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From the IAUC President

Welcome to the first edition of the *Urban Climate News* for 2014 – Issue No. 51 – and my first issue writing to you as the incoming President of the IAUC. These are big shoes to fill and I thank the Board for both their confidence and support in this new role. I look forward to helping build on our past successes as an organization and continuing the spirit of a largely virtual, low cost organization that belongs to its members.

On behalf of all IAUC members I would like to thank Gerald Mills for serving as President for the past four years. As attendees of ICUC8 will recall, Gerald also pulled double duty as the organizer for the well attended and well run ICUC8 in Dublin. Such was the success of ICUC8 that for the first time funds were generated for the IAUC. These funds will no doubt assist us with IAUC operations that serve our members. The presence of these funds also prompts us to initiate within the Board the position of Treasurer, in which Gerald will serve in an interim capacity until the Board meets at ICUC9 to regularise the position and there is a call for nominations. Thanks are also due to Rohinton Emmanuel (Glasgow Caledonian University, UK) for his service as Secretary and to the ongoing work of David Pearlmutter, editor of the *Urban Climate News*. A call for nominations to fill positions on the Board of the IAUC has just been issued, and I encourage everyone to take part in this process.

Joining me as the new Secretary of the IAUC is David Sailor from Portland State University (USA). David will be familiar to IAUC members for his work on anthropogenic heat and moisture emissions for which he gave a plenary presentation at ICUC7 in Yokohama, Japan. He is also active in research on building energy analysis, green building research, and the urban heat island. As an engineer, much of his work focuses on applied aspects of urban climate as it affects urban inhabitants and potential design strategies for their mitigation. David was recently awarded the AMS Board on the Urban Environment "BUE Award" at the 11th Symposium on the Urban Environment. The citation for his award reads "*For his seminal contributions to urban anthropogenic heating research, and outstanding leadership and service to the AMS Board on the Urban Environment.*" Congratulations David and thank you for agreeing to serve IAUC as our Secretary.

Inside the Spring issue...

This issue of the *Urban Climate News* includes a feature report on the modeling of directional albedo with high resolution imagery by Shai Kaplan and colleagues from Arizona State University, USA, and a project report on the moderating effect of desert plants on pedestrian thermal stress by David Pearlmutter and colleagues at Ben-Gurion University, Israel. I have contributed a conference report on the

(*...continued on Page 12*)

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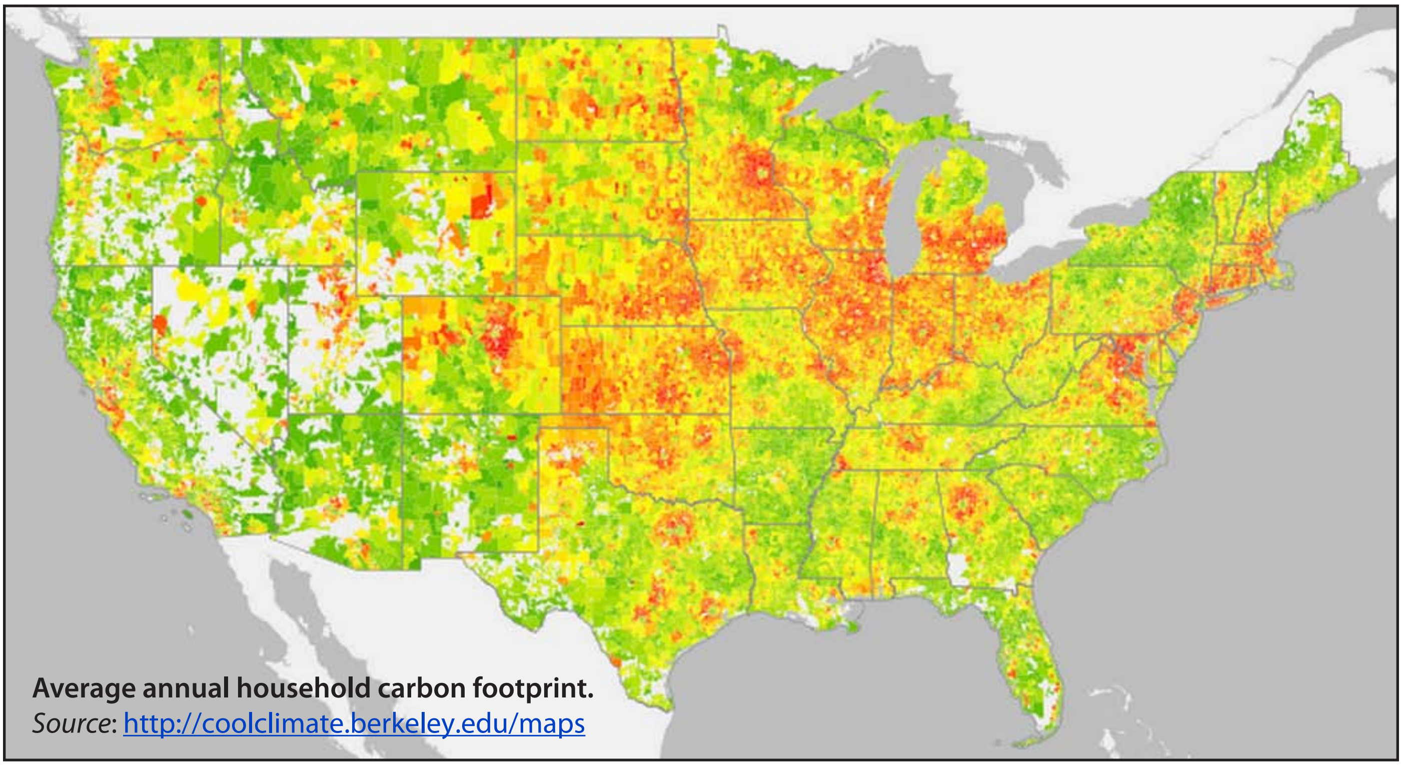
Suburban sprawl cancels carbon footprint savings of dense urban cores



Average annual household carbon footprint.
Source: http://coolclimate.berkeley.edu/maps

January 2014 — According to a new study by researchers at the University of California, Berkeley, population-dense cities contribute less greenhouse gas emissions per person than other areas of the country, but these cities' extensive suburbs essentially wipe out the climate benefits.

Dominated by emissions from cars, trucks and other forms of transportation, suburbs account for about 50 percent of all household emissions -- largely carbon dioxide -- in United States.

The study, which has been accepted for publication in the journal Environmental Science & Technology (ES&T), uses local census, weather and other data -- 37 variables in total -- to approximate greenhouse gas emissions resulting from the energy, transportation, food, goods and services consumed by U.S. households, so-called household carbon footprints.

Interactive carbon footprint maps for more than 31,000 U.S. zip codes in all 50 states are available online at http://coolclimate.berkeley.edu/maps.

"The goal of the project is to help cities better understand the primary drivers of household carbon footprints in each location," said Daniel Kammen, Class of 1935 Distinguished Professor of Energy in the Energy and Resources Group and the Goldman School of Public Policy, and director of the Renewable and Appropriate Energy Laboratory. "We hope cities will use this information to begin to create highly tailored, community-scale climate action plans."

A key finding of the UC Berkeley study is that suburbs account for half of all household greenhouse gas emissions, even though they account for less than half the population. The average carbon footprint of households living in the center of large, population-dense urban cities is about 50 percent below average, while households in distant suburbs are up to twice the average: a factor of four difference between lowest and highest locations.

"Metropolitan areas look like carbon footprint hurricanes, with dark green, low-carbon urban cores surrounded by red, high-carbon suburbs," said Christopher Jones, a doctoral student working with Kammen in the Energy and Resources Group. "Unfortunately, while the most populous metropolitan areas tend to have the lowest carbon footprint centers, they also tend to have the most extensive high carbon footprint suburbs." Taking into account the impact of all urban and suburban residents, large metropolitan areas have a slightly higher average carbon footprint than smaller metro areas.

Developing sustainable cities

"A number of cities nationwide have developed exceptionally interesting and thoughtful sustainability plans, many of them very innovative," Kammen said. "The challenge, however, is to reduce overall emissions. Chris and I wanted to determine analytically and present in a visually striking way the impacts and interactions of our energy, transportation, land use, shopping, and other choices. Cities are not islands: they exist in a complex landscape that we need to understand better both theoretically and empirically."

The UC Berkeley researchers found that the primary drivers of carbon footprints are household income, vehicle ownership and home size, all of which are considerably higher in suburbs. Other important factors include population density, the carbon-intensity of electricity production, energy prices and weather.

"Cities need information on which actions have the highest potential to reduce greenhouse gas emissions in their communities," explained Kammen. "There is no one-size-fits-all solution."

Efforts to increase population density, for example, appear not to be a very effective strategy locally for reducing emissions. A 10-fold increase in population density in central cities yields only a 25% reduction in greenhouse gas emissions.

"That would require a really extraordinary transformation for very little benefit, and high carbon suburbanization would result as a side effect," Jones said.

Increasing population density in suburbs appears to be an even a worse strategy, he said. Surprisingly, population dense suburbs have significantly higher carbon footprints than less dense suburbs.

"Population dense suburbs also tend to create their own suburbs, which is bad news for the climate," explains Jones.

So if building more population-dense cities is not a viable solution for city planners, what is? The project website includes a tool that calculates carbon footprints for essentially every populated U.S. zip code, city, county and U.S. state (31,531 zip codes, 10,093 cities and towns, 3,124 counties, 276 metropolitan regions and 50 states) as well as an interactive online map allowing users to zoom in and out of different locations. Households and cities can calculate their own carbon footprints to see how they compare to their neighbors and create customized climate action plan from over 40 mitigation options.

In some locations, motor vehicles are the largest source of emissions, while in other locations it might be electricity, food, or goods and services. California, for example, has relatively low emissions associated with household electricity, but large emissions from transportation. The opposite is true in parts of the Midwest, where electricity is produced largely from coal.

Tailored emission lowering strategies

The real opportunity, say the authors, is tailoring climate solutions to demographically similar populations within locations.

"Suburbs are excellent candidates for a combination of solar photovoltaic systems, electric vehicles and energy-efficient technologies," said Kammen. "When you package low carbon technologies together you find real financial savings and big social and environmental benefits."

The authors argue that cities need to step out of traditional roles in planning urban infrastructure and learn how to better understand the needs of residents in order to craft policies and programs that enable the adoption of energy and carbon-efficient technologies and practices.

One example of this is the CoolCalifornia Challenge, a statewide carbon footprint reduction competition to name the «Coolest California City." The program, run by Jones and Kammen and sponsored by the California Air Resources Board and Energy Upgrade California, will be accepting applications for new cities in February. Each city creates their own, targeted strategies to reduce barriers and increase motivation to engage residents in climate action.

"People need to act within their own spheres of influence, where they feel they can make the most difference," Jones said. "We hope the information provided in these tools will help individuals, organization and cities understand what makes the most impact locally and to enable more tailored climate strategies.

From global to local: UHIs amplify climate change impacts for Latinos

SWiTCHBOARD
Natural Resources Defense Council Staff Blog

April 2014 — The effects of climate change are negatively impacting the health of people worldwide. In the United States these impacts affect Latinos more, largely because most live in large metropolitan areas, where both global and local drivers of climate change stress the health of populations. Latinos are acutely aware that climate change is affecting their well-being, which is why they are strongly supporting action on climate change. However, they do so not only for their own sake: they are also deeply concerned about their children, future generations, as well as for others across the globe.

Latinos in the United States maintain cultural and family ties to their countries of origin, where the impacts of extreme weather are all too visible as hurricanes, floods, and droughts destroy lives, crops, and property. Currently, Latinos number 17 percent of the United States' population (up from nearly 12 percent in 2000), a rapidly growing demographic that is increasingly shaping electoral outcomes. Latinos believe that we all share in the obligation to fight climate change. A recent poll shows that 9 out of 10 Latinos support the government taking action to curb carbon pollution that accelerates climate change while 8 out of 10 want the President to act. This holds true across political affiliations and income levels: 71 percent of Democrats, 44 percent of Republicans, and 63 percent of independents express strong support for carbon pollution standards, while 91 percent of those making less than 20,000 dollars a year, and 86 percent of those who earn more than 80,000 also feel very strongly about curbing global warming.

In this piece, I will explore some of the global and local drivers of climate change and how the Latino population is being affected.

Globally, the accumulation of carbon pollution in the Earth's atmosphere is driving temperature increases that are putting people and environments at risk. But climate change drivers, impacts, and vulnerable people are unevenly distributed across the globe, which is to say that place matters in identifying the most vulnerable populations. Indeed, geography matters in the traditional ways we think about differences in the intensity and duration of weather-related events and impacts across the globe (think of floods, droughts, or hurricanes in tropical vs. temperate climates, or in the capacity to deal with weather-related disasters in developed vs. developing countries, for example).

But place also matters a great deal in other ways we don't often think about. When we "zoom into" countries and the cities within, we see that climate change impacts work in many different ways, and not necessarily for the same reasons that drive warming at the global scale.

People in cities typically conduct most of their daily activities in downtown or central business districts. It's true that population densities are generally higher in the city, and that more combustion-related activities from vehicles, factories, air conditioning and heating increase demand for energy production, feeding back into carbon emissions. But at the scale of a city, the most salient driver of local warming is the pattern of urban development.

Cities have high quantities and types of horizontal and vertical surfaces like concrete and steel buildings, glass facades, highways, paved roads, commercial strips, and industrial areas. Energy exchanges along these surfaces and urban canyons create environments that are markedly hotter than the surrounding countryside or rural areas. The materials used to build the urban environment are largely non-absorbent, meaning that because of their density they are very efficient at absorbing heat during the day, but not at releasing it back at night. As one moves out from the city center to more suburban or rural areas, the heating effect diminishes because impervious materials give way to more porous land surfaces like hills, forests, soil, plains, or agricultural fields.

Scientists refer to this warming pattern as an Urban Heat Island because the gradient of high-to-low temperatures radiating out from the city center resembles an "island" of high temperatures in a "sea" of generally cooler rural environments. The urban heat island is one of the best understood effects of human-induced local climate change, and has been known to scientists since at least 1833.

Of course, none of this means that global warming is not warming up cities. But the time scale at which carbon pollution is warming up the globe works differently from the way urban heat islands are warming cities. Global warming operates in years or decades as carbon pollution accumulates in the atmosphere, while the urban heat island is local, city-specific, and observable during 24-hour day/night periods.

Getting back to how geography matters, low-income, inner-city neighborhoods in general (where many Latinos live) have little vegetation and green spaces, which are known to help reduce high temperatures. In addition, Latinos are more likely than others to find work in outdoor environment occupations like construction or landscape maintenance, further increasing their exposure to high temperatures. In general, the low social and economic status of many Latinos also prevents them from accessing preventive health care than can help them deal with pre-existing conditions like cardiovascular disease and diabetes, diseases that can potentially trigger emergency room visits or death under extreme heat exposure.

During hot summers, the cycle of intense daytime heat accumulation and slow release at night is increasing extreme heat stress among people in cities—and Latinos are feeling the impacts more strongly. For one, the Latino population in the United States is highly urban: out of the 50.4 million Latinos living in the US, 45 percent live in the metropolitan areas of California, New York, Texas, Arizona, and Florida. High rates of poverty (25.3 percent, compared to 13.2 for all Americans) and low educational attainment (only 14 percent have at least a Bachelor's degree) limit Latinos' access to air conditioning and personal vehicles that can provide immediate respite from extreme heat.

It is increasingly evident to politicians of all persuasions that they should take action to curb climate change. Climate change has emerged into the public consciousness as a pressing issue that cannot be ignored. Latinos have demonstrated they are ready to support decisive action to combat the negative consequences that await this and future generations if climate change continues unabated.

– By Juan Declet-Barreto, PhD, NRDC Climate and Health Fellow, Climate and Clean Air Program.

Original blog post: http://switchboard.nrdc.org/blogs/kknowlton/from_global_to_local_urban_hea.html

Seven million premature deaths annually linked to air pollution

March 2014 — In new estimates released recently, WHO reports that in 2012 around 7 million people died – one in eight of total global deaths – as a result of air pollution exposure. This finding more than doubles previous estimates and confirms that air pollution is now the world's largest single environmental health risk. Reducing air pollution could save millions of lives.

New estimates

In particular, the new data reveal a stronger link between both indoor and outdoor air pollution exposure and cardiovascular diseases, such as strokes and ischaemic heart disease, as well as between air pollution and cancer. This is in addition to air pollution's role in the development of respiratory diseases, including acute respiratory infections and chronic obstructive pulmonary diseases.

The new estimates are not only based on more knowledge about the diseases caused by air pollution, but also upon better assessment of human exposure to air pollutants through the use of improved measurements and technology. This has enabled scientists to make a more detailed analysis of health risks from a wider demographic spread that now includes rural as well as urban areas.

Regionally, low- and middle-income countries in the WHO South-East Asia and Western Pacific Regions had the largest air pollution-related burden in 2012, with a total of 3.3 million deaths linked to indoor air pollution and 2.6 million deaths related to outdoor air pollution.

"Cleaning up the air we breathe prevents noncommunicable diseases as well as reduces disease risks among women and vulnerable groups, including children and the elderly," says Dr Flavia Bustreo, WHO Assistant Director-General Family, Women and Children's Health. "Poor women and children pay a heavy price from indoor air pollution since they spend more time at home breathing in smoke and soot from leaky coal and wood cook stoves."

Included in the assessment is a breakdown of deaths attributed to specific diseases, underlining that the vast majority of air pollution deaths are due to cardiovascular diseases as follows (outdoor air pollution-caused deaths – breakdown by disease):

40% – ischaemic heart disease;
40% – stroke;
11% – chronic obstructive pulmonary disease (COPD);
6% - lung cancer; and
3% – acute lower respiratory infections in children.

(and indoor air pollution-caused deaths – by disease):

34% - stroke;
26% - ischaemic heart disease;
22% - COPD;
12% - acute lower respiratory infections in children;
6% - lung cancer.

The new estimates are based on the latest WHO mortality data from 2012 as well as evidence of health risks from air pollution exposures. Estimates of people's exposure to outdoor air pollution in different parts of the world were formulated through a new global data mapping. This incorporated satellite data, ground-level monitoring measurements and data on pollution emissions from key sources, as well as modelling of how pollution drifts in the air.

Risks factors are greater than expected

"The risks from air pollution are now far greater than previously thought or understood, particularly for heart disease and strokes," says Dr Maria Neira, Director of WHO's Department for Public Health, Environmental and Social Determinants of Health. "Few risks have a greater impact on global health today than air pollution; the evidence signals the need for concerted action to clean up the air we all breathe."

After analysing the risk factors and taking into account revisions in methodology, WHO estimates indoor air pollution was linked to 4.3 million deaths in 2012 in households cooking over coal, wood and biomass stoves. The new estimate is explained by better information about pollution exposures among the estimated 2.9 billion people living in homes using wood, coal or dung as their primary cooking fuel, as well as evidence about air pollution's role in the development of cardiovascular and respiratory diseases, and cancers.

In the case of outdoor air pollution, WHO estimates there were 3.7 million deaths in 2012 from urban and rural sources worldwide.

Many people are exposed to both indoor and outdoor air pollution. Due to this overlap, mortality attributed to the two sources cannot simply be added together, hence the total estimate of around 7 million deaths in 2012.

"Excessive air pollution is often a by-product of unsustainable policies in sectors such as transport, energy, waste management and industry. In most cases, healthier strategies will also be more economical in the long term due to health-care cost savings as well as climate gains," says Dr Carlos Dora, WHO Coordinator for Public Health, Environmental and Social Determinants of Health. "WHO and health sectors have a unique role in translating scientific evidence on air pollution into policies that can deliver impact and improvements that will save lives."

The release of today's data is a significant step in advancing a WHO roadmap for preventing diseases related to air pollution. This involves the development of a WHO-hosted global platform on air quality and health to generate better data on air pollution-related diseases and strengthened support to countries and cities through guidance, information and evidence about health gains from key interventions.

Later this year, WHO will release indoor air quality guidelines on household fuel combustion, as well as country data on outdoor and indoor air pollution exposures and related mortality, plus an update of air quality measurements in 1600 cities from all regions of the world.

Source: http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/

Climate Change Responses To Shape Asia's Future

April 2013 — Challenges such as extreme weather, rising seas and worsening scarcity of drinking water are forcing many Asian governments to confront the changes being wrought by a warming planet even as some point to rich Western nations as major culprits.

Millions of people in the region have already been displaced by floods and droughts thought related to global warming, a United Nations scientific panel said in a report meant to guide policymakers and form the foundation for a new climate treaty due next year.

Experts say Asia and the South Pacific, home to 4.3 billion people or 60 percent of all humankind, faces rising risks from climate change that threaten food security, public health and social order.

Scientists who back the **Intergovernmental Panel on Climate Change (IPCC)** say there is overwhelming evidence that carbon emissions from industrialization and energy-intensive modern lifestyles have driven an increase in the world's average temperature over the past century. Failed global efforts to significantly reduce emissions means that nations are now focusing efforts on adapting to a hotter earth.

Just as colonialism determined much of Asia's past, adapting to profound disruptions from climate change will determine the region's future, said Rajendra Kuma Pachauri, a co-chairman of the climate panel who has spent the past 26 years working on the issue. "We have no choice but to start mitigating for climate change today," he said.

Asia's growing economic importance and rapidly urbanizing populations will give it a pivotal role in humanity's handling of climate change, said Saleemul Huq, director of the International Centre for Climate Change and Development at the Independent University in Bangladesh. "It's where the population is, it's where the young population is, it's where the growth dynamism will occur in the next few decades," Huq said after the IPCC met in Yokohama to endorse a summary of a 32-volume report.

The climate report outlines in unprecedented detail the regional-level threat of conflicts, food shortages, rising deaths from diseases spread through contaminated water and mosquito-borne illnesses such as dengue and malaria. In a region where memories of past famines remain fresh, floods and droughts will likely worsen poverty while pushing food prices and other costs higher, the report said.

"There are so many Asian countries that are among the most vulnerable. We've seen so many extreme events hit Asia in recent years," said Kelly Levin, a senior associate at the World Resources Institute.

In Myanmar and Bangladesh, coastal farmlands are tainted by sea water from storm surges and rising sea levels, making soil too saline in key rice producing regions. In their seas, warming temperatures and rising acidity are killing off tropical coral reefs, endangering vital sources of protein.

In Nepal, which accounts for just 0.02 percent of global emissions of greenhouse gases contributing to global warming, fast melting Himalayan glaciers are triggering floods as overburdened dams collapse. "We are not primarily responsible but we are the victims of climate change," said Sandeep Chamling Rai, a Nepalese who is international adaptation coordinator for the World Wildlife Fund.

Even in wealthy, industrialized Japan, changing climate is expected to double the risks from floods and deaths due to heat and expand the areas affected by disease-carrying mosquitoes.

Assessing the risks for a region with geography that spans alpine plateaus to rainforests is daunting, especially given the lack of research on areas such as central Asia, said Yasuaki Hijioka, a lead author of the Asia section of the report.

Asia has not made as much progress as Europe and the U.S in assessing risks, Hijioka said. Western countries can draw up policies based on detailed research, he said. "In our case, we can only just show some case studies."

Yet Asia is not lagging in adapting to the changes already underway, said Huq of the International Centre for Climate Change and Development. Use of renewable energy already is expanding rapidly as countries seek to reduce carbon emissions and to counter the environmental degradation brought on by full-steam-ahead industrialization. Progress is mixed, and it does not always depend on the wealth of the societies involved.

Having shut down all its nuclear reactors for checks following the March 2011 disaster in Fukushima, Japan has scaled back its targets for emissions reductions after ramping up use of coal, gas and oil to fire its thermal power plants.

Experts at the climate talks praised Bangladesh, one of Asia's poorest nations, for its efforts to reduce flooding risks by capturing silt to raise ground levels in its low-lying coastal areas and for building sturdy, multi-storied storm shelters that are credited with saving many lives from surging sea waters during cyclones.

India, the fourth biggest energy consumer and third-largest emitter of carbon, has begun to increase use of renewable energy, doubling its solar generation capacity in 2013, albeit from a modest level, and aiming to generate 15 percent of its power through renewable energy by 2020.

China, which years ago overtook the U.S. as the world's biggest carbon emitter, has swiftly increased its wind and solar power generation, retrofitting older power plants with emissions controls and rapidly expanding its use of nuclear power.

Regardless of who is to blame for the legacy of carbon emissions in the industrial world, in Asia policymakers understand that carrying on with business as usual is just too risky.

"I think they're on the verge of realizing that's not in their best interest," said Huq.

Source: http://www.huffingtonpost.com/2014/04/01/climate-change-asia_n_5068451.html

Modeling Directional Albedo with High Resolution Imagery





By Shai Kaplan (skaplan3@asu.edu), Christopher S. Galletti, Winston T.L. Chow, Soe W. Myint, and Anthony J. Brazel

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Introduction

In arid environments, one of the challenges facing cities is the alteration of the radiation budget and modification of the surface energy balance (Grimm *et al*., 2008; Imhoff *et al*., 2000; Georgescu *et al*., 2012). Land surface albedo is a critical component of the urban surface energy balance as it affects stored and reflected energy, which can govern important biophysical processes such as evapotranspiration, photosynthesis, and carbon assimilation (Liang, 2000), and influences temperature-related phenomenon such as the Urban Heat Island (UHI) and human comfort (Georgescu *et al*., 2011; Oke, 1987).

Remote sensing is the only feasible method for continuous monitoring and measurement of surface albedo variability across a city. To date, there has been little work in relating broadband albedo to the multispectral data from high resolution sensors, mostly because the focus of previous albedo measurements has been at larger scales where medium or low resolution imagery is sufficient, and due to the infeasibility of high resolution images (cost, availability).

However, urban land covers can vary greatly over small distances that often make the use of medium or low resolution satellites difficult for the study of fine details. The aims of this project are: (1) to assess whether it is feasible to use high resolution imagery to model directional albedo (hereafter referred to as albedo) by exploring the relationship between directional albedo obtained empirically *in-situ* (using a portable spectrometer) of different man-made features (impervious surfaces), soil, vegetation covers (grass, shrubs, trees) and albedo obtained from high resolution imagery; and (2) to develop a set of coefficients that can be applied to QuickBird images over arid environments so that albedo can be estimated at the neighborhood scale.

Data and Study area

Two QuickBird multispectral images (2.4 m resolution) were acquired: the first over Phoenix on July 11th, 2012, at 10:40 h local time, and a second over Las Vegas on September 2nd, 2012, at 10:57 h local time (Figure 1). The former was used to develop the models, and the latter was used for its validation. The QuickBird sensor produces images with four bands: 1) blue (450-520 nm), 2) green (520-600 nm), 3) red (630-690 nm), and 4) near infrared (760-900 nm). The raw images data were converted to top of atmosphere (TOA) reflectance following Krause (2005). Surface reflectance was derived using the FLAASH atmospheric correction module in ENVI software.

The training image of West Phoenix was collected from a QuickBird flyover during the week of our fieldwork. This area was chosen because it includes a multitude of land use/and land cover types and an all-wave net radiometer that includes a pyranometer (Hukseflux NR01) installed in situ on a micrometeorological tower (WPHX; Figure 1) at a height of 22.3 m (73 ft) a.g.l. Based on the instrument height and sensor field-of-view (Oke, 2006), we estimated a circular source area for radiation (and albedo) measurements of 230 m radius, centered at the WPHX site. A mean mid-day value of surface albedo was subsequently derived from the pyranometer and used for validation.

Methods

In this project we focus on directional albedo as a first order empirical observation. Calculations of directional albedo are essentially an integral estimated from spectral reflectance, between wavelengths λ_x and λ_y. The calculation of the broadband albedo (α_Λ) then follows from Liang (1999) and Liang (2000), and can be estimated from the spectral reflectance measured at a surface:

$$\alpha_\Lambda = \int_{\lambda_x}^{\lambda_y} r \, d\lambda$$

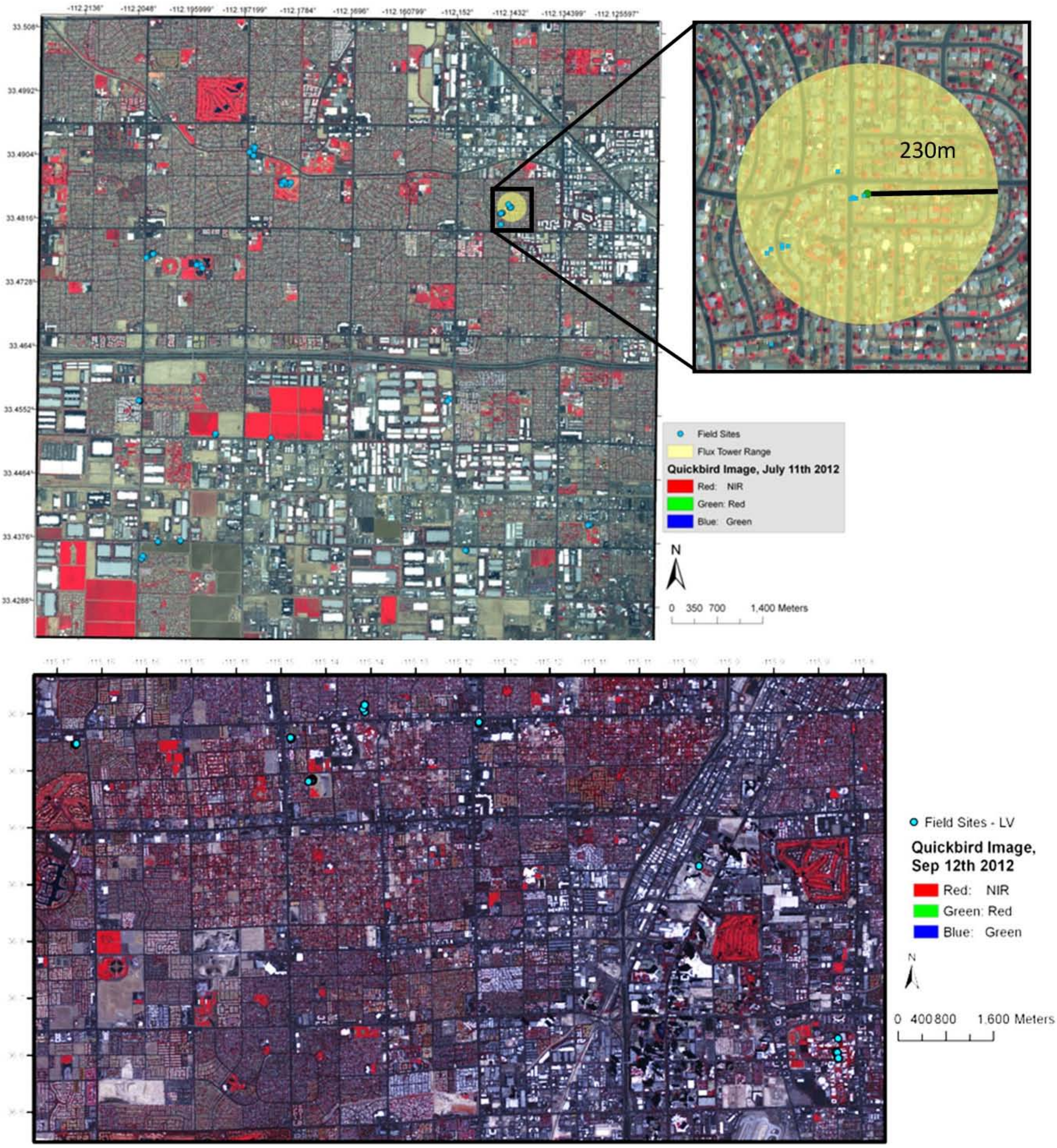

Figure 1. Top: QuickBird images of the Phoenix study area and estimated source area for the installed pyranometer at WPHX ; Bottom: QuickBird image of Las-Vegas. Dots represent field locations where spectral signatures were collected.

where α_Λ is the dimensionless broadband directional albedo covering a waveband between wavelengths λ_x and λ_y, and r is the mean spectral reflectance between wavelengths λ_x and λ_y. We considered two broad wavebands: the visible and near infrared - α_{vnir} (450-900 nm), and the total visible and near infrared - α_{tot} (350-2320 nm). The reason that we adopted the first is because it corresponds to the satellite spectral range. The second was adopted because downward fluxes beyond this range are very small (Prado and Ferreira, 2005).

The spectral reflectance measurements were tak-

Figure 2. Measuring spectral reflectance in the field. Left: a parking lot in Phoenix; Middle: front-yard in Las-Vegas; Right: white rooftop at UNLV.

en in the field using an ASD FieldSpec-4 Wide portable spectrometer (Figure 2). For the purposes of this study we assume a Lambertian surface, an assumption that has been shown to be robust and does not lead to significant error (Liang *et al*. 2003). Samples from both cities include all major land cover types and were collected from different land uses including parks, industrial/commercial areas, residential areas, and agriculture. Figure 3 shows the spectral signature for the dominant land cover types in Phoenix.

To parameterize the coefficients, we implemented a backward elimination regression process that automatically prune the most significant QuickBird bands and adjust the coefficients. To fine-tune the model, we then applied a Monte Carlo-like simulation with 10,000 iterations on the final variables for each model. In each iteration, 15% of the observations were excluded from the regression process. The mean of all the iterations was recorded as the final coefficient for each variable.

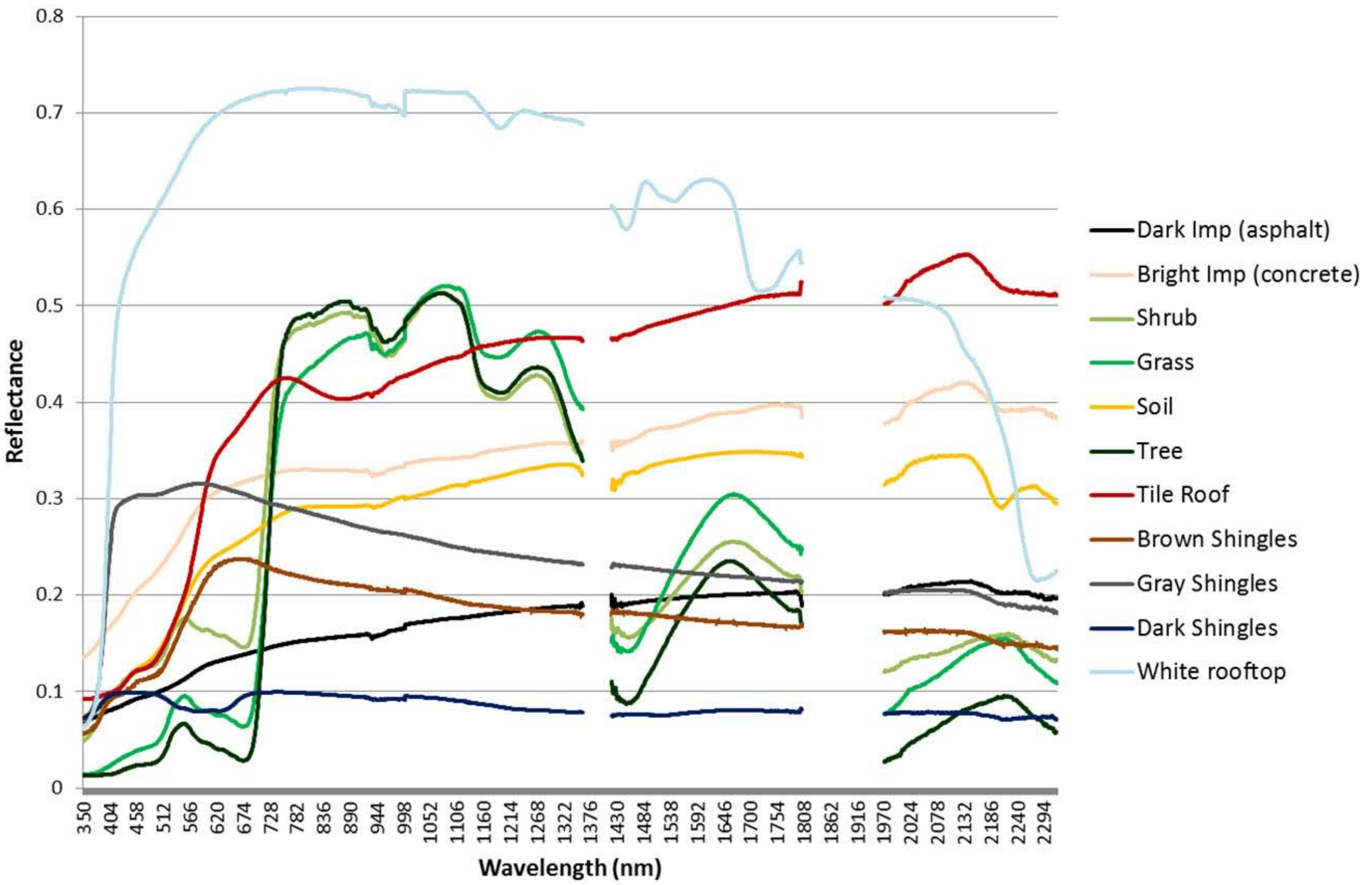

Figure 3. Spectral signatures of dominant land cover in the PHX region.

Four sets of coefficients were developed: 1) $\alpha_{tot\text{-}toa}$ 2) $\alpha_{tot\text{-}surf}$ 3) $\alpha_{vnir\text{-}toa}$ 4)$\alpha_{vnir\text{-}surf}$. The coefficients were evaluated by the r-square produced from the multiple regression models, as well as compared to shortwave radiation data from the WPHX NR01. Finally, the coefficients of the best statistical model were applied to a second QuickBird image taken over Las-Vegas, and the resulting albedo image values were compared to ground measurements (i.e. – spectral albedo measured with the portable spectrometer).

Results and Discussion

The following are the formulas for estimating albedo from QuickBird in an arid urban environment, for TOA and surface reflectance (surf):

$$\alpha_{vnir\text{-}toa} = -1.0389b_1 + 1.7178b_2 + 0.2809b_4$$

$$\alpha_{vnir\text{-}surf} = 0.546b_2 + 0.431b_4$$

$$\alpha_{tot\text{-}toa} = -0.2482b_1 + 0.7392b_3 + 0.3780b_4$$

$$\alpha_{tot\text{-}surf} = -0.482b_3 + 0.491b_4$$

where b_x is the reflectance of QuickBird band x.

To evaluate our models, we applied the coefficients from all four models to the Phoenix image, calculated the mean albedo for all pixels within the pyranometer source area and compared with the pyranometer measured albedo for the same day and within 10 minutes of the image capture time. Regression analysis shows that all models are in high agreement with overestimation compared to the pyranometer measurements (Table 1). The overestimation could be attributed to the difference between the pyranometer's hemispherical integrated albedo and the directional spectral albedo estimated by our models. Results show that all models have small RMS error (<0.008), and that surface models show a positive bias whereas TOA models show smaller negative bias. Whether this is due to the method used or some other factor remains an open question for future study. Figure 4 illustrates the broadband albedo map using the TOT/Surface model.

To further evaluate the model's accuracy and provide additional information on the estimation accuracy, the two best derived models were applied to the image taken over Las Vegas. The same statistical evaluation was applied for estimating the accuracy of the model (Table 2). Figure 5 shows the resulting albedo image produced by the best model (VNIR/ Surface).

Table 1. Predicted albedo for the four models, the R^2 of the models, and the error statistics associated with each model.

Albedo at micrometeorological tower: 0.168

Albedo Range / Reflectance Correction Type	Predicted Albedo at FT	R^2	Bias	RMS
VNIR / Top-of-Atmosphere	0.226	0.939	-0.097	0.007
VNIR / Surface Reflectance	0.191	0.944	0.27	0.007
Total Shortwave / Top-of-Atmosphere	0.235	0.93	-0.0004	0.008
Total Shortwave / Surface Reflectance	0.207	0.95	0.39	0.007

Table 2. Models statistical evaluation for the Las Vegas image: the R^2 of the models, and the error statistics associated with the best two models (i.e. surface).

Albedo Range	R^2	Bias	RMS
VNIR	0.928	0.301	0.01
Total Shortwave	0.90	0.46	0.0133

Visually, the spatial pattern and magnitude of albedo for both locations look reasonable, and follow general land cover properties. For example, large industrial/commercial/hotel buildings with white roof tops show high albedo and parking lots and asphalt roads show low albedo. The difference in statistical evaluation results could be attributed to variations in climate and image characteristics between study areas. While further study is needed, the conversion formulas produce generally high accuracy and can be used to predict broadband albedo from Quickbird images over arid urban environments.

Summary

Characterizing and developing high resolution albedo is important at the neighborhood or sub-city scale where albedo can play an important role in land surface temperatures, especially towards mitigating excessive urban warmth. We developed new

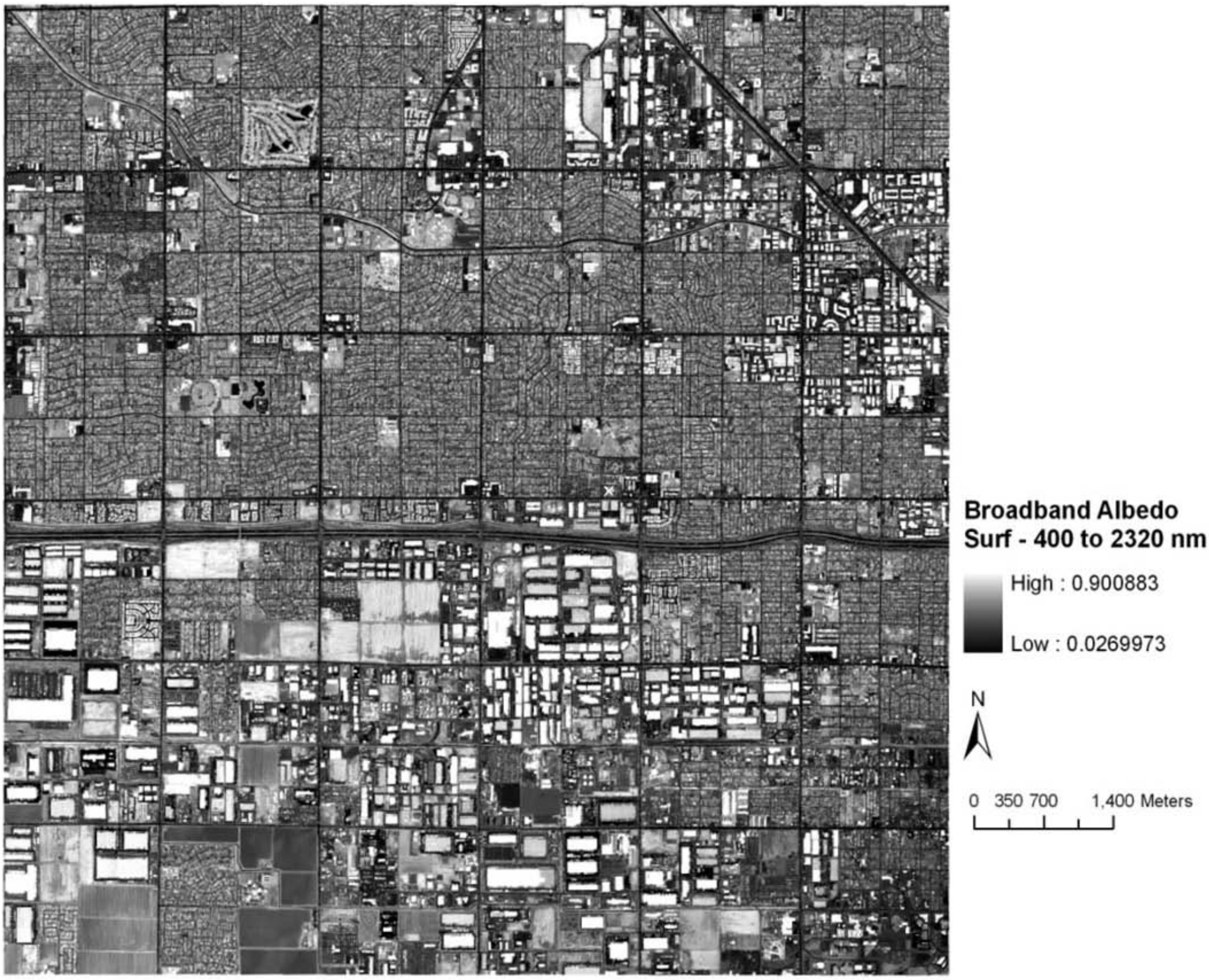

Figure 4. High resolution albedo map of the Phoenix study area, using the TOT/Surf model.

Figure 5. Broadband albedo map of the Las Vegas study area, using the VNIR/Surf model.

coefficients for estimating and modeling broadband albedo from high resolution QuickBird images over two urban environments in an arid climate. The results indicate a high level of accuracy for both locations, suggesting they are robust despite differences in climatic and image characteristics. We conclude that high resolution imagery is capable of modeling broadband albedo. Applying the methodology described herein over different urban areas and during different seasons will allow further validation and sensitivity testing, as well as fine tuning and more generalization of the proposed coefficients.

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(continued from Page 1)

recent 11th Symposium on the Urban Environment held at the American Meteorological Society Annual Meeting in Atlanta, Georgia. As a reminder of how urban areas can be very sensitive to weather events, the Atlanta region had a significant (at least in terms of impact) winter storm just before the conference. The resultant impacts generated discussion of not only the state of municipal preparations for that type of weather but also the overall planning of the city, especially with respect to transportation.

Looking beyond the specifics of the Atlanta event, IAUC members should be aware of the recently released 5th Assessment Report by Working Group II of the Intergovernmental Panel on Climate Change. Chapter 8 of that the report is entitled "Urban Areas". The executive summary identifies, among several themes, that "*Urban climate change risks, vulnerabilities and impacts are increasing across the world in urban centres of all sizes, economic conditions and site characteristics.*" It also recognizes the influence of cities on their local climate that can add to the climate risk experienced by cities, and states that this is known with high confidence, based on high agreement and high evidence. Somewhat less confidence is ascribed to the summary points related to urban climate risks and actions that can be undertaken to help urban areas adapt. These may be areas where research by IAUC members can contribute.

Finally, I would like to update IAUC members on the status of ICUC9. ICUC9 will be held 20-24 July, 2015 in Toulouse, France. I am pleased to announce that we will again be meeting jointly with the American Meteorological Society 12th Symposium on the Urban Environment. This should make for an exciting meeting and I encourage all IAUC members to reserve this time now on their calendars. The conference venue in Toulouse will be an excellent setting for both ICUC9 and social activities; it is close to both the city centre and airport and there is an adjoining metro stop facilitating ease of travel about the city. More details on ICUC9 will be coming soon.

– James Voogt, IAUC President

The moderating effects of urban vegetation on pedestrian thermal stress in a hot-arid environment

Case studies in the Negev Desert of Israel

The population of desert cities is increasing rapidly, due to a combination of natural growth, rural in-migration, and – in some cases – creeping desertification. The typically harsh climatic conditions in such regions, which are intensified by the urban heat island and compounded by regional and global changes, often make pedestrian activity thermally stressful and deepen residents' reliance on energy-intensive air conditioning in buildings and vehicles. In this context, urban landscape vegetation is vital for climatic moderation – potentially offering shaded public spaces and lower surface temperatures. At the same time, though, sources of high-quality water for irrigation are often scarce – and this limitation highlights the need for "efficient" solutions that provide maximal environmental benefit with minimal natural resources.

In a series of experimental studies conducted at the Sede-Boqer campus of Ben-Gurion University's Institutes for Desert Research in the hot-arid Negev desert of Israel, we have examined the "cooling efficiency" of urban vegetation, quantifying both the potential for moderating pedestrian thermal stress and the irrigation water required to achieve it. Here we describe briefly some previous studies, and then focus on a recent campaign in which we compared the cooling efficiency of different ground-cover plants which can provide an alternative to water-intensive grass lawns (Figure 1).

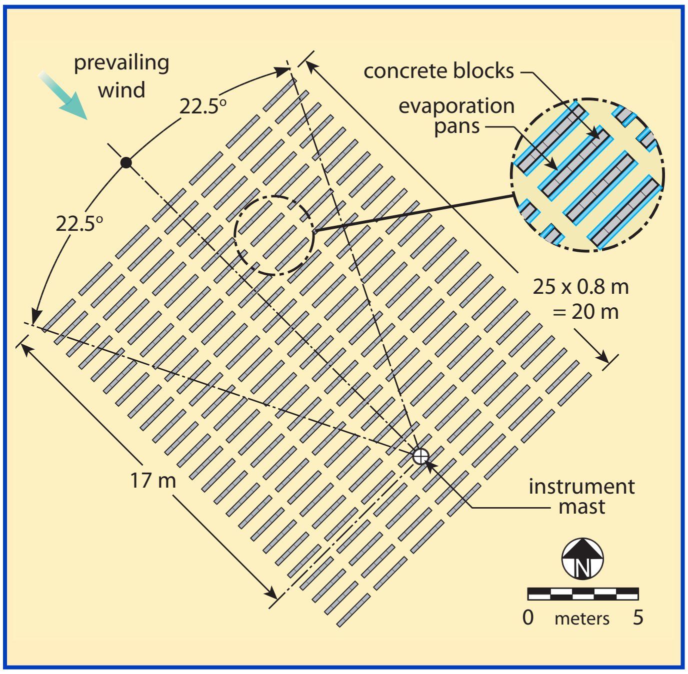
Evapotranspiration and the urban "oasis" effect

The energy balance of desert cities is driven by intense solar radiation, which raises the temperature of impermeable surfaces as they absorb and store this energy. Vegetation has an important influence on this energy balance, because although green areas tend to have a low albedo and thus absorb a large part of the incident radiation, they also maintain lower temperatures than typical paved areas because they are cooled by evapotranspiration.

The "oasis effect" resulting from evapotranspiration over vegetated terrain was first analyzed at the urban scale using the Open-Air Scaled Urban Surface (OASUS) model of Pearlmutter *et al*. (2009). Freely evaporating water surfaces were placed in precise quantities within the scaled urban "canyons" to represent vegetated areas using a pan coefficient, and fluxes of net radiation, sensible heat, latent heat and storage were all measured to "close" the surface energy balance. It was found that the latent heat flux component is determined by the availability of

Figure 1. Investigating the effects of vegetation at the scale of urban clusters (top), urban spaces (middle), and urban materials (bottom).

moisture relative not only to the horizontal surface area, but to the three-dimensional surface area of the urban fabric (Figure 2). This finding has important implications for urban cooling, and provides an indication of the benefits that can be realized by planning strategically distributed green elements such as parks.



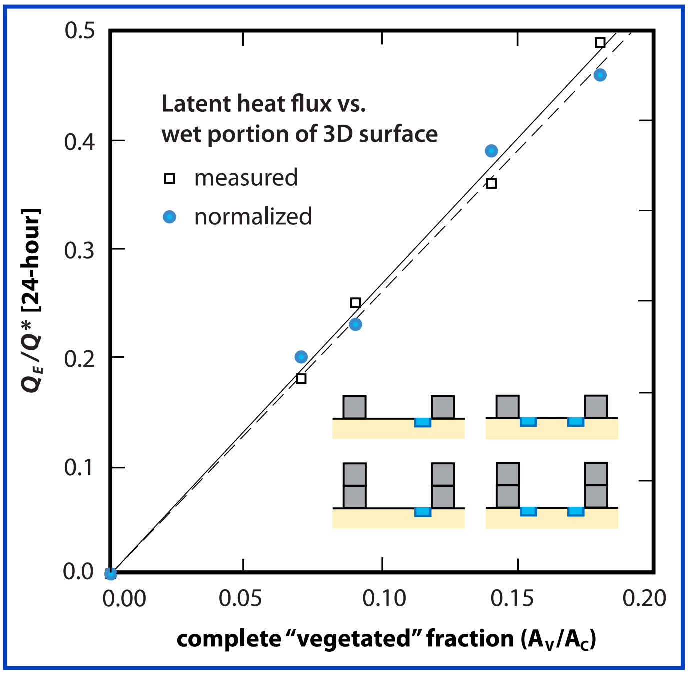


Figure 2. Plan of OASUS model experimental setup (left), and results showing proportional latent heat flux as a function of the three-dimensional vegetated fraction (right).

At the microclimatic scale, the combined effect of shade trees and vegetative ground cover on the microclimate of urban spaces was observed full-scale in controlled outdoor experiments (Shashua-Bar *et al*. 2009). Measurements were made in two semi-enclosed courtyards with various combinations of mature trees, artificial shading, grass and paving (Figure 3). For each landscape configuration, the Index of Thermal Stress (ITS) was calculated from measured data to reflect radiative and convective energy exchanges between a hypothetical pedestrian and the surrounding urban environment (Shashua-Bar *et al*. 2011). With the inclusion of a sweat efficiency factor based on measured humidity, this index expresses the rate of evaporative cooling that is required for the pedestrian's body to maintain thermal equilibrium with its surroundings, and may be expressed on a subjective thermal sensation scale based on empirical correlations – which were recently updated for arid open spaces, as reported previously in UCN and by Pearlmutter *et al*. (2014).

Figure 3. Courtyard setup with various combinations of overhead shading and ground cover.

While conditions in a paved, unshaded courtyard were found to be uncomfortable throughout the summer daytime hours, each of the landscape treatments made a clear contribution to improved thermal comfort (Figure 4). Firstly, the introduction of irrigated grass in place of paving and bare soil reduced the level of thermal stress significantly, mainly due to the lower radiative surface temperature of the grass. Shading, by either trees or artificial mesh, reduced the duration of discomfort by over half and limited its maximum severity – though the effect of the tree canopy was more pronounced, due to its lower radiative surface temperature.

In combination with grass, the locally adapted shade trees yielded thermally comfortable conditions at all hours in an otherwise stressful outdoor environment. Even more significantly, it was found that by limiting the exposure of the ground to the dry atmosphere and to direct radiation, this combination of trees and grass required less total water for irrigation than exposed grass did *alone*.

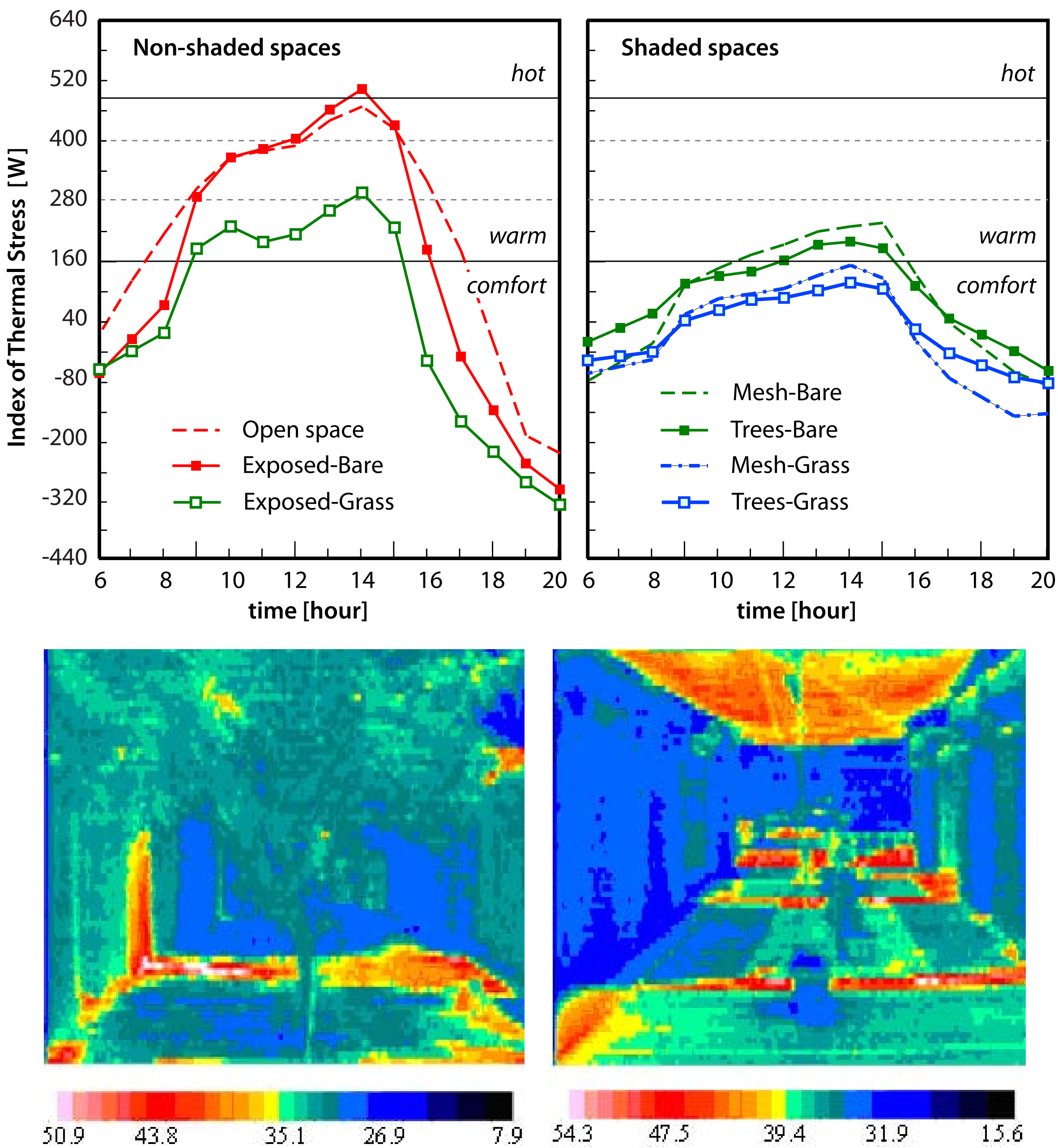


Figure 4. Top: Hourly ITS in courtyard spaces, with thermal sensation thresholds based on Shasha-Bar *et al.*, 2011 (dotted lines) and revised thresholds based on Pearlmutter *et al.*, 2014 (solid lines). Bottom: Simultaneous thermal images of courtyard spaces with trees and grass (left) and artificial mesh and bare ground (right), showing significantly higher surface temperatures on underside of mesh than tree canopy, and wide variation of ground temperatures from shaded grass (coolest) to stripes of unshaded paving (hottest).

In order to quantify the benefits of improved comfort with respect to their "costs" in terms of water required for irrigation, the "cooling efficiency" of the different landscape treatments was gauged by comparing the total evapotranspiration from the vegetation in the courtyards with the reduction in thermal stress they provide – both expressed in terms of their equivalent energy values. The most efficient landscape strategy was found to be that of shade trees alone, which require relatively little irrigation due to their modest water loss (expressed as a low value of latent heat) and through their shading effect provide a significant moderation of thermal stress (expressed as a low value of pedestrian heat gain) – see Figure 5.

Climatically "efficient" urban vegetative cover

Grass is perhaps the most common type of planted ground cover, worldwide, but it may not be the best-suited for arid environments. Plants in such areas must not only be economical in their water requirements, but should also be capable of surviving extended periods of drought and, preferably, allow irrigation with brackish water. The suitability of several types of plants for green roof systems in the light of these requirements was investigated by Schweitzer and Erell (2013). The cooling effect and water use of several types of plants suitable for extensive green roof systems were assessed using small test cells, which were insulated and equipped with internal thermal mass to provide a thermal response comparable to that of real buildings. The water requirements of the plant species tested ranged from 2.6-9.0 liters/m^2 per day (Figure 6) in typical summer conditions for Tel Aviv (which is located on the Mediterranean coast, and is less arid than the Negev). *Aptenia cordifolia* was the most efficient in its use of water, providing the highest cooling benefit per unit of water required for irrigation. However,

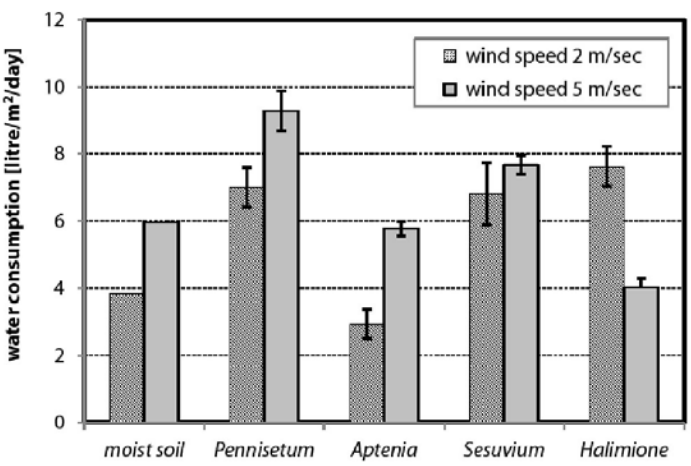


Figure 6. Daily water requirements of several types of plants in a shallow substrate, in Tel Aviv summer conditions. Note that the highest evapotranspiration value is from a surface covered with grass (*Pennisetum*).

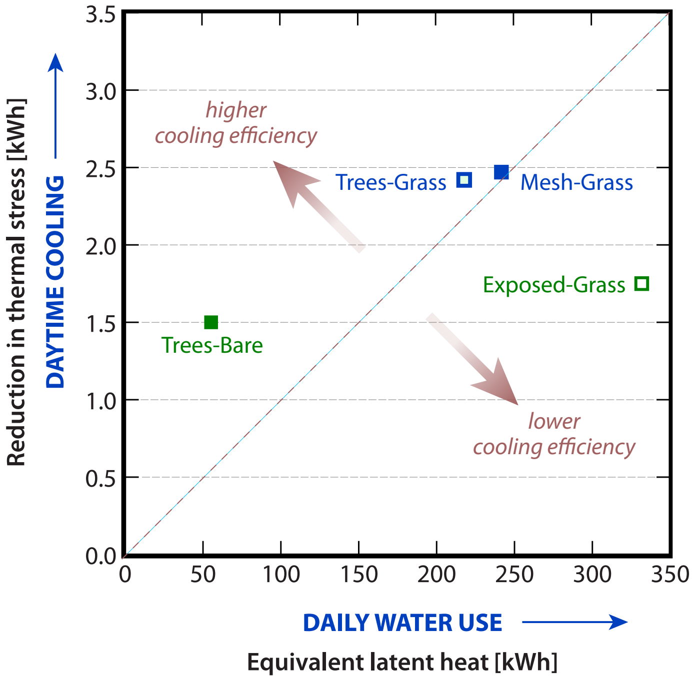


Figure 5. The cooling efficiency of various landscape treatments, quantified by their stress-reduction 'benefit' vs. their irrigation 'cost'.

the cooling efficiency of all roof variants studied was very low, and the reduction in the sensible heat load of the model building attributed to the green roof system was less than 5% of the latent heat content of the water lost to evapotranspiration. In this context, it is hard to justify widespread construction of green roofs in arid environments on the basis of their contribution to building energy conservation alone, although other benefits may nevertheless make them attractive in certain applications.

The potential contribution of ground cover plants to pedestrian thermal comfort would appear to be a more effective use of limited water resources in arid land cities: Uniquely among all urban surfaces, plants combine a low albedo with low surface temperature. High-albedo surfaces involve a trade-off between reflecting more sunlight and emitting less long wave radiation, and may thus impose an equal or even higher load on a pedestrian than conventional dark pavements (Erell *et al*., 2014). Plants, however, reduce both short wave and long wave radiation – but they require irrigation, and in the case of grass this can be a decisive environmental as well as economic consideration.

Given the exorbitant water requirements of grass, a further experimental study investigated the potential of succulent plants for use as an alternative in urban landscaping (Snir *et al.* 2013). Small plots planted with a total of six species (Figure 7) were used to compare the characteristic albedo and radiant surface temperature, as well as the water requirements, of different types of ground-cover vegetation. The data describing their thermal and

Figure 7. Planted experimental plots for measurement of surface albedo and radiative surface temperature.

optical properties were then used for calculating the Index of Thermal Stress (ITS) in urban spaces using them for ground coverage in varying amounts, and in turn for determining their "cooling efficiency" with respect to their water requirements.

Albedo – All of the plant varieties were seen to have a significantly lower albedo (in the range of 0.20-0.26 at mid-day) than bare loess soil, which reflects close to 40% of the incoming solar radiation (Figure 8a). These values are also significantly lower than that of a paved surface made of medium gray concrete tiles (0.32), but higher than that of artificial grass, which had an average reflectivity of only 13%. Differences between the group of succulent plants and the others, including grass, were not significant, indicating that all of them would reflect relatively little solar energy onto the body of a pedestrian.

Surface temperature – It was found that the plots with succulent plant varieties reached surface temperatures of over 45°C at mid-day in summer, whereas the grass and other non-succulents (Figure 8b) maintained temperatures that were some 10 degrees lower. However all of the vegetated surfaces remained significantly cooler than the "dry" surfaces that were observed for comparison, with the concrete pavers approaching 55°C, the bare soil 60°C, and the artificial grass reaching 70°C!

These comparisons highlight the cooling effect of evapotranspiration from the irrigated plots, as even with their low albedo, the transpiring plants – together with evaporation from the wet soil – maintain relatively low temperatures by channelling much of the absorbed solar energy into latent rather than sensible heat.

Microclimatic thermal stress – The albedo and surface temperature data were used in this case as input for calculating the Index of Thermal Stress (ITS, as described above) for a hypothetical pedestrian in an urban space. The hourly ITS values shown in Figure 8c, which represent a person standing on a ground surface covered entirely by one of the vegetated or non-vegetated treatments, indicate relatively small differences between the various planted surfaces – all of which allow for lower thermal stress than the "dry" surfaces.

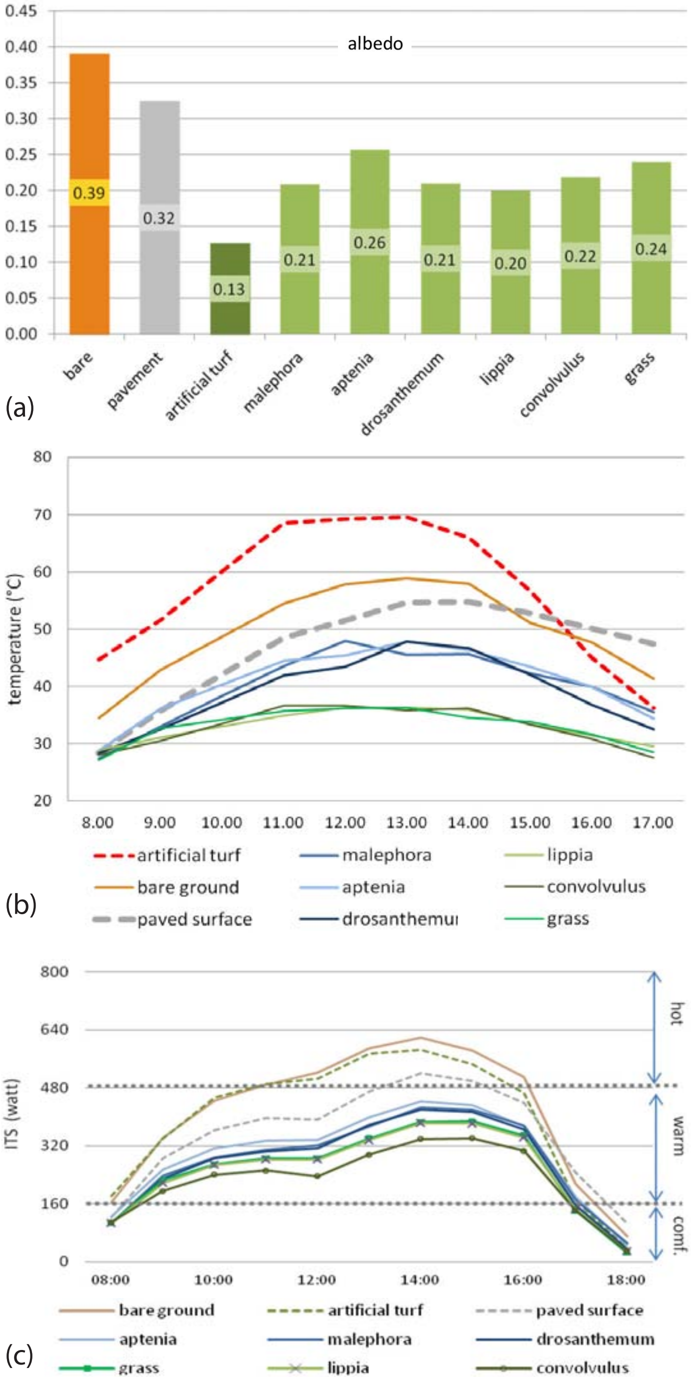


Figure 8. Comparison of urban ground-cover materials, in terms of (a) average mid-day surface albedo, (b) hourly radiative surface temperature, and (c) hourly ITS for a space in which they are deployed.

Under summer conditions, the thermal sensation category for a person standing on a vegetated surface will be "warm" for most of the daytime hours, whereas a person standing on bare ground or on artificial turf, which are not cooled by evapotranspiration, will experience thermal stress between 11:00-16:00 exceeding the 480W threshold defined as 'hot" (based on the survey of Pearlmutter *et al.* 2014, previously reported in UCN). In other words, a high "price" in terms of thermal stress is imposed by both dry materials – bare soil due to its high albedo and intense reflected radiation, and artificial turf due to its low albedo and high radiant surface temperature. Grey concrete paving yields intermediate results, with thermal stress significantly higher than vegetation but somewhat lower at mid-day than the other dry surfaces.

Water consumption and cooling efficiency – Despite the marginal advantage of grass and similar plants over the succulents in terms of ITS, the succulent plants demonstrated a relatively low level of water loss under conditions of limited irrigation, which ultimately endowed them with a higher cooling "efficiency". The daily water consumption of the different plants was measured by periodically weighing sample pots embedded in the plots, and data were also taken from recommended irrigation requirements in Israel. Both sets of data showed significantly lower water requirements for the succulent plants, *Melaphora, Aptenia* and *Drosanthemum*. As seen in Figure 9, this lower irrigation requirement results in a high cooling efficiency, which is calculated as the ratio between the reduction in thermal stress afforded by the vegetative treatment (in kWh per person) and the latent heat of evaporation (in kWh per unit area) represented by that planted surface's water loss.

Conclusions

While ongoing research should continue to clarify the ways in which green infrastructure can be economically and sustainably used to counter the effects of urban heat stress, this series of investigations highlights some points which may be useful for urban designers. First, it is clear that pronounced benefits may be gained by using trees and ground-cover plants which are relatively drought-resistant, and which, in that sense, are well adapted for a hot-arid climate. Second, it is clear that these plants – which by way of evapotranspiration convert solar radiation into latent, rather than sensible heat – can ameliorate thermal stress even when their effects on *air temperature* are minimal. In the case of trees this is primarily through the direct shading of a person's body, although the radiative burden on a pedestrian is further eased when the body is exposed to the relatively cool surfaces of shaded ground and leafy tree canopies. In the case of vegetative ground cover, it is due to the unique combination of low solar reflectivity and low radiant surface temperatures – both of which contribute to a moderation of stress for urban inhabitants.

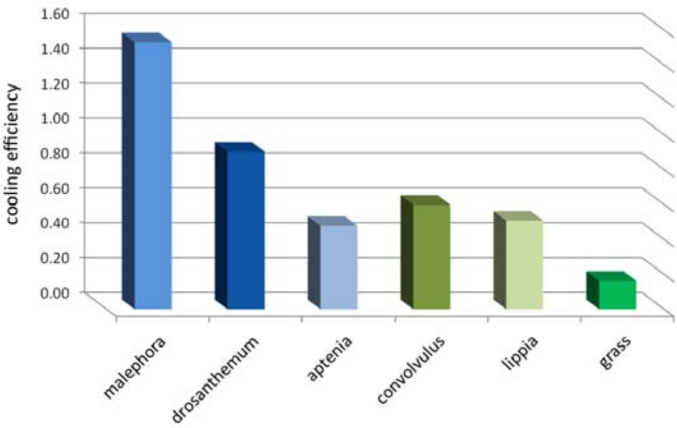


Figure 9. Cooling efficiency of various succulent plants (blue) and non-succulents (green).

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11th Symposium on the Urban Environment in Atlanta, Georgia

By James Voogt, *IAUC President*

The **11th Symposium on the Urban Environment** was held in conjunction with the American Meteorological Society Annual Meeting 2-6 Feb. 2014 in Atlanta GA. The theme for the annual meeting, "Extreme Weather – Climate and the Built Environment: New Perspectives Opportunities, and Tools," had a distinct urban flavour. The meeting was hosted by outgoing AMS President **Marshall Shepherd**, who will be familiar to many IAUC members for his research on urban meteorology, especially related to understanding urban effects on precipitation.

As it turned out, the choice of theme seemed prescient. In the week leading up to the annual meeting, Atlanta had a significant snow event that, in the words of CNN, "paralyzed Atlanta", a metropolitan region that is home to approximately 6 million residents. The storm led to traffic chaos with a reported 2,000 cars abandoned on roadsides and many commuters reported trapped on Atlanta interstate highways overnight or sheltering at their workplaces. The snowstorm itself – between 1 and 3 inches (2.5 – 7.6 cm) of snow fell over the Metro Atlanta region[1]– was well forecast in advance, but a combination of factors led to massive traffic jams that disrupted winter maintenance and resulted in the State Governor declaring a state of emergency for the entire state of Georgia. In response to swift and furious criticism of the state of preparation, the Governor created a severe weather warning and preparedness task force to advise how the state could better respond to such events. This event clearly highlights both the sensitivity of cities to weather events and the need to better bridge the divide between meteorology and the user communities in terms of the communication of forecast information and warnings.

By the time I arrived in Atlanta, the snow had melted, although clearly the event was still the talk of the town. The site of the conference was the Georgia World Conference Center – Hall C in fact – which, on the first day walking past Hall A and then Hall B, underscored just how big the Center was. Big enough that a shuttle service was available, even from the nearest hotel. Despite the overall size of the venue, the meeting rooms were in close proximity to one another and rooms serving conferences with related themes were often adjoining, allowing for relatively easy room-hopping.

The conference opened with the Presidential Plenary, featuring **Andrew Revkin**, Dot Earth Blogger for *The New York Times*. He posed the question: "Is the new communication climate good for the human-climate relationship?" as a starting point for the panel discussion

that followed. Andy illustrated how new communication technologies provide opportunities for improving the human-climate relationship. He closed his talk in a novel way – by playing guitar and singing a song he wrote about the 1995 spring floods in Colorado, the chorus of which was "*They say Nature has a habit of cleaning up mistakes / Don't build a town on a mountainside unless you like high stakes*."

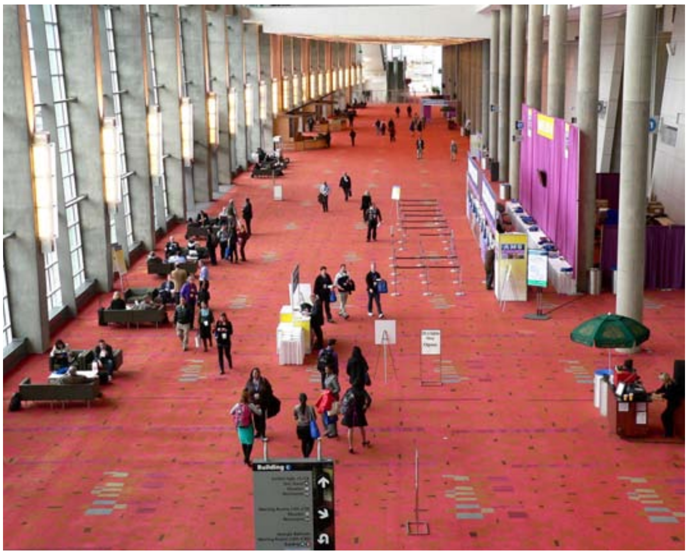
The Urban Environment Symposium consisted of 11 oral and 2 poster sessions with 79 and 56 presentations respectively. Presenters represented at least 16 different countries with Australia, South Korea, Japan, Brazil, China and Russia among the more distant homes for participants. There were no parallel sessions in the Urban Environment Symposium, although of course, meeting in conjunction with the AMS Annual Meeting always involves multiple parallel conferences and requires some careful inspection of the overall program. Sessions included "Urban Adaptation and Mitigation Strategies", "Intersections of Global Climate Change and Urbanization", "Biometeorology and Public Health in Urban Areas", "Impacts of Aerosols and Urban Environments on Precipitation", "Modeling, Observation and Input Data Requirements for Understanding and Prediction Interdisciplinary Urban Phenomenon", "Urban Development, Planning and Sustainability", "Urban Canopy and Rough-

[1] http://www.srh.noaa.gov/ffc/?n=20140128winterstorm

ness Sublayers", and "Urban Energy and Water Balances".

Five joint sessions were held that dealt with annual meeting themes. These included "Urban Hydroclimate and Floods", "Impact of Extreme Weather and Climate on the Urban Environment" and "New-generation Meso-scale to Urban Scale Modeling Capabilities for Air Pollution Research and Prediction".

Of particular note to IAUC members was the special joint session "History of Urban Climate Research" co-sponsored by the Stanley A. Changnon Symposium and 12th History Symposium. It featured six invited presentations that spanned a wide range of observational and modeling perspectives on urban climate. **Walt Dabberdt** presented "A Selective Overview of Urban Meteorological Studies in the US" in which he showed six sample studies drawn from 34 studies identified in the period 1921-2012. The full set of references and studies is available as a document from the conference web site. **Vladimir Janković** spoke on "Urban Meteorology: A Historical Perspective". He identified limitations that have restricted how urban climate research has translated to urban planning. In response to a question on how this gap might be overcome, Vladimir noted that almost all funding for the urban meteorological projects during his study period came from national science agency type sources with very little from planning or architecture agencies. His view was that involving the planning community within the research process would be key to progress, a conclusion that has been echoed in a recent NSF Report on Urban Meteorology[2]. **Dev Niyogi** presented "The History and Future of the La Porte Anomaly" in which he concludes, based on historical observations and more recent model simulations, that the La Porte anomaly was a fact and was characterized by complex interactions between land use and aerosols. **Sue Grimmond**, in "From Clouds to Cloud Computing: The Role of Observations in the History of Urban Climatology", pointed to a future of crowd sourced data, wi-fi sensors and decision making that could be linked to these new instrument types. She also suggested that we should consider urban areas as a place to test new meteorological instruments and to better understand how urban effects are observed both intentionally and unintentionally. **Bob Bornstein** presented "History of Numerical Urban Meteorological-Modeling" and pointed to the need for better urban hydrology and building energy models within urban models. The final speaker, **Marshall Shepherd**, asked "Can Cities Create or Modify Precipitation: Have We Answered This Question and What is Next in 2014 and Beyond?" – and discussed the four main hypotheses of how urban areas influence precipitation: destabilization of the atmosphere, roughness influences,



Site of the AMS Annual Meeting, Feb. 2-6 2014 in Atlanta.

microphysical and dynamic influences of aerosols and the bifurcation of pre-existing precipitation cells. With respect to the last of these he wondered whether cities might create von Karman-like vortices in their wake. In his summary, Shepherd identified some areas that are less well understood, including urban-snow events and the winter urban water balance, urban climate archipelagos that represent merged urban areas and their impacts on weather and climate, the shape, size and form of the urban precipitation effect and the incorporation of better physical understanding of urban precipitation into planning (e.g. flooding and water resources).

While not formally holding Joint sessions, there were a number of sessions in the 5th Conference on Environment and Health related to the urban environment. Sessions such as "Heat Models-International Perspectives and Applications", "Perspectives of Biometeorology", "Heat and Human Health Models", "The Built Environment and Health: Adaptation and Mitigation Strategies" had many urban-related presentations in them, and were easily accessed since they were in an adjoining room. Another session of interest to urban environment attendees was the invited keynote presentation from **Michael Brown** (Los Alamos National Labs) who spoke on "Plume Modeling in the Urban Environment – Challenges and Issues".

The AMS provides online access to recordings of many of the presentations as well as conference papers or handouts. See https://ams.confex.com/ams/94Annual/webprogram/11URBAN.html for a full listing of the available presentations and materials.

The conference wrapped up on Thursday afternoon with those in late sessions not leaving until Friday or later. And just in time. On Feb. 12th, a second major snow and ice storm arrived to test the Governor's new task force. This time Atlanta was ready.

[2] http://www.nap.edu/openbook.php?record_id=13328

Recent publications in Urban Climatology

In this edition a list of publications are presented that have come out between December 2013 and end of February 2014. As usual, papers published since this date are welcome for inclusion in the next newsletter and IAUC online database. Please send your references to the email address below with a header "IAUC publications" and the following format: Author, Title, Journal, Volume, Pages, Dates, Keywords, Language, URL, and Abstract. In order to make the lives of the Bibliography Committee members slightly more easy, please send the referenecs in a .bib (or .ris) format.

Enjoy!

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CALL FOR PAPERS:20TH INTERNATIONAL CONGRESS OF BIOMETEOROLOGY

The International Society of Biometeorology will hold its 20th International Congress of Biometeorology (ICB2014) in Cleveland, Ohio, USA from 28 September - 1 October 2014. ICB2014 is co-sponsored by the American Meteorological Society (AMS).

ICB2014 embraces all areas of biometeorology, with a focus primarily on the theme "Adaptation to Climate Risks". Over the past two decades, climate and meteorological science has been increasingly integrated with biological, ecological, and social science to develop more sophisticated means to identify climatological risks and to provide the operational framework to deal with these risks on biota, from microorganisms to humans. This has led to unprecedented cooperation between atmospheric and social scientists from a broad array of disciplines. The theme reflects local and regional environmental priorities, and fosters an international comparison of risk analyses and associated intervention and evaluation activities.

Among the general paper and poster sessions, there will be a number of special sessions:

- human health challenges in a world with increasing climate variations
- extreme event warning methodology and implementation
- national and local governmental responses to potential climate risk
- climate challenges in the developing world
- risk communication
- Geographic Information Systems (GIS) and atmospheric hazard vulnerability
- historical trend analysis and an evaluation of changes in extreme event frequencies
- Universal Thermal Climate Index
- phenological evaluation of climate change and variability
- climate and tourism
- animal response and adaptation to a changing climate
- contribution of livestock to climate change and mitigation
- aerobiology and human health
- aging in a changing climate
- water-borne disease and climate
- agriculture and forest biometeorology

The website http://www.icb2014.com will serve as the official site of the conference. Updates will be posted regularly, as the agenda and activities develop, and you can join a mailing list to stay current of developments. The abstract deadline is **28 May 2014**. Authors of accepted presentations will be notified via e-mail in June 2014. We look forward to your participation in ICB2014. Questions may be sent to Scott Sheridan (Chair of the ICB2014 Organizing Committee) at ssherid1@kent.edu.

Upcoming Conferences...

URBAN ENVIRONMENTAL POLLUTION 2014: Climate Change and Urban Environment
Toronto, Canada • June 12-15, 2014
http://www.uepconference.com/

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

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

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

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

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

The IAUC Board: Call for Nominations 2014

We are now calling for nominations for three new members of the Board of the International Association for Urban Climate. This is to replace Alberto Martilli (CIEMAT, SPAIN), Aude Lemonsu (CNRS/Meto France, FRANCE), and Silvana di Sabatino (University of Salento [Lecce], ITALY) whose terms on the Board expire in 2014.

The procedures for Board elections are available at the IAUC website (www.urban-climate.org); follow "IAUC Procedures and Administrative Matters" under 'Organisation' in the main navigation menu). To see the present composition of the IAUC board, follow the 'Current Board Members' link from the same website. The nomination process will be conducted as described below.

(1) If you are nominating another person, proceed as follows:

a. Email the IAUC Secretary indicating the name and affiliation of your nominee.

b. Also name *TWO* other persons who support the nomination. They must also email the Secretary indicating their support of the nominee within the nomination period.

c. The nominee should also email the Secretary indicating her/his willingness to stand. The nominee should also provide his/her affiliation, country and supply a short statement containing a reference to their link to IAUC and urban climate which will be shared with the membership at the election (if there is one). That statement must not exceed 250 words, a limit that will be rigorously applied (longer statements will be truncated after the 250th word).

(2) If you are nominating yourself, proceed as follows:

a. Email the IAUC Secretary indicating that you are nominating yourself.

b. Also name *THREE* other persons who support your nomination. They must also email the Secretary indicating their support for your nomination within the nomination period.

c. You should also provide your affiliation and country. Please also supply a short statement that will be shared with the membership at the election. That statement must not exceed 250 words, a limit that will be rigorously applied (longer statements will be truncated after the 250th word).

Also please note the following:

(i) All nominees, nominators and persons supporting a nomination must be members of the IAUC as of this moment. New members will not be eligible to vote or be nominated in this round of elections.

(ii) All required information, as outlined in (1) or (2) above, must be received by the Secretary by *Friday, May 16th 2014, 11:59 pm* (UTC).

(iii) E-mails should be sent to the Secretary at email address: Sailor@pdx.edu. *DO NOT* use the 'reply' function of your mailer to contact the Secretary. Receipt of nomination e-mails will be confirmed. No other method of communication will be accepted.

(iv) It is the responsibility of the nominator and/or nominee to ensure that all necessary e-mails are sent to the Secretary within the nomination period. No reminders will be sent in the case of incomplete nominations.

(v) If more than three nominations are received, an election will be conducted via email or the web, with the three candidates receiving the highest vote counts being deemed to have been elected. If an election is necessary, the exact procedure will be described in an email to the current membership.

* Please note that the Board is seeking members eager to play an active role in the development of the society and who reflect the diversity of the membership in terms of their perspectives, fields of study and geographical location.

– David Sailor, IAUC Secretary

Proceedings of ICUC

There have been eight International Conferences on Urban Climate (ICUC) since 1989, and since 1999 they have been held on a three year cycle. ICUC9 will take place in Toulouse, France, 20-24 July 2015. The proceedings for each of the ICUC events since 2003 are now available on the IAUC website (www.urban-climate.org) under the ICUC tab. The most recent event (ICUC8) is available in pdf portfolio format so that individual papers can be searched for, and extracted (ISBN number 9781905254774). The ICUC6 and ICUC8 files are very large (200 MB) and we suggest that you save the file from the site, rather than directly open for viewing. ICUC6 and ICUC5 files both have index files listing each paper. The ICUC7 proceedings are still available on the conference website. – *Gerald Mills*

2012	Dublin, Ireland	icuc 8 Proceedings (PDF)
2009	Yokohama, Japan	icuc 7 Proceedings (HTML)
2006	Göteborg, Sweden	icuc 6 Proceedings (PDF)
2003	Lodz, Poland	icuc 5 Proceedings (ZIP)
1999	Sydney, Australia	Unavailable
1996	Essen, Germany	Unavailable
1993	Dakha, Bangladesh	Unavailable
1989	Kyoto, Japan	Unavailable

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; Past President, 2014-
- Jennifer Salmond (University of Auckland, NZ): 2005-2009; Secretary, 2007-2009
- James Voogt (University of Western Ontario, Canada), 2000-2006; Webmaster 2007-2013; President, 2014-
- 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 (Univ. of Tsukuba, Japan): 2011-2015
- David Sailor (Portland State University, USA): 2011-2015; Secretary, 2014-

* *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 June. Items to be considered for the upcoming issue should be received by **May 31, 2014** and may be sent to Editor David Pearlmutter (davidp@bgu.ac.il) or to the relevant section editor:

News: Winston Chow (winstonchow@nus.edu.sg)
Conferences: Jamie Voogt (javoogt@uwo.ca)
Bibliography: Matthias Demuzere (matthias.demuzere@ees.kuleuven.be)
Projects: Sue Grimmond (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.