Global climate change, heat waves and health impact: lessons from Ahmedabad Heat Action Plan

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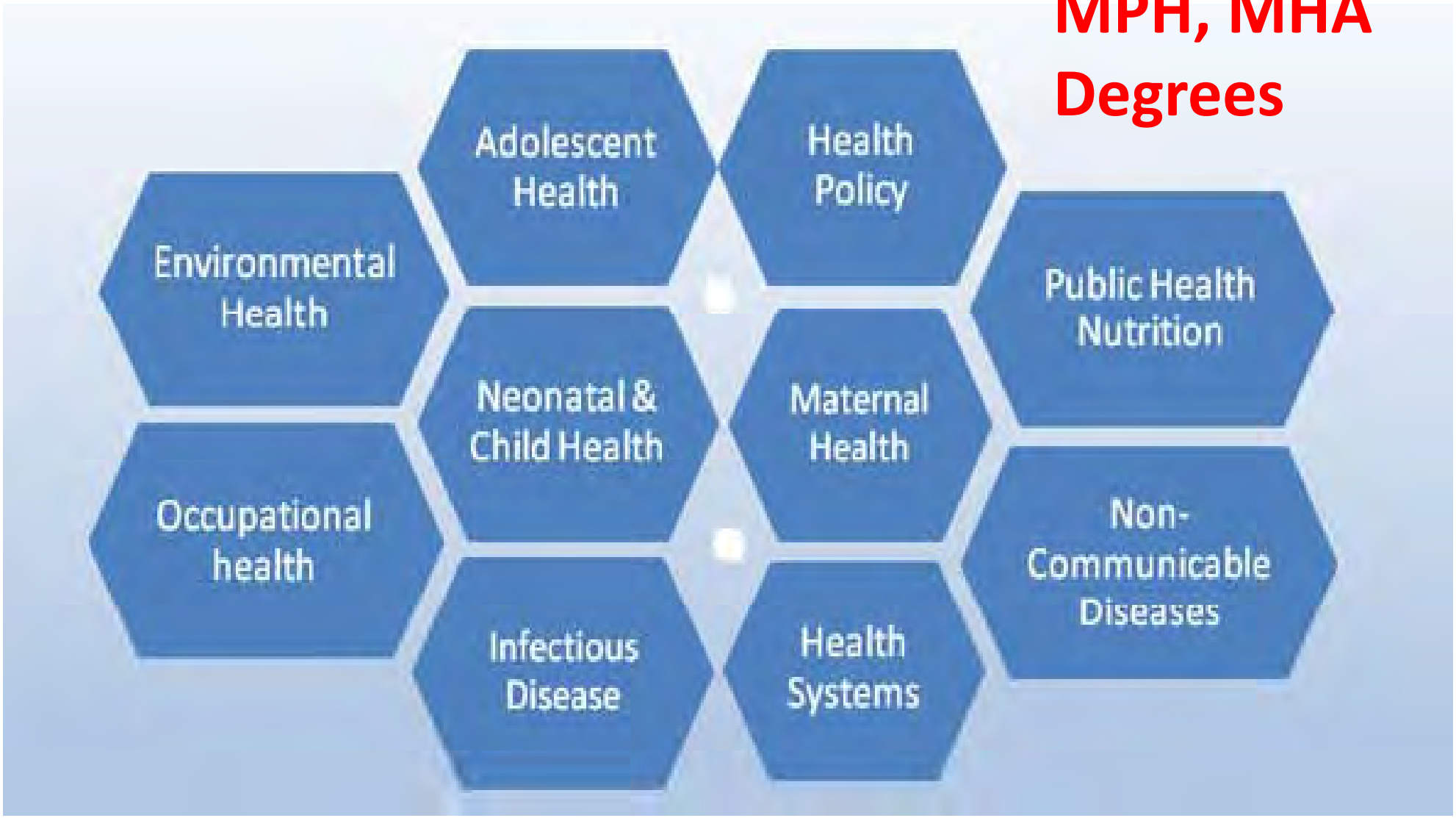
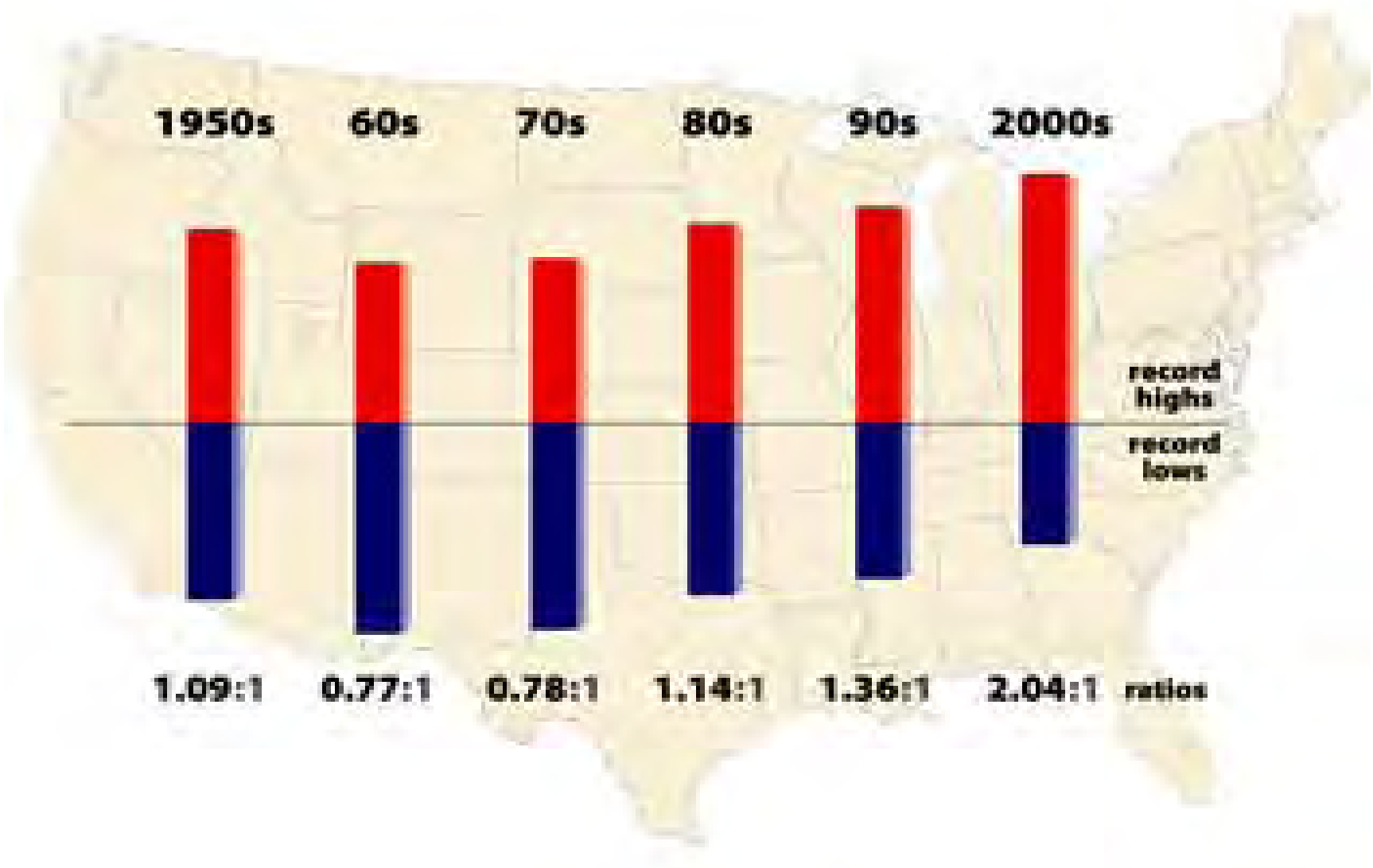
India's First Public Health University

MPH, MHA Degrees

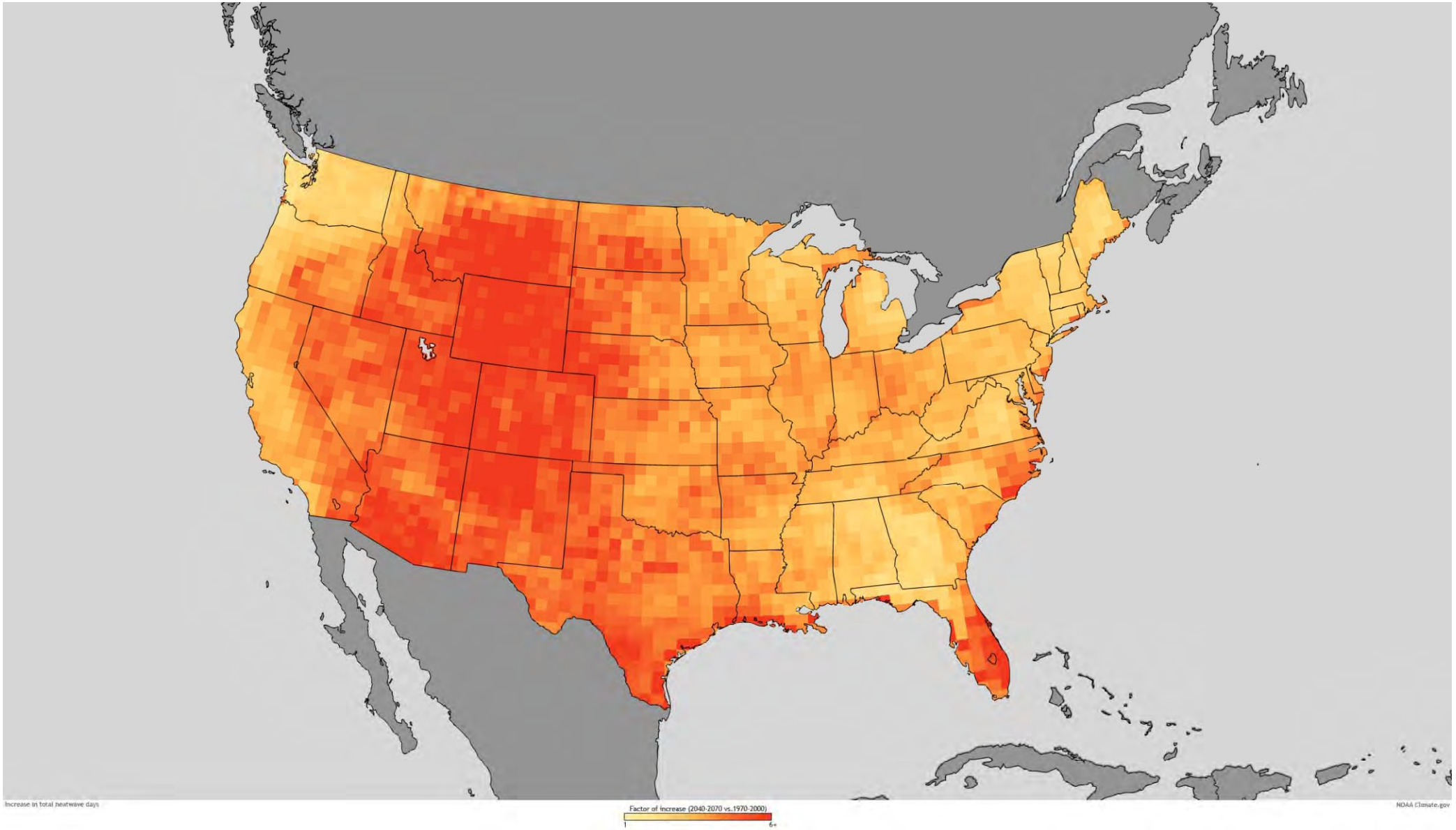


The ratio of record daily temperature highs (Red) to record daily lows (Blue) observed at about 1,800 weather stations in USA from January 1950 through September 2009.

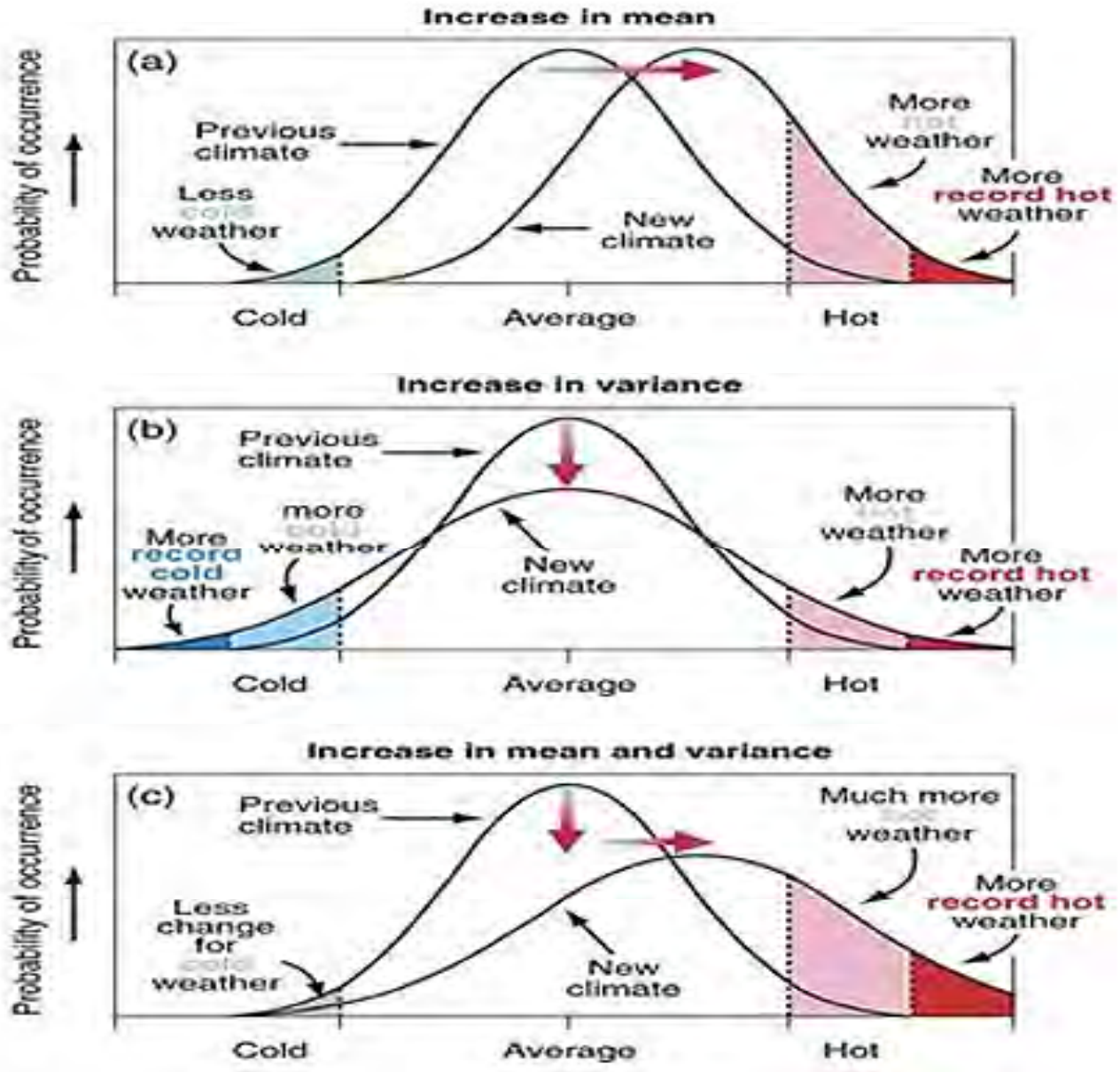
Source: Meehl et al. 2009



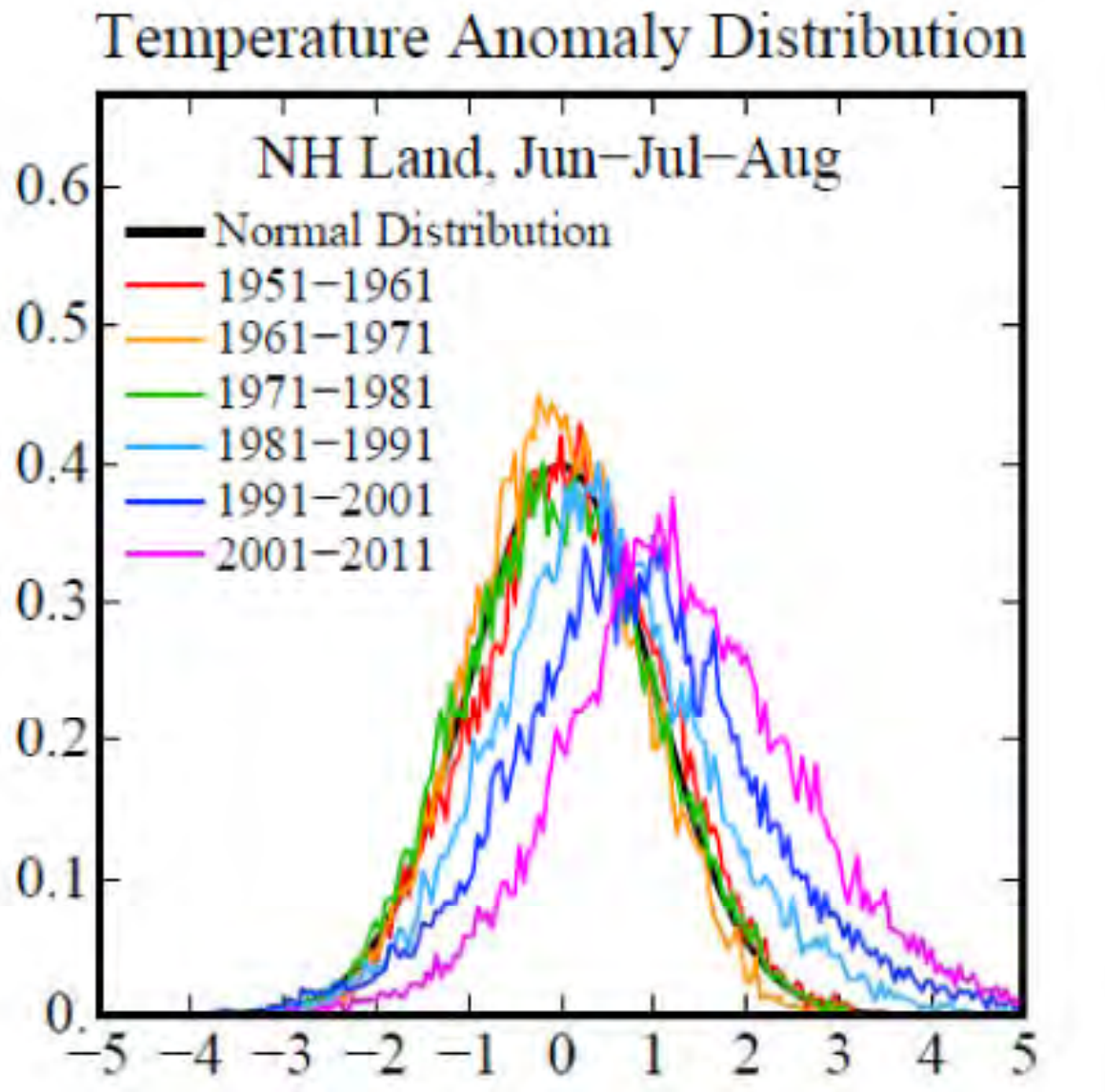
Increase in Total U.S. Heat wave Days



Effect of Climate Change: IPCC (2001) – Mean temperature is going up and variability increasing - probability of extremes - increasing



Frequency of summer temperature anomalies (how often they deviated from the historical normal of 1951-1980) over the summer months in the northern hemisphere. Source: NASA/ Hansen et al. 2012



A heat wave is generally defined as a period of several days to weeks of abnormally hot weather.

- In the past 3-4 decades, there has been an increasing trend in high-humidity heat waves, which are characterized by the persistence of extremely high night-time temperature.[1]
- **The combination of high humidity and high night-time temperature can make for a deadly pairing, offering no relief and *posing a particular threat for the elderly.***
- **Extreme heat events are responsible for more deaths annually than hurricanes, lightning, tornadoes, floods, and earthquakes combined.[2]**

Heat and Humidity = Heat Index

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Heat Index in deg. Celsius

Metrication of Template:HeatTable

		temperature (°C)																
		27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
Relative Humidity (%)	**40**	27	28	29	30	31	32	34	35	37	39	41	43	46	48	51	54	57
	45	27	28	29	30	32	33	35	37	39	41	43	46	49	51	54	57	
	50	27	28	30	31	33	34	36	38	41	43	46	49	52	55	58		
	55	28	29	30	32	34	36	38	40	43	46	48	52	55	59			
	60	28	29	31	33	35	37	40	42	45	48	51	55	59				
	65	28	30	32	34	36	39	41	44	48	51	55	59					
	70	29	31	33	35	38	40	43	47	50	54	58						
	75	29	31	34	36	39	42	46	49	53	58							
	80	30	32	35	38	41	44	48	52	57								
	85	30	33	36	39	43	47	51	55									
	90	31	34	37	41	45	49	54										
	95	31	35	38	42	47	51	57										
	100	32	36	40	44	49	54											

- Caution
- Extreme Caution
- Danger
- Extreme Danger

Record warmest days in last 20 years

- Seventeen of the 18 warmest years in the 136-year record all have occurred since 2001, with the exception of 1998.
- The year 2016 ranks as the warmest on record.

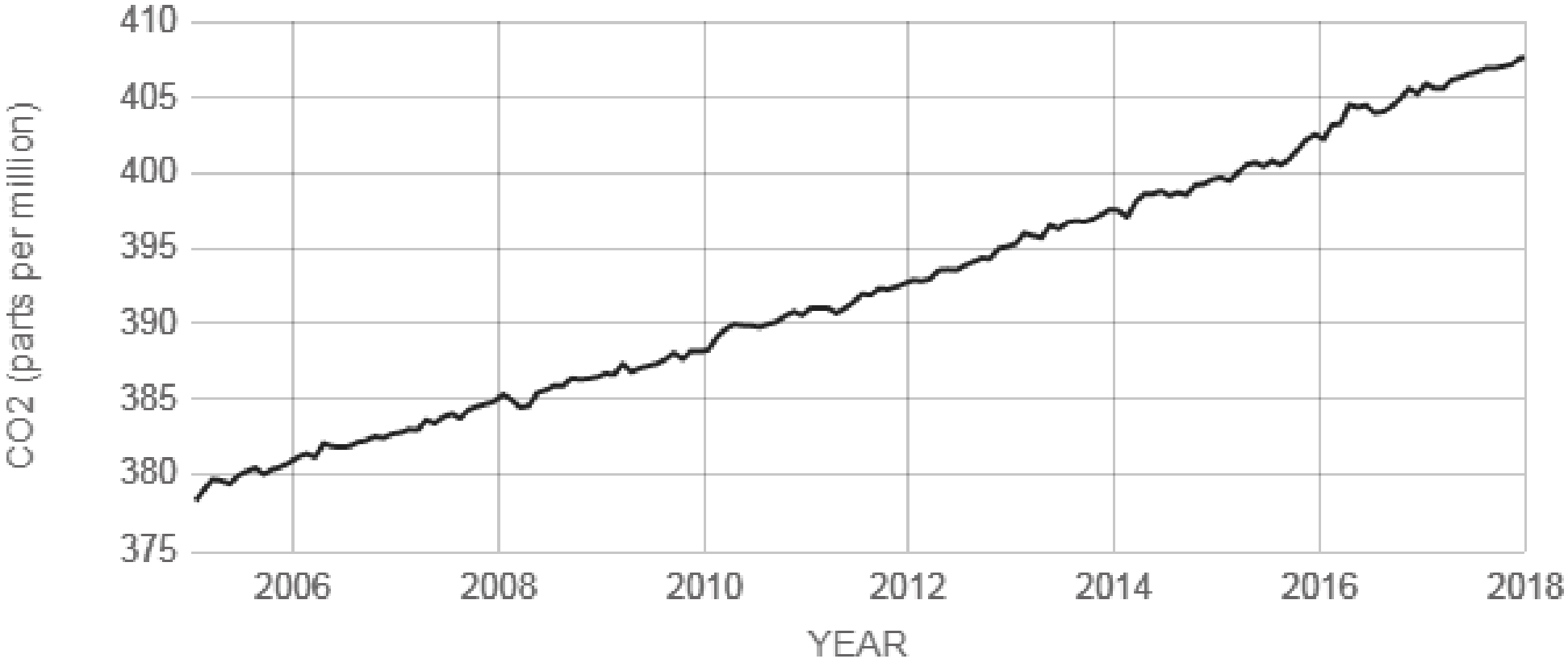
(Source: NASA/GISS).

Why Climate Change:

Carbon Dioxide (Green House Gases

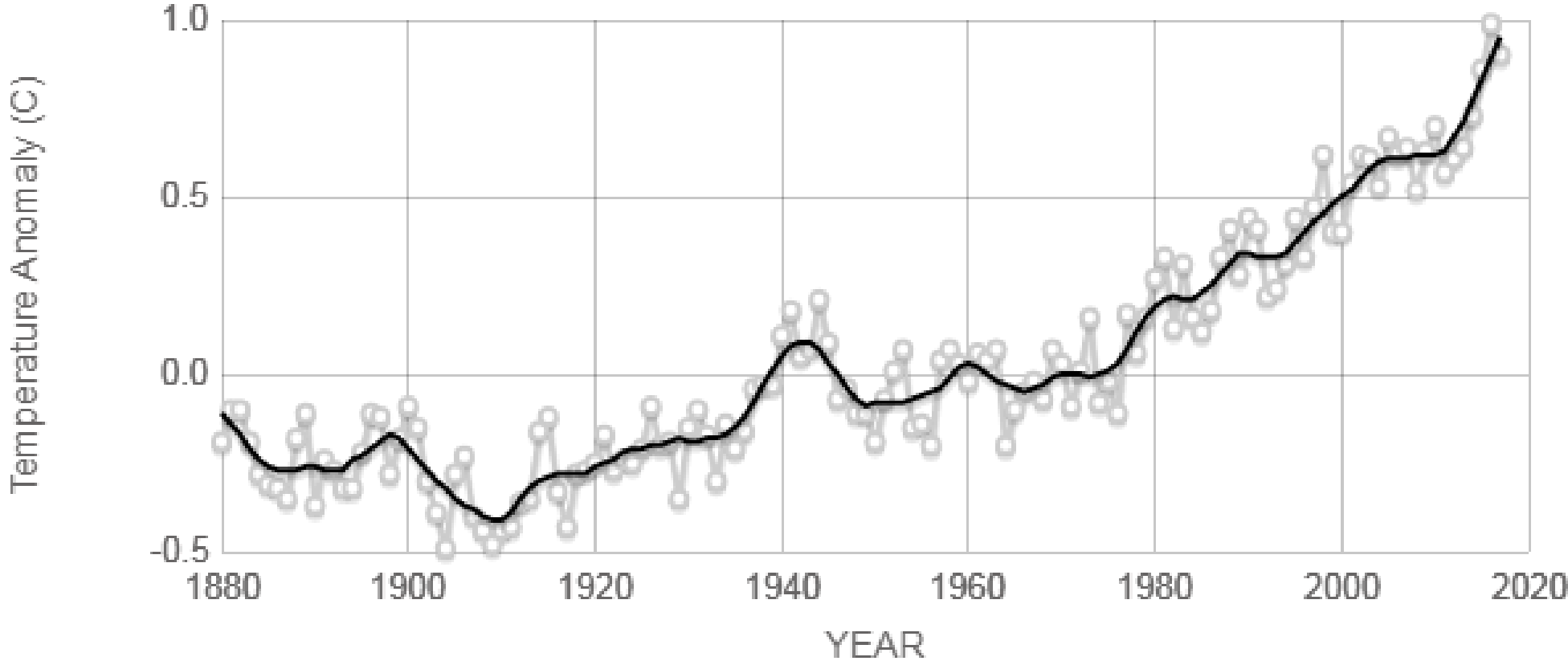
LATEST MEASUREMENT: January 2018

407.79 ppm



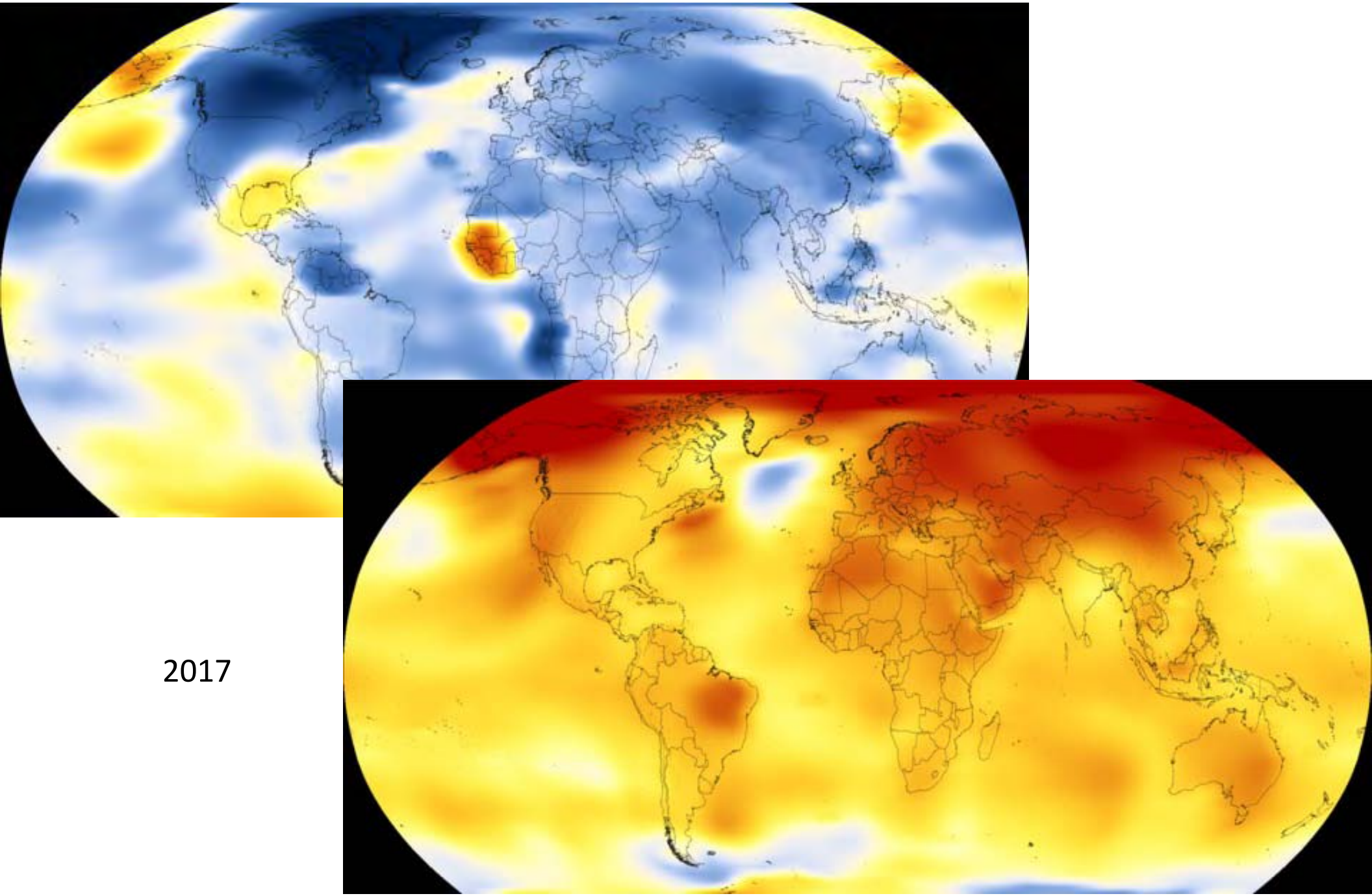
Source: climate.nasa.gov

Global Average temp increase 1880- 2017



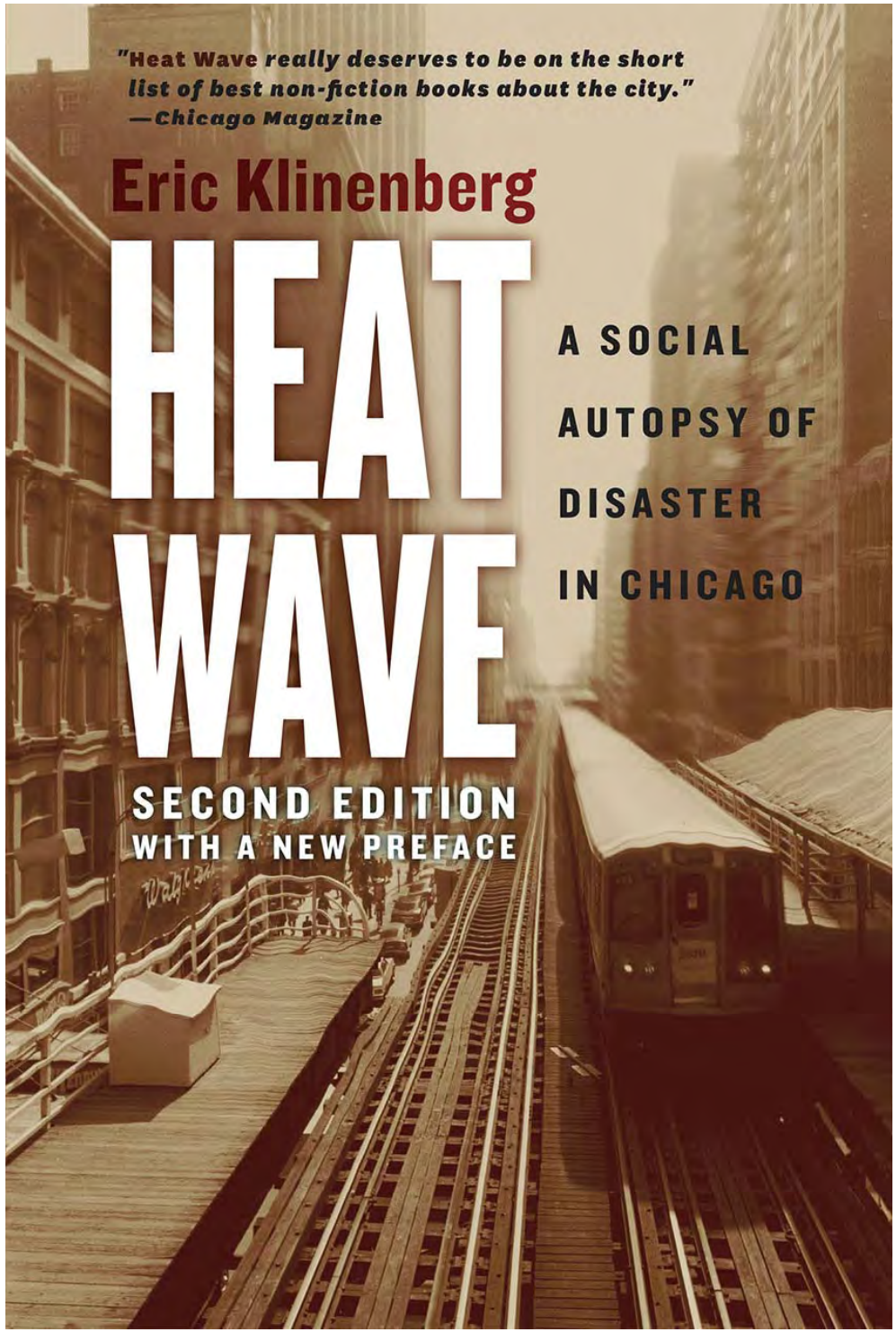
Source: climate.nasa.gov

Temperature increase 1884 to 2017

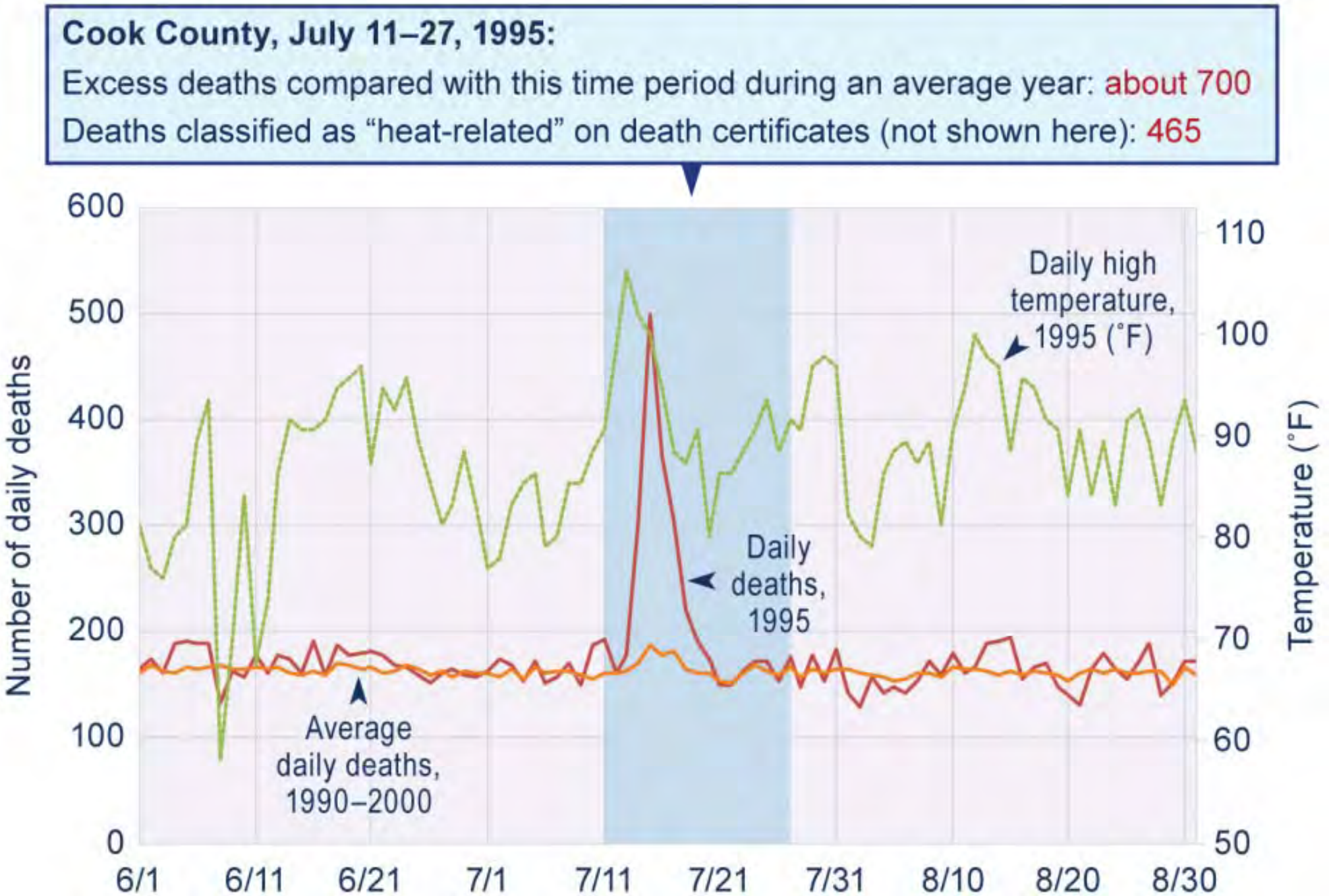


2017

Chicago heat wave 1995



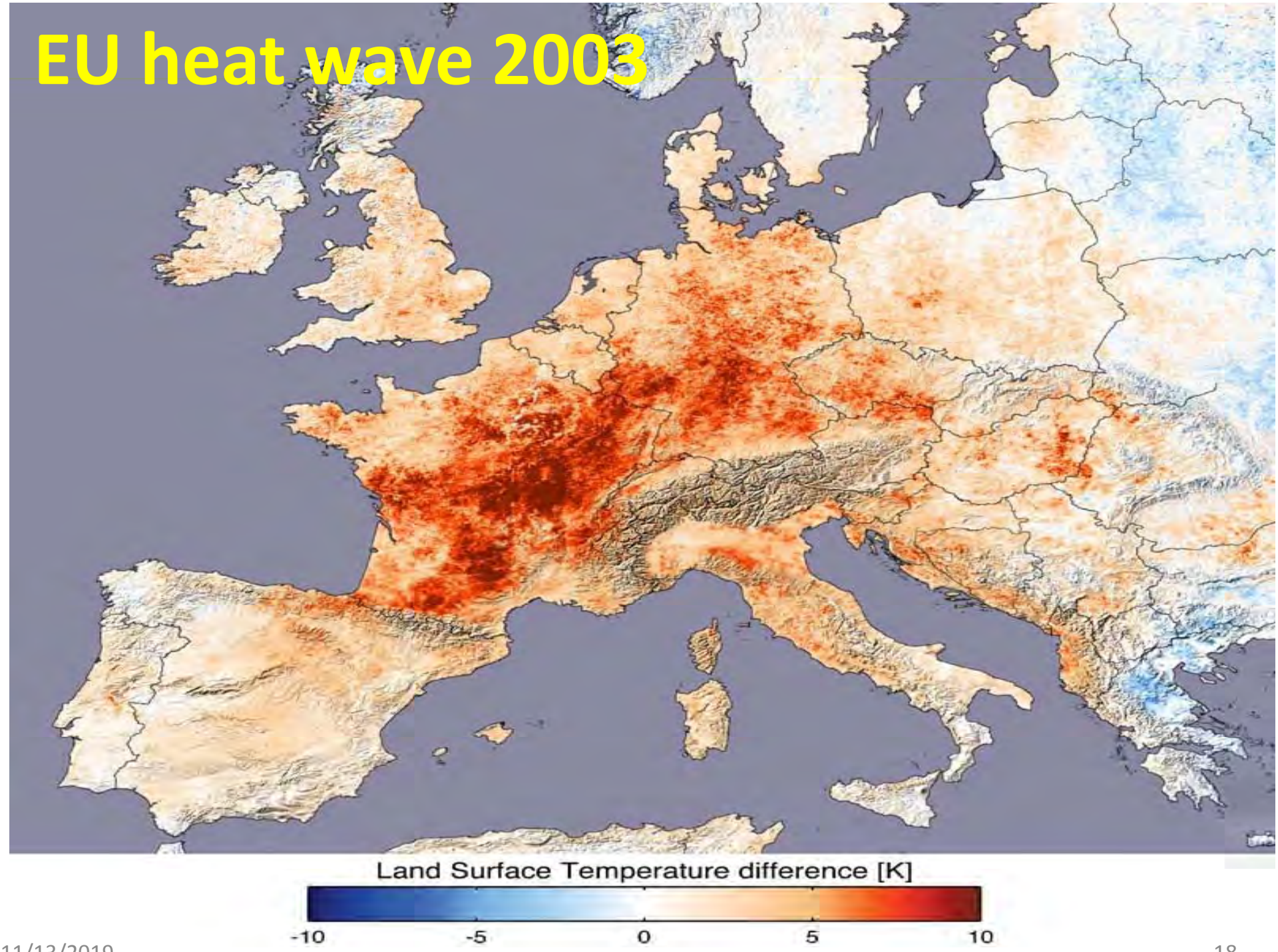
Chicago (Cook county) heat wave 1995 USA



Who are affected in heat wave: old, poor, isolated – without social support, no cooling or support

Mass Grave in Chicago after Heat Wave

EU heat wave 2003



European Heat Wave 2003

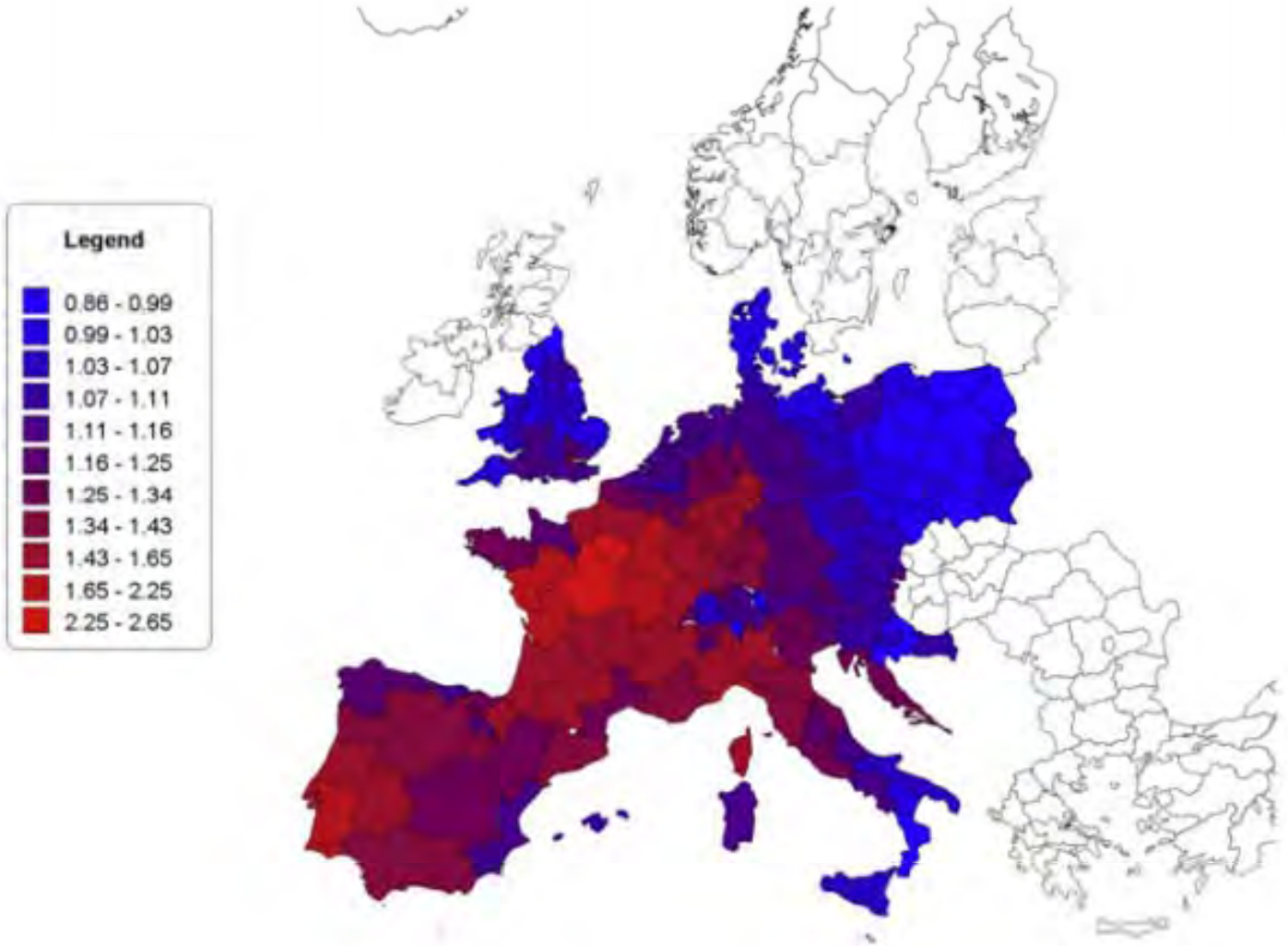
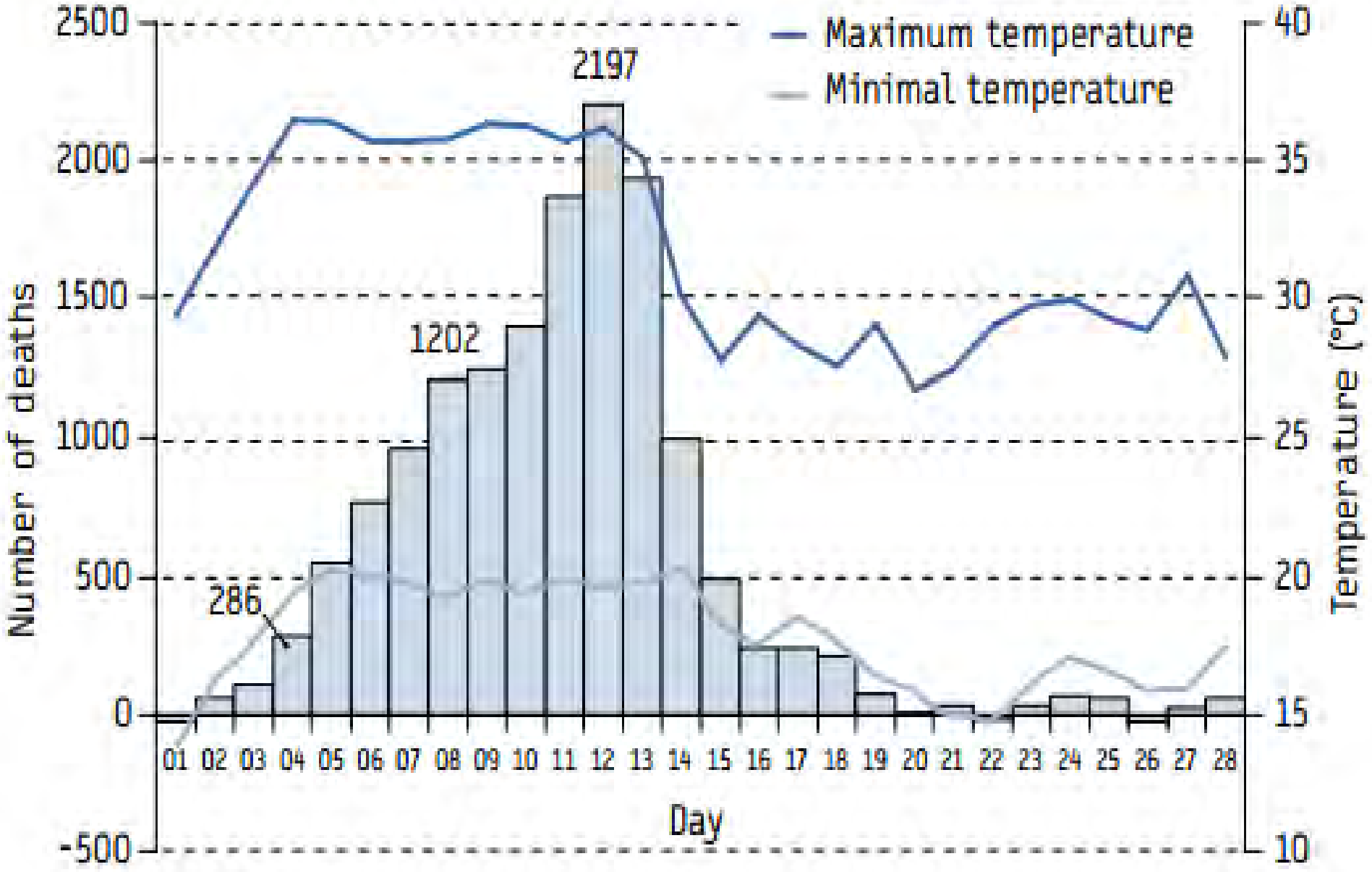


Fig. 2. Standardized daily death frequencies (1 means equal to the median death number, 2 means twice the median death number) between 3 and 16 August 2003, in 16 European countries, for 177 NUTS.

Daily excess of deaths during August 2003 and minimal and maximal daily temperatures [1], France



European Heat wave – 2003

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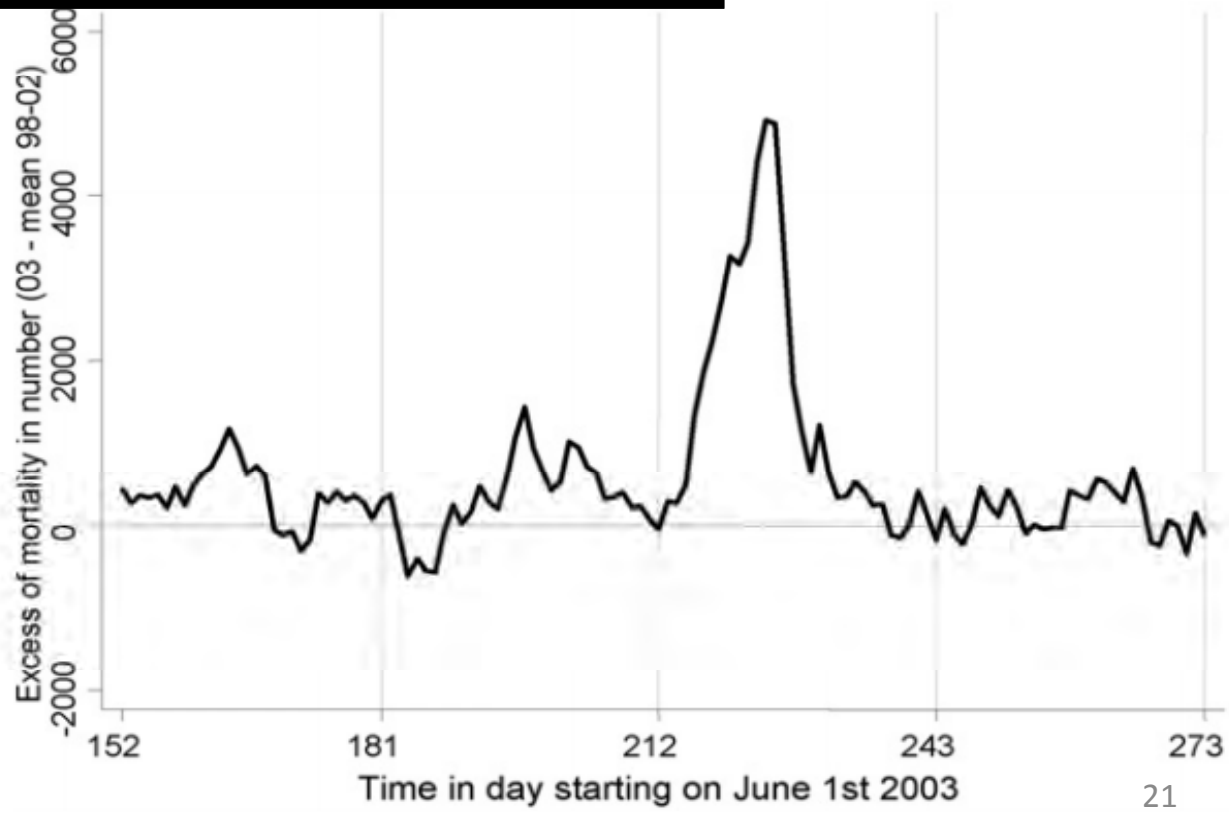
Epidemiology / Épidémiologie

Death toll exceeded 70,000 in Europe during the summer of 2003

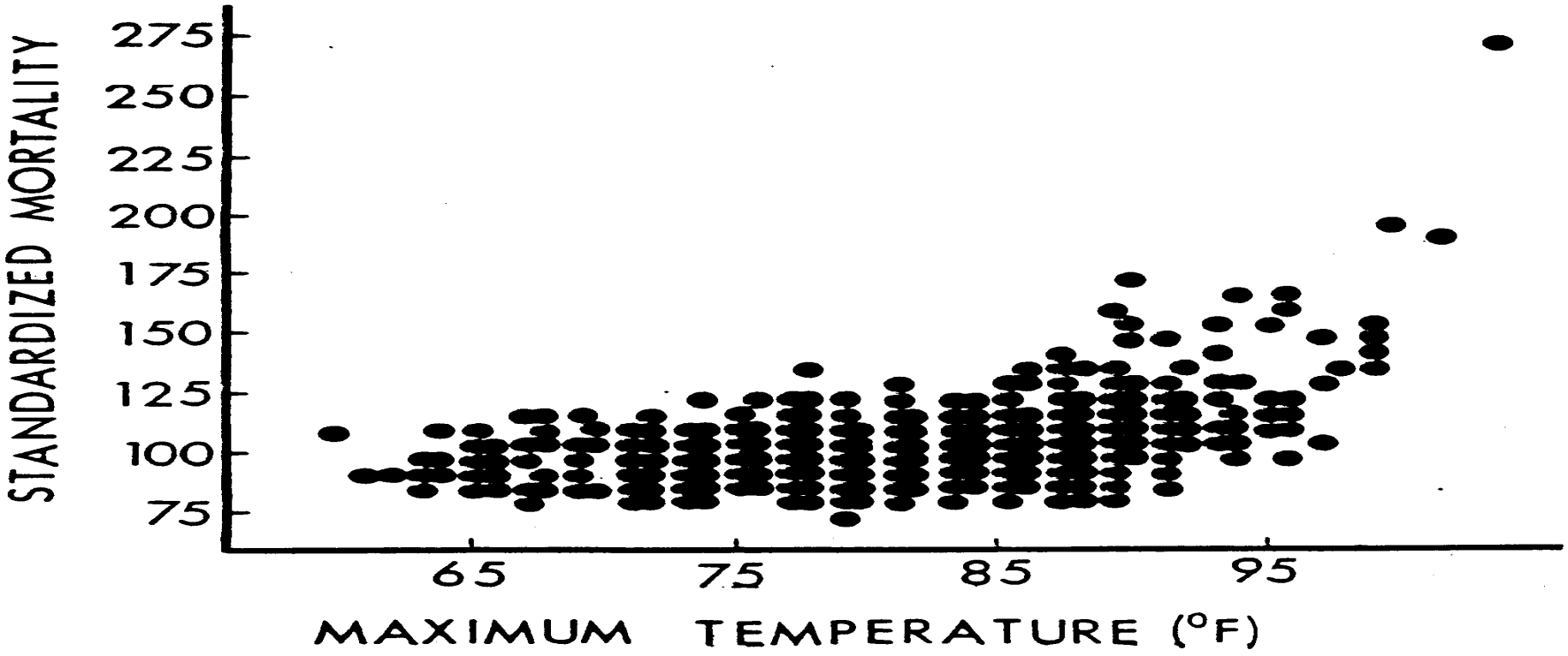
Jean-Marie Robine [a,*], Siu Lan K. Cheung [a], Sophie Le Roy [a], Herman Van Oyen [b], Clare Griffiths [c], Jean-Pierre Michel [d], François Richard Herrmann [d]



New York Daily Mortality with Temp

FIGURE V-8

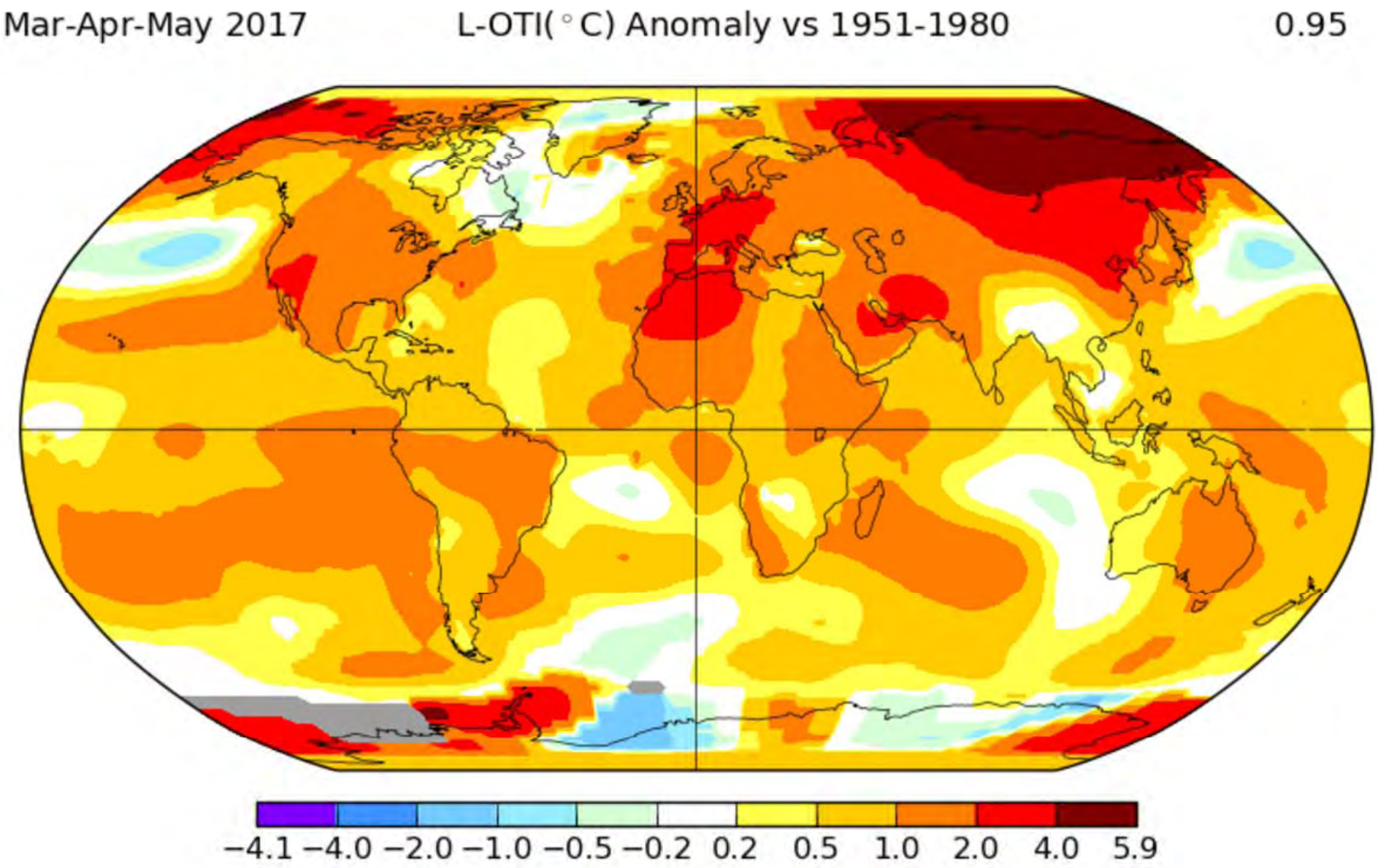
Daily Summer-Season Standarized Mortality Versus Maximum Temperature: New York



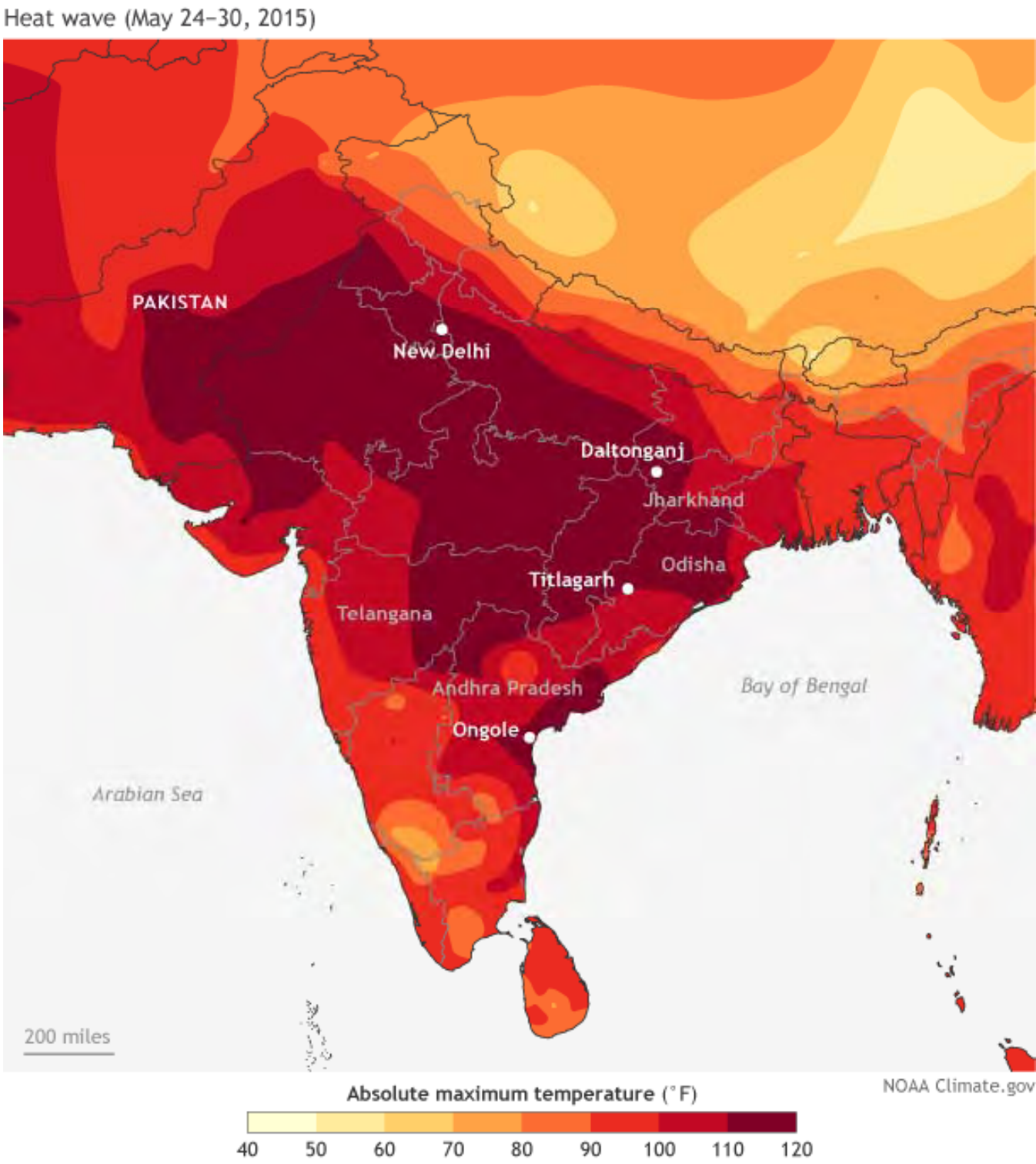
Source: Kalkstein, L.S., R.E. Davis, J.A. Skindlov, and K.M. Valimont. The impact of human-induced climatic warming upon human mortality: A New York City case study. Proceedings of the International Conference on Health and Environmental Effects of Ozone Modification and Climate Change, in press.

Forest and city fires during heat waves and summer

Temperature increase in 2017 as compared to 1951-80



Heat wave in 2015

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Heat wave in Pakistan - 2015

Pakistan – Rush to Buy Ice 2015

Pakistan Heat wave

Increase in severe heat waves with different climate scenario projections

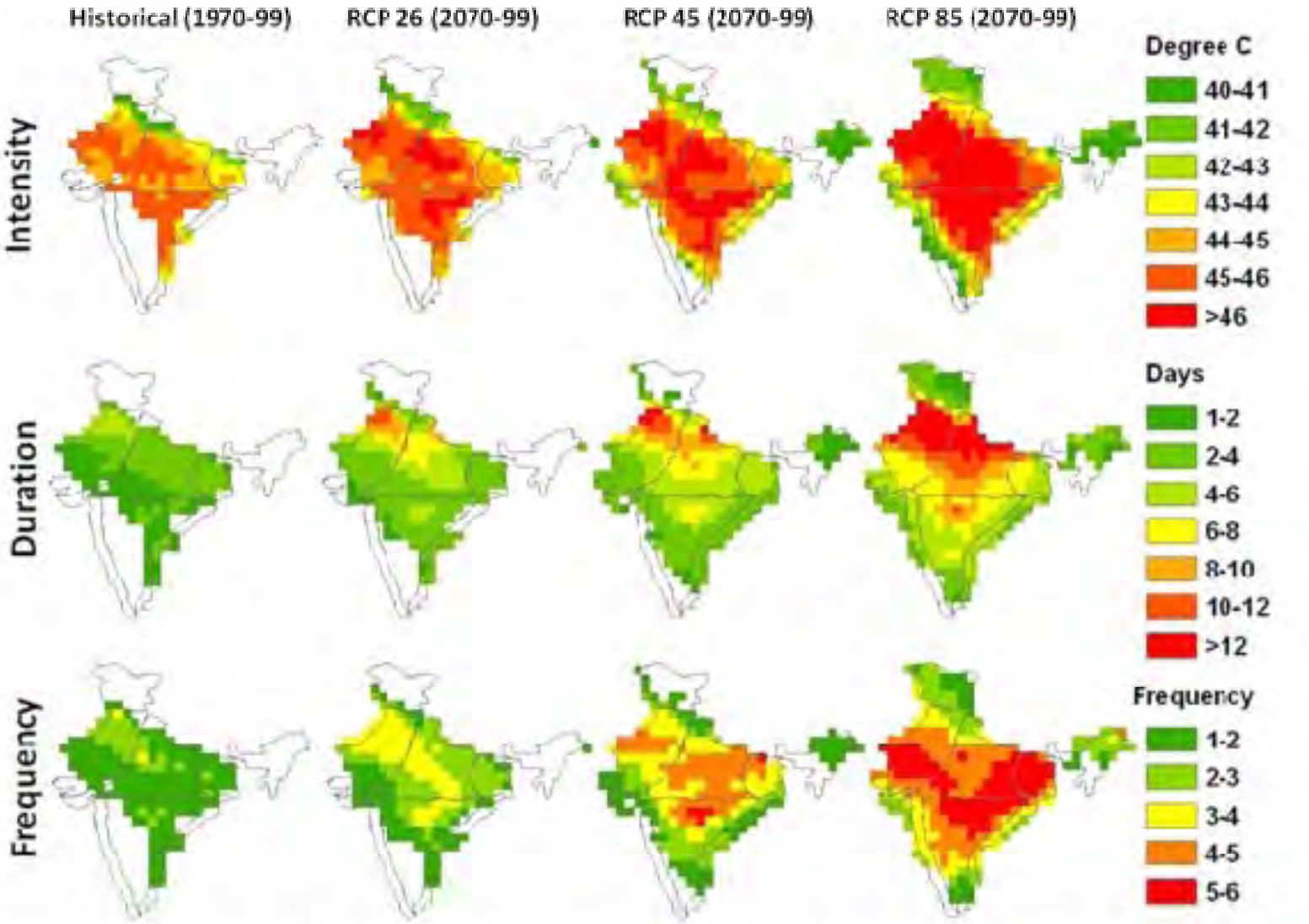


Fig. 2 Intensification of severe heat waves for different emission scenarios as predicted by the ensemble of 7 ESMs

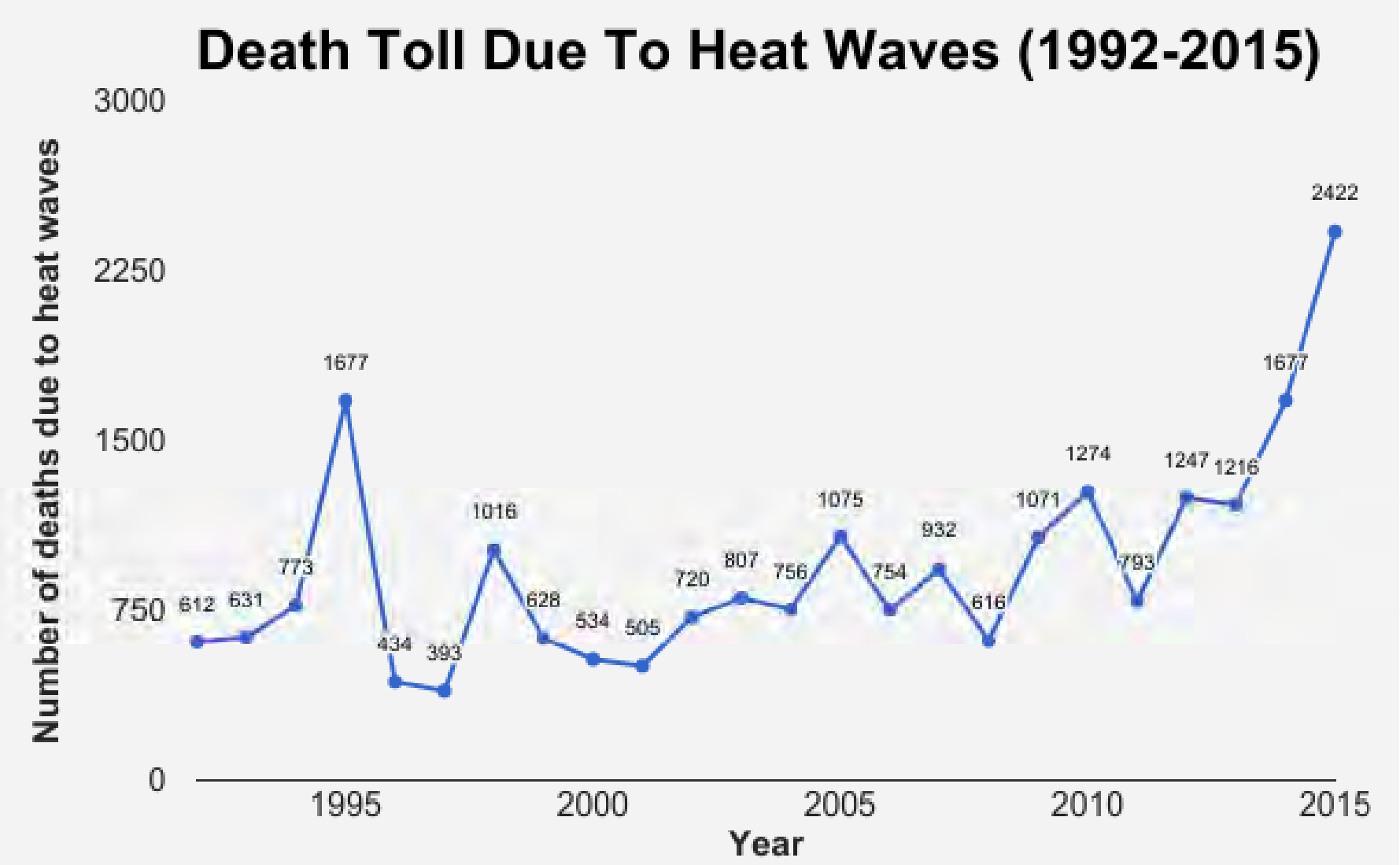
Source: Murari et al (2015)

Heat is here

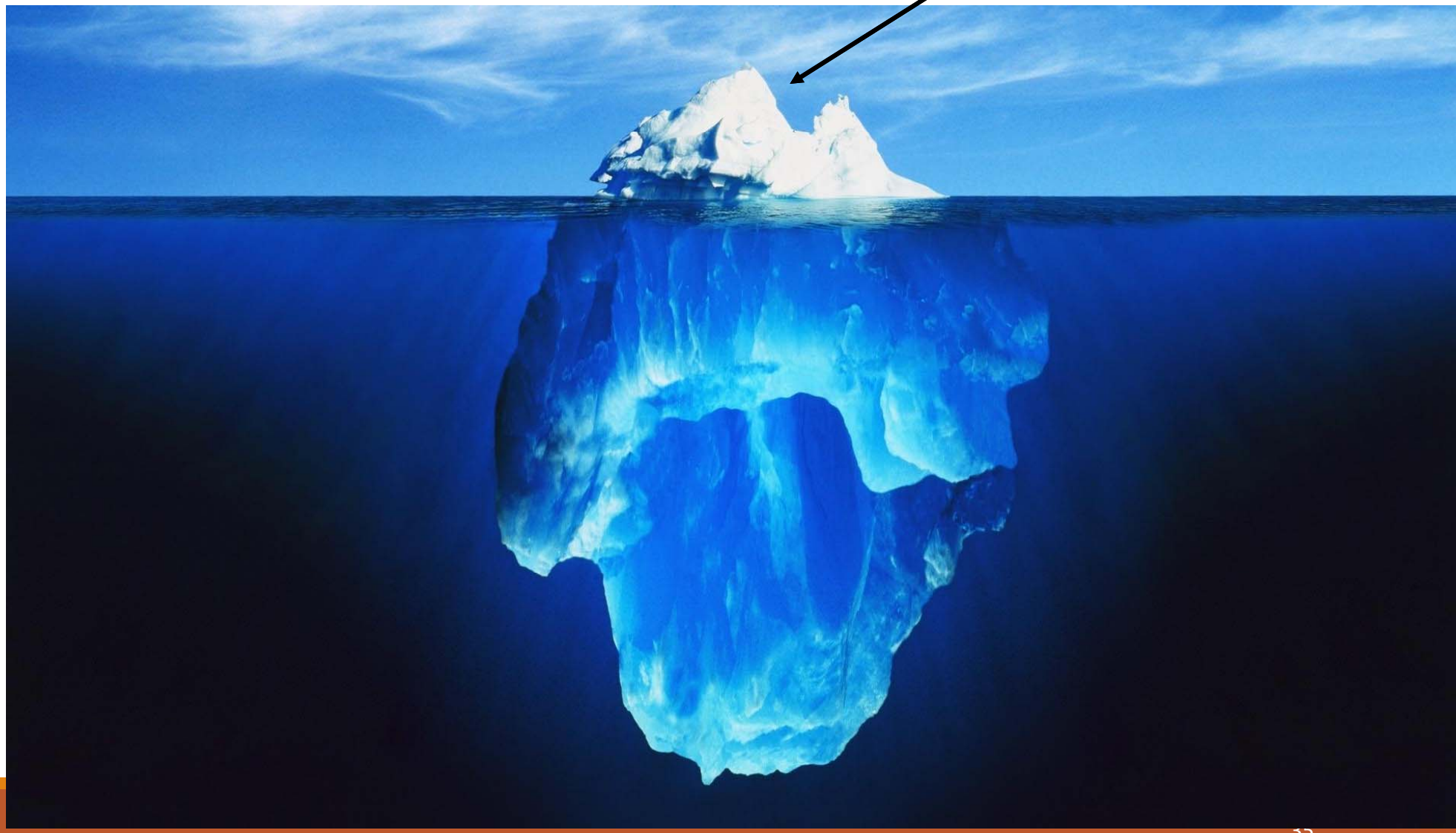
Bats Drop during excrement heat waves

Water shortage and heat in summer : deadly combination

Official death due to Heat waves : India

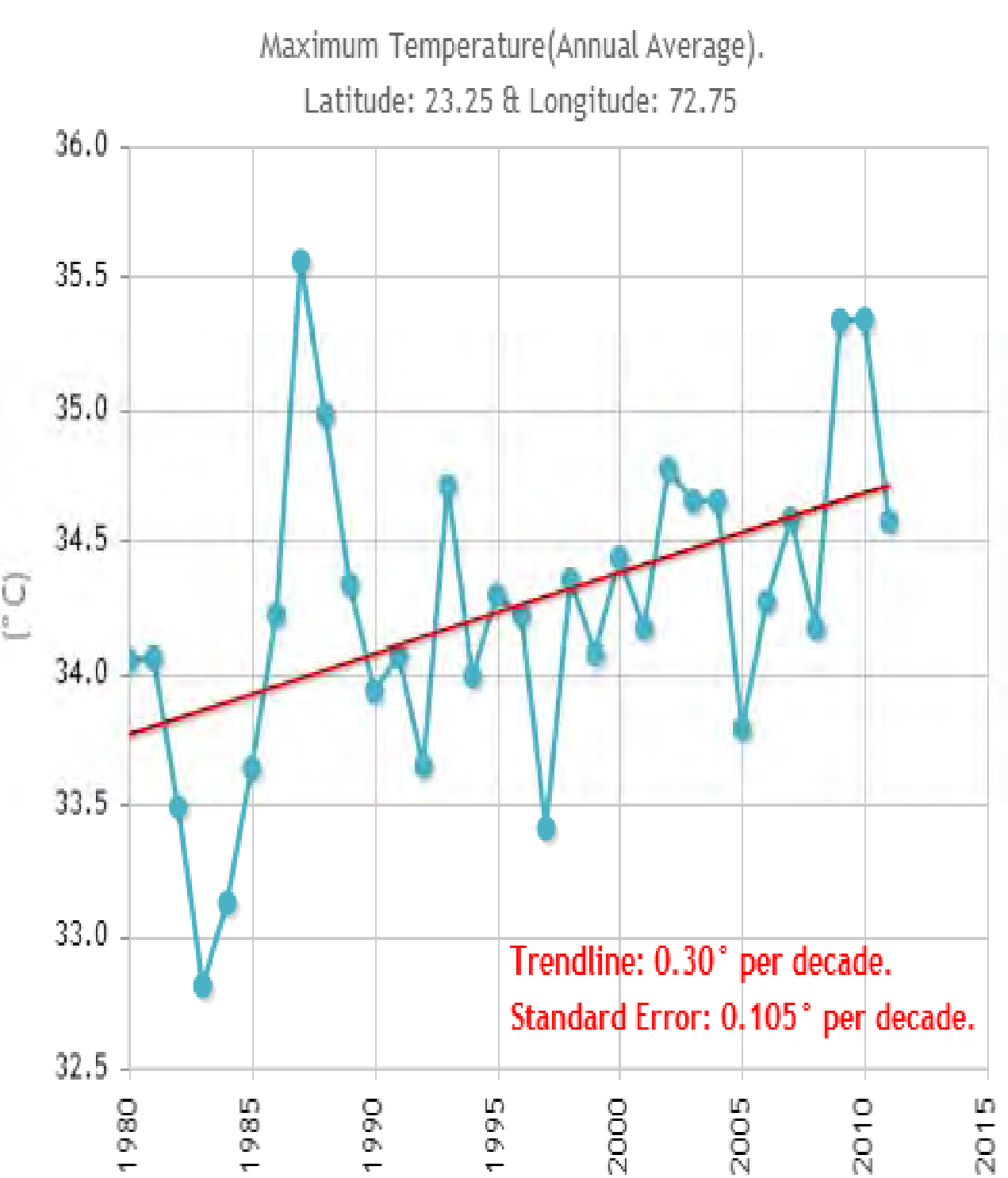


Heat wave deaths are like ice burgs -10% visible



Heat Action Plan for Ahmedabad city: journey and lessons

First scientific workshop in March 2011 followed by MOU signed with IIPHG, AMC, NRDC USA under Vibrant Gujarat

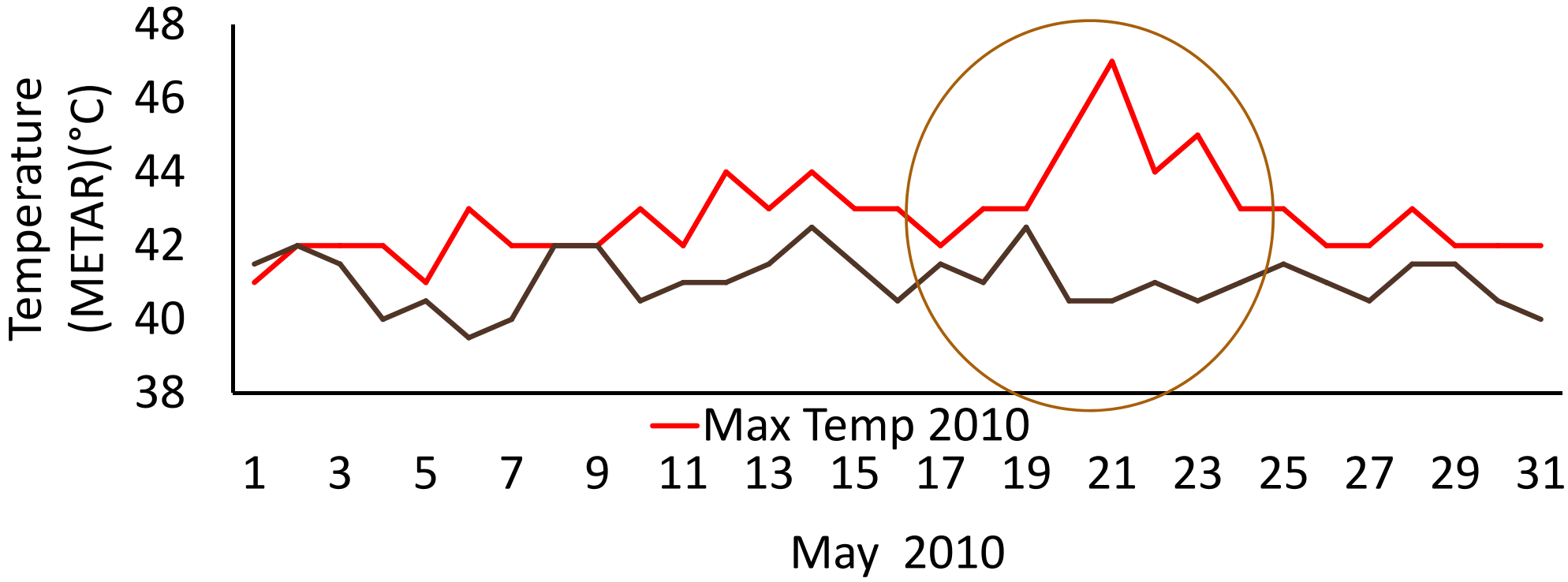


In Ahmedabad, annual average of maximum temperatures have been increasing steadily over the past 30 years

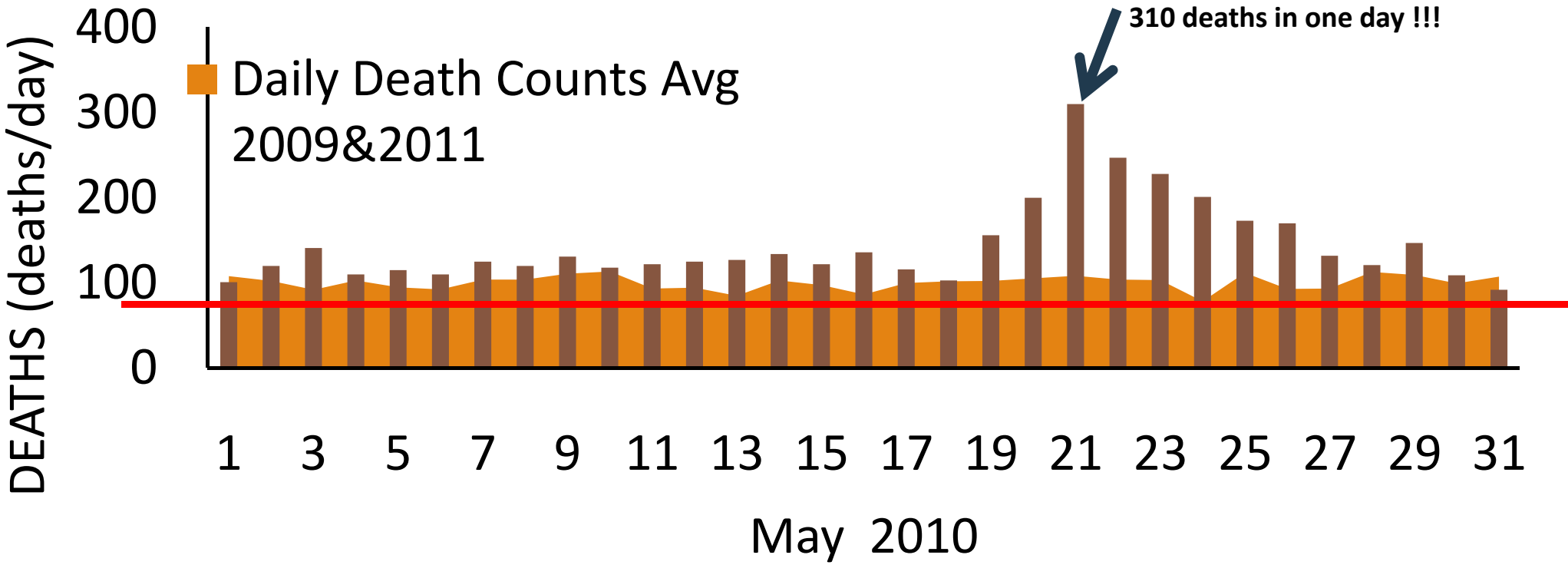
Graph data:

Analysis of temperature and mortality data of Ahemdabad.

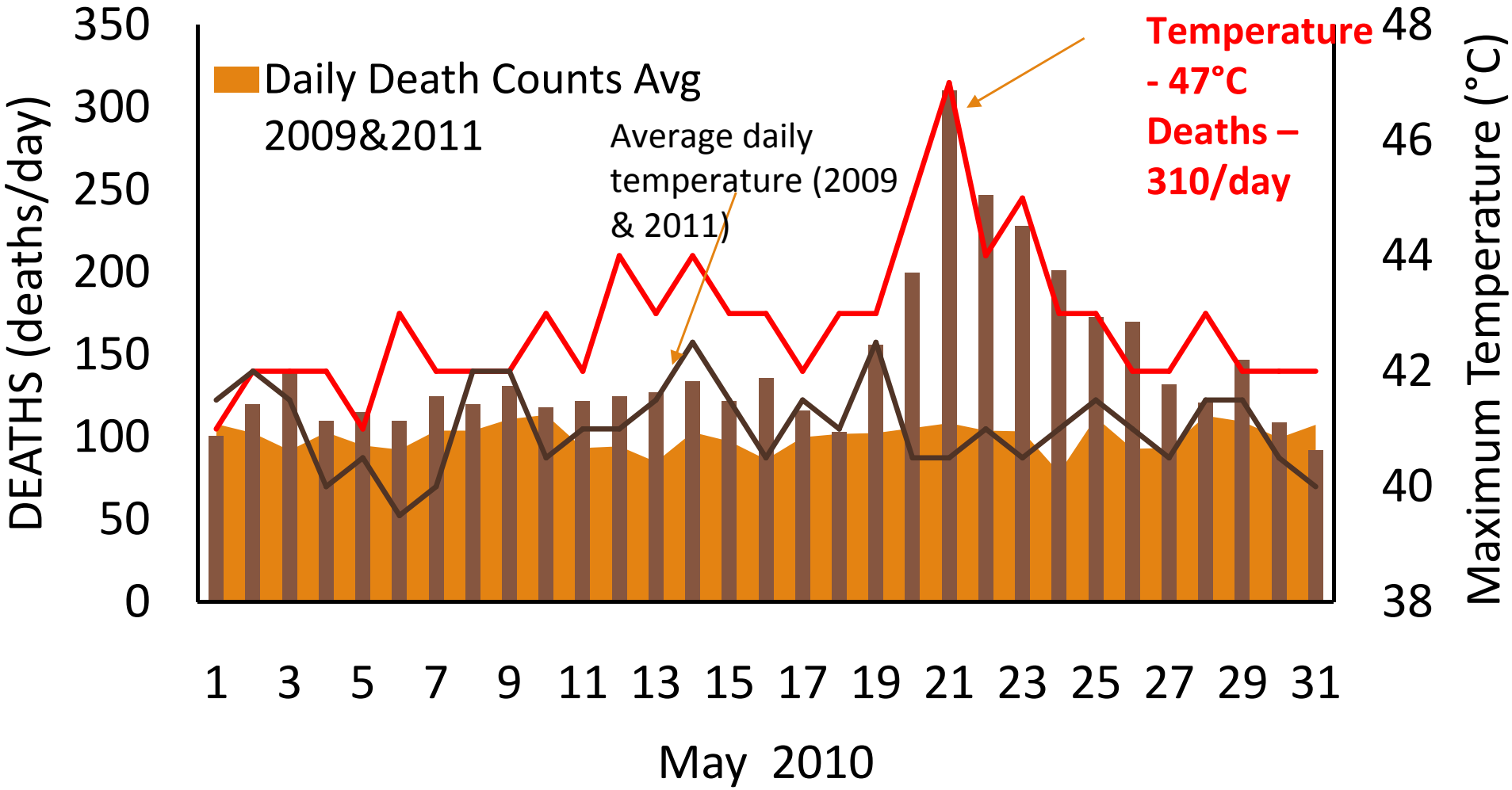
2010 Heat wave in Ahmedabad – Temp. reached 47deg C on 21st May



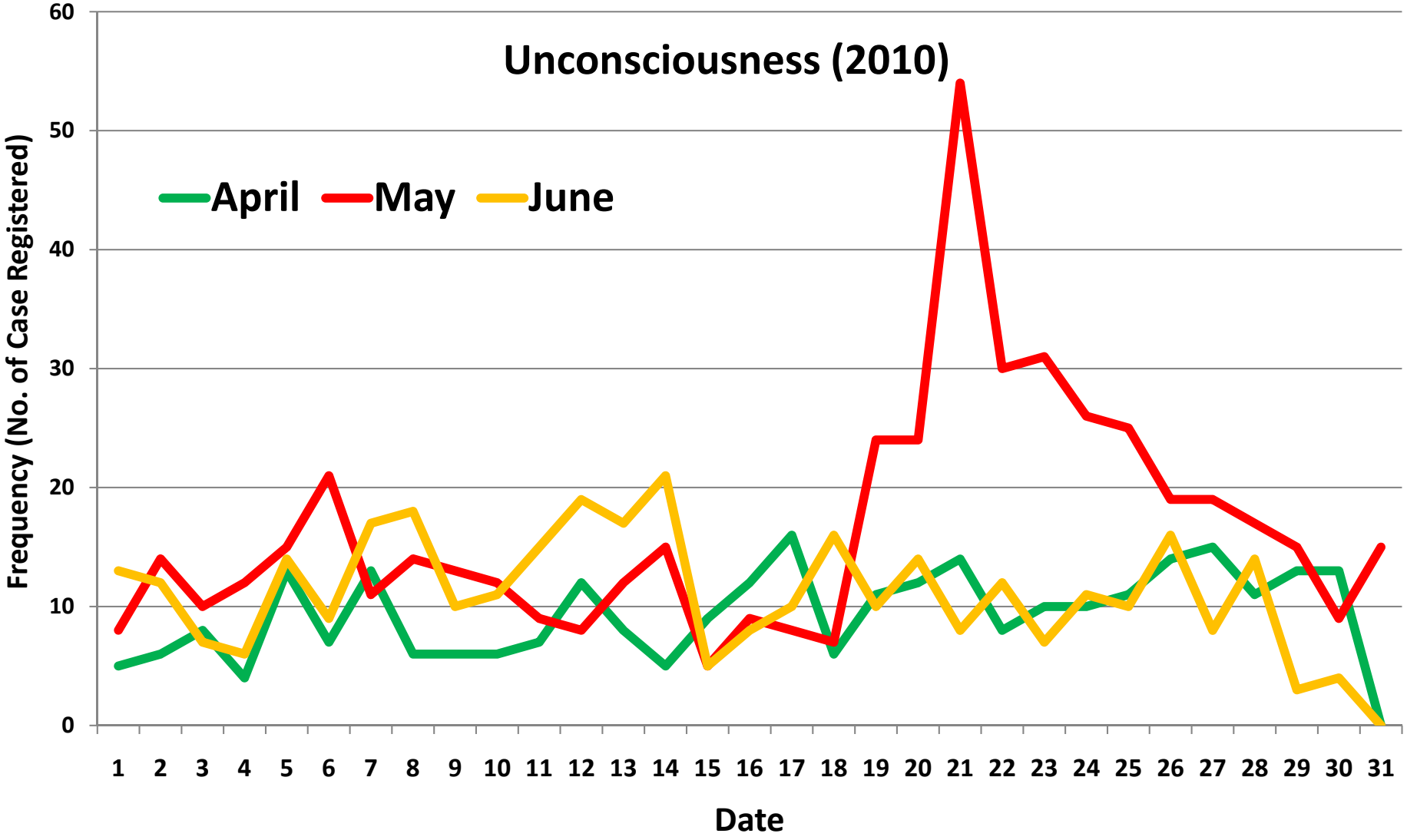
2010 Heat wave – daily mortality compared to 2009 and 2011 – 310 vs 100 deaths per day



2010 Ahmedabad "Heat Wave": May 20-27th – excess deaths 800 in one week and 1344 excess deaths in May 2010.



Ambulance calls for Unconsciousness case -EMRI 108

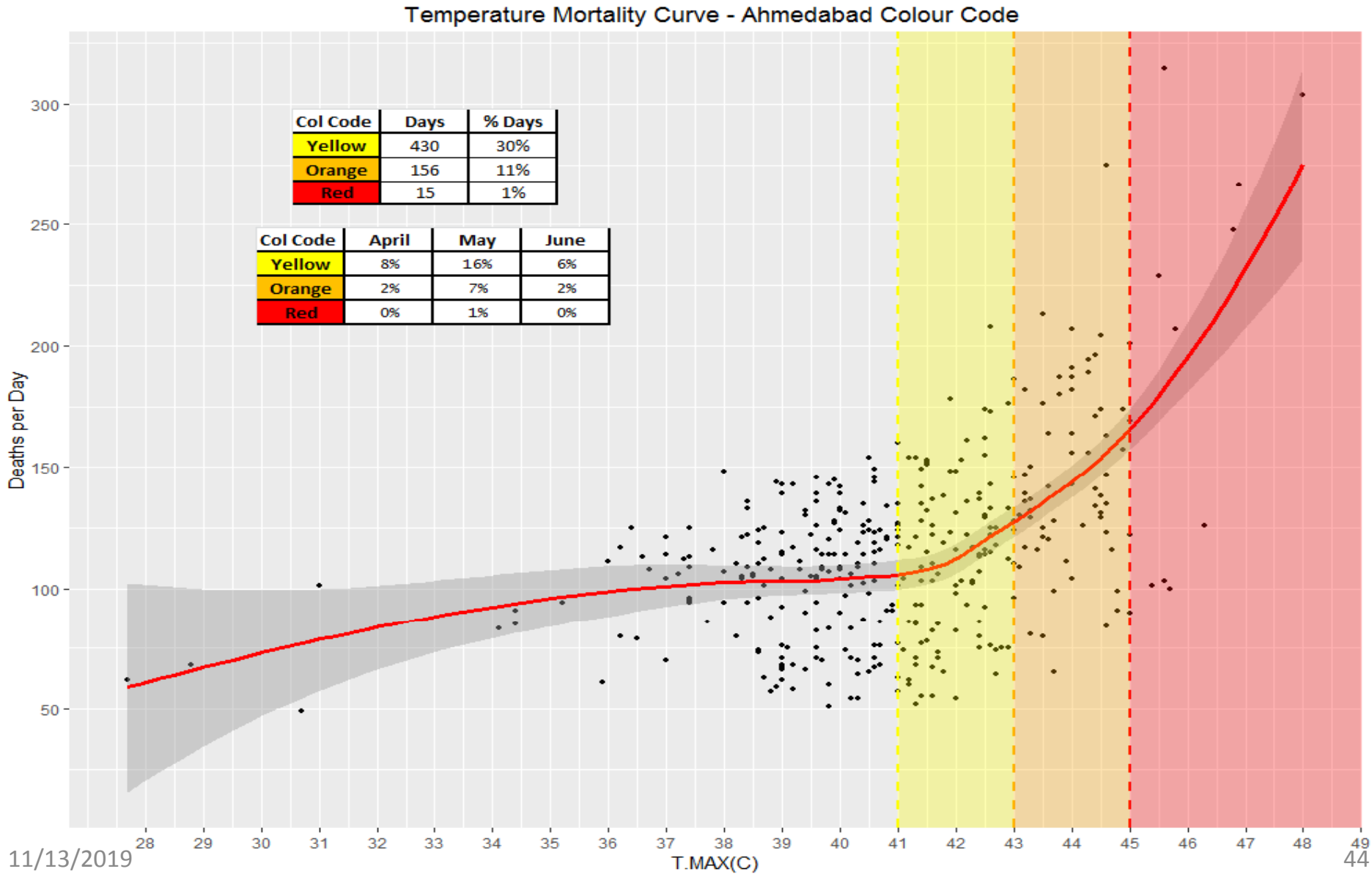


Scientific Work & advocacy

- **Establishing Temperature – Mortality Relationship**
- Scientifically determining the thresholds with color codes to issue warnings at various levels
- Assessing various vulnerable groups

- Communicating the findings to various policy groups, Governments, Scientific Community and other interested NGO's.

Temperature Mortality scatter plot and fitted Curve – Thresholds 41, 43, 45 deg C



Col Code	Days	% Days
Yellow	430	30%
Orange	156	11%
Red	15	1%

Col Code	April	May	June
Yellow	8%	16%	6%
Orange	2%	7%	2%
Red	0%	1%	0%

Slum Community Heat Vulnerability Survey

- *Method* - 300 slum community households surveyed (primarily female heads of household); providing information for a total of 1,650 individuals
- *Key Findings* – **Slum communities are vulnerable and unaware of temperature and extreme heat dangerous**
- Those who have not sought

Info on heat are *11 times more like*

to have heat illness.

- *Key Recommendations* – Educate, Warn & treat early


Summer 2011 community survey respondents

Heat related admissions and mortality among **new-borns** in Ahemdabad in 2010

— **Dr. Khyati Kakkad prof paediatrics, Ahmedabad and Dr. Perry Sheffield USA**

During April, May, and June 2010,

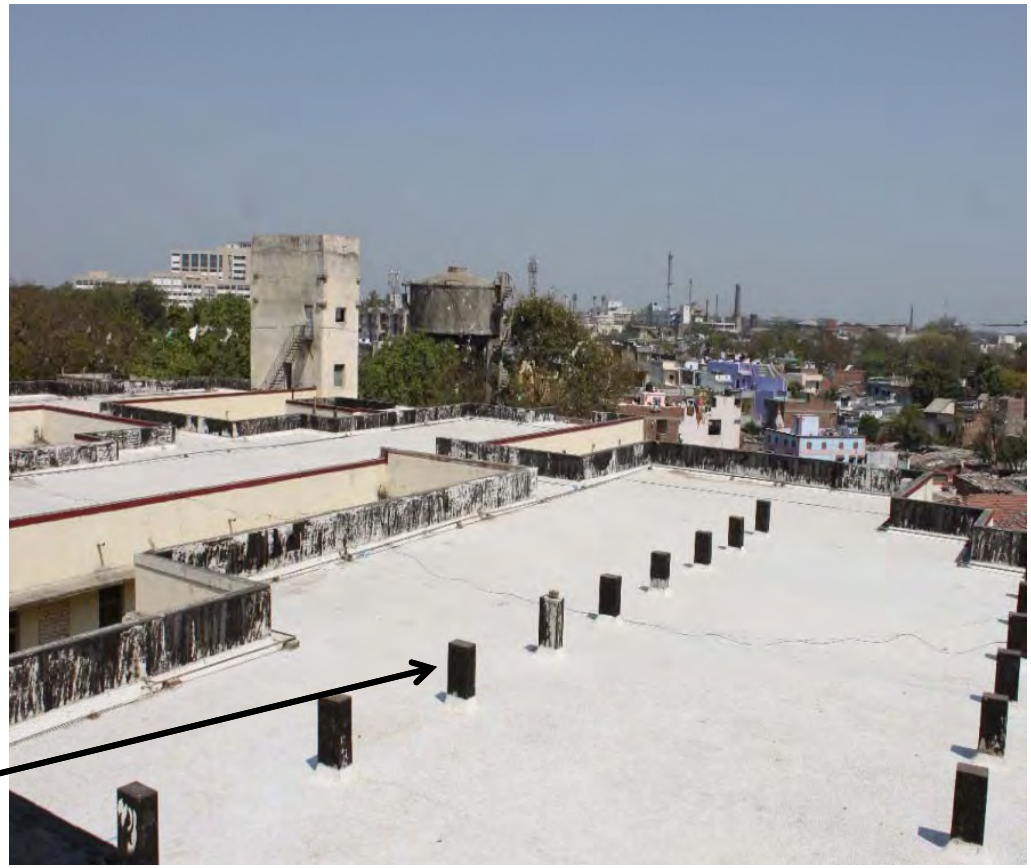
24 NICU admissions with high temp. without infection in newborns in SCL hospital: versus 8 and 4 admissions in 2009 and 2011, respectively

Increased NICU admissions in hospital ward: Possible cause - slum house have tin roof and poor ventilation etc. so gets very hot

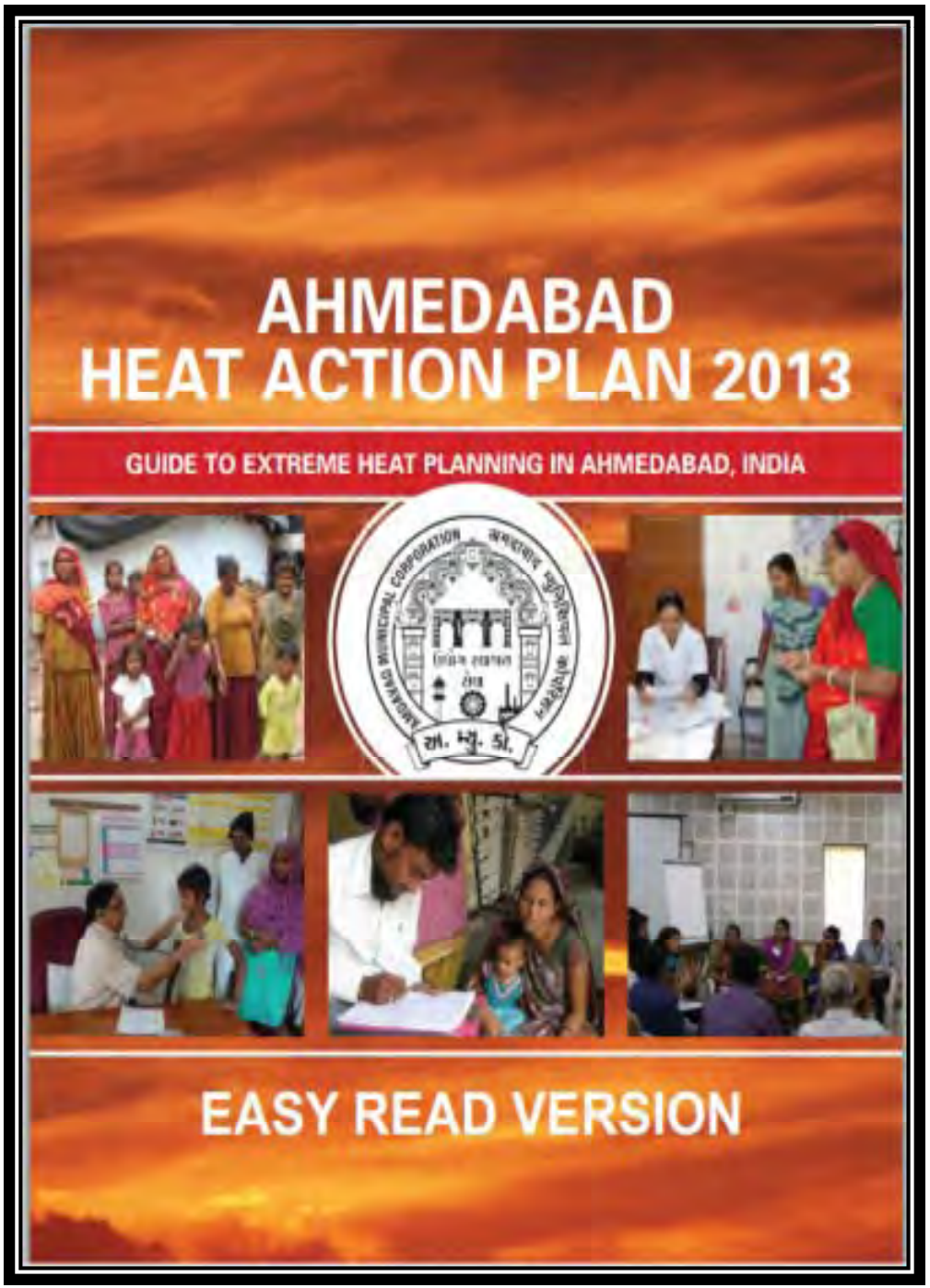
Some deaths happened in NICU:

Because NICU became very hot as it was on top floor and under black tar covered roof.

As a solution, NICU was moved to the ground floor and the roof was replaced with a cool roof (china mosaic).



Pilot AHMEDABAD HEAT ACTION PLAN in 2013



Key steps in developing HAP

- City government engagement
- Background data & analysis – weather and mortality / health
- Understanding city and vulnerable groups
- Early warning system and setting thresholds
- Feasible interventions and its detailing – IEC
- Writing the plan and disseminating
- Implementing and monitoring the impact
- Revising the plan and scaling it up

Fighting Climate Effects:
Protecting People from Extreme Heat in One of India's Fastest-Growing Cities

Focus Groups, Interviews, Pamphlets

- March 2012 Workshop, *Health Effects of Heat in Relation to Climate Change*
  - 2 focus groups held for health care professionals
  - Dozens of semi-structured interviews with govt.

Dr. Perry Sheffield, Mt. Sinai School of Medicine, with focus group of Ahmedabad medical professionals (Mar 2012).

Informational pamphlets and hoardings in English (left) and Gujarati (right),

Fighting Climate Effects:
Protecting People from Extreme Heat in One of India's Fastest-Growing Cities

Community Outreach

Intervention – 2

Building Capacity of medical community

Case Definitions

Heat Illness - Typical Presentations

Clinical Entity	Age Range	Setting	Cardinal Symptoms	Cardinal Signs	Pertinent Negatives	Prognosis
Heat rash	All, but frequently children	Hot environment; +/- insulating clothing or swaddling	Itchy rash with small red bumps at pores in setting of heat exposure; bumps can sometimes be filled with clear or white fluid	Diffuse maculopapular rash, occasionally pustular, at hair follicles; pruritic	Not focally distributed like a contact dermatitis; not confluent patchy; not petechial	Full recovery with elimination of exposure and supportive care
Heat cramps	All	Hot environment, typically with exertion, +/- insulating clothing	Painful spasms of large and frequently used muscle groups	Uncomfortable appearance, may have difficulty fully extending affected limbs/joints	No contaminated wounds/tetanus exposure; no seizure activity	Full recovery with elimination of exposure and supportive care
Heat exhaustion	All	Hot environment; +/- exertion; +/- insulating clothing or swaddling	Feeling overheated, lightheaded, exhausted and weak, unsteady, nauseated, sweaty and thirsty, inability to continue activities	Sweaty/diaphoretic; flushed skin; hot skin; normal core temperature; +/- dazed, +/- generalized weakness, slight disorientiation	No coincidental signs and symptoms of infection; no focal weakness; no aphasia/dysarthria; no overdose history	Full recovery with elimination of exposure and supportive care; progression if continued exposure
Heat syncope	Typically adults	Hot environment; +/- exertion; +/- insulating clothing or swaddling	Feeling hot and weak; lightheadedness followed by brief loss of consciousness	Brief, generalized loss of consciousness in hot setting, short period of disorientation if any	No seizure activity, no loss of bowel or bladder continence, no focal weakness, no aphasia/dysarthria	Full recovery with elimination of exposure and supportive care; progression if continued exposure
Heat stroke	All	Hot environment; +/- exertion; +/- insulating clothing or swaddling	Severe overheating; profound weakness; disorientation, obtundation, seizures, or other altered mental status	Flushed, dry skin (not always), core temp ≥40°C; altered mental status with disorientation, possibly delirium, coma, seizures; tachycardia; +/- hypotension	No coincidental signs and symptoms of infection; no focal weakness; no aphasia/dysarthria; no overdose history	25-50% mortality even with aggressive care; significant morbidity if survive

Intervention – 3 *Reducing Heat Exposure & Promoting Adaptive Measures – water, cooling centers*

Intervention – 4

Early Warning System &

Inter-Agency Emergency Response Plan

भारत सरकार
पृथ्वी विज्ञान मंत्रालय
भारत मौसम विज्ञान विभाग
मौसम केंद्र,
आर एस/आर डब्ल्यू भवन,
हवाई अड्डा, अहमदाबाद-382,475
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Government of India
Ministry of Earth Sciences
India Meteorological Department
Meteorological Centre,
RS/RW Building, Airport,
Ahmedabad-382 475.
Phone: 070-22865012
Fax: 079-22865449

Issuing Office: Meteorological Centre, Ahmedabad
Time of Origin : 1200 Hrs. IST
Date : 09/05/ 2016
HAP2016050901

Five days City weather forecast (Maximum temperature forecast) for Ahmedabad

Maximum Temperature forecast	Maximum temperature in deg Celsius	Probability of occurrences	High Temperature Warning
Day1 (Valid from time of origin to 0830 Hrs. IST of 10/05/2016)	43	Most likely	
Day2(Valid from 0830 Hrs. IST of 10/05/2016 to 0830 Hrs. IST of 11/05/2016)	43	Most likely	
Day3(Valid from 0830 Hrs. IST of 11/05 /2016 to 0830 Hrs. IST of 12/05/2016)	43	Very likely	
Day4(Valid from 0830 Hrs. IST of 12/05 /2016 to 0830 Hrs. IST of 13/05/2016)	44	Likely	
Day5(Valid from 0830 Hrs. IST of 13/05 /2016 to 0830 Hrs. IST of 14/05/2016)	44	Likely	

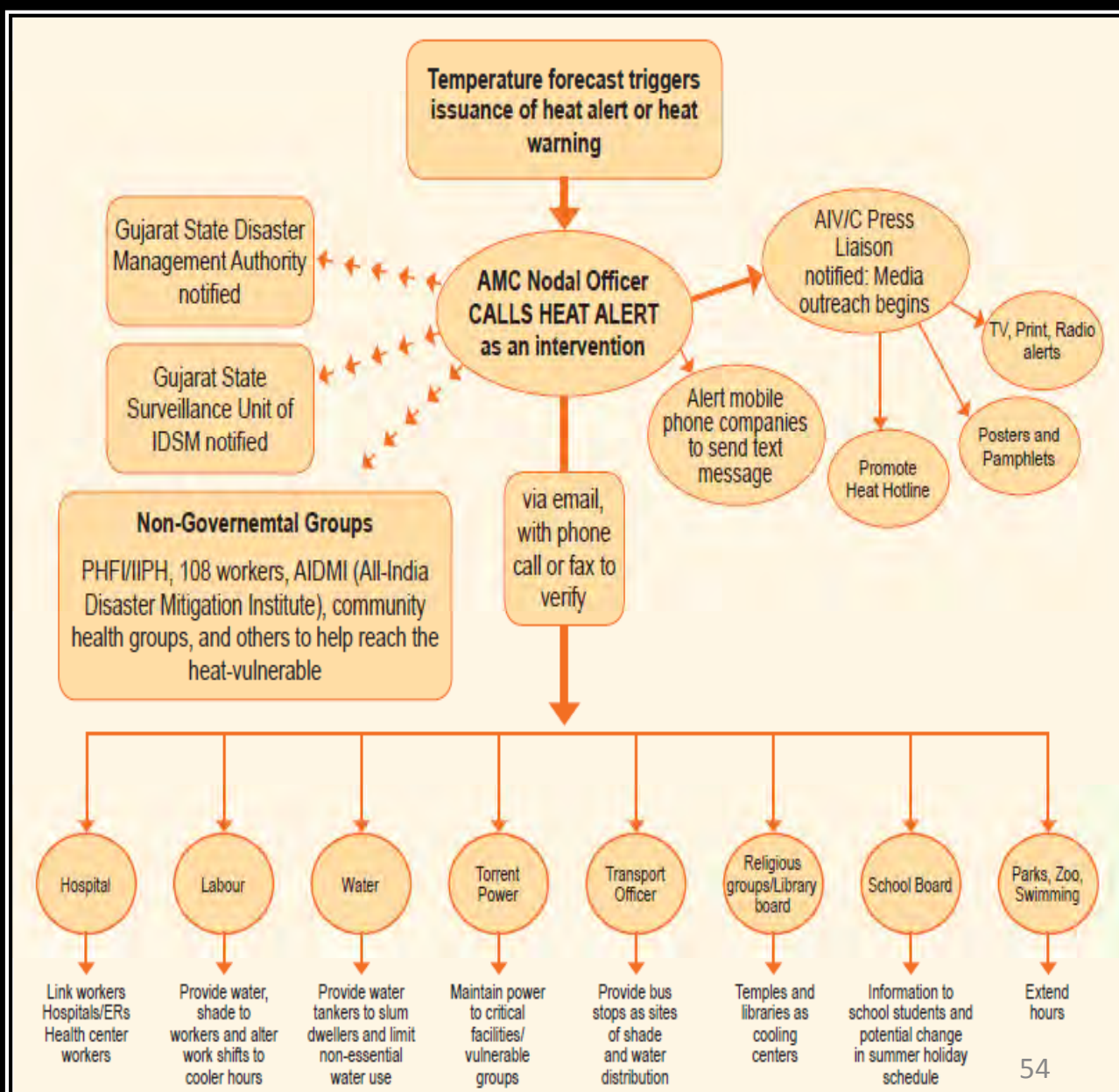
Legend: **Probability of occurrences**

Unlikely: less than 25 %
Likely: 25 to 50 %
Very likely: 50 to 75 %
Most likely: 75 to 100 %

Levels:

Yellow: 41.1- 43 deg Celsius
Orange: 43.1- 44.9 deg Celsius
Red: ≥45.0 deg Celsius

For Director In-charge
Meteorological Centre
Ahmedabad



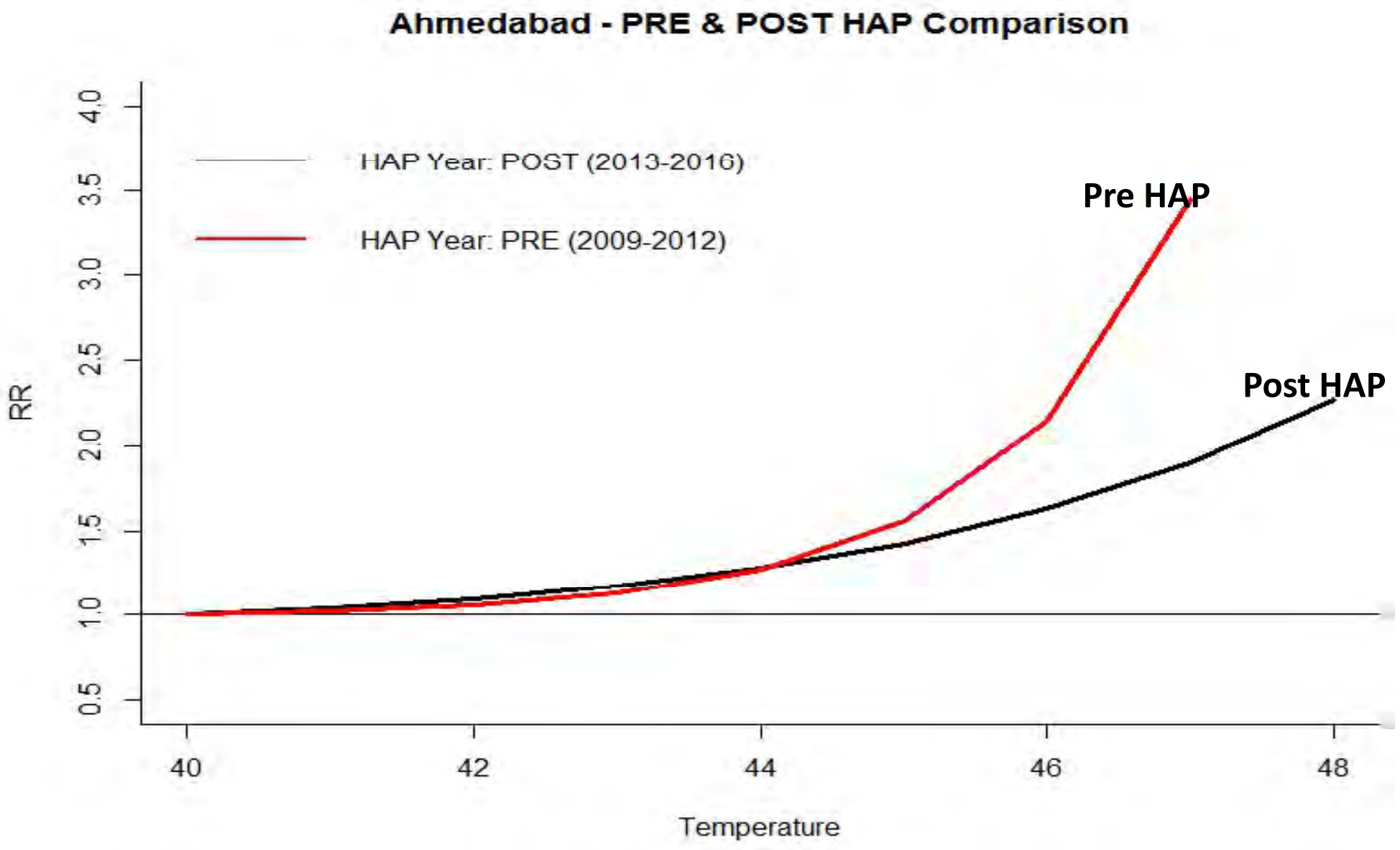
HAP - 2017, Cool Roofs Initiative by AMC

Impact of Heat Action Plan

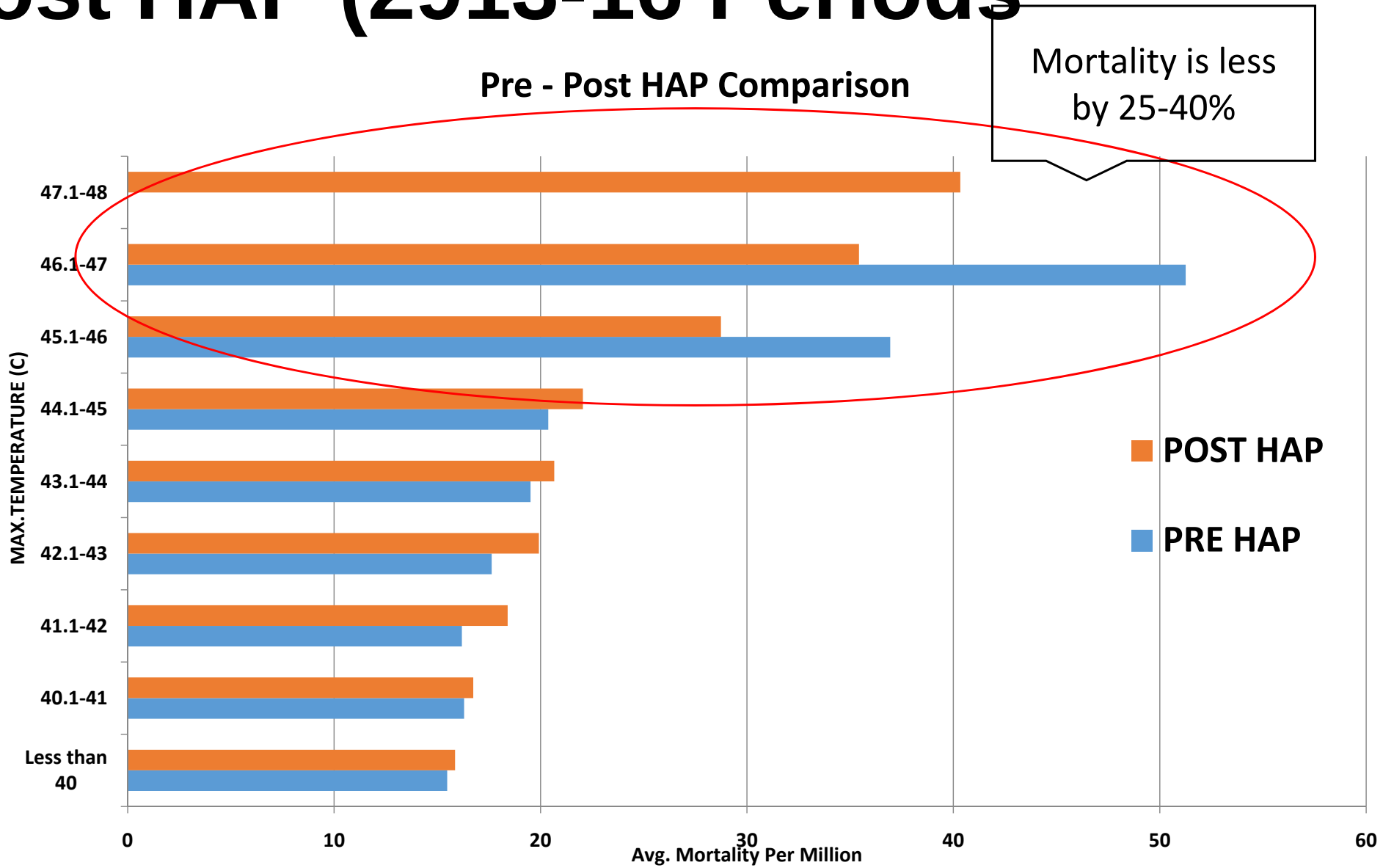
- Reduction in all cause of mortality during heat waves

- Decrease in heatstroke cases and deaths

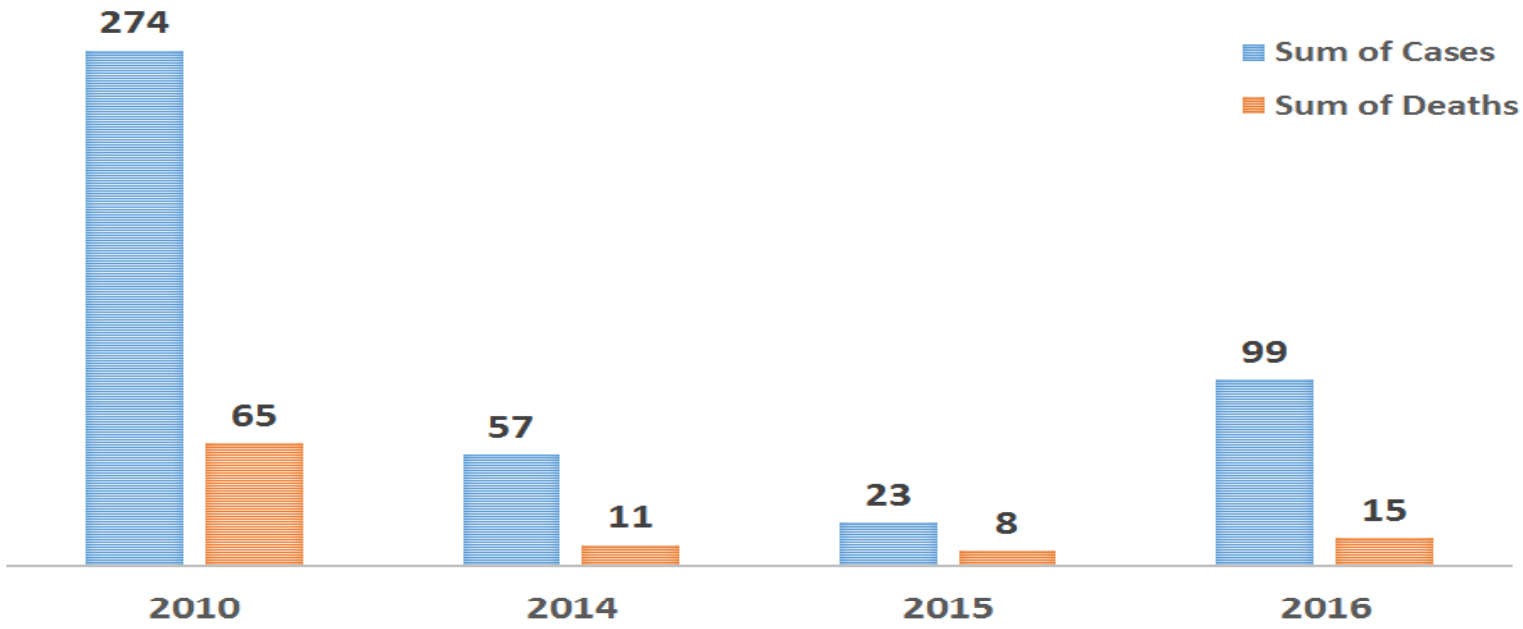
Relative Risk of Death with max temperature – Ahmedabad Pre & Post HAP



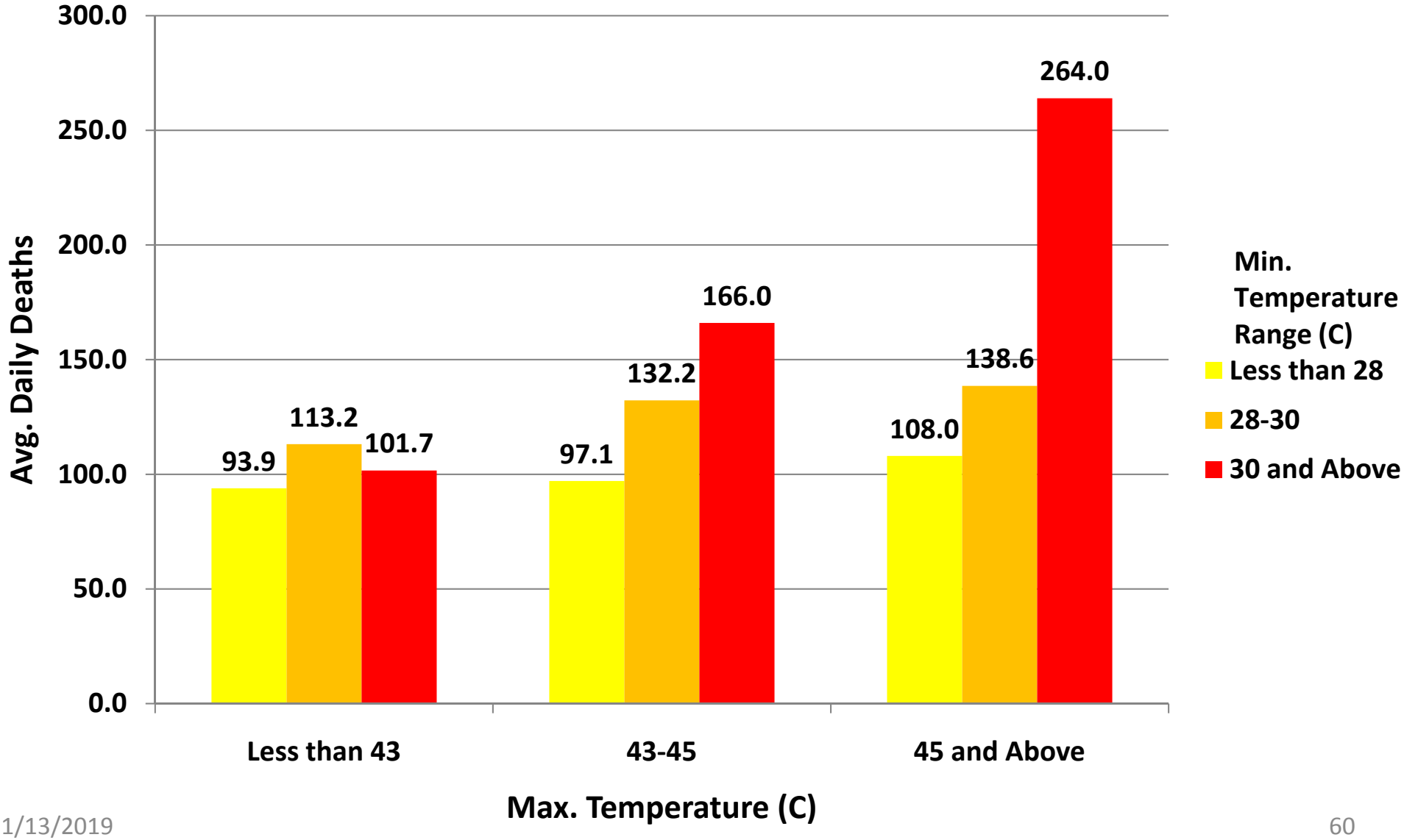
Mortality per million for Max temp. Ahmedabad - Pre (2009-12) and Post HAP (2913-16 Periods



Heat Stroke Mortality and Morbidity before and after HAP on Selected 5 Municipal Hospitals of AMC



Combined effect of Min – Max Temperature on Ave. Daily Deaths in Ahmedabad 2001-2015



Scale up of HAP in other states

- Maharashtra govt asked us to help set up HAP in 7 cities near Nagpur
- NDMA asked to help develop a model national plan for Heat
- Rajasthan UNICEF asked us to help develop heat action plan and cold action plan for 2 rural talukas in Rajasthan

Policy Papers: Issue Briefs

Available online from:
http://www.nrdc.org/international/india/extreme-heat-preparedness/

Recommendations for Vulnerable Groups and Primary Actors

- Municipal Government
- Medical Providers
- Workers in High-Risk Occupations
- Slum Communities

Recognition Heat as a Disaster and Need for HAP

NDMA BETA VERSION RELEASED

Skip to Main Content | -A A +A

National Disaster Management Authority
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सुरक्षा किट

- एक रेडियो और टोर्च तथा अतिरिक्त बैटरियां
- पेय जल, क्लोरिन गोलियां और खाद्य पदार्थ
- मोमबतियां और एक माचिस
- बुखार, सर दर्द, आदि जैसी सामान्य बीमारियों के लिए दवाइयां
- आपात दूरभाष नंबर और पतों की सूची
- पेय जल लाने के लिए प्लास्टिक की बाल्टी
- सभी चीजे ले जाने के लिए एक वाटर प्रूफ थैला
- राशन कार्ड और पहचान– पत्र जैसे महत्वपूर्ण दस्तावेज

Alert | WEATHER WARNING:- 27 September (Day 1): ♦ Heavy

Search... Go

Heat Wave

- Information
- Do's and Dont's
- Recover and Build
- Emergency Kit

Information

A Heat Wave is a period of abnormally high temperatures, more than the normal maximum temperature that occurs during the summer season in the North-Western parts of India. Heat Waves typically occur between March and June, and in some rare cases even extend till July. The extreme temperatures and resultant atmospheric conditions adversely affect people living in these regions as they cause physiological stress, sometimes resulting in death.

The Indian Meteorological Department (IMD) has given the following criteria for Heat Waves :

- Heat Wave need not be considered till maximum temperature of a station reaches atleast 40°C for Plains and atleast 30°C for Hilly regions
- When normal maximum temperature of a station is less than or equal to 40°C Heat Wave Departure from normal is 5°C to 6°C Severe Heat Wave Departure from normal is 7°C or more
- When normal maximum temperature of a station is more than 40°C Heat Wave Departure from normal is 4°C to 5°C Severe Heat Wave Departure from normal is 6°C or more

THE ASIAN AGE

Delhi | Mumbai | Kolkata | London

Published on *The Asian Age* (http://www.asianage.com)

Home > India > 'UP, Bihar must follow Gujarat'

'UP, Bihar must follow Gujarat'

By *editor*
Created *11 Jun 2014 - 00:00*

Vardhan slams states' action in battle against encephalitis

Bihar CM Nitish Kumar and Uttar Pradesh ruling party chief Mulayam Singh Yadav may not be publicly subscribing to Prime Minister Modi's style of functioning, the Centre has suggested the two states to subscribe the Gujarat model in dealing with menacing encephalitis, that has resulted in 500-600 deaths this year so far.

Harsh Vardhan at a meeting to review encephalitis cases in Uttar Pradesh and Bihar

In a meeting held today Dr Harsh Vardhan asked both UP and Bihar officials to replicate the "early warning system" installed in Ahmedabad. The minister asked the officials to approach the Natural Resources Defence Council and the Indian Institute of Public Health to replicate the existing system of Ahmedabad. "The government of Gujarat gets support from local health and environment groups to prepare local communities to the onset of extreme heat so that they can take all the necessary steps to protect themselves. My ministry will be happy to extend all possible assistance to put in place a preparedness plan," he said during a high-level meeting held Tuesday, following recent deaths of over 40 children in Bihar due to encephalitis.

Expanding HAP across India with help from NDMA – state DMA

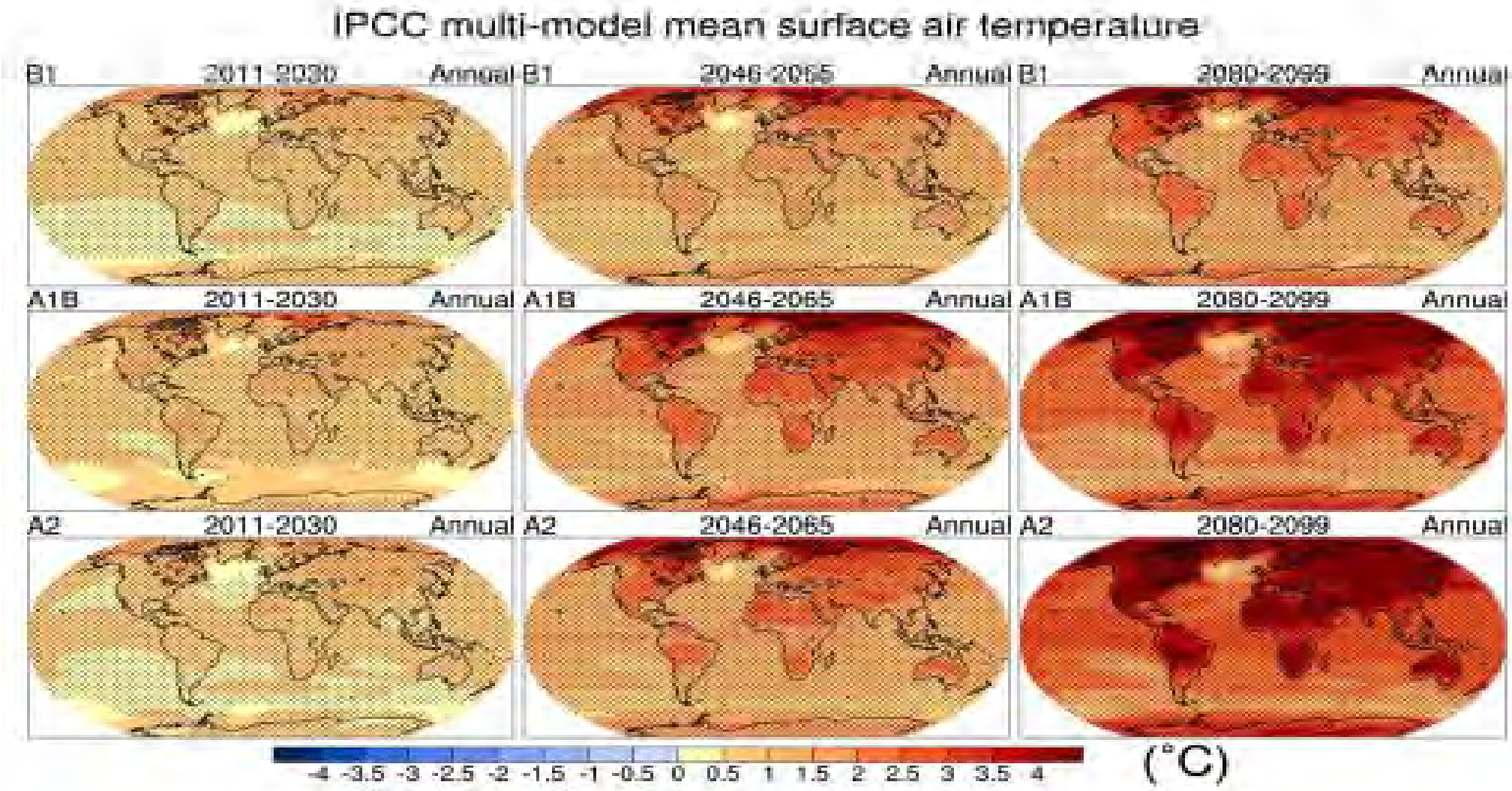
- States with HAP
  - Haryana
  - Odhisa,
  - Telangana,
  - Andhra Pradesh,
  - Uttar Pradesh
  - Bihar
  - Karnataka

- HAP as a part of State Disaster Management Plan
  - Gujarat
  - Rajasthan

Key lessons on development of HAP at local level

- Involvement of Local city or district administrative and health and political leadership
- Use of Local IMD and Heath data -death registration, OPD, Indoor admission, ambulance calls… data
- Facilitation by local and national institutions / experts
- Learning and adapted HAP developed in other countries / cities
- Measurement of process of implementation and Impact on mortality and morbidity

This is the beginning of climate change – worse still to come – so lets prepare now for next 80 years



Thank You from all the partners