Urban Climate News

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From the IAUC President

Welcome to the September 2018 edition of the *Urban Climate News*, and to my first column as President of the IAUC.

First, a little about me for those who may not know me. I'm a Professor in the School of Earth, Atmosphere and Environment at Monash University, Australia where I lead a research group working primarily on fundamental and applied research on urban climate and climate adaptation in cities. I have been involved with the IAUC for many years, was elected an IAUC Board Member in 2015 and have chaired the Awards Committee of IAUC since then. I am honored and privileged to be taking up the Presidency of a vibrant, strong and healthy IAUC, a position that is in no small part due to the excellent work of my predecessors in this role and the wonderful work of the many IAUC Executive office-holders and IAUC Board members over the years.

I want to particularly acknowledge **James Voogt**, the outgoing IAUC President, who has provided excellent leadership over the last three years and who has presided over a range of important new initiatives, including the recent IAUC diversity and equity statement and associated activities. The incoming Executive and Board will do its best to support these important initiatives. I also want to acknowledge the substantial and important work of **David Sailor**, the outgoing IAUC Secretary. As everybody knows, this is the role where much of the hard work is done, and David has provided huge support to the IAUC in the last three years in areas such membership, Board business, elections and ICUC conference proposals. I look forward to working with **Andreas Christen** who is taking over this this important role as David steps aside. Also warranting special acknowledgment is **David Pearlmutter**, who efficiently and creatively puts together this *Urban Climate News* quarter after quarter (and actually enjoys doing it, as he told me at ICUC-10!)

Speaking of ICUC-10, on behalf of the ICUC Board and all members, I want to thank Co-Chairs **Jorge Gonzales** and **Dev Niyogi** and their organizational team for their massive efforts in staging an excellent conference in New York August 6-10. More than 600 delegates from 50 countries made over 600 presentations. In addition, there were 5 excellent and well-attended plenaries. The location in Manhattan and engagement with local city government made it a truly memorable conference experience. We look forward to reporting in the next newsletter the location of the next ICUC.

Inside the September issue...

I hope that you enjoy reading this edition of *Urban Climate News*. As usual it is full of interesting articles, announcements and special reports. In particular I want to draw your attention to the report on the award of the Luke Howard Award to Professor **Wilhelm Kuttler** "for his outstanding leadership in the development of urban climate science and its international community, and also for his profound impact on German urban planning, legislation, guidelines and codes through application of urban climate understandings".

Finally, I look forward to serving the membership of IAUC over the next three years, building upon the excellent legacy that we have. As we move into the IPCC-AR6 round, cities are now front and central in climate change discussion and policy-making, so we have unique and excellent opportunities to strengthen the influence and profile of our discipline and our membership. Please feel free to contact me at the email address listed below.

– Nigel Tapper,
IAUC President
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Before-and-after satellite photos show the staggering amount of water Hurricane Florence dumped on North Carolina

September 2018 — Hurricane Florence was the worst flooding event in East Coast history, according to some reports.

The storm churned into North Carolina on September 14, bringing storm surge, flooding, and intense rainfall. More than 33 inches of rain fell in parts of the state. Thousands of people evacuated their homes, at least 37 people died, and millions lost power. More than 100,000 homes are still without electricity days after the storm. The flooding also caused rivers to overflow, fields to fill with water, and millions of farm animals to drown. Agricultural losses will be in the billions.

The damage continues to mount — new reports indicate that a dam breach is causing coal ash from a power plant to spill into a river.While these reports from the ground show how difficult and devastating the storm has been, images from above provide a different perspective on the flooding.

See here a series of aerial satellite images from NOAA, ESRI Disaster Response, and Digital Globe that show parts of North Carolina before and after the storm. You can swipe back and forth to see the damage Florence has caused.

Fields and farmed were covered by water (ESRI/NOAA). ***Source:*** http://uk.businessinsider.com

If Hurricane Florence is the new norm, here's how to redesign our cities to cope with climate change

Miami, Shanghai, Osaka and scores of other cities could be mostly underwater in 100 years. What's our plan?

September, 2018 — As Hurricane Florence barreled towards the United States, residents on the Carolina coast were preparing for days of potentially catastrophic flooding. While the winds had slowed in recent days, the National Hurricane advisory was warning of "life-threatening storm surge and rainfall". For those living in cities such as Wilmington and Charleston, what was to be done? Boarded windows, emergency shelters, evacuation.

In 1900, after a Category 4 hurricane hit the barrier-island city of Galveston in Texas, and after at least 6,000 people had been killed, a massive endeavour was undertaken to rebuild from the ruins. Homes were raised on stilts and new foundations were filled with silt. A 16 kilometre sea wall was erected to protect the city from storm waves. It was a staggeringly ambitious undertaking; one that recognised the continuing threat of storms to the area. Galveston is still standing.

But that was a response at the beginning of the 20th century. How can our cities adapt to the effects of climate change we are witnessing now? Hurricane season is getting worse, sea levels are rising, the air is becoming hotter. Do we build bigger sea walls, or do we fundamentally rethink how our cities relate to the natural world? If, as some experts predict, Miami, Shanghai, Osaka and scores of other cities could be mostly underwater in 100 years, what is our plan?

"It's very important not to allow a conversation that speaks about solutions," says Godofredo Pereira, programme leader of environmental architecture at the Royal College of Art. "You don't solve a hurricane." Far better, he explains, that we talk about the need for cities in different parts of the world to cope with the damage that could be wrought by yearly storms. Urban planning, particularly in coastal zones, will need to face up to the increasing likelihood of buildings being flooded, or torn apart by wind and debris, or for thousands of people to be without places to sleep. In the longer-term, away from emergency relief, there are conversations to be had around how cities work from the ground down.

"There have to be different ways of thinking about occupying the city," Pereira says. "Architecture will be called upon to think about the mitigation of water level rises, the ratios between permeable and impermeable soils."

Blocking water can only get you so far. At some point, cities may need to consider how to best let water in; how to replace concrete that leads to surface runoff with structures that allow rain to be absorbed. Danish studio Tredje Natur has been working on a module tile for this purpose since 2014. The Climate Tile is designed to supplement existing sewage systems, using a system of holes and tunnels to funnel rainwater to areas of vegetation. Another project, developed by landscape studio SLA and also set in Denmark, is due to be built in Copenhagen's Nørrebro district. It similarly seeks to mitigate flooding from heavy rainfall, using a sunken basin inside a park that forms a retention area for rainwater.

There's something comforting in the mockups of these designs, full of children playing and aspirational young professionals walking hand in hand, unperturbed by the effects of flooding. They make climate change look rosy. But there's a gulf between the rainwater flooding that Copenhagen faces and the destruction caused by last year's hurricane season to Puerto Rico, the Dominican Republic, the Virgin Islands and Miami. Even within a single city, there's inequality between the quality of infrastructure and housing from one district to the next. How a city acts is not simply an engineering decision, but a social decision.

And how this nebulae of factors could affect a city's architectural response is made even more complex when you consider the web of commercial and governmental considerations. "It's very important to understand that climate change is not only a physical problem," says Pereira. "It emerges out of socio-political transformation and its consequences are socio-political."

Closer to home, the UK is also having to think about how to build for the future. Alex Whitcroft is a director at the studio bere:architects. The firm recently designed the London Bridge Staircase, which connects the bridge with the River Walkway situated eight metres below. "Part of the strategy was around what happens if the Thames rises," he says. "Can we turn a staircase into something that would potentially be underwater at high tide?"

Rising river levels are a concern, but Whitcroft notes the more immediate issue facing UK building design is changing seasonal temperatures. The fashion for huge swathes of uncurtained glass in large commercial buildings, for example, is best suited for mild climes. As summers get hotter, problems start to surface.

"At the moment we have the luxury of cold nights, but everyone notices when you have a hot week. Buildings don't cool down. We haven't created our building stock to deal with that. We also don't have it at the opposite end of the spectrum. Earlier this year we had a harsh, icy winter and a lot of people couldn't heat their homes."

It's less dramatic than floods and storms, but if the UK's buildings aren't properly designed to cope with colder, wetter winters, the issue can spread. Once again, the issue becomes a socio-political one. Combining moisture with central heating, for example, can create damp, which can lead to more illnesses, which can put a bigger strain on an already struggling health service. "If you factor in the holistic cost," says Whitcroft, "the effect of our poor building stock is huge."

The air is not only getting hotter and colder, but more toxic. This week the EU Court of Auditors said that air pollution is "the biggest environmental risk" to public health in Europe, although the levels dealt with by the likes of London, Paris and Berlin still pale in comparison to those of cities such as Kanpur and Delhi in India. An architecture studio in Dubai recently released a particularly dystopian concept for dealing with the problem in the latter, based around a vast network of 100-metre high towers that absorb smog.

Climate Tile. *Source: Tredje Natur,* http://uk.businessinsider.com

The Blade Runner-esque concept chimes with prototypes made by the Dutch artist and designer Daan Roosegaarde, who has been developing air-purifying towers, albeit of a different order. The seven-metre tall structures vacuum smog particles from the air, which the artist's studio then turns into jewellery. It's a nice idea, and has been trialled in public spaces in Beijing, Amsterdam and Krakow, but is it ultimately a short-term salve?

"Perhaps it's time to think about what it means to live in extreme conditions and adapt drastic measures," says the architect Jennifer Chen. "Instead of maintaining the existing coastlines, should the cities be retreated with the receding shores? And in cases where cities are already highly flood prone, or under sea level, what would it take to live in the water?"

A course Chen teaches at the Bartlett School of Architecture looks to science-fiction as a way to understand and reflect on how architecture should respond to the age of the anthropocene. It says our relationship to nature is no longer a sufficient response to the volatile conditions of the world's climate. The solution, in this case, is to stop trying to preserve our current way of life, and instead to think about what it means to live in a whole new reality – one with a lot more water.

That rhetoric is likely to be of little comfort to the citizens of Wilmington and Charleston who are boarding their windows. The connection between short-term survival and long-term planning is a complex one, and it is crucial to remember that at the heart of all these questions are human lives. How are homes built in the 19th and 20th century supposed to fit into this new world order? Are sunken communities an inevitability? There are lots of questions. What's becoming clear is that cities across the globe need to come up with answers.

"We are constantly being outpaced," says Chen. "It's no longer enough to only think about mitigating the effects of climate change, but to consider ways to adapt to the changing environment. At some point, the dam won't hold."
Source: Thomas McMullan, http://uk.businessinsider.com

New cities may make millions more vulnerable to climate change

September 2018 — A forthcoming study of over a hundred new cities being built around the world suggests developers and planning authorities are doing very little to make their projects resilient to climate change. On the contrary, a boom in new city projects in coastal areas – including some on reclaimed land in the sea – appears to fly in the face of the danger of rising sea levels and more frequent extreme weather events.

When McGill geography professor Sarah Moser mapped 120 new cities under construction across Asia, Latin America, Africa and the Middle East, she was struck by how many of them were in vulnerable coastal areas.

"I think this has to do with the fact that a lot of these projects are real estate projects. Everyone wants to live on the coast and new cities are often geared towards the wealthy – they're investment vehicles," Moser says.

But the short-sighted pursuit of profit may be just one of many forces driving the surge in new cities in coastal areas. Ambitious, eye-catching projects often form part of political narratives in which authorities seek to portray themselves as making a break from the past. In some cases, new cities are billed as a utopian solution to overcrowding and congestion.

Deciphering the politics and ideology behind the development of new cities has been a major theme of Moser's work as an urban and cultural geographer. Now, the data she has gathered on the extent of urban development in coastal areas has compelled her to examine the new city phenomenon through the lens of sustainability. Her new study will scrutinize the optimistic claims made by proponents of new cities in coastal areas. "They just keep saying over and over: 'This will solve all our problems, it's going to be great!'" Moser says. "Those involved in real estate, property or construction are making money, but there's no voice of reason stepping in and saying, 'This is not a good idea.'"

With support from the MSSI Ideas Fund, Moser and her collaborator, Idowu Ajibade of Portland State University, aim to be that voice of reason. Through several case studies, the researchers will examine how climate change and resilience planning are being integrated – if at all – into the design of new cities. Moser's early findings are disheartening.

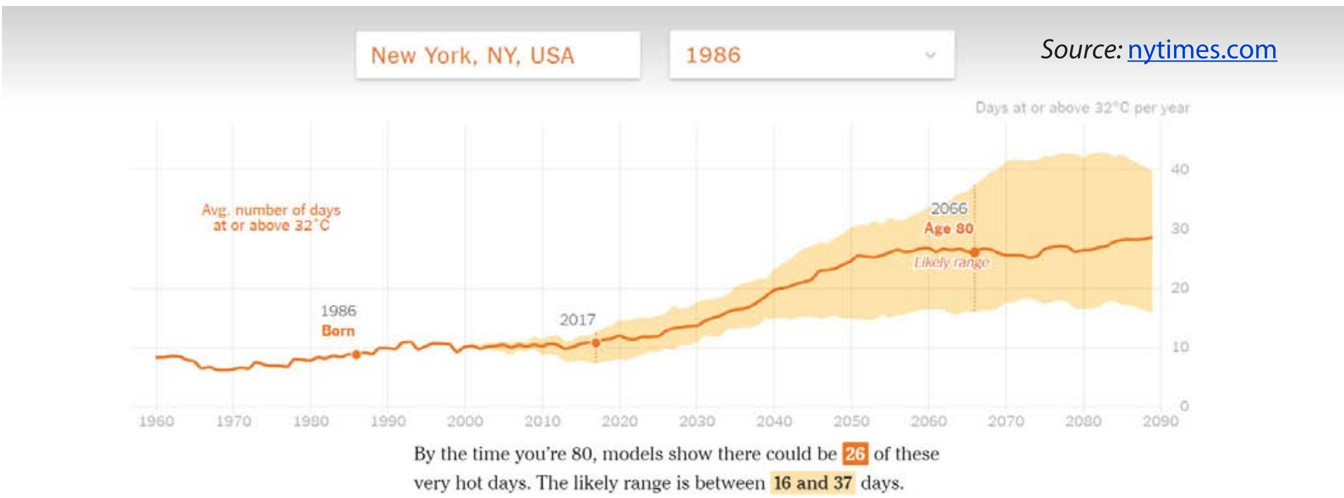
"I've determined that there are only about eight cities out of 120 that are even talking about climate change. It's really a minimal effort," she says.

Forest City, a futuristic high-rise project being built on reclaimed land in the narrow body of water that separates Malaysia from Singapore, is one example of a vulnerable master-planned city that Moser has studied closely. If completed as planned, the new city will have the highest density of any population centre on the planet, housing 700,000 people on four artificial islands.

The project illustrates the cavalier attitude some new city builders are taking towards climate change. On a visit to the site, Moser recalls asking her guide if those behind the project were worried about rising sea levels.

"Oh no," the guide replied. "The sea is not rising in Malaysia – only in other countries." *Source:* https://phys.org/news/2018-09-cities-millions-vulnerable-climate.html

How Much Hotter Is Your Hometown Than When You Were Born?



Source: nytimes.com

As the world warms because of human-induced climate change, most of us can expect to see more days when temperatures hit 32°C or higher. See how your hometown has changed so far and how much hotter it may get.

In India, Summer Heat May Soon Be Literally Unbearable

July 2018 — On a sweltering Wednesday in June, a rail-thin woman named Rehmati gripped the doctor's table with both hands. She could hardly hold herself upright, the pain in her stomach was so intense.

She had traveled for 26 hours in a hot oven of a bus to visit her husband, a migrant worker here in the Indian capital. By the time she got here, the city was an oven, too: 111 degrees Fahrenheit by lunchtime, and Rehmati was in an emergency room.

The doctor, Reena Yadav, didn't know exactly what had made Rehmati sick, but it was clearly linked to the heat. Dr. Yadav suspected dehydration, possibly aggravated by fasting during Ramadan. Or it could have been food poisoning, common in summer because food spoils quickly.

Dr. Yadav put Rehmati, who is 31 and goes by one name, on a drip. She held her hand and told her she would be fine. Rehmati leaned over and retched.

Extreme heat can kill, as it did by the dozens in Pakistan in May. But as many of South Asia's already-scorching cities get even hotter, scientists and economists are warning of a quieter, more far-reaching danger: Extreme heat is devastating the health and livelihoods of tens of millions more.

If global greenhouse gas emissions continue at their current pace, they say, heat and humidity levels could become unbearable, especially for the poor.

It is already making them poorer and sicker. Like the Kolkata street vendor who squats on his haunches from fatigue and nausea. Like the woman who sells water to tourists in Delhi and passes out from heatstroke at least once each summer. Like the women and men with fever and headaches who fill emergency rooms. Like the outdoor workers who become so weak or so sick that they routinely miss days of work, and their daily wages.

"These cities are going to become unlivable unless urban governments put in systems of dealing with this phenomenon and make people aware," said Sujata Saunik, who served as a senior official in the Indian Ministry of Home Affairs and is now a fellow at the Harvard University School of Public Health. "It's a major public health challenge."

Indeed, a recent analysis of climate trends in several of South Asia's biggest cities found that if current warming trends continued, by the end of the century, wet bulb temperatures — a measure of heat and humidity that can indicate the point when the body can no longer cool itself — would be so high that people directly exposed for six hours or more would not survive.

In many places, heat only magnifies the more thorny urban problems, including a shortage of basic services, like electricity and water.

For the country's National Disaster Management Agency, alarm bells rang after a heat wave struck the normally hot city of Ahmedabad, in western India, in May, 2010,

Clearing trees on construction sites can worsen urban heat. *Source:* nytimes.com

and temperatures soared to 118 degrees Fahrenheit, or 48 Celsius: It resulted in a 43 percent increase in mortality, compared to the same period in previous years, a study by public health researchers found.

Since then, in some places, local governments, aided by the Natural Resources Defense Council, an advocacy group, have put in place simple measures. In Ahmedabad, for instance, city-funded vans distribute free water during the hottest months. In the eastern coastal city of Bhubaneswar, parks are kept open in afternoons so outdoor workers can sit in the shade. Occasionally, elected officials post heat safety tips on social media. Some cities that had felled trees for construction projects are busy trying to plant new ones.

The science is unequivocally worrying. Across the region, a recent World Bank report concluded, rising temperatures could diminish the living standards of 800 million people.

Worldwide, among the 100 most populous cities where summer highs are expected to reach at least 95 degrees Fahrenheit by 2050, according to estimates by the Urban Climate Change Research Network, 24 are in India.

Rohit Magotra, deputy director of Integrated Research for Action and Development, is trying to help the capital, Delhi, develop a plan to respond to the new danger. The first step is to quantify its human toll.

"Heat goes unreported and underreported. They take it for granted," Mr. Magotra said. "It's a silent killer."

On a blistering Wednesday morning, with the heat index at 111 degrees Fahrenheit, he and a team of survey takers snaked through the lanes of a working-class neighborhood in central Delhi. They measured temperature and humidity inside the brick-and-tin apartments. They spoke to residents about how the heat affects them.

"Only by 4 a.m., when it cools down, can we sleep," a woman named Kamal told him. Her husband, a day laborer, suffered heatstroke this year, missed a week's work, and, with it, a week's pay.

A shopkeeper named Mohammed Naeem said that while he managed to stay cool in his ground-floor space, his father's blood pressure rose every summer, as he sweltered in their top floor apartment all day.

Through the narrow lanes all morning, young men hauled stacks of paper to a printing plant that operated on the ground floor of one house. A tailor sat cross-legged on the floor, stitching lining onto a man's suit. A curtain of flies hung in the air.

A woman named Abeeda told Mr. Magotra that she helped her husband cope during the summer by stocking glucose tablets in the home at all times. Her husband works as a house painter. Even when he is nauseous and dizzy in the heat, he goes to work, she said. He can't afford not to.

Across town, workers covered their faces with bandannas as they built a freeway extension for Delhi's rapidly growing number of cars. The sky was hazy with dust. Skin rash, dry mouth, nausea, headaches: These were their everyday ailments, the construction workers said. So debilitating did it get that every 10 to 15 days, they had to skip a day of work and lose a day's pay.

Ratnesh Tihari, a 42-year-old electrician, said he felt it getting hotter year by year. And why would that be surprising? He pointed his chin at the freeway extension he was helping to build. "It's a fact. You build a road, you cut down trees," he said. "That makes it hotter."

Worldwide, by 2030, extreme heat could lead to a $2 trillion loss in labor productivity, the International Labor Organization estimated.

Delhi's heat index, a metric that takes average temperatures and relative humidity into account, has risen sharply — by 0.6 degrees Celsius in summer and 0.55 degrees during monsoons per decade between 1951 and 2010, according to one analysis based on data from 283 weather stations across the country.

Some cities are getting hotter at different times of year. The average March-to-May summertime heat index for Hyderabad had risen by 0.69 degrees per decade between 1951 and 2010. In Kolkata, a delta city in the east, where summers are sticky and hot anyway, the monsoon is becoming particularly harsh: The city's June-September heat index climbed by 0.26 degrees Celsius per decade.

Joyashree Roy, an economist at Jadavpur University in Kolkata, found that already, most days in the summer are too hot and humid to be doing heavy physical labor without protection, with wet-bulb temperatures far exceeding the thresholds of most international occupational health standards.

And yet, walk through the city on a stifling hot day in June, and you'll find people pedaling bicycle rickshaws, hauling goods on their heads, constructing towers of glass and steel. Only a few people, like herself, Dr. Roy pointed out, are protected in air-conditioned homes and offices. "Those who can are doing this. Those who can't are becoming worse," she said. "The social cost is high in that sense."

A New Delhi street. Air conditioners can contribute to heat waves by blowing hot air out into the city. ***Source:*** nytimes.com

Researchers are tinkering with solutions. In Ahmedabad, city funds have been used to slather white reflective paint over several thousand tin-roofed shanties, bringing down indoor temperatures.

In Hyderabad, a similar effort is being tested. A pilot project by a team of engineers and urban planners covered a handful of tin-roofed shacks with white tarpaulin. It brought down indoor temperatures by at least two degrees, which was enough to make the intolerable tolerable. Now they want to expand their cool-roof experiment to a 1-square-kilometer patch of the city, installing cool roofs, cool walls and cool sidewalks, and planting trees. Their main obstacle now: funding.

Rajkiran Bilolikar, who led the cool-roof experiment, has a personal stake in the project. As a child, he would visit his grandfather in Hyderabad. There were trees all over the city. It was known for its gardens. He could walk, even in summer. Now a professor at the Administrative Staff College of India in Hyderabad, Mr. Bilolikar can't walk much. His city is hotter. There are fewer trees. Air-conditioners have proliferated but they spew hot air outside.

Mr. Bilolikar says it's hard to persuade policymakers, even the public, to take heat risk seriously. It's always been hot in Hyderabad. It's getting hotter slowly, almost indiscernibly. Heat, he says, is "a hidden problem."

At home, he had resolved not to use his air-conditioner. Through his open windows, though, his neighbor's machine blew hot air into his apartment. His three-year-old daughter became so overheated that her skin was hot to touch. Reluctantly, he shut his windows and turned his machines on. *Source:* Somini Sengupta, https://www.nytimes.com/2018/07/17/climate/india-heat-wave-summer.html?smtyp=cur&smid=tw-nytimes

Climate change is making urban animals smaller, new study finds

May 2018 — Climate change is affecting all the planet's inhabitants, but some changes are more unexpected than others. In a new study, researchers report that rising temperatures are accelerating animals' metabolism, which could end up making them smaller in the long run.

If you're dreaming of a vacation on an island, then I've got some good news: you're probably already on an island — a heat island, that is. Cities are much hotter than the surrounding rural and natural environment, sometimes by several degrees. To make matters even worse, not only are cities warmer than surrounding areas, but they also experience extensive fragmentation, which places a lot of stress on urban animals.

Our planet is urbanizing faster and faster, as more and more people move to cities. In turn, this puts more and more stress on urban animal communities. A team of researchers wanted to test whether the effects of this urbanization are changing the body size of animals. "Because higher ambient temperature increases metabolic rates and the associated costs for a given body size, global climatic warming is expected to drive shifts to communities consisting of smaller species," the study reads.

Essentially, hotter temperatures accelerate the animals' metabolism, and this drives them to become slightly smaller. This is not the first study to claim this — back in 2011, a different study also found that climate change is shrinking animals.

Thomas Merckx and colleagues studied individuals from more than 700 species and 10 different taxonomic groups, including butterflies and spiders, that lived along a gradient of habitats in northern Belgium. They analyzed both urban and non-urban environments, comparing the results.

Results showed that most of the time, this was what happened: urban creatures were slightly smaller, confirming Merckx's theory. However, this was not always the case. In three of the instances, urban creatures were actually larger, not smaller, and it's not clear why this is the case. It might have something to do with increased food resources available in urban areas.

However, researchers suggest another idea: bigger animals tend to be better at dispersing and finding new habitats. Because cities fragment habitats, being able to find new habitats efficiently is an important trait. Either way, the fact that cities are changing the size of animals is worrying and could have significant ecosystem consequences.

The White ermine Spilosoma lubricipeda. Macro-moth communities consist on average of larger, more mobile species in urbanized settings. *Source:* www.zmescience.com

"We thus demonstrate that the urban-heat-island effect and urban habitat fragmentation are associated with contrasting community-level shifts in body size that critically depend on the association between body size and dispersal. Because body size determines the structure and dynamics of ecological networks, such shifts may affect urban ecosystem function."

Researchers say that their study will be very relevant for future efforts which aim to understand, predict and mediate population resilience in urban ecosystems.

The study "Body-size shifts in aquatic and terrestrial urban communities" has been published in *Nature*.

Source: https://www.zmescience.com/science/news-science/climate-change-animals-smaller-23052018/

Similarity in the daily cycle of air temperature in a natural stone "city" and a human-made concrete city

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The city of Hong Kong and its urban cool island phenomenon

Hong Kong is known to be one of the most compact high-rise cities in the world. Its skyline is also one of the most well-known in the world as a tourist attraction. More than 10 years ago, the building environment laboratory at the University of Hong Kong examined the 24-hr surface temperature distribution of this city using an infrared camera (Yang and Li, 2009).

Figure 1 shows both a daytime and night time view of the city, different from those presented in Yang and Li (2009). As we viewed from the Kowloon shore of the Victoria Harbor to the northern shore of the Hong Kong Island, we saw a rather uniform surface temperature distribution along nearly all building heights in the daytime, while a strong thermal stratification was observed at night time. Two buildings are highlighted in the figure. The first is the International Finance Centre Tower 2 (known as 2IFC) to the right, with a height of 415 m. The second building is the Central Plaza with a height of 374 m. Hence we did not find anything particularly different from what we expected for this high-rise compact city, except that on the sunny side (viewed from the Victoria Peak), the surface temperature variation can be very significant and the buoyancy driven wall flows can be very important for city ventilation as discussed in Yang and Li (2009). However, interestingly, it seems from Figure 1 that the infrared images of the exterior temperature of the high-rise buildings offer a method for measuring the nocturnal boundary layer height in such a city, and thus a future study may be useful.

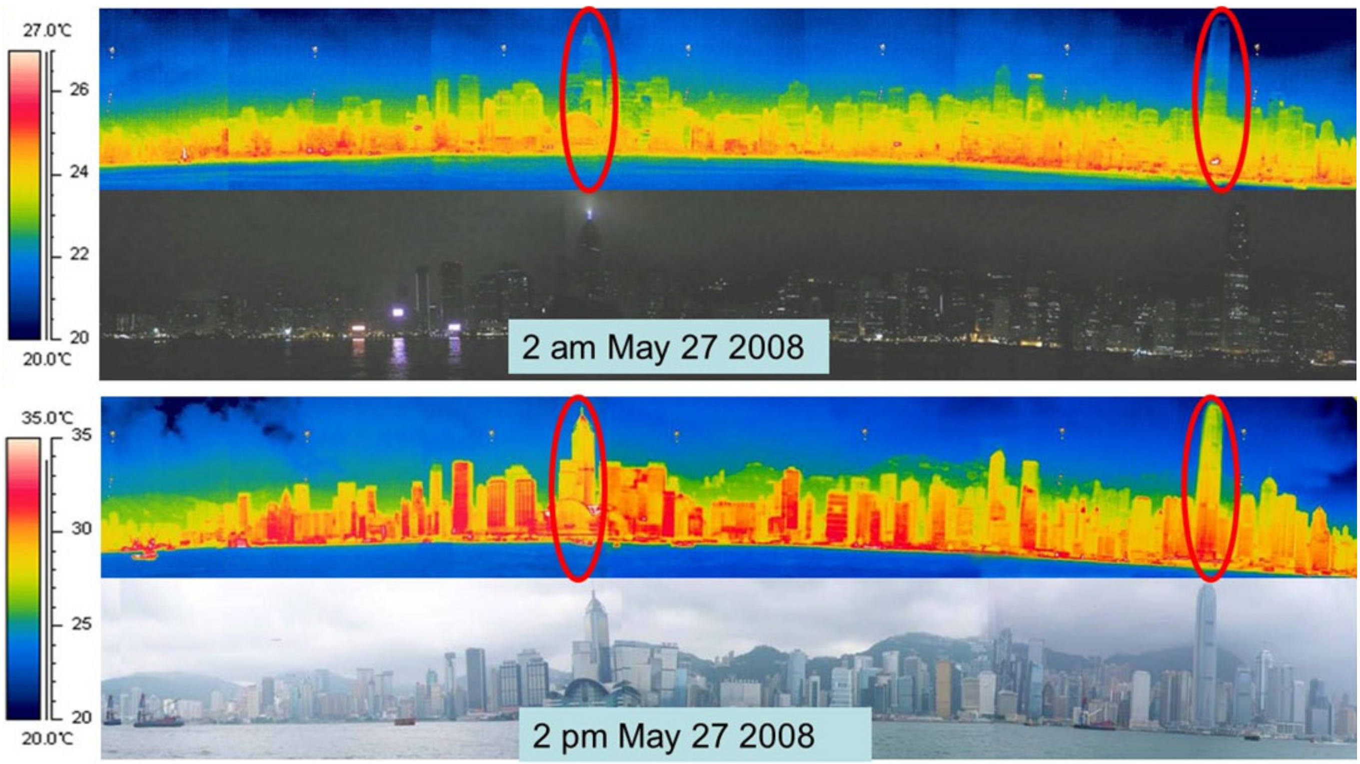

Figure 1. The skyline of the northern shore of the Hong Kong island as viewed by an infrared camera (the same camera used in the study reported by Yang and Li, 2009).

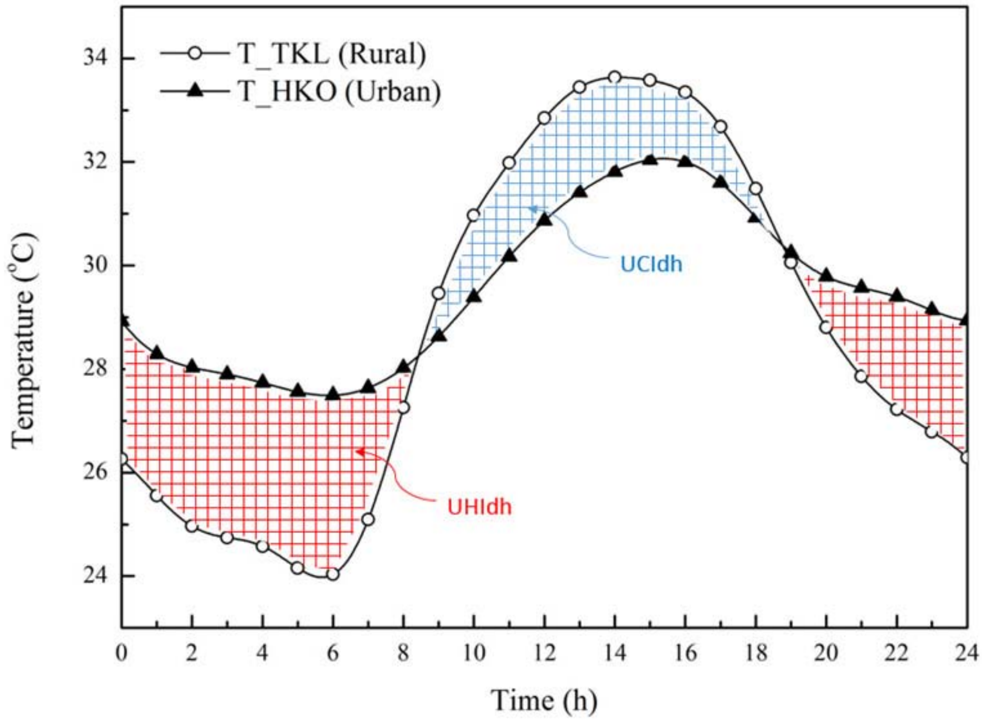

Figure 2. Comparison of the observed data of diurnal urban (weather station: HKO) and rural (weather station: TKL) air temperatures in Hong Kong from 1988 to 2014 to illustrate the definition of UCI degree hours and UHI degree hours. Details can be found in Yang et al, (2017).

Recently, we examined the daily temperature profiles at both an urban site and a rural site in Hong Kong, and found the urban cool island phenomenon was substantial in daytime in Hong Kong (Yang et al, 2017 and Figure 2). The urban heat island (UHI) phenomenon has been studied extensively in the literature, but there are relatively few reports on the UCI phenomenon. Based on a lumped urban air temperature model, our analyses in Yang et al (2017) suggest that when anthropogenic heat is small or absent, a high-rise and high-density city experiences a significant daytime UCI effect. This is explained by an intensified heat storage capacity and the reduced solar radiation gain of urban surfaces. However, if the anthropogenic heat in the urban area increases further, the UCI phenomenon still exists, yet UCIdh decrease dramatically in a high-rise compact city. The definition of the UCI degree hours (UCIdh) is shown in Figure 2. The concept of UCI degree hours and UHI degree hours (Yang et al., 2017) seems to be a useful quantification index for urban/rural temperature differences. In a low-rise and low-density city, the UCI phenomenon also occurs when there is no anthropogenic heat, but easily disappears when there is even a little anthropogenic heat, when the UHI phenomenon dominates. This probably explains why the UHI phenomenon is often observed in many cities around the world, but the UCI phenomenon is rarely observed.

Stone forest

Questions still remained if the hypothesis of the thermal storage induced urban cool island phenomenon in Yang et al (2017) was right. This led us to a field study in a "stone forest" in Yunnan Province in southwest China (Wikipedia, 2018). The Stone Forest (24.81°N, 103.32°E) is also a well-known tourist destination (Butler, 2018). In Chinese, the Stone Forest is called Shilin (石林). Different from the tourists, the researchers considered the stone forest as a suitable small-scale model for urban climate study. The stone forest is a collection of limestone outcrops that looks like a forest made of stones. The height of the limestone ranges from 10 to 30 m. These stones are thought to be thermally similar to buildings in cities as the thermal properties of the stones are very similar to those of the concrete of human-made structures in cities. The thermal environment in such a stone forest may thus be considered to simulate well that of cities. As a scenic area, the stone forest is protected and is only accessible for sightseeing, so it has little or no anthropogenic heat or air pollution. Basically, in nearly the same place, we were able to access four different typical urban morphologies and environment scenarios, i.e. high-rise compact, low-rise sparse, garden, and isolated single stone.

We first measured the thermal environment of the air – the air temperature and relative humidity – at 11

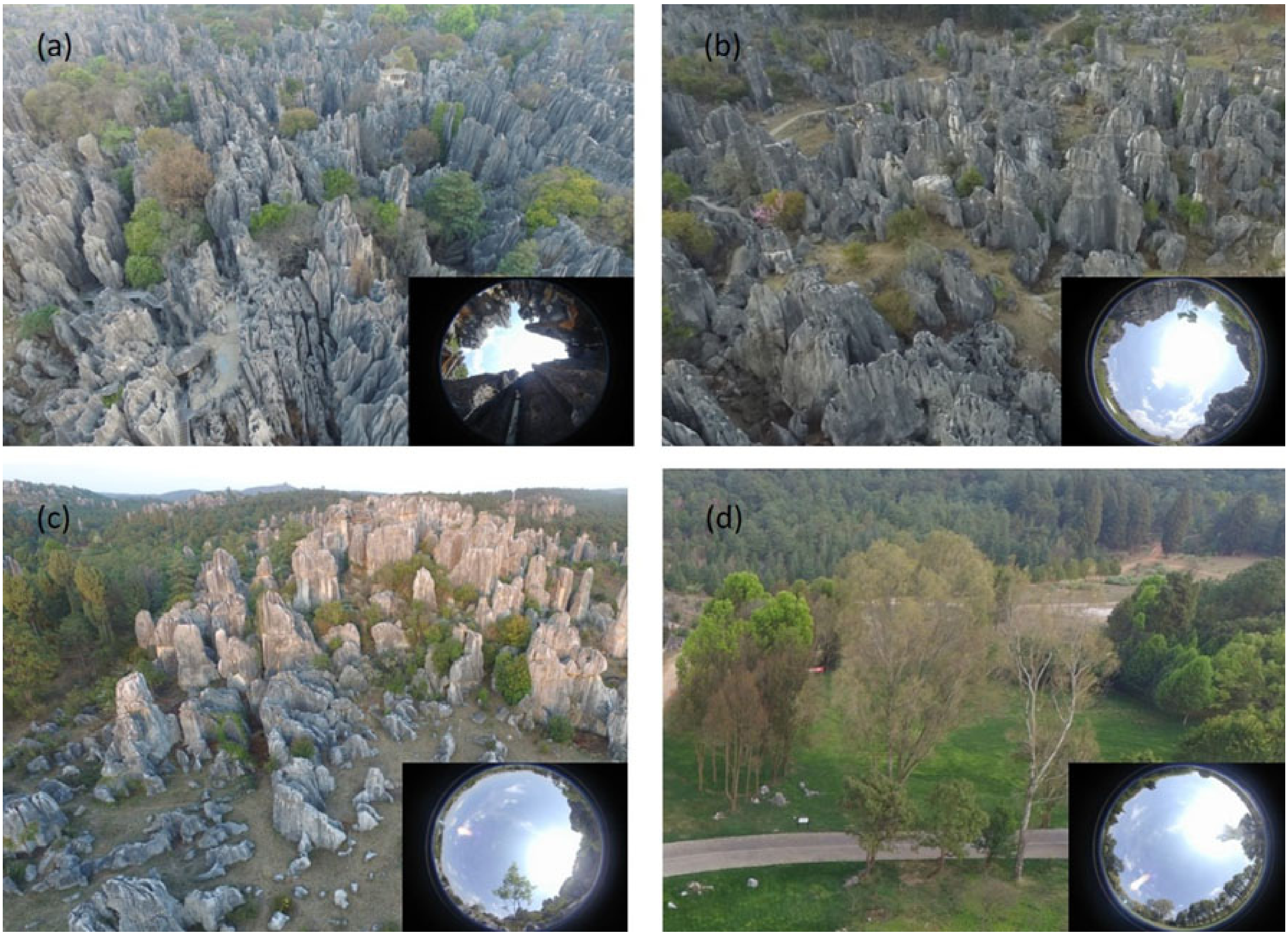

Figure 3. Aerial and fish-eye pictures of selected Stone Forest areas: (a) high-rise compact, (b) low-rise sparse, (c) garden, and (d) rural. A video of the Stone Forest that we took is also posted at https://youtu.be/takVQF7i-QQ.

observation locations in different stone forests (Figure 3) for 24 hours in nearly 1 year. A grassland just outside the stone forest area was also chosen as a remote site to represent rural areas; a weather station was installed to measure the background air temperature, wind conditions, and solar radiation. Another weather station was also installed in a relatively open area to measure the wind conditions and solar radiation inside the stone forest. The instruments were synchronized and operated at 30-min intervals.

The results in the daily temperature cycle of the high-rise compact stone forests are similar to observations in Hong Kong, as shown in Figure 4. What is interesting is that in the high-rise compact area in the stone forest, the daily temperature profile shows an urban cool island phenomenon; however, in a lower-rise sparse area (Figure 3b), the forest area has a higher air temperature for 24 hours than the corresponding "rural area". The similar daily cycle variation between the high-rise compact area of the Stone Forest and Hong Kong also suggests that the Stone Forest is a good field model for urban climate studies.

Co-existence of daytime cool and nighttime heat island

How to explain that the urban nighttime heat island and the urban daytime cool island can co-exist? This was explained by Wang et al (2017) using the data in Hong Kong. The daily temperature variations can be approximated as the mean temperature with daily and semi-daily harmonics. The daily maximum temperature and minimum temperatures are highly associated with mean temperature and the amplitudes, which are governed by different factors. The higher mean temperature in urban areas has been well documented in many studies. If there is no impact of storage, but only an increase in the mean temperature, the urban heat island intensity will be constant throughout the day. However, if the thermal storage effects exist, the amplitude of the 24-hr cycle of the urban air temperature will be reduced. Then the difference in daily maximum temperature will be much smaller than the difference in daily minimum temperature between the urban and rural area. This is the well-known asymmetry in the urban daily temperature cycle as discussed in Wang et al (2017). Further, if we have even more impact

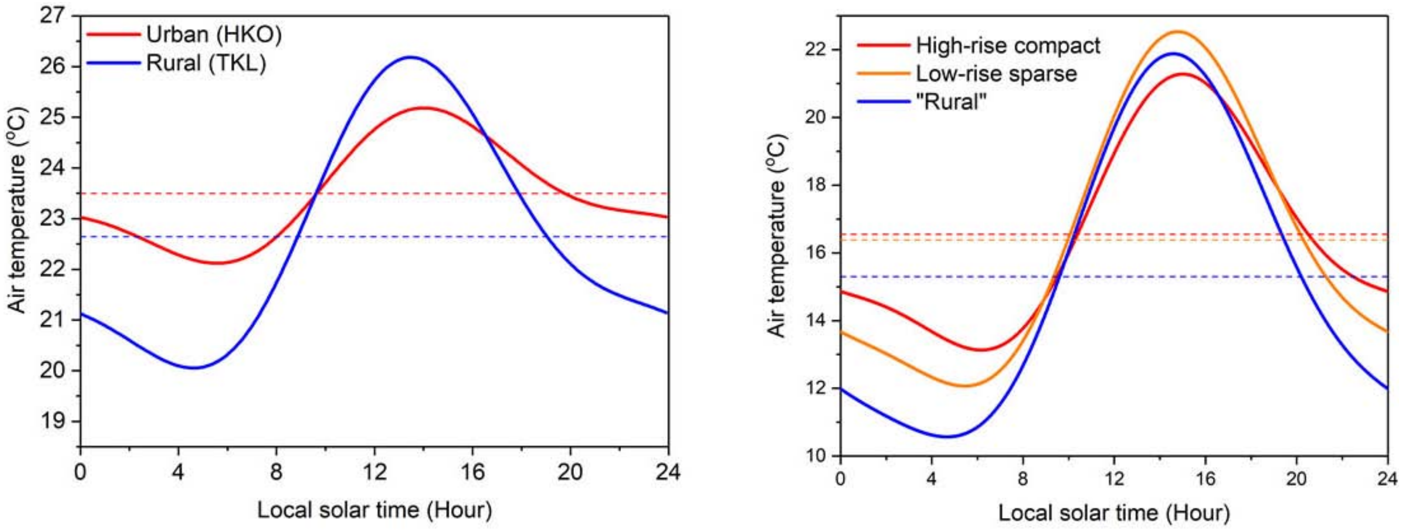

Figure 4. Comparison of the daily air temperature cycles between Hong Kong (left) and Stone Forest (right). The mean temperatures are shown by horizontal lines.

from the thermal storage part, and the reduction of the amplitudes exceed the increase in mean temperature, the daytime cool island appears.

Possible implications

The observed data in Hong Kong and the stone forest reveal the co-existence of UHI and UCI phenomena. This is very interesting from the urban climate control point of view. Urban morphology affects the urban albedo, wind penetration, and thermal storage and heat distribution. The different daily temperature profiles in high rise compact and low rise sparse stone forests suggest that urban morphology plays a dominant role in controlling the co-existence of the UHI and UCI phenomena. Urban morphology may be used to control the urban air temperature. Our studies call for attention to be paid to the potential approach for designing our urban thermal climate by optimizing the urban morphology.

Welcome to visit the natural stone city

In addition to the studies here, we also see the similarity of culture as people in both Hong Kong and the Stone Forest are very hospitable, so no wonder both places are known to be among the world's most popular tourist destinations. This explains how our researchers were able to access the measurement site with the support of a local researcher, Professor Li Yuhui and the friendly people who work in the Stone Forest. We are grateful for their support and kind understanding of the importance of the study. Zhao Puchu (1907-2000), a renowned Chinese calligrapher and a Buddhist, once wrote a poem about the Stone Forest: "高山为谷谷为陵, 三亿年前海底行; 可惜前人文罕记, 石林异境晚知名". The following is a nonprofessional English translation: *"Here, the high mountains turned into valleys, and valleys into hills. Who has ever imagined that they all swam on a seabed 300 million years ago? A pity that our ancestors seldom left any written records about it, and the Shilin wonder just became a sleeping beauty."*

The next time you happen to visit Hong Kong, a flight of 2 hr 40 min can take you to the natural stone "city" from Hong Kong, and you may experience the similar cool island phenomenon in both forests, and come up with fresh ideas about how we can design our human-made ones better.

Acknowledgement

Our work was funded by a RGC CRF project (HKU9/CRF/12G) of the Government of the Hong Kong SAR, China, and a grant awarded by the Key Laboratory of Eco Planning and Green Building, Tsinghua University, MOE, China. We are grateful to Prof Li Yuhui, Prof Lin Borong, and Dr PW Chan for their collaboration, and to Dr Yang Xinyan, Dr Luo Zhiwen and Dr Wang Yi for their contribution as can be seen from the co-author lists of the cited references.

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Rapid drop of surface temperature in urban terrain during rainfall: Physical representation and reduced models

This article summarizes the recently published paper: Omidvar, H., Song, J., Yang, J., Arwatz, G., Wang, Z.-H., Hultmark, M., et al. (2018). Rapid Modification of Urban Land Surface Temperature during Rainfall. Water Resources Research, 1–20. https://doi.org/10.1029/2017WR022241, and Hamidreza Omidvar's ongoing Ph.D. work at Princeton University.

Introduction

Various phenomena and processes in and over urban terrain are strongly influenced by earth surface temperature such as the urban heat island (UHI), surface energy budgets, and urban microclimatology (Stull, 1988). The importance of this parameter is more highlighted in extreme scenarios, e.g. where there is a rapid cooling in hot urban surfaces (which are hotter than those in rural areas due to the UHI) during rainfall (Ramamurthy & Bou-Zeid, 2014). This rapid cooling is due to a combination of runoff heat advection, evaporation, and infiltration processes. The abrupt change of surface temperature eventually affects atmospheric dynamics and stability, which can contribute to the development of rain-generating storms over urban terrain or downstream. In addition, the runoff carries a significant amount of heat pollution from hot urban surfaces to streams directly or via drainage networks, having adverse effects on the health and ecology of these streams (Krause et al., 2004; Nelson & Palmer, 2007). The aim of this study is to develop a modeling framework that helps us predict the temperature of pavement surfaces and runoff during rainfall as well as to describe the important physical basis of runoff-pavement heat transfer. Finally, using this full prognostic model, we introduce a zero-dimension (bulk) model that not only produces outputs which almost match the full model results, but also is very computationally efficient.

Model description

The runoff-pavement heat transfer model has two parts:

(i) A Runoff dynamics part, that solves for velocity and depth of the runoff during rainfall using the kinematic wave approach (Brutsaert, 2005; Parlange et al., 1983)

(ii) A Runoff-pavement heat budget part, that solves a heat diffusion-advection equation for runoff in conjunction with a 2D heat conduction (plus infiltration advection term in the case of pervious pavement) equation for pavement to obtain the solutions for the runoff and pavement temperature.

For the two interface boundary conditions, surface energy budget equations are solved, i.e. for the runoff-air interface the solved equation is $R_{lw}+LE+Q_r+H+Q_{wt}=0$, and for the runoff-pavement interface $R_{sw}+Q_{wb}+G=0$ is solved, where in these equations R_{sw} and R_{lw} are net shortwave and longwave radiation fluxes respectively; Q_{wb} is heat

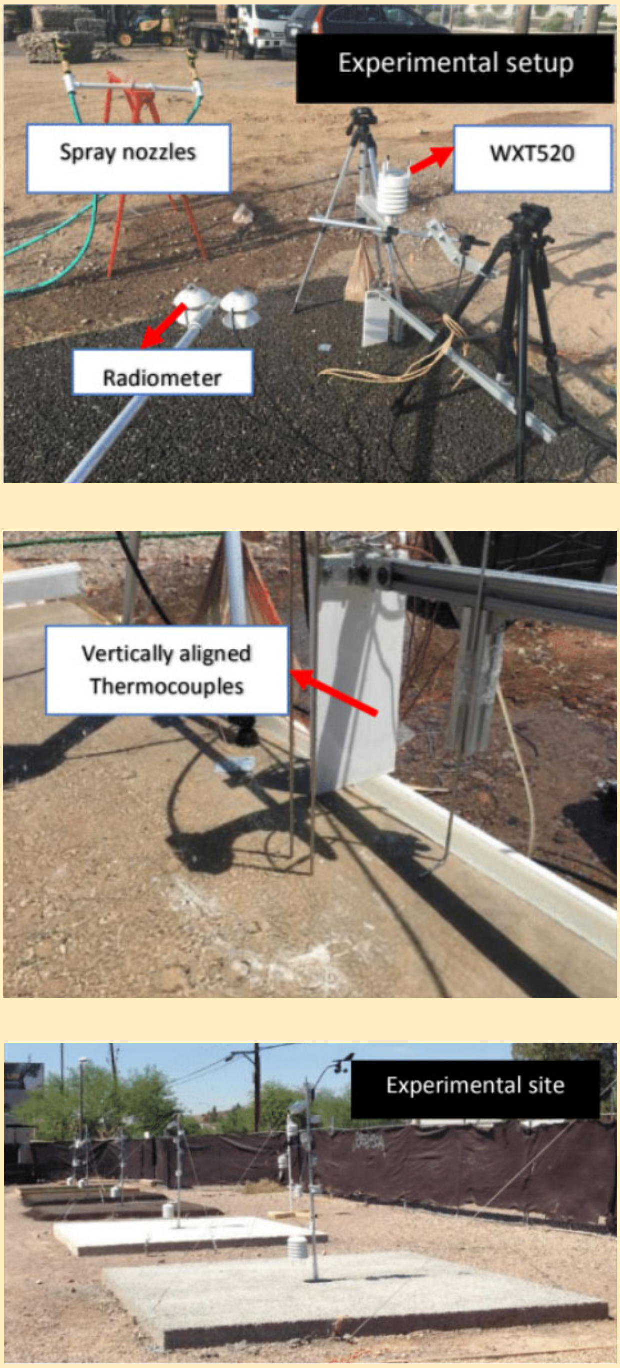

Figure 1. Experimental setup and site. Note that the setup in the photo of the experimental site (bottom) does not belong to the current study.

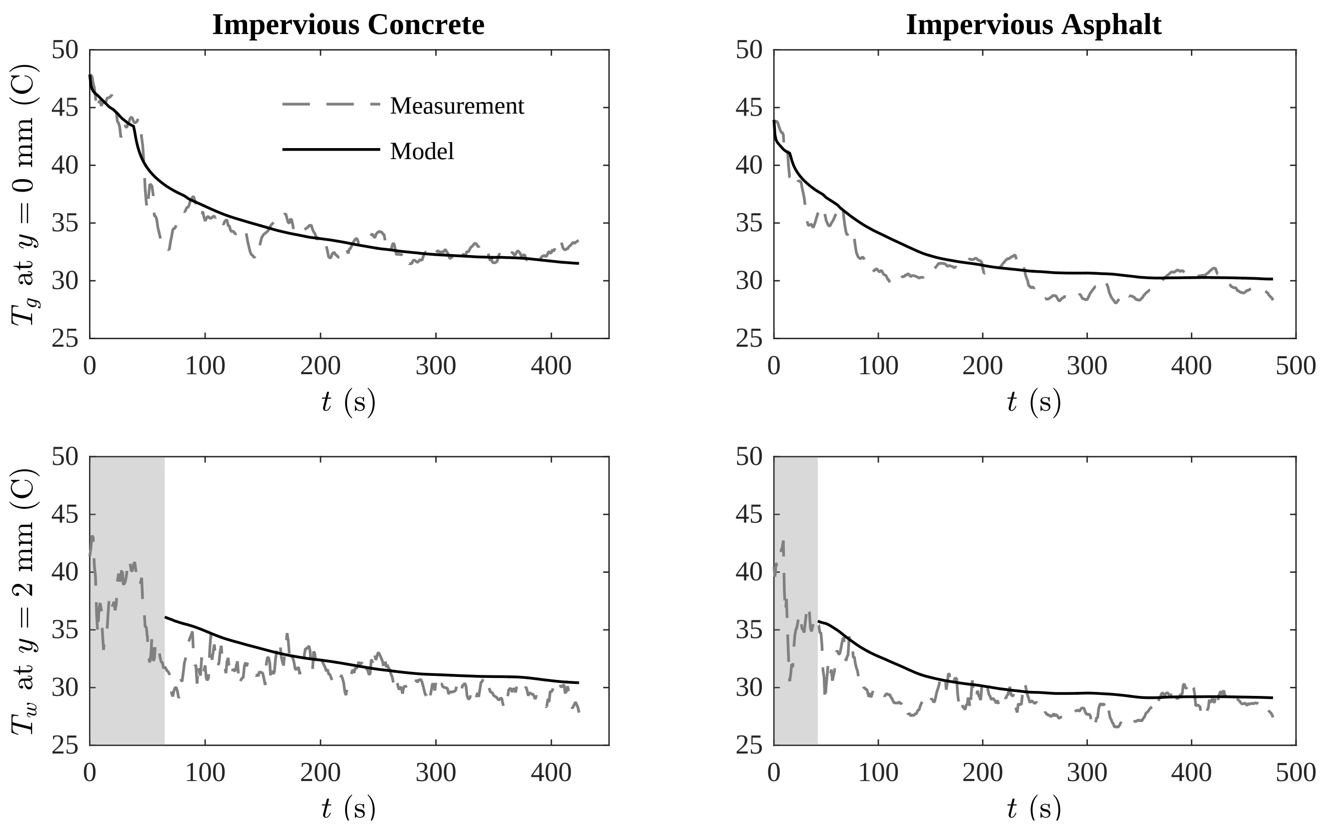

Figure 2. Comparison between measurement data and model results for horizontally-averaged ground surface temperature (top panel) and runoff temperature at 2 mm above the ground at pavement downstream (bottom panel) for two cases of impervious concrete (left panel) and asphalt (right panel). Note that the runoff temperature at 2 mm above the ground corresponds to the first thermocouple above the ground in the vertically aligned thermocouples setup (Figure 1). The shadowed regions in the bottom panels correspond to runoff depths less than 2 mm where the comparison between model results and measurement data is not valid.

exchange flux between runoff and the ground surface (bottom interface); *G* is ground heat flux; *LE* is latent heat flux; Q_r is net rain heat flux; *H* is sensible heat flux; and Q_{wt} is heat exchange flux between runoff and its surface (top interface). All terms are expressed in W m^{-2}. Among these energy terms, downwelling shortwave and longwave are the inputs of the model, and the rest are evaluated using simple models (more details in Omidvar et al. (2018)). All the equations explained above are solved numerically using finite difference schemes.

Experimental campaign and model validation

The model described in the previous section was validated using data from a set of experimental campaigns at a site near Arizona State University campus (Coordinates: 33°26'24.8"N, 111°55'25.8"W). Figure 1 shows the experimental site with different pavement types, and an example of experimental setup and sensors. The experiments were conducted over different kinds of pavements (pervious and impervious asphalt and concrete) under artificial rain using spray nozzles. To measure different parameters and variables in the problem, we used various novel sensors such as four-component radiometers for measuring radiation, multiple thermocouples for measuring temperature inside the runoff as well as pavement surface, and a Vaisala weather transmitter for air properties.

Figure 2 shows the time series of ground surface (T_g) and runoff temperature (T_w) during rainfall for both the model and experiments for two cases of impervious asphalt and concrete. As one can see, the model results and experiment data are in good agreement. A good agreement was also seen when comparing the results of the model and experiment data for pervious pavements (results are not shown here).

Sensitivity analysis and reduced model

Using the validated model, we conducted a set of sensitivity analyses of the model to different pavement and rain properties to identify the important parameters that modulate the heat transfer between the runoff and pavement. Below is a list of key points from these sensitivity analysis tests:

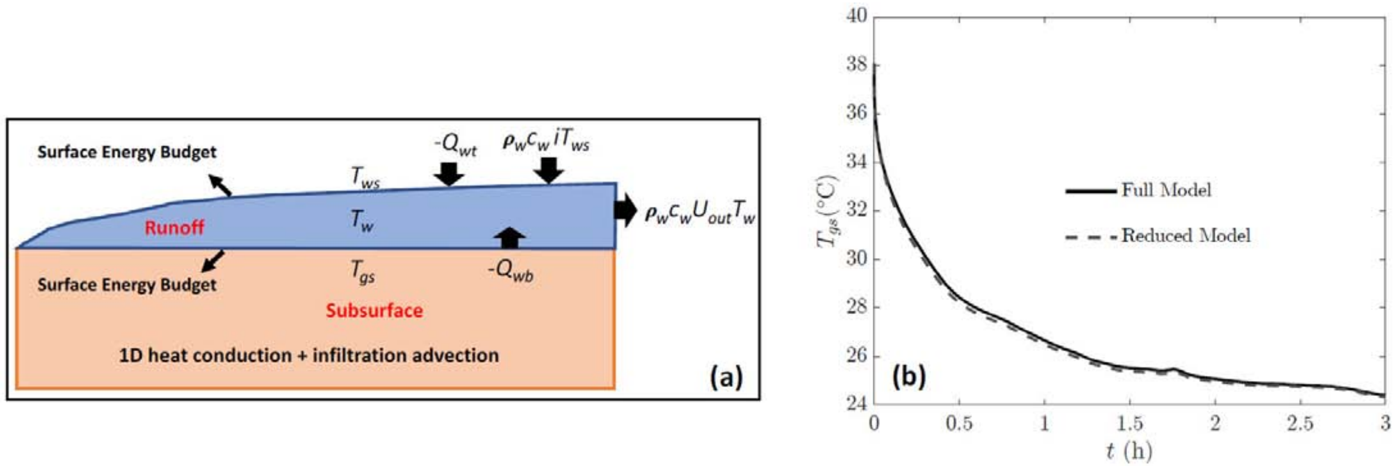

Figure 3. Schematic of bulk energy model (a), and the comparison between full and reduced models for time series of horizontally averaged ground surface temperature (b).

1. The model is most sensitive to the rain temperature and pavement albedo; therefore, when specifying these two parameters as inputs of the model, a more careful consideration is needed. While it is less challenging to specify surface albedo in urban areas due to availability of data sets that document material properties in cities (Mills et al., 2015), evaluating rain temperature is still a challenging task that needs more research attention.

2. Pavement properties such as heat effusivity or albedo mostly modulate the initial temperature of pavement surface (and subsurface) before rain starts that consequently this temperature modification propagates to during and after rainfall period.

3. The model sensitivity to the pavement length and slope is very week, suggesting the horizontal thermal equilibrium of the runoff and pavement during rainfall.

In addition to the third key point above, we also found out that the vertical temperature gradient inside the runoff can also be very small – especially when runoff depth is small, which is the case for most of real rainfall events. This leads us to follow the idea of the bulk energy method for the runoff, in order to reduce the complexity of the full model.

Figure 3a shows the schematic of this bulk model. In this method, we use 3 averaged temperature points: (1) averaged runoff temperature (T_w), (2) averaged ground surface temperature (T_{gs}), and (3) averaged runoff surface temperature (T_{ws}). For the interface boundary conditions, we solve surface energy budget equations similar to the full model but using just one temperature point for each interface. Inside the subsurface, a 1D heat conduction (plus the infiltration term for pervious pavements) equation is solved. Finally, for the runoff, we solve the bulk energy equation:

$$\rho_w c_w \frac{d(hT_w)}{dt} = -Q_{wb} - Q_{wt} + \rho_w c_w i T_{ws} - \rho_w c_w U_{out} T_w$$

meaning that the rate of change in the total runoff heat content (left hand side of the equation) is equal to the sum of all energy terms entering and leaving the runoff (right hand side of the equation). In this equation, ρ_w is the density of water; c_w is specific heat capacity of water; h is the averaged runoff depth; i is the rain intensity; and U_{out} is the effluent-averaged velocity of runoff downstream. Figure 3b shows the time series of averaged ground surface temperature for both full and bulk (simple) models in a case of 3 hours rainfall (for more details about the rainfall data used here refer to Omidvar et al. (2018)). As can be noted, the simple model predicts the ground surface temperature fairly close to the full model. A similar conclusion is obtained when comparing the time series of averaged runoff temperature and surface energy budget terms for the full and bulk model (results are not shown here).

Summary and discussion

In this study, we developed and validated a prognostic model for the runoff-pavement heat transfer during rainfall by combining runoff dynamics with runoff and pavement heat budgets. With this model, we are able to determine dominant physical processes inside the runoff and pavement, and identify crucial hygro-thermal pavement properties in the cooling process of urban pavements during rainfall. In addition, we proposed a reduced version of the full model that uses averaged temperature values and solves a bulk energy equation for the runoff. The outputs of the reduced model are almost matched to the full model, indicating that this simple model takes into account most important physical processes in the runoff and pavement while it needs less computational resources than the full version. Currently, coarse geophysical models, e.g. Weather Research and Forecasting or Urban Canopy models (Li & Bou-Zeid, 2014; Wang et al., 2013), do not consider the rapid drop in the earth surface temperature during rainfall, especially in urban areas where this temperature drop can be significant due to the existence of hotter pavements (because of the UHI) before the rain starts. The reduced pavement-runoff heat transfer model that we discussed here is computationally efficient enough to be a suitable candidate for implementing in large-scale weather and climate models in order to study the effect of rapidly cooling pavement during rainfall on large-scale atmospheric motions and dynamics.

Acknowledgments

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10th International Conference on Urban Climate rises to the challenge of "sustainable and resilient" cities

It has been nearly half a millennium since a European explorer named Giovanni da Verrazzano sailed up the Atlantic coast of North America and made an unprecedented stop in New York harbor, and it has been just over half a decade since a superstorm named Sandy did the same. In the wake of Verrazzano's landfall, millions of immigrants would eventually flood to New York and ultimately change the very definition of a city – and in the wake of Sandy, lessons would be learned that are already changing the very definition of a city's relationship with climate.

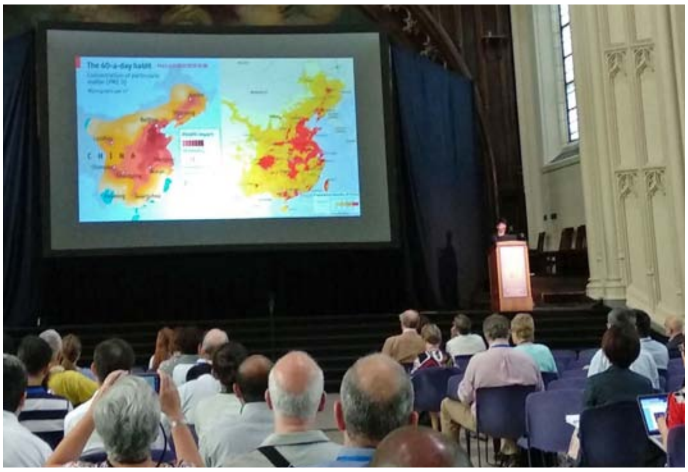
"Hurricane Sandy was the worst natural disaster ever to strike New York City," the mayor's Chief Resiliency Officer **Daniel Zarilli** recently said, "and it forced us to directly address the future impacts of climate change. We must now consider not only flooding but other effects of sea-level rise, and urban heat, which is the largest killer of all. By institutionalizing climate resiliency, the city of New York is becoming a model for how science can inform climate change adaptation as well as mitigation."

Zarilli was addressing a diverse group of newcomers from around the world who had gathered in New York City for the opening session of **ICUC10 – the 10th International Conference on Urban Climate**, held in conjunction with the 14th Symposium on the Urban Environment on August 6-10 at the City College of New York. His remarks followed those of conference organizers **Jorge Gonzales**, **Dev Niyogi** and **Prathap Ramamurthy**, along with outgoing IAUC President **Jamie Voogt**, all of whom touched on the Conference theme of "Sustainable and Resilient Urban Environments."

Plenary Speakers

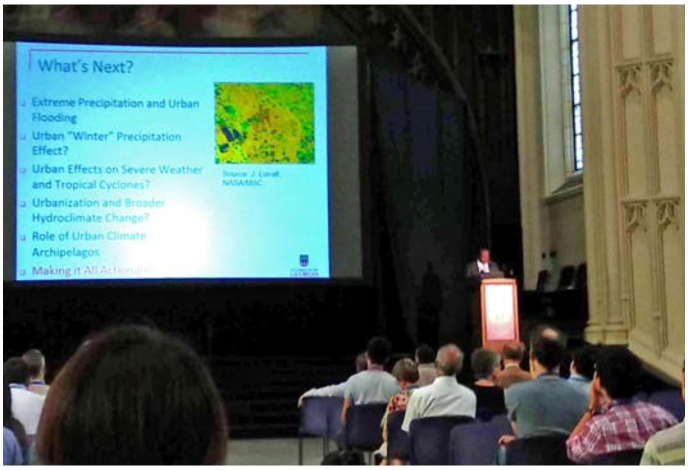
This theme was elaborated by a series of five plenary speakers who offered a range of perspectives on the conceptual shift from sustainability to resiliency, and stimulated the urban climate community to consider how its work can contribute not only in mitigating the negative impacts of climate change in cities, but also in adapting to an altered future reality – in which storms, heat waves and other extreme events are likely to increase in both their magnitude and frequency.

Cynthia Rosenzweig, who heads the Climate Impacts Group at the NASA Goddard Institute for Space Studies, led off by describing the record heat levels and accompanying environmental stresses which cities are facing and the importance of developing climate risk information as the basis for building climate resiliency into future urban planning. The New York City Panel on Climate Change, convened in 2008 and again in 2015, has codified in local law that city government must provide such information as part of its climate protection initiative, which since Sandy has a central focus on resiliency. As part of the effort to promote science-based policy, resiliency design guidelines and climate projections have been published and closer cooperation is being urged between the Urban Climate Change Research Network (UCCRN) and organizations like the IAUC – as well as with the WMO and the IPCC, which according to Rosenzweig is "finally waking up to the critical role of cities in climate change."



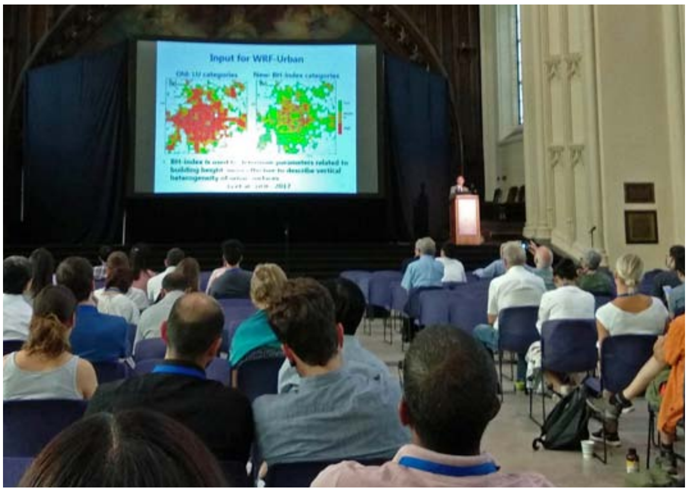
The second plenary address was given by **Chao Ren** of the University of Hong Kong, on Urban Climate Science for Planning Healthy Cities in Asia. She shared a wealth of practical experience in urban climate consultancy for planners and decision-makers in high-density Asian cities, including China's new National Technical Guide on 'Urban Climatic Considerations in City Master Planning' which focuses on measures such as urban ventilation corridors, urban greenery and the thermal environment, and rainwater management through "sponge city" development.

Urban precipitation was also the focus of **J. Marshall Shepherd** of the University of Georgia, who asked the audience to go beyond the question, "Does Urbanization Affect Precipitation?" His discussion pivoted toward the future of urban hydrometeorological studies, and the formulation of key questions regarding the relative the impact of urbanization on large-scale weather systems, severe weather, frozen precipitation, landfalling hurricanes and land surface hydrology. Through a series of cutting edge projects, he described some of the emerging research that is on the of urban climatology, together with its associated challenges and opportunities.



Alan F. Blumberg of Jupiter Technology Systems in Hoboken, NJ brought urban precipitation into a tangible and local context, drawing on operational results from the New York Harbor Observing and Prediction System (NYHOPS) to illustrate how the impacts of increasingly erratic weather on coastal cities can be quickly and accurately predicted. He sees the "urban ocean" as a new frontier, with climate change making it more crucial than ever to understand the breadth of dynamical processes that influence near-coastal ocean circulation and to answer questions about how property owners and communities can thrive in the face of extreme weather events and rising sea levels.

The final plenary speaker was **Shiguang Miao** from the Institute of Urban Meteorology at China's Meteorological Administration in Beijing. Miao reported on the SURF Project, whose objective is to provide a better understanding of urban terrain, convection, and aerosol interactions for improved forecast accuracy. While Beijing was presented as a test case, these improved understandings are transferable to many large cities globally and in fact the SURF Project explicitly aims to promote cooperative international research that can enhance urban weather forecasts for a host of societal applications, including those related to health, energy, hydrology, climate change, air quality, urban planning, and emergency-response management.



Scientific Sessions

Over the five days of the conference more than 60 scientific sessions were held, with some 400 oral presentations devoted to issues ranging from the highly technical to the broadly social – and all relating to the dynamics of cities and their climates.

Series of multiple sessions proceeded along common thematic lines, with:

• a total of ten sessions each on *Urban Climate Processes and Urban Design and Planning with Climate*,

• eight sessions on *Numerical Studies of Urban Environments*,

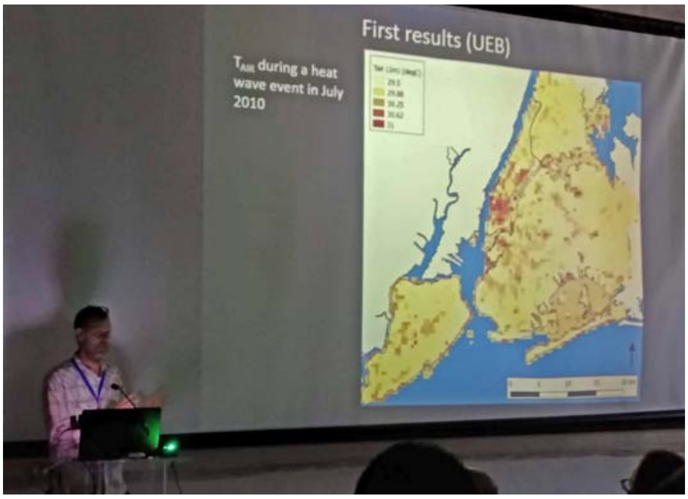
• six sessions on urban *Biometeorology*,

• four sessions each on *Climate Change Adaptation & Mitigation in Urban Environments*, *New Observational Techniques to Study Urban Climate* and *Urban Remote Sensing*,

• three sessions each on *Extreme Weather in Cities and Megacity Climate*,

• two each on *Urban Hydrology* and *Quantification of Urban Greenhouse Gas Emissions*, and

• one on *Urban Governance*.



In addition, a number of special sessions were initiated to highlight particularly timely or noteworthy subjects:

• two of these looked at *Vulnerability, Adaptation, and Exposure to Extreme Heat*,

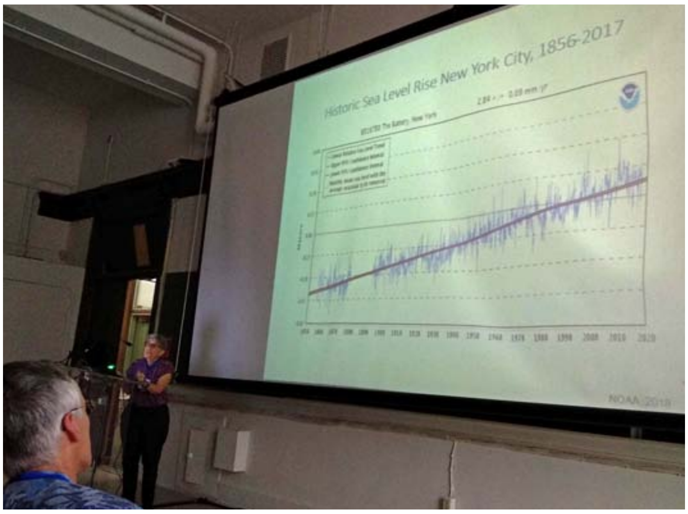
• two were on the emerging field of *Crowdsourcing*,

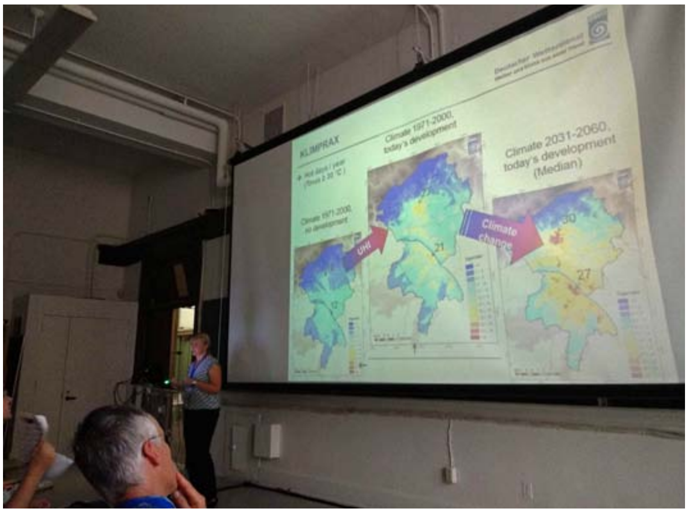
• two focused on the community-initiated *WUDAPT* project (see p. 20), and

• a final special session was devoted to the *Lifetime Career of Jason Ching* (see p. 23).

Along with all of these oral presentations, two sessions were organized for the formal viewing of posters, which themselves covered a vast array of urban climate initiatives and described ongoing work from around the world.

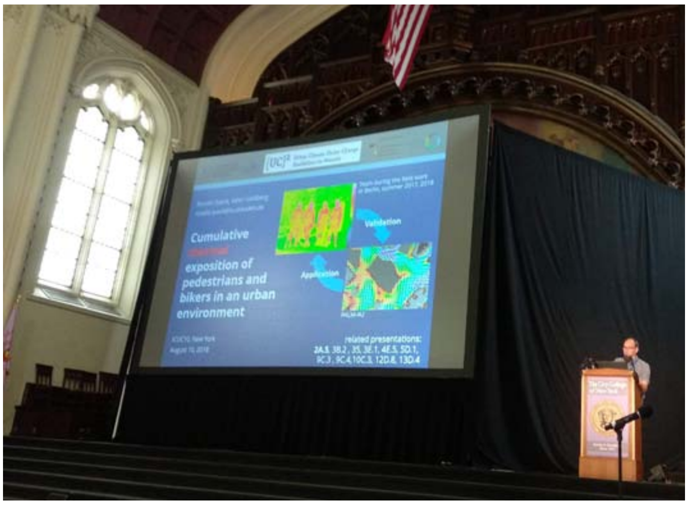
Abstracts of the scientific presentations at ICUC10/SUE14 are available online through the AMS-sponsored MeetingApp, at https://ams.confex.com/ams/ICUC10/meetingapp.cgi/.


Historic Sea Level Rise New York City, 1856-2017
NOAA 2018

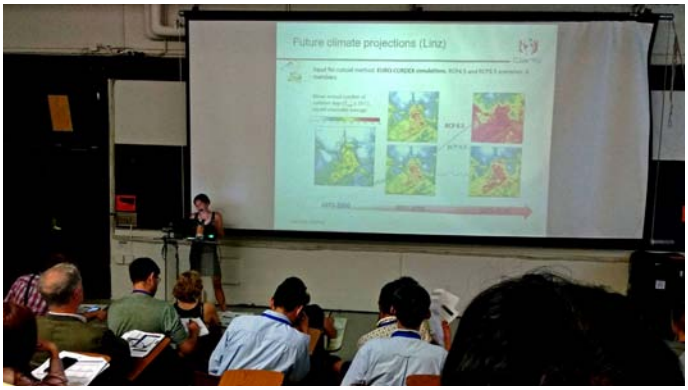

KLIMPRAX
Climate 1971-2000, today's development
Climate 2031-2060, today's development (Median)
Climate change
UHI


Mean radiant temperature


Study area


Cumulative
exposition of pedestrians and bikers in an urban environment
Validation
Application


Motivation
Climate Change
Cyberattacks
Urbanization
Deregulation
Aging infrastructure
Renewable energy
ASU


Future climate projections (Linz)

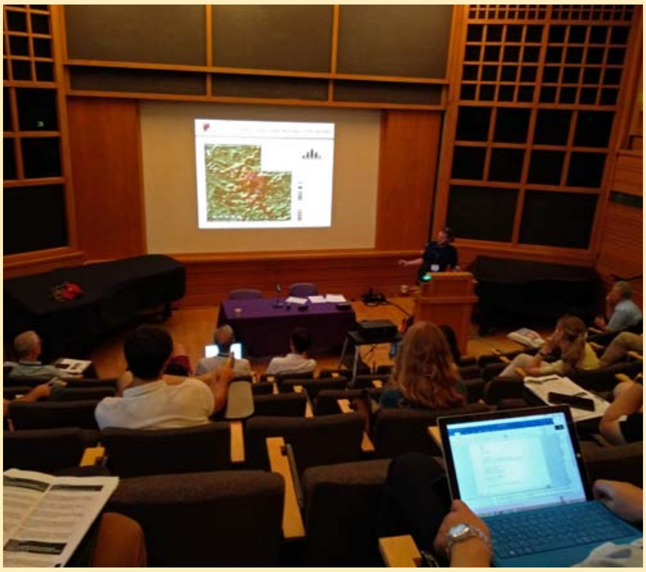

Challenges

Special Session on World Urban Database and Access Portal Tools (WUDAPT)

The World Urban Database and Access Portal Tools (WUDAPT) project was envisaged as an urban climate community initiative to gather, store and disseminate data on cities that could be used to support climate research. The acquisition of data was structured in a hierarchically framework recognising the great variation in available urban data that was consistent in content and scale. The lowest level of data (L0) is the production of Local Climate Zone (LCZ) maps for selected urban areas using a protocol that relies on freely available satellite data, user derived training areas and classification software. The protocol for developing these LCZ maps is now well developed and results in a series of landscape descriptors (urban canopy parameters) that may be linked to a variety of models. Higher levels of data (L1 & L2) are designed to capture information on the basic urban elements (most especially buildings; that is, dimensions, materials, functions, etc.) either through observation or simulation, by sampling or complete survey.

The basic structure of the project was established in 2012 after ICUC8 in Dublin and confirmed at a subsequent workshop. At ICUC9 in Toulouse a special session presented the WUDAPT concept to a large audience. So, ICUC10 is the first opportunity to assess its impact and development. A measure of its success to this point is the number of presentations in New York that invoked the WUDAPT approach as a part of their research. Formally, there was a poster session with 16 presentations, and there were two oral sessions with 11 presentations (see Table, next page).

Most of the work presented utilised the LCZ mapping approach developed in WUDAPT to set the context for the research or to generate parameter values to run models. The sessions showed the global extent of WUDAPT research that included Singapore, Sao Paulo, Kampala, San Francisco, etc. For example, **Oscar Brousse** and **Andrea Zonata** presented on deriving canopy parameters for models and **Alessandra Rodrigues Prata Shimomura** stressed the importance of understanding natural landscapes and their seasonal changes in detecting the urban landscape from Landsat imagery. Others (**Guillaume Dumas**) focussed on evaluating the quality of LCZ derived data and the potential for examining landscape change in fast growing cities and its impact on the local climate (e.g. **Ran Wang**'s work on the Pearl River Delta region). One of the advantages of adopting a common methodology is the ability of the audience to immediately recognising the landscapes types in different cities – as such the project has succeeded in improving communication between researchers.



Benjamin Bechtel relates WUDAPT L0 data to remotely sensed surface urban heat island cover.

However, there were also significant advances presented in the development of WUDAPT itself:

- **Iain Stewart**, who along with **Tim Oke** developed the LCZ scheme introduced a simple means of incorporating topographic variations into its application for urban heat island studies.
- **Jason Ching** discussed the potential for generating UCP data at higher levels using various approaches, including computer simulations of entire urban landscapes.
- **Valéry Masson** presented on the use of building typologies to gather information on the fundamental elements of cities.
- **Benjamin Bechtel** related the WUDAPT L0 data to global urban heat island cover as derived from satellite data.
- **Matthias Demuzere** gave an intriguing talk on the potential for generating a global LCZ map using GoogleEarth. Such information would provide support for developing climate change modelling initiatives and for considering adaptation responses.

— *Gerald Mills, University College Dublin*

Special Session on World Urban Database and Access Portal Tools (WUDAPT)

Cochairs: Gerald Mills, School of Geography, Univ. College Dublin, Dublin, Ireland; Jason Ching, Institute for the Environment/CEMPD, Univ. of North Carolina, Chapel Hill, NC and Linda See, IIASA, Laxenburg, Austria

Speaker and co-authors	Topic
Iain Stewart, Institute of Global Cities, University of Toronto	Developing a Field Guide to Identify Local Climate Zones in Cities
Oscar Brousse, KU Leuven, Leuven, Belgium; and H. Wouters, M. Demuzere, W. Thiery, J. Van de Walle, and N. P. M. van Lipzig	Urban Climate Modelling using Local Climate Zones in Data Scarce Area. The Case of Kampala, Uganda
Jason Ching, Univ. of North Carolina, Chapel Hill, NC; and L. See, C. Ren, V. Masson, G. Mills, M. Neophytou, M. F. WONG, A. Middel, M. Bonhomme, J. Feddema, and L. Ferreira	Characterizing and Generating WUDAPT Level 1 UCP Data
Valéry Masson, Meteo-France/CNRS, Toulouse, France; and M. Bonhomme, J. Hidalgo, N. Tornay, S. Faraut, R. Schoetter, L. See, D. Duarte, L. S. Ferreira, J. Ching, and G. Mills	Using Architectural Archetypes and Crowdsourcing to Collect More Detailed Information for WUDAPT
Julia Hidalgo, CNRS, Toulouse, France; and G. Dumas, V. Masson, G. Petit, B. Bechtel, E. Bocher, M. Foley, R. Schoetter, and G. Mills	Comparison between Local Climate Zones Maps Derived from Administrative Datasets and Satellite Observations
Alessandra Rodrigues Prata Shimomura, and A. T. Ferreira	Local Climate Zone Classification Adapted for Mapping Agricultural Areas in Metropolitan Areas
Helge Simon, Johannes Gutenberg Univ. Mainz, Mainz, Germany; and T. Kropp, F. Sohni, and M. Bruse	Development of a New Portal Tool for WUDAPT: Simulation of WUDAPT Local Climate Zone Classifications Using the Microclimate Model ENVI-Met
Ariane Middel, Temple Univ., Philadelphia, PA; and J. Lukasczyk, S. Krayenhoff, and R. Maciejewski	Level 1 UCP Data from Google Street View and Applications in Biometeorology
Benjamin Bechtel, Univ. of Hamburg, Hamburg, Germany; and C. Small, M. Demuzere, P. Sismanidis, and J. A. Voogt	Climatological Surface Urban Heat Island By Local Climate Zones (WUDAPT level 0)
Matthias Demuzere, Ghent Univ., Gent, Belgium; and B. Bechtel, N. Gorelick, R. Chao, E. Ng, G. Mills, and J. Ching	Towards a Global LCZ Map?
Ran Wang, Chinese Univ. of Hong Kong, Shatin, Hong Kong; and M. Cai, C. Ren, Y. Xu, Y. Shi, and K. K. L. Lau	Investigating Surface Heat Island in the Pearl River Delta Region and Its Relationship with the Local Land Cover Change from the 1990s to the 2010s
Andrea Zonato, Univ. of Trento, Trento, Italy; and A. Martilli, S. Di Sabatino, L. Giovannini, D. Zardi, and G. Pappaccogli	Evaluating the Performance of a Novel WUDAPT Averaging Technique to Define Urban Morphology with Mesoscale Models

Special Poster Session on World Urban Database and Access Portal Tools (WUDAPT)	
Authors	**Topic**
Agnese Salvati, M. Palme and F. De La Barrera	Urban Morphology Parameterization for Climate Modelling in Urban Planning
Luciana Schwandner Ferreira and D. Duarte	Land Surface Temperature, Vegetation Cover and Urban Morphology over Different Local Climate Zones in São Paulo Metropolitan Region
Narein Perera, and R. Emmanuel	Lessons from a Country-Wide Application of World Urban Database and Access Portal Tools (WUDAPT) Protocols: The Case of Sri Lanka
Muhammad Omer Mughal, X. Li, T. Yin, A. Martilli, M. A. Dissegna, and L. K. Norford	Incorporating Remote Sensing Data into WRF to Improve Urban Climate Modeling: A Case Study in Singapore
Tamás Gál, N. Skarbit, G. Molnár, and A. Z. Gyongyosi	Weather and Climate Modeling Possibilities Using Local Climate Zone Concept and Observation Network in Szeged, Hungary
Natasha Picone	Combining Models of Urbanization and Climate Change Scenarios to Improve the Environmental Urban Footprints Tandil City, Argentina
Xilin Zhou, Tohoku Univ., Sendai, Japan; and T. Okaze, C. Ren, M. Cai, M. Kasai, Y. Ishida, and A. Mochida	Mapping Local Climate Zones for Japanese Ordinance-Designated Cities Based on Urban Morphology Detection: A Case Study of Sendai
Xinwei Li, Chinese Univ. of Hong Kong, Institute of Future Cities, Hong Kong, Hong Kong; and C. Ren, R. D. Bornstein, and H. Fraker	Land Surface Temperature Analysis by using Local Climate Zone - Case Studies for San Francisco Bay Area Cities
Xuemei Wang, AER, Guangzhou, China; and J. Dai	Evaluating the Influence of Urban Canopy Parameters on Meteorological Condition and Surface Ozone
Xiaoshan Yang, Nanjing Tech Univ., Nanjing, China; and L. Yao, T. Jin, Z. Jiang, and L. L. H. Peng	Assessing the Thermal Behavior of Different 'Local Climate Zones' in Nanjing, China
Pak Shing Yeung, Hong Kong Univ. of Science and Technology, Hong Kong, Hong Kong; and J. C. H. Fung, M. F. WONG, and R. Chao	Refinement of Roughness Length Value for the Weather Research and Forecast (WRF) Model based on the understanding of Local Climate Zone
Thibaut Vairet, ThéMA, Dijon, France; and Y. Richard, T. Thevenin, B. Pohl, J. Pergaud, J. Emery, J. Dudek, and C. Lac	Comparison between Simulation, in Situ Network and Local Climate Zone for Urban Climate Study. a Case Study for a Medium-Sized European City: Dijon, France
Michael Mau Fung Wong, Hong Kong Univ. of Science and Technology, Hong Kong, Hong Kong; and J. C. H. Fung, J. Ching, P. S. Yeung, W. P. Tse, C. Ren, and R. Wang	Evaluation of the uWRF Performance in Hong Kong with UCPs Derived Based on WUDAPT/NUDAPT Dataset and the Guidance for Implementation
Petros Mouzourides, Univ. of Cyprus, Nicosia, Cyprus; and A. Eleftheriou, M. K. A. Neophytou, J. Ching, and A. Kyprianou	Establishing a Communication Channel between Geographic-Based Information and Gridded Climate Model Parameters for WUDAPT

Special Session for Jason Ching's lifetime career

At ICUC10 a special session was held to recognise the contribution of **Jason Ching** to the field of urban climate science. Coincidently, ICUC10 took place 50 years after his first publication in the scientific literature; this paper spoke about the application of boundary layer theory to non-uniform surfaces, a constant theme in his subsequent work: *It is not difficult to model the eddy viscosity to give a much better description of the conditions near the surface. However, the generalization to nonuniform horizontal conditions will require considerably more effort and imagination. It is along these lines that future work will be directed with continued emphasis on the large-scale synoptic changes and their effects on the planetary boundary layer.*[1]

The session began with an overview of Jason's career (**Mills**) and the following presentations reflected aspects of Jason's career including his contribution to the study of air quality (**Baklanov**), the development of models (**Niyogi**) and of observational programmes (**Grimmond**) and the application of scientific evidence (**Ng**). The focus of this session was on Jason's *urban* work, which meant that his contributions to atmospheric processes and air quality more generally were not given the attention they richly deserve. However, the session captured the essence of his citizenship including: his natural inquisitiveness, his fundamental belief in scientific method and progress, and the value of building scientific communities where knowledge is shared. What characterised the presentations were personal accounts of Jason's work and the influence it had on their intellectual curiosity and development of others.

Jason began his meteorological education at the University of Hawaii (BS in 1962) before continuing to Penn State University (MS in 1964) and finally to the University of Washington (PhD in 1974). He joined the US EPA in the mid-1970's and was part of some of the most important air quality (AQ) field experiments at that time that examined the physics and chemistry of the atmospheric boundary layer. During his 30 year career at the EPA he worked on some of the most significant atmospheric projects of the 20th century, as legislation on air quality directed scientific enquiry from observation and discovery (e.g. the Regional Air Pollution Study - RAPS) to understanding and modelling (e.g. The Community Multiscale Air Quality Modeling System - CMAQ). The former produced some seminal papers in urban climate science, including work on turbulence[2] and on the substrate heat flux[3]. The latter corresponded with paradigmatic shifts in thinking on multi-purpose models[4] that included atmospheric chemistry and deposition[5], dealing with multi-scale processes[6], sub-grid variability[7] and descriptions of the urban landscape[8]. Jason continues to make significant contributions to the field since his 'retirement'; he is currently based at the Center for Environmental Modeling and Policy Development at UNC.

Gerald Mills offers an overview of Jason Ching's career and describes how it contributed to the development of urban climate science.

Each of the contributors to the session described aspects of Jason's work. **Sue Grimmond** spoke of his work on the substrate heat flux, which became a core part of her own research into its relationship with net radiation (e.g. the hysteresis effect). **Dev Niyogi** referenced the work on integrating canopy processes within mesoscale models as revelatory. **Alexander Baklanov** spoke of developments in air quality modelling and the development of CMAQ as part of a 'one atmosphere' approach to integrating atmospheric chemistry with climate models. **Edward Ng** provided the view of an architect whose concern is the application of scientific knowledge to improving urban climates; he spoke of the NUDAPT project and the possibilities that it opened for climate-based urban design. My experience with Jason has been via the World Urban Database and Access Portal Tools (WUDAPT) project (see p. 20).

The hallmark of Jason's career has been an abiding interest in atmospheric sciences (especially the formation of the boundary-layer), allied to a keen interest in the work of others and the potential for creating scientific communities to create and disseminate knowledge.

— *Gerald Mills, University College Dublin*

Special Session for Jason Ching's lifetime career *Co-organisers: G. Mills and D. Niyogi*	
Speaker	**Topic**
Gerald Mills, UCD, Ireland	Jason Ching and the Development of Urban Climate Science
Alexander Baklanov, WMO	Urban Air Quality
Dev Niyogi, Purdue, US	The Development and Application of WRF
Sue Grimmond, U. Reading, UK	Urban Observations
Edward Ng, CUHK, Hong Kong	Climate Science and Urban Decision-Making
Jason Ching, UNC, US	Reflections

[1] Ching, J.K. and Businger, J.A., 1968. The response of the planetary boundary layer to time varying pressure gradient force. Journal of the Atmospheric Sciences, 25(6), pp.1021-1025

[2] Ching, J.K.S., 1985. Urban-scale variations of turbulence parameters and fluxes. *Boundary-Layer Meteorology*, 33(4), pp.335-361.

[3] Doll, D., Ching, J.K.S. and Kaneshiro, J., 1985. Parameterization of subsurface heating for soil and concrete using net radiation data. *Boundary-Layer Meteorology*, 32(4), pp.351-372.

[4] Chen, F., Kusaka, H., Bornstein, R., Ching, J., Grimmond, C.S.B., Grossman- Clarke, S., Loridan, T., Manning, K.W., Martilli, A., Miao, S. and Sailor, D., 2011. The integrated WRF/urban modelling system: development, evaluation, and applications to urban environmental problems. *International Journal of Climatology*, 31(2), pp.273-288.

[5] Dupont, S., Otte, T.L. and Ching, J.K., 2004. Simulation of meteorological fields within and above urban and rural canopies with a mesoscale model. *Boundary-Layer Meteorology*, 113(1), pp.111-158.

[6] Ching, J. and Majeed, M.A., 2012. An approach to characterize within-grid concentration variability in air quality models. *Atmospheric Environment*, 49, pp.348-360

[7] Ching, J., Herwehe, J. and Swall, J., 2006. On joint deterministic grid modeling and sub-grid variability conceptual framework for model evaluation. *Atmospheric Environment*, 40(26), pp.4935-4945.

[8] Ching, J., Brown, M., Burian, S., Chen, F., Cionco, R., Hanna, A., Hultgren, T., McPherson, T., Sailor, D., Taha, H. and Williams, D., 2009. National urban database and access portal tool. *Bulletin of the American Meteorological Society*, 90(8), pp.1157-1168.

At the ICUC10 Conference Banquet dinner, Jason Ching reflected on his lifetime career in climate science.

Extracurricular Activities

The tenth ICUC stood out from previous conferences with the addition of several hands-on Workshops and Town Hall meetings. One of these workshops examined *Atmospheric Moisture Distribution*, another allowed participants to tackle an actual project in NYC related to *Urban Design and Climate*, and others delved into specific products – with two workshops on satellite imagery from *GOES* and a Practical Workshop on the *UMEP* climate service tool. The Town Hall format was used to provide interactive settings for group conversation, in one case to *Meet the Authors* of books on urban climate, and in another to initiate what has become a prominent goal of the IAUC – to promote *Diversity and Women in Urban Climate*.

Changing of the guard: Incoming IAUC President NIgel Tapper (left) chats with outgoing President Jamie Voogt.

Leena Järvi leads a Town Hall meeting on "Diversity and Women in Urban Climate".

What was not new in NY was the opportunity to meet old friends and forge relationships with others in the field – something which has always attracted participants to international gatherings of the urban climate community. For the traditional *Conference Banquet*, participants converged on Times Square and were served dinner followed by a number of award presentations. **Fei Chen** was honored for his lifetime achievement by the AMS, the storied career of **Jason Ching** was celebrated by the IAUC, and **Wilhelm Kuttler** was named as the recipient of the 2018 Luke Howard Award (see p. 42).

— David Pearlmutter, UCN Editor

International Society of Biometeorology "Student and New Professionals" (ISB-SNP) group members at ICUC10. Pictured are (seated, left-to-right): Jennifer Vanos, Mary Wright, David Hondula and Dae-Geun Lee; (standing, left-to-right): Peter Crank, Stephanie Jacobs, Yulyia Dzyuban, Charlie Lam, Paul Chakalian, Britta Janicke, and Ariane Middel.

Announcing: ICUC-10 Student Award Winners

Oral Best Presentation Awards

Oscar Brousse, KU Leuven, Belgium; Urban Climate Modelling using Local Climate Zones in Data Scarce Area. The Case of Kampala, Uganda

Peter Crank, Arizona State University, USA; Behaviors and Risk Perceptions of Elderly Populations in the Face of Extreme Heat and Poor Air Quality -- a Comparison Across Three Sunbelt Cities.

Daniel Fenner, Technische University Berlin, Germany; The Influence of Urban Surface Properties on Air Temperature Patterns during Hot Weather Conditions in Berlin, Germany

Mariana B. Alfonso Fragomeni, University of Georgia, USA; Integrating Planning and Climate: A Collaborative Framework to Address Heat Vulnerability

William Morrison, University of Reading, UK; Longwave Radiation Fluxes Observed with Ground-Based Thermography to Model Urban Thermal Anisotropy

Oral Presentation Honourable Mention Awards

Rainer Hilland, University of Western Ontario, Canada; The Effect of Sub-Facet Scale Geometry on Vertical Facet Temperatures in Urban Street Canyons.

Saud Al Khaled, Arizona State University, USA; Between Aspiration and Actuality: A Systematic Review of Urban Heat Mitigation Strategies in Hot Urban Deserts

Beatriz Sanchez, CIEMAT, Spain; Impact of Atmospheric Stability on Pollutants Dispersion in Urban Areas Using a CFD-RANS Model

Vincenzo Sessa, University of Southampton, UK; Stable Stratification Effects in a Spatially-Developing Urban Boundary Layer

Erin B. Wetherley, University of California Santa Barbara; Analysis of Urban Surface Heterogeneity and Land Surface Temperature Variability across a Megacity

Poster Best Presentation Awards

Isabella Capel-Timms, University of Reading, UK; An Agent-Based Model to Capture Dynamics of Anthropogenic Heat Flux

Doo-Il Lee, Korea, Kongju National University, Korea; An Urban Surface Energy Balance Model for Microscale Modeling of Real Urban Environments

Judith Lorenz, TU Dresden, Germany; Urban Modification of Heavy Precipitation - Observational Findings from Berlin, Germany

Takashi Nishimoto, University of Tokyo, Japan; Development and Verification of Urban Canopy - Building Energy Coupled Model Considered Multiple Building Types

Andreas Wicki, University of Basel, Switzerland; Multiple Linear Regression Analysis for the Quantification of the Urban Heat Island Distribution

Poster Honourable Mention Award

Pak Shing Yeung, Hong Kong University of Science and Technology, Hong Kong; Refinement of Roughness Length Value for the Weather Research and Forecast (WRF) Model based on the understanding of Local Climate Zone

Michael Mau Fung Wong, Hong Kong University of Science & Technology, Hong Kong; Evaluation of the uWRF Performance in Hong Kong with UCPs Derived Based on WUDAPT/NUDAPT Dataset and the Guidance for Implementation

Harold Gamarro, City College of New York, USA; Assessment of uWRF-Solar forecasts for New York City

Jae-Hee Hahm, Kangwon National University, Korea; Strong Wind Estimation on the Korean Peninsula and its Impacts on Urban Extreme Weather

Edwin Alejandro Ramirez Aguilar, Federal University of São Carlos, Brazil; Population Density and Urban Heat Island in Bogotá, Colombia

William P. Lowry Graduate Student Prize

Made to the student author/presenter of the best presentation in urban biometeorology/bioclimatology presented at the IAUC meetings by a graduate student:

David L Miller, University of California Santa Barbara, USA; Gross Primary Productivity of a

ICUC-10 Student Award Winners (cont.)

Large Metropolitan Region Using in Situ Measurements and Worldview-2 Satellite Imagery

William P. Lowry Methodology Prize

An award made to the presenter at the IAUC meetings that incorporates the best conceptual or experimental methodology:

Hongshan Guo, Princeton University, USA; Sensing and Mapping to Characterize the Long-Wave and Short-Wave Infrared Urban Environment.

William P. Lowry African Student Travel Award

Modest Maurus Baruti, Ardhi University, Tanzania; Outdoor Micro-climate and People's Thermal Perceptions in Informal Settlements of Warm Humid Dar es Salaam, Tanzania

Japan Prize

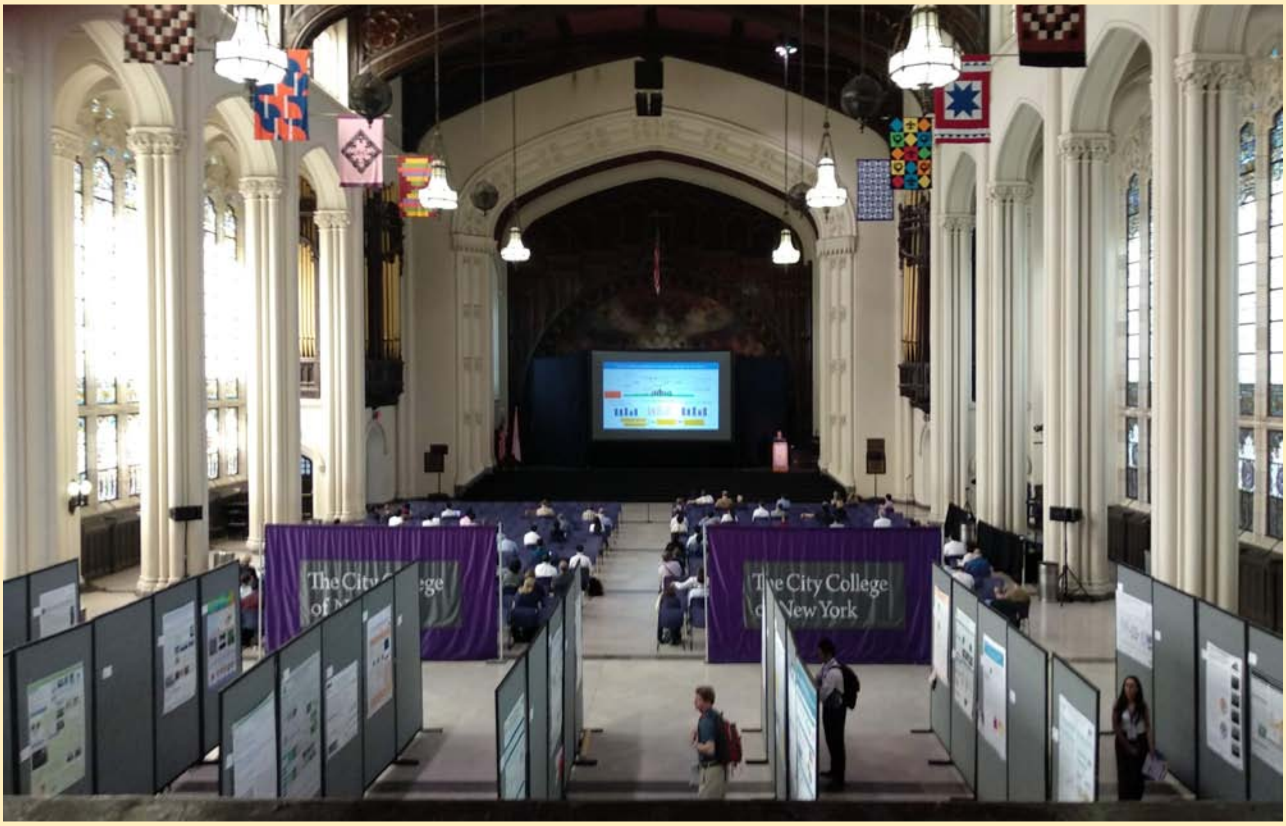
The Japan Prize honors researchers from developing countries who are judged to have given the best papers at an ICUC conference. These awards are made possible by Professor Y. Nakamura and seven of his colleagues from Japan.

Surabhi Mehrotra, Indian University of Technology, Mumbai, India; An Investigation of Intra-Urban Thermal Profile at Neighbourhood Level: A Case of Mumbai

Ankur Prabhat Sati, Indian Institute of Technology Delhi, India; Comparison of Model Simulated Meteorology in Context of Increasing Urbanization over National Capital Region, India.

Karoline Meneguzzi Tonani, Ifes, Vitoria, Brazil; Odorant Gases Dispersion from Sewer Processes in Urban Environments: Mathematical Modeling and Public Perception Annoyance

The committee (A. Christen, C. Mitra, P. Ramamurthy, J.A. Voogt) would like to congratulate all the student participants of ICUC-10. There were more than 200 student presentations at ICUC-10 and the quality of presentations was very high. The committee would also like to thank all the members of the scientific committee and other volunteers who assisted with the substantial work of evaluating the presentations.



An extensive gallery of photos from ICUC10 in NY may be viewed at:
http://www.icuc10.org/gallery

"Hello LCZ! Hello WUDAPT!"Deep Learning Based Seminar in Chengdu, China

WUDAPT project has won the support of numerous schools of architecture in China

The "Hello LCZ! Hello WUDAPT!" Deep Learning Based Seminar, organized by the School of Architecture and Design, Southwest Jiaotong University, experts, scholars and graduate students from the University of North Carolina and the University of Toronto, as well as numerous schools of architecture in China, gathered on May 26-27, 2018 to discuss the development of the WUDAPT project and the application of the Local Climate Zone scheme for climate-sensitive urban design and planning in China.

Dr. **Jason Ching** delivered the keynote presentation of the seminar. He reviewed the research progress of WUDAPT Level 0 and developments towards Level 1 and 2 towards supporting fit-for-purpose and localized modeling tools, which are key to studying the impact of local cities on climate change. One of the developers of Local Climate Zones, Dr. **Iain Stewart** from the Institute of Global Cities, University of Toronto gave a video presentation, introducing the principles, practices and prospects of Local Climate Zones. His presentation is now available on the WUDAPT website at www.wudapt.org.

The WUDAPT project has been well promoted in China and supported by a number of schools of architecture. At present, the WUDAPT team has selected cities in China including Hong Kong, Guangzhou, Beijing, and Chengdu as testbed cities for the project. Researchers in schools of architecture in China have also contributed to studies related to the WUDAPT project.

Prof. **Tang Yan** of Tsinghua University introduced research progress on Local Climate Zones and its applications in urban planning. Prof. **Zhang Xiaoling** of Chengdu University of Information Technology gave a talk on the application of urban climate maps in climate-sensitive planning. Prof. **Tong Ziyu** of Nanjing University reported on urban morphological analysis at macro scale based on Local Climate Zones. Prof. **Liu Zhihong** from Chengdu University of Information Science and Technology presented a talk on the influence of the development of urban agglomeration in Sichuan Basin on air pollution. Prof. **Wang Zhihao** of Kunming University of Science and Technology

Dr. Jason Ching delivered the keynote presentation.

Group photo of the participants at Southwest Jiaotong University.

introduced the theory, methods and practice of mobile observations for urban thermal environment monitoring. Prof. **Huang Yuan** of Southwest Jiaotong University shared crowdsourcing solutions based on urban form and function and their prospects for moving from Level 0 to Level 1 and 2 data collection in WUDAPT. Dr. **Shen Li** from Southwest Jiaotong University introduced the prospects for remote sensing of Local Climate Zones. Graduate students also shared their research results, including applications of WUDAPT, wind and heat environmental experimentation, thermal comfort evaluation, stationary and mobile surveys, heat wave vulnerability, mesoscale meteorological modeling, and urban form analysis.

A workshop on WUDAPT was held on the evenings of May 26 and on May 27. Dr. Shen Li and Prof. Huang Yuan conducted the WUDAPT Level 0 Workshop. Prof. Wang Zhihao et al. organized the *Mobile Survey Verification of Local Climate Zones Workshop* and Prof. Liu Zhihong et al. organized the *Modeling Application of WUDAPT Products Workshop*. Dr. Jason Ching conducted the *WUDAPT Level 1 and 2 Workshop*. The workshop participants were very interested in the collection modes of Level 1 and 2 data. Taking Chengdu as an example, the workshop leaders and students discussed the main problems that we confronted during the process of optimizing urban data collection programs that aim to support customizing the new WUDAPT portal tool called Digital Synthetic City for implementing Level 1 and 2. These discussions of Chengdu, as a testbed city, will provide a reference for solving these problems in many cities of China.

The WUDAPT project is a leading-edge and creative research program that is of great significance for exploring climate-sensitive urban design and planning. This seminar will promote the research and applications of Local Climate Zones in a number of schools of architecture in China, and will promote the development of the WUDAPT community in China.

— Jingyi Liu (fmailiya@163.com)
Southwest Jiaotong University

Recent Urban Climate Publications

Acero JA, Arrizabalaga J (2018) Evaluating the performance of ENVI-met model in diurnal cycles for different meteorological conditions. *Theoretical and Applied Climatology* 131(1-2) 455–469.

Aguilar-Velazquez D, Reyes-Ramirez I (2018) A wavelet analysis of multiday extreme ozone and its precursors in Mexico city during 2015-2016. *Atmospheric Environment* 188 112-119.

Albright CM, Schramm H (2018) Improvements and Applications in Climate Data Analysis for Determining Reference Rainfall Years. *Journal of Applied Meteorology and Climatology* 57 413–420.

Alchapar NL, Cotrim-Pezzuto C, Correa EN, Labaki LC (2017) The impact of different cooling strategies on urban air temperatures: the cases of Campinas, Brazil and Mendoza, Argentina. *Theoretical and Applied Climatology* 130(1-2) 35–50.

Anderson GB, Oleson KW, Jones B, Peng RD (2018) Classifying heatwaves: developing health-based models to predict high-mortality versus moderate United States heatwaves. *Climatic Change* 146 439–453.

Anderson GB, Oleson KW, Jones B, Peng RD (2018) Projected trends in high-mortality heatwaves under different scenarios of climate, population, and adaptation in 82 US communities. *Climatic Change* 146 455–470.

Andrianou XD, Makris KC (2018) The framework of urban exposome: Application of the exposome concept in urban health studies. *Science of the Total Environment* 636 963-967.

Arsiso BK, Tsidu GM, Stoffberg GH (2018) Signature of present and projected climate change at an urban scale: The case of Addis Ababa. *Physics and Chemistry of the Earth*, Parts A/b/c 105 104-114.

Arsiso BK, Tsidu GM, Stoffberg GH, Tadesse T (2018) Influence of urbanization-driven land use/cover change on climate: The case of Addis Ababa, Ethiopia. *Physics and Chemistry of the Earth*, Parts A/b/c 105 212-223.

Asamoah B, Kjellstrom T, Ostergren PO (2018) Is ambient heat exposure levels associated with miscarriage or stillbirths in hot regions? A cross-sectional study using survey data from the Ghana Maternal Health Survey 2007. *International Journal of Biometeorology* 62 319–330.

Azhdari A, Soltani A, Alidadi M (2018) Urban morphology and landscape structure effect on land surface temperature: Evidence from Shiraz, a semi-arid city. *Sustainable Cities and Society* 41 853-864.

Azizalrahman H, Hasyimi V (2018) Towards a generic multi-criteria evaluation model for low carbon cities. *Sustainable Cities and Society* 39 275-282.

In this edition is a list of publications that have come out between **June and August 2018**. As usual, papers published since this date are welcome for inclusion in the next newsletter and IAUC online database. Please send your references to the email address below with a header "IAUC publications" and the following format: Author, Title, Journal, Year, Volume, Issue, Pages, Dates, Keywords, URL, and Abstract. Please send the references **in a .bib format**.

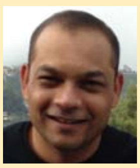
As of this month, Pravin Bhiwapurkar from the University of Cincinnati joined the BibCom team. Note that we are always looking for (young) researchers to join and contribute to the Committee. If you are interested to join or would like to receive more information, please let me know via the email address below.

Regards,

Matthias Demuzere
Chair IAUC Bibliography Committee
Hydrology & Water Management Lab
University of Ghent, Belgium
matthias.demuzere@ugent.be

The Bibliography Committee

Lilly Rose Amirtham



Pravin Bhiwapurkar

Ashley Broadbent

Peter Crank

Rohinton Emmanuel

Kathrin Feige

Lech Gawuc

Rafiq Hamdi

Julia Hidalgo

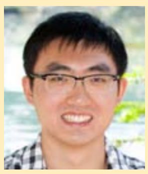
Martina Petralli

Iara Santos

Abel Tablada

Marie-Leen Verdonck

Hendrik Wouters



Qunshan Zhao

Bae M-J, Murphy CA, García-Berthou E (2018) Temperature and hydrologic alteration predict the spread of invasive Largemouth Bass (Micropterus salmoides). *Science of the Total Environment* 639 58-66.

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Upcoming Conferences...

WORLD FORUM ON URBAN FORESTS: CHANGING THE NATURE OF CITIES
Mantua, Italy • November 28 - December 1, 2018
https://www.wfuf2018.com/

PASSIVE & LOW ENERGY ARCHITECTURE (PLEA 2018): SMART & HEALTHY WITHIN THE 2° LIMIT
Hong Kong, China • December 10-12, 2018
http://www.plea2018.org/

AMERICAN GEOPHYSICAL UNION FALL MEETING SESSION ON "URBAN AREAS & GLOBAL CHANGE"
Washington, D.C., USA • December 10-14, 2018
https://fallmeeting.agu.org/2018/

JOINT URBAN REMOTE SENSING EVENT (JURSE)
Vannes, France • May 22-24, 2019
http://www.jurse2019.org

ENERGY AND SOCIETY IN TRANSITION: 2ND INTERNATIONAL CONFERENCE ON ENERGY RESEARCH AND SOCIAL SCIENCE
Tempe, Arizona USA • May 28-31, 2019
https://www.elsevier.com/events/conferences/international-conference-on-energy-research-and-social-science

INTERNATIONAL CONFERENCE ON SUSTAINABILITY IN ENERGY AND BUILDINGS (SEB-19)
Budapest, Hungary • July 4-5, 2019
http://seb-19.kesinternational.org/

Calls for Abstract submissions...

Atmosphere – Special Issue on "Urban Climate" (deadline 31 December 2018)

Professor Wilhelm Kuttler receives 2018 Luke Howard Award

Wilhelm Kuttler (center) is given the 2018 Luke Howard Award at the METTOOLS conference in Braunschweig, Germany on September 25, 2018 by IAUC Secretary Andreas Christen (left) and local conference host Stephan Weber (right). (Photo: TU Braunschweig).

The recipient of the 2018 Luke Howard Award for Outstanding Contributions to the Field of Urban Climatology is Prof. Dr. **Wilhelm Kuttler** from the University of Duisburg-Essen in Germany. Prof. Kuttler receives the Association's highest honour for his outstanding leadership in the development of urban climate science, and for his promotion of the international community that has emerged and led to the formation of IAUC.

Prof. Kuttler's contributions to the field over a 40-year career include important works on urban air quality, carbon cycle, temperature and humidity effects, and the linking of urban climate knowledge to planning practice. His career has bridged a critical period when urban climate science developed from a largely descriptive study into a physically-based understanding of the links between urbanisation and atmospheric changes. His work straddled the North American approach based on measurement and modelling within the context of the energy budget, and the German and Japanese approach that took a more 'holistic' landscape approach in its study of city climates, the latter retaining its strong links with urban planning and design. Prof. Kuttler's publications incorporate the research cultures of both of these approaches. Generations of students in Germany and beyond have read and learned from his writings and have frequently benefitted from his critical, but always constructive, feedback at conferences, workshops and seminars.

Nationally, within Germany Prof. Kuttler's work has had huge impact on municipal and federal state planning and legislation, as well as planning guidelines and codes. He has lead the production of more than 80 expert reports for cities, towns and municipalities in Germany and later contributed to national standard literature on climate change in Germany. As a result of his work he has been awarded several national prizes, including the Badge of Honour of the German Association of Engineers, and the Reinhard Süring Medal of the German Meteorological Society for his applied meteorological work in the fields of urban climate and air pollution.

Internationally, for many years Prof. Kuttler has been a leader in the development of the field of urban climatology and its communication. Apart from his role as Professor of Urban Climate at the University of Duisburg-Essen, he has worked with colleagues on a series of international meetings (Japanese–German Meetings on Urban Climatology) to increase scientific dialogue in the field and to discuss urban planning techniques to incorporate urban climate knowledge. In 1996, he was the Head of the Scientific Committee that hosted the International Conference on Urban

Wilhelm Kuttler in his address at the award ceremony reflected on the pioneering work of Luke Howard in urban climatology. He acknowledged the tremendously stimulating collaborations he experienced within Germany and internationally that enabled him to develop and advance urban climate science and link it with urban planning and design (Photo: Helmut Mayer).

Climatology (the first such conference named ICUC) in Essen. Subsequently he has served on the Board of the IAUC and contributed to each of the ICUC events. As a senior and respected member of the international community of urban climatologists, Prof. Kuttler has made a huge contribution to the development and success of the present-day IAUC.

Outgoing President Jamie Voogt announced Prof. Kuttler as the recipient on August 9 at ICUC-10 in New York. The official award ceremony took place at the 10th Conference on Environmental Meteorology (METTOOLS) of the German Meteorological Society in Braunschweig, Germany on September 25, 2018. IAUC Secretary Andreas Christen presented the award to Prof. Kuttler along with a personalized reprint of Luke Howard's "The Climate of London".

— *Andreas Christen, IAUC Secretary*

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- **President**: Nigel Tapper (Monash University, Australia), 2018-2022.
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The next edition of ***Urban Climate News*** will appear in late December. Contributions for the upcoming issue are welcome, and should be submitted by November 30, 2018 to the relevant editor.

Submissions should be concise and accessible to a wide audience. The articles in this Newsletter are unrefereed, and their appearance does not constitute formal publication; they should not be used or cited otherwise.

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