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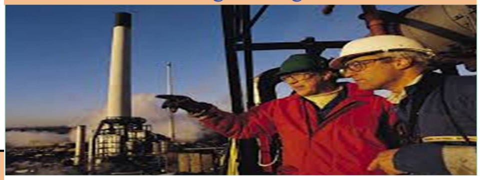

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The influence of 3D architecture patterns on urban surface temperature at the community scale

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DESCRIPTION

The global population is predicted to grow by two billion people over the next 30 years, rising from 7.7 billion in 2020 to 9.7 billion in 2050 (United Nations 2019). The continuous fast population expansion, as well as the accelerated rate of urbanisation (United Nations, 2018), places further strain on cities' already overstressed horizontal land resources. To accommodate tremendous population expansion, human dwelling spaces must swiftly extend vertically. The concentration of people in densely populated places exacerbates thermal conditions and contributes to the formation of an Urban Heat Island (UHI). When the outside humidity and temperature reach a wet bulb temperature of 35 °C, individuals are unable to cool their bodies by sweating. Exposure to this moist bulb condition Even the strongest among us will perish in a matter of hours. Climate change and the increasing frequency of heat waves exacerbate urban heat island (UHI) conditions, threatening cities' livability and sustainability.

The circumstances of an Urban Heat Island (UHI) can be defined by either air temperature or land surface temperature (LST). Air temperature is commonly monitored at meteorological stations 2 metres above ground, and this method has historically been employed for Urban Heat Island (UHI) research. However, because meteorological stations are frequently restricted and dispersed, they only offer partial estimates of temperature fluctuations in spatially continuous areas. With the introduction of satellite remote sensing technologies, it is now feasible to analyse the Urban Heat Island (UHI) in great detail across enormous areas. The Land Surface Temperature (LST) quantifies how hot the Earth's surface is when a satellite looks through the atmosphere to the ground, and it is an excellent indication of the of the energy balance in land surface processes physics.

The relationship between Land Surface Temperature (LST) and 2D urban formations has gotten much attention across the world, although its 3D equivalent has garnered far less. A few studies have been conducted to investigate the influence of 3D urban form on Land Surface Temperature (LST). These studies provide useful information regarding the influence of 2D/3D factors on Land Surface Temperature (LST). Nonetheless, two knowledge gaps must be filled. First, no studies have been published on the marginal impacts of 3D architectural patterns on Land Surface Temperature (LST). Instead of determining if the Land Surface Temperature has a positive or negative association marginal effects can provide quantitative insights into the mitigating impact as well as its degree (LST) and influencing factors

Second, while existing research mostly focus on the combined impacts of vegetation cover, buildings, and/or water bodies, a complete and exclusive examination of the influence of 3D architectural patterns at the neighbourhood scale remains lacking. This research aims to bridge these two gaps. Building is an important feature of urban form and a significant contribution to the UHI effect. Investigating the relative contributions and marginal impacts of the 3D architectural design on urban temperature conditions contributes to a better understanding of the human-environment relationship. Because only a few metrics were available for accurately evaluating the spatial composition and layout of buildings, there was a dearth of detailed inquiry into the 3D architectural pattern. The most widely used metrics are building height, volume, form coefficient, and sky view factor.

A collection of landscape metrics was recently developed to describe the 3D morphology of structures. These metrics fully reflect the ecological and social significance of urban architectural patterns and are promising for analysing the influence of Urban Heat Island (UHI) Because of the constraints and advancements indicated above, the impact of 3D building features on Land Surface Temperature (LST) must be studied both collectively and individually in order to give direction for heat mitigation in future upward city expansion. The primary goal of this research is to investigate how 3D building metrics govern urban surface temperature in Shanghai's core city, which is representative of a typical high-rise compact city setting. The examination is carried out on a local size to offer architectural designers and planners with the necessary recommendations. The main factors responsible for seasonal variations in urban thermal conditions are also investigated.