Enabling Decision Support Services in Health
A NOAA Initiative on Climate and Health for Africa

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Outline

- Background CPC International Desks
- Climate and Health for Africa
    - Heat – Health Project
        - Strategy for Heat – Health Early Warning
        - Heat Wave Forecast Strategy and Verifications
        - Experimental Heat – Health Early Warning
        - Gaps, Next Steps, and Discussion

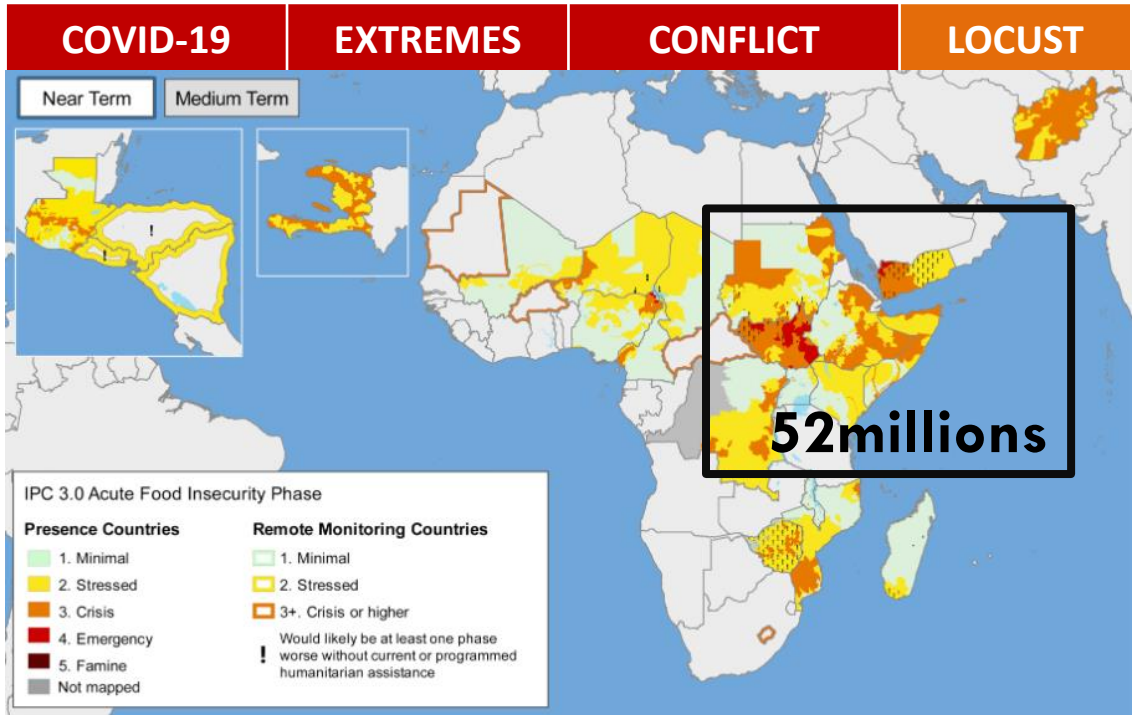
Background CPC International Desks

- Provide access to real time global and regionalized weather and climate forecasts for the world
- To Support the USG humanitarian mission oversea, primarily USAID, DOS, DOD, USDA
  - Food security
  - Natural disasters
- Collaborate with U.N FAO and WFP to provide information tailored to reducing hunger
- Work with WMO to develop the capacity of NMHSs and to enable early warning

Background CPC International Desks

Decision Support Services – Food Security

- USAID monitors food security in the developing world very closely
- Need for timely weather information to mount a response to food insecurity
- Requirement for food assistance in 2019: 28 Billion dollars. USAID spent 6 Billion dollars
- Hazards outlooks are primary input to FEWS NET food security outlooks



Drought, economic shocks, continued conflict, and the indirect impacts of COVID-19 drive high assistance needs. A risk of Famine persists in South Sudan, Yemen, and northeast Nigeria.

Across 46 countries, **113 million** people require emergency food assistance in 2020, **25% more** than peak needs prior to the anticipated impacts of COVID-19.

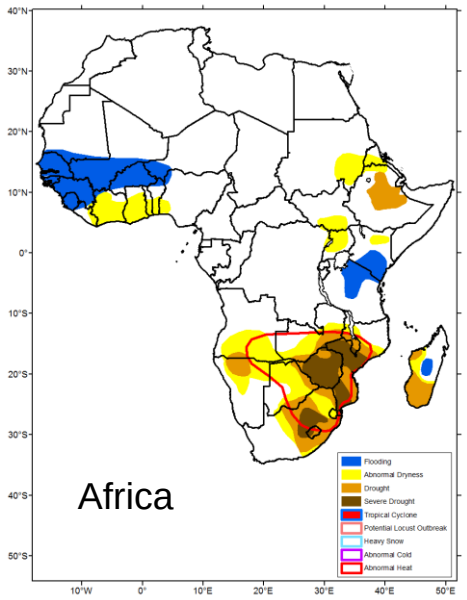
Source: FEWS NET

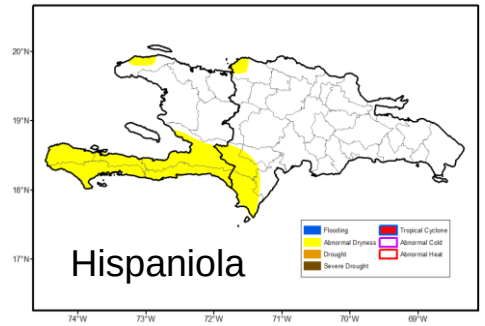
USAID funds CPC about $1M/year in support of famine early warning, to prevent hunger, malnutrition, and to reduce disaster.

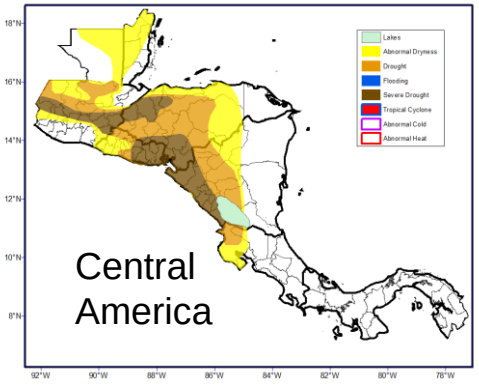
Background CPC International Desks

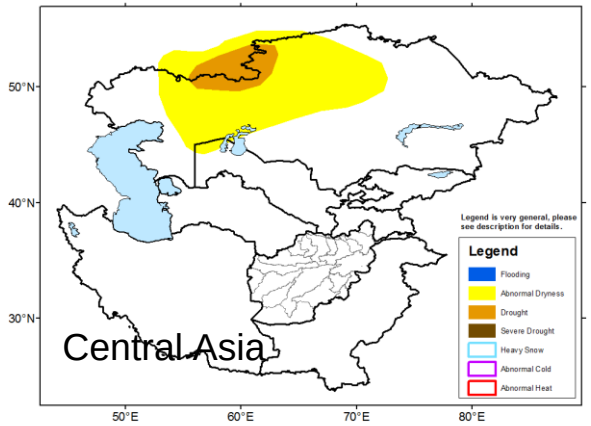
Hazards Outlooks for Food Security

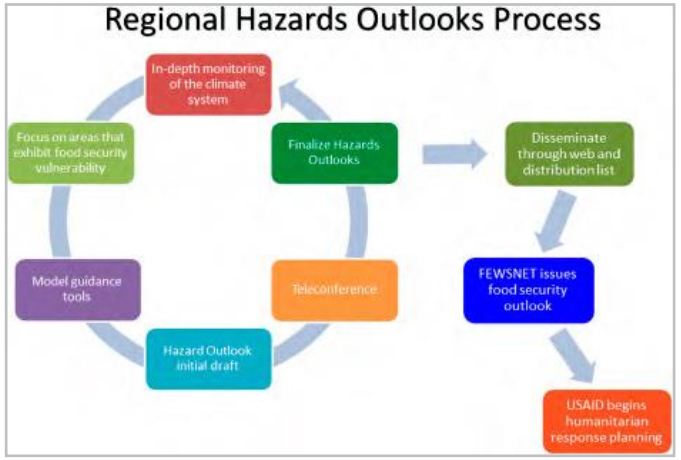
Integrating weather, climate, and land information to inform humanitarian response planning.











Hazards outlooks are based on the long term monitoring of the climate system and forecasts to gain knowledge of the current state of the climate and evolution in the near future from one week to a month or season

Climate and Health for Africa

Background

- CPC work on climate and health started in 2004 – NOAA OHHI, Congress Appropriation, $18M
- CPC effort extended in 2010: climate and cholera
- WHO established ClimHealth Africa with NOAA one of the founding institutions
- NWS funded CPC to conduct two scoping workshops in Africa and to initiate a climate and health activity
  - Goal: To contribute to climate-based early warning systems for public health
  - Recommendations
    - Deliver training for the health sector
    - Provide real time weather and climate information to enable decision making in health
    - Focus Areas: heat-health and infectious disease

Observing mosquito larvae in a pond in Niger

- Malaria ranks 3rd among major infectious disease threats in Africa
- About 90% of all malaria deaths in the world occur in Africa
- 300-500 million cases: 1-3 million deaths each year (90% children under 5 years old)

NWS – OLR SLA Climate and Health Milestone for Africa

Heat-Health	Infectious Diseases
• Sarah Diouf • Endalkachew Bekele • Murali Malasala • Ibrahima Diouf • Peitao Peng • Met Service Senegal • Ministry of Health of Senegal • Other international institutions	• Ibrahima Diouf • Pierre-Honore Kamsu-Tamo • Assaf Anyamba, NASA (IRAP) • Met Service of Senegal • Ministry of Health of Senegal • University of Liverpool • International Center for Theoretical Physics and other institutions

Heat Waves Facts

- Heat waves frequency and intensity have been increasing globally. Over the past decade, the world's attention has focused on record breaking heat and associated health outcomes

- The five warmest years on record occurred over the past five years (2015 – 2019), with the record set in 2016, and 2019 ranked a close 2nd according to NOAA and NASA

- Africa is one of the regions most affected by heat waves due to population increase and poor infrastructure. More than 500 people died of heat waves in Niger (Central Sahel) in 2010 due to heat waves

Enabling Heat Health Early Warning

NOAA – Ministry of Health and ANACIM Senegal Workshop on Heat Waves and Impact on Health, Dakar, Senegal, Dec 2019

At AMS 100, PR of Senegal with WMO briefed PR of the U.S. with WMO on workshop outcomes and recommendations
Further discussions with PR of Tanzania followed to work the same effort in Tanzania

Participants from the health community in the Sahel: Burkina Faso, Mali, Niger, and Senegal, during a break out group, working on a strategy for preparing a health impact risk map and a bulletin for heat – health early warning.

Enabling Heat Health Early Warning

Aggravating Factors

- Access to information
- Access to water and power
- Access to health centers
- Type of activity
- Population density
- Habitat
- Health conditions

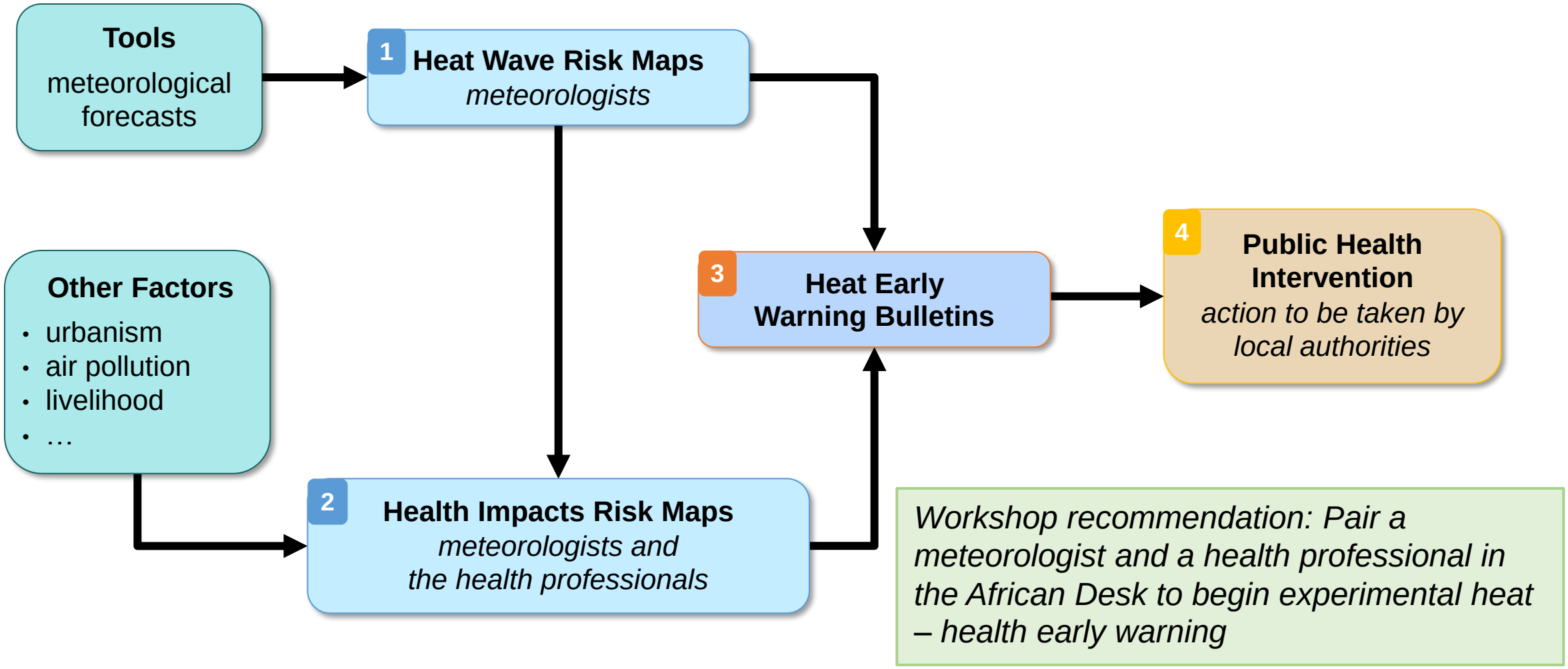
Enabling Heat Health Early Warning

Heat Alert Code

Alert Code	Alert	Health Risks
	Extremely dangerous: Heat Strokes	Aggravation of cardiovascular diseases
	Dangerous: Heat Strokes	Fatigue, severe dehydration, fainting, cramps
	Very Uncomfortable: Care Required	Dehydration, confusion, headache, dizziness
	Watch	Negligible

Enabling Heat Health Early Warning

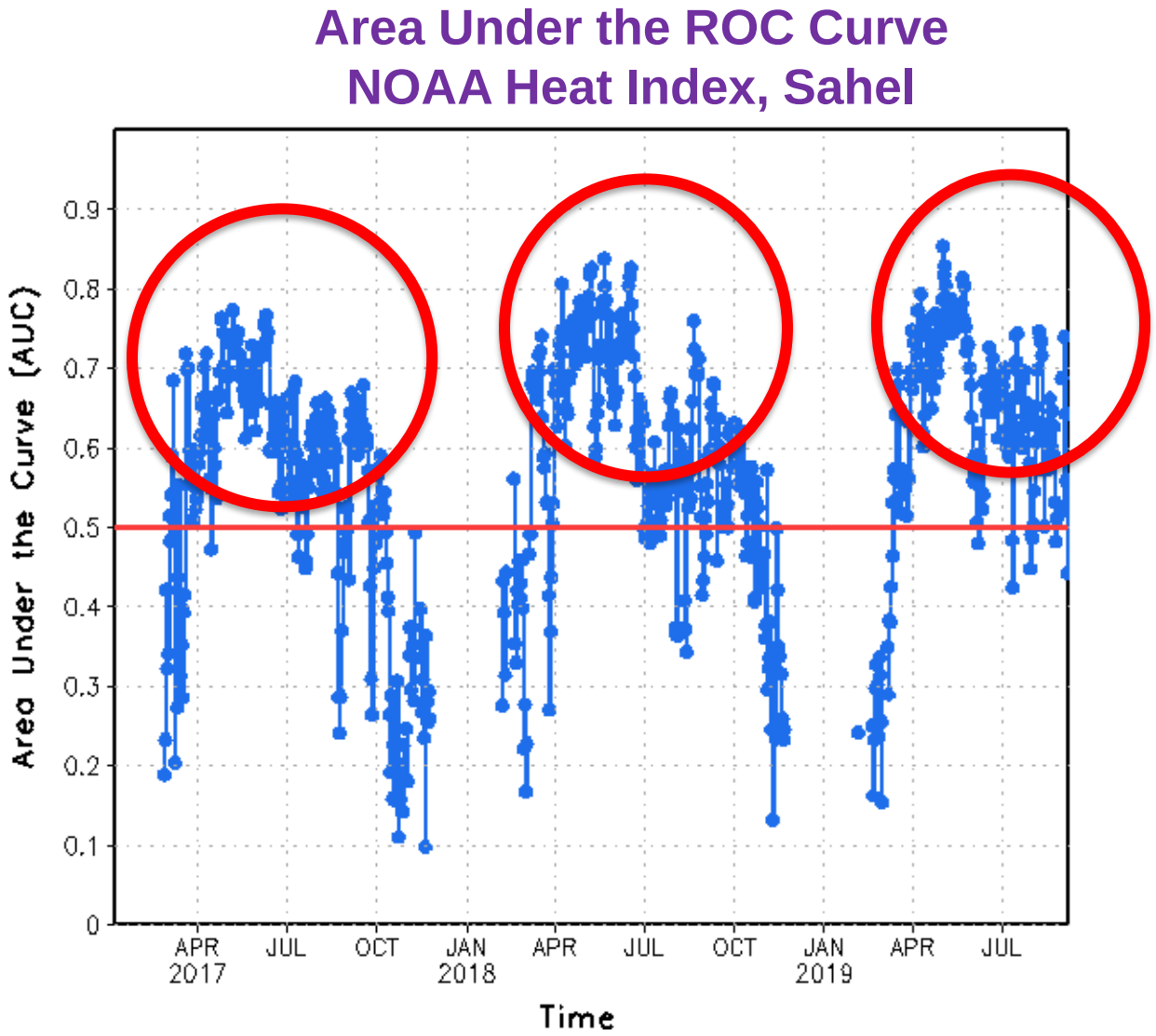
Strategy for enabling Heat – Health Early Warning



Heat Wave Forecasts Strategy

- **Heat Wave Definition:**
  - Heat index values exceeding X_t°C for at least 3 consecutive days
  - Tmax or Tmax and Tmin > n^{th} percentile for 3 consecutive days
- **Models:** NCEP GEFS, CFSv2, NAEFS
- **Verification Data and Period:**
  - GDAS for Heat Index
  - GHCN-CAMS for Tmax and Tmin
  - Verification Period: 2017-2019

NCEP GEFS Performance – Week-2 Heat Index

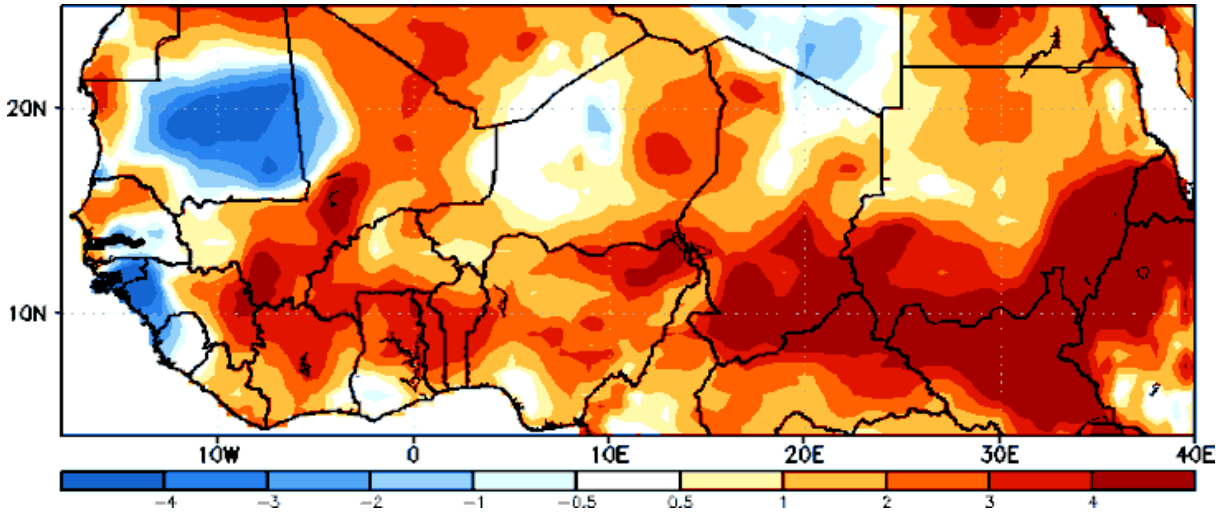


Scores above the 0.5 red horizontal line indicates good performance of the NCEP GFS to predict heat waves at week-2

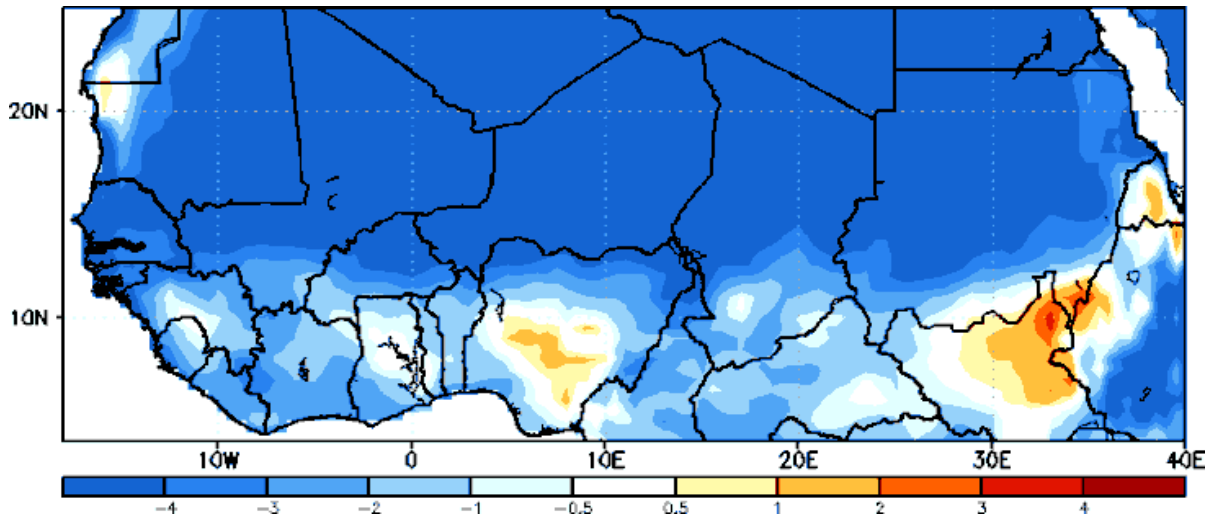
Biases in GEFS week-2 Tmin and Tmax forecasts

Differences between observations and GEFS week-2 Tmin and Tmax forecasts

Tmin



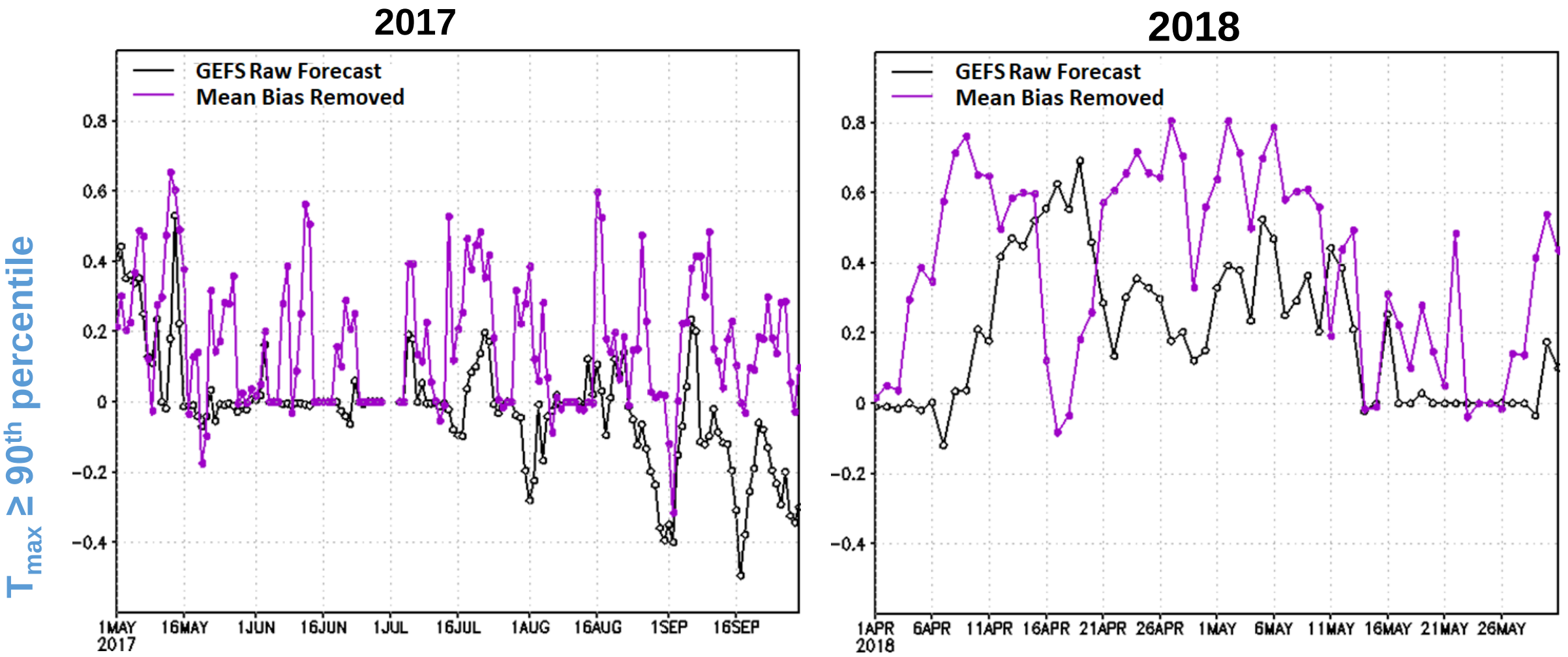
Tmax



Positive bias in Tmin forecasts and negative bias in Tmax forecasts

GEFS Forecast Performance – Week-2 Tmax

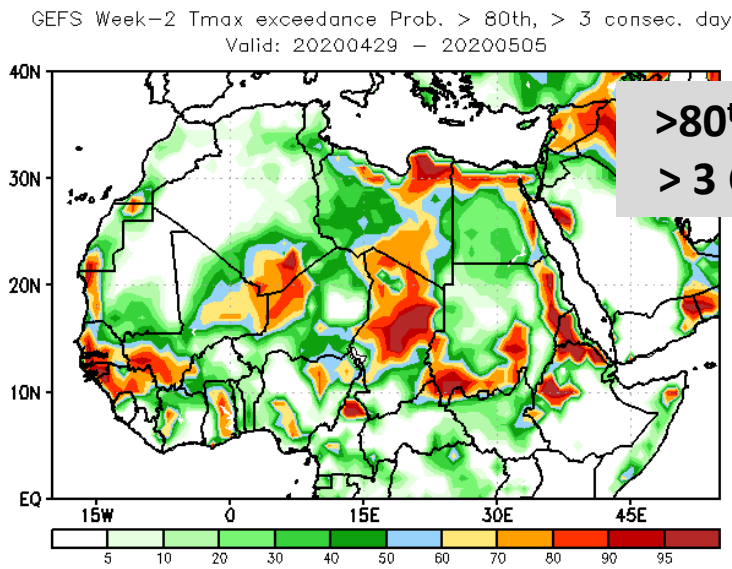
HSS Tmax > 90th Percentile



GEFS Heatwave Forecast Tools for Week 2, Valid 29 April – 5 May 2020

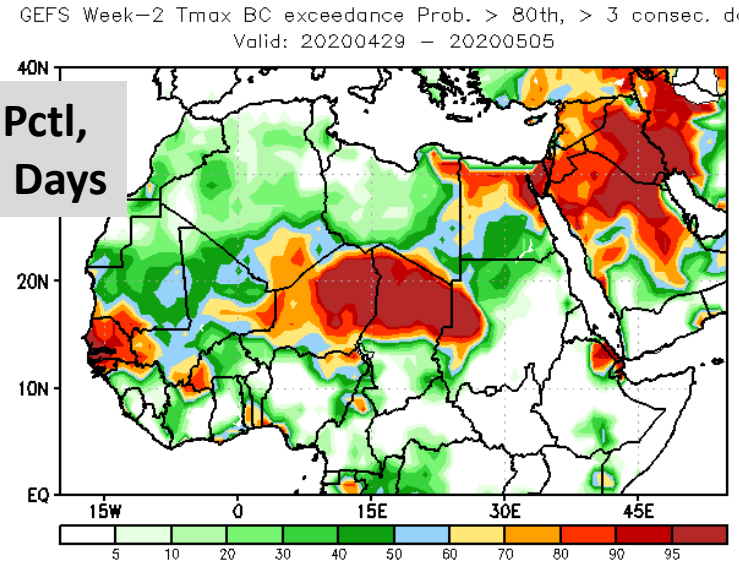
GEFS Raw and BC Tmax Probability Forecasts

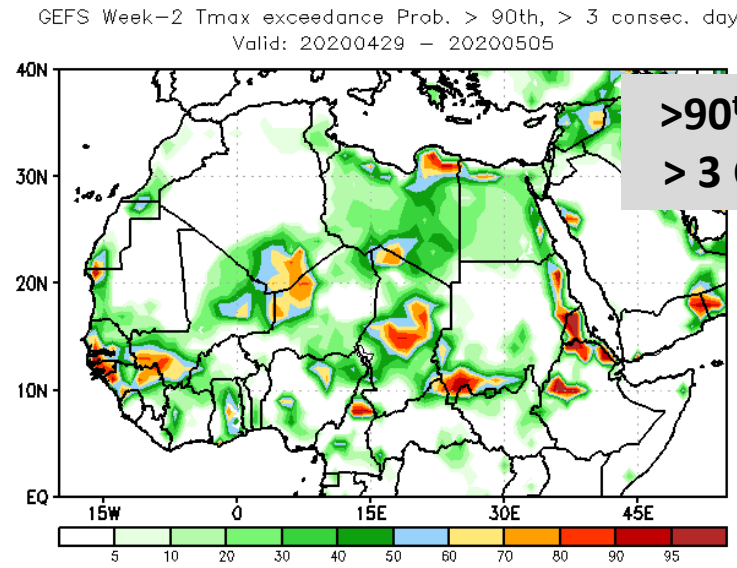
Raw Forecast



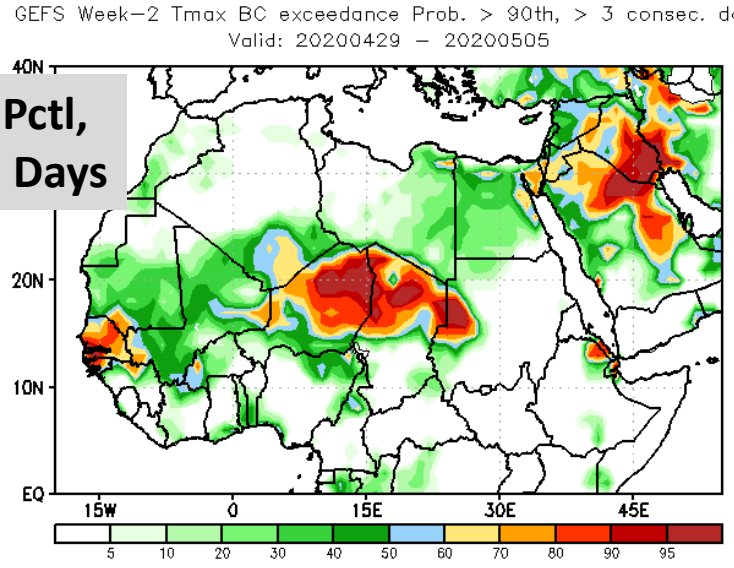
>80th Pctl, > 3 C. Days

Bias Corrected Forecast



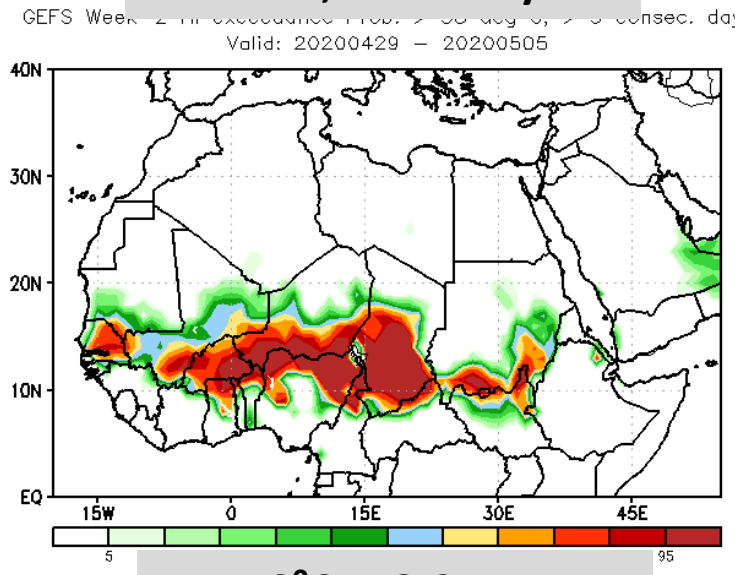


>90th Pctl, > 3 C. Days

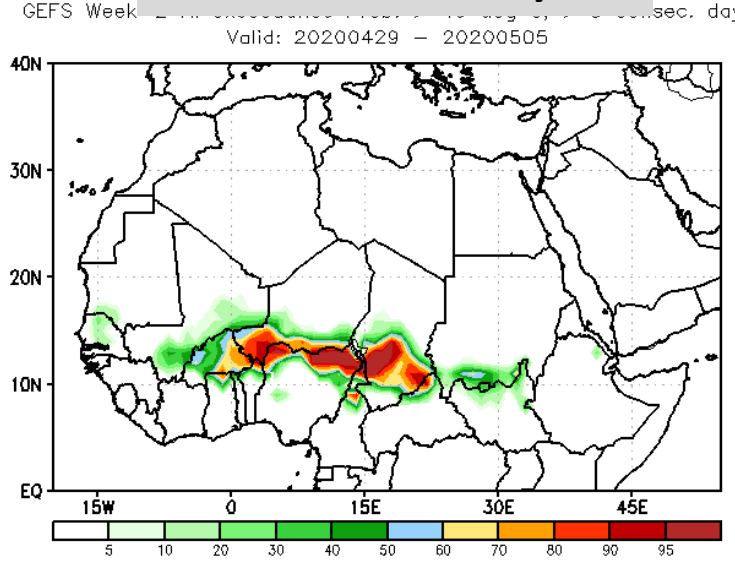


GEFS HI Probability Forecasts

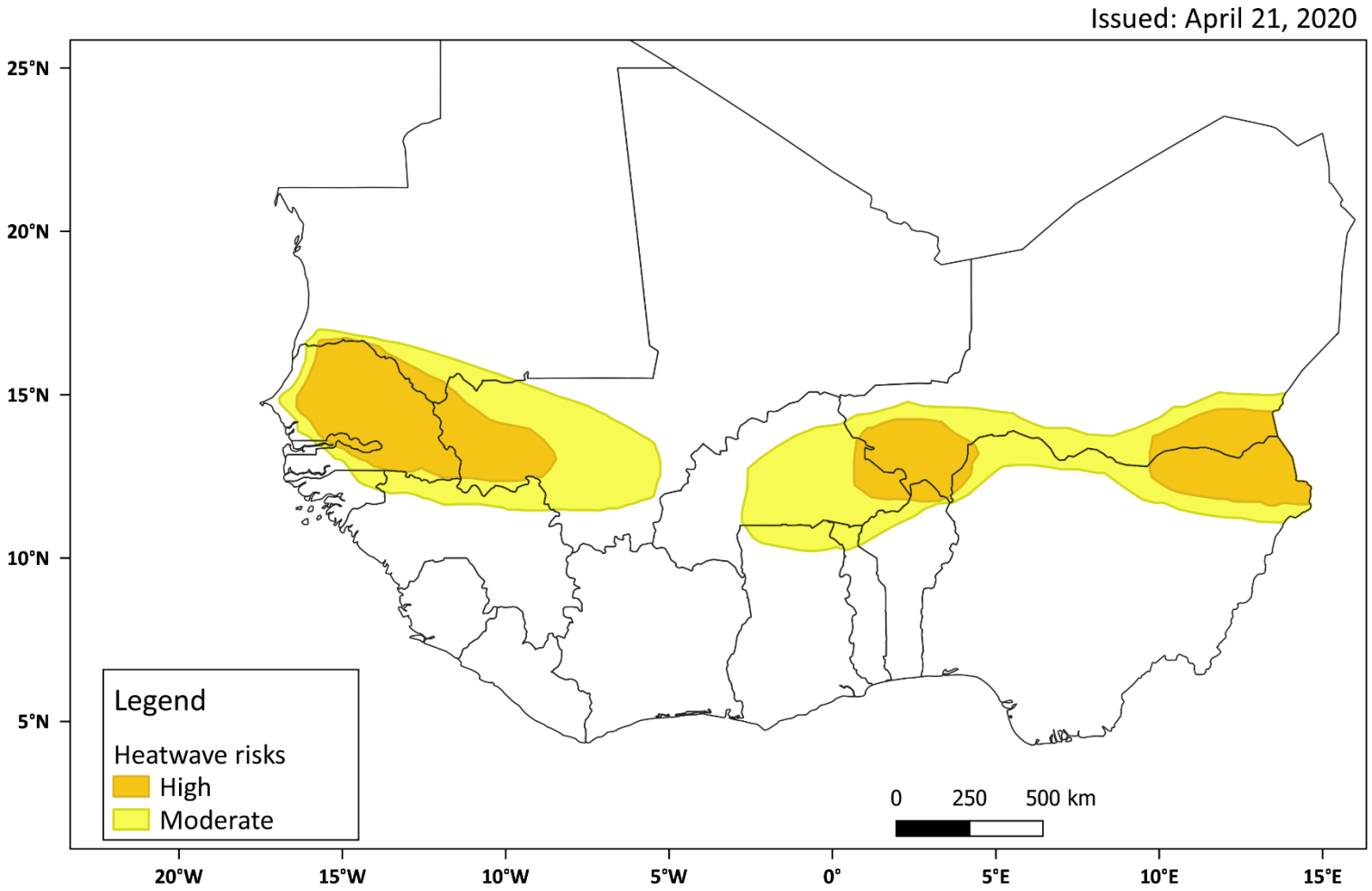
>38^{0}C, > 3 C. Days



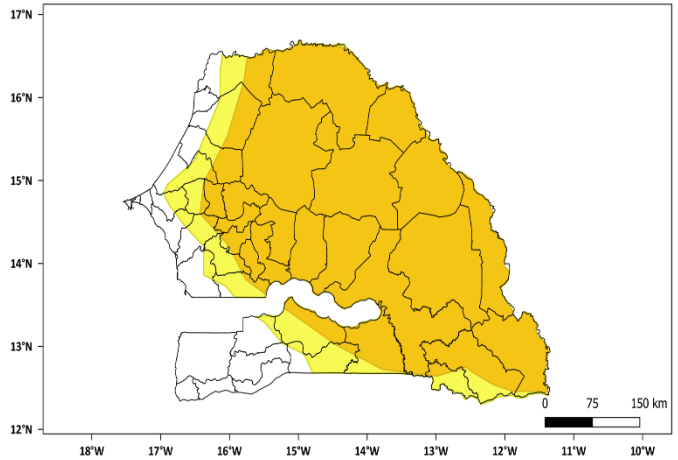
>40^{0}C, > 3 C. Days



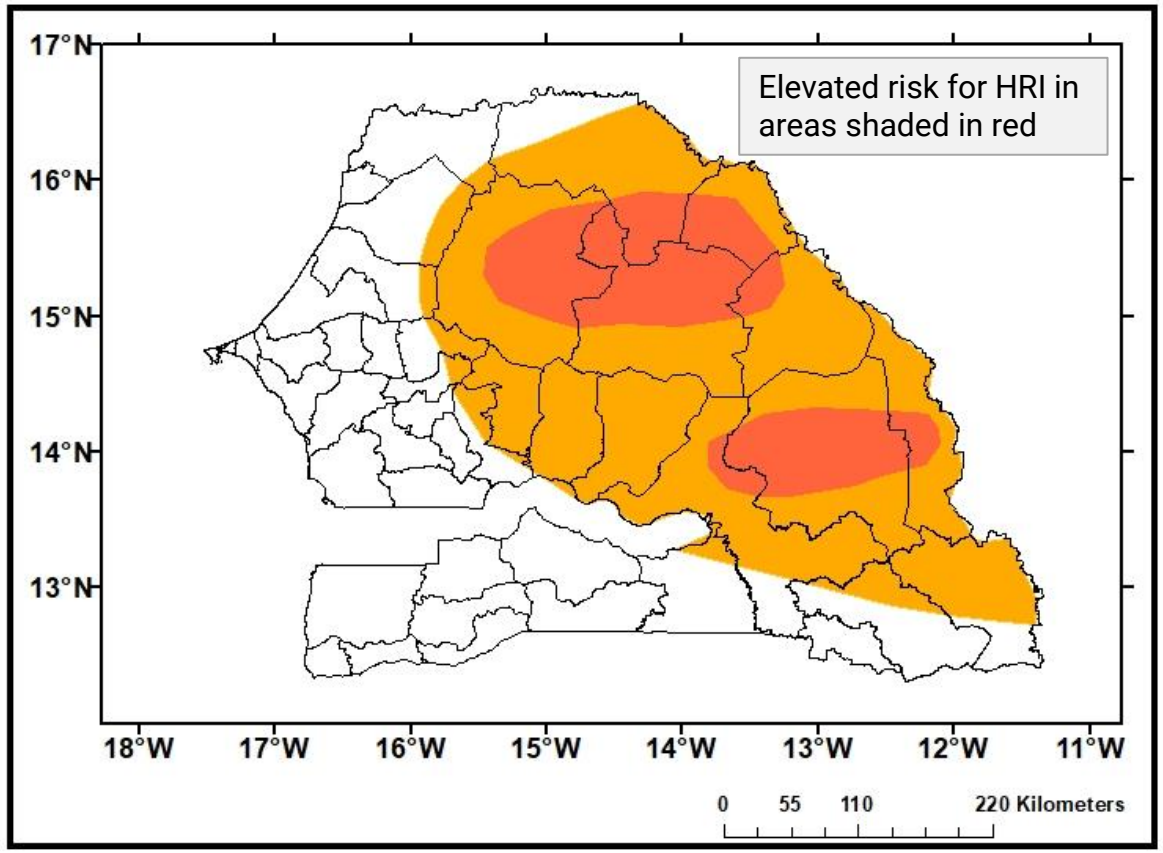
Week-2 HW Forecasts, 29 April – 5 May 2020



Zoom into Senegal



Experimental Heat – Early Warning



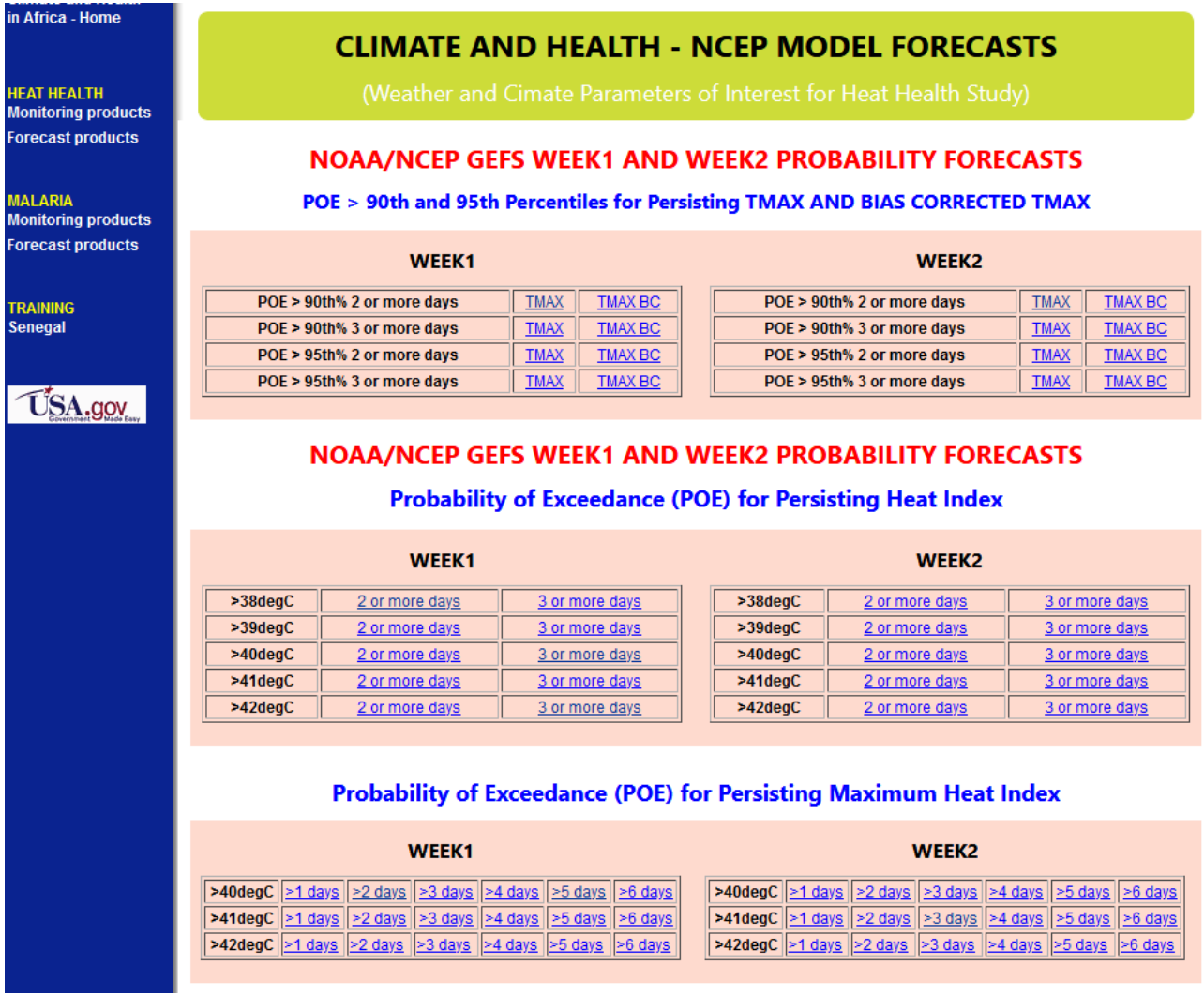
- Produced by trainees Met and health
- Updated twice a week Tuesdays and Fridays
- Heat health risk out to two weeks
- Description of potential illnesses
- Actions to take to mitigate impacts of heat

Alert Code	Alert	Health Risks
	Extremely dangerous: Heat Strokes	Aggravation of cardiovascular diseases
	Dangerous: Heat Strokes	Fatigue, severe dehydration, fainting, cramps
	Very Uncomfortable: Care Required	Dehydration, confusion, headache, dizziness
	Watch	Negligible

Summary Heat Waves Forecasts

- Week-2 heat waves over the Sahel are quite predictable.
- Predictability higher for the HI than Tmax and Tmin.
- The mean bias correction method improves skill better than the EMC hybrid method
- The CMCE improves skill over the GEFS raw and bias corrected forecasts. Gives advantage to the use of NAEFS

Heat Forecasting – R2O



https://www.cpc.ncep.noaa.gov/products/international/climatehealth/heat-health_forecasts.shtml

- Website designed to provide met Services with tools for week-1 and week-2 forecasts of heat waves
- Fostering collaboration between meteorologists and health professionals to assess health impacts and enable heat – health early warning

Health environmentalist and meteorologist working at the International Desks, March 2020

Heat – Health Next Steps

- Follow up with the Senegal Met Service and Ministry of Health
- MoH, ANACIM, and CPCID to meet for a debrief on heat – health training
- Trainees to present their work and accomplishments while in training
- Meteorologist trainee to train forecasters at the Senegal Met Service on heat wave forecasting tools
- Health Environmentalist trainee to work with health districts in Senegal to validate the heat – health impacts forecasts
- Resume heat wave forecasts in the fall and involve the health sector early on to prepare for the heat season of 2021
- Organize a workshop to evaluate the heat – health project

Heat – Health Next Steps

- Continue to engage the health sector – Resume work with Tanzania
- Interest in expanding the heat wave project to other regions
  - North Africa (Egyptian Meteorological Authority)
  - Caribbean (Caribbean Institute of Meteorology and Hydrology)
  - Latin America (Pan American Health Organization) – Also COVID-19
  - South Asia (Indian Institute of Tropical Meteorology)
- Need to test other definitions of heat waves:
  - Heat duration: Tmax and Tmin above a threshold T
  - Heat severity
- Challenges
  - Human resource
  - Keeping the health sector engaged

Heat – Health Next Steps

- Continue to improve heat waves forecasts and sharing with institutions in Africa
- Work on model post processing week3-4 and monthly forecasts
  - Apply consistency approach to improve forecast skill
  - Neural Networks
  - Knowledge of S2S phenomena
- Evaluate the new FV3-GEFS for timescales for week2, week3-4 HW forecasts
- Create an inventory of heat wave events 1999-present
- Classify and create composites of heat wave events
- Use hybrid statistical – dynamic approach to improve forecasts

Thank you

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