



Development, implementation and impact of Ahmedabad Heat Action Plan and its scaling to national level

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Key Areas of Health Research Degrees MPH, MHA, PGDPHM,



Chicago Heat Wave

Cook County, July 11–27, 1995:

Excess deaths compared with this time period during an average year: **about 700**

Deaths classified as “heat-related” on death certificates (not shown here): **465**



Who are affected in heat wave: old, isolated, without cooling or support



Mass Grave in Chicago after Heat Wave



[Link to this photo](#)

The mass burial of 68 unclaimed bodies, including 41 people who died in the heat wave according to officials, in Homewood on Aug. 25, 1995.

Heat wave – Global Scenario



ELSEVIER

Available online at www.sciencedirect.com



C. R. Biologies 331 (2008) 171–178

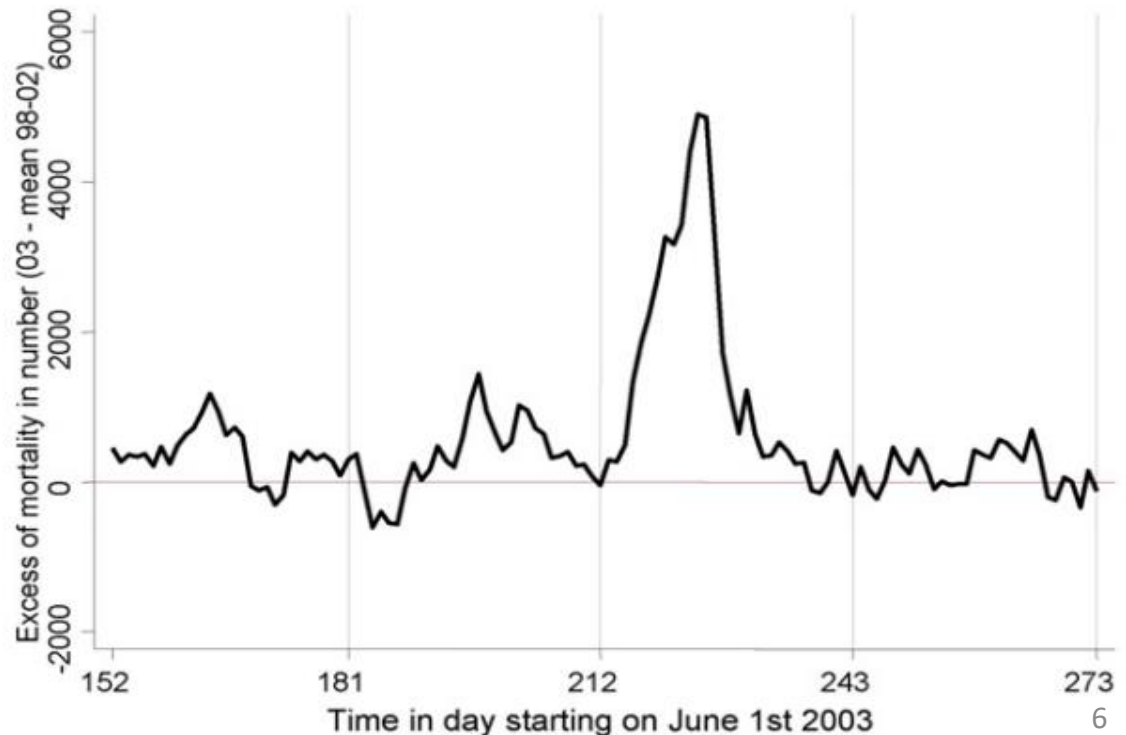
Epidemiology / Épidémiologie



<http://france.elsevier.com/direct/CRASS3/>

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

Jean-Marie Robine^{a,*}, Siu Lan K. Chan^b,
Clare Griffiths^c, Jean-Pierre Lallemand^d



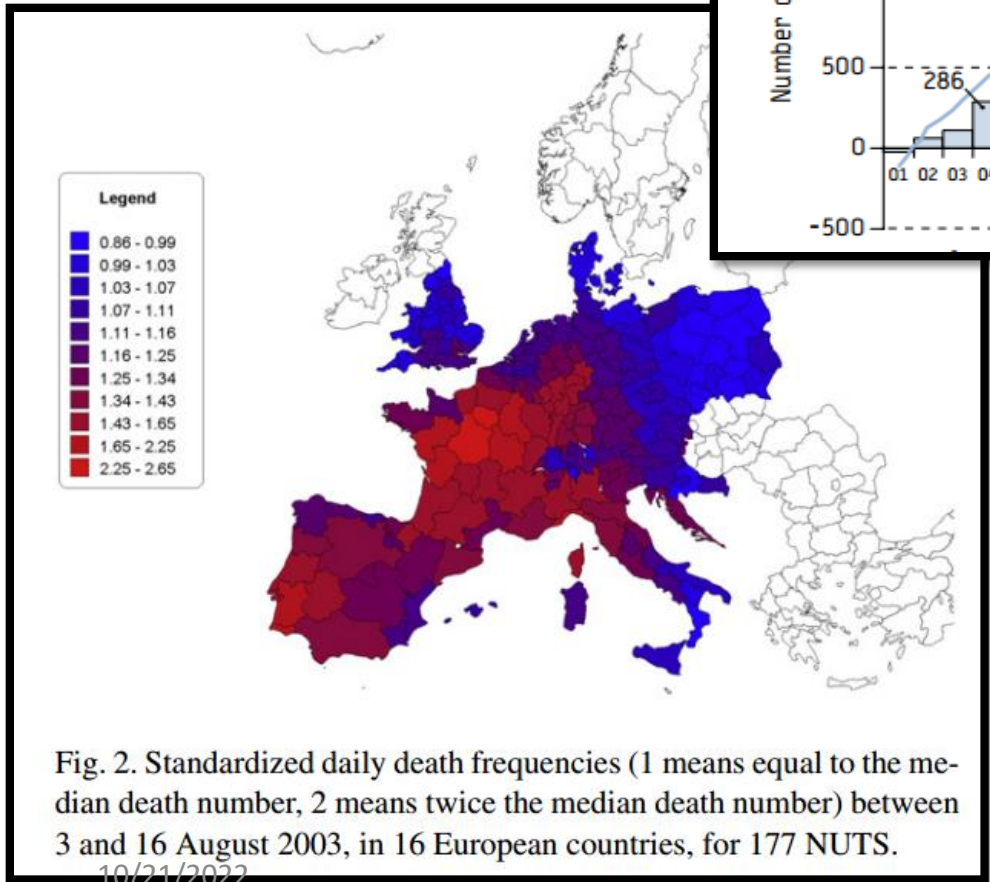
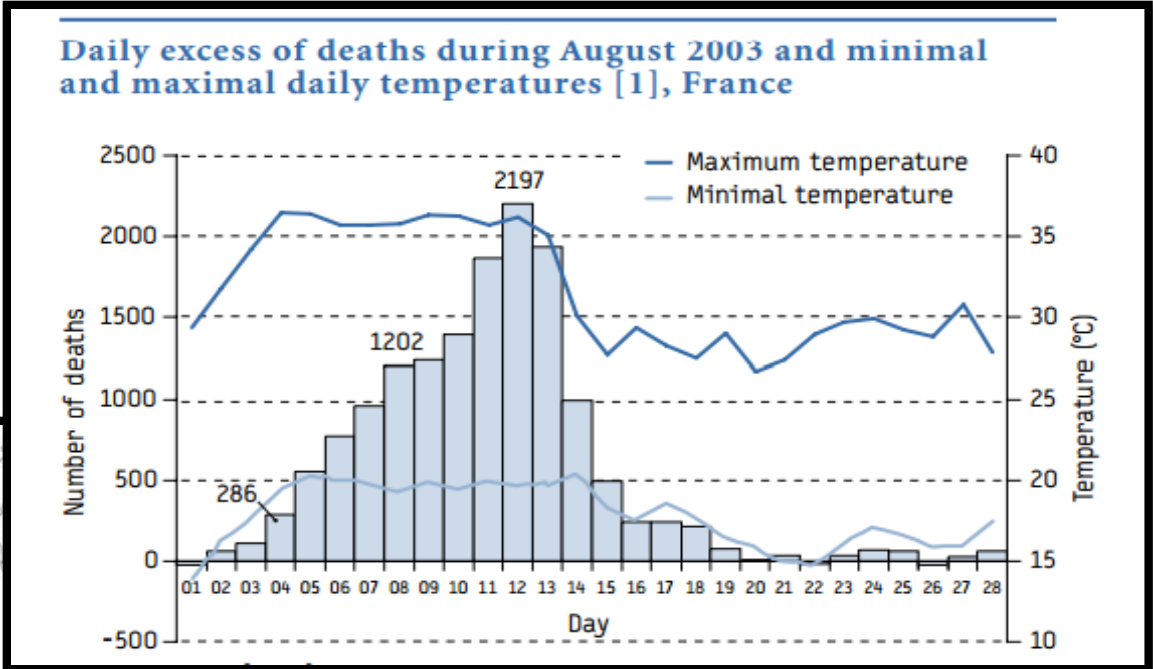
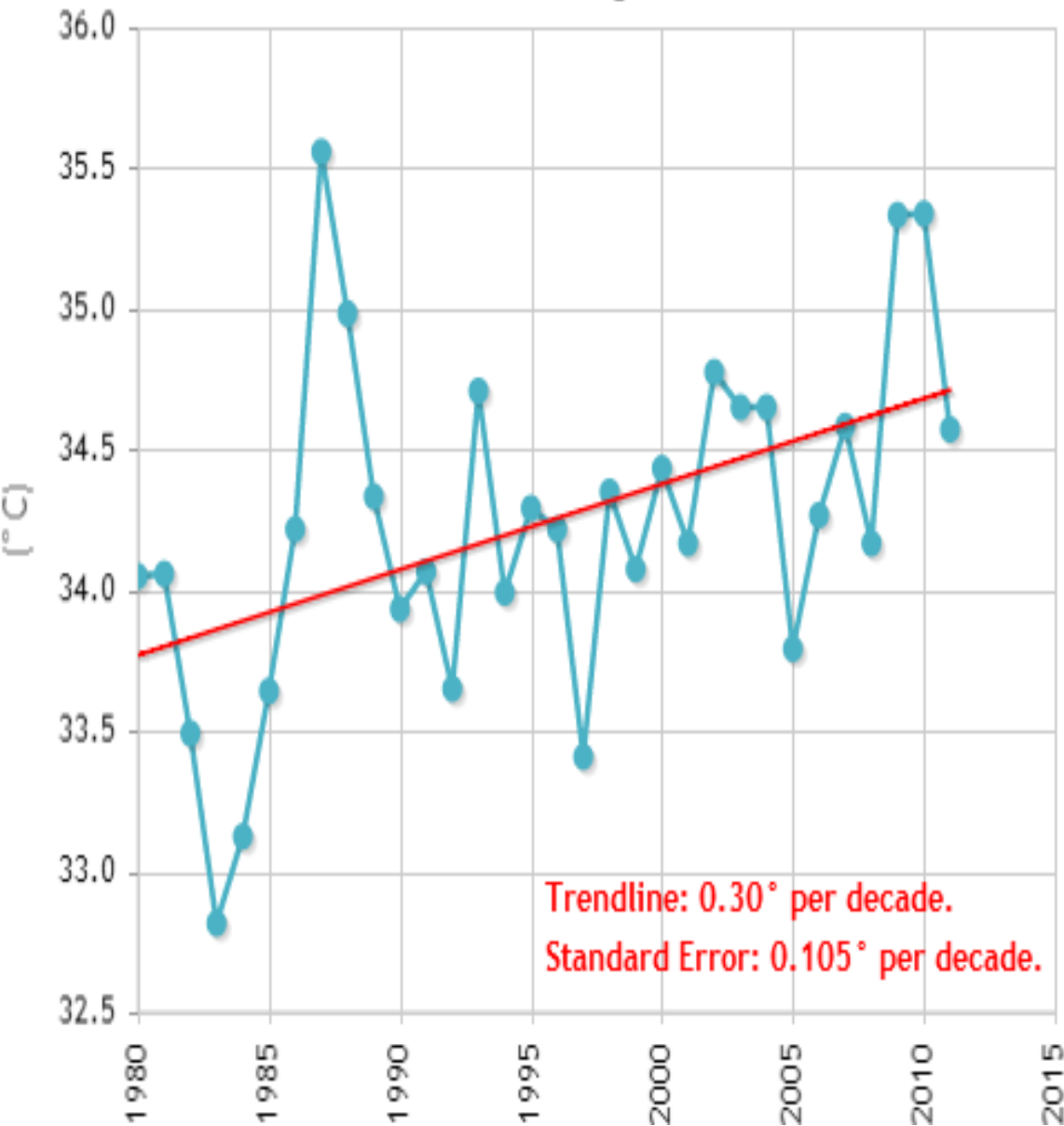


Fig. 2. Standardized daily death frequencies (1 means equal to the median death number, 2 means twice the median death number) between 3 and 16 August 2003, in 16 European countries, for 177 NUTS.

10/21/2022

Maximum Temperature(Annual Average).

Latitude: 23.25 & Longitude: 72.75

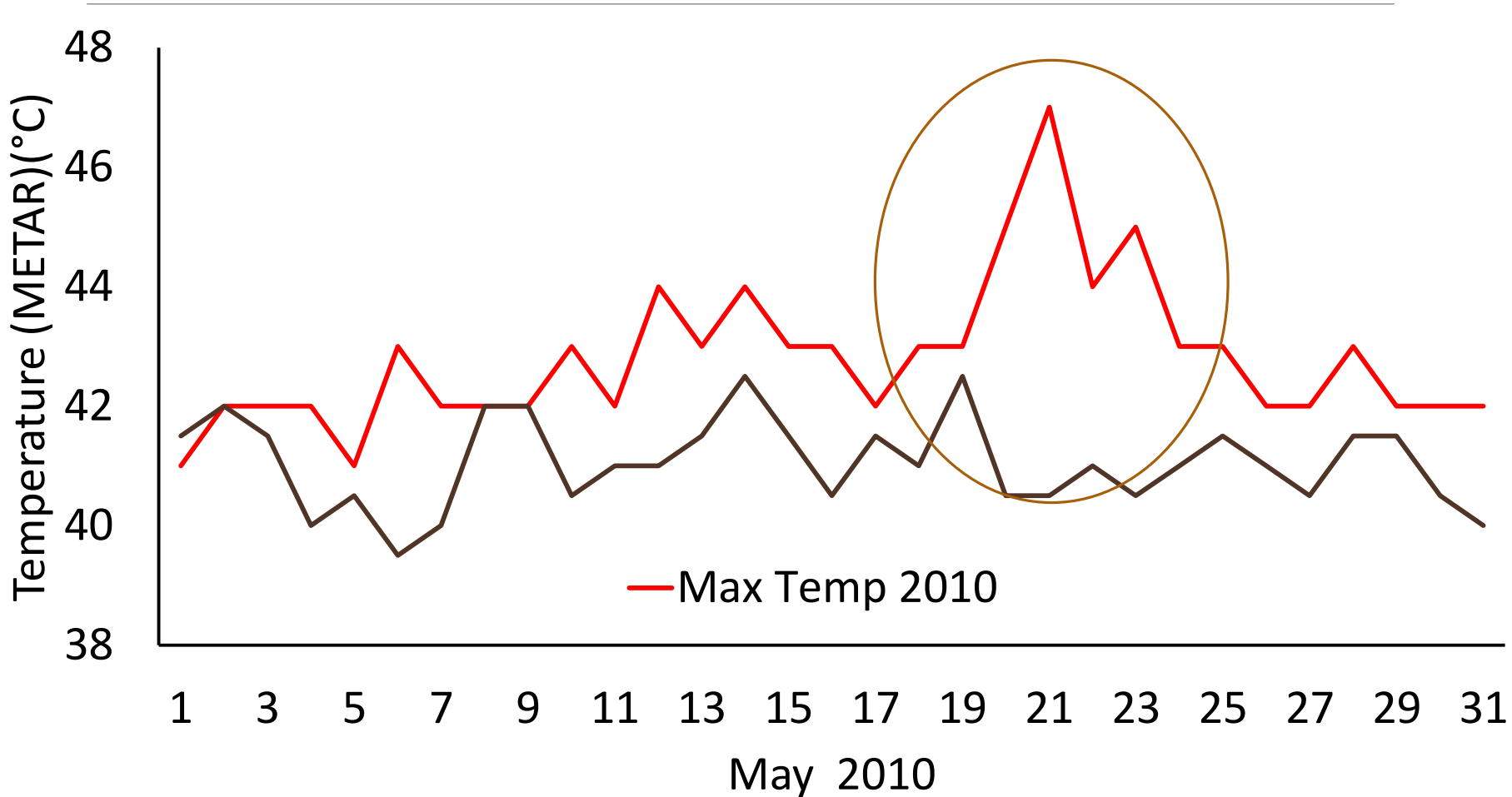


In Ahmedabad, annual average of maximum temperatures have been increasing steadily over the past 30 years

Graph data:
HOTHAPS

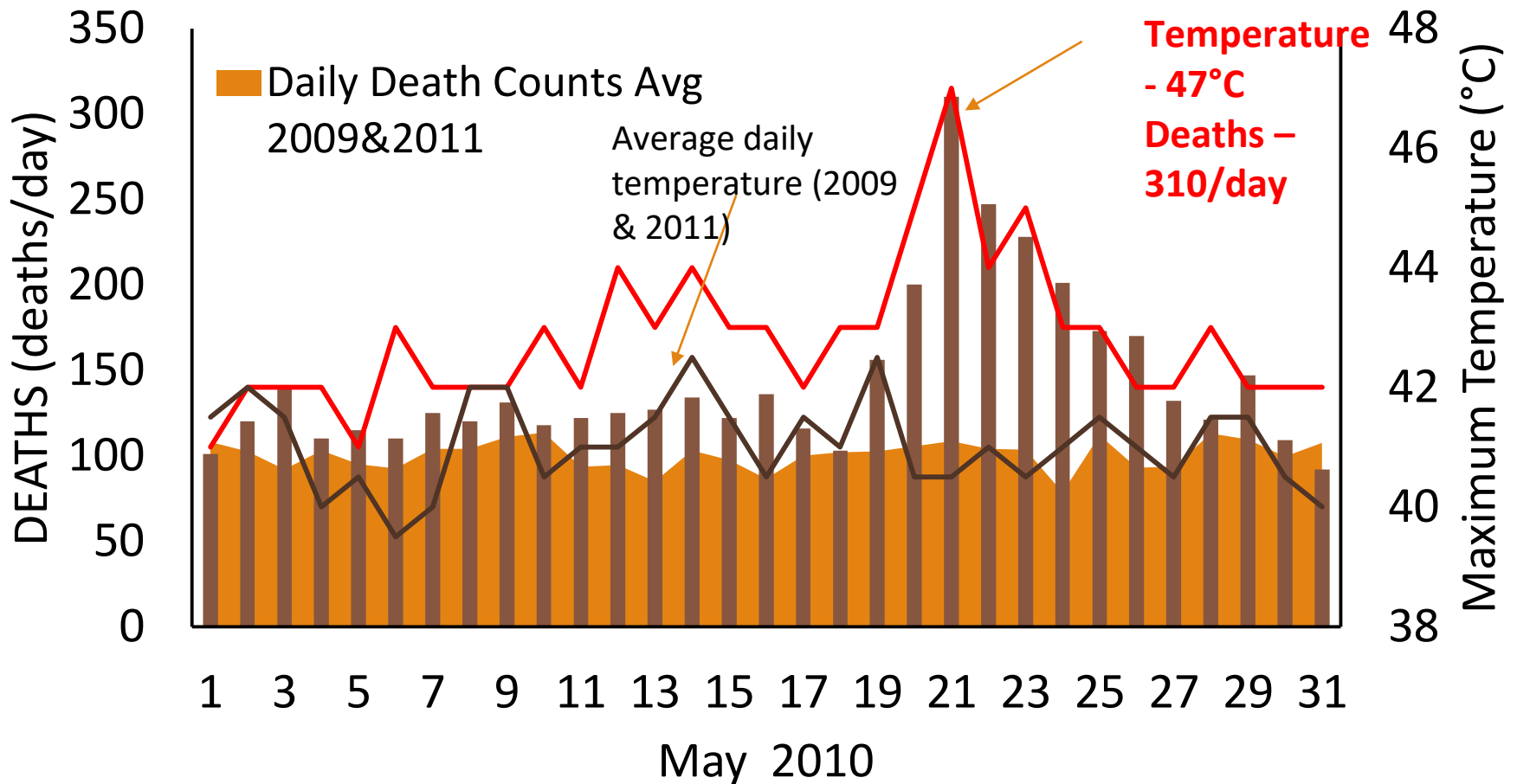
Analysis of temperature and mortality data of Ahmedabad.

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

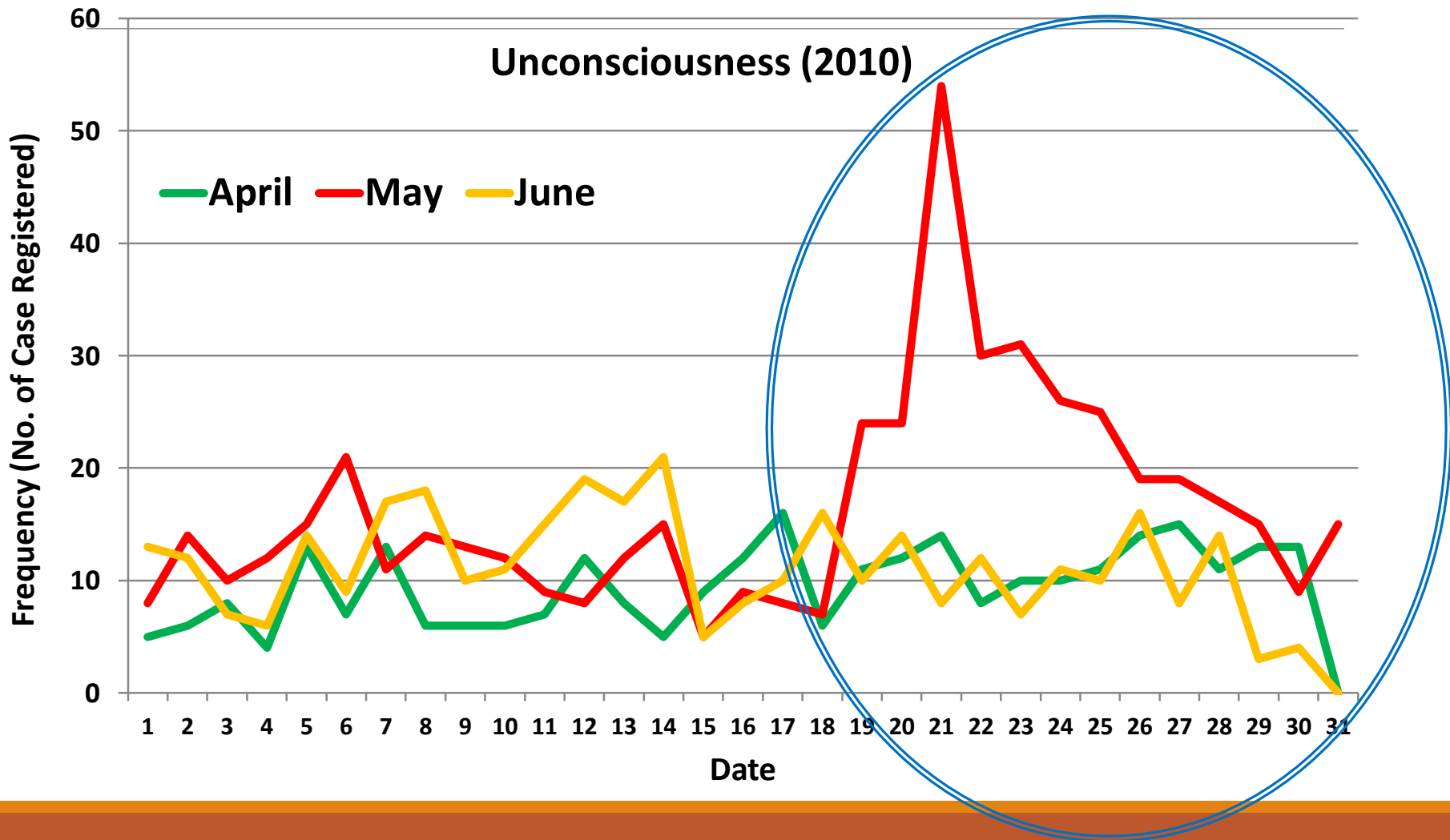


2010 Ahmedabad heat wave :

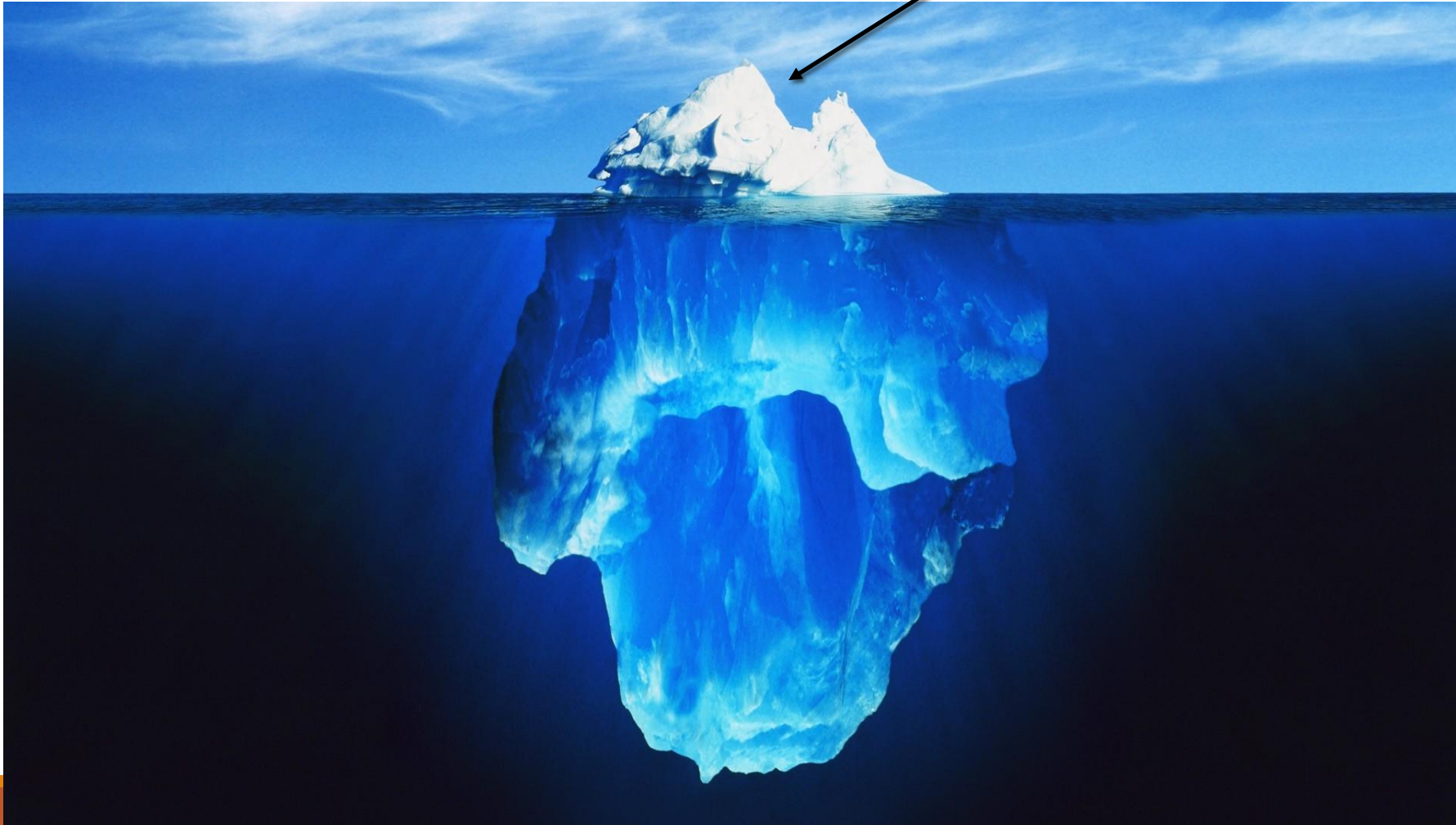
May 20-27th – excess deaths 800 in one week and 1344 excess deaths in May 2010.



EMRI – Unconsciousness case registered

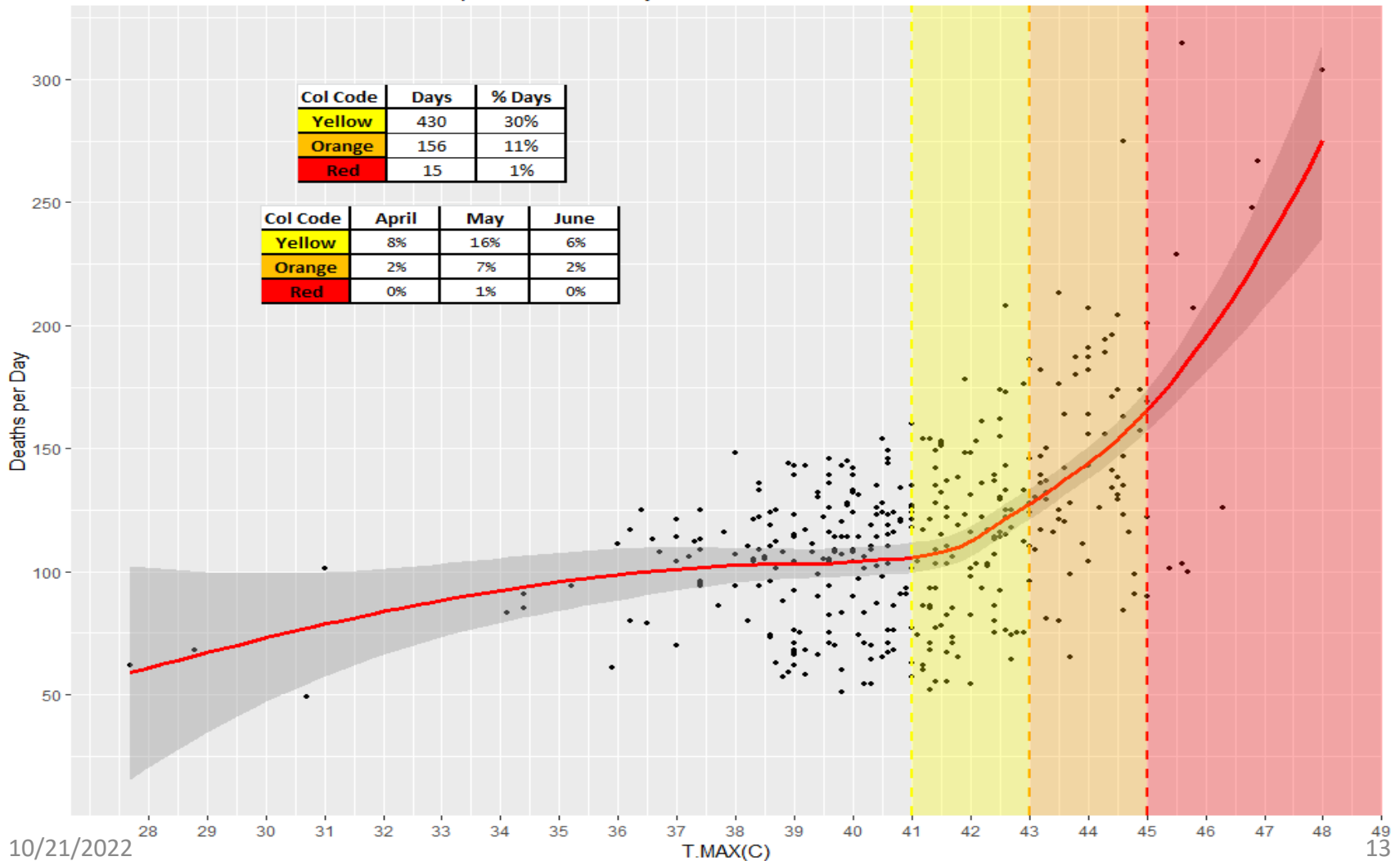


Heat wave deaths are like an iceberg -10% visible



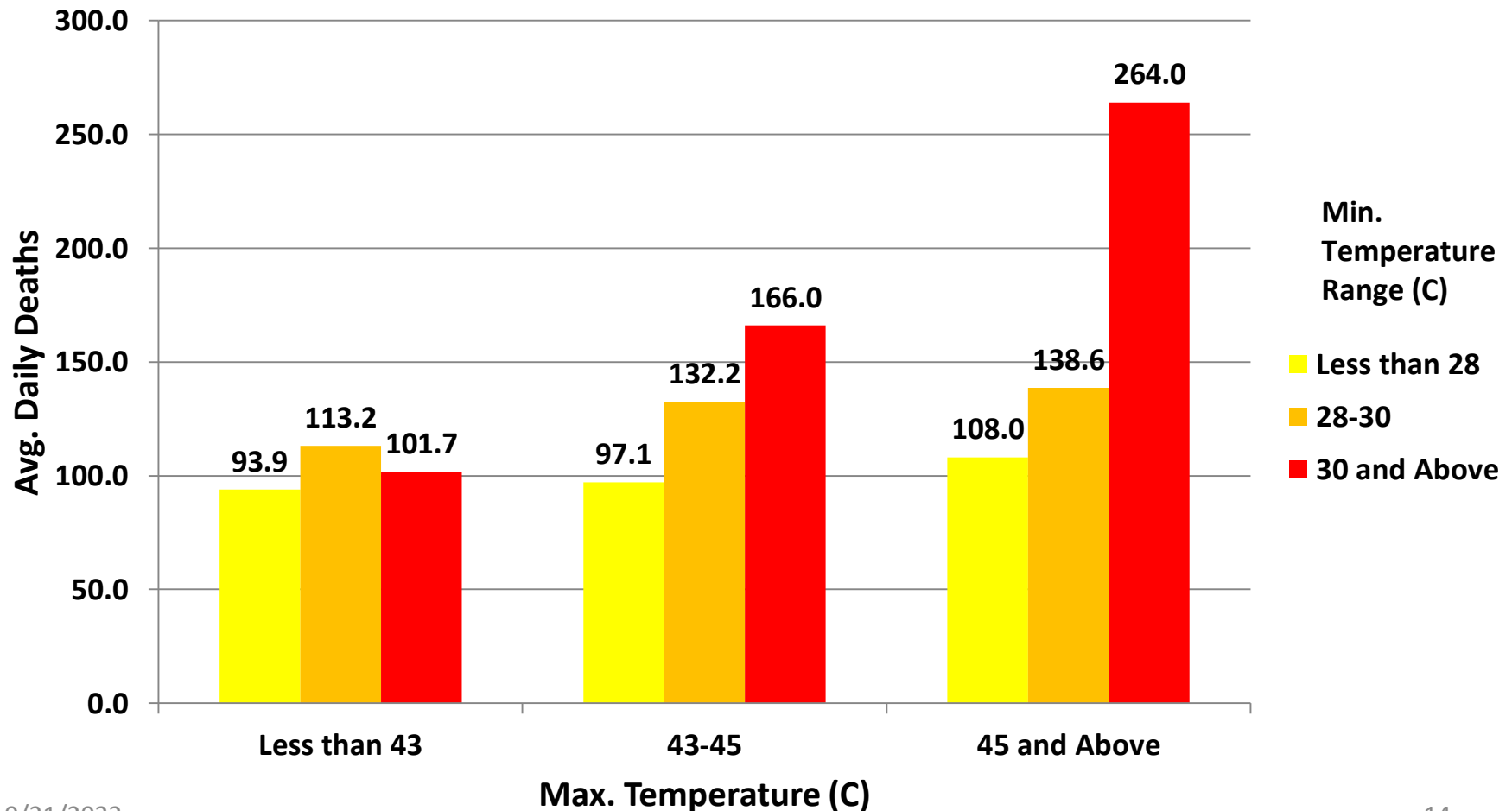
Temperature Mortality Curve – Alert thresholds 41, 43, 45 dec C

Temperature Mortality Curve - Ahmedabad Colour Code

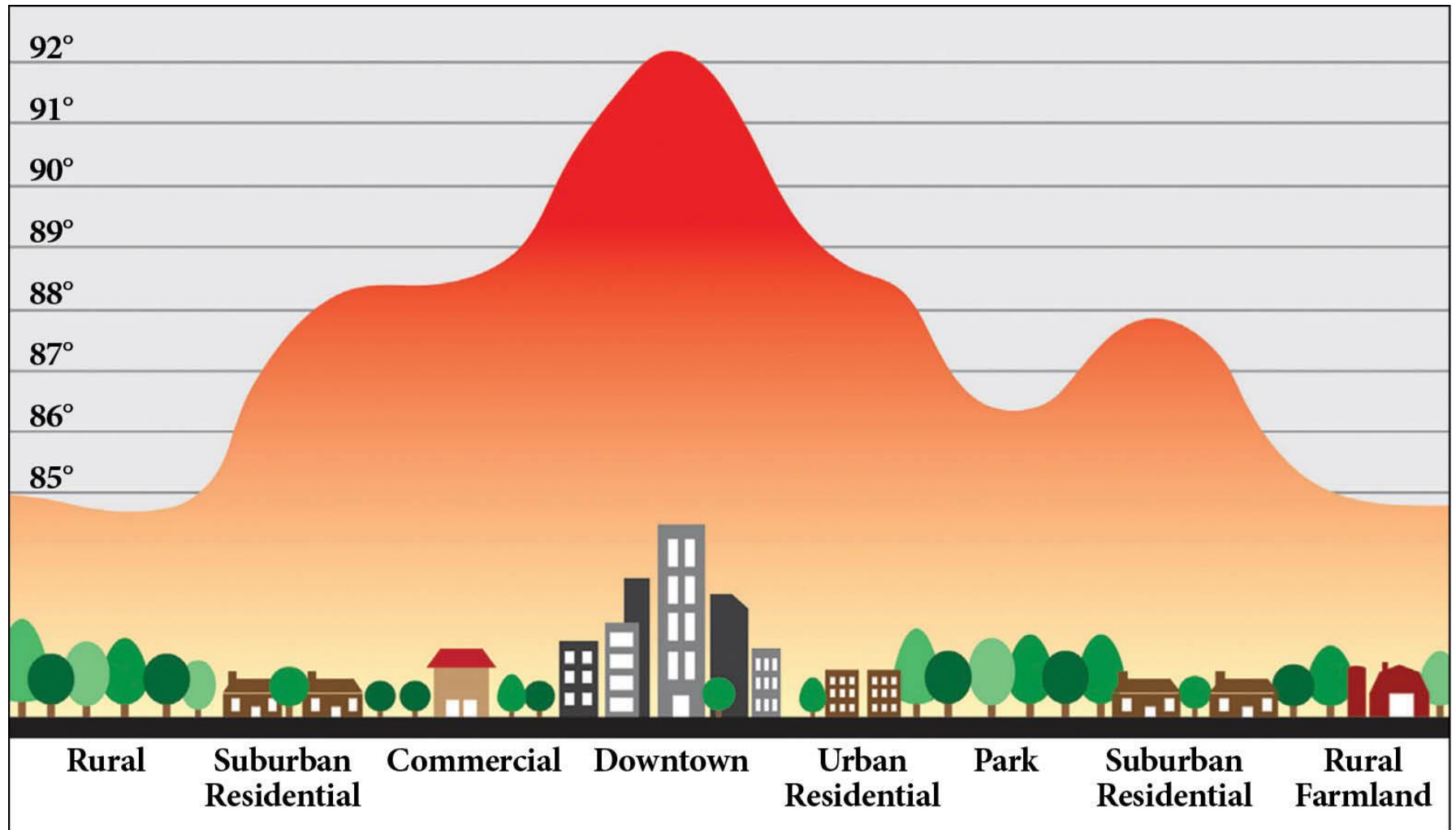


Min – Max Temperature and associated ave. daily death in Ahmedabad

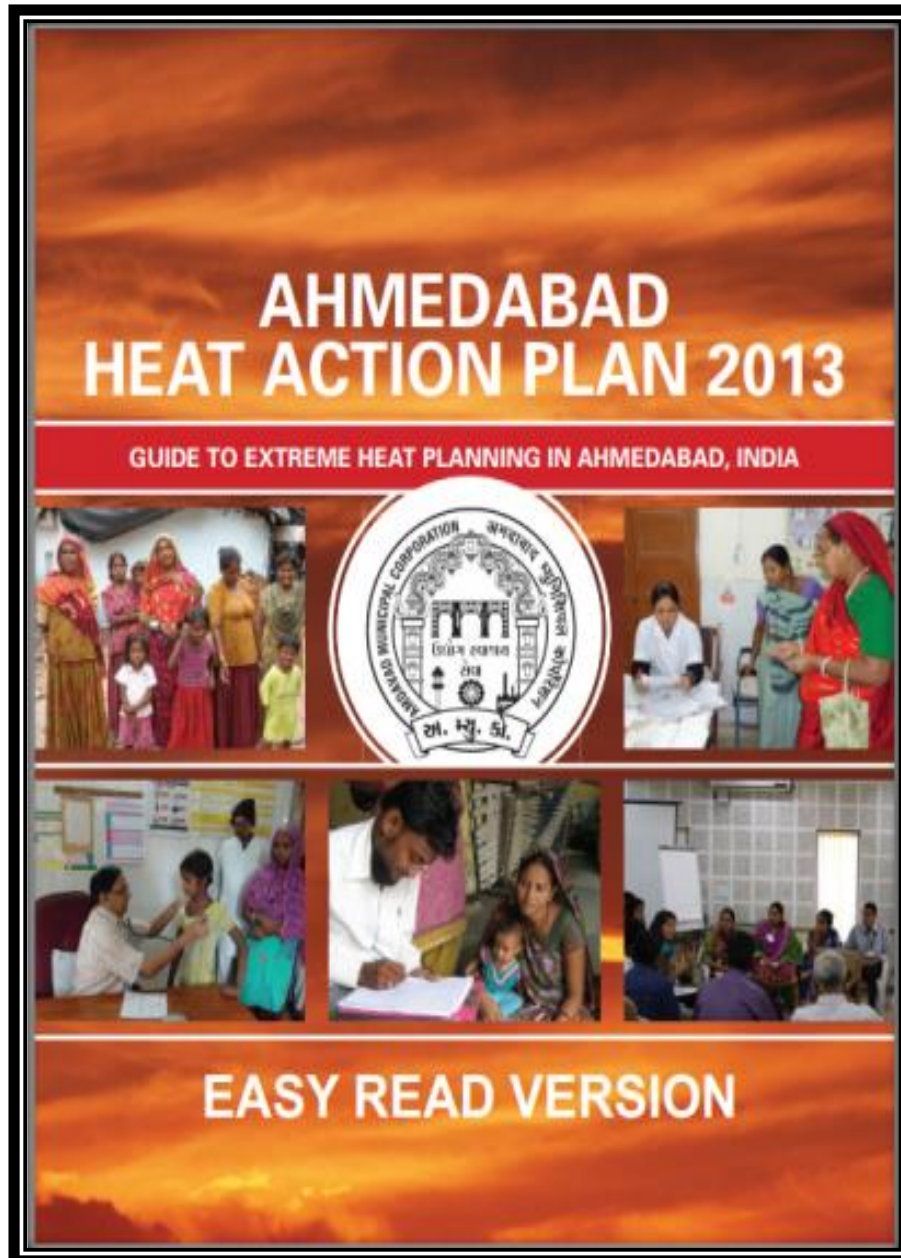
Ahmedabad (2001-2015)



Measuring Urban heat Island and personal exposure in direct sun light



Pilot AHMEDABAD HEAT ACTION PLAN in 2013



5 key interventions of the HAP

1. Awareness and publicity of dangers of heat and how to protect
2. Capacity building of Medical systems
3. Reducing heat exposure and adaptive measures
4. Early warning system and interagency response plan
5. Monitoring of impact of heat action plan on health

People protect themselves – impact of health education.



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 disorientation	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 $\geq 40^{\circ}\text{C}$; 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

Building hospital and health system readiness

- Cooling ward in each major hospitals
- Cooling packs or ice
- Doctors and nurses oriented to treatment of heat stroke
- IV fluid and other medicines procured
- Health workers in the community trained to educate the community
- Urban health centers readiness improved

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



Changing housing and area planning

Cool Roofs

Cool roofs function primarily by reflecting heat incident on a building back to the atmosphere to a greater extent than a regular roof surface.

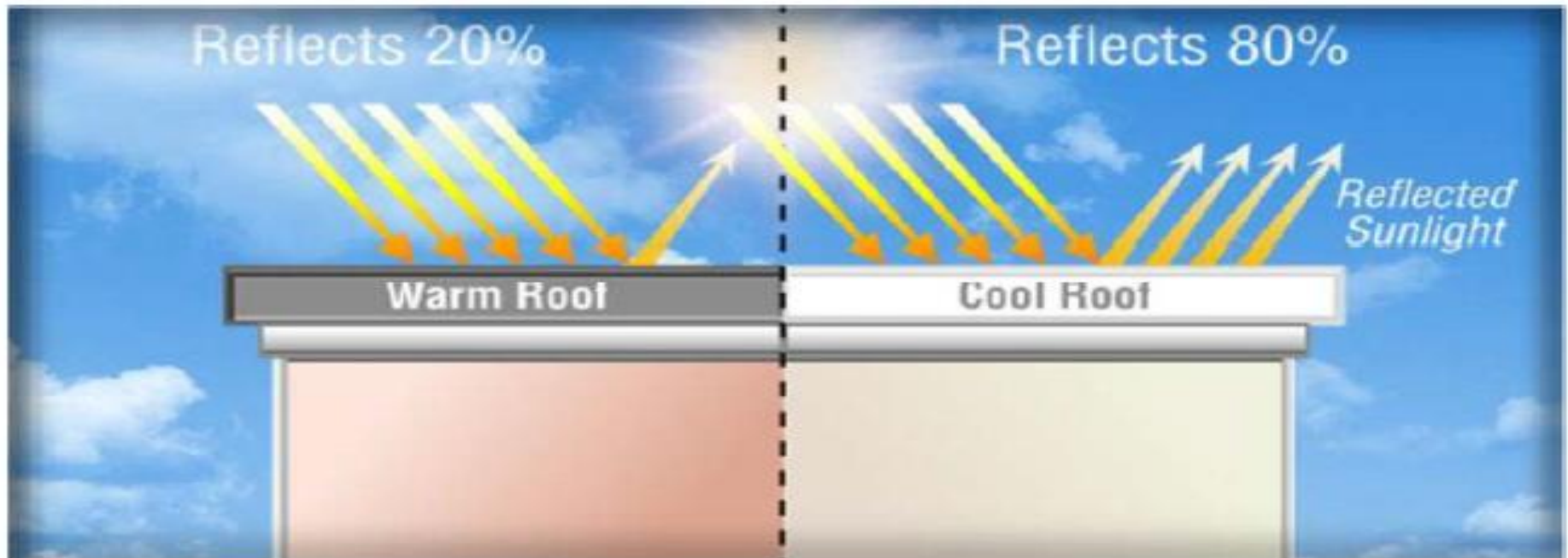


Figure 1: How a cool roof works

Intervention – 4

Early Warning System & Inter-Agency Emergency Response Plan

भारत सरकार
 पृथ्वी विज्ञान मंत्रालय
 भारत मौसम विज्ञान विभाग
 मौसम केंद्र,
 आर एसआर इन्फ्रानु भवन,
 हवाई अड्डा, अहमदाबाद-382,475
 फोन नं. 079 22865012



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

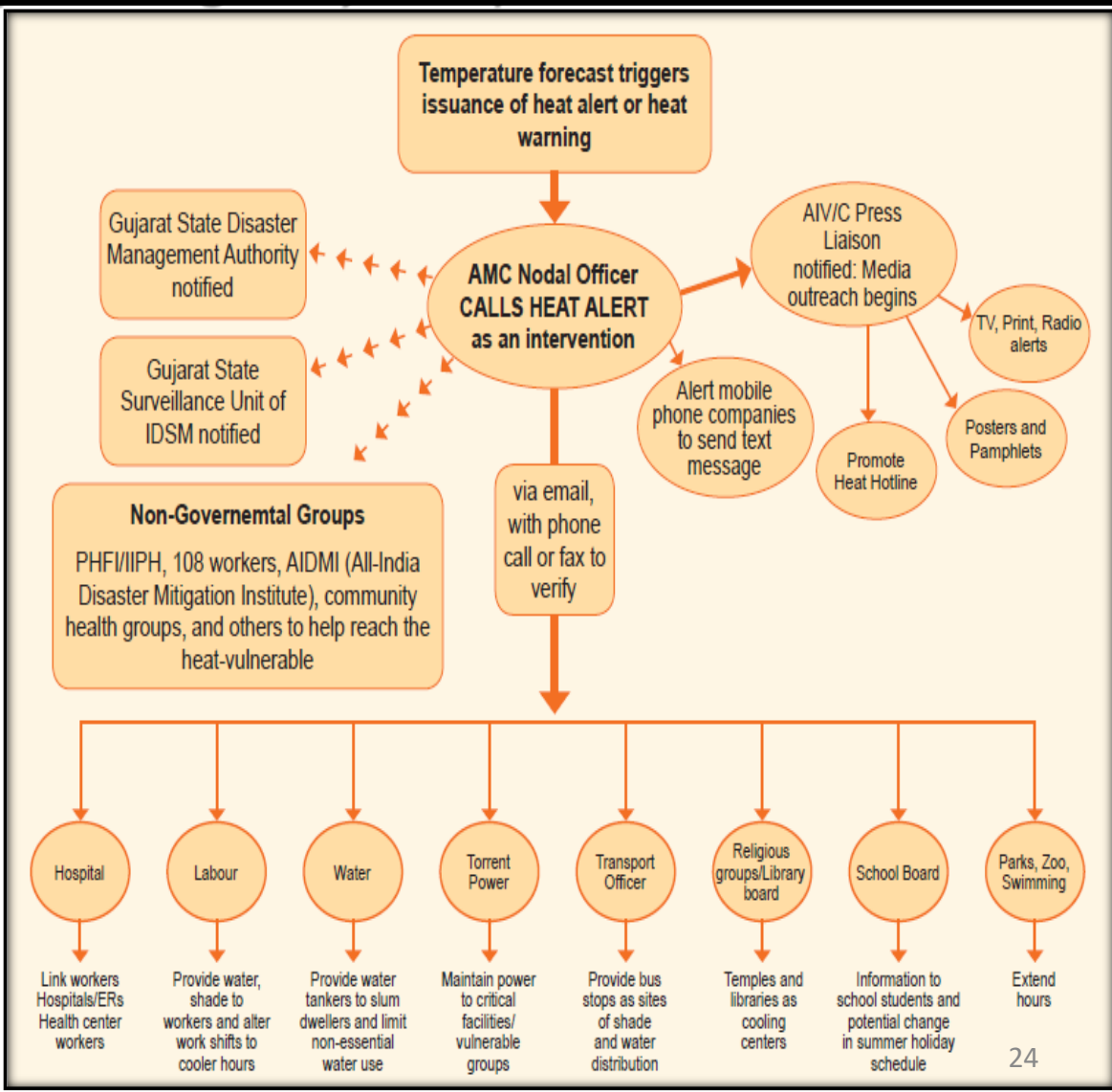
Five days City weather forecast (Maximum temperature forecast) for Ahmedabad

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 Levels:
 Unlikely: less than 25 % Yellow: 41.1- 43 deg Celsius
 Likely: 25 to 50 % Orange: 43.1- 44.9 deg Celsius
 Very likely: 50 to 75 % Red: ≥45.0 deg Celsius
 Most likely: 75 to 100 %

For Director In-charge
 Meteorological Centre
 Ahmedabad

10/21/2022

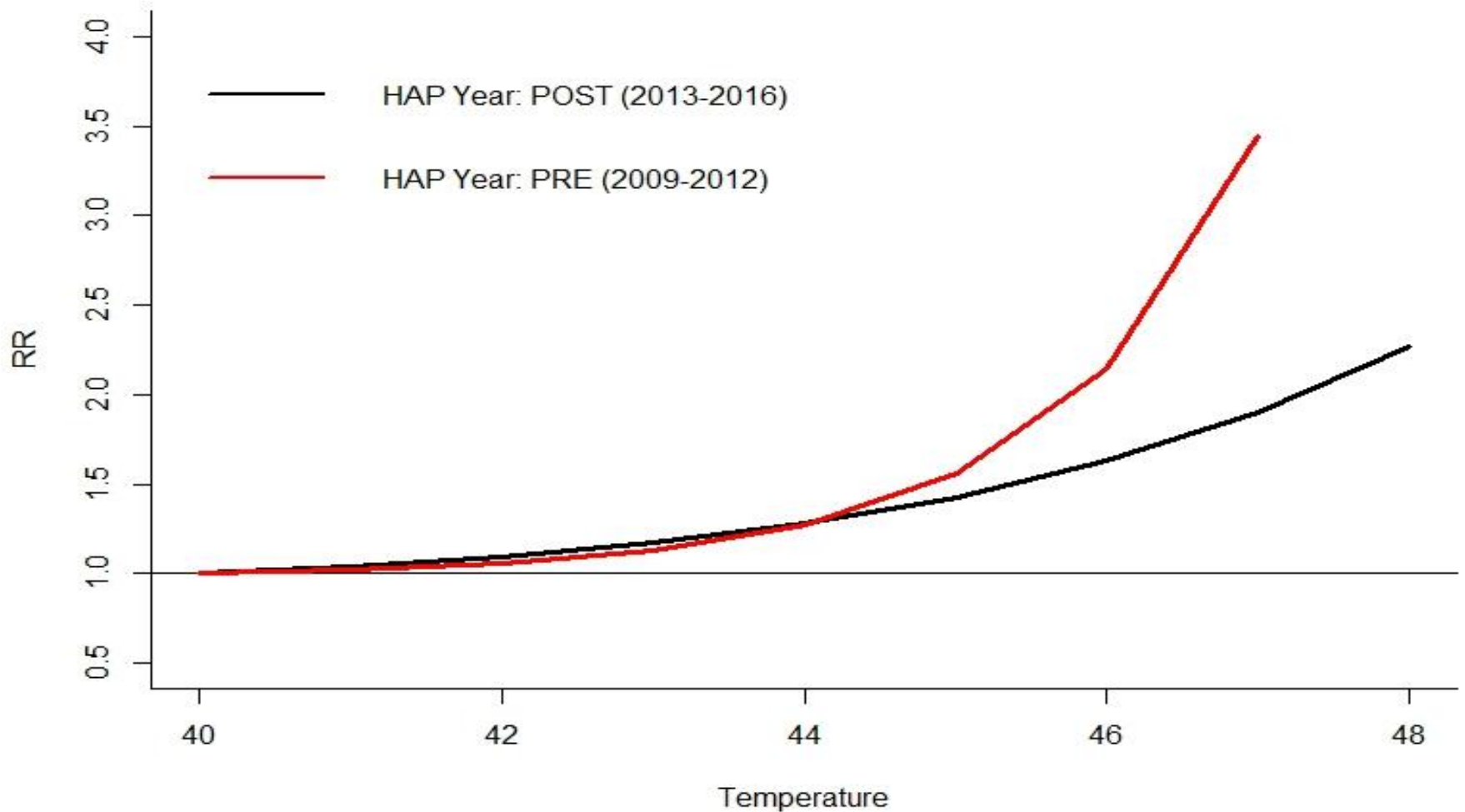


5. Assessment of Impact of Heat Action Plan

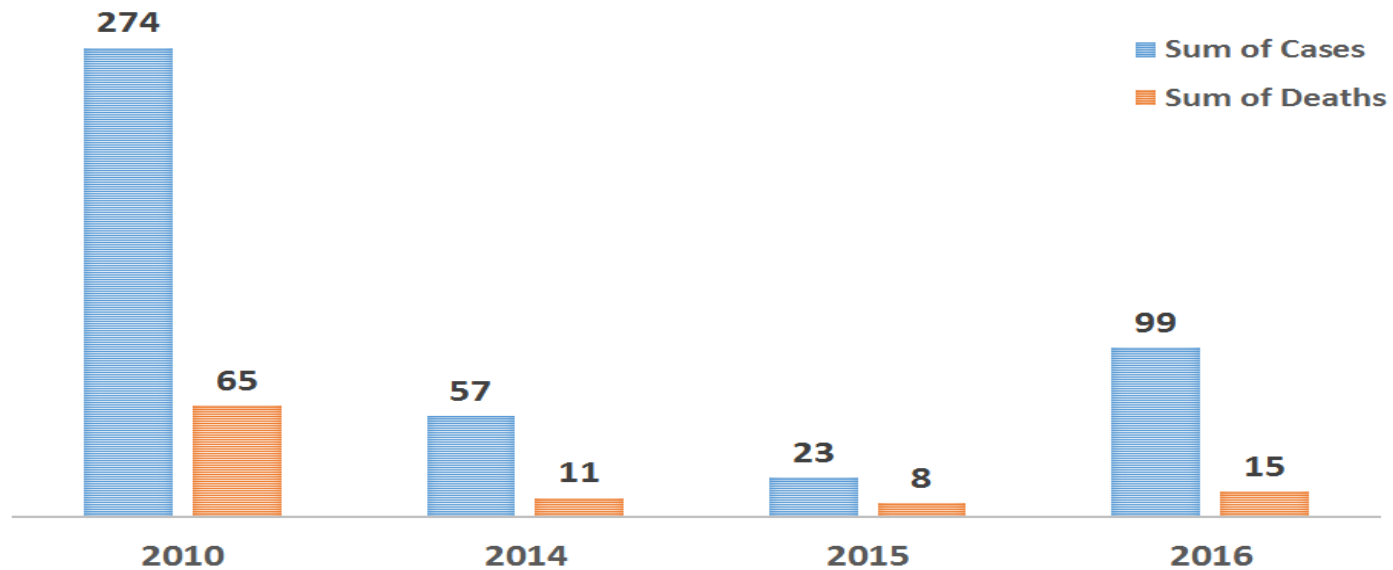
- Reduction in all cause of mortality during heat waves
- Decrease in heat stroke cases and deaths

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

Ahmedabad - PRE & POST HAP Comparison



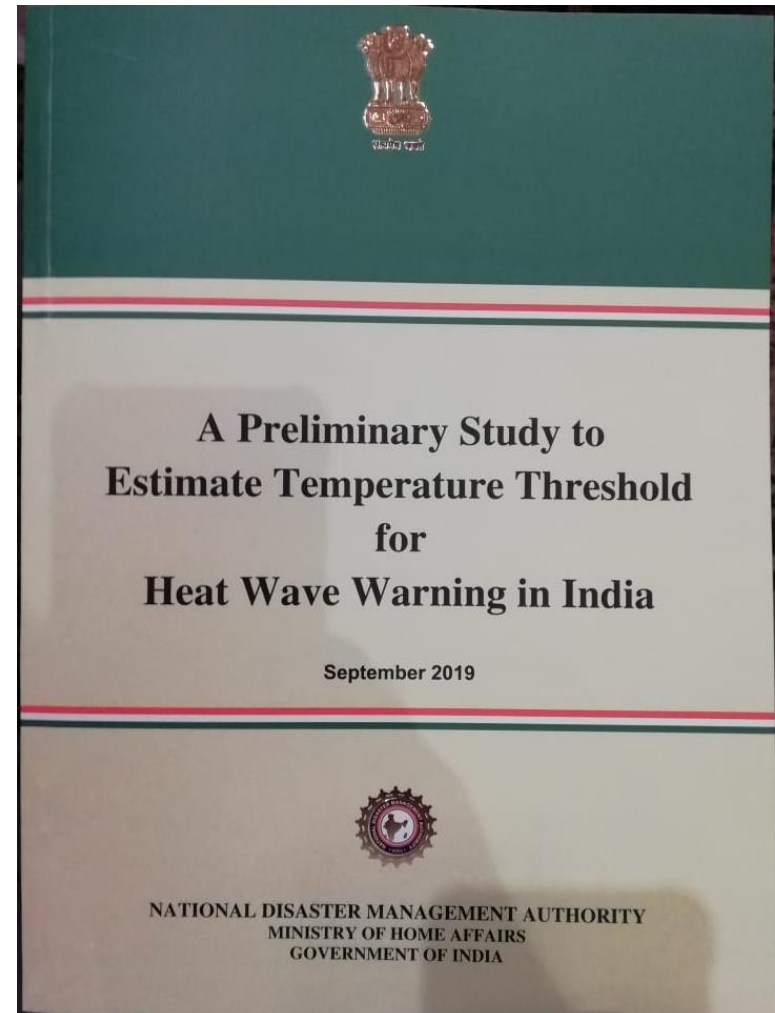
Heat Stroke Mortality and Morbidity before and after HAP on Selected 5 Municipal Hospitals of AMC



Counts of post-HAP days, expected and observed mortality and estimated avoided mortality post-HAP period for each of the heat warning categories for Ahmedabad:

Variable	Any warning	Yellow warning	Orange warning	Red warning
Days Post-HAP	98	36	41	21
Expected deaths after HAP (95% CI)	16,012 (13,956–18,067)	5015 (4868–5162)	6307 (6114–6500)	4690 (2974–6406)
Observed deaths after HAP	13,632	4608	5634	3390
Avoided mortality after HAP (95% CI)	2380 (324–4435)	407 (260–554)	673 (480–886)	1300 (-416–3016)
Average annualized avoided mortality after HAP (95% CI)	1190 (162–2218)	203 (130–277)	336 (240–443)	650 (-208–1508)

- **IIPHG, IMD and NDMA have jointly worked together to determine preliminary thresholds of maximum temperature for 100 cities in India.**
- **The report released on occasion of 15th Foundation Day of NDMA**



EXPANDING HEAT RESILIENCE ACROSS INDIA

- In 2019, the national government is working with 23 states and over 100 cities and districts to implement and develop heat action plans in India.
- IMD continues to provide daily temperature forecasts to over 350 cities.



Recognition Heat as a Disaster and Need for HAP



NDMA

National Disaster Management Authority
Government of India

BETA

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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 पत्तों 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

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Heat Wave

▶ Information

▶ Do's and Dont's

▶ Recover and Build

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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

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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.

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.



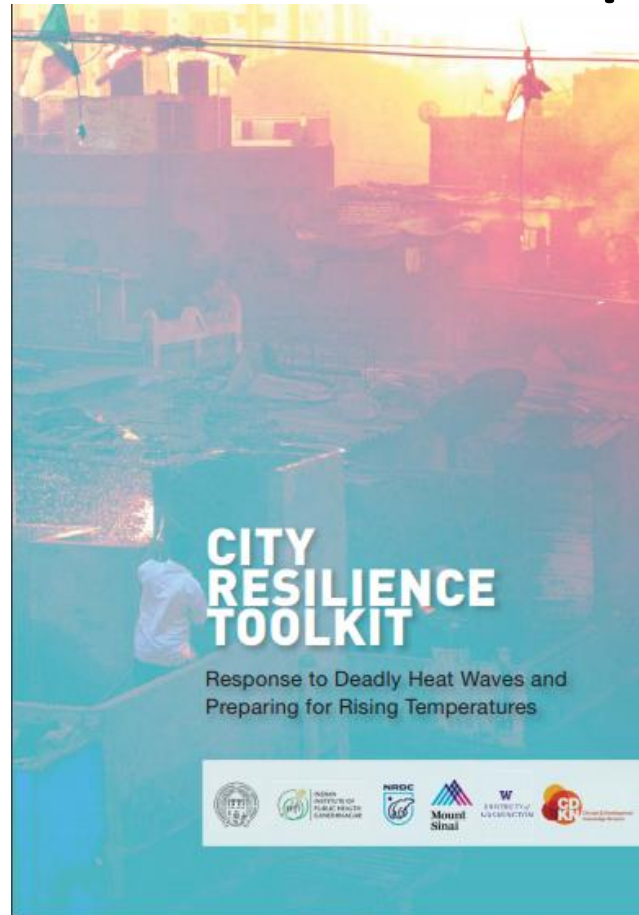
Harsh Vardhan at a meeting to review encephalitis cases in Uttar Pradesh and Bihar

10/21/2022

8th Earth Care Award 2018 for our pioneer work in Ahmedabad HAP



City Resilience toolkit and How to Manual- Guide for other cities and state of India to develop HAP



Lessons from Ahmedabad HAP

- **Involvement of Local city or district administrative and health and political leadership**
- **Engagement with all stakeholders: IMD for weather data, Health data for analysis, city govt for various actions.**
- **Analysis of Local mortality and morbidity data and correlation with temperature data to determine thresholds**
- **Facilitation by local and national institutions / experts – universities**
- **Learning and adapted HAP developed in other countries / cities**
- **Measurement of process of implementation and Impact on mortality and morbidity**

Useful Resources and References

You Tube Links on IEC Materials:

- <https://www.youtube.com/watch?v=2of1yeYaF5E&list=PLOuQBh7LWB0jTNdwr5sVIR2VRDKdenY8f>
- <https://www.youtube.com/watch?v=Icr07IJKs>
- <https://www.youtube.com/watch?v=El3qjemf-rw>

NDMA Guidelines on Heat Wave

- <http://www.ndma.gov.in/images/guidelines/heatwaveguidelines2017.pdf>
- <http://www.ndma.gov.in/en/heat-do-s-and-dont-s>




Published Ahmedabad Heat Action Plan Evaluation Paper

Hindawi
Journal of Environmental and Public Health
Volume 2018, Article ID 7973519, 8 pages
<https://doi.org/10.1155/2018/7973519>



Research Article

Building Resilience to Climate Change: Pilot Evaluation of the Impact of India's First Heat Action Plan on All-Cause Mortality

Jeremy J. Hess ^{1,2}, Sathish LM,² Kim Knowlton,³ Shubhayu Saha,⁴ Priya Dutta,² Parthasarathi Ganguly,² Abhiyant Tiwari ², Anjali Jaiswal,³ Perry Sheffield ⁵, Jayanta Sarkar,⁶ S. C. Bhan,⁷ Amit Begda,⁸ Tejas Shah,⁸ Bhavin Solanki,⁸ and Dileep Mavalankar²

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⁴Emory University, Atlanta, GA, USA

⁵Icahn School of Medicine at Mount Sinai, New York, NY, USA

⁶Indian Meteorological Department, Gujarat, India

⁷Indian Meteorological Department, Delhi, India

⁸Ahmedabad Municipal Corporation, Ahmedabad, India

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Background. Ahmedabad implemented South Asia's first heat action plan (HAP) after a 2010 heatwave. This study evaluates the HAP's impact on all-cause mortality in 2014–2015 relative to a 2007–2010 baseline. **Methods.** We analyzed daily maximum temperature (T_{max})-mortality relationships before and after HAP. We estimated rate ratios (RRs) for daily mortality using distributed lag nonlinear models and mortality incidence rates (IRs) for HAP warning days, comparing pre- and post-HAP periods, and calculated incidence rate ratios (IRRs). We estimated the number of deaths avoided after HAP implementation using pre- and post-HAP IRs. **Results.** The maximum pre-HAP RR was 2.34 (95%CI 1.98–2.76) at 47°C (lag 0), and the maximum post-HAP RR was 1.25 (1.02–1.53) estimated at 47°C (lag 0). Post-to-pre-HAP nonlagged mortality IRR for T_{max} over 40°C was 0.95 (0.77–1.22), 1.07 (0.89–1.31) for 41°C, 1.19 (1.01–1.41) for 42°C, 1.31 (1.13–1.53) for 43°C, 1.43 (1.25–1.65) for 44°C, 1.55 (1.37–1.77) for 45°C, 1.67 (1.49–1.89) for 46°C, and 1.79 (1.61–2.01) for 47°C.

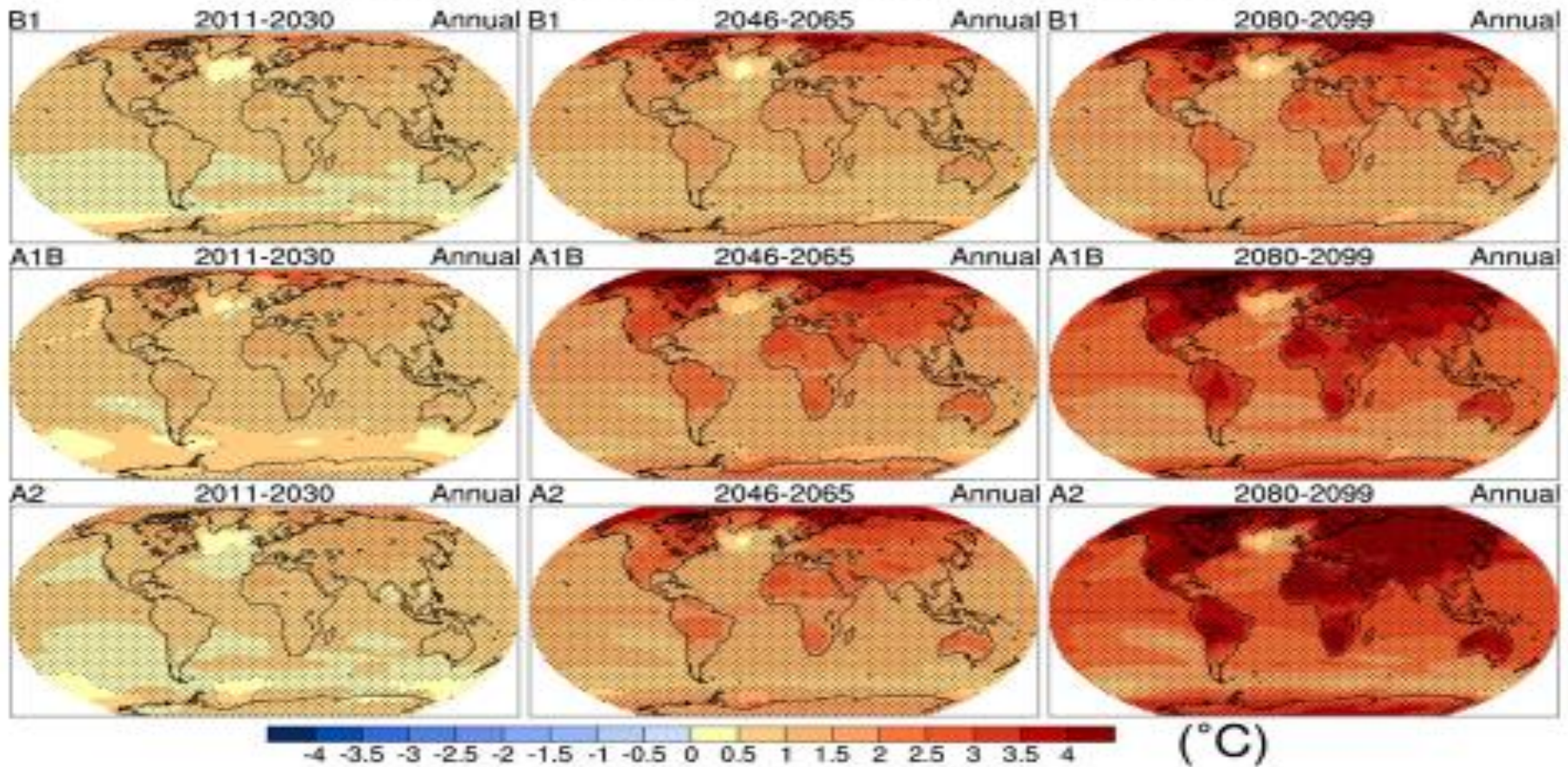
Useful Resources and References

Published Scientific Articles:

- *PlosOne Journal Article: Heat-Related Mortality in India: Excess All-Cause Mortality Associated with the 2010 Ahmedabad Heat Wave* (March 2014): <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0091831>
- *International Journal of Environmental Research and Public Health Journal Article: Development and Implementation of South Asia's First Heat-Health Action Plan in Ahmedabad* (Gujarat, India) (January 2014): <http://www.mdpi.com/1660-4601/11/4/3473>
- *Journal of Environmental and Public Health: Neonates in Ahmedabad, India, during the 2010 Heat Wave Journal Article: A Climate Change Adaptation Study* (January 2014): <http://www.hindawi.com/journals/jeph/2014/946875/>
- *A Cross-Sectional, Randomized Cluster Sample Survey of Household Vulnerability to Extreme Heat among Slum Dwellers in Ahmedabad, India Journal Article* (June 2013): <http://www.mdpi.com/1660-4601/10/6/2515>
- *Indian Journal of Occupational and Environmental Medicine: Perceived heat stress and health effects on construction workers* (Jan 2016): <http://www.ijoem.com/text.asp?2015/19/3/151/174002>
- *Building Resilience to Climate Change: Pilot Evaluation of the Impact of India's First Heat Action Plan on All-Cause Mortality.* (Jan 2018): <https://www.hindawi.com/journals/jeph/2018/7973519/abs/>

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

IPCC multi-model mean surface air temperature





**Thank You from all the
partners**