ICPAC SERVICES

SEWA Info Session, 23 October 2025

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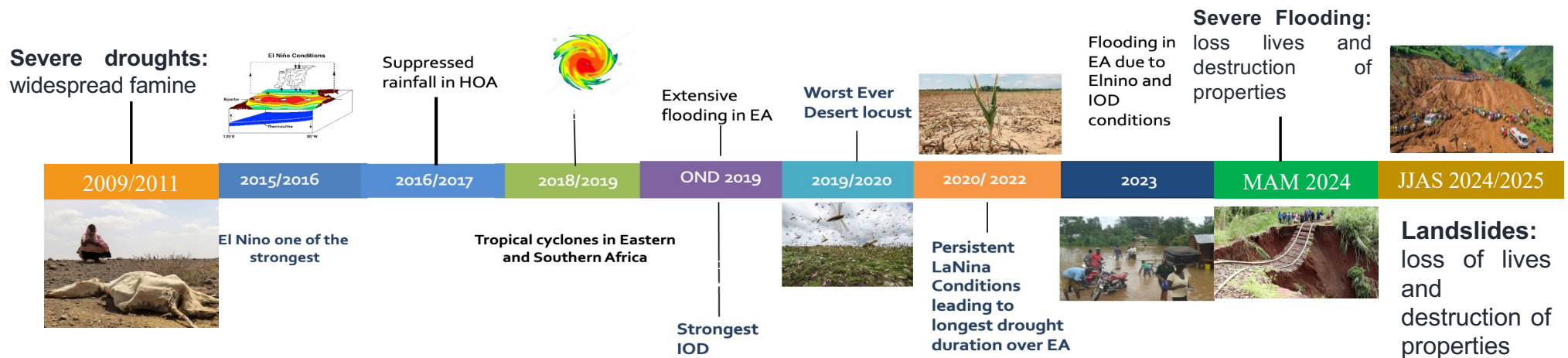
10/23/25

OUTLINE

- Why Climate Services Matter for East Africa's Resilience
- Brief About ICPAC
- Products and Services (including Data and Methods)
- User Engagement Platforms
- Digital platforms/Multi-Hazard Early Warning Systems (MHEWS)
- Impact-Based Forecasting (IbF): Ongoing Initiatives
- Gaps and Challenges
- Key Priorities and Expectations under the SEWA Project
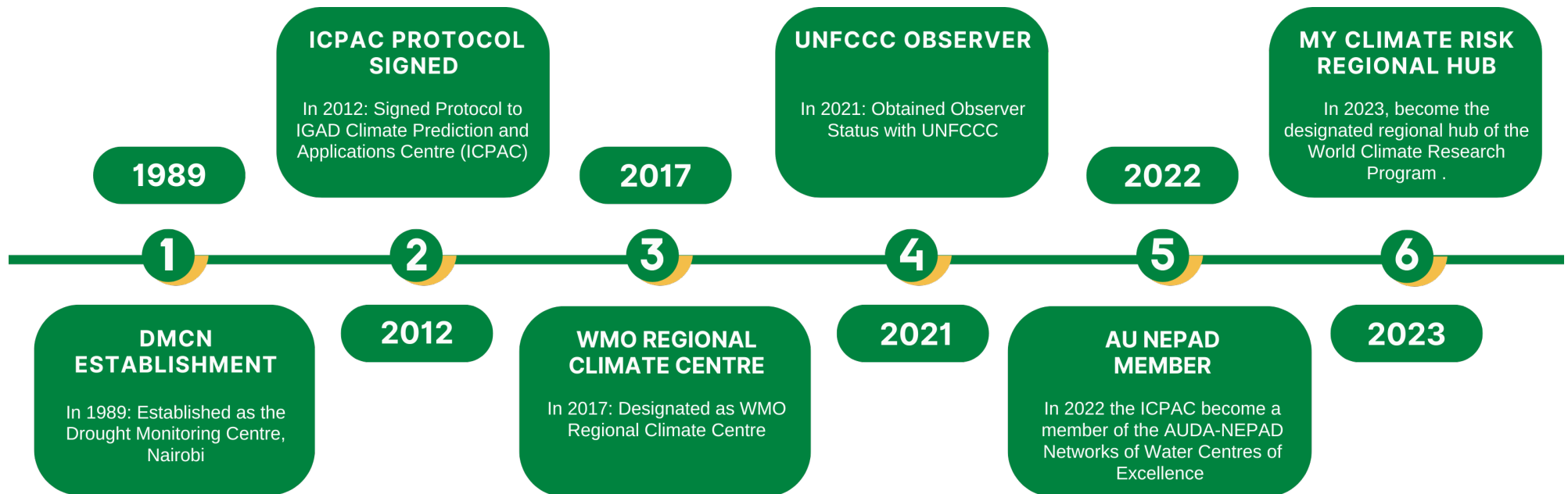- Opportunities

WHY CLIMATE SERVICES MATTER FOR EAST AFRICA'S RESILIENCE?

- Eastern Africa is one of the most climate-vulnerable regions, yet also one of the most under-served in terms of actionable climate information.

- Extreme weather and climate shocks impacting livelihoods, food security, health, and water resources.

- Climate information is vital for timely, informed decisions-mitigating risks and harnessing opportunities

Severe droughts: widespread famine

Suppressed rainfall in HOA

Extensive flooding in EA

Worst Ever Desert locust

Flooding in EA due to Elnino and IOD conditions

Severe Flooding: loss lives and destruction of properties

| 2009/2011 | 2015/2016 | 2016/2017 | 2018/2019 | OND 2019 | 2019/2020 | 2020/ 2022 | 2023 | MAM 2024 | JJAS 2024/2025 |

El Nino one of the strongest

Tropical cyclones in Eastern and Southern Africa

Strongest IOD

Persistent LaNina Conditions leading to longest drought duration over EA

Landslides: loss of lives and destruction of properties

Intensifying Climate Shocks in frequency and severity Threaten Lives and Livelihoods in Eastern Africa

BRIEF ABOUT ICPAC

1989

ICPAC PROTOCOL SIGNED

In 2012: Signed Protocol to IGAD Climate Prediction and Applications Centre (ICPAC)

2017

UNFCCC OBSERVER

In 2021: Obtained Observer Status with UNFCCC

2022

MY CLIMATE RISK REGIONAL HUB

In 2023, become the designated regional hub of the World Climate Research Program .

1 **2** **3** **4** **5** **6**

DMCN ESTABLISHMENT

In 1989: Established as the Drought Monitoring Centre, Nairobi

2012

WMO REGIONAL CLIMATE CENTRE

In 2017: Designated as WMO Regional Climate Centre

2021

AU NEPAD MEMBER

In 2022 the ICPAC become a member of the AUDA-NEPAD Networks of Water Centres of Excellence

2023

VISION: To be a world-class centre of excellence in climate services for sustainable development in the Greater Horn of Africa

MISSION: Foster climate services and knowledge to enhance community resilience for prosperity in the Greater Horn of Africa

8 IGAD Member States +

3 East African States

300 million people

Mandate: A Hub for Climate Services in Eastern Africa

Network: Works with NMHSs, sector ministries, humanitarian agencies, academic institutions, development partners

WHAT DO WE DO? KEY SERVICE AREAS

Climate Monitoring and Forecasting

Agriculture and Food Security

Disaster Risk Management

Water Resources
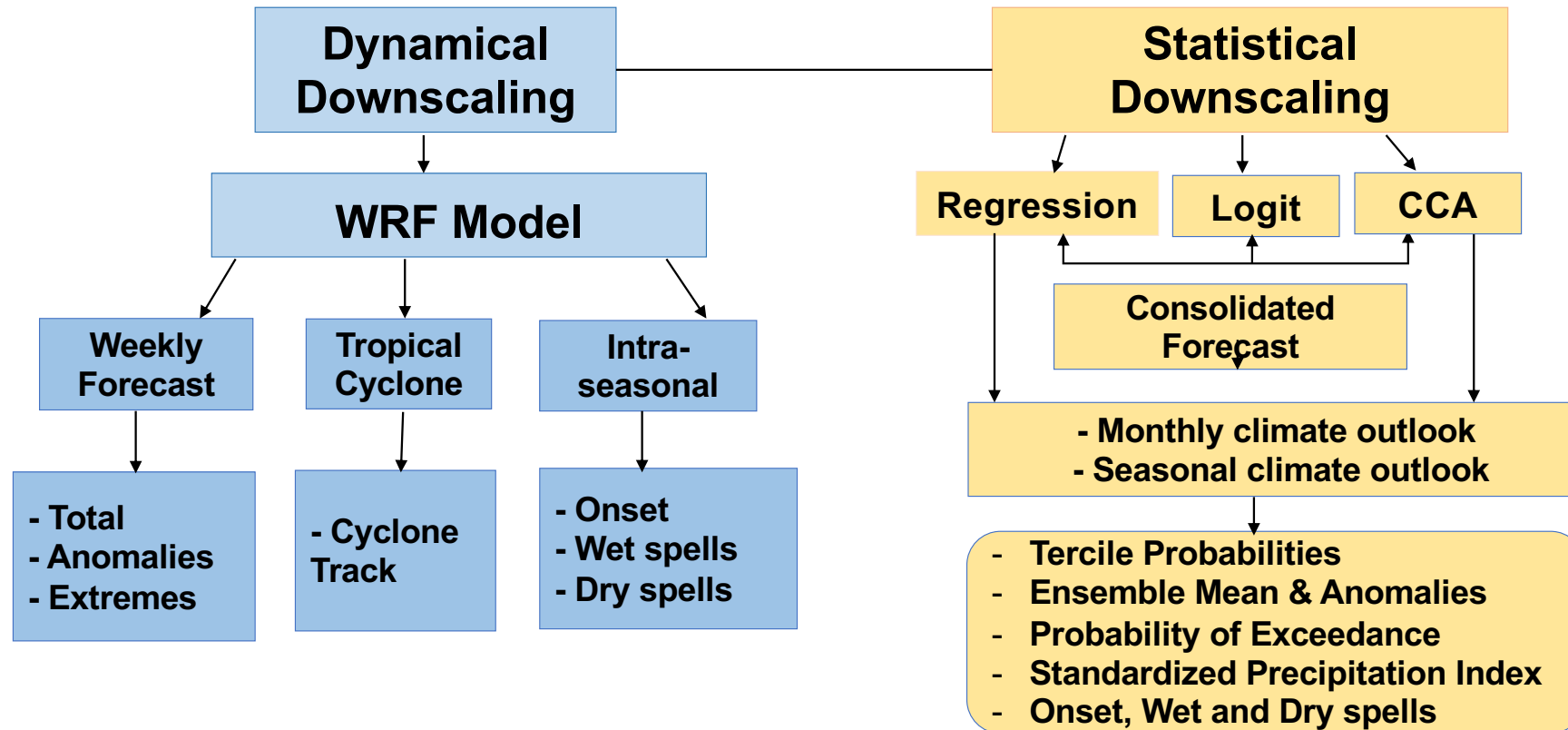
Environmental Monitoring

Climate Information and Co-production

Climate Change

Capacity Development

FORECASTING

Downscaling Techniques at ICPAC

DYNAMICAL FORECASTING

- WRF is used to downscale CFSv2, which has ~38km horizontal resolution; forecasts are available online at a 6-hour interval on a 7-day rotating basis with four-times-a-day initialization;
- Extensive physics options, initial/boundary conditions, and sensitivity tests were conducted to enhance WRF precipitation simulation accuracy over GHA;

- WRF is used to generate weekly weather forecasts at 10km resolution (hourly to daily outputs);
- ICPAC supported NMHSs in implementing WRF for 6-hour weather forecasts;
- Used to predict intra-seasonal rainfall patterns (onset, dry/wet spells);
- Tracks tropical cyclone paths and predicts impacts when one forms nearby.

IGAD CLIMATE PREDICTION AND APPLICATIONS CENTRE
(**ICPAC**)
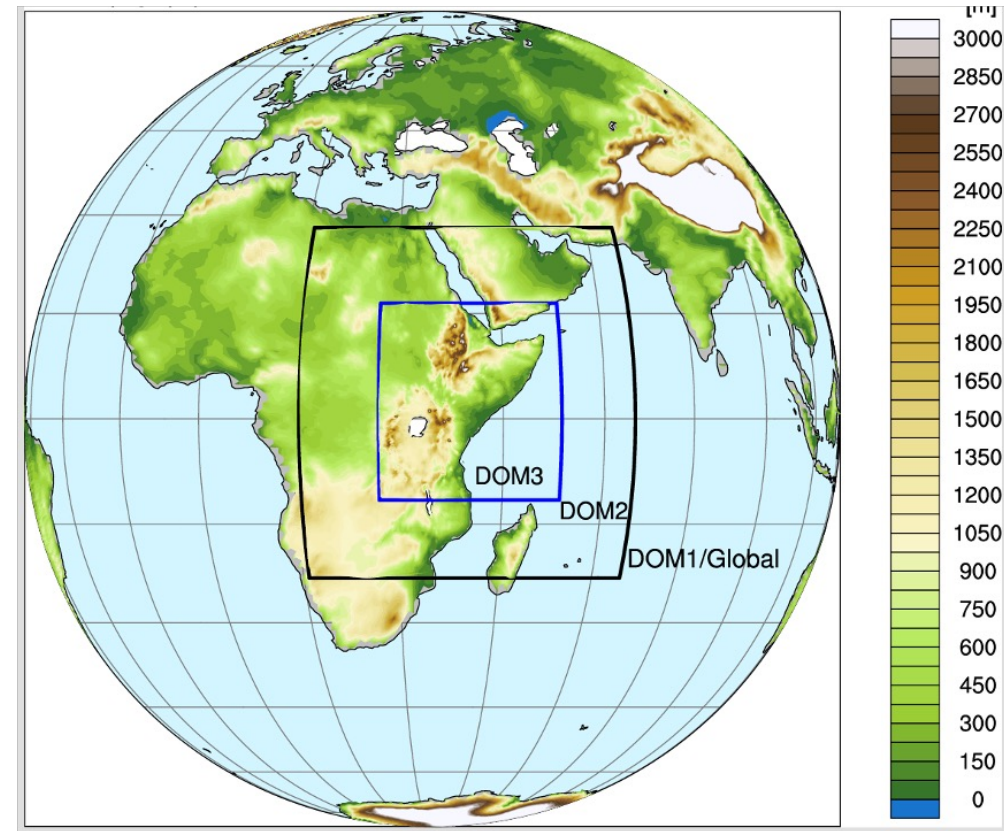
DETERMINISTIC WEEKLY, EXTREME RAINFALL, TC, AND HEAT STRESS FORECASTING

➢ WRF is operationally used to predict rainfall totals, extreme temperatures (min/max, including experimental heat stress), extreme rainfall surpassing the 90th, 95th, and 99th percentiles, and surface winds.

MEKUNU: 24 May 2018
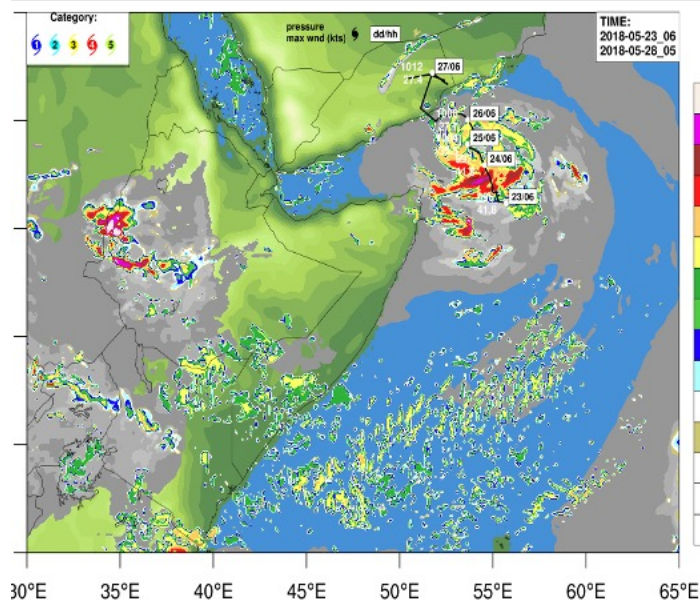
Exceptional Rainfall for 19-26 Mar 2025

Heavy Rainfall   Very Heavy Rainfall   Extremely Heavy Rainfall
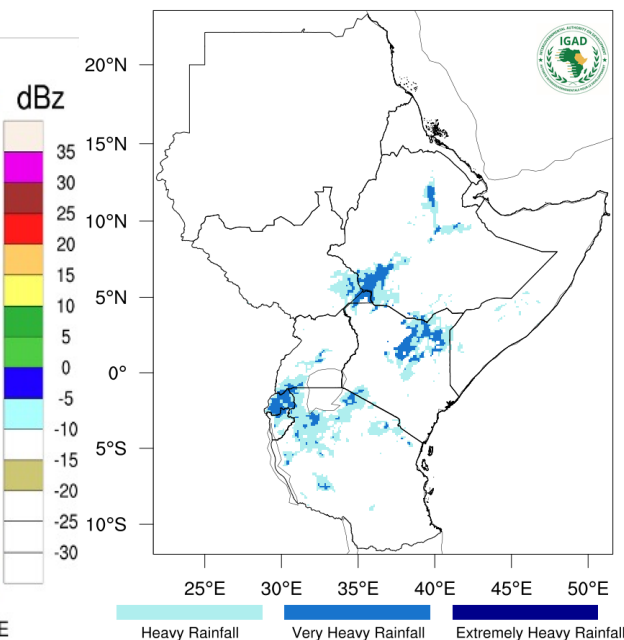
Heat Stress Index : 2025-03-19

KEY
Caution   : Heat fatigue with prolonged exposure
Extreme Caution : Heat exhaustion
Danger   : Heat exhaustion/ heat stroke probable
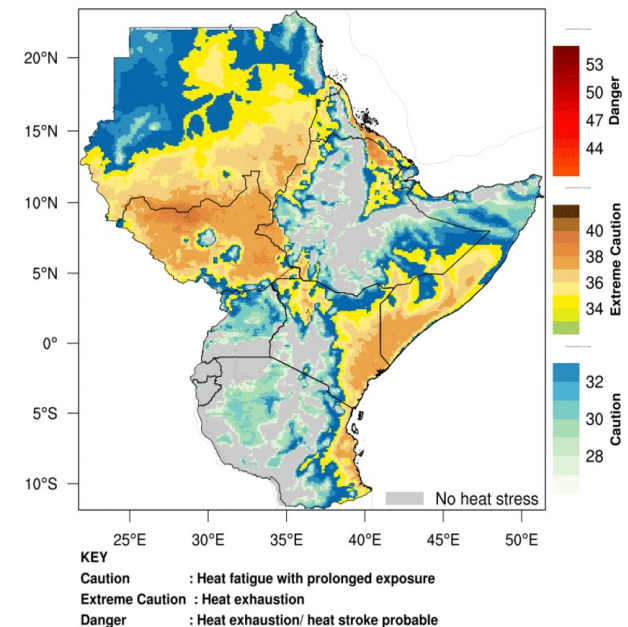
STATISTICAL DOWNSCALING AND CALIBRATION TECHNIQUES

- ICPAC has implemented an objective seasonal climate forecasting approach, in line with WMO recommendations, since May 2019.

- Statical downscaling and bias-correction of GCM forecasts are performed using three techniques: linear regression, canonical correlation analysis (CCA) and logistic regression.

- The consolidated seasonal and monthly outlooks are objectively produced by combining the outputs from linear regression, CCA and logistic regression.

Techniques

Linear Regression	Canonical Correlation Analysis (CCA)	Logistic Regression
Regressing model ensemble mean values against observation at each grid point	Identification of the optimal correlation between GCM-predicted and observed rainfall.	Based SST over Nino3.4 region and Western V Gradient
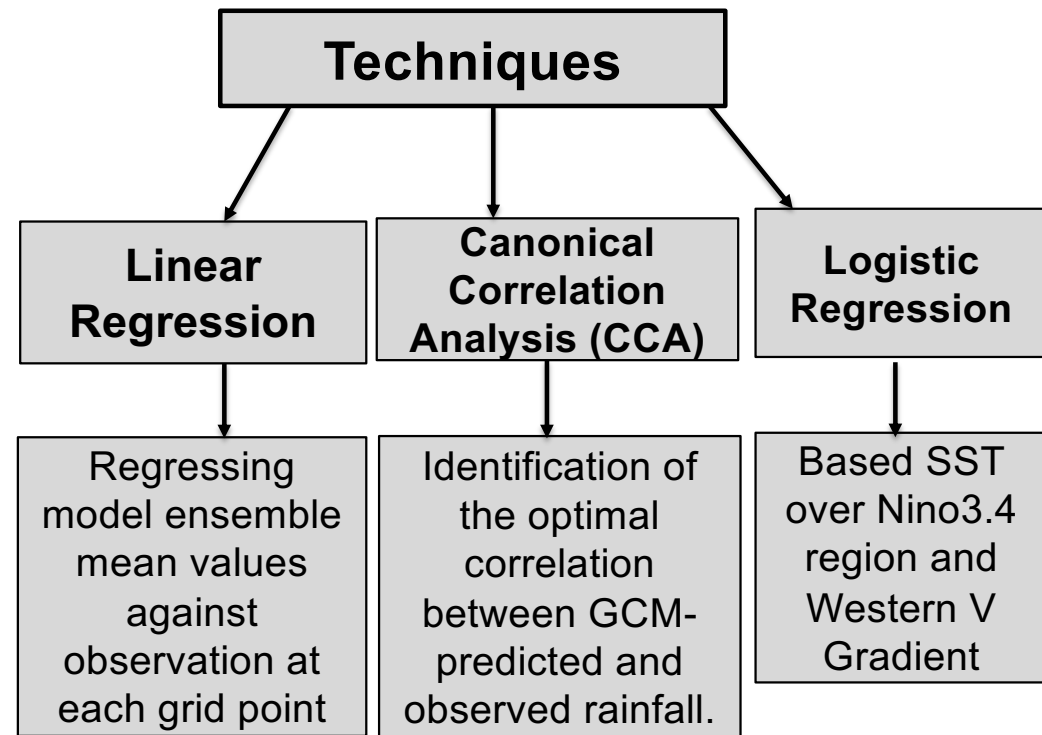
Objective Forecast = (eReg + CCA+Logit)/3

| NASA | GFDL-SPEAR | CCSM4 | CFSV2 | DWD | ECMWF | CMCC | MetF |
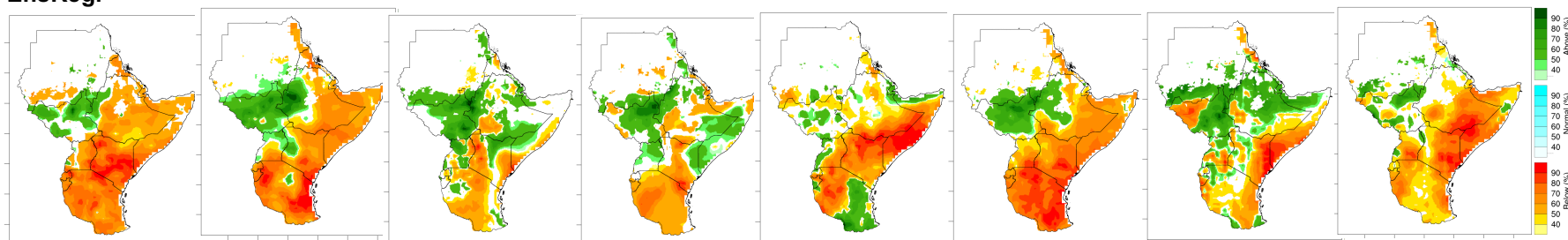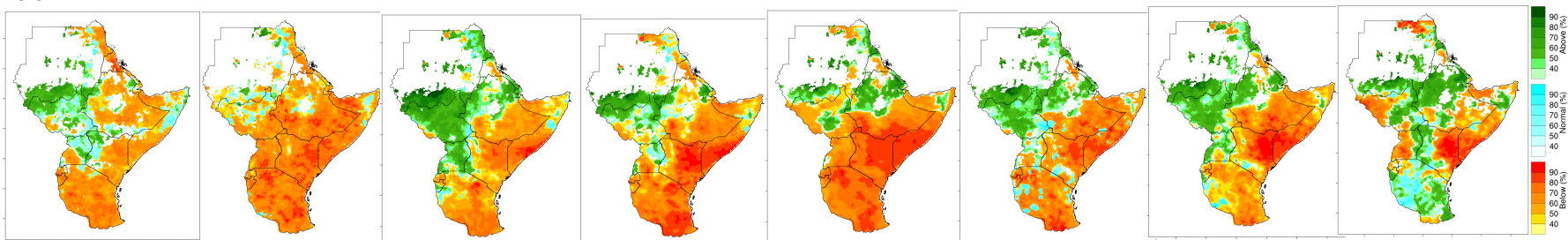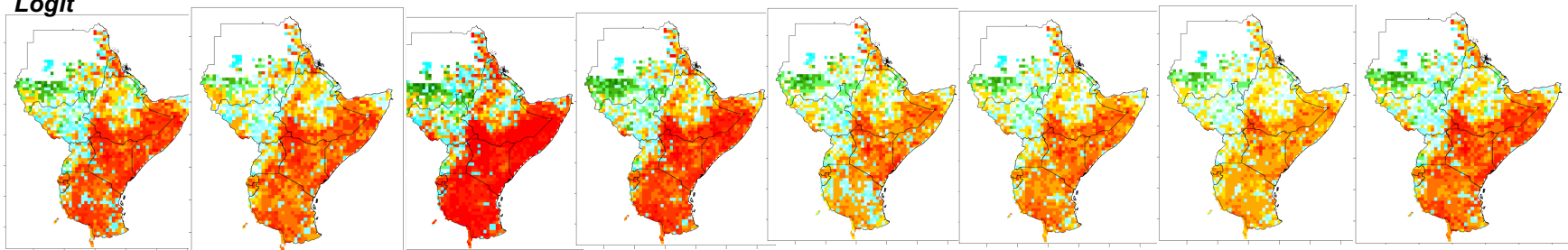
Tercile Forecasts

Rainfall

Temperature

Probability of Exceedance

Probability of receiving at least 300 mm

Probability of receiving at least 400 mm

Prob for 200 mm

PROPABILITY (%)
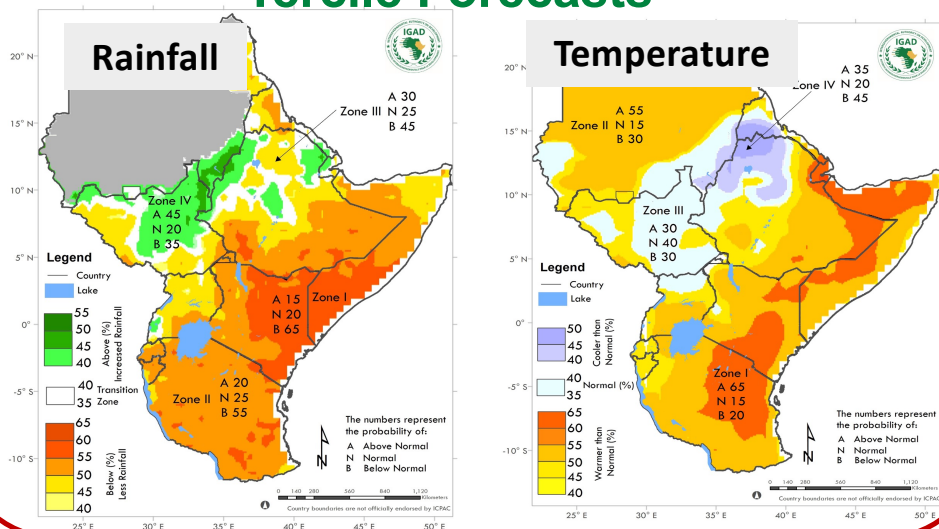
Tailored Forecast Products

Onset Date

Onset Probability

Maximum Dry-spell Length

Start Date of the Max Dry-spell
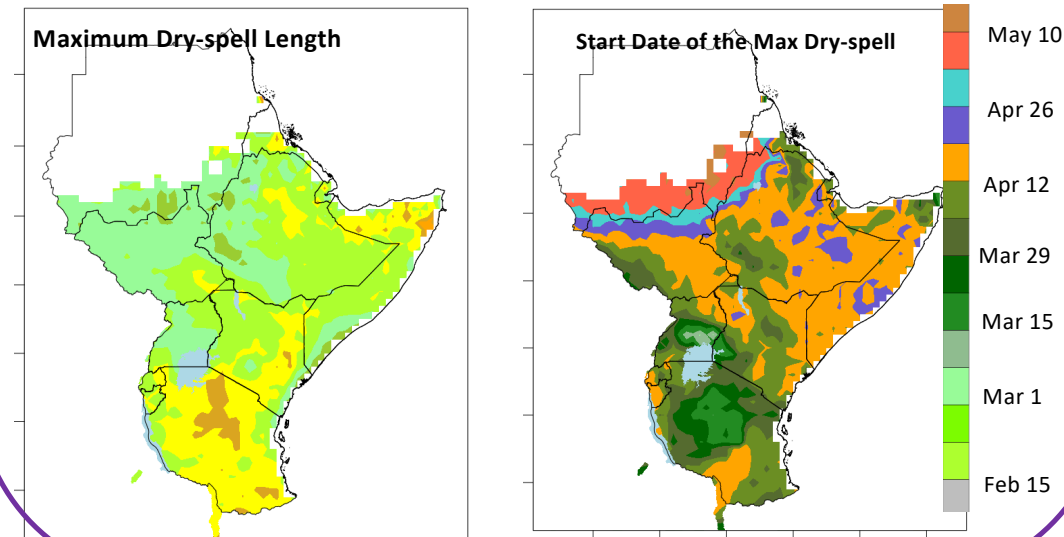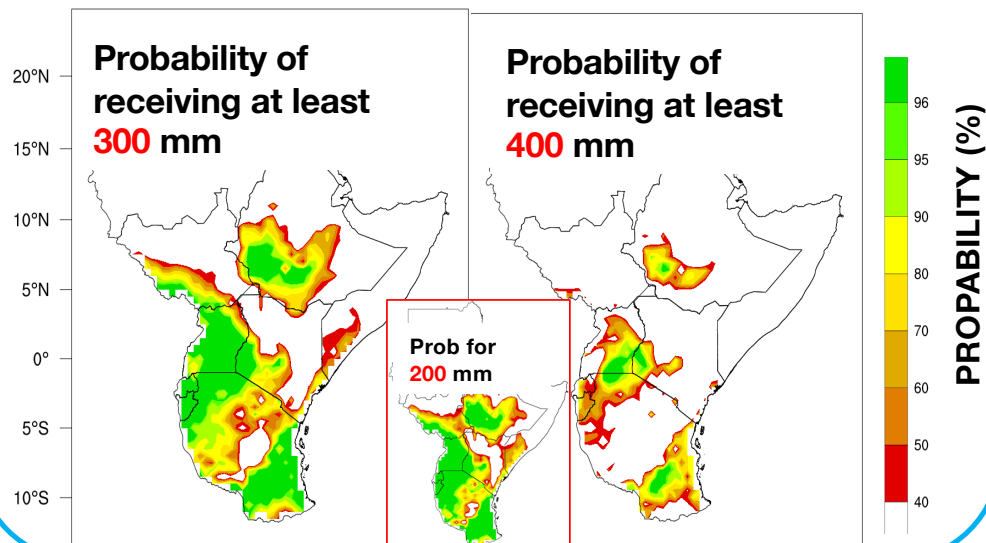
SUB-SEASONAL PROTOTYPE PRODUCTS

Week1
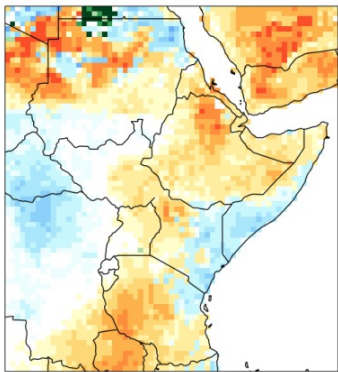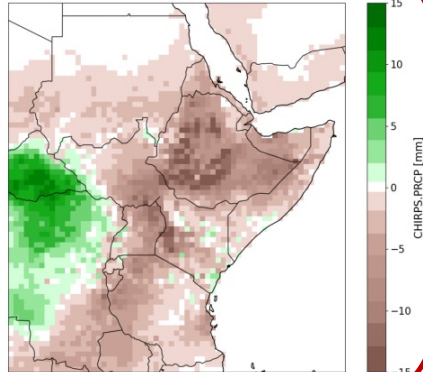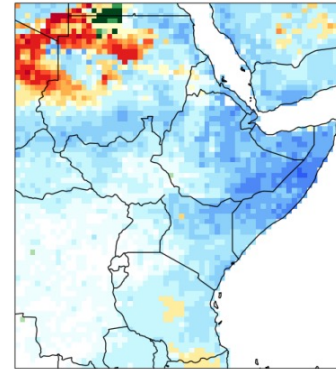
Week 2

Week 3
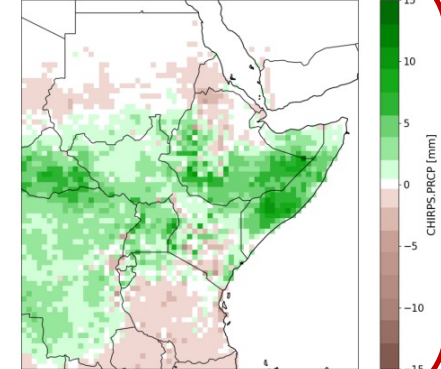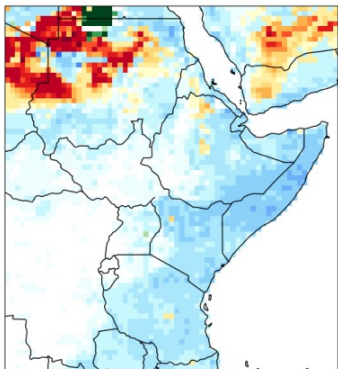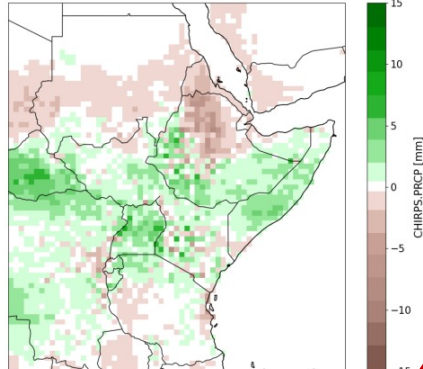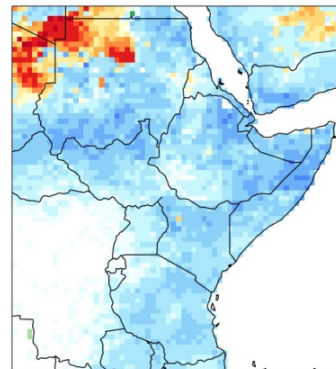
Week 4
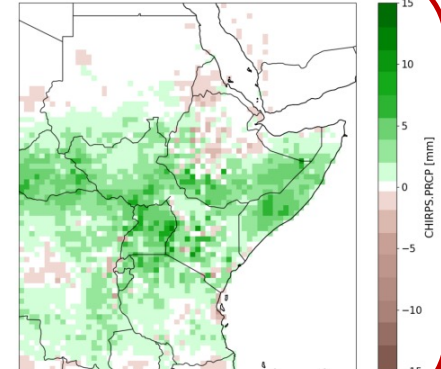
CLIMATE CHANGE PRODUCTS
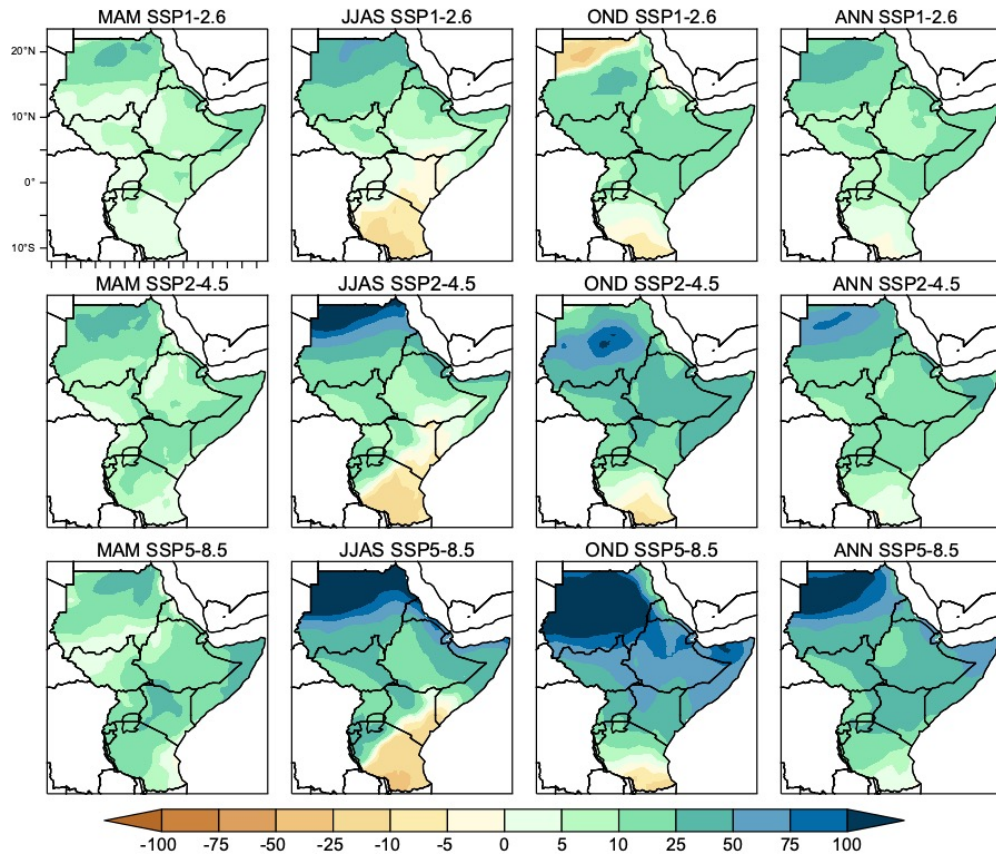
Future Rainfall and Temperature Projections for GHA under SSP Scenarios

CC RCC Viewer: https://www.icpac.net/rcc/climate-change/
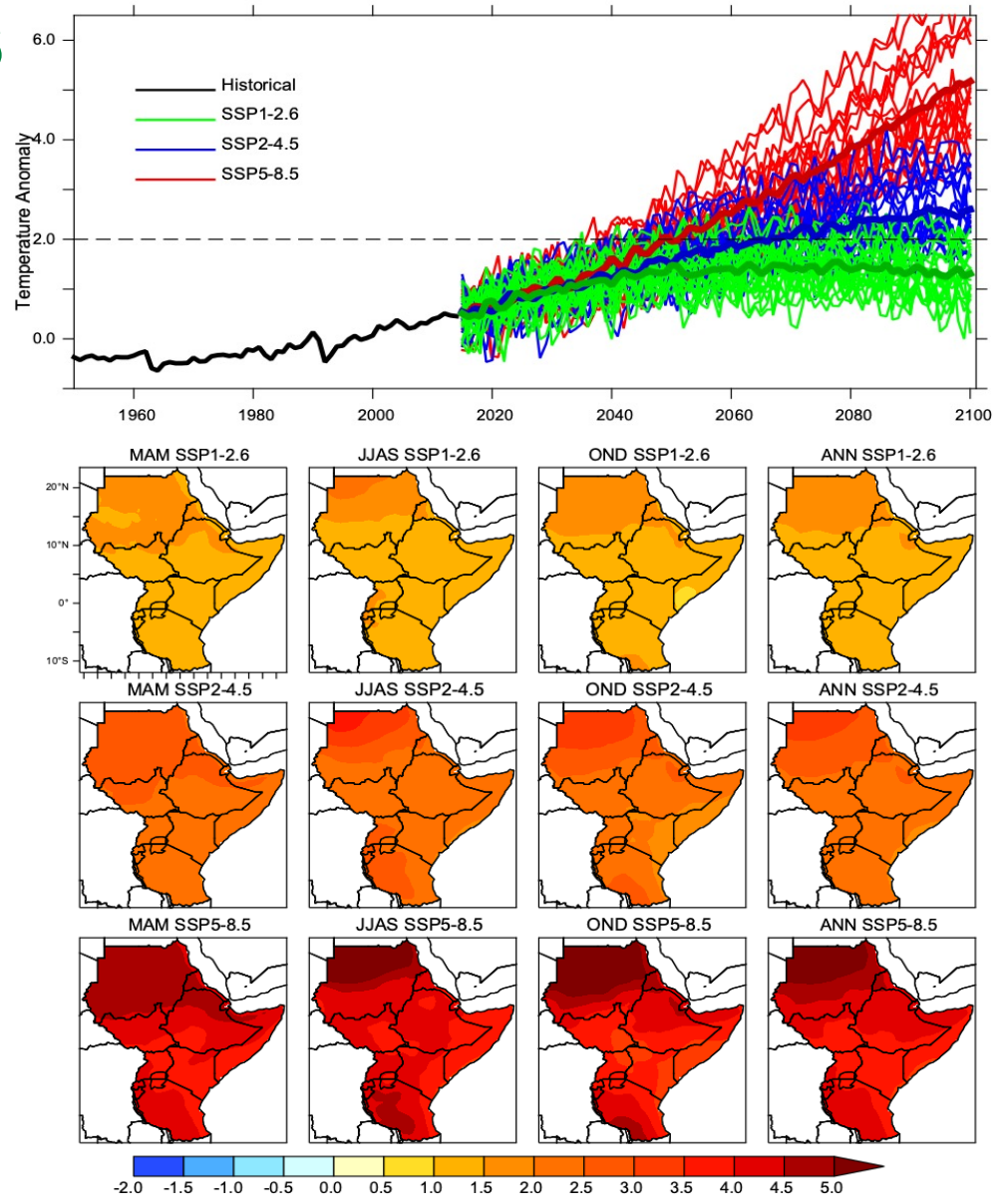
SEAMLESS EARLY WARNING INFORMATION

Strategic planning

Preparedness planning

Response and relief

Planning informed

S2S

Climate change

Seasonal

S2D

Monthly

Weekly

Hourly to Daily

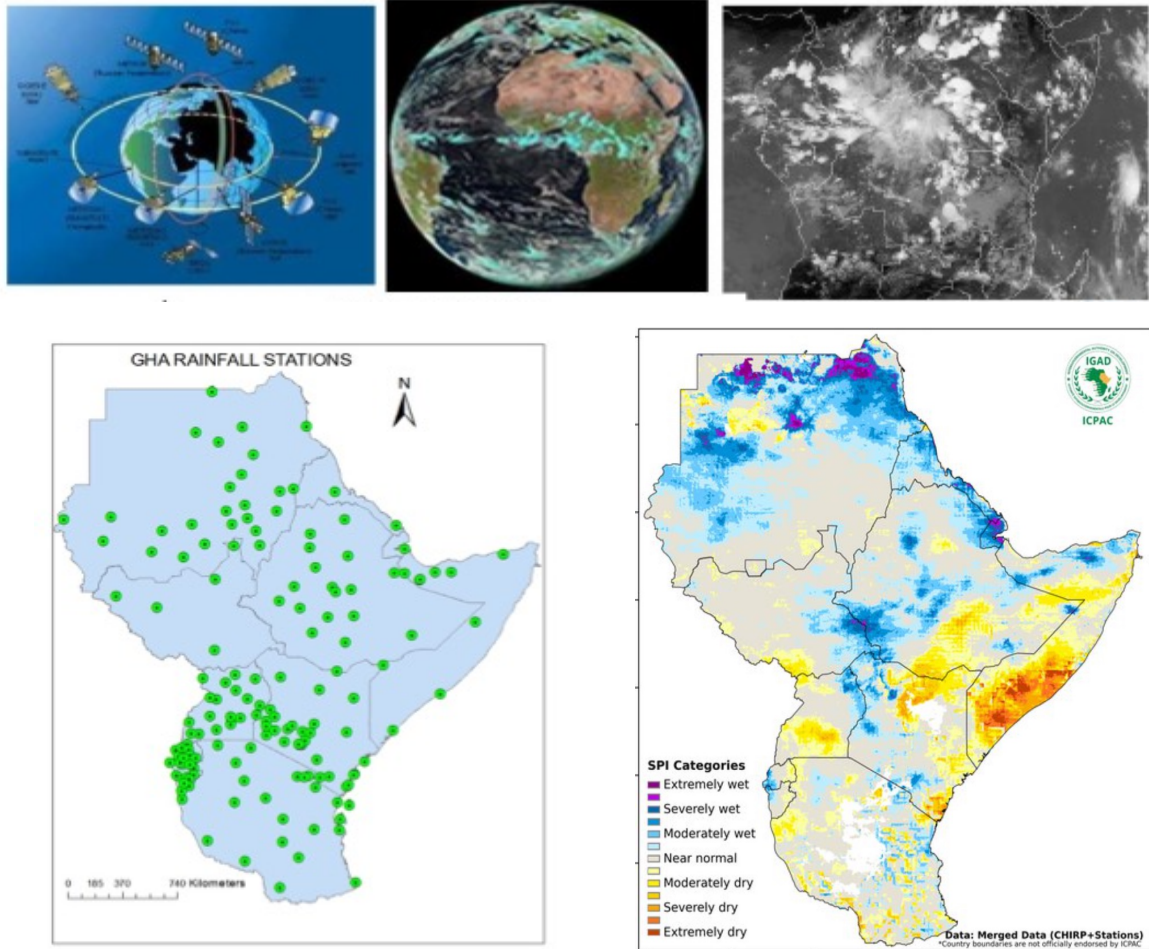Timescales
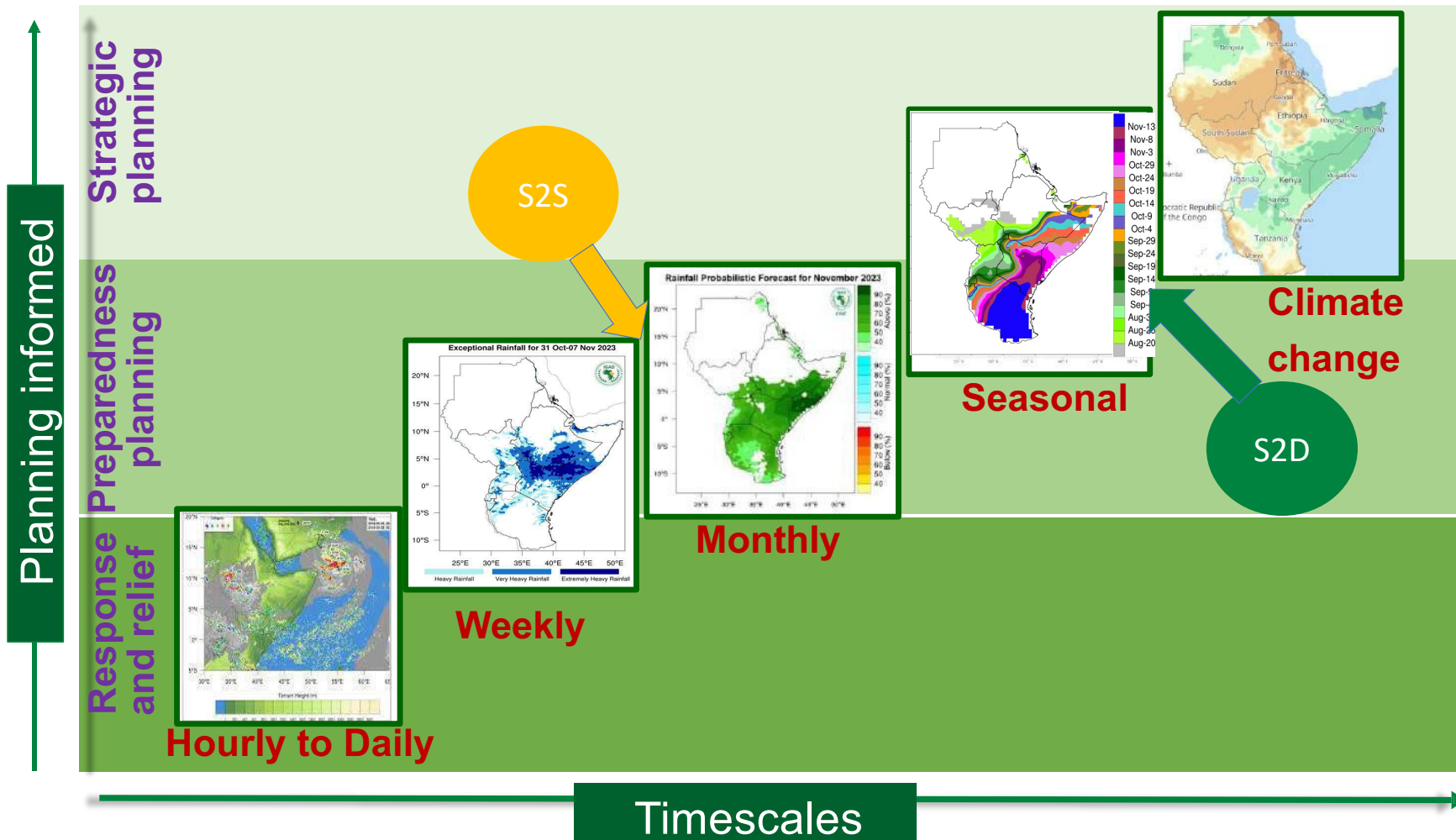
CLIMATE DATA SERVICES

- ICPAC receives station data from 157 active weather stations.

- Produce blended and gridded high resolution regional and national climate data sets using various tools

- Support to MS regarding data management, Climsoft/CDT, data libraries and maprooms

- A regional data sharing protocol signed with NMHSs to allow sharing of more data

GHA RAINFALL STATIONS

0   185   370   740 Kilometers

SPI Categories
- Extremely wet
- Severely wet
- Moderately wet
- Near normal
- Moderately dry
- Severely dry
- Extremely dry

Data: Merged Data (CHIRP+Stations)
*Country boundaries are not officially endorsed by ICPAC

RARS ANTENNA

- **Implemented under the EU-funded SAWIDRA Programme** through the AfDB ClimDev-Africa Special Fund (CDSF)

- Antenna tracks and receives polar-orbiting meteorological satellites — including NOAA, EUMETSAT's METOP, and CMA's FengYun series

- Aim to enhance access to near-real-time satellite data to strengthen regional Numerical Weather Prediction (NWP) and improve forecast accuracy

- Software upgrade required, maintenance and system upgrades of RARS stations are planned under the SEWA project

MONITORING OF CROPS, FORESTS AND PESTS

Desert Locust Movement Prediction August 2021
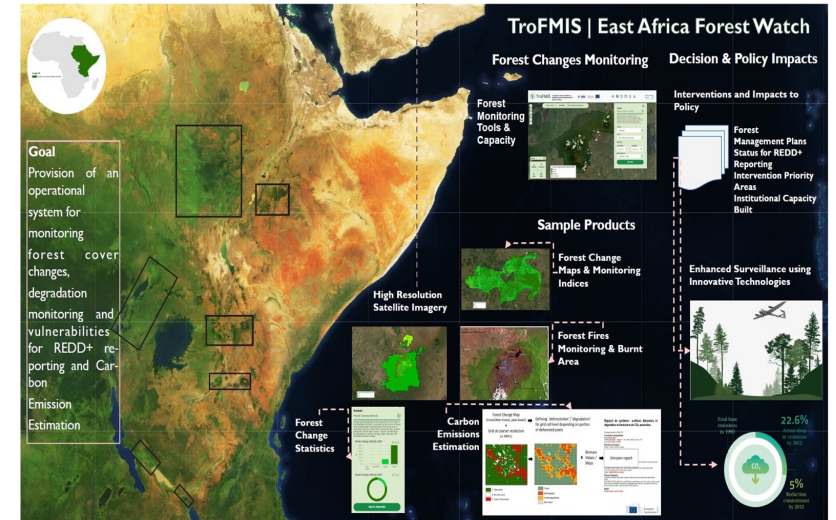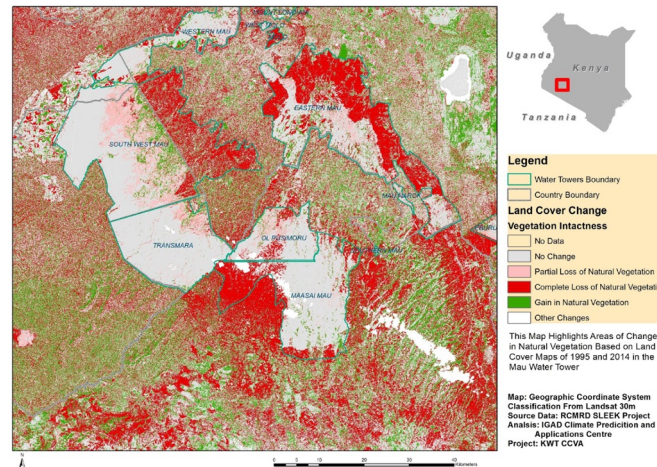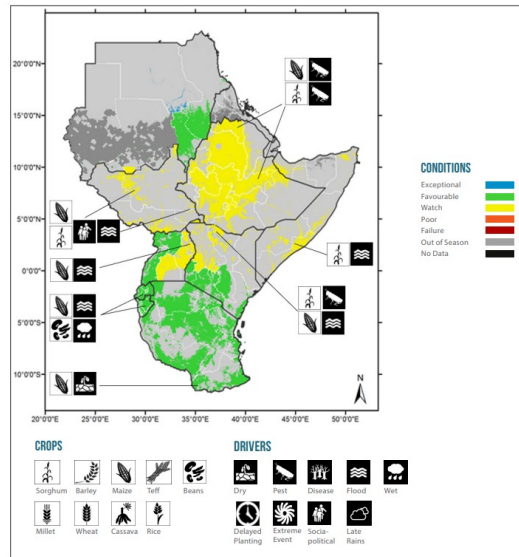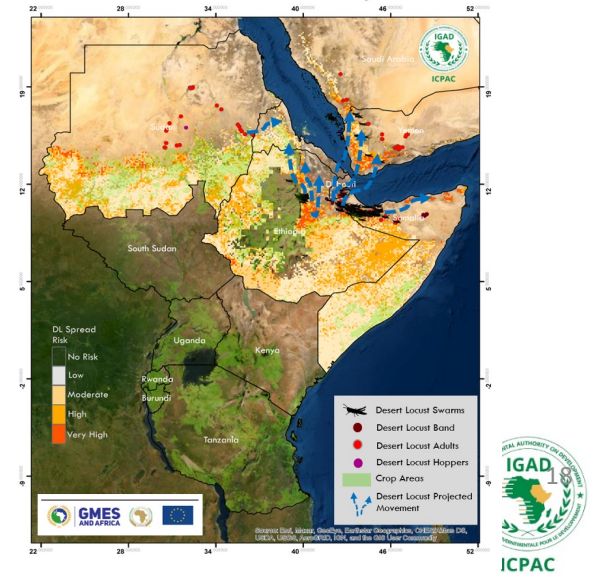

- Crop monitor analyses various crops conditions at different times of the cropping season

- Protected forests monitoring for carbon emission estimation

- Desert locust prediction helps in planning on resources allocation for control measures

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User Engagement Platforms

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CO-PRODUCTION OF CLIMATE SERVICES WITH USERS

- **GHACOF** is a regional platform convened 3 times a year (MAM, JJAS, OND seasons)

- It is the **backbone of co-produced, user-driven climate services**.

- **Brings together:** Decision-makers, climate & research scientists, media, development partners, and users of climate information

- **Supports:** Co-design, co-development, and co-ownership of climate services

- **Facilitates:** Enhanced interactions, user feedback, sharing best practices, and outreach

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DRM working group

Conflict working group

Livestock working group

Water working group
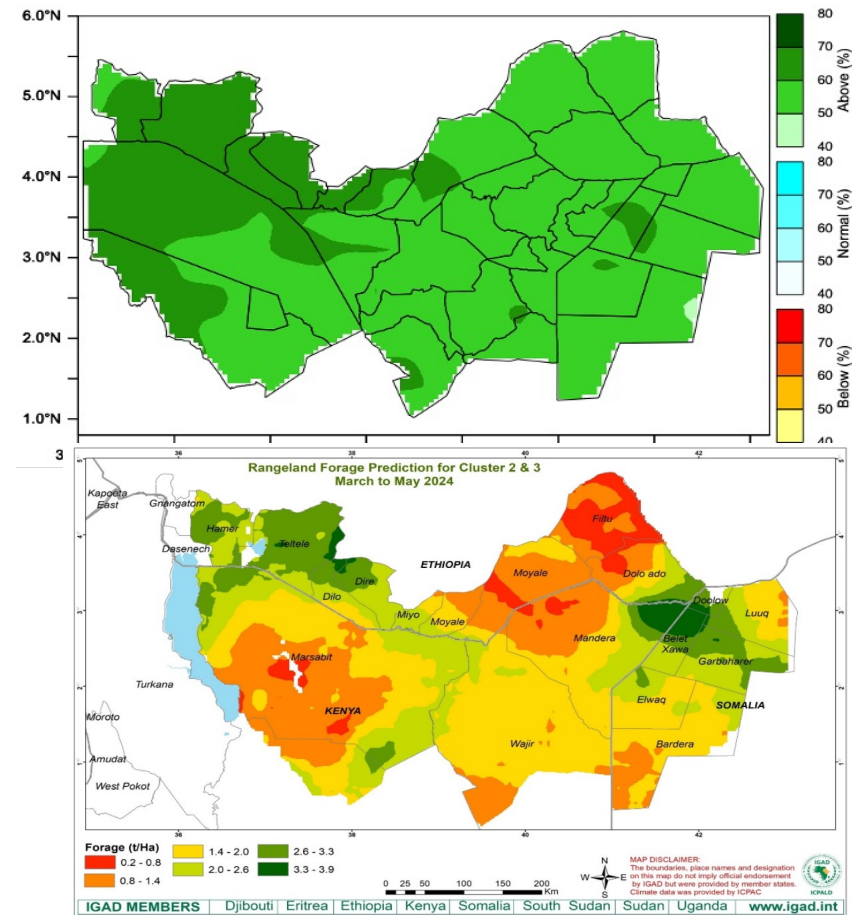
Agriculture & food security group

Media Working Group

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CO-PRODUCTION OF CLIMATE SERVICES WITH USERS

Sub-regional Climate Outlook Forums for IGAD Cross-border Areas

- Support to Sub-Regional COFs for IGAD Cluster Communities

- **Goal**: Enhance **uptake of climate early warning information** for early response

- **Agro-advisories co-developed** with national & regional partners and disseminated

- **Journalists trained** on climate information interpretation → stronger media dissemination

- **Advisories translated** into **local languages** → improved community access

Rangeland Forage Prediction for Cluster 2 & 3
March to May 2024

Forage (t/Ha)
0.2 - 0.8
0.8 - 1.4
1.4 - 2.0
2.0 - 2.6
2.6 - 3.3
3.3 - 3.9

IGAD MEMBERS | Djibouti | Eritrea | Ethiopia | Kenya | Somalia | South Sudan | Sudan | Uganda | www.igad.int

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LINKING REGIONAL CLIMATE SERVICES TO LOCAL AGRICULTURAL ADVISORIES

GHACOF → NCOF → PSP → PICSA

Stakeholders generating agricultural advisories based on seasonal climate forecasts

Farmers taken through RAM process
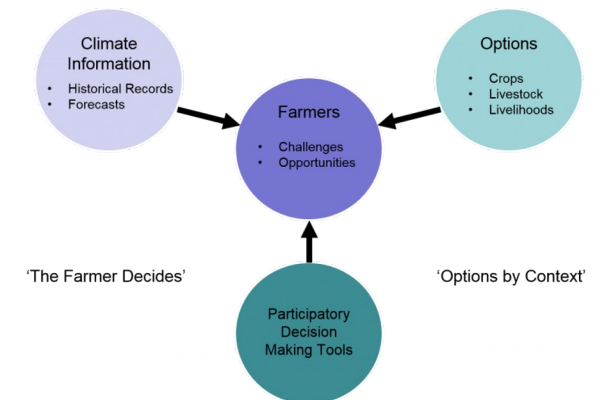
Supporting a pilot climate service demonstration

CAPACITY BUILDING

- **Capacity building** is one of the main focus of ICPAC's interventions to enhance the delivery and use of climate services across the region.
- **Key Areas of Capacity Building:** Climate modelling and prediction, Data Management, co-production, anticipatory action, disaster risk management

Multi-hazard Early Warning Systems

Multi-Hazard Early Warning Systems

**Regional multi-hazard monitoring and early warning platform**

- Suite of geospatial early warning applications called the East Africa Watch

- Support integrated multi-hazard early warning
  - East Africa **Drought** Watch
  - East Africa **Agriculture** Watch
  - East Africa **Forest** Watch
  - East Africa **Hazards** Watch
  - East Africa Floods Watch
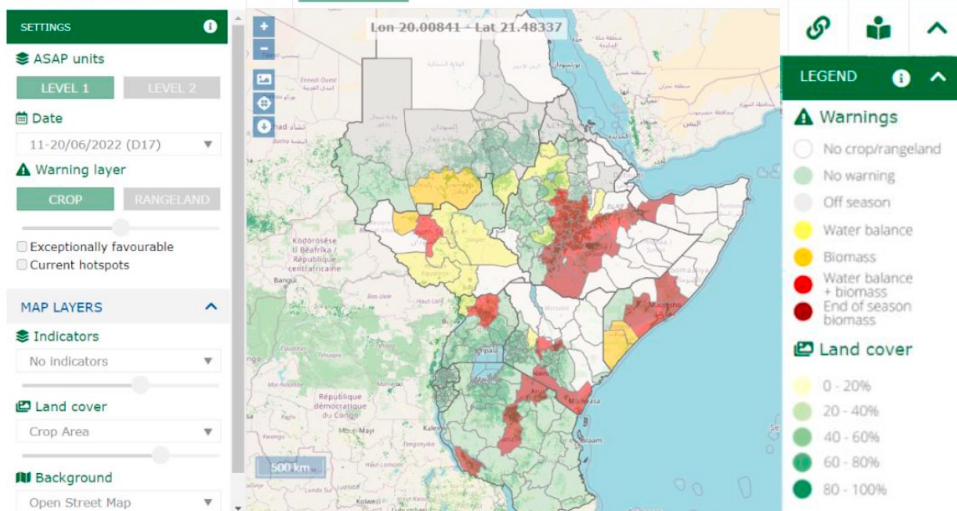 - East Africa Pests Watch

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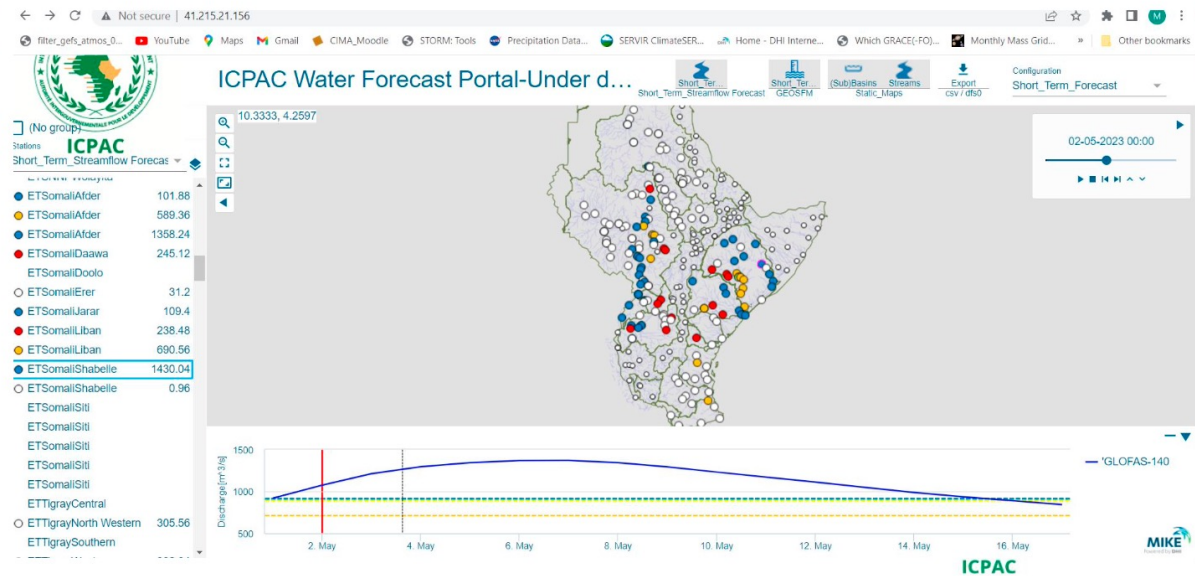ICPAC

East Africa Hazards Watch
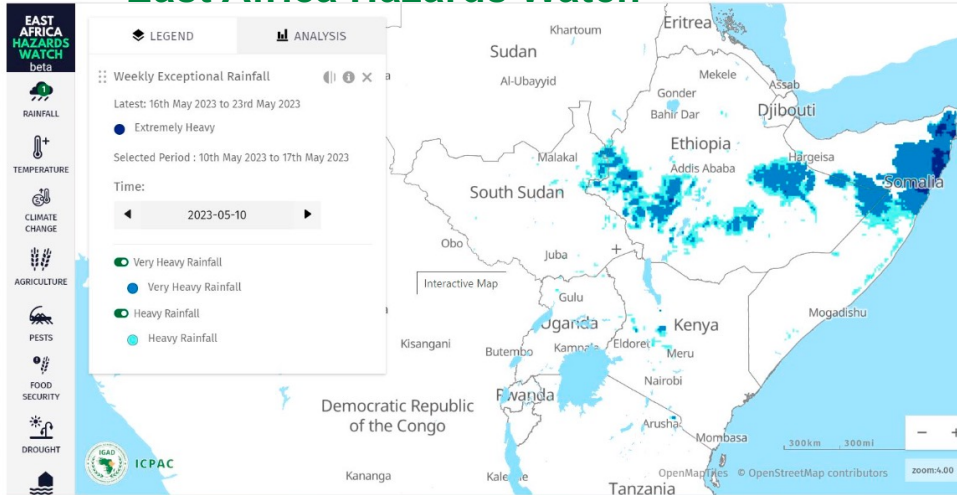
East Africa Drought Watch
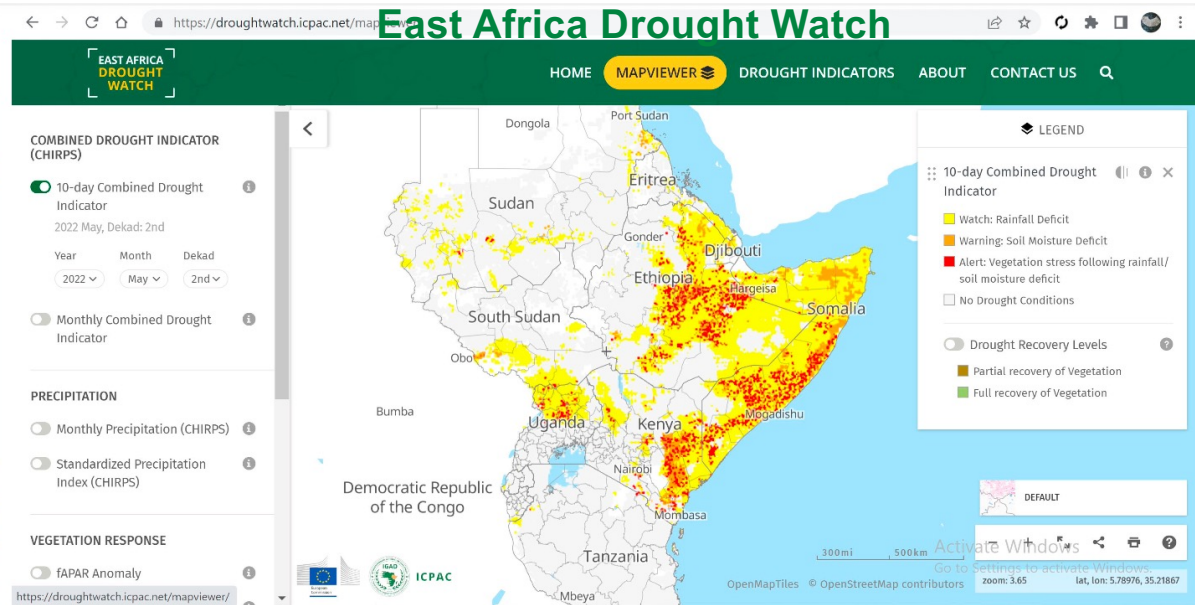
MULTI-HAZARD EARLY WARNING SITUATION ROOM

- One of the 6 situation rooms in Africa together with African Union and ACMAD
- Multi-Hazard Monitoring
- Coordinate early action

- Rapid mapping of affected areas
- Capacity building on anticipatory risk
- Supporting African Union Situation Room

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IMPACT-BASED FORECASTING: CURRENT STATUS & INITIATIVES

IMPACT-BASED FORECASTING: CURRENT STATUS

Transitioning from Weather - Hazard- to Impact-Based Forecasting
Moving from what the weather will be to what the weather will do

- Impact-Based Forecasting (IBF) bridges the gap between traditional weather forecasts and real-world impacts — enabling decision-makers, communities, and responders to take timely, informed action that saves lives, livelihoods, and resources.

- Implementation of both IbF requires working together with different agencies e.g., climate services, sectors, administrators, donors & communities

$$Risk = Probability \times Impact$$

Standard Impact Based Risk Measure
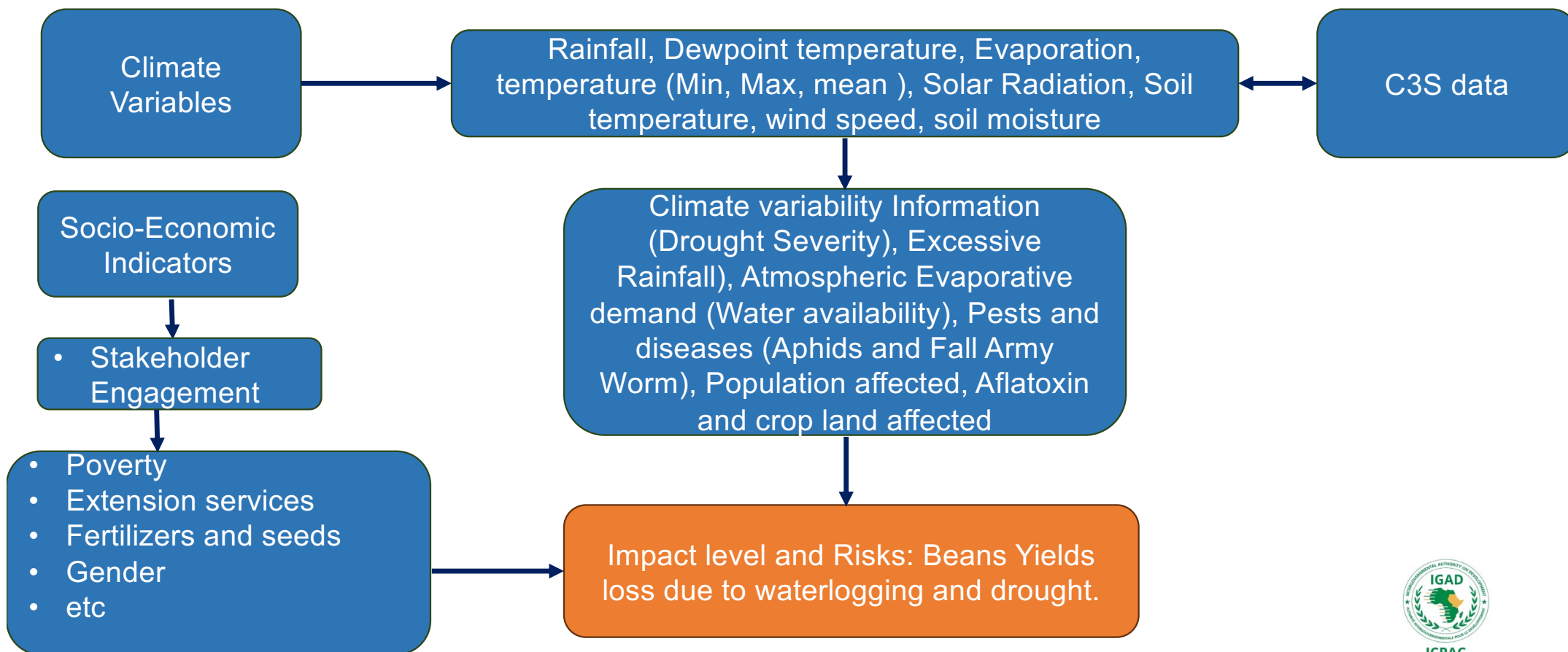
Impact communication through risk matrices

IMPACT-BASED FORECASTING (IBF) FOR AGRICULTURE PROTYPE DEVELOPMENT FOR (MACHAKOS MAKUENI COUNTIES, KENYA)

Development of impact-based forecasting tools to support agricultural advisories

Impact-based Forecasting (IBF) Using Machine Learning

Predicting Crop Yields using ML Algorithms

Climate data and OND (Short Rains Beans Yields)

Spatial Distribution of XGBoost Predictions

Spatial Distribution of Actual Yields

Impact Risks levels = Climate Information (Hazard) X Exposure Information X Vulnerability Information
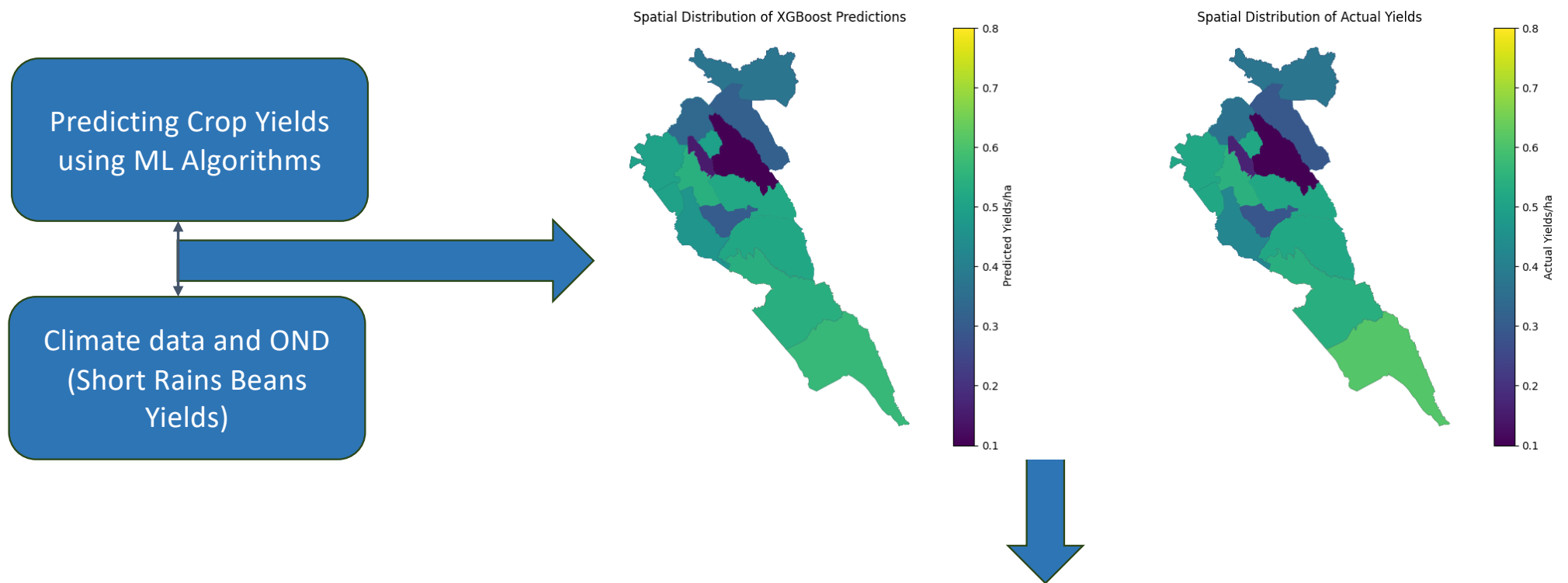
DROUGHT THRESHOLDS AND TRIGGERS

MAM Forecast Rainfall (Probabilistic)
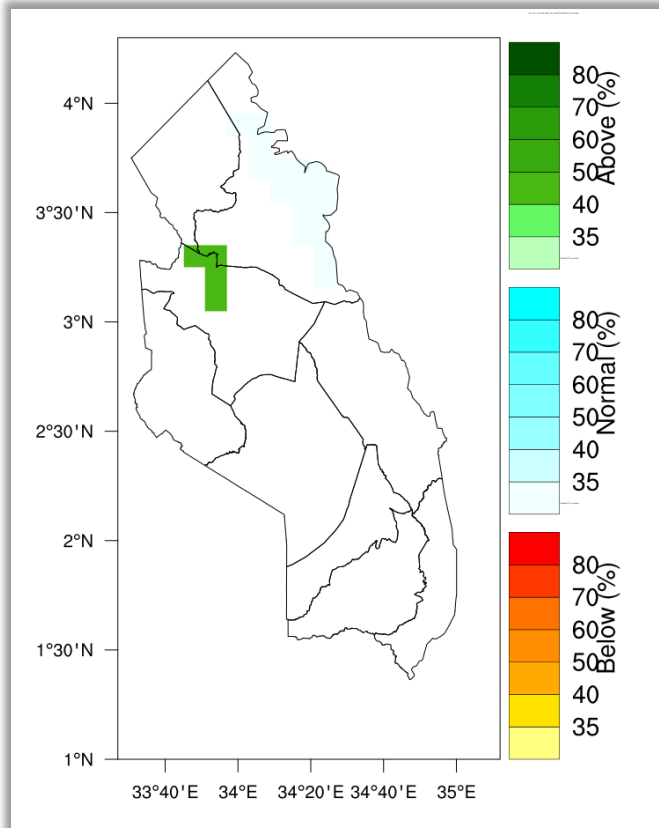
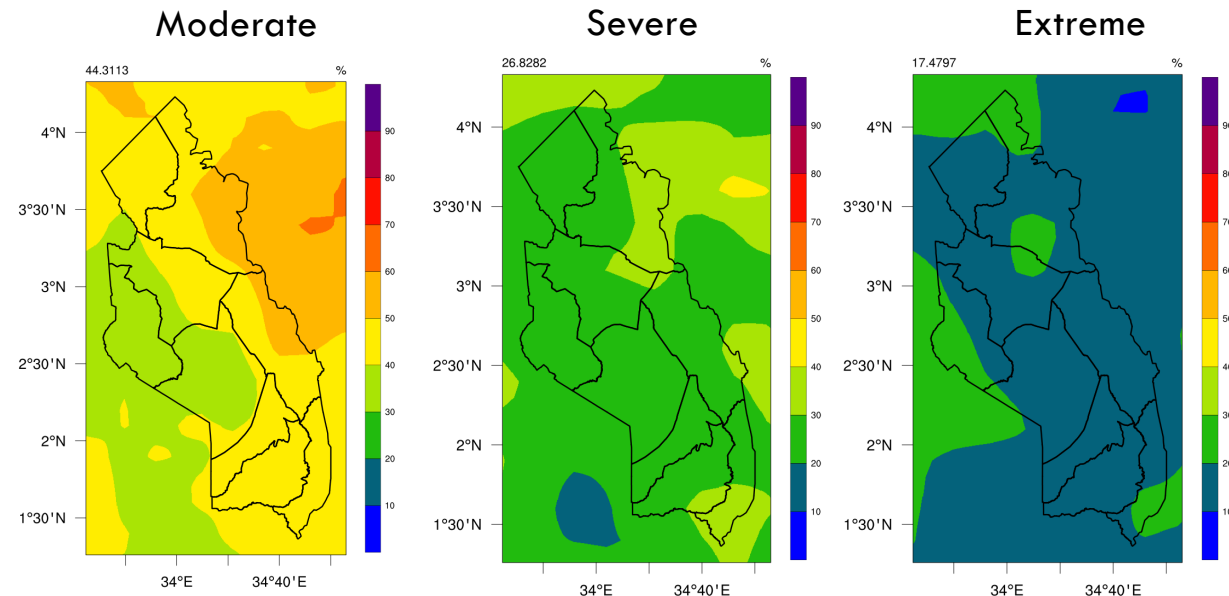| MODERATE EVENTS TRIGGER	SEVER EVENTS TRIGGER	EXTREME TRIGGER
45%	30%	14%

SPI Forecast

Moderate	Severe	Extreme

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HAZARD MODELING, IMPACT ESTIMATION, CLIMATE STORYLINES FOR DROUGHT AND FLOOD DISASTERS IN EASTERN AFRICA

- Model hazards, estimate impacts, and develop climate storylines for an event catalog on drought and flood disasters in Eastern Africa
- Integration of ensemble prediction systems to create counterfactual, physically consistent narratives of real events, offering a new lens through which to view disaster risk and preparedness
- Data streaming and cloud computing operations to enable efficient handling of complex data workflows, ensuring cost-effectiveness and sustainability of IBF.
- Exploration of GenAI in forecast improvement and Bayesian networks in risk assessment.

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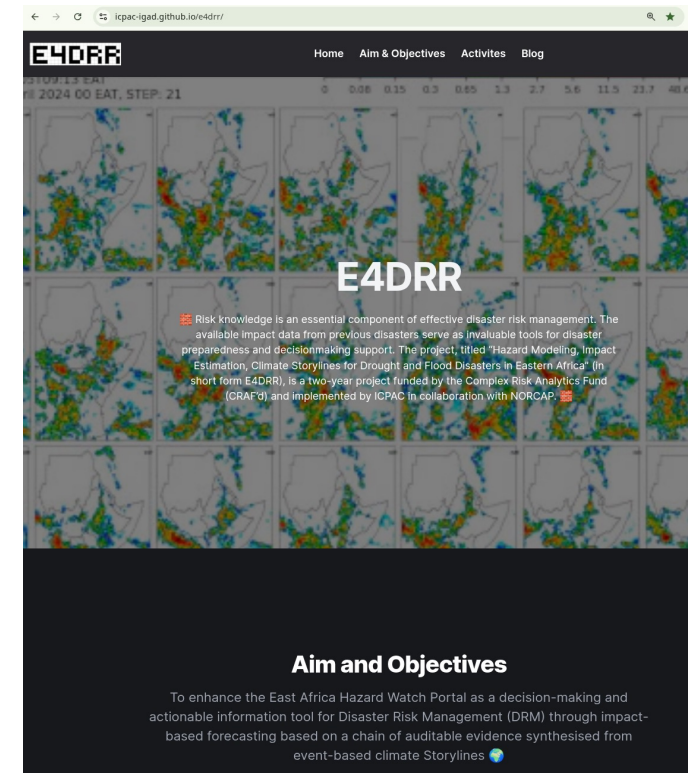
AI-DRIVEN FORECASTING

- ICPAC is partnering with WFP, University of Oxford and ECMWF to develop and apply AI (machine Learning) to improve weather and climate forecasts; In tern ICPAC will build the capacity of NMHSs

- The collaboration leverages ECMWF's physical modelling expertise, Oxford's AI/physics-based modelling innovations, and ICPAC's regional forecasting mandate to improve anticipatory early-warning systems for extreme weather, enabling more timely and actionable forecasts.

Ensemble mean

Ensemble standard deviation

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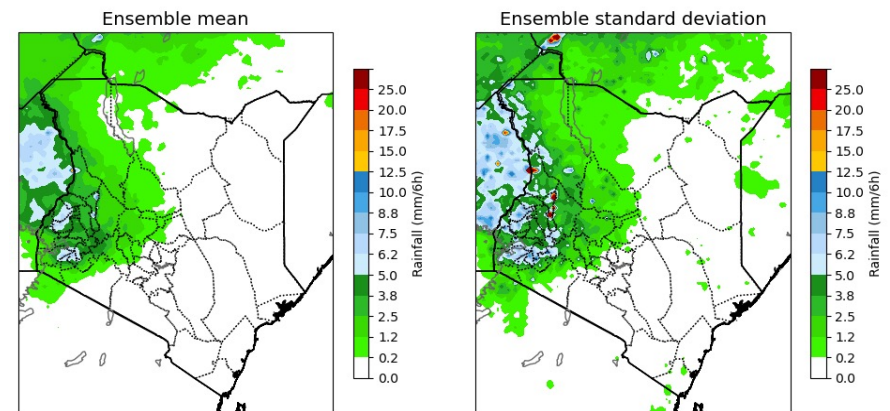
WRF MODEL CUSTOMIZED FOR IBF

- Need for fine-tuning and practical deployment of the WRF model customized for IBF in the domains of agricultural applications (**WRF-Crop**), water resource management (**WRF-Hydro**), and renewable energy systems (**WRF-Solar/Wind**);

  - ➢ WRF-Hydro is installed and operational at ICPAC

  - ➢ Regional daily streamflow forecasts, extending 10 days ahead are now generated, **improving flash flood preparedness**;

  - ➢ Sustainability and additional calibration for various rivers are still required

IGAD CLIMATE PREDICTION AND APPLICATIONS CENTRE
(**ICPAC**)

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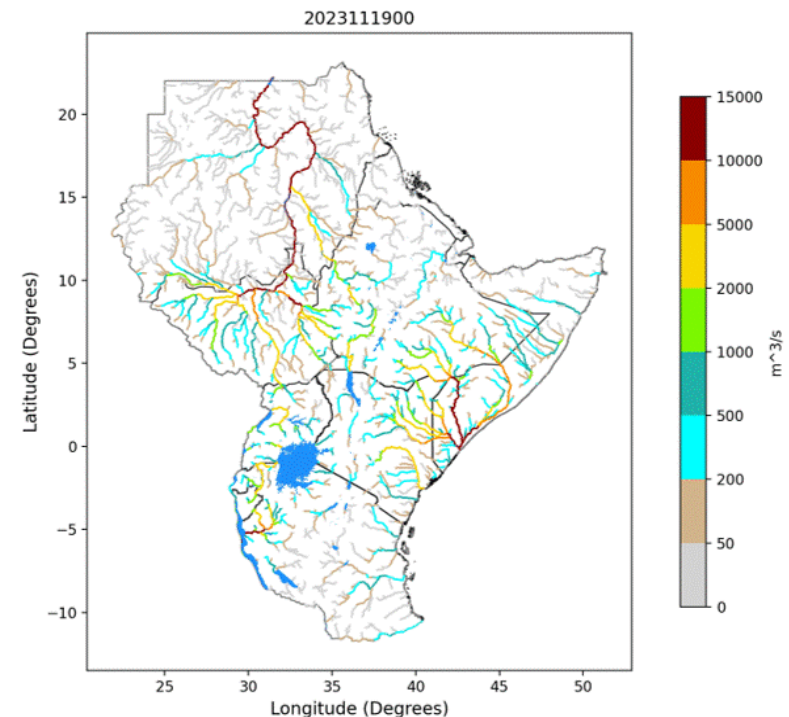
GAPS/CHALLENGES, PRIORITIES AND OPPORTUNITIES

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GAPS AND CHALLENGES

- Limited availability of ground-based observations and uneven spatial coverage

- Limitations in Data Assimilation: embedding satellite, radar, and in-situ observations into forecasting workflows to boost accuracy

- Lack of standardization in data collection and consolidated repository for the impact and socio-economic datasets

- Limited Technical and Institutional Capacity for IBF Implementation

- Inadequate Computing Infrastructure, particularly systems with GPUs to leverage machine learning techniques

IGAD

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ICPAC'S KEY EXPECTATIONS UNDER THE SEWA PROJECT

- Improve access to Copernicus and ECMWF high resolution datasets

- Support the development and strengthening of IbFs combining EO data, climate models outputs, and vulnerability data

- Strengthen ICPAC's capacity in data integration, impact-based forecasting and visualization

- Access to Cloud computing/environment to process IbF and AI/ML

- Enhance collaboration between ICPAC and European partners (particularly the European NMHSs)

- Implementation of ECMWF's Machine Learnning (IFS) Model

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OPPORTUNITIES

- **Leverage Synergies:** Align with ongoing and planned IbF-related initiatives (e.g., Gates Foundation, Climate Action Window, CRAF'd, WISER Kenya) to ensure complementarity and shared learning.

- **Co-design User-Centered Services:** Leverage multi-stakeholder platforms such as GHACOF for co-production, validation, and continuous refinement of tailored, user-driven impact-based services.

- **Integrate Existing Systems:** Incorporate SEWA products into the East Africa Hazards Watch to strengthen real-time monitoring and early warning capabilities.

- **Promote Sustainability and Scaling:** Position SEWA as a catalyst for long-term sustainability, ensuring continuity, institutional ownership, and regional scaling of ICPAC's IBF systems.