



The African Multi-Hazard Early Warning for Early Action System

Lorenzo Alfieri

CIMA Foundation



Ministero degli Affari Esteri
e della Cooperazione Internazionale



Introduction

Goal

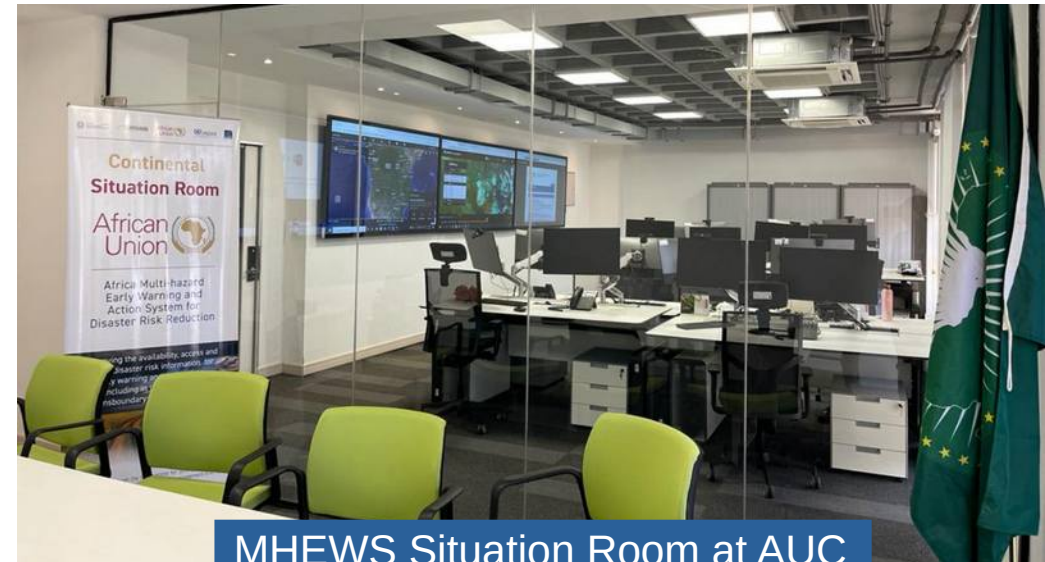
An African Multi-Hazard Early Warning and Action System (AMHEWAS) for Disaster Risk Reduction

Key activities

- Design of legal and institutional framework
- Set up of situation rooms with 24/7 operation and Standard Operating Procedures
- Operational tools for monitoring and forecasting extreme hydro-meteorological events
- Issuing of regular bulletins for hazard monitoring and forecasting
- Capacity building for staff and experts from Member States and RECs



AMHEWAS Conference
Nairobi, October 2021



MHEWS Situation Room at AUC
Addis Ababa, Ethiopia

Impact-based forecasting and warning

A paradigm shift from the traditional concept of “What the weather will be” to the more user-centered “What the weather will do”

Hazard forecast

Based on hydro-meteorological variables and their exceedance of fixed or climatology-based thresholds

Impact-based forecast

Qualitative description of impacts resulting from expected weather extremes

Impact forecast

Detailed quantitative information on the impacts of upcoming disasters

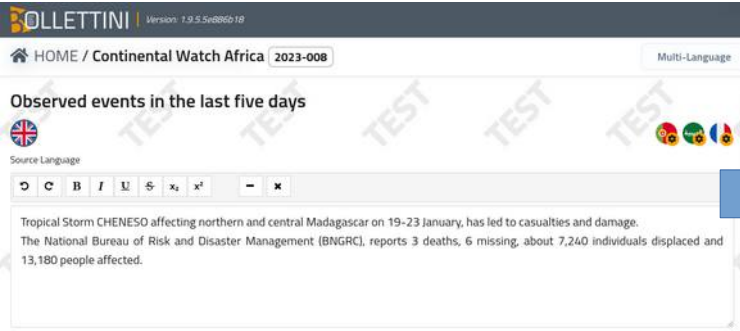
EXAMPLES

“Extreme rainfalls exceeding 100 mm in 24 hours are expected to hit western Cameroon on 21 July”

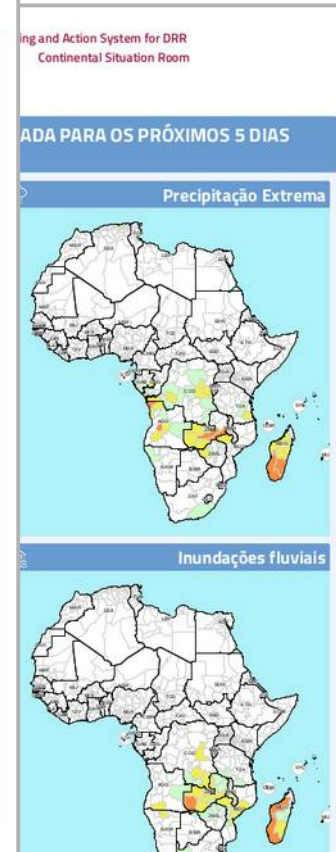
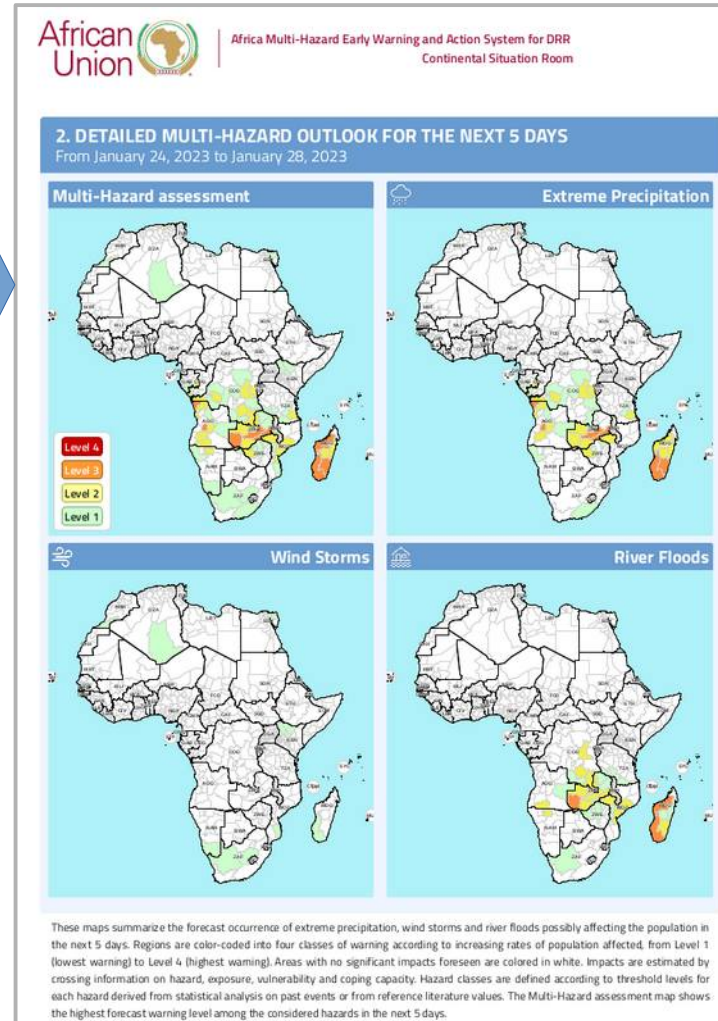
“Warning level 3 due to extreme rainfalls in western Cameroon, which are expected to affect population and disrupt the transport networks on 21 July”

“Extreme rainfalls in western Cameroon on 21 July are expected to affect 40,000 people, 13km of roads and 15,000 hectares of crop land”

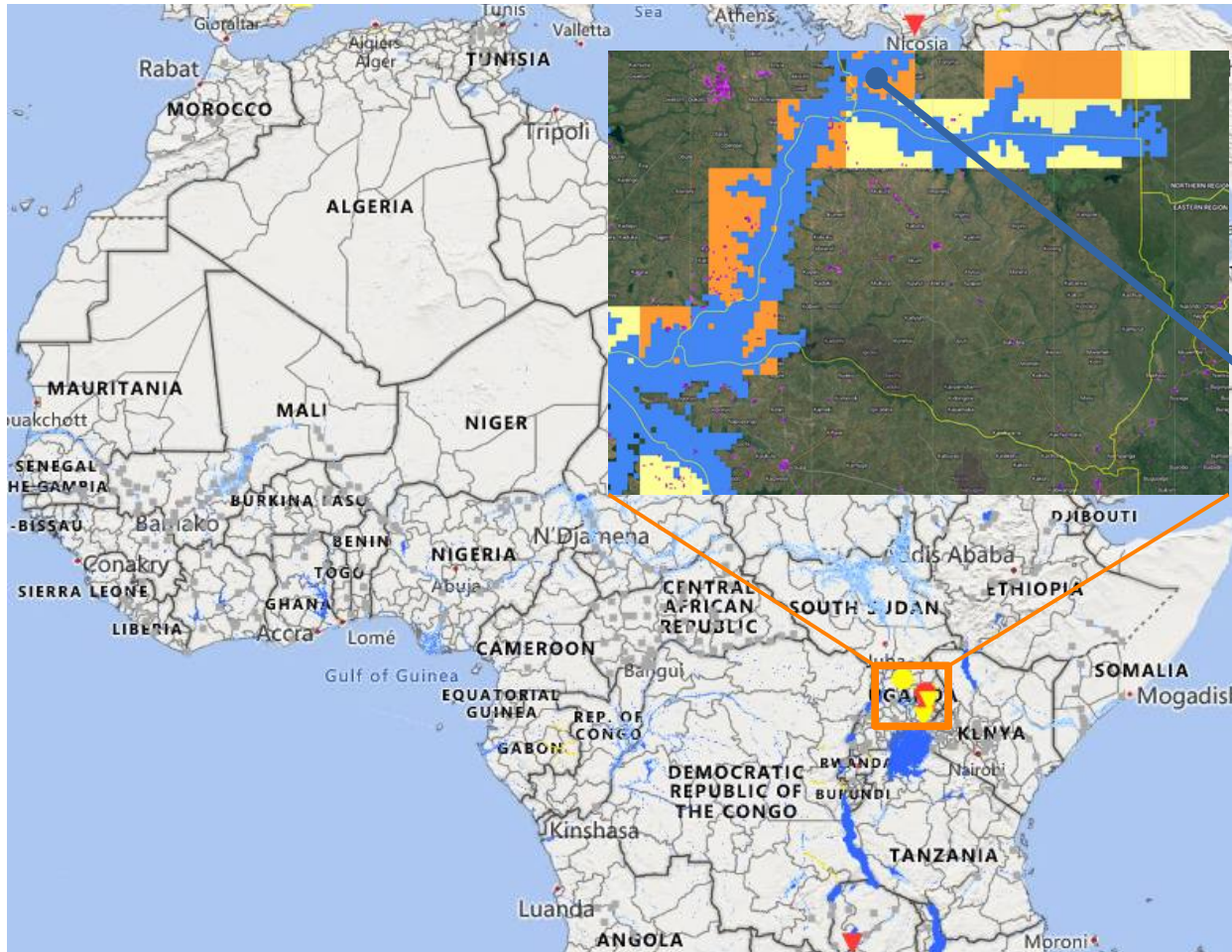
Impact-based warnings in the Continental Watch



- CW with 5-day multi-hazard outlook issued every Tuesday and Wednesday
- Produced in 4 languages (EN, FR, PT, AR) through automated translation and manual check (+ editing option)

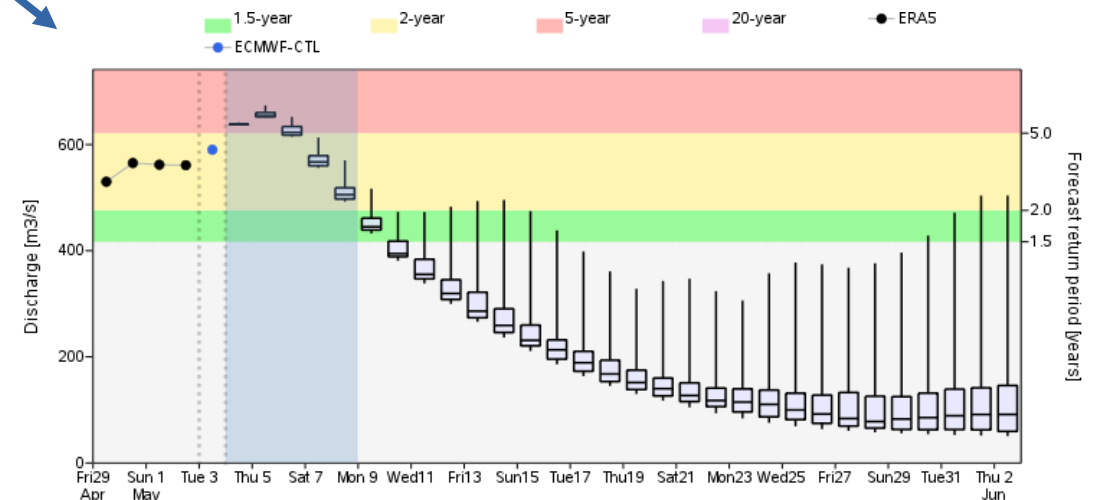


River floods



GloFAS forecasts 2022-05-04

- Forced by **ECMWF weather forecasts**
- GloFAS discharge threshold exceedance for return periods **between 2 and 500 years** ($0.1^\circ \sim 11 \text{ km}$ grid)
- **5-day forecast horizon**, mean of 51 ensemble members



5-day forecast

Flood-PROOFS East Africa

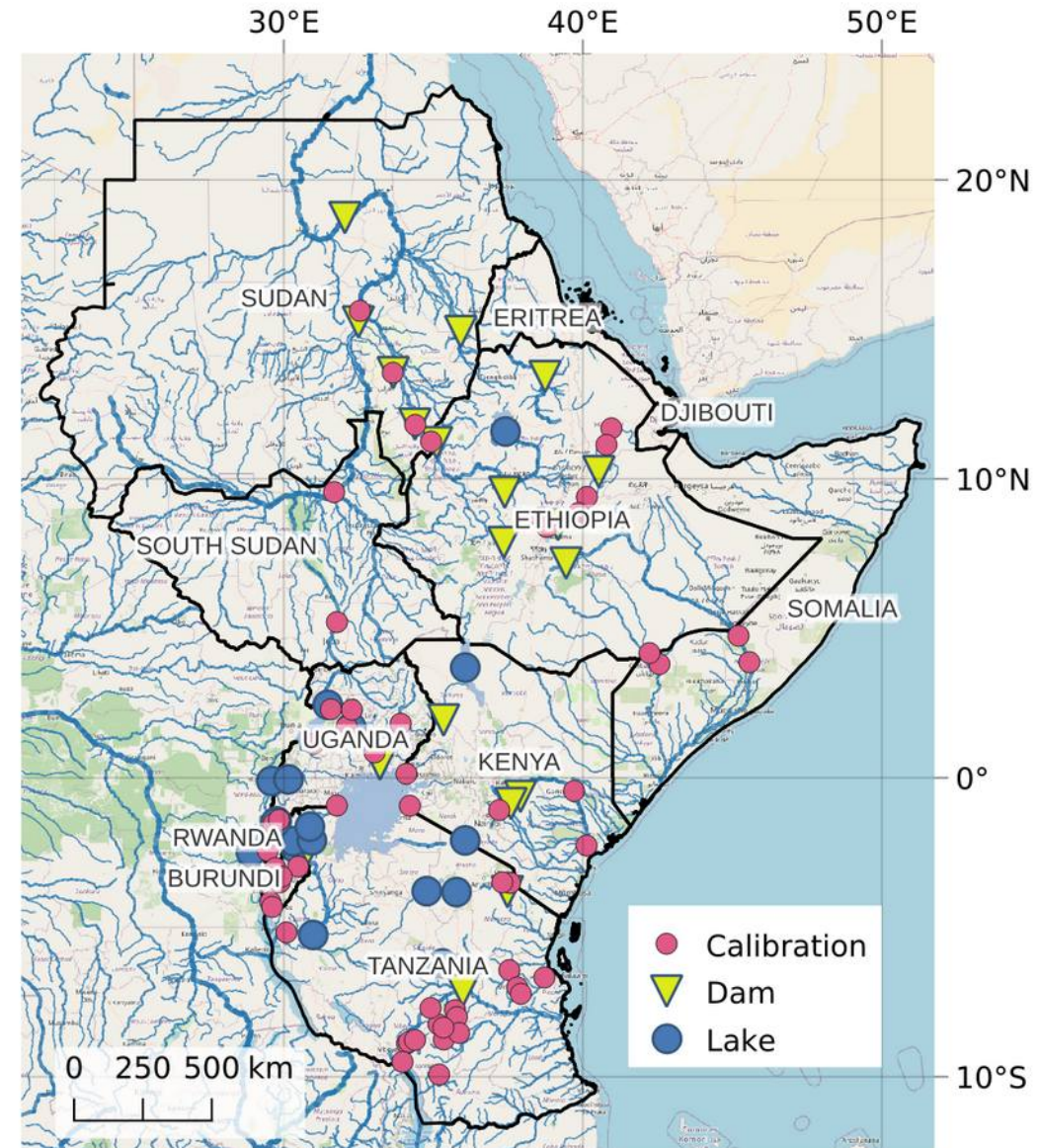
Flood-PROOFS East Africa is an impact-based riverine flood forecasting system for the Greater Horn of Africa (GHA)

Modeling steps:

1. Distributed hydrological modeling with the **Continuum** model
2. Threshold exceedance analysis based on a coherent long term hydrological reanalysis
3. Link to inundation mapping (**from JRC / GloFAS**)
4. Risk assessment framework applied to 5-day hydrological forecasts and 6 exposure layers + flood warning levels for AMHEWAS



Alfieri et al., NHESS (2024)

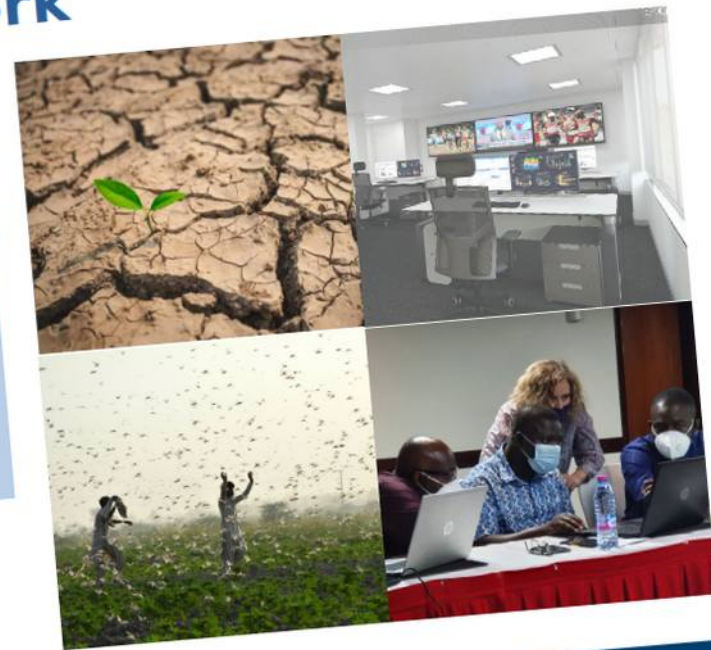




1 year ago...

Ongoing and future work

- Inclusion of additional hazards (drought, ...)
- Model and forecast evaluation
- Multi-model and ensemble forecasts
- Training of trainers and of Member states/RECs
- Set-up of situation rooms in other RECs
- Transfer system operation to African partners



www.cimafoundation.org

www.cimafoundation.org

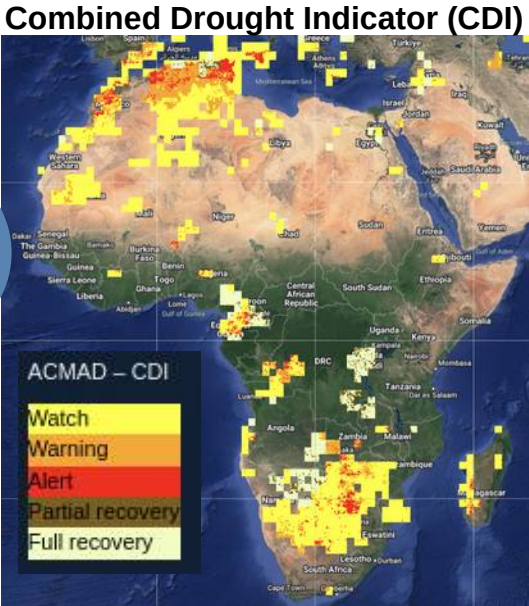
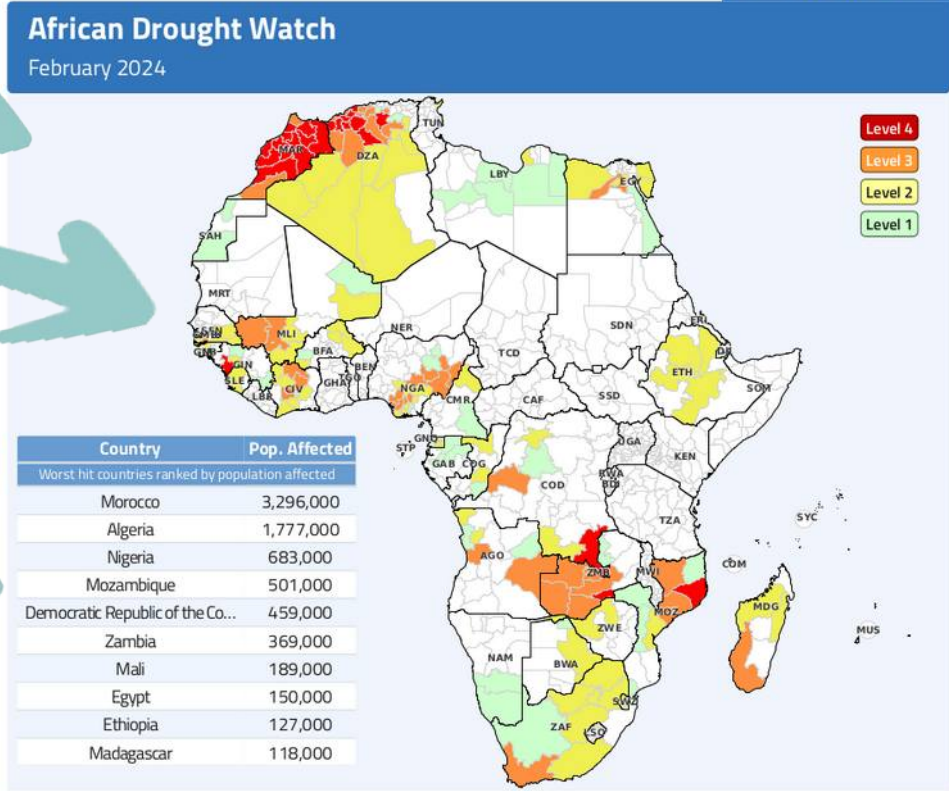
The African Drought Watch

The African Drought Watch is an **impact-based** continental drought bulletin, soon to be issued **every month** by **AUC** to its Member States and AMHEWAS partners



Africa Multi-Hazard Early Warning and Action System for DRR
Continental Situation Room

Issue no. 2024-010



Hazard

Coping Capacity

INFORM Risk Index
Disaster Risk Management Knowledge Centre

GHS Population density
Population
Exposure

Vulnerability curves for drought

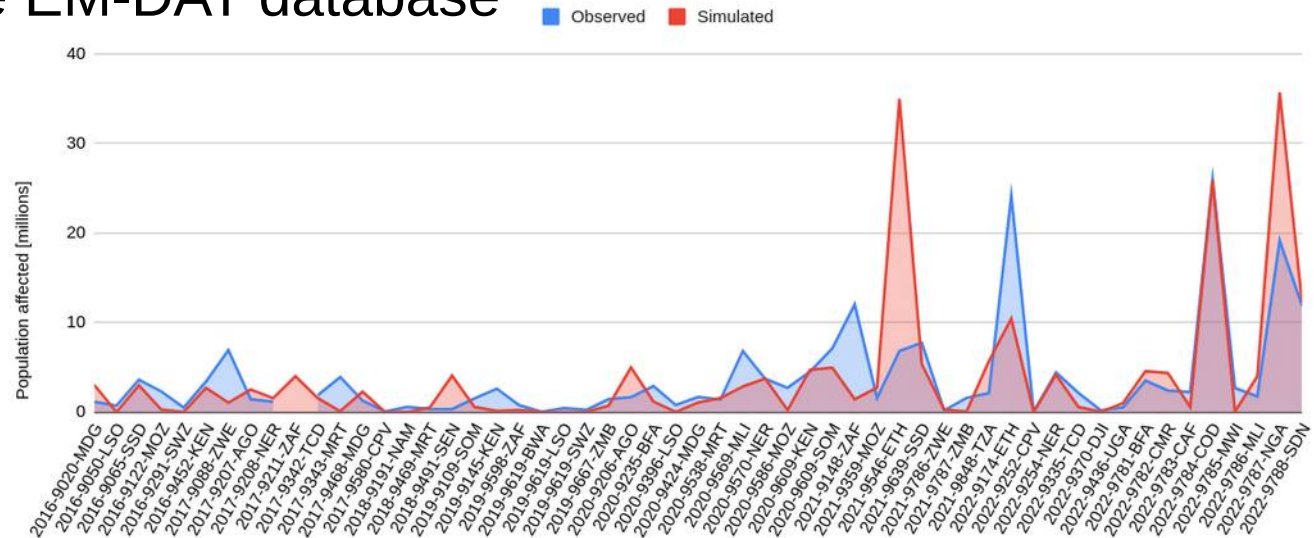
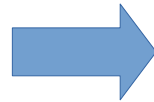
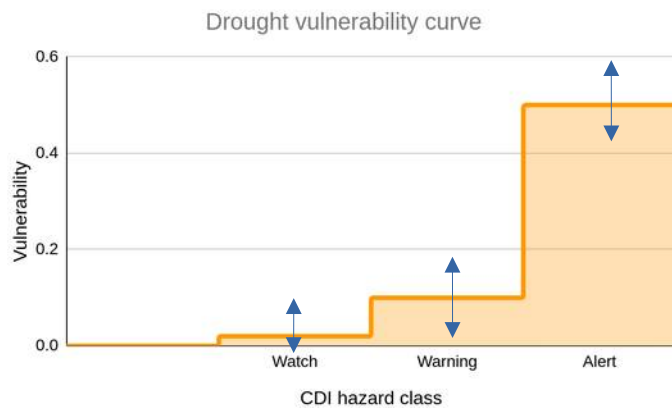
By defining the Exposed population (Ep_i) in each hazard class i as the product

$$Ep_i = H_i * Pop_i * LCC$$

we can then write:

$$OI = V_1 * Ep_1 + V_2 * Ep_2 + V_3 * Ep_3$$

Vulnerability curves were calibrated by matching simulated drought impacts with observed data taken from 55 droughts recorded in Africa from 2016 to 2022 and with affected population available in the EM-DAT database



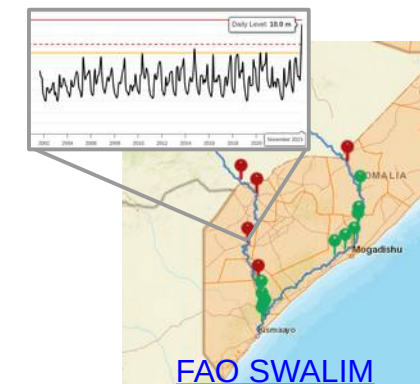
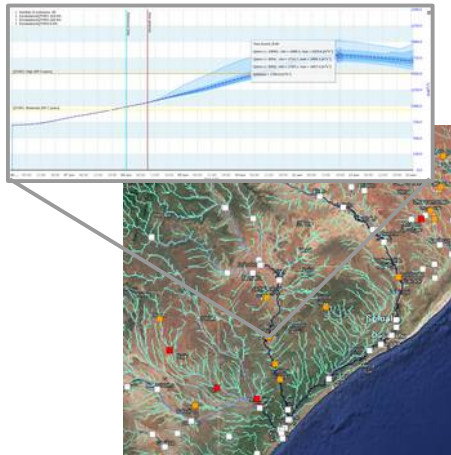
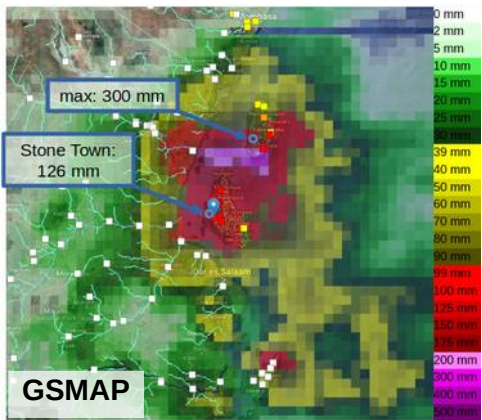
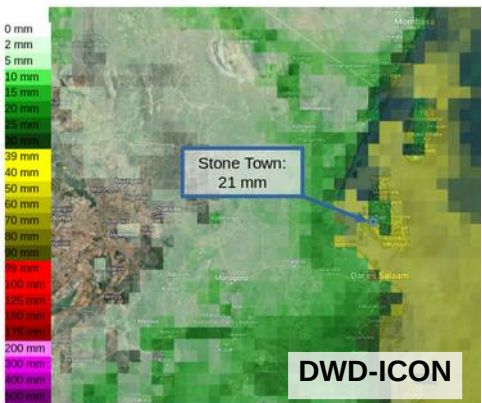
Forecast evaluation of FloodPROOFS East Africa

CON: Scarcity of observed data for evaluation

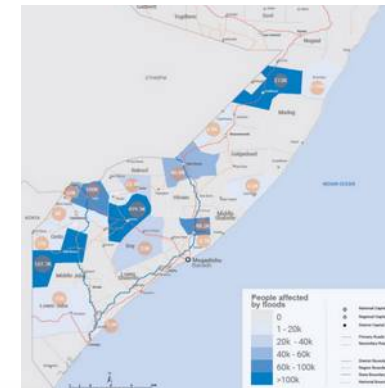
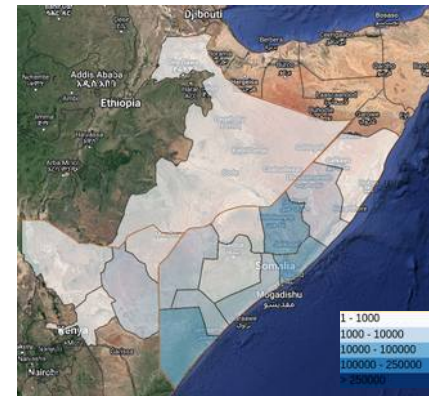
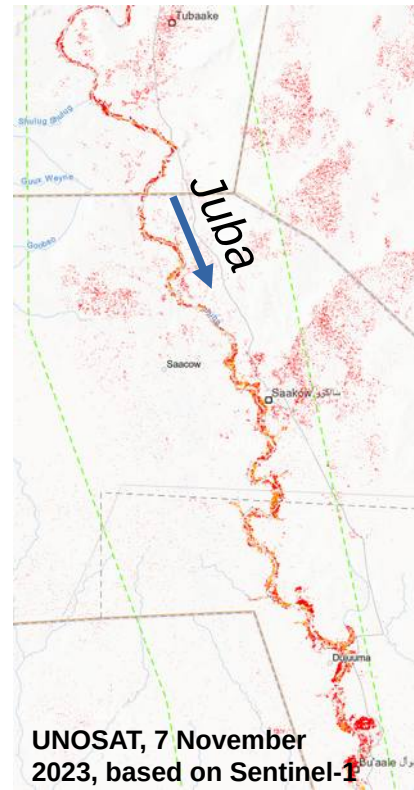
PRO: Evaluation at different steps of the modelling chain

Event-based evaluation

Zanzibar 4-5 November 2023

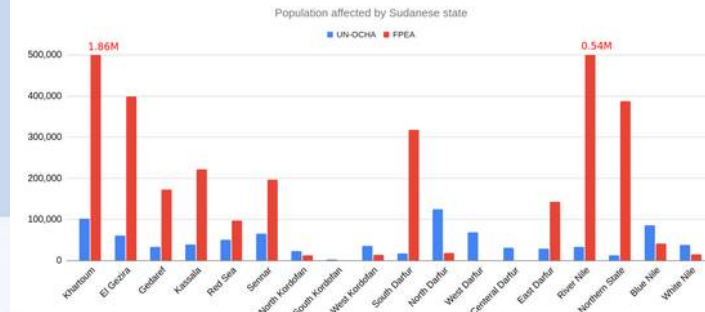
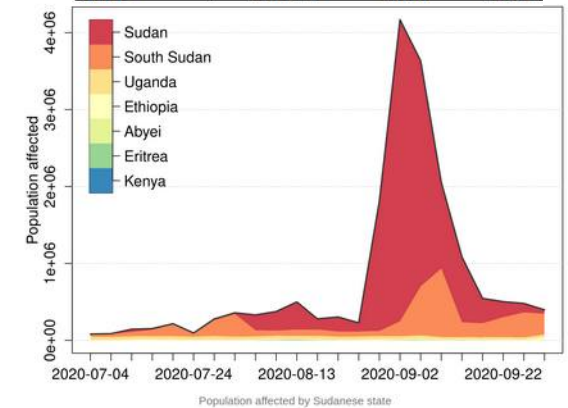


Somalia November 2023

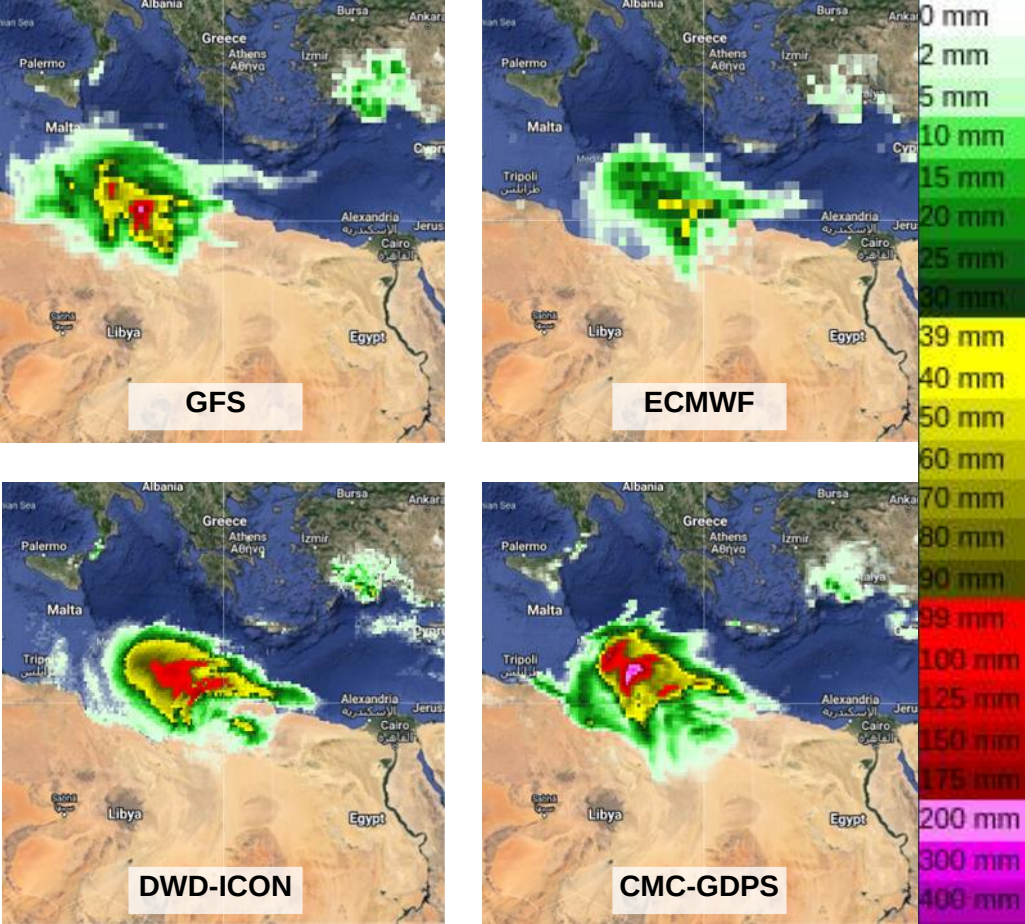


Nile floods 2020

	Population Affected [1,000]		
	EMDAT	FPEA	GloFAS
Sudan	875	3920	39.7
South Sudan	1042	891	184
Uganda	8.7	49	0
Total	1925.7	4860	223.7

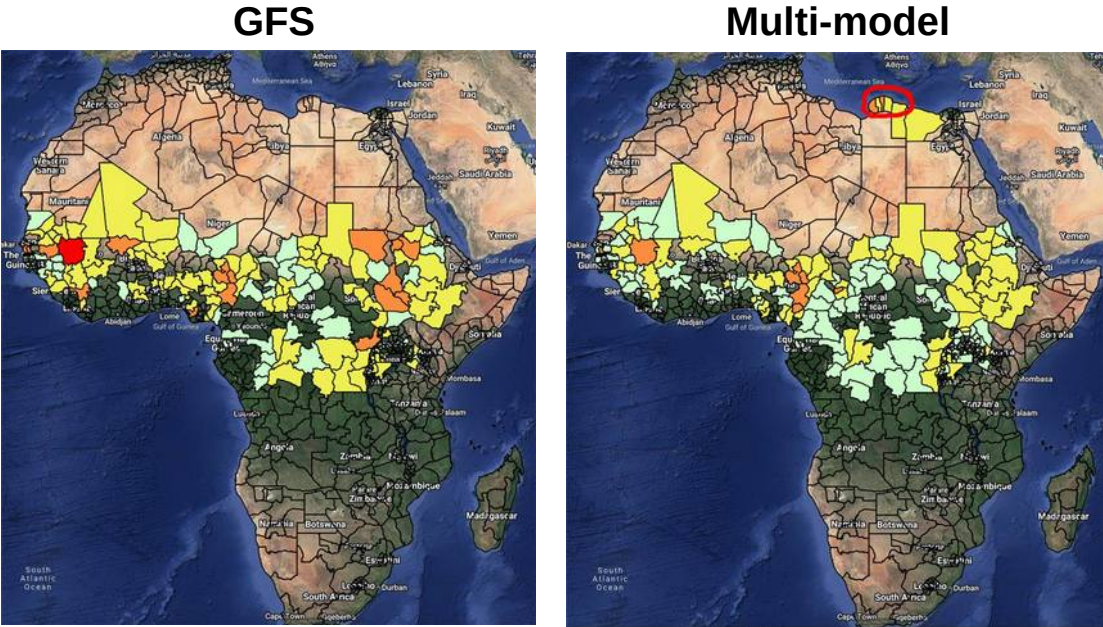


Multi-model forecasts



NWP Forecast 8 September 2023 over NE Libya
48h precipitation ending on 11 Sep 2023 12 UTC

Multi-model impact based classification of warning levels
 Model weights assigned based on expert evaluation at ACMAD
 More robust evaluation of affected areas and reduction of single-model outliers



IBF Forecast 8 September 2023

Situation rooms and training activities

- ✓ 2 Continental Situation Rooms
- ✓ 4 Regional Situation Rooms
- ✓ Country level Situation Rooms planned in Tanzania, Namibia and Ethiopia
- ✓ Training courses on AMHEWAS products already delivered to representatives of 37 AUC Member states in 5 RECs
- ✓ 1 Training of trainer course
- ✓ E-learning platform for online courses



Conclusions

CEMS products are state of the art components, feeding the AMHEWAS workflow at different steps and enabling effective multi-hazard impact-based monitoring and forecasting for the well-being of ~1.5 billion people

✓ **CEMS / JRC products used in AMHEWAS:**

- ✓ GloFAS 5-day discharge forecasts
 - ✓ Global flood hazard maps
 - ✓ GHS Population density
 - ✓ GDO drought monitoring and forecasting data
 - ✓ INFORM Risk Index
- } Soon updated with GloFAS v4

Thank you!



info@cimafoundation.org

www.cimafoundation.org