UR Himeji+

UNDERSTANDING RISK GLOBAL FORUM 2024

TRADITION • INNOVATION • RESILIENCE

強靭性 革新 伝統

Extreme Heat in Cities:

From assessment to action

Speakers:

Ross Eisenberg

Dileep Mavalankar

Daniel Sullivan

Nuala Cowan

Extreme Heat in Cities

From assessment to action

Understanding Risk 2024 | June 18, 2024

City Resilience Program

GFDRR
Global Facility for Disaster Reduction and Recovery

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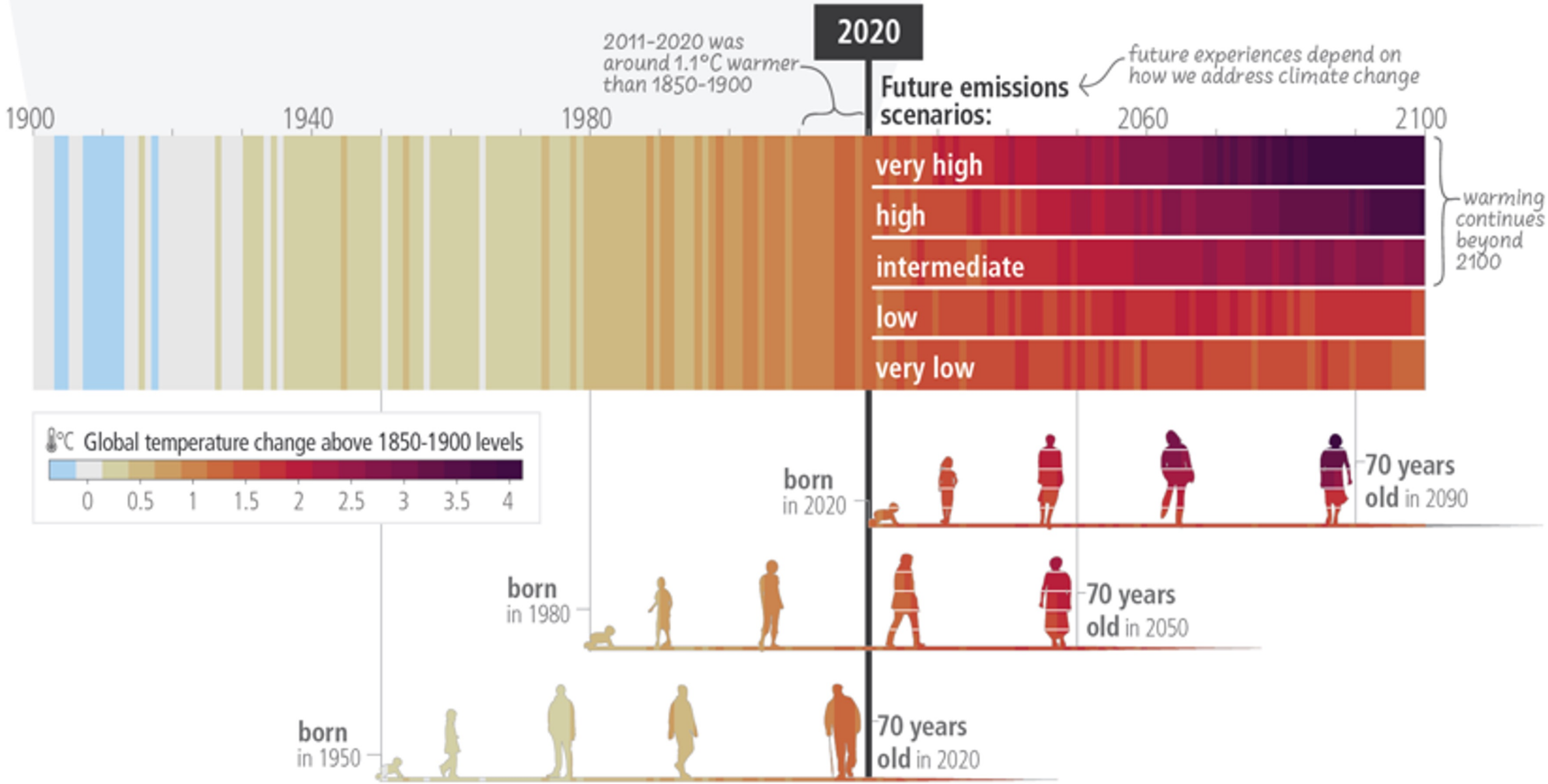
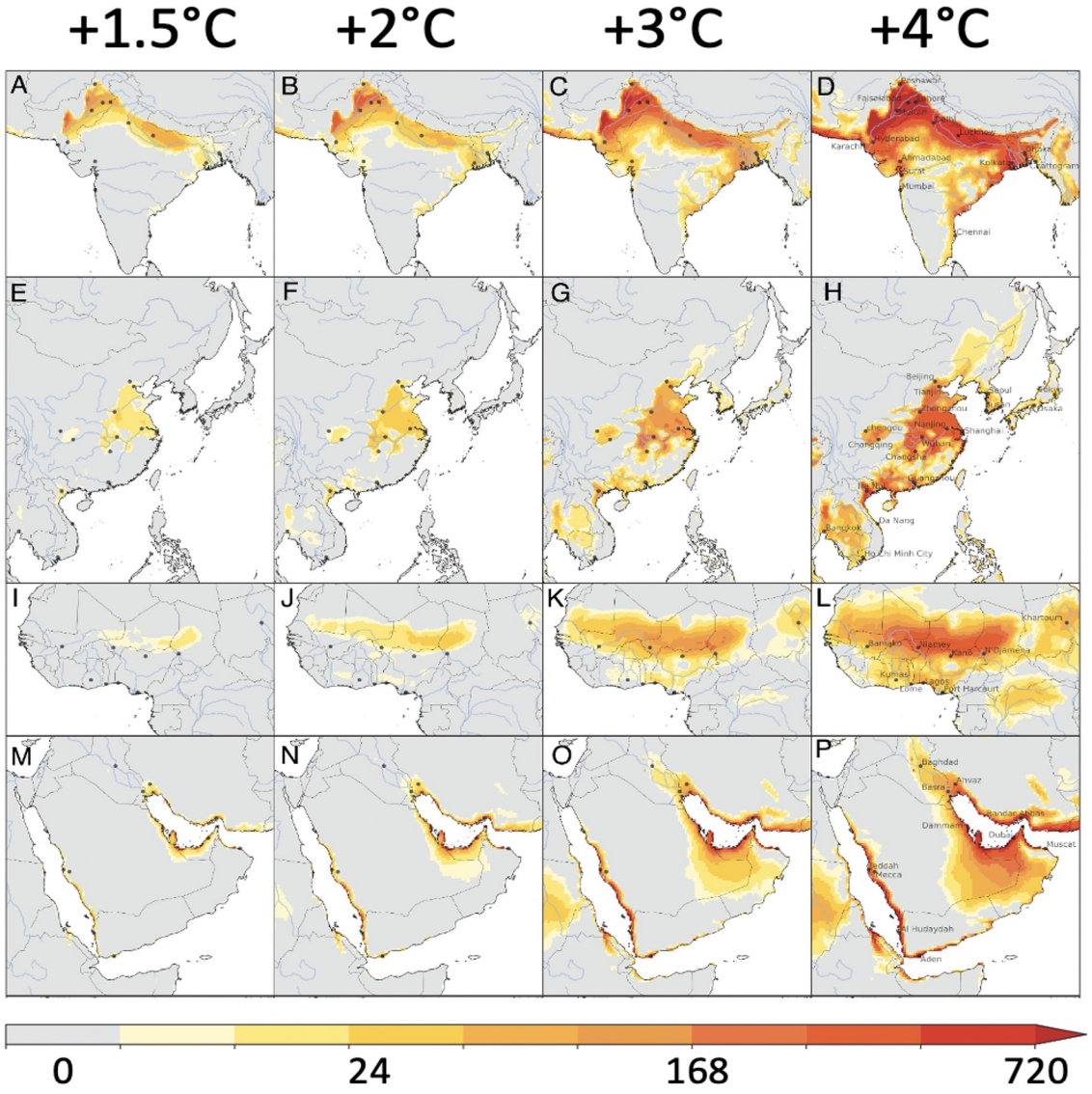
c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term





Extreme heat in 2050: Annual hours above acute heat stress threshold (35°C WBGT) under climate scenarios

"If global temperatures increase by 2°C, 2.2 billion residents of the Indus Valley, 1 billion in eastern China and 800 million in sub-Saharan Africa will annually experience many hours of heat that surpass human tolerance."

Indian Express (May 2024) citing Vecellio et al (2023).

Q1: What island is this? (c. 1609)

Q2: Which would have the greater impact on local temperatues, rain, and wind?

A) 400 years of climate change

B) Building a megacity here

Manhattan 1609

Manhattan 2009

Cities are heating up twice as fast.

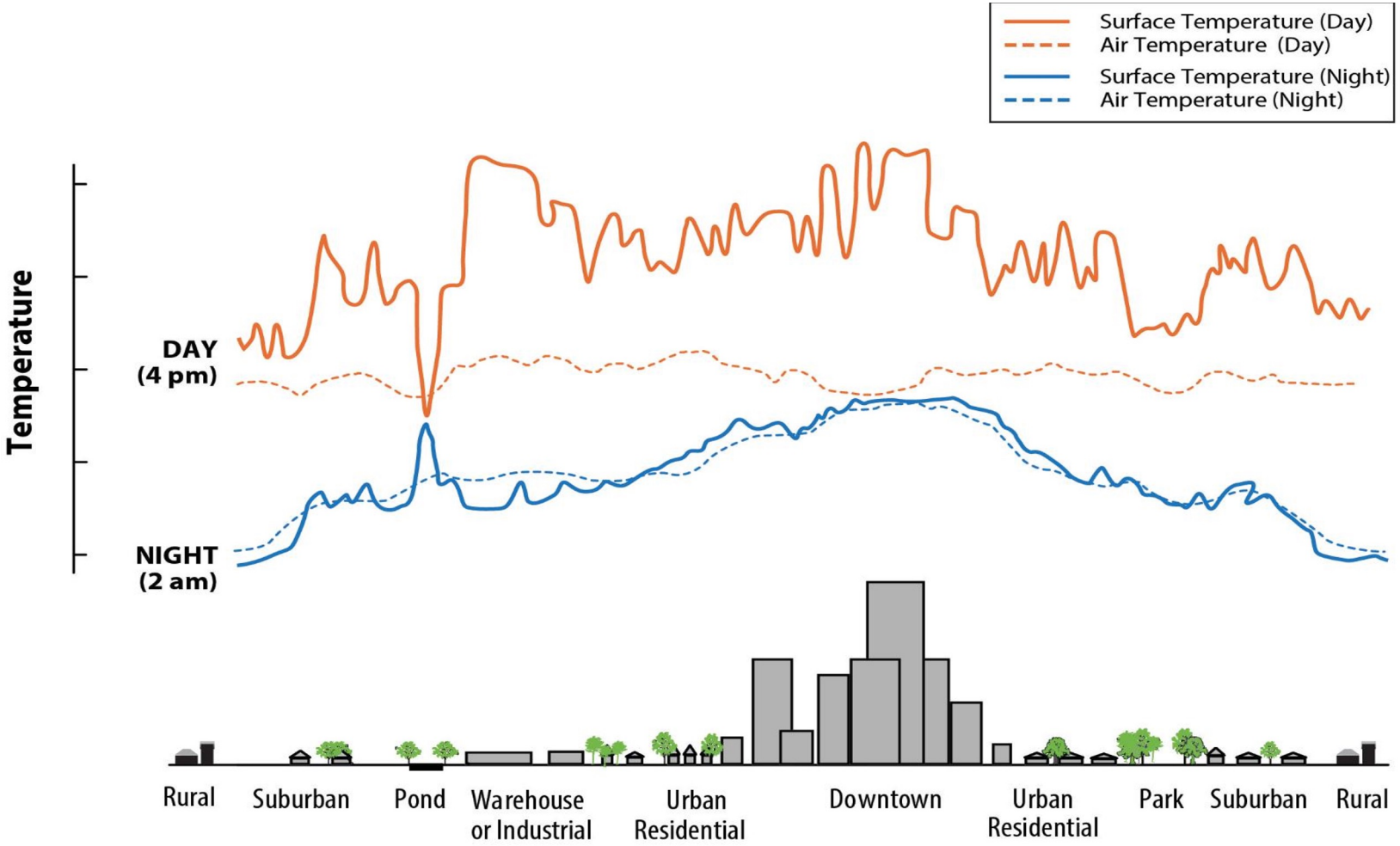
Dark urban surfaces

Lack of vegetation

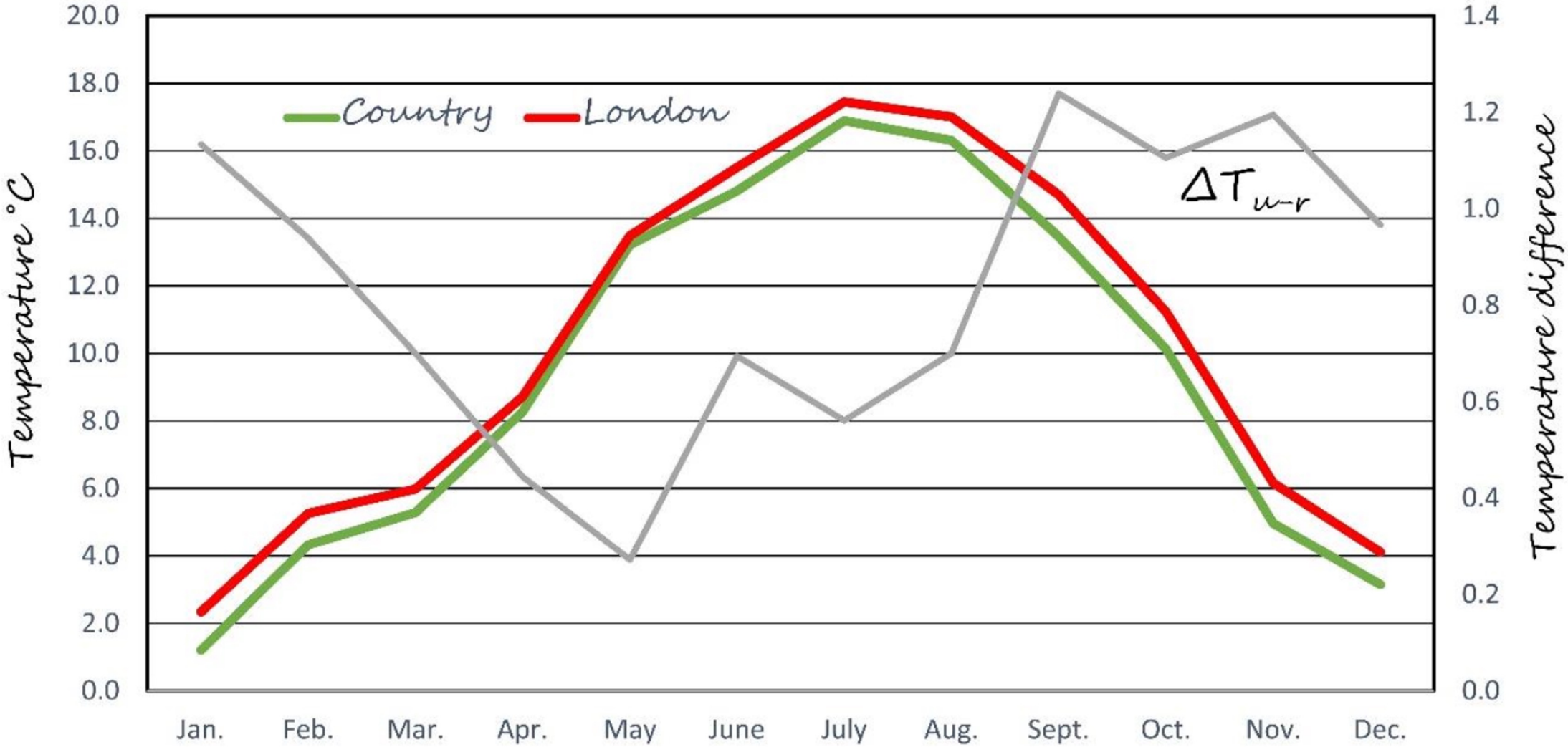
Human-generated heat

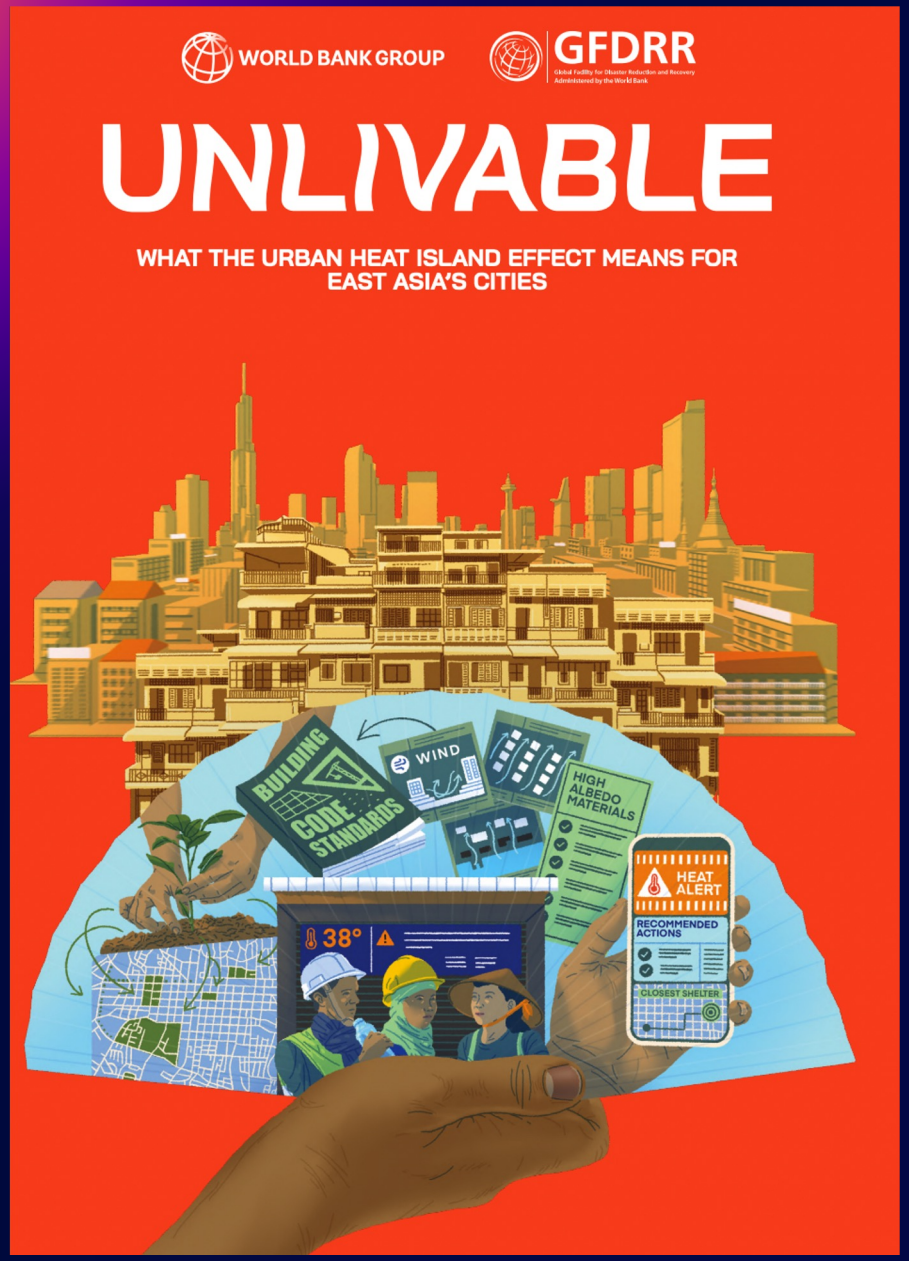
Heat-trapping urban design

Urban materials absorb and radiate the sun's energy



Average Temperature 1807-1816





Places

People

Institutions

Japan’s Heat Stroke Alert System

COLOR	HEAT THRESHOLD (°C WBGT)	CATEGORY	MAIN ACTIONS RECOMMENDED
Red	Above 31	Dangerous	Exercise should be stopped.
Orange	28–31	Warning	Refrain from heavy exercise; frequent rest and hydration are strongly encouraged.
Yellow	25–28	Watch	Frequent rest and hydration are strongly encouraged during heavy exercise.
Sky blue	21–25	Caution	Hydration is encouraged.
Blue	Below 21	Generally safe	Appropriate hydration is suggested.

PANELISTS

Dileep Mavalankar

Indian Institute of Public Health /
GFDRR, World Bank

Daniel Sullivan

City of Cape Town

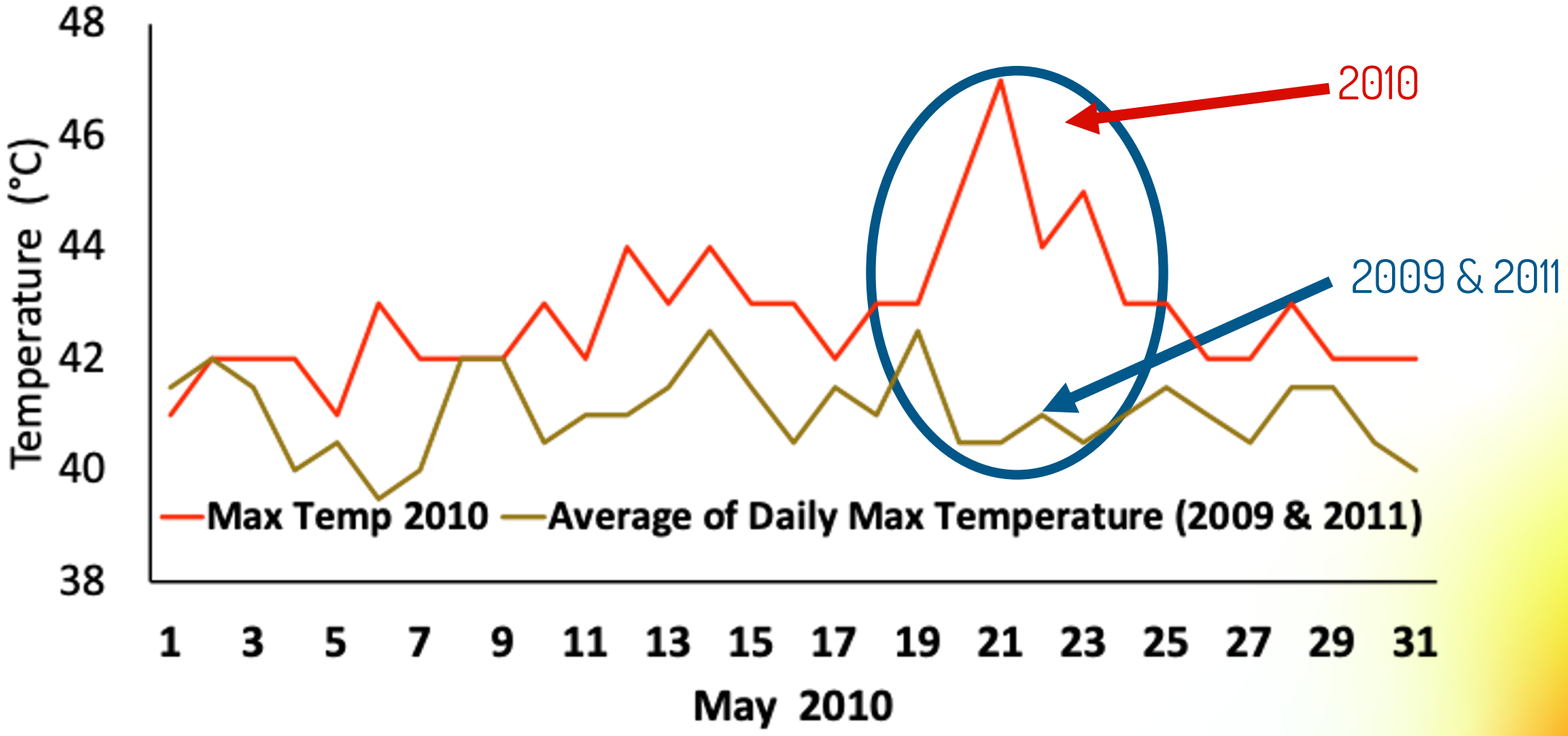
Nuala Cowan

GFDRR, World Bank

DILEEP MAVALANKAR

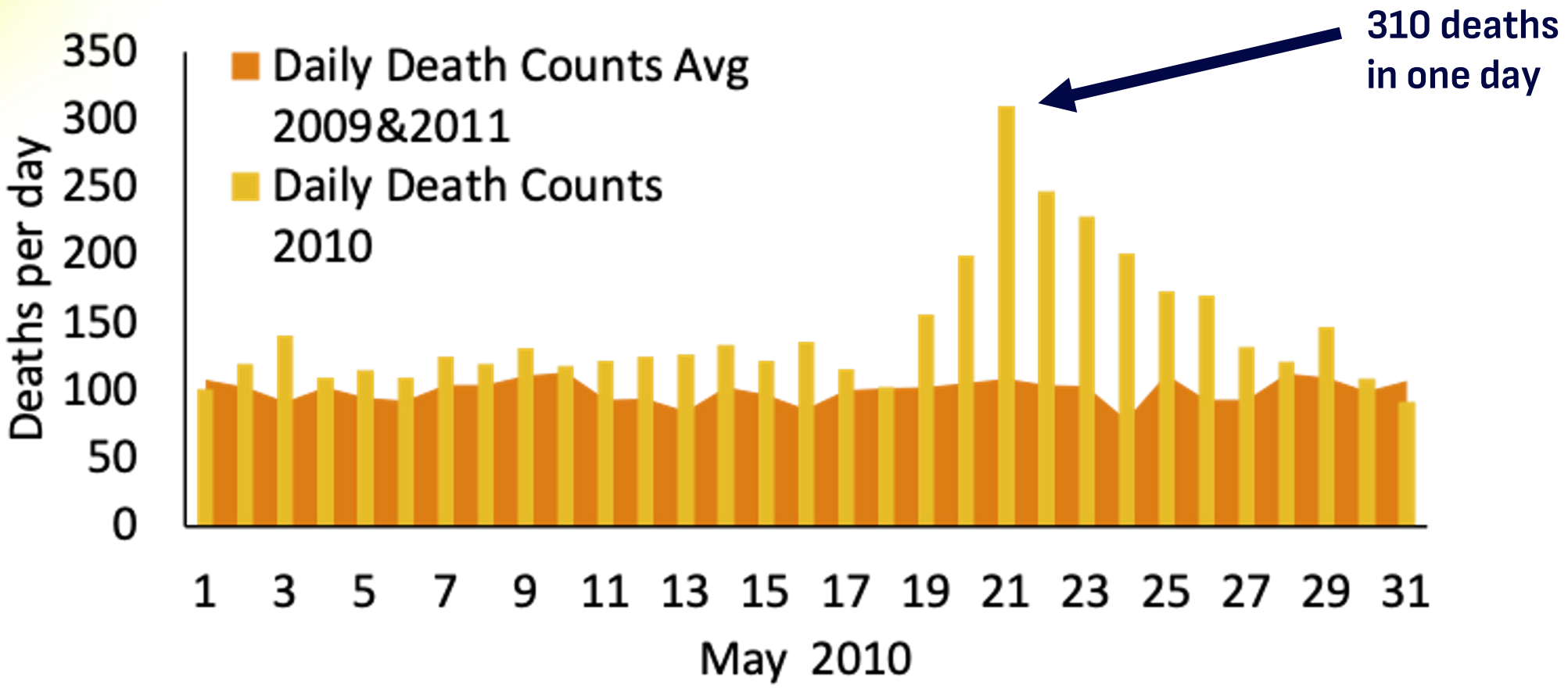
Experience of the Heat Action Plan Ahmedabad city, India

During the May 2010 heatwave, temperatures in Ahmedabad hit 47 °C



Source: Indian Institute of Public Health - Gandinagar

The all-cause mortality rate increased to 310 deaths per day on May 21st (city baseline: 100 deaths per day)

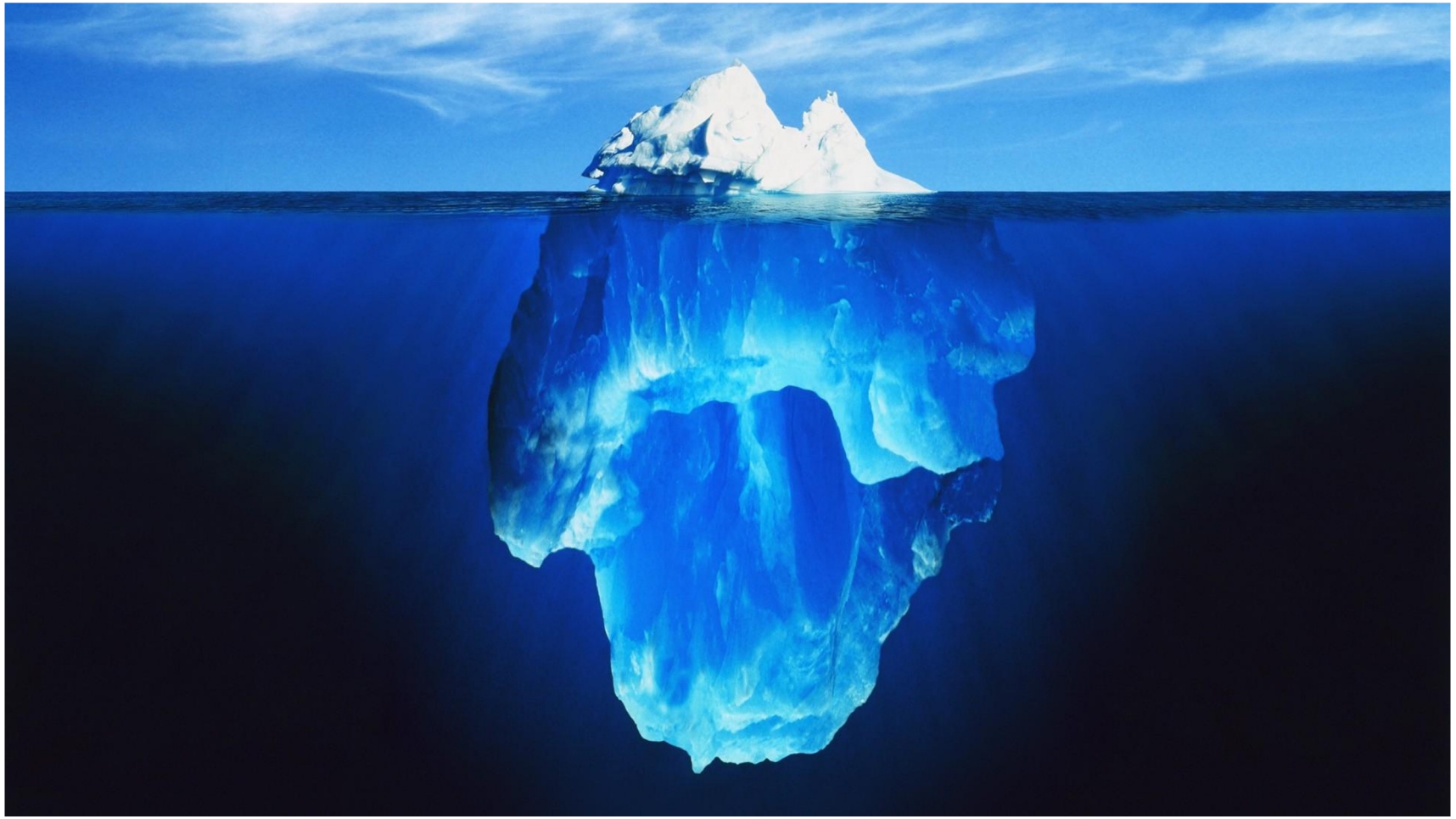


Source: Indian Institute of Public Health – Gandinagar

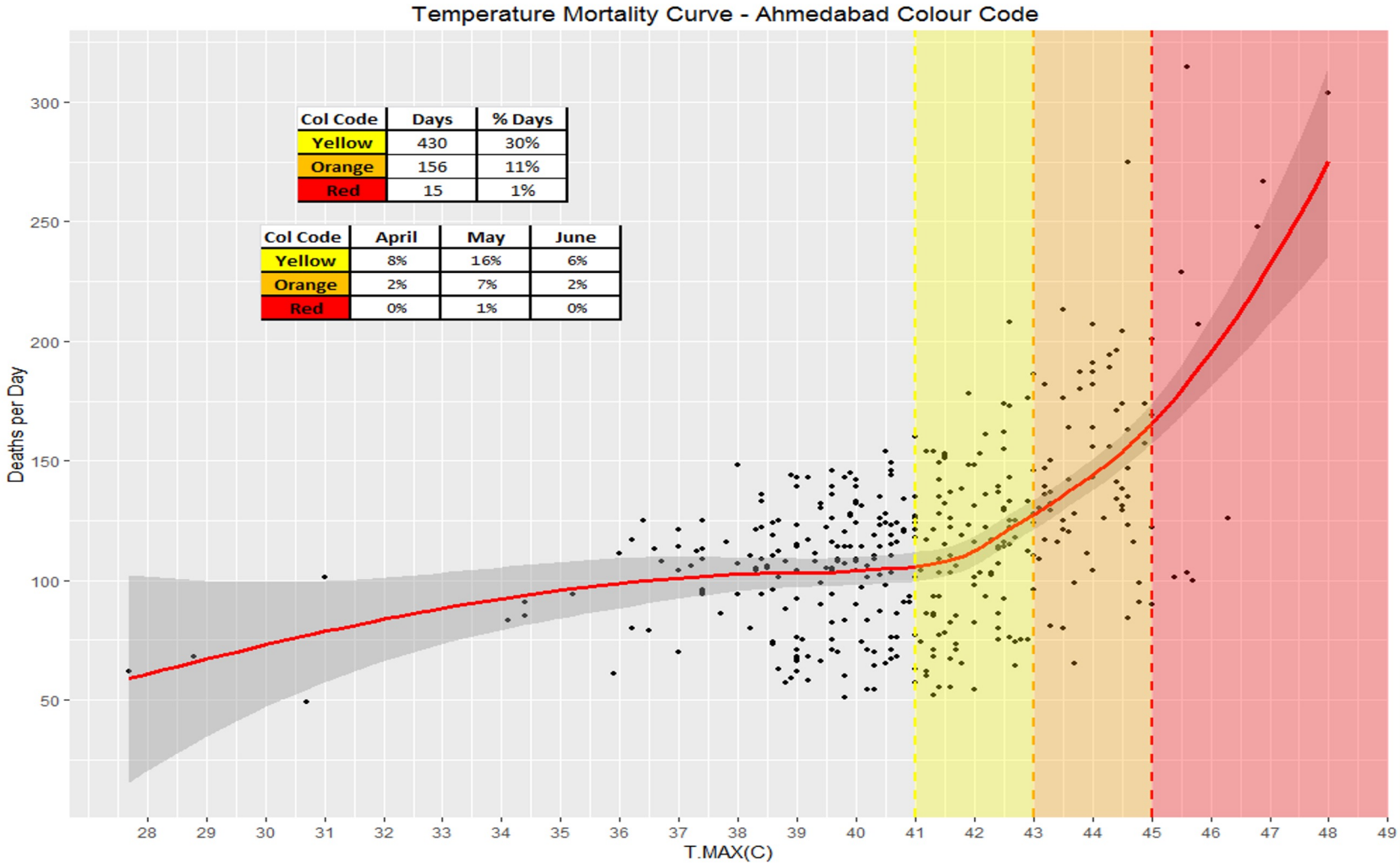
Reported heat wave deaths are like tip of an iceberg: 10% visible, 90% not visible

Reported heat stroke deaths: **76**

Heat wave associated excess mortality: **800**



Setting early warning thresholds based on temperature-mortality relationship



Note: The scatter plot and fitted curve show daily maximum temperature and daily all-cause mortality for Ahmedabad between 2001 to 2016. Source: Indian Institute of Public Health, Gandinagar

HAP COMPONENTS

EARLY WARNING SYSTEM & INTER AGENCY EMERGENCY RESPONSE PLAN

Alert residents of predicted high and extreme temperatures & formally communication channels to alert governmental agencies

PUBLIC AWARENESS & COMMUNITY OUTREACH

Communicate the risks of heat waves and implement practices to prevent heat-related deaths and illnesses

CAPACITY BUILDING OF MEDICAL PROFESSIONALS

Training focus on primary medical officers and other paramedical staff, and community health staff

REDUCING HEAT EXPOSURE AND PROMOTING ADAPTIVE MEASURES

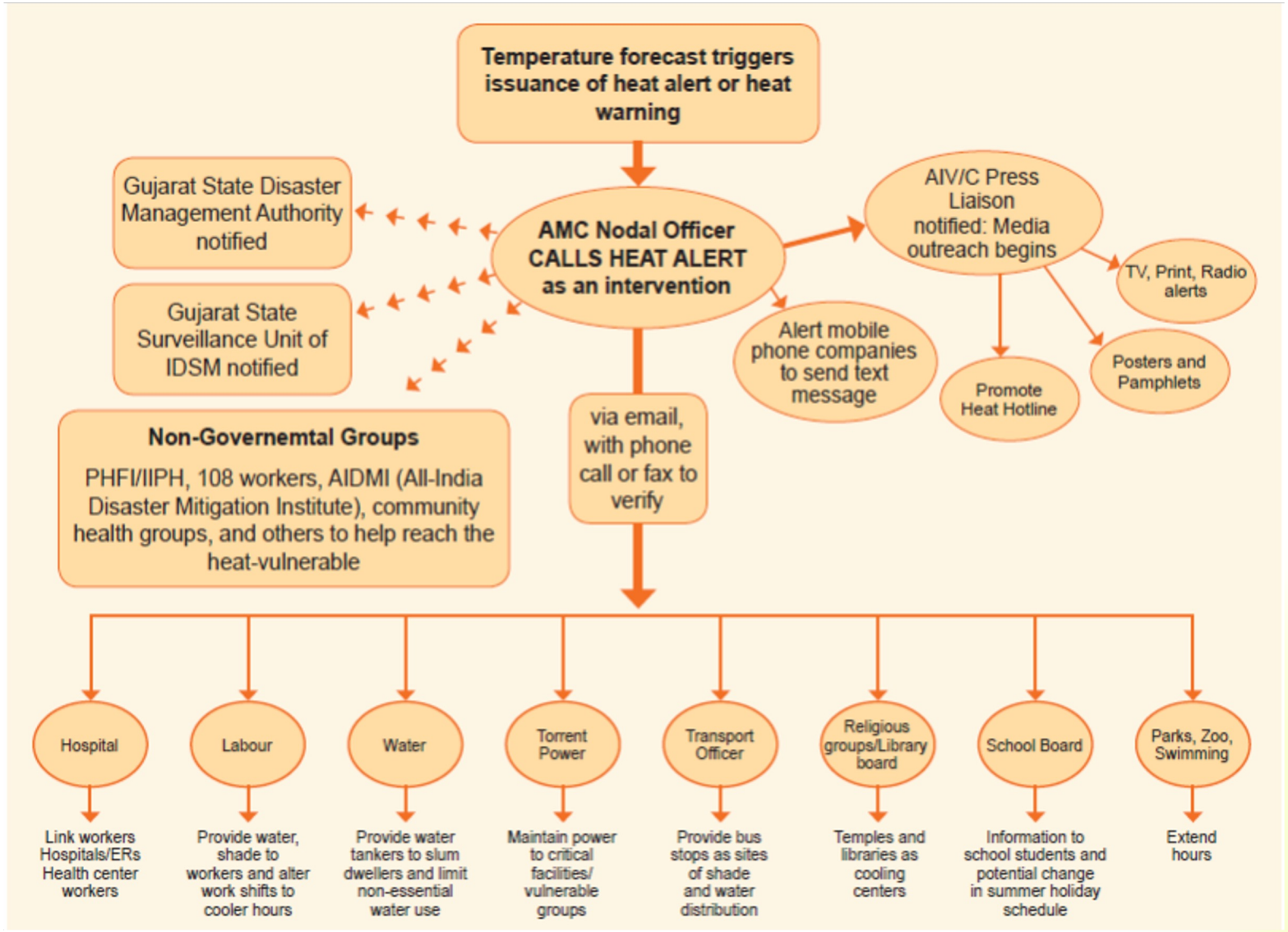
Access to potable drinking water and cooling spaces during extreme heat days & promote adaptive measures.

Intervention 1: Early Warning System & Inter-Agency Emergency Response Plan

Temp prediction by IMD sent to nodal officer

Yellow, Orange

Red warnings



Intervention 2: Public Awareness & Community Outreach

Intervention 3: Building Capacity of Health Staff and Facilities

Case Definitions

Heat Illness - Typical Presentations

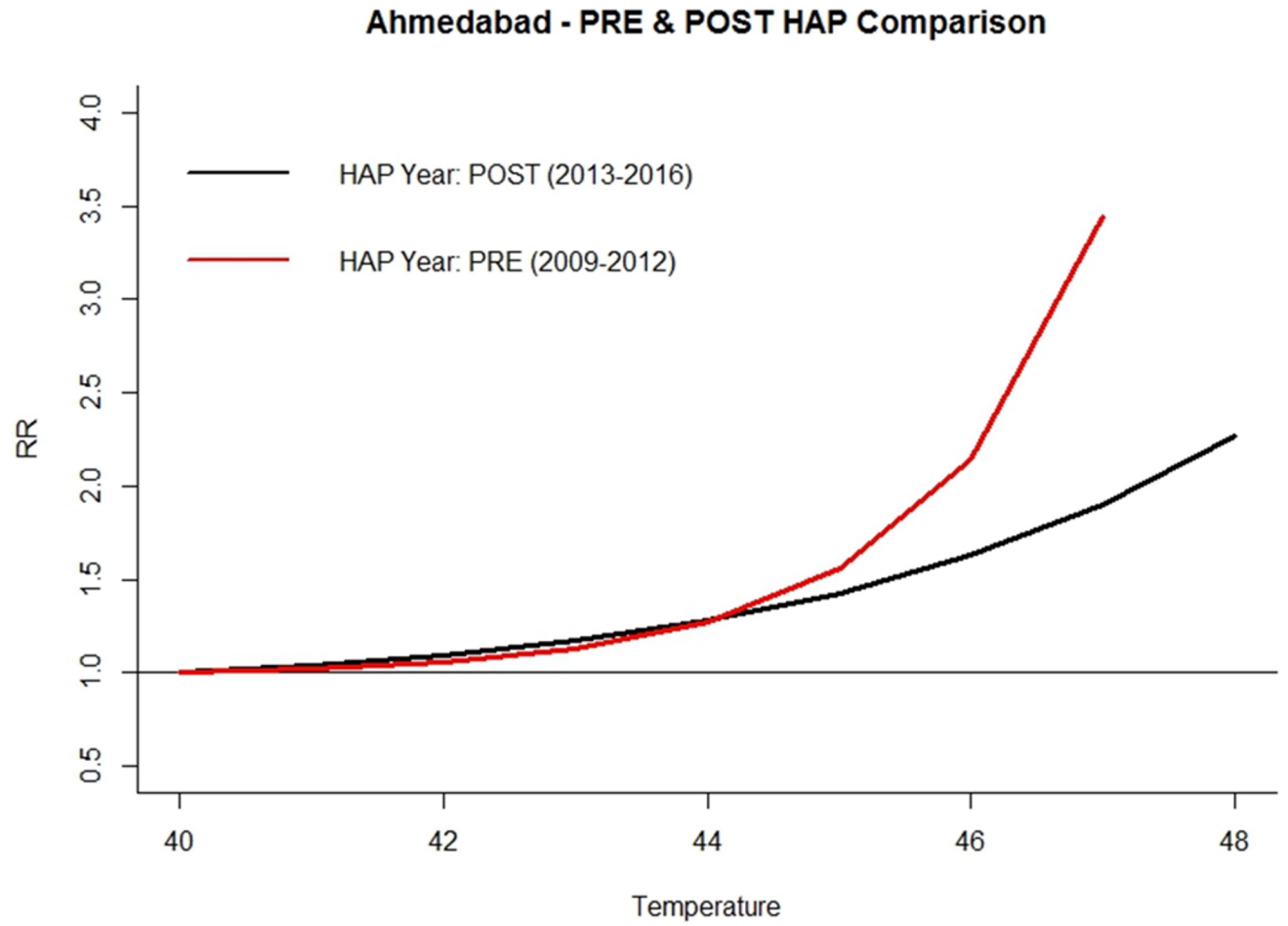
Clinical Entity	Age Range	Setting	Cardinal Symptoms	Cardinal Signs	Pertinent Negatives	Prognosis
Heat rash	All, but frequently children	Hot environment; +/- insulating clothing or swaddling	Itchy rash with small red bumps at pores in setting of heat exposure; bumps can sometimes be filled with clear 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 4: Reducing Heat Exposure & Promoting Adaptive Measures

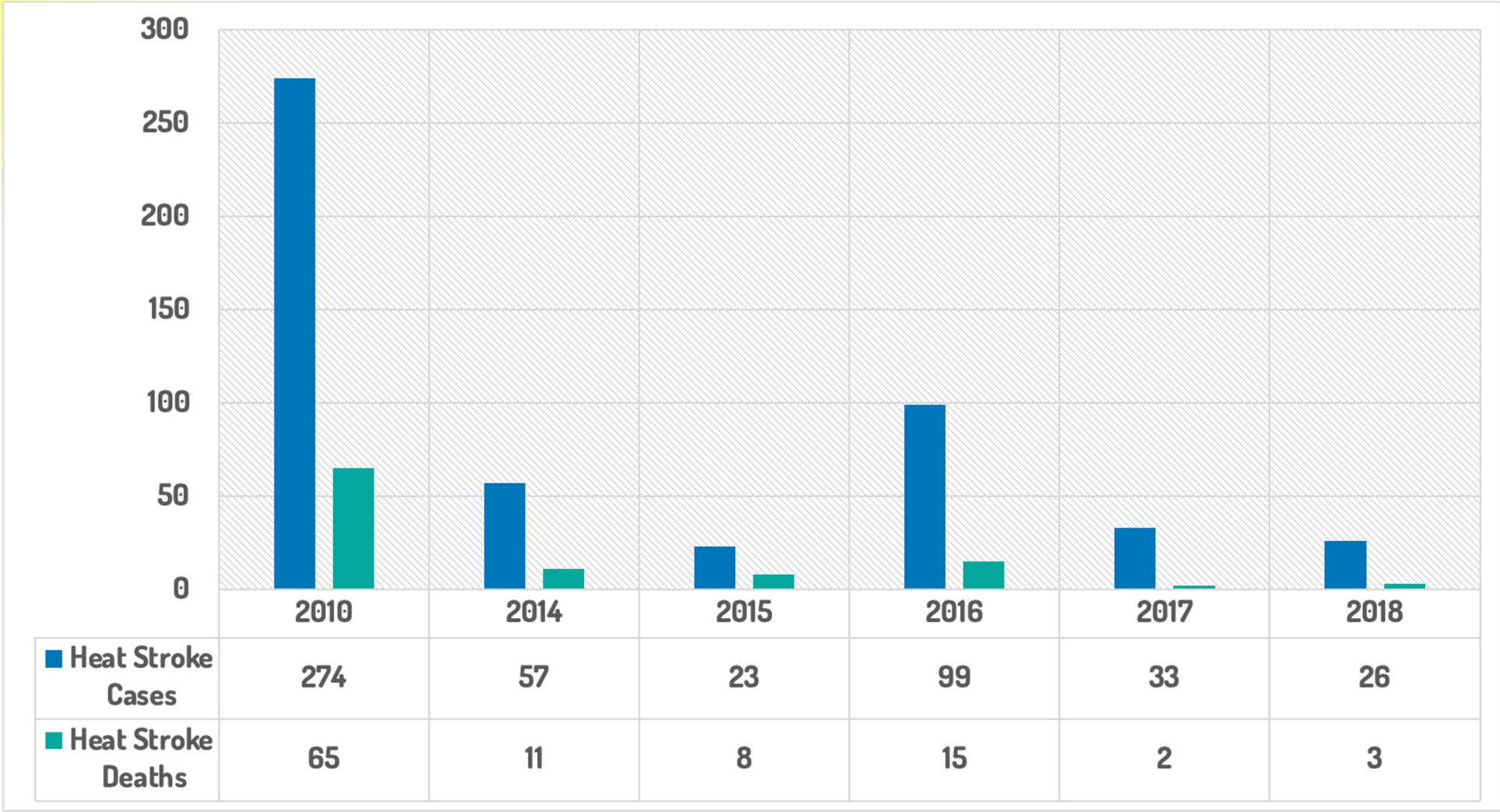
Impact of Ahmedabad Heat Action Plan

Estimated 1,190 average annualized deaths avoided in the post-HAP period

Source: Hess et al., 2018



Year wise Diagnosed Heat Stroke cases & deaths



	2010	2014	2015	2016	2017	2018
Heat Stroke Cases	274	57	23	99	33	26
Heat Stroke Deaths	65	11	8	15	2	3

Key Messages

- Heat Action Plans can save lives even in emerging economies
- Assessment and action leads to Impact
- This heat action plan is being replicated throughout India under leadership of National Disaster Management Authority

DANIEL SULLIVAN

Embedding a Heat Response

CITY OF CAPE TOWN

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ISIXEKO SASEKAPA
STAD KAAPSTAD

Embedding a Heat Response

Daniel Sullivan
Resilience Department | Future Planning and Resilience Directorate

Making progress possible. Together.

Resilient Cities > Resilience Strategy

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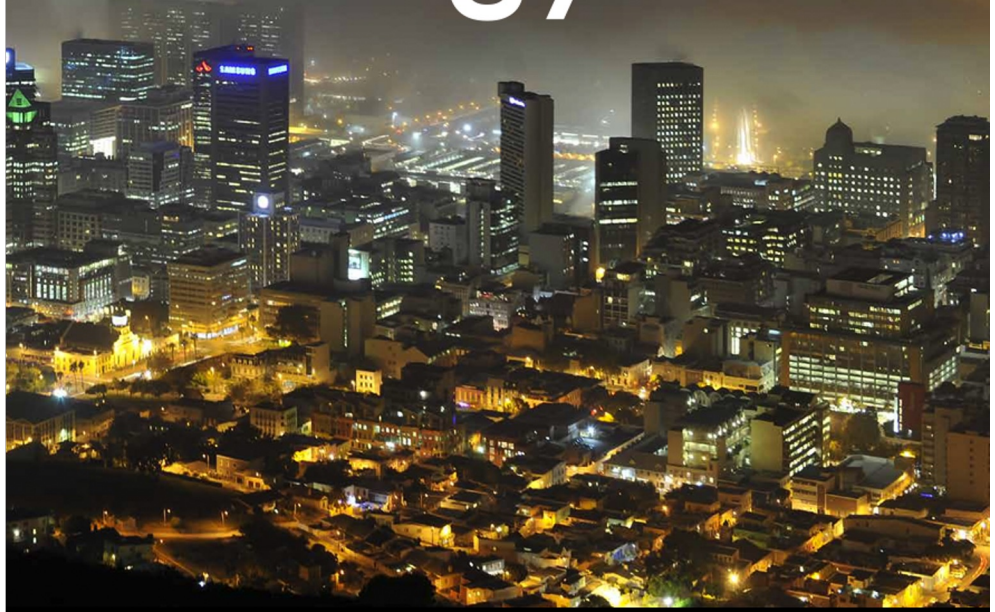
CAPE TOWN
Resilience Strategy



RESILIENT CAPE TOWN

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PIONEERED BY THE ROCKEFELLER FOUNDATION
100 RESILIENT CITIES

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CLIMATE CHANGE STRATEGY

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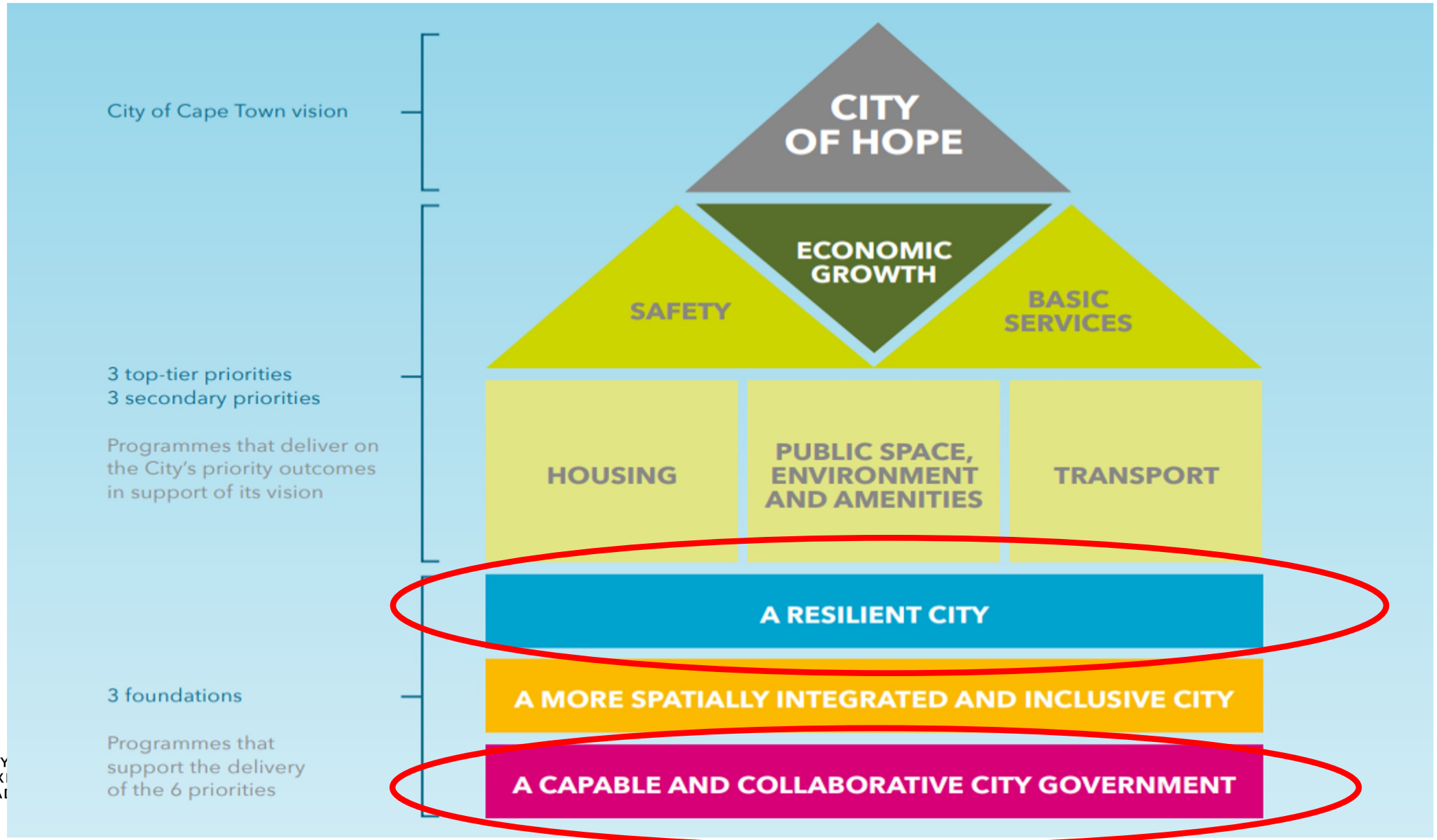
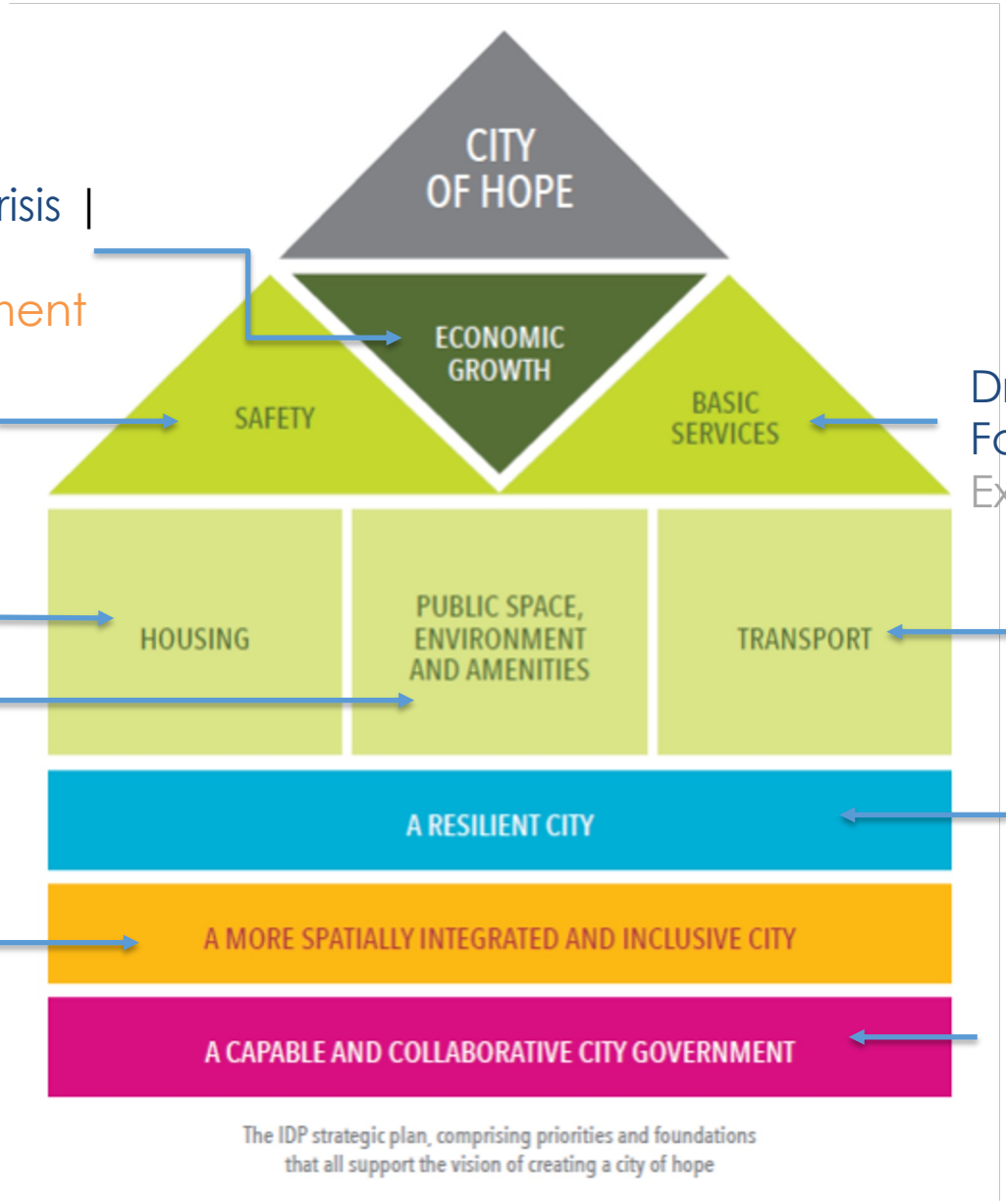
City Strategy: 5 year plan



IDP (2022 – 2027): Most relevant shocks & stresses identified for Resilience Responses



The IDP strategic plan, comprising priorities and foundations that all support the vision of creating a city of hope

Financial Crisis | Poverty | Unemployment

Civil Unrest | Crime & Violence

Informal settlements

Trauma | Substance Abuse

Lack of social cohesion | Rapid urbanisation | Food insecurity

Drought | Infrastructure Failure | Power outage | Extortion | Loadshedding

Traffic congestion

Flooding | **Heat waves** | Gale force winds | **Fire** | **Climate change**

Cyber attack | Insecure municipal finances

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Climate Change Strategy

VISION:

To become a climate-resilient, resource-efficient, and carbon-neutral city that enables inclusive economic development and healthy, thriving communities and ecosystems

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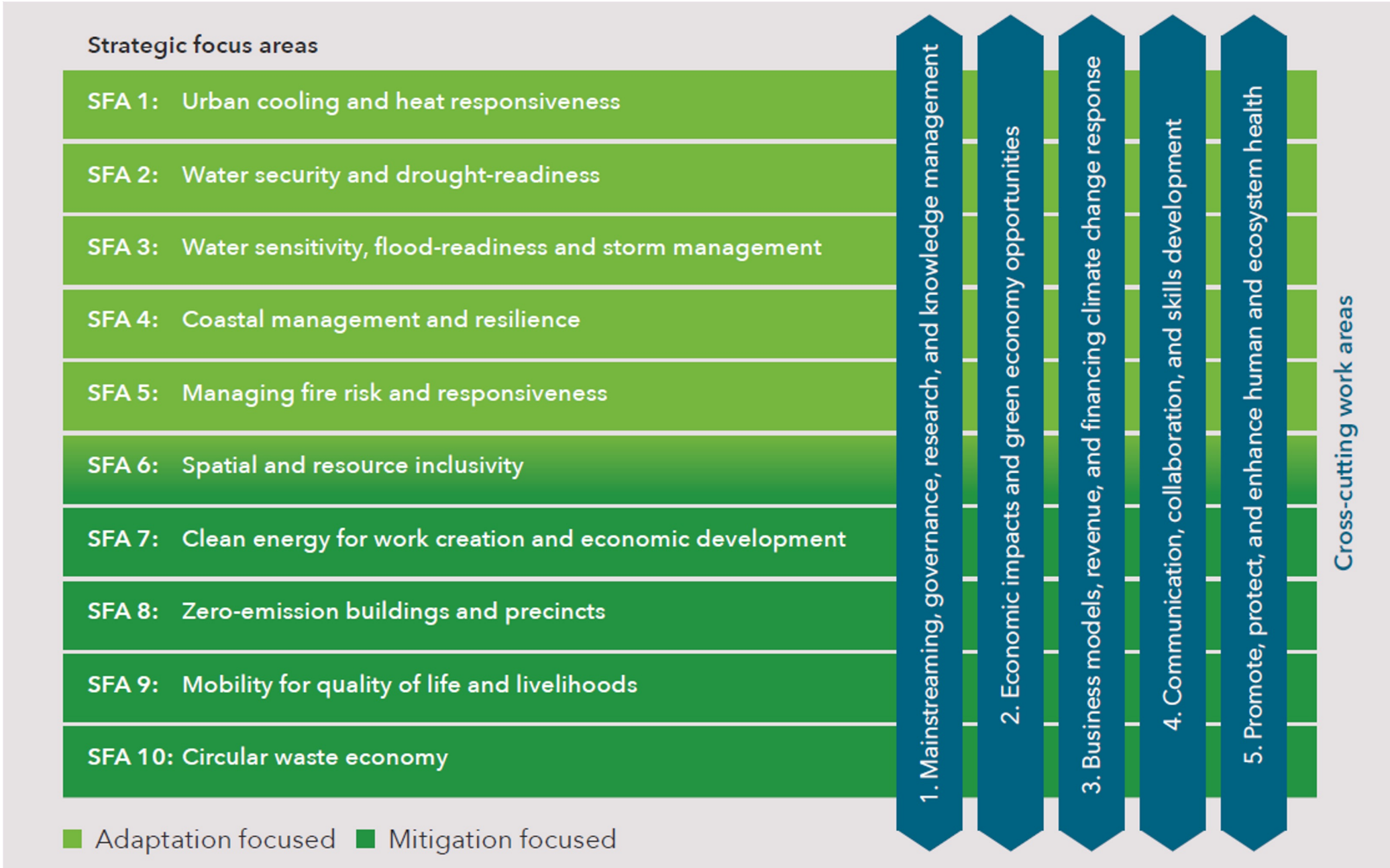
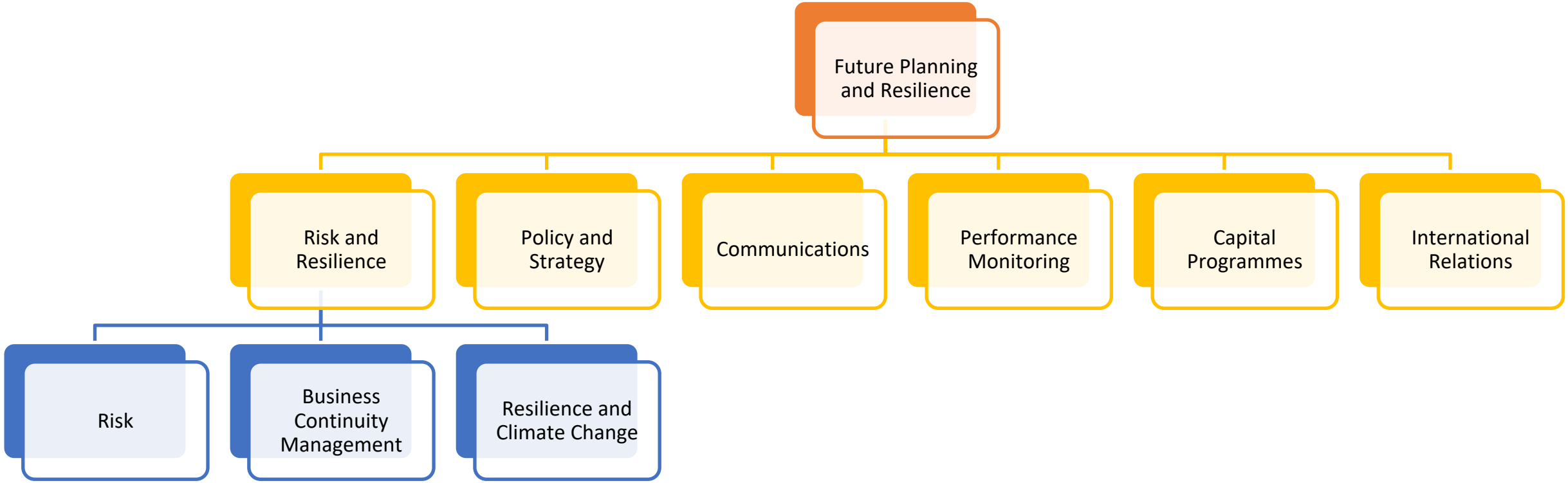


Structures to deliver on strategy

Transversal Department within City Government



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Overview of Risk and Resilience Functions

To enhance how the City pursues the attainment of resilience outcomes throughout its operations (including to climate change threats) are considered during the ongoing identification and effective treatment of risk and opportunities (this is being encapsulated in Risk and Resilience Framework)

A networked approach

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Building Heat Resilience

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Heatwaves are identified as a priority risk in the 2020 City of Cape Town Disaster Risk Assessment

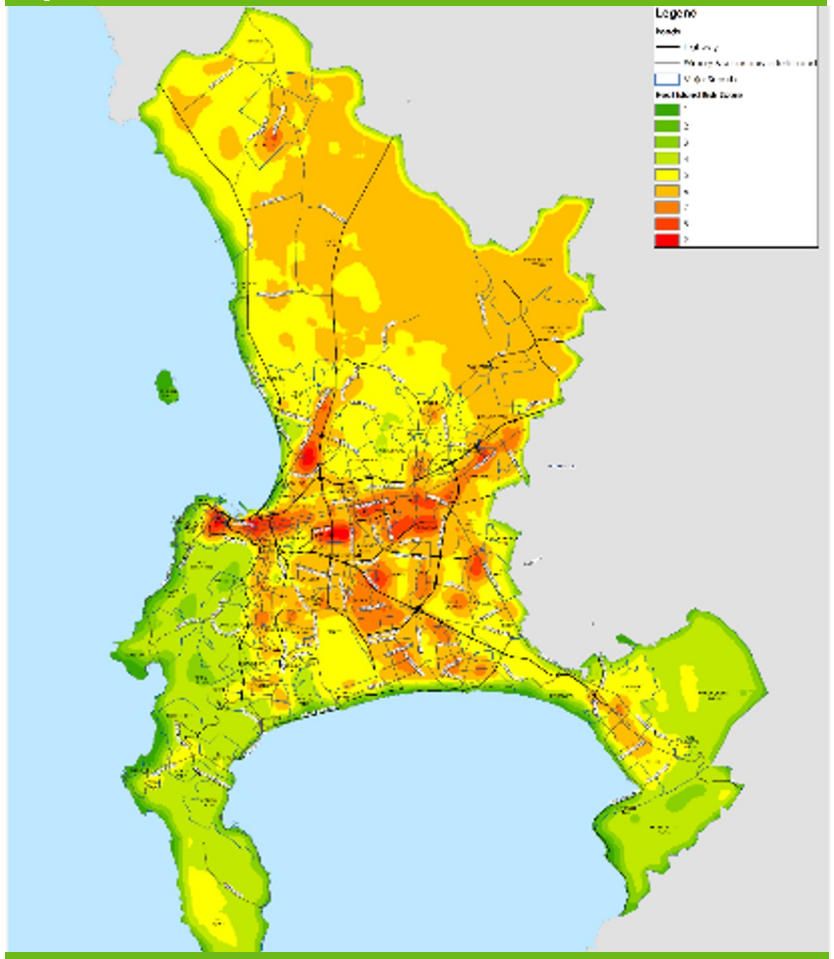
STRUCTURAL FIRES (INFORMAL)	DISRUPTION: ELECTRICITY
CIVIL UNREST	MAJOR HAZARDOUS INSTALLATION
FLOODS	COASTAL EROSION
SEVERE WEATHER	ANIMAL DISEASES
COMMUNICABLE HUMAN DISEASES	HEAT WAVES
SEISMIC HAZARDS	RAIL INCIDENTS
SEA-LEVEL RISE	SHIPPING INCIDENTS
DISRUPTION: WATER SUPPLY	TSUNAMI
NUCLEAR: KOEBERG NUCLEAR POWER STATION	DISRUPTION: WASTE REMOVAL/MANAGEMENT (ILLEGAL DUMPING)
WILDFIRES	
STRUCTURAL FIRE: FORMAL	CRITICAL INFRASTRUCTURE: SANITATION
ROAD INCIDENTS	AIR POLLUTION
DROUGHT	DAM FAILURE
WATER POLLUTION	ENDEMISM: LOSS TO BIODIVERSITY
PEST INFESTATION	MARINE POLLUTION
STORM SURGE/ COASTAL FLOODING	AIRCRAFT INCIDENTS
HAZMAT INCIDENTS: ROAD, RAIL & INDUSTRIES	STRUCTURAL COLLAPSE
	AERIAL CABLEWAY INCIDENT HAZARDS

Some Actions from Heatwave and High-Heat Day Action Plan

Action 1.1: Establish heat readiness as a function of the City's Business Continuity Co-ordinating Committee

2024 Status: Implementation
Lead: Risk and Resilience

Action 1.3 Develop and implement an early-warning and real-time monitoring system for heat



2024 Status: Implementation
Lead: Risk and Resilience

Action 1.8: Develop a generic high heat day and heat wave guideline for City workers including a departmental risk assessment tool

CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	**Heat Stress Workplace Management Guideline**
CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	**Heat stress risk assessment**
Department: Human Resources	**Version No:** 01
Branch: Occupational Health & Safety	**November 2023**
Complied by: Occupational Hygiene Services	**Unique No:** 6/21/1/P

6.3 Implement Heat Stress Control Strategies

2024 Status: Implementation
Lead: Occupational Health and Safety

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Thank You

Making progress possible. Together.

NUALA COWAN

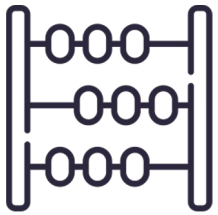
Innovative approaches to urban heat assessment

PARTICIPATORY HEAT MAPPING IN INDONESIA, SOUTH AFRICA & THE WESTERN BALKANS

Measuring heat exposure

WHY?

From initial awareness to action: policy roadmap



TAKING STOCK

- What is the evidence of urban heat islands in the city?
- How can heat mitigation contribute to my city's existing strategies and plans?

GATHER & ANALYZE DATA

- How does heat exposure differ within my city?
- Where do vulnerable people live and work?
- Are there already urban cooling measures in place? How are they performing?

STAKEHOLDER ENGAGEMENT

- Which groups can serve as effective champions? What support or resources do they need?
- Which organizations/ groups should be part of policy design?

POLICY & INVESTMENT DESIGN

- What mix of cooling strategies offers the most immediate, high-impact results?

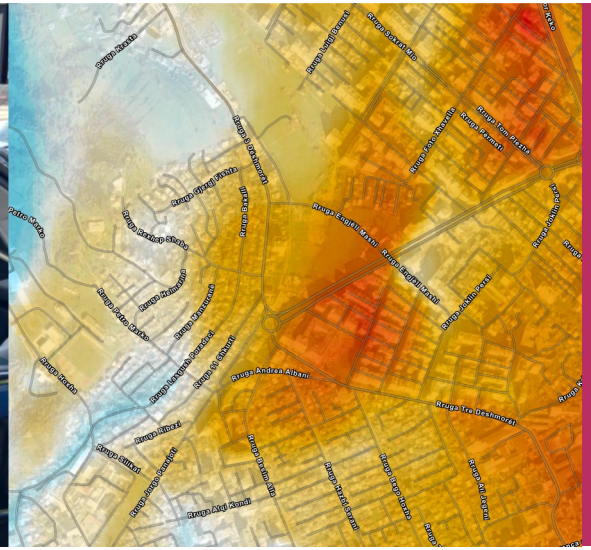
HEAT MAPPING & CITIZEN ENGAGEMENT UNLOCK ACTION

Source: adapted from ESMAP Cool Cities Primer

Measuring heat exposure

HOW?

Citizen science heat mapping campaigns



How do we do it?

Vehicle based heat mapping using mounted sensors

What are the outputs?

City-wide maps showing heat at different time periods during the day

What can this tell me?

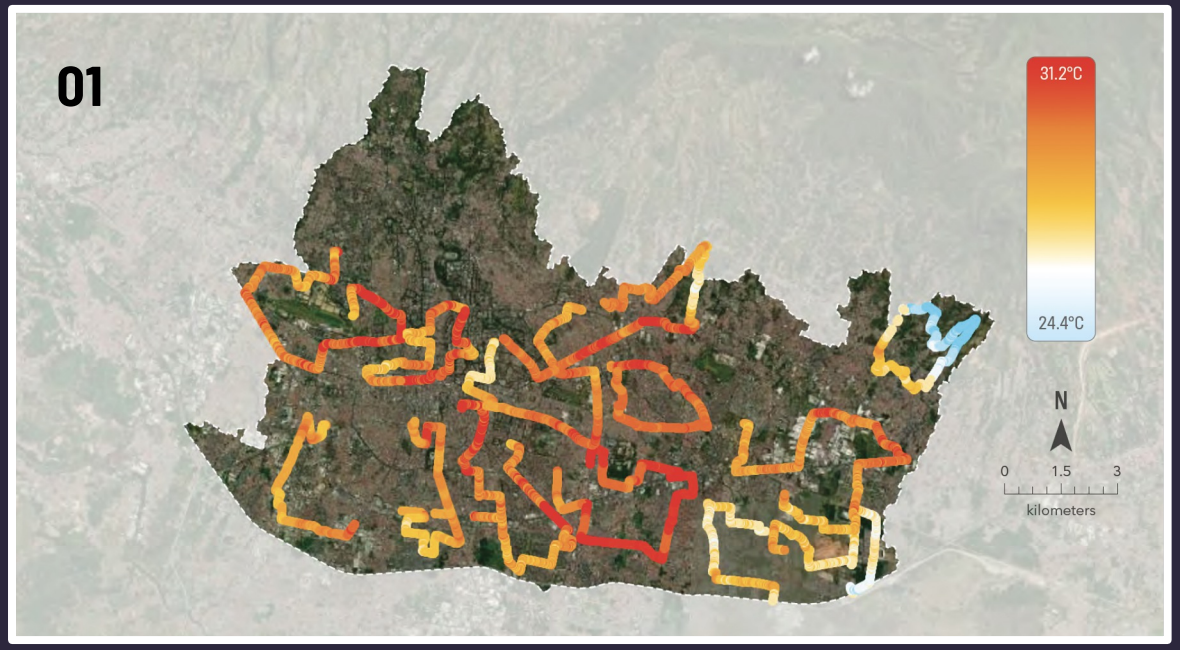
Does my city experience an urban heat island effect?
Do temperatures differ sharply between neighborhoods?

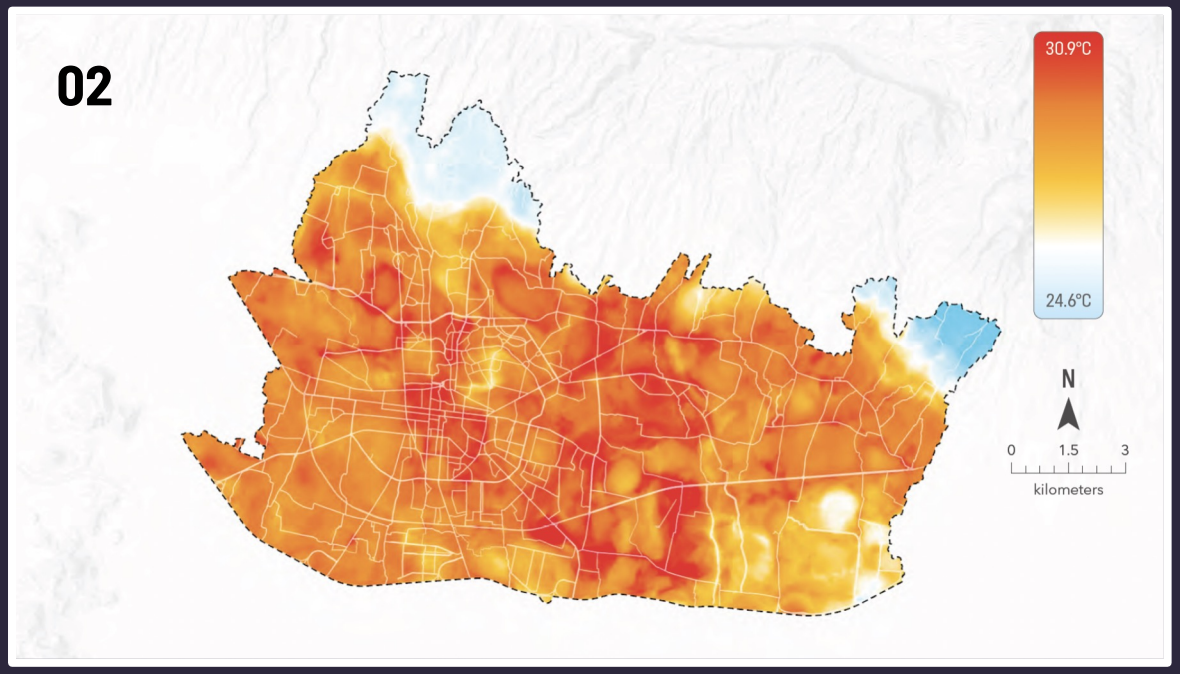
On a hot summer's day, air temperatures can vary by 10°C between neighborhoods. Community heat mapping campaigns provide an established methodology to measure temperature differences across a city. Cities can use the resulting datasets to prioritize heat mitigation actions that target the most affected areas.

vehicle traverse method

Participants drive pre-planned routes with heat sensors attached to their vehicles

1. **Set up:** Partnership established with NGO or university; volunteers recruited.
2. **Planning:** Set date for campaign; routes planned and equipment shipped.
3. **Campaign**: Volunteers drive designated routes (during three periods 6-7 am, 3-4 pm, and 7-8 pm) collecting thousands of data points.
4. **Analysis**: Area-wide map of heat and humidity developed.
5. **Engagement**: Communication assets; workshop





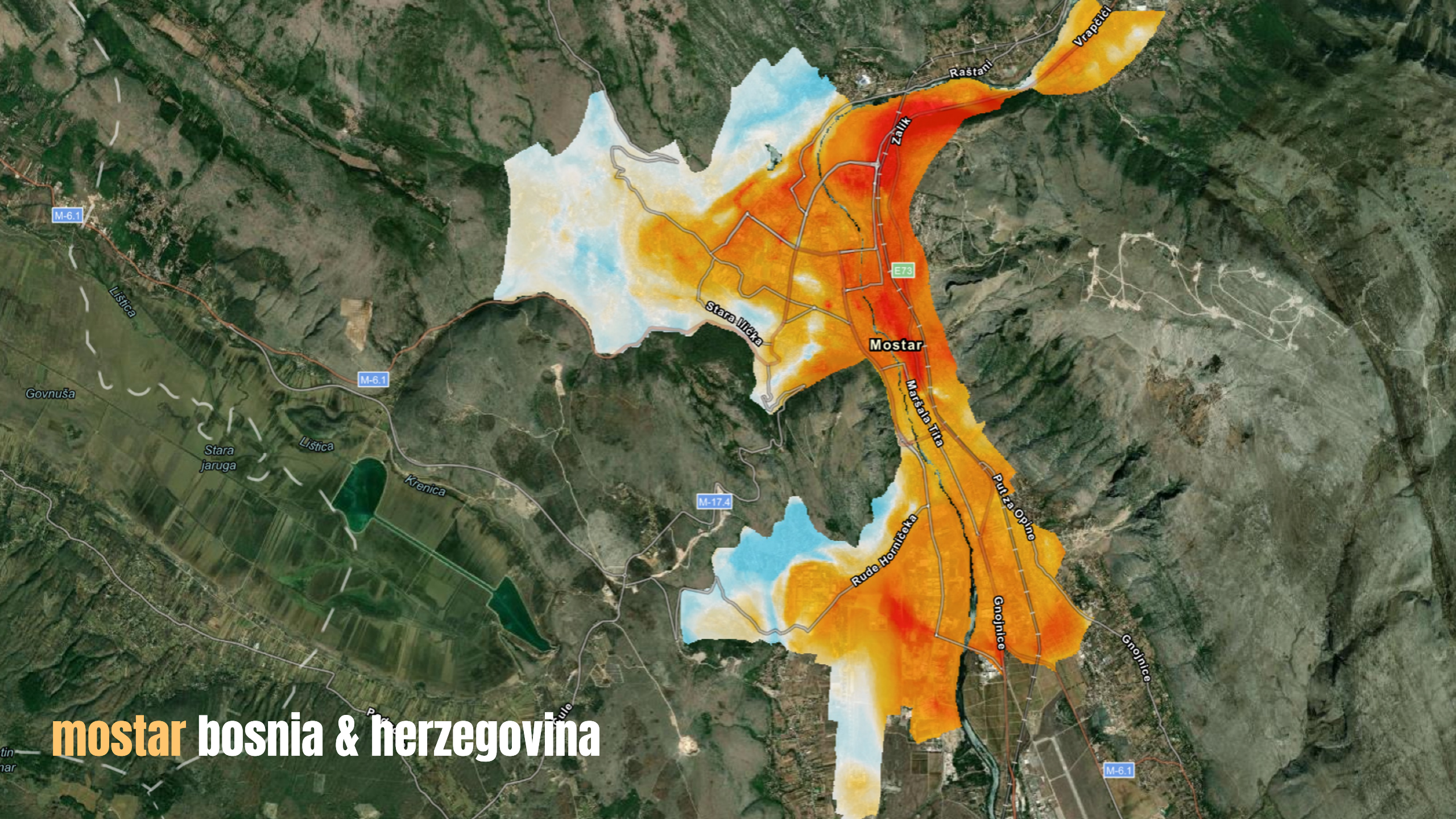
results: about the maps

Two sets of maps comprise the final results from the campaign process, and they include:

01 **Point temperatures** collected along predetermined routes for **three** traverse time periods; 6 - 7 am, 3 - 4 pm, and 7 - 8 pm

02 **Area-wide heat maps**, displaying either the modeled temperature or heat index across the entire study area at each traverse period.

mostar bosnia & herzegovina



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FLIR cameras

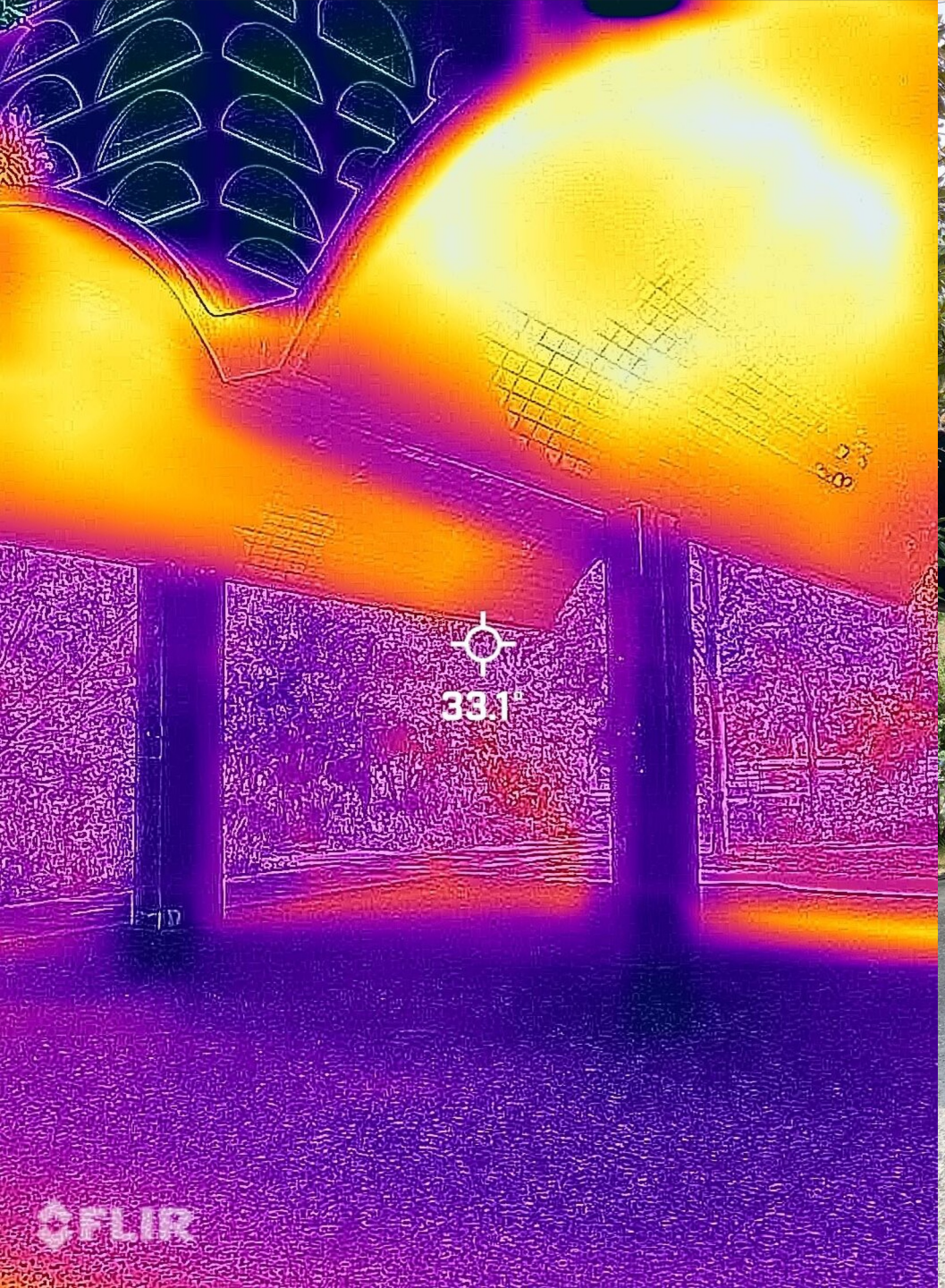
investigation at micro scale

task: volunteers also examined the surface temperatures of various locations using FLIR thermal imagery cameras (which can be fitted to a standard smartphone)

objective: examine where people are affected by heat (or cool) in their everyday lives.

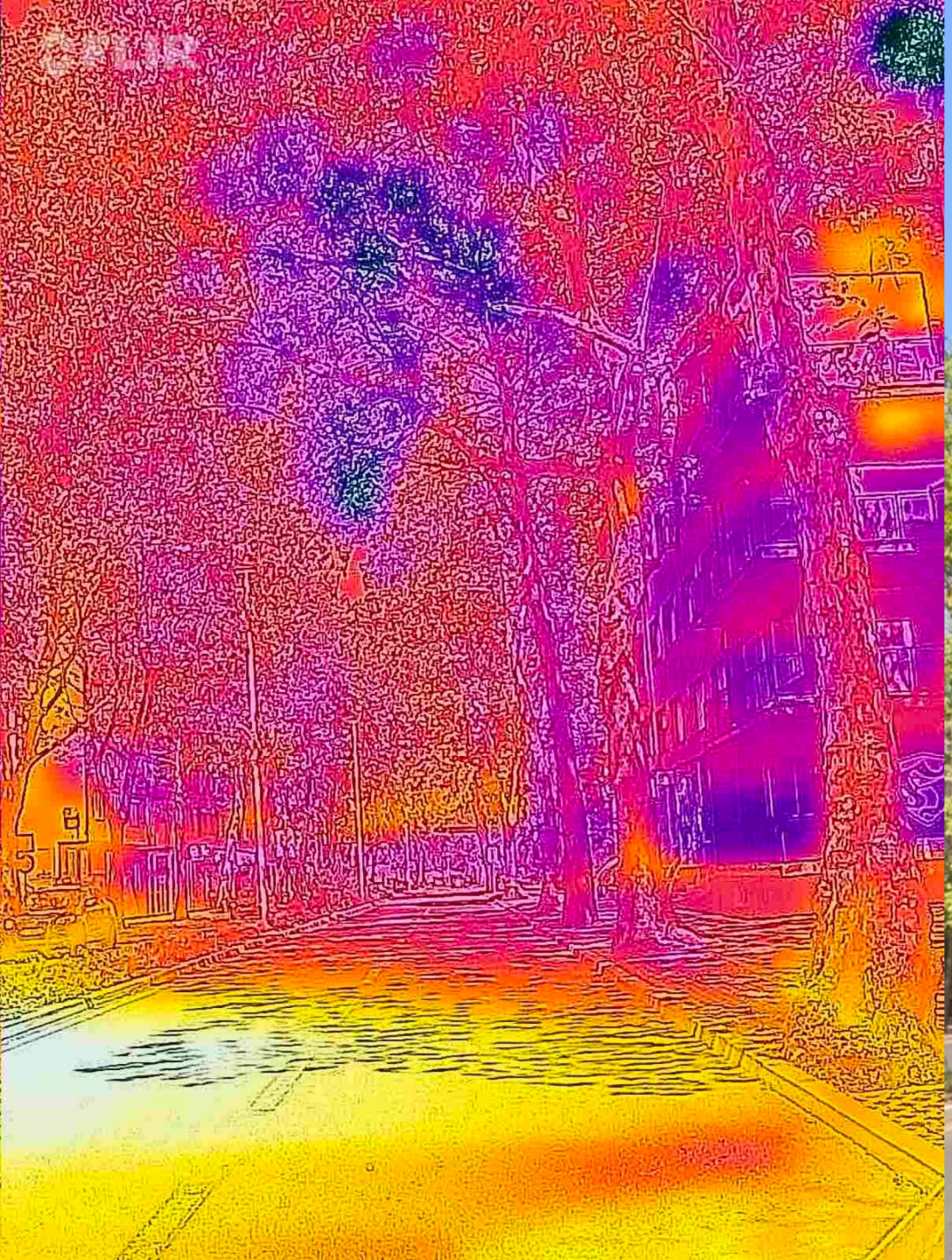
approach: short survey, with geotagged thermal imagery

- Take photos (FLIR picture, normal picture)
- Capture location (lat & lon)
- Fill out a short survey about heat conditions, shade and any obvious heat stress mitigation measures
- Repeat at several other locations



Shade structures

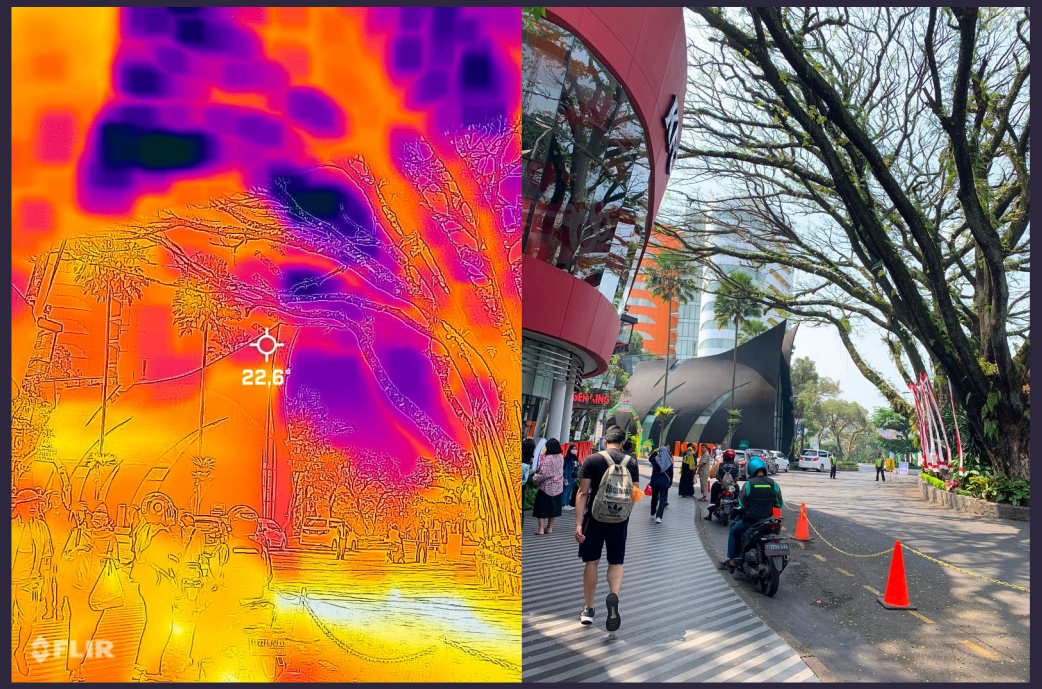
This shade canopy appears to be soaking up the majority of the heat. There is a significant difference in the temperature of the concrete under the canopy, and the concrete outside



natural shade

The temperature difference between concrete surfaces (both road and building facade) shaded by tree canopy, and those that are not, are quite apparent

heat at ‘significant places’ in Bandung



Mall of Ciwalk (shopping center)

“Lots of activities and people gathering at the mall. Not much vegetation because it is located in the middle of tall buildings, hotels and highways. Building materials contribute in generating heat.”

Shopping center: Pasar Baru

“The area is very hot because it is a fully built area with trade and service functions (shops and markets) without any trees at all. The type of road pavement and building are quite influential on the heat, coupled with the number of vehicle.”

Bandung

july 2022

168.6 km²

Study Area

36

Volunteers

15

Routes

51,331

Measurements

33.7°

Max Temperature

7.0°

Temperature Differential










western balkans

ALBANIA | BOSNIA & HERZEGOVINA august 2023

Tirana, Albania

57 km2
Study Area

36.1°
Max Temp (°C)

6.4°
Temperature Differential (°C)

Vlore, Albania

20 km2
Study Area

31.4°
Max Temp (°C)

4.3°
Temperature Differential (°C)

Shkodra, Albania

20 km2
Study Area

32.9°
Max Temp (°C)

6.5°
Temperature Differential (°C)

Sarajevo, BiH

31 km2
Study Area

34.5°
Max Temp (°C)

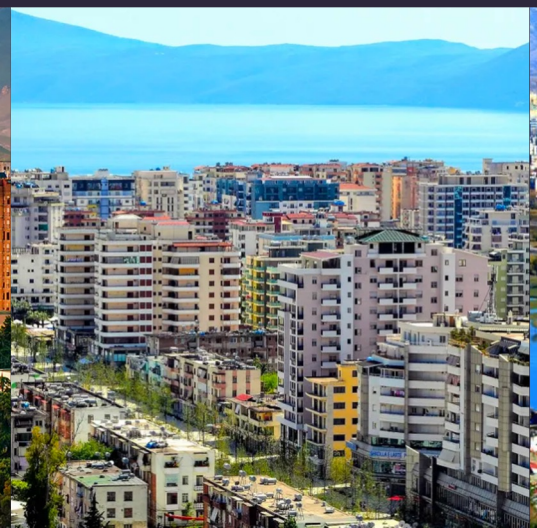
7.4°
Temperature Differential (°C)

Mostar, BiH

29.5 km2
Study Area

40.7°
Max Temp (°C)

6.5°
Temperature Differential (°C)


south africa

CAPE TOWN | TSHWANE | BUFFALO CITY march 2024

Cape Town

208 km2
Study Area

24
Number of Volunteers

34.5°
Max Temp (°C)

7.4°
Temperature Differential (°C)

Tshwane

200 km2
Study Area

24
Number of Volunteers

36.2°
Max Temp (°C)

6.1°
Temperature Differential (°C)

Buffalo City

165 km2
Study Area

30
Number of Volunteers

39.0°
Max Temp (°C)

6.1°
Temperature Differential (°C)


Together we can adapt and thrive.

thank you

Please direct any heat campaign questions to:

Nick Jones | njones@worldbankgroup.org

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TRADITION • INNOVATION • RESILIENCE

Thank you !

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