ECMWF @ 50

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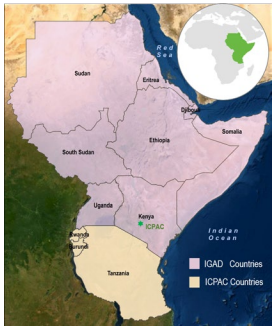

Forecasting tools for enhanced Decision making in Eastern Africa

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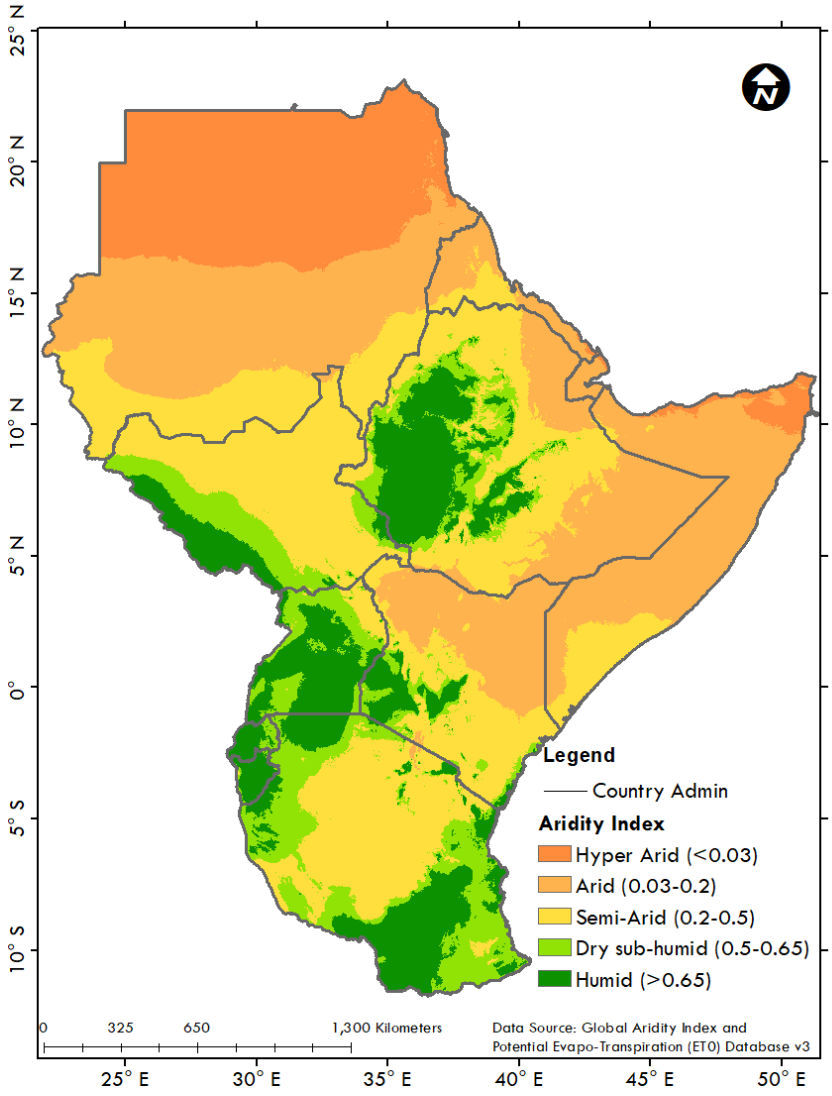
EASTERN AFRICA REGION



- Most parts of Eastern Africa are Arid and Semi-arid. The communities are highly vulnerable to climate variability.
- Eastern Africa is host to over 300 million people.
- Approximately 70% of the population depends directly on agricultural productivity for their livelihood.
- The livelihood in the regions is mostly pastoral, Agro-pastoral and cropping.

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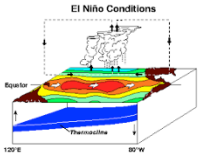
RECENT INTERPLAY OF CLIMATE RISK FACTORS OVER EASTERN AFRICA

Severe droughts led to famine

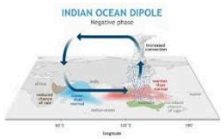


Suppressed rainfall in HOA

East of Madagascar

West of Madagascar

Worst ever Desert locust



Extensive flooding

Flooding in EA due to Elnino and IOD conditions

2009/2010	2015/2016	OND2017	MAM 2018	MAM2019	OND 2019	MAM 2020	2021-2022	OND2023	MAM2024
	El Nino one of the strongest		Excessive flooding	Suppressed rainfall	Extensive flooding in EA		**Persistent LaNina conditions leading to longest drought duration**		Flash and riverine floods observed over several areas

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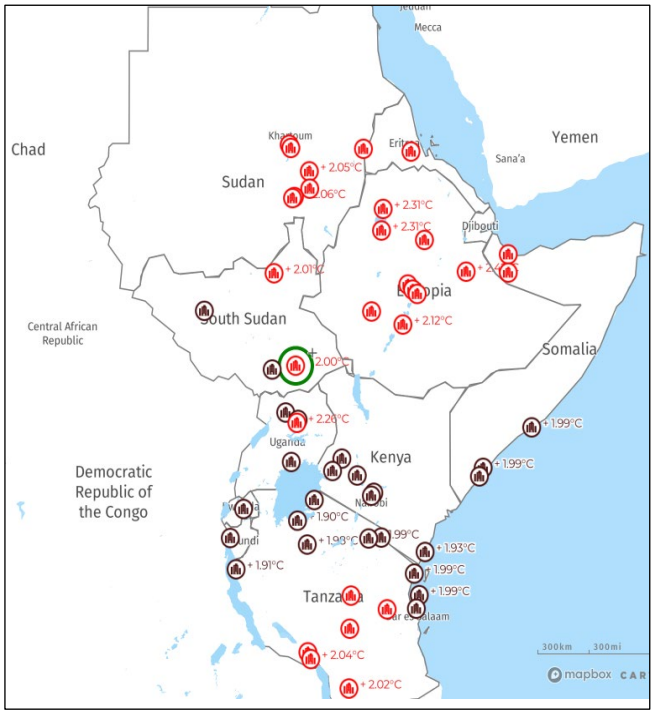
TEMPERATURE IS INCREASING



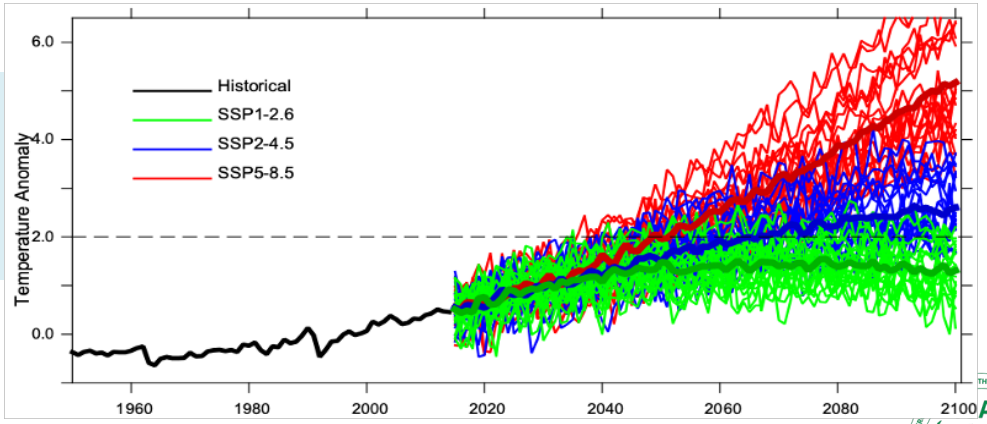
- Projections shows further warming in the future

The New York Times

Extreme Heat Wave Pushes South Sudan to Close Schools

Climate change already worsened floods and droughts in the young nation. Now, soaring temperatures are forecast for two weeks.

Share full article



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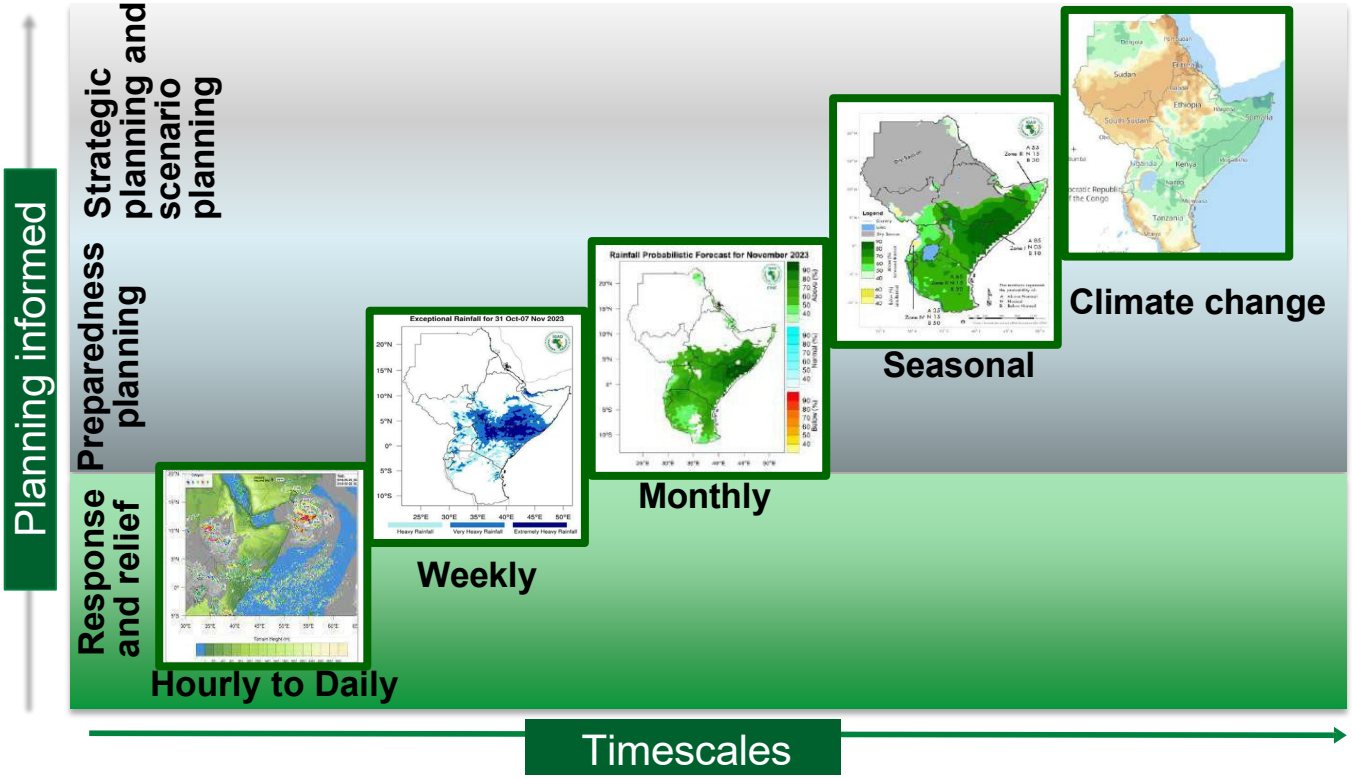
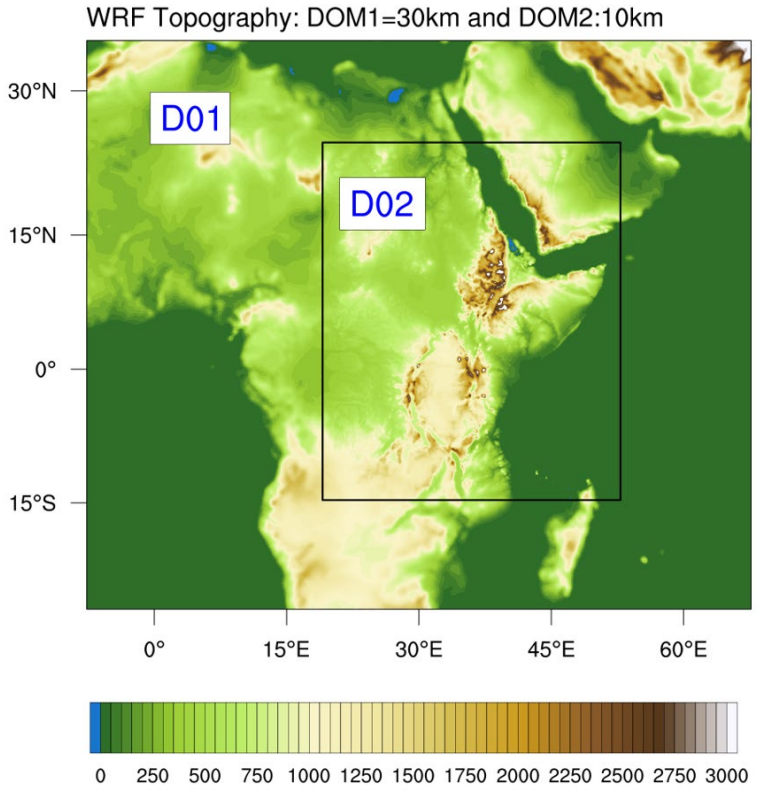
SEAMLESS EARLY WARNING INFORMATION



Dynamical Downscaling utilising the Weather Research and Forecasting Model



Initial and boundary conditions are from NCEP Climate Forecast System version 2 (**CFSv2**)

The model runs:

- Twice a week to produce the weekly forecasts at 10km resolution (Hourly to daily outputs)
- At the beginning of rainfall season to generate intra-seasonal rainfall characteristics at 30km resolution
- When tropical cyclone develops in nearby Ocean to track the path of the cyclone

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The Weather Research and Forecasting Models Customization Experiments

Physics	Parameterisation	Reference
Cumulus	Betts Miller Janjic Grell 3D Kain Fritsch (Moisture, RH) Multi-Scale Kain Fritsch Scheme New Tiedke	Janjić (1994) Grell, and Devenyi, (2002) Kain, (2004) Zheng et al., (2016) Zhang and Wang, (2017)
Microphysics	Aerosol–aware Thompson Scheme Purdue Lin Scheme Thompson WSM6 WDM	Thompson (2014) Chen and Sun (2002) Thompson et al (2008) Hong and Lim (2006) Lim and Hong (2010)
Shortwave Radiation	Dudhia	Dudhia (1989)
Longwave radiation	RRTM	Mlawer et al. (1997
Land surface Scheme	NOAH	Tewari et al. (2004)
Planetary Boundary Layer	YSU	Hong et al. (2006)
	ACM	Pleim (2007)

Gudoshava et al., 2025, in preparation

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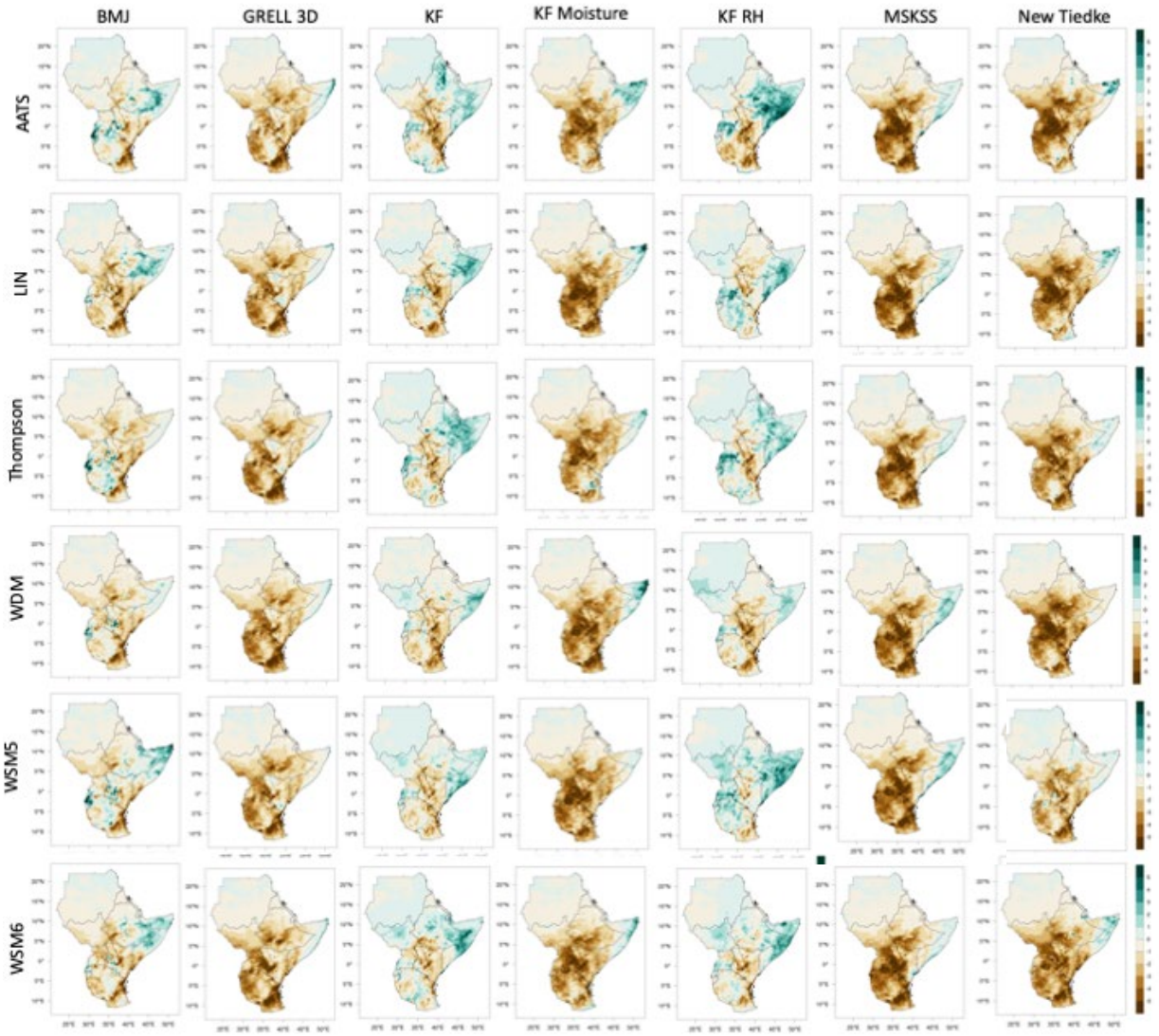
WRF CUSTOMIZATION EXPERIMENTS OUTPUTS: MEAN BIAS



7 Cumulus and 6 microphysics schemes were utilised in the customisation experiments

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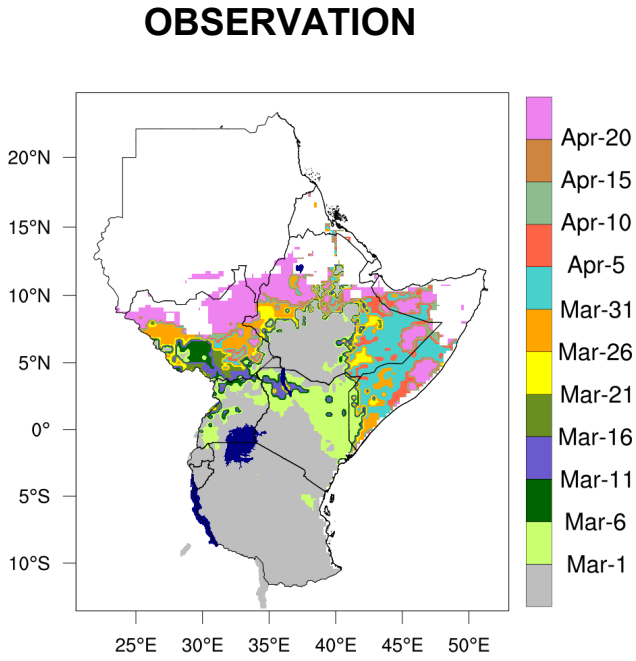
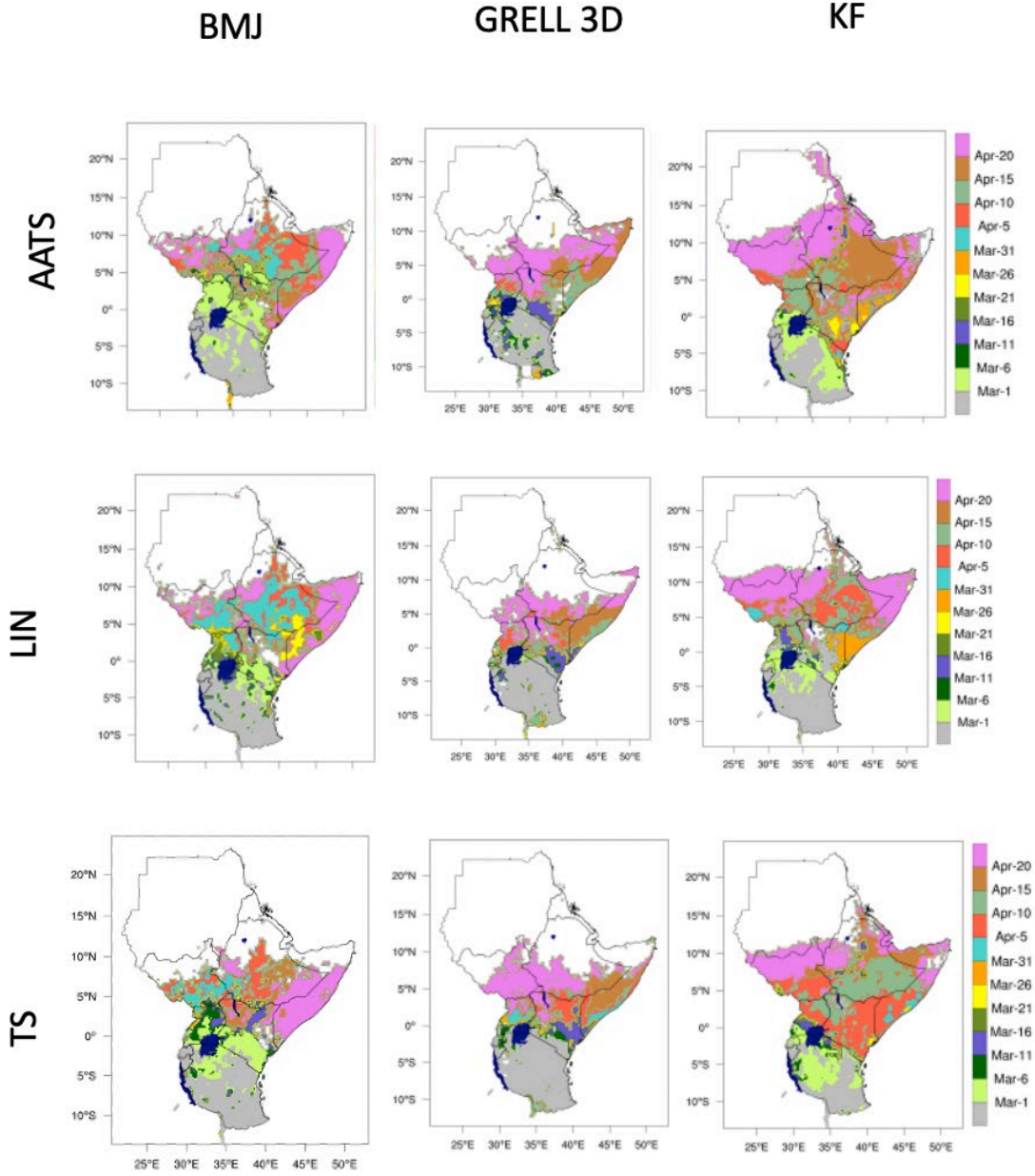
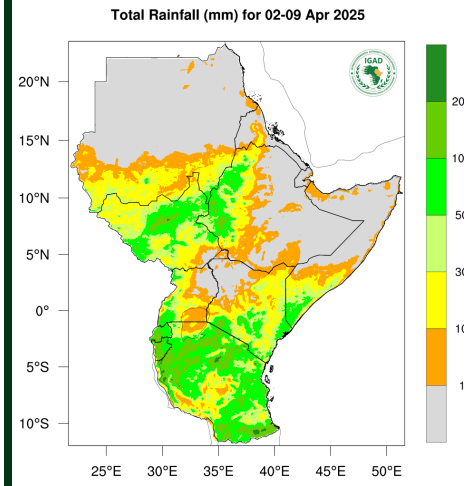
ONSET PROGRESSION



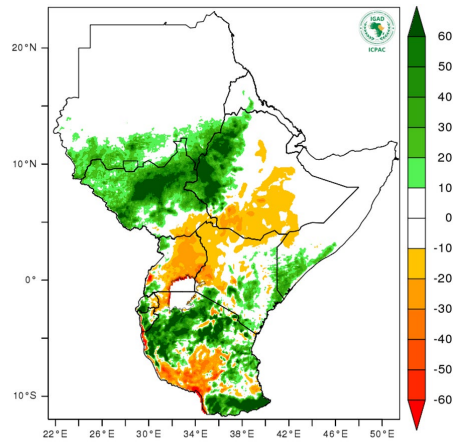


Weekly WRF Products

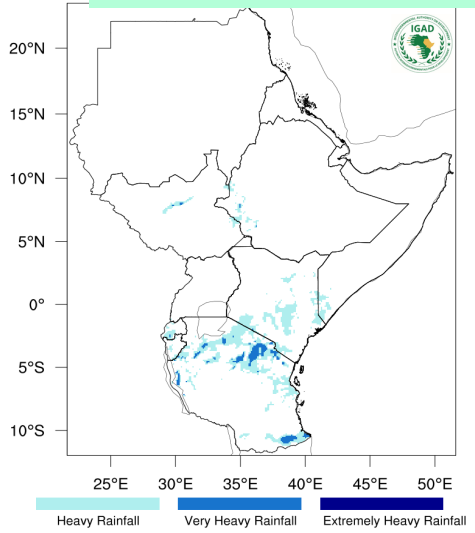
Total Rainfall



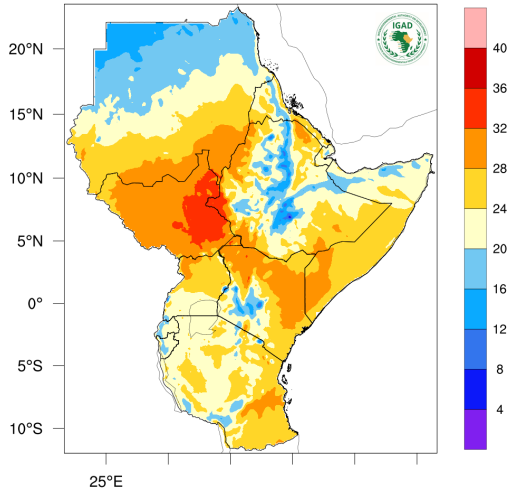
Rainfall anomaly



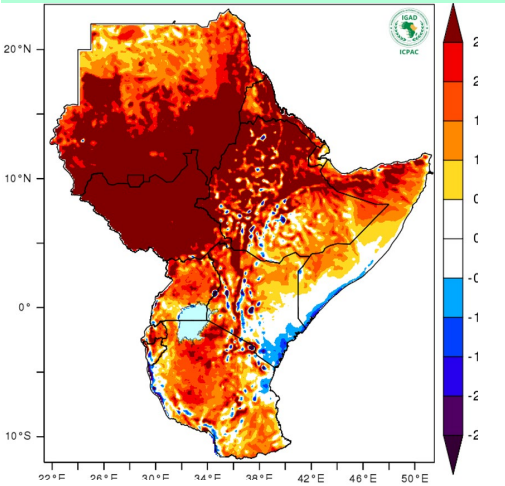
Exceptional Rainfall



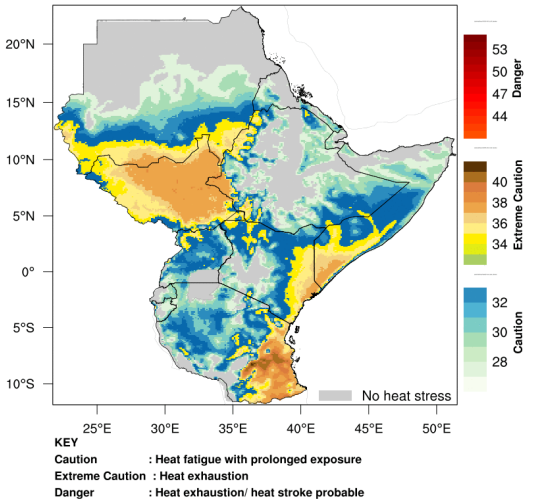
Average temperature



Temp. anomaly



HEAT STRES



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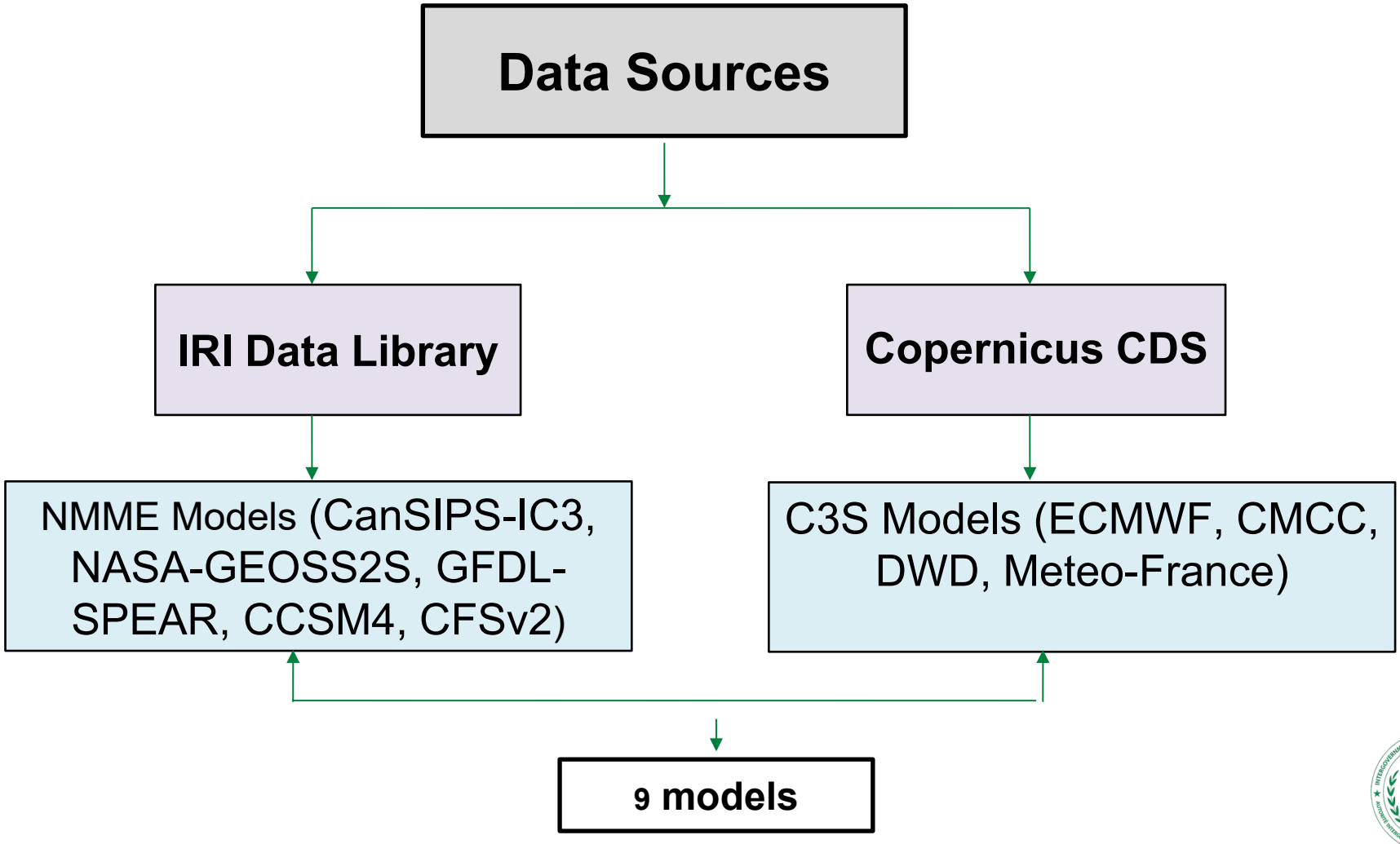
Statistical Downscaling of the Monthly and Seasonal Forecast



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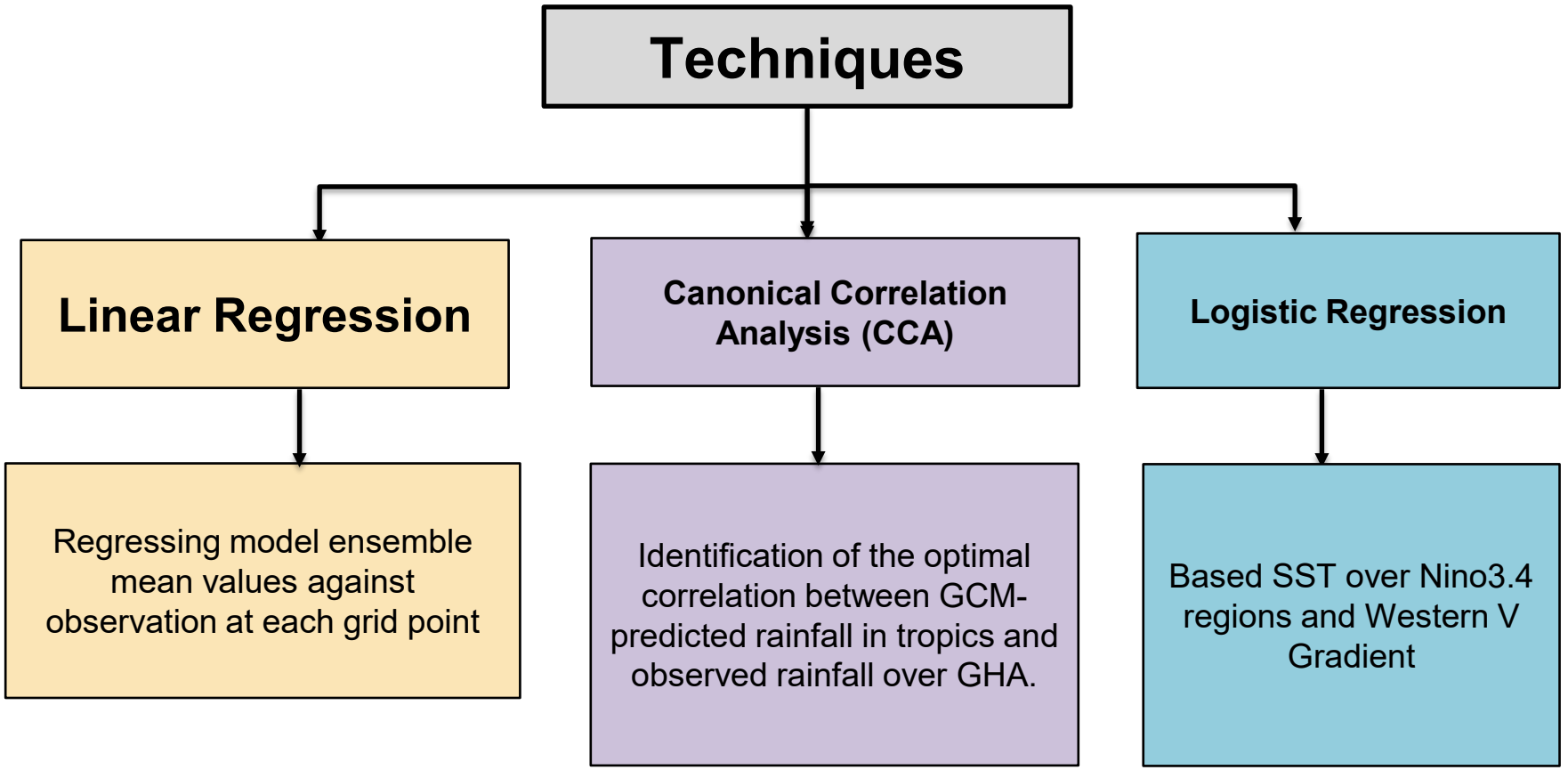
Statistical Downscaling Techniques



Objective Forecast = (eReg + CCA+Log)/3

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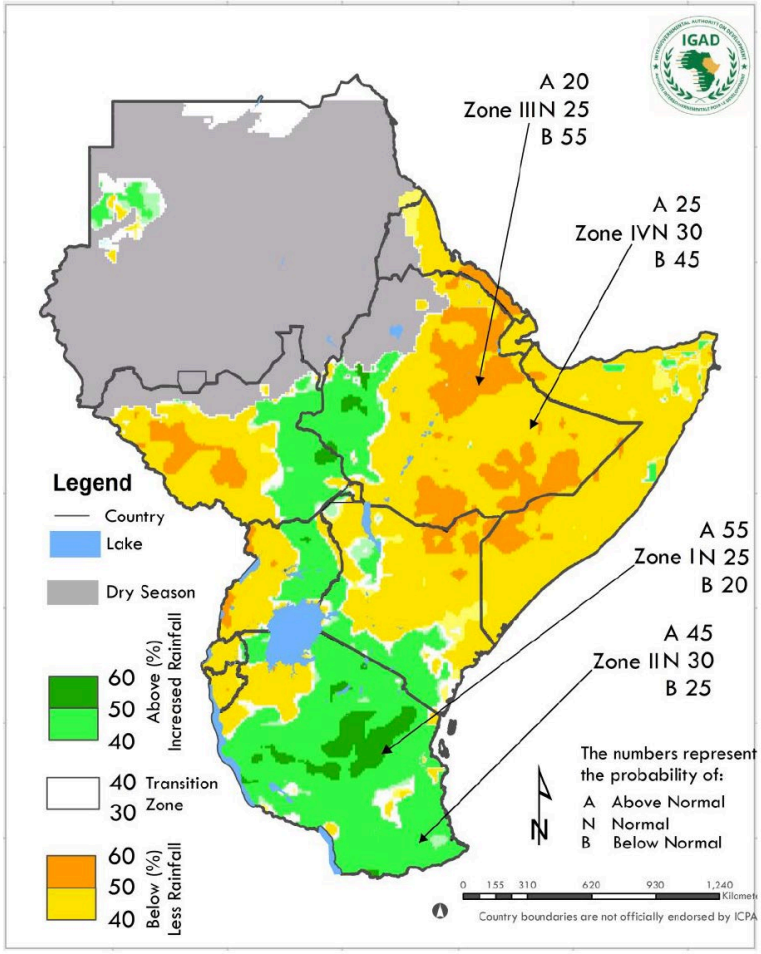
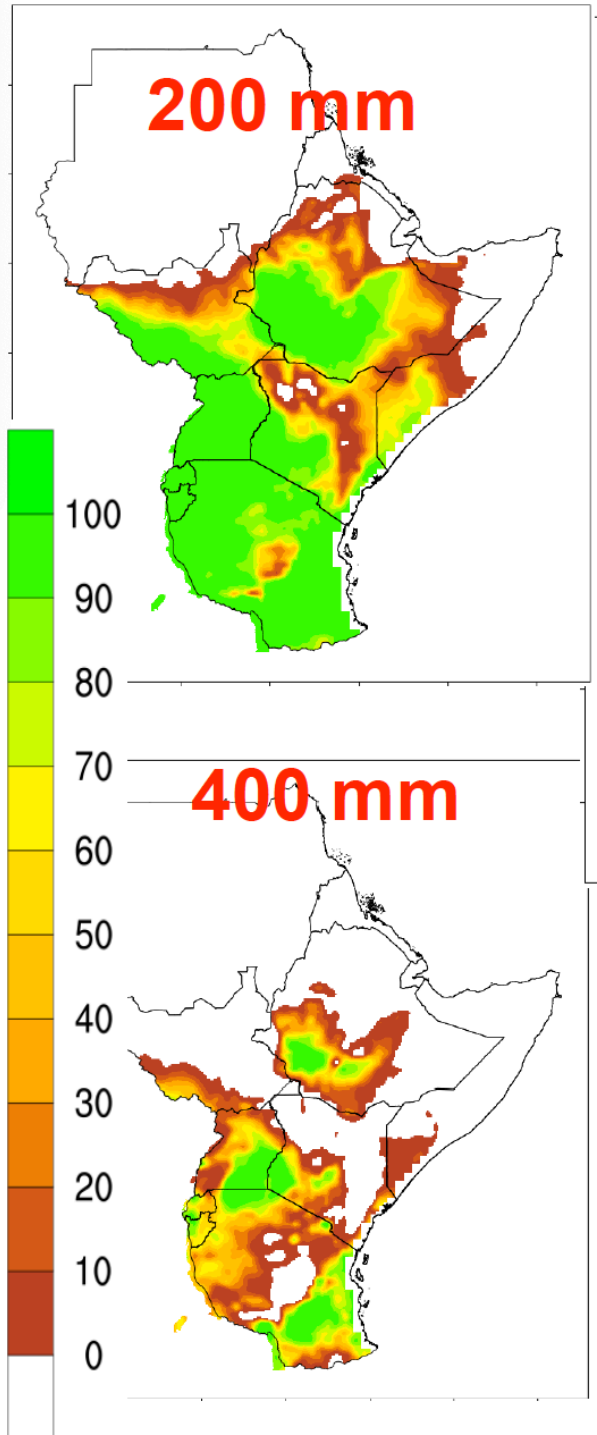
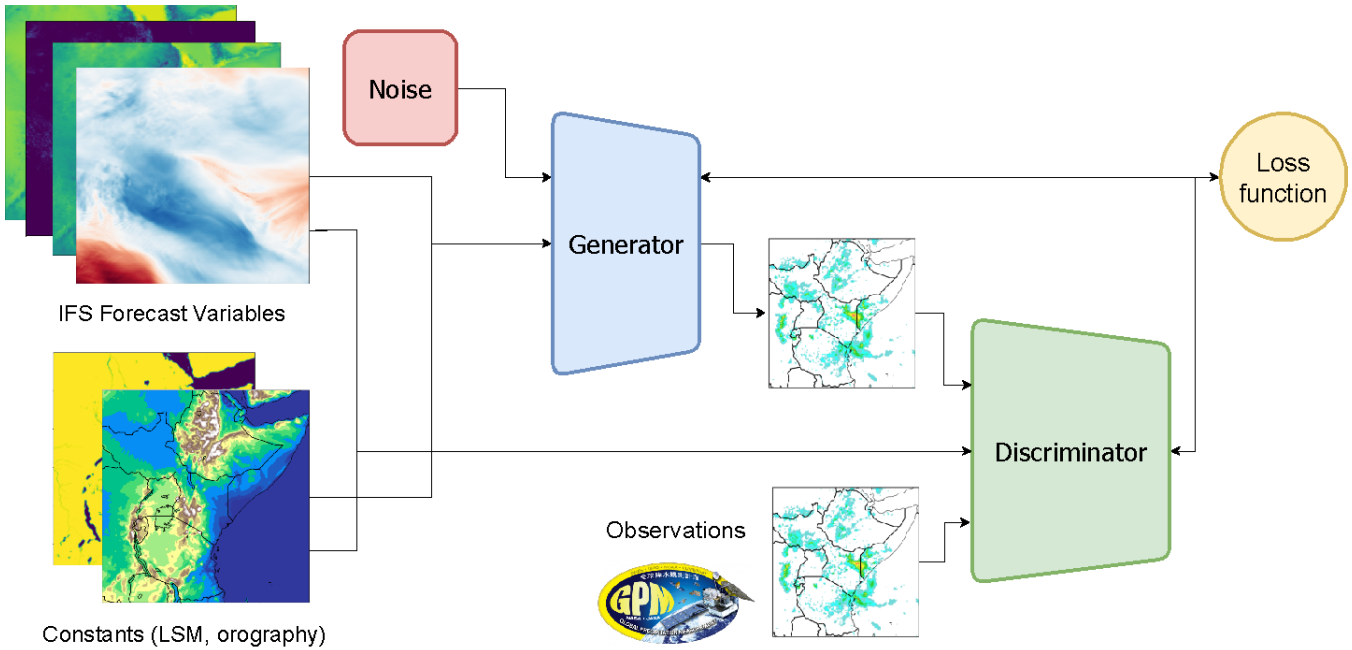
SAMPLE OUTPUTS FROM MULTI-MODEL, MULTI-METHOD TECHNIQUE



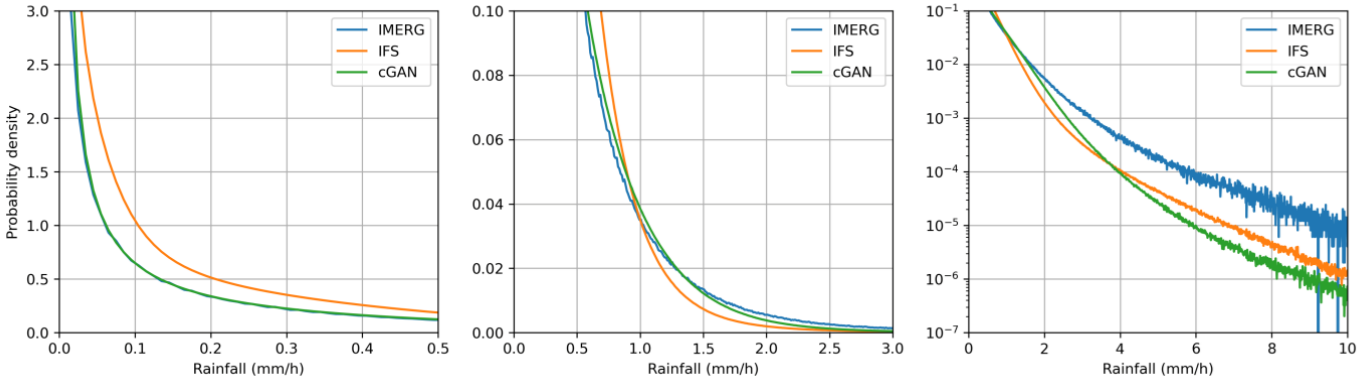


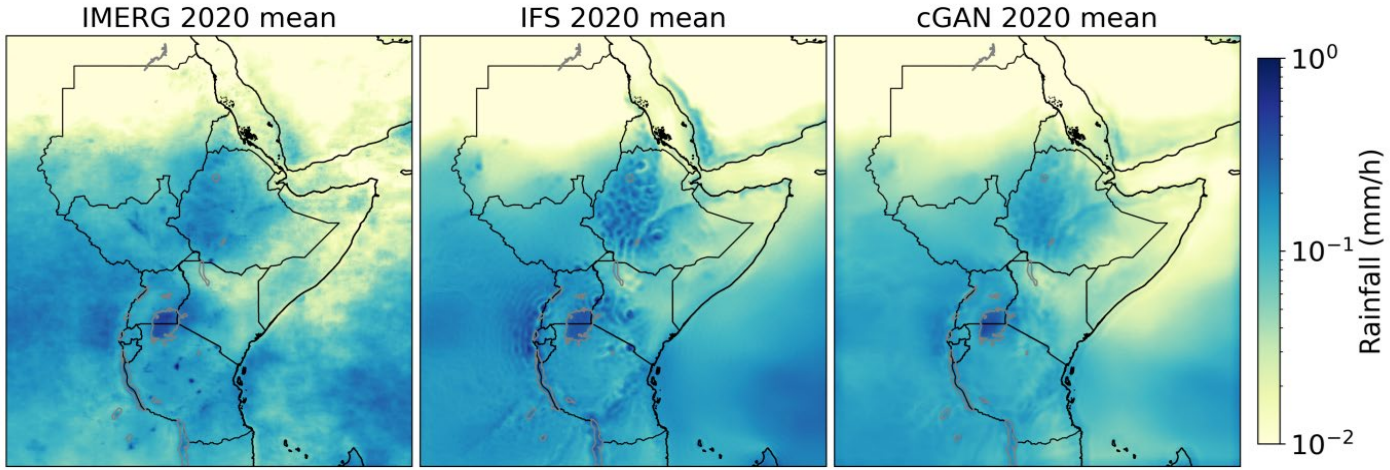
UTILIZATION OF ML FOR POSTPROCESSING

- Conditional Generative Adversarial Network (cGAN)
- Conditioned on IFS:
  - 14 forecast variables
  - Land-sea mask
  - Orography
- 6 Hourly
- 0.1 x 0.1 degrees resolution
- Observational: IMERG
- Probabilistic predictions.



UTILIZATION OF ML FOR POSTPROCESSING





- cGAN performs better for the light and moderate rainfall

Cooper et al., 2025; in,preparation

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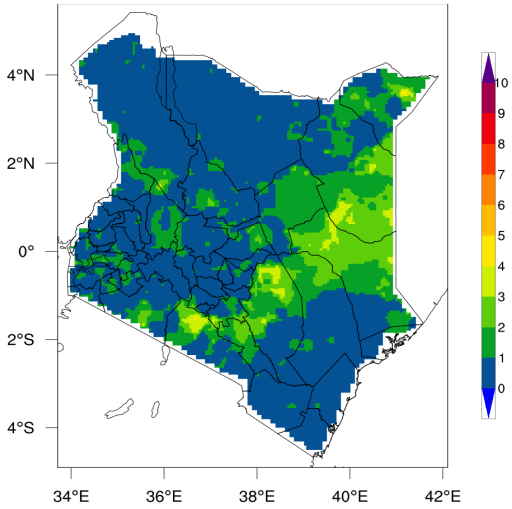
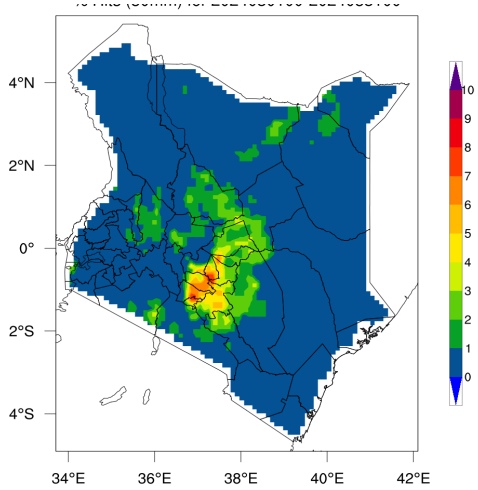
Performance of the cGAN Results for April 2024

50mm Rainfall Threshold

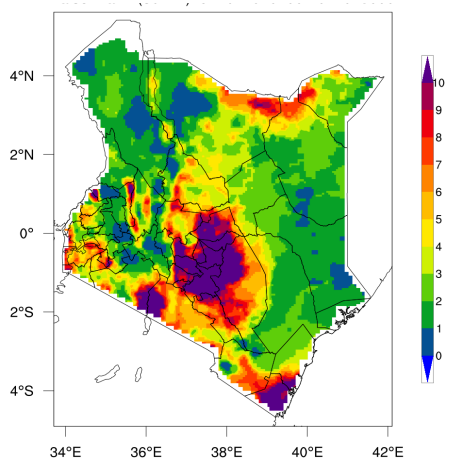
MISSES



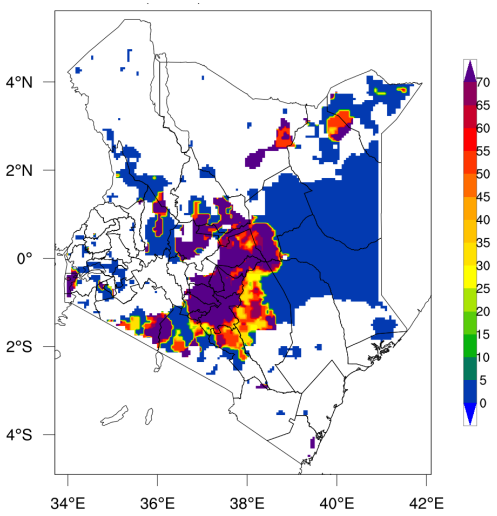
HITS (No.)



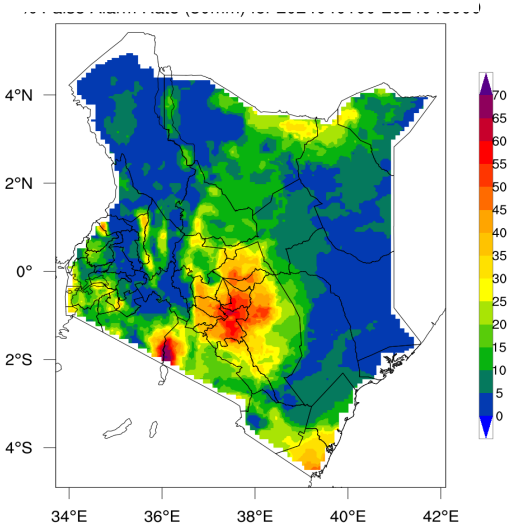
FALSE ALARMS (No.)



HIT RATE



FALSE ALARMS RATE



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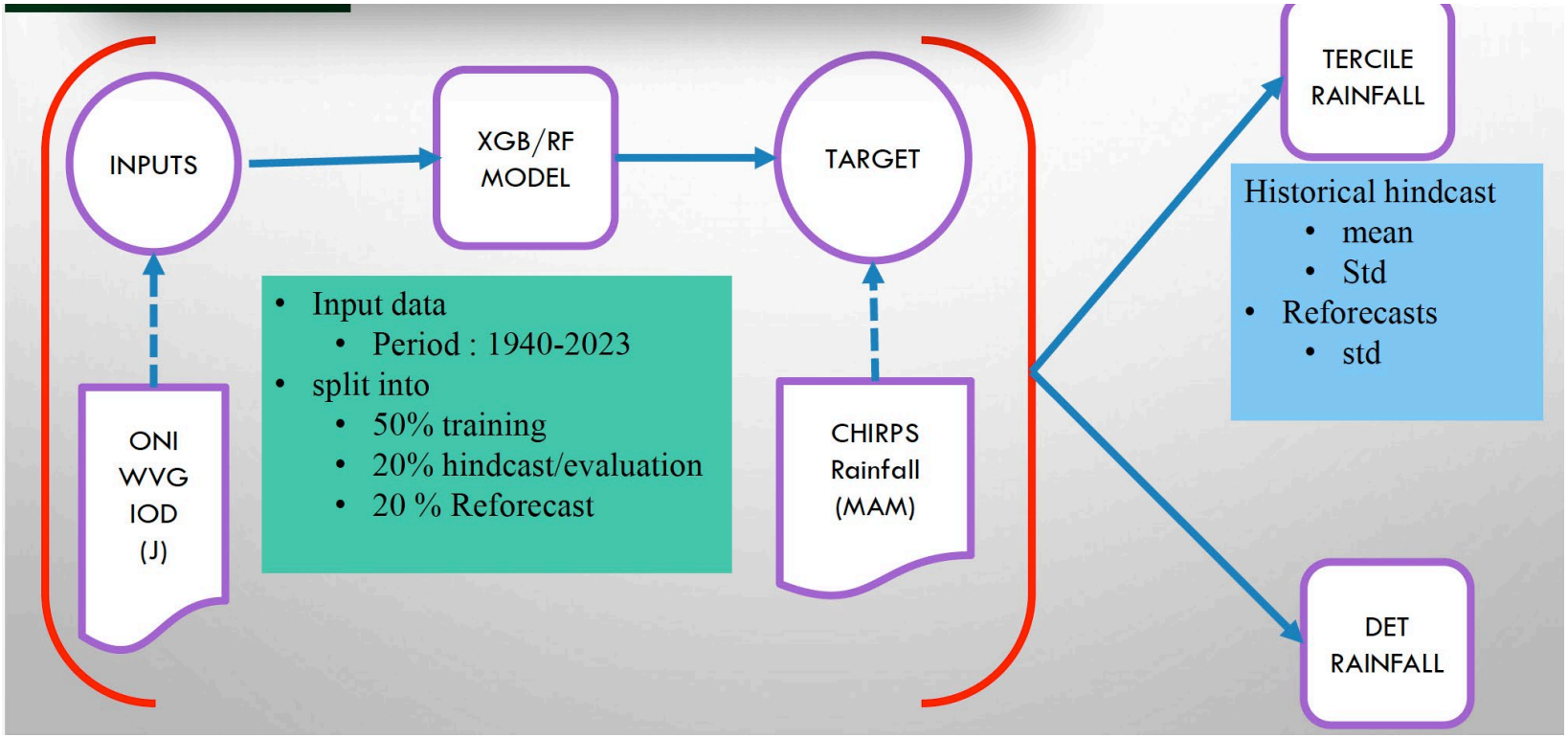
Machine Learning at Seasonal Timescales



Chinyoka et al.,2025; inpreparation

RANDOM FOREST AND XGBOOST

Feature	Random Forest	XG-Boost
Model Complexity	Simpler	More complex
Accuracy	Good	Often better
Speed (training)	Faster (sometimes)	Can be faster, especially with optimized settings
Overfitting	Less prone	More prone without tuning

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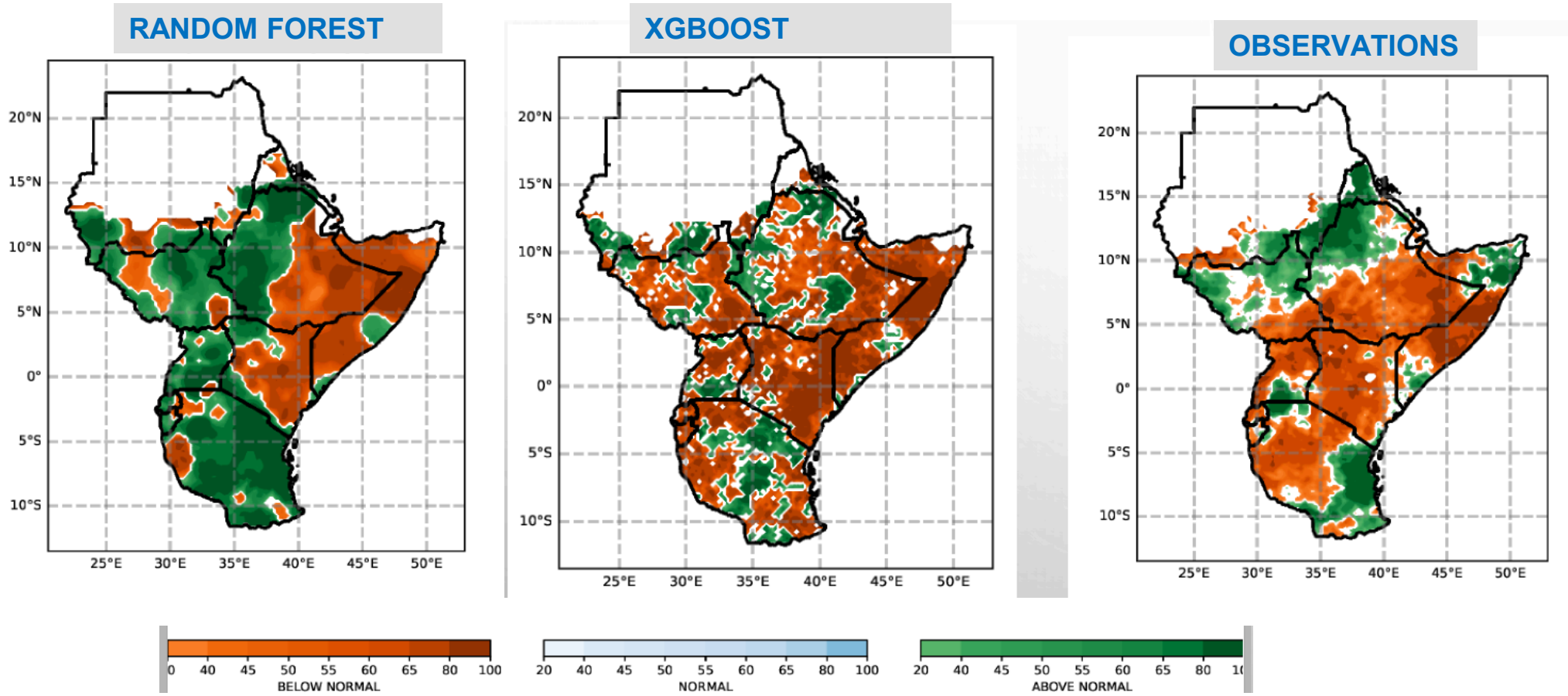
MAM 2017 Sample Outputs



Chinyoka et al., 2025, under preparation

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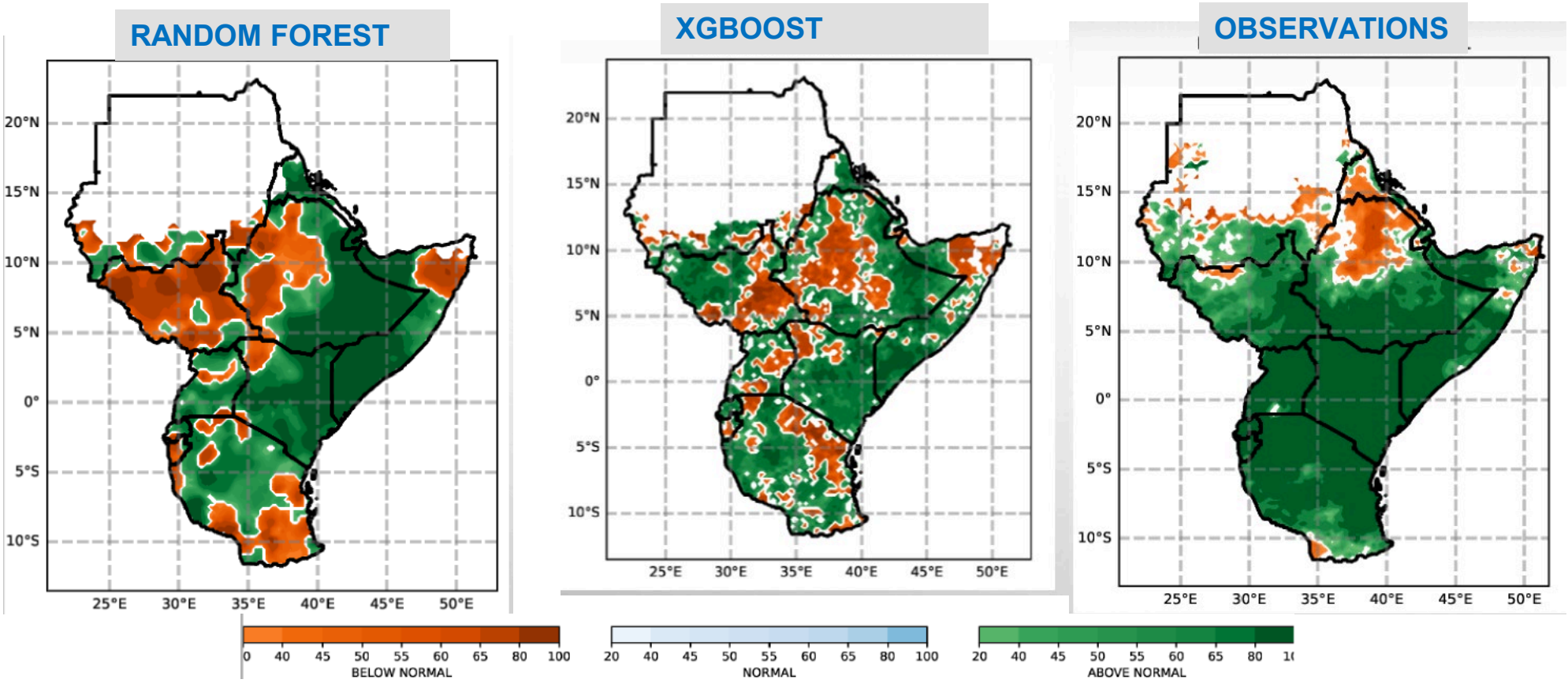
MAM 2018 Sample Outputs



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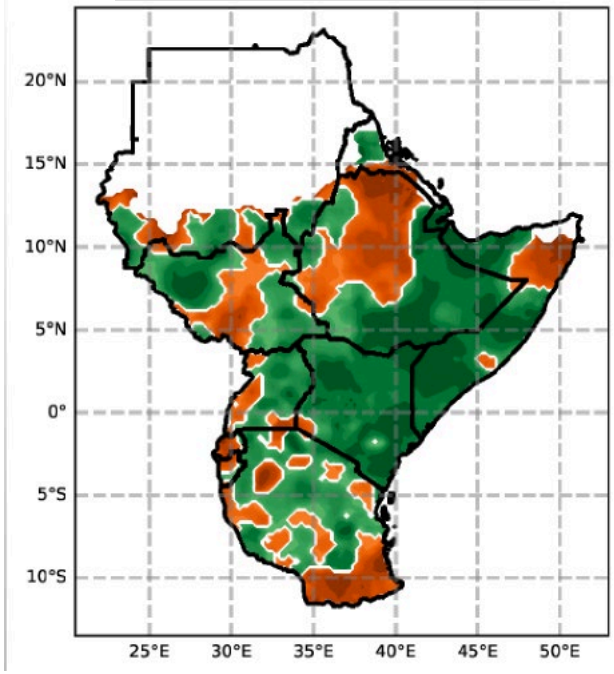
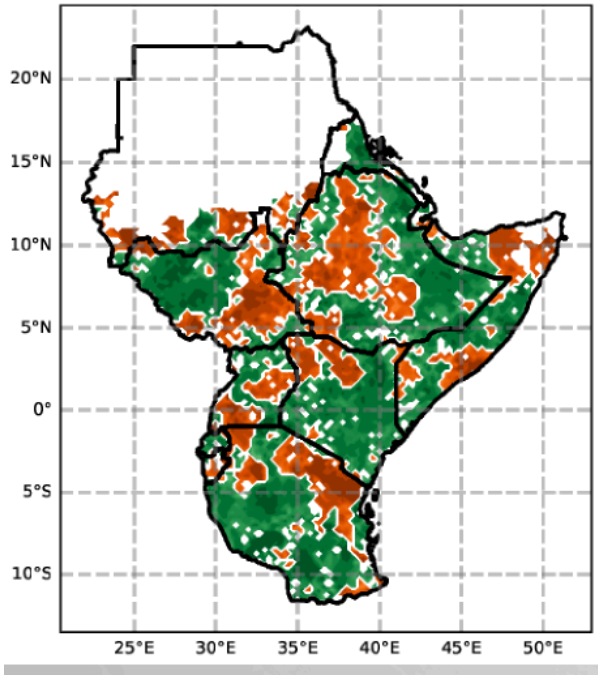
MAM 2023 SAMPLE OUTPUTS

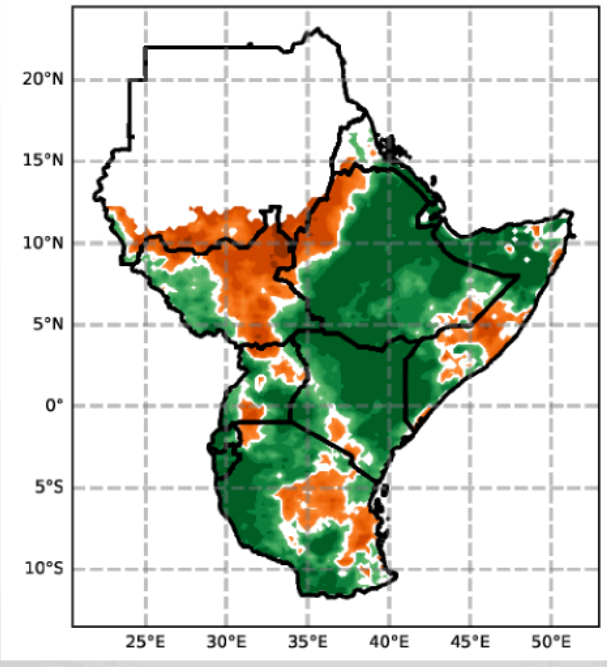
RANDOM FOREST

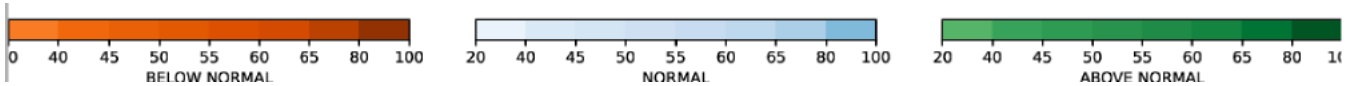


XGBOOST



OBSERVATIONS





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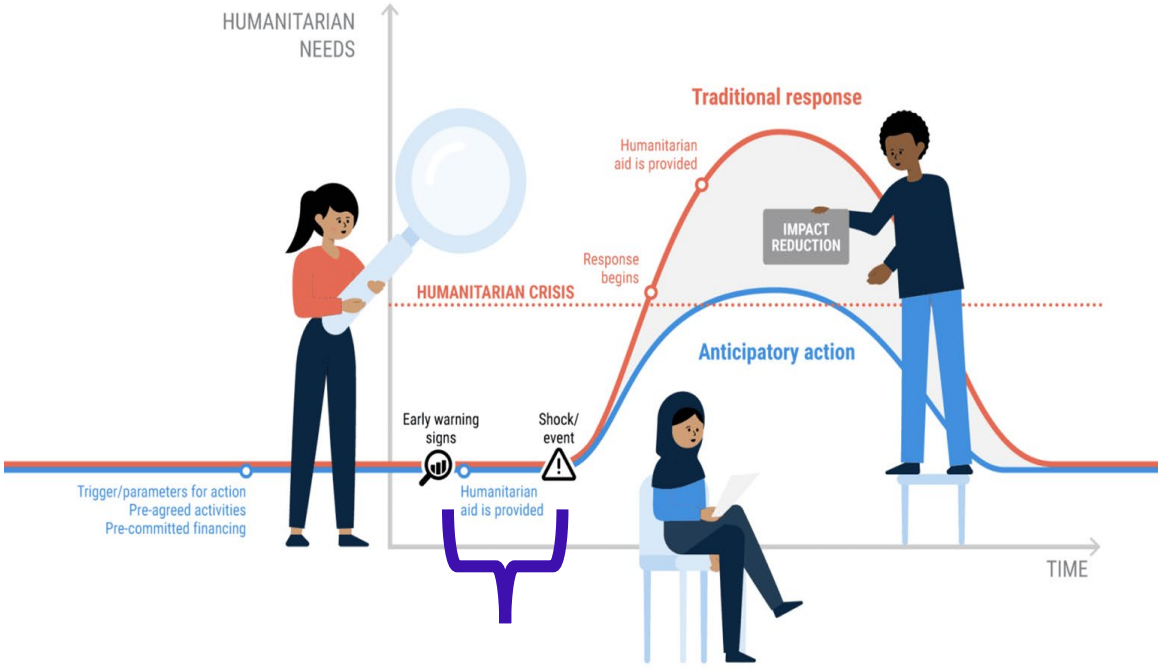
DISASTER PREPAREDNESS : Anticipatory Action

- **Pre-defined** actions taken **before** predicted hazards to **prevent** or **reduce** acute humanitarian impacts before they occur

Pre-defined triggers	*Forecast & risk information*
Pre-agreed actions	*Embedded in Action Plans; SOPs; EAPs; AAPs*
Pre-arranged financing	*Funds pre-allocated and automatically released*



AA

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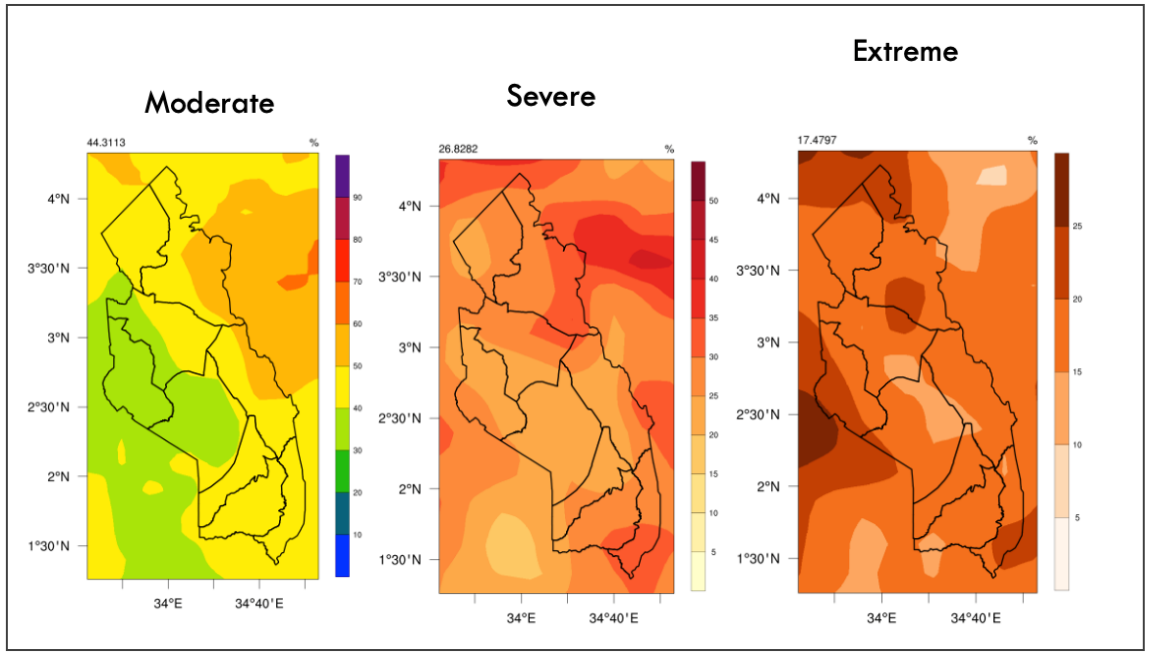
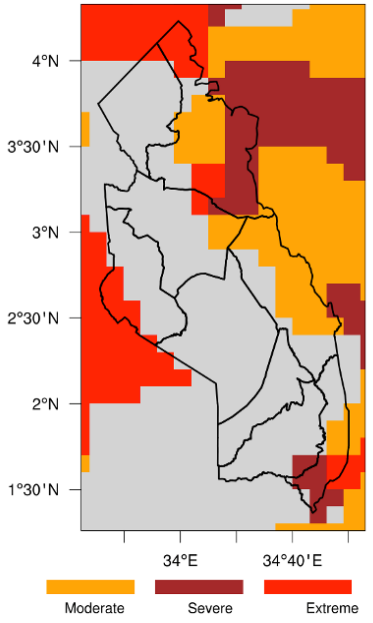
Sample Products for triggering Anticipatory Actions

MODERATE EVENTS TRIGGER	SEVER EVENTS TRIGGER	EXTREME TRIGGER
45%	30%	14%





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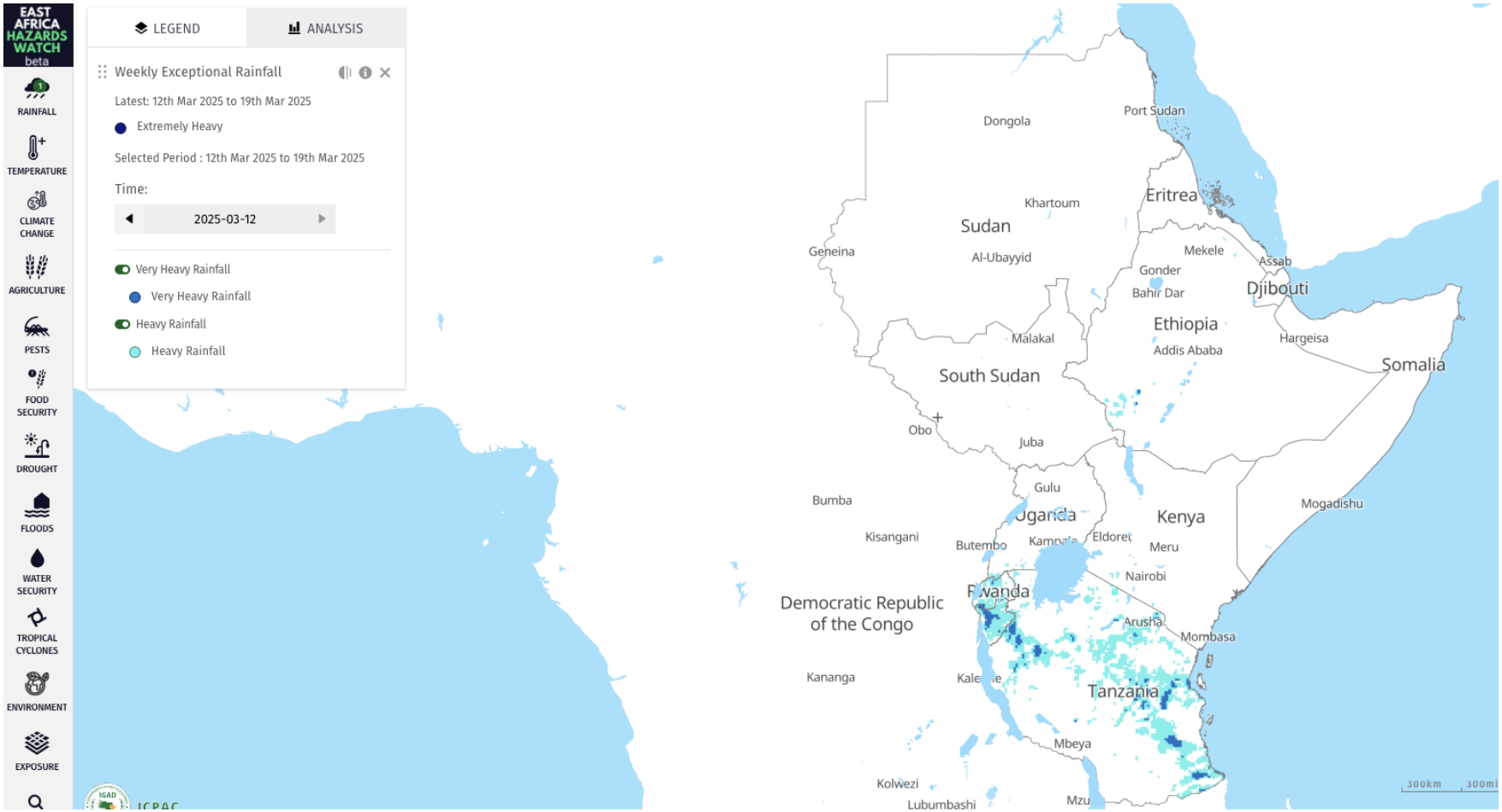
EAST AFRICA HAZARDS WATCH



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Conclusion

- Forecasting tools—ranging from short-term weather models to seasonal products—are essential enablers of proactive planning in climate-sensitive sectors.

- The integration of these tools into local, national, and regional systems is strengthening climate resilience and adaptive capacity across the region.

- As climate risks increase, leveraging forecasting tools is not just a technical necessity—but a strategic pathway toward sustainable development and risk reduction in Eastern Africa.

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THANK YOU

For further questions reach out at
masilin.gudoshava@igad.int, climateforecasters@igad.int

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