



**USAID**  
FROM THE AMERICAN PEOPLE

# **It's Getting Hot in Here: Understanding and Addressing the Risks of Heat on Human Health**

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**Adaptation Community Meeting  
March 21, 2019**



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FROM THE AMERICAN PEOPLE

# Heat Waves and Human Health

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Pete Epanchin  
E3/Global Climate Change Office

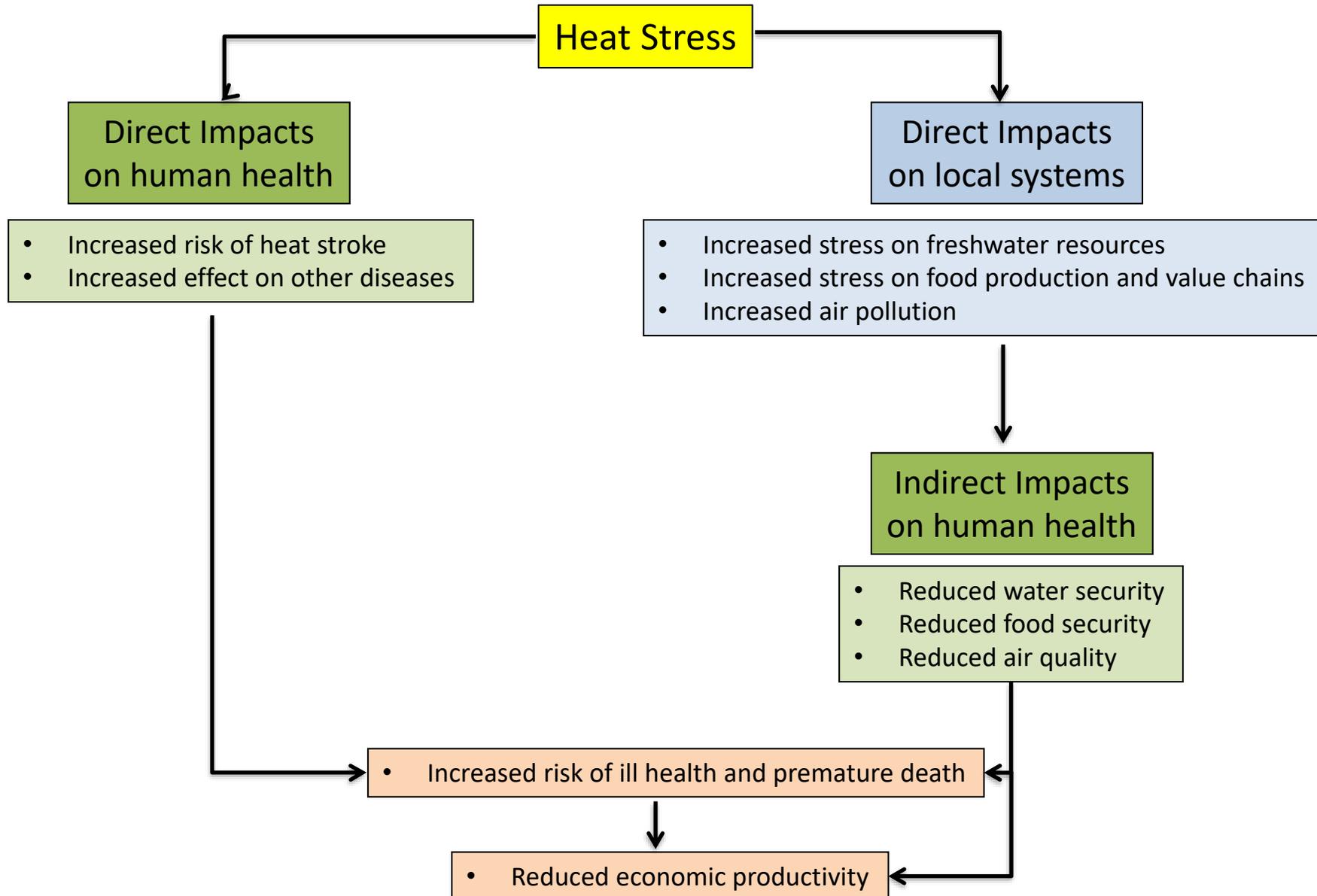
March 21, 2019  
Adaptation Community Meeting

# HEAT WAVES AND HUMAN HEALTH

EMERGING EVIDENCE AND EXPERIENCE TO INFORM  
RISK MANAGEMENT IN A WARMING WORLD

- 
- **Adaptation Thought Leadership and Assessments (ATLAS)**
    - February 2019
      - Veronique Lee
      - Fernanda Zermoglio
      - Kristie L. Ebi
  - **Publicly available on [climatelinks.org](https://climatelinks.org)**

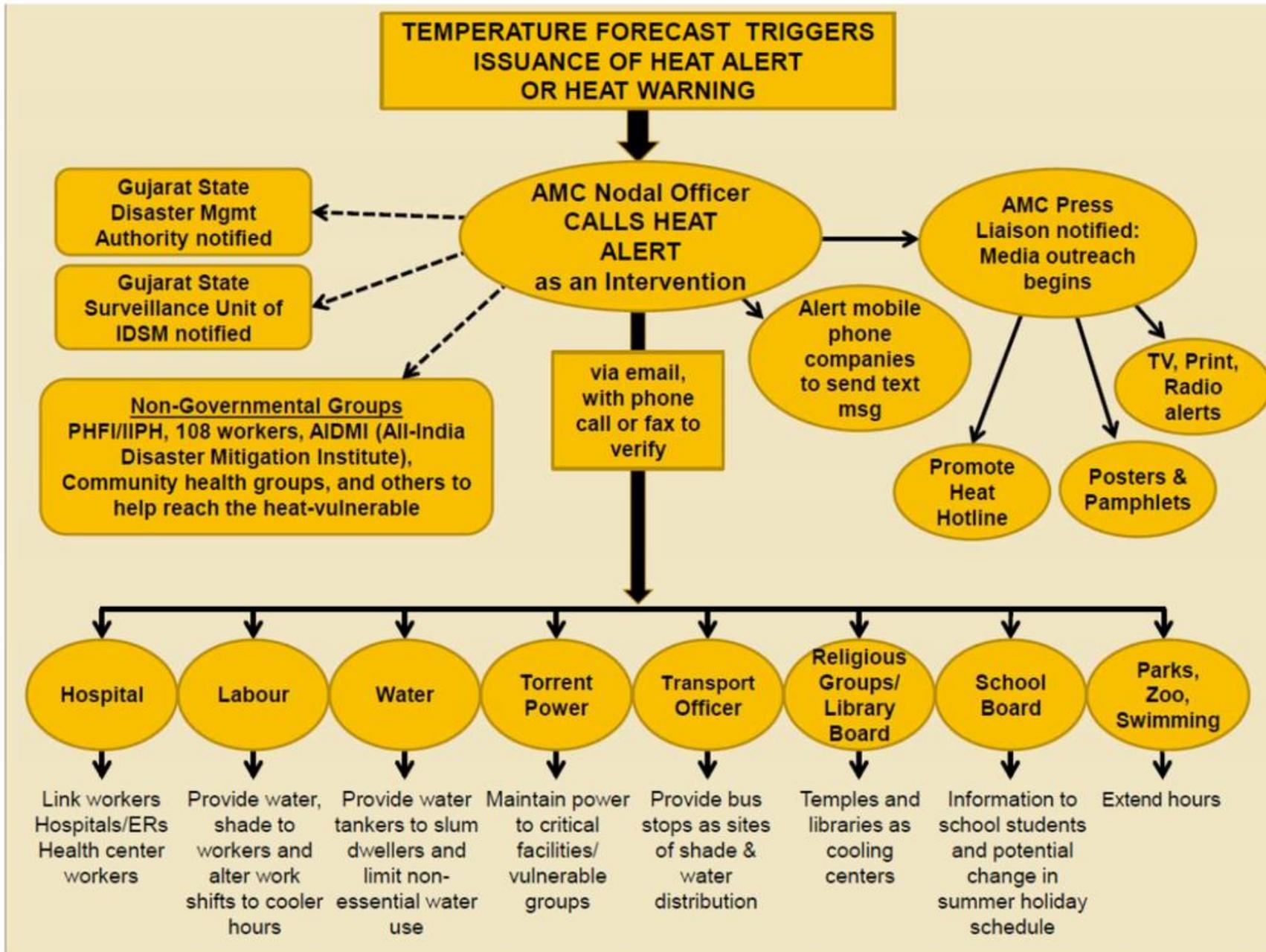
# Direct & Indirect Effects of Heat Stress on Health





Heat wave, 46°C (114.8°F)  
Lahore, Pakistan

# Communication Plan for a Heat Alert, Ahmedabad, India



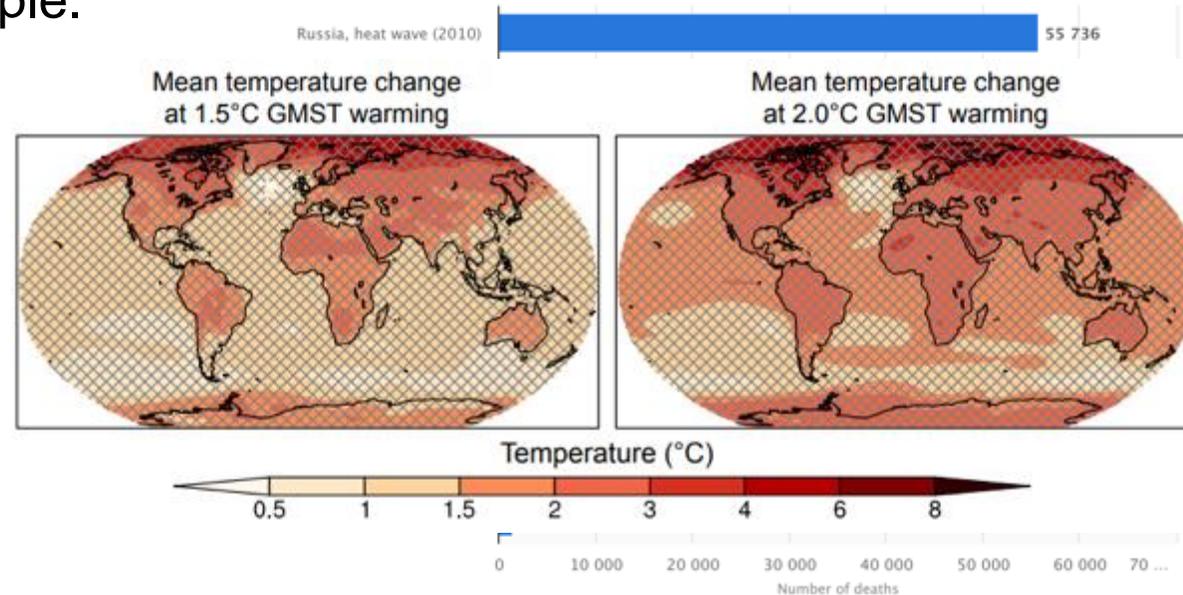


## Extreme Heat

Roop Singh  
Adaptation Community Meeting – March 2019

### 3 Critical Things to Know about Extreme Heat

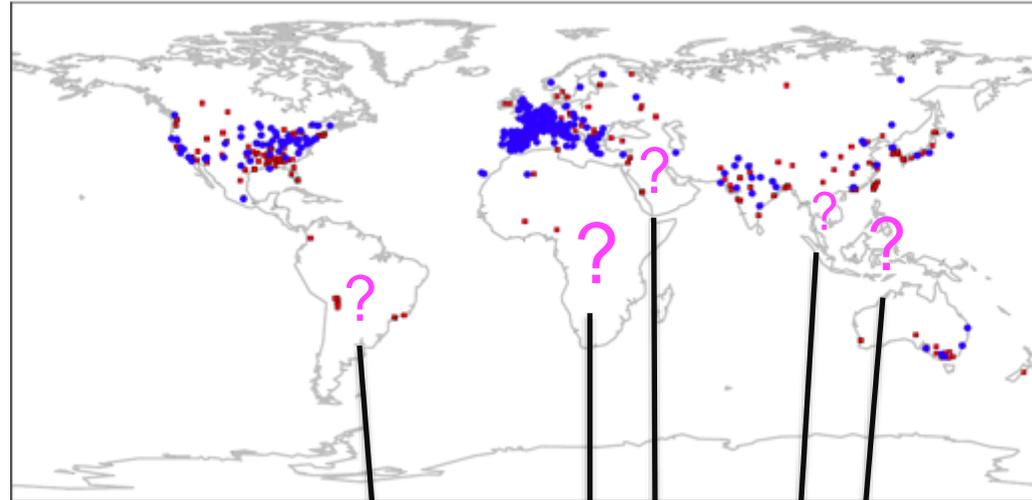
1. Extreme heat kills.
2. It is one of the most obvious and confident projections we have of the future.
3. The solutions are simple.



# Where are the gaps?

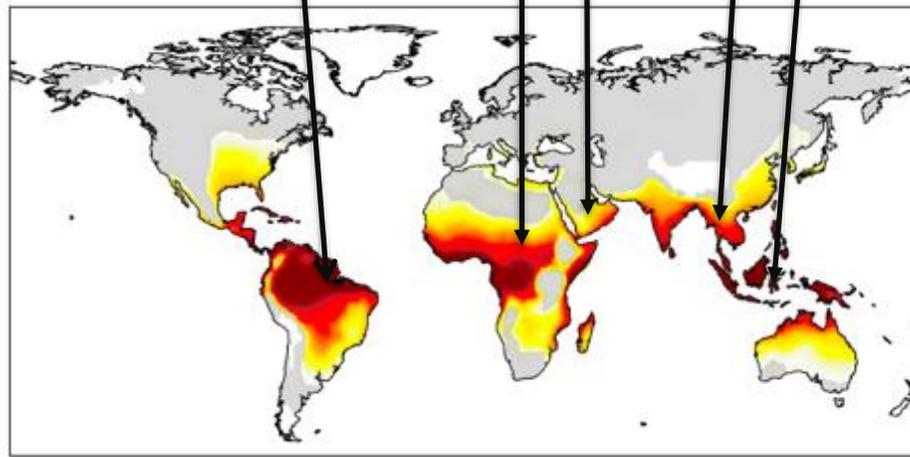


Climate  
Centre



**Red** = Places where the relationship between heat & mortality have been documented

**Blue** = Places where specific extreme heat episodes have been studied



Places where deadly climate conditions are expected in high emissions scenario (our current trajectory).



Number of days per year above deadly threshold

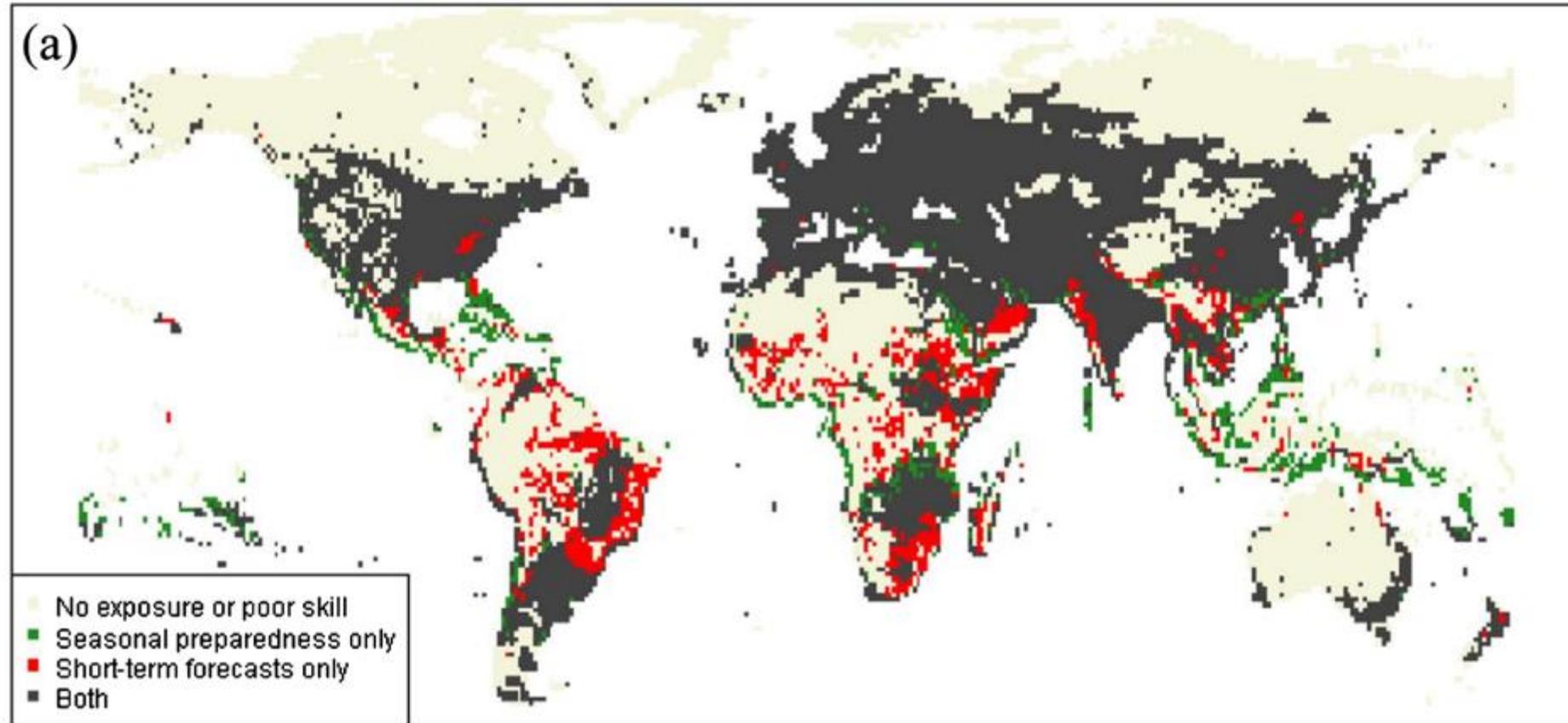
(Mora et al., 2017)

science • policy • practice • innovation

# Where are the opportunities?

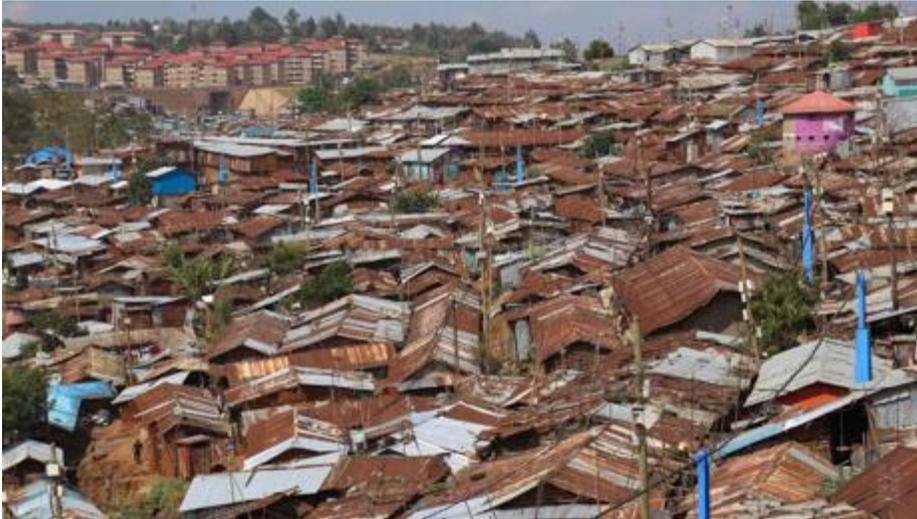


## Heat



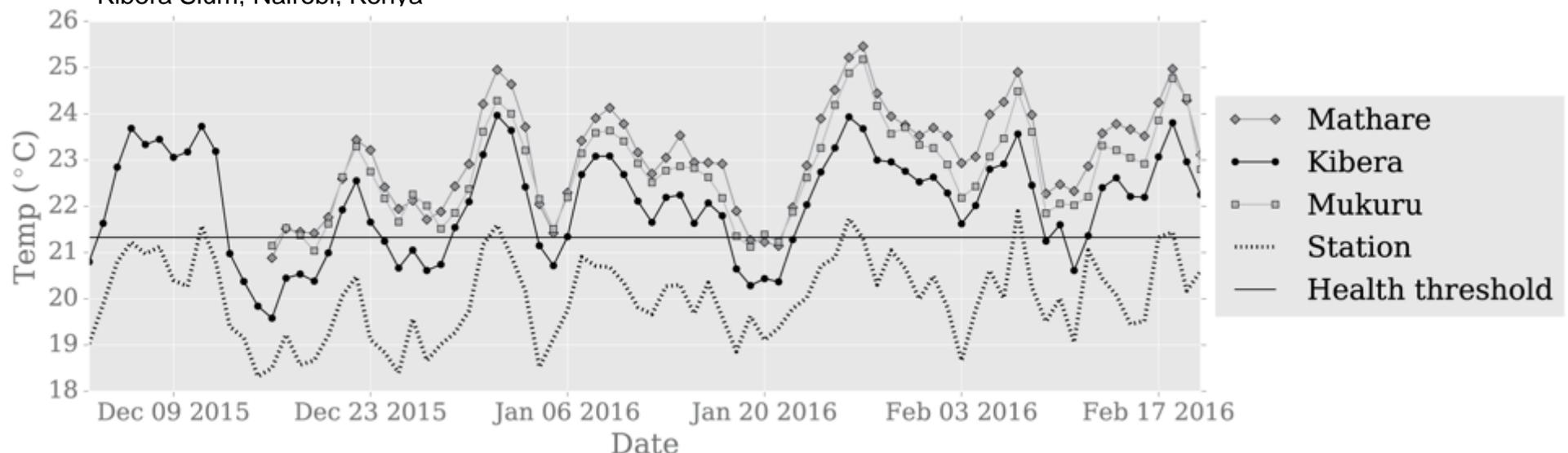
Coughlan de Perez et al. 2018

## Vulnerability and exposure determine who is affected



- Slums have dense, tin housing, little vegetation, limited public utilities & services
- Temperatures in Kibera are regularly higher than in the main observation station
- Within a range associated with increased mortality

Kibera Slum, Nairobi, Kenya





## Working in partnerships to raise awareness and mobilize action

1. Research with Columbia University to highlight the relationship between extreme heat and mortality:
  - During an 8-day heat wave in Bangladesh **3,800** excess deaths occurred
2. Partnership with BBC Media Action to disseminate messages on risk of heat-related illnesses and how to avoid the heat during the 2017 hot season.
  - Reached 3.9 million people through Facebook campaign



## How are we addressing this problem?

### Heat Wave Sign On Letter

- Indicates that heat waves are a priority for a broad coalition of meteorological and health orgs, city groups, researchers, humanitarian actors and civil society organizations.
- Highlights key research and action gaps that need to be addressed in order to prevent heat-related mortality and morbidity world wide

### City Heat Wave Guide

- For: 'city managers' with a focus in Asia and Africa
- What to do **before**, **during** and **after** a heat wave
- What can you do if there is no work on heat in your city?
- Case studies from around the world
- Developed jointly by American Red Cross and Climate Centre



# Real Time Climate Information for Heat-Health Early Warning

**Wassila M. Thiaw**

**Climate Prediction Center (CPC)**

National Oceanic and Atmospheric  
Administration (NOAA)

Washington, DC

**CPC Collaborators:** Sarah Diouf,  
Endalkachew Bekele,  
Ibrahima Diouf,  
Vadlamani Kumar



# Predictability of Heat Waves in Africa



NOAA's CPC has been working on heat waves since 2018

## **Objective: To evaluate the forecast quality of heat waves in Africa**

- Construct historical weekly frequency of daily maximum Heat Index (HI), maximum and minimum air temperature ( $T_{\max}$  and  $T_{\min}$ ) at various threshold values to document heat wave events;
- Define a heat wave as a weather event of three consecutive days with daily  $T_{\max}$  exceeding the 90th percentile; or three consecutive days with daily NOAA's HI exceeding a threshold, between  $39^{\circ}$  C and  $42^{\circ}$  C.
- Investigate the predictability of these events at week-2 time scale;
- Use the reforecast data from the GEFS to assess the quality of the forecasts;
- Develop experimental heat products for our climate-health collaborators who can provide feedback and guidance towards an operational forecasting system.



# Heat Waves - Definition

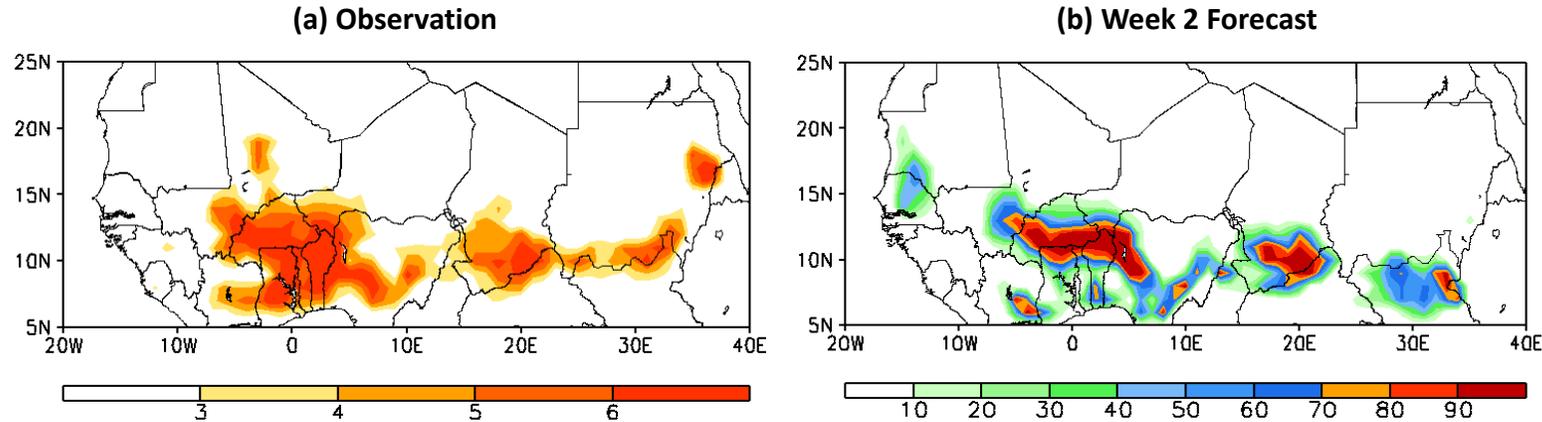
**Heat wave: Prolonged period of extreme and unusual warm weather.**

- Daily maximum or minimum air temperature, or the heat index (HI), exceeding a threshold value.
  - A heat wave is a period of three consecutive days with daily  $T_{\max}$  exceeding the 90th percentile in the 30-year climatological record from 1981 to 2010.
  - A heat wave is a period of three consecutive days with daily NOAA's HI exceeding a given threshold, between  $39^{\circ}\text{ C}$  ( $102^{\circ}\text{ F}$ ) and  $42^{\circ}\text{ C}$  ( $108^{\circ}\text{ F}$ ).



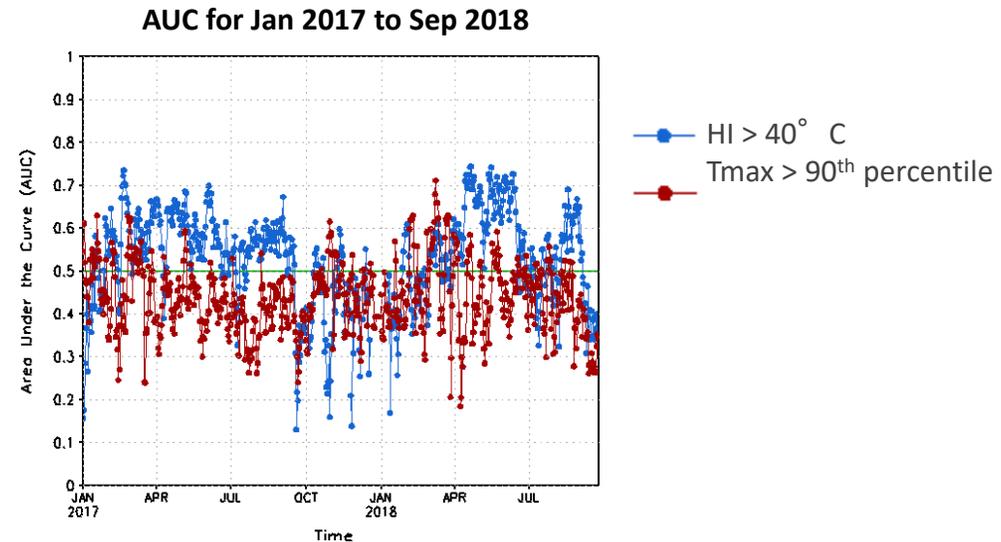
# Heat Wave Event 22 – 28 April 2016

## Heat Index > 40° C



- (a) Number of consecutive days with HI > 40° C (104° F) during between April 22 to 28, 2016.
- (b) Probability that the HI > 40° C (104° F) during at least 3 consecutive days, 22-28 April, 2016 (IC: 14 April 2016) in

*A discriminative skill measure called Area Under the ROC (relative operating characteristics) Curve (AUC) is used to measure the performance of the forecasts. Forecasts are accurate for AUC values greater than 0.5. The higher the AUC value, the more accurate the forecasts. A perfect score is 1.*

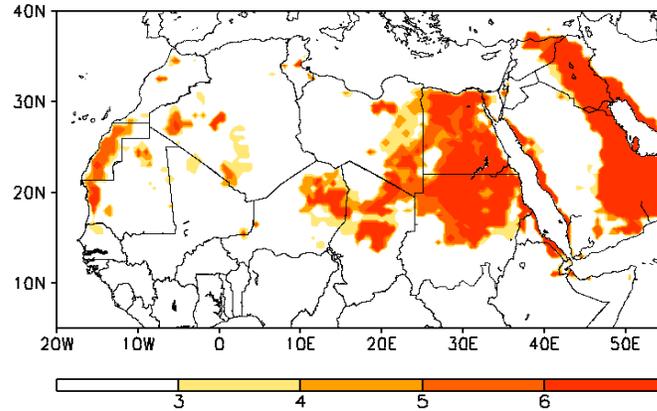




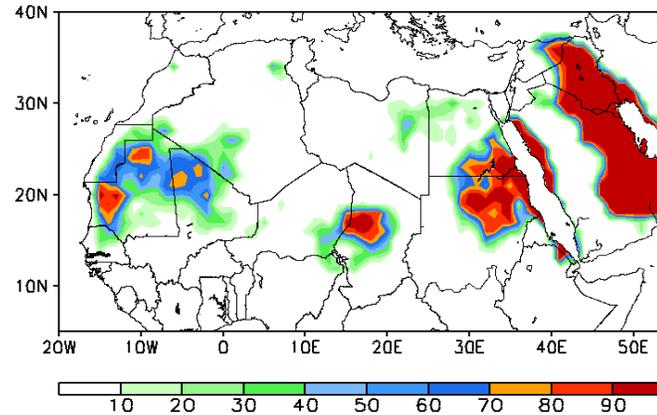
# Heat Wave Event 7 – 13 August 2015

## Heat Index > 40° C

(a) Observation

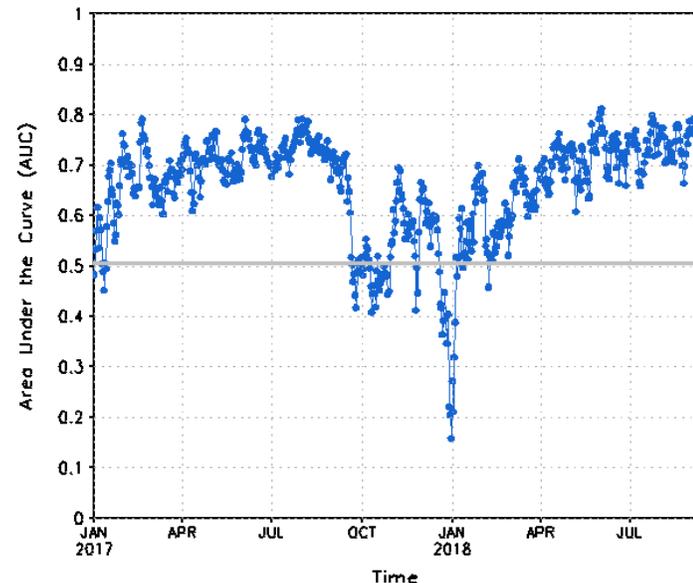


(b) Week 2 Forecast



- (a) Number of consecutive days with HI > 39° C (102° F) from 7 to 13 August, 2015 in Northern Africa.
- (b) Probability that the HI > 39° C (102° F) during at least 3 consecutive days from 7 to 13 August, 2015 (IC: 30 July 2015) in Northern Africa.

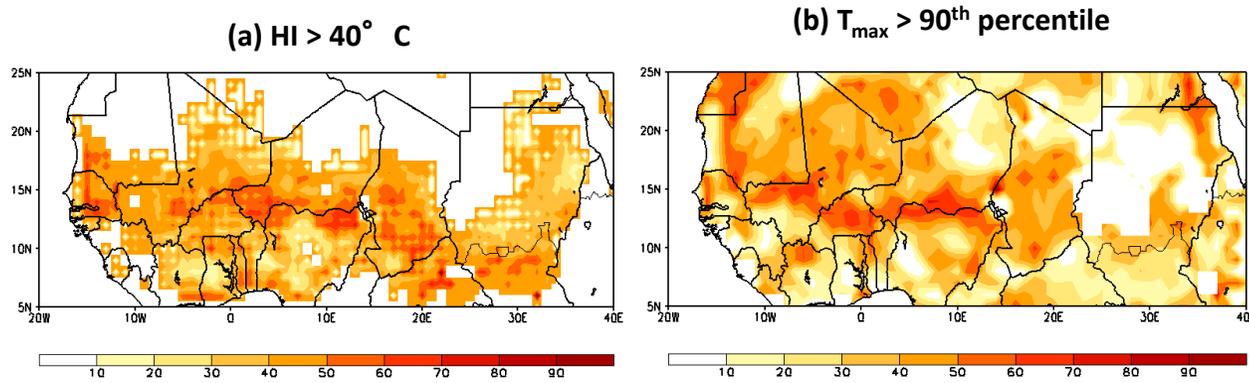
AUC for Jan 2017 to Sep 2018



*A discriminative skill measure called Area Under the ROC (relative operating characteristics) Curve (AUC) is used to measure the performance of the forecasts. Forecasts are accurate for AUC values greater than 0.5. The higher the AUC value, the more accurate the forecasts. A perfect score is 1.*



# Discussion



*Heidke Skill Score (HSS) (color shade) is used to measure the performance of the forecasts. The higher the score, the more red the shade, and the more accurate the forecasts. A perfect score is 100.*

*HSS April-May 2015-2018 for forecasts based on (a) the HI. (b) the 2mTmax.*

- NCEP GEFS model tends to perform reasonably well at depicting heat waves as defined by the NOAA HI, at the week-2 time scale.
- Information, if provided in **real-time**, can be valuable to the health sector and communities to issue **early warnings for health risks** associated with heat waves.
- **Need to better understand the critical HI thresholds** that affect the health of vulnerable populations. Requires **close collaboration with health services** in Africa.
- Note that the week-2 forecast (i.e., forecasts for one week, with a lead time of 8 days) is more accurate for the HI than for the  $T_{max}$ .
- This is probably due to the model negative bias in  $T_{max}$ . Work is in progress to correct this bias and to reassess the performance of the forecasts.



# Website – CPC International Desks



<http://www.cpc.ncep.noaa.gov/products/international/index.shtml>

Introduction

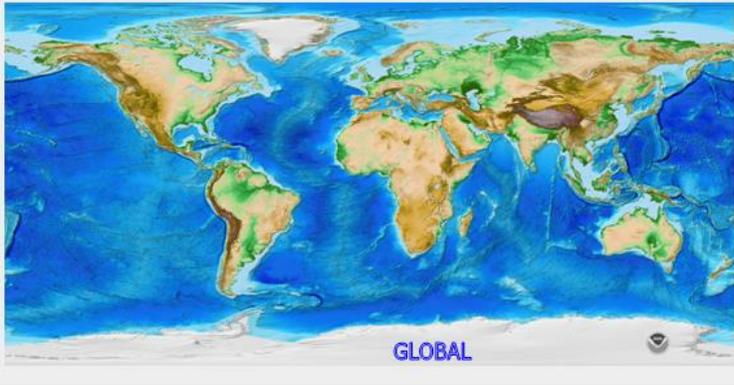
African Training Desk  
Introduction  
Requirements  
Curriculum  
Visitor Countries

Short&Medium-Range  
Forecasts  
GFS GEFS & GDAS

Climate Forecasts  
CF Sv2 Forecasts  
NMME

Special Products  
Africa  
Central Asia  
C.Amer & Caribbean  
South Asia

General Products



GLOBAL

Current Satellite IR Imagery

Global Pacific & Atlantic Indian & Pacific Atlantic & Indian

CPC provides the public with access to **real time regionalized weather and climate information** that enables decision-making in various socio-economic sectors

CPC is working toward developing a website to provide access to real time heat information relevant to the health sector to **accelerate climate based heat-health early warning systems**

### CLIMATE AND HEALTH - AFRICA

**HEAT HEALTH - NOAA NCEP MODEL FORECASTS**  
(Weather and Climate Parameters of Interest for Heat Health Study)

GEFS	CFS	NMME
<b>Week1 Forecasts</b> <a href="#">Week1 2m Min Temperature Anom</a> <a href="#">Week1 2m Max Temperature Anom</a> <a href="#">Week1 2m Ave Temperature Anom</a> <a href="#">Week1 2m Relative Humidity</a>	<b>Week3+Week4 Forecasts</b> <a href="#">WK3+Wk4 2m Air Temperature Anom</a>	<b>MONTHLY FORECASTS</b> <a href="#">2m Air Temperature</a>
<b>Week2 Forecasts</b> <a href="#">Week2 2m Min Temperature Anom</a> <a href="#">Week2 2m Max Temperature Anom</a> <a href="#">Week2 2m Ave Temperature Anom</a> <a href="#">Week2 2m Relative Humidity</a>		<b>SEASONAL FORECASTS</b> <a href="#">2m Air Temperature</a>

**Prob. Week1 Averaged Daily Max HeatIndex > 40degC**

<a href="#">1 or more</a>	<a href="#">2 or more</a>	<a href="#">3 or more</a>	<a href="#">4 or more</a>	<a href="#">5 or more</a>	<a href="#">6 or more</a>
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**Prob. Week1 Averaged Daily Max HeatIndex > 41degC**

<a href="#">1 or more</a>	<a href="#">2 or more</a>	<a href="#">3 or more</a>	<a href="#">4 or more</a>	<a href="#">5 or more</a>	<a href="#">6 or more</a>
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**Prob. Week1 Averaged Daily Max HeatIndex > 42degC**

<a href="#">1 or more</a>	<a href="#">2 or more</a>	<a href="#">3 or more</a>	<a href="#">4 or more</a>	<a href="#">5 or more</a>	<a href="#">6 or more</a>
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The Global Heat Health Information Network  
Supporting to Global Heat Health Disaster Risk Reduction

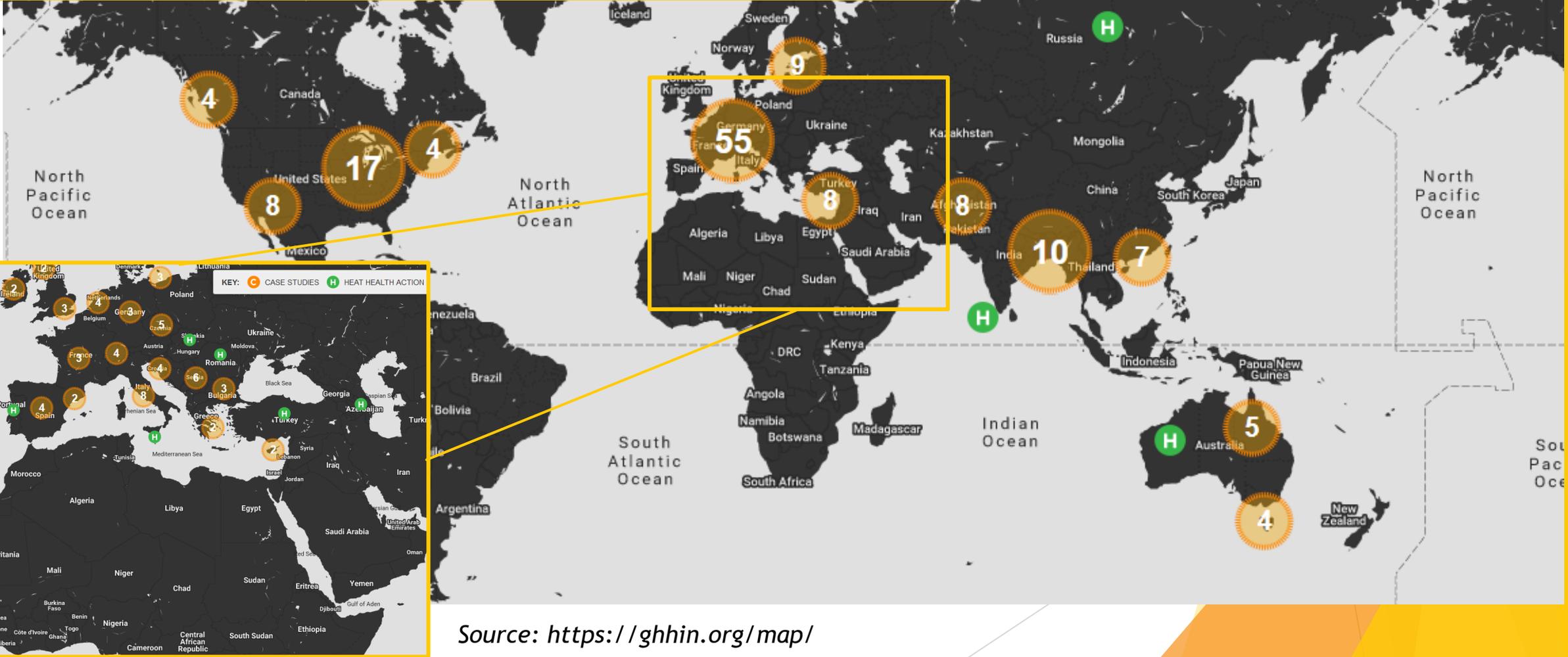
# Global Priorities and Action for Addressing Extreme Heat Risks

UCAR Affiliate / NOAA Climate Program Office  
NOAA Climate Program Office  
WMO/WHO Joint Office for Climate and Health

Hunter Jones  
Juli Trtanj  
Joy Shumake-Guillemot

# Practitioners around the world are taking action to manage heat risk...

KEY: **C** CASE STUDIES **H** HEAT HEALTH ACTION PLANS



Source: <https://ghin.org/map/>

# An Evaluation of Portable Wet Bulb Globe Temperature Monitor Accuracy

Earl Cooper, EdD, ATC, CSCS\*; Andrew Grundstein, EdD, ATC; Adam Rosen, PhD, ATC†; Jessica Miles, PhD, ATC‡; Patrick Curry, MS, ATC||

\*University of Georgia, Athens; †University of Nebraska at Omaha; ‡University of Northern Arizona, Phoenix; ||Greenwich Country Day School, Atlanta, Georgia

**Context:** Wet bulb globe temperature (WBGT) is the gold standard for assessing environmental heat stress during physical activity. Many manufacturers of commercially available WBGT monitors performed accuracy tests (n = 10) at 20°C and 25°C. The mean difference between the WBGT provided by the monitors and the reference WBGT was 0.425% (range -0.85% to 0.025%) performed at 20°C and 0.425% (range -0.85% to 0.025%) performed at 25°C. The mean difference between the WBGT provided by the monitors and the reference WBGT was 0.425% (range -0.85% to 0.025%) performed at 20°C and 0.425% (range -0.85% to 0.025%) performed at 25°C. The mean difference between the WBGT provided by the monitors and the reference WBGT was 0.425% (range -0.85% to 0.025%) performed at 20°C and 0.425% (range -0.85% to 0.025%) performed at 25°C.

...but how do we make sure it's done with the best available evidence, and that we are learning from each other?

Sports Med  
DOI 10.1007/s40279-015-0386-8

LETTER TO THE EDITOR

**Is the Wet-Bulb Globe Temperature (WBGT) Index Relevant for Exercise in the Heat?**

Franck Brocherie<sup>1</sup> · Grégoire P. Millet<sup>1</sup>

Journal of Science and Medicine in Sport (2008) 11, 20–32



REVIEW

**Wet-bulb globe temperature (WBGT)—its history and its limitations**

Grahame M. Budd

Contents lists available at ScienceDirect

**Applied Ergonomics**

journal homepage: [www.elsevier.com/locate/apergo](http://www.elsevier.com/locate/apergo)

**Should electric fans be used during a heat wave?**

Ollie Jay<sup>a,b,\*</sup>, Matthew N. Cramer<sup>b</sup>, Nicholas M. Ravanelli<sup>b</sup>, Simon G. Hodder<sup>c</sup>

<sup>a</sup> Thermal Ergonomics Laboratory, Exercise and Sport Science, Faculty of Health Sciences, University of Sydney, 75 East Street, Lidcombe, NSW 2141, Australia  
<sup>b</sup> School of Human Kinetics, University of Ottawa, K1N 6N5, Canada  
<sup>c</sup> Environmental Ergonomics Research Centre, Loughborough University, Leics LE11 3TU, United Kingdom

TEMPERATURE  
2016, VOL. 3, NO. 3, 358–360  
<http://dx.doi.org/10.1080/23328940.2016.1211073>

FRONT MATTER: DISCOVERY

**Electric fan use in heat waves: Turn on or turn off?\***

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES  
Issue: *Human Health in the Face of Climate Change*

**Iterative management of heat early warning systems in a changing climate**

Jeremy J. Hess<sup>1,2,3</sup> and Kristie L. Ebi<sup>1,2</sup>

<sup>1</sup>Department of Environmental and Occupational Health Sciences, School of Public Health, <sup>2</sup>Department of Global Health, Schools of Medicine and Public Health, and <sup>3</sup>Division of Emergency Medicine, Department of Medicine, School of Medicine, University of Washington, Seattle, Washington

Address for correspondence: Jeremy J. Hess, M.D., M.P.H., University of Washington, 4225 Roosevelt Way NE #100, Seattle, WA 98125. [jjhess@uw.edu](mailto:jjhess@uw.edu)

Extreme heat is a leading weather-related cause of morbidity and mortality, with heat exposure becoming more widespread, frequent, and intense as climates change. The use of heat early warning and response systems (HEWSs) that integrate weather forecasts with risk assessment, communication, and reduction activities is increasingly widespread. HEWSs are frequently touted as an adaptation to climate change, but **little attention has been paid to the question of how best to ensure effectiveness of HEWSs as climates change further**. In this paper, we discuss findings showing that HEWSs satisfy the tenets of an intervention that facilitates adaptation, but climate change poses challenges infrequently addressed in heat action plans, **particularly changes in the onset, duration, and intensity of dangerously warm temperatures**, and changes over time in the relationships between temperature and health outcomes. **Iterative management should be central to a HEWS**, and iteration cycles should be of 5 years or less. Climate



**National Weather Service**  
Building a Weather-Ready Nation

**NATIONAL WEATHER SERVICE IS LOWERING HEAT ADVISORY THRESHOLDS FOR NORTHERN NEW ENGLAND AND MUCH OF NEW YORK**

Partnerships and Capacity to building heat health management networks

Understanding Risk and Predicting Health Outcomes

Observations, Forecasts, EWS, and Information Products to Inform Action

Action to Manage heat risk: actions, interventions and effectiveness

Communications for Heat Action

## GHHIN Thematic Areas



**GHHIN is a forum for scientists and practitioners, enhancing global-to-local learning for heat health risk reduction**



Improve awareness and urgency for the silent disaster that increasing heat and heatwaves pose to human health, wellbeing, and productivity worldwide

Improve the availability, awareness, synthesis and co-production of resources and information



Facilitate a truly transdisciplinary approach that also integrates practitioners and researchers

Focus on science for action - speeding the transition of research to operations/applications and the feedback from practitioners to inform research needs



**Attendees of the First Global Forum on Heat and Health agreed upon four common goals for the network**

## What 3 Services Should GHHIN Provide?

- Synthesis Report that identifies research and operational gaps and needs, best practices for interventions and forecasts, capacity and training needs
- Online knowledge sharing platform
- Evidence Reviews and Inventories of Good Practice

## What would you like to see in a GHHIN online platform?

- Guidance and resources
- Synthesis of new findings and studies
- Inventory of effective interventions

## What level of networking would be most helpful?

- With countries/contexts similar to my own in other world regions

**Over the next 2-5 years, GHHIN will address these goals with a web platform for sharing, synthesis report, and in-person opportunities for idea exchange**

**Second Global Forum on Heat and Health in..?**



GLOBAL **HEAT** HEALTH  
INFORMATION NETWORK

<https://ghin.org/>

Want to get  
involved in  
GHIN?  
Check out  
[ghin.org](https://ghin.org/) to  
join the  
mailing list  
and get more  
information.

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**Pete Epanchin**, Climate Adaptation Specialist, USAID, E3/Global Climate Change Office,  
[pepanchin@usaid.gov](mailto:pepanchin@usaid.gov)

**Roop Singh**, Climate Risk Advisor, Red Cross Red Crescent Climate Centre,  
[singh@climatecentre.org](mailto:singh@climatecentre.org), Twitter: @RoopSingh, [www.climatecentre.org](http://www.climatecentre.org)

**Wassila Mamadou Thiaw**, Meteorologist, National Oceanic and Atmospheric  
Administration (NOAA) and Team Leader for Climate Prediction Center (CPC)  
International Desks, [wassila.thiaw@noaa.com](mailto:wassila.thiaw@noaa.com)

**Hunter Jones**, Climate and Health Projects Manager, National Oceanic and Atmospheric  
Administration (NOAA) Climate Program Office (CPO), [hunter.jones@noaa.gov](mailto:hunter.jones@noaa.gov),  
<https://ghhin.org>