

From the IAUC President

Colleagues, welcome to the March 2016 issue of the *Urban Climate News*.

As you may have seen from the website or email announcement, the Board has selected **New York City** as the host city for **ICUC-10**. ICUC-10 is scheduled for June 2018 at the City University of New York and will again be held jointly with the 14th AMS Symposium on the Urban Environment. This will be the first ICUC to be held in the Americas. The decision was a difficult one as all the finalists, which also included Hong Kong, Phoenix, and Singapore, had very strong proposals and organizing teams, and represent excellent destinations for an urban climate conference. I would like to thank all those members involved in the proposals for their efforts and to the Board for their thoughtful discussion and deliberations. Finally, thank you to all the IAUC members who participated in the process by completing the member survey of ICUC locations, which is an important part of the selection process.

ICUC-10 has adopted a theme of sustainable coastal urban environments. It recognizes the large urban population who live in coastal areas and who may be particularly exposed to hazards associated with climate change. The impacts from Superstorm Sandy on the New York area provide some local context for this theme.

The importance of climate change and cities is reflected in this edition of the *Urban Climate News*: Edward Ng (CUHK) has contributed a feature article "Adapting Asian cities to climate and urban climatic changes" and UCN editor David Pearlmutter has provided a special report "Towards net zero-energy settlements: A European demonstration project". Also included are two urban project reports by winners in the ICUC-9 student presentation competition: Stephanie Jacobs of Monash University: "Comparison of modelled thermal comfort during a heatwave in Melbourne Australia", and Brian Bailey of the University of Utah: "Incorporating resolved vegetation in city-scale simulations of urban micrometeorology and its effect on the energy balance". Thanks to all our contributors in this issue and to editor David Pearlmutter for putting it all together.

And on the theme of IAUC, ICUC and climate change, I received an email the other day from flyingless.org. It contained a petition initiated in October 2015 that calls upon universities and academic professional associations to greatly reduce their flying-related footprint as part of an effort to cut greenhouse gas emissions. Considering that IAUC is a scientific organization related to the study

Inside the Spring issue...

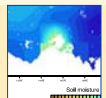
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of the atmosphere and its changes brought about by urbanization, this gave me pause. The petition asks academic professional associations: "to measure and report the environmental impact of their conferences; to radically reduce the amount of flying needed for conferencing; to establish and publish short- and medium-term benchmarks for reductions; and to work with university-based members to meet key professional objectives in ways that do not require flying and that are sustainable." The FAQ page associated with the petition provides an extensive collection of material on the environmental impact, common misconceptions (for example the authors take on the impact of carbon offsetting) and possible responses by universities and professional associations. It provides interesting reading in its own right and a useful reference list. (...continued on [page 30](#))

– James Voogt,
IAUC President

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Climate guru James Hansen warns: expect much worse sea level rise

Former NASA researcher and father of climate change awareness says melting of ice sheets could cause 'several meters' rise in a century, swamping coastal cities

March 2016 — The current rate of global warming could raise sea levels by “several meters” over the coming century, rendering most of the world’s coastal cities uninhabitable and helping unleash devastating storms, according to a paper published by James Hansen, the former NASA scientist who is considered the father of modern climate change awareness.

The research, published in *Atmospheric Chemistry and Physics*, references past climatic conditions, recent observations and future models to warn the melting of the Antarctic and Greenland ice sheets will contribute to a far worse sea level increase than previously thought.

Without a sharp reduction in greenhouse gas emissions, the global sea level is likely to increase “several meters over a timescale of 50 to 150 years”, the paper states, warning that the Earth’s oceans were six to nine meters higher during the Eemian period – an interglacial phase about 120,000 years ago that was less than 1°C warmer than it is today.

Global warming of 2°C above pre-industrial times – the world is already halfway to this mark – would be “dangerous” and risk submerging cities, the paper said. A separate study, released in February, warned that New York, London, Rio de Janeiro and Shanghai will be among the cities at risk from flooding by 2100.

Hansen’s research, written with 18 international colleagues, warns that humanity would not be able to properly adapt to such changes, although the paper concedes its conclusions “differ fundamentally from existing climate change assessments”.

The IPCC has predicted a sea level rise of up to one meter by 2100, if emissions are not constrained. Hansen, and other scientists, have argued the UN body’s assessment is too conservative as it doesn’t factor in the potential disintegration of the polar ice sheets.

Hansen’s latest work has proved controversial because it was initially published in draft form last July without undergoing a peer review process. Some scientists have questioned the assumptions made by Hansen and the soaring rate of sea level rise envisioned by his research, which has now been peer-reviewed and published.

Michael Mann, a prominent climate scientist at Pennsylvania State University, said the revised paper still has the same issues that initially “caused me concern”.

“Namely, the projected amounts of meltwater seem... large, and the ocean component of their model doesn’t resolve key wind-driven current systems (e.g. the Gulf Stream) which help transport heat poleward,” Mann said



Arizona Avenue is seen underwater following coastal flooding in Atlantic City, New Jersey, in January. More than 13 million Americans are at risk with a 1.8 meter rise in sea level. Source: theguardian.com

in an email to the Guardian.

“I’m always hesitant to ignore the findings and warnings of James Hansen; he has proven to be so very prescient when it comes to his early prediction about global warming. That having been said, I’m unconvinced that we could see melting rates over the next few decades anywhere near his exponential predictions, and everything else is contingent upon those melting rates being reasonable.”

Hansen was one of the first scientists to push climate change into the public’s consciousness, following a series of appearances before Congress in the 1980s. He retired from his role at NASA in 2013 and has become increasingly outspoken about the need to slash emissions, criticizing last year’s Paris climate deal as a “fraud” because it didn’t go far enough.

His new research warns that water gushing from melted glaciers is already influencing important ocean circulations near both poles. The added cold water risks “shutting down” the North Atlantic heat circulation, triggering a series of storms similar to Hurricane Sandy, which hobbled New York City in 2012.

“If the ocean continues to accumulate heat and increase melting of marine-terminating ice shelves of Antarctica and Greenland, a point will be reached at which it is impossible to avoid large-scale ice sheet disintegration with sea level rise of at least several meters,” the paper states. “The economic and social cost of losing functionality of all coastal cities is practically incalculable.”

Hansen said the world was “pretty darned close” to the point of no return, warning that emissions need to

be cut by about 6% a year in order to stabilize the climate.

“What we are threatening to do to young people is irreversible, it’s irreparable harm,” he said. “This is something they didn’t cause but will be out of their control. Among the top experts, there’s agreement that this is very urgent, we can’t continue on this path hoping that emissions will go down, we have to take actions.”

Hansen reiterated his call for a global tax on carbon, denying that the roles of scientist and advocate for change are conflicted.

“This isn’t advocacy, this is what is needed,” he said. “We are allowing fossil fuel companies to use the atmosphere as a free waste dump. If scientists don’t say it then politicians will tell you what’s needed and that will be based upon politics rather than science. I don’t see any reason to not make the whole story clear, or to draw a line and say ‘I’m not going to step beyond this.’”

Tom Wagner, NASA’s program scientist for the cryosphere, said Hansen has done an “amazing job” in providing a “provocative” piece of research on sea level rise.

“It’s an interesting paper as it’s one of the few times



James Hansen argues that the effects of melting glaciers, such as this one near Ilulissat, Greenland, could be devastating. Source: theguardian.com

when all of these different fields have been combined,” he said. “It is at odds with some research from other places. He’s made a great effort to combine the Eemian period to what is happening today, which is hard to do. It’s a tough one.

Source: <https://www.theguardian.com/science/2016/mar/22/sea-level-rise-james-hansen-climate-change-scientist>

City birds are smarter, healthier than country birds

March 2016 — It seems like living in the urban jungle has given birds street smarts, too, [according to researchers](#) from the McGill University in Quebec, Canada.

In a first-ever study comparing bird brains in the city to their country counterparts, results showed that city birds have better problem-solving capabilities, such as accessing to food in drawers, and are more daring.

The birds have adapted to their tough urban environment, allowing them to learn new tricks of the trade.

A team of three researchers, namely Jean-Nicholas Audet, Simon Ducatez and Louis Lefebvre, conducted the study with more than 50 Barbados bullfinches from different parts of the Carribean Island.

The Carribean was a prime location since some of its areas have human settlements, while others are mostly untouched.

Audet, a doctoral candidate in Biology told [CBC News](#) that he was inspired to do the test after being “hounded by birds at a restaurant terrace in Barbados.”

Barbados bullfinches are the only endemic bird species in the island-nation. They are seedeaters and have shown great adaptation with humans.

Besides attitude and skill, urban birds also showed better immunity than rural counterparts, with Audet [saying](#) that they seem to “have it all.”

Their study is published in the current issue of the journal [Behavioral Ecology](#).



A Barbados bullfinch performs a task for the study. Source: natureworldnews.com

On the other hand, other research show that not only bullfinches have certain smarts. [Mental Floss](#) compiled a list of surprisingly smart birds, including Galapagos woodpeckers that arm themselves to get grub and ravens that are excellent meat cutters.

Studies on crows have also been quite extensive. Prior research show that crows can recognize faces, have sharp memory and can pass information to their offspring.

Now, researchers from University of Washington are figuring out if crows also know about death, as per this [AP report](#). Source: <http://www.natureworldnews.com/articles/20318/20160322/city-birds-country-birds-urban-rural-animal-behavior-behavior-cognitive-behavior-adaptation-university-of-mcgill.htm>

From Sydney to New York, landmarks go dark for Earth Hour

March 2016 — From Sydney’s Opera House to New York’s Empire State Building and Paris’s Eiffel tower, landmarks worldwide dimmed their lights for the 10th edition of the Earth Hour campaign against climate change.

Millions of people from 178 countries and territories were expected to take part in WWF’s Earth Hour this year, organisers said, with monuments and buildings such as Berlin’s Brandenburg Gate plunging into darkness for 60 minutes from 8:30 pm local time on March 19th.

The annual event kicked off in Sydney, where the Earth Hour idea originated in 2007. “We just saw the Sydney Harbour Bridge switch its lights off... and buildings around as well,” Earth Hour’s Australia manager Sam Webb told AFP from The Rocks area.

Earth Hour’s global executive director Siddarth Das said organisers were excited about how much the movement had grown since it began nine years ago. “From one city it has now grown to over 178 countries and territories and over 7,000 cities, so we couldn’t be happier about how millions of people across the world are coming together for climate action,” he told AFP from Singapore ahead of the lights out.

Over 150 buildings in Singapore dimmed their lights, while Taipei’s 101 skyscraper gradually turned lights off for one hour and the city’s four historical gates and bridges also went dark. The lights also dimmed across Hong Kong’s usually glittering skyline, although online commentators pointed out that China’s People’s Liberation Army garrison headquarters on the harbour front kept the lights blazing. “Imagine being the manager of the only building in a major metropolis to forget,” said one Twitter post alongside a picture of the PLA building lit up against a darkened skyline.

After Asia, Earth Hour shifted to Europe where St Peter’s Basilica, Rome’s Trevi Fountain and the Parthenon temple in Athens were among a slew of iconic sites to go off-grid. In London, the lights were shut off at the Houses of Parliament, the London Eye, Tower Bridge, St Paul’s Cathedral, Buckingham Palace and Harrods department store. In Paris, the Eiffel Tower was plunged into darkness, as was the Kremlin in Moscow.

When New York’s Empire State Building went dark, one New Yorker joked on Twitter “I was wondering why my skyline is black.” In Chile’s capital, Santiago, the La Moneda presidential palace cut off its lighting for an hour, while in Mexico, the capital city’s Monument to the Revolution went dark as well.

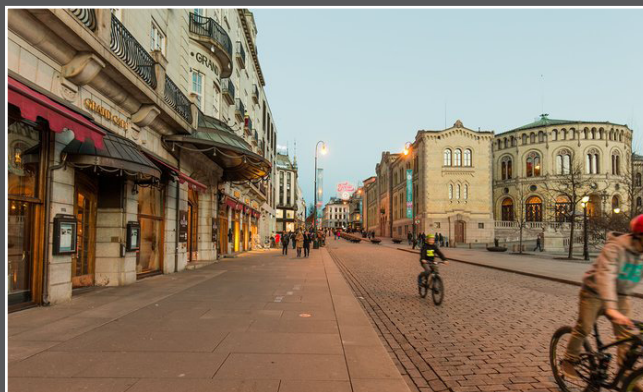
Meanwhile Canadian Prime Minister Justin Trudeau tweeted a cozy photo of himself and his wife, illuminated only by candlelight, with a fireplace glowing in the background. “We’re all on this planet together. During #EarthHour and every day thereafter,” he wrote. *Source:* http://articles.economicstimes.indiatimes.com/2016-03-20/news/71678546_1_earth-hour-lights-eiffel-tower

Are these the seven most sustainable cities?

Landmarks around the world went dark for Earth Hour this weekend, but many cities are making longer term moves towards sustainability. From Hamburg to São Paulo – seven cities taking radical steps
See more at: theguardian.com



Banning coffee pods and bottled water - Hamburg



Getting cars out of the city centre - Oslo



Better buses - Bogotá



Mobility on demand - Helsinki



Big data city - Seoul



Paying cyclists - Paying cyclists - Milan



Advertising-free street - São Paulo

Warmer climate places 50 US cities at risk for Zika virus

March 2016 — With warmer temperatures this year, 50 U.S. cities are faced with higher risk of Zika virus spread, scientists found.

The Centers for Disease Control and Prevention (CDC) reports that there are 258 travel-associated Zika virus infections in its various states while in U.S. territories, three were travel-associated while 283 are locally-acquired. If the virus continues to spread, however, scientists created a map to show which states will be impacted the most.

In a new study published in the journal PLOS Currents Outbreaks, researchers from the National Center for Atmospheric Research (NCAR), NASA Marshall Space Flight Center and the University Corporation for Atmospheric Research (UCAR) observed 50 U.S. cities. They wanted to demonstrate which cities have ideal weather conditions that could boom *Aedes aegypti* mosquito numbers during warmer months.

One key factor that contributed to the Zika virus spread in the Americas is warm temperature. With the right mix of certain conditions including warmer weather, these are favorable for populations of mosquito along the East Coast as far as New York and in the southern parts of the country including Los Angeles and Phoenix.

The researchers created computer models by using data on climate, air travel, mosquito breeding patterns and socioeconomic status to determine which areas would make for a hospitable environment for Zika virus outbreak.

They found that between December and March, the weather condition is not conducive for mosquitoes except in south Texas and south Florida because of their relatively warm conditions. From July to September, however, weather conditions are very suitable for *Aedes aegypti* mosquitoes.

The computer models show that the highest mosquito abundance would likely to occur in southeast and south Texas. Areas like southern Florida and south Texas are likely to be affected by travel-related virus spread while they offer suitable environments for populations of mosquitoes.

"This research can help us anticipate the timing and location of possible Zika virus outbreaks in certain U.S. cities," said Andrew Monaghan of NCAR. He added that even if there is still more to learn about Zika virus, shedding light on the mosquito patterns and where they can thrive in the country could help establish mosquito control efforts.

The researchers stressed that even if Zika virus would spread in mainland U.S., it would not be like the outbreak that ravaged through the Americas. Most Americans live in air-conditioned rooms which are sealed from the outdoors which lessens the contact between humans and disease-causing mosquitoes. Source: <http://www.techtimes.com/articles/142748/20160321/warmer-climate-places-50-us-cities-at-risk-for-zika-virus.htm>



Adapting Asian Cities to Climate and Urban Climatic Changes: A Chinese Tale

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The COP21 Paris Agreement and developing countries in Asia

COP21 in Paris has recently been concluded. For the first time in over 20 years there is a determination to achieve a legally binding agreement on climate change: to keep global warming below 2 degrees C. As the world celebrates, we need to read further into what has been agreed. Eventually, it is not about “what is agreed”, it is about “what can be achieved”.

Beyond this “below 2 degrees C”, the COP21 Paris Agreement, Article 2(2) acknowledges the fact that although the responsibility is common, the capabilities of the parties need to be differentiated. The Agreement articulates that “Each Party shall prepare, communicate and maintain successive na-

tionally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.” (Paris Agreement 2015). The Agreement continues in Article 2(4) to distinguish the actions of developed country parties and developing country parties.

There are 42 countries in Asia. Many of them have a GDP of less than US\$10,000 per capita; among them are China, India, Indonesia, Philippines, Bangladesh, Pakistan, Vietnam, and Thailand (Table 1). These eight East Asian countries have a total population of around 3,400 million – this represents almost half of the world’s population of 7,130 million.

Table 1. A comparison of GDP, population and annual CO₂ emissions for selected Asian countries
(Source: various online reports)

	CO ₂ emissions (tonnes per capita)	Population (millions)	Total CO ₂ emissions (kilotonnes)	GDP (US\$ per capita)
World	5.0	7,130	35,650,000	11,000
USA	16.5	320	5,280,000	53,000
China	7.6	1,340	10,184,000	7,500
India	1.8	1,200	2,160,000	1,700
Indonesia	1.8	240	432,000	3,500
Pakistan	0.8	180	144,000	1,500
Bangladesh	0.4	145	58,000	1,300
Philippines	1.0	100	100,000	3,000
Vietnam	1.9	90	171,000	2,200
Thailand	3.9	85	331,000	5,500
Japan	11	130	1,430,000	39,000
South Korea	13	50	650,000	26,000
Singapore	9	6	54,000	56,000
Hong Kong	7	7	49,000	39,000

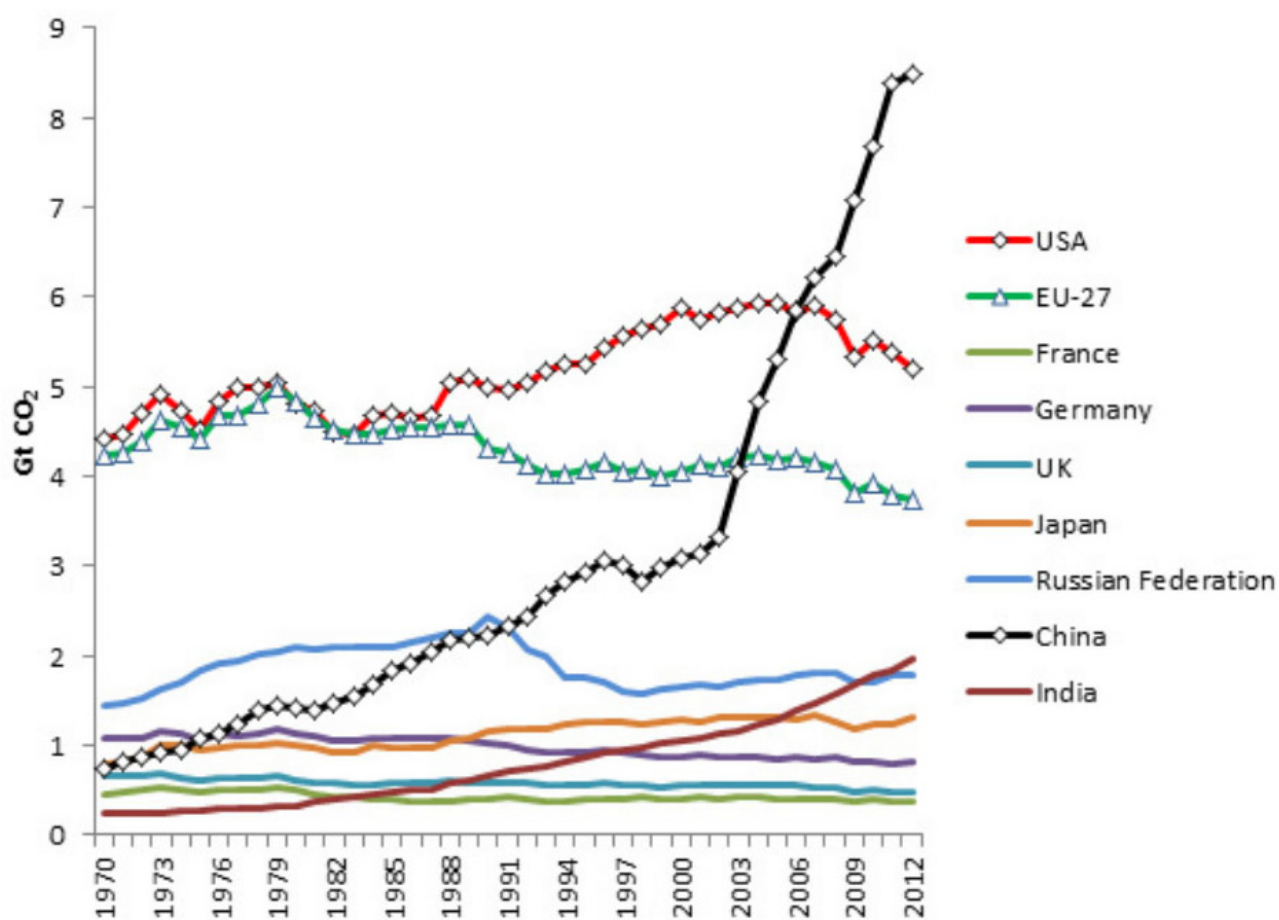


Figure 1. Total CO₂ emissions of major emitters in 1970–2012. (Zhu Liu, 2015)

Under Article 2(4) of the Agreement, these eight developing countries are only required to “enhance” their mitigation efforts, and are only “encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances”.

The crucial point to note is: how does China see itself? On the one hand, from an economic and social development point of view, China is still very much a developing country; however, from a total energy consumption and CO₂ emission point of view, it is a major contributor. The fact is, if China chooses only to “enhance” its mitigation efforts as in Article 2(4) of the Agreement, it is difficult to see how the two degree limit may be achieved.

Apart from the issue of mitigation, the Agreement also touches on the issue of adaptation. Article 7(1) of the Agreement spells it out clearly: “Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development

and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2.” The determinant of adoption of any adaptation strategy is the cost involved – and it remains to be seen how Article 9 of the Agreement on financial aids might be substantiated.

It is very easy for a nation to develop an adaptation plan. However, a plan is only as good as how it is implemented and realised. For many Asian developing countries, this, perhaps more than the need for mitigation measures, is the real challenge. Apart from the need to finance adaptation measures, the other challenge is technology. Both detection and facilitation technologies are needed, that is to say, knowing “where the problems are” and “how to tackle the problem” require technological know-how that may exceed the capability of many developing nations. This is where Article 10 and 11 of the Agreement on technology transfer may assist.

A reading of the COP21 Paris Agreement, as outlined above, provides the context when the national plans of different Asian countries are dissected.

Table 2. CO₂ emissions (megatonnes per year) from 1850 to 2010.
(Source: World Resources Institute)

	1850	1900	1920	1940	1960	1980	2000	2010
UK	122	420	470	475	583	578	533	478
USA	-	662	1,871	1,900	2,858	4,703	5,747	5,469
China	-	-	26	86	780	1,465	3,607	8,159

China's National Climate Change Program

In terms of industrialisation, China started late. The World Resources Institute has compiled a set of historical data (Table 2). Since the turn of the twenty-first century, China has industrialised rapidly (Figure 1). By 2005, it had surpassed the USA as the world's largest CO₂ emitter. By 2010, China's annual CO₂ emission level was about 8,200 megatonnes, and it is increasing rapidly at about 3% per year.

China issued its first National Climate Change Program in 2007 (NDRC-China, 2007). In a nutshell, the 2007 Program set up six guiding principles (UN, 2007):

- To address climate change within the framework of sustainable development;
- To place equal emphasis both on mitigation and adaptation;
- To integrate climate change policy with other interrelated policies;
- To rely on the advancement and innovation of science and technology;
- To follow the principle of “common but differentiated responsibilities”; and
- To actively engage in wide international cooperation.

The 2007 Program also set up a number of Objectives (UN, 2007):

- To reduce energy consumption per unit GDP by 20%;
- To increase the share of renewable energy to 10% of primary energy supply;
- To stabilize nitrous oxide emissions from industrial processes at the 2005 level;
- To control the growth rate of methane emissions;
- To increase the forest coverage rate to 20%; and
- To increase the carbon sink by 50 million tonnes over the 2005 level.

It is not difficult to see, when examining the principles and objectives of the 2007 Program, that for China the development of its economy has very much been the overarching concern. For example, given the average growth rate of about 8% per year, achieving the CO₂ intensity target of 20% over five years means that actually more CO₂ will be emitted. Indeed, in the years between 2005 and 2010, China's CO₂ emissions increased from 5,935 to 8,159 megatonnes per year. This represents an increase of 37%.

In 2011, a revised set of policies was published (NDRC-China, 2011). It set the CO₂ intensity target of 17% reduction over five years. Even given the slowdown of the Chinese economy, the undeniable fact is that China's total CO₂ emission will still be on an upward trend.

A recent report by the Netherlands Environmental Assessment Agency highlights that China's CO₂ emission level in 2014 was around 10,500 Mt; this is an annual increase of about 7% since 2010. In 2014 at the UN Climate Summit, China committed to peaking its total CO₂ emissions by 2030. This was in line with an earlier announcement (November 2014) on the “US - China Joint Announcement on Climate Change and Clean Energy Cooperation”. China had also set the goal of reducing its carbon intensity by up to 45% by 2020. How the promise is to be fulfilled is a major question. But the most important fact is that China's CO₂ emissions, given an annual growth rate of say 5%, will in 2030 be around 22,000 megatonnes. Unfortunately, this number alone will make COP21's two degree target impossible.

China's Adaptation Strategies

Given the impossible story China has so far presented in terms of mitigation, it seems that adaptation measures are its only hope. The 2011 policy document reveals that the emphases are on water,

health, land use, forestry, transport, air pollution, and industrial processes. No target was set, and, surprisingly, sea level rise was not mentioned. Subsequently, in 2013, a set of revised policies was published (NDRC-China, 2013). The six highlights are:

(A) Disaster Prevention and Mitigation: The Ministry of Civil Affairs, the Ministry of Agriculture and the Ministry of Water Resources now work closely together to build defensive infrastructure for extreme weather. Above all else is the production of flood risk maps and assessment mechanism. However, given the vastness of China's territory, the task is challenging.

(B) Monitoring and Early Warning: The China Meteorological Administration and the State Oceanic Administration are charged with providing the needed early warning and monitoring mechanism.

(C) Agriculture and Water Resources: The Outline of National Agricultural Water Conservation (2012–2020) promotes water-saving agriculture. Strictest Water Resources Management Systems have been developed for river basin protection.

(D) Coastal Areas and Ecosystems: Overseen by the State Oceanic Administration, the coastal defences are being reinforced. The long coast lines and the cities on or near the flood plains are the key challenges. A report by the Organization for Economic Cooperation and Development (OECD) reckons that a number of Chinese cities, including Guangzhou, Shanghai, Tianjin, Hong Kong, and Qingdao, are ranked in the top 20 most vulnerable cities in the world (Pan et al., 2011).

(E) Public Health: For Climate Change's impact on public health, the issue of heatwaves has not been explicitly mentioned. Drinking water and PM_{2.5} are the focuses.

Despite the above highlights of China's action plans, a question remains: is China ready for Climate Change? For the Chinese Government, the most risky challenges are agriculture and water resources (Darkin, 2008). Drought-related and flood-related crop failure poses the highest impact not only socially and economically, but also politically. China's agriculture and water infrastructures are outdated. A lot of investment is going to be needed. Apart from building defensive measures, advances in agro-biological technology are also needed.

Having policies and action plans are one thing, realising them is another. The rapid urbanisation

and economic development of China during the last 30 years has in a way set the direction and priority of the nation. Government leaders and officials are not going to dampen the short-term economic gains in return for long-term benefits. At the end of the day, let us hope that it is not going to be too little too late.

From Climate Change to Urban Climate

2030 or 2050 is too far away for politicians, but 2014 was not. Premier Xi Jinping in his opening address at the Asia-Pacific Economic Cooperation (APEC) November 2014 meeting in Beijing reminded delegates of Beijing's air pollution and urban climate problems. He hoped that, as part of his "Chinese dream", one day China will see "blue sky, green mountains and clean water". The directive set off a chain reaction.

The address was preceded by the National Plan on Climate Change 2014–2020 published in September 2014 (NDRC-China 2014). The paper mentions, for the first time, policies related to urban climate and urban living. Keywords like urban heat island, heat stress prevention, building design, transportation planning, open space provision, urban greenery, and water body have been included.

Almost immediately after Xi's address, China finally passed its 2009 draft Design Standard for Thermal Environment of Urban Residential Areas (JGJ, 2013). It specifies that the urban heat island effect will be limited to 1.5 degrees C.

In May 2015, the 2011 draft Technical Guideline for Climatic Feasibility Demonstration in Urban Overall Planning by the China Meteorological Administration was passed. As a major basis of city planning, the document mentions the need to calculate and quantify human thermal comfort, air pollution index, urban heat island intensity, mixing height, and so on.

In June 2015, the Ministry of Housing and Urban-Rural Development (MHURD) published a draft policy paper titled National City Environmental Protection and Development Policies (MHURD, 2015). It highlights the importance of Xi's "blue sky, green mountains and clean water". The key strategies are "city air corridors" and "urban greening". It recommends that China's major cities – and there are 291 of them – need to complete their Greening Masterplan and Air Corridor Masterplan by 2017.

The MHURD's paper was followed by a joint MHURD/NDRC paper in February 2016 on Climate Change Adaptation Action Plan for Cities (MHURD/NDRC, 2016). It requires results to be realised by the local governments of 30 key cities.

One of the bigger cities to have attempted an initial understanding is the city of Wuhan. It is located inland on the Yangtze River 700 km west of Shanghai. It has more than 10 million inhabitants. The city's climate is humid subtropical (Köppen Cfa). It has very hot and humid summers, but is well endowed with lakes in and around the city.

Using the excellent GIS database of the city's planning department, the research team at the Chinese University of Hong Kong calculated the city's Frontal Area Density (FAD) as the basis of its air path understanding (Figure 2). Potential air path locations at the urban and neighbourhood scales are then identified (Figure 3). The understanding provides a useful initial basis for planners.

What is next?

So, one city is almost there, and there are 290 more to go. Two challenges lie ahead.

The first challenge must be the technical capability to quickly finish the initial assessment of all 290 cities. For that to happen, detailed urban morphological data of the cities are needed. The recent WUDAPT initiative by Gerald Mills, Jason Ching, Ren Chao and others provides us with hope (Ching et al., 2015). As of today (March 2016), Professor Ren Chao's team has already finished most major cities to WUDAPT Level 0. Her team will complete all 290 cities by the end of the year. The harmonised database will provide the much-needed basis for an air corridor assessment of these cities. Based on the dataset, Ren's team will be able to quickly assemble the urban climatic maps of all the cities (Ren, 2011). Planning advices may then follow.

The other challenge is more difficult because it is beyond science. It has to do with the political will and more importantly the administrative capability for professional planners to take on the scientific information and merge it into their day-to-day practice of city planning. According to Professor Ingegard Eliasson, the challenge is conceptual, knowledge-based, institutional, and technical (Eliasson, 2000). The call has been echoed by Professor Gerald Mills and his co-authors (Mills et al., 2010).

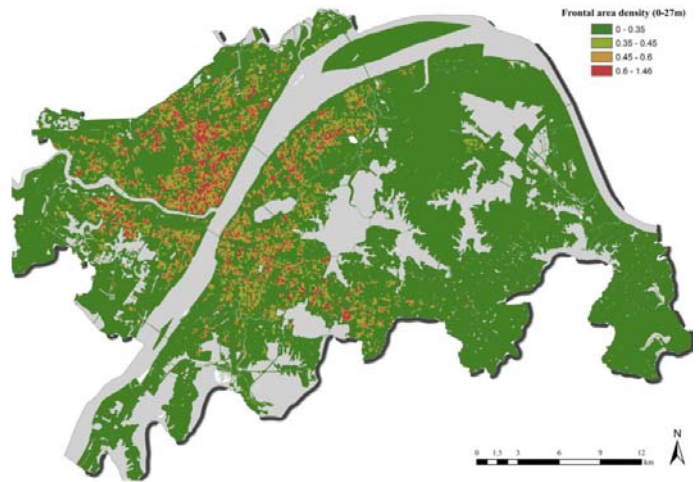


Figure 2. The FAD map of Wuhan. (Source: Author)

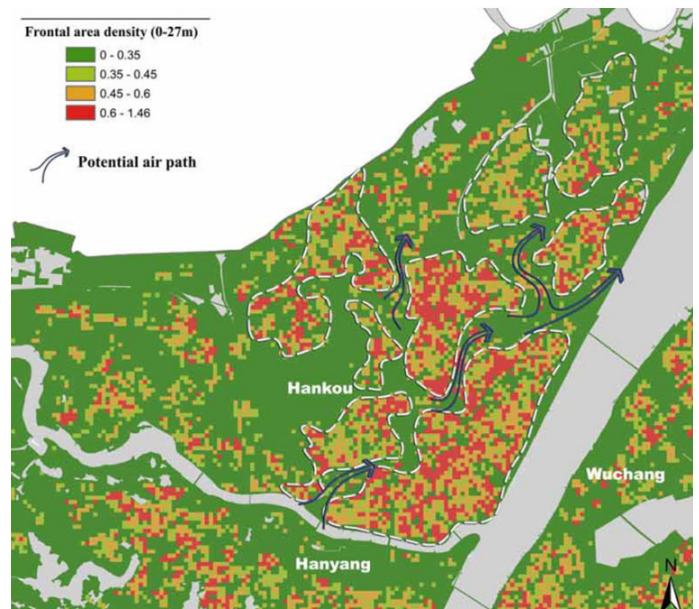


Figure 3. Using the FAD map of Wuhan, the existing air paths through the city may be defined. They need to be protected. (Source: Author)

And two fundamentals of the quality of the needed information are "prevailing" and "criticality" (Mills, 2006; Ng, 2011). Let us see how our leaders can cross the river by feeling the stones!

As for now, my take-home message when I gave the plenary lecture at the 9th ICUC conference in Toulouse is still valid: *The giants of our discipline, Professor Tim Oke, Professor Bob Bornstein, and the like, and our predecessors have inspired us much on what we need to "know", now it is our turn to pay respect by making "real" what we know.*

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Local soil moisture product improves Australian heatwave simulation

Introduction

On January 28-30, 2009 the city of Melbourne in south-eastern Australia experienced a record-breaking heatwave with three days above 43°C and one night above 30°C. Following the event, over 374 excess deaths and 714 hospitalisations were attributed to the heatwave (Victorian Department of Health 2009).

Heatwaves in southeastern Australia are typically driven by synoptic scale processes comprising an anti-cyclone to the east of the continent that advects hot dry air from the desert interior of Australia to the southeast of the country, where Melbourne is located (Pezza et al. 2011). Heatwaves in southeast Australia have also been associated with large scale modes of variability such as the negative phase of the Southern Annular Mode (Marshall et al. 2013) and the La Niña phase of the El Niño Southern Oscillation (Parker et al. 2014).

Perkins (2015) found that antecedent soil moisture conditions had a large impact on Australian heatwaves, where drier soils mean longer, hotter and more heatwave days per season. Indeed, antecedent soil moisture and its negative correlation with maximum temperature was shown to contribute greatly to the intensity and spatial extent of the January 2009 heatwave when simulated with a short lead time (Kala et al. 2015).

For urban areas, where soil or vegetation covered surfaces are increasingly being replaced by impervious surfaces, soil moisture can impact the magnitude of the urban heat island (Hafner & Kidder 1999), as well as the soil temperature and air pollution concentration (Jacobson 1999).

The January 2009 heatwave event came at the end of a 13-year drought for southeastern Australia (Ummenhofer et al. 2009). As such, there was no rain recorded at Melbourne Airport weather station between January 9, 2009 and February 7, 2009 (Engel et al. 2013). The daily maximum temperature in Melbourne is known to be 1-3°C higher after drought conditions (Nicholls and Larsen 2011), which may have contributed to the intensity of the 2009 heatwave.

For southeastern Australia, accurate soil moisture profiles for model initialisation are essential for simulating the spatial extent and intensity of heatwaves (Kala et al. 2015). Our research tests this by simulating the January 28-30, 2009 heatwave using two different methods of initialising soil moisture, one wetter and one drier, to determine whether improving the accuracy of soil moisture measurements can improve the representation of extreme heat in urban areas using Melbourne as a case study.

The motivation for this research is that heatwaves over Australia are predicted to become hotter, longer and more frequent with climate change (Cowan et al. 2014), and they have been shown to exacerbate the urban heat

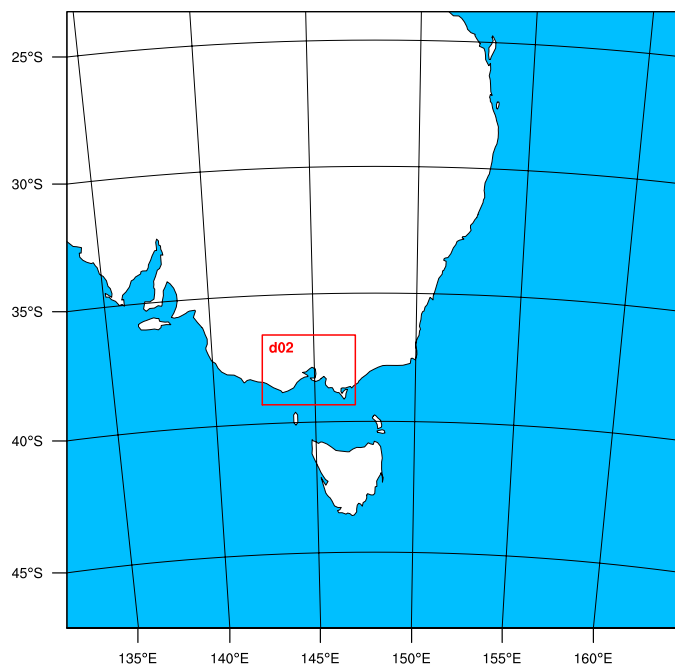


Figure 1. Domain 1 covers the entire figure at a 10km grid resolution and the red box shows the 2km inner domain for Melbourne and its surrounding areas.

island (Li and Bou-Zeid 2013), which creates a higher risk of heat stress in urban areas (Fischer et al. 2012). There is also evidence that human resilience to heat is very sensitive to particular temperature thresholds (Nicholls et al. 2008), making more accurate simulations crucial, particularly over cities. Therefore, it remains pertinent to simulate heatwaves accurately and understand the full impact of soil moisture initialisation for the modelling of Australian heatwaves, particularly in urban areas.

Data and methods

This study uses a modelling framework and compares simulations to instrumental near-surface temperature observations to determine how different soil initialisation techniques affect the accuracy of a modelled Australian heatwave.

Model framework

We used the Weather Research and Forecasting model (WRF) V3.6.0 (Skamarock et al. 2008) driven by 0.7° x 0.7° gridded ERA Interim reanalysis data (Dee et al. 2011) to simulate the January 28-30, 2009 heatwave at a 2km spatial resolution over Melbourne. WRF was coupled to a single layer urban canopy model (Kusaka et al. 2001; Chen et al. 2011) to better represent the urban features of the city. WRF has been extensively used to simulate urban areas (Argüeso et al. 2014, 2015; Salamanca et al. 2012) and heatwaves (Kala et al. 2015; Stegehuis et al. 2015).

We used the MODIS land surface categories in WRF which as a default have only one urban category. How-

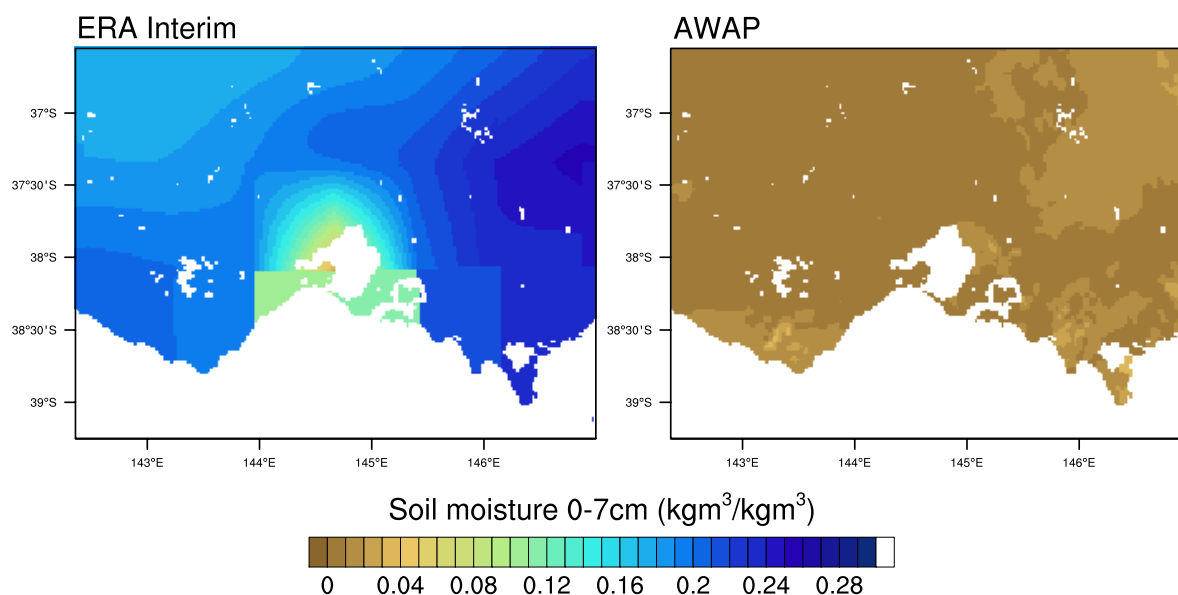


Figure 2: The ERA Interim top layer of soil moisture used in Experiment 1 compared to the AWAP soil moisture used as the top layer of the simulation in Experiment 2. The AWAP soil moisture is an order of magnitude dryer. Note that this scale only varies between 0 and 0.3. The soil moisture variable actually varies between 0 and 1, though not in this domain, where water covered surfaces (shown here in white) have a soil moisture of 1.

ever, the single layer urban canopy model in WRF allows for three different urban categories: low, medium and high density, so to define these three urban categories for Melbourne, the land surface data set from Jackson et al. (2010) was used. The low, medium and high density urban fractions in WRF were set to 0.71, 0.77 and 0.8 respectively based on values in Coutts et al. (2007). These values were chosen as the fraction of urban surface that is not vegetation. We used two domains in the WRF simulations with Melbourne and its surrounding areas as the innermost domain. The largest domain had a 10km resolution and the innermost domain a 2km resolution (Figure 1). All domains used one-way nesting.

The physics schemes used in WRF were the Noah land surface scheme, the Yonsei University boundary layer scheme, the Kain-Fritsch cumulus scheme (only for the larger domain with a resolution of 10km), the Dudhia shortwave radiation scheme, the Monin-Obukhov surface similarity scheme, the Rapid Radiative Transfer Model longwave radiation scheme and the WRF Single Moment 5-class microphysics scheme. This group of physics schemes has been deemed one of the best combinations for southeastern Australia on seasonal (Evans and McCabe 2010) and diurnal timescales (Evans and Westra 2012).

Experimental design

To determine the sensitivity of temperatures in heatwaves to the initial conditions of soil moisture, two experiments were performed. Experiment 1) ran WRF using ERA Interim as the model driver for three days with the first day discarded as model spin up and repeated this process until the heatwave was fully simulated. These three-day simulations were repeated 8 times to form an 8-

member ensemble to reduce the sensitivity to initial conditions (Georgescu et al. 2014). Each ensemble member was initialised 6 hours apart. Experiment 2) ran WRF with the same setup as Experiment 1, but the top layer of ERA Interim soil moisture (0-7cm) was replaced with gridded $0.05^\circ \times 0.05^\circ$ soil moisture data from the Australian Water Availability Project (AWAP, <http://www.csiro.au/awap/>). The AWAP soil moisture is a locally made high resolution soil moisture reanalysis product, which has undergone local verification on monthly and weekly time scales (Raupach et al. 2009). The top layer AWAP soil moisture is an order of magnitude drier than the ERA Interim soil moisture, showing the large difference between the two products (Figure 2). We ran each ensemble from 18UTC January 24, 2009 until 18UTC January 31, 2009.

Observational data

To test the accuracy of our two model experiments we validate WRF against two observational datasets. First, we obtained gridded AWAP maximum and minimum temperature data (Jones et al. 2009). This data has been interpolated from observational weather stations around Australia to a $0.05^\circ \times 0.05^\circ$ grid. To compare the 2km resolution WRF to the ~ 5 km resolution gridded data we interpolated the WRF data to the AWAP grid using a nearest neighbour method so that the two datasets were directly comparable.

Next, three-hourly 2m temperature data from six urban Australian Bureau of Meteorology weather stations in Melbourne were obtained to compare the results from the closest WRF gridpoint to the weather stations. We calculated a root mean square error (RMSE) between WRF and the weather station for the warmest part of

Table 1. The latitude, longitude and altitude of the 6 urban weather stations.

Station name	Latitude (°)	Longitude (°)	Altitude (m)
Essendon Airport	-37.73	144.91	78.4
Laverton RAAF	-37.86	144.76	20.1
Melbourne Airport	-37.67	144.83	113.4
Moorabbin	-37.98	145.10	12.1
Scoresby	-37.87	145.26	80.0
Viewbank	-37.74	145.10	66.1

Table 2. The root mean square error (RMSE, in °C) between the observational urban weather stations and the closest WRF grid point over the warmest part of the day and the coolest (bold** indicates lower RMSE value).**

Weather Station	Experiment 1 (ERA Interim soil moisture)		Experiment 2 (AWAP soil moisture)	
	12pm-6pm	12am-6am	12pm-6pm	12am-6am
Essendon Airport	1.68	2.84	1.29	2.81
Laverton RAAF	1.15	1.95	1.15	1.69
Melbourne Airport	1.56	2.07	1.03	2.47
Moorabbin	2.07	3.41	1.65	3.04
Scoresby	2.47	3.15	1.83	2.59
Viewbank	2.72	2.63	2.21	2.33

the day (12pm-6pm) for the three days of the heat wave and the coolest part of the day (12am-6am) for the two middle nights of the heatwave. A cold front swept across Melbourne at 6pm on the final day of the heatwave, yet in Experiments 1 and 2, WRF simulated the cold front at 8pm. This resulted in an unusually large error between the observed 2m temperature and the WRF values, which lead to an over inflation of the RMSE values. Therefore, for our warmest part of the day RMSE calculations, we have excluded the 6pm value on January 30, the final day of the heatwave. The observational data is from 00:00 January 28 2009 until 00:00 January 31 2009 (local Australian Eastern Daylight time) and the weather station details are in Table 1.

These simple measures of validating WRF against near-surface temperature will highlight which soil moisture initialisation experiment best simulates the January 2009 heatwave over Melbourne.

Results

The area-averaged urban temperature bias of the WRF heatwave simulations show that the maximum temperature is underestimated and the minimum temperature is overestimated for both Experiment 1 and 2. Experiment 1 had an ensemble mean maximum temperature bias of -2.92°C and a minimum temperature bias of 4.68°C, whereas Experiment 2 had an ensemble mean maximum temperature bias of -1.87°C and a minimum temperature bias of 3.86°C. The maximum and minimum temperature

bias for Experiment 2 is over 1°C lower than for Experiment 1 indicating that the drier soil simulation is better at achieving the extremely high maximum temperatures of the heatwave in Melbourne as well as the cooler nights.

The large minimum temperature bias for both experiments is partially due to the extremely high observational minimum temperature on the first night of the heatwave. Throughout this night the minimum temperature was 30.5°C at Melbourne Airport weather station, and while WRF is prone to overestimating the minimum temperature, it still did not achieve this unusually high night-time temperature.

The explanation for these results is that the antecedent soil moisture conditions are known to have a negative correlation with maximum temperature (Kala et al. 2015). This is because liquid water has a higher heat capacity than air, meaning it takes more time to heat up and cool down. Drier soils are filled with more air than water and so are able to warm up during the day and cool down at night faster than soils with a higher moisture content.

When comparing the 2m temperature from 6 urban weather stations to the closest WRF gridpoint we found that Experiment 2 performed better for the warmest part of the day (12pm-6pm) and the coolest part of the day (Table 2). This confirms the ensemble mean results where having the drier AWAP soils in the simulation enables WRF to better simulate the diurnal variability of the heatwave. It is worth noting that WRF is on a 2km grid and so choosing one representative point to compare to a weather sta-

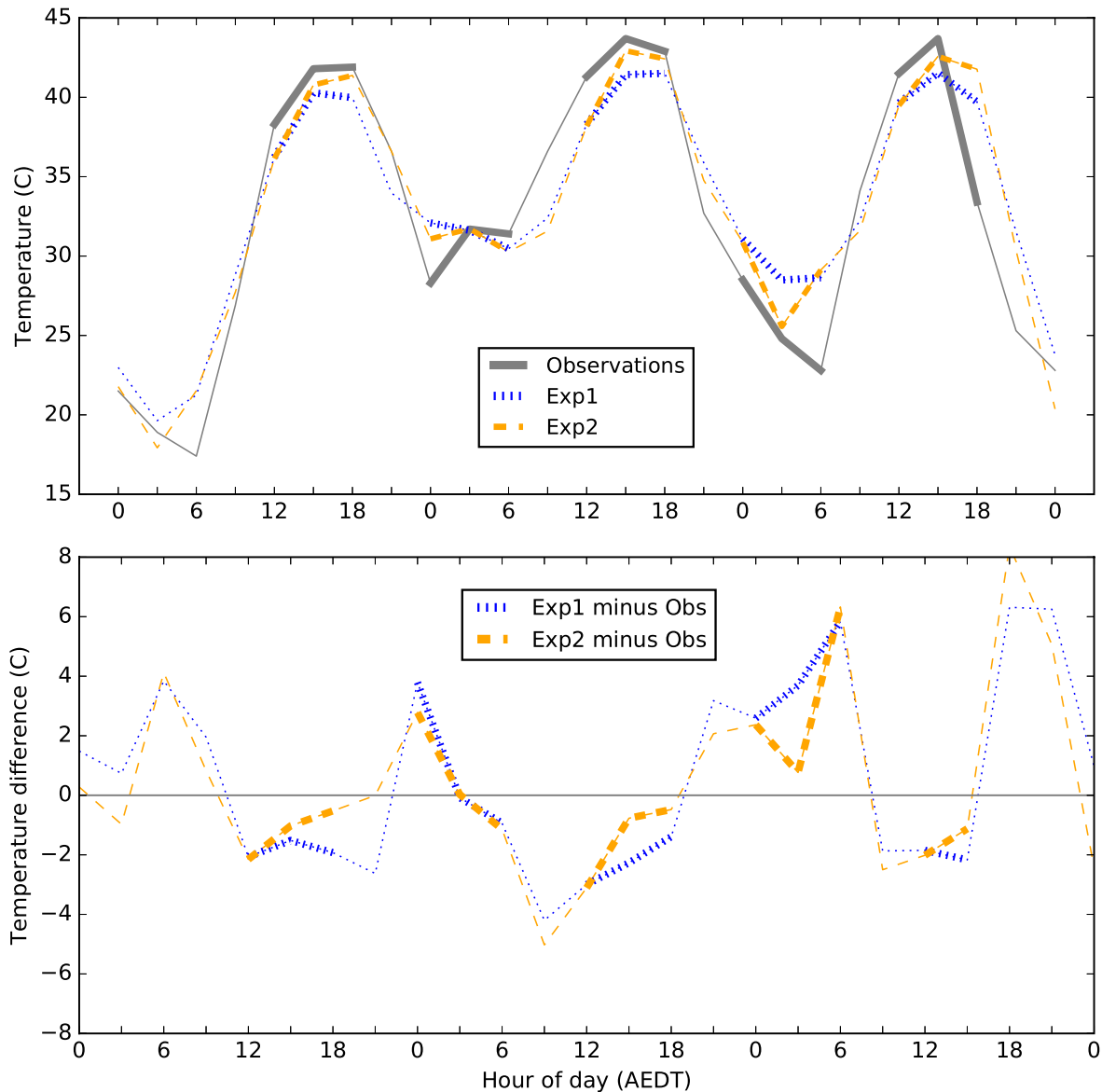


Figure 3: (a) The 3 hourly 2m temperature for Moorabbin weather station observational data (grey), Experiment 1 (blue) and Experiment 2 (orange). (b) Experiment 1 minus observations (blue) and Experiment 2 minus observations (orange). The warmest and coolest parts of the day 12pm-6pm and 12am to 6am, respectively, are shown in bold. It is from the bold values that the RMSE in Table 2 are calculated. Times are in Australian Eastern Daylight Time (+11UTC).

tion is a strict test of the model. Nevertheless, the weather station results broadly agree with the gridded data.

Using Moorabbin as an example, Figure 3a shows that Experiment 2 has a greater diurnal variability than Experiment 1, and when compared to observations it clearly performs better during the warmest and coolest parts of the heatwave. It is clear that the timing of the cold front in the observations is earlier than the WRF simulations resulting in unusually large errors at 6pm on the final day of the heatwave (Figure 3b). This is why the final 6pm timestep was excluded from RMSE analysis.

At Melbourne Airport weather station Experiment 1 performs better during the coldest part of the day (Table 2). It is clear from Figure 4a that Experiment 2 performs

best at Melbourne Airport during the warmest part of the day and during the second night of the heatwave with a temperature difference of less than 1°C (Figure 4b). However, the RMSE discrepancy is due to the unusually hot first night of the heatwave, which was particularly prominent at Melbourne Airport compared to the other five weather stations analysed. Experiment 1 has wetter soils and so does not cool down as much as Experiment 2, which for this first night meant that its errors were smaller at Melbourne Airport, resulting in a smaller overall RMSE for Experiment 1. These results suggest that the errors are not uniform across the heatwave and that each experiment performed better during different days and nights of the heatwave.

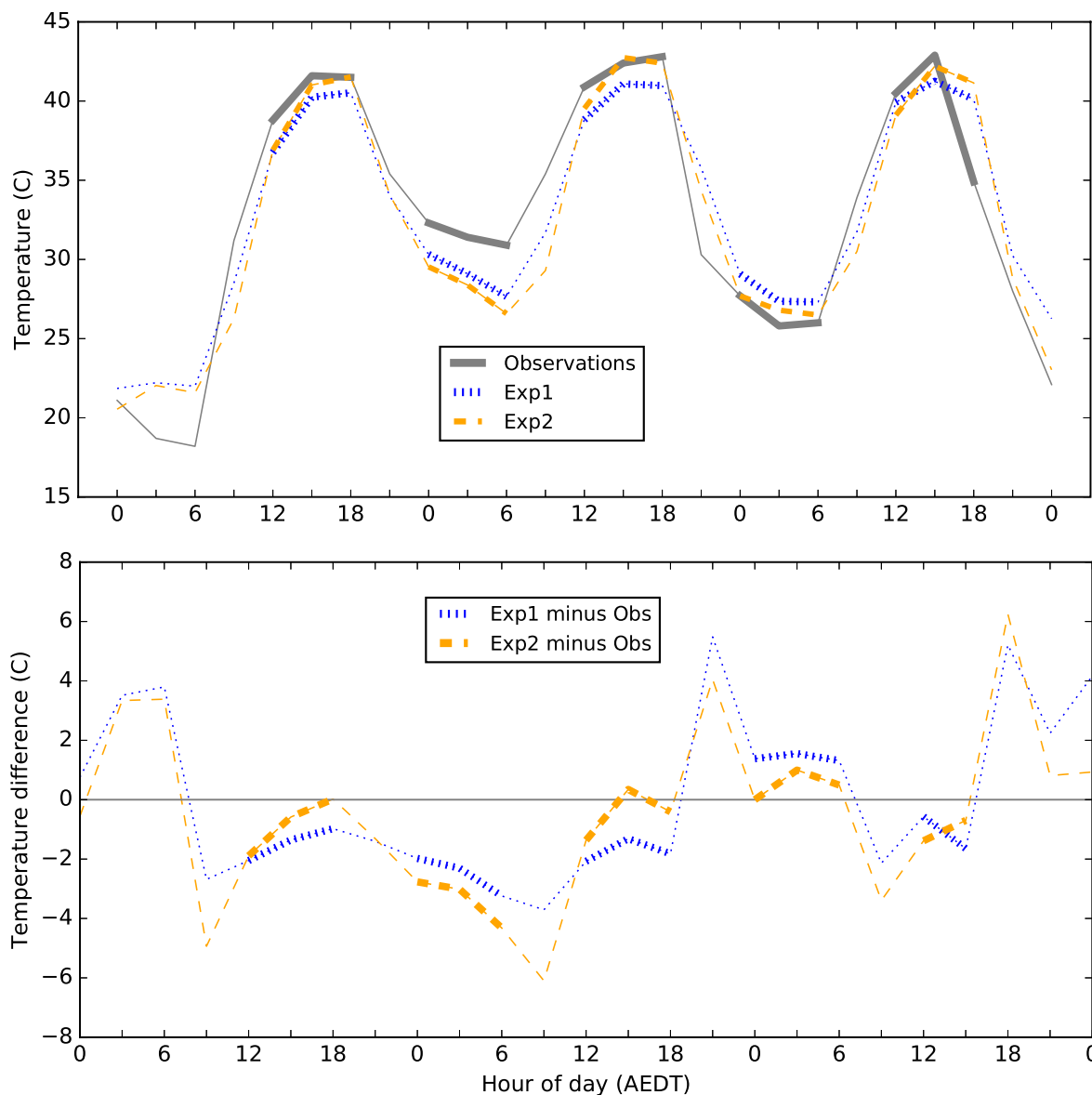


Figure 4: (a) The 3 hourly 2m temperature for Melbourne Airport weather station observational data (grey), Experiment 1 (blue) and Experiment 2 (orange). (b) Experiment 1 minus observations (blue) and Experiment 2 minus observations (orange). The warmest and coolest parts of the day 12pm-6pm and 12am to 6am, respectively, are shown in bold. It is from the bold values that the RMSE in Table 2 are calculated. Times are in Australian Eastern Daylight Time (+11UTC).

Conclusions

Antecedent soil moisture conditions are crucial for determining the length, intensity and number of heatwave days per season in Australia. With regards to modelling, if simulating with a short lead time accurate soil moistures are fundamental in determining the spatial extent and intensity of Australian heatwaves. Heatwaves are also known to exacerbate the urban heat island, posing increased heat stress risks for urban residents.

With this as motivation we performed a small model validation on the ability of WRF to simulate the near-surface temperatures of the January 2009 heatwave over Melbourne. We conducted two experiments, the first using

the default ERA Interim reanalysis soil moistures in WRF and the second replacing the top layer of ERA Interim soil moisture with the much drier Australian made AWAP soil moisture product. Our results showed that the drier soil moisture product enabled WRF to more accurately simulate the diurnal variability of the heatwave in the urban environment. By using this alternate and arguably more accurate product, we can improve accuracy of WRF simulations during heatwaves. This avoids the use of long runs, which, while they can improve the soil moisture initialisation are also more computationally expensive. For future research we plan to use the drier soil simulations as a control run for testing urban heat mitigation scenarios during heatwaves in Melbourne.

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Incorporating resolved vegetation in city-scale simulations of urban micrometeorology and its effect on the energy balance

Introduction

Urban vegetation plays a critical role in the exchange of heat and mass across a wide range of scales. Shading and evaporative cooling by trees reduce air and surface temperatures, which can increase human comfort, reduce building energy usage, and mitigate the urban heat island effect (Akbari et al., 2001; Oberndorfer et al., 2007; Susca et al., 2011). Urban vegetation can also improve air quality through deposition and respiration processes (Akbari et al., 2001; Nowak et al., 2007).

Despite the clear benefits of urban vegetation, it is difficult to determine how their local effects translate across neighborhood- and city-scales, and the degree to which their benefits offset their costs. It is relatively straightforward to determine the *local* effects of urban vegetation by measuring the surface and air temperature in the direct vicinity of the vegetation. However, the widespread effects of vegetation are extremely difficult to measure directly due to the complicated interactions between micrometeorology and topography.

Remote sensing has been successfully used to measure citywide surface temperature (e.g., Nichol, 2005; Weng, 2009). However, air temperature is the quantity that is most relevant in assessing the microclimate of humans.

Modeling is one commonly used method to fill in the gaps of limited measurements. The wide disparity in length scales between tree, building, and city-scales presents substantial difficulty in modeling the effects of vegetation on urban microclimate. City-scale models are too coarse to represent localized changes in urban form, and building/tree-scale models are too inefficient to feasibly represent whole city-scales.

To address these issues, we have developed a new modeling framework that includes highly detailed models for three-dimensionally resolved urban vegetation. The model directly resolves buildings and trees, but is computationally efficient enough to include city-scales.

In this work, the modeling system is used to explore several “what if?” scenarios regarding various urban vegetation configurations.

Model overview

The overall goal of the model is to provide the three-dimensional distribution of temperature and temperature-related quantities (e.g., fluxes of radiation, sensible heat, moisture) in the urban environment over kilometer-scales at meter or sub-meter resolution. This requires resolving the effects of individual trees and buildings. It is not feasible to resolve every individual leaf within the domain, as this likely amounts to trillions of leaves in an

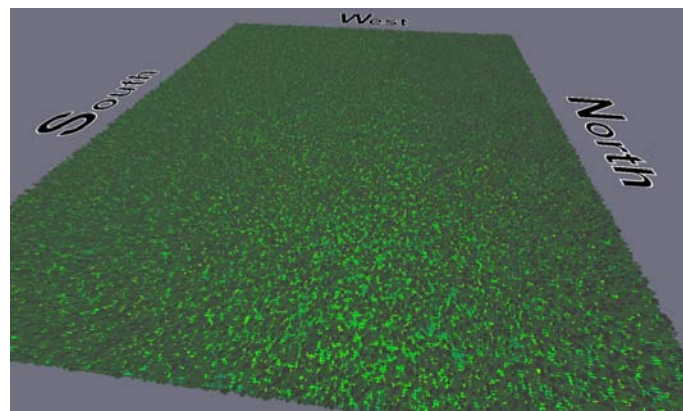


Figure 1. Example simulation domain of 115,591 trees comprised of 1.65 million vegetation volumes.

expected urban area. To incorporate sub-tree heterogeneity without having to represent every leaf, vegetation is discretized into sub-volumes of arbitrary shape and size, within which properties are constant (Bailey et al., 2014). Solid surfaces such as the ground or buildings are discretized into sub-areas called patches. Using this approach, urban domains can be built up using these primitive elements analogous to Lego® blocks. For each vegetation volume, the user must specify radiative properties of the leaves (emissivity, transmissivity, reflectivity), the leaf area density, and the leaf angle distribution function. For each patch, radiative properties and the bi-directional reflectance distribution function (BRDF) must be specified.

Radiation model: Radiation absorption, scattering, and emission by patches or vegetation volumes was modeled using the approach developed by Bailey et al. (2014) and Overby et al. (2016). The model uses a quasi-deterministic ray tracing approach to determine radiation transport over PAR, NIR, and TIR bands. The effects of leaf anisotropy are incorporated by integrating the leaf angle distribution function to determine radiation transfer parameters (e.g., attenuation coefficient, scattering phase function).

Surface energy balance model: Surface fluxes of heat and moisture, as well as surface temperature were modeled using the approach of Bailey et al. (2016). The radiation model described above is used to drive a surface energy balance model for all surfaces and vegetation volumes in the domain, which considers a balance between radiation, sensible heat, latent heat, and, in the case of the ground and buildings, energy storage.

Turbulent transport model: Turbulent transport is the mechanism that couples heat and moisture transport between individual elements in the urban domain. The model of Briggs (2015) was used, which solves an advective

tion-diffusion equation for heat and moisture. The advection component requires a three-dimensional prediction of the ensemble turbulent wind field, which is provided by the Quick Urban & Industrial Complex (QUIC) model (Singh et al., 2008).

GPU acceleration

The above models have high demands in terms of computational resources. This means that standard desktop and laptop computers are not powerful enough to run them in a reasonable length of time. Supercomputers provide the required power, but many anticipated model users (e.g., urban planners) do not have access to supercomputing resources.

Graphics processing units (GPUs), which are standard hardware on all desktop and laptop computers, are essentially miniature supercomputers that were designed to perform graphics-related computations with high efficiency. They are exceptionally suited to perform the expensive ray-tracing calculations associated with the radiation models. The NVIDIA OptiX ray-tracing framework was used to perform highly efficient radiation simulations in parallel on commodity-level GPUs. Bailey et al. (2014) showed that using this framework allowed the execution time of the radiation models to scale linearly with domain size. This has allowed us to run domains with hundreds of thousands of trees at sub-meter resolution (Fig. 1). Additionally, the turbulent transport model is also accelerated by leveraging the parallelism afforded by the GPUs.

Impact of urban vegetation on citywide microclimate

The simulation tool was used to examine various urban vegetation scenarios in Salt Lake City, UT USA. City databases of building and tree locations were used to reconstruct a 5 km² area of the downtown portion of the city. This area consisted of 552 buildings and 1,812 trees, each of which were resolved by a model grid of size 4 m³ (Fig. 2).

The simulations were driven by a mean wind originating out of the Southwest (Fig. 3a). The mean air temperature was set at 21°C. Radiative conditions were characteristic of Salt Lake City for clear-sky conditions on October 1.

Figure 3 shows simulated air and surface temperature distributions for 14:00 local time. Substantial reductions in surface temperature can be seen in areas of shadow, vegetation, and grass. The range of surface temperature in the domain is greater than 15°C. However, reductions in air temperature are much less dramatic (range of less than 3°C), as localized effects of heterogeneity are mixed out by turbulent transport.

To assess the impacts of trees on microclimate, three

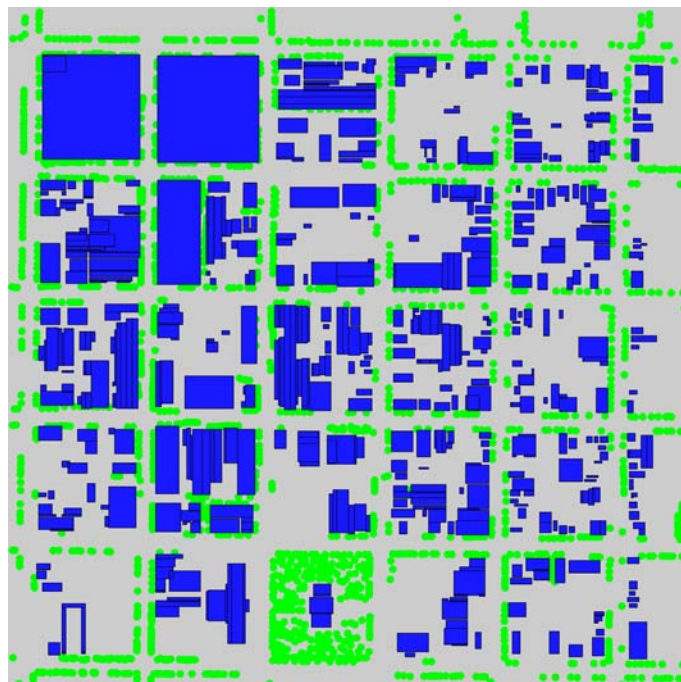


Figure 2. Salt Lake City test case, which consists of 552 buildings and 1,812 trees. Individual buildings shown in blue, trees shown in green.

different scenarios were simulated. Cases were considered with no trees, the actual number of trees, and double the actual number of trees. Plane averages of temperature are given in Fig. 4 for each of these cases. Values at a height of zero correspond to surface temperatures.

Trees reduced the domain-averaged surface temperature, but this reduction was small at about 0.5°C. When the number of trees was doubled, the average surface temperature was only negligibly reduced. This indicated a scenario of diminishing returns, where trees began to shade each other rather than the ground. Air temperature was negligibly impacted by vegetation at all heights. Although localized reductions in air temperature due to vegetation can be several degrees, overall these reductions were negligible when integrated over the entire domain.

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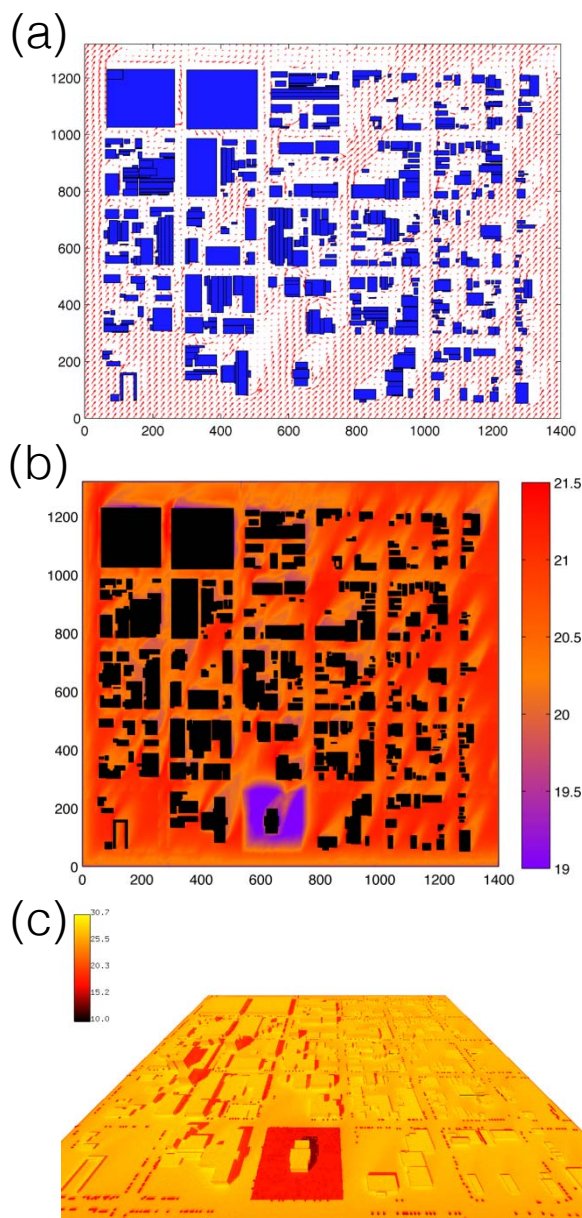


Figure 3. Salt Lake City test case simulation of (a) mean wind velocity vectors at a height of 2 m, (b) air temperature at a height of 2 m, (c) surface temperature.

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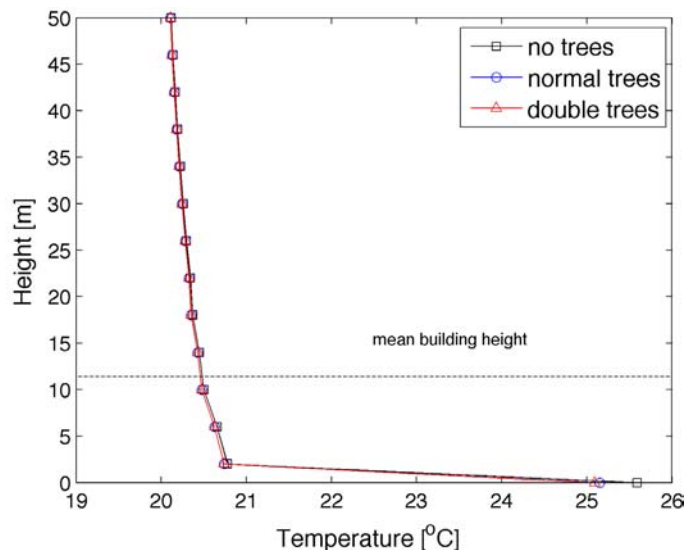


Figure 4: Profiles of temperature for various vegetation scenarios: no trees, the actual number of trees, and double the actual number of trees. The temperature at a height of zero corresponds to the average surface temperature, and all other heights correspond only to air temperature.

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ZERO-PLUS: Achieving near-zero and positive energy settlements in Europe using advanced energy technology

By David Pearlmutter, Editor

In Europe, over 40% of final energy use occurs in residential and commercial buildings, making the “building sector” the largest consumer of energy and emitter of carbon. There is a growing reliance in much of Europe on energy-intensive air-conditioning, which is expected to intensify in a climate that is warming both globally due to climate change, and locally in cities due to UHI effects. In addition to the implications for public health and well-being, the burden of rising energy consumption in buildings has a pronounced economic dimension, as fuel poverty becomes a reality for an increasing number of EU citizens.

In response to a growing perception that the trajectory of energy use patterns in buildings is not sustain-

able, the European Union has established specific policies aimed at reducing fossil fuel consumption and their related greenhouse gas emissions. The “Europe 2020” strategy adopted by the European Commission stipulates three targets to be met by the year 2020 (relative to 1990): a reduction in GHG emissions of 20%, an increase in energy efficiency of 20%, and an increase in the contribution of renewable energy sources equivalent to 20% of final energy consumption. By simultaneously reducing consumption and relying on “clean” production, a goal has emerged of achieving “net zero-energy” (NZE) – by which energy consumption decreases over time and is eventually matched by an equivalent supply of energy from renewable sources. Net zero-energy buildings are thus intended to have highly energy efficient performance, and the low amount of energy that they require comes from sustainable non-fossil resources.



Partners in the European ZERO-PLUS project met recently in Dalmine, Italy to discuss advanced technologies for achieving extreme energy efficiency – highlighting the multi-faceted relationship between climate and the built environment.



Zero-energy settlements use efficiently designed buildings and systems to reduce energy demand to a minimum, and then meet this demand by generating renewable energy on-site. The ZERO-PLUS project will demonstrate that this ambitious strategy for cutting carbon emissions can be achieved at a significantly lowered cost. Pictured above: the existing BedZed development in London (left) and Schlierberg settlement in Freiburg (right).

The “Energy Performance in Buildings Directive” (EPBD) issued by the EU requires that by the year 2020, all new buildings be “nearly” zero-energy.

This month in Dalmine, Italy, a diverse group of European academics, practitioners and industrial partners met to demonstrate the feasibility of achieving the net zero-energy concept in practice. They are contributors to an ambitious [Horizon 2020](#) project entitled “Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology” or ZERO-PLUS – which aims to show that at an urban scale, residential settlements can not only be designed to produce more energy than they consume, but they can also be realized with significantly reduced costs.

The project is being coordinated by **Prof. Mat Santamouris** from the University of Athens, and includes research partners from a host of institutions around Europe. The selected “zero-plus” technologies will be integrated in the design and construction of four actual case study projects in Italy, Cyprus, France and the UK. In each of these “settlement-scale” case studies, advanced technologies which are found to be most cost effective for the particular climate and site requirements will be selected and implemented. The investment in these technologies will be concentrated in four main areas that are considered critical for minimizing the “net” consumption of energy: a) energy-conserving building envelope systems, b) high-efficiency heating and cooling systems, c) renewable and low-carbon energy supply systems, and c) smart energy management systems for optimizing the distribution of energy services at the building and settlement level. Much of the design emphasis at the settlement scale is placed on contributing to UHI mitigation, and in turn to energy conservation through reduced cooling loads.

While the zero-energy concept has largely focused until

now on achieving a net zero balance within the framework of an individual building, the settlement scale has important advantages in terms of energy management. Taking advantage of energy exchange within a local “smart-grid” overcomes important limitations of “autonomous buildings,” for which on-site energy storage can be prohibitively expensive. Such storage is essential given the intermittent nature of solar radiation and wind flow, the primary renewable sources of energy for local power generation.

Even if individual buildings within a neighborhood or district do not meet the NZE target due to limiting factors such as their inefficient space-to-volume ratio, or their sizable energy demand due to specific needs, the cumulative NZE balance still can be achieved at a larger scale if there is compensation by other buildings with better performance. This framework potentially allows greater flexibility in architectural design, and a larger variety of building forms and functions. With a mix of residential and commercial uses, for example, large structures such as parking facilities and commercial buildings may provide ample space for on-site energy generation using rooftop solar photovoltaic panels, while reducing the embodied energy of ground based PV field arrays which require dedicated foundations and supporting structures.

According to a study conducted by the International Energy Agency in 2010, more than 200 projects around the world have been realized in the last two decades with a reputable claim of a net zero-energy balance. Every year more and more projects are being built, since more developers and architects are inspired by the demonstrated benefits of the NZE building approach. The increasing efficiency and affordability of technologies is also a significant convincing factor – which is why the ZERO-PLUS demonstration of feasibility in actual built projects is so important.

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In this edition a list is presented of publications that have generally come out between **December 2015 and February 2015**. As usual, papers published since this date are welcome for inclusion in the next newsletter and IAUC [online database](#). Please send your references to the email address below with a header "IAUC publications" and the following format: Author, Title, Journal, Year, Volume, Issue, Pages, Dates, Keywords, URL, and Abstract. In order to make the lives of the Bibliography Committee members easier, please send the references **in a .bib format**.

Please note that we are still supporting (young) researchers to join and contribute to the Committee. If you are interested to join or would like to receive more information, please let me know via the email address below.

Regards,

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Upcoming Conferences...

INTERNATIONAL CONFERENCE ON COUNTER-MEASURES TO URBAN HEAT ISLANDS
NUS, Singapore • May 30 - June 1, 2016
<http://www.ic2uhi2016.org/>

EUROPEAN FORUM ON URBAN FORESTRY (EFUF 2016)
Ljubljana, Slovenia • May 31 - June 4, 2016
<http://efuf2016.gozdis.si/>

FIRST INTERNATIONAL CONFERENCE ON URBAN PHYSICS (FICUP)
Quito - Galápagos • Sept 25 - Oct 2, 2016
<http://www.ficup2016.com/>

2ND URBAN & INFRASTRUCTURE DEVELOPMENT CONFERENCE FOR EAST AND CENTRAL AFRICA
Kampala, Uganda • October 5-6, 2016
<http://uidc.siup.ac.ug/>

(continued from [page 1](#))

The good news (as I see it) is that IAUC/ICUC already do quite a few of the things that are on the suggested response list: we meet less than annually, we use online infrastructure for archiving ICUC materials (see <http://www.urban-climate.org/icuc/>), and we tend to meet in major cities. What can we do better? Two of their suggestions resonated with me: allow easier remote access to some or all of the conference and to strengthen regional conferences associated with the association. Perhaps we can, in conjunction with future ICUC organizers, help facilitate online access to our conference. This can occur through member participation online, or, in a different example provided in the petition FAQ, through the selected remote plenary presentation by speakers who might otherwise not attend ICUC. And the strong interest in hosting an ICUC, as reflected in the quality and number of proposals for hosting ICUC-10, might suggest that IAUC could consider a regional level of conference to accommodate the growing interest in urban climates and climate change, while also respecting the impact our travel has on the environment. Perhaps the two can even be joined – a regional, on-line conference? An idea to contemplate perhaps? I'd welcome your thoughts and ideas. In the meantime, the IAUC Board will work with ICUC-10 organizers to ensure we work towards best practices in reducing the environmental impact of our conference.



Prof. Arieh Bitan (right), a former IAUC Board member and recipient of the 2006 Luke Howard Award, was recently presented with a citation for **Lifetime Contribution** by the president of the Israeli Meteorological Society, **Dr. Noah Wolfson (left)**. This distinction was given previously to Prof. Yair Goldreich, the 2013 Luke Howard Award winner.

IAUC Board Members & Terms

- Gerald Mills (UCD, Dublin, Ireland): 2007-2011; President, 2009-2013; Past President, 2014-2018 (nv)
- James Voogt (University of Western Ontario, Canada), 2000-2006; Webmaster 2007-2013; President, 2014-2018
- Andreas Christen (University of British Columbia, Canada): 2012-2016
- Rohinton Emmanuel (Glasgow Caledonian University, UK): 2006-2010; Secretary, 2009-2013; Past Secretary 2014-2018 (nv)
- David Pearlmutter (Ben-Gurion University of the Negev, Israel): Newsletter Editor, 2009-*
- Aude Lemonsu (CNRS, France): 2010-2014; ICUC-9 Local Organizer, 2013-2018 (nv)
- David Sailor (Arizona State University, USA): 2011-2015; Secretary, 2014-2018
- Alexander Baklanov (University of Copenhagen): 2013-2017
- Curtis Wood (Finnish Meteorological Inst., Finland): 2013-2017
- Valéry Masson (Météo France, France): ICUC-9 Local Organizer, 2013-2018 (nv)
- Fei Chen (NCAR, USA): 2014-2018
- Edward Ng (Chinese University of Hong Kong, Hong Kong): 2014-2018
- Nigel Tapper (Monash University, Australia): 2014-2018
- Aya Hagishima (Kyushu University, Japan): 2015-2019
- Jorge Gonzales (CUNY, USA): ICUC-10 Local Organizer, 2016-2021
- Dev Niyogi (Purdue University, USA): ICUC-10 Local Organizer, 2016-2021

* *appointed members*

nv = non-voting

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Newsletter Contributions

The next edition of *Urban Climate News* will appear in late June. Contributions for the upcoming issue are welcome, and should be submitted by May 31, 2016.

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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.