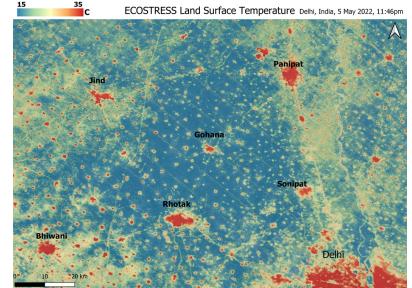


Sri Bala - A Data-Driven Analysis On Urban Heat Island Effect in Indian Cities

The urban heat island effect is a phenomenon where urban areas experience higher temperatures compared to surrounding rural areas. Given the recent infrastructure developments in India, I was curious to see if weather data in the past decade aligns with this hypothesis. Tier I cities in India have the highest population and are the most thriving urban centres – these include Ahmedabad, Bengaluru, Chennai, Delhi, Hyderabad, Kolkata, Mumbai, and Pune. With my dataset limited to A-G cities, I analyzed the first four cities average temperature in comparison to surrounding areas within a +/-1 coordinate radius.



The analysis shows these major urban centers have a higher average temperature than their neighboring rural locations, which supports the UHI hypothesis.

Urban Cities Average Temp in 2024 vs. Surrounding Cities:

- **Ahmedabad:** Urban temperature = 27.03°C; Nearby cities (Gandhinagar, Adalaj, Dholka) = 21.02°C to 21.92°C
- **Chennai:** Urban temperature = 27.9°C; Nearby areas (Ananipalle, Chandragiri, Erraguntlakota) = 24.34°C to 25.05°C
- **Bengaluru:** Urban temperature = 23.01°C; Nearby areas (Chintamani, Bowringpet, Anekal) = 21.94°C to 22.21°C
- **Delhi:** Urban temperature = 24.47°C; Surrounding towns (Charthawal, Gohna, Gurgaon) = 22.98°C to 23.86°C



Next, I queried the dataset to focus on key urban heat indicators and analyze if the cities following these patterns have high urban development. One of the first key UHI indicators is an increase in nighttime temperatures over time. Night temperatures increase disproportionately in urban areas, since heat is trapped by materials such as concrete and asphalt.

Top 10 Cities with Highest Night Temperature Increase (2010 - 2024)

Chittandikavundanur – 4.47

Dharmastala – 3.36

Anamalais – 3.32

Chinnampalaiyam – 3.03, *Expansion of textile/manufacturing*

Beltangadi – 3.03, *Undergoing expansion, lacks green buffers*

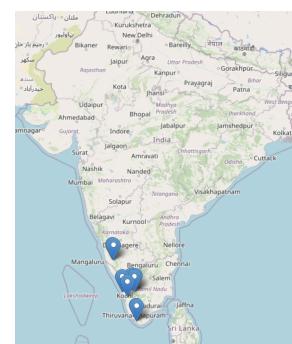
Dharmapuram – 2.82

Aruvikkara – 2.82

Chavakkad – 2.81

Guruvayur – 2.81, *Major pilgrimage site*

Angamali – 2.78, *Near Kochi's metro expansion*



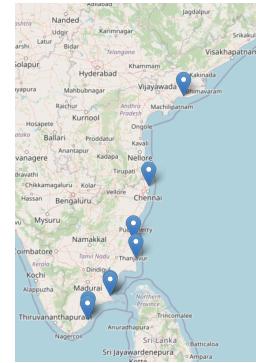
Most of these cities are located in the states Kerala, Karnataka, and Tamil Nadu, where there have been notable urbanization trends. Research notes that Kerala's coastal zones face elevated humidity from oceanic warming. These cities also fall under Tier III - Growing Urban Centres currently undergoing rapid urbanisation.

Next I analyzed the Diurnal temperature range (DTR). DTR is the difference between the highest and lowest temperatures in a day. It's a key climate indicator that affects human health, plant growth, and crop yields, and it is measured by subtracting the minimum temperature from the maximum temperature for a 24-hour period. Shrinking DTR is an urban heat indicator.

Top 10 Cities with Lowest Average DTR (2024)

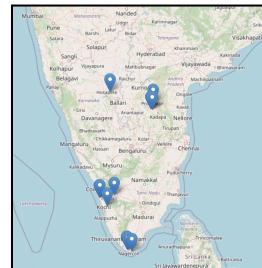
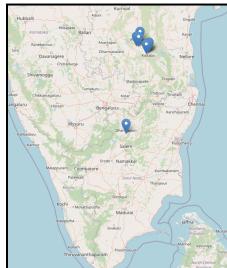
- Chinna Gollapalem – 4.63
- Andanappettai – 6.09
- Chittarkottal – 6.19
- Devipattinam – 6.19
- Diglipur – 6.27
- Diu – 6.38
- Annamalainagar – 6.70
- Attippattu – 6.71
- Attimarappatti – 7.18
- Arumuganeri – 7.20

Considering the location of these regions, coastal influence and proximity to water likely moderates temperatures. The low DTR in this case does not exactly align with the urban heat island effect.



I also looked into long term temperature trends to examine warming due to city growth over time.

warmest cities on avg ('10-'24) | warmest 2010 | warmest 2024



From 2010 to 2024, The warmest regions have shifted towards the cities with up and coming urban development.

The cities Chittandikavundanur (warmest avg at 29.53 C) and Chavakkad (2nd warmest avg at 28.6 C) were also in the top 5 of highest average temperature difference between 2010 and 2024. This points to influences of development in these regions. I also analyzed humidity-temperature relationships and if there was a relation to urban areas having lower humidity and higher apparent temperature.

Highest Difference Between Perceived and Actual Temperature and Avg Humidity:

Ayirapuram: 5.46, 86.03%, **Chalungalpadam:** 5.06, 85.26%, **Changanacheri:** 4.98, 85.33%, **Alleppey:** 4.95, 84.27%, **Alwaye:** 4.94, 84.26%

All of these cities were also in the list for the highest humidity. The difference is likely explained by the feeling of humidity over urban development. Additionally, the top 5 cities with lowest humidity across 10 years were all cities near the Thar Desert in Rajasthan.

Sources:

- [Ranking of Indian Cities Based On Living Index](#)
- [Climate Knowledge Portal](#)
- [Urban Heat Islands](#)
- <https://india.mongabay.com/2024/06/urban-growth-fuels-warming-in-indian-cities-finds-a-study/>
- <https://timesofindia.indiatimes.com/india/urbanization-led-to-overall-60-enhancement-in-warming-in-indian-cities-iit-study/articleshow/110341765.cms>
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