



INTERVENTIONS SHOULD FOC ON MINIMISING UHI EFF

Matthias Roth, Associate Professor and Deputy Head, Department of Geography, National University of Singapore, speaks exclusively with **Hannah Jo Uy** of *Climate Control Middle East* on his work as a principal investigator in the Urban Climate Lab, the international move towards climate-sensitive design, and on how recognition of the importance of urban heat island (UHI) effect in the GCC region can serve as a catalyst in the efforts to improve outdoor thermal comfort and, as a result, reduce the use of energy and emission of greenhouse gases. Excerpts...

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Could you please elaborate on the nature of your work at the Urban Climate Lab?

In our lab, we try to understand how the presence of a city affects the climate and weather, primarily at the local scale. When natural surfaces are replaced by three-dimensional structures, primarily made of concrete, it is easy to imagine that such changes will affect how much energy is received from the sun, the surface and air temperature, the storage of heat energy in the urban fabric or wind flow. For our research, we primarily use experimental methods, meaning we are leaving the air-conditioned comfort of our offices and measure the urban climate properties outdoors. To do so, we install arrays of sensors in specifically determined locations across the city to be able to answer a particular research question. Given the complexity of the urban atmosphere and logistical issues with deploying instruments in the real city environment, we also engage in numerical modelling and use our measurements to improve and evaluate urban climate models.



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Matthias Roth

Singapore has been making great strides in terms of research through initiatives such as Cooling Singapore. Do you see the same progress elsewhere in the world? Can the model of Singapore be replicated and recreated in other countries?

Singapore has, indeed, made some progress recently, and at present, there is strong support for research in the wider area of “liveable”, “sustainable”, or “eco” city. There are many other cities, however, which have also seriously considered climate-sensitive design and planning to improve the quality of their atmospheric environments. Examples are Stuttgart in Germany; Chicago, New York City and Phoenix in the United States; Melbourne in Australia and Hong Kong. What has helped Singapore to achieve success in a relatively short period is a concerted effort by a strong government to invest in environmental research targeting specific questions of environmental quality and liveability, as the population keeps growing and the building density increases. These questions are particularly pressing in Singapore, given its nature as a city-state with no hinterland and natural resources.





Could you please comment on how greater appreciation and recognition of Urban Heat Island (UHI) effect among manufacturers, developers, architects and the general public can help improve quality of life and meet the long-term energy-consumption and environmental goals of countries, particularly those in the GCC region?

The urban heat island (UHI) is the most ubiquitous characteristic of the urban climate. The UHI is manifested as higher temperatures in the city compared to the undeveloped rural surroundings. Cities in already warm or hot regions are affected the most. Here, the UHI will increase the ambient outdoor temperature and decrease outdoor thermal comfort to a possibly intolerable level. Add to this the effects of anthropogenic global warming, and temperatures in some cities in the GCC region may possibly even exceed a threshold for human adaptability, as recent research has shown.

This issue should, therefore, be given high priority, particularly in the GCC region, where population growth is greatest and vulnerability to excess heat highest.

Developers, architects and city planners should, therefore, have a basic understanding of the science behind the UHI, based on which mitigation and adaptation efforts can be formulated and implemented. Interventions should focus on minimising the UHI effect to enable the population a functional outdoor lifestyle. Such mitigation efforts need to consider the local background climate, because they will be different for a city located in a hot and dry desert climate compared to one in a wet tropical climate. Reducing ambient temperature in warm and hot places also has the added benefit of reducing usage of air conditioning and, hence, energy. This will help reduce emissions of greenhouse gases responsible for global anthropogenic warming, when the energy is produced by burning fossil fuels.

In light of the rapid expansion of many cities across the GCC region and its growing population, how should relevant stakeholders incorporate climatological concerns into their design in a more conscious manner? Where does the responsibility lie and



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how can government regulators, developers and academics work together to truly make sustainable cities?

First, I don't think cities will ever be truly sustainable, at least not in an ecological or environmental sense. We should, therefore, be careful in using this term too liberally; at best, we can work towards developing a "more sustainable" city. Much responsibility in this respect lies with city or national governments, developers and, ultimately, banks, as well. Rules or incentives need to be created to enshrine climate-sensitive design principles not only in the individual building but also in city-wide planning process. Banks should favour lending money or offer preferential conditions to developers who follow these principles. One way forward might be through highlighting the co-benefits of applying climate-sensitive design; for example, at the individual building level a dwelling with "green" features will likely have lower life-time running costs in terms of energy use, and if located in an area of the city that has a more liveable outdoor environment, will also likely maintain a higher resale value.

In one of your talks you mentioned that climatological concerns must be given stronger emphasis to avoid high levels of heat stress, which reduces human comfort, and space cooling needs, to prevent increase in energy usage. In your experience, has more effort been made towards this?

While respective efforts are underway, I don't think there is enough data available to show that they have made a difference; it is too early for a conclusive statement.

Aside from the human aspect, taking into account climatological concerns can also help reduce a country's energy consumption and, by extension, reduce operating cost and help countries meet their respective environmental targets, do you think this will encourage more people to get involved in promoting awareness of urban climate and society's impact on it?

The climate change or anthropogenic global warming dimension is obviously an important one and can help raise people's awareness for action.

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greenhouse gases (GHG) believed to cause anthropogenic warming is emitted by activities associated with running a city, the energy-saving potential is obvious, as is the potential for effective GHG mitigation at the individual city level.

Could you share your thoughts on whether one cooling solution over the other can help trigger or mitigate UHI? Some have made a case for the use of green roofs, increased vegetation and the retrofitting of buildings with more energy-efficient utility infrastructures, such as District Cooling systems. Do you believe the same?

There are, indeed, differences in the effectiveness of individual mitigation methods, which depend on the local climate and scale of the anticipated effect. One of the most popular interventions –

the “green” roof, for example – reduces energy use in the top floor of an individual building; however, it will have a small effect on ambient outdoor temperature and, hence, the UHI. Maintaining urban parks or trees along streets to provide shade on the pavement, on the other hand, directly affects ambient temperature at street level, where people move and live. Use of “green” features in hot and dry climates may also be limited by the availability of water, in which case a reflective roof may be a more sensible mitigation option. In the end, a combination of interventions at different scales is needed to effectively lower ambient temperature in cities. [ccme](#)



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