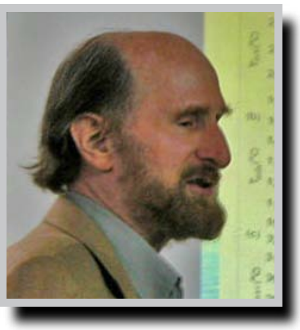
Urban Climate News

Quarterly Newsletter of the IAUC

ISSUE NO. 31 MARCH 2009 • www.urban-climate.org • INTERNATIONAL ASSOCIATION FOR URBAN CLIMATE

From the IAUC President

I am very delighted to announce that the IAUC Board has selected **Bob Bornstein**, Professor in the Meteorology Department of San José State University, San José (USA) as the winner of the 2008 IAUC Luke Howard Award. This award is given to an individual who has made outstanding contributions to the field of urban climatology in a combination of research, teaching, and/or service to the international community of urban climatologists. Clearly, Bob has made significant contributions in each of these areas with his important early work on the urban climate of New York City, supervision of a large number of graduate students and involvement as journal editor, in numerous conferences and as past Board member of IAUC amongst other accomplishments (see further details on p. 32). Please join me in congratulating Bob on this highly deserved recognition.



I would also like to thank the Awards Committee for their work and those who submitted nominations and wrote support letters. The award will be presented at the ICUC-7 which takes place in a few months time in Yokohama (Japan).

The extension of the abstract deadline for ICUC-7 has been keenly embraced and almost 500 oral or poster presentations from about 400 unique first authors were eventually submitted. It is very encouraging to see such great interest in urban climate research and the IAUC, and I would like to thank everyone who has shown their support for this conference. The scientific program is currently under preparation and will be posted on the conference website as soon as it is available (http://www.ide.titech.ac.jp/~icuc7/). We are currently inviting proposals to host the next ICUC conference in 2012 (ICUC-8). If you are considering submitting a proposal or have questions regarding the process, please contact Gerald Mills (gerald.mills@ucd.ie).

The present newsletter once again includes a wide range of urban climate news items, reports, announcements and the bibliography section which covers some 40 journals. In particular I would like to draw your attention to the **Feature** article on modeling global climate change in urban areas which was contributed by Keith Olsen and co-authors, and three **Urban Project** reports about air pollution projects in London and Toulouse and a mesocsale observing network in Helsinki.

Finally, the next issue of the newsletter will be published right on the eve of ICUC-7. If you have any news, projects, country reports, upcoming conferences or would like to share information about your work or organization, please contact David Pearlmutter (davidp@bgu.ac.il) to find out how you can contribute.

Matthias Roth

geomr@nus.edu.sg

Inside the Spring issue...

In memory: T. J. Chandler

Professor Tony John Chandler died at his home near Eastbourne, England, on 17 July 2008. He was in his 80th year.

Born in Leicester on 7 November 1928 to Harold William and Florence Ellen Chandler, he attended Hinckley Grammar School (1939–1942) and then Alderman Newton Boys' School in Leicester (1942–1946). In 1946 he entered King's College of the University of London and graduated three years later with a first class BSc special degree in Geography with Mathematics. He took a Teacher's Diploma at the University of London, and spent his period of national service (1950–1952) teaching meteorology and commonwealth studies to servicemen at RAF Cranwell. In 1952 he was appointed to his first university post as an assistant lecturer at Birkbeck College and worked on an MSc degree, which included a thesis on the historical geography of Leicestershire, his home county. At the end of his third year at Birkbeck, he was promoted to lecturer and began his pioneering work on the urban climate of Greater London. In 1956 Chandler joined University College London (UCL), as successively lecturer (1956), reader (1965) and professor (1969) until his departure to a chair at the University of Manchester in 1973. At UCL, Tony Chandler lectured in introductory and advanced meteorology and climatology, and in cartography, to undergraduates. Chandler also taught as part of a variety of Master's degrees in architecture, botany, and geology (hydrology). His teaching style was clear and rigorous; there could be no ambiguity when it came to scientific principles. Undergraduates who had taken courses in mathematics and the sciences in their final years before entering university especially appreciated this approach, but these were a minority in each cohort of geographers.

Tony Chandler's innovative doctoral research grew out of *The London Climatological Survey*, which had two distinctive strands. The first involved operating a mobile recording station in a Land Rover that he drove across London along carefully chosen traverses to register temperature and humidity conditions. The vehicle and its equipment were purchased through grants from the Royal Meteorological Society, the University of London and UCL. The second strand involved encouraging more than sixty schools, teacher training colleges and private individuals to maintain climatological recording stations. Their work had to be supervised, monitored and encouraged, testing Chandler's powers of persuasion and tact.

The *Survey* attracted the attention of geographers, meteorologists, town planners and architects in the UK and abroad. Its methods and findings, especially the 'urban heat island' and London's pattern of air pollution, were presented in scholarly writing and they were discussed widely in the media. In 1964 Tony Chandler submitted his doctoral thesis, *Studies of the Climate of London*, from which his famous book, *The Climate of London* (1965), rapidly emerged. Chandler worked largely on his own, albeit with occasional discussion with the climatologist Professor Gordon Manley who was then at Bedford College. The work of *The London Climatological Survey* was aided and extended by grants from the Department of Scientific and Industrial Research, with automatic temperature recorders being installed on the top of the Post Office Communications Tower in central London. *The Climate of London* was dedicated to the memory of Luke Howard who wrote the first book of the same name in 1818. Howard's book is revered, and Tony Chandler considered it 'monumental' – containing, as it does, the first recognition of urban climate effects. Chandler's book itself is similarly considered to be a classic. It is a full account of the climate of the city unmistakably written by a physical geographer. It reveals an intimate knowledge of place and its controls upon the local and regional climate. It blends myriad strands of standard climate records with his meticulous *Survey* observations and superb explanations of the underlying atmospheric principles. The airflow, heat island, fog and air pollution sections were particularly outstanding. *The Climate of*

Professor Tony Chandler (1928-2008)

London remains without peer as a comprehensive account of a city's climate. Further, it contains original research and interpretations that remain seminal and helped to steer the thinking involved in the process-oriented work in urban climate which followed. It remains core reading in urban climatology. Another project involved making air temperature and humidity traverses across the smaller cities of Leicester and Brighton.

***The Climate of London* remains without peer as a comprehensive account of a city's climate.**

Certainly Tony Chandler was given ample scope to focus his teaching and research at UCL. His scientific reputation grew rapidly and he was invited by Helmut Landsberg to be the World Meteorological Organization (WMO) Rapporteur on Urban Climates (1965–1969). He was justly proud to be invited to be President of the joint WMO/ World Health Organization Symposium on Urban Climates and Building Climatology, held in Brussels in 1968. This was the first truly international meeting on urban climates and a great success. His work as Rapporteur raised the profile of the subject through several influential publications including a comprehensive *Selected Bibliography of Urban Climate* (1970) and *Urban Climatology and its Relevance to Urban Design* (1976).

He was a member of the editorial board of *Weather* (1958–1961), and the Council of the Royal Meteorological Society (1961–1964), served on several committees and was Secretary of the RMetS in the early 1970s. After 1969, he was a member of the editorial board of *Boundary Layer Meteorology*. Chandler served on various committees of the Royal Geographical Society (receiving the prestigious Back Award in 1963) and on the organizing group for the International Geographical Congress held in London in 1964. He was a consultant to the UK Atomic Weapons Research Establishment, Aldermaston, in the same period. In the late 1960s Chandler acted as a consultant on the advisory board for the construction of the Brighton Marina. In 1970, he began his chairmanship of the British National Committee for Geography Working Group to prepare evidence to submit to the Royal Commission on Environmental Pollution.

Chandler supervised a small group of doctoral students who worked on urban thunderstorms, air pollution, evapotranspiration, the long-distance transport of atmospheric smoke and sulphur dioxide, and the relative influences of surface roughness and temperature on urban airflow. These years at UCL were extremely productive and largely happy. And yet something was missing; he wanted to run a university department and ideally also a research unit. An opportunity arrived in 1973 and he accepted a Chair of Geography at the University of Manchester and in 1974 became the Head. He had the pleasure of seeing the department move into a new building that doubled its accommodation. He was also chairman of the Pollution Research Unit at the university and worked with a larger scientific team than at UCL. Despite his administrative efforts he found time to co-edit *The Climate of the British Isles* (with S. Gregory, 1976) and wrote various reports and articles. The list of external commitments grew formidably: vice-presidency of the Royal Meteorological Society (1973–1975); membership of the WMO Committee on Climate and Environmental Problems (1972– 1974), the Royal Commission on Climate and Environmental Pollution (1973–1977), the UK Government's Clean Air Council, the Council of the Natural Environment Research Council (1974–1979) and scientific secretaryship of the Royal Society Study Group on Pollution and the Atmosphere (1975–1977).

Early in 1977, Tony Chandler was invited to become Master (President) of Birkbeck College in October of that year, as successor to the political economist Ronald Tress. This return to his alma mater was irresistible but the pressures of working with challenging personnel issues required greater skills of diplomacy and compromise than he, as a single-minded scientist, could muster.

Chandler resigned as Master on medical grounds in January 1979. At the age of 50, he entered what would prove to be three decades of retirement. This was a great shame because at that time he was probably the world's pre-eminent urban climatologist; the absence of his insight and sage advice was a great loss to the small community with like interests.

He updated his textbook *Modern Meteorology and Climatology* (1972, 1981) and indulged in his hobbies of collecting clocks, reading, listening to music, and travelling, especially in the Alps. In 1989 he was made an Honorary Research Fellow at UCL and a Visiting Professor at King's College, returning to deliver some lectures to undergraduates in each institution. However, recurrent ill health meant that such arrangements could not last.

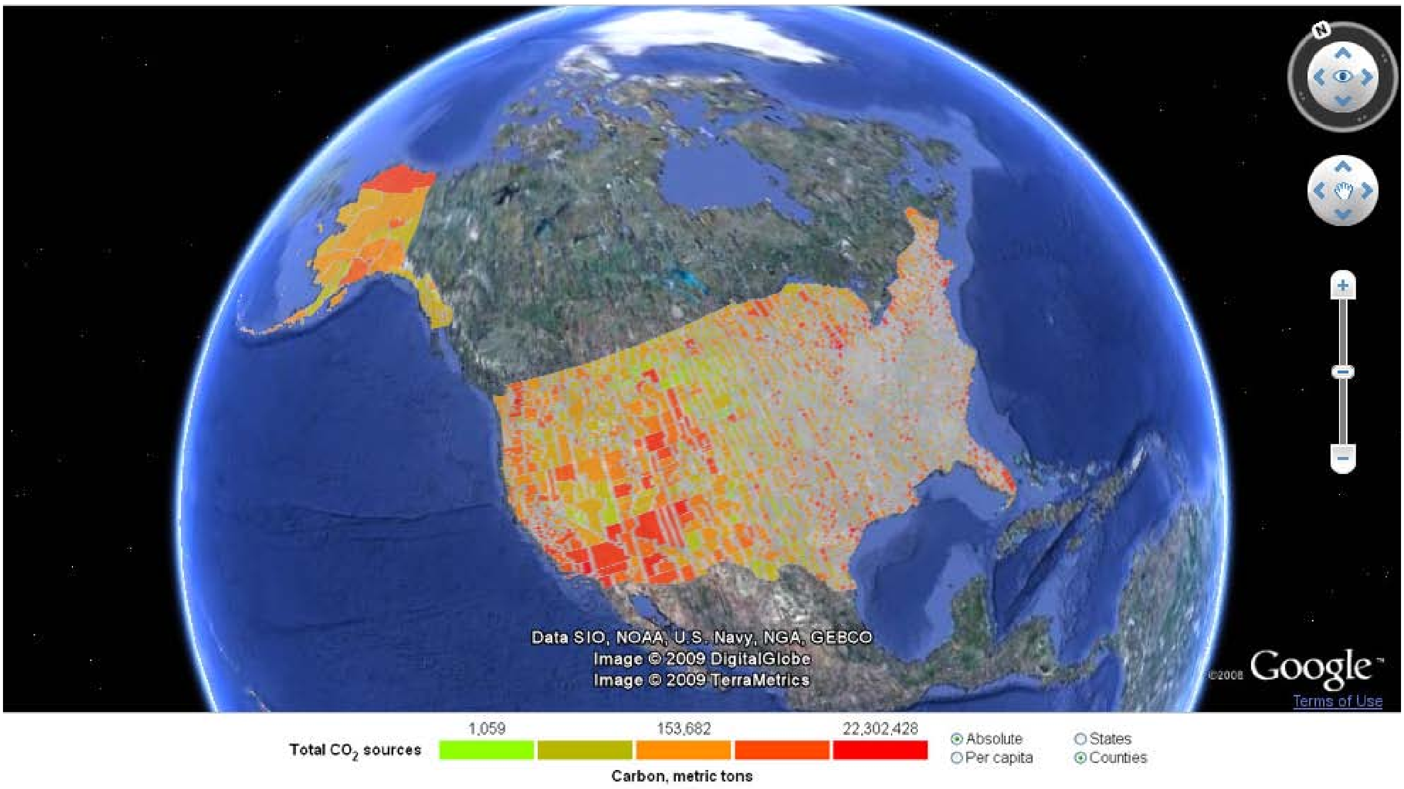
His wife, Margaret Joyce (nee Weston, m. 1954), predeceased him and he spent his final years in some isolation near Eastbourne. His daughter Kathryn and son Adrian survive him.

Tim Oke[1] and Hugh Clout[2]

[1] *University of British Columbia, Vancouver, Canada*
[2] *University College London*

*Republished from Weather **64**(2): pp.53-54 (February 2009)*

Interactive Carbon Dioxide Map Of U.S. Released On Google Earth



February, 2009 — Interactive maps that detail CO_2 emissions from fossil fuel combustion are now available on the *Google Earth* platform. The maps, funded by NASA and the U.S. Department of Energy through the joint North American Carbon Program, can display fossil fuel emissions by the hour, geographic region, and fuel type.

A team led by researchers at Purdue University integrated seven primary data sets, including imagery of Earth's surface captured by the NASA-built *Landsat 5* satellite, fossil-fuel CO_2 emissions data from the U.S. Environmental Protection Agency and U.S. Department of Energy, and population data from the U.S. Census Bureau.

Researchers from the project, named "Vulcan" for the Roman god of fire, constructed an unprecedented inventory of the CO_2 that results from the burning of 48 different types of fossil fuel. The data-based maps show estimates of the hourly CO_2 outputs from factories, power plants, vehicle traffic and residential and commercial areas.

First released to the scientific community in April 2007, the emissions data have now been integrated into an image-based format that has become a standard online viewing tool for content that spans broad geographic areas.The new Vulcan maps assimilate fossil-fuel carbon dioxide emissions data that was previously available from disparate sources and in different formats into one comprehensive data product. The fine level of detail offers more accuracy for estimating the fossil fuel contribution to the global carbon budget, the balance of carbon absorbed by Earth and released into the atmosphere. The Vulcan data product provides new scientific opportunities to assess the relationship between fossil fuel emissions and climate in the atmosphere and to see what future variability and extremes may bring.

View the Vulcan carbon dioxide map on Google Earth at: http://www.purdue.edu/eas/carbon/vulcan/GEarth/

"One of the goals of the U.S. Climate Change Science Program is to assist with scientifically based formulation of policy and decision making," said Peter Griffith, director of the Carbon Cycle and Ecosystems Office at NASA's Goddard Space Flight Center, and coordinator of the North American Carbon Program. "By allowing non-specialists to see changes in carbon dioxide emissions in time and across broad areas, we're helping them to understand critical information for climate change policy decisions."

Vulcan Project data and maps will complement observations from the Atmospheric Infrared Sounder on NASA's Aqua spacecraft and the upcoming Orbiting Carbon Observatory, which is set to launch next week. This mission will use space-based instruments to precisely make the first global measurements of atmospheric carbon dioxide with the accuracy and geographic coverage required to improve estimates of the sources and sinks of the greenhouse gas.

Gurney and colleagues now have a second phase of NASA-funded work underway to create similar inventories of carbon dioxide emissions for Canada and Mexico.

Source: www.sciencedaily.com/releases/2009/02/090222184453.htm

Focus on Phoenix: Cities are key culprits in local climate shifts

January, 2009 — In the old comic books, super-villains brandished an exotic weather-control device to threaten the world's cities. Turns out all the villains really needed were the cities, whose growth increasingly influences the weather with devices no more exotic than an office building or a freeway. "There's no doubt man has impacted his local environment," said Tony Haffer, meteorologist in charge at the National Weather Service in Phoenix. "It's reached the point that it's more than just meteorologists and climatologists looking at this. Engineers that build and plan cities are looking for ways of mitigating the effects of putting in more concrete and asphalt."

The real-life power of urban areas to shape and reshape weather and climate was the theme of the recent AMS conference (see page 25), and Phoenix provides a fitting backdrop for the gathering: it was here that scientists conducted some of the earliest research into the urban heat island, and the city's rapid growth has given scientists a living laboratory to test theories and chart discoveries. Two Arizona State University researchers have found evidence that human activities - in this case, driving cars - can control the weather almost as precisely as the comic book super-villain. Weekday commuter traffic appears to weaken winter rain storms in Phoenix, according to a paper written by ASU graduate student Bo Svoma and an ASU professor, Robert Balling.

Svoma used data about patterns in traffic volume in the Valley and compared it with rainfall patterns and found a stunning match: rainfall totals are lower during the week, when traffic is heaviest, and higher on the weekends, when fewer cars are on the road. The link is the small particles spewed by vehicles, Svoma said. The pollutants interfere with the rainmaking process in the clouds. As pollution levels grew, the amount of rain shrank. On the weekend, the storms rebounded and normal amounts of rain fell. The cycle was most apparent in the central urban areas and on the Valley's east side, where the pollutants are carried by the wind.

Phoenix's growth also has changed the way meteorologists chart and forecast the weather. The National Weather Service reports official rainfall at Phoenix Sky Harbor International Airport in the central city, yet storms, especially during the monsoon, deliver widely varying amounts of rain across the Valley. Weather Service forecaster Paul Iñiguez decided to find a way to better reflect rainfall in a sprawling urban area and developed the Phoenix Rainfall Index, a system of averaging regional precipitation. "We have this huge metro area and yet we're still basing everything off this one gauge," Iñiguez said. "We needed a way to put a storm in context."

Using the existing network of rain gauges operated by the Flood Control District of Maricopa County, Iñiguez mapped out 132 locations stretched out to the suburban edges. He chose sites with at least 10 years of data to add value to comparisons. Then he devised a formula that, in its basic terms, averages rainfall for a single day, generating a rainfall index. It's more complicated than just an average, but the figure takes into account isolated areas that receive a lot of rain or not much at all. In a storm from July 1998, Sky Harbor recorded 1.02 inches, but the rest of the Valley received little rain and, in the end, the rainfall index was just 0.01 of an inch. A second storm in August 2006 showed the airport can miss rain: Sky Harbor reported 0.01 inch, but when the other gauges were factored in, the index was 0.31 inch.

To learn more about the elements of the heat island, a team of researchers studied a swath of central Phoenix for 24 hours last April. ASU graduate student Brent Hedquist and a colleague from the Universita del Salento in Italy led teams that measured temperature on the ground and from the air and recorded images using heat-sensing cameras. The teams produced thousands of images, some so precise they registered differences between a car with air-conditioning and one without. Hedquist used the images and his own painstaking fieldwork to construct models of several downtown Phoenix blocks. The models use the shape and location of the building, the materials used in its construction and its surroundings, down to the last paving stone and palo verde tree.

"When I first started studying the urban area in Phoenix, the whole idea of mitigation of the heat island was barely on the table," said Anthony Brazel, an ASU geographer who has pioneered heat-related research. "Today, there's a huge emphasis on what can we do about it."

Brazel and a team of ASU researchers have worked with the city of Phoenix to study the effects of the heat island on water use, with a goal of delivering ideas that could help the city make decisions about water conservation and urban planning. Phoenix and other desert cities have long wrestled with the conflict between trying to reduce outdoor water use and maintaining enough vegetation to keep the heat island from swallowing neighborhoods. Involving policy-makers in scientific research will become even more critical if global temperatures continue to climb and the climate itself changes, Brazel said. "As a world society, we're becoming more urban than ever. If we're going to protect the quality of life, we have to do more now."

Source: http://www.azcentral.com/news/green/articles/2009/01/11/20090111climate-cities0111.html

Australia Government Blames Deadly Heat Wave on Climate Change

February, 2009 — "The worst heat wave to strike Australia in a century is due to climate change." That was the blunt message Australians received from their government, as they struggled to cope with heat-related chaos including buckling rail lines, heat-related deaths and sweeping power blackouts. "Eleven of the hottest years in history have been in the last twelve, and particularly in the southern part of Australia, we're seeing less rainfall," said Climate Change Minister Penny Wong. "All of this is consistent with climate change, and all of this is consistent with what scientists told us would happen."

The heat topped 43°C in Melbourne for three straight days – for the first time in recorded history. Over 500,000 homes and businesses were left without power as the demands from air conditioners overwhelmed the electrical grid and exploded an electrical substation in the city. The blackout shut down the entire train service in Melbourne, trapping people in elevators, blocking roads as traffic lights failed, and forcing hospitals to turn away patients. The Australian Open had to suspend games due to heat. The government was passing out water bottles to commuters and urging the elderly to stay indoors. Over 20 heat-related deaths were recorded, and residents at one nursing home started putting their clothes in the freezer to cope with the scorching temperatures.

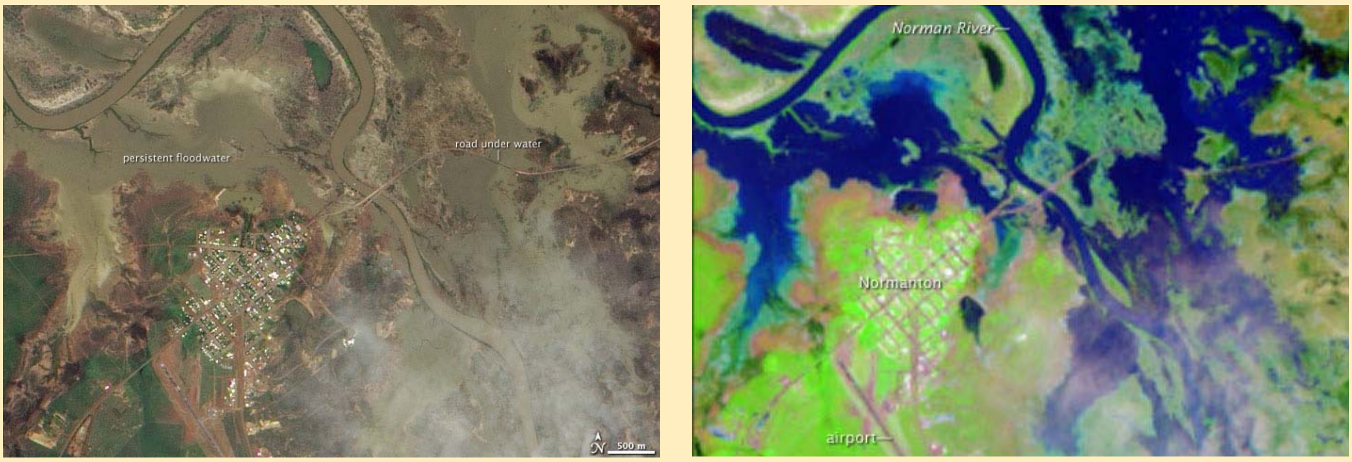
The tail end of the heat wave also precipitated the Victorian fires, which on February 7 resulted in Australia's highest ever loss of life from a bushfire. The fires destroyed nearly 2,000 homes, 3,500 structures in total and damaged thousands more. Many towns north-east of the state capital Melbourne were badly damaged or almost completely destroyed.

Most of the south of the country is also gripped by an

unprecedented 12-year drought. The Australian Alps have had their driest three years ever, and the water from the vast Murray-Darling river system now fails to reach the sea 40 per cent of the time. Harvests have fallen sharply. Even modest temperature rises, now seen as unavoidable, are expected to increase drought by 70 per cent in New South Wales, cut Melbourne's water supplies by more than a third, and dry up the Murray-Darling system by another 25 per cent.

Prof. David Karoly of the University of Melbourne said "The heat is unusual, but it will become much more like the normal experience in 10 to 20 years. It is clear that the current public transport system is not able to cope and it is also clear that the water supply system is stretched. The health services and the road system are also obviously stretched to their limits. The system can't cope now, and it is just going to get much worse."

Source: http://www.desmogblog.com/australia-government-blames-deadly-heat-wave-climate-change



Even while southeastern Australia battled high heat and the most deadly fires in their history in February 2009, much of the rest of Australia flooded. Wet-season rains brought severe flooding to Western Australia, Queensland, and New South Wales. The most widespread flooding was in Queensland, where more than one million sq km flooded. These images, captured by the Advanced Land Imager (ALI) on NASA's Earth Observing-1 (EO-1) satellite, show the small northern Australian city of Normanton on March 12, 2009 – after heavy flooding in February had receded somewhat. The floods were the worst in 35 years, and the second-worst on record. In the natural-color image on the left, the town's roads form a neat brown grid. The image on the right shows the scene in false color, combining infrared and visible light to make water features far more obvious. *Source*: http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=37470

Wildfires: Why California Should Consider Australia's Policy

"Prepare, Stay and Defend"

March, 2009 — Even as debate rages over the safety of Australia's "Prepare, stay and defend, or leave early" policy of wildfire defense, fire researchers at the University of California, Berkeley, and in Australia say that the strategy is worth consideration in California and other regions in the United States.

Questions about the policy, which encourages able residents to stay home and actively defend their property from wildfires, are being renewed in the wake of Australia's devastating fires, which began on Feb. 7 and killed 210 people, burned down 1,800 homes and scorched 1,500 square miles of land.

"The key element of Australia's policy is to train willing homeowners to protect their homes in an active wildfire," said Scott Stephens, associate professor of fire science and co-director of UC Berkeley's Center for Fire Research and Outreach. "What the Australian strategy does is actively engage and help homeowners to become part of the solution rather than just to need evacuation. However, it should be noted that some California communities are so vulnerable that a "prepare and leave early" strategy may be the only option."

The Australian approach also includes a more strategic land-use management policy in which decisions about new housing in areas vulnerable to wildfires are overseen at the state level, ensuring a more consistent standard for fire-resistant building codes and in urban development, the researchers said.

In contrast to Australia, the researchers said, fire agencies in California focus primarily on mandatory evacuations followed by fire suppression. Not only has this approach not reduced property loss, it could increase the risk for people if the evacuations are carried out at the last minute, the researchers argued.

Over the past several years, scientists from UC Berkeley's Center for Fire Research and Outreach have been collaborating with colleagues from Australia to study best practices in an effort to reduce the loss of life and property from wildfires. Nearly three weeks after the southern Australia wildfires, the looming question is whether the "Prepare, stay and defend, or leave early" policy helped or hurt in that disaster – an issue that is sure to be addressed in an official inquiry established to investigate the country's deadliest wildfire in recorded history.

With the verdict from the latest fire pending, scientists are looking at a recent review of the policy, which was based upon 60 years of historical evidence. That review concluded that the policy is fundamentally sound. The researchers point to the beneficial culture of preparation

A recent Southern California brush fire burning close to homes. *Source:* ScienceDaily

inherent in the policy. For instance, months or even years before fire season begins, residents are involved in reducing the vulnerability of their homes with such activities as clearing dangerous vegetation around their property or installing ember-blocking screens for their attic vents. They also emphasized that homeowners in Australia go through an annual training program run by local fire agencies, and are provided with appropriate supplies such as hoses, radios and protective clothing.

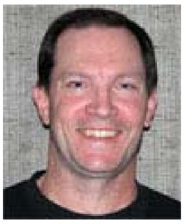
"The Australian approach is different from what many call "shelter-in-place," an American concept stemming from other environmental hazards and connoting more passive action by residents," said Max Moritz, cooperative extension specialist in wildland fire and co-director with Stephens of the Center for Fire Research and Outreach. "There is active participation from the homeowners before and possibly during a fire. In the process, they become more aware of the risks of living in an urban-wildland interface, and both homes and people are better prepared to handle fires when they inevitably occur."

The Australian wildfire management strategy, adopted after the country's 1983 "Ash Wednesday" brushfires, is based upon the premise that it is often riskier to leave a home as a fire front approaches than to stay sheltered while actively defending it. In that 1983 fire, 75 people died and many more were injured, most while outside their homes trying to escape.

Before adopting the policy in any part of California, it would be necessary to determine which areas in the state might be candidates for the Australian approach, said Moritz. "Such a map would take into account what we know about fire patterns, weather, age of structures and the ability to evacuate," he said. "We need the equivalent of a flood zone map for fire to better understand our own landscape and risk." *Source*: http://www.sciencedaily.com/releases/2009/02/090226102308.htm

Progress Toward Modeling Global Climate Change in Urban Areas

By Keith Oleson[1] (oleson@cgd.ucar.edu) with **Gordon Bonan,**[1] **Johannes Feddema**[2] **and Trisha Jackson**[2]
[1]**National Center for Atmospheric Research (NCAR) and** [2]**University of Kansas**




Most global climate models that are utilized for climate change research do not account for urban surfaces. Although urban areas represent a small fraction of the global land surface (1-4%), a large proportion of the world's population resides in these areas (>50%). Given the significant differences in climate (e.g., energy balance, temperature, and humidity) between urban areas and vegetated surfaces, it is appropriate to begin to address the lack of representation of this land surface type in global climate models. Such a representation would greatly aid in assessing climate impacts on urban populations. In this study, a parameterization for urban surfaces incorporated into the land surface component of a global climate model is briefly described and results from preliminary climate simulations are presented.

Community Land Model – Urban

A parameterization for urban surfaces has been incorporated into the Community Land Model (CLM) (Oleson *et al*. 2008a) as part of the Community Climate System Model (CCSM) (Collins *et al*. 2006a) project at the National Center for Atmospheric Research (NCAR). The primary purpose of the urban model as coupled to a global climate model is to provide climate and climate change information (e.g., near-surface air temperature and humidity, surface hydrology, etc.) for urban environments, where the majority of people work and live. Second, the urban model is designed to capture observed features of urban climate and provide insight into the physical mechanisms underlying these features.

The urban representation is based upon the "urban canyon" concept of Oke (1987) in which the canyon geometry is described by building height to street width ratio. The canyon system consists of roofs, walls, and canyon floor. Walls are further divided into shaded and sunlit components. The canyon floor is divided into pervious (e.g., to represent residential lawns, parks) and impervious (e.g., to represent roads, parking lots, sidewalks) fractions. Energy balances and surface temperatures are determined for each canyon surface. The boundary conditions for roofs and walls are determined by an interior building temperature held between prescribed maximum and minimum temperatures, thus explicitly resolving space heating and air conditioning (HAC) fluxes. Anthropogenic sources of heat from traffic and waste heat from HAC can be incorporated as modifications to the canyon energy budget. The urban model produces sensible heat, latent heat, and momentum fluxes, emitted longwave, and reflected solar radiation, which are area-averaged with fluxes from non-urban "landunits" (e.g., vegetation, lakes) to supply grid-cell averaged fluxes to the atmospheric model. The model formulation and some quantitative and qualitative evaluation are documented in Oleson *et al*. (2008b; 2008c).

Urban Surface Datasets

Global applications of the model make use of datasets of present day urban extent and urban material properties developed by Jackson (2007). Urban extent is derived from LandScan 2004 (LandScan™ Global Population Database. Oak Ridge, TN: Oak Ridge National Laboratory. Available at http://www.ornl.gov/landscan/), a population density dataset derived from census data, nighttime lights satellite observations, road proximity and slope (Dobson *et al*., 2000). For each of 33 distinct regions across the globe, thermal (e.g., heat capacity and thermal conductivity), radiative (e.g., albedo and emissivity) and morphological (e.g., height to width ratio, roof fraction, average building height, and pervious fraction of the canyon floor) properties of roof/wall/road are provided.

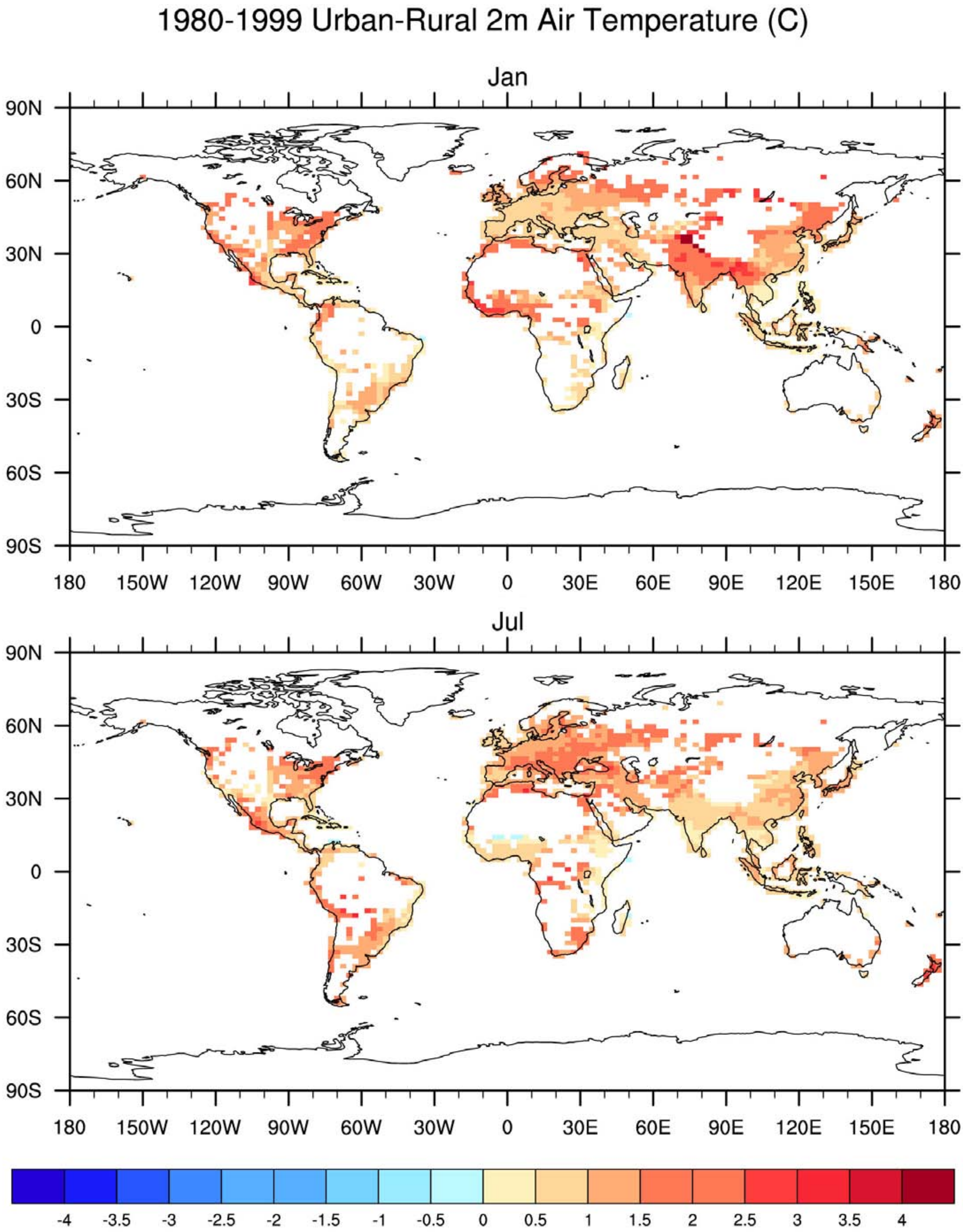


Figure 1. 1980-1999 climatology of urban minus rural surface air temperature (urban heat island) for the NWF simulation. See text for more details.

Description of urban climate simulations

For this study, CLMU is coupled to the Community Atmosphere Model (CAM) (Collins *et al*. 2006b). Two climate simulations were run, the purpose of which are to exercise the model and examine its behavior under a wide range of conditions that are climatically consistent with model runs for the IPCC Fourth Assessment Report (AR4). The simulations run from 1941-2099 at a spatial resolution of 1.9° latitude by 2.5° longitude. Sea surface temperatures, sea-ice, and greenhouse gases (CO2, CH4, N2O, CFCs) are prescribed for 1941-1999 from an AR4 20th century CCSM3 ensemble member, and for 2000-2099 from an AR4 A2 scenario (high emissions) CCSM3 ensemble member. For reference, the AR4 A2 scenario results in a globally averaged surface temperature increase of 3.13°C for the 2079-2098 AR4 multi-model ensemble mean compared to the 1980-1999 base period. The first simulation (designated as NWHF – no waste heat flux) uses prescribed minimum/maximum temperatures from the global dataset to maintain realistic interior building temperatures thereby simulating HAC. The second simulation (WHF) also adds waste heat fluxes to the urban canyon that are derived by assuming 50% efficiency of the HAC system on average. In other words, for every 1 W/m^2 required for HAC, 2 W/m^2 due to energy consumption is dissipated as heat within the urban canyon.

Results

Urban heat islands are of particular interest in climate and weather studies. The urban air temperature can be used to assess the simulated urban heat island by comparing it to the temperature from the "rural" surfaces in the model (e.g., the vegetated surfaces). For example, Figure 1 shows present day (1980-1999) urban heat islands produced by the model for January (top) and July (bottom) for the NWHF simulation. A significant number of model grid cells have an urban landunit; however, a very small minimum threshold of 0.1% of the grid cell by area is used to resolve urban areas. As such, there is very little effect on the large-scale climate from the introduction of urban surfaces in these simulations (not shown). Note also that individual cities are not resolved at this resolution; rather the urban areas are a highly averaged representation of any number of individual cities and urban density types present in a grid cell. The heat island is positive nearly everywhere in both seasons, with a magnitude ranging from near-zero to 4°C. To put these urban heat islands in perspective, the average an-

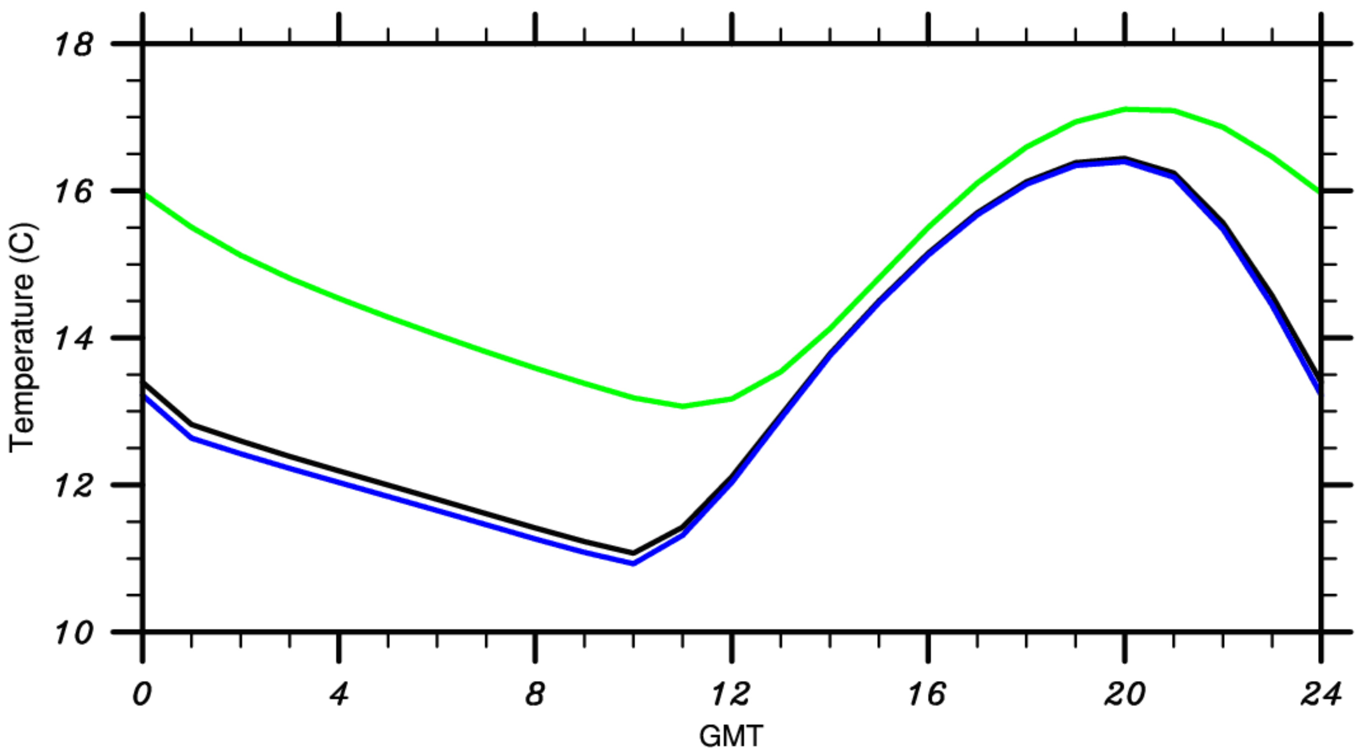


Figure 2. Annual average (1980-1999) diurnal cycle of urban (green), rural (blue), and grid average (black) air temperature for a grid cell located at 40.7°N, 287.5°E for the NWF simulation.

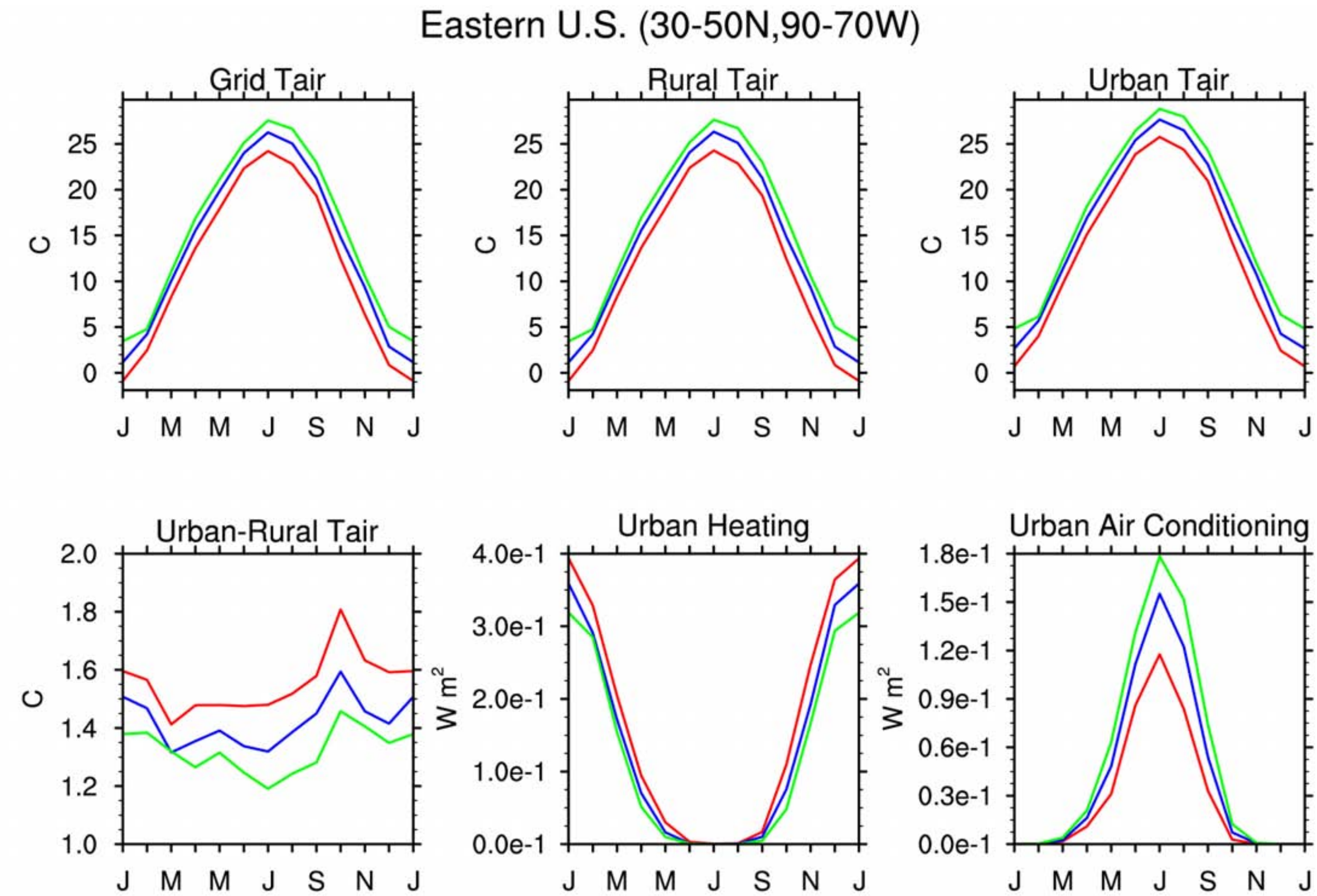


Figure 3. Seasonal cycle of grid cell average, rural and urban air temperature (Tair) and urban heating and air conditioning fluxes in the Eastern U.S. for the NWHF simulation for 1980-1999 (red), 2046-2065 (blue), and 2079-2098 (green).

nual urban heat island simulated by the model for the period 1980-1999 is 1.1°C, which is about half of the global warming simulated by the model for the period 2046-2065 (2.1°C). Due to the addition of waste heat to the urban canyon, the WHF simulation yields a larger average annual urban heat island of 1.4°C.

Figure 2 shows a comparison of the annual average diurnal cycle of urban, rural, and grid cell average temperature for a single grid cell encompassing the New York City region. The grid cell average temperature is minimally affected by the urban surfaces because of the small fraction of urban cover; however, there are significant differences in the diurnal cycle between urban and rural land cover types. The model simulates a heat island primarily through increases in the urban minimum temperature compared to the rural temperature. There is relatively little difference in the maximum temperature between rural and urban areas; thus the diurnal temperature range is reduced (Figure 2). The rural surface warms faster in the morning and cools faster in the afternoon than the urban surface because the urban area stores more heat during the day and releases it later in the day or at night (not shown). The heat island begins developing in early afternoon and peaks just after sunset. Such behavior is confirmed by observations in a qualitative sense.

An interesting aspect of the NWF simulation is that the heat island generally appears to decrease slightly in a warmer 21st century climate. An example for the Eastern U.S. is shown in Figure 3. The grid average, rural, and urban air temperatures are all warmer for the future time slices; however, the urban-rural contrast decreases. In part, this may be due to the energy fluxes required to keep the building temperatures between minimum and maximum thresholds, i.e., the HAC fluxes. In winter, the present day heat island is partly maintained by building heat. In a warming climate, less heat is required to keep the buildings warm which reduces the urban-rural contrast. In summer, increased air conditioning appears to be acting against the warming, thereby reducing urban warming compared to rural. However, the treatment of air conditioning in this particular simulation is thermodynamically inconsistent in that the heat removed from the inside of the building should be returned to the urban canyon. In the second simulation (WHF), the future heat island in the Eastern U.S. increases in summer due to the addition of waste heat (not shown).

Summary

Preliminary climate simulations which exercise CLMU under a wide range of climatic conditions have been completed. Results indicate that heating, air conditioning, and waste heat fluxes may be important for simulating realistic heat islands and for determining how heat island characteristics might change in a warming climate. CLMU is currently scheduled to be released in conjunction with the next version of CLM and CCSM (version 4). It is expected that the CCSM user community will contribute toward further model development and evaluation. In particular, evaluation of the realism of the spatial and temporal variability of the simulated heat island is needed.

References

Collins, W.D., and Coauthors, 2006a: The Community Climate System Model version 3 (CCSM3). *J. Climate*, 19, 2122-2143.

Collins, W.D., P.J. Rasch, B.A. Boville, J.J. Hack, J.R. McCaa, D.L. Williamson, and B.P. Briegleb, 2006b: The formulation and atmospheric simulation of the Community Atmosphere Model Version 3 (CAM3). *J. Climate*, 19, 2144-2161.

Dobson, J. E., E.A. Bright, P.R. Coleman, R.C. Durfee, and B.A. Worley, 2000: LandScan: A global population database for estimating populations at risk. *Photogrammetric Engineering and Remote Sensing*, 66 (7), 849-857.

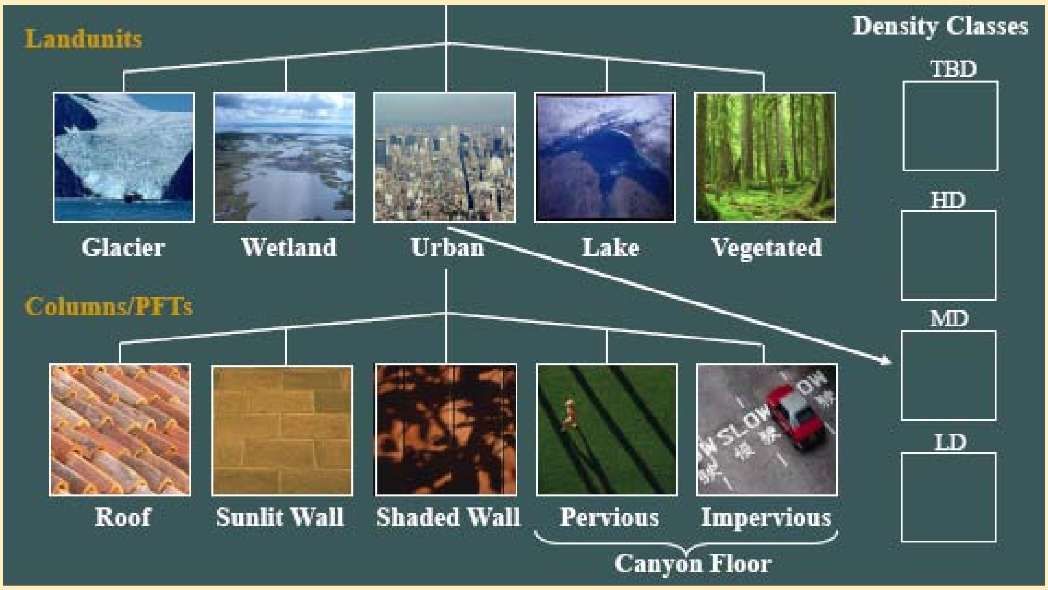
Jackson, T., 2007: *Developing a Dataset for Simulating Urban Climate Impacts on a Global Scale*. M.A. Thesis, Geography, University of Kansas.

Oke, T.R., 1987: *Boundary Layer Climates*. 2d ed. Routledge, 435 pp.

Oleson, K.W., G.-Y. Niu, Z.-L. Yang, D.M. Lawrence, P.E. Thornton, P.J. Lawrence, R. Stockli, R.E. Dickinson, G.B. Bonan, S. Levis, A. Dai, and T. Qian, 2008a: Improvements to the Community Land Model and their impact on the hydrological cycle, *J. Geophys. Res.*, 113, G01021, doi:10.1029/2007JG000563.

Oleson, K.W., G.B. Bonan, J. Feddema, M. Vertenstein, and C.S.B. Grimmond, 2008b: An urban parameterization for a global climate model. 1. Formulation and evaluation for two cities, *J. Appl. Meteorol. Clim.*, 47, 1038-1060.

Oleson, K.W., G.B. Bonan, J. Feddema, and M. Vertenstein, 2008c: An urban parameterization for a global climate model. 2. Sensitivity to input parameters and the simulated urban heat island in offline simulations, *J. Appl. Meteorol. Clim.*, 47, 1061-1076.



Urbanizing CLM (CLMU): the division of grid cells into landunits, and urban landunits into canyon facets. The urban landunit can be further divided into density classes (e.g., tall building district, high, medium, and low density).

Canopy and Aerosol Particle Interactions in the Toulouse Urban Layer

The CAPITOUL Project

The CAPITOUL experiment is a joint experimental effort in urban climate, aiming to study (i) the energetic exchanges between the surface and the atmosphere, (ii) the dynamics of the boundary layer over the city and (iii) the interactions between urban boundary layer and aerosol chemistry. The campaign took place in the city of Toulouse in southwest of France, from February 2004 to February 2005.

Toulouse is relatively isolated from significant relief and coastlines, so that it is not influenced by valley or sea breezes, favoring the apparition of urban effects on the boundary layer. The old city core is very homogeneous in terms of building height and construction materials (red brick walls and tile roofs, Fig. 1). The one-year duration of the field measurements allowed the study of both the day-to-day and seasonal variability in urban climate processes. The observational network included surface stations (meteorology, chemistry , energy balance) with a 30m high tower installed on a 20m high roof (Fig. 2), profilers, and, during intensive observing periods, aircraft and balloons (launched from the countryside and also the city center – Fig. 3). A complete description of the campaign as well as the first results are presented in a special issue in *Meteorology and Atmospheric Physics* (http://www.springerlink.com/content/v9p38ju105q1/?sortorder=asc&p_o=0).

Figure 1. View of Toulouse downtown roofs from the terrace of the central site.

1. General Overview

The first paper of this special issue (Masson *et al* 2008) gives a general view of the experiment, describing the goals, experimental set-up and a summary of the results.

The nine following papers present original scientific advances attributable to CAPITOUL. These papers refer to three main aspects of the urban climate:

2. The urban canopy energetics

- Pigeon *et al* (2008) present the modelling of the anthropogenic heat flux by the TEB urban scheme (Masson 2000) and its evaluation against anthropogenic fluxes estimated by an inventory of energy consumption (Fig. 5). This inventory has been compared before

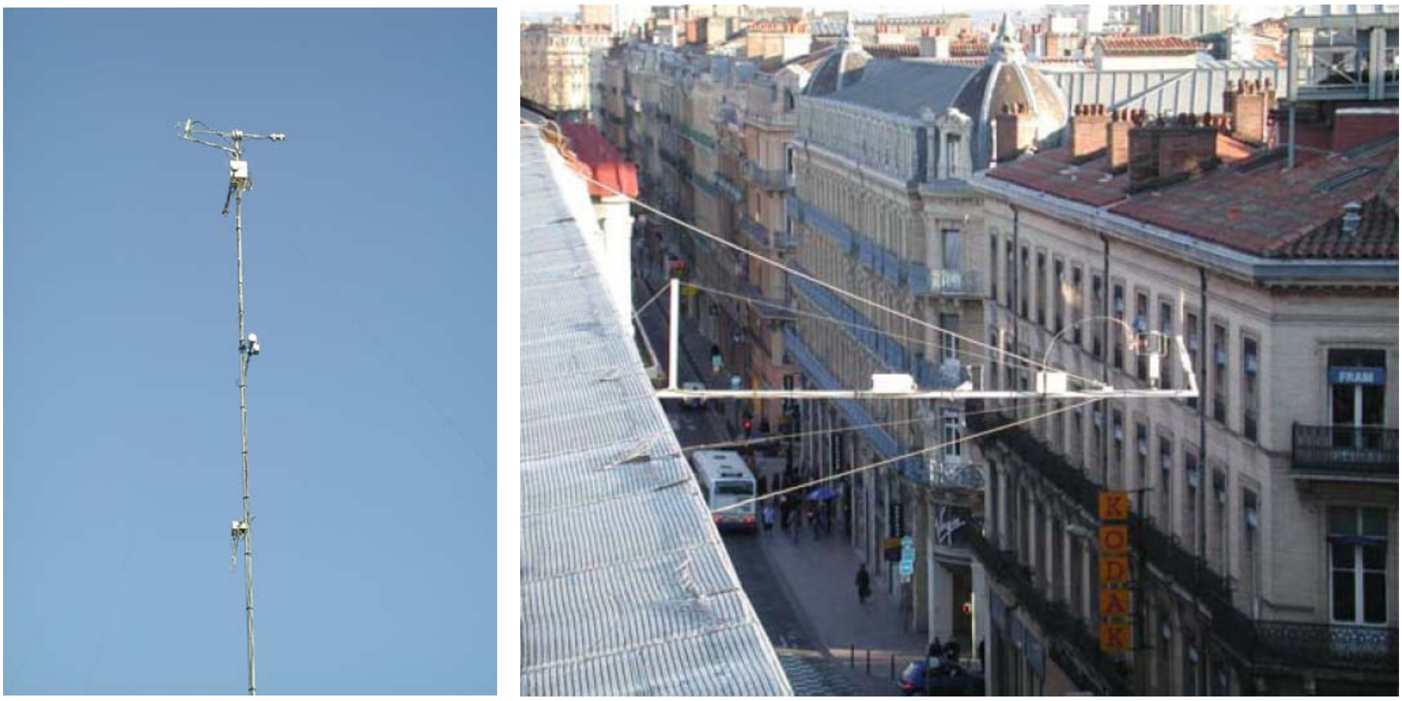


Figure 2: (Left) surface energy balance pneumatic tower; (right) 5 m turbulence-aerosol measurement boom at the top of one street canyon.

Figure 3: Radio-sounding site in city center.

against a new method using standard surface energy balance measurements (Fig. 4, work previously published by Pigeon *et al* 2007).

- The first observations of nocturnal thermal anisotropy (Fig. 6) are presented by Lagouarde and Irvine (2008). No azimuthal anisotropy was found at night, but there is a zenithal dependency. This can be linked to the fraction of roofs viewed and to the vertical gradient of wall surface temperatures.
- These radiative heterogeneities of the urban surface, shown by the thermal infrared data acquired during the campaign, are modelled on a domain of approximately 1 km^2 with the Gastellu-Etchegorry (2008) model.
- With the objective of classifying the ground and roof surfaces over the urban area, Lachérade *et al* (2008) developed and tested on CAPITOUL data the ICARE model to estimate the ground optical properties whatever the irradiated ground conditions (even in shadows).

3. The urban boundary layer flows

- An urban breeze circulation (Fig. 7) was observed on a warm summer day (Hidalgo *et al* 2008a). While the city air is colder than that of the countryside in the morning, the sensible heat flux becomes larger during the afternoon, leading to the urban breeze circulation. Aircraft measurements show that an urban breeze starts in early afternoon, with convergence at low levels (with convergent winds between 1 and 2 m s^{-1}, Fig. 5), and divergence in the upper boundary layer.
- This episode was successfully simulated by Hidalgo *et al* (2008b).
- In-situ and aircraft SF6 tracer measurements in and over a suburban area show the plume to behave differently relative to inhomogeneous thermally-driven turbulence (Lac *et al* 2008). The data were used to validate a coupled meteorology-dispersion model used in emergency response situations.

4. The aerosol-boundary layer interaction

- An increase of the relative abundance of black carbon in the ultra-fine mode causes a decrease of the single scattering albedo of aerosols from 0.9 to 0.5, which can lead to a diurnal average heating value of 4.5 K day^{-1} in the urban boundary layer (UBL) (Gomes *et al* 2008). There is a strong link between the UBL height and aerosol concentration.
- This strong seasonal variability was also observed in the chemical speciation of the aerosol, throwing into relief the influence of various dominant sources (Calvo *et al* 2008).

Data from the CAPITOUL campaign are available to the scientific community on the campaign web site (http://medias.cnrs.fr/capitoul). Interested scientists are encouraged to employ this unique coupled energetics/dynamics/aerosols dataset in order to improve our knowledge of urban climate.

Articles of the CAPITOUL special issue

(Meteorology and Atmospheric Physics, December 2008, Volume **102**, Numbers 3-4):

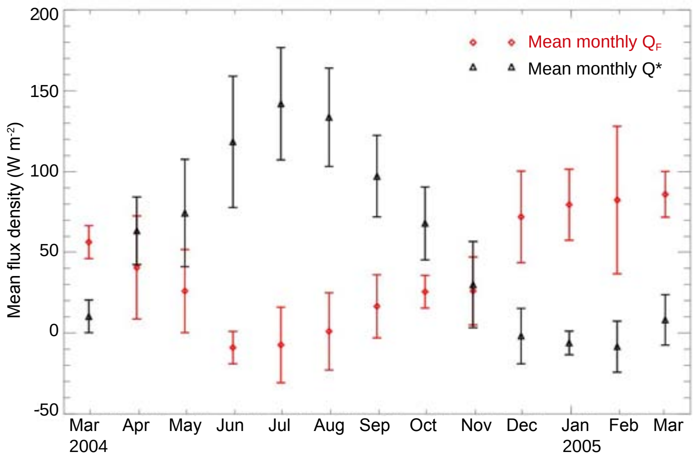


Figure 4: Annual cycle of monthly averaged net radiation (black, measured on the tower) and anthropogenic heat flux (red) estimated from the integrated residual method (Pigeon *et al* 2007).

Masson V., L. Gomes, G. Pigeon, C. Liousse, V. Pont, J.-P. Lagouarde, J. Voogt, J. Salmond, T. Oke, J. Hidalgo, D. Legain, O. Garrouste, C.Lac, O.Connan, X. Briottet, S. Lachérade, 2008: The Canopy and Aerosol Particles Interactions in TOulouse Urban Layer (CAPITOUL) experiment. *Meteorology and Atmospheric Physics*, 102 (3-4), 135-157.

Pigeon G., M. A. Moscicki, J. A. Voogt and V. Masson, 2008: Simulation of Fall and Winter energy balance over a dense urban area using the TEB scheme, *Meteorology and Atmospheric Physics*, 102 (3-4), 159-171.

Lagouarde J.-P., M. Irvine 2008: The directional anisotropy in thermal infrared measurements over Toulouse during CAPITOUL experiment: first results, *Meteorology and Atmospheric Physics*, 102 (3-4), 173-185.

Gastellu-Etchegorry J.P., 2008, 3D modeling of satellite spectral images and radiation budget of urban landscapes, *Meteorology and Atmospheric Physics*, 102 (3-4), 187-207.

Lachérade S., C. Miesch, D. Boldo, X. Briottet, C. Valorge, H. Le Men, 2008: ICARE: A physically-based model to correct atmospheric and geometric effects from high spatial and spectral remote sensing images over 3D urban areas, *Meteorology and Atmospheric Physics*, 102 (3-4), 209-222.

Hidalgo J., G. Pigeon, V. Masson, 2008 (a): Urban-breeze circulation during the CAPITOUL experiment: Experimental data analysis approach, *Meteorology and Atmospheric Physics*, 102 (3-4), 223-241.

Hidalgo J., V. Masson, G. Pigeon, 2008 (b): Urban-breeze circulation during the CAPITOUL experiment: Numerical approach, *Meteorology and Atmospheric Physics*, 102 (3-4), 243-262.

Lac C., F. Bonnardot, C. Camail, O. Connan, D. Maro, D. Hebert and M. Rozet, 2008: Atmospheric dispersion experiment during CAPITOUL to evaluate an operational disper-

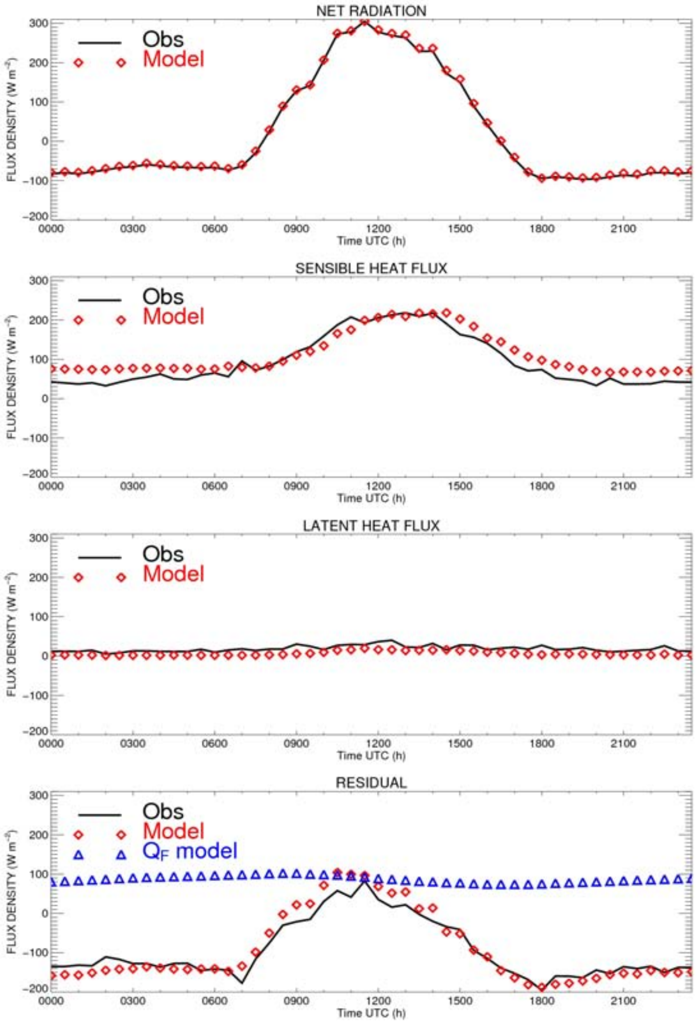


Figure 5: Comparison between simulated (TEB) and observed components of the wintertime Surface Energy Balance (mean diurnal cycle for 20-28 Feb. 2005).

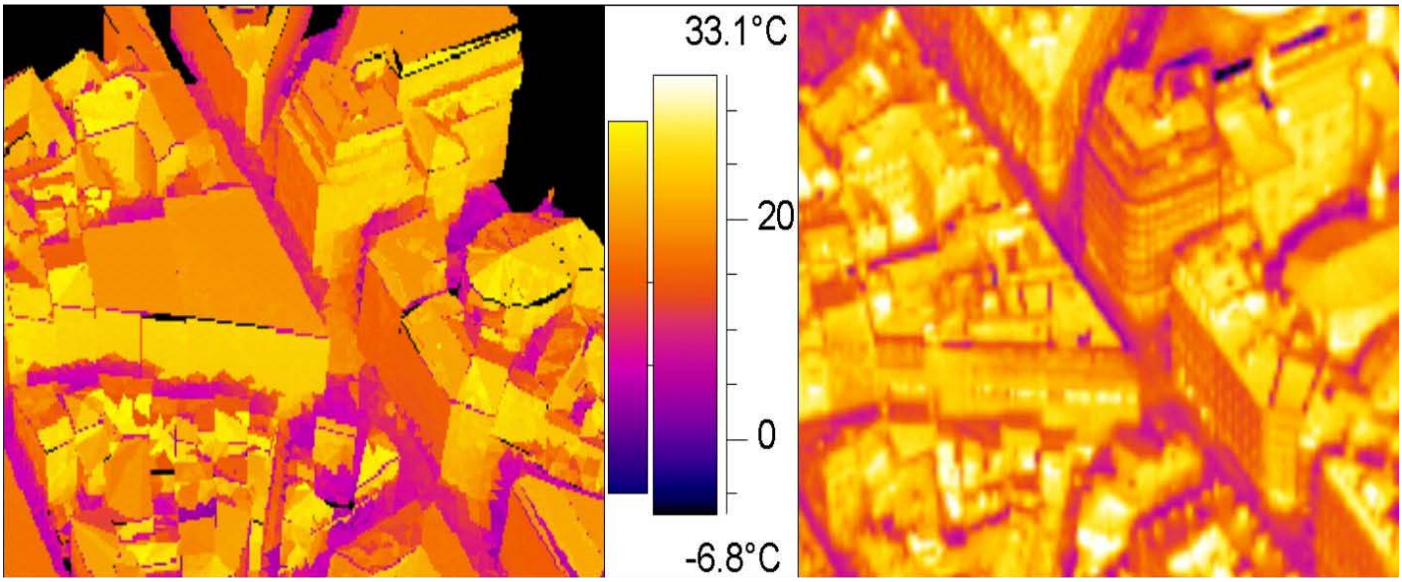


Figure 6: Thermal anisotropy of the urban canopy: simulation with SOLENE model (left) and aircraft observation (right). (courtesy of A. Hénon, ECN, Nantes, France).

sion modelling system: Evaluation of a mesoscale dispersion modelling tool during the CAPITOUL Experiment, *Meteorology and Atmospheric Physics*, 102 (3-4), 263-287.

Gomes L., Z. Veresoglou, S. Rojas, V. Pont, and M. Mallet, 2008: Evolution of the chemical, microphysical and optical properties of aerosol particles in the Toulouse urban layer during CAPITOUL, *Meteorology and Atmospheric Physics*, 102 (3-4), 289-306.

Calvo Ana, Véronique Pont, Catherine Liousse, Bernard Dupré, Armand Mariscal, Cyril Zouiten, Eric Gardrat, Pierre Castera, Corinne-Galy Lacaux, Amaya Castro, Roberto Fraile, 2008: Intra-Annual and monthly trends of the chemical composition of urban aerosols in Toulouse, France (CAPITOUL-Canopy and Aerosol Particles Interaction in TOulouse Urban Layer-experiment), *Meteorology and Atmospheric Physics*, 102 (3-4), 307-323.

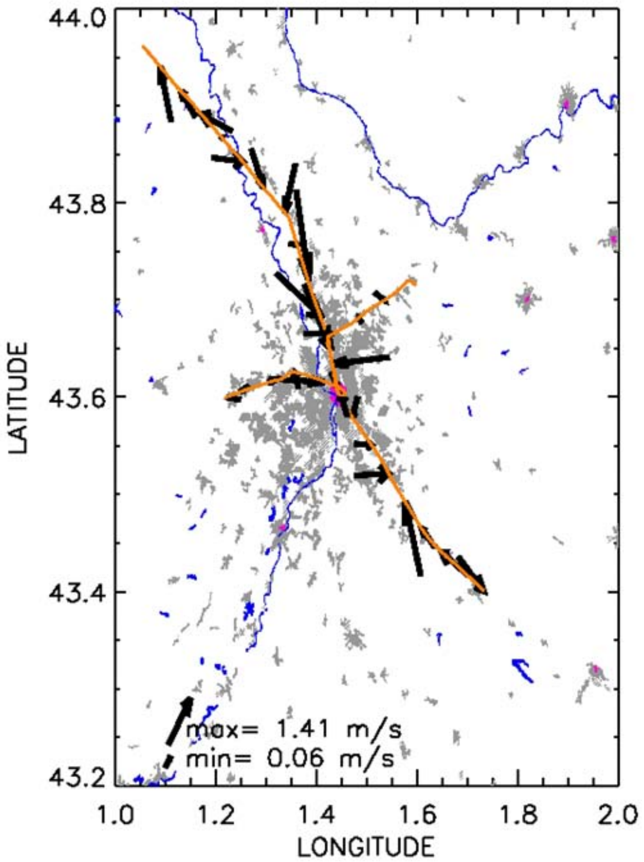


Figure 7: Urban breeze (convergent branch in the lower boundary layer) observed by the aircraft.

Other references on CAPITOUL:

Pigeon G, Legain D, Durand P, Masson V. 2007. "Anthropogenic heat release in an old European city (Toulouse, France)". *International Journal of Climatology*, 27(14), 1969-1981.

Pigeon G., A. Lemonsu, V. Masson and J. Hidalgo, 2008 "From urban climate observation to integrated modelling of the city", *La Météorologie*, 62, I-IX.

Team Members:

V. Masson (CNRM-GAME)
L. Gomes (CNRM-GAME)
G. Pigeon (CNRM-GAME)
C. Liousse (Laboratoire d'Aérologie)
V. Pont (Laboratoire d'Aérologie)
J.-P. Lagouarde (INRA/EPHYSE)
J. Voogt (Univ. Western Ontario)
J. Salmond (Univ. Birmingham)
T. R. Oke (U. British Columbia)
J. Hidalgo (CNRM-GAME)
D. Legain (CNRM-GAME)
O. Garrouste (CNRM-GAME)
C. Lac (CNRM-GAME)
O. Connan (IRSN)
X. Briottet (ONERA)
S. Lachérade (ONERA)

Valéry Masson
valery.masson@meteo.fr

The Helsinki Testbed Mesoscale Observing Network: Experiences 2005–2009

Introduction

The Helsinki Testbed is a research and operational program designed to provide new information on atmospheric observing systems and strategies, mesoscale weather phenomena, urban and regional forecast and dispersion modeling and their verification, applications in a high-latitude coastal environment, and data distribution for the public and the research community. Specifically, the observing instrumentation focuses on meteorological observations of meso-gamma-scale phenomena that are often too small to be detected adequately by traditional observing networks. The brainchild of the Finnish Meteorological Institute (FMI) and the Vaisala Corporation, the Helsinki Testbed was first introduced to the IUAC in the October 2005 *IUAC Newsletter*. Here, we report on the history, experiences, and milestones of the Helsinki Testbed since that first article.

The domain of the Helsinki Testbed, roughly 150 km x 150 km, covers much of southern Finland and the Gulf of Finland and includes Finland's most populous city, Helsinki (Fig. 1). The Helsinki Testbed is composed of a variety of different observing instruments. In addition to 46 existing weather stations operated by FMI, an instrumented 320m tall radio mast, and a 145m tall mast at a nuclear power plant, originally more than 100 new weather transmitters (Vaisala WXT510s) were added, including more than 40 communication mast sites of 60–100m height. The weather transmitters measure temperature, humidity, air pressure, rain, and wind speed and direction. Other data sources have included radiosonde data, road weather observations, an RD-69 disdrometer, precipitation occurrence sensor systems (POSS), a hydrometeor size detector, special versions of weather transmitters equipped with photosynthetically active radiation (PAR), CO_2, or drop-size distribution capability, total lightning location system, a Doppler lidar, and a Doppler sodar. These observations fall under the umbrella of three Doppler radars, two of which have dual-polarimetric capabilities.

Additionally, an increased number of radio-sounding, ceilometer, precipitation weighing gauge, and wind profiler with radio acoustic sounding system observations were collected for five specific measurement campaigns during 2005–2006. After the campaigns the number and type of observation have evolved, but the developed services have essentially continued to serve the public and research efforts.

A recent addition to the Testbed is the University of Helsinki's and FMI's SMEAR-III urban measuring station consisting of a 31m tower equipped with meteorological instrumentation at several heights. Measurements include profiles of the temperature and wind and radiation components (Fig. 2). The fluxes of sensible heat, momentum, carbon dioxide and water vapor are measured by the eddy-covariance technique. Next to the tower is situated an air-conditioned container where a diversity of aerosol particle and gas concentration instrumentation is located. Aerosol measurements include size distributions, chemical composition, and optical properties.

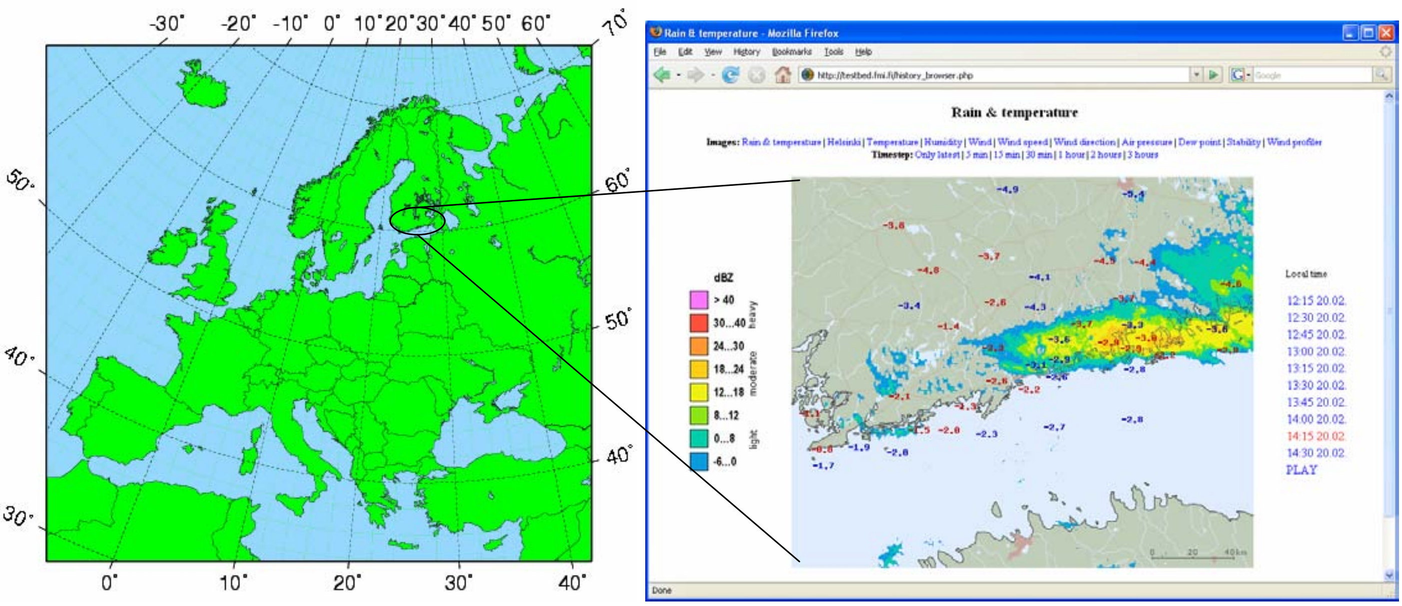


Figure 1. The approximate location of the Helsinki Testbed domain (left), and the most popular animation page of the http://testbed.fmi.fi Web site (right).

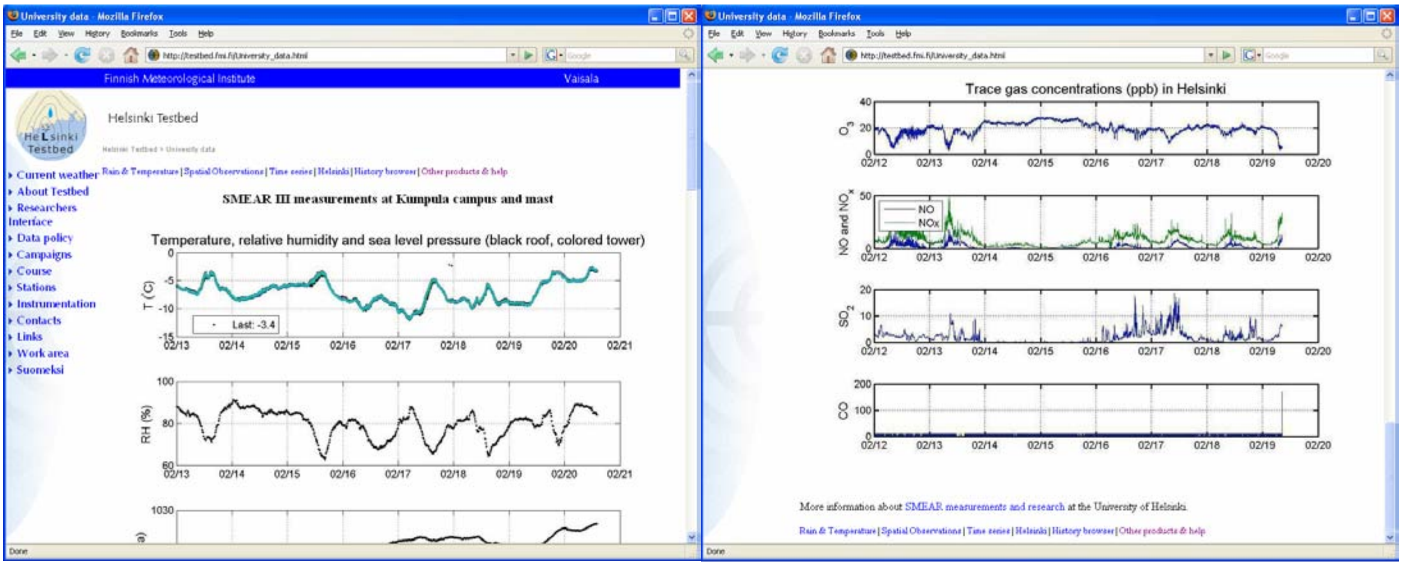


Figure 2. SMEAR-III measurements on Testbed Web site.

Project evolution and cooperation

The initial project was designed to be a fixed-period research project of mesoscale meteorology. Although the Helsinki Testbed was conceived by FMI and Vaisala, other corporate and governmental agencies contributed by providing their data, showing the private or societal need, acting as end-users, and funding the project. The main financier was the Finnish Funding Agency for Technology and Innovation (*Tekes*). Real-time data was planned to be publicly available and measurements were to be done during five usually month-long specific measurement campaigns between August 2005 and August 2006. During the course of the project, additional observing periods (March–April, June–July, September–December 2006, and January–August 2007) were conducted. Starting in September 2007, the Helsinki Testbed continued to serve as a research and development platform for other projects, and Tekes, the main funding source for the development phase, was not involved in operating or developing the network itself, but continued to fund research and development projects using the network. Table 1 gathers some of the most relevant efforts utilizing Testbed.

Table 1: Selected Helsinki Testbed projects and collaborations

- MTT Agrifood Research Finland's Soilweather project 2007–2008
- EU PREVIEW PREVention Information and Early Warning 2005–2008
- Cloudsat, ESA Earthcare and NASA's Global Precipitation Measurement Mission (GPM) with HTB acting as calibration and test site
- COST Action ES0702 (European ground-based observations of essential variables for climate and operational meteorology) 2008–2012
- Combining and quality of surface weather station and dual polarization radar data (PIPO) 2007–2008
- *Ubicasting* – Ubiquitous weather services 2007–2009
- Finnish Wind Atlas project 2008–2009
- Data integration to FMI weather and warning services for authorities
- Data integration to FMI on-duty forecaster's workstation
- Data integration to FMI public weather services
- Vaisala's product development projects
- NOAA ESRL Global Systems Division cooperation with LAPS system implementation
- Green Net Finland, a consortium of environmental business and public organizations, innovation project as preform for business ventures
- ICT-SHOK funded EnviTori (2008–2010) project for establishment of environmental data marketplace
- Second phase of European Space Agency's COPS project (2008–2009) seeking innovative ways how remotely sensed earth observation data and related data collected in situ can be exploited
- Thesis works among atmospheric science students at the University of Helsinki

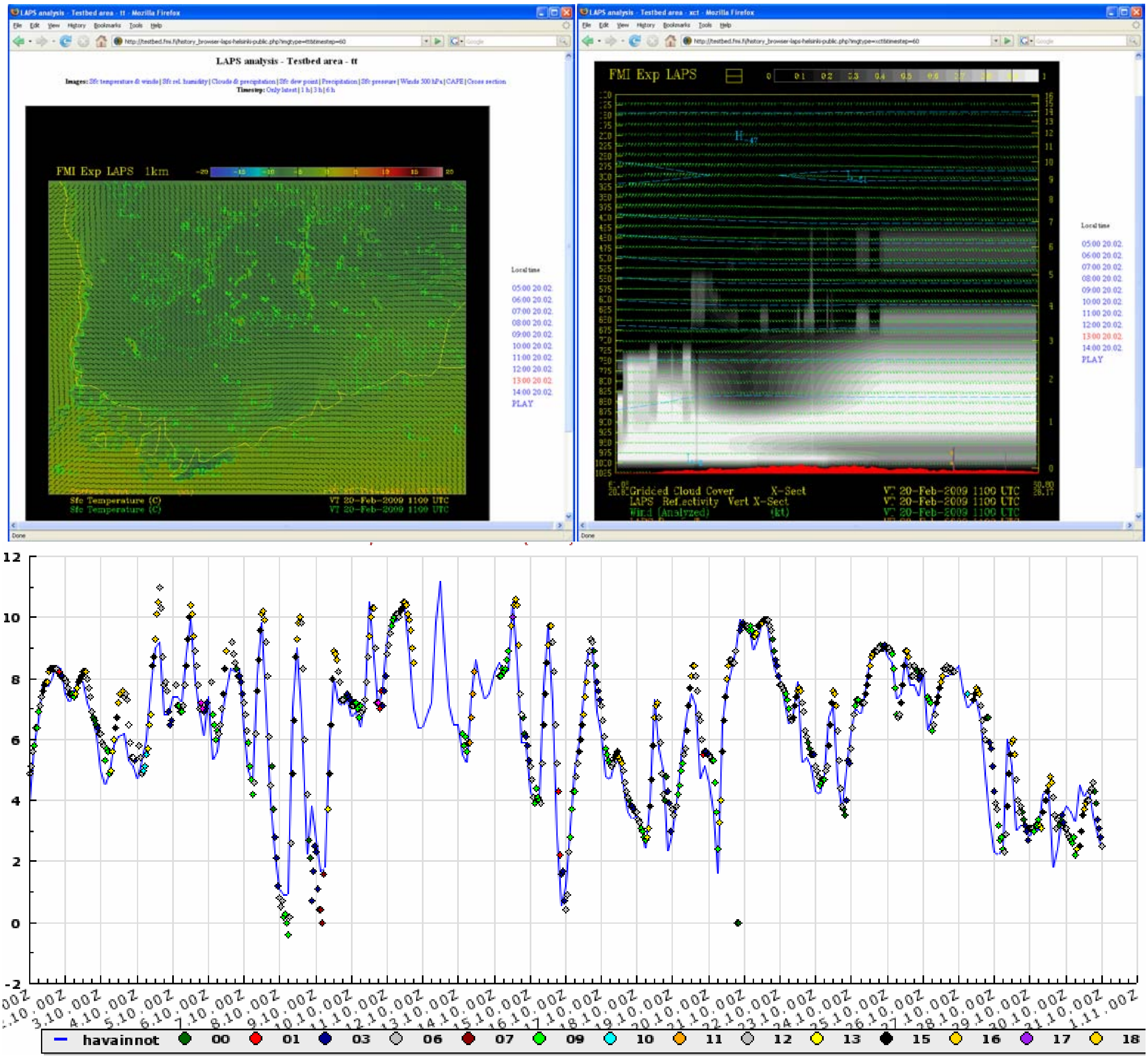


Figure 3. Upper panel: LAPS temperature analysis for the Southern Finland area (left), and analysis east-west cross-section at the middle of the domain (right). Lower panel: LAPS surface analyses (colored dots) compared with an independent road weather station temperature observation (°C, blue line) in the city of Nokia, Finland. The data is shown for October 2008. (Figure courtesy of Erik Gregow, FMI.)

One of the most important follow-on and joint projects is *Ubicasting*, or Ubiquitous Weather Services, the first phase of which ran from 2007 to 2009. Funded by *Tekes*, *Ubicasting* shifted the focus from collecting observations to developing applications benefiting citizens, businesses, governmental authorities, and industries. Pilot applications for end users have been developed for weather, air quality and traffic weather services.

One of the central features of the Helsinki Testbed in Ubicasting is the Local Analysis and Prediction System (LAPS; Albers *et al*. 1996), providing data assimilation and data visualization. The system has been originally developed by the NOAA Earth Systems Research Laboratory's Global Systems Division. Although LAPS is run operationally at 1-km horizontal grid spacing using the Helsinki Testbed data, more work remains to determine the optimal configuration (e.g., domain, resolution, use of ensembles, sensitivity to assimilation parameters) to provide the best analysis and forecasts. LAPS currently ingests its background field from the ECMWF model and observational data from NOAA polar-orbiting satellites, Testbed masts, Doppler radar reflectivities and radial winds, surface instrumentation, and radiosondes. Some publicly available products of this routinely running system are shown in Fig. 3, with a time series of the excellent comparison between the LAPS surface temperature and an independent road-weather station.

The second phase of *Ubicasting* is expected to start in 2009 and continues through 2011 with three main components. The first component is the evaluation and continued development of the LAPS production system, with the goal of producing an hourly data assimilation and modeling cycle over Finland, resembling the U.S. National Weather Service's Rapid Update Cycle (RUC) model. The second component is research improving the modeling of the atmospheric boundary layer, atmospheric mixing height, urban air quality, and road weather by coupling fine-scale observation, analysis, and forecasting systems together. Third, the road maintenance, weather, and dispersion applications are validated and further developed, and a new aviation meteorology application area is started. This third component seeks to improve the services to other governmental authorities, to make the partners competitive, and penetrate new markets. The consortium for this project consists of two main public-sector research partners (Finnish Meteorological Institute and Helsinki University) and three main enterprise partners (FMI Commercial Services, Vaisala Oyj, and Insta Defsec Oy). There are also five more enterprise and public parties representing end-users of the selected application areas.

An example of research using data from the Helsinki Testbed

One aspect of mesoscale meteorology that the Helsinki Testbed is well suited to study is fronts moving through southern Finland. Analysis of several fronts indicates nonclassical structures and evolutions that challenge our conceptual models of fronts. For example, on 31 October 2007, the radar data and data from several instrumented towers indicated a structure reminiscent of a density current (Fig. 4), although other characteristics of the front argue against this interpretation. Specifically, the front occurred within, not at the leading edge of, a region of near-continuous rain, as observed by the radar, a collocated disdrometer, and a precipitation occurrence sensor. Thus, evaporation into the cold pool is unlikely to have contributed toward the cold pool. Data from the Kivenlahti tower and the radar indicate that the cold pool was less than 1 km deep, with all the cold air underneath the melting layer. Consequently, this case illustrates one of the problems with inferring the dynamics of a front from its morphology. Unexplained near-surface prefrontal warming, seen in other fronts across the world, remains unexplained. This case is a precursor to a larger study of the interaction between fronts and the near-surface boundary layer to be conducted in southern Finland over the next few years.

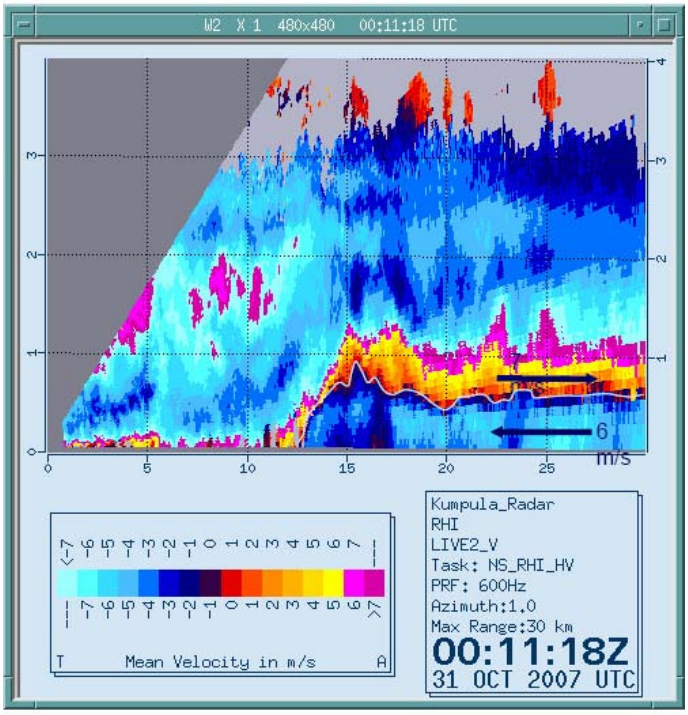


Figure 4. Doppler radar data from the Kumpula radar in the Helsinki Testbed. Range–Height Indicator (RHI) plot across the cold front showing the shear across the front in the radial wind (m s^{-1}). (Figure courtesy of Matti Leskinen, University of Helsinki.)

The public is one of our biggest supporters!

The importance and popularity of the Helsinki Testbed to the public is evident from Web site statistics. Around 20,000 different users typically visit the Web site each week, much more if interesting weather is occurring. For example, during the severe storm in the Helsinki area that flooded roads and shut down the Finnish broadcasting system on 22 August 2007, the Helsinki Testbed Web site faced 26,000 different visitors on that day, suggesting that tens of thousands of citizens must be accustomed to the regular and free service. Yet another encouraging sign from outside the meteorological community was when the Helsinki Testbed won first prize in the community category of the "Productive Idea of the Year 2006" national contest organized by the Junior Chamber International of Finland.

But, perhaps the most telling evidence of the value of the Testbed data to the public are the results of user surveys conducted in 2006 and 2008, both producing similar results. In 2008, a voluntary Web-based survey lasting one month was available on the Helsinki Testbed Web page—over 6,300 people responded! On a scale from 1 to 5, 81% of the respondents indicated the maximum interest (5) in using the service in the future, and an additional 17% replied with a 4. Of the respondents, 52.5% said they have recommended the service to others, and 47.4% indicated that they would be ready to do so. Seventy-five percent of the respondents said that they used data for private purposes or simply have a general interest in the weather, 15% said that they used the data in their profession, and 2% said that they used the data in scientific research. Respondents found the most valuable information to be the weather radar data and the most popular surface station variables were temperature, precipitation and wind. Map and time series displays seemed to be equally popular, whereas map animation pages constantly get the highest number of page loads.

Concluding remarks

Although the public interest and research importance of the Helsinki Testbed has been demonstrated, many questions remain about the value of the data to each stakeholder, the cost-effectiveness of research results, and the quantifiable improvements in forecasting, modeling, and warning services. The goal of the Helsinki Testbed is to create outstanding and economically attractive weather services for people and industries. Clearly, no parties are likely to support the network infrastructure unless they make a profit from it or see it is as a vital part of their strategy. As an indication of what we believe justifies our efforts, a recent study by the Technical Research Centre of Finland (VTT) showed at least a five-fold return on societal benefits on investments in weather services in Finland. Whether the Helsinki Testbed can achieve the full five-fold benefit to society, or at the least break even, remains to be seen with a full cost–benefit analysis.

Initially, the Helsinki Testbed was a research project envisioned to have a limited period of existence, but its popularity has now partially transformed it into a quasi-operational weather observation network. Many parts of the core network infrastructure can be said to have passed the proof-of-concept stage, whereas many functional features should be revisited or expanded. As we have seen in the past with the Helsinki Testbed, we expect the network to continue in the future, albeit occasional re-evaluation and rearrangement will occur along the way. And, we expect that such evaluation does occur in a testing environment. In this sense, the term testbed has been a good name for the network because it stresses the nature of the endeavor.

Acknowledgements

The Helsinki Testbed was partially funded by *Tekes*. Schultz is partially supported by Vaisala Oyj. Jim Steenburgh provided constructive comments on an earlier version of this article.

Reference

Albers, S., J. McGinley, D. Birkenheuer, and J. Smart 1996: The Local Analysis and Prediction System (LAPS): Analyses of clouds, precipitation, and temperature. *Weather and Forecasting*, 11, 273–287.

The Helsinki Testbed Web page

The project's Web site is http://testbed.fmi.fi

In addition to graphs and maps of real-time and archived data, as well as free research data requiring self-registration, the Web site also features:

- past presentations from the yearly Helsinki Testbed-related workshops, at http://testbed.fmi.fi/About_Testbed.en.html

- lecture notes from a course on mesoscale observing networks, at http://testbed.fmi.fi/Course.en.html

Jani Poutiainen[1] and David M. Schultz[1,2]

[1] Finnish Meteorological Institute
Helsinki, Finland

[2] Division of Atmospheric Sciences and Geophysics, Department of Physics
University of Helsinki, Helsinki, Finland

Corresponding author address:
Prof. David M. Schultz
FMI, Erik Palménin Aukio 1, P.O. Box 503
FI-00101 Helsinki, Finland

E-mail: david.schultz@fmi.fi

Short range dispersion experiments in central London: The DAPPLE-HO project

Introduction

In 2004, results were presented in this newsletter from the DAPPLE project (Dispersion of Air Pollutants and their Penetration into the Local Environment[1]) [1]. The follow-on project, DAPPLE-HO, was funded by The Home Office (part of the UK Government concerned, amongst other things, with security and anti-terrorism issues) and began in 2006. The main aim of the DAPPLE-HO project was to extend knowledge of short-range (<1 km) dispersion processes in urban areas, principally in order to assist emergency response situations. Recently, Session 15 of the 8th Symposium on the Urban Environment at the 89th Annual Meeting of the American Meteorological Society in Phoenix, Arizona was devoted to results from the DAPPLE project[2]. Shortly the project will end and some of the key findings are reported here.

Fieldwork and methodology

The research team comprised the Universities of Surrey, Reading, Bristol, Cambridge and Leeds, Imperial College in London, and Golder Associates Ltd. A detailed account of experimental methodology and first results is reported elsewhere [2]. Previous results at the site showed that street level flow patterns were strongly related to above roof wind direction [3]. For the 2007 spring field experiments the Universities of Reading and Leeds deployed 4 sonic anemometers at the intersection; 1 in a street canyon; 1 at roof level; and 1 on the BT Tower at z = 190 m. These instruments were run continuously for several weeks to capture mean flow patterns over a range of wind directions and stability. Over the campaign, a mean rooftop wind speed of 1.8 ms^{-1} was recorded and the representativeness of this reference was tested by comparison with the BT Tower reference, which is very well exposed. Tracer experiments were carried out on days with mean roof-top winds of 2.9, 2.6, 1.9 and 1.1 ms^{-1}, covering a representative range of conditions and directions. Three sonic anemometers were also deployed at source locations on tracer days to record near-field flow conditions.

Fixed point tracer release experiments were performed on 4 separate days during June 2007. The positions of all19 samplers are shown as red dots in Figure 1 and were all located less than 500 m from the sources. Source locations are marked with blue stars, and were selected according to forecast wind direction. Three different perfluorocarbon (PFC) tracers were released simultaneously near the intersection (X), in a street parallel to the wind (Y) and in a street perpendicular to the wind (Z) to ascertain sensitivity of plume shape to source location. 15 minute releases were used, with 30 minute samples captured. PFCs have very low background concentrations, and the offline negative-ion chemical ionisation (NICI) detection technique, developed by the University of Bristol, is very sensitive, allowing only about 100 mg of material to be released [4].

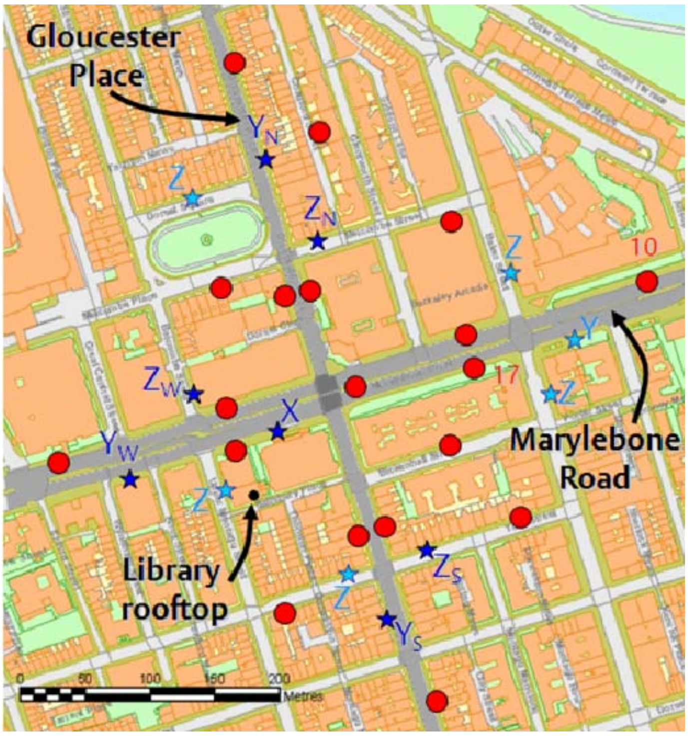


Figure 1. Layout of samplers (red dots) and sources (blue stars).

Tracer results

The dosage *D* is defined as the integral of concentration, *C* over the time of exposure, *t* (in this case 30 minutes). The dimensionless dosage is defined as $D^*=DUH^2/M$, where *H* is mean building height, *U*

[1] http://www.dapple.org.uk

[2] http://ams.confex.com/ams/89annual/techprogram/session_22806.htm

is rooftop reference wind speed and *M* is mass of tracer released. Figure 2 shows *D** as a function of *R/H* for all experiments, where *R* is the straight-line distance between source and sampler. Data are coloured according to the angle on which the receptor lies with respect to the mean rooftop wind direction: downwind for ±45°, crosswind for ±45 - 90°, upwind for ±90 - 180°. "Channelled" indicates sites on a major road near-parallel to the wind (note high concentrations and little dispersion in this case). Out to a distance of ~ 6-8*H* from the source, tracer can be transported in any direction; beyond this radius, transport is predominantly downwind. This translates to exposure of a couple of blocks radius around a suspected source in an emergency situation, where upwind dispersion is likely to occur. Finally, despite large variability it is surprising that there appears to be a robust upper limit: the line in Figure 2 shows the relationship $D^* = 12\,(R/H)^{-2}$ which is remarkably simple and can be used to estimate downwind decay of dosage and hence response strategies. This decay law was originally found to hold for the wind tunnel tracer release data [5] but holds with a similar coefficient for field scale data.

Eight mobile releases were performed on 13th March 2008 from an instrumented vehicle from the University of Leeds. The stop-start motion of the vehicle meant that line emissions were highly variable along the Marylebone Road route (see Figure 3): the line emission rate was typically 12 times greater for stationary vehicles compared to vehicles with speed >10 km per hour. This suggests that vehicle emissions may be better represented by superposition of point releases rather than a constant line emission.

Intersection flow

As cities are generally made up of relatively short streets connected by intersections, one focus of the DAPPLE-HO project was to determine the role of intersections in dispersing gases. Extensive use was made of the EnFlo wind tunnel at the University of Surrey, using both flow measurements [6] and flow visualisation. At the intersection, flow is a complex overlay of channelling flow along streets, corner vortices shed by buildings, and significant upward displacement as shown in Figure 4. Flow patterns are very sensitive to both wind direction and local building geometry, and are highly unsteady, which leads to effective turbulent mixing.

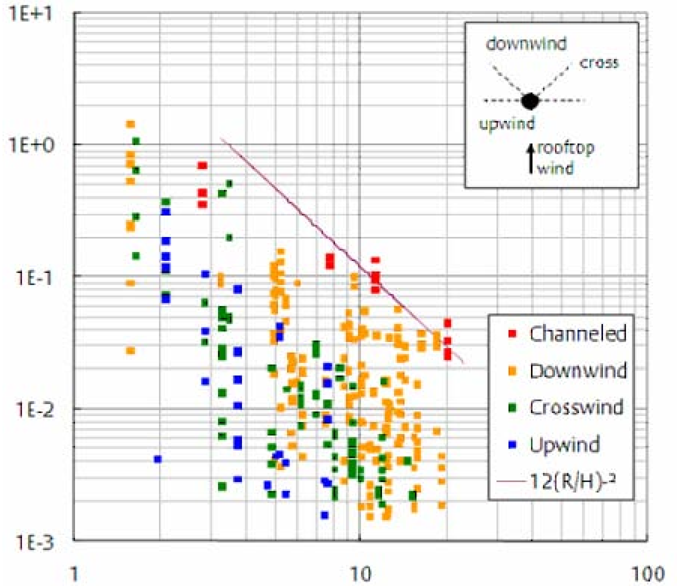


Figure 2: Dimensionless dosage, *D as a function of normalised distance, *R/H*.**

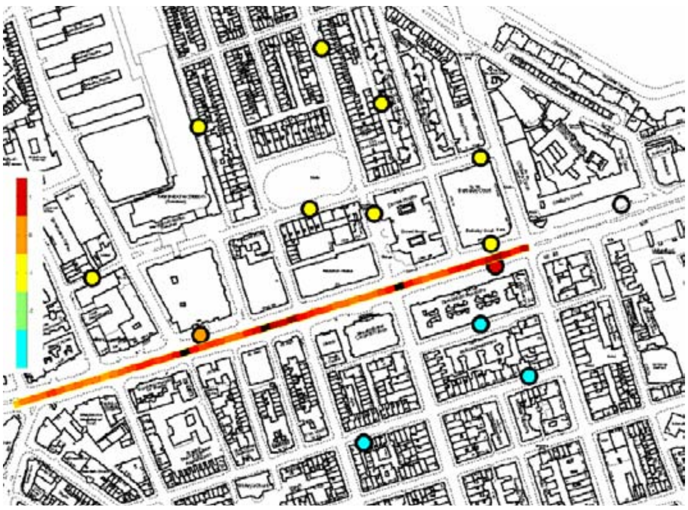
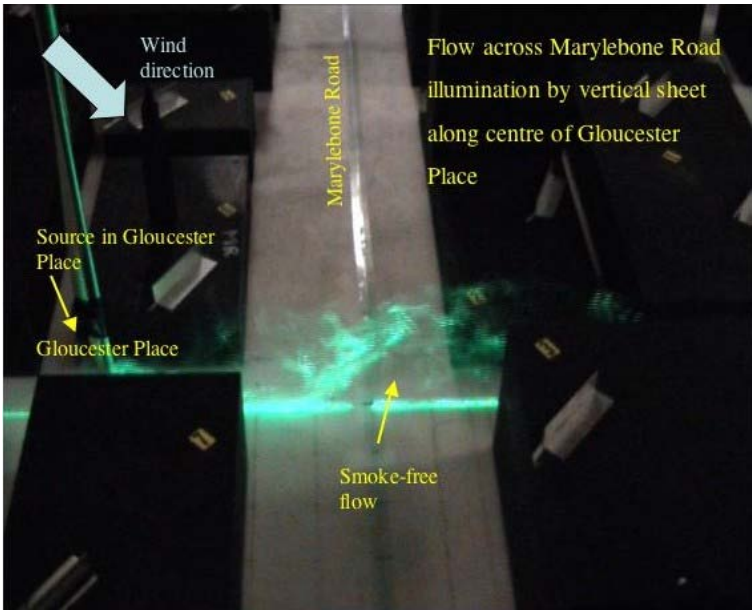


Figure 3: Dimensionless dosage for mobile release (circles; cooler colours show order of magnitude reduction; blue: background). Coloured line shows vehicle speed (black: stationary; lighter colours: increased speed).

Conclusions

During DAPPLE-HO many tracer release experiments were performed in the complex geometry of central London. Medium-term flow measurements were used to ascertain whether experiments were conducted in representative flow conditions. Supporting wind tunnel experiments showed very similar tracer decay characteristics and proved a useful tool in analysing complex intersection flow. Despite the complexity, some simple relationships have emerged which may assist emergency responders in case of accidental or terrorist gas release.



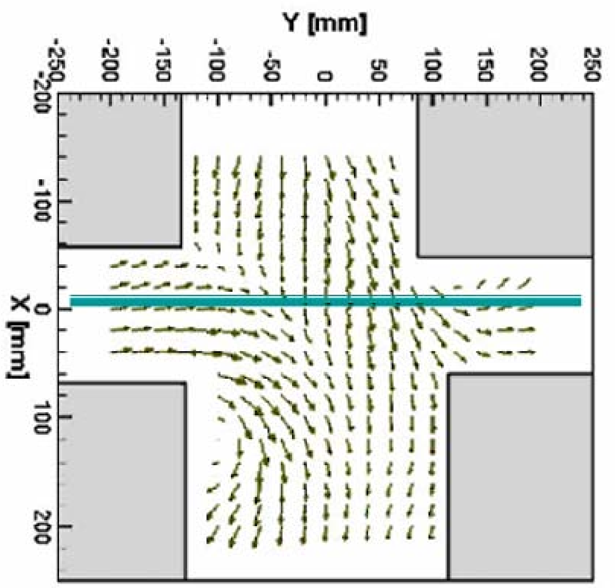


Figure 4: a) Flow visualisation at intersection using smoke and laser light sheet at EnFlo wind tunnel b) horizontal cross-section of flow at equivalent height of 5m. Green line shows laser light sheet. Model is 1:200 scale. Video of the flow visualisation can be viewed at www.dapple.org.uk.

References:

[1] Arnold, S.J. et al. (2004) Dispersion of air pollution and penetration into the local environment, DAPPLE, *Science of the Total Environment*, 332, 139-153

[2] Wood, C.R., et al. (2009) Dispersion experiments in central London: the 2007 DAPPLE project, *Bulletin of the American Meteorological Society*, in press.

[3] Dobre, A., Arnold, S.J., Smalley, R.J., Boddy, J.W.D., Barlow, J.F., Tomlin A.S. and Belcher, S.E. (2005) Flow field measurements in the proximity of an urban intersection in London, UK, *Atmospheric Environment*, 39, 4647-4657.

[4] Simmonds, P.D., Greally, B.R., Olivier, S., Nickless, G., Cooke, K.M. and Dietz, R.N. (2002) The background atmospheric concentrations of cyclic perfluorocarbon tracers determined by negative ion-chemical mass spectrometry, *Atmospheric Environment*, 36, 2147-2156.

[5] Robins, A. (2008) EnFlo ground level concentration data and the inverse square decay law, DAPPLE EnFlo Note, July 2008, DAPPLE website (www.dapple.org.uk).

[6] Carpentieri, M., Robins, A.G. and Baldi, S. (2009) Three-dimensional mapping of wind flow at an urban canyon intersection, submitted to *Boundary-Layer Meteorology*.

Team members:

University of Surrey: Alan Robins (Project Leader)

University of Reading: Janet Barlow, Stephen Belcher, Curtis Wood

University of Leeds: Alison Tomlin, Ahmed Balogun, James Tate

University of Cambridge: Rex Britter

Golders Associates: Samantha Arnold

Corresponding author:

Dr. Janet Barlow

Department of Meteorology
University of Reading,
PO Box 243, Earley Gate
Reading, RG6 6BB

j.f.barlow@reading.ac.uk

Urban-related aspects of the AMS Annual Meeting in Phoenix, Arizona

By James Voogt
with Matthias Roth and Scott Krayenhoff

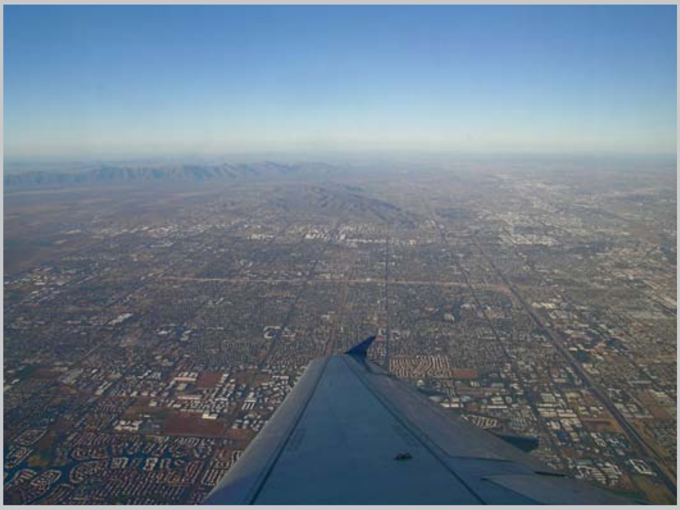
The 2009 Annual Meeting of the American Meteorological Society was organized around the broad theme of "Urban Weather and Climate: Now and the Future" and incorporated a number of conferences and joint sessions related to urban climate and urban applications of climate and meteorology. The meeting was held in Phoenix AZ at the massive, brand new Phoenix convention centre. The careful planning by AMS staff of room assignments for related sessions made it possible for attendees to switch sessions to view individual papers. The Phoenix setting provided a week of sun and warm temperatures for attendees to enjoy during their lunch and coffee breaks.

Urban climatologists at the AMS meeting (from left): Ha Pe Schmid, Matthias Roth, Tim Oke, Sue Grimmond, James Voogt and Andreas Christen (Photographs courtesy of Matthias Roth)

The Annual meeting opened with a Presidential Forum of four panelists examining the overall meeting theme. The panel presentations included "An Urbanizing World" (Kai N. Lee, The David & Lucile Packard Foundation), "Implications of climate change for expanding cities world-wide" (Julian C. Hunt, Univ. College London) "Coastal Processes and Impacts—Particularly as they Relate to Coastal Cities—in a Changing Global Climate with Rapidly Expanding Urban Populations (Susan K. Avery, Wood's Hole) and "Urban Weather and Climate Services: Meeting the Challenges of Growing Cities and a Changing Climate" (M. Glackin DOC/NOAA). With the exception of J. Hunt, who has done work related to urban mesoscale effects, the panelists represented expertise at larger climatic scales and/or a broader more interdisciplinary view of atmospheric science. Their presentations provided a broad overview, directed towards meteorologists whose experience with urban-scale issues may be minimal and for whom background training in broader environmental and social sciences may be limited. For a review of the Presidential Forum and an interview with AMS President Walter Dabberdt on the Urban theme of the Annual Meeting see the "Daily BAMS (Bulletin of the American Meteorological Society)" for Sunday and Monday that are available from http://www.ametsoc.org/meet/annual/.

The primary urban-related conference at the meeting was the Eighth Symposium on the Urban Environment. As part of the overall AMS Meeting theme there were also a number of special symposiums. These included the Symposium on Urban High Impact Weather, a Special Symposium on Measurements in the Urban Environment and Observations and a special named symposium in honour of the accomplishments of Timothy R. Oke. Together, the urban-related presentations included approximately 153 oral and 58 posters, spread over the four days of the conference. In addition, 43 other papers from conferences at the Annual Meeting also featured 'urban' in their title.

Holding the urban environment symposium at the annual meeting allowed for the co-sponsorships of some sessions among a number of AMS committees, thereby providing both a broad exposure of urban climate research to conference attendees as well as featuring urban-related work by researchers that are from different sub-disciplines and who might not normally appear at an urban climate conference. As examples, Teddy Holt (NRL) gave an invited 30-minute presentation on the use of coastal-urban mesoscale ensembles to assess sea breeze and heat island interactions in a joint session on "Geographic Effects on Urban Weather and Climate" hosted jointly by seven different conferences and symposia, and Jim Purpura (NOAA/NWS) discussed "Fire at the Urban Interface: The San Diego County Wildfires of October 2007" in a session on "Observations/Studies of High-Impact Weather in Urban Regions" joint with eight different conferences/symposia. A special joint session on "Sustainable Urban Design" co-sponsored by five different conferences and symposia featured an invited presentation by Emily Talen (ASU) on the issues related to "The Centrality of Design in the Reduction of Urban Sprawl." In the same session, Lily Parshall of Columbia University presented an interesting talk entitled "Urban climate modeling, heat island mitigation and local knowledge: co-producing science for urban policy" – in which she presented, using three case studies, how urban climate researchers responded to the input of local environmental planners to produce scientifically valid and politically acceptable results. In total, 24 sessions were held as joint sessions with other (and sometimes multiple other) conferences and symposia.



Some of the notable aspects of the Urban Symposium and linked special sessions included:

- A first report on results from the international urban surface energy balance model comparison study (see Issue 27); a session on results from the DAPPLE project (see p. 22); an energy balance session reporting results from the Canadian EPiCC project (see Issue 27) and a session on measurements in urban environments introducing comprehensive, long-term sensor networks in Oklahoma City (see Issue 27), New York City, Helsinki (see p. 17), Montreal and Vancouver.
- The Oke Symposium consisted of an invited session with four papers, a luncheon presentation by incoming IAUC president Gerald Mills and several other sessions joint with the Urban Symposium Conference. The opening invited session featured a 30-minute presentation by T.R. Oke on the need to adopt common protocols in urban heat island research, as well as presentations by M. Best (UK Met Office) on how T. R. Oke's work influenced development of urban models within larger scale weather and climate models, by H.-P. Schmid (Research Center Karlsruhe) on spatial homogeneity, surface variability texture and spatial representativeness in urban areas, and by I. Stewart (Univ. of British Columbia) on "urban thermal zones" – a new concept related to "urban climate zones" that may improve our description of heat islands and replace the often too vague, or imprecise terms of "urban" and "rural" as they relate to measurements of the urban heat island.

The Wednesday evening AMS Awards Banquet included the presentation of the Helmut E. Landsberg Award (awarded in recognition of an individual or team for exemplary contributions to the fields of urban meteorology, climatology, or hydrology) to **Sue Grimmond**, past-president of IAUC, "for numerous important contributions that have greatly advanced urban meteorology and urban climate sciences, and for sustained and effective leadership that has energized the urban climate research community." Congratulations to Sue on this great achievement!

Sue Grimmond receiving the Landsberg award from AMS President Walt Dabberdt at the AMS awards banquet.

Gerald Mills, in his lunchtime presentation, examined the parallels between Luke Howard and Tim Oke in the study of urban climates. Mills notes the importance of: good observations, communication and scientific communities as factors that both Howard's and Oke's work have embraced.

Finally, in a Tuesday morning presentation, Bob Bornstein (SJSU) provided an overview of Oke's work on Urban Heat Islands and how his work has influenced modeling of the UHI in the urban boundary layer.

For those not in attendance at the conference, the AMS has introduced two features that provide access to the conference presentations: conference pre-print papers are available now for papers where the authors have provided them, and a recording of the actual presentation (if permission was granted by the presenter) will be available from the AMS sometime in March 2009.

Readers are encouraged to check the AMS Annual meeting program website at: http://www.ametsoc.org/MEET/annual/programsandevents.html for links to all programs and access to the preprints and recorded presentations.

The 7th International Conference on Urban Climate (ICUC-7)

June 29 – July 3, 2009 • Yokohama, Japan

Venue: Pacifico Yokohama-Pacific Convention Plaza

Invitation

The International Association for Urban Climate (IAUC) warmly invites you to the *Seventh International Conference on Urban Climate (ICUC-7)* to be held in Yokohama, Japan from June 29 to July 3, 2009. *ICUC-7* is the continuation of a series of conferences starting in Kyoto, Japan in 1989, followed by those in Dakha, Bangladesh in 1993, Essen, Germany in 1996, Sydney, Australia in 1999, Lodz, Poland in 2003, and Göteborg, Sweden in 2006. The success of this series has helped to create a cohesive international community of urban climatologists.

The aims of the conference remain to provide an international forum where the world's urban climatologists can meet, to showcase and discuss modern developments in research and the application of climatic knowledge to the design of better cities. *ICUC-7* wishes to cater to the interests of a diverse community of meteorologists, climatologists, hydrologists, ecologists, engineers, architects and planners and others interested in these topics. On behalf of the organisers we are honoured to invite you to attend.

Dr. Manabu Kanda, *ICUC-7* Local Organizer
Dr. Matthias Roth, President of IAUC

Scientific Programme

The conference will address topics such as (but not limited to):

- *Airflow over cities including turbulence, urban roughness and drag, changes of wind speed and direction, urban circulation systems, wind engineering*
- *Urban impacts on surface moisture, dew, evaporation, humidity, fog, cloud and precipitation*
- *Exchanges of heat, mass and momentum between the urban surface and its boundary layer*
- *Short- and long-wave radiation in polluted air, urban visibility*
- *Urban heat islands, their nature, genesis and mitigation*
- *Remote sensing of cities and urban climate*
- *Emission, dispersion, transformation and removal of air pollutants and their impact on the urban climate*
- *Models of the urban atmosphere at all scales*
- *Forecasting urban weather, comfort, hazards, air quality*
- *Topoclimatology of cities including the effects of coasts, valleys and other landforms*
- *Climates of impervious surfaces such as streets, highways, runways and parking lots*
- *Climatic performance of urban trees, lawns, gardens, parks, irrigation, rivers, lakes and reservoirs*
- *Climate sensitive urban design and planning*
- *Building climates (interior and exterior) and the climatic performance of built features*
- *Urban bioclimates relevant to the functioning of plants, wildlife and humans*
- *Cities and global climate change (urban climate adaptation and mitigation)*

Abstract Submission

Submission of extended abstracts: May 15, 2009 (following acceptance of short abstract)

Registration

- Online registration: April 1 – May 31, 2009
- Onsite registration: June 28 – July 3, 2009

Registration fees

	Online	*Onsite*
Full registration	65,000 JPY	70,000 JPY
Student/Retired	40,000 JPY	45,000 JPY
Accompanying person	12,000 JPY	15,000 JPY

Fees include access to all sessions, CD-ROM proceedings/program, on-site internet access.

The International Scientific Committee will be composed of the board members of the IAUC (http://www.urban-climate.org/)

Contact Information:

Manabu Kanda, Chairman
Secretariat of ICUC-7
Tokyo Institute of Technology
E-mail: icuc7secretariat.mk@ide.titech.ac.jp
Web site: http://www.ide.titech.ac.jp/~icuc7/

The scientific program is currently under preparation and will be posted on the conference web site as soon as it is available.

See more upcoming conferences on page 33 . . .

Recent publications in Urban Climatology

Here is the last compilation for papers published until February 2009. Thanks to everyone for their contribution.

If you have a peer-reviewed paper published since February 1 2009 please send us the reference for inclusion in the next newsletter with a header "IAUC publications" and the following format:

Author:

Title:

Journal:

Volume:

Pages:

Dates:

Keywords:

Language:

Abstract:

Happy reading,

Julia Hidalgo

jhidalgo@labein.es

Alcoforado, M.; Andradea, H.; Lopesa, A. & Vasconcelosa, J. (2009), Application of climatic guidelines to urban planning: The example of Lisbon (Portugal), *Landscape and Urban Planning* **90**(1-2), 56-65.

Coutts, A. M.; Beringer, J. & Tapper N. J. (2008), Investigating the climatic impact of urban planning strategies through the use of regional climate modelling: a case study for Melbourne, Australia, *International Journal of Climatology* **28**(14), 1835 - 1976.

Asawa, T.; Hoyano, A. & Nakaohkubo, K. (2008), Thermal design tool for outdoor spaces based on heat balance simulation using a 3D-CAD system, *Building and Environment* **43**(12), 2112-2123.

Bady, M.; Kato, S. & Huang, H. (2008), Towards the application of indoor ventilation efficiency indices to evaluate the air quality of urban areas, *Building and Environment* **43**(12), 1991-2004.

Barbaro, S.; Bonanno, A., B. M.; Rizzo, G. & Aronica, S. (2009), The impact of landfills on the air quality of towns: a simple heuristic model for the city of Palermo, *International Journal of Environment and Pollution* **36**(1-2-3), 287-304.

Bulut, Y.; Toy, S.; Irmak, M.; Yilmaz, H. & Yilmaz, S. (2008), Urban-rural climatic differences over a 2-year period in the City of Erzurum, Turkey, *Atmosfera* **21**, 121-133.

Calvo, A.; Pont, V.; Liousse, C.; Dupré, B.; Mariscal, A.; Zouiten, C.; Gardra, E.; Castera, P.; Lacaux, C.; Castro, A. & Fraile, R. (2008), Intra-Annual and monthly trends of the chemical composition of urban aerosols in Toulouse, France (CAPITOUL-Canopy and Aerosol Particles Interaction in TOulouse Urban Layer-experiment), *Meteorology and Atmospheric Physics* **102**(3-4), 307-323.

Cheng, Y.; Lee, S. C.; Cao, J.; Ho, K. F.; Chow, J. C.; Watson, J. G. & Ao, C. H. (2009), Elemental composition of airborne aerosols at a traffic site and a suburban site in Hong Kong, *International Journal of Environment and Pollution* **36**(1-2-3), 166-179.

Ćiçek, I.; Türkoğlu N. (2009), The effects of urbanization on water vapour pressure in a semi-arid climate, *Theoretical and Applied Climatology* **95**(1-2), 125-134.

Deng, Y.; Goodchild, M. F. & Chen, X. (2009), Using NDVI to define thermal south in several mountainous landscapes of California, *Computer & Geosciences* **35**(2), 327-336.

Dutkiewicz, V.; Alvi, S.; Ghauri, B.; Choudhary, M. & Husain, L. (2009), Black carbon aerosols in urban air in South Asia, *Atmospheric Environment* **43**(10), 1737-1744.

El-Askary, H.; Kafatos, M. (2008), Dust storm and black cloud influence on aerosol optical properties over Cairo and the Greater Delta region, Egypt, *International Journal of Remote Sensing* **29**(24), 7199-7211.

Farias, W.; Jr., O. P.; Naccarato, K. & Pinto, I. (2009), Anomalous lightning activity over the Metropolitan Region of Sao Paulo due to urban effects, *Atmos Research* **91**, 485-490.

Gál, T.; Lindberg, F. & Unger, J. (2009), Computing continuous sky view factors using 3D urban raster and vector databases: comparison and application to urban climate, *Theoretical and Applied Climatology* **95**(1-2), 111-123.

Garland, R.; Schmid, O.; Nowak, A.; Achtert, P.; Wiedensohler, A.; Gunthe, S. S.; Takegawa, N.; Kita, K.; Kondo, Y.; Hu, M.; Shao, M.; Zeng, L. M.; Zhu, T.; Andreae, M. O. & Pöschl, U. (2009), Aerosol optical properties observed during Campaign of Air Quality Research in Beijing 2006 (CAREBeijing-2006): Characteristic differences between the inflow and outflow of Beijing city air, *Journal of Geophysical Research Atmosphere* **114**, D00G04.

Gastellu-Etchegorry, J. (2008), 3D modeling of satellite spectral images and radiation budget of urban landscapes, *Meteorology and Atmospheric Physics* **102** (3-4), 187-207.

Gomes, L.; Veresoglou, Z.; Rojas, S.; Pont, V. & Mallet, M. (2008), Evolution of the chemical, microphysical and optical properties of aerosol particles in the Toulouse urban layer during CAPITOUL, *Meteorology and Atmospheric Physics* **102** (3-4), 289-306.

Gonçalves, M.; Jimenez-Guerrero, P. & Baldasano, J. M. (2009), High resolution modeling of the effects of alternative fuels use on urban air quality: Introduction of natural gas vehicles in Barcelona and Madrid Greater Areas (Spain), *Science of The Total Environment* **407**(2), 776-790..

Grote, R.; Lehmann, E.; Brümmer, C.; Brüggemann, N.; Szarzynski, J. & Kunstmann, H. (2009), Modelling and observation of biosphere?atmosphere interactions in natural savannah in Burkina Faso, West Africa, *Physics and Chemistry of the Earth*, Parts A/B/C **34**(1-2), 251-260.

Gál, T. & Unger, J. (2009), Detection of ventilation paths using high-resolution roughness parameter mapping in a large urban area, *Building and Environment* **44**(1), 198-206.

Han, J.; Yang, W.; Zhou, J.; Zhang, G.; Zhang, Q. & Moschandreas, D. J. (2009), A comparative analysis of urban and rural residential thermal comfort under natural ventilation environment, *Energy and Buildings* **41**(2), 139-145.

Hang, J.; Sandberg, M. & Li, Y. (2009), Effect of urban morphology on wind condition in idealized city models, *Atmospheric Environment* **43**(4), 869-878.

Hanna, S. & Baja, E. (2009), A simple urban dispersion model tested with tracer data from Oklahoma City and Manhattan, *Atmospheric Environment* **43**(4), 778-78.

Hidalgo, J.; Masson, V.; Baklanov, A.; Pigeon, G. & Gimeno, L. (2008), Advances in Urban Climate Modelling, *ANYAS* (Annals of the New York Academy of Sciences) issue on "Trends and directions in climate research" ISBN: 978-1-57331-732-0.

Hidalgo, J.; Masson, V. & Pigeon, G. (2008), Urban-breeze circulation during the CAPITOUL experiment: Numerical approach, *Meteorology and Atmospheric Physics* **102** (3-4), 243-262.

Hidalgo, J.; Pigeon, G. & Masson, V. (2008), Urban-breeze circulation during the CAPITOUL experiment: Experimental data analysis approach, *Meteorology and Atmospheric Physics* **102** (3-4), 223-241.

Holloway, T.; Spak, S.; Barker, D.; Bretl, M.; Moberg, C.; Hayhoe, K.; Dorn, J. V. & Wuebbles, D. (2008), Change in ozone air pollution over Chicago associated with global climate change, *Journal of Geophysical Research Atmosphere* **113**, D22306.

Holt, T.; Pullen, J. & Bishop, C. (2009), Urban and ocean ensembles for improved meteorological and dispersion modelling of the coastal zone, *Tellus A* **61**, 232-249.

Hopke, P.; Cohen, D. D.; Begum, B. A.; Biswas, S. K.; Ni, B.; Pandit, G. G.; Santoso, M.; Chung, Y.; Davy, P.; Markwitz, A.; Waheed, S.; Siddique, N.; Santos, F. L.; Pabroa, P. C. B.; Seneviratne, M. C. S.; Wimolwattanapun, W.; Bunprapob, S.; Vuong, T. B.; Hien, P. D. & Markowicz, A. (2008), Urban air quality in the Asian region, *Science of The Total Environment* **404**(1), 103-112..

Janjai, S.; Masiri, I.; Nunez, M. & Laksanaboonsong, J. (2008), Modeling sky luminance using satellite data to classify sky conditions, *Building and Environment* **43**(12), 2059-2073.

Jentsch, M.; Bahaj, A. B. S. & James, P. A. (2008), Climate change future proofing of buildings? Generation and assessment of building simulation weather files, *Energy and Buildings* **40**(12), 2148-2168.

Jia, Y.; Rahn, K. A.; He, K.; Wen, T. & Wang, Y. (2008), A novel technique for quantifying the regional component of urban aerosol solely from its sawtooth cycles, *Journal of Geophysical Research Atmosphere* **113**, D21309.

Kassomenos, P.; Karakitsios, S. & Pilidis, G. (2009), Daily variation of traffic emissions in Athens, Greece, *International Journal of Environment and Pollution* **36**(1-2-3), 324-335.

Kastendeuch, P. P. & Najjar, G. (2009), Simulation and validation of radiative transfers in urbanised areas, *Solar Energy* **83**(3), 333-341.

Katsoulis, B. D. & Pnevmatikos, J. D. (2009), Statistical analysis of urban air-pollution data in the Athens basin area, Greece, *International Journal of Environment and Pollution* **36**(1-2-3), 30-43.

Kolokotroni, M. & Giridharan, R. (2008), Urban heat island intensity in London: An investigation of the impact of physical characteristics on changes in outdoor air temperature during summer, *Solar Energy* **82**(11), 986-998.

Krüger, E.L. & Pearlmutter, D. (2008), The effect of urban evaporation on building energy demand in an arid environment, *Energy and Buildings* **40**(11), 2090–2098.

Kumar, P.; Garmory, A.; Ketzel, M.; Berkowicz, R. & Britter, R. (2009), Comparative study of measured and modelled number concentrations of nanoparticles in an urban street canyon, *Atmospheric Environment* **43**(4):, 949-95.

Lac, C.; F.Bonnardot; C.Camail; O.Connan; D.Maro; D.Hebert & M.Rozet (2008), Atmospheric dispersion experiment during CAPITOUL to evaluate an operational dispersion modelling systemEvaluation of a mesoscale dispersion modelling tool during the CAPITOUL Experiment, *Meteorology and Atmospheric Physics* **102** (3-4), 263-287.

Lachérade, S.; Miesch, C.; Boldo, D.; Briottet, X.; Valorge, C. & Men, H. L. (2008), ICARE: A physically-based model to correct atmospheric and geometric effects from high spatial and spectral remote sensing images over 3D urban areas, *Meteorology and Atmospheric Physics* **102** (3-4), 209-222.

Lagouarde, J. & Mark, I. (2008), The directional anisotropy in thermal infrared measurements over Toulouse during CAPITOUL experiment : first results, *Meteorology and Atmospheric Physics* **102** (3-4), 173-185.

Li, W.; Yang, C. & Sun, D. (2009), Mining geophysical parameters through decision-tree analysis to determine correlation with tropical cyclone development, *Computer & Geosciences* **35**(2), 309-316.

Marta, J.; Panão, O.; Gonçalves, H. J. & Ferrão, P. M. (2009), Numerical analysis of the street canyon thermal conductance to improve urban design and climate, *Building and Environment* **44**(1), 177-187.

Masson, V.; Gomes, L.; Pigeon, G.; Liousse, C.; Pont, V.; Lagouarde, J.; Voogt, J.; Salmond, J.; Oke, T.; Hidalgo, J.; Legain, D.; Garrouste, O.; C.Lac; O.Connan; Briottet, X. & Lachérade, S. (2008), The Canopy and Aerosol Particles Interactions in TOulouse Urban Layer (CAPITOUL) experiment, *Meteorology and Atmospheric Physics* **102** (3-4), 135-157.

Matsui, H.; Koike, M.; Takegawa, N.; Kondo, Y.; Griffin, R. J.; Miyazaki, Y.; Yokouchi, Y. & Ohara, T. (2009), Secondary organic aerosol formation in urban air: Temporal variations and possible contributions from unidentified hydrocarbons, *Journal of Geophysical Research Atmosphere* **114**, D04201.

McNabola, A.; Broderick, B. M. & Gill, L. W. (2009), A numerical investigation of the impact of low boundary walls on pedestrian exposure to air pollutants in urban street canyons, *Science of The Total Environment* **407**(2), 760-769.

Mole N. (2009), Some comments on 'The flow across a street canyon of variable width—Part 2: Scalar dispersion from a street level line source' by Serge Simoëns and James M. Wallace, *Atmospheric Environment* **43**(2), 479.

Nejadkoorki, F.; Nicholson, K.; Lake, I. & Davies, T. (2008), An approach for modelling CO2 emissions from road traffic in urban areas, *Science of The Total Environment* **406**(1-2), 269-278.

Newman, S.; Xu, X.; Affek, H. P.; Stolper, E. & Epstein, S. (2008), Changes in mixing ratio and isotopic composition of CO2 in urban air from the Los Angeles basin, California, between 1972 and 2003, *Journal of Geophysical Research Atmosphere* **113**, D23304.

Papanastasiou, D. K. & Melas, D. (2009), Climatology and impact on air quality of sea breeze in an urban coastal environment, *International Journal of Climatology* **29**(2), 305-315.

Pigeon, G.; Moscicki, M. A.; Voogt, J. A. & Masson, V. (2008), Simulation of Fall and Winter energy balance over a dense urban area using the TEB scheme, *Meteorology and Atmospheric Physics* **102** (3-4), 159-171.

Pullen, J.; Ching, J.; Sailor, D.; Thompson, W.; Bornstein, B. & Koracin, D. (2008), Open Access Progress Toward Meeting the Challenges of Our Coastal Urban Future, *Bulletin of American Meteorological Society* **89**, 1727–1731.

Ryu, Y. & Baik, J. (2009), Flow and dispersion in an urban cubical cavity, *Atmospheric Environment* **43**(10), 1721-1729.

Santamouris, M. (2009), Environmental quality of the built environment: the Joint 2nd PALENC07 and 28th AIVC conferences, International Journal of Sustainable Energy 28(1), 1--2.

Shooter, D. & Brimblecombe, P. (2009), Air quality indexing, *International Journal of Environment and Pollution* **36**(1-2-3), 305-323.

Simoëns, S. (2009), Response to comment of Nils Mole, *Atmospheric Environment* **43**(2), 479-480.

Souza, L. C. L.; Postigo, C. P.; Oliveira, A. P. & Nakata, C. M. (2009), Urban heat islands and electrical energy consumption, *International Journal of Sustainable Energy* **28**(1), 113-121.

Stathopoulou, M.; Synnefa, A.; Cartalis, C.; Santamouris, M.; Karlessi, T. & Akbari, H. (2009), A surface heat island study of Athens using high-resolution satellite imagery and measurements of the optical and thermal properties of commonly used building and paving materials, *International Journal of Sustainable Energy* **28**(1), 59-76.

Szymanowski, M. & Kryza, M. (2009), GIS-based techniques for urban heat island-spatialization, *Clim Research* **38**, 171-187.

Taseiko, O.; Mikhailuta, S.; Pitt, A.; Lezhenin, A. & Zakharov, Y. (2009), Air pollution dispersion within urban street canyons, *Atmospheric Environment* **43**(2), 245-252.

Unger, J. (2009), Connection between urban heat island and sky view factor approximated by a software tool on a 3D urban database, *International Journal of Environment and Pollution* **36**(1-2-3), 59-80.

Unkaševi, M. & Toši, I. (2009), Changes in extreme daily winter and summer temperatures in Belgrade, *Theoretical and Applied Climatology* **95**(1-2), 27-38.

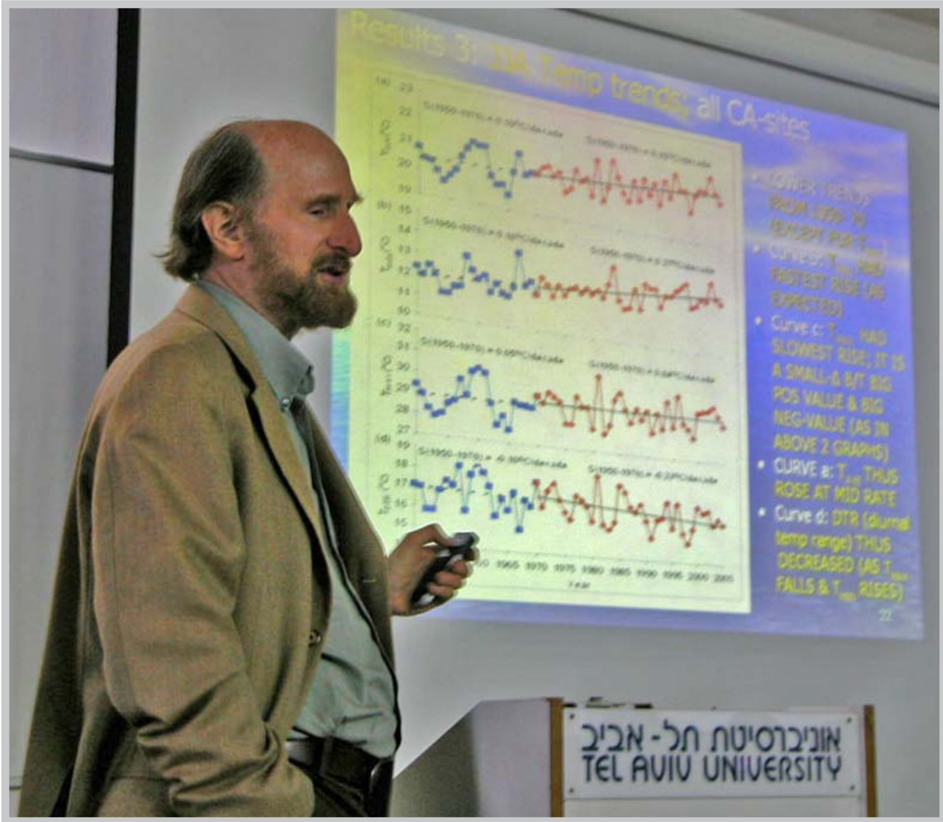
Laowagul, W.; Yoshizumi, K.; Mutchimwong, A.; Thavipoke, P.; Hooper, M.; Garivait, H. & Limpaseni, W. (2009), Characterisation of ambient benzene, toluene, ethylbenzene and m-, p- and o-xylene in an urban traffic area in Bangkok, Thailand, *International Journal of Environment and Pollution* **36**(1-2-3), 241-254.

Yilmaz, S.; Toy, S.; Irmak, M.; Yilmaz, H. & Bulut, Y. (2008), Determination of temperature differences between asphalt concrete, soil and grass surfaces in the city of Erzurum, Turkey, *Atmosfera* **21**, 135-146.

Zhang, C.; Chen, F.; Miao, S.; Li, Q.; Xia, X. & Xuan, C. (2009), Impacts of urban expansion and future green planting on summer precipitation in the Beijing metropolitan area, *Journal of Geophysical Research Atmosphere* **114**, D02116.

Zinzi, M. & Fasano, G. (2009), Properties and performance of advanced reflective paints to reduce the cooling loads in buildings and mitigate the heat island effect in urban areas, *International Journal of Sustainable Energy* **28**(1), 123--139.

Bob Bornstein honored with 2008 IAUC Luke Howard Award



Professor Bob Bornstein, this year's recipient of the Luke Howard Award, delivering a recent guest lecture on urban climate at Tel Aviv University.

The IAUC Board is delighted to announce that **Bob Bornstein** is the winner of the **2008 IAUC Luke Howard Award**.

Over the last three decades Professor Bob Bornstein has shown an outstanding commitment to the field of urban meteorology. His determination, intellectual curiosity, intuition and scientific insight have resulted in seminal papers in at least three key areas of urban meteorology, including urban heat island influences on thunderstorm development, air pollution meteorology, and mesoscale modeling of urban areas.

Demonstrating the benefits of an integrated measurement-modelling approach, Professor Bornstein's work has provided a significant contribution to our understanding of the urban boundary layer. Using a combination of observational, theoretical, statistical and numerical modelling approaches, he has published key papers which have improved our understanding in many areas of urban climate – including urban boundary layer structure, air pollution, urban heat islands, urban modification of frontal systems, climates of tropical cities, and the use of remote sensing in urban planning.

Professor Bornstein is perhaps best known for his work on the urban climates of New York City (NYC) in their many dimensions. Here he demonstrated what can be achieved by the continual probing of observational data, which over the years he subjected to different analyses to test hypotheses and evaluate new ideas. The understanding and pioneering insights into urban boundary layer processes developed as a result of this meticulous process have resulted in many subsequent successful studies based on the solid foundations of his ideas.

Professor Bornstein has also dedicated himself to teaching and university service. He has supported and mentored 30 graduate students. He has received notable academic awards such as the San José State University Outstanding Professor and the Phi Kappa Phi award for distinguished academic achievement. His leadership, enthusiasm and energy within the urban community is reflected in his continuing and extensive involvement in numerous conferences, workshops and meetings, his generosity with his time and his willingness to serve the community.

Professor Bornstein has also contributed to the development and wider recognition of the field of urban meteorology within the scientific community. As a Journal editor for *Atmospheric Environment*, and associate editor of both *Environmental Software* and the *Journal of Applied Meteorology* he has helped ensure the scientific integrity and high standards of urban meteorological research within peer reviewed literature.

In many ways Professor Bornstein epitomizes the qualities for which the Luke Howard Award stands. His passion for research, dedication to students, enthusiastic service to the wider community and tireless devotion to the subject and the enduring quality of his work have provided a secure foundation for the subject and serve as a model for future generations of scientists.

Bob Bornstein is Professor of Meteorology in the Meteorology Department of San José State University, San Jose, USA (http://www.met.sjsu.edu/faculty/bornstein/bornstein.html).

Jennifer Salmond
Interim-Chair IAUC Awards Committee

Upcoming Conferences...

"MEGACITIES: AIR QUALITY & CLIMATE IMPACTS FROM LOCAL TO GLOBAL SCALES," SPECIAL SESSION AT EGU GENERAL ASSEMBLY

Vienna, Austria • April 19-24, 2009

http://meetingorganizer.copernicus.org/EGU2009/session/247

FOURTH JAPAN-CHINA-KOREA JOINT CONFERENCE ON METEOROLOGY

Tsukuba City • May 26-28, 2009

http://wwwsoc.nii.ac.jp/msj/jckjc09/index.html

CITY FUTURES IN A GLOBALISING WORLD: AN-INTERNATIONAL CONFERENCE ON GLOBALISM AND URBAN CHANGE

Madrid, Spain • June 4-6, 2009

http://www.cityfutures2009.com/

FIFTH URBAN RESEARCH SYMPOSIUM ON "CITIES AND CLIMATE CHANGE: RESPONDING TO AN URGENT AGENDA"

Marseille, France • June 28-30 (+ special day July 1), 2009

http://www.urs2009.net/index.html

INTERNATIONAL CONFERENCE ON MEGACITIES: RISK, VULNERABILITY AND SUSTAINABLE DEVELOPMENT

Leipzig, Germany • September 7-10, 2009

http://www.megacity-conference2009.ufz.de/

COUNTERMEASURES TO URBAN HEAT ISLAND IN LBL: SECOND INTERNATIONAL CONFERENCE

Berkeley CA, USA • September 21 – 23, 2009

http://heatisland2009.lbl.gov

Board Members & Terms

- Toshiaki Ichinose (National Institute for Environmental Studies, Japan): 2007-2011
- Benedicte Dousset (Hawai`i Institute of Geophysics and Planetology, USA): 2006-2010
- Rohinton Emmanuel (Glasgow Caledonian University, UK): 2006-2010; Secretary-Elect, 2009-2010
- Kevin Gallo (National Oceanic and Atmospheric Administration (NOAA), USA): 2006-2010
- Petra Klein (University of Oklahoma, USA): 2007-2011
- Sue Grimmond (King's College London, UK): 2000-2003; President, 2003-2007; Past President, 2007-2009*
- Manabu Kanda (Tokyo Institute of Technology, Japan): 2005-2009, ICUC-7 Local Organizer, 2007-2009.
- Sofia Thorsson (University of Gothenburg, Sweden): 2008-2012
- Sven Lindqvist (Göteborg University, Sweden): ICUC-6 Local Organizer, 2004-2006*
- Gerald Mills (UCD, Dublin, Ireland): 2007-2011; President-Elect, 2009-2010
- Tim Oke (University of British Columbia, Canada): President, 2000-2003; Past President, 2003-2006; Emeritus President 2007-2009*
- Matthias Roth (National University of Singapore, Singapore): 2000-2003; Secretary, 2003-2007; Acting-Treasurer 2006; President 2007-2009
- Jennifer Salmond (University of Birmingham, UK): 2005-2009; Secretary, 2007-2009
- James Voogt (University of Western Ontario, Canada), 2000-2006; Webmaster 2007-*

* appointed members

IAUC Committee Chairs

Editor IAUC Newsletter: David Pearlmutter
Bibliography Committee: Julia Hidalgo
Membership Committee: TBA
Nominating Committee: Tim Oke
Int. Representative Committee: TBA
Chair Teaching Resources: Gerald Mills
Interim-Chair Awards Committee: Jennifer Salmond
WebMaster: James Voogt

Newsletter Contributions

The next edition will appear in late June. Items to be considered for the next edition should be received by **May 31, 2009**. The following individuals compile submissions in various categories. Contributions should be sent to the relevant editor:

News: Winston Chow (wtchow@asu.edu)
Conferences: Jamie Voogt (javoogt@uwo.ca)
Bibliography: Julia Hidalgo (jhidalgo@labein.es)
Projects: Sue Grimmond (Sue.Grimmond@kcl.ac.uk)

General submissions should be relatively short (1-2 A4 pages of text), written in a manner that is accessible to a wide audience and incorporate figures and photographs where appropriate. In addition we like to receive any images that you think may be of interest to the IAUC community.