"Constraints in temperature thresholds determination in India"

This heat wave is making me as unproductive as any typical workday.

False Positive Forecast...!?!

Abhiyant Tiwari

What is **Heat Stress**?

"A situation where **too much heat** is absorbed by a person…"

How much heat is too much heat? Is that what we call **heat wave**?

What is **Heat Wave**?

- "A prolonged period of abnormally hot weather…"
- No universal definition/threshold
- Local phenomenon

Criteria for Heat Wave in India by IMD

Criteria for Heat Wave:

Heat wave need not be considered till maximum temperature of a station reaches at least 40° C for Plains and at least 30° C for Hilly regions.

a) **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

b) **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

c) **When actual maximum temperature remains 45ºC or more irrespective of normal maximum temperature, heat wave should be declared.**

Hot day

In the northern plains of the country, dust in suspension occurs in many years for several days, bringing minimum temperature much higher than normal and keeping the maximum temperature around or slightly above normal. Sometimes increase in humidity also adds to this discomfort. Nights do not get cooled and become uncomfortable. To cover this situation, hot day concept has been introduced as given below:

Whenever, the maximum temperature remains 40ºC or more and minimum temperature is 5° C or more above normal, it may be defined as Hot Day, provided it is not satisfying the heat wave criteria given above.

Europe Heat wave - 2003

Around 15000 people died alone in France at Temperature ~37°C

IMD Heat Wave

Definition starts at 40°C for plains

Why is threshold estimation necessary?

- No universal definition of heat wave

- Spatial phenomenon – Regional, Sub-Regional, Local

- No one size fit for all – effects can vary

- Threshold is a practical decision - credibility, accuracy, cost

- Many methods - simple and complex approaches
  - **Statistical Simple and Biometeorological Complexed**

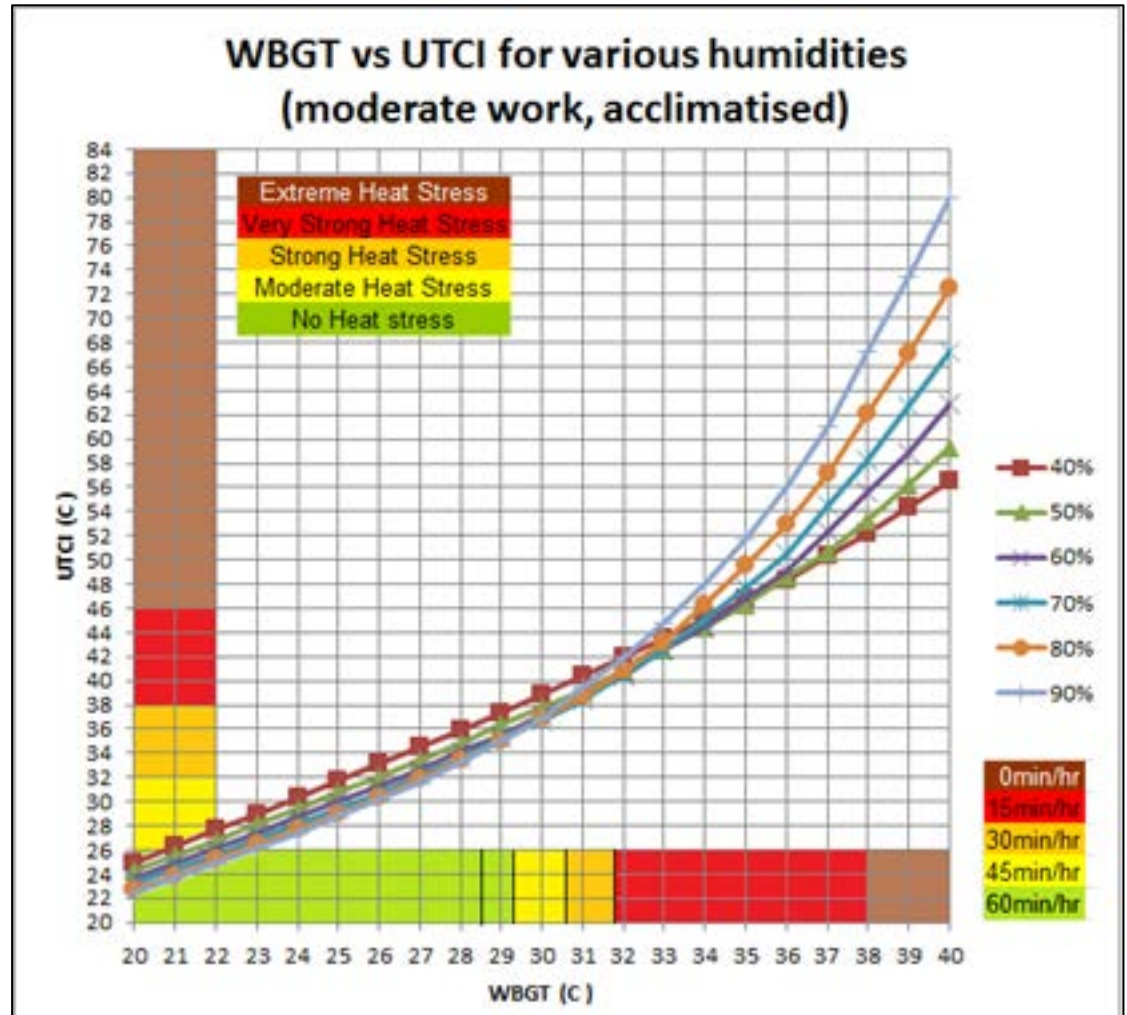**Local thresholds are essential for effective heat health early warning system**

What is threshold for heat?

A Thermal variable at which the risk of adverse health outcome increases substantially.
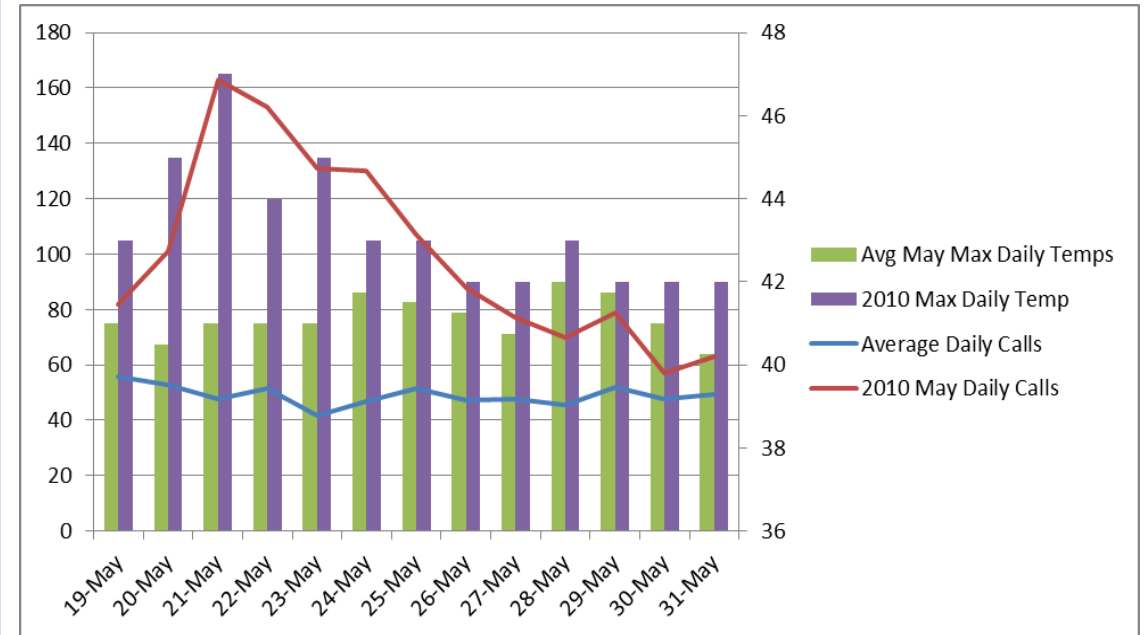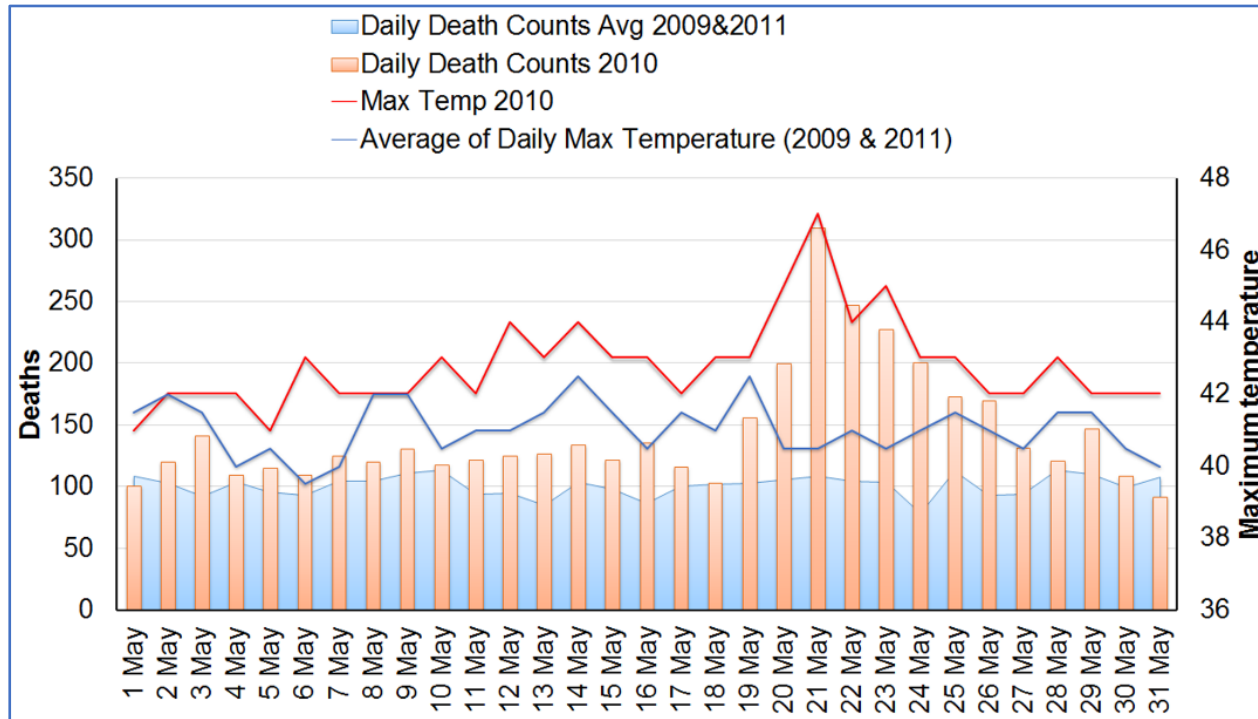
What are thermal variables?

- Tmax
- Tmin
- Tmean
- HI
- PT
- Humidex
- WBGT
- UTCI

Tmax – most widely used variable

WBGT vs UTCI for various humidities (moderate work, acclimatised)

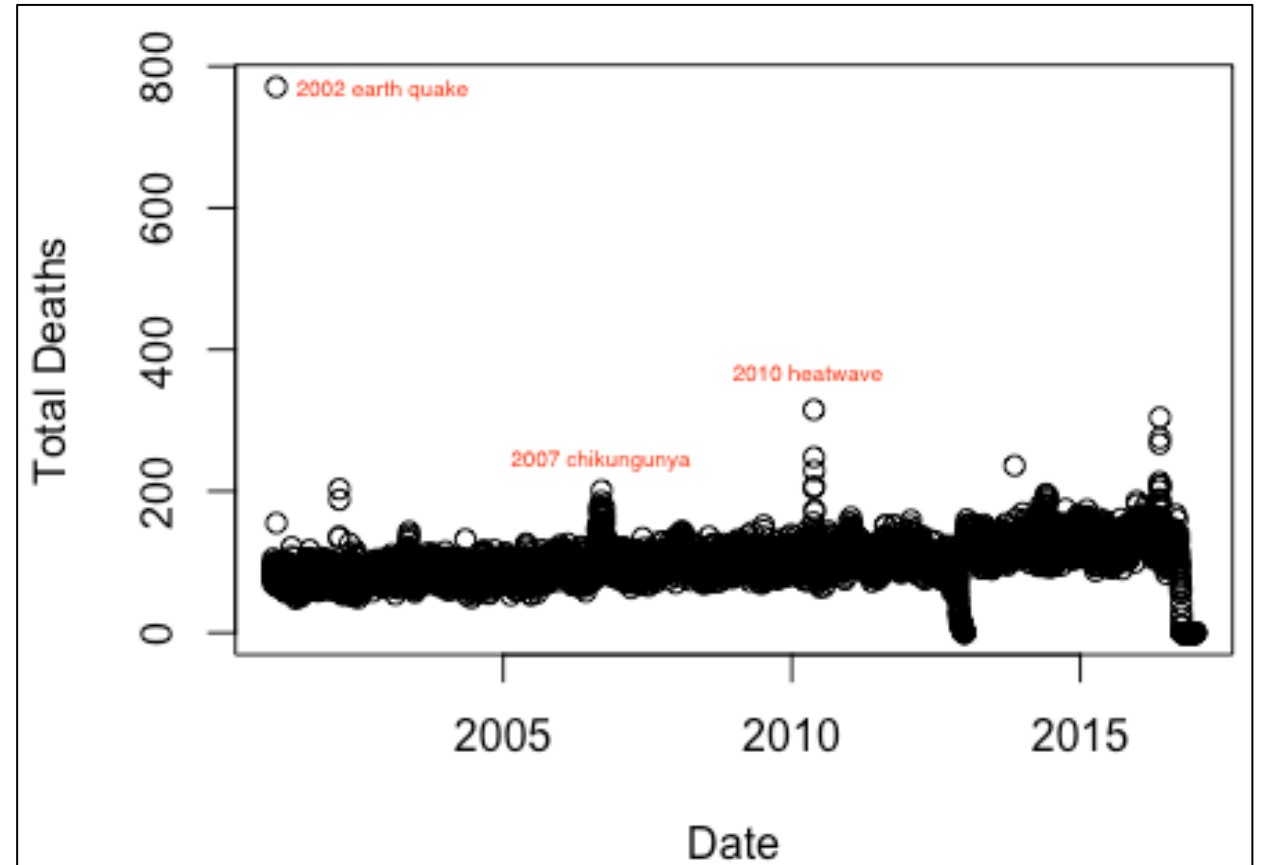# Which health impact (outcome) variable can be used?

- All cause daily mortality count data

- Cause specific daily mortality count data

- Hospital daily admissions count data

- Emergency ambulance (108) services daily call count data

All cause daily mortality – most widely used variable

How to estimate heat threshold for health impact?

- Epidemiological Study Methods

- Percentile Based

- Published Research

Epidemiological Study Method

✓Time series analysis

Who can do it?

Epidemiologist / Biostatistician in

- State or District Medical Colleges
- Public health institutions like IIPHG
- Any other domain expert or institute with interest

Things to consider:

- Confounders like Air Pollution, Outbreaks
- Acute or Average Effect (Prolong Duration)
- Lag Effect

Percentile Based

✓90th, 95th, 99th (Seasonal / Monthly)

Who can do it?

- IMD has already done for several cities/districts

"In situations where there is basic meteorological information but no health data, a percentile-based threshold (90th, 95th) could be contemplated as a warning trigger value."

– 2015 WMO WHO Heatwaves and Health: Guidance on Warning-System Development.
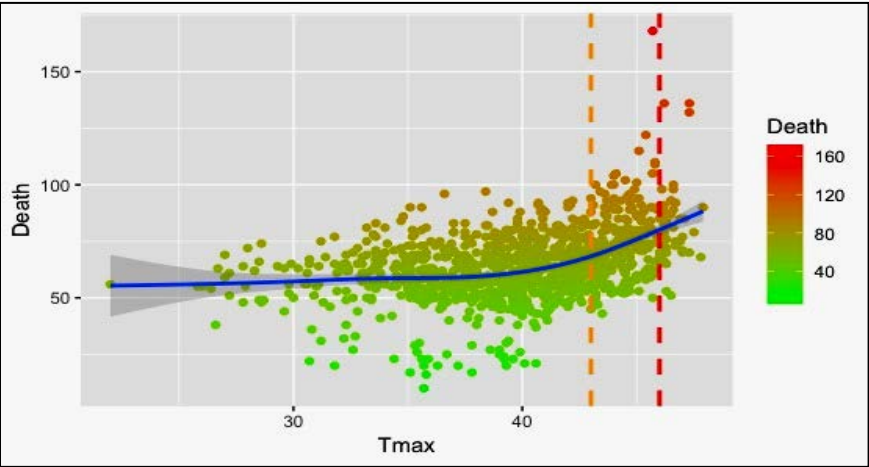
What should be the statutory unit for threshold estimation ?
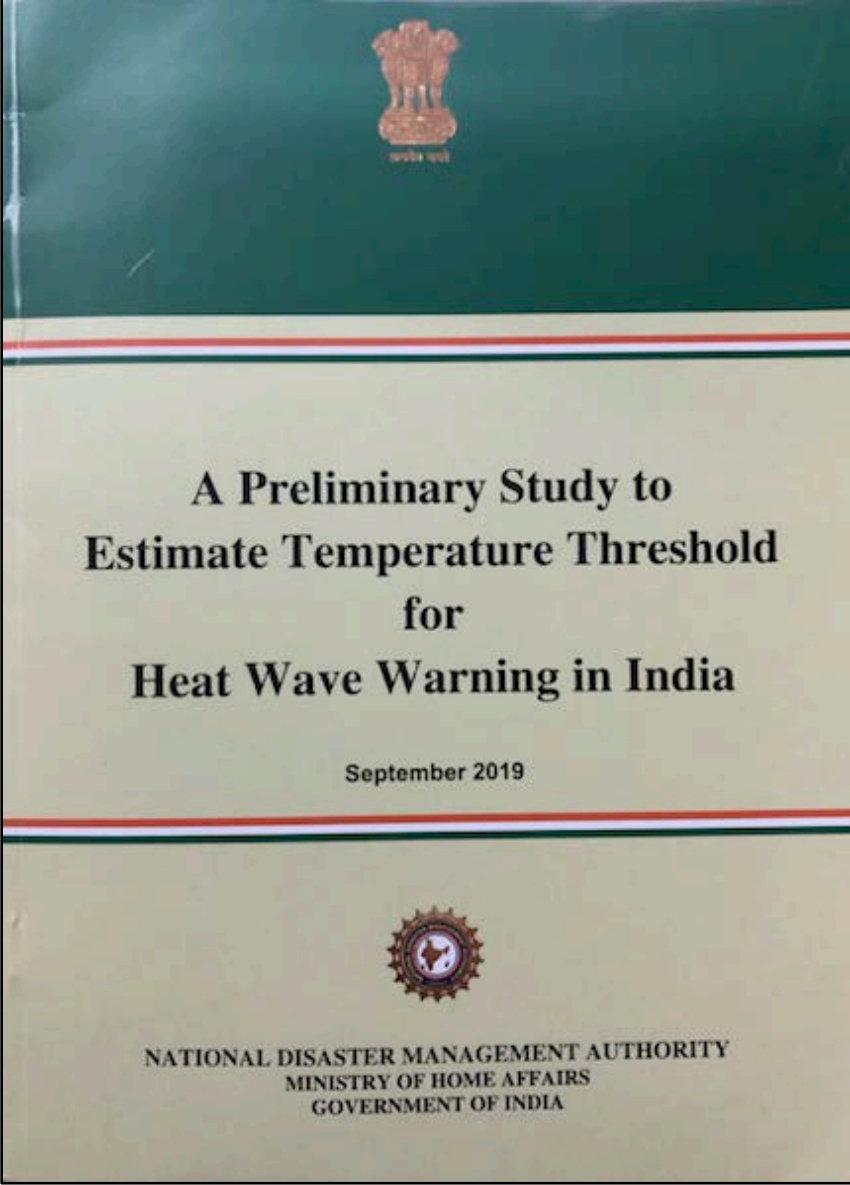## Megacity / City / UA / District / Village?

- Ambient temperature doesn't vary much geographically within district unless major differences in contour/weather system

- Threshold estimation should be done at Megacity (**Population > 1 Million**) and District levels.

- They should be the operational units for HAP development and implementation.

- States should develop state specific guidelines using national guidelines issued by NDMA and cities/districts should prepare and implement their local heat action plans with locally determined thresholds for early warning.

Thresholds Determination for Heat Early Warning

Preliminary study to estimate temperature threshold for heat wave warning in India done for 103 cities across 19 States and UTs done by NDMA, IMD & IIPHG in September 2019.

S.N.	City	Month	Yellow	Orange alert (Heat alert day)	Red alert (Extreme heat alert day)
1	AKOLA CITY	April	43.0	43.8	44.7
		May	44.3	45.0	46.3
		June	43.1	44.1	45.0
2	CHIKALTHANA (AURANGABAD)	April	41.2	41.4	41.7
		May	41.7	42.2	42.8
		June	41.4	41.6	41.9
3	NADED	April	42.2	43.0	43.6
		May	43.2	43.7	44.5
		June	42.6	43.0	44.0
4	NASHIK	April	38.9	39.5	40.4
		May	38.7	39.3	40.1
		June	34.3	35.3	37.1
5	PARBHANI	April	43.0	43.5	44.0
		May	43.9	44.5	45.5
		June	43.4	43.8	44.1
6	PUNE	April	39.4	40.0	40.8
		May	39.0	39.7	40.4
		June	34.2	35.8	37.3
7	SOLAPUR	April	42.3	42.6	43.2
		May	42.6	43.1	43.7
		June	40.7	41.3	41.8
8	YEOTMAL	April	42.0	42.5	43.6
		May	43.5	44.0	45.0
		June	39.0	40.1	42.8

A Preliminary Study to
Estimate Temperature Threshold
for
Heat Wave Warning in India

September 2019

NATIONAL DISASTER MANAGEMENT AUTHORITY
MINISTRY OF HOME AFFAIRS
GOVERNMENT OF INDIA

PS: Can be further strengthened and extended to more cities / districts if data is made available

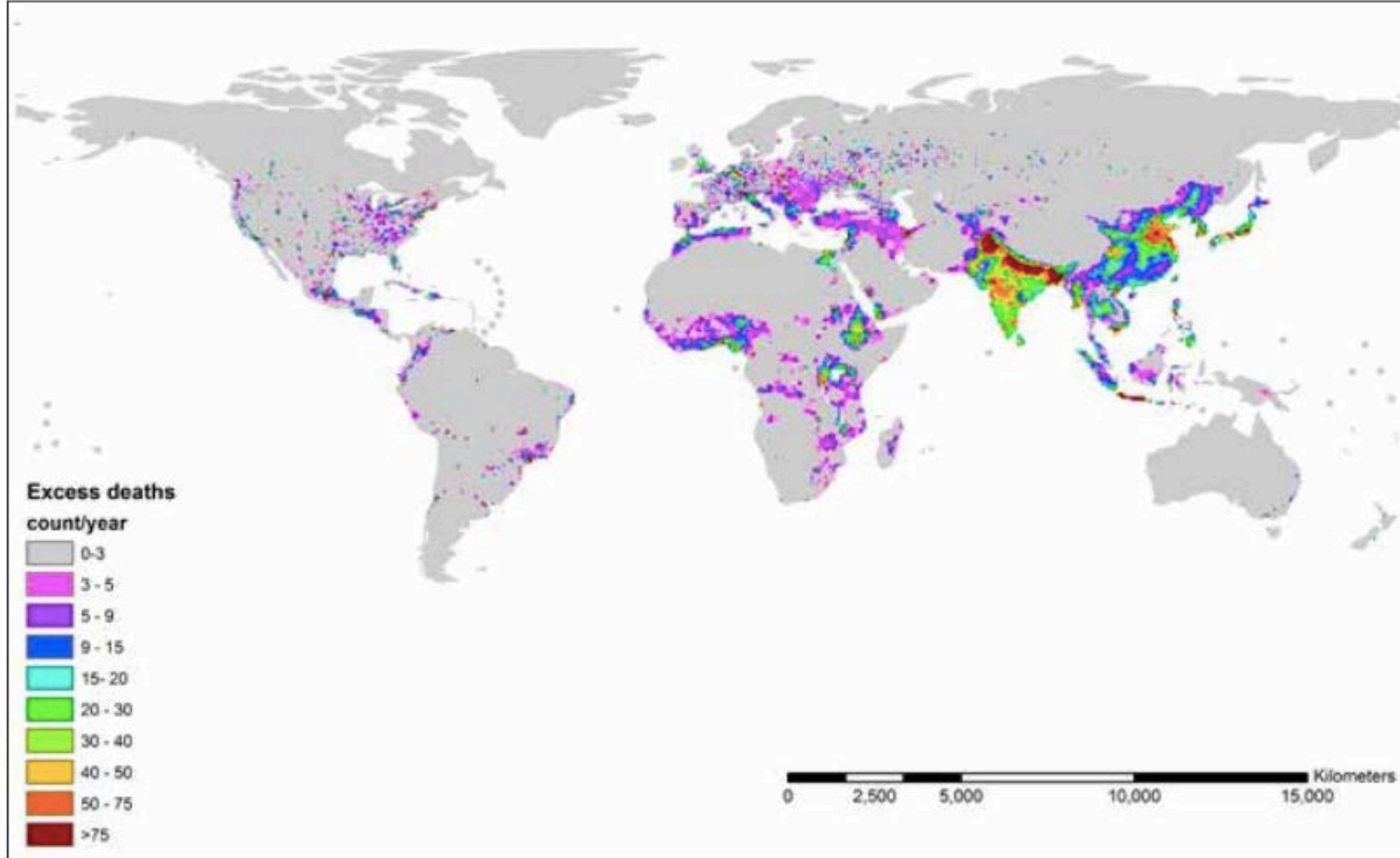Forewarned, forearmed; to be prepared is half the victory.
~ Miguel de Cervantes

92,207 after 2030

2,55,486 after 2050

Additional deaths each year due to Heat Wave

Where these additional deaths will happen?

Excess deaths count/year

- 0-3
- 3 - 5
- 5 - 9
- 9 - 15
- 15- 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 75
- >75

Mortality counts shown for 0.5 degree grid cells.

Thanks

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