

# Beating the urban heat island effect in Singapore

Compact group of high-rise buildings can be 4.3 deg C warmer than rural areas

Ang Qing

Ever wondered why some places in Singapore feel hotter than others at night?

A recent study helmed by researchers from the National University of Singapore (NUS) found that areas with dense clusters of buildings in the city are warmer than less dense housing estates in Seletar and Holland Village.

A compact group of high-rise buildings is the hottest on clear windless nights, with the temperature measuring an average of 4.3

HEATED BATTLE

**Leaving existing natural areas intact and adding more shade-providing vegetation are part of solutions to combat heat in the city.**



**PROFESSOR MATTHIAS ROTH**, from NUS' department of geography, on ways to mitigate unwanted heating effects.

deg C more than undeveloped land in Lim Chu Kang, while a dispersed low-rise residential area with some vegetation is the coolest at 2.5 deg C warmer than the reference.

This is due to varying intensities of the urban heat island effect, a phenomenon whereby densely built areas experience higher air temperatures than undeveloped rural areas.

The extra heat becomes more palpable at night, when energy from solar radiation trapped in urban structures during the day is released as heat. Urban heat island intensity peaks under clear, calm and dry conditions, which maximise rural cooling whereas urban areas cool at a slower rate.

These findings, published in the *International Journal of Climatology* last Wednesday, came from data collected between 2008 and 2014 from 20 air temperature stations across Singapore.

The six-year study of heat in urban and rural areas in Singapore is one of the most comprehensive in a tropical city to date, said its first author Matthias Roth from NUS' Department of Geography, adding that the next longest study for Singapore was conducted over 13 months.

Urban areas across Singapore have resulted in an additional warming of possibly up to 1.5 deg C

of the island, putting urban-induced warming here on a similar magnitude to global warming, the report noted.

"These findings confirm that rising temperatures in Singapore are not just due to global warming, but possibly up to half is contributed by local urbanisation," said Professor Roth, who has studied urban climates and the heat island effect here for more than 20 years.

This means that populations of tropical cities, already experiencing high temperatures and high

humidity, will be more vulnerable to extreme heat events as a result of urban heat and global warming, the study noted.

Past research in Singapore has shown that urban heat island intensity at night doubled in magnitude between 1965 and 2004 as well as expanded with the development of new housing and industrial districts.

The recent report also found that exposure to heat in Singapore during the daytime is most severe from April to June in built areas

with low-rise buildings, a high percentage of waterproof surfaces and a corresponding lack of vegetation that could provide shade and reduce heat absorption.

These include residential estates in Serangoon Gardens and industrial areas in Woodlands, where temperatures can soar to as high as 36 deg C.

On the other hand, some areas will also experience a cool island effect around midday.

Prof Roth said: "If we compare the temperature at 1pm between

the Central Business District and Lim Chu Kang, it is actually warmer in Lim Chu Kang by up to 1 deg C because the city at street level experiences shading from tall buildings.

"But these tall buildings will still soak up energy during the daytime, so it will be relatively warm at night as built areas give off heat then. Some of which, however, will be retained within the deep street canyons. Lim Chu Kang, on the other hand, will be much cooler at night, since natural, vegetated sur-

## Hot spots in Singapore

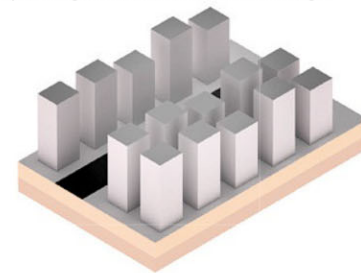
A recent study measuring urban heat in Singapore between 2008 and 2014 identified parts of the island where warming is felt more strongly.

Which places experience urban heat more intensely?

Hot ←

### HOT URBAN AREA

Compact high-rise and mid-rise buildings

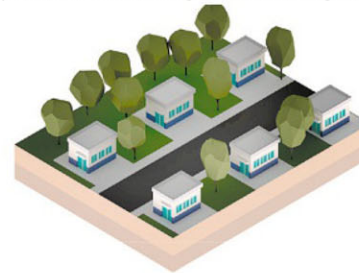


Example: Offices at Raffles Place

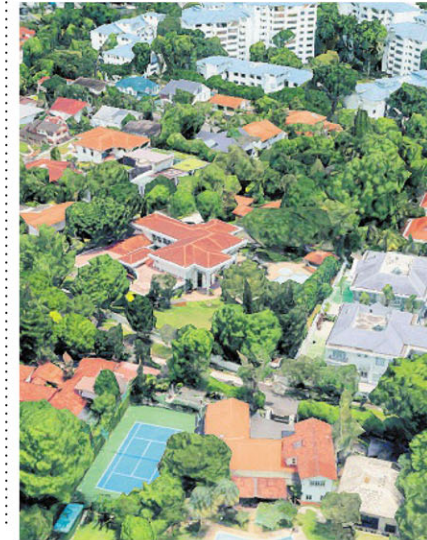


### COOL URBAN AREA

Sparse low-rise buildings with some vegetation

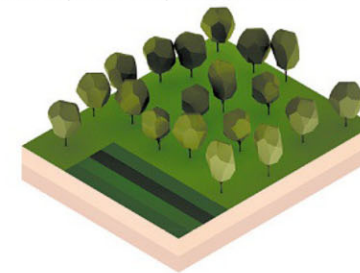


Example: Housing estate near Holland Village



### RURAL AREA

Green spaces with plants and trees



Example: Farms in Lim Chu Kang

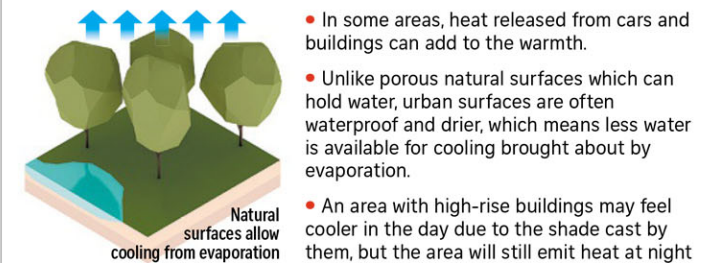
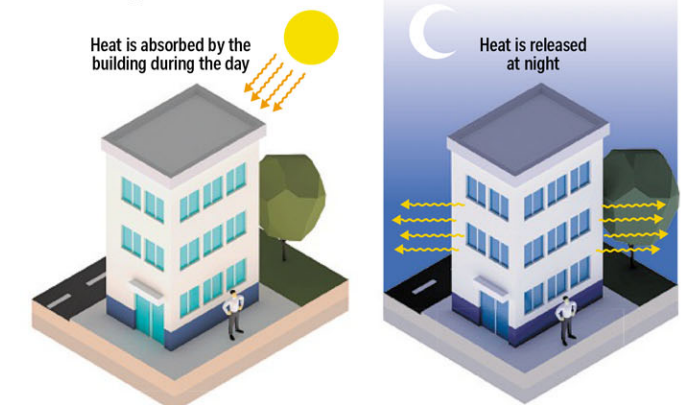


### What is the urban heat island effect?

Singapore is experiencing warming which is higher than the global average due in part to the urban heat island effect — a phenomenon where urban regions are hotter than nearby rural, undeveloped areas.

### Why do some urban areas experience heat more intensely at night?

• Many urban building materials such as concrete absorb a lot of energy from the sun. This is particularly felt at night when this energy is released as heat.



- In some areas, heat released from cars and buildings can add to the warmth.
- Unlike porous natural surfaces which can hold water, urban surfaces are often waterproof and drier, which means less water is available for cooling brought about by evaporation.
- An area with high-rise buildings may feel cooler in the day due to the shade cast by them, but the area will still emit heat at night



### Why are some urban areas cooler than others?

- Generous tree cover provides shade and reduces heat absorption in the day so less heat is released at night.
- Areas with fewer buildings that trap heat and release it at night are cooler.

Source: MATTHIAS ROTH  
PHOTOS: GOOGLE EARTH STRAITS TIMES GRAPHICS

faces absorb less heat during the day, and whatever was absorbed during the daytime can easily escape into the air."

Knowing the maximum impact of various built-up areas on the thermal environment will be useful for understanding areas prone to heat risk as well as climate-sensitive urban planning and design, said Prof Roth, adding the Government has recognised these issues.

To address heating caused by urbanisation, the authorities and academics have already taken

steps to study and help the island beat the heat.

The National Parks Board's initiative to plant one million more trees islandwide by 2030, for example, will help to mitigate some of the unwanted heating effects caused by increasing urbanisation.

Said Prof Roth: "Leaving existing natural areas intact and adding more shade-providing vegetation are part of solutions to combat heat in the city."

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