# Urban Climate News

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## Inside the Summer issue...



## From the IAUC President

Dear Colleagues, welcome to the 48th edition of *Urban Climate News*. The first edition of the IAUC's online newsletter was published October 2003, so we are approaching the 10th anniversary of our flagship publication. Its continued vitality relies on the contributions of IAUC members and the considerable skill and dedication of our Editor, David Pearlmutter. This edition has a distinct focus on applied climatology and on the social-demographic perspective on coping with extreme heat events, as well as the role of urban parks and forests for mediating thermal stress.

In preparing this short piece, I was struck by two items in the news and what they tell us about urban climates and policies to affect change. The first is a report that was produced as part of the EU "Year of Air", which has focused on achieving better air quality. *The Review of evidence on health aspects of air pollution – REVIHAAP* (interim report) consists of answers to 24 questions such as: What evidence is available directly assessing health benefits from reducing air pollution? The responses are based on the analysis of published research drawn from geographically diverse sources. The report has a superb bibliography and although it does not have a focus specifically on urban areas, much of the evidence is drawn from urban studies. The work makes it clear that achieving the objective of good air quality is far from complete (even in 'developed' world cities) and that the current WHO standards should be revisited.

The second item is a report produced for New York City (*A Stronger, More Resilient New York*) that focuses very much on urban design to protect the city from projected consequences of climate change, most notably sea-level rise. What strikes the reader is the extent to which the report uses the Hurricane Sandy event as an opportunity to discuss climate change and New York's response. For myself, the report illustrates (once again) the importance of singular, often catastrophic events, in reforming policies and recognising the relationship between the places we build and occupy and the vagaries of climate and weather. It also illustrates the potential for historical analyses of past events and their impact as a complement to projections of future climates.

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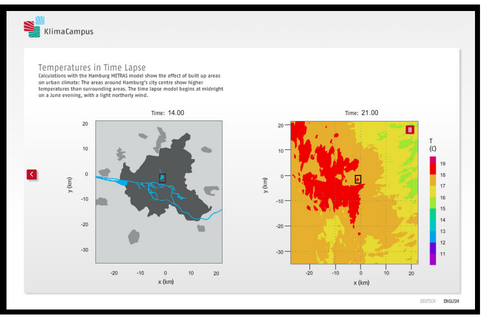
Check out these multi-media links >>

# The Urban Jungle: Small steps to a big Solution

*June 2013* — The World Bank recently released a report, Turn Down The Heat: Climate Extremes, Regional Impacts and the Case for Resilience, which is a scientific analysis of climate change in specific regions. While the report gives a clearer picture of how climate change will affect the Sub-Saharan, South East Asian and South Asian region, there's one more interesting thing the report mentions.

It says: "Climate change poses a particular threat to urban residents and at the same time is expected to further drive urbanization, ultimately placing more people at risk to the clusters of impacts outlined above."

If you look at data across the South Asian region, you will find that most of the data with respect to climate change revolves around agricultural areas or coastal regions. If you try searching for data on climate change and its impact on urban areas, specifically for South Asian cities, it is extremely difficult.

The closest set of data you can find that gives you a sense of the scale of the problem is this: Almost half of India's population will be urbanized by 2050. That's almost 600 million people or a little less than half of South Asia's population in urban areas. Yet there is no measurable data available that can specifically cut across socio-economic factors to show how cities in urban India are contributing to climate change in terms of greenhouse gas emissions, rain water harvesting, etc.

When you look at the larger picture and the fact that climate change will further drive urbanisation, you wonder why is there such a gap in data collection in urban areas. Then again, things are happening although it is at the beginning.

It is only in the last three years that cities across the world have started to track their carbon footprint. And things are set to change as the World Resource Institute has partnered with Cities Climate Leadership Group (C40) and Local Governments for Sustainability (ICLEI) to develop the Global Protocol for Community-Scale GHG Emissions (GPC) Pilot Version 1.0. This guide, when out in 2014, will become the first internationally accepted framework for city-level GHG inventories.

While we wait on that data to get a clear understanding of where South Asian cities stand and how they need to tackle specific issues regarding climate change, the report by the World Bank gives an indicator of things ahead.

If issues regarding climate change are not addressed, these are the possible things that could happen in South Asia by the 2040s with a mere two degree rise in temperature: per capita water availability in South Asia will decrease by more than 10 percent, malnutrition will increase by 14.5 percent, childhood stunting will increase by five percent, and overall crop production will increase by only 12 percent from 2000 levels instead of 60 percent (which would have happened without climate change).

Much more work is needed in this area and while this global study is a step in the right direction, we spoke to many experts who raised similar points on what individuals can do to help. Here is what Anumita Roychowdhury, head of research and advocacy at the Center for Science and Environment, says.

*Energy* – "People have this myth that they have to bring their ACs down to 18°C to make it cold," she says. "The optimal thermal comfort should be 25-27; bringing it down to 18 will only increase your energy budget. Instead of bringing it down, you can keep it on at 25 degrees and put on fan. That combo is more effective than 18 degrees." You can also use green roofs or have reflective materials on your roof to reflect back the heat. When it comes to electricity, there's one common thing people do. They leave their television sets on standby. That consumes more energy, so if you are not watching TV, just switch it off.

*Basic lifestyle adjustments* – It is time for people to understand water and use efficient fixtures in their houses. What we try to do when we open the tap is we want the full volume to gush out; but that is extremely wasteful. You should get retrofit devices to regulate the flow. Similarly, there are new shower technologies that mix air with water to give volume; so, you get a sense of water without using much. See if you can reduce the flush capacity of a regular 30 litres with one flush to 10-12 litres. It is possible with the latest technology. Reuse water: every time you wash your vegetables, you should be able to use the water to water your plants.

*Short-distance travel* – If people become conscious of the fact that they need to cut down short distance travel like dropping off their children, they can not only reduce the impact on emissions but also improve their health. Today, people are increasingly using vehicles for short distances. If it is possible, we should demand public transport, and demand infrastructure for walking and cycling.

These are all choices that impact our ecological footprint: if we are conscious, a million small steps can add up to a big solution. *Source:* ForbesIndia.com

# Can The Threat Of Climate Change Make Cities Richer And Healthier?

*If cities are trying to reduce their footprint and investing in a climate-proof infrastructure, the benefits are astounding*

*June 2013* — Climate change, we're told, is a scary thing. There's nothing but floods, droughts, hurricanes, fires, and heat waves for us to look forward to. Superstorm Sandy was a mere preview of that future--the kind of thing we can expect to happen much more frequently down the line. So you can imagine my surprise upon seeing this phrase emblazoned across the top of [a report](#) from the Carbon Disclosure Project: "How climate change action is giving us wealthier, healthier cities."

It's not that climate change itself is making cities richer and healthier, the CDP postulates. But all the preparations they're making--like emissions reductions and energy efficiency – are creating more walkable and bikeable neighborhoods, attracting investments, and cutting costs.

The report analyzed data from members of the [C40 Cities Climate Leadership Group](#) in 110 cities around the world, including Tokyo, New York, and London. The CDP's main conclusion:

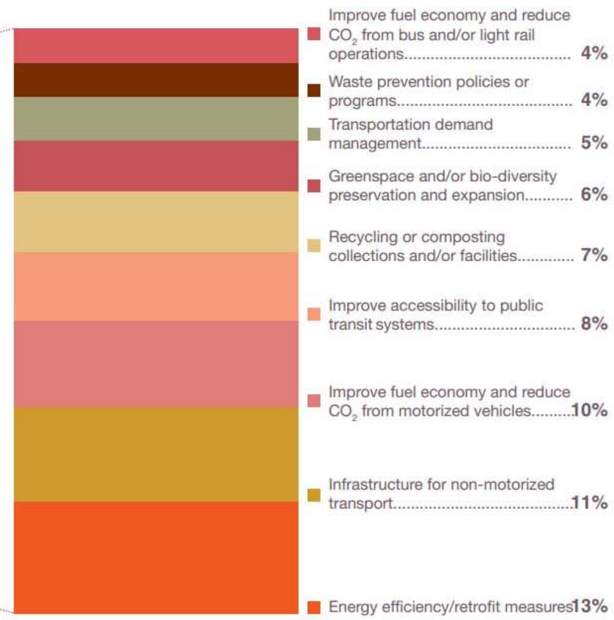
> *The data from these cities makes clear that the benefit of taking action on climate change at the city level is not limited to reducing emissions or adapting to warmer temperatures. The cities in the survey are engaged on the issue of climate change, and, as a result, are saving money, creating more attractive investment environments, and enabling citizens to live healthier lives. In short, climate change action by local governments around the world is creating wealthier, healthier cities.*

Energy efficiency measures are by far the most popular actions that cities are taking to cut down on $CO_2$ emissions – mainly by cutting down on energy demand in buildings, boosting municipal fleet fuel efficiency, and reducing the energy consumption of outdoor lighting.

These three actions make up 25% of everything that cities are doing to reduce emissions. And they pay off: in Washington, D.C., a plan to retrofit thousands of residential building units owned by the D.C. Housing Authority (5,400 units have been retrofitted so far) has yielded $3.9 million in electricity savings each year along with $2.4 million in operations and maintenance savings – not to mention the energy bill savings for residents.

The report also suggests that taking emissions reduction actions can be attractive to businesses. After analyzing all 800 actions that the surveyed cities are taking, here's what the CDP has deemed the best for business (based on academic research on whether they lead to economic growth):

62%




**Common emissions reduction actions tha will make cities more attractive to business (% of actions).**

According to the report, cities strongly believe (91% of respondents) that taking action on climate change will make them better places to invest. CDP points out places where this is already happening: In Detroit, for example, a renewed interest in cycling has led to the growth of the bicycle manufacturing industry.

Cities are also tackling the potential health consequences of climate change – things like cholera from flooding and general increased disease risk from heat waves. Municipalities are taking different approaches based on the threats they face. Mexico City is dealing with heat waves by implementing better epidemiological monitoring, which has found that poorly preserved street food left out in the heat is giving people stomach issues. Cape Town is confronting its flooding-related health risks by outlining "no-development" areas, keeping a strong stormwater runoff infrastructure, and doing coastal vulnerability mapping.

All of these actions are unquestionably making certain cities more attractive to investors and residents. And they're saving lots of money. Eventually, even the best-prepared cities will be hit by climate-related disasters that cost many millions, if not billions, of dollars – but the prepared cities will be wealthier and healthier than areas that failed to do anything. *Source:* [fastcoexist.com](#)

# Air pollution becomes Asia's migraine headache

*Air pollution has become a curse for millions of city-dwellers in Asia, posing a mounting risk to the very young and very old, pregnant women and people with heart and respiratory problems, say experts.*

*June 2013* — Air pollution has become a curse for millions of city-dwellers in Asia, posing a mounting risk to the very young and very old, pregnant women and people with heart and respiratory problems, say experts.

"The levels of pollution in parts of China, India and elsewhere in Asia are just astronomically high and the health impacts are dramatic," said Bob O'Keefe of the Health Effects Institute (HEI), a US not-for-profit research agency.

"This is a threat that was really under-estimated in the past," said O'Keefe.

This week, Singapore grappled with record levels of air pollution, unleashed by land fires in neighbouring Indonesia.

In January, pollution in Beijing went off the scale of an air-quality monitor at the US embassy, and the city's hospital admissions surged by 20 percent.

In August 2012, Hong Kong suffered its highest-recorded pollution, prompting the territory to urge vulnerable population groups to stay indoors.

HEI estimates, derived from an exceptionally detailed analysis called the Global Burden of Disease, say that some 3.2 million people around the world died prematurely from outdoor air pollution in 2010.

China and India together accounted for some 2.5 million of these deaths, sharing the tally roughly equally.

The death toll in China has risen by a third over 20 years, but worse pollution is only part of the reason. As China becomes more prosperous, its citizens are attaining greater ages, reaching 70 or 80 years or beyond -- when people become more vulnerable to heart and respiratory stress from air pollution.

A study published last August in the journal Nature Climate Change estimated that forest and land fires in Southeast Asia kill an additional 15,000 people annually from air pollution during the El Niño weather phenomenon, when drier soil often causes blazes to go out of control. (There is no El Niño at present.)

An investigation by US researchers, published in February, found that among three million births recorded in nine countries in North and South America, Europe, Asia and Australia, there was a clear link between worse air pollution and lower birth weight.

Low birth weight -- when a newborn weighs less than 2.5 kilos (5.5 pounds) -- is associated with ill health, premature death and cognitive problems in later life.

Health experts point to two main dangers from air pollution.

**People wear face masks as haze covers Johor city in Johor Bahru, southern Malaysia. (AFP Photo)**

One concerns particulate matter (PM) -- the sooty specks emitted from fossil fuels, forest fires and land clearances.

Cathryn Tonne, at the London School of Hygiene and Tropical Medicine, points the finger at so-called PM2.5 -- particles measuring 2.5 micrometres across or less, or 30 times smaller than a human hair.

Mainly generated by the burning of coal and oil for power stations, and diesel and petrol for transport, these are many times more perilous than PM10 particles, which are 10 micrometres across, Tonne and colleagues found in research into heart deaths in England and Wales.

"We found that for every 10 microgrammes per cubic metre in PM2.5, there was a 20-percent increase in the death rate," Tonne said.

By way of comparison, the WHO has a recommended maximum of 10 microgrammes of PM2.5 per cubic metre as an annual exposure -- and a maximum over a 24-hour period of 25 microgrammes per cubic metre.

In the United States, the annual PM2.5 limit is a recommended 12 microgrammes per cubic metre, and in the European Union (EU), it is 25 microgrammes.

In Beijing's smog scare in January, though, levels reached a whopping 993 microgrammes per cubic metre... almost 40 times the WHO's advised safety limit.

The other big danger from air pollution is ozone, a triple molecule of oxygen that in the stratosphere is a vital shield against DNA-damaging sunlight, but at ground level -- where it is typically created by a reaction between nitrogen oxides in traffic fumes and sunlight -- it is an irritant for the airways.

Short-term spikes in ground-level ozone have long been linked to heart attacks and severe asthma.

But research conducted in the US, published in 2009, suggests that cumulative exposure is also a big risk factor. The probability of dying from respiratory disease rose by as much as 50 percent as a result of long-exposure to high concentrations of ozone. *Source:* http://www.channelnewsasia.com/news/asiapacific/air-pollution-becomes/719268.html

# An experimental investigation of the role of urban greening in reducing heat stress inside buildings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*An experimental investigation was carried out to determine the effect of trees on indoor thermal comfort and heat stress. Descriptive parameters of thermal conditions were measured between September 2010 and February 2011 in and around two buildings of similar architectural design, located on the campus of the Federal University of Technology in Akure, Nigeria. One of the buildings is shaded on its southeastern side by trees, while the other is not. Comparisons were made of the indoor-outdoor air temperature difference and heat stress conditions, as measured and computed inside and outside the tree-shaded and unshaded buildings. Indoor-outdoor temperature differences were higher during the day, ranging from 0.2-5.4°C for the unshaded building, while the the difference for the tree-shaded building was not more than 2.4°C. Cases of heat stress were observed almost throughout the working/school hours inside the unshaded building, while it was observed only during the period of maximum temperature in the tree-shaded case. Hence, this study calls for tree planting as a means for mitigating and adapting to the global trend of rising urban air temperatures.*

## Introduction

Global climate change is making already hot seasons in hot parts of the world even hotter; an additional 2-4°C increase can be expected in these places during this century (IPCC, 2007; Kjellstrom, 2009). In urban areas, with rapid development of buildings, roads and other major physical structures, the temperature increase is likely to proceed faster and to higher levels due to the urban heat island effect (Oke, 2003). However, urban greening has been said to be the major mitigating measure of climate change and the urban heat island; it can also provide benefits in terms of improved air quality and human health through reduced energy use, and generally improved human comfort, particularly in cities with warm climates. Green areas can potentially be more comfortable environments in warm weather but also less comfortable in colder weather owing to the reduction in temperature by simply intercepting solar radiation. Oke (1972) showed that both the maximum and minimum temperature declined with the increase of the percentage of green vegetation in a settlement.

Increasing temperatures raise serious environmental as well as human health concerns. The physiological basis for the direct effects of heat and increasing temperature on humans and their work capacity is well understood (Bridger, 2003; Parsons, 2003). Even though the human body has physiological heat control mechanisms that maintain a relatively stable core body temperature when the external air temperature is greater than 37°C, temperatures a few degrees higher than this can, under certain circumstances, lead to extreme thermal stress and malfunctioning of bodily systems. These heat control mechanisms rely heavily on cooling through the evaporation of sweat, which becomes less efficient as the relative humidity of the air increases. A combination of conditions such as high environmental temperature and high humidity (which decreases the efficiency of sweating), clothing that increases core temperature (and reduces ability to sweat), physical exertion and dehydration can disturb the body's equilibrium, which can result in extreme heat stress and, when severe, can even lead to heat stroke and death (Acuña-González, 2004). Heat exhaustion and heat stroke are of particular importance for occupational health: a working person creates metabolic heat internally in the body (particularly through muscular work), which adds to the heat stress in hot environments. If cooling methods in the workplace are insufficient, the only way for a working person to reduce heat stress is to take breaks or reduce the pace of work. This reduces 'work capacity' (and daily work output) and economic productivity.

This study made use of the Wet Bulb Globe Temperature (WBGT) index developed by the United States Army many decades ago (USDAAF, 2003) to determine indoor heat stress, as the climatic variables used to define heat exposure and 'microclimate' using this index are primarily temperature and humidity in the work/study place. The study investigates temperature differences inside and outside two buildings which are similar in their architectural design, including their materials and orientation, as well as in their time of construction and their location (being only 60 meters apart). The first building (referred to as Building A) accommodates the academic and administrative spaces of the University's School of Agriculture and Agricultural Technology (SAAT), while the second building (referred to as Building B) accommodates some of the academic activities in the School of Engineering and Engineering Technology (SEET) as well as some other central administrative activities.

### Study site

The study was carried out at the Ilesha Road campus of the Federal University of Technology in Akure, Nigeria. Akure, located at latitude 7°17'N and longitude 5°18'E, is a medium-sized, but rapidly growing urban centre in Nigeria with the university's campus located on its north-western side. The area experiences a warm humid tropical climate, with average rainfall of about 1500 mm per annum. Annual average temperature ranges between 21.4°C and 31.1°C, while the mean annual relative humidity is about 77%. Its vegetation is of the tropical forest type.

High trees shade Building A on its façade facing the southeast, while Building B is unshaded on its southeast façade as shown in Figure 1 below. Internal spaces of the same perimeter, floor area, volume and position (to the southeastern side) were chosen in both buildings for the study. The internal spaces are each 12 m in length, 10 m in breadth and have a headroom height of 10 meters. The space in Building B is presently used as the University's goods acquisition office/store, while in Building A the space is presently used as a students' computer laboratory.

### Data and Methods

Temperature and relative humidity measurements were taken around the clock inside both buildings using shielded portable Lascar EL-USB-2 temperature/humidity data loggers while outdoor air temperature was measured using i-button temperature sensors and loggers between September, 2010 and February, 2011. The idea is to have representative data for the peak of both wet and dry seasons in Nigeria. Each parameter was averaged over hourly, daily and monthly time intervals.

Owing to data availability, we used the approximation of WGBT used by the Bureau of Meteorology that does not take into account variations in the intensity of solar radiation or of wind speed, and assumes a moderately high radiation level in light wind conditions. This simplified formula of WBGT is given by:


**Figure 1. Outdoor environment showing the presence (Building A, left) and absence (Building B, right) of shade trees in both buildings. Photographs by the author, 2012.**

$$WBGT = 0.567\ T_a + 0.393\ e + 3.94$$

where:

$T_a$ = Dry bulb temperature (°C)

$e$ = Water vapour pressure (hPa)

The vapour pressure can be calculated from the dry bulb temperature and relative humidity as follows:

$$e = \frac{rh}{100} \text{ x } 6.105 \exp\left(17.27 \frac{T_a}{237.7 + T_a}\right)$$

where:

$rh$ = relative humidity (%)

A conversion table to determine WGBT according to dry bulb temperature and relative humidity can be found at http://www.bom.gov.au/info/thermal_stress/#wbgt. The correspondence of WGBT ranges with "thermal zones" is given in Table 1.

## Data Selection and Control

Quality control of the collected data was ensured by correcting missing values through the results of regression analysis. An observation in this regard is the temperature spike inside Building A from the 25th to 29th of November, 2010 as well as from the 1st to 22nd of December, 2010. Figure 2 shows a comparison of days with and without the temperature spike (discussed in a later section). For an unbiased comparison, temperature data for these days (with spike) were not used. This avoids an exaggerative influence of the observed spikes on the results.

**Table 1. WGBT thermal zones (hse.gov.uk)**

| WBGT | Thermal zones |
|---|---|
| 20-25 | caution |
| 25-32 | extreme caution |
| 32-39 | danger |
| above 40 | extreme danger |

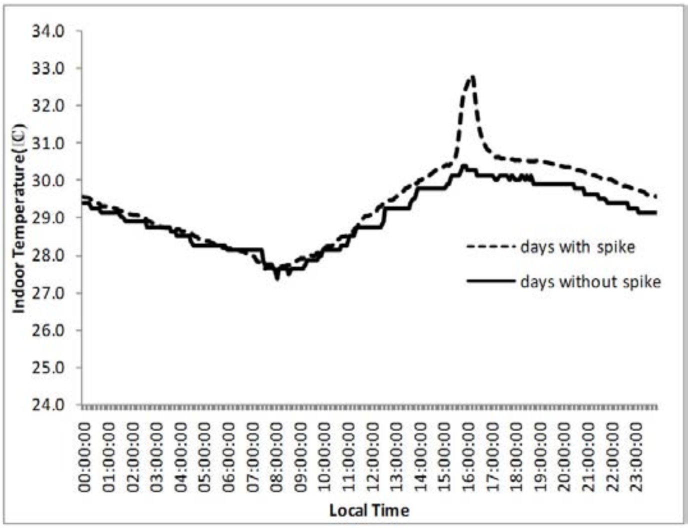


**Figure 2. Comparison of indoor temperature on days with and without spikes in Building A.**

## Results and Discussion

*Indoor temperature variation during working/school hours*

Figure 3 shows the variation of indoor temperature during working hours (08:00-16:00) inside the two buildings. In September, the temperature in the unshaded building was found to be higher than that in the tree-shaded building at all times, with a minimum difference between the two of 0.3°C at 08:00, and a peak difference of 2°C between 14:00 and 16:00. Similarly, in October the temperature value was higher inside the unshaded building with a difference of 0.2°C at 08:00 and maximum of 1.8°C between 14:00 and 16:00. In November, which is the hottest month of the study, the early hour difference was about 0.1°C but this reached a peak of 2.1°C at 13:00 before declining to 1.6°C at 16:00. In December 2010, which is the onset of the harmattan season, the early hour temperature difference was about 0.6°C and the peak difference at 13:00-14:00 was 1.9°C. There was a change in pattern in January 2011, when the harmattan was most evident: the shaded building's temperature was higher at most times.

This can attributed to the fact that more insolation was received due to leaf-shed, leading to the trapping of long-wave radiation and heating of the surrounding environment which in turn transfers heat to the building; this repeats itself in February 2011. Therefore, it is important to note that the trees were seen to be effective in reducing summer heating, but had no effect during the winter (dry season).

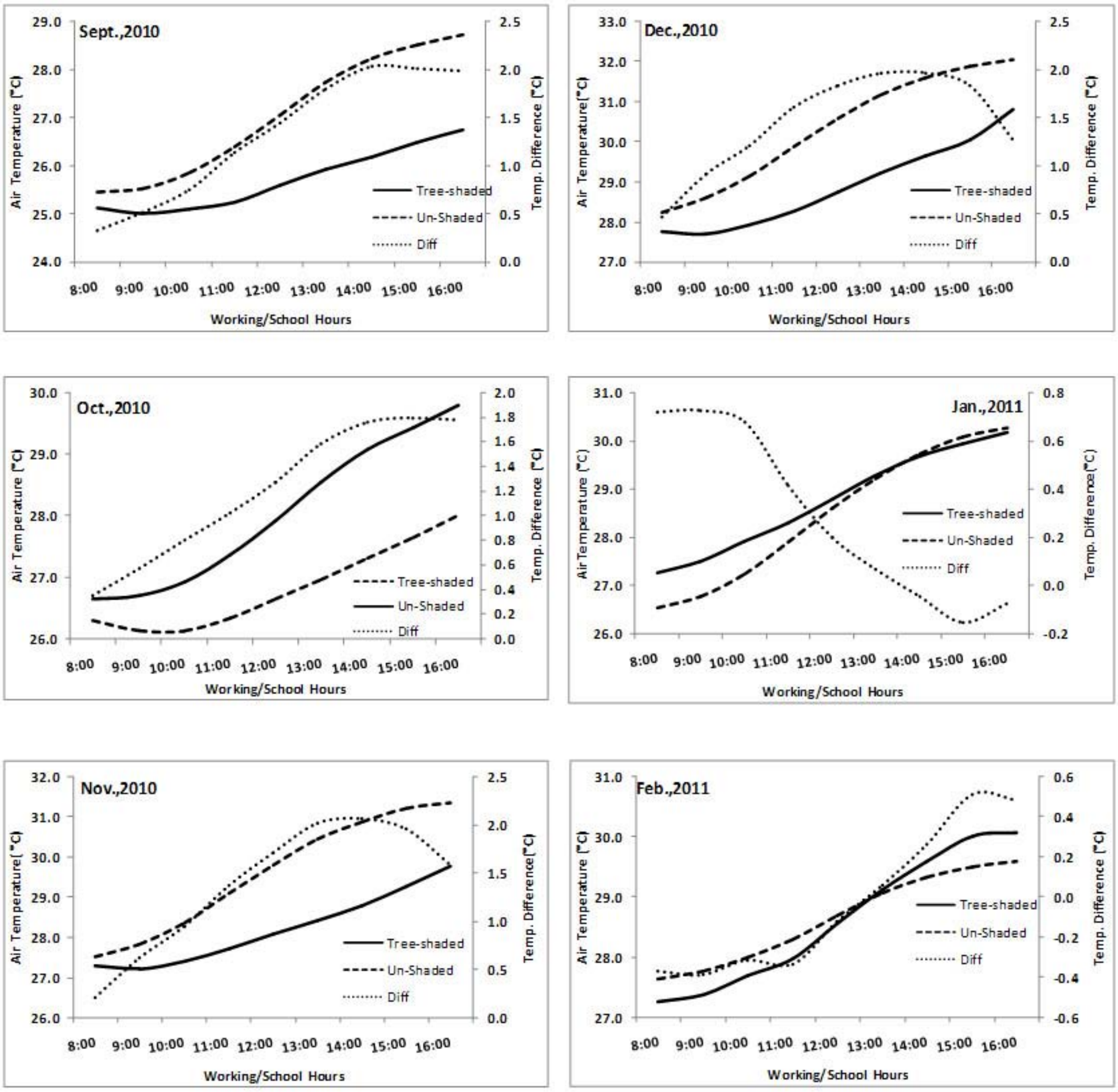


**Figure 3. Indoor temperature variation and difference during working/school hours.**

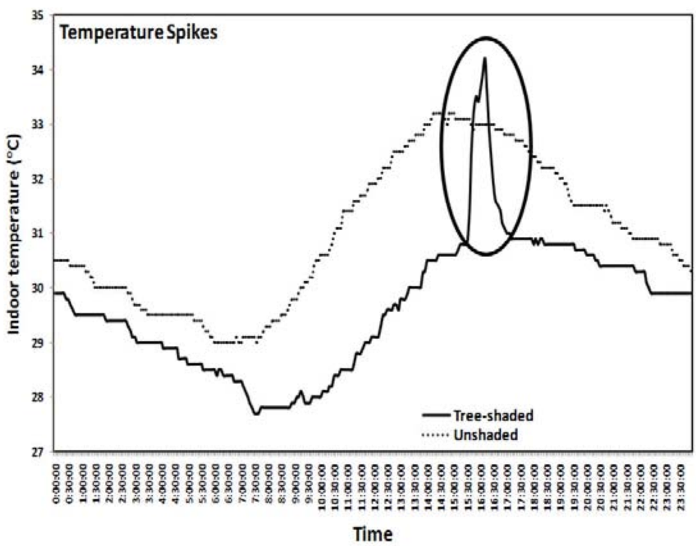


**Figure 4. Mean indoor temperature profile showing period with spike in Building A, as compared with Building B.**

Thus deciduous trees are recommended as a design strategy for addressing both summer and winter conditions.

Results of a one-way ANOVA test performed on the data show a significant difference between temperature values between the two buildings during the wet months only, and no significant difference during the dry months, as shown in Table 2.

As mentioned previously, a sharp temperature spike was noticed during analysis of indoor temperature (see Fig. 2). It occurred during the weekdays when students are having their computer practical classes. Figure 4 shows that though temperature values were higher at most times inside the unshaded Building B, during periods of maximum temperature (14:00 to 16:00, when students occupied the laboratory) a sharp increase was observed in the tree-shaded Building A. This indicates the occurrence

**Table 2. Summary of one-way ANOVA to detect significant difference (95% confidence interval) in indoor air temperature during work/school hours (08:00-16:00) between Building A (tree-shaded) and B (unshaded).**

| | Groups | Average | Variance | F | P-value | F crit |
|---|---|---|---|---|---|---|
| September | Building A<br>Building B | 25.72<br>27.05 | 0.43<br>1.70 | 7.55 | 0.01* | 4.49 |
| October | Building A<br>Building B | 26.83<br>28.05 | 0.48<br>1.47 | 6.84 | 0.02* | 4.49 |
| November | Building A<br>Building B | 28.23<br>29.62 | 0.83<br>2.16 | 5.84 | 0.03* | 4.49 |
| December | Building A<br>Building B | 28.90<br>30.35 | 1.20<br>2.09 | 5.75 | 0.03* | 4.49 |
| January | Building A<br>Building B | 28.77<br>28.49 | 1.17<br>2.06 | 0.22 | 0.64 | 4.49 |
| February | Building A<br>Building B | 28.63<br>28.65 | 1.24<br>0.57 | 0.00 | 0.96 | 4.49 |

of congestion inside the space and significant heat stress at this time.

*Inside-outside temperature differences*

To understand the interaction between vegetation cover and indoor temperature, it is important to examine the differences between indoor and outdoor temperatures at each location. Inside-outside temperature differences for the unshaded Building B, as depicted in Figure 5, show that during the day – especially between 10:00 and 16:00 – the outdoor temperature is higher than the indoor. In September 2010 the maximum difference was observed at night (21:00-22:00) with a value of 4.6°C, while the minimum value of -3.3°C was observed during the day at noon. The maximum difference increased in October, rising to 5.8°C at night while the minimum also increased to -3.5°C; this shows that October 2010 was hotter than September 2010. The increasing trend continued in November, with the maximum difference of 6.2°C observed at night (22:00- 00:00) and the minimum value of -4.1°C occurring at 14:00; there was a time shift in the occurrence of both minimum and maximum temperature differences: the minimum shifted to 14:00 from 12:00 while the maximum difference shifted to between 22:00 and 00:00. It also shows the situation in December, where the maximum value experienced at night (23:00-3:00) increased to 8.0°C and the minimum value increased

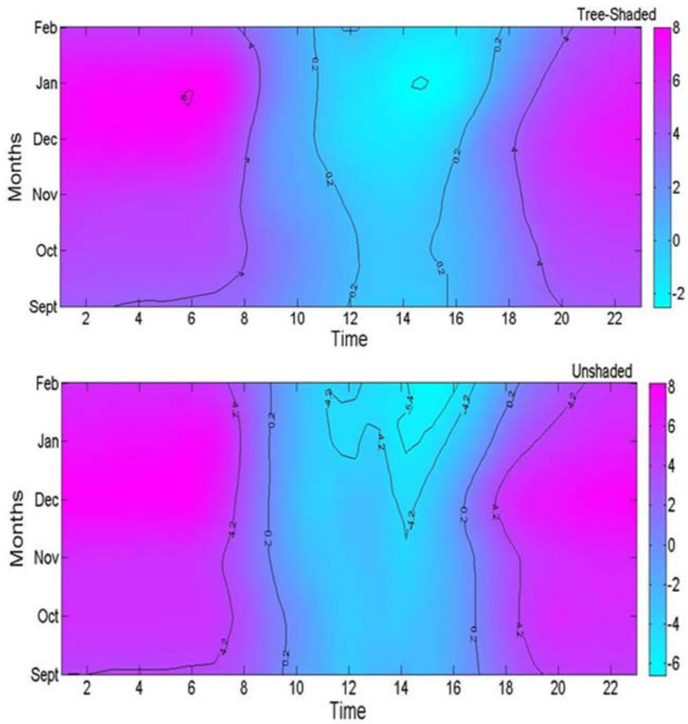


**Figure 5. Indoor–outdoor temperature differences for Buiding A (tree-shaded, top) and Building B (unshaded, bottom).**

to -4.5°C during the day (14:00). In January, 2011 the pattern changed a little as the maximum difference was reduced from 8.0°C in December to 7.6°C in January. This may be a result of reduced temperature in the morning as an effect of the intense harmattan, but the temperature increased more than usual during the day as the minimum value increased to

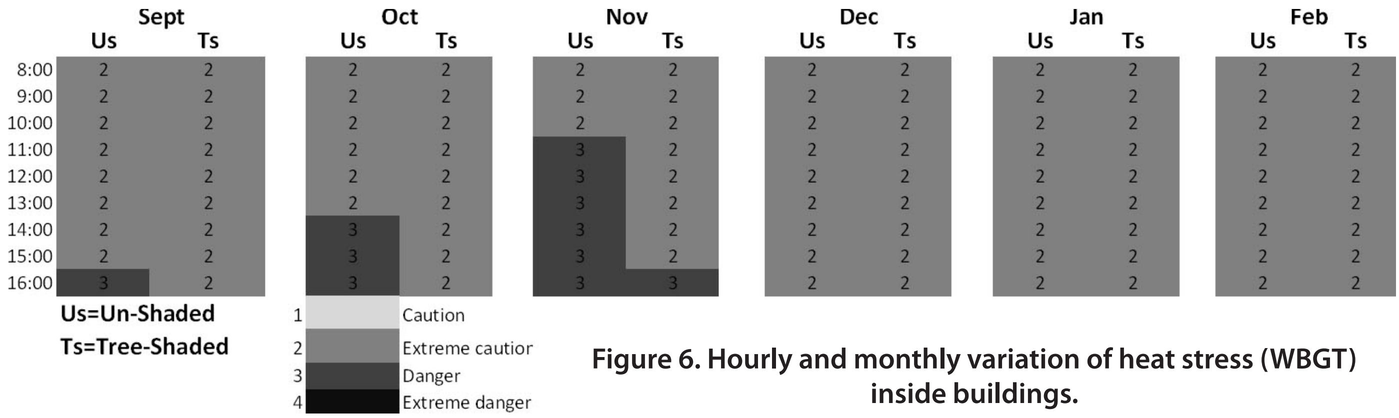


**Figure 6. Hourly and monthly variation of heat stress (WBGT) inside buildings.**

-5.5°C. The trend continued in February, as the maximum value was reduced from 7.6°C in the previous month to 5.7°C and the minimum also increased from -5.5°C to -6.6°C in February 2011.

The indoor-outdoor temperature difference of the tree-shaded Building A shows increasing maximum and minimum differences with increasing dryness. It also shows that the minimum difference in Building A is lower than the minimum difference of Building B. In September 2010, the maximum value of 4.5°C occurred at night (23:00) and the minimum of -0.4°C occurred during the day. In October, 2010 the maximum difference value increased to 5.2°C at night (22:00-23:00) while the minimum difference was reduced to -0.2°C during the day (13:00). The increasing trend continued in November, as the maximum value increased to 6.1°C at night (22:00-23:00) and the minimum value also increased to -0.7°C during the day (14:00). The case was not different in December, 2010 as the maximum and minimum value are still on the increasing side; the maximum had increased to 7.6°C at night (01:00-03:00) and the minimum value increased to -1.5°C during the day (13:00-14:00). A similar pattern was observed in January, 2011 when the maximum rose to -2.5°C during the day (14:00-15:00). The emergence of the rainfall season had an effect on the pattern, as the maximum value was reduced to 5.5°C at night (1:00-3:00) and the minimum value was also reduced to -1.4°C during the day (15:00-16:00).

*Heat stress inside buildings*

Figure 6 shows the indoor monthly and hourly classification of WBGT according to Table 1. In September, 2010, extreme caution conditions were observed throughout the working/school hours inside both buildings except for one hour of danger conditions observed inside Building B at 16:00. In October, 2010 Building B experienced three hours of danger conditions between 14:00-16:00 while the rest of the period experienced extreme caution, but Building A experienced only one hour of danger conditions while extreme caution conditions were observed in other times. In November, 2010 danger conditions were observed for six hours from 11:00 -16:00 and other periods were extreme caution, but Building A experienced a lesser period of danger conditions which was only at 16:00 while the rest of the period had extreme caution conditions. Between December, 2010 and February, 2011 extreme caution was observed throughout in both Building A and Building B. This indicates little to no heat stress during the dry months. The results of one-way ANOVA analysis performed on WGBT values shown in Table 3 indicates a significant difference ($P<0.05$) in the mean values of WGBT between September, 2010 and January, 2011. It informs that although the heat stress classification might be the same, the values are significantly different.

This result conforms with the findings of Kjellstrom (2009) in which it was concluded that heat stress is likely to be common during hot seasons, but culturally accepted methods to reduce impacts on health and work capacity (such as 'siesta') are generally effective in avoiding serious health impacts. However, these culturally accepted methods will undoubtedly reduce the hourly productivity of the exposed workers. Consequentially, heat reduces work performance (Ahasan M.R, 1999) and can reduce attentiveness and assimilation of students.

## Conclusion

Daytime temperature is significantly higher inside the unshaded Building B than in the tree-shaded Building A, especially in November and January. Students are prone to heat stress inside Building A, as a

Table 3. Summary of one-way ANOVA to detect significant differences (95% confidence interval) in WBGT during working/school hours (08:00-16:00) between Building A and Building B.

| | Groups | Average | Variance | F | P-value | F crit |
|---|---|---|---|---|---|---|
| September | Building B<br>Building A | 30.55<br>29.07 | 1.70<br>0.33 | 9.71 | 0.007* | 4.49 |
| October | Building B<br>Building A | 31.20<br>30.16 | 1.45<br>0.55 | 4.85 | 0.043* | 4.49 |
| November | Building B<br>Building A | 32.26<br>30.96 | 1.51<br>0.44 | 7.88 | 0.013* | 4.49 |
| December | Building B<br>Building A | 30.44<br>29.60 | 0.16<br>0.12 | 22.58 | 0.001* | 4.49 |
| January | Building B<br>Building A | 26.45<br>27.23 | 0.57<br>0.25 | 6.73 | 0.020* | 4.49 |
| February | Building B<br>Building A | 29.58<br>29.35 | 0.09<br>0.13 | 2.21 | 0.156 | 4.49 |

temperature spike was observed whenever the students are having their practical classes. This calls for more cooling that would reduce the temperature or better still a spacious laboratory with passive cooling. Outdoor temperature differences clearly show the importance of greening (i.e. trees) in reducing outdoor temperature, it was observed that the Building B's outdoor temperature was 3.1-5.4°C higher than Building A's; this calls for tree planting in mitigating and adapting to the increasing global warming effect. Concerned authorities should therefore provide more spacious laboratories for students to carry out their practical classes, as this observed heat stress condition is injurious to their health, and reduces the assimilation and concentration of students.

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# Urban heat impacts on the elderly in Vienna: Stakeholder views and coping behaviors of elderly residents

## 1. Introduction

Urban residents often suffer from the impacts of heat stress. Particularily the elderly, when living under the influence of urban heat islands, are heavily affected. Several studies have documented that the morbidity and mortality rates among the elderly are increased during and after heat periods in many cities around the world (Anderson & Bell, 2009; Fouillet *et al*., 2008; Hajat *et al*., 2002; Michelozzi *et al*., 2003; O'Neill *et al*., 2003). Similar impacts of heat waves have also been observed for Vienna (Hutter *et al*., 2007). Robine *et al*. (2008) estimates that the 2003 heat wave in Europe resulted in about 70,000 deaths among the elderly. Therefore, the reduction of the vulnerability of elderly people appears to be a high-priority aim for city administrators.

In the future, urban heat will become far more important on the global level (IPCC, 2007). It is projected that heat waves, hot days (with temperatures above 30°C) and tropical nights (with temperatures not below 20°C) will increase during the 21st century in Vienna (Formayer *et al*., 2008). Many cities including Vienna also have a large and increasing elderly population and a high number of those live isolated in poor housing conditions (Hutter *et al*., 2011). While previous research has identified several heat-related risk factors for elderly residents, knowledge on their heat-avoiding behaviors is lacking. The question arises as to what the elderly do when it is hot? Are their coping behaviors effective in decreasing their heat exposure? Are stakeholders aware that the elderly are a vulnerable group? How can cities reduce the vulnerability of their elder residents?

**Heat periods have impacts on the health status of urban residents; elderly people tend to suffer in particular. *Source*: Allex *et al*., 2013**

## 2. Objective of the project STOPHOT

The project "STOPHOT: Cool towns for the elderly – protecting the health of elderly residents against urban heat" aims at reducing the heat vulnerability of people older than 65 years against urban heat in Vienna. STOPHOT specifically investigates the elderly's awareness of heat risks, their perception of heat stress and behaviors avoiding heat impacts (Wanka *et al*., 2012). STOPHOT will develop sustainable short- and long-term preventive measures for the built and green environment and will encourage proper behavior of the elderly during heat waves. The study seems to be the first one in Austria which develops adaption measures in an inter- and transdisciplinary manner to reduce the vulnerability of elderly urban residents.

## 3. Methods

An inter- and transciplinary team consisting of experts from public health, urban and green space planning, sociology and gerontology, representatives of the elderly and city administration, retirement/care home managers etc. is working collaboratively on this project. STOPHOT relies on a mixed-methods approach that combines qualitative and quantitative sociological, participatory as well as planning methods (Figure 1).

About 400 residents above 65 years old living in private homes both within and outside of heat island affected urban areas answered questions during a telephone interview about their awareness of heat stress, perception of climate change as well as their physical and mental reaction to heat and their adaptive behaviors. A telephone survey among younger persons (n=200) controlled age as a potentially major influencing variable. Furthermore, face-to-face interviews with elderly living in retirement and care homes (n=200) in- and outside urban heat island areas were conducted. Fifteen in-depth interviews with stakeholders from city planning, green space management, health care, retirement and care homes explored their awareness and perception of climate change risks and their perceived relevance of heat impacts on elderly residents.

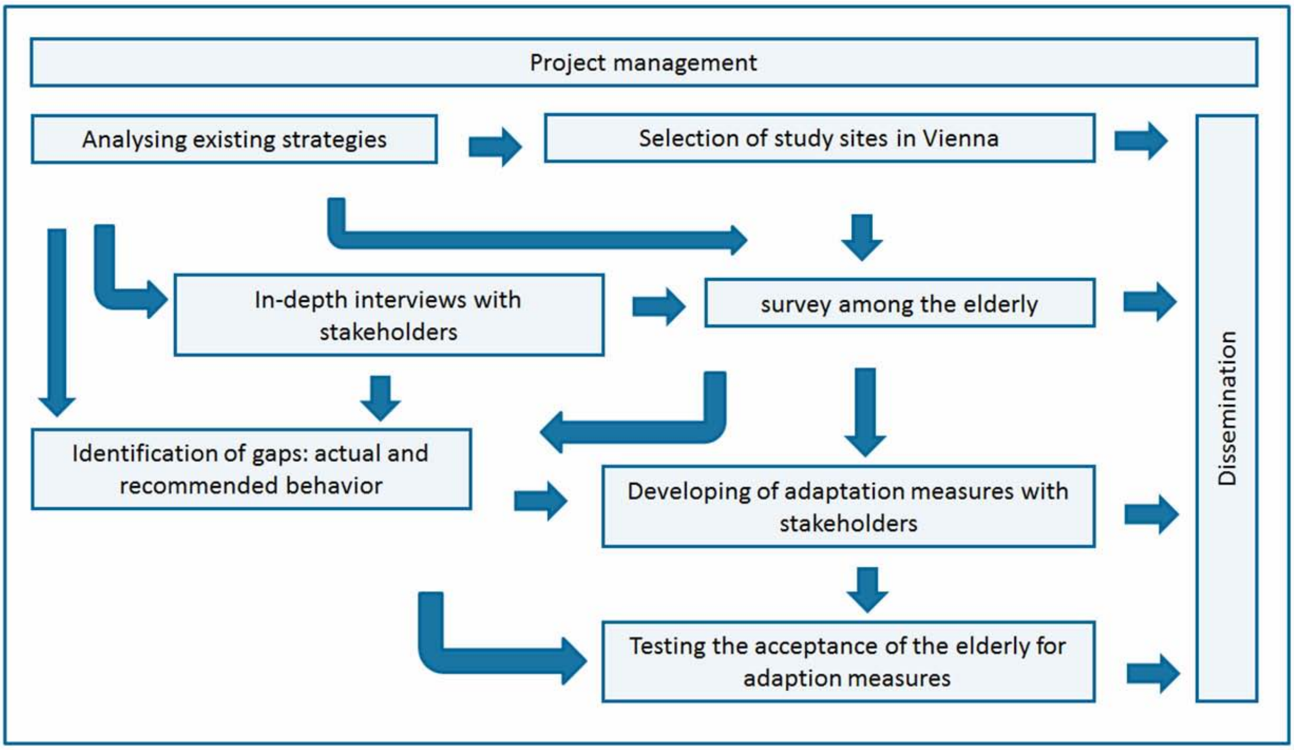


**Figure 1. STOPHOT workflow plan**

Within a workshop, stakeholders discussed survey results and developed first sustainable management and planning measures for urban heat islands, which will be evaluated by the elderly. These evaluation results will be presented in a second workshop and stakeholders canrefine their management and planning measures.

## 4. Results

*Do the elderly perceive more hot days?*

Half of the elderly report experiencing more hot days, more hot nights and longer periods of heat than they did ten years ago. They perceive climate change to be a serious problem which may have catastrophic consequences. Inhabitants of retirement homes, persons with higher educational status as well as persons living in areas with little green space are more aware of climate change impacts. However, the elderly also believe that climate change will not affect them personlly anymore due to their old age.

*What do the elderly do when it is hot?*

Heat primarily affects the elderly's energy balance. They are fatigued and have sleeping problems. The elderly feel well-informed about proper behavior during heat waves. They use newspapers, television and radio as information sources. Respondents living in retirement homes often mention home management, doctors and care personnel as sources of information. They perceive personal information as more helpful than media information. The most common recommendation elderly people receive from their doctor is to increase their liquid intake during heat waves.

In accordance with these recommendations, seniors' most commonly deployed measure against heat stress is drinking. They also wear lighter clothes, draw the curtains during the day, shift their physical activities to the morning or the evening hours and keep the windows closed during the day. They reduce their outdoor activities to a greater extent than younger people.

The majority of older people stay in their apartment when it is hot because they believe that their home is cooler than the outdoors. The elderly who stay at home during heat waves live in small apartments with bad insulation in disadvantaged neighborhoods with few attractive green spaces. However, such appartments may become rather hot during heat waves. They are dissatisfied with their neighborhood and discuss the lack of social ties and age discrimination in the residential area. This risk group has a low socio-economic status and a poorer health condition. They are of old age, and more females can be found in this group. Because of the heat and the less attractive residential environment, they are more likely to withdraw from public life. Those, however, who leave their private home do suffer less from heat stress. They visit semi-public (gardens, inner yards) and public (parks, waters) areas (Allex *et al*., 2013).

*What do stakeholders think about urban heat & the elderly?*

Most stakeholders are aware of climate change and heat waves, but they often have not yet linked these impacts to the urban elderly. While stakeholders from the field of "planning/green space" have already dealt with heat and climate change, mostly at workshops or conferences, representatives of older people have only had discussions on that topic with senior citizens.

The experts know of many measures which can make summer heat more bearable for the elderly. They frequently mentioned "sufficient drinking", "greening of roofs/facades/courtyards", "planting and preservation of trees/avenues", "preserving/enlarging green spaces in the city" and "more drinking fountains in public spaces" as possible measures.

Although the stakeholders named many measures, few have so far been implemented for the elderly in Vienna. The City of Vienna has established a heat wave warning system and developed a list of recommendations regarding proper behavior during heat waves. This information sheet has already been distributed to those elderly who live alone in private homes. The representatives of retirement homes mentioned several measures already being implemented in their retirement homes, such as "drinking fountains in the common areas", "diet food on heat days" and "apartments with heat protection".

Some stakeholders believe that a risk already exists for elderly people, especially if there is no person who cares for them. Other experts believe that the risk will only exist in the future. The risk of the elderly living in retirement homes is estimated to be as high as that of those who live in private homes. Representatives of the elderly, though, regard the risk level to be lower due to residential care in their retirement homes (Allex *et al*., 2013).

## 5. Lessons learned

As urban populations are ageing and temperatures are rising, the planning and design of urban areas has to consider the interaction between social and climatic factors to sustain an age-friendly city. Cities should focus on the elderly who are less privileged in terms of their living situation and health status. During heat waves, they may become more isolated because of staying in their home, potentially further increasing their heat risk. It appears that urban heat impacts are a matter of social inequality.

However, several relevant stakeholders in Vienna do not feel any direct responsibility regarding this issue, and only few measures have so far been implemented for the elderly. A responsible unit within the city government and multidisciplinary collaboration between various organisations and working groups are needed to make full use of potential synergies. The STOPHOT team is currently developing recommendations for urban and green space planning, health care services, retirement homes, the elderly living in private homes etc. Some examples for measures are listed in Table 1.

**Table 1. Exemplary measures addressing urban heat impacts on the elderly.**

| Challenge | Measures |
|---|---|
| **Accessibility of blue/green spaces** | Elderly friendly and cool corridors to public green/blue spaces, e.g. trails through green inner yards and street alleys, resting sites such as benches at shadowy places, accessible public toilets, air-conditioned public transport to green/ blue spaces… |
| **Green cooling rooms** | Need for safe and quiet green/blue spaces providing comfortable temperature conditions coupled with elderly-friendly offerings, such as guided leisure activities… |
| **Cool cities** | Increase of green and blue infrastructure such as vertical green, trees, green roofs; building elements such as window shutters; better cooperation between urban planners, architects and senior clubs; changes in legal building regulations… |
| **Information** | Providing information about proper behaviour before and during heat waves targeting risk groups and their relatives, friends and neighbours; information about in- and outdoor cool spaces such as churches; senior clubs can assist in information distribution. |

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# Meteorological effects of the urban forest "Parco Nord" (Milano, Italy)

## Introduction

The urban forest "Parco Nord Milano" covers more than 600 hectares with approximately 100 ha of forest plantations and with the remaining occupied by green spaces, recreational facilities and agricultural areas. The area is characterized by the *Querco-Carpinetum* boreoitalicum alliance (Pignatti, 1998) and, along rivers and water bodies, the forest is dominated by *Populus spp.*, *Salix spp*. and *Querco-Ulmetum minoris*. This type of forest vegetation is reflected in the variety of species used in Parco Nord Milano since its establishment in 1983, such as *Acer spp*., *Carpinus betulus*, *Fraxinus spp*., *Prunus avium*, *Quercus cerris, Quercus robur, Tilia spp., Ulmus spp.*; coniferous species such as *Pinus sylvestris* and *Pinus wallichiana* were also introduced. Understory species were not part of the first plantations but were introduced later or through secondary successions (*Sambucus nigra, Crataegus monogyna, Cornus sanguinea, Viburnum lantana, and Corylus avellana*).

In the first plantations trees were planted at 3 m distances (1110 trees/ha) but afterwards different plantation schemes and density were adopted (up to 3000 trees/ha), and other vegetation types introduced (shrubs). Over the years these plantations developed different growth models (Marziliano *et al*., 2013) and provided important ecosystem services, especially in terms of perceived well-being (Lafortezza *et al*., 2009).

The aim of this work is to show some preliminary micrometeorological analysis of the data gauged by the **EMONFUR** project (http://www.emonfur.eu/).

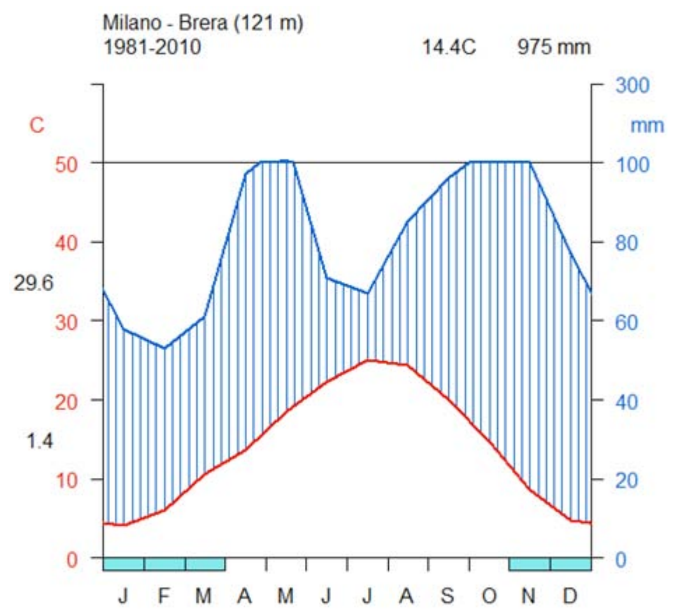


**Figure 1. The Bagnouls and Gaussen climogram of Milano Brera (1981-2010).**


The dataset has been gathered to calibrate and validate dynamical models for the description of the effects of an urban park on a built environment and to define the presence and relevance of water stress conditions on the urban forest vegetation. These models can be useful (i) to improve the knowledge of meteorological and hydrological variables that drive PNM vegetation growth and development (Larcher, 1995; Taiz and Zeiger, 2006), (ii) to better manage urban vegetation considering its radiative and thermal functioning as well as water resources/limitations (irrigation, canopy management, pest and disease management and so on) and (iii) to establish some ecosystem services useful to enhancing citizen well-being.

Our approach was focused on the microscale (PNM, Milano UHI, rural surroundings) and the mesoscale (upper plain of the Po river). The Bagnouls and Gaussen climogram (Figure 1) describes the Milano climatic regime (1981-2010), highlighting the presence of a transitional climate between Koeppen's Csa (Mediterranean) and Cfb (Oceanic) with (i) absence of a well defined dry season, (ii) thermal regime with thermal maximum in July and thermal minimum in January and (iii) rainfall regime with two equinoctial maxima and the absolute maximum in autumn. Interesting is also the temporal distribution of rainfall minima, with the absolute minimum in February (an oceanic signal of Cfb type, coming from Cfb Oceanic France) and a secondary minimum in July (a Mediterranean signal of Csa type, coming from the Gulf of Genoa).

This climatic context of the study area was affected at the end of the '80s of the last century by a climatic shift characterized by an increase of 1.5°C of mean yearly temperatures (Mariani *et al*., 2012) with a relative steadiness of rainfall. This change caused an abrupt increase in summer drought with significant effects on the growth and health of forest vegetation (Sanesi *et al*., 2007; Marziliano *et al*., 2013 ).

## Data, methods and some preliminary results

Measurements adopted for this paper (Figure 2) come from three experimental meteorological stations of the EMONFUR project (Parco Nord Milano, Bosco Fontana, Azienda Carpaneta) with time series starting in 2012, 16 urban and rural stations of the Regional Meteorological Service of ARPA Lombardia with time series since 2002 and four stations of PNM with time series since 2008. The gathered data are air temperature and relative humidity (2 m into the canopy and top of the forest canopy for EMONFUR stations, 2 m above short grass for all others), precipitation (9 stations), wind speed and direction (7 stations), global solar radiation (4 stations), soil temperature and soil humidity (only for EMONFUR stations). The final result is a dataset from 23 sites that have been quality checked, processed and supplemented with data from the sonic anemometer installed at PNM by ARPA Lombardia (time series from 2011).

More specifically, our approach focuses on a semi-empirical energy balance model describing the urban heat island and the mitigation effect of wooded areas. The urban effects on radiation balance are considered in terms of both their long- and short-wave components. The resulting net radiation represents the forcing variable of the energy balance determining three fluxes (sensible, latent, ground). Surface temperatures are finally obtained from the sensible heat flux, applying turbulent exchange coefficients parameterized for different environments.

A relevant part of this algorithm is represented by the water balance which is approached by means of the continuity equation (conservation of mass applied to a water reservoir) in order to describe water stress evolution during time. The applied model is a monolayer water balance with an hourly step and based on the following equation:

$$WC_{h+1} = WC_h + R_r - R_u - ET_0 * k_c * W_{lfr} - Inf$$

where $WC_{h+1}$ and $WC_h$ are respectively the water content at hours h+1 and h, $R_r$ is hourly precipitation, $R_u$ is the runoff (5% for rainfall events of the winter semester and 10% for rainfall events of the summer one), $ET_0$ is the reference crop evapotranspiration simulated with the Penman-Monteith model (Allen *et al*., 1998), $k_c$ is the crop coefficient estimated on the base of growing degree days accumulation and Wlfr is a water limiting factor based on a specific response curve ($W_{lfr}$=1 for water content between field capacity and the upper limit of the easily available water $E_{aw}$ ; $W_{lfr}$=0 for water at maximum water capacity $M_{wc}$ and permanent wilting point $P_{wp}$ and values that decrease linearly between 0 and 1 for water content declining from $E_{aw}$ and $P_{wp}$ or increasing from $F_C$ to $M_{wc}$). The maximum water that can be stored into the soil once the drainage is concluded has been determined from soil survey data (Roberto Comolli, personal communication).

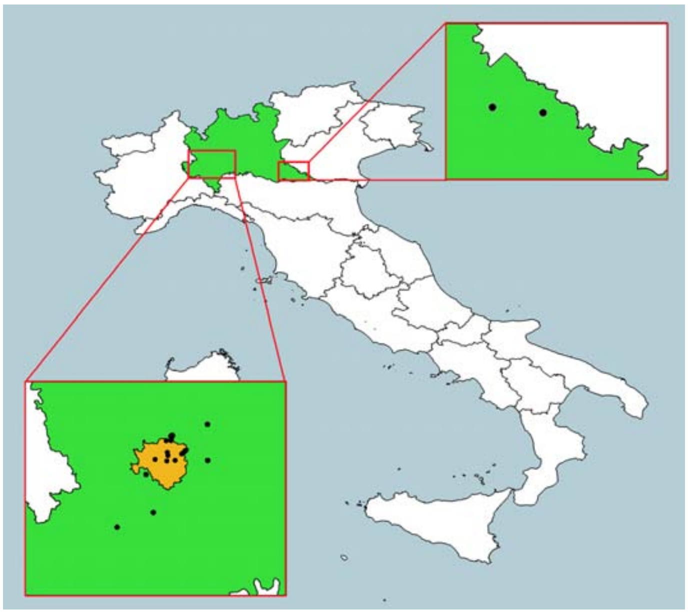

**Figure 2. Location of meteorological stations used for the EMONFUR project. In the lower left box, the orange area represents the Milano urban district. In the upper right box are the positions of the Bosco Fontana and Carpaneta stations.**

The energy balance model (Oke, 1978) has been adopted applying the equation of the surface radiation balance:

$$R_n = SR\ (1 - A) - RL_{up} + RL_{down}$$

and the equation of the surface radiation balance:

$$R_n + G + H + LE + A_h + C_a = 0$$

where $R_n$ is the net radiation, SR is the global solar radiation, A is albedo, RL is long-wave radiation, H, LE and G are respectively sensible, latent and ground heat fluxes, $A_h$ is horizontal advection and $C_a$ is the anthropic heat release (all values are in W $m^{-2}$ with the exception of the albedo which is a fraction in the 0-1 range). All the algorithms have been parameterized to take into account the effects of land use and soil hydrological characteristics.

Figures 3 and 4 show some preliminary results of the data analysis. More specifically Figure 3 shows the yearly evolution of the main energy balance variables at noon while Figure 4 highlights the evolution of water and energy balance variables as a function of weather synoptic patterns during the period from 5 to 12 September 2003 (only weather patterns of 6, 8 and 12 September are shown). More specifically, from 5 to 7 September the weather in Milano was ruled by a strong subtropical anticyclone followed by the transit of a weather disturbance

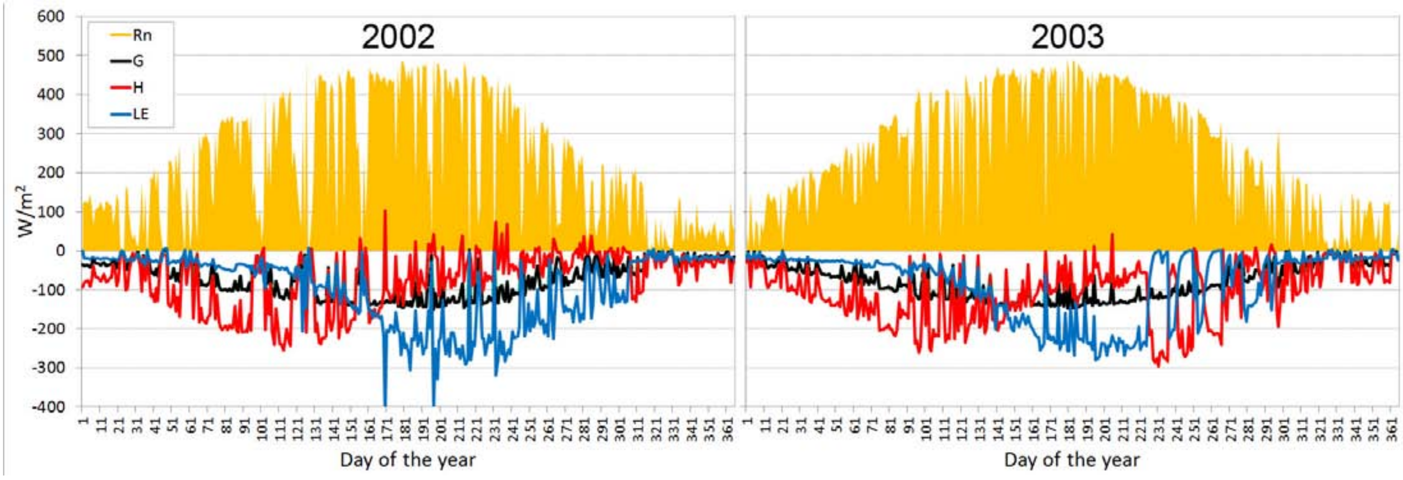


**Figure 3. Evolution of the main energy balance variables at noon (years 2002-2003).**

(8-9 September) and a new stable phase opened by a strong Alpine foehn episode (10-12 September). These synoptic patterns have strong effects on net radiation and Bowen ratio. This latter shows a strong decrease due to the partial refilling of the soil water reservoir followed by the recovery of the latent heat exchanges.

## Future work

The main future work will be the calibration and validation of simulation models with data from surface standard weather stations, sonic anemometer, sensors of soil water content and soil temperature. This will be important to enhance the management of PNM vegetation adopting approaches coherent with physiological features of forest vegetation and weather driving variables. Possible related activities could be referred to the establishment of the hereafter listed ecosystem services for PNM visitors driven by meteo-climatic information:

- aid to the decision of time and place of visit and of activities like walking, biking, etc. (e.g. online weather data)
- stimulation of smart behaviors as a function of current and forecasted conditions of soil and vegetation (water excess, drought, snow presence, etc).
- improvement of the awareness of the impact of the Urban Heat Island on citizens' lives and the importance of the mitigation offered by well-managed vegetation.

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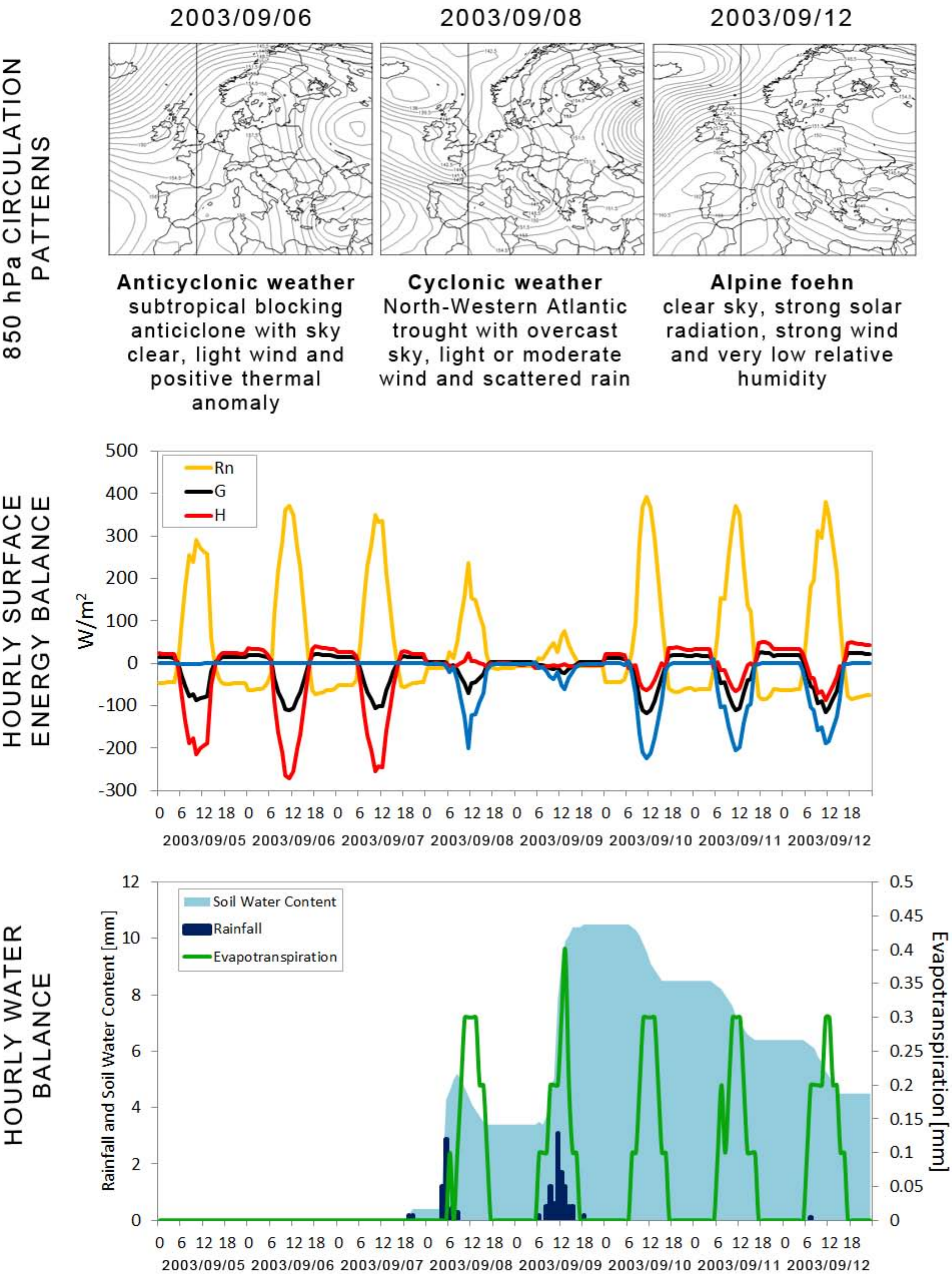



**Figure 4. Evolution of water and energy balance variables as a function of weather synoptic patterns (period of 5 -12 September 2003).**


# THE WALKING URBAN FOREST

## A dynamic green infrastructure for our cities

By David Pearlmutter, Editor

The city of Milano, in northern Italy, has 22 million square meters of parks, woodlands, street trees and green roofs. This amounts to a total of 17 square meters of green space per resident, with an additional square meter having been added in each of the last two years.

As in other cities, this mosaic of urban oases in Milano provides a variety of "services" – it offers recreation and rejuvenation, it moderates the heat island and mediates air quality, it controls runoff and assimilates industrial by-products, and it sustains a diversity of habitats for the many living creatures traversing the metropolitan landscape. The extent to which these, and many other, essential functions – which in some cases may be complementary, but in others merely overlapping or outright contradictory – are actually fulfilled depends not just on the quantity of planted areas, but also on their quality, location and continuity. Therefore the viability of the urban ecosystem depends very much on decisions made by the people entrusted with its planning and maintenance.

But is there an overall vision of how to manage this "green infrastructure" – of how to make it accessible for those in need of its psychological benefits, and of how to protect it for the next generation of pedestrians, joggers, picnickers and tourists? As it turns out, municipal leaders are grappling with this question, having realized that such a vision of a "future green city" is not an idle intellectual exercise but a political imperative: *citizens expect their city to protect its green space*.

This was one the clear messages to emerge from the **16th European Forum on Urban Forestry (EFUF)**, hosted in Milano on May 7-11, 2013. It was a message expressed in the central theme of the forum, entitled "The Walking Urban Forest: A Dynamic Green Infrastructure for our Cities." As conveyed by **Cecil Konijnendijk**, the Coordinator of EFUF, such meetings have been taking place since 1998 as a venue for scientists and policy makers to exchange ideas and incrementally close the gaps between best knowledge and best practice.

Particularly in Europe, where some 375 million citizens live in urban areas and where the EC and its environmental agencies are quite active in their efforts to address climate change, investing in urban green infrastructure follows the principle that one should never "waste a crisis": not only do green spaces store carbon, they also provide a great number of other benefits at little cost to municipalities. Residents of green neighborhoods have better health and quality of life, children have access to places for play and exercise, resilience to flooding and mudslides is enhanced, and in the long run public expenditures for health care and other services may be reduced. Therefore green infrastructure is being seen as a "no regret measure" – a safe investment for the EU, and one which includes a core research component through programs like Horizon 2020.

The 4-day EFUF conference was held in conjunction with the first working group meetings of the European **COST Action FP1204** (profiled in the last edition of *Urban Climate News*), where the challenges of urban forestry and green infrastructure were discussed intensively on three fronts: environmental aspects, social aspects and governance aspects. The inclusion of the latter topic is an acknowledgement that old models of top-down, government-led decision making have largely been replaced by a more polycentric reality – in which dynamic networks of stakeholders, including both state and non-state actors, are actually setting policy and implementing it through communal stewardship of the urban environment.

The EFUF conference sessions were organized around these same themes of environmental, social and governance-related issues, and much of the discussion was directly or indirectly related to urban climate.

A plenary talk by **Roland Ennos** focused on the physical benefits of trees in towns, and the effect of planting conditions and species on tree growth and environmental performance. The latter was gauged in terms of the potential for reduction in air and radiant temperatures, as well as storm water retention.

Several presentations provided microclimatic findings from the EMONFUR project (see pages 16-19), being conducted in Milano's own **Parco Nord**. A full day of the conference was spent in this expansive urban park, which allowed for an intimate encounter with many of the issues – climatic and otherwise – which arise when managing a large public resource.

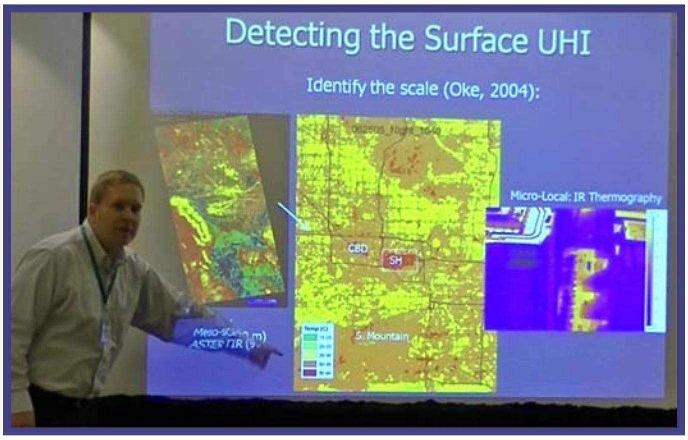
Attention was also focused on the planning and preparation for **EXPO 2015** in Milano, which will include extensive waterways and vast planted tracts – and for which 5,000 trees are now growing in local nurseries in specially designed "Air-Pots" that produce dense and fibrous root systems in a dramatically short time!


# Urban weather takes the stage at AAG annual meeting in Los Angeles

By Chandana Mitra / Photos by Winston Chow

The 'City of Angels' in April 2013 heralded the flock of Geoscientists to congregate, exchange and evaluate scientific research and education. Every year the Association of American Geographers (AAG) brings under one roof a dynamic group of scientists who are researching in different parts of the world, dealing with economy, climate, health issues, culture, politics and environment. But they all connect on the same platform, sharing and evaluating their research portfolios.

This year Los Angeles AAG again saw the unique gathering of meteorologists and climatologists in an invigorating discussion on urban climate. Urban weather and climate sessions continued one after the other from 8.30 am to 6.40 pm, including one panel session and four paper sessions. First was a panel session on the report 'Urban Meteorology: Forecasting, Monitoring, and Meeting Users' Needs' by the National Research Council. The panel experts were Drs. **Randy Kepler, Xubin Xeng, Petra Klein, James Voogt** and **Mark Arendt**. This panel session was intended to bring together members of this NRC committee and key participants of the relevant workshop to engage the attendants of the AAG Annual Meeting. The panel discussed ideas about planning and funding the next generation of research and development efforts in the field of urban meteorology, and highlighted possible future directions. This was jointly organized by AAG and AMS (American Meteorological Society) and chaired by **Chandana Mitra** of Auburn University. The four paper sessions all engaged various aspects of urban climate; three of these sessions were organized by **Chandana Mitra** and **Winston Chow** and the other by **Johannes Feddema** and **Gerald Mills**. The three sessions organized by Winston Chow and Chandana Mitra were based on remote sensing and modeling techniques used in urban climate; mitigation, micro-




meteorology and urban precipitation amongst others. The presentation topics spanned from urban heat island aspects to cool island effects to micrometeorology to green roof energy balance in various cities globally. The other session organized by Drs. Johannes Feddema and Gerald Mills was on the need for and proposed development of a database of global urban characteristics for use in climate modeling. The presenters introduced a new and interesting technique to classify cities using GEO-WIKI, a web-based system that takes GoogleEarth images for a city and presents the user with a randomly selected box (100 m on a side). The central box is classified using the buttons on the right and a level of confidence is expressed. The work of classifying is done by many users, and when there is agreement among users about a cell its value is fixed.

The discussions following the presentations were very intriguing and opened up new avenues of dialogue. The 2013 sessions were very successful and the presidents of AAG and AMS, Drs. **Julie Winkler** and **Marshall Shepherd**, decided together with the IAUC to organize urban climate sessions on similar lines at next year's AAG in Tampa. So gear up from now for AAG 2014, to present your exciting research and get feedback.

## Recent publications in Urban Climatology

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

Enjoy!

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## Climate and the Built Environment at AMS

The theme for the **2014 AMS Annual Meeting** is "Extreme Weather—Climate and the Built Environment: New perspectives, opportunities, and tools". Herein, we broadly define weather and climate extreme events to include, but not be limited to, severe storms, tornados, tropical cyclones, floods, winter storms, drought, temperature extremes, derechos, aircraft turbulence, wildfires, extreme solar activity, and ocean-land responses (e.g. storm surges, landslides, debris flows). Our society is a "built environment," increasingly connected by cyber, energy, water, transportation, health, social, and other infrastructures—one that interacts with the natural environment through ecosystem functions supplied by wetlands, barrier islands, etc. The sustainability of this built environment and stewardship of our natural ecosystems are clearly related to quality of life.

Under the auspices of the proposed theme, traditional topics related to advances in observations, modeling, and applications can be explored at the **11th Symposium on the Urban Environment**. Papers and posters are invited on all subjects dealing with urban environment issues, including in-situ and remote-sensing observations, modeling, theoretical, forecasting, and applied studies such as societal and economic impacts of urbanization.

The following joint sessions are planned: 1) with the 26th Weather Analysis and Forecasting / 22nd Numerical Weather Prediction Conference and 26th Conference on Climate Variability and Change on "Impacts of extreme weather and climate events on Urban Environment and Sustainability"; 2) with the 28th Conference on "Urban Hydrology and Flood"; 3) with the 18th Joint Conference on the Applications of Air Pollution Meteorology on "New-generation mesoscale to urban scale modeling capabilities for air pollution research and prediction", and 4) with the History Committees.

Other planned session-themes include: urban energy and water balances; urban canopy and roughness sublayers; modeling, observation, and input data requirements for understanding and predicting interdisciplinary urban phenomenon; global climate change and urbanization; impact of extreme weather and climate on urban environment, biometeorology and public health in urban areas; urban development sustainability, role of aerosols on precipitation in urban areas; weather forecasting for cities; adaptation and mitigation strategies, urban climate and hydrology; and urban planning. Please contact the program chairpersons (contact information noted below) by 1 May if you would like to propose a session topic for this conference.

For additional information please contact the program chairpersons, **Fei Chen**, feichen@ucar.edu; **Jan Kleissl**, jkleissl@ucsd.edu; **Dev NIyogi**, dniyogi@purdue.edu; and **Jorge Gonzalez**, gonzalez@me.ccny.cuny.edu.

— *Fei Chen, Chair,* AMS Board on Urban Environment

## Candidates for IAUC Board Elections

Dear Members,

The nomination period for nominating members to serve on the IAUC Board has now closed. Six individuals have come forward and we thank them for their interest in serving the Board.

**1. BAKLANOV, Alexander** – Danish Meteorological Institute

**2. BENTLEY, Mace** – James Madison University (from 15 August)

**3. MIAO, Shiguang** – China Meteorological Administration

**4. OOKA, Ryozo** – The University of Tokyo

**5. REN, Chao** – The Chinese University of Hong Kong

**6. WOOD, Curtis** – Finnish Meteorological Institute

Given the number of vacancies (02), the Board has decided to conduct a vote among members to fill the vacancies. Members will shortly receive an electronic invitation to participate in the vote. The invitation will be titled 'IAUC Board Election 2013' and will be limited to those who were members of the IAUC at the time of the call for nomination (28.05.2013). The invitation will also provide a link to candidate statements.

The vote will remain open for a period of one month and I would like to urge you to cast your vote early.

– Dr. Rohinton Emmanuel, Secretary, IAUC

***Up, up and away.*** **David Pearlmutter, fearless editor of the *Urban Climate News*, records thermal images of a settlement in the Negev desert in Israel – from the basket of a hot-air balloon.** *Photo by Wolfgang Motzafi-Haller*

### 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, 2009-2011
- Jennifer Salmond (University of Auckland, NZ): 2005-2009; Secretary, 2007-2009
- James Voogt (University of Western Ontario, Canada), 2000-2006; Webmaster 2007-*; 2009-2013
- Manabu Kanda (Tokyo Institute of Technology, Japan): 2005-2009, ICUC-7 Local Organizer, 2007-2009.*
- Andreas Christen (University of British Columbia, Canada): 2012-2016
- Rohinton Emmanuel (Glasgow Caledonian University, UK): 2006-2010; Secretary, 2009-2011
- Jason Ching (EPA Atmospheric Modelling & Analysis Division, USA): 2009-2013
- David Pearlmutter (Ben-Gurion University of the Negev, Israel): Newsletter Editor, 2009-*
- Alberto Martilli (CIEMAT, Spain), 2010-2014
- Aude Lemonsu (CNRS/Meteo France), 2010-2014
- Silvana di Sabatino (Univ. of Salento, Italy), 2010-2014
- Hiroyuki Kusaka (University of Tsukuba, Japan): 2011-2015
- David Sailor (Portland State University, USA): 2011-2015

* *appointed members*

### IAUC Committee Chairs

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

### Newsletter Contributions

The next edition of ***Urban Climate News*** will appear in late September. Items to be considered for the upcoming issue should be received by **August 31, 2013** and may be sent to Editor David Pearlmutter (davidp@bgu.ac.il) or to the relevant section editor:

**News**: Winston Chow (wtchow@asu.edu)
**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.