

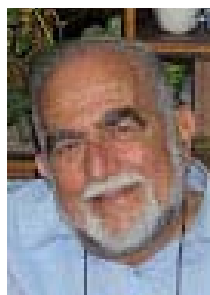
From the IAUC President

Colleagues, welcome to the 49th edition of *Urban Climate News*, the quarterly newsletter of the IAUC. We are approaching a milestone for the IAUC when the 50th edition, representing 10 years of newsletters, is published this December. The current edition contains a great variety of pieces on urban climate projects and news from a number of authors, so let me confine myself here to some items of IAUC news.

First, I want to congratulate **James Voogt** (Dept. of Geography, Western University, Canada) on his election by the IAUC committee to the role of President of the IAUC, starting next January. Jamie will be well known to much of the membership from various ICUC meetings and will bring his equanimity to the position. Our society has made great progress since our formation in 2000, and I have no doubts that under his leadership, the IAUC will continue to develop.



Second, let me formally congratulate **Valéry Masson** and **Aude Lemonsu** who won the right to hold the 9th International Conference on Urban Climate in 2015. ICUC9 will be held in Toulouse, France from July 20-24, 2015; the website announcing this is at <http://www.meteo.fr/cic/meetings/2015/ICUC9/>. In addition, the organisers introduce the venue in this edition (see [page 29](#)) and I expect that there will be regular updates in the coming months.



Thirdly, I have the pleasure of announcing that **Yair Goldreich** is the recipient of the 2013 Luke Howard Award. Prof. Goldreich is a climatologist with extensive interests in climate variations and the role of topography. He is one of the 'recent' pioneers in the field

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of urban climatology, starting his research on urban heat islands in complex urban settings in the 1970s. A more complete report will be produced in the next edition of *Urban Climate News*.

Finally, I would urge you (if you have not already done so) to join the [IAUC website](#). Our organisation is free to join and will remain so into the future. Joining allows members to take part in conversations and will allow you to download materials that are developed in the coming years. It will also allow the IAUC to establish ourselves as the primary scientific body for the advancement of our field of study. If you have difficulties registering your details on the website, please contact me directly at gerald.mills@ucd.ie using "IAUC membership" in the email header.

Gerald Mills
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The Ten Cities That Are Leading The Way In Urban Sustainability

Cities are the laboratories where the most innovative ideas for surviving in the future can be tested. These 10 – from New York to Tokyo to Bogota – were just awarded City Climate Leadership Awards for their work.

September 2013 — With a few exceptions, national governments aren't going to make a big dent in climate change and associated environmental problems. They're too big, slow, and in many cases, don't even want to acknowledge a problem that's so politically inconvenient. Over the past half decade or so, it has become increasingly apparent that [cities](#) are leading the way – and ultimately, have the greatest chance at boosting our chances for survival in the face of declining resources and rising seas.

This week, Siemens and C40 (the Cities Climate Leadership Group), announced the 10 winners of the inaugural City Climate Leadership Awards, given to municipalities around the world that have demonstrated “excellence in urban sustainability and leadership in the fight against climate change.” Below, the winners.

BOGOTA: URBAN TRANSPORTATION

This city took the Urban Transportation award for its ultra-efficient bus and taxi fleets. Bogota's Bus Rapid Transit system, launched in 2000, shuttles over 70% of the city's 7.1 million person population. Future goals include replacing all of the city's diesel fleet with hybrid and electric buses, electrifying the entire the taxi fleet, and adding a new metro line.

MELBOURNE: ENERGY EFFICIENT BUILT ENVIRONMENT

Melbourne won in the Energy Efficient Built Environment category for a sustainable buildings program that gives building managers and owners financing for energy and water retrofits.

COPENHAGEN: CARBON MEASUREMENT & PLANNING

Copenhagen scooped up the Carbon Measurement & Planning award for its ambitious 2025 Climate Plan – an attempt to make the city completely carbon neutral by 2025. If it succeeds in cutting emissions to 400,000 tons, Copenhagen will be the first carbon neutral capital city in the world.



This Mexico City building [eats smog](#).

MEXICO CITY: AIR QUALITY

It may not be the first city that pops into your head when you think about clean air (it was at one point the most polluted city in the world), but Mexico City took the Air Quality award for ProAire, a program that has dramatically cut CO₂ emissions and air pollution over the last 20 years through everything from vehicle emissions reductions to containment of urban sprawl. It's proof that a solid plan can significantly improve air quality.

MUNICH: GREEN ENERGY

Munich received the Green Energy award for its initiative to power the city completely using renewable sources by 2025. So far, the city is 37% of the way there – in 2015, wind projects will cause that number to climb to 80%.

RIO DE JANEIRO: SUSTAINABLE COMMUNITIES

The Morar Carioca Program (an urban revitalization plan) is behind Rio's win in the Sustainable Communities category. The [program](#) aims to “formalize” and reurbanize all of Rio's favelas by 2020, with a combination of better landscaping, infrastructure, educational tools, and more – a move that will help with health and wellness for the 20% of the city population that lives in these settlements.

NEW YORK: ADAPTATION & RESILIENCE

New York City won in the Adaptation & Resilience category for its now-famous post-Sandy action plan, dubbed [A Stronger, More Resilient New York](#). The program consists of 250 ambitious infrastructure resilience initiatives across a number of categories, including transportation, telecommunications, parks, insurance, and buildings.



Read more about New York's [\\$20 billion resilience plan](#).

SAN FRANCISCO: WASTE MANAGEMENT

San Francisco took the Waste Management award for an incredibly effective 11-year-old zero waste program, which now sees 80% of all trash diverted from landfills. By 2020, the city hopes to bring that up to 100%—a goal that, as a resident, seems quite possible.

SINGAPORE: INTELLIGENT CITY INFRASTRUCTURE

Singapore is the Intelligent City Infrastructure recipient – an award given for its Intelligent Transport System, which is made up of an amalgam of smart transportation initiatives, like real-time traffic data from GPS-equipped

taxis and an [electronic road toll collection system](#). The result: Singapore has less congestion than most cities.

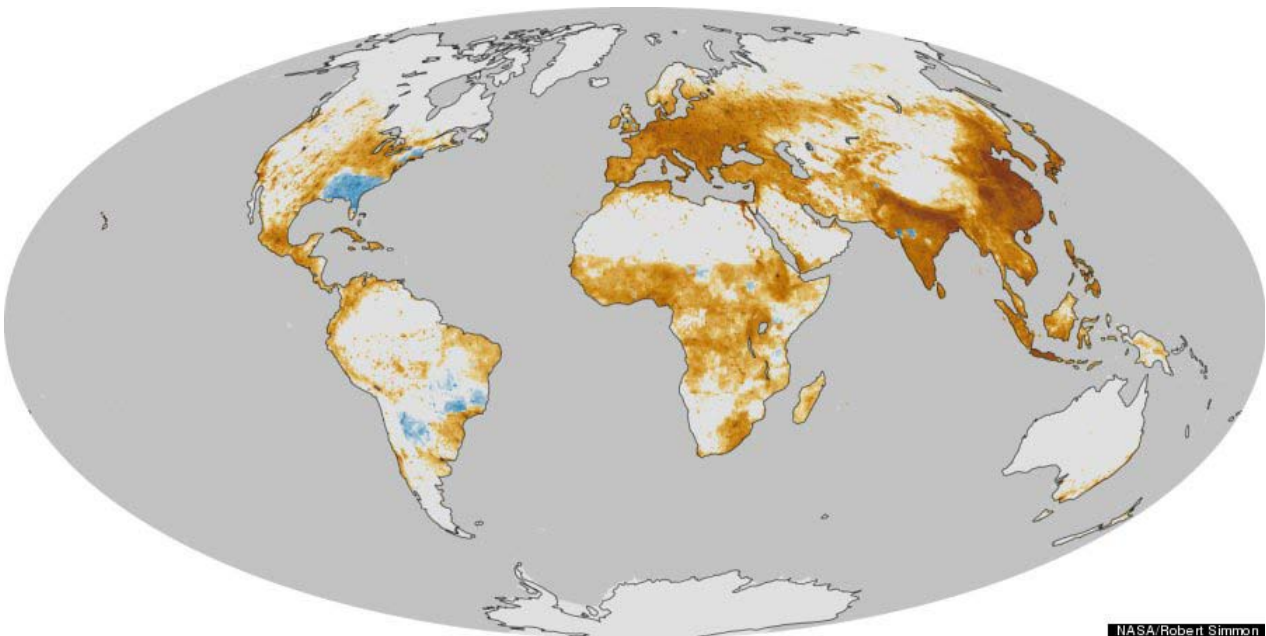
TOKYO: FINANCE & ECONOMIC DEVELOPMENT

Tokyo won in the Finance & Economic Development category, for its launch of the world's first cap and trade program in 2010. Today, the program has 1,100 participating facilities, which have cut emissions by a total of 13% in the city and prevented over 7 million tons of CO₂ from being released.

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Take all of the best qualities of these municipalities – effective road management, cap and trade, sustainable energy, excellent public transportation, a zero waste program, and so on – and you have an urbanist's dream city. That dream city may not be a reality yet, but the first step to creating one (or many) is learning from cities that already excel in specific areas. Because, while the United States may have a hard time adapting resilience lessons from Japan, New York City might be much more willing to learn from Tokyo.

Source: <http://www.fastcoexist.com/3016816/the-10-cities-that-are-leading-the-way-in-urban-sustainability>



October 2013 — Drawing on data from PM<sub>2.5</sub> [research](#), this recently-produced [NASA map](#) illustrates where fine particulate matter is the most deadly. As of October 15th, however, the map was not accessible on NASA's [website](#) – pending a decision by the U.S. Congress to fund government services.

## Beijing Ramps up Pollution Fight, Challenges Remain

September 2013 — Tough measures by Beijing municipal authorities in the city's uphill battle to improve air quality are set to bring profound changes in urban transportation and industrial production.

The Beijing municipal government outlined in early September its efforts to tackle air pollution on multiple fronts over the next four years.

The Beijing 2013-2017 Clean Air Action Plan is aimed at a 25 percent reduction by 2017 in the density of airborne particles measuring less than 2.5 microns in diameter, or PM<sub>2.5</sub> that many blame for causing the city's smog.

To achieve this goal, authorities set some ambitious targets in the plan. Among them, the city seeks to cap growing automobile ownership and wean itself off coal.

"Cleaning up Beijing's air is likely to cost the entire society nearly one trillion yuan (163 billion U.S. dollars) in the next five years, and government investment is likely to be 200 to 300 billion yuan," said Fang Li, deputy director of Beijing Municipal Environmental Protection Bureau, at a press conference about the action plan.

According to the plan, automobile ownership in Beijing will be capped at 6 million by the end of 2017. The city already had 5.35 million cars on the road at the end of July of this year, contributing to 22.2 percent of PM<sub>2.5</sub> density in Beijing through exhaust fumes.

At present, only 20,000 car license plates are distributed each month to prospective car buyers under a lottery scheme to curb car growth. The quota is set to shrink further if Beijing wants to cap cars at 6 million by 2017, leaving more aspiring car buyers waiting hopelessly.

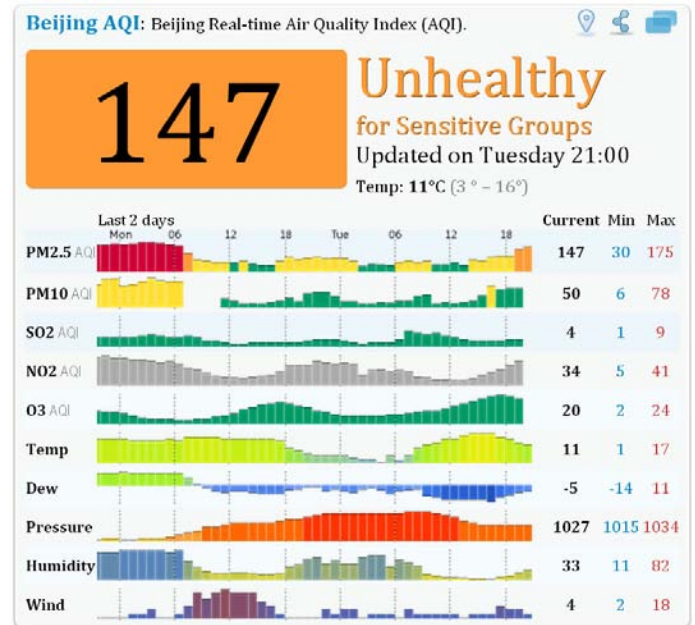
Authorities have also limited the number of cars traveling on the road based on the last digits of license plates to ease traffic gridlock, a problem transport authorities say often goes hand in hand with air pollution.

"When traveling speeds slow to 20 km per hour from 25, the pollutants discharged from cars increase 20 percent," said municipal transport spokesman Rong Jun. While such measures run contrary to the wishes of residents to own and drive cars, the Beijing Municipal Commission of Transport says they are at the center of the city's effort to curb air pollution – an effort that has produced marked effects.

Rong said that by parking 900,000 cars each day, the city managed to reduce 42,000 tons of car emissions in 2012.

To counter the inconvenience caused by these restrictions, the commission also promised to increase use of public transport and promote vehicles powered by alternative and clean energy.

Industrial production in and around the nation's capital is also likely to undergo profound changes as the action plan leaves energy-guzzling factories to either



Air quality in Beijing and other cities can be tracked in real time at <http://aqicn.org/city/beijing/>.

upgrade to fuel-efficient and clean production or shut down.

A consensus has emerged that air quality in the nation's capital will not improve unless Beijing's neighbors join the fight. Industrial activities in neighboring regions, home to a number of steel plants, are a major culprit in Beijing's increasingly unhealthy air.

In a more coordinated move to combat air pollution, the governments of Beijing's neighboring regions recently signed an agreement with the Ministry of Environmental Protection on what they will do to mitigate the environmental impact of local industrial production.

Beijing's neighboring Hebei Province has vowed to phase out 60 million tons of steel production capacity and slash coal consumption by 40 million tons by 2017. A similar but smaller cut will also be enforced in Beijing, where coal consumption has dropped continuously in the past decade to 2.3 million tons last year and is expected to be more than halved by 2017.

Hebei's cuts will likely take a heavy toll on the province's economic growth, as steelmaking has been the region's pillar industry. Worsening air pollution is forcing the province to accelerate a transition toward other environmentally friendly industries.

"Both Beijing and Hebei are under tremendous pressure to meet the coal reduction targets, but we are resolved to make it against all odds," said Gao Xinyu, head of the division of energy development at the Beijing Municipal Commission of Development and Reform.

Source: [english.peopledaily.com.cn/90882/8409099.html](http://english.peopledaily.com.cn/90882/8409099.html)

## Rooftop Farming Is Getting Off The Ground

September 2013 — From vacant lots to [vertical “pink-houses,”](#) urban farmers are scouring cities for spaces to grow food. But their options vary widely from place to place.

While farmers in post-industrial cities like Detroit and Cleveland are claiming unused land for cultivation, in New York and Chicago land comes at a high premium. That’s why farmers there are increasingly eyeing spaces that they might not have to wrestle from developers: rooftops that are already green.

The green roof movement has slowly been gaining momentum in recent years, and some cities have made them central to their sustainability plans. The city of Chicago, for instance, boasts that 359 roofs are now partially or fully covered with vegetation, which provides all kinds of environmental benefits — from reducing the building’s energy costs to cleaning the air to mitigating the [urban heat island effect](#).

Late this summer, Chicago turned a green roof into its first major rooftop farm. At 20,000 square feet, it’s the largest soil-based rooftop farm in the Midwest, according to the Chicago Botanic Garden, which maintains the farm through its Windy City Harvest program.

“We took a space that was already a productive green roof, and we said, ‘Why not take that one step further and grow vegetables on it?’” says Angie Mason, director of the Chicago Botanic Garden’s urban agriculture programs. That required adding lots of soil amendment, or nutrients, to the rocky medium already up there.

The farm sits atop McCormick Place, the largest convention center in North America, and the goal is for it to supply the center’s food service company, SAVOR... Chicago, with between 8,000 to 12,000 pounds of food a year – more than 10,000 servings. It sounds like a lot, but SAVOR serves about 3 million people a year at McCormick Place.

In the first season, Mason says the Windy City Harvest farmers, which include underemployed ex-offenders, will be growing kale, collards, carrots, radishes, peppers, beans, beets, cherry tomatoes and various herbs at the McCormick Place farm. The project’s coordinators chose these crops because they’re well-suited to a rooftop setting and they’re fast-growing.

Over the next few years, Mason says the plan is to expand the farm to other sections of the McCormick Center roof for a total of 3 acres of cultivation. That would make it the biggest rooftop farm in the U.S., bigger than Brooklyn Grange, which operates a farm of 2.5 acres, or 108,000 square feet, on two roofs in New York City.

Joe Nasr, with the Centre for Studies in Food Security at Ryerson University in Toronto, says projects like these are part of a larger trend toward expanding food production in cities. “Rooftops will be part of the mix of urban spaces



Harvesting lettuce at the Chicago Botanic Garden’s 20,000 sq.ft. rooftop vegetable garden.

that will be increasingly used to ‘scale up’ urban agriculture,” Nasr said.

And roof farms in particular can offer a wide array of perks to the building owners.

“When it is feasible to do so, you would be adding benefits to whatever the green roof [already] provides: food, space for community gathering and teaching in many cases, increased biodiversity (depending on the roof) and care for the roof — many green roofs fail because they are out of sight, out of mind, thus neglected,” Nasr says.

So why don’t we see more of these rooftop urban farms?

According to Mason, urban farmers are just beginning to figure out how to make them work. And they’re learning that not every green roof is well-suited for farming.

“You’re looking at liability and insurance risk of having people on a rooftop, and then you’ve got to make sure it’s structurally sound enough to withstand the extra soil weight for production,” says Mason. “And you’ve got to make sure that you’re training people so that they aren’t compromising the rooftop membrane” and damaging it.

Nasr agrees that there are many obstacles to transforming more green roofs into farms: from permitting to delivering soil and water to the roof, to dealing with growing conditions that are typical of roofs (sun, wind, snow).

But for urban farmers who can find a roof and building owners who will get on board, the potential benefits are worth pursuing, he says. And Mason says she sees plenty of opportunity in Chicago to convert more green roofs into farms — and plenty of building owners interested in burnishing their green credentials.

Of course, you don’t have to go as big as a farm to take advantage of the space and sunlight on a roof to grow food. People have been container-gardening on roofs for a long time, and as we reported, this form of [micro-gardening is taking off](#).

Source: NPR (<http://www.opb.org/artsandlife/article/npr-rooftop-farming-is-getting-off-the-ground/>)

Can we please  
stop  
drawing  
trees  
on  
top of  
skyscrapers?



Just a couple of years ago, if you wanted to make something look trendier, you put a bird on it. Birds were everywhere. I'm not sure if Twitter was what started all the flutter, but it got so bad that Portlandia performed a skit named, you guessed it, "Put a Bird On It".<sup>1</sup>

It turns out architects have been doing the same thing, just with trees. Want to make a skyscraper look trendy and sustainable? Put a tree on it. Or better yet, dozens. Many high-concept skyscraper proposals are festooned with trees. On the rooftop, on terraces, in nooks and crannies, on absurdly large balconies. Basically anywhere horizontal and high off the ground. Now, I should be saying architects are drawing dozens, because I have yet to see one of these "green" skyscrapers in real life. (There's one notable exception—BioMilano, which isn't quite done yet.) If—and it's a big if—any of these buildings ever get built, odds are they'll be stripped of their foliage quicker than a developer can say "return on investment". It's just not realistic. I get it why architects draw them on their buildings. Really, I do. But can we please stop?

There are plenty of scientific reasons why skyscrapers don't—and probably won't—have trees, at least not to the heights which many architects propose. Life sucks up there. For you, for me, for trees, and just about everything else except peregrine falcons. It's hot, cold, windy, the rain lashes at you, and the snow and sleet pelt you at high velocity. Life for city trees is hard enough on the ground. I can't imagine what it's like at 500 feet, where nearly every climate variable is more extreme than at street level.

Wind is perhaps the most formidable force trees face at that elevation. Ever seen trees on the top of a mountain? Their trunks bow away from the prevailing winds. That may be the most visible effect, but it's not the most challenging. Wind also interrupts the thin layer of air between a leaf and the atmosphere, known as the boundary layer.

The boundary layer is tiny by human standards—it operates on a scale small enough that normally slippery gas particles behave like viscous fluids.

For plants, the boundary layer serves to control evapotranspiration, or the loss of gas and water through the tiny pores on a leaf's underside, known as stomata. In calm conditions, a comfortably thick boundary layer can exist on a perfectly smooth leaf. But plants that live in hot or windy places often have adaptations to deal with the harsh conditions, including tiny hairs on their leaves which expand each leaf's surface area and thus its boundary layer. Still, plants in these environments aren't usually tall and graceful. In other words, not the tall trees we see in architectural drawings.

Next let's add extreme heat and cold to the mix. Extreme cold, well, we all know what that does. It can kill a plant, turning the water inside its cells into lethal, crystalline knives. At the other end, hot conditions post a different set of challenges. To cool off, plants can "sweat" by opening their stomata to release water vapor, at least as long as there's water available. But even then, plants reach a limit. At certain temperatures, which vary from plant to plant, the photosynthetic machinery inside a leaf starts to break down. Keep in mind these are temperatures on the surface of a leaf, not ambient air temperature. The surface of leaf—especially in direct sunlight, as on the unshaded side of a skyscraper—can be many degrees hotter than the air, up to 14° C in some species (nearly 26° F).

Then there are the logistical concerns. How are these trees going to be watered and fertilized? Pruned? How will they be replaced? How often will they need to be replaced? As someone who grows bonsai, I can tell you that stressed plants require constant attention. Daily monitoring, in fact, and sometimes even more frequently. It's not easy. Growing simple green roofs is a chore, and those plants are chosen for their hardiness and low maintenance. Trees are generally not as well adapted to the wide range of conditions likely to be experienced on the side of a skyscraper.

All of this may sound a bit ridiculous coming from someone like me, an advocate for more trees in urban spaces. It probably comes from having seen one too many sketches of a verdant vertical oasis but too few of them actually built. Plus, having studied plant physiology, I know that it's a pipe dream in many ways. Trees just weren't made for such conditions. Now if someone want to gin up a tree that can survive on top of a skyscraper, go ahead, I guess. But I can think of far better things we should be putting our time and effort into, like preserving places that already have trees growing on them or planting more on streets that need them.

— Tim De Chant

<http://persquaremile.com/2013/03/07/trees-dont-like-it-up-there/>

1. "What a sad little tote bag. I know! I'll put a bird on it." Etc.

## A Summary of Urban Heat Island and Outdoor Comfort Studies in Glasgow, UK



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*Given its long urban history of growth and decline, Glasgow, UK, provides a historically significant opportunity to study the local climatic changes brought about by urban variables. This paper looks into historical air temperature changes within the central area of Glasgow relative to its surroundings and to present urban-vs-rural (UHI) as well as intra-urban differences in temperatures when accounting for urban morphology aspects. In addition, summarized results from an extensive field survey are presented, conducted with the local population and focusing on outdoor thermal comfort. Comparisons between actual thermal perception votes are compared to relevant index results such as PET and UTCI.*

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### Introduction

The importance of understanding the heating induced by urban settlements has been stressed by many authors, and consequences for urban planning and global warming have been considered over the last decade. A recent publication on climate change-related issues in buildings encourages researchers in the field to carry out more work on understanding and managing the Urban Heat Island (UHI) phenomenon (De Wilde, 2012).

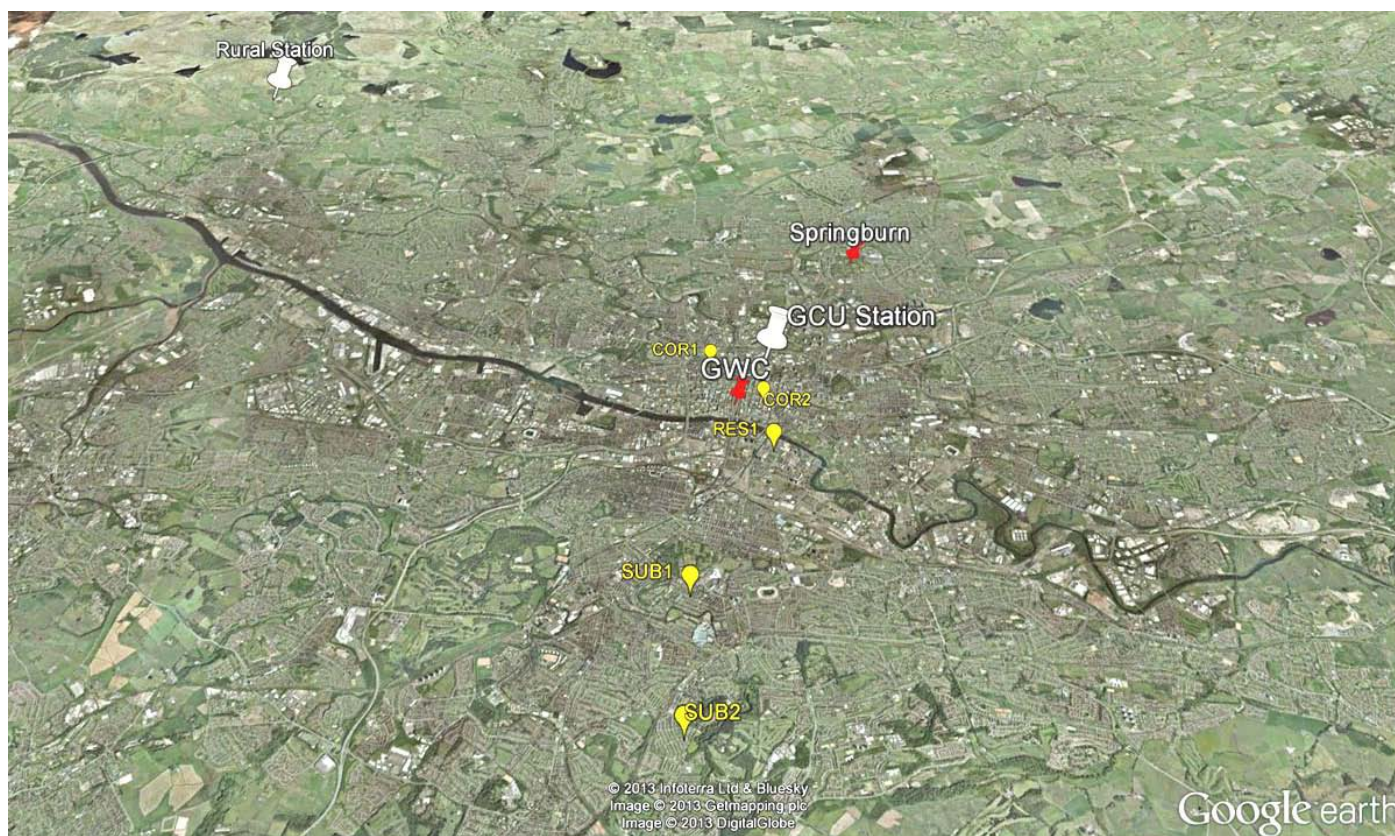
In tropical areas the formation of UHIs associated with climate change can bring about serious consequences; thus heat island mitigation should be part of present and future urban design strategies. However, as shown by Kolokotroni *et al.* (2012) and by Emmanuel and Krüger (2012), UHI effects in temperate regions may not be that detrimental: the benefit of energy savings for heating is only marginally offset by increases in cooling demand.

Next to changes in ambient temperature resulting from urbanization, which is the main aspect considered in traditional UHI analyses, human biometeorology looks into the integral aspect of the relevant climatic variables in terms of an outdoor thermal index which can inform the design of public places (Vanos *et al.* 2010). Whereas UHI analyses may serve several purposes, such as the quantification of past and prediction of future urbanization effects on urban climate, allowing the calculation of changes in energy demand in buildings as a result of the modified urban climate, one of the goals of outdoor thermal comfort studies is thus related to climate-responsive urban planning at the local scale. Modifications to urban form are able to promote improved outdoor thermal conditions that positively influence the use of open spaces: depending on the

background climatic conditions, shaded or sunlit open areas resulting from carefully manipulated urban geometry could result in a greater pedestrian use of urban spaces, contributing at least partially to their attractiveness. The possibility of linking urban geometry to outdoor comfort could thus contribute to planners' and designers' ability to create better urban places.

The validity of results obtained from research on UHIs is sometimes constrained by the non-observation of atmospheric conditions: short term measurements can be affected by atmospheric conditions during the measurement period, leading to inconclusive results or to incorrect correlations between microclimate and urban geometry attributes. Oke's recommendation of days with cloudless skies and light winds (Oke, 1987) is sometimes interpreted as clear sky conditions only, and that requisite may not be sufficient. Kolokotsa *et al.* (2009) show in their study that anticyclonic conditions greatly contribute to the development of the UHI during summer and use a synoptic conditions classification scheme (Kassomenos, 2003) as a reference to investigate the UHI in Hania, Greece. In a similar experiment as the one described in the present paper, the authors set up a string of temperature/relative humidity (T/RH) weather-shielded data loggers across the urban area of Hania, analyzing data with respect to atmospheric conditions throughout the monitoring period in summer. Their findings show strong correlations between observed UHI intensity and wind blowing from the north and west.

The present paper is part of a broad research initiative aimed at the understanding of the urban heat island effect in the city of Glasgow, UK. We started off by analyzing historical temperature trends provided by the MIDAS Surface



**Figure 1. BADC Stations Springburn and Glasgow Weather Centre GWC (red pins), intra-urban monitoring points (paddles) and pair of weather stations in and around Glasgow (white pins). (Google Earth Image)**

Weather Stations network of the British Atmospheric Data Centre (BADC) in terms of air temperature differences between a 'rural' and an 'urban' site (Emmanuel and Krüger 2012); in a second stage we set up a pair of fully equipped weather stations for assessing local UHI and a string of T/RH data loggers located across the city for the analysis of intra-urban temperature differences, duly accounting for background atmospheric conditions (Krüger and Emmanuel 2013). Finally, from an extensive series of surveys with questionnaires (N=763) administered to street users, we were able to compare actual thermal perception votes to results from two relevant outdoor human thermal comfort indices: the Physiologically Equivalent Temperature index, PET (Krüger *et al.* 2012a) and the Universal Thermal Climate Index, UTCI (Krüger *et al.* 2012b).

### Experimental set-up

**Study area** – According to the Koeppen-Geiger climate classification system, Glasgow (55°51'N, 04°12'W, at sea level) lies within a region of temperate climate with maritime influences (Cfb). Seasonal differences are thus softened. The precipitation level is one the highest in the UK (approximately 1100 mm per annum). The mean maximum temperatures in the warmest season (July and August) are lower than 20°C while mean daily temperature is over 10°C at least during five months of the year (UK Met Office, 2011).

**Research methods** – The pairwise comparison of an 'urban' and a 'rural' weather station was based on data from the Met Office Integrated Data Archive (MIDAS) Surface Weather Stations network, provided by the British Atmospheric Data Centre (BADC) registered at a 'rural' and at an 'urban' location: Springburn (rural) and Glasgow Weather Centre (urban) (Figure 1). Coincidental data for the period of 1974-1985 were used for this comparison. At both stations, maximum and minimum temperature data were provided within a 24h cycle, using either a liquid-in-glass thermometer or, from the 1980s electrical resistance thermometers (ERT).

The long-term monitoring with T/RH data loggers corresponds to a set of five locations within downtown Glasgow, expanding from the city core 6 km to the south side of the River Clyde; in addition, measurements at two weather stations were implemented, one at a rural location approximately 15 km to the northwest, outside the urban area, and another one on campus at the Glasgow Caledonian University (Figure 1). The T/RH data loggers (Tinytags TGP-4500, placed within naturally ventilated radiation shields) were used for assessing intra-urban differences at stations set up along a N-S transect from February through September 2011. The two weather stations (Davis VantagePro2, both equipped with solar radiation sensors) were located on an E-W axis and recorded data between March and August 2011. The urban weather station was



sited on the rooftop of a low-rise building (6 m from street level) and the rural station was located at an experimental farm on the outskirts (Figure 1).

The two sets of data (inter-urban versus intra-urban measurements) were classified into different day types (Table 1) according to the atmospheric stability groups defined by the modified Pasquill-Gifford-Turner (PGT) classification scheme (Mohan and Siddiqui, 1998). For that, the definition of stability classes was based on the mean wind speed for each daily period, the maximum intensity of solar radiation during daytime and the average cloud cover during night time. Since the 'Weather Underground' station used provides cloud cover data for the daytime period (estimated from solar radiation data), but no reliable cloud cover data at night, it was assumed that the sky was clear when this was the case during most of the day. In this sense, wind speed was the dominant factor for defining the night time PGT class.

The field surveys were carried out between March and July 2011, over 19 outdoor comfort campaigns, covering a wide range of weather types, typically clear-sky conditions, and each spanning up to three hours. The area covered comprised six selected locations within the pedestrian downtown streets (Figure 2). Climatic variables were monitored with a Davis VantagePro2 weather station, additionally equipped with a globe thermometer (gray sphere with an enclosed temperature Tinytag-TGP-4500 logger) (Figure 3). Data from all sensors were averaged over five minutes, so as to offset the response time of the globe thermometer (Nikolopoulou et al. 1999). A comfort questionnaire was tailored according to ISO 10551, one section consisting of questions related to gender, age, height, weight, clothing insulation, time of residency and estimated time spent outdoors prior to the interview; and another section consisting of two symmetrical 7-point two-pole scales, used for assessing the respondents' thermal perception and preference.



Figure 2. Monitoring points along the pedestrian area.



Figure 3. 'Mobile' weather station (Davis Vantage Pro2) with gray globe thermometer.

Table 1. PGT atmospheric stability classes.

| WS<br>(m/s) | Daytime SR (W/m <sup>2</sup> ) |                  |                  | Night time CC (octas) |                  |                  |                   |
|-------------|--------------------------------|------------------|------------------|-----------------------|------------------|------------------|-------------------|
|             | High <sup>1</sup>              | Mod <sup>2</sup> | Low <sup>3</sup> | Cloudy                | Low <sup>4</sup> | Mod <sup>5</sup> | High <sup>6</sup> |
| ≤2          | A                              | A-B              | B                | C                     | G-F              | F                | D                 |
| 2-3         | A-B                            | B                | C                | C                     | F                | E                | D                 |
| 3-5         | B                              | B-C              | C                | C                     | E                | D                | D                 |
| 5-6         | C                              | C-D              | D                | D                     | D                | D                | D                 |
| >6          | C                              | D                | D                | D                     | D                | D                | D                 |

Legend: WS wind speed, SR global solar radiation, CC cloud cover, <sup>1</sup>(>600), <sup>2</sup>(300-600), <sup>3</sup>(<300), <sup>4</sup>(0-3), <sup>5</sup>(4-7), <sup>6</sup>(8), A (highly unstable or convective), B (moderately unstable), C (slightly unstable), D (neutral), E (moderately stable), and F (extremely stable), G (extremely stable, low wind).

## Results

Pairwise comparison of 'urban' and 'rural' data – Figure 4 shows histograms of temperature differences ( $\Delta T_{u-r}$  according to a bin range of 1°C) between the 'urban' and 'rural' sites during a 12-year period from 1974-1985. Those differences were found to be statistically significant ( $p < 0.001$ ).

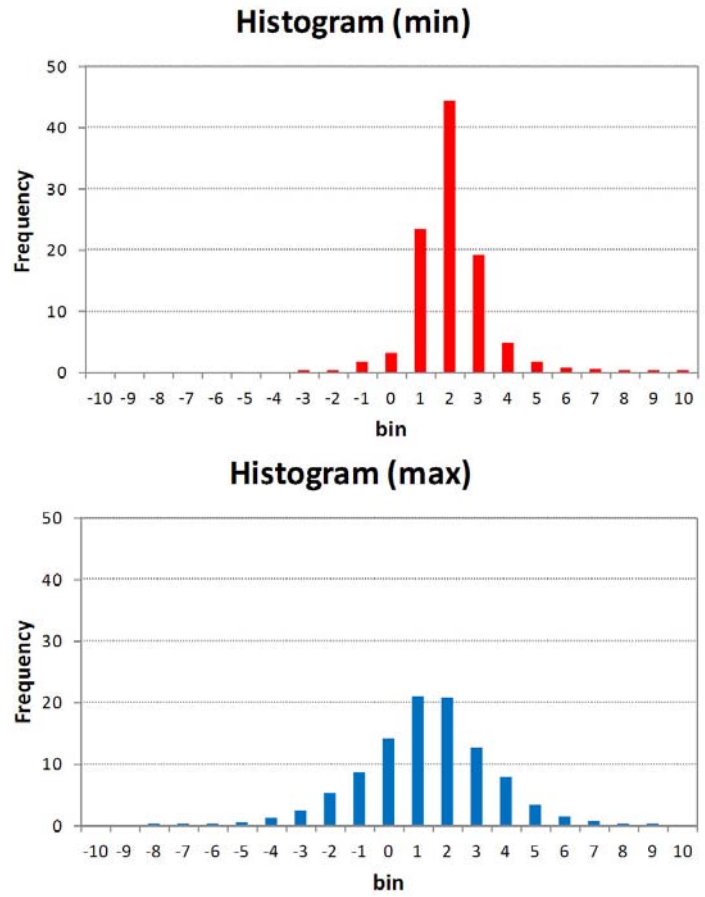
Histograms suggest that minimum temperature differences are more consistently positive and narrowly distributed, i.e. the urban station presents the nocturnal

heat island effect more frequently and more consistently, while the maximum temperature difference has a wider frequency distribution and smaller amplitude. It is even negative in some instances (reflecting a daytime cool island effect in the city centre). Average differences are also more pronounced for the daily minima, which also show the smallest standard deviations (Table 2). The coefficients of variation further corroborate the observation made above regarding both histograms, showing a higher consistency in 'urban' – 'rural' temperature differences in the daily minima. However, it is for the winter periods that the nocturnal heat island effect is more clearly pronounced.

*Inter-urban versus intra-urban measurements* – For both inter- and intra-urban measurements, the analysis was performed for three different time periods: a) the whole monitoring period; b) for a cold and a warm period; c) for stable days according to PGT definitions and to a decreasing order of atmospheric stability (Day Type I – Day Type III). In addition, the series of days which were not classified according to PGT (unstable days with mean air pressure lower than 1020 hPa) were added to the analysis.

*Intra-urban locations* – Hourly differences from the 'Group Mean' were computed for every location and day and night periods were defined from sunrise and sunset hours. The highest (negative) difference from the group mean was found for SUB2 (Table 3), which is the most distant location of the transect, with the highest sky view factor, surrounded by green spaces and situated almost on the outskirts of the urban area. The most central locations (COR1 and COR 2) exhibit positive differences relative to the group mean and are thus warmer during night time, especially COR2, a typical urban canyon. COR2 consistently showed the highest (positive) temperature difference from the mean. With regard to the 'maximum relative difference' (Max Rel Diff), the PGT classification scheme allowed us to identify the maximum intensity (invariably SUB2-COR2) for the most stable night time conditions, serving as a proxy for the maximum UHI intensity. The group of unstable days (not classified according to the PGT scheme and termed 'Unclassified days') yielded the lowest

|                            | Summer    |           | Winter    |           | All periods |           |
|----------------------------|-----------|-----------|-----------|-----------|-------------|-----------|
|                            | daily max | daily min | daily max | daily min | daily max   | daily min |
| Average                    | 0.5       | 1.4       | 1.2       | 1.8       | 0.8         | 1.6       |
| Standard Deviation         | 2.2       | 0.8       | 1.8       | 1.4       | 2.1         | 1.2       |
| Coefficient of Variation % | 478       | 56        | 152       | 81        | 261         | 74        |



**Figure 4. Histograms for  $\Delta T_{u-r}$ : left – daily minima (night time); right – daily maxima (daytime).**

maximum relative difference, which further stresses the relevance of accounting for stability patterns.

*Permanent weather stations* – Results (Table 4) indicate that the UHI intensity (max night) can range between 2.9 and 3.9 degrees, with the highest intensity being reached under one of the PGT classified days. This figure is slightly

|                   | SUB2        | SUB1        | RES1        | COR1       | COR2       | Max Rel Diff |
|-------------------|-------------|-------------|-------------|------------|------------|--------------|
| All data          | -1.5        | -0.4        | -0.6        | 0.6        | 1.6        | 3.1          |
| Cold period       | -1.4        | -0.4        | -0.5        | 0.5        | 1.5        | 3.0          |
| Warm period       | -1.6        | -0.4        | -0.6        | 0.7        | 1.6        | 3.2          |
| <b>Day Type I</b> | <b>-2.7</b> | <b>-0.5</b> | <b>-0.9</b> | <b>1.2</b> | <b>2.1</b> | <b>4.9</b>   |
| Day Type II       | -1.6        | -0.5        | -0.7        | 0.7        | 1.5        | 3.1          |
| Day Type III      | -1.4        | -0.4        | -0.6        | 0.6        | 1.6        | 3.0          |
| Unclassified days | -1.4        | -0.4        | -0.5        | 0.5        | 1.5        | 2.9          |

higher (0.8K) than the overall UHI intensity, as well as the intensity for the two separate periods of analysis (cold and warm). The difference in UHI intensity relative to 'Unclassified days' is of 1K.

*Applicability of the outdoor thermal comfort indices PET and UTCI* – The PET index has been frequently used as a reasonable predictor of thermal comfort/discomfort conditions in outdoor spaces (Ali-Toudert and Mayer, 2006; Matzarakis *et al.* 1999; Svensson *et al.* 2003; Thorsson *et al.* 2007). Furthermore, PET is one of the indicators used by German standards in urban and regional planning (VDI, 1998). The RayMan model (Matzarakis *et al.* 2007; Matzarakis *et al.* 2010) was used here for PET calculations.

UTCI in turns aims to assess outdoor thermal conditions in several applications of human biometeorology, consisting of a one-dimensional quantity which summarises the interaction of environmental variables. This assessment is based on an advanced multi-node model of human thermoregulation (Fiala *et al.* 2010, Fiala *et al.* 2011) and coupled with a state-of-the-art clothing model (Havenith *et al.* 2012). Values of the UTCI equivalent temperature were obtained by the simplified regression approach provided by the operational procedure (Bröde *et al.* 2012).

Comparisons between actual thermal sensation votes against predicted thermal sensation expressed in the PET scale were based on binned data. A weak correlation was found for the raw (unbinned) data ( $r^2 = 0.45$ ) between PET and actual thermal sensation. For the binned data, the correlation was high ( $r^2 = 0.91$ ) and significant ( $p >> 0.05$ ) – see Figure 5.

From a calibration of the PET comfort/discomfort ranges for Glasgow (Krüger *et al.* 2012), the 'optimal' ranges for human thermal sensation in Glasgow were found to be considerably lower than the ones suggested by the literature for PET (Matzarakis *et al.* 1999 suggest 18-23°C on the PET scale as the comfort range; in contrast to that, we identified the range of 9-18°C from field data analysis).

For UTCI, results suggested that clothing levels are fairly

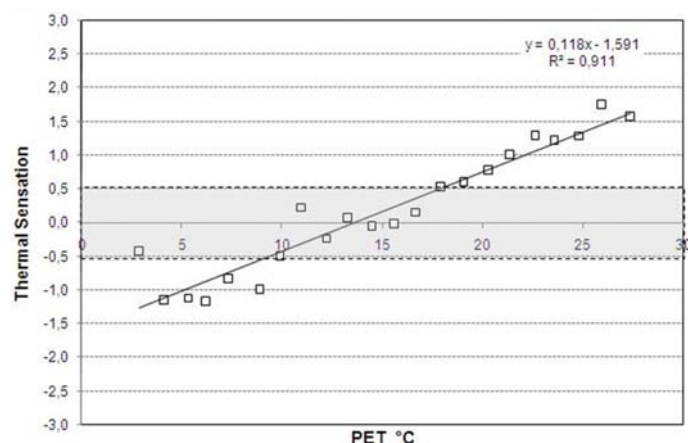


Figure 5. Mean thermal sensation versus PET values (bin=1.2°C PET)

Table 4. Urban Heat Island  $\Delta T_{u-r}$  (K) for different atmospheric conditions and periods of the day.

|                   | avg night  | min night  | max night  |
|-------------------|------------|------------|------------|
| All data          | 2.1        | 1.4        | 3.1        |
| Cold period       | 2.2        | 1.5        | 3.2        |
| Warm period       | 2.1        | 1.3        | 3.1        |
| <b>Day Type I</b> | 2.2        | 1.3        | 3.4        |
| Day Type II       | 2.4        | 1.8        | 3.2        |
| Day Type III      | <b>2.6</b> | <b>1.6</b> | <b>3.9</b> |
| Unclassified days | 1.3        | 2.9        | 2.9        |

well predicted by UTCI's clothing model. A small offset was noticed from the onset of the summer period, with UTCI overestimating actual clothing, which suggests that people under those climatic conditions accept lower air temperatures and indeed regard those as comfortable due to acclimatization. For calculated UTCI, a slight underestimation of the actual thermal sensation was noticed. Table 5 presents the error analysis of the dynamic thermal sensation (DTS) predicted by the UTCI-Fiala model in relation to actual thermal responses. It should be stressed that the low correlations are due to the fact that bulk data were used (as opposed to binned data as in the case of PET).

## Conclusions

The series of analyses performed leads us to some overall conclusions:

- The pairwise comparison between 'urban' and a 'rural' weather stations indicates a clear UHI effect. Seasonal differences show that in general the nocturnal UHI is stronger in winter than in summer, even though it is more consistent in the summer season.

- Although the consideration of PGT stability classes did not add much to the UHI analysis performed for the urban and rural stations set up for our study, the most extreme temperature differences within the urban area (intra-urban stations) could be more clearly identified when the

Table 5. Number of observations (n), averaged errors (bias), root mean squared errors (RMSE) and Pearson correlation coefficients (r) of the observed thermal sensation votes compared to the dynamic thermal sensation predicted by the UTCI-Fiala model for the reference conditions.

| Exposure Time | n   | bias  | RMSE | r    |
|---------------|-----|-------|------|------|
| short term    | 567 | -1.67 | 2.09 | 0.43 |
| steady state  | 567 | -0.22 | 1.26 | 0.45 |
| averaged      | 567 | -0.75 | 1.45 | 0.45 |

atmospheric stability criterion was adopted.

- For PET, results indicated that the predicted thermal sensation matches well with observed thermal sensation in pedestrian streets of Glasgow. However, 'optimal' ranges for thermal comfort conditions in Glasgow were found to be lower than the ones suggested by literature. Regarding UTCI, the index was found to overestimate, though minimally, pedestrian thermal sensation in Glasgow.

**Planning Implications:** In their drive towards sustainable and ecologically sound places, shrinking cities such as Glasgow will need to consider the local climate implications of their current urban trajectories. While population may decline, the underlying urban morphology largely remains in place, leading to the continuation of the urban climate anomaly. In the case of Glasgow, this aspect of shrinking is beneficial: the urban warmth created by a judicious arrangement of land use / land cover could be exploited for energy efficient uses such as district heating, thereby enhancing the feasibility of low carbon options such as district ground source heating or other communal renewable technologies. Our work shows that the UHI itself does not go away, even in shrinking cities; therefore the opportunities to be sustainable and low carbon might still be available. At the same time, the summertime trends suggest that overheating may become a distinct possibility in the future. These realities should inform shrinking cities in their attempt to re-invent themselves in a carbon- and energy-efficient fashion.

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## Climate Science in Urban Design : A historical and comparative study of applied urban climatology

'Climate Science and Urban Design' originated in chats between two researchers in different faculties of the University of Manchester: **Michael Hebbert**, a historian turned town planner in the School of Environment and Development of the Faculty of Humanities, and **Vladimir Jankovic**, a meteorologist turned science historian in the Centre for the History of Science Technology and Medicine of the Faculty of Life Science. Starting out from a shared interest in nineteenth century initiatives to promote public health through improved ventilation, they had made an unexpected discovery in the library catalogue – *Urban Climatology and its Relevance to Urban Design*, published as WMO Technical Note 149 (Chandler, 1976).

The work was apparently un-cited, didn't fit the standard narratives of environmental design and was all the more interesting for having a Mancunian connection, since the author Tony Chandler had built up a short-lived specialisation in urban climatology as Professor of Geography at the University of Manchester.

Here was the trigger. We resolved to investigate the background to WMO Technical Note 149, and understand the context and timing of its publication. Furthermore, we proposed to connect this forgotten history with contemporary applications of climatology to urban design around the world under the agenda of carbon mitigation and climate change adaptation: hence the sub-title 'historical and comparative study', the primary points of comparison being the four municipalities of Manchester, New York, Stuttgart and Tokyo.

The modestly scaled proposal was awarded £278,207 by the UK's Economic and Social Research Council (ESRC) under grant RES-062-23-2134. In formal terms it

ran from January 2010 to November 2011, with a methodology based upon a combination of desk study, archival work, interviews and field visits. **Brian Webb**, a city planner, joined the team as research officer. Short though it was, the research proved to be highly productive in terms of outputs and impacts. ESRC's post-project evaluation grades it 'Outstanding'.

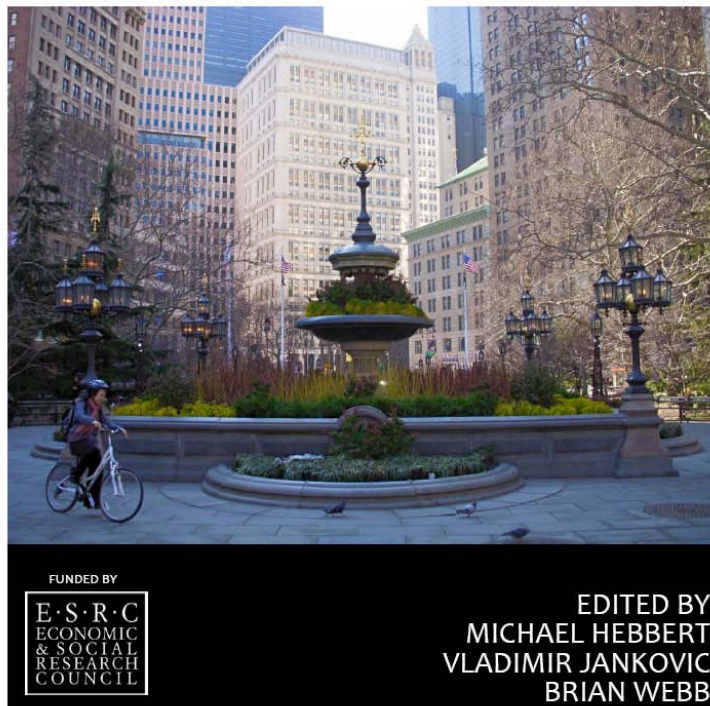
Taking the historical and comparative aspects in turn, the project established a broad historical perspective stretching from the early nineteenth century compilation of Luke Howard's *Climate of London* (Howard, 1833) through the seminal publication of Albert Kratzer's *Stadtklima* (Kratzer, 1937) to the development of modern urban climate science over the eight decades intervening. 'A historical review of urban climatology and the atmospheres of the industrialized world' (Jankovic, 2013) is the main statement of this science-history narrative, developing an earlier contribution entitled 'Hidden Climate Change - urban meteorology and the scales of real weather' in *Climatic Change* (Jankovic and Hebbert, 2012). The role

of Helmut Landsberg is highlighted. He was central in the many attempts in the decades after 1960 to promote the application of urban climatology in urban design through WMO, UN-Habitat, the International Society for Biometeorology and other international networks. That bravely prophetic but unsuccessful attempt at international knowledge transfer is written up as 'Urban Climatology applied to Urban Planning: a postwar knowledge circulation failure' for *International Journal of Urban and Regional Research* (Hebbert and MacKillop, 2013).

The comparative dimension of the project involved field visits in Japan, Germany and the US, extensive

# CITY Weathers

meteorology and urban design 1950-2010



correspondence, and an invited two-day workshop in Manchester. The workshop proceedings are accessible in e-book format under the title *City Weathers: meteorology and urban design 1950-2010* (Hebbert, Jankovic and Webb, 2011). After-dinner viewing for workshop participants was the classic documentary on the work of the Stuttgart municipal climatology team presented by the Federal German government at UN-Habitat in 1976. It can still be enjoyed on the project website ([www.sed.manchester.ac.uk/architecture/research/csud/workshop/media](http://www.sed.manchester.ac.uk/architecture/research/csud/workshop/media)), though without the benefit of the fascinating introduction from Prof. Jürgen Baumüller who helped make the movie. One of the main goals of the project was to raise awareness amongst planners and urban designers of Stuttgart's *Klimaatlas* method and its wider potential. Examples of this consciousness-raising for a technical audience are 'Vitruvian Revival Now' (Hebbert, 2010) and 'Towards a Liveable Urban Climate - Lessons from Stuttgart' (Hebbert and Webb, 2012).

Coming to the present moment, perhaps the most important result of the project has been to challenge the widespread perception that climate-aware urban design is a new and untried activity. In the context of a special issue of *Urban Studies* on cities and climate change, the co-investigators demonstrate the relevance for current climate strategy of half a century or more applied urban climatology, under the banner 'The Precedents and Why They Matter' (Hebbert and Jankovic, 2013).

'Climate Science and Urban Design' raised more questions than it had time to answer: so follow-up work continues. At the time of writing, further papers are under review for *International Planning Studies* and *Urban Climate*, as well as a chapter on urban climate design for the *Research Handbook on Climate Governance*, edited by Eva Lovbrand and Karen Backstrand, forthcoming from Edward Elgar Publishing. Vladimir Jankovic is convening a workshop on *Applied and Commercial Climatology* under the auspices of the International Commission on the History of Meteorology ([www.meteohistory.org](http://www.meteohistory.org)). To be held at the Centre for the History of Science, Technology and Medicine, University of Manchester, on November 21–22, 2013, the meeting will allow comparison between the trajectory of urban climatology and other categories of 'service' climatology. Vladimir will also contribute to a session on the history of urban climatology convened by Bob Bornstein at the American Meteorological Society Annual Meeting in Atlanta on February 2–6, 2014. He is continuing to interview practitioners and will be delighted to hear from anyone interested in sharing their experiences of the last fifty years of urban climatology and meteorology (Vladimir Jankovic is at CHSTM, University of Manchester, and can be contacted at [Vladimir.jankovic@manchester.ac.uk](mailto:Vladimir.jankovic@manchester.ac.uk)).

Michael Hebbert has moved to UCL where he is fol-

lowing up contemporary applications of urban climate mapping. However his main research task in the months ahead is to get back to the book manuscript that was interrupted five years ago by that discovery of WMO Technical Note 149. The book is about street design and the original draft did not contain the word climatology. Things will be very different now.

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## No building is an 'energy' island: The cautionary tale of the *Fryscrapper*

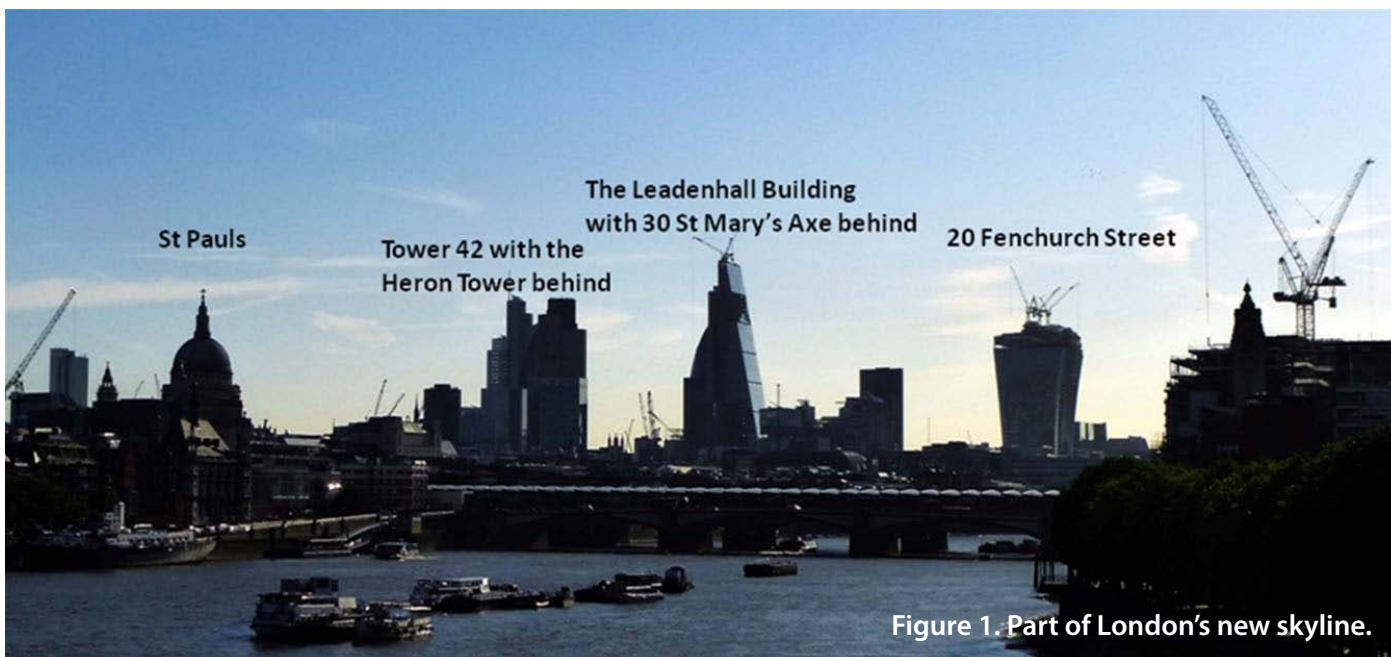


Figure 1. Part of London's new skyline.

A building in the City of London became internationally famous in early September when its reflected radiation caused parts of a nearby parked car to melt, peeled paint and cracked paving at the entrance to a local cafe. The fact that a building could generate such an extreme event in a temperate mid-latitude climate in September surprised many. More generally, it highlights the mutual dependence of buildings (and outdoor environments) on the climate modified by urban form (the layout, arrangement and design of buildings) at a neighbourhood scale.

The building at the centre of the story is officially 20 Fenchurch Street (20FC) but its unusual shape (concave, convex and cantilevered) has earned it several other names, including the *Pint* and the *Walkie-Talkie* (and after recent events, it has been named the *Fryscrapper*). It forms part of a rapidly changing urban landscape in central London where tall, glass-walled buildings protrude well above neighbouring buildings and streets that follow a traditional form: 3-4 story (15 m) brick/stone buildings on relatively narrow streets (Figure 1).

The building at 20FC was given planning permission in 2006 and was originally designed to be nearly 200 m tall but its height was reduced to overcome concerns about its visual impact on other buildings of historical importance, such as the nearby St Paul's Cathedral. The final building form, designed by Rafael Viñoly, will be 160 m tall and have 37 levels. Office space is confined to levels 3 to 34 and encloses over 60,000 sq. m of office space. The top three floors are to be a sky garden, when completed, which forms part of the building's landscaping strategy.<sup>1</sup>

Construction began in 2009 and, apart from the uppermost floors, the outer façade is complete (Figure 2). Its plot area is approximately square but the plan view of all floors shows that the façades on the east and west sides are slightly convex, while those on the north and south sides are slightly concave. However, what makes the building shape unusual is that the floor space increases with height: level 3 has a floor space of 1363 sq. m. but level 32 has 2691 sq. m.<sup>2</sup> To enclose this space the façades curve outward from the base on both the north and south sides; the shaping of the building near the roof means that the curvature on the south façade is greater. At level 3 the distance from the core (which contains the lift and service channels) is 11.5 m but at level 32 is 20.5 m. As a result, the façade bows outward at an angle of about 9.5° off vertical near roof level.

The outer surface of Fenchurch 20 is glazed. Glass has become ubiquitous as the outer facade of tall buildings: it is light in weight, transmits light and has low insulation values. The albedo of glass is normally quite low but this property is highly dependent on the angle of incidence of solar radiation. When this angle is large (usually  $\geq 80^\circ$ ) its reflectivity increases rapidly and the smooth surface reflects in a specular fashion, in other words the beam will reflect at a 90° angle from the incidence angle. For 20FC these conditions occurred in early September near noon in London, when the Sun is about 40° above the horizon. This angle combined with the slightly off axis

1. Main ESA Text & Figures, Volume 1 of the environmental statement addendum
2. <http://www.20fenchurchstreet.co.uk/>



Figure 2. Number 20 Fenchurch Street as viewed from Cheapside (left) and as viewed (right) near the base of the south-facing facade, showing its concave shape.

orientation of the building caused the solar beam to be reflected in a specular fashion off the south-facing façade. Moreover, its curvature focussed the solar energy onto the street surface and buildings on Eastcheap, about 60 m away (Figure 3).

There has been significant interest in the story both locally and internationally, with the press reporting various high surface temperature readings ( $>100^{\circ}\text{C}$ ), alongside impressive photographs that clearly demonstrate the strength of the beam.<sup>3</sup> For a brief period of time, screens were erected and street parking blocked; however, as the effect was temporal in nature (limited to a few hours a day, for specific solar altitudes) these temporary responses have ended and a permanent solution is now being sought.

There are many examples of similar reflection problems. Two of the best known are the Vdara building in Las Vegas (also designed by Viñoly with a concave face) and the Museum Tower Complex in Dallas. The latter is especially interesting as the reflections are causing overheating problems for the Nasher Sculpture Center and its collection.<sup>4</sup> However, despite the acknowledged issues with glass reflectivity, assessing its impact is not routine. In fact, Viñoly argued that tools did not exist to analyse these problems and that the reason the problem arose in London is that climate change had resulted in more sunny days!

What 20FC shows is that no building is an 'energy' island, especially when placed in an urban setting. The energy management strategy of 20FC clearly complies with current practice, whereby the building systems are

fully optimised to ensure its energy management is inherently efficient; it employs low/zero carbon technologies such as roof mounted photovoltaic cells<sup>5</sup> and has a Building Energy Rating of  $21.6 \text{ kgCO}_2 \text{ m}^{-2} \text{ yr}^{-1}$ . Yet, it affects the energy management of surrounding buildings.

To a considerable extent, this problem arises from a systemic failure to address form (at building and urban scales) and focus on fabric and technology as the means of meeting building energy standards. A recent series of UK Government reports, entitled 'Zero Carbon Non-domestic Buildings'<sup>6</sup> investigated the role of building form as an energy management parameter but concluded that it may be disregarded in an economic context where energy savings can be made elsewhere. As a result, it is at the urban planning scale that some of the impacts of buildings on their surroundings are considered; these may include issues about visual appearance, access to light (or sun) and wind effects. However, the mutual effect that buildings have on their respective

3. See <http://www.bbc.co.uk/news/magazine-23944679> and <http://www.theguardian.com/artanddesign/2013/sep/04/walkie-talkie-screen-death-ray>

4. <http://www.bloomberg.com/news/2013-08-20/dallas-tower-dithers-as-glass-roasts-museum-masterpieces.html>

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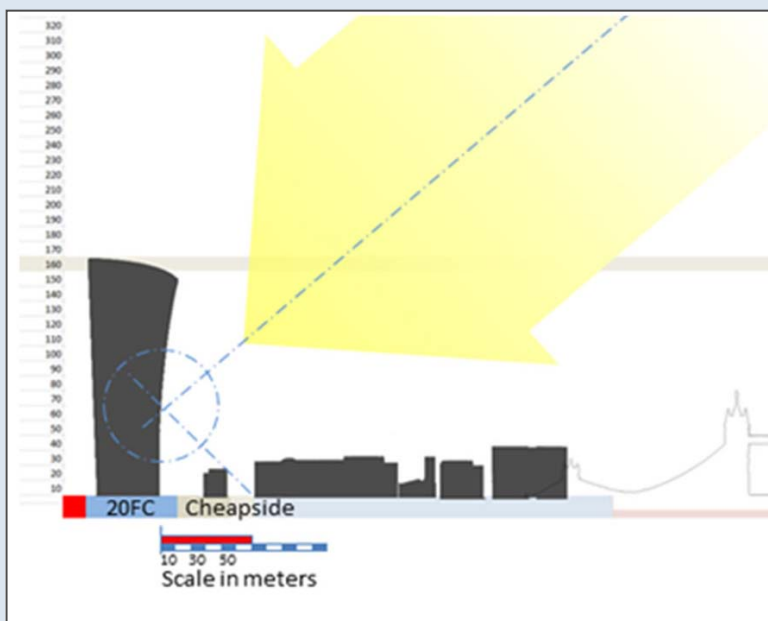


Figure 3. A cross-section of the building profile extending from 20 Fenchurch St. to the Thames river (left), and (right) the restaurant that received the brunt of the reflected beam.

energy performances is not included in these assessments and the opportunity for a holistic evaluation of a neighbourhood is lost. 20FC is illustrative of this process. The higher rent that can be charged for office space at higher floor levels is the economic justification for the building’s essential shape. The building design encloses this form in an unusual outer skin that does not detract from its energy efficiency. However, the overall result is an undesirable impact on the surrounding area that was considered but underestimated in the building design and planning phases of the project.

A recent examination of the role of building and urban form (as represented by ratio of building height to street width) using widely available dynamic thermal simulation tools (IES-VE) shows that urban form can exert a significant effect on building energy performance.<sup>7</sup> This is especially the case for modern buildings that generate considerable internal heat (from office equipment) during daylight hours when external (solar) gains through the glass walls is at a maximum. In these situations, mu-

tual shade, even in a temperate mid-latitude climate can be beneficial.

The specular reflection off 20 Fenchurch Street that caused such a furore is an unusual event but it serves to highlight the need for a more comprehensive assessment of how individual buildings interact with each other in the shared urban landscape.



Dr. **Julie Futcher** is an architect working on the issue of urban form and building energy management. She recently completed her PhD on this topic at UCD, Ireland.

Dr. **Gerald Mills** is a geographer interested in the urban climate ([gerald.mills@ucd.ie](mailto:gerald.mills@ucd.ie)).

7. See Futcher et al. (2013a) The Role of Urban Form as an Energy Management Parameter; *Energy Policy* 53 (2013) 218–228 and (2013b) Urban Form and Function as Building Performance Parameters; *Building and Environment* 62 (2013) 112–123.

## Urban green infrastructure in Sofia, Bulgaria



By David Pearlmutter, Editor

The city of Sofia, surrounded by mountains at the center of the Balkan peninsula, is the capital of Bulgaria and home to some 1.3 residents. On October 2-3, 2013 it was also home to a diverse group of European researchers who converged to discuss the challenges of urban forests and green infrastructure.

The meeting was part of [COST Action FP1204](#), a Europe-wide collaboration meant to facilitate partnerships and promote best practices among both theoreticians and practitioners. In laying out the motivations for the initiative, project coordinator **Carlo Calfapietra** from Italy and local organizer **Miglena Zhiyanski** from Sofia stressed the benefits of crossing boundaries – between countries as well as disciplines – in furthering these goals.

The bulk of the gathering was devoted to discussions in three working groups, which had been set up previously to address (1) environmental, (2) social and (3) governance-related aspects of urban greening. A fourth working group is devoted to dissemination of materials, and will coordinate the output of the other three groups.

Working Group 1 focused its attention on environ-

mental services provided by green infrastructure in cities, within the context of climate change processes taking place from the local scale to the global. It was decided to collect and catalog data from the different European countries on a range of physical processes, involving carbon, water, energy, air and soil quality, biodiversity, phenology, wood and bio-energy, food, and characteristics of urban tree species. A new item on the group's agenda involves so-called "grey-green interactions" – that is, the interface between the biotic and the built elements which coexist in the urban environment. The group plans to produce an opinion paper in the coming months, summarizing its insights on the implications of climate change for these processes and the environmental services to which they are linked.

"Socio-cultural services" were the focus of Working Group 2, which has embarked on the collection of both qualitative and quantitative data regarding these social issues in member countries. The emphasis in Group 2's work is on the equitable distribution of ecosystem services among different sectors and strata of society, and on understanding the obstacles to improved equity as well as potential mechanisms for overcoming them.

Since public green spaces in cities – parks, forests, and even shade trees planted along streets and squares – are amenities that are shared between many stakehold-

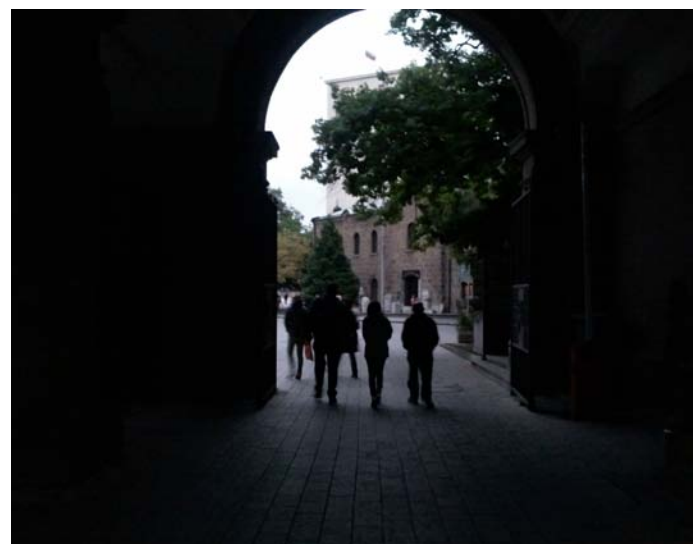
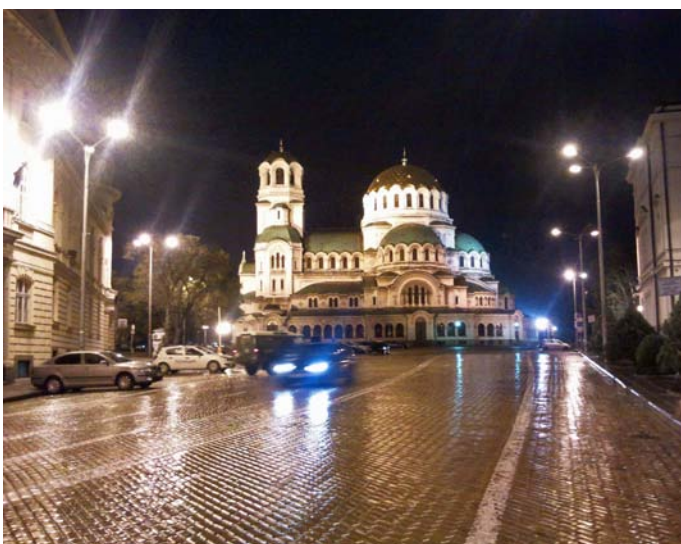
ers, their design and management are intimately tied up with governance and public policy. Working Group 3 looked at the management of these common “assets” through the lens of poly-centric, rather than strictly top-down governance, recognizing that stakeholders such as neighborhood associations, NGOs, professional unions and private companies can wield just as much influence as national, regional and local governments – and therefore all of these actors are integral parts a complex governance network. Three sub-groups were formed to look in detail at the management of physical resources, collaborative processes, and policy-making, respectively, with case studies collected from different countries to learn from successes and failures in these realms.

Working Group 4 began the process of integration between the separate strands of the working groups, and future dissemination of their products. Modeled (appropriately enough) on a “tree” of knowledge – with the uptake of information through the group’s roots, and diffusion through its branches – this process is being undertaken with an eye towards a variety of publications that will emphasize the perceptions and benefits of urban greening. An important goal is to involve more



stakeholders in urban forests and green infrastructure by providing informative papers in the languages of each of the countries.

The next meeting of COST Action FP1204 will take place concurrently with the [European Forum on Urban Forestry](#), to be held on June 3-7, 2014 in Lausanne, Switzerland. The group’s management committee also adopted a proposal to hold the following get-together in Israel, with a target date of October 28, 2014.



## Worldwide discourse on Passive and Low-Energy Architecture continues at PLEA2013 in Munich, Germany

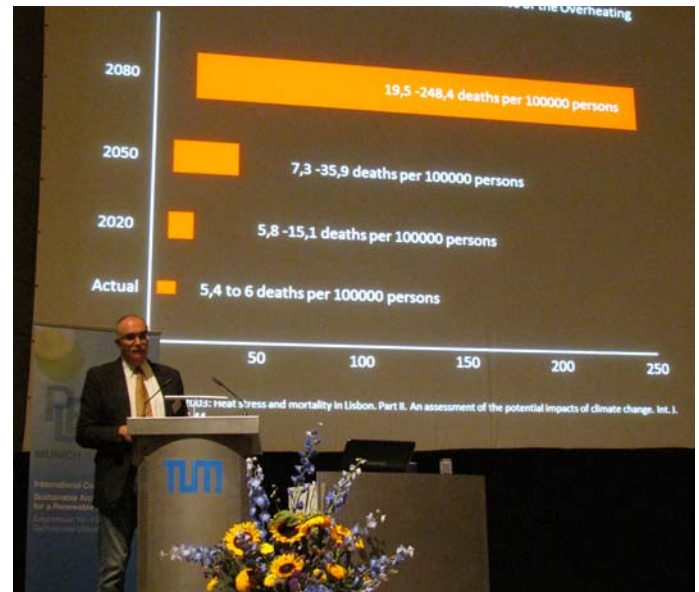
The international conference on [Passive and Low-Energy Architecture \(PLEA\)](#) has been a yearly fixture since 1982 – engaging thousands of professionals, academics and students from over 40 countries in an ongoing discourse on sustainable design of the built environment.

This year's PLEA conference took place in Munich, Germany on September 10-12, and featured a number of sessions and talks devoted to urban climate-related topics (full papers are available at <http://www.plea2013.de/>).

A keynote address on mitigation techniques to counterbalance climatic change and urban heat islands was given by Prof. **Mat Santamouris** of National and Kapodistrian University of Athens, Greece. He presented a number of approaches involving the use of cool materials, the development of smart materials with high optical and thermal performance, the use of greenery in the urban environment through appropriate landscape design, the use of appropriate heat sinks such as ground, ambient air and water to dissipate the excess ambient heat, appropriate shading and solar control of urban surfaces, and the use of cool and green roofs in urban buildings.

Several sessions of oral presentations were directed specifically at urban issues, including two on outdoor thermal comfort. A wide variety of thermal comfort aspects were brought up, as reflected in the topics of the talks.

Experimental field work on the relationship between thermal perception and a variety of urban features included studies from the Netherlands (**Wiebke Klemm** et al.); Germany (**Hyunjung Lee** and **Helmut Mayer**); Brazil (**Eduardo Krüger** and **Peter Bröde**); and the UK (**Patricia Martin del Guayo**). Some dealt with modern city neighbourhoods, while others sought lessons from



**Mat Santamouris** shows future projections of heat stress and mortality in Lisbon, based on an assessment of the potential impacts of climate change. *Photos: Isaac A. Meir*

historic city centers (**Carolina Vasilikou** and **Marialena Nikolopoulou**). **Syed Kushol** and colleagues from Bangladesh examined microclimatic variations in Dhaka City, while **Patricia Drach** et al. investigated the effect of ventilation on comfort in Rio de Janeiro neighborhoods.

A new energy balance model was presented by **Etienne Burdet** et al., and several studies employed existing tools, such as ENVI-MET, to analyze conditions in old and refurbished neighbourhoods (**Angeliki Chatzidimitriou** et al; **Tania Sharmin** and **Koen Steemers**). **Shohei Noguchi** et al. looked at the relationship between surface characteristics, urban geometry and the thermal environment.

Three presentations were made by students working with **Evyatar Erell** and **David Pearlmutter** in Israel, employing the CAT and ITS models. A study by **Daniel Boneh** found that high-albedo urban materials do not necessarily mitigate overall thermal stress under hot-arid conditions, another by **Keren Snir** analyzed the cooling efficiency of various types of ground-cover vegetation in terms of their moderating effect on pedestrian stress (as indicated by the ITS) vs. their water requirements, and a third by **Yannai Kalman** modeled the effects of building height in Tel-Aviv on both outdoor comfort and building energy efficiency.

Next year's PLEA conference will be held in the city of Ahmedabad, India on December 16-18, 2014, under the theme of "Sustainable Habitat for Developing Societies." Information is available at <http://www.plea2014.in/>.



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In this edition a list of publications are presented that have come out until the end of August 2013. As usual, papers published since this date are welcome for inclusion in the next newsletter and IAUC online database. Please send your references to the email address below with a header "IAUC publications" and the following format: Author, Title, Journal, Volume, Pages, Dates, Keywords, Language, URL, and Abstract.

Enjoy!

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## Upcoming Conferences...

**2014 AMS ANNUAL MEETING: EXTREME WEATHER – CLIMATE AND THE BUILT ENVIRONMENT**  
Atlanta, Georgia • February 2-6, 2014  
<http://annual.ametsoc.org/2014/>

**BEHAVIORAL AND PSYCHOLOGICAL RESPONSES TO WEATHER at AAG ANNUAL MEETING**  
Tampa, Florida • April 8-12, 2014  
<http://www.aag.org/annualmeeting>

**EUROPEAN FORUM ON URBAN FORESTRY (EFUF 2014)**  
Lausanne, Switzerland • June 3-7, 2014  
<http://www.efuf2014.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/cic/meetings/2015/ICUC9/>

## IAUC Board Elections 2013: Meet the new members

The online vote to select two new IAUC Board members was recently concluded. **Alexander Baklanov** (Copenhagen, Denmark) and **Curtis Wood** (Helsinki, Finland) were elected to the Board for a 4-year period, starting August 2013.

They will replace Gerald Mills and Rohinton Emmanuel as members of the IAUC board. Although Gerald and

Rohinton's terms on the IAUC Board have come to an end, they will continue to serve as President and Secretary respectively until the end of 2013. The Board would like to congratulate the new members on their election and would also like to thank all the candidates who generously agreed to stand for election.

Rohinton Emmanuel, *Secretary*

### Alexander Baklanov

- Editor-in-chief, *Urban Climate* ([www.journals.elsevier.com/urban-climate](http://www.journals.elsevier.com/urban-climate));
- Research Dept., Danish Meteorological Inst. (DMI, <http://dmi.dk>) and Niels Bohr Inst., University of Copenhagen (<http://www.nbi.ku.dk>)

Prof. Baklanov has more than 30 years of experience in developing multi-scale integrated meteorology/climate and air quality models for urban areas, especially focusing on a new generation of online coupled modelling of two-way interacting meteorological and atmospheric chemical transport processes.

He has published about 350 scientific publications, including 12 books and more than 150 peer-reviewed papers (h-index is 22). He has led many international research projects, including large urban climate-related European Union projects: FP5 FUMAPEX: 'Integrated Systems for Forecasting Urban Meteorology, Air Pollution and Population Exposure' (<http://fumapex.dmi.dk>), FP7 MEGAPOLI: 'Megacities: Emissions, urban, regional and Global Atmospheric POLLution and climate effects, and Integrated tools for assessment and mitigation' (<http://megapoli.info>). During the last six years he was a deputy director of the Danish Strategic Research Centre for Energy, Environment and Health (CEEH, <http://ceeh.dk>) and a national representative at COST Action 715 'Urban Meteorology' (1998-2004). He is Chairman of the COST Action ES1004 EuMetChem: 'European framework for online integrated air quality and meteorology modelling' (<http://eumetchem.info>), a member of the Scientific Advisory Group of the WMO GAW Urban Research Meteorology and Environment (GURME) programme, a member of the International Eurasian Academy of Sciences (IEAS), Co-organiser and chair of several international urban climate and air quality related conferences and workshops, e.g. the annual session of European Geophysical Union Assembles: 'Megacities: Air Quality and Climate Impacts from Local to Global Scales' since 2008 and member of IAUC since 2000. More information is available at <http://www.baklanov.dk>.



### Curtis Wood

- Researcher (in micro-meteorology, boundary-layer meteorology, turbulence, urban climate), Air Quality Unit, Finnish Meteorological Institute (FMI), Helsinki, Finland

Curtis became interested in a range of geophysical topics within weather, climate, oceans and fluid dynamics; and associated physical, mathematical, statistical and computing techniques when he studied, lectured and researched Meteorology at the University of Reading (BSc 2003, PhD 2007). Recent research has been with Profs Janet Barlow, Stephen Belcher, Sue Grimmond and Alan Robins -- among others -- on areas including urban dispersion, micro-meteorology and boundary-layer meteorology using e.g. eddy-covariance, tracer dispersion, lidar and scintillometry. His urban-climate research has been a tale of two cities: London and Helsinki.

In 2011, he moved to Helsinki (to the FMI) to co-found Helsinki UrBAN (Helsinki URban Boundary-layer Atmosphere Network, <http://urban.fmi.fi>). He thus continues to analyse observational datasets to improve the understanding of the urban boundary layer, with the final goal of improving weather and air-quality prediction.

He has served the academic community through organizing conferences, sitting on committees (including the Council of the Royal Meteorological Society), chairing conference sessions (e.g. at ICUC-8), and is currently an Associate Editor for the journal *Atmospheric Science Letters*. He has also led and taken part in activities with schools and the general public.



Multi-media link >>



We are pleased to announce that the next **International Conference on Urban Climate** will be located in **Toulouse** from the **20th to 24th of July, 2015**.

<http://www.meteo.fr/cic/meetings/2015/ICUC9/>

The city of Toulouse, in the South-West of France, is known as the “pink” city, with a typical architecture of handmade brick buildings and monuments. It lies on the banks of the River Garonne, half-way between the Atlantic Ocean and the Mediterranean Sea, and 600 km from Paris. The “Canal du Midi”, linking Toulouse to the Mediterranean Sea, is inscribed as a UNESCO World Heritage Site. Toulouse university is one of the oldest in Europe (founded in 1229) and, with more than 97,000 students, is the third-largest university campus of France. Toulouse is also the centre of the European aerospace industry.

The conference centre is located in the heart of the old city core. The conference centre is accessible by metro (2 stations from city centre) and by walking (10 min. from the “Capitole” place in the city centre through nice historic roads). More information on the conference centre can be found at <http://www.centre-congres-toulouse.fr>.

ICUC meetings are pre-eminent events for the presentation of research on the urban climate effect at all scales and have set important benchmarks for the development of the field. The aims of this conference are to provide an international forum where the world’s urban climatologists can discuss modern developments in research, and the application of climatic knowledge to the design of better cities. In addition to conventional ICUC sessions and themes, interdisciplinary themes focusing on application and transfer will be proposed. These interdisciplinary themes will include topics such as: urban law and links with climate regulations, decision making and transfer to public policy.

Waiting to see all of you in Toulouse for this important event of the Association,

The local scientific committee.

**V. Masson** (Météo-France)



**A. Lemonsu** (CNRS)



## Board Members & Terms

- Tim Oke (University of British Columbia, Canada): President, 2000-2003; Past President, 2003-2006; Emeritus President 2007-2009\*
  - Sue Grimmond (King’s College London, UK): 2000-2003; President, 2003-2007; Past President, 2007-2009\*
  - Matthias Roth (National University of Singapore, Singapore): 2000-2003; Secretary, 2003-2007; Acting-Treasurer 2006; President, 2007-2009; Past-President 2009-2011\*
  - Gerald Mills (UCD, Dublin, Ireland): 2007-2011; President, 2009-2013
  - Jennifer Salmond (University of Auckland, NZ): 2005-2009; Secretary, 2007-2009
  - James Voogt (University of Western Ontario, Canada), 2000-2006; Webmaster 2007-2009; 2009-2013
  - Manabu Kanda (Tokyo Institute of Technology, Japan): 2005-2009, ICUC-7 Local Organizer, 2007-2009.\*
  - Andreas Christen (University of British Columbia, Canada): 2012-2016
  - Rohinton Emmanuel (Glasgow Caledonian University, UK): 2006-2010; Secretary, 2009-2013
  - Jason Ching (EPA Atmospheric Modelling & Analysis Division, USA): 2009-2013
  - David Pearlmutter (Ben-Gurion University of the Negev, Israel): Newsletter Editor, 2009-\*
  - Alberto Martilli (CIEMAT, Spain), 2010-2014
  - Aude Lemonsu (CNRS/Meteo France), 2010-2014
  - Silvana di Sabatino (Univ. of Salento, Italy), 2010-2014
  - Hiroyuki Kusaka (University of Tsukuba, Japan): 2011-2015
  - David Sailor (Portland State University, USA): 2011-2015
- \* *appointed members*

## IAUC Committee Chairs

Editor, IAUC Newsletter: David Pearlmutter  
 Bibliography Committee: Matthias Demuzere  
 Nominating Committee: Tim Oke  
 Chair Teaching Resources: Gerald Mills  
 Interim-Chair Awards Committee: Jennifer Salmond  
 WebMaster: James Voogt

## Newsletter Contributions

The next edition of *Urban Climate News* will appear in late December. Items to be considered for the upcoming issue should be received by **November 29, 2013** and may be sent to Editor David Pearlmutter ([davidp@bgu.ac.il](mailto:davidp@bgu.ac.il)) or to the relevant section editor:

**News:** Winston Chow ([winstonchow@nus.edu.sg](mailto:winstonchow@nus.edu.sg))

**Conferences:** Jamie Voogt ([javoogt@uwo.ca](mailto:javoogt@uwo.ca))

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**Projects:** Sue Grimmond ([Sue.Grimmond@kcl.ac.uk](mailto:Sue.Grimmond@kcl.ac.uk))

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.