



ICPAC



RESEARCH PROGRAM ON  
Climate Change,  
Agriculture and  
Food Security



# WRF FORECAST PRODUCTS AT ICPAC

Objective Climate Forecasts for Agriculture and Food Security Sector  
in Eastern and Southern Africa Training of Trainers Workshop

31<sup>st</sup> August  
Victoria Falls, Zimbabwe



ICPAC

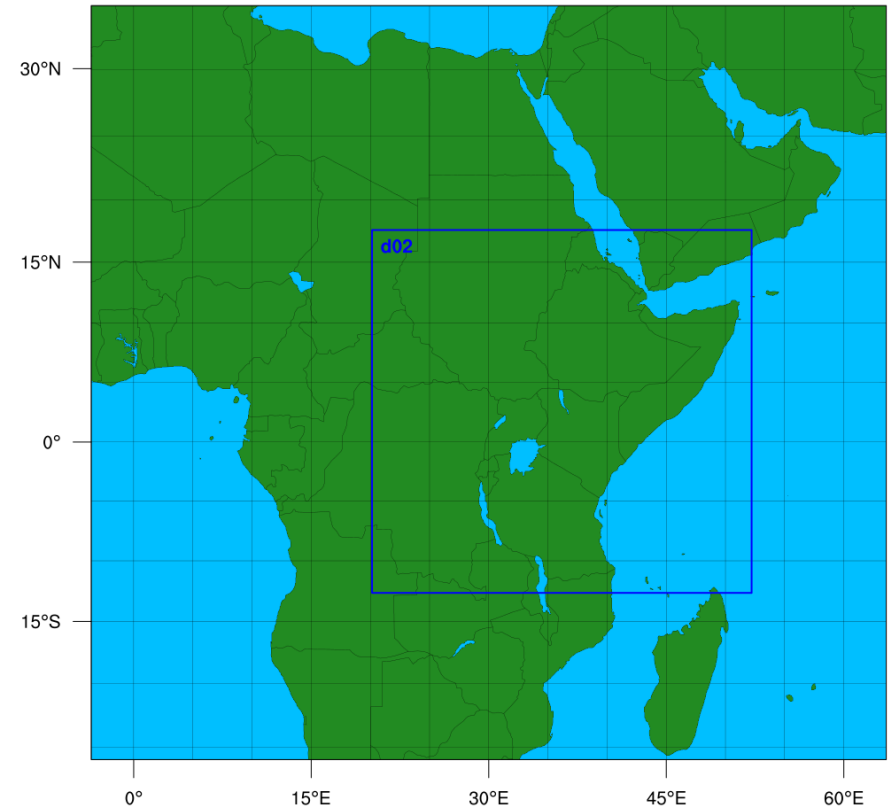
# INTRODUCTION

- The advanced research version of the Weather Research and Forecasting model (WRF) is widely used for both studying as well as forecasting a variety of high-impact weather/climate related events.
- The model is open source and has numerous schemes that can be changed allowing users to customise the model for their regions.

# WRF DOMAIN

- WRF model is used operationally over the Eastern Africa region.
- Spatial resolution of 30 km and 10 km for nested domain with 28 vertical levels.
- The operational forecast is initialized utilizing the CFSv2.

Domain Configuration for ICPAC



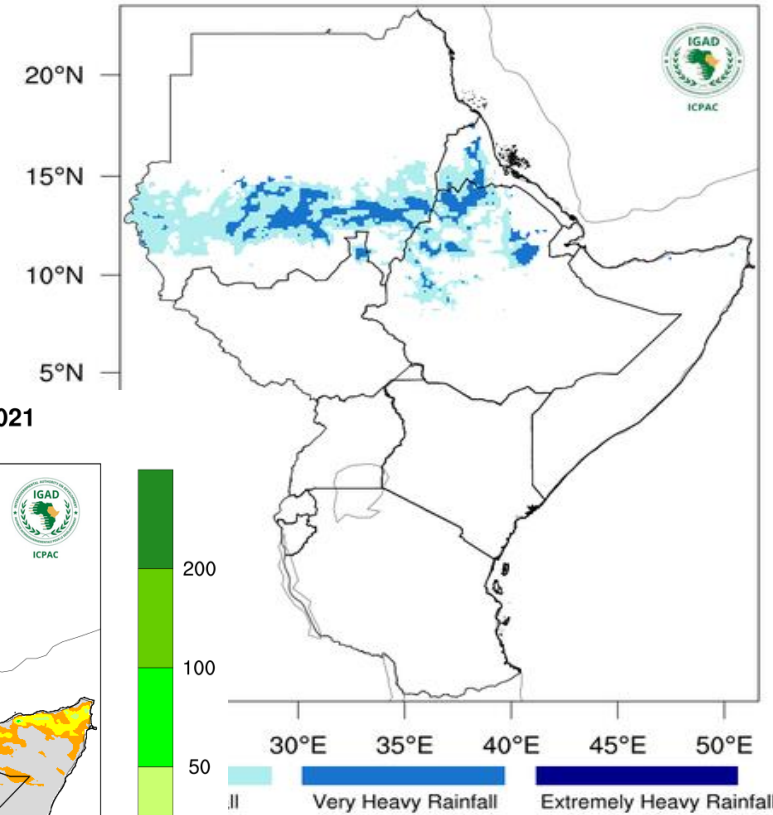
# OPERATIONAL WEEKLY FORECASTS

## HEAVY RAINFALL RISK

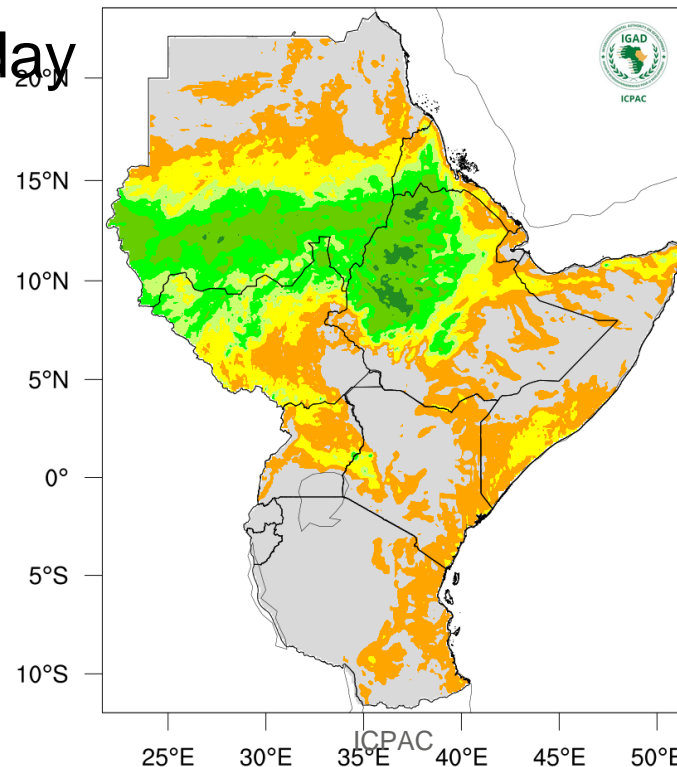
# WEEKLY PRODUCTS

- Products include; total rainfall, temperature, wind and exceptional rainfall
- Useful for flood risk monitoring
- Updated every Monday

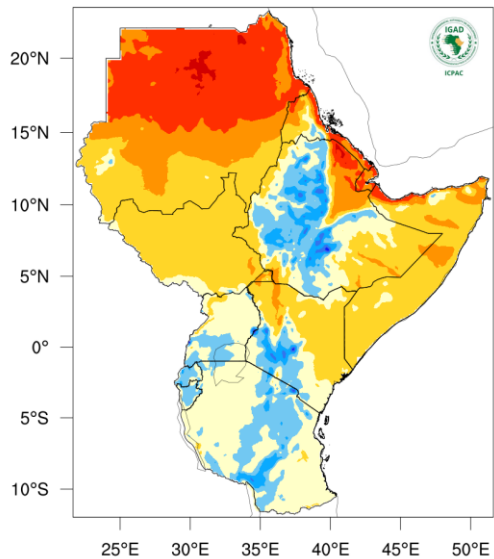
Exceptional Rainfall for 24-31 Aug 2021



Total Rainfall (mm) for 24-31 Aug 2021



Mean Temperature (C) for 24-31 Aug 2021

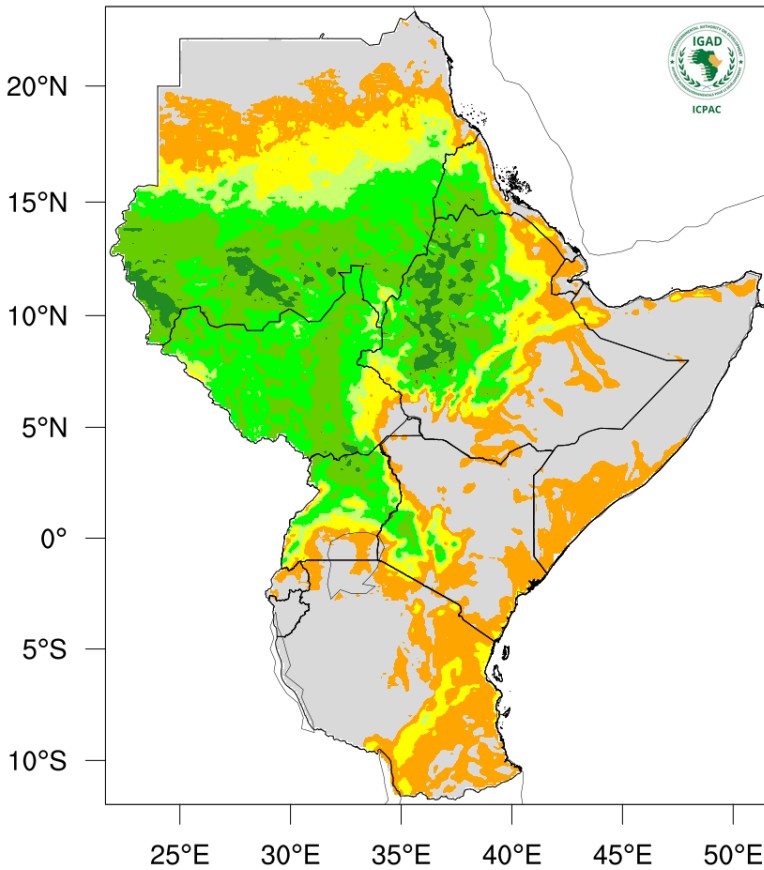


Wednesday, September 1, 2021

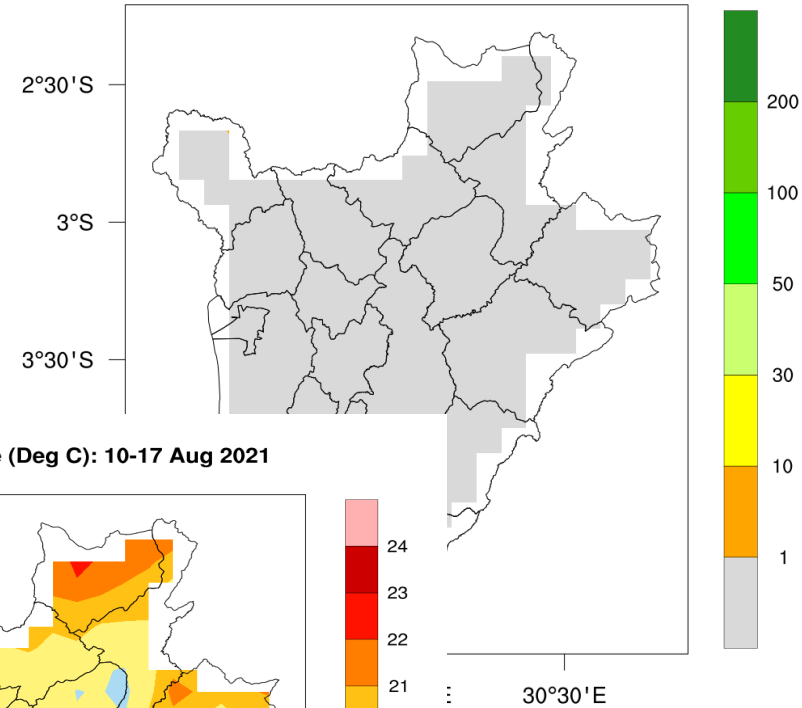
# REGIONAL RESOURCE SHARING

- Utilization of the HPC offers opportunity for common framework/resource sharing between ICPAC & NMHSs

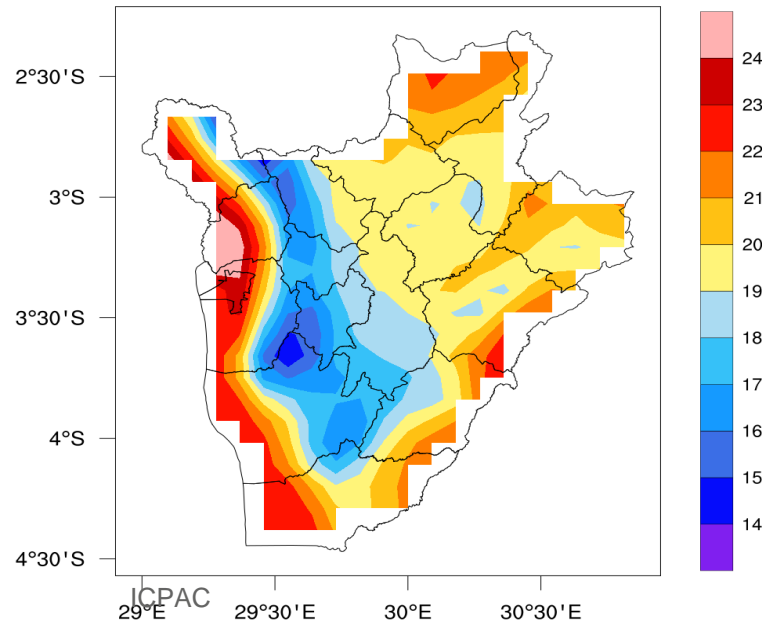
Total Rainfall (mm) for 10-17 Aug 2021



Rainfall Forecast (mm): 10-17 Aug 2021



Mean Temperature (Deg C): 10-17 Aug 2021

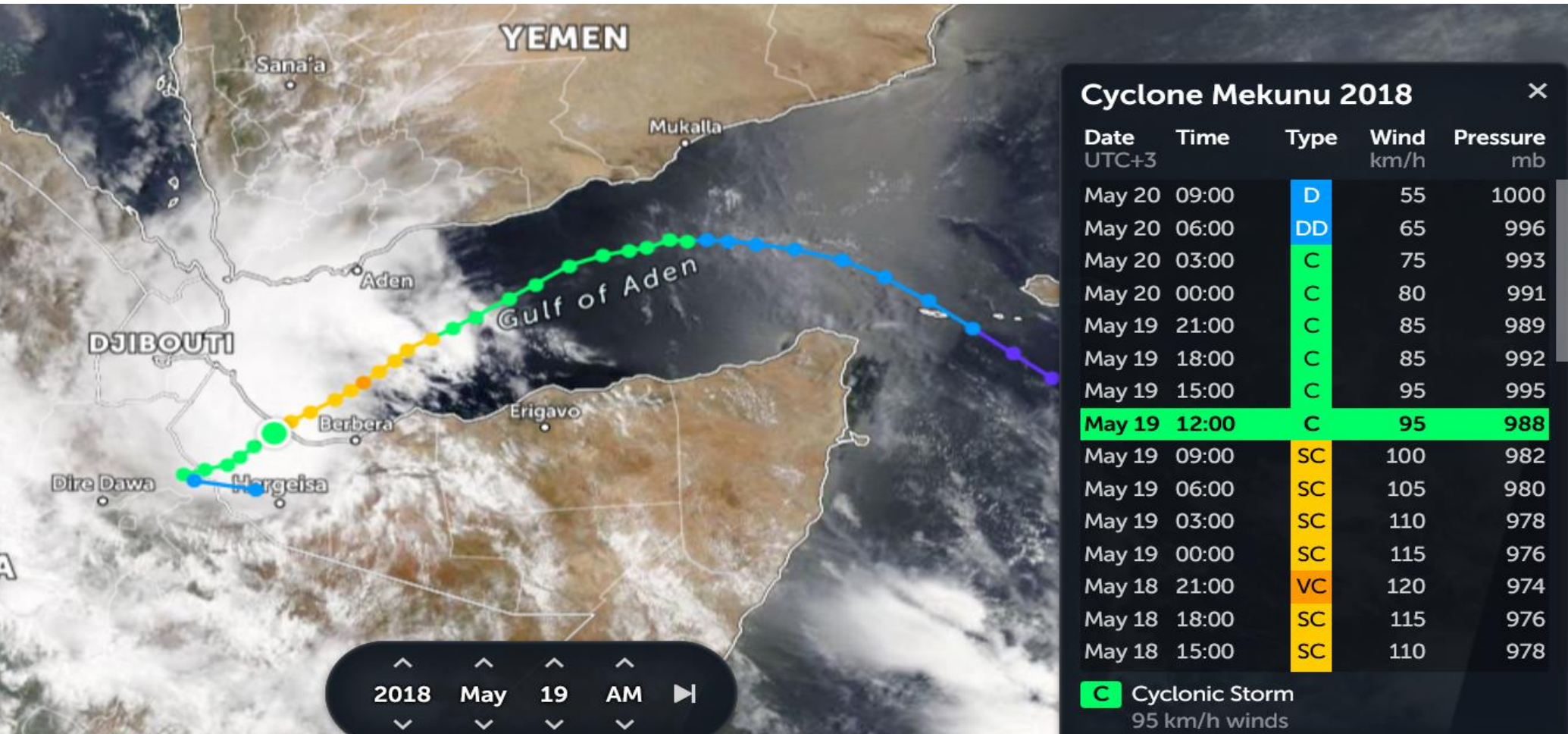


# TROPICAL CYCLONE FORECASTS

## RISKS TO SEA FARERS & COASTAL COMMUNITIES



# ADDRESSING CURRENT RISKS THROUGH NWP



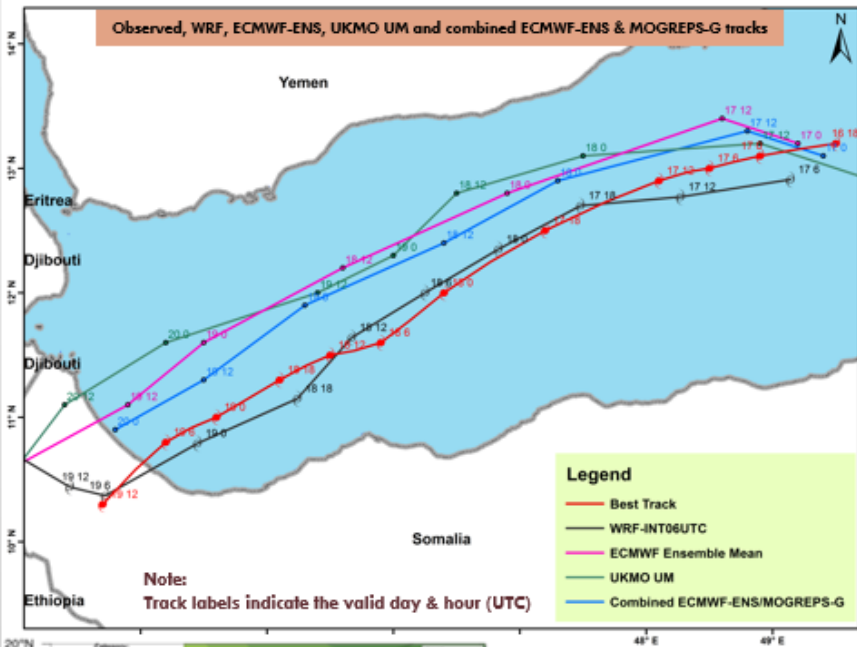
Source: <https://zoom.earth/storms/mekunu-2018/#layers=daily>



# ADDRESSING CURRENT RISKS THROUGH NWP

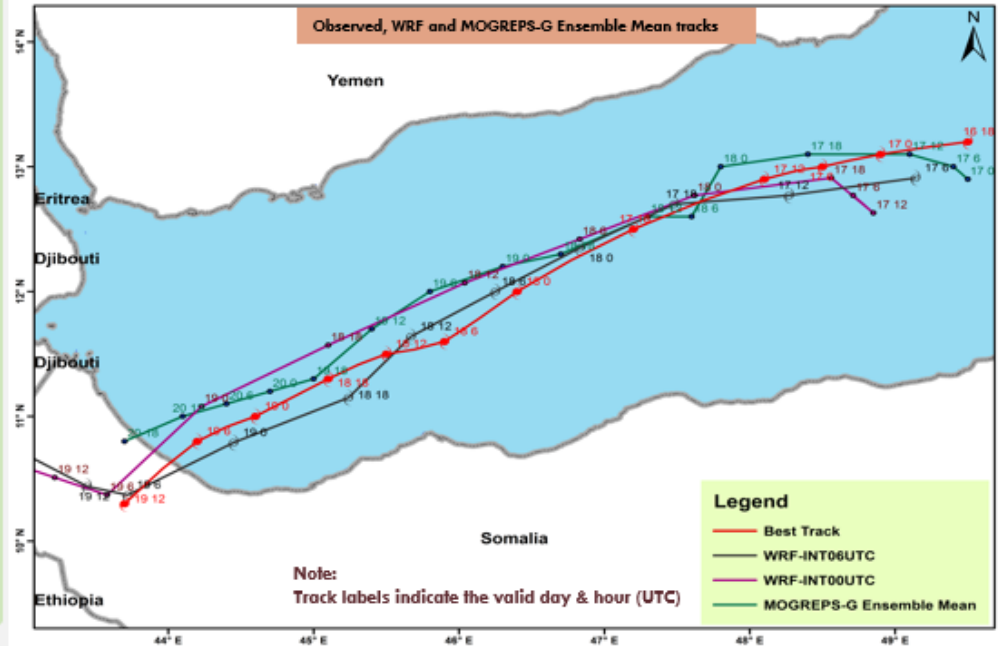
## Track Location

- Most of the models have an overall track that is north of the observed track, with MOGREPS-G and WRF the closest



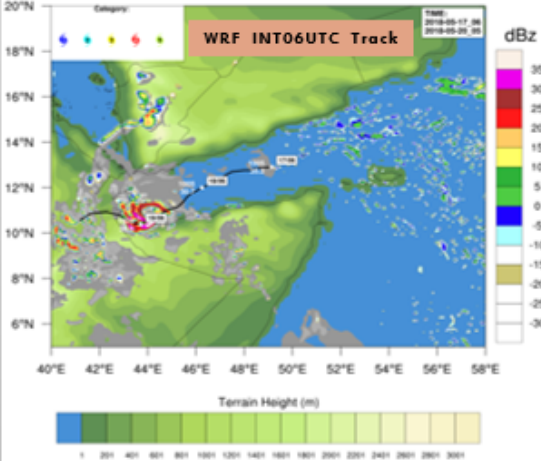
## Time of Landfall

- Landfall occurred between 06-12UTC on the 19<sup>th</sup>
- WRF indicated an earlier landfall (00-06UTC)
- ECMWF-ENS had a delayed landfall (12-18UTC)



- For this case study, WRF forecasted the track of the cyclone better than other operational models
- Vortex-tracking WRF for early warning on cyclone landfalls over the Western Indian Ocean

Source: Mwanthi, A., Salih, A., Segele, Z., & Artan, G. (2019). Application of Vortex-Tracking WRF in Forecasting Tropical Cyclones; Case of Tropical Cyclone Sagar 16-20th May 2018. In *Geophysical Research Abstracts* (Vol. 21).

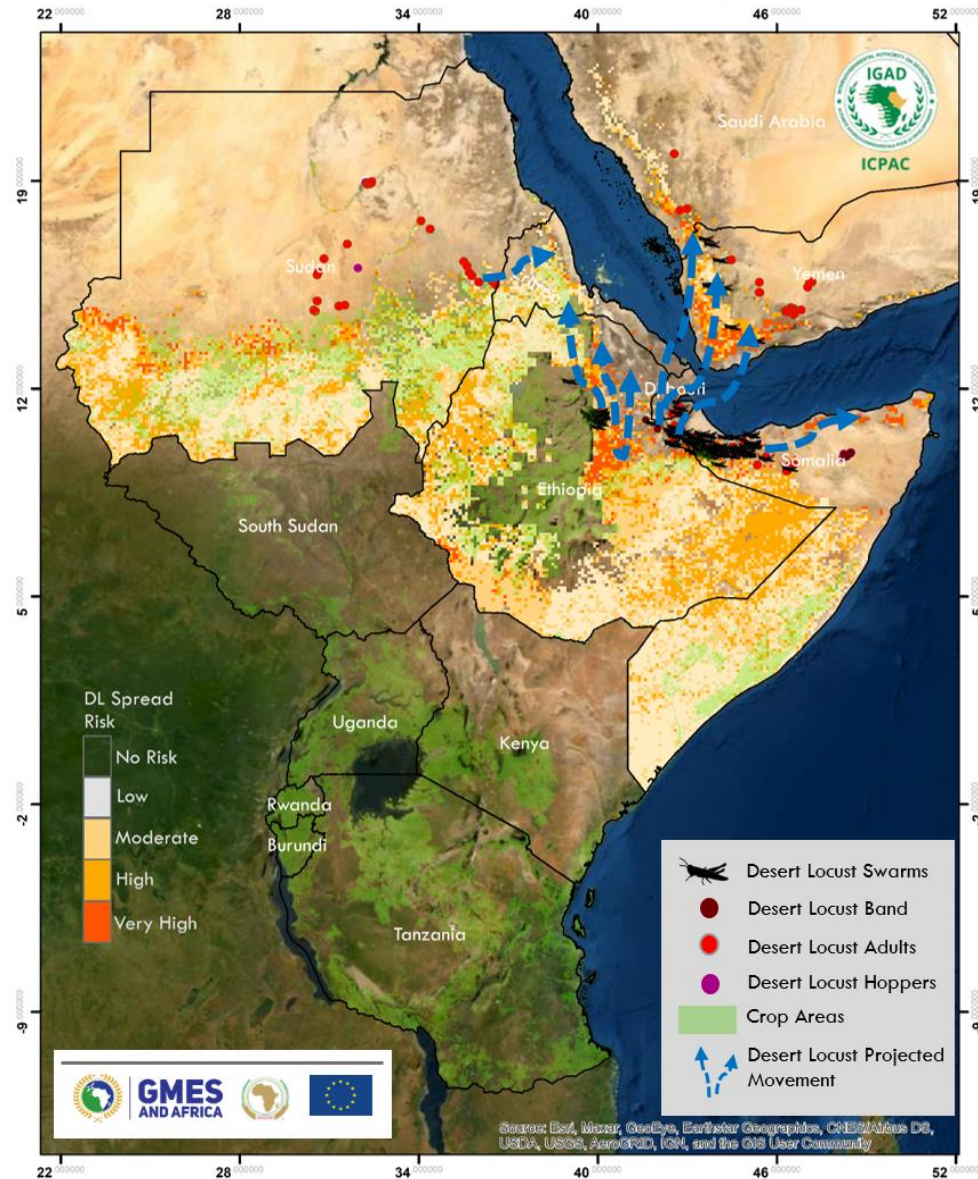


# APPLICATIONS TO DESERT LOCUST MOVEMENT

## AGRICULTURE AND FOOD SECURITY

# DESERT LOCUSTS

- DL are a threat to the food security over the region.
- The forecast for desert locust are a form of an early warning system and help stakeholders to take appropriate action.
- The input to the desert locust movement prediction include, WRF total monthly rainfall, relative humidity, temperature and soil moisture.



Source: GMES



# FORAGE FORECAST

## ASAL AREAS in EASTERN AFRICA





# **INTRA-SEASONAL CHARACTERISTICS FORECASTS**

## AGRICULTURE AND FOOD SECURITY

# ONSET DEFINITION

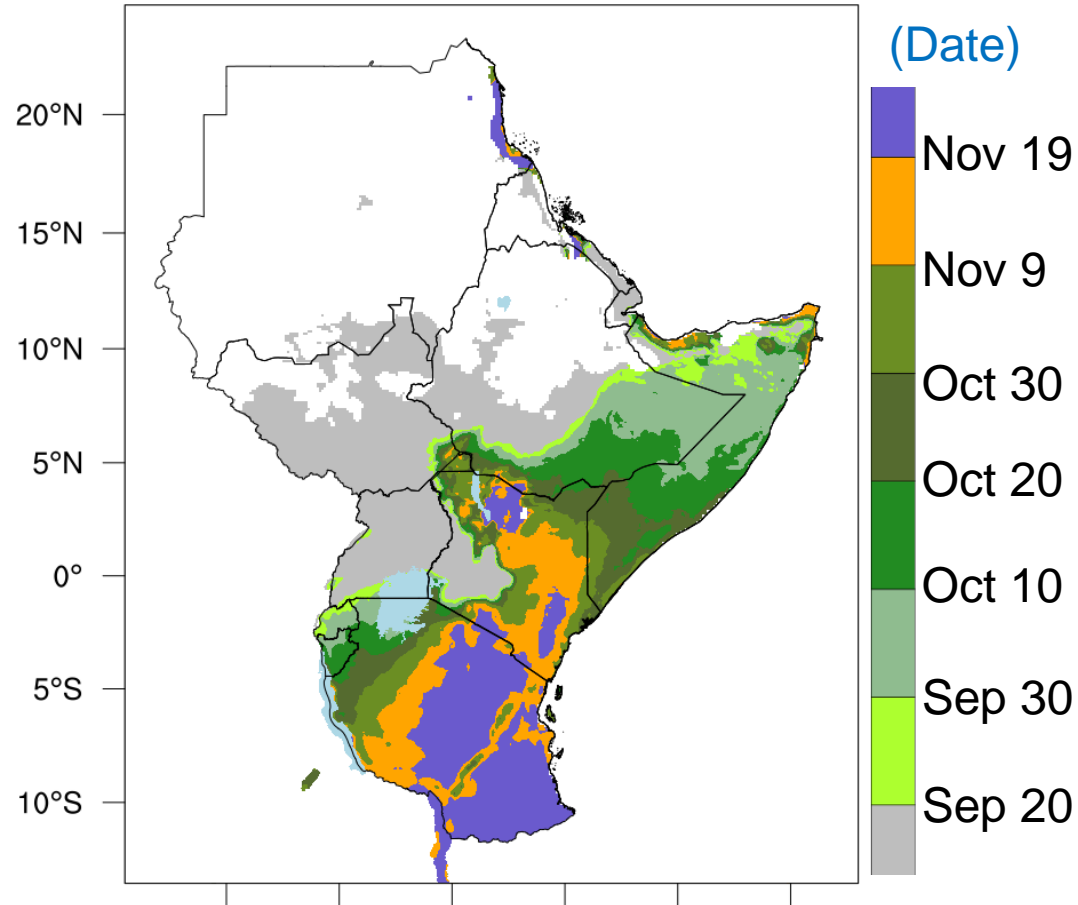
- Various techniques are utilised to calculate onset including, thresholds on accumulated rainfall, accumulated anomalies and percentage cutoff.
- For our seasonal forecasts we use the threshold on accumulated rainfall technique.
- The onset is defined as the first day of the wet season when a wet spell of accumulated rainfall in 3 consecutive days is at least 20 mm and there is no dryspell of at least 7days in the next 21days.



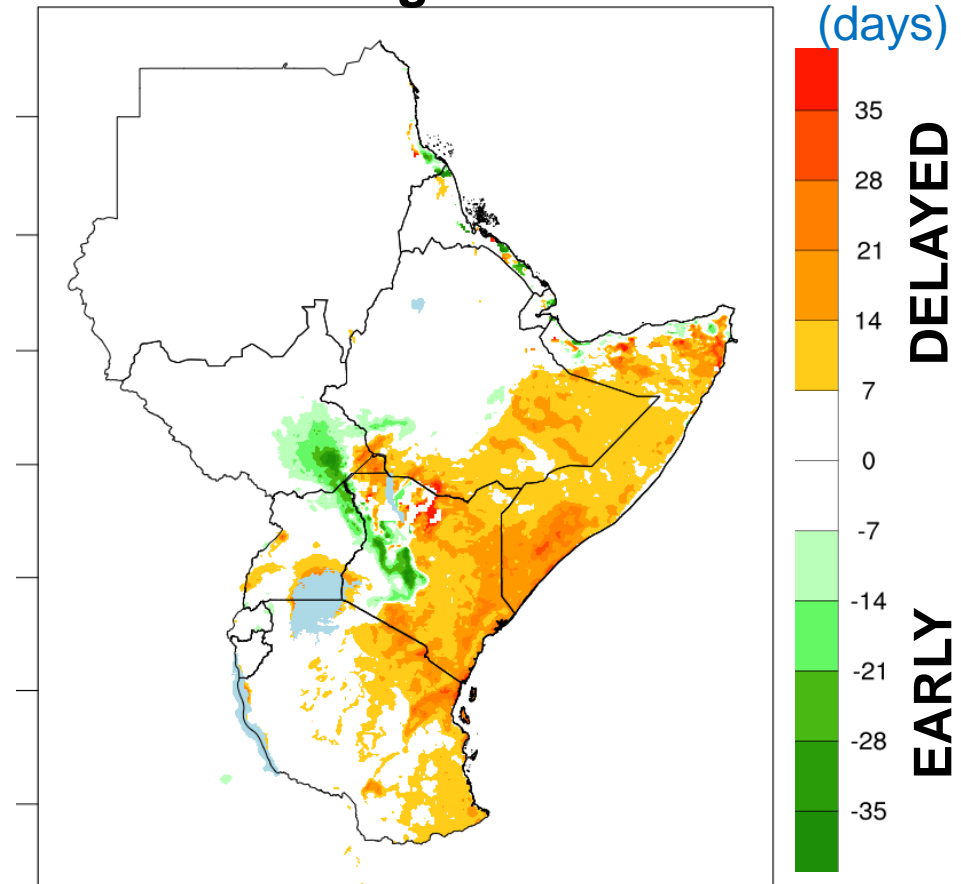
# ONSET OF OND 2021 SEASON

Change from 1981-2010  
Average Onset

## ONSET DATES



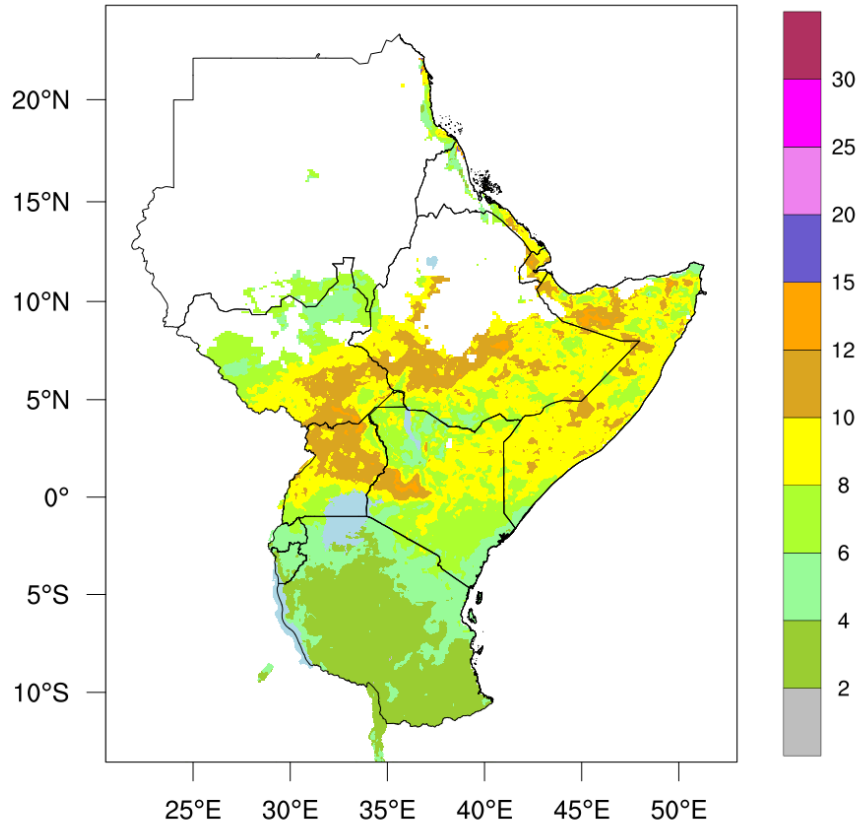
Average of 43 WRF ensemble members driven by the CFSv2 model



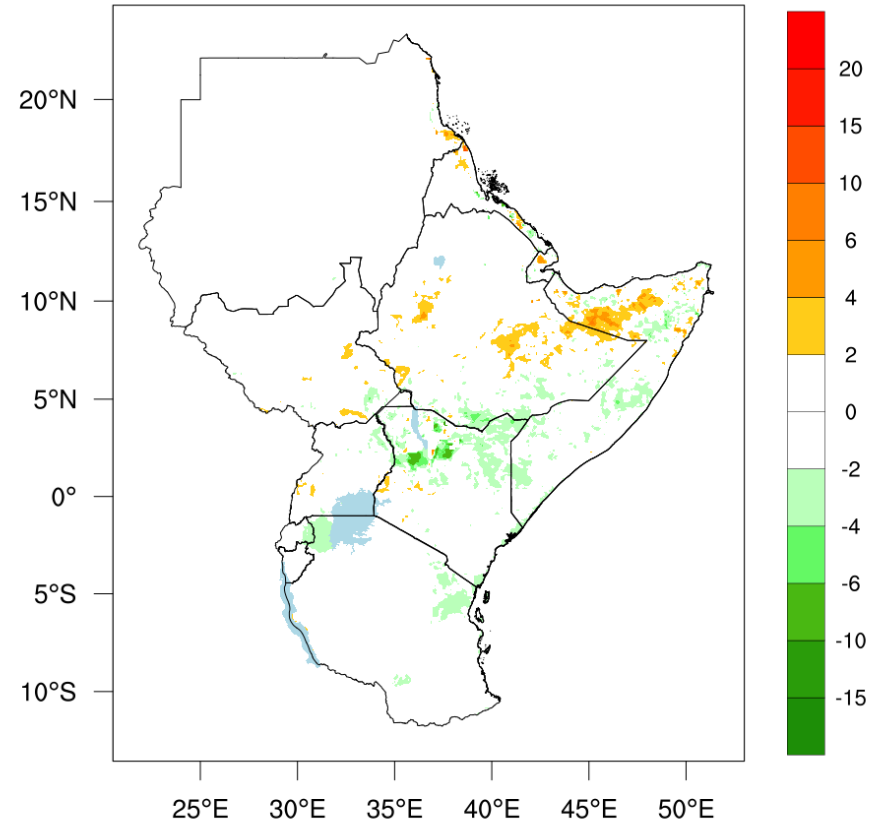
Delayed onset favored over eastern Kenya and southern Somalia

# MAXIMUM DRY SPELLS ANOMALIES WITHIN SEASON

OND 2021: Maximum dryspells (Ens Mean)

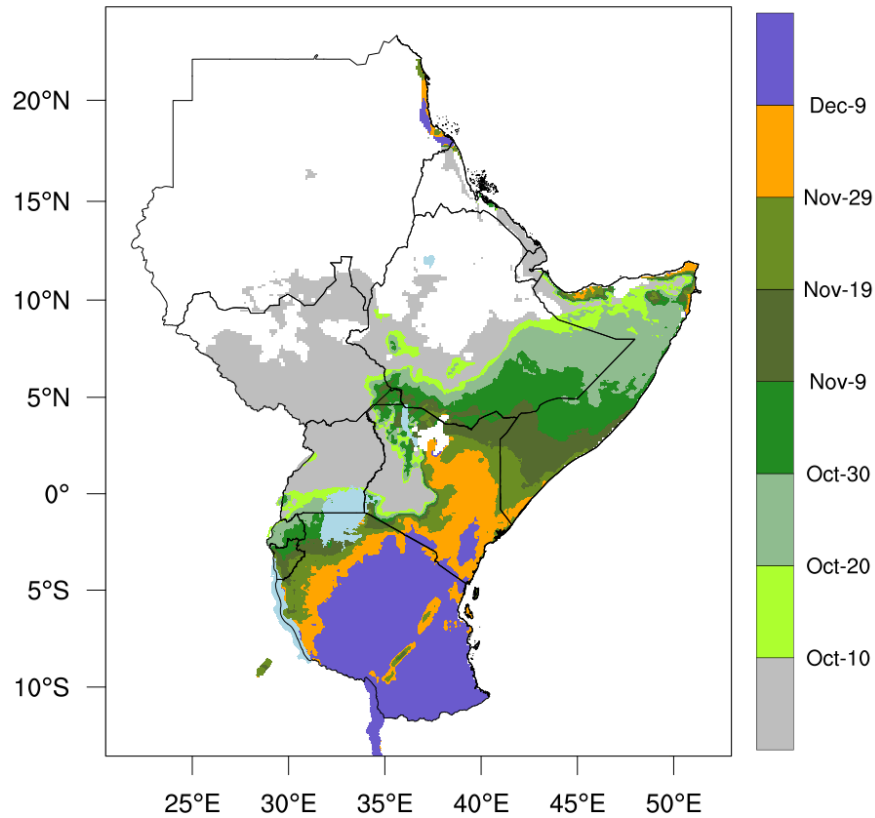


OND Dryspell Ens. Mean Anomaly

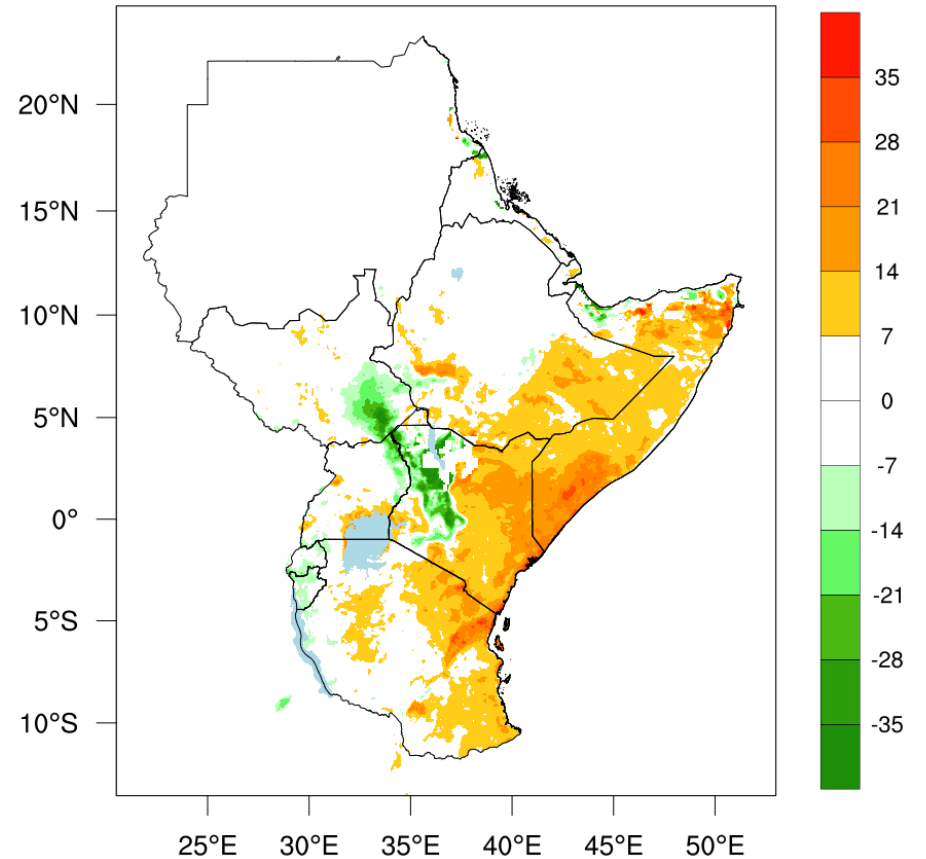


# TIMING OF DRY SPELL AFTER ONSET

OND 2021: Time of dryspell after onset (Ens Mean)

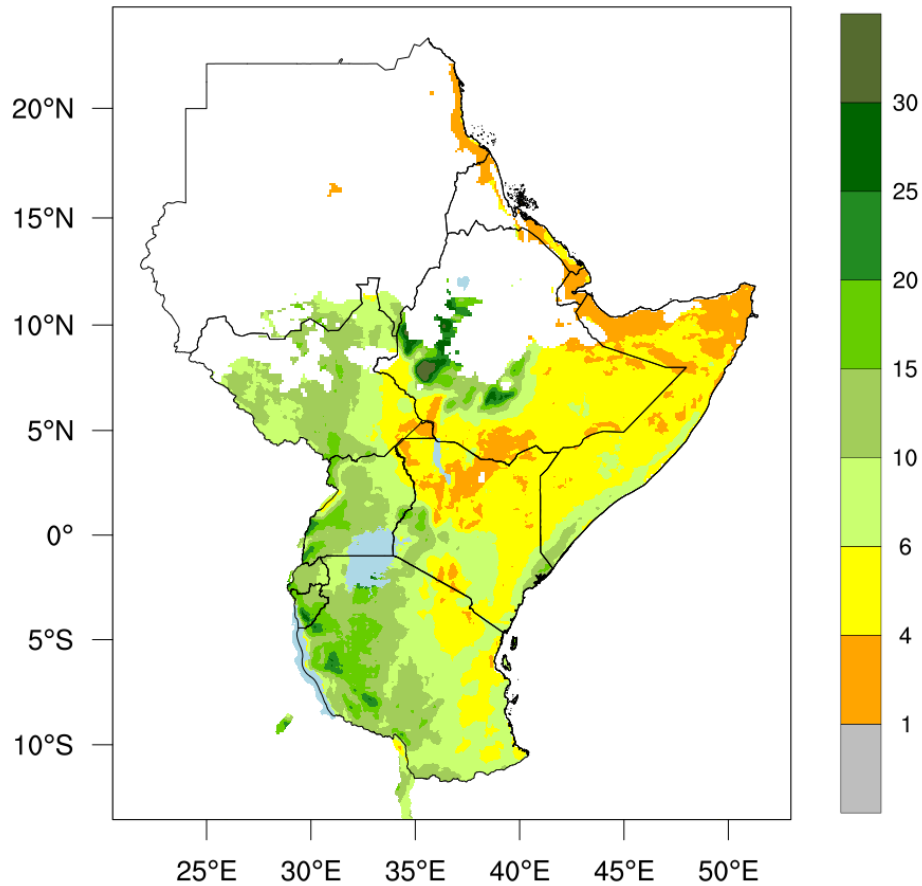


OND Dry Start after onset Ens. Mean Anomaly

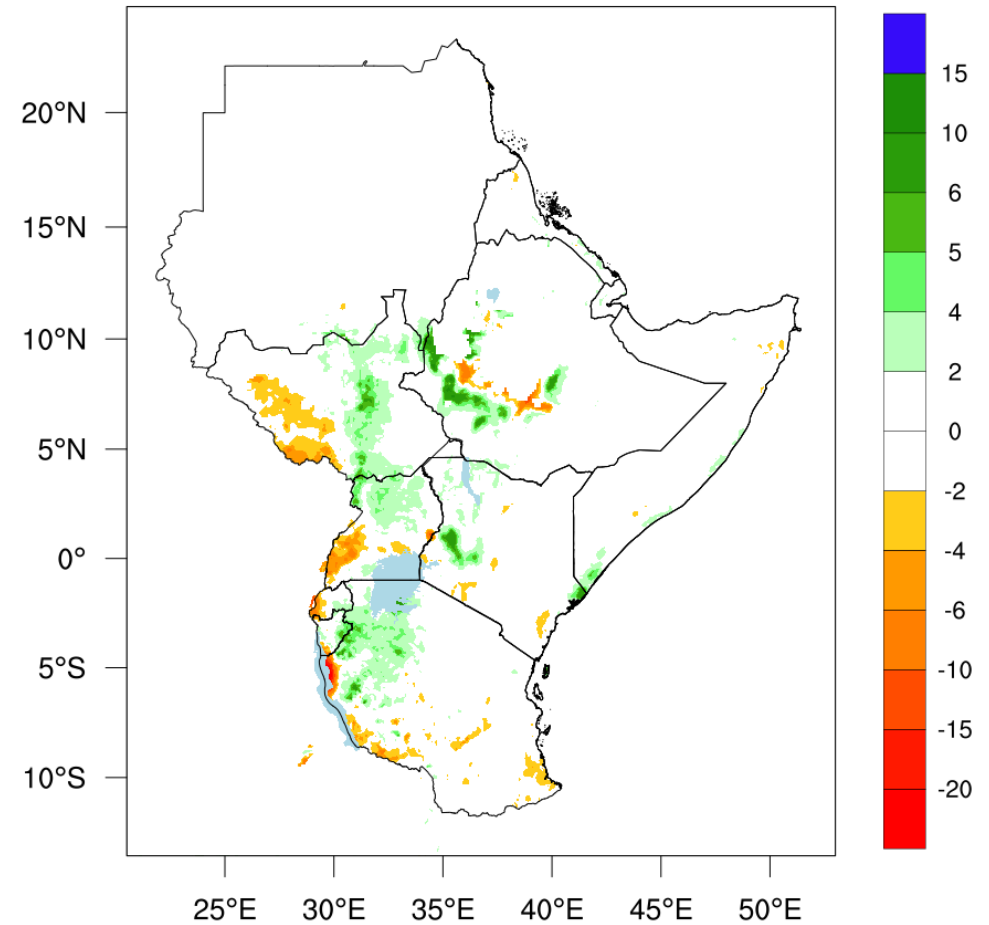


# MAXIMUM WET SPELLS ANOMALIES WITHIN SEASON

OND 2021: Maximum wetspells (Ens Mean)



OND Wetspell Ens. Mean Anomaly





# DESIGN VS USER EXPERIENCE



User experience

Design

# THANK YOU



# EXTRA SLIDES: MODEL EVALUATION

## WRF HINDCAST FORECASTS

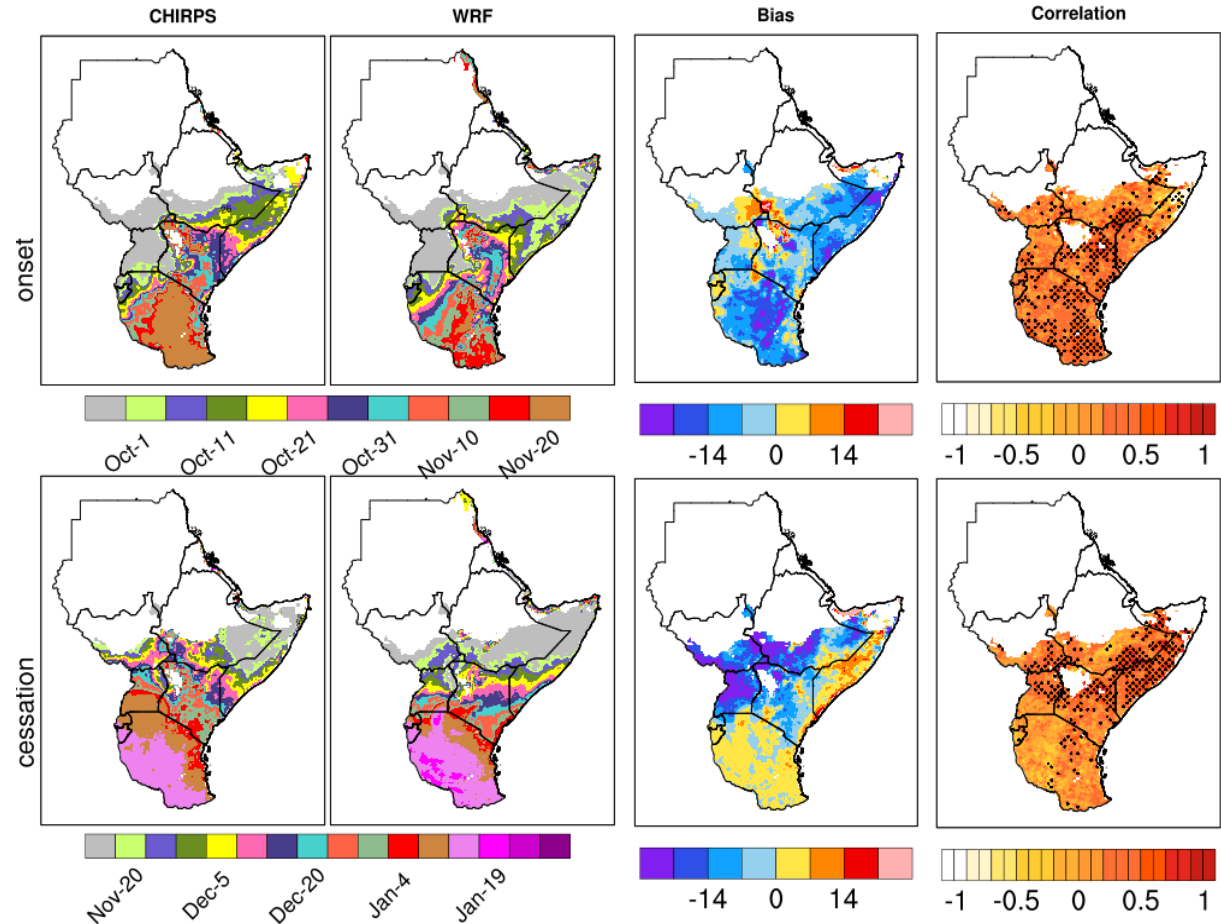


# DATA AND METHODS

- 30 years WRF hindcast is evaluated against Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS).
- CHIRPS daily datasets is available from 1981 to 2010 with a resolution of  $0.25^\circ$ .
- The ERA5 reanalysis is utilised to evaluate the moisture flux transport over the region.
- Spatial resolution of 30km with 28 vertical levels.
- The hindcast simulations is initialized with CFSR datasets.

# BIAS AND CORRELATION OF WRF HINDCAST

- Low Bias in onset over parts of Uganda, Ethiopia and Kenya
- High correlations for onset over most parts of the region.
- Model can also predict the cessation however the correlations are lower than in onset.



# MOISTURE FLUX AND VERTICALLY INTEGRATED

- Model is able to reproduce the moisture fluxes over western Indian Ocean.
- In October the model is able to reproduce the reversal of moisture fluxes over the northern part of the Indian Ocean.

