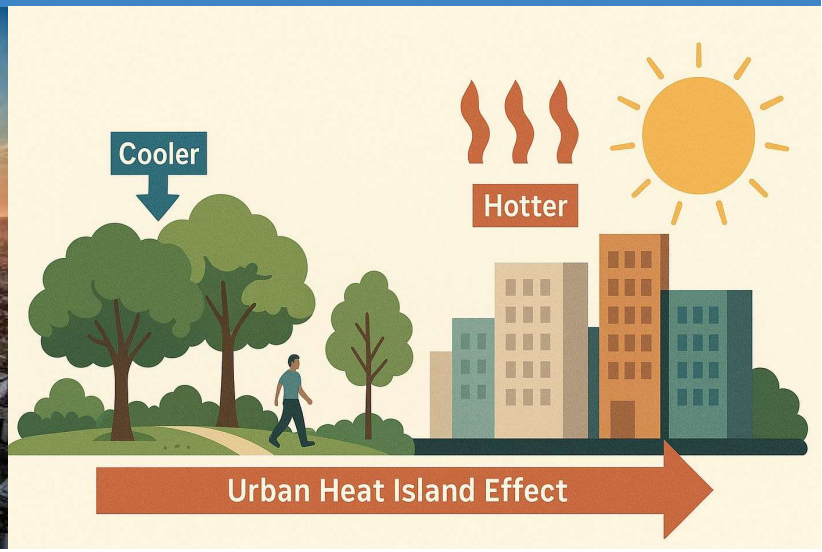
Urban Heat Islands

Analyzing the Data from Indian Cities



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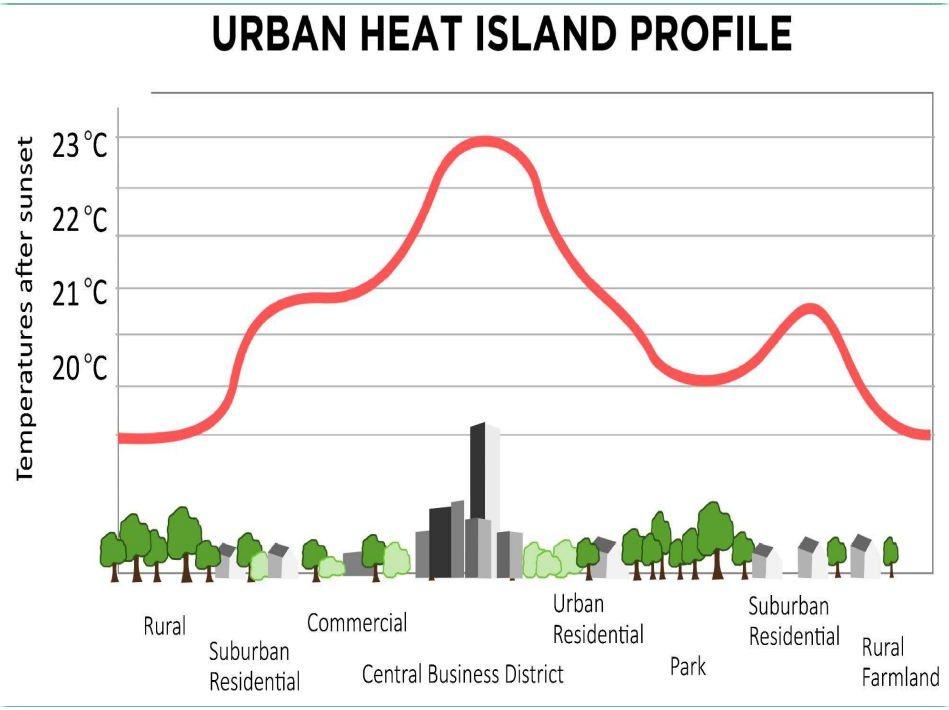
What is an Urban Heat Island?

- An Urban Heat Island (UHI) is a metropolitan area that is significantly warmer than its surrounding rural areas.
- This phenomenon occurs because buildings, roads, and other infrastructure absorb and re-radiate the sun's heat more than natural landscapes.
- The effect is typically more pronounced at night as the stored heat is slowly released back into the atmosphere.



Key Drivers of the UHI Effect

Dense Infrastructure

Materials like concrete and asphalt have high thermal mass, absorbing and storing heat all day.

Lack of Vegetation

Reduced trees and green spaces limit evapotranspiration, a natural cooling process.

Urban Geometry

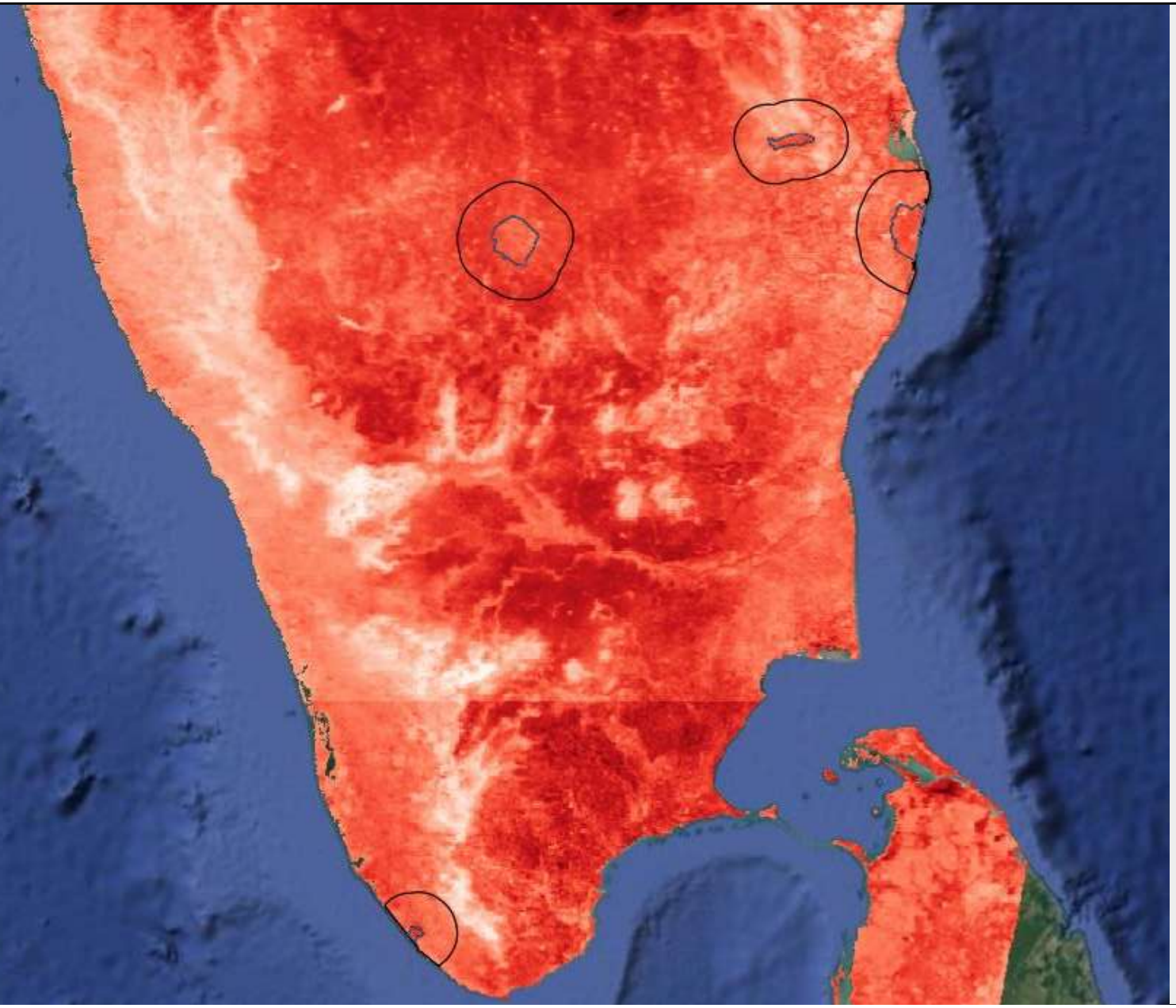
Tall buildings create "urban canyons" that trap hot air and block cooling winds from circulating.

Waste Heat

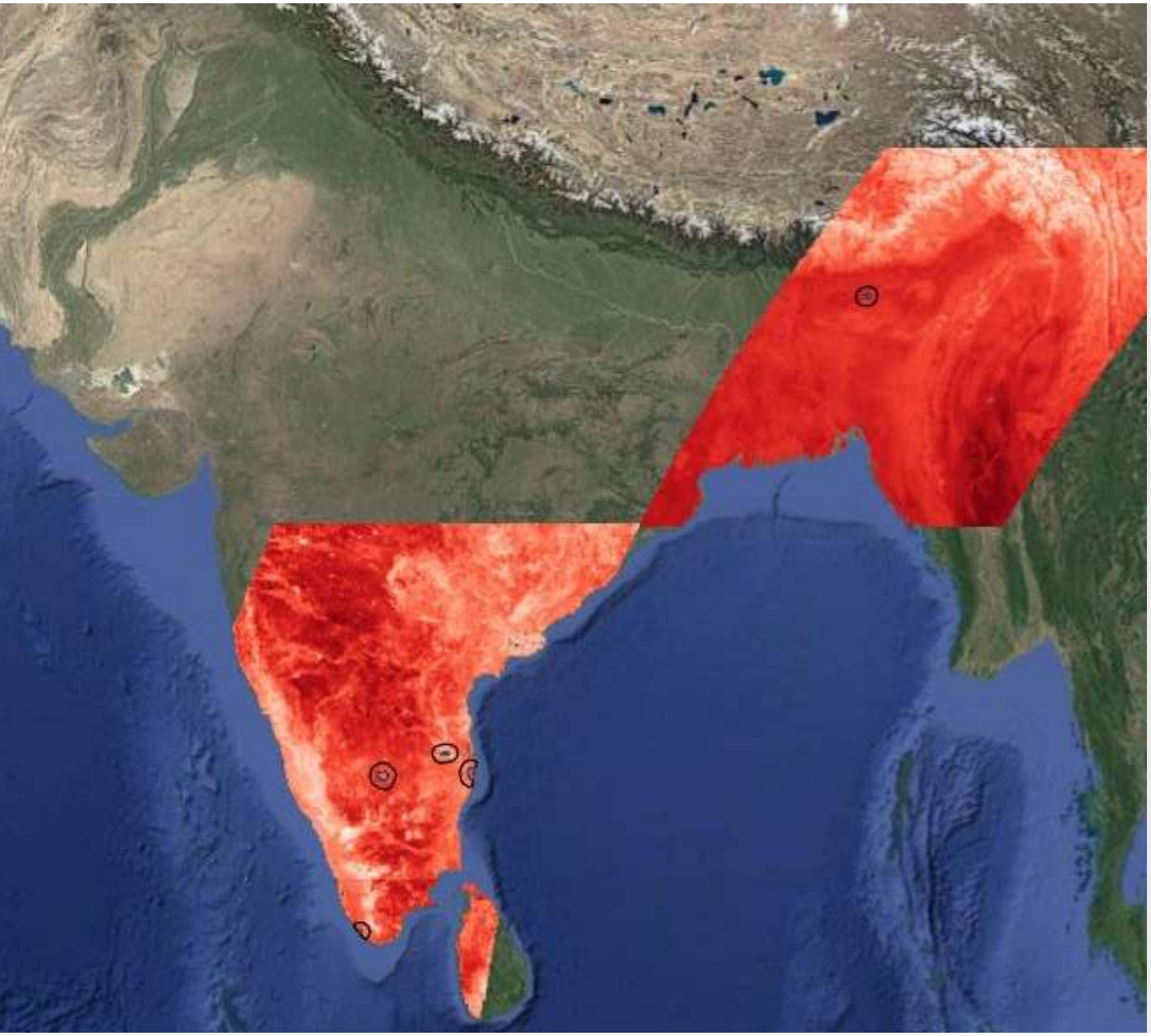
Heat generated from vehicles, air conditioners, and industrial processes adds to the ambient temperature.

A Look at the Data

2024 Summer Analysis in Key Indian Cities



2024 Summer Analysis in Key Indian Cities map



2024 Summer

Analysis in Key

India map

2024 Summer: Daytime UHI Effect

City	Mean Temp (K)	City vs. Surrounding (K)
Chennai	306.49	+1.54 K
Bengaluru	307.75	-1.91 K
Thiruvananthapuram	305.02	+2.14 K
Guwahati	300.11	+1.65 K
Tirupati	308.49	+2.98 K

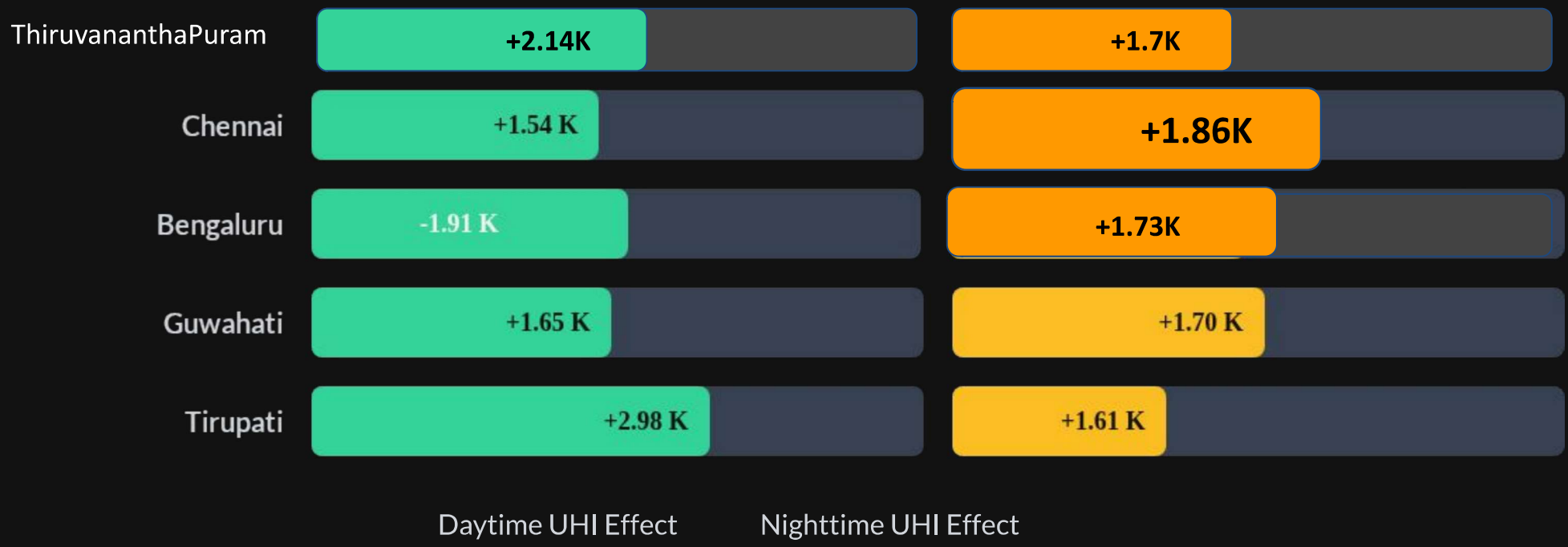
Daytime data shows significant warming in Tirupati (+2.98K) and Thiruvananthapuram (+2.14K). Bengaluru's urban core appears cooler than its surroundings.

2024 Summer: Nighttime UHI Effect

City	Mean Temp (K)	City vs. Surrounding (K)
Chennai	299.74	+1.86 K
Bengaluru	298.32	+1.73 K
Guwahati	299.62	+1.70 K
Tirupati	298.86	+1.61 K
Thiruvananthapuram	299.6271	1.702991

highlighting heat retention.

UHI Intensity: Day vs. Night (K)



Case Studies from the Data

Tirupati: Highest Daytime UHI

With a **+2.98 K** difference, Tirupati's urban area was significantly hotter than its surroundings during the day. This was the most intense daytime UHI effect recorded in this study.

Bengaluru: The Day/Night Reversal

The urban core was **1.91 K cooler** by day (an "Urban Cool Island"), but became **1.73 K warmer** at night. This is a classic sign of urban materials absorbing heat and releasing it after sunset.

Why This Matters: The Impacts

- **Increased Energy Consumption:** Higher demand for air conditioning leads to more energy use, higher costs, and increased greenhouse gas emissions.
- **Public Health Risks:** Elevated temperatures, especially at night, prevent the body from cooling down and can exacerbate heat-related illnesses like heat stroke.
- **Poor Air & Water Quality:** UHI can trap pollutants like ozone, leading to smog. Runoff from hot surfaces also warms local water bodies, harming aquatic life.

How Can We Mitigate the UHI Effect?

Green Infrastructure

Planting trees and creating green roofs/walls provides shade and cools the air through evapotranspiration.

Cool Materials

Using reflective "cool roofs" and permeable pavements that absorb less heat and reflect more sunlight.

Smart Urban Design

Designing cities to optimize airflow, create wind corridors, and incorporate water features for natural cooling.

Conclusion: Key Takeaways

- **UHI is Confirmed:** The 2024 data clearly shows a measurable UHI effect is a reality in the studied Indian cities.
- **Nighttime is Critical:** The effect is most consistent and widespread at night, as urban materials release stored heat and prevent natural cooling.
- **Local Variations Exist:** Bengaluru's unique "Daytime Cool Island" reversal highlights that local geography and planning matter significantly.
- **Solutions are Urgent:** Mitigating UHI with green infrastructure and cool materials is essential for public health and energy efficiency.

Project file links

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References

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Questions?

Thank You