Urban Climate News

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From the IAUC President

Welcome to the 52nd edition of the *Urban Climate News*.

This is the time of year when the Board of the IAUC gives thanks to those members who have completed their terms and welcomes those members newly elected by the membership. Thanks are due to **Alberto Martilli** (CIEMAT, Spain), **Aude Lemonsu** (CNRS / Météo France, France) and **Silvana di Sabatino** (University of Salento [Lecce], Italy) for their service to the Board. Joining the Board are **Fei Chen** (NCAR, USA), **Edward Ng** (The Chinese University of Hong Kong, Hong Kong), and **Nigel Tapper** (Monash University, Australia). Our new board members represent a range of geographical locations and bring varied scientific interests and extensive experience to the Board. A total of 380 eligible ballots were cast, a number very similar to the past few elections. Thanks to our secretary **David Sailor** for conducting the election.

We are nearing one year in the countdown to **ICUC-9 in Toulouse, France** that will be jointly held with the AMS 12th Symposium on the Urban Environment **20-24 July 2015**. A first call for abstracts is now being issued and I encourage everyone to reserve those dates now. Closer at hand is the World Weather Open Science Conference in Montréal Canada. A number of our members are participating in urban-themed topics (and, I'm sure others) that include "New technologies and observation instrumentation innovations: from urban to global scales." and "Urban scale environmental prediction systems". The aim of the conference is to bring together both the weather science and user communities to review the state of the art and plot the course of future science for the next decade.

On the operational front, IAUC has digitally outgrown its current webhost site. This necessitates a (virtual) move to provide more room for our growing resources, which include the archive of *Urban Climate News*, *ICUC Proceedings*, the *Urban Climate Bibliography*, *The Urban Flux Network*, *Classic Texts*, *Teaching Resources* and more.

Inside the Summer issue...

If you haven't visited recently, check out http://www.urban-climate.org/resources/. And if you have ideas for resources that you don't see, please let me know. I hope the move will be transparent to users, but there may be a transition period in which some resources are not available. We will keep members informed via the web or email as necessary.

– James Voogt,
IAUC President

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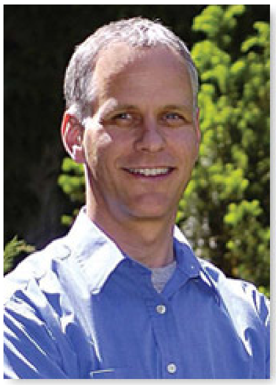


The World Cup's Climate Wild Card

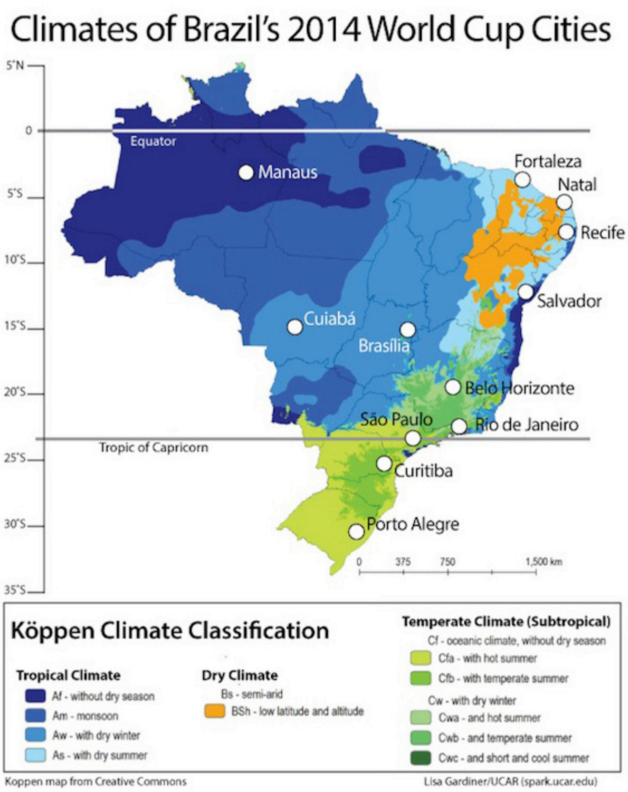
[Editor's note: this article has been modified slightly to reflect the fact that the World Cup is now behind us...]

June 2014 — When I read that the soccer balls used for World Cup games have been specially designed for the climate in Brazil, that got me wondering – which climate? Brazil has many different climates. And [were] the players ready for a wide range of climates too?

Technically it's winter in the Southern Hemisphere, but that doesn't stop the heat or humidity in a place like Manaus, Brazil, at the heart of the Amazon rainforest. During the match between England and Italy it was a sweltering 90 degrees Fahrenheit. With over 80 percent humidity, the difference between air and water was slight.

But during the match between France and Honduras, 2,000 miles away in Porto Alegre, Brazil, the temperature on the field only got up to 73 degrees. Humidity was much lower too – still high compared to many places, but much less humid than Manaus. In the evening, temperatures were chilly enough for a sweater.

Brazil is huge, spanning about 40 degrees of latitude, and includes ten different climates. Brazilians peppered 12 soccer stadiums for the World Cup throughout many of these climates, providing the opportunity for players to move from hot and moist stadiums like the one in Manaus to cooler and drier stadiums like the one in Porto Alegre or even a hot and dry stadium like the one in Natal.



Adapted from: Alvares et al. (2013) Köppen's climate classification map for Brazil, *Meteorologische Zeitschrift*, 22(6):711-728. *Source*: Scientific American

Italy's forward Ciro Immobile sprays water on his face after his team won their World Cup match in Manaus, Brazil.

If you [watched] World Cup games and predicted which teams will win matches, might I suggest that you [should have taken] into account the climate where matches are played. You can do this with a map of regional climates like the one shown here. The map is no soothsaying octopus, but it can provide a good first guess at what types of weather soccer players will encounter around the country. Plus, you [would] be the envy of all other soccer fans if you watch each game with a colorful map in hand.

The Köppen Climate Classification System divides land into different climate types based on average temperature and precipitation. This is regional climate variation. The climate varies over geography depending on factors such as distance from the equator, altitude, and proximity to a coast. All the patchiness of regional climates worldwide, averaged together, is global climate.

I doubt that showcasing regional climates was the reason for the 12 locations, but, for the weather and climate fans among us, it is an exciting twist. A team that's winning at temperate stadiums might be struck down when faced with a midday match in extreme heat. My hypothesis is that dehydration and heat exhaustion [would] be more common in matches in the blue areas on the map, which are hottest and most humid, and the orange areas, which are hot and dry. The World Cup stadiums in green areas in the south likely have less heat-related ailments, however there's another variable that could compromise the athletes: smog. Several of the cities in the south are more known for air pollution than hot weather.

In preparation for a match in the hot and humid Manaus, the English and Italian teams were training for the climate. According to the LA Times, the Italian players were running on treadmills in a sauna and the British were training in thick extra layers of clothing to get used to the heat.

There [is] an extra opponent on the field – climate. If you watch matches, also watch for climate. It's invisible, but [makes] an impact. The different climates within Brazil are a wildcard in World Cup games. Any octopus could predict that. – *By Lisa Gardiner, Scientific American*

http://blogs.scientificamerican.com/guest-blog/2014/06/16/the-world-cups-climate-wildcard/

Extreme Heat Threatens Lives Of World Cup Players

June 2014 — The 2014 World Cup in Brazil was notable for more than hard-fought matches and stoppage time goals; it was also the first time official water breaks were called due to excessive heat and humidity. And as climate change drives up not only average temperatures but extreme heat and humidity, experts say outdoor events like the World Cup could pose a danger to the health of athletes.

In a draw between the United States and Portugal, for instance, the referee stopped play in the 39th minute so players could get water. The game was played in the Arena da Amazonia in Manaus, the subject of much criticism for its location in the middle of the Amazon rainforest — built solely for four World Cup matches. "At times it felt like [I was] having hallucinations due to the heat," Italian player Claudio Marchisio said after his team defeated England in Manaus.

Dr. Thomas Trojian, Director of Injury Prevention and Sports Outreach Programs at the New England Musculoskeletal Institute, says temperature alone isn't a representative way to measure threats to athletes. According to Trojian, events like the World Cup must monitor the heat stress on athletes by using the Wet Bulb Globe Temperature (WBGT), which measures radiant heat, humidity, wind speed, cloud cover and more. Earlier this month, Rogerio Neiva Pinheiro, a judge in Brasilia's labor court, ordered FIFA, soccer's governing body, to allow players water breaks if the composite temperature according to the WBGT exceeds 32 degrees Celsius. Fail to comply and face a fine of 200,000 reais ($90,000), Pinheiro said.

"It really is the extremes where we experience stresses in the climate system most acutely."

"As you exercise you generate heat and if there's heat outside, you can't dissipate that heat and get rid of the heat in your body," Trojian explained, "which then elevates your body temperature and once it reaches above 104 [degrees F], the proteins in your body start to break down, they get damaged, and people can die."

The danger posed by high heat and humidity is exacerbated by current climate trends. "It's hard to rationally deny that there are global changes and the fluctuations in temperature, especially with the increase in high temperatures, are going to effect people and that includes athletics," Trojian said.

As greenhouse gas emissions continue to rise, it's not

England's Daniel Sturridge douses himself during the group D World Cup soccer match between England and Italy at the Arena da Amazonia in Manaus. *Source*: ThinkProgress.org

just driving up average temperatures across the globe, but extreme high temperatures, as well. "It really is the extremes where we experience stresses in the climate system most acutely," said Noah Diffenbaugh, an associate professor of environmental earth system science at Stanford University and author of multiple studies on changes in extreme heat. "And we know not only that global warming is occurring — that the global mean near surface air temperature has been increasing — but also that in many parts of the globe, the occurrences of heat extremes has been becoming more frequent."

The research Diffenbaugh and his team have undertaken found that in many parts of the globe, the occurrence of extremely hot seasons has been increasing, meaning more of the region is experiencing these extremes. Using climate models to look forward and ask, as global warming continues, what the likelihood will be that different parts of the globe will move into a novel heat regime — where every year is hotter than what used to be the hottest year — Diffenbaugh said the current World Cup site is part of the region experiencing the most dramatic changes.

"We find that actually in the Tropics is where there is the clearest and most immediate emergence of this permanent extreme heat — and for large areas of the Tropics, there is greater than 50 percent likelihood that will occur in the next couple of decades if global warming continues along its current trajectory," Diffenbaugh said. "Tropical South America, Tropical Africa, Tropical Southeast Asia – we see 50 percent likelihood of moving to this extreme heat regime prior to 2040" if global emissions continue on a path similar to the current trajectory.

As a result, exercising won't be the only activity to get more dangerous; working outdoors will become more challenging, as well. "In terms of impacts of climate change, it's easier to adjust when in the calendar a particular event is held than it is to adjust when in the calendar a person is able to work outside," Diffenbaugh said. "Certainly I'm not a medical expert, but the players in the World Cup seem to be working hard when they're playing and there are millions of people that labor outside in the heat to earn a living that don't have the same kind of choice about when in the year they work."

While Diffenbaugh isn't examining the impacts of extreme heat on labor, he said the questions are being asked at the academic level. According to a recent analysis of the economic toll climate change could take on the United States, extreme heat poses a major threat to public health and labor. With the number of days over 95 degrees Fahrenheit projected to double or triple by 2050, the report projects that the American Southeast could see its labor productivity cut by three percent.

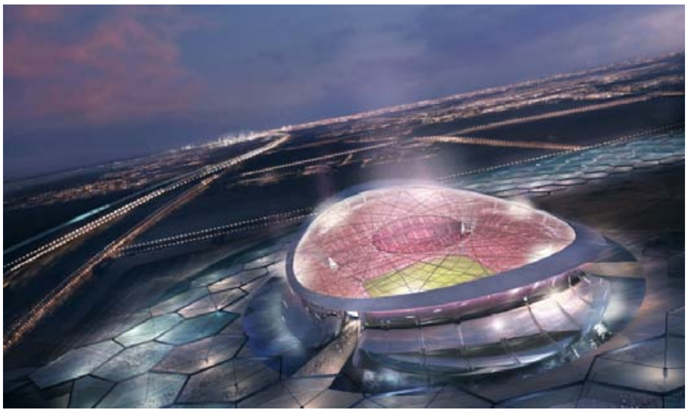
Looking out over the next century, if global carbon emissions continue unchecked, we're headed for somewhere around 4° C (or 7.2° F) of global warming, Diffenbaugh said. "And when we're looking at that level of global warming, then most land areas of the globe experience extreme seasonal heat mostly every year," he said. According to the latest analysis from the United Nations' Intergovernmental Panel on Climate Change, that level of warming would lead to "severe and widespread impacts on unique and threatened systems, substantial species extinction, large risks to global and regional food security, and the combination of high temperature and humidity compromising normal human activities."

For Dr. Trojian, the risks that come from exertion in high heat and humidity aren't just something to be monitored several decades down the road, but need to be taken into consideration now. "I think that changes in the global environment are going to put more and more athletes at risk, especially…when FIFA, the international federation, decides to put the World Cup in Qatar," Trojian said. Qatar, site of the 2022 World Cup, "is a very bad choice heat illness-wise," Trojian said. "You're putting athletes at risk; it's very dangerous for them."

"I think that changes in the global environment are going to put more and more athletes at risk."

A glance at the summer forecast for Qatar shows high temperatures ranging between 108 and 113 degrees Farenheit. These brutal conditions, coupled with rampant human rights abuses, led an international labor group to project that more than 4,000 workers could die in the lead-up to the World Cup. "Whether the cause of death is labelled a work accident, heart attack (brought on by the life threatening effects of heat stress) or diseases from squalid living conditions, the root cause is the same — working conditions," the report found.

A view of newly-planted grass inside the Arena da Amazonas Stadium in the heart of Brazil's Amazon rainforest. *Source*: The Nation



A visual representation for a planned stadium to be built for the 2022 World Cup in Lusail City, Qatar. *Source*: Al Jazeera

Qatar has promised to install solar-powered cooling systems in the stadiums it will construct for the World Cup. The systems have not been proven to work on such a large scale, however, and the "innovative technology" is still being developed, according to Doha News. The country recently cut the number of stadiums it plans to build by a third, due to rising costs and delays, Bloomberg reported. In January, FIFA Secretary-General Jerome Valcke told France Inter Radio, in what was apparently an unauthorized comment, that he believes the 2022 World Cup will be moved to winter. "The idea of moving the Middle East's first World Cup to the cooler winter months arose out of concern for the health and safety of both players and fans alike, as well as out of environmental concerns associated with the Qatar organizing committee's ambitious stadium cooling plans," Al Jazeera reported. *Source*: http://thinkprogress.org/climate/2014/06/26/3453392/world-cup-heat-illness/

Cool Roofs Might Be Enough to Save Cities from Climate Overheating

New research suggests that planting gardens atop roofs or painting them white could offset both the local urban heat island effect and global warming – although one roof type does not cover all situations

February 2014 — Crickets chirp and bees buzz from sedum flower to flower atop the post office in midtown Manhattan during a visit to the 9th Avenue facility on a perfect New York City fall day. On a sprawling roof that covers most of a city block a kind of park has been laid, sucking up carbon dioxide and other air pollution, filtering rainfall, making it less acidic.

Such verdant roofs may form part of an effective strategy for both cooling buildings and helping combat climate change, according to new research published in *Proceedings of the National Academy of Sciences (PNAS)* on February 11. Other solutions cited in the study include white roofs that reflect more sunlight back to space or hybrid roofs that combine aspects of white and green, or planted, roofs.

A large enough number of such roofs could "completely offset warming due to urban expansion and even offset a percentage of future greenhouse warming over large regional scales," says sustainability scientist Matei Georgescu at Arizona State University, who lead the research. That conclusion contradicts previous findings by researchers from Stanford University, who found that reflective roofs actually might increase global warming.

Roofs have quickly become a sticky subject, touted by some, such as former U.S. Secretary of Energy Steven Chu, as one solution to global warming. That's because cities are hot places. As buildings replace forest or grasslands, the local temperature rises—the so-called urban heat island effect. The amount of urban land in the U.S. is predicted to increase by as much as 261,000 square kilometers by 2100, a more than doubling from the current 250,000 square kilometers, according to models developed by the U.S. Environmental Protection Agency.

That translates to an area nearly the size of Colorado, containing at least one house for every hectare of land. By the end of this century, according to the new research, some "megapolitan" regions of the U.S. could see local average temperatures rise by as much as 3 degrees Celsius, in addition to whatever global warming may do.

For example, New York City has some 100 square kilometers of rooftop, most of it tar or other black roofing materials, absorbing heat and helping to make buildings—and the city as a whole—hotter in summer. Some city roofs have measured temperatures as high as 70 degrees C, thanks to their being black, with concomitantly high cooling costs, not to mention local temperatures raised by a degree or more Celsius.

As part of a project known as Cool Roofs, volunteers in New York City have been painting black roofs white and have so far covered more than 500,000 square meters of roof, though that's less than one percent of the possible area. The U.S. Department of Energy suggests such reflective rooftops can keep a given roof 30 degrees C cooler than surrounding traditional rooftops. Even better, according to new research from Lawrence Berkeley National Laboratory, white roofs are the cheapest roofing option based on a study of 22 commercial roofing projects. The lab's research confirms the Arizona findings that white roofs reduce global warming, proving three times more effective at countering climate change than even green roofs, thanks to all that reflected sunlight.

The green roof atop a post office building in Midtown Manhattan offers cooling, water filtration and even rest for weary urbanites. *Source*: ScientificAmerican.com

But the new research published in *PNAS* suggests that such white roofs would have different impacts in different places. So, in New York City any energy savings on air-conditioning in the summer are counterbalanced by increased heating usage in winter (although this can be addressed with optimal roof design or roofs with adjustable reflectivity). And white roofs can reduce precipitation as well, by reducing the amount of warm, humid air rising and, thus, the number of clouds and eventual rainfall. "Adaptation to urban-induced climate change depends on specific geographic factors," Georgescu adds, noting that white, reflective cool roofs work well in California, but could reduce rainfall from Florida up the U.S. east coast, for example. "What works over one geographical area may not be optimal for another," he says.

Green roofs may be a better fit for New York City, for example, because they provide better insulation during winter, along with cooling benefits in the summer. Water evaporation from the plants lowers overall temperatures—and releases more humidity into the air. And, they offer ancillary benefits like green space for weary urban minds.

Here's how a green roof works: a layer of felt retains water for hardy plants like sedum or certain grasses, covered by about an inch of "soil"—really a man-made substrate composed of porous shales and clays. The key is to have a strong roof, strong enough to hold its weight in water. But although expensive, the $5-million planted roof offers benefits beyond combating climate change, compared with white roofs. In New York City the rain falls at a pH of around 4.2—very acidic—but after filtered through a green roof it is 6.2 or higher (the higher the pH, the less acidic). The evaporative cooling provided by the roof also reduces local temperatures by around 2 degrees C.

The *PNAS* findings do not jibe with some other research, however. In 2011 Stanford University researchers found that white roofs would provide some local cooling but at the expense of more global warming, largely because such cooling means less hot air rising and therefore fewer clouds forming. That lack of clouds would cause more warming downwind. The reflected sunlight also hits more of the soot and other pollutants commonly found in the atmosphere above cities, which also increases warming, according to the computer model simulation. The Stanford scientists suggested roofs covered in photovoltaic panels would do a better job, by producing electricity that then obviates the need for more fossil fuel–burning power plants.

Many scientists disagree with the Stanford analysis, including yet another team of Lawrence Berkeley researchers who found that white roofs on every building globally could offset the effect of some 44 billion metric tons of greenhouse gas emissions, or more than a year's worth of global climate changing pollution. And at least one Stanford climate modeler suggests that local cooling has never been shown to create global warming. "I do not deny that such a case is possible," climate modeler Ken Caldeira of Stanford wrote in 2011, when the original research suggesting white roofs could worsen climate change was published. "I am highly skeptical that it would be a common occurrence," added Caldeira, who had a white roof installed over part of his own home for cooling purposes.

Regardless, the space for reflective or even green roofs is limited. Urban areas cover less than 1 percent of the globe (although that number is likely to increase in coming decades), and less than half of that area is roof- or road-top, amenable to whitening. It also fails to capture the complexity of an urban environment, such as how replacing trees with buildings affects the water table and wind speeds. "Urbanization affects not just surface albedo," says urban environment researcher Karen Seto of the Yale School of Forestry and Environmental Studies, who was not involved in any of the research. The new *PNAS* study "is an innovative first step, but limited in terms of what impacts they're looking at," she adds.

In the meantime, black roofs remain a human health risk. In the deadly Chicago heat wave of 1995 those living on the top floor of a building with a black roof were most likely to die, according to subsequent analysis. "Black roofs should be outlawed," geochemist Wade McGillis of the Lamont–Doherty Earth Observatory at Columbia University told me during my visit to the post office green roof. "If you're going to put up a roof, don't put up black."

Source: http://www.scientificamerican.com/article/cool-roofs-might-be-enough-to-save-cities-from-climate-overheating/

Growing Green Cities

June 2014 — The future of the world's climate will be decided in our cities. Urban areas already account for up to 70% of global CO_2 emissions, and that share is likely to increase in the coming decades, as more people – billions more – move to cities, and as urbanization drives global economic growth. From the standpoint of both climate change and growth, the rise of cities represents a challenge and an opportunity.

The nexus between urban expansion and climate protection is infrastructure. Upgrading urban infrastructure can drive economic growth and reduce carbon emissions at the same time. But how will the world's cities pay for new and greener infrastructure?

The good news is that mayors – in developed and developing countries alike – are no longer waiting for national governments to strike a global climate agreement. Not only Copenhagen, London, and Munich, but also Johannesburg, Rio de Janeiro, and Shanghai are drawing up their own environmental programs. Such plans are variously ambitious – ranging from wish lists to enforceable targets – but the trend toward sustainable urban living is clear.

If cities are to reduce their carbon footprint, they will need massive investments in their infrastructure. Three-quarters of rich countries' CO_2 emissions come from just four types of infrastructure: power generation, residential and commercial buildings, transport, and waste management. Any urban sustainability program must therefore include a shift to renewable energy and combined heat and power stations, more public buses and trains, cleaner private vehicles, better insulation of offices, hospitals, apartment blocks, and other buildings, and smarter management of waste and water – along with much else.

Infrastructure investments are also necessary to cope with continued urbanization: by 2050, there could be as many people living in urban areas as are alive today. And new infrastructure will be needed to maintain cities' role as the drivers of economic growth: the world's 600 major cities already generate more than half of global GDP, and urban areas will contribute disproportionately to future wealth creation.

In all, around $2 trillion a year will be needed for the next 20 years to keep the world's cities liveable and to reduce their carbon emissions. Where will this money come from?

Only a few cities are rich enough to upgrade their infrastructure on their own. Most cities – especially in developed countries – cannot rely on more transfers from national governments. Public spending on infrastructure has plummeted in Europe and the United States since the 1960s; and, with public budgets under strain, it is unlikely to recover. Faced with a growing infrastructure-investment gap, cities will need more private investment.

Two trillion dollars a year will be needed for the next 20 years to keep the world's cities liveable and to reduce their carbon emissions. Where will this money come from? *(Photo: F. Ugolini)*

Banks have traditionally financed a large share of infrastructure outlays. But, six years after the start of the financial crisis, banks in many countries are still trying to repair their balance sheets, while new capital and liquidity requirements will make it more expensive for banks to finance long-term lending in the future.

Meanwhile, pension funds, insurance companies, and other institutional investors are increasingly investing in infrastructure. Unlike banks, they have long-dated liabilities, for which the long-term, predictable returns from infrastructure investments can be a good match. In an environment of extremely low interest rates and frothy equity markets, infrastructure also looks like an attractive and reasonably safe alternative to stocks and bonds, yielding returns that can ultimately finance the pensions of the West's aging societies.

So far, however, institutional investors have invested relatively little in infrastructure, partly owing to shortcomings in the overall investment environment. For example, some governments have retroactively changed their policies for renewables, which has made investors more cautious. Moreover, new capital requirements can make it very expensive for insurers to invest in infrastructure.

Furthermore, many institutional investors do not yet have sufficient expertise to venture into infrastructure. And, because infrastructure is not yet a clearly defined asset class, investors often find it difficult to plan, assess, and manage their holdings in this area.

These obstacles apply to all infrastructure investments. But urban infrastructure is at a particular disadvantage. For starters, many city officials have limited experience dealing with private investors, which can make it difficult to get fruitful partnerships off the ground. More important, urban infrastructure projects tend to be small, dispersed, and diverse. For most private investors, the effort required to find, evaluate, and manage such projects is far greater than the return that they can expect, which is why institutional investors often prefer large, more easily assessed projects such as wind parks, pipelines, or motorways.

If more private money is to flow into urban infrastructure, the institutional setup must change. Very large cities can establish their own institutions to match infrastructure projects and investors, as Chicago has already done through its Infrastructure Trust. For the rest, governments should create national institutions to support sustainable urban infrastructure investments.

Such "Green Cities Platforms" could start by providing consultancy services, matching investors to projects, and serving as forums for knowledge sharing. They would then be well positioned to act as aggregators – packaging, standardizing, and marketing sustainable urban infrastructure projects. At a later point, they could move on to raise money in the capital market and fund sustainable infrastructure alongside other investors.

If the barriers to private investment in urban infrastructure could be overcome, the world would benefit from lower CO_2 emissions, faster economic growth, and sounder retirement savings. This is a dialogue worth having.

Source: http://www.project-syndicate.org/commentary/michael-heise-proposes-a-mechanism-for-boosting-private-investment-in-urban-infrastructure

Beijing expects healthy air by 2030

June 2014 — The Chinese capital's fine-particulate pollutant intensity is expected to drop to the internationally recognized safe level in 16 years, environmental authorities said.

Pan Tao, head of the Beijing Municipal Research Institute of Environmental Protection, said the concentration of $PM_{2.5}$ – particulate matter with a diameter of 2.5 micrometers – is likely to be reduced regularly to no more than 35 micrograms per cubic meter by 2030.

"Improving air quality in the city is not going to be an easy task," Pan said on Tuesday during the 2014 Beijing International Academic Symposium on Urban Environment.

"It takes time and effort to turn the ship around."

The World Health Organization has said the concentration of $PM_{2.5}$ should be no greater than 35 micrograms per cubic meter.

Air quality with a higher intensity is considered unhealthy, especially for the old and young, and those with heart and lung problems.

The Beijing Environmental Protection Bureau said that the intensity of $PM_{2.5}$ in 2013 was 89.5 micrograms per cubic meter – still two and a half times above the standard.

The bureau's recently released plan said the intensity of $PM_{2.5}$ is to be reduced to 60 micrograms per cubic meter. The 2017 target is still harmful to people's health, but achieving the goal is challenging, Pan said.

The rapid expansion of Beijing, the population explosion and improper urban planning have hindered environmental improvements, he said. "The current pollution emission is far beyond the environmental capacity in the city, and any adverse climate condition would easily result in smoggy days. The key to current air quality improvement lies in emission reduction."

To ensure that Beijing residents can enjoy cleaner air by 2017, governments in the area have been imposing harsh fines against polluting enterprises to reduce the region's notorious smog.

Many companies, especially those with coal-fired boilers and cement plants, have been fined for excessive smoke exhaust, lacking or having faulty emission-monitoring facilities and leaving coal dumps uncovered in the past few months, the Beijing Environmental Protection Bureau said.

The amount of sulfur dioxide in Beijing's air has been reduced 77 percent since 1998, while nitrogen dioxide has been cut by 30 percent and PM_{10} by 42 percent, the research institute said.

Source: http://www.chinadaily.com.cn/china/2014-07/02/content_17635872.htm

Beijing residents look forward to a brighter future. ***Photo: David Pearlmutter***

Combined effects of urban expansion and climate change on temperature in Sydney


By Daniel Argüeso (d.argueso@unsw.edu.au) and **J.P. Evans**
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The influence of city sprawl under climate change conditions over Sydney was examined using a Regional Climate Model coupled to an Urban Canopy Model. Two periods of 20 years were simulated at very high spatial resolution for present and future climate conditions incorporating both greenhouse gases and urban expansion effects. The results indicate that urbanization impact on minimum temperature is comparable to the magnitude of the climate change at local scales over the next 50 years, especially during winter and spring. Maximum temperature changes, however, seem to be driven solely by climate change with no impact from urban expansion. Other climate variables also responded to changes in land use, such as surface evaporation and to a lesser extent, wind.

1. Introduction

Anthropogenic climate change and urbanization pose considerable challenges. Urban population growth will take the percentage of people living in cities to over 65% of total world population by mid-century (UN, 2012). Climate change will increase near-surface global temperature by 0.4 to 2.6°C by that time compared to the recent past climate (IPCC, 2013), with important repercussions for population.

In this scenario, understanding how climate change will manifest in the unique environment of cities is crucial to adequately assess risks for urban population and design strategies tailored to reduce their vulnerability.

Despite our knowledge of the urban climate significantly improving since the early study by Howard (1833), the question of how urbanization and climate change will interplay in the future remains open to a large extent. Valuable insight into the role of urban areas in shaping future climate was provided by previous studies, but they used Global Climate Models (GCMs) and hence were prone to limitations due to the GCMs' coarse spatial resolution. Regional Climate Models (RCMs) have arisen as a useful tool to dynamically downscale large-scale information from GCMs (Rummukainen, 2010) at resolutions gradually closer to urban climate scales (Argüeso *et al*. 2012). In addition, urban canopy models (UCMs) have been coupled with RCMs enabling the study of urban climate from a new perspective.

Some of the few studies (Georgescu *et al*. 2012; Kusaka *et al*. 2012) that have investigated the effect of urbanization under climate change scenarios used the Weather Research and Forecasting (WRF) modeling system (Skamarock *et al*. 2009) coupled to a UCM to downscale large-scale information for the urban environment. These studies focused on megapolitan expansion effects but were limited to the warm season only, when population often endures adverse heat-stress conditions.

In this study, the same modeling system was selected but the approach adopted was different in that the climate implications of Sydney (Australia) sprawl were examined over periods that are climatologically meaningful (20 years) and for all seasons. The climate of the Sydney area was simulated using unparalleled spatial resolution (2 km) under present (1990-2009) and future (2040-2059) climate conditions according to SRES A2 scenario and assuming moderate changes of land use to estimate the magnitude of the urban expansion compared to the climate change signal.

2. Methodology

The area of study covers the Sydney Area in Australia (approximately 34°S and 151°E). It is located on the Australian Eastern Seaboard, a narrow strip

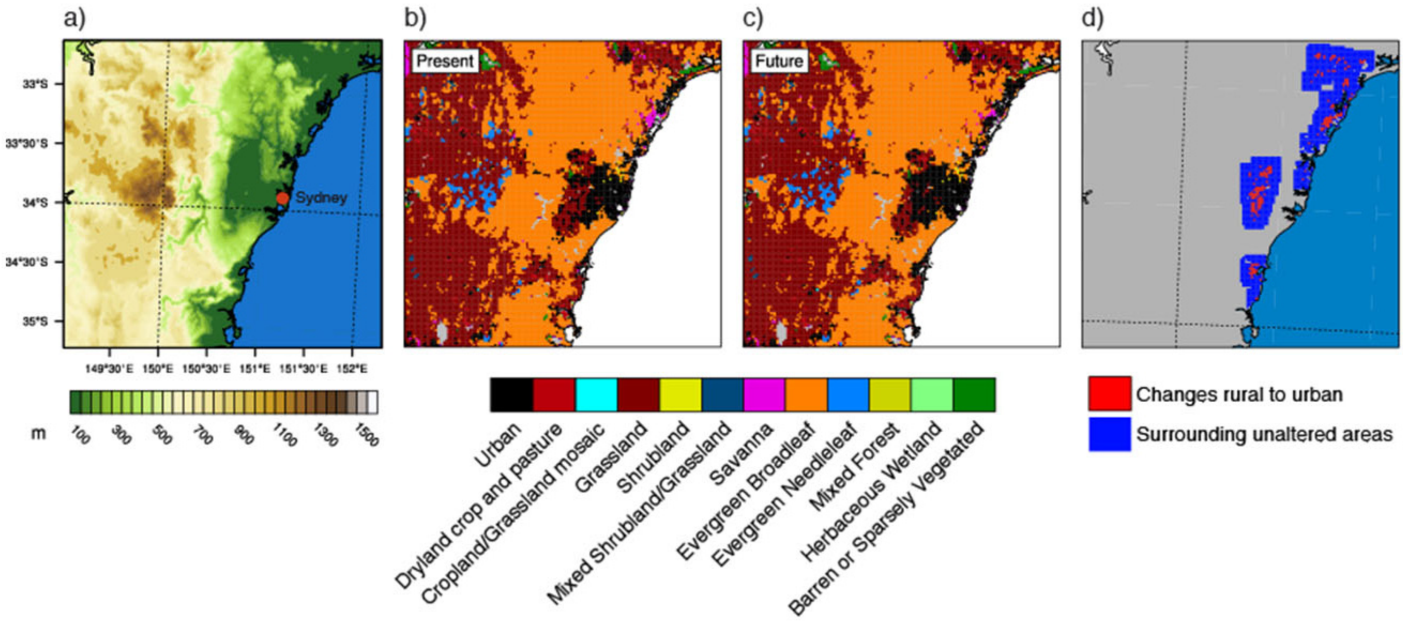

Figure 1. a) Model domain and topography. b) Present land use categories. c) Future land use categories. d) Changes from rural in the present to urban in the future (red), surrounding grid cells to any area of projected urban expansion.

along the eastern coast characterized by a clearly distinct climate from the rest of Southeast Australia, partly due to the presence of the Great Dividing Range and the influence of the ocean. Such a geographical configuration warrants the use of RCMs to better capture the climate of the region, which is poorly represented in coarse-resolution GCMs.

The Advanced Research WRF (ARW) coupled to a Single-Layer Urban Canopy Model (Kusaka *et al*. 2001) was selected to downscale CSIRO-MK3.5 GCM for a high-emission scenario over the Sydney region. As mentioned before, two periods were simulated at 2-km spatial resolution over the domain (shown in Figure 1a). Further details on the model configurations may be found in Argüeso *et al*. (2014) and Evans and McCabe (2010), as well as references of model evaluations in the region.

Present and future land cover maps (Figure 1b-c) derived from data generated by the state of New South Wales (NSW), replaced the default land use from the model in each of the simulations. Future urban land expansion (Figure 1d) was determined according to NSW Department of Planning, which allocates areas for future urban development and consolidation in order to accommodate the expected increase in population.

The comparison of changes in temperature projected by the model between areas of urban expansion and the surrounding unaltered grid cells serves as an indicator of the potential footprint of urbanization in a changing climate.

3. Results and discussion

Seasonal changes in near-surface temperature reveal that daily maximum temperature (Tmax) is projected to change similarly over the domain and across all seasons (Figure 2a-d). Larger increases are expected in the inner west of the model domain, especially during winter (up to 2.5°C). On the other hand, summer will see a rise in Tmax between 1.0 and 1.5°C over most of the region according to the prescribed climate change signal. The presence of new urban areas (see Figure 1d) cannot be detected in any of the plots showing seasonal changes and thus the changes seem to be driven exclusively by the large scale.

Daily minimum temperature (Tmin) will be subjected to overall larger seasonal changes than Tmax. However, the most remarkable feature of Tmin seasonal changes is the evident footprint of newly urbanized areas (Figure 2e-h). Unlike Tmax, minimum temperature changes are strongly affected by both large-scale climate change and local urbanization. The areas exposed to future land-use changes are clearly identifiable in the spatial pattern of Tmin seasonal changes. Such a contrast between areas of

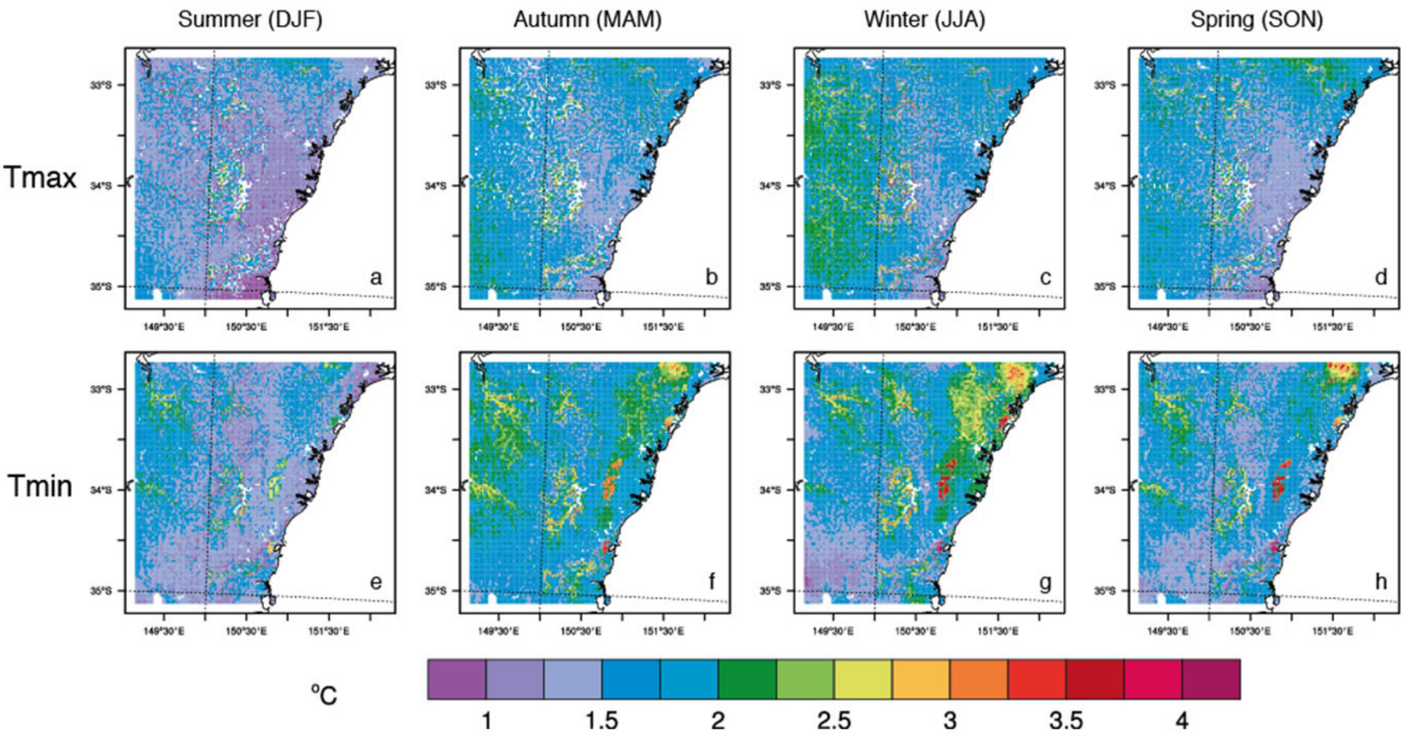

Figure 2. Seasonal changes in daily maximum temperature (a-d) and daily minimum temperature (e-h) obtained from the difference between future and present climate simulations.

urban expansion and the surroundings stands out during winter and spring, when Tmin could increase up to 4°C in new urban areas compared to changes rarely exceeding 2°C in the neighboring grid cells (Figure 2g-h). Despite seasonal differences, the land use change footprint is noticeable throughout the year.

The differences in response of temperature extremes to urbanization and climate change is in agreement with previous studies that characterized the urban heat island (UHI) for present climate and found greater UHI intensity during the night (Arnfield 2003; Grimmond and Oke 1999). Changes in the temperature diurnal cycle were also analyzed (see original paper) over areas of city growth and adjacent grid cells showed that the largest impact of urbanization is projected around sunrise. Indeed, climate change broadly displaces the diurnal cycle toward higher temperature values, whereas the combined effect of climate change and urbanization modifies the shape of the diurnal cycle, reducing the diurnal temperature range.

An excerpt of extreme indices from the Expert Team on Climate Change Detection and Indices (ETCCDI) was selected and we investigated changes in adverse conditions that might have particular repercussions for urban populations. Especially warm nights (TN90p) will substantially increase (from 10% to 90% of total nights) in areas of city growth, comparatively more than in the surroundings (60% of nights in the future). Similarly, no cool nights (TN10p) as we know them today will occur in areas of urban development, whereas neighboring counterparts will still see them happening in the future, although also with a strong reduction. Hot days (TX90p) will also become more frequent and cool days more rare, but the city does not seem to play a role in these changes.

The projected changes are compatible with the energetic basics of the UHI (Oke 1982), which attributes relative warmth of urban areas to increased heat capacity, delay of heat loss due to reduced Sky View Factor and air trapping, and evaporative cooling inhibition by impervious surfaces. Most of these features are observed in the diurnal cycle of the surface energy budget (Figure 3).

In areas with no land-use changes, climate change alone does not alter the surface energy balance significantly. However, when both climate change and urban expansion are considered, latent heat exchanges are considerably reduced in new urban areas. Latent heat is channeled into sensible heat because evaporation is considerably reduced, and the latter will reach higher values than in the present, es-

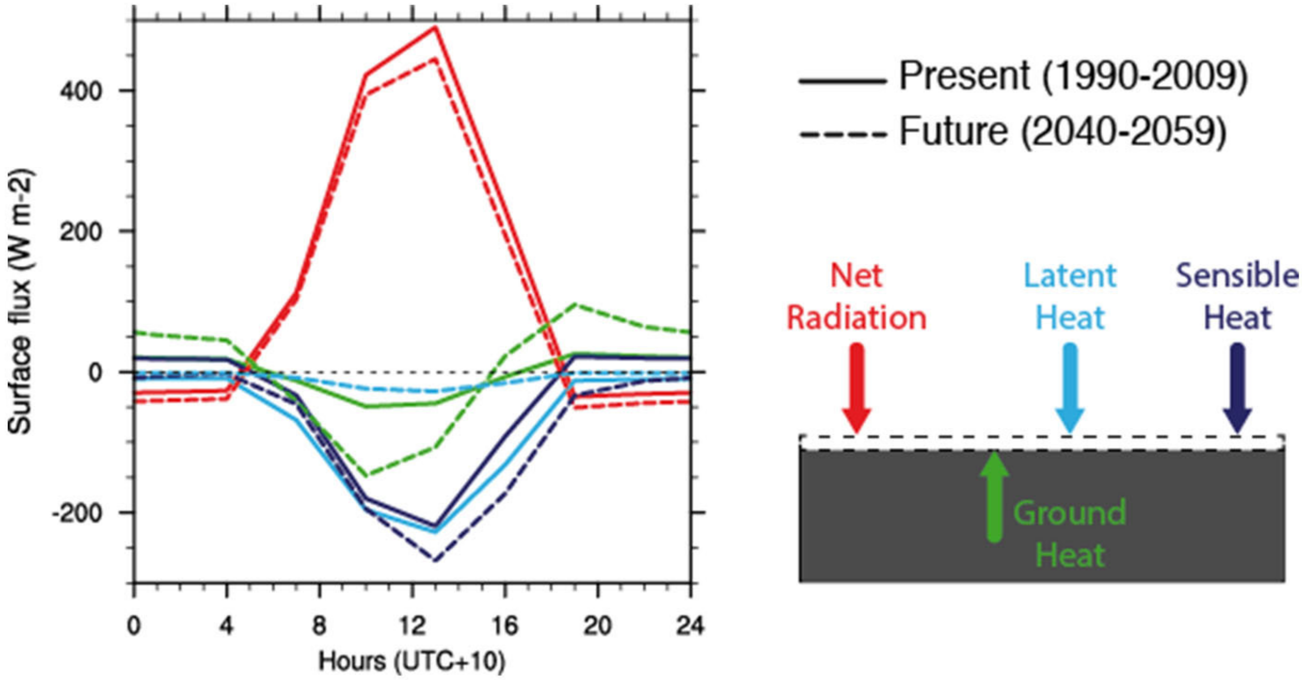

Figure 3. Daily cycle of the surface energy balance components averaged over areas of urban expansion during summer (DJF) from the present (solid lines) and future (dashed lines) simulations. Positive (negative) fluxes indicate gain (loss) of energy by the infinitesimal surface layer. The components of the budget are: Net radiation (red), ground heat flux (green), latent heat flux (cyan) and sensible heat flux (purple).

pecially after midday. During the warmest hours of the day, net radiation in new urban areas is reduced and the ground heat uptake increased. Around sunset, the signs of net radiation and sensible heat reverse. In areas of urban expansion, nighttime radiation from the surface slightly increases and sensible heat from the atmosphere to the ground decreases. The new partition has no perceptible impact on Tmax but does affect minimum temperature, which reaches much higher values when climate change and urbanization act together.

Other variables such as wind and surface evapotranspiration were explicitly examined too. Urbanization has an effect on both of them, but wind is only slightly affected under light wind regimes and not when high wind speeds occur. Surface evapotranspiration is strongly diminished leading to values close to 0 mm/month in new urban areas.

4. Summary

Urban expansion of Sydney has a clear footprint in future climate projections on a range of variables, such as surface evapotranspiration, wind and temperature. Minimum temperature was systematically projected to increase due to urban development, adding to warming caused by GHGs. Changes were noticeable in all seasons, but they were particularly marked in winter and spring. Combined effects of urbanization and climate change during these seasons could double the increase in minimum temperature due to global warming alone by 2050, which indicates that the magnitude of the urbanization impact on minimum temperature is locally comparable to the climate change signal. On the contrary, maximum temperature seem to be independent of the land-use change from rural to urban and changes are explained by climate change.

As a result of the aforementioned changes, the frequency of warm and tropical nights will increase substantially in the future, whereas changes in particularly high daytime temperature are more related to topography and distance to the ocean, rather than land-use changes.

Population vulnerability to higher temperatures is strongly related to nighttime conditions (Loughnan *et al.* 2013) and therefore, in view of results presented here, further investigation on the direct links between future urban-induced climate changes and human comfort is necessary. This work is now being extended to assess changes in heat stress due to potential changes of both temperature and relative humidity and determine to what extent these compensating factors dominate changes in human heat stress. Another factor to consider in the future is the effect of anthropogenic heat, which represents an additional and potentially important source of heat in cities that could intensify the warming effect of urbanization in a changing climate.

Acknowledgement

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References

Argüeso, D., J. M. Hidalgo-Muñoz, S. R. Gámiz-Fortis, and Y. Castro-Díez, 2012: High-resolution projections of mean and extreme precipitation over Spain using the WRF model (2070–2099 versus 1970–1999). *J. Geophys. Res*, 117, doi:10.1029/2011JD017399.

Argüeso, D., J. P. Evans, L. Fita, and K. J. Bormann, 2014: Temperature response to future urbanization and climate change. *Climate Dyn*, 42, 2183–2199, doi:10.1007/s00382-013-1789-6.

Arnfield, A. J., 2003: Two decades of urban climate research: a review of turbulence, exchanges of energy and water, and the urban heat island. *International Journal of Climatology*, 23, 1–26, doi:10.1002/joc.859.

Evans, J. P., and M. McCabe, 2010: Regional climate simulation over Australia's Murray-Darling basin: A multitemporal assessment. *J. Geophys. Res*, 115(D14114), doi:10.1029/2010JD013816.

Georgescu, M., M. Moustaoui, and A. Mahalov, 2012: Summer-time climate impacts of projected megapolitan expansion in Arizona. *Nature Climate* 3, 37–41, doi:10.1038/nclimate1656.

Grimmond, C., and T. R. Oke, 1999: Heat storage in urban areas: Local-scale observations and evaluation of a simple model. *Journal of Applied Meteorology*, 38, 922–940.

Howard, L., 1833: *The climate of London deduced from meteorological observations made in the metropolis and at various places around it*. Harvey and Darton, London.

IPCC, 2013: *Climate Change 2013: The Physical Science Basis*. Working Group I Contribution to the IPCC Fifth Assessment Report. Cambridge University Press, Cambridge, United Kingdom and New York, 2216 pp.

Kusaka, H., H. Kondo, Y. Kikegawa, and F. Kimura, 2001: A simple single-layer urban canopy model for atmospheric models: Comparison with multi-layer and slab models. *Boundary-Layer Meteorology*, 101, 329–358.

Kusaka, H., M. Hara, and Y. Takane, 2012: Urban Climate Projection by the WRF Model at 3-km Horizontal Grid Increment: Dynamical Downscaling and Predicting Heat Stress in the 2070's August for Tokyo, Osaka, and Nagoya Metropolises. *Journal of the Meteorological Society of Japan*, 90B, 47–63, doi:10.2151/jmsj.2012-B04.

Loughnan, ME, Tapper, NJ, Phan, T, Lynch, K, McInnes, JA 2013: *A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities*. National Climate Change Adaptation Research Facility, Gold Coast, 128 pp.

Oke, T. R., 1982: The energetic basis of the urban heat island. *Q J Roy Meteor Soc*, 108, 1–24.

Rummukainen, M., 2010: State-of-the-art with regional climate models. Wiley Interdisciplinary Reviews: *Climate Change*, 1, 82–96.

Skamarock, W. C. and Coauthors, 2009: *A Description of the Advanced Research WRF Version 3*. NCAR/TN-475+STR NCAR TECHNICAL NOTE, 125.

UN, 2012: *World Urbanization Prospects, the 2011 Revision*. United Nations Department of Economics and Social Affairs, Population Division, New York.

Beyond mainstreaming: Reframing governance for urban climate resilience

Introduction

In this paper we focus on the limitations of notions of mainstreaming urban resilience. We argue that generally there is such a fundamental failure of urban governance that there is often nothing to mainstream into, and argue the need for more politically nuanced approaches to urban resilience that can put in place some of the building blocks of the kind of polycentric, multi-scale governance founded on adaptive, flexible learning oriented institutions that resilience theories advocates. In doing so the paper draws on a number of recent publications by colleagues and partners within the ISET network, and practical and research experience in Thailand, Vietnam and Indonesia (Friend, Jarvie *et al*. 2013).

Dynamics of Urbanization in Asia

Much of Asia is now going through a fundamental transformation as it urbanizes, affecting everything from ecological landscapes, social structures and social relations to core values and aspirations. Some countries are going through a transition from small-scale, often largely subsistence agriculture, to heavily urbanized and industrialized economies within little over a generation. Much of this urbanization is occurring in secondary cities, and it is this pace and scale of growth that is at the heart of the future challenge around urbanization and climate change in Asia.

Urbanization is often equated with the administrative units of cities, with definitions of cities based on their location, historical boundaries, their densities of built-up space and populations. Yet the emerging cities of contemporary Asia are quite unlike the cities of the past. The scale of the mega-cities, in geographical area and population, has never been witnessed before. Moreover, the critical dependence on complex systems of infrastructure and technology is perhaps the defining characteristic of contemporary urbanization.

Urbanization and the cities that are created are driven by global capital flows and become physical embodiments of political and economic power. Cities are embodiments of socially constructed meaning and power. The physical layout of cities, the design and scale of buildings and public space are all symbolic representation of and ways of giving form and meaning to political and social power relations (Swyngedouw and Heynen, 2003). Previously cities were testaments to imperial, national and royal power. Contemporary cities represent other power relations and values. Of course, these power structures and values are often vigorously contested, and it is these tensions that permeate the sphere of urban climate policy and planning.

People in Can Tho still access natural water sources for domestic use and consumption – even as these become increasingly polluted as the urban area expands. Photos: R. Friend

The planning of cities and urbanization must be seen as a political process (Harvey, 2008). Whether framed in terms of renewal or resilience, inevitably these actions are tied up with a whole range of political values and contests. As with the history of urban renewal and regeneration strategies, urban climate resilience also faces potential controversy with the ways it plans to shape urbanism for certain benefits, and values. As in any such process, there are winners and losers. Urban resilience is not neutral (Friend and Moench, 2013).

There are of course additional challenges. Urbanization is intimately linked to global environmental change, contributing to climate change through emissions, construction and land conversion while also creating new risks and vulnerabilities through the refashioning of ecological landscapes and the concentration of economic assets and people in hazardous space. Urbanization of the future will need to balance a mix of highly contested local values and interests, with the harsh realities of ecological constraints and planetary boundaries. Forging an urban future that is both ecologically viable and socially just is first and foremost a challenge of governance – of balancing conflicting values and interests. This balance will set the agenda for how resilience is approached, of what, for whom and by whom.

Current global efforts around urban resilience only offer partial recognition of the political dimensions of this challenge. Global discourse on urban resilience tends to adopt a rather technocratic approach, founded on creating the strategies, policies and plans, and attracting investment finance as if such processes were entirely neutral and free from potential controversy or contestation. It is an agenda that is increasingly framed around physical infrastructure and finance mechanisms. It ignores often murky governance mechanisms that might be needed to deal with future climate uncertainty and risk, to manage public finance, and to ensure socially just, equitable outcomes.

This is also further complicated by the discourse of resilience itself. Resilience has entered policy discourse but often without the core theoretical principles of complex systems. Largely it is the connotations of maintaining system function, of bouncing back that are most influential. However, this discourse easily supports narratives of order over justice, opening up a whole additional set of challenges for policy and practice (Friend and Moench, 2013). The term "resilience" has also become a buzzword in many contexts to justify or spin "business and usual" agendas.

Forging an urban future that is both ecologically viable and socially just is first and foremost a challenge of governance – of balancing conflicting values and interests.

This approach is manifest in a push towards mainstreaming urban resilience. Many development actors and projects have now taken on board the call to mainstream resilience as a rallying cry. There is a certain logic to putting urban resilience at the heart of policy and planning. Yet calls for mainstreaming, and associated recommendations founded on policy champions and resilience planning, often fail to acknowledge the dynamics of urbanization or the core governance gaps. Much effort is directed towards the government rather than processes of governance; towards policy and plans, rather than promoting processes of accountability, transparency and public participation; towards individual government champions rather than networks of alliances of citizens, private and public sector. Talk of mainstreaming only further deflects attention from system failings and governance gaps (Friend, Jarvie *et al*. 2013). Such calls are at risk of promoting a one-sided view of resilience that is imposed from above, and that disempowers and disadvantages certain groups of urban people. It also fails to draw on the rich intellectual history of resilience thinking.

The significance of complex systems and services

Part of the problem lies in the rather limited thinking of what constitutes the city. In the context of urban climate resilience, the city is often taken to be a specific administrative unit – but in the case of rapidly urbanizing Asia, existing administrative units do not correspond with the territories that are urbanizing. The urbanizing areas of many cities include the core area that has been an established urban centre, with the administrative units around it that are now becoming urbanized. As such, the city 'system' that resilience aims to address, is going through a rapid process of change as urbanization spreads. There is no clear geographical or territorial boundary of such changing urbanizing areas.

While cities in some form have existed for much of history in Southeast Asia, there is something unique about the contemporary cities that are emerging. This is both in the scale of contemporary cities and the pace of change. For example, Thai cities such as Udon Thani expect to double in size and population within the next 10 years. From a remote town in a notoriously poor province, renowned for its export of labour, Udon is becoming a regional urban centre, attracting investment and migrants from across the Mekong.

Urbanization becomes increasingly dependent on systems – water, food, energy, waste, and transport – that are derived from beyond territorial boundaries. The dependence on physical infrastructure, technologies and complex institutions is a critical feature of the way that these systems are created and maintained, and of how the services that they generate are accessed and distributed. For Graham and Marvin (2001) 'infrastructures are the key technological and physical assets of modern cities'. Increasingly linked across regional and global scales, essential resources such as capital, labour and information move on transport and communication infrastructure between and across urban areas, often in previously unimagined ways (Friend and Moench, 2013). The global scale, and the inter-linkages between urban centres is also referred to as a 'pan-urbanism' (Moris, 2014). But these inter-linkages are not merely between urban centres. As flows of resources and people often cross administrative and ecological boundaries, distinctions between rural and urban are increasingly blurred.

This means that there are greater linkages between different areas, and that risks and vulnerabilities are recreated and redistributed. Urbanization is less about the space than the process of transformation, and linkages between geographies that are created.

Rethinking policy and practice

Perhaps more fundamentally, we need to rethink our approach to governance, policy and practice to both understand the current dynamics of urbanization and to be better positioned to address the challenges of building urban resilience, and to do it in ways that can generate socially just outcomes.

Efforts around shaping urban policy and practice are framed as technical or managerial challenges, often with implicit assumptions of what policy is, how it operates and how it can be influenced (Friend, Jarvie *et al*. 2013).

Underpinning many of these current efforts, especially within the framework of development programmes and projects, are assumptions of policy as following linear processes, of bureaucratic rationality – in which sound science-based information leads to an assessment of policy options, and the selection of the best option. While this appears a crude summary, we see this kind of simplistic representation of policy becoming manifest in many ways. Much of the effort around policy influence is in generating and communicating evidence on the rather optimistic assumption that decisions, and then actions, will follow.

In the context of urban climate resilience, the city is often taken to be a specific administrative unit – but in the case of rapidly urbanizing Asia, existing administrative units do not correspond with the territories that are urbanizing. Photo: J. Jarvie

Yet we also know that policy processes rarely follow these simple steps, that policies and plans may never be implemented, or that they are reshaped in their implementation – leading to a range of often unintended consequences. Others approach policy and planning as inherently political acts, concerned with the exercise of power and the creation and manipulation of rules to unfairly affect distribution of political and economic benefits.

Drawing on both political economy perspectives and resilience thinking, others approach policy processes as murky and clumsy. Policy is inherently experimental (Verweij, Douglas *et al*. 2006). Policy actions can never be guaranteed to deliver the policy outcomes that are intended. Anthropological approaches to policy illustrate the contested discourse, knowledge and power within policy processes (Shore and Wright, 1997). Such analysis suggests that the speeches and documents of policies and plans are but the theatre of policy, in many situations acting as a smokescreen to divert attention from real interests and objectives, and that much policy is purposively designed never to be implemented. Equally, implementation of policy is also contested, and actions are shaped according to competing interests of ever-shifting networks and alliances.

The failure of urban governance

Much of the climate adaptation literature highlights the inherent uncertainty and risk of climate change, and the resilience concepts of strengthening capacity to learn and reorganize. This leads to calls for climate governance that is founded on adaptive, flexible and learning-oriented institutions, able to operate at multiple ecological scales and across sectors and tiers of government. While there is a logical appeal to suggest these arguments, the challenge is to reconcile such ideals with the realities of current urban governance, and the fundamental failures of urban governance that characterize much of rapidly urbanizing Asia (Friend, Jarvie *et al*. 2013). It is essential to recognize the political nature of the forces that are driving urbanization, and how these influence urban governance.

Urbanization is central to the established orthodoxy of economic development. Yet in most of urbanizing Asia, this is only partly planned at best. The main role of the state is geared towards putting in the physical infrastructure, that then allows for investment, and then providing services. The key infrastructure comes first, and the city follows. There is no clear vision of what an urban future would look like – of how cities might be laid out, of how urban citizens could shape their urban environment. This is to be determined by individual, private sector led investments rather than a shared vision of urban values and futures.

The state plays two critical and perhaps incompatible roles. The state has played both an entrepreneurial and a managerial role, investing and also acting as a system of checks and balances (Harvey, 2006). This conflicting role is especially significant given that much of the effort around mainstreaming is actually geared towards providing finance to local governments, and finance is the basis of their political capital.

While the tools and techniques of urban planning are well established, the practice is something quite different. Urban planning hinges on the application of spatial planning. But it is here that we see the greatest challenge. On the whole, there has been a complete and absolute failure of land use planning in rapidly urbanizing areas. While the plans themselves look convincing, it is often a process of painting by numbers – updating maps after the fact to take account of changes on the ground. Rather than applying land use plans as the basis of realizing a strategic vision of an urban future, land use plans can serve to identify areas for investment and conversion for the benefit of the powerful. The knowledge of land use plans becomes critical capital (Ribeiro, 2005).

The main pressure on existing land use planning systems has been related to investment capital. Speculative investment in land has driven much of this urbanization. With free capital both within the region, and globally, investment in and redevelopment of land has attracted huge amounts of investment capital (Harvey, 2012). This has often been driven by and attracted to low-value land where revenues from conversion and further investment are the highest. In Southeast Asia this has often been low-value agricultural, wetland land – prone to flooding or in other ways hazardous – or under ambiguous land title regimes.

Urbanization has thus gone against existing land use plans and over-ruled environmental legislation. Indeed, the insider knowledge of land use plans has had a market value, allowing for speculative investment ahead of state planning decisions, creating a whole new set of political and economic alliances that further blur the boundaries between the state and the market.

From across Thailand to Vietnam and south to Indonesia, this has led to a range of well-documented problems of pollution and land degradation, creating a whole new set of vulnerabilities and risks that will be further intensified by climate change. Within this whole process the rights of citizens, and non-citizen urban residents, to shape their urban future has been tightly constrained.

Creating the conditions for urban governance

If we take this situation as the starting point – of a process of urbanization that is fiercely contested, driven by political and investment interests, with a failure of both governance and the market to prevent environmental degradation and the emergence of climate climate-related risks – then the challenge is less about mainstreaming urban climate resilience into failed governance processes and practices, than it is about creating the conditions for urban governance that can take on board the principles of resilience. In many cases there are such fundamental gaps in policy and practice that there is nothing to mainstream into (Friend and Moench, 2013). Moreover, such principles that are so central to resilience-based theories of governance – of adaptive, flexible, learning learning-oriented institutions and processes, and of multi-scale, polycentric governance – do not sit easily with the realities of contemporary urbanization.

...the challenge is less about mainstreaming urban climate resilience into failed governance processes and practices, than it is about ***creating the conditions for urban governance*** *that can take on board the principles of resilience.*

Realising the principles of urban governance requires putting at centre stage both the rights and needs of diverse urban citizens with accountable, representative and transparent state processes, as well as the emerging ecological constraints of planetary boundaries and climate change. It means choosing sides – putting the interest of a collective populace ahead of powerful interests able to manipulate planning and broader governance processes. From our perspective, at the heart of these challenges, and in view of the need to improve such core urban planning practices such as land use planning, are access rights as enshrined in the Rio Summit's Principle 10 – access to information, public participation, and redress and remedy.

If we take the technological approach that sees cities as set in stone – as systems in their own right that are not contested – then the kinds of interventions we promote, particularly around infrastructure, and the kinds of processes that we promote that do not create the kind of governance space – can lead to unjust interventions and outcomes. Given the significance of the financial drivers of urbanization and the history of urbanization, such outcomes should be expected.

Much of the current effort is framed around financial investment for infrastructure needs. Clearly many urbanizing areas in Asia have a need for investment, since much infrastructure is not present, or is already fragile and failing, and many urban governments struggle to provide the services, and create the conditions needed for citizen well-being and healthy lives.

But if we see cities as products of capital investment and infrastructure, and appreciate the political dimensions of such flows as well as the risks associated with leakages, we must also be concerned that investment without appropriate governance mechanisms – which can ensure that infrastructure is designed and located for the needs of diverse citizens, or that can provide the mechanisms for transparency and accountability – can actually make a bad situation even worse.

In the same way that historical case studies of gentrification and renovation of urban studies areas are now seen to have had revealed a whole range of social impacts, including the creation and exacerbation of social divisions and conflict, the new agenda of urban climate resilience, unless founded on a more nuanced approach to governance, policy and practice, and aligned with commitments to rights and justice, may come to be seen as the new bogey man of urban development. As Friend and Moench (2013; p. 104) argue:

> *An emphasis on system resilience, depending on how it is defined, can easily detract attention from existing inequalities and injustices. The concern here is that the discourse around city systems resilience can easily become framed as a 'trade-off' between the needs of the system against particular groups within the system. Intriguingly we most commonly meet framings in which system resilience come along with the necessary costs to be borne by the poorer groups (we see similar arguments around economic efficiency and austerity and also sustainability). Yet it is less common to see arguments around city system resilience and the need for costs to be borne by the wealthy and powerful in the interests of the greater good.*

Urban resilience alone is not enough to ensure just outcomes. Resilient systems are not always just or equitable, and the discourse of resilience can lend itself to all kinds of policy narratives that are counter to values of social justice and equity. The debate must also be framed in terms of governance and rights to the city.

...the new agenda of urban climate resilience, unless founded on a more nuanced approach to governance, policy and practice, and aligned with commitments to rights and justice, may come to be seen as the new bogey man of urban development.

Residential areas - both of well established communities and new developments - are often located directly next to critical water infrastructure in Bangkok, the capital of Thailand. Photo: R. Friend

References

Friend, R., *et al.* (2013) Mainstreaming Urban Climate Resilience into Policy and Planning: Reflections from Asia. *Urban Climate* 7: 6-19.

Friend, R. and M. Moench (2013) What is the purpose of urban climate resilience? Implications for addressing poverty and vulnerability. *Urban Climate* 6: 98-113.

Harvey, D. (2006) From Managerialism to Entrepeneurialism: the transformation in urban governance in late capitalism. Geografiska Annaler Series B, Human Geography 71 71(1): 3-17.

Harvey, D. (2008) *The right to the city*.

Harvey, D. (2012) *Rebel cities: from the right to the city to the urban revolution*, Verso Books.

Moris, J. (2014) Reimagining Development 3.0 for a Changing Planet. IDS Working Papers 435.

Ribeiro, G. (2005) Research into Urban Development and Cognitive Capital in Thailand. *The Journal of Transdisciplinary Environmental Studies* 4(1).

Shore, C. and S. Wright (1997) *Anthropology of policy: Perspectives on governance and power*, Routledge.

Swyngedouw, E. and N. C. Heynen (2003) Urban political ecology, justice and the politics of scale. *Antipode* 35(5): 898-918.

Verweij, M., *et al*. (2006) Clumsy solutions for a complex world: the case of climate change. *Public Administration* 84(4): 817-843.

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Urban Forestry & Green Infrastructure

European experts gather in ***Lausanne, Switzerland*** *to explore the role of trees in the climate of streets, parks and entire cities*

Cities depend on a healthy and functioning natural environment for the provision of ecosystem services, which create the foundation for urban sustainability. Forest ecosystems, in particular, provide essential services that are often taken for granted: temperature regulation, carbon sequestration, filtration and purification of air, water and soils, storm water management and flooding reduction, prevention of soil erosion, and the provision of viable habitats for animal species and recreational opportunities for people. If these systems become degraded, the value of the ecosystem services they provide will be reduced or even lost – and their restoration or replacement with alternative infrastructure is time-consuming, expensive and sometimes impossible.

*   *   *

This message was a central theme at the **17th International Conference of the European Forum on Urban Forestry (EFUF 2014)**, which attracted both academics and practitioners from over 30 countries to the Swiss city of Lausanne during the first week of June. In tandem with the conference was the latest bi-annual meeting of the European **COST Action FP1204** (see UCN 49, p. 18) known as *GreenInUrbs*, where members of three working groups continued to grapple with the environmental, social and governance-related aspects of Urban Forestry (UF) and Green Infrastructure (GI).

Carlo Calfapietra from the National Research Council in Italy, coordinator of the COST Action, kicked off the EFUF conference by summarizing the progress of the three working groups – which are now in the midst of producing policy papers and other intermediate documents that are intended to capture the state of the art in UF and GI practice. Up-to-date information on research activities undertaken within the framework of the action, including short-term scientific missions bringing together researchers from different European member and partner countries, can be found on the COST Action website at www.greeninurbs.com.

The ecological importance of UF and GI for cities was underlined by **Shela Patrickson**, the first in a series of plenary speakers and Manager of the Cities Biodiversity Center of ICLEI – an international consortium of cities and local governments dedicated to sustainable development. She considered the economic, as well as social and environmental value of urban forests in a series of urban cases studies from Europe (Brussels and Bonn) and Canada (Edmonton and Montreal), where green infrastructure policy is being implemented in practice. By quantifying the equivalent monetary value that is embodied by a tree in the city due to its multiple benefits, the case for "greening the concrete jungle" could be made in terms that are convincing to municipal decision-makers – within the specific local context of each city.

A local Swiss example was offered by **Emmanuel Rey** of EPFL in Lausanne, who presented a series of alternative design morphologies for a residential development in Bern at the interface with a forested area – considering the broader issue of "green density" in cities. An especially engaging plenary talk was also given by **Arne Arnberger** from Vienna, who has closely examined the neglected relationship between urban development and recreation there. He described the impact of urban densification around two large forested areas, which has led to a dramatic increase in the size of the local population living within walking distance and in turn to an upsurge in park visitation. In order to cope with crowdedness, visitors (and their dogs) become displaced to more ecologically-sensitive sections of the forest and amplify the pressure on its ecological services – necessitating the establishment of additional green space in the city.

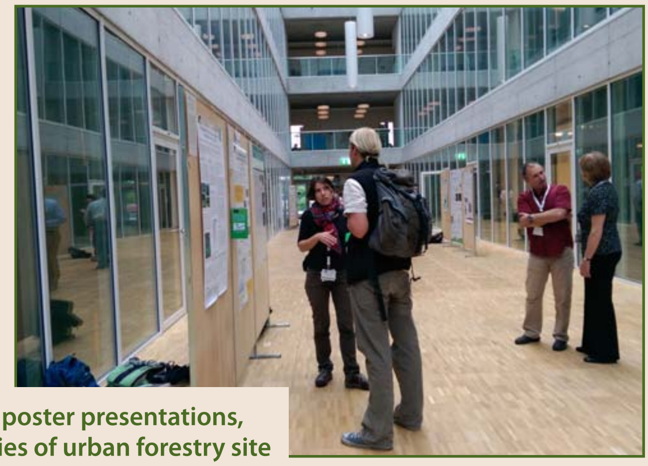
A significant share of the research presented at EFUF was directly related to urban climate, and especially the microclimate of city spaces over a variety of scales. **Ruzana Sarusi**, working with **Stephen Livesley** in Melbourne, Australia, recorded significant reductions in mean radiant temperature in residential streets that had dense, well-developed tree canopies – but also presented evidence that human thermal stress is critically dependent on a range of spatial variables such as street orientation and pedestrian location. **Sten Gilner** and colleagues in Dresden looked at differences in the cooling effects of different tree species, examining not only microclimatic parameters but also the Leaf Area Index and leaf-gas exchange. Comparing five species of urban street trees, they showed that the higher the LAI and the transpiration, the higher the cooling effects of the trees.

The influence of forested areas on the urban heat island of Milano, Italy was investigated by **Simone Parisi** and colleagues using a surface energy balance model applied to meteorological time series from stations in the city and in Parco Nord, a large peri-urban park, to track relative variations in the ratio of sensible and latent heat during the summer months. They found significant inter-annual variability as a function of water variability in the park, which in turn indicated meaningful differences over time in the suitability of the park for use by city dwellers.

One approach to moderating the effects of urban warming is to utilize the nighttime drainage of cool air through valleys surrounding a city. In Aachen, which is among several German locations in which this effect has been studied, **Timo Sachsen** and colleagues installed weather stations to monitor the effects of green space on air flow and found a significant impact of vegetation density and surface roughness wind speed – with thick concentrations of bushes and trees even deflecting the stream into surrounding valleys. Also presented by **yours truly** was a survey of recent studies carried out in the hot-arid Negev region of Israel, analyzing the effects of vegetation on pedestrian thermal stress and quantifying the "cooling efficiency" of different landscape treatments in urban spaces (see UCN 51, p. 13).

The proceedings of EFUF 2014 can be found online at www.efuf2014.org/.

— *David Pearlmutter*



In addition to oral and poster presentations, EFUF 2014 featured a series of urban forestry site visits and social events – with a backdrop provided by the green infrastructure of Lausanne.

Photos: F. Ugolini / D. Pearlmutter

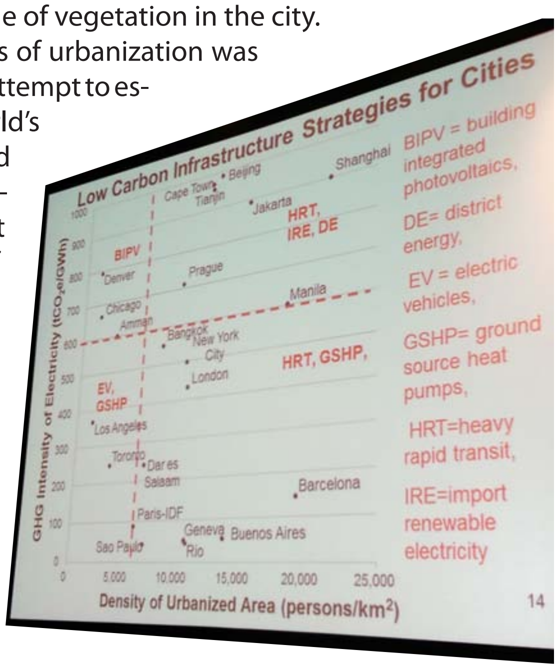
Climate Change and the Urban Environment

Toronto hosts international conference on Urban Environmental Pollution from June 12-15, 2014

"We need to learn more about cities and how they function. We know that they consume enormous quantities of materials and energy and release large quantities of wastes. Cities are the source of air, water and soil pollutants. Heat islands and CO_2 domes, combined with particulates and ozone affect human health. Lack of park and green space disconnects urban residents from the natural world and may have adverse psychological effects."

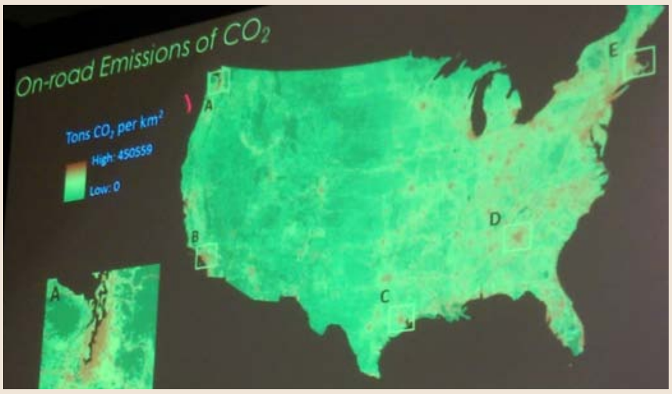
With these words, Conference Chair **Bill Manning** welcomed over a hundred delegates to this year's international conference on **Urban Environmental Pollution (UEP2014)** in Toronto, Canada. Under the theme of "climate change and urban environment," the meeting provided a cross-disciplinary platform to explore the nature of the urban environment and how it affects human health and well-being. Among the topics covered, urban climate-related issues were prominent – ranging from urban greenhouse gas emissions to the alleviation of thermal stress in the built environment, with an ongoing emphasis on the role of vegetation in the city.

The first in a series of invited speakers to grapple with the impacts of urbanization was **Chris Kennedy** of University of Toronto, who presented an ambitious attempt to estimate the overall energy use and carbon dioxide emissions of the world's cities. The method which he described for quantifying energy-related CO_2 was developed as a four-step process, starting with a multiple regression model describing urban energy use for electricity, transport and heating based on an empirical dataset from 22 urban regions of varying size, density, wealth and climate. The regression equations were used to estimate energy consumption in all world cities with over 100,000 inhabitants, and emissions factors for each category of energy use were then used to quantify carbon emissions. Finally, the model was used to determine how future emissions might change as a consequence of population growth, urban density, climate and technology. In a related presentation, **Iain Stewart** showed preliminary results of a study quantifying the "urban metabolism" (defined as the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste) of the world's "mega-cities" (defined as urban areas with population over 10 million).



Mega-cities were also the focus of a wide-ranging talk by **Gerd Folberth** of the UK Met Office, who emphasized the interrelations between urban air quality and climate. He stressed both the vulnerability of the world's 30 mega-cities (most of which are located in coastal areas and thus susceptible to global sea-level rise), and their impact as concentrated sources of not only long-lived greenhouse gases, but also short-lived air pollutants – which are also linked to climate change through numerous physical and chemical atmospheric pathways. He summarized findings from an urban modeling study conducted in the framework of MEGAPOLI, a European FP7 collaborative project, and highlighted several open questions related to megacity footprints, energy efficiency and food production which also have implications for air quality and climate.

Lucy Hutyra of Boston University also examined urbanization as a dominant source of carbon emissions, but also as a driver of major changes in land use and land cover – which impact biotic carbon pools and fluxes and make cities the largest and most dynamic elements of the global carbon cycle. She described a multidisciplinary study aimed at characterizing the sources and sinks of CO_2 across urban-rural gradients, acknowledging that urban forests contain significant biomass stocks and have consequences for ecosystem productivity.



One consequence of a changing climate is the increasing intensity and frequency of heat waves, which can be exacerbated in cities by heat island effects. The question of whether urban and rural temperatures respond in the same way to heat waves was taken up by **Dan Li** of NOAA's Geophysical Fluid Dynamics Lab at Princeton, using a combination of observational and modeling analyses in the Baltimore-Washington urban corridor. It was found that due to synergistic effects, heat waves not only elevate regional temperatures but also intensify urban-rural differences – indicating that heat stress severity in cities is likely to increase by even more than the sum of the background UHI and heat wave effects. Since this added impact is primarily attributed to a lack of surface moisture, the effectiveness of mitigating strategies such as green (planted) as well as cool (high-albedo) roofs was evaluated at city scale, using the Weather Research and Forecasting (WRF) model in conjunction with the Princeton Urban Canopy Model (PUCM) and found to reduce urban surface temperatures by up to about 5 K.

Suzanne Jochner from Technische Universität München looked at urban phenology as a bio-indicator for urban warming in German cities, as well as in the tropical city of Campinas in Brazil. While used for many years to detect UHI effects, plant phenology in warm and dry urban areas has more recently been considered as a predictor of climate change impacts – and in this study, temperature and humidity along urban gradients were measured together with atmospheric concentrations of ozone, NO_2 and foliar nutrients. Temperature was found to be the most influential factor on tree phenology, such that plants in cities flower earlier than those in the countryside. However, urban-rural differences in onset dates were found to be very sensitive to conditions in the period shortly before flowering, with cold periods producing pronounced differences and warm periods leading to an almost simultaneous onset of phenological phases. Urban air pollutants were also seen to influence onset dates, as well as other biological processes: for instance, NO_2 decreased pollen production and tropospheric ozone was positively correlated with allergen content.

David Nowak of the USDA Forest Service offered a panoramic overview of urban forests (that is, all trees within an urban area) – discussing the ways that trees affect air quality and climate change, and presenting data on the variations of urban tree cover across the United States. His analyses of the magnitude and value of urban forests related to three realms: air pollution removal and human health, carbon storage and sequestration, and building energy use and consequent pollutant emissions.

The final invited speaker at UEP2014 was **Ryo Moriwaki** of Ehine University in Japan, who will be known to many IAUC members as one of the organizers of ICUC-7 in Yokohama. He is also one of the pioneers in research on urban energy and scalar exchanges on the basis of tower measurements, and has analyzed the impacts of urban morphology as well as anthropogenic emissions on turbulent flow, air temperature and carbon dioxide and water vapor concentrations. The interrelated anthropogenic influences on CO_2 and H_2O in cities were the focus of his talk, which also introduced a new and unique approach to monitoring urban cloud cover, as a vehicle for analyzing the effects of urbanization on cloud height and thickness.

In addition to the series of invited speakers, a full schedule of submitted oral and poster presentations was included in the conference program – which can be viewed online at: www.uepconference.com/.

—David Pearlmutter, Editor

Recent publications in Urban Climatology

In this edition a list of publications are presented that have come out between March and May 2014. 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 in the following format: Author, Title, Journal, Volume, Pages, Dates, Keywords, Language, URL, and Abstract. In order to make the lives of the Bibliography Committee members slightly more easy, please send the references in a .bib format.

Also, I would like to take the opportunity to thank Dr. **Bruno Bueno**, who recently resigned as a member of the bibliographic committee. Thanks for contributing many years to the collection of research papers on Urban Climatology!

Finally, in case someone is interested to join the Bibliography Committee, please let me know via the email address below.

Regards,

Matthias Demuzere

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Abdel-Ghany, A. M.; Al-Helal, I. M. & Shady, M. R. (2013), Human Thermal Comfort and Heat Stress in an Outdoor Urban Arid Environment: A Case Study, *Advances in Meteorology*.

Aditya, V. B. & Thomas, T. (2014), Policy climates and climate policies: Analysing the politics of building urban climate change resilience, *Urban Climate* 7(0), 20-32.

Aher, G.; Pawar, G.; Gupta, P. & Devara, P. (2014), Effect of major dust storm on optical, physical, and radiative properties of aerosols over coastal and urban environments in Western India, *International Journal of Remote Sensing* 35(3), 871-903.

Amorim, J. H.; Valente, J.; Cascao, P.; Rodrigues, V.; Pimentel, C.; Miranda, A. I. & Borrego, C. (2013), Pedestrian Exposure to Air Pollution in Cities: Modeling the Effect of Roadside Trees, *Advances in Meteorology*.

Argüeso, D.; Evans, J.; Fita, L. & Bormann, K. (2014), Temperature response to future urbanization and climate change, *Climate Dynamics* 42(7-8), 2183-2199.

Bauche, J. P.; Grigorieva, E. A. & Matzarakis, A. (2013), Human-Biometeorological Assessment of Urban Structures in Extreme Climate Conditions: The Example of Birobidzhan, Russian Far East, *Advances in Meteorology*.

Bieringer, P. E.; Longmore, S.; Bieberbach, G.; Rodriguez, L. M.; Copeland, J. & Hannan, J. (2013), A method for targeting air samplers for facility monitoring in an urban environment , *Atmospheric Environment* 80(0), 1-12.

Birkmann, J.; Garschagen, M. & Setiadi, N. (2014), New challenges for adaptive urban governance in highly dynamic environments: Revisiting planning systems and tools for adaptive and strategic planning , *Urban Climate* 7(0), 115-133.

Chen, Y.; Lin, P. & Matzarakis, A. (2013), Vertical variability of thermal comfort in urban areas: The example of Taipei 101, *Meteorologische Zeitschrift* 22(6), 753-759.

Cheng, I.; Zhang, L.; Mao, H.; Blanchard, P.; Tordon, R. & Dalziel, J. (2014), Seasonal and diurnal patterns of speciated atmospheric mercury at a coastal-rural and a coastal-urban site, *Atmospheric Environment* 82(0), 193-205.

Coppola, D.; Laiolo, M.; Delle-Donne, D.; Ripepe, M. & Cigolini, C. (2014), Hot-spot detection and characterization of strombolian activity from MODIS infrared data, *International Journal of Remote Sensing* 35(9), 3403-3426.

Davis, M. (2013), Happy City: Transforming Our Lives Through Urban Design, *Nature* 503(7474), 36.

Deng, X.; Zhao, C. & Yan, H. (2013), Systematic Modeling of Impacts of Land Use and Land Cover Changes on Regional Climate: A Review, *Advances in Meteorology*.

Deventer, M. J.; Griessbaum, F. & Klemm, O. (2013), Size-resolved flux measurement of sub-micrometer particles over an urban area, *Meteorologische Zeitschrift* 22(6), 729-737.

Egerhazi, L. A.; Kovacs, A. & Unger, J. (2013), Application of Microclimate Modelling and Onsite Survey in Planning Practice Related to an Urban Micro-Environment, *Advances in Meteorology*.

Eludoyin, O. M.; Adelekan, I. O.; Webster, R. & Eludoyin, A. O. (2014), Air temperature, relative humidity, climate regionalization and thermal comfort of Nigeria, *International Journal of Climatology* 34(6), 2000-2018.

Frey, C. & Kuenzer, C. (2014), Land-surface temperature dynamics in the Upper Mekong Basin derived from MO-

DIS time series, *International Journal of Remote Sensing* 35(8), 2780-2798.

Friend, R.; Jarvie, J.; Reed, S. O.; Sutarto, R.; Thinphanga, P. & Toan, V. C. (2014), Mainstreaming urban climate resilience into policy and planning; reflections from Asia , *Urban Climate* 7(0), 6-19.

Fruin, S.; Urman, R.; Lurmann, F.; McConnell, R.; Gauderman, J.; Rappaport, E.; Franklin, M.; Gilliland, F. D.; Shafer, M.; Gorski, P. & Avol, E. (2014), Spatial variation in particulate matter components over a large urban area, *Atmospheric Environment* 83(0), 211-219.

Georgescu, M.; Moustaoui, M.; Mahalov, A. & Dudhia, J. (2013), Summer-time climate impacts of projected megapolitan expansion in Arizona, *Nature Climate Change* 3(1), 37-41.

Giovannini, L.; Zardi, D.; de Franceschi, M. & Chen, F. (2014), Numerical simulations of boundary-layer processes and urban-induced alterations in an Alpine valley, *International Journal of Climatology* 34(4), 1111-1131.

Hamdi, R.; Van de Vyver, H.; De Troch, R. & Termonia, P. (2014), Assessment of three dynamical urban climate downscaling methods: Brusselss future urban heat island under an A1B emission scenario, *International Journal of Climatology* 34(4), 978-999.

He, J.; Yu, Y.; Liu, N. & Zhao, S. (2013), Numerical model-based relationship between meteorological conditions and air quality and its implication for urban air quality management, *Int. J. of Environment and Pollution* 53(3/4), 265-286.

Heusinkveld, B. G.; Steeneveld, G. J.; van Hove, L. W. A.; Jacobs, C. M. J. & Holtslag, A. A. M. (2014), Spatial variability of the Rotterdam urban heat island as influenced by urban land use, *Journal of Geophysical Research: Atmospheres* 119(2), 677-692.

Hu, L.; Brunsell, N. A.; Monaghan, A. J.; Barlage, M. & Wilhelmi, O. V. (2014), How can we use MODIS land surface temperature to validate long-term urban model simulations? *Journal of Geophysical Research: Atmospheres* 119(6), 3185-3201.

Huang, C.; Li, Y.; Liu, G.and Zhang, H. & Liu, Q. (2014), Recent climate variability and its impact on precipitation, temperature, and vegetation dynamics in the Lancang River headwater area of China, *International Journal of Remote Sensing* 35(8), 2822-2834.

Jinming, F.; Jun, W. & Zhongwei, Y. (2014), Impact of Anthropogenic Heat Release on Regional Climate in Three Vast Urban Agglomerations in China, *Advances in Atmospheric Sciences* 31(2), 363-373.

Ke, X.; Ma, E. & Yuan, Y. (2014), Scenario Simulation of the Influence of Land Use Change on the Regional Temperature in a Rapidly Urbanizing Region: A Case Study in Southern-Jiangsu, China, *Advances in Meteorology*.

Kharol, S. K.; Kaskaoutis, D. G.; Sharma, A. R. & Singh, R. P. (2013), Long-Term (1951-2007) Rainfall Trends around Six Indian Cities: Current State, Meteorological, and Urban Dynamics, *Advances in Meteorology*.

Komarov, V.; Lavrinenko, A.; Lomakina, N. & Iln, S. (2014), Experience of using a dynamic stochastic approach for solving the problem of very short-range forecasting of state parameters of the atmospheric boundary layer, *Russian Meteorology and Hydrology* 39(2), 77-83.

Kulkarni, A. T.; Mohanty, J.; Eldho, T. I.; Rao, E. P. & Mohan, B. K. (2014), A web GS based integrated flood assessment modeling tool for coastal urban watersheds, *Computers & Geosciences* 64, 7-14.

Kwak, K.-K. & Baik, J.-J. (2014), Diurnal variation of NOx and ozone exchange between a street canyon and the overlying air, *Atmospheric Environment* 86(0), 120-128.

Lee, H.; Holst, J. & Mayer, H. (2013), Modification of Human-Biometeorologically Significant Radiant Flux Densities by Shading as Local Method to Mitigate Heat Stress in Summer within Urban Street Canyons, *Advances in Meteorology*.

Lee, S.-H. & Fernando, H. J. S. (2013), Dispersion of an urban photochemical plume in Phoenix metropolitan area, *Atmospheric Environment* 80(0), 152-160.

Li, C.; Zhou, J.; Cao, Y.; Zhong, J.; Liu, Y.; Kang, C. & Tan, Y. (2014), Interaction between urban microclimate and electric air-conditioning energy consumption during high temperature season, *Applied Energy* 117(0), 149-156.

Lin, C.-H.; Lin, T.-P. & Hwang, R.-L. (2013), Thermal Comfort for Urban Parks in Subtropics: Understanding Visitors Perceptions, Behavior and Attendance, *Advances in Meteorology*.

Lin, Y.; Liu, A.; Ma, E.; Li, X. & Shi, Q. (2013), Impacts of Future Urban Expansion on Regional Climate in the Northeast Megalopolis, USA, *Advances in Meteorology*.

Lopes, A.; Alves, E.; Alcoforado, M. J. & Machete, R. (2013), Lisbon Urban Heat Island Updated: New Highlights about the Relationships between Thermal Patterns and Wind Regimes, *Advances in Meteorology*.

Luo, P.; Takara, K.; Apip; He, B. & Nover, D. (2014), Reconstruction assessment of historical land use: A case study in the Kamo River basin, Kyoto, Japan, *Computers & Geosciences* 63, 106-115.

Lwasa, S.; Mugagga, F.; Wahab, B.; Simon, D.; Connors, J. & Griffith, C. (2014), Urban and peri-urban agriculture and forestry: Transcending poverty alleviation to climate change mitigation and adaptation, *Urban Climate* 7(0), 92 -106.

Mahmood, R.; Pielke, R. A.; Hubbard, K. G.; Niyogi, D.; Dirmeyer, P. A.; McAlpine, C.; Carleton, A. M.; Hale, R.; Gameda, S.; Beltrán-Przekurat, A.; Baker, B.; McNider, R.; Legates, D. R.; Shepherd, M.; Du, J.; Blanken, P. D.; Frauenfeld, O. W.; Nair, U. & Fall, S. (2014), Land cover changes and their biogeophysical effects on climate, *International Journal of Climatology* 34(4), 929-953.

Mao, Y.; Wilson, J. D. & Kort, J. (2013), Effects of a shelterbelt on road dust dispersion, *Atmospheric Environment* 79(0), 590-598.

Moustris, K. P.; Nastos, P. T. & Paliatsos, A. G. (2013), One-Day Prediction of Biometeorological Conditions in a Mediterranean Urban Environment Using Artificial Neural Networks Modeling, *Advances in Meteorology*.

Mues, A.; Manders, A.; Schaap, M.; Van-Ulft, L. H.; Van-Meijgaard, E. & Builtjes, P. (2013), Differences in particulate matter concentrations between urban and rural regions under current and changing climate conditions, *Atmospheric Environment* 80(0), 232-247.

Nastos, P.; Matzarakis, A.; Nikolopoulou, M. & Lin, T.-P. (2013), Advances in Urban Biometeorology, *Advances in Meteorology*.

Nastos, P. T. & Matzarakis, A. (2013), Human Bioclimatic Conditions, Trends, and Variability in the Athens University Campus, Greece, *Advances in Meteorology*.

Ndetto, E. L. & Matzarakis, A. (2013), Effects of Urban Configuration on Human Thermal Conditions in a Typical Tropical African Coastal City, *Advances in Meteorology*.

Padmakumari, B.; Maheskumar, R. S.; Harikishan, G.; Morwal, S. B.; Prabha, T. V. & Kulkarni, J. R. (2013), In situ measurements of aerosol vertical and spatial distributions over continental India during the major drought year 2009, *Atmospheric Environment* 80(0), 107-121.

Panteliadis, P.; Strak, M.; Hoek, G.; Weijers, E.; Zee, S. & Dijkema, M. (2014), Implementation of a low emission zone and evaluation of effects on air quality by long-term monitoring, *Atmospheric Environment* 86(0), 113-119.

Pataki, D. E. (2013), Urban greening needs better data, *Nature* 502(7473), 624.

Petralli, M.; Massetti, L.; Brandani, G. & Orlandini, S. (2014), Urban planning indicators: useful tools to measure the effect of urbanization and vegetation on summer air temperatures, *International Journal of Climatology* 34(4), 1236-1244.

Popova, V. (2014), Summertime warming in the European part of Russia and extreme heat in 2010 as manifestation of large-scale atmospheric circulation trends in the late 20th–early 21st centuries, *Russian Meteorology and Hydrology* 39(3), 159-167.

Probáld, F. (2014), The urban climate of Budapest: past, present and future, *Hungarian Geographical Bulletin* 63(1), 69-79.

Ramsey, N. R.; Klein, P. M. & Moore-III, B. (2014), The impact of meteorological parameters on urban air quality, *Atmospheric Environment* 86(0), 58-67.

Rao, K. S. M.; Verma, T. S.; Chimidza, S. & John, S. K. (2014), A new method of quantifying aerosol concentrations in atmosphere, *Meteorology and Atmospheric Physics* 124(1-2), 83-96.

Reckien, D.; Flacke, J.; Dawson, R. J.; Heidrich, O.; Olazabal, M.; Foley, A.; Hamann, J. J. P.; Orru, H.; Salvia, M.; Hurtado, S. D. G.; Geneletti, D. & Pietrapertosa, F. (2014), Climate change response in Europe: whats the reality? Analysis of adaptation and mitigation plans from 200 urban areas in 11 countries, *Climatic Change* 122(1-2), 331-340.

Retchless, D.; Frey, N.; Wang, C.; Hung, L.-S. & Yarnal, B. (2014), Climate extremes in the United States: recent research by physical geographers, *Physical Geography* 35(1, SI), 3-21.

Rodríguez, R.; Navarro, X.; Casas, M. C.; Ribalaygua, J.; Russo, B.; Pouget, L. & Redaño, A. (2014), Influence of climate change on IDF curves for the metropolitan area of Barcelona (Spain), *International Journal of Climatology* 34(3), 643-654.

Ryu, Y.-H.; Baik, J.-J. & Lee, S.-H. (2013), Effects of anthropogenic heat on ozone air quality in a megacity, *Atmospheric Environment* 80(0), 20-30.

Santos-Juusela, V. D.; Petaja, T.; Kousa, A. & Hameri, K. (2013), Spatial-temporal variations of particle number concentrations between a busy street and the urban background, *Atmospheric Environment* 79(0), 324-333.

Sharma, S. K.; Kumar, M.; Rohtash; Gupta, N. C.; Saraswati; Saxena, M. & Mandal, T. K. (2014), Characteristics of ambient ammonia over Delhi, India, *Meteorolgy and Atmospheric Physics* 124(1-2), 67-82.

Shi, W.; Tao, F. & Liu, J. (2014), Regional temperature change over the Huang-Huai-Hai Plain of China: the roles of irrigation versus urbanization, *International Journal of Climatology* 34(4), 1181-1195.

Shrestha, S. R.; Oanh, N. T. K.; Xu, Q.; Rupakheti, M. & Lawrence, M. G. (2013), Analysis of the vehicle fleet in the Kathmandu Valley for estimation of environment and climate co-benefits of technology intrusions, *Atmospheric Environment* 81(0), 579-590.

Sifakis, N. I. & Iossifidis, C. (2014), CHRISTINE Code for High ResolutIon Satellite mapping of optical ThIckness and

ANgstrom Exponent. Part I: Algorithm and code, *Computers & Geosciences* 62, 136-141.

Sifakis, N. I.; Iossifidis, C. & Kontoes, C. (2014), CHRISTINE Code for High Resolution Satellite mapping of optical Thickness and ANgstrom Exponent. Part II: First application to the urban area of Athens, Greece and comparison to results from previous contrast-reduction codes, *Computers & Geosciences* 62, 142-149.

Simpson, I. J.; Marrero, J. E.; Batterman, S.; Meinardi, S.; Barletta, B. & Blake, D. R. (2013), Air quality in the Industrial Heartland of Alberta, Canada and potential impacts on human health, *Atmospheric Environment* 81(0), 702-709.

Song, B. & Park, K. (2014), Validation of ASTER Surface Temperature Data with In Situ Measurements to Evaluate Heat Islands in Complex Urban Areas, *Advances in Meteorology*.

Stathakis, D. & Faraslis, I. (2014), Monitoring urban sprawl using simulated PROBA-V data, *International Journal of Remote Sensing* 35(7), 2731-2743.

Stewart, I. D.; Oke, T. R. & Krayenhoff, E. S. (2014), Evaluation of the 'local climate zone' scheme using temperature observations and model simulations, *International Journal of Climatology* 34(4), 1062-1080.

Szell, M. (2014), The New Science of Cities, *Science* 343(6174), 970-971.

Wong, P.; Lai, P.-C. & Hart, M. (2013), Microclimate Variations between Semienclosed and Open Sections of a Marathon Route, *Advances in Meteorology*.

Yang, L.; Tian, F.; Smith, J. A. & Hu, H. (2014), Urban signatures in the spatial clustering of summer heavy rainfall events over the Beijing metropolitan region, *Journal of Geophysical Research: Atmospheres* 119(3), 1203-1217.

Young, D. T.; Chapman, L.; Muller, C. L.; Cai, X.-M. & Grimmond, C. S. B. (2014), A Low-Cost Wireless Temperature Sensor: Evaluation for Use in Environmental Monitoring Applications, *Journal of Atmospheric and Oceanic Technology* 31(4), 938-944.

Zhan, J.; Huang, J.; Zhao, T.; Geng, X. & Xiong, Y. (2013), Modeling the Impacts of Urbanization on Regional Climate Change: A Case Study in the Beijing-Tianjin-Tangshan Metropolitan Area, *Advances in Meteorology*.

Zhang, B.; Zhang, L.; Guo, H.; Leinenkugel, P.; Zhou, Y.; Li, L. & Shen, Q. (2014), Drought impact on vegetation productivity in the Lower Mekong Basin, *International Journal of Remote Sensing* 35(8), 2835-2856.

Zhang, F.; Zhu, X. & Liu, D. (2014), Blending MODIS and Landsat images for urban flood mapping, *International Journal of Remote Sensing* 35(9), 3237-3253.

Zhao, C.; Jiang, Q.; Sun, Z.; Zhong, H. & Lu, S. (2013), Projected Urbanization Impacts on Surface Climate and Energy Budgets in the Pearl River Delta of China, *Advances in Meteorology*.

Zhuang, B. L. andLi, S.; Wang, T. J.; Deng, J. J.; Xie, M.; Yin, C. Q. & Zhu, J. L. (2013), Direct radiative forcing and climate effects of anthropogenic aerosols with different mixing states over China , *Atmospheric Environment* 79(0), 349-361.

Zoest, J.-v. & Hopman, M. (2014), Taking the economic benefits of green space into account: The story of the Dutch TEEB for Cities project, *Urban Climate* 7(0), 107-114.

Zuoqiang, H.; Zhongwei, Y.; Zhen, L.; Weidong, L. & Yingchun, W. (2014), Impact of urbanization on low-temperature precipitation in Beijing during 1960-2008, *Advances in Atmospheric Sciences* 31(1), 48-56.

Upcoming Conferences...

INTERNATIONAL GEOGRAPHICAL UNION (IGU) REGIONAL CONFERENCE
Kraków, Poland • 18-22 August 2014
http://www.igu2014.org/

20TH INTERNATIONAL CONGRESS OF BIOMETEOROLOGY (ICB)
Cleveland, Ohio, USA • Sep. 28 - Oct. 1, 2014
http://www.icb2014.com

URBANIZATION AND GLOBAL ENVIRONMENTAL CHANGE (UGEC)
Taipei, Taiwan • November 6-8, 2014
http://www.ugec2014.org/

DRYLANDS, DESERTS AND DESERTIFICATION (DDD 2014)
Sede Boqer, Israel • November 17-20, 2014
http://in.bgu.ac.il/en/desertification

PASSIVE AND LOW-ENERGY ARCHITECTURE (PLEA 2014)
Ahmedabad, India • December 16-18, 2014
http://www.plea2014.in/

INTERNATIONAL CONFERENCE ON URBAN CLIMATE (ICUC9)
Toulouse, France • July 20-24, 2015
http://www.meteo.fr/icuc9/

ICUC9 in Toulouse, France: First Call for Abstracts

The joint 9th International Conference on Urban Climate and 12th Symposium on the Urban Environment (SUE), sponsored by the International Association for Urban Climate and the American Meteorological Society, will be held in Toulouse, France, 20-24 July 2015.

In the year of the 21st session of the Conference of the Parties on Climate Change Policy & Practice, the focus of ICUC9 will be put on the recent scientific activities on Climate change mitigation & adaptation in urban environments, as well as on the transfer to institutional stakeholders urban planners to include urban climate considerations in their practices.

Of course, traditional topics covered by ICUC and SUE and related to advances in observations, modeling, and applications are also eligible. Any papers and posters on subjects dealing with urban climate issues are welcome.

The conference topics include, but are not limited to :

Climate change mitigation & adaptation in urban environments

- Cities in climate models (global and regional scales)
- Climate services for cities
- Forecasting and impacts of extreme weather events in cities
- Adaptation/mitigation strategies (e.g. urban greening)
- Incentives for adoption/implementation of mitigation and adaptation plans

Transfer of urban climate knowledge to urban planners

- Urban weather forecasting
- Indicators and climate maps
- Storm surges and flooding maps
- Warning plans
- Public policies
- Amendment / development of planning regulations

Study of urban climate processes

- Boundary layer and canopy layer Urban Heat Islands
- Surface and subsurface Urban Heat Islands
- Surface energy and water balances
- Greenhouse gases in the urban environment
- Flows and dispersion in the urban canopy layer
- Precipitation/fog/clouds
- Air quality/aerosols/radiative transfers in the urban boundary layer
- Influence of urban vegetation

Geospatial datasets

- Urban climatology studies
- New remote sensing technologies and data
- Local Climate Zones
- Urban database and link with models

New observational and modeling techniques and methods to study urban climates

- Field campaigns, sensor and network development
- Wind tunnel & hardware model experiments
- Statistical models
- CFD/LES/Dispersion models
- Numerical weather prediction and mesoscale modeling
- Urban canopy parameterizations

Bioclimatology and public health

- Outdoor microclimate and comfort
- Indoor comfort & air quality
- Human perception
- Climate resilient design

Urban design with climate

- Building climates
- Energy supply and demand in cities - the role of urban climates
- Sustainable design practices
- Morphological urban design

Urban planning with climate

- Enhancement/amendment of urban zoning
- Governance challenges for tackling urban heat

Interdisciplinarity

- Hydrology and floods in link with urban climates
- Biodiversity
- Link with social and human sciences

ICUC9 Call for Abstracts (cont.)

Submission Deadlines

Opens: Tuesday, July 22, 2014

Closes: Monday, December 1, 2014

23:59 pm Central Europe Time

Notification: Early February 2015

Helpful Information

Abstracts for the 9th International Conference on Urban Climate need to be submitted according to the instructions that appear in the official Call for Abstracts. Only those abstracts submitted via the official submission website will be considered. There is no cost for submitting an abstract.

All abstract submissions will be peer reviewed and may be submitted as an oral presentation and/or a poster presentation. Each abstract should represent complete and original results. As in previous ICUC, authors are limited to participation as "Presenter" in a maximum of ONE (1) abstract submissions.

For additional scientific information please contact the local scientific commitee (Valéry Masson and Aude Lemonsu) at : icuc9@meteo.fr

For any technical information on the submission procedure, please contact :

icuc9.secretary@meteo.fr

INTERNATIONAL ASSOCIATION FOR URBAN CLIMATE

Newsletter Contributions

The next edition of ***Urban Climate News*** will appear in late September. Items to be considered for the upcoming issue should be received by **August 31, 2014** and may be sent to Editor David Pearlmutter (davidp@bgu.ac.il) or to the relevant section editor:

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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.