

Cities taking longer to shed heat despite surrounding greenery: Study

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- *A study of 44 large Indian cities suggests that urban areas are taking longer to shed heat, despite having greenery in surrounding rural or suburban areas.*
- *There is a slow and consistent increase in the background temperature of cities– a signature of human-caused global warming and local climatic changes.*
- *Evidence from the study suggests that more green spaces within the city's boundary could reduce the temperature in the city and outlying areas.*

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At nights, cities are often hotter than the suburbs or the countryside. They become 'islands' of higher temperature within a larger rural landscape, in a phenomenon called the urban heat island effect.

A recent [study](#) spanning 44 Indian cities with a population of more than a million observes that urban built-up areas are taking longer to shed heat, despite having greenery in surrounding rural or suburban areas.

One of the reasons could be the "slow and consistent" increase in the background temperature of cities. This increase is a signature of man-made actions influencing global warming and the local climate, state the scientists at IIT-Kharagpur who carried out the study.

The research team mapped the surface urban heat island intensity (SUHII) for 44 major cities of India from 2000 to 2017, across all seasons. SUHII is the difference between urban and surrounding rural land

surface temperatures.

Cities investigated in the study saw a noticeable increase in nighttime temperatures (0.007 degree Celsius–0.64 degree Celsius/decade) relative to their rural neighbourhoods, from 2000 to 2017. This indicated the continuous heating of urban surfaces (or slow cooling) in the night.

“Additionally, in contrast to past studies, we see that most of the cities have enhanced temperatures (positive heat island intensity) during the daytime as well. Cities with higher temperature will get even hotter. And heat islands can negatively impact health by worsening heatwaves,” IIT-Kharagpur’s scientist and study co- author Jayanarayanan Kuttippurath told Mongabay-India, batting for greening strategies within cities and careful selection of building materials.

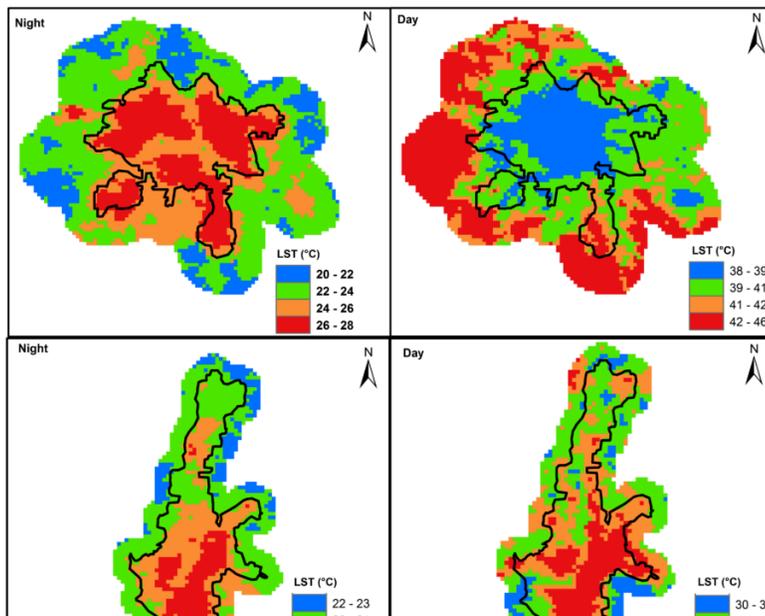
The World Meteorological Organisation has highlighted that the year 2019 concluded a decade of exceptional global heat and high-impact weather, including the prolonged heatwave in India. The country sizzled as it battled one of the longest heatwaves in three decades.

The 2018 IPCC Special Report on 1.5 degrees warned that future warming and urban expansion could lead to more extreme heat stress in megacities across the world. “At two-degree Celsius-plus warming, Karachi (Pakistan) and Kolkata (India) could expect annual conditions equivalent to their deadly 2015 heat waves,” the IPCC report warned, referring to the year when heat-related illnesses killed at least 4,000 people in South Asia, primarily in India and Pakistan.

For cities, such as Kolkata, Chennai and Thiruvananthapuram, that have a higher vegetation cover in its outlying rural areas, the study found a heightened heat island effect in the daytime. “The opposite effect is observed in cities that have less green cover in its surroundings (e.g. Delhi), where the effect of heat island is prominent at nights,” said study lead author Sarath Raj.

The overall increase in nighttime temperatures in cities is also supported by the analysis of aerosols, night lights, rainfall and vegetation in the study regions.

“The important message is that human-caused global warming and climate change are not letting cities cool down at night,” said Jayanarayanan Kuttippurath.



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The local climate shapes the impact of urban heat islands

Since the heat islands in urban spaces primarily depend on the surface temperature in those spaces, the impact of heat islands will be strongest in the regions with higher temperatures.

“For instance, the average summer temperatures of Delhi is about 40 degrees Celsius, which will be more environmentally stressed and witness adverse health impact than a city like Srinagar or Pune, where the average summer temperature is much lower than that of Delhi, although both cities might have the same heat island intensity value,” the researcher explained.

This drives home the importance of local climate in creating heat islands of varying intensity.

The heat island effect will further modify the pollutant levels and transport of pollutants in the city region and can exacerbate localised effects such as haze formation in cities like Delhi.

“Therefore, the background temperature has a big role in deciding the impact of heat islands in urban regions. On top of it, as the average global temperature goes up (global warming) the heat island effect is also expected to increase, which is an important concern in the context of climate change,” Jayanarayanan Kuttippurath added.

The authors explain that metropolitan areas become heat islands when infrastructural development (asphalt and concrete for roads, buildings, and other structures) necessary to accommodate growing populations is pursued at the expense of the green cover.

“Selection of building materials is also important in this context,” stressed Jayanarayanan Kuttippurath. “Changes in urban surfaces (impervious surface or changes in land use) modify the temperature of a city. Building material and surfaces such as asphalt absorb the sun’s heat, leading to an increase in surface temperatures and overall temperatures. Infrastructure can considerably alter the temperature of a region/city,”

Displacing trees and vegetation minimises the natural cooling effects of shading and evaporation of water from soil and leaves (evapotranspiration). Tall buildings and narrow streets can heat air trapped between them and reduce airflow. Waste heat from vehicles, factories, and air conditioners may add warmth to their surroundings, further exacerbating the heat island effect, as stated on University Corporation for Atmospheric Research’s Centre for Science Education [webpage](#).

India has been urbanising at a very fast rate. A United Nations report on population estimates that India’s urban population will [take over its rural population](#) by the end of 2050. At present, [one-third](#) of India’s total population is urbanised (31.6 percent) with the number of cities/urban agglomeration with million-plus residents [increasing](#) from 35 in Census 2001 to 53 in Census 2011.

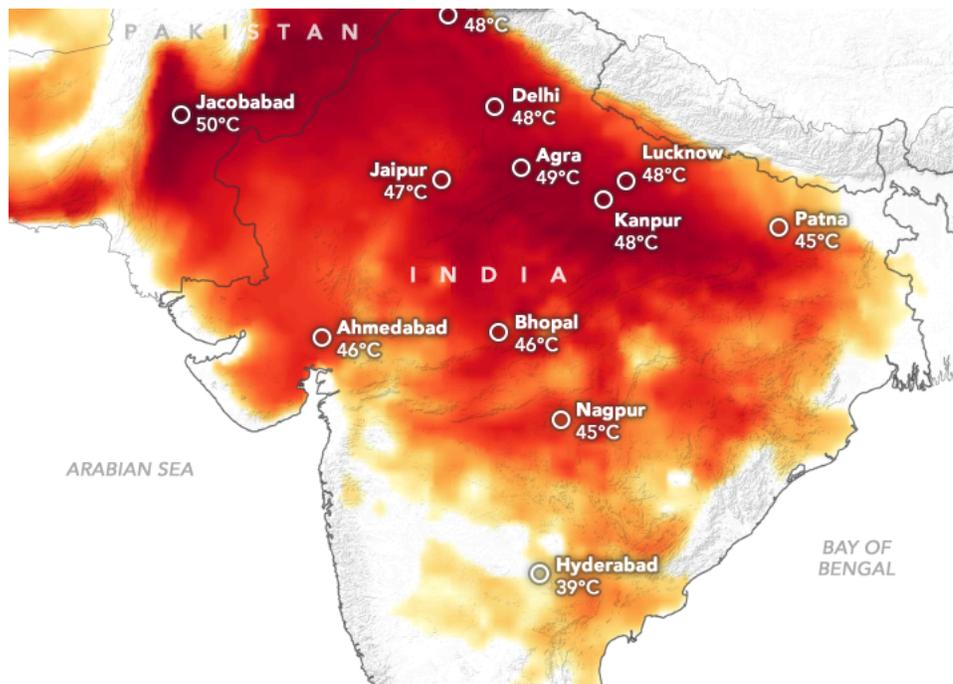
For instance, Kerala now has as many as 7 million-plus cities/urban areas, a quantum jump from the situation in 2001 when just Kochi urban area was a million-plus city, [according](#) to the Ministry of Housing and Urban Affairs.

Keeping it cool is crucial, with authors cautioning that the surface heat island effect will be enhanced if the city planning does not account for the management of its green cover, pollution, water bodies and wetlands, local weather and climate (temperature and rainfall), socio-economic factors (e.g. population), and urban infrastructure (e.g. green buildings and eco-friendly building materials).

Conservation and expansion of green areas in and around cities could be an effective mitigation strategy to counter the effects of urban heat islands. Evidence from this study suggests that more green spaces within the city and its boundary could reduce the temperature in the city and its neighbourhood.

Independent researcher Hem Dholakia said research has shown positive impacts of green infrastructure in mitigation of heat.

“This green infrastructure includes the planting of trees and vegetation (which can form part of urban planning exercises). Other interventions at the urban planning level include cool pavements. This means the use of materials other than asphalt and concrete (that tend to exacerbate the urban heat island effect). Specifically for building, green roofs (i.e. roofs with vegetation can provide direct cooling benefits. These interventions may also reduce the overall cooling requirements and help save energy,” Dholakia, who was not associated with the study said.



India experienced one of the worst heatwave spells in last several decades. Map Source: NASA.

In 2019, India launched a comprehensive [cooling action plan](#) envisioned to address the cooling requirement across sectors, listing out actions which can help reduce the cooling demand, including cool rooftops, which can counter urban heat island effects. The plan provides for the reduction of cooling demand, refrigerant transition, enhancing energy efficiency and better technology options with a 20-year time horizon. It recommends funding and support for initiatives led by local municipalities and NGOs, such as cool-roof programmes, off-grid micro-systems for cooling, and localised heat-action plans.

One such example of a cool roof program is in the west Indian city of Ahmedabad in Gujarat. In 2017, the Ahmedabad Municipal Corporation (AMC) [introduced a pilot](#) cool roofs program for over 3,000 low-income homes as part of the city's Heat Action Plan. The AMC works with partners Natural Resources Defense Council (NRDC), Indian Institute of Public Health- Gandhinagar (IIPH-G) and Mahila Housing Trust (MHT) and others to implement the cool roofs initiative as part of the heat action plan for protecting communities from extreme heat. The city started scaling up the cool roofs initiative to a city-wide cool roof program in 2019, according to the NRDC [blog post](#).

CITATION

Raj, S., Paul, S. K., Chakraborty, A., & Kuttippurath, J. (2020). Anthropogenic forcing exacerbating the urban heat islands in India. *Journal of Environmental Management*, 257, 110006.

Banner image: The presence of trees helps reduce the night temperature in Chennai. Photo by S. Gopikrishna Warriar/Mongabay.

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