

# Risk Identification and Preparedness for Extreme Heat: Some Lessons from the Field

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Regional and Rural Development Planning

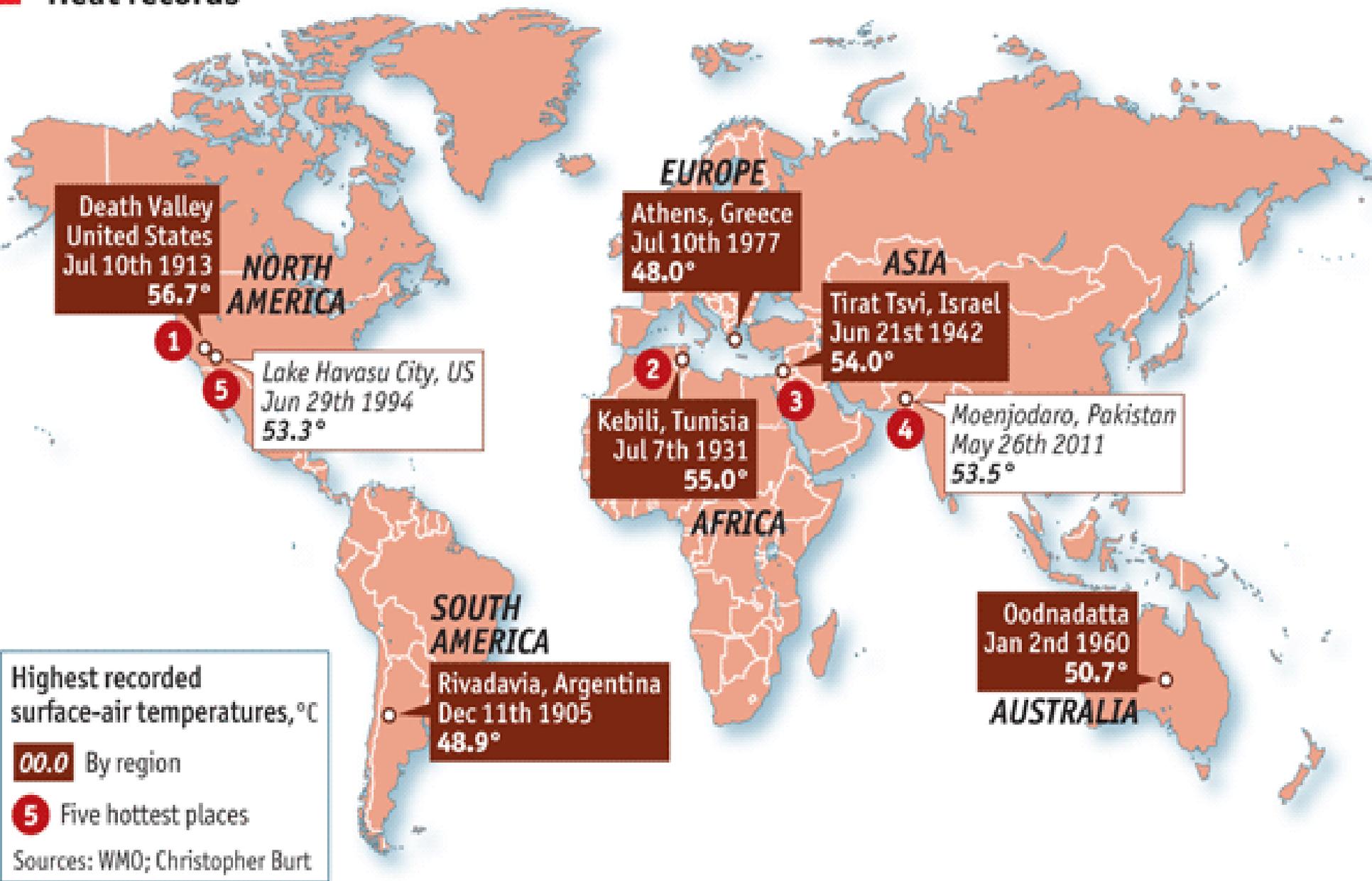
School of Environment, Resources and Development

Asian Institute of Technology

# Outline

- Survey
- Identifying the vulnerable groups
- Adapting to heat
- Action plan

# Heat records



2016

# India reels under deadly **heatwave**

**BRACE YOURSELVES** IMD predicts increase in temperature as shooting mercury sparks water clashes across country

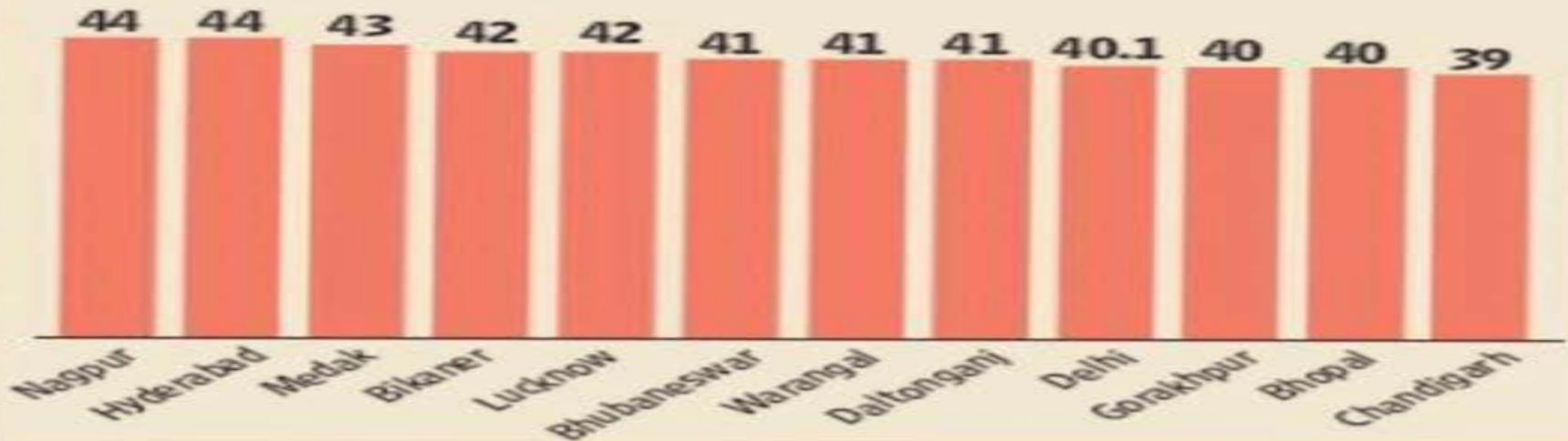
## SCORCHING TO DEATH

Unusually hot summer has already claimed over 100 lives

**91** Total deaths reported so far from three heat wave-hit states



Maximum temperature (°C) in major locations



# Water trains bring scant relief here

Ground report from Marathwada region of Maharashtra, parched by back-to-back drought years

**LATUR, APRIL 27**  
Haribhau Kamble, an unemployed labourer in India's richest state of Maharashtra, is forced to queue for water even as the government puts on trains to ship water to the region parched by back-to-back drought years.

## MAHARASHTRA



### MARATHWADA

Latur, Aurangabad, Nanded, Parbhani, Jalna, Beed, Hingoli and Osmanabad districts in Marathwada are the worst hit

Like Kamble, millions of Indians have been hung out to dry in the state with the worst drought in four decades ravaging crops, killing livestock, emptying reservoirs and slowing hydroelectric power output. Mismanagement of water resources, with powerful politicians pushing for bigger supplies to industries, have made the situation worse, experts say.

"The government says it is bringing water by train every day, but we are getting water once a week," Kamble said, after standing in line for three hours to fill two pitchers at a tap in Latur district, 500 km southeast of Mumbai in drought-stricken Marathwada region. Locals had been hoping a 50-wagon daily water train would ease shortages, but they were dis-



**PIPE DREAM** Residents hold plastic hoses as they fetch water from a government-run water tanker in Masurdi village of Latur. REUTERS



**46.3°**  
Sonepur  
(ODISHA)

**44.1°**  
Jamshedpur  
(JHARKHAND)

**43.3°**  
Churu  
(RAJASTHAN)

**42.2°**  
Hisar  
(HARYANA)

**40.2°**  
Amritsar  
(PUNJAB)

appointed as the 25 lakh litres carried by the train and ferried by tankers to villages was not enough to meet the needs of Latur's five lakh people and Marathwada's 1.9 crore.

Marathwada, home to many sugar mills in Maharashtra, is one of the several regions in India that received

below-average June-September rains in 2015. New Delhi estimates that overall 33 crore, a quarter of the country's population, are currently affected by drought.

Water is set to get scarcer over the next two months as temperatures soar above 40 degrees Celsius, drying up Marathwada reservoirs that

are now just 3 per cent full. "That Maharashtra would face a water crisis was clear when monsoons failed, yet the state took no action to curb supplies to water-guzzling industries like beer and sugar," said Parineeta Dandekar, associate coordinator at the South Asia Network on Dams, Rivers and People.

"There are limits on how much water the government can supply by train. Had it reserved water sources for drinking last year, the situation would have been much better now." The need of the hour is cost-effective steps such as enforcing restrictions on water use and ensuring canals do not leak. — Reuters

## HEATWAVE TOLL SURGES PAST 4,000 IN 4 YEARS

### 4,204 people

have died due to heatwaves since 2013 till March 2016, Union Minister YS Chowdary said in the Lok Sabha on Wednesday

### 87 people

died till March this year, Chowdary said in a written response to a question in Parliament

### 56 deaths

have been seen in Telangana, followed by 19 in Odisha. Andhra Pradesh has recorded eight deaths, while Maharashtra, Tamil Nadu, Karnataka and Kerala have one casualty each due to heatwave

### 1,433 people

died in 2013, of whom 1,393 were from undivided Andhra Pradesh

### 549 died

in 2014, but the toll again rose to 2,135 in 2015

### 1,422 deaths

In 2015 were recorded in Andhra Pradesh, followed by 584 in Telangana

## Centre puts onus on states for drought

New Delhi: Under attack over dealing with the drought in the country, the Centre on Wednesday put the responsibility for addressing the situation on states. Insisting that the government was doing its bit to provide relief to those affected, Agriculture Minister Radha Mohan Singh said: "The role of Centre and state is different. It is clearly defined in the manual for drought management and we cannot change it overnight. The Centre's role is to monitor and the state's role is to provide assistance and help the affected people at ground level." — TN



# Heat Health –2013 News

Home > Ahmedabad > Report

## Saturday heats up, cop dies on duty

Sunday, Apr 28, 2013, 12:36 IST | Place: Ahmedabad | Agency: DNA

DNA Correspondent

It is believed the traffic head constable may have died of sunstroke.

### Mercury slips to 43 degree Celsius in Ahmedabad

TNN May 24, 2013, 04:23AM IST

THE TIMES OF INDIA, AHMEDABAD  
THURSDAY, JUNE 6, 2013

#### AROUND GUJARAT

#### Groom dies of heat stroke

**Palanpur:** Severe heat claimed the life of a newly wedded groom in Bhonja village in Dhanera taluka of Banaskantha on Tuesday. Vela Patel (24) was offering post-marriage prayers in the village temple



Saturday was hotter than other days, so much so that an on-duty traffic police head constable fell victim to the heat. He fell on the footpath at Rajendra Park crossroads in Amraiwadi area of the city due to the heat, police sources said.

"The incident occurred on Friday evening

### Ahmedabad: 44 degree Celsius on Monday, expect worse in coming days

DNA | May 21, 2013

## Heat wave conditions to continue Gujarat

Press Trust of India , Express news service : Tue May 21 2013, 05:03 hrs

## No relief from heat, Ahmedabad sizzles at 43.6 degrees

TNN May 17, 2013, 06:12AM IST

Tags: weather condition | Indian Meteorological Department

AHMEDABAD: The city was like a furnace on Thursday when the mercury climbed to 43.6 degree Celsius. This was the second consecutive day when the maximum temperature rose above 43 degrees.

**Ahmedabad:** Ahmedabad and Idar were the hottest places in the state on Monday with both recording a maximum temperature of 44 degrees Celsius. This is the second time in May that the city is witnessing such high temperature.



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

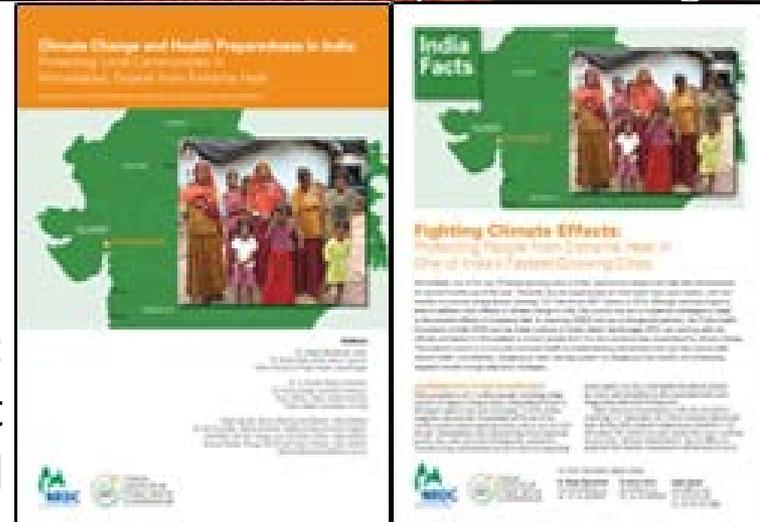
# Heat Health Collaboration: Scientific Research to Support Policy

- ❑ PHFI, IIPH, NRDC partnerships.
- ❑ MoUs with Ahmedabad Municipal Corporation & Gujarat govt.
- ❑ Partnerships increase with CDKN: Emory University, Georgia Tech, Mt. Sinai Medical School.



March 2011: Indo-US scientific workshop 40 experts discuss heat-adaptation strategies

March 2012:  
Fact sheet and report released & disseminated

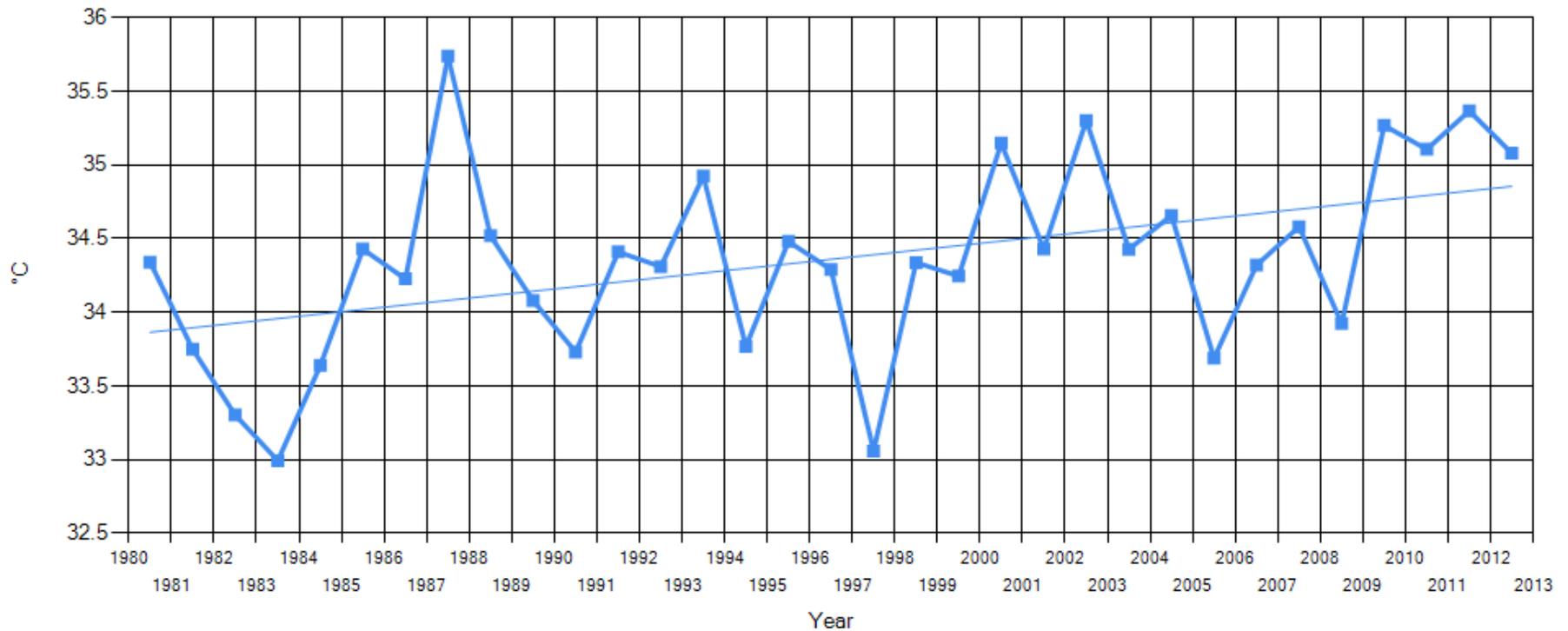




# Heat is increasing

**Fighting Climate Effects:**  
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### AHMADABAD Annual Temp Max [°C]



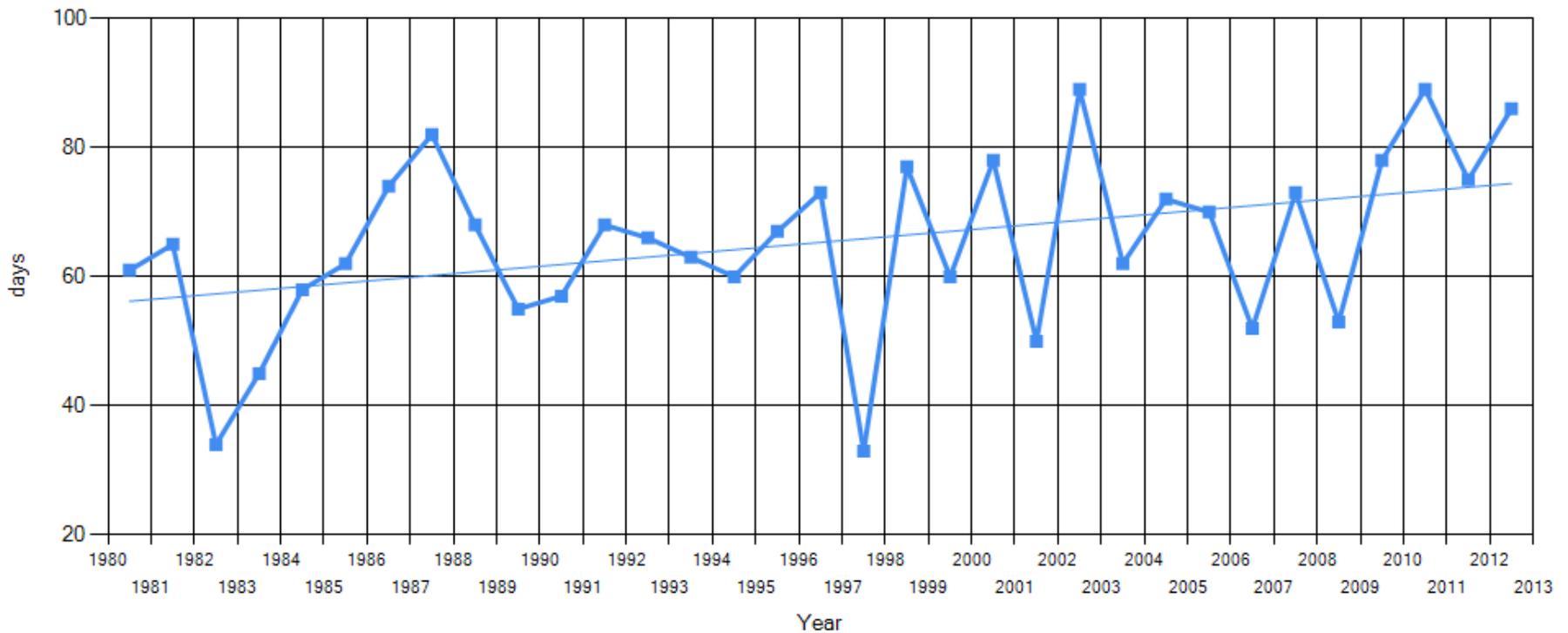
Temp Max [°C]  
Linear Trend: 0.30948 °C/dec,  
SE=0.10913°C



# Heat is increasing

**Fighting Climate Effects:**  
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**AHMADABAD Annual Temp Max [°C], Days > 39°C**



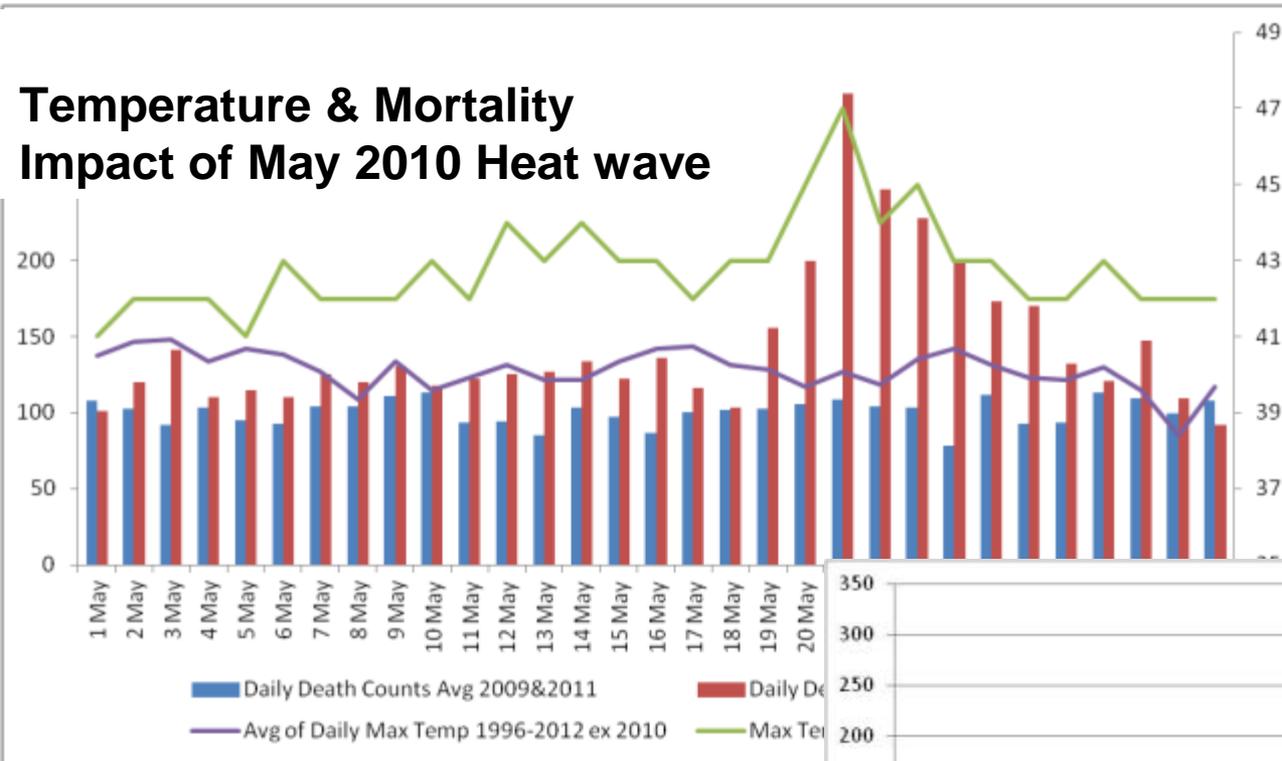
Temp Max [°C]  
Linear Trend: 5.69519 days/dec,  
SE=2.32655days



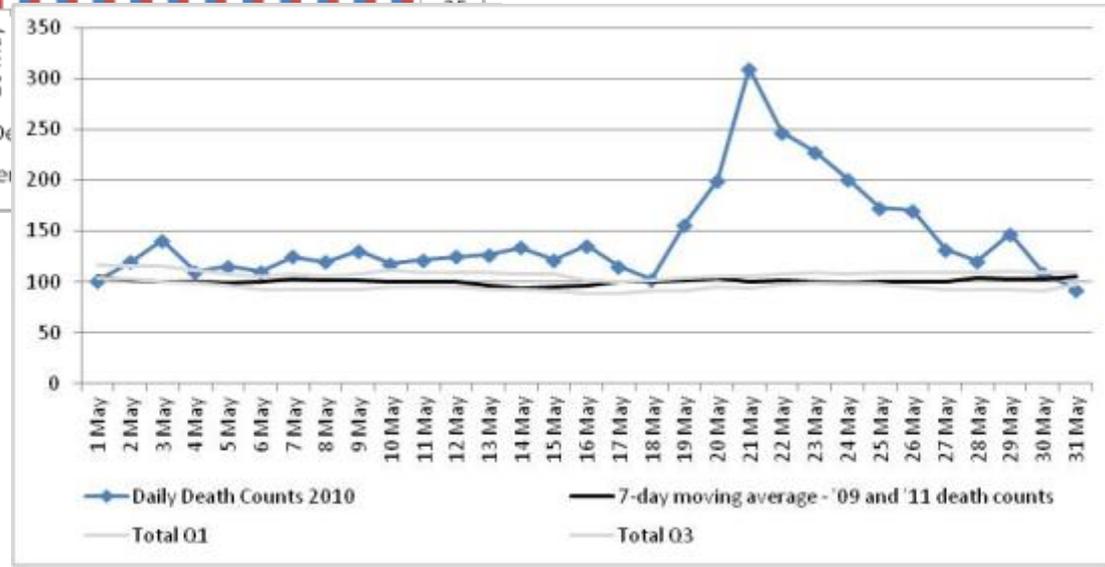
# The Challenge - Heat Kills

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## Temperature & Mortality Impact of May 2010 Heat wave



May 2010 compared with  
7-day moving average  
deaths\*, '09 and '11



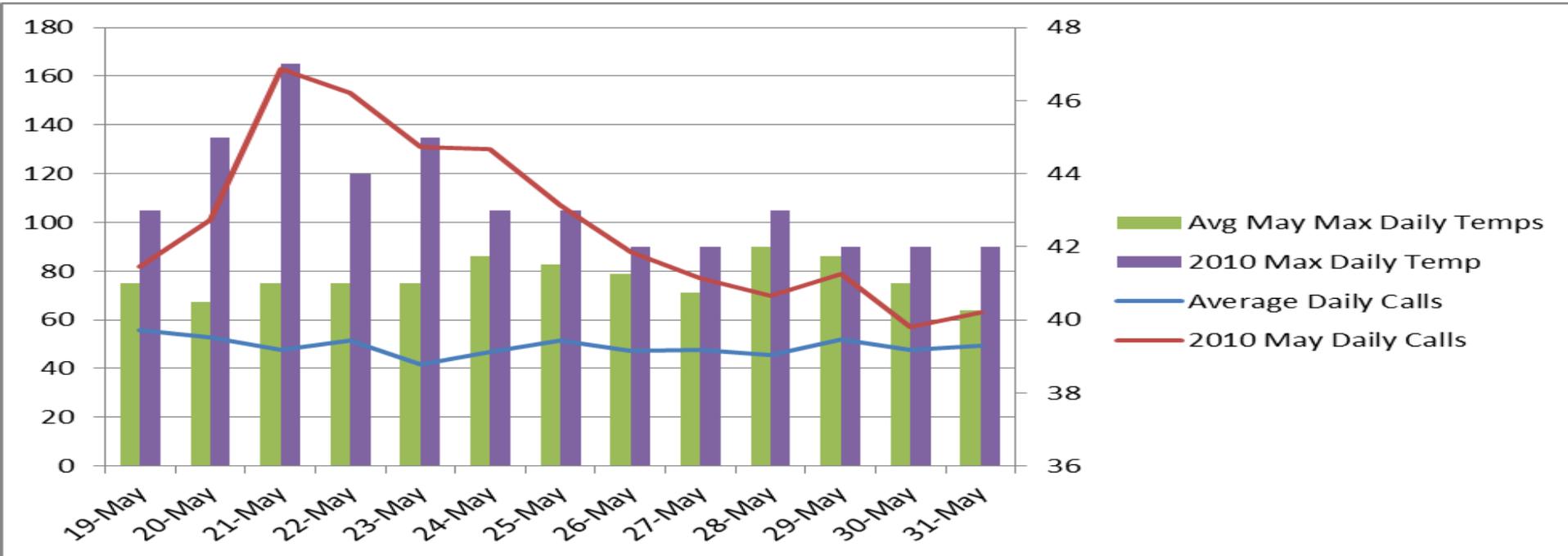
Data source: Mortality statistics: AMC;  
Temperature: IMD



# How Does the Heat Kill?

**Fighting Climate Effects:**  
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## Temperature & Excess Ambulance calls through GVK EMRI 108 of May 2010 Heat wave



Data source: Mortality statistics: GVK EMRI 108;  
Temperature: IMD



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# Slum Community Heat Vulnerability Survey

- *Method* - 300 slum community members surveyed (primarily female heads of household); provided information on behalf of their households, providing information for a total of 1,650 individuals
- *Key Findings* – Slum communities are vulnerable and unaware of temperature and extreme heat dangerous
- *Key Recommendations* – Educate, Warn & Mitigate



Summer 2011 community survey respondents



# Construction Worker Vulnerability Survey (HOTHAPS)

- *Method* – 100 workers from 4 construction sites from new west zone of Ahmedabad
- *Key Findings* – All construction workers are working in dangerous conditions – exposed to heat stress conditions (above ACGIH\* standards); 10 percent hospitalized at least once during summer
- *Key Recommendations* – Educate, Employer Mitigation & Protective Policies



\*American Conference of Governmental Industrial Hygienists



**Fighting Climate Effects:**  
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# 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), circulated to the public during Ahmedabad's hottest months in 2011 & 2012.



# Blog Posts & Media Articles

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

Saturday, June 15, 2013 13:31:40 GMT

THE WALL STREET JOURNAL | INDIA

INDIA REAL

The daily pulse of the world's largest d

« PREVIOUS

News Digest Politics Economy & Business South Asia Technol

April 18, 2013, 9:00 AM

## Ahmedabad Preps For Heat Wave

nature.com | Sitemap

indigenus

a blog from Nature India

Nature India > Blog > Post

NATURE INDIA | INDIGENUS

## Heat warning system for India's harsh sum

12 Apr 2013 | 11:49 BST | Posted by Subhra Priyadarshini | Category: Climate Ch

Health, Relief

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Home News Analysis S & T Editorial Column

## Ahmedabad gets its act together

In May, 2010, as many as 51 persons in Ahmedabad, mostly s citizens, died of sunstroke when the mercury rose to 46.5°C. administrators consider the year as an eye opener; they witne humble shanties turning into solar ovens, causing sunstrokes set to work to tackle the problem. This year, the city municipal corporation has launched a heat action plan which is said to b of the "first comprehensive early warning system and prepare plan for extreme heat events in India".

The plan "creates immediate and longer-term actions to incre preparedness, information-sharing, and response coordinatio reduce the health impacts of extreme heat on vulnerable populations." The plan includes issuing alerts, especially to th



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Natural Resources Defense Council Staff Blog

HOME ISSUES CONTRIBUTORS

→ Top Stories: Fracking | Safe Chemicals | Defending the Clean Air Act

Frances Beinecke's Blog

## Indian City Leads the Way on Protecting People from Extreme Heat of Climate Change

## Policy Papers: Issue Briefs



## Recommendations for Vulnerable Groups and Primary Actors

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

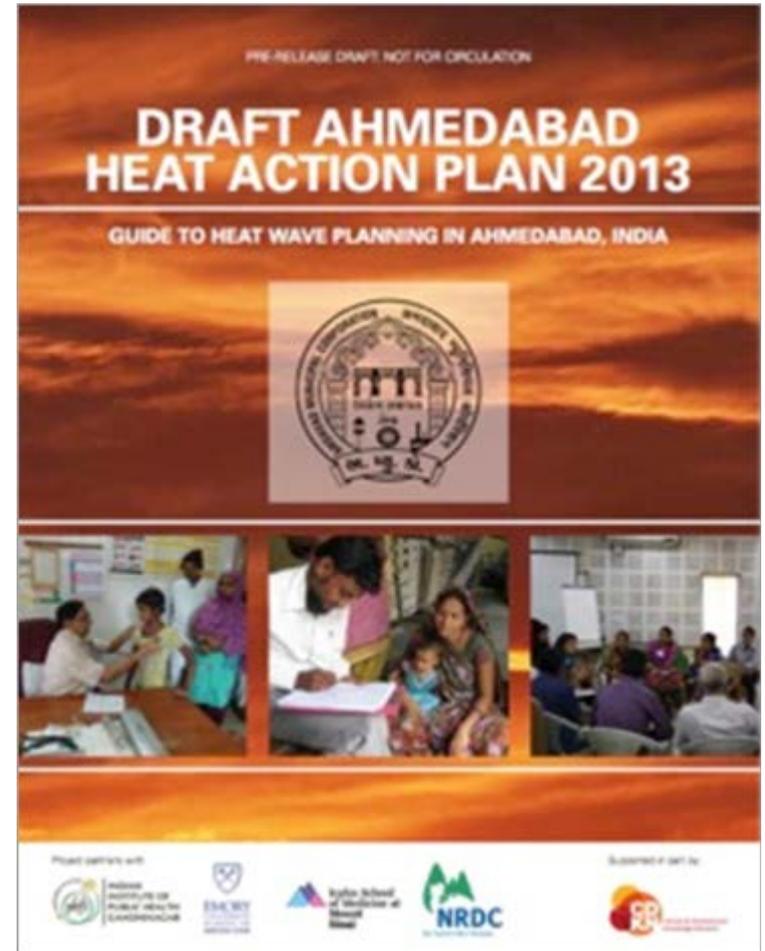
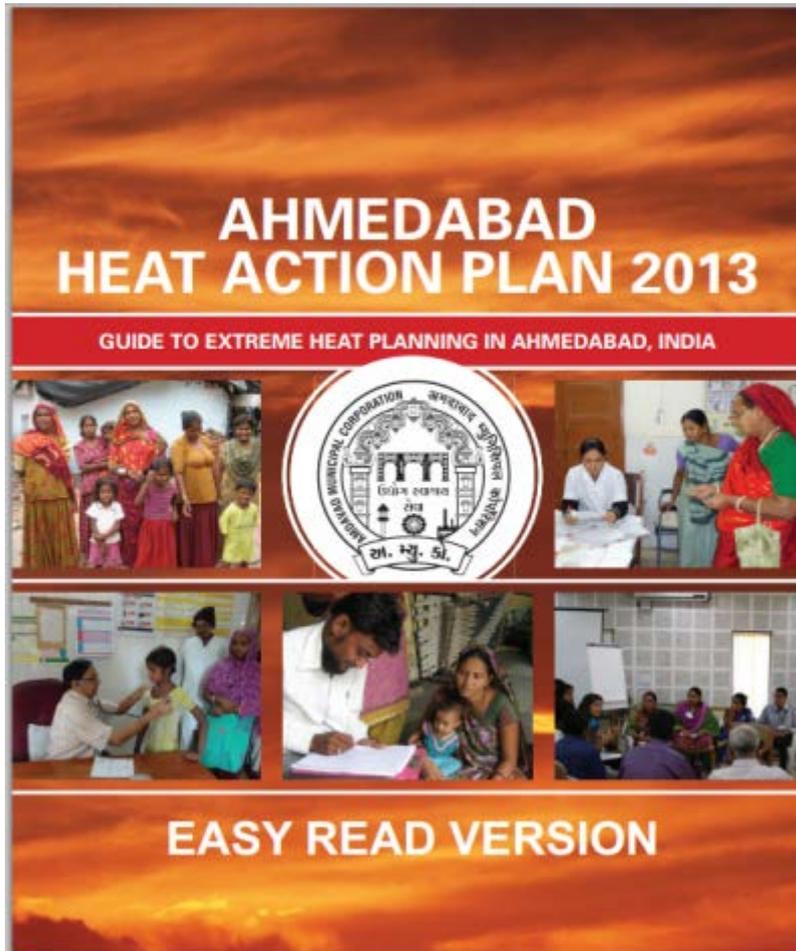
Available online from:

<http://www.nrdc.org/international/india/extreme-heat-preparedness/>



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

# Heat Action Plan



Available online from:

[www.egovamc.com/downloads/HealthCare/healthpdf/heat\\_action\\_plan.pdf](http://www.egovamc.com/downloads/HealthCare/healthpdf/heat_action_plan.pdf)





# Community Outreach

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

**HOW TO SAVE YOURSELF FROM HEAT WAVES**

NRDC ICMH INDIAN INSTITUTE OF PUBLIC HEALTH GANDHINAGAR

- Drink water, chaas, and other liquids (no soft drinks)
- Stay out of the sun
- Find a place to cool down
- Wear light clothing
- Check in with friends & family

**DRINK MORE WATER**

In case of an emergency, CALL 108

**હીટ એલર્ટ**  
**ગરમીથી તમે કેવી રીતે બચશો**

- પાણી, ઊંચા અથવા અન્ય પ્રવાહી પીવો (ડંડા પીણા નહીં)
- તડકામાં ન રહો
- ઢાળવા રંગના કપડાં પહેવો
- ડંડક વાતુ હોઈ સ્થળ શોધી કાઢો
- મિત્રો અને કુટુંબીજનોની સંભાળ રાખો

**ધ્યાન આપવા લાયક લક્ષણો:**

- ગરમીની ભાવનાઓ કે તાવ
- ખૂબ પસવેલો વધે અને ભાંગાણ વાગવો
- પાચાણ દુષ્કારો વધે અને ઊંચા અથવા

**HEAT ALERT**

**Dos & DON'Ts DURING HEAT WAVES**

- Drink water, chaas, and other liquids (no soft drinks)
- Stay out of the sun
- Find a place to cool down
- Wear light clothing
- Check in with friends & family

**Symptoms to watch for:**

- Heat rash or cramps
- Heavy sweating and weakness
- Headache and nausea
- Lack of sweating despite the heat
- Red, hot, and dry skin
- Muscle weakness or cramps
- Nausea and vomiting

**DRINK MORE WATER**

People at high risk: children, elders, and pregnant women

In case of an emergency, CALL 108

**ગરમીથી તમે કેવી રીતે બચશો**

NRDC ICMH INDIAN INSTITUTE OF PUBLIC HEALTH GANDHINAGAR

- પાણી, ઊંચા અથવા અન્ય પ્રવાહી પીવો (ડંડા પીણા નહીં)
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**પાણી વધુ પીવો**

ઈમરજન્સીમાં ૧૦૮ પર ફોન



# Early warning system - CFAN

<b>Monday 20 May 2013 - ORANGE ALERT LEVEL</b>	Current Forecast (Created 19-May )	20-May	21-May	22-May	23-May	24-May	25-May	26-May
	Alert Level	Orange	Orange	Orange	Yellow	Yellow	Yellow	Yellow
	Likelihood of Crossing Threshold	High	High	Med	High	High	Med	High
	Maximum Temp (+/- 1 SD)	44.2°C (43.9-44.5)	44.1°C (43.7-44.4)	43.5°C (43.0-44.2)	42.9°C (42.3-43.6)	42.1°C (41.5-43.0)	41.7°C (40.8-42.9)	41.5°C (40.5-42.3)
	Probability of "Safe Day"	0%	0%	0%	0%	10%	25%	20%
	Probability of "Hot Day"	4%	4%	41%	78%	88%	73%	78%
	Probability of "Very Hot Day"	96%	96%	59%	22%	2%	2%	2%
	Probability of "Extreme Heat Day"	0%	0%	0%	0%	0%	0%	0%

<b>Alert Levels:</b>	Safe <41°C	Hot 41.2°C - 43.4°C	Very Hot 43.5°C - 45°C	Extreme Heat >45°C	Likelihood of Crossing Threshold High>75% Med 50-75% Low<50%
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# Early warning system - CFAN

Date	Forecast Issued						Current Forecast
	13-May	14-May	15-May	16-May	17-May	18-May	19-May
14-May	High						
15-May	High	High					
16-May	High	High	High				
17-May	High	High	High	High			
18-May	High	High	High	High	High		
19-May	High	High	High	High	High	Med	
20-May	High	High	High	High	High	Med	High
21-May		High	High	High	High	Med	High
22-May			High	High	High	High	Med
23-May				Med	High	High	High
24-May					Med	High	High
25-May						Med	Med
26-May							High

If you have trouble seeing the content of this email, you can view an online version here:

<http://www.cfanclimate.com/BETA/NRDC/NRDCemailcontent.html>

username: *NRDC*

password: *2013Test*

# Early warning system – MET

BHARAT SARKAR  
MINISTRY OF EARTH SCIENCE  
INDIA METEOROLOGICAL DEPARTMENT



DIRECTOR  
Meteorological Centre,  
RS/RW Building,  
Ahmedabad Airport  
Ahmedabad-380003  
Tel: 079 22865165/22865012  
**DATED: 23/05/2013**

## PRESS BULLETIN

### SYNOPTIC SITUATION:-

GENERALLY NORTH-WESTERLY WINDS ARE PREVAILING AT LOWER LEVELS OVER THE REGION.

### LOCAL FORECAST FOR AHMEDABAD:- SKY WILL BE MAINLY CLEAR.

MAXIMUM TEMPERATURE WILL BE AROUND 42 °C.

TODAY'S MAX TEMP 42.5 °C DEP +1 °C

TODAY'S MIN. TEMP 26.8 °C DEP 0 °C

R. H. RECORDED AT 0830 HRS IST 67 %

R. H. RECORDED AT 1730 HRS IST 25 %

RAINFALL FROM 19/0830 HRS IST TO 20/0830 HRS IST 000.0 MM

RAINFALL FROM 20/0830 HRS IST TO 20/1730 HRS IST 000.0 MM

SEASONAL TOTAL RAINFALL (FROM 01/01/2013) => 005.5 MM DEPARTURE FROM NORMAL = -004.3 MM

Sun rise : 05:55 hrs IST : Moon rise : 18:33 hrs IST

Sun set : 19:18 hrs IST : Moon set : 04:57 hrs IST

### STATE FORECAST :-

WEATHER WILL BE SUNNY IN ALL DISTRICTS OF GUJARAT STATE & IN DIU DAMAN DADRA NAGAR HAVELL.

HIGH TEMPERATURE WARNING:- NIL

# Early warning system – MET

STATION	MAX TEMP. (°C)	MIN. TEMP (°C)	Rainfall Yesterday's 0830 hrs to Today's 0830 hrs (mms)	Rainfall Today's 0830 hrs to today's 1730 hrs(mm)	STATION	MAX TEMP. (°C)	MIN. TEMP (°C)	Rainfall Yesterday's 0830 hrs to Today's 0830 hrs (mms)	Rainfall Today's 0830 hrs to Today's 1730 Hrs (mms)
<b>GUJARAT REGION</b>					<b>PORBANDAR</b>	34.2	26.8	000.0	000.0
AHMEDABAD	42.5	26.8	000.0	000.0	RAJKOT	42.0	25.9	000.0	000.0
DEESA	39.8	26.3	000.0	000.0	VERAVAL	33.8	27.0	000.0	000.0
GANDHI NAGAR	41.8	27.5	000.0	000.0	DIU	34.5	26.5	000.0	000.0
IDAR	-	-	000.0	000.0	SURENDRANAGAR	40.8	26.7	000.0	000.0
V.V. NAGAR	-	25.4	===	===	MAHUVA	34.8	22.7	000.0	000.0
BARODA	41.2	27.6	000.0	000.0	BHUJ	39.0	26.3	000.0	000.0
SURAT	34.5	27.8	000.0	000.0	K. MANDVI	-	-	-	-
VALSAD	34.9	24.6	000.0	000.0	NALIYA	35.5	27.4	000.0	000.0
<b>SAURASHTRA &amp; KUTCH</b>					KANDLA PORT	36.1	27.3	000.0	000.0
AMRELI	-	-	000.0	000.0	KANDLA AIRPORT	41.2	26.6	000.0	000.0
BHAVNAGAR	42.6	26.0	000.0	000.0					
DWARKA	32.2	27.2	000.0	000.0					
OKHA	33.1	27.9	000.0	000.0					

# Capacity Building - User guides



Hoardings have been put up across the city, including this one in front of the VS Hospital

## USER GUIDE: AMC'S EARLY WARNING SYSTEM

*(For Internal AMC Use Only – Not for Distribution – June 2013)*

This user guide outlines the three alert levels in the AMC's early warning system in Ahmedabad. The early warning system is an important component of the city's Heat Action Plan to protect and prepare Ahmedabad's residents for heat events. The heat alerts are triggered by temperature thresholds and correlate with the following color signals:

### COLOR SIGNALS

<b>WHITE</b>	<b>No Alert</b>	<b>&lt; 41°C</b>
<b>YELLOW ALERT</b>	<b>Hot Day Advisory</b>	<b>41°C – 43.4°C</b>
<b>ORANGE ALERT</b>	<b>Heat Alert Day</b>	<b>43.5°C – 45°C</b>
<b>RED ALERT</b>	<b>Extreme Heat Alert Day</b>	<b>&gt; 45°C</b>

For the early warning system, **temperature forecast for a seven-day period will be communicated to the AMC Nodal Officer and key health officials via daily automatic emails.** An example email is explained below. The forecasts are developed and generated from the Climate Forecast Applications Network in cooperation with Georgia Tech.

The AMC Heat Action Plan and its early warning system are designed to be consistent with the Indian Meteorological Department and Ahmedabad Meteorological Centre processes. The Indian Meteorological Department has defined the criteria for heat wave and the Meteorological Centre, Ahmedabad currently determines whether to declare a heat wave, as discussed in the Heat Action Plan.

The early warning system currently involves four levels: "No Alert"; "Hot Day Advisory"; "Heat Alert Day"; and "Extreme Health Alert Day" with color signals. The early warning



# Capacity Building - Action items

## AMC Nodal Officer

Action	Yellow	Orange	Red
Activate the alert and local response citywide by notifying the key city departments, the AMC Deputy Municipal Commissioners and the Gujarat state agencies via email listserve, fax or telephone.	X	X	X
Display flags and other devices in the appropriate color to communicate the alert.	X	X	X
Disseminate public messaging about the dangers of heat-related illness through an AMC Nodal Office press officer and media outlets.	X	X	X
Receive weekly reports of the public health impact from health officials.	X	X	X
Coordinate with the local press and media outlets to publicize heat warnings.	X	X	X
Increase access to places to cool off, including parks, lakes, swimming pools, public libraries, shopping malls, and the BRTS routes.	X	X	X
Ensure that communication channels remain operational during the alert.	X	X	X
Verify receipt of alert and confirm that appropriate actions are taken.	X	X	X
Activate "cooling centers" such as temples and public buildings like libraries and malls, and/or AMC-run temporary night shelters.		X	X
Open emergency shelters for local communities.		X	X
Hold frequent conference calls with a coordinated response team to discuss reports and address breaking developments.		X	X
Ensure that communication channels remain operational.		X	X
Communicate the suspension of all non-essential uses of water via the AMC Water Project's protocol procedures.			X
Communicate to the local utility company to prioritize maintaining power to critical facilities (such as hospitals and UHCs).			X
Extend hours of temporary emergency centers for residents without water or power.			X
Hold daily conference calls to discuss reports and address breaking developments with a coordinated response team.			X
Adjust the alert when local forecast temperatures fall below the relevant threshold by notifying the relevant agencies via email listserve, fax or telephone.	X	X	X

## Key Departments and Stakeholders

Department	Yellow	Orange	Red
Press and Media	X	X	X
AMC HD	X	X	X
AMC HD	X	X	X
AMC HD		X	X
AMC HD		X	X
AMC HD		X	X
AMC HD		X	X
PH and LW	X	X	X
PH and LW	X	X	X
PH and LW	X	X	X
Press and Media	X	X	X
Press and Media	X	X	X
AMC Press Officer		X	X
108 Service		X	X
108 Service		X	X
108 Service		X	X
CO Groups		X	X
CO Groups		X	X
AMC Water Department			X
Local Utility Boards			X
CO Groups and LW			X



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

# Next steps - Research

- Chart / Record review of all summer afternoon emergency room admissions
- WBGT temperature measurements in city
- Study on heat resilient habitats and traditional heat protective behaviors
- Thermal maps from ISRO (possibly)



WBGT instrument used for temperature measurements across the city

# Next steps - Implementation

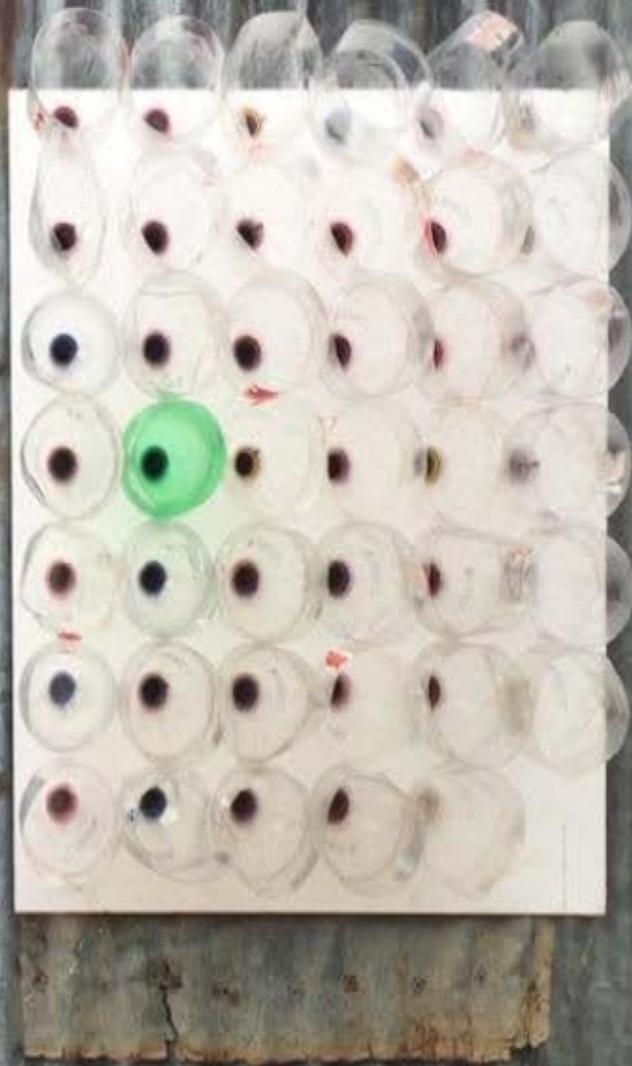


Site visit for the purchase of weather monitoring instruments

- Weather monitoring stations at 6 spots in Ahmedabad
- Real-time temperature displays
- Case study on construction workers for best practices
- Additional variables for threshold trigger determination in HAP



North India, 2016: The sale of air-coolers has increased drastically due to the summer heat. (Praveen Kumar/HT Photo)



The Eco-Cooler doesn't require any electricity to function!