROPOSED METEOROLOGICAL SAFETY OVERSIGHT CHARGES FOR CONSTRUCTION

PROJECT Cost(tzs) Linear & Spot	Project Class	No. of Weather Bulletin	Fee Amount(Tzs)
<50Million	A	1	100,000, upon request
50Million -500Million	B	4	825,000
501Million-10Billion	C	8	1,500,000
>10Billion	D	12	5,000,000

Conclusion

Project disruption,

Loss of productivity,

increased prolongation costs,

environmental non-compliance,

higher insurance premiums,

higher closure bonds and financial assurance,

Social License risks

Take home message

- To **note** the benefits of cost recovery for Tailor-made meteorological services and products for road construction and transportation.
- To **note** the existing charges.

Thank you!