Issue No. 4
April, 2004.

IAUC Newsletter

International Association for Urban Climate

www.urban-climate.org

President's Column

Nominations: I would like to remind you that the nominations for the IAUC Board close on April 13th (see page 13). I would encourage you to think about standing yourself or nominating someone else. Most of our business is done via email. We need for people to be actively involved in the Board to ensure the success of IAUC.

Named Awards: The Howard family have very graciously agreed to the name of Luke Howard being used in association with the IAUC's award for outstanding contributions in urban climatology (see p14). Also, the family of William (Bill) Lowry have very generously proposed to provide support for graduate awards in recognition of the many contributions of Bill to urban climatology and biometeorology.

ICUC6: The next ICUC conference is to be held in Gothenburg (Göteborg) Sweden in 2006 (www.gvc.gu.se/icuc6/index.htm). Professor Sven Lindqvist, chair of the local organizing committee, has joined the Board of IAUC as an ex-officio member. Göteborg University is the home to a large group of urban and road climatologists (www.gvc.gu.se/ngeo/urban/Urban.htm).

Newsletters: Please think about submitting contributions to the next newsletter. Please contact either Gerald Mills (gerald.mills@ucd.ie) and/or me. We are always open to suggestions of other items that could be included and/or people that could be approached to prepare a short piece. Also, we would welcome feedback about the newsletters. The deadline for the next newsletter is May 31.

Membership: We are looking for individuals to join the membership committee to help us disseminate information about IAUC especially to countries where we have small number of members. If you would like to join this committee please contact Janet Barlow (j.f.barlow@reading.ac.uk).

Had a paper published recently? Let us know about it. Please email details to Jenny Salmond (j.salmond@bham.ac.uk) so she can include it in the list in the next Newsletter.

Contents

Conferences of interest to IAUC Members. Please provide us with information about urban climate related conferences. We can send out announcements on our email list (urbclim@lists.acs.ohio-state.edu) and email the information to James Voogt (javoogt@uwo.ca) so it can be included in a list in the next Newsletter and put onto our web site.

Website: We are in the midst of changing the location of our website. Please make certain that you use www.urban-climate.org as the url to ensure that you stay connected.

I want to extend my sincere thanks to **John Arnfield** for serving as the IAUC the webmaster. He has provided this support from the beginning of IAUC and it has been critical to the growth of the organization. I am pleased to announce that **James Voogt** will be the new IAUC webmaster.

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President, IAUC

Urban Software

www.townscope.com

TownScope III software provides powerful visual and analysis tools that support the process of urban design decision-making in a sustainable development perspective. This version is partly based on the TownScope 2.0 version developed at the Laboratory of Architectural Methodology (LEMA) at the University of Liege (Prof. A. Dupagne) by S. Azar, J. Teller and P. Petillon during the POLIS research project (1996-98). POLIS was funded by the European Commission (DG XII - Directorate 'F' - R&TD: Energy project) and was devoted to urban planning research actions to improve solar access, passive cooling and microclimate [1]. TownScope 2.0 built upon research at LEMA on sustainable urban design, which focused on direct solar radiation.

TownScope III couples a three-dimensional urban information system with design analysis tools. It is distinguished by its use of visual tools that present the results of environmental analyses and allow easy comparison between design options. Together, the visualization and computation tools, allow the designer to visualize, evaluate and compare different options for one given project.

Visualisation Tools: These help the user to visually understand the influence of some construction on its environment. For example, a stereographic projection of solar paths (Fig. 1a) shows the obstruction mask generated by the urban scene and the sky paths of the sun for one day of each month (15^{th}) at one given position. From this information daylight shadings for any day of the year and any hour can be obtained (Fig. 1b).

Computation Tools: These calculate elements of the urban microclimate affected by design decisions and consist of:

- Assessment of the direct, diffuse and reflected solar radiation.
- Evaluation of human thermal comfort in an urban open space.
- Analyses of Sky opening, View lengths and Visibility that provide attributes of the perceptive qualities of urban open spaces.

The first two computations listed above can be performed at any geographical location and for any day of the year. The user specifies the latitude of the urban site and provides monthly mean values of some meteorological parameters (humidity, turbidity, cloudiness, etc). Surface opacities and vegetation mask values (by month) are integrated and used in the calculation of direct and diffuse radiation receipt. The user can attribute these properties graphically to any geometrical surface in the urban scene. Diffuse sky radiation can be calculated using either isotropic or non-isotropic modes. To assess thermal comfort, TownScope uses the solar access processor to compute the received energies and calculates (in a rough way) the long-wave radiation emitted by the surrounding surfaces. The results of this analysis are four values: sweat rate, sweat evaporation rate, skin wetness and sensation temperature. The third computation tool listed above evaluates the shape (morphology) of urban open spaces and is not discussed here.

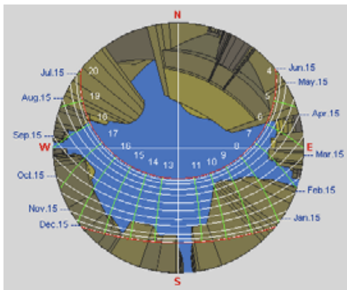

Fig. 1a: Solar paths projection.

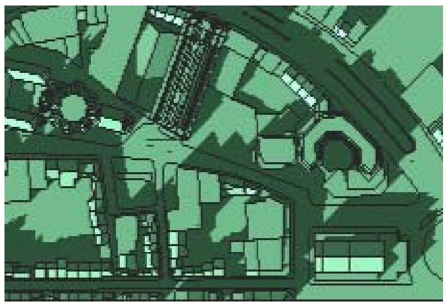

Fig. 1b: Daylight shadings rendering.

Any analysis of a project requires three components: the urban scene (obtained from any supported CAD file); a selected computation tool and; a selected element at which calculations are performed. Analyses can be performed for single points, a sequence of points or a selected area.

All the analyses are completed using spherical projections. In the case of solar access, the calculation of direct radiation receipt uses a stereographic projection to determine the obstruction mask for the selected points. Diffuse radiation receipt is obtained using an orthogonal projection to determine the sky visible portion ratio (sky view factor). These two calculations (mask, visible sky), combined with the maximum possible values computed from the meteorological data, generate the direct and diffuse energy flux values. The orientation of the calculated surface is very important. For example, at high northern latitudes, in December, south facing vertical surfaces will receive more direct radiation than horizontal surfaces. Figure 3a shows the results of a solar access analysis on horizontal surface element (direct energy for March 15). Executing the same analysis for the same element using two different urban designs, allows the user to compare these projects in terms of their affect on solar access. In Figure 3b a comparison between two projects (A and B) for direct radiation receipt at noon on March 15 is shown. The drawn values are (Results_A – Results _B). The modified surfaces of project B are framed in light grey within the results view.

For solar access analysis only, TownScope allows comparison to unobstructed site values, thus showing the solar energy (direct and diffuse) lost due to buildings (Fig. 4).

There are many more tools and utilities available in TownScope III. In this paper we focused mainly on those concerning the solar access assessment. A trial version of the software is available on the website (www.townscope.com). Please feel free to download it, try it and send me any comments or suggestions.

Information about spherical projections and urban terminology is available at the LEMA – University of Liege Website: www.lema.ulg.ac.be/tools/audience/

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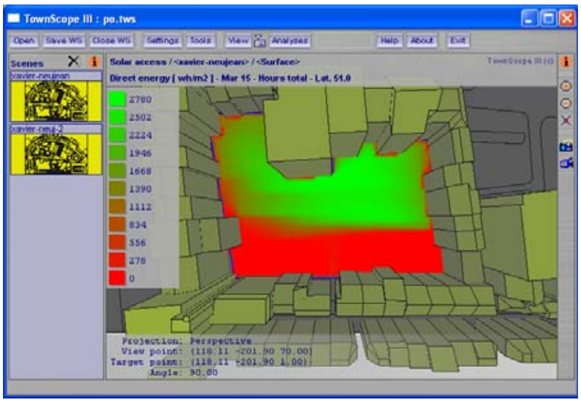

Figure 3a: Direct solar radiation receipt on a horizontal surface on March 15.

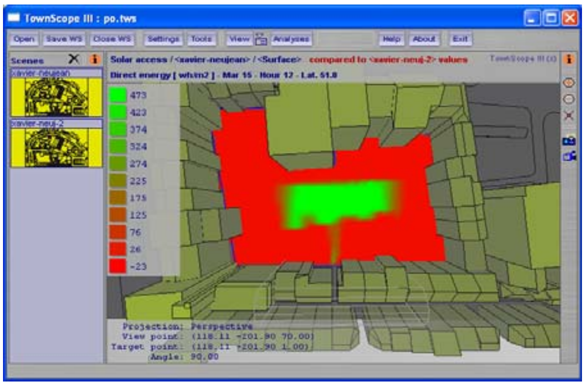

Figure 3b: Comparison between two urban projects in terms of direct solar radiation receipt on a horizontal surface at noon on March 15.

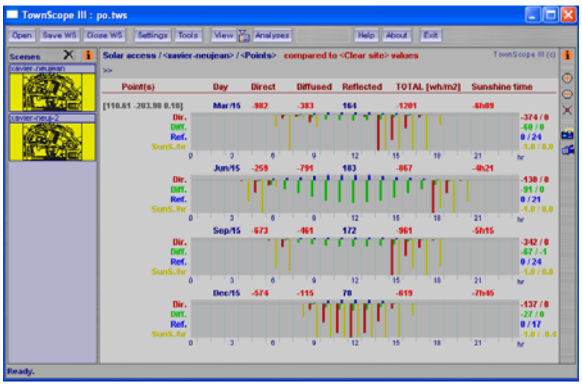

Fig. 4: Solar access results for a selected point element.

1. Teller J. and Azar S. 2001: TOWNSCOPE II—A computer system to support solar access decision-making. Solar Energy 70, 187-200.

Old News: Urban Climatology and the Art of Leaping.

Being invited to write about my perspective on the study of urban climates in this IAUC newsletter, I must confess that I won't write about anything really new. Instead, I am going to write about something admirably old. In this respect, I enjoy being out of fashion.

Facing an old problem, however, does not mean to face something with no significance for us today. On the contrary, if we take old problems as those that obviously cannot be solved easily, then an old problem deserves special attentiveness: as we may struggle incessantly with the problem – and sometimes unwittingly fall into its traps.

Allow me, therefore, to direct your attention to what I would like to call the overall undertaking of urban climatology: namely to *scientifically* get hold of (or grip) urban climate as something which, in the end, interests or concerns us as human beings in a *(non-scientific) everyday world*. (At least, we like to remember this everyday world significance when applying for funds.)

Of course, each member of the IAUC is positioned differently within this overall undertaking. Some of us are involved in the development of abstract physico-mathematical models, some measure energy fluxes to investigate the processes that cause certain urban climate phenomena, some investigate the significance of certain geographical factors, some do field measurements to find out about the spatial extension of a specific urban climate phenomenon, some are interested in economic effects, some deal with urban planning recommendations, some try to optimize biometeorological models, some interview people about urban climate matters, etc. According to these different approaches, the members of the IAUC might work at desks (with their PC), in laboratories, in "the field", in conference rooms, etc.

These different places reflect different functional-cultural contexts which appear to be more or less open to or protected from everyday world elements and relations. Furthermore, as we speak of flux densities and heat capacities, velocities and temperatures, coordinates and sky view factors, urban plumes, park cool islands, urban canyons, greenbelts, comfort and people, we obviously use (a mixture of) different languages which range from an abstract idealized language of mathematics and physics to the everyday world language.

This interweavement of approaches that have varying degrees of "closeness" to the everyday world (or abstractness respectively) may suggest that there is a continuum extending from the everyday world to the abstract idealized world, along which one can "slide" easily and uncritically in both directions. In the routine of our scientific life we often act as if we could "slide" in this way. That is we tend to forget that in the course of our practical and theoretical activities we move between layers that belong to a variety of different functional-cultural contexts or fields of meaning and languages. In the same way we usually do not reflect upon what I have described above as the overall undertaking of urban climatology. By taking this "overall undertaking" for granted, we tend to forget that we are entangled in a very fundamental and very old problem of science in general: the inevitable discrepancy between the scientific approach to a phenomenon and our everyday world experience of that phenomenon.

When we accept this fundamental problem, it is not possible to think of a continuum and to "slide" uncritically between the everyday world and an abstract idealized world of physics and mathematics (and the variety of layers between these "extremes", e.g. those referring to geographical factors). Rather we have to accept and recognise that there are "gaps" that we have to (or try to) leap across. The most fundamental gap is the one between the scientific approach to urban climate and people's everyday world experience of it, but by the practical and theoretical activities within each urban climatological study we also come across "smaller" gaps between (elements of) different functional-cultural contexts and languages. We leap across such gaps by interpretation (and never 1:1 relations). As these gaps can be of varying "size" and as interpretations (or "leaps") always imply transformations, we have to make sure we do not lose sight of each leap's starting point. Only then we can keep in mind the inevitable discrepancy between what is to be interpreted and the actual interpretation, and minimize the danger of transformations that have gone too far or not far enough, and of interpretations that are wrong, inappropriate or unfounded. The fact that the different fields of meaning, which we try to connect by these leaps, are entangled with each other by history and culture, can veil our sight of these gaps and thereby lead to misinterpretations. But without this entanglement we would not be able to interpret – to do urban climatology at all. This implies that we do not only need very sophisticated scientific methods and elaborated abstract theories, but *also* our non-scientific everyday world experience for doing urban climatology in a critical way. We have to leave *and* get or stay close(r) to *both* of these "opposite worlds" at the same time. This is what I regard to be the fundamental problem and challenge of (urban) climatology (see Fig. 1).

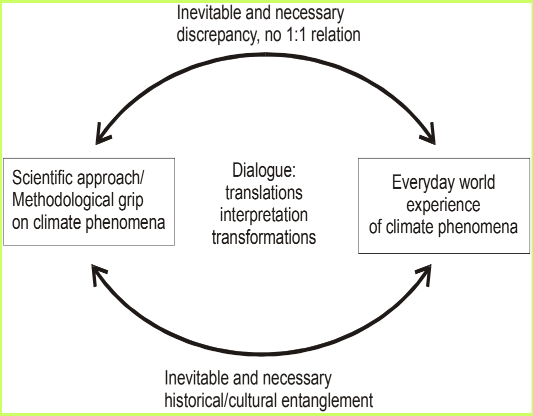

Figure 1: The fundamental problem and challenge of (urban) climatology.

Not all of the approaches within urban climatology are confronted with this fundamental and insolvable problem (and challenge) to the same degree. But even "pure" physical or mathematical approaches remain tied to it, because they are performed by human beings who have learnt climatology on the basis of their everyday world experiences. Those studies are tied to the problem strongest, which cherish or produce the illusion of being able to solve it, like those that model human bioclimatology (or biometeorology). However, the gap between measured and calculated quantities and the qualities that are experienced bodily by *human* (not only physiological) beings can never be closed, no matter how hard we try.

In my studies (see references), I have begun to illuminate this fundamental climatological problem and its manifold variations. My research is based on my own practical experience in urban climatology and incorporates the philosophical positions of hermeneutics and phenomenology. I attempt to expose a complex variety of different layers of meaning (belonging to the world of science and/ or to the everyday world) that come into play and interact in urban climatological interpretations: consciously or unconsciously, explicitly or implicitly, in an illegitimate way or in a very fruitful way which helps to revise previous inadequate interpretations. Thereby I try to reveal characteristic features of (urban) climatological thinking, whose dimensions cannot be measured, modelled or calculated, but rather need an experienced researcher and a certain attitude of openness which keeps in mind the discrepancy between what is to be interpreted and the actual interpretation.

Such an attitude, which we usually do not explicate in the natural sciences, is the core of human sciences or arts. I thus advocate abandoning an absolute distinction between these and the natural sciences. To decide to seriously take up such a modified self-understanding in urban climatology, means to concentrate not only on urban climatological methods and theories, but also on fundamental problems that come along with the challenge of our overall undertaking. Of course, this won't make these problems disappear. But at least, it would help us to orientate ourselves in the jungle of dimensions or variations that these problems show, and help us not to fall into their traps. What of attempts to predict not only physiological thermal "comfort", but even human behaviour such as the route that people select through city streets by means of a bioclimatological approach? Does this make a difference? Yes, it does. Some of the "gaps" are and will always be too big to dare to leap.

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Urban Project Report

FUMAPEX

Integrated Systems for Forecasting Urban Meteorology, Air Pollution and Population Exposure

The main problem in forecasting urban air pollution (UAP) is the prediction of episodes with high pollutant concentration in urban areas where most of the well-known methods and models, based on in-situ meteorological measurements, fail to realistically produce the meteorological input fields for the UAP models.

UAP models in operational Urban Air Quality Information and Forecasting Systems (UAQIFS), as a rule, use simple in-situ meteorological measurements which are fed into meteorological pre-processors. Lacking an adequate description of physical phenomena and the complex data assimilation and parameterisations of numerical weather prediction (NWP) models, these pre-processors do not achieve the potential of NWP models in providing all the meteorological fields needed by modern UAP models to improve the urban air quality forecasts. However, during the last decade substantial progress in NWP modelling and in the description of urban atmospheric processes was achieved. Modern nested NWP models are utilising land-use databases down to hundred meters resolution or finer, and are approaching the necessary horizontal and vertical resolution to provide weather forecasts for the urban scale. In combination with the recent scientific developments in the field of urban sublayer atmospheric physics and the enhanced availability of high-resolution urban surface characteristics, the capability of the NWP models to provide high quality urban meteorological data will therefore increase.

Despite the increased resolution of existing operational NWP models, urban and non-urban areas mostly contain similar sub-surface, surface, and boundary layer formulation. These do not account for specifically urban dynamics and energetics and their impact on the numerical simulation of the atmospheric boundary layer and its various characteristics (e.g. internal boundary layers, urban heat island, precipitation patterns). Additionally, NWP models are not primarily developed for air pollution modelling and their results need to be designed as input to urban and mesoscale air quality models. Therefore, UAQIFS requires a revision of the conventional conception of urban air pollution forecasting.

A new European Union research project "Integrated Systems for Forecasting Urban Meteorology, Air Pollution and Population Exposure" (FUMAPEX) was initiated by COST Action 715 scientists to address these research needs. This work falls within the bounds of the Fifth Framework Programme (FP5), Sub-programme: Environment and Sustainable Development, Key Action 4: City of Tomorrow and Cultural Heritage. FUMAPEX is a member of the CLEAR cluster of European Urban Air Quality Research (www.nilu.no/clear).

The main objectives of FUMAPEX (Nov. 2002 – Nov. 2005) are to improve meteorological forecasts for urban areas, to connect numerical weather prediction models to urban air pollution and population exposure (PE) models, to build improved Urban Air Quality Information and Forecasting Systems, and to demonstrate their application in cities subject to various European climates. The FUMAPEX scheme to accomplish these is shown in Figure 1.

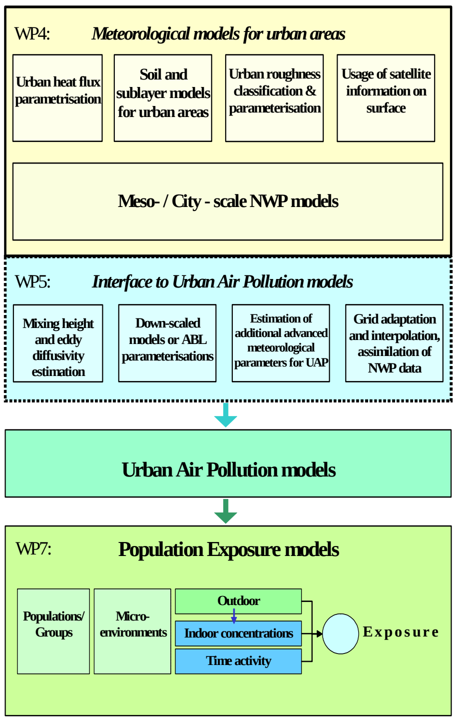

Figure 1. FUMAPEX scheme of the improvements of meteorological forecasts (NWP) in urban areas, interfaces and integration with urban air pollution (UAP) and population exposure (PE) models for the Urban Air Quality Information Forecasting and Information Systems (UAQIFS).

Urban Project Report

The improvement of urban meteorological forecasts will also provide information to city management regarding additional hazardous or stressing urban climate (e.g. urban runoff and flooding, icing and snow accumulation, high urban winds or gusts, heat or cold stress in growing cities and/or a warming climate). Moreover, the availability of reliable urban scale weather forecasts could be of relevant support for the emergency management of fires, accidental toxic emissions, potential terrorist actions etc.

In order to achieve the innovative project goal of establishing and implementing an improved new UAQIFS to assist sustainable urban development, the following steps will be achieved:

1. Improve predictions of the meteorological fields needed by UAP models by refining resolution and developing specific parameterisations of the urban effects in NWP models,
2. Develop suitable interface/meteorological pre-processors from NWP to UAP models,
3. Validate the improvements in NWP models and meteorological pre-processors by evaluating their effects on the UAP models against urban measurement data,
4. Apply the improved meteorological data to UAQIFS, emergency preparedness and population exposure models and compare and analyse the results, and
5. Successfully link meteorologists/NWP modellers with urban air pollution scientists and the 'end-users' of UAQIFS.

The necessary steps are evolved in ten separate, but inter-linked Work Packages realised by 16 participants and 6 subcontractors. They represent the following NWP centres, research organisations, local/city authorities from ten European countries: Danish Meteorological Institute (A. Baklanov, A. Rasmussen), German Weather Service (B. Fay), Hamburg University (M. Schatzmann), Centro De Estudios Ambientales Del Mediterrano (M.M. Millàn), Ecole Centrale de Nantes (P. Mestayer), Finnish Meteorological Institute (J. Kukkonen), ARIANET (S. Finardi), Environmental Protection Agency of Emilia-Romagna Region (M. Deserti), Norwegian Meteorological Institute (N. Bjergene), Norwegian Institute for Air Research (L.H. Slordal), University of Hertfordshire (R. Sokhi), INSA CNRS-Universite-INSA de Rouen (CORIA, A. Coppalle), Finnish National Public Health Institute (M. Jantunen), Environmental Protection Agency of Piedmont (F. Lollobrigida), Joint Research Center (A. Skouloudis), Swiss Federal Institute of Technology (A. Clappier, M. Rotach), and subcontractors: S. Zilitinkevich (Uppsala University), G. Schayes (Université catolique de Louvain), Danish Emergency Management Agency (S.C. Hoe), Helsinki Metropolitan Area Council (P. Aarnio), Norwegian Traffic Authorities (P. Rosland), Municipality of Oslo (I. Myrtveit).

BOX 1

The Work Package Structure

- WP 1: Analysis and evaluation of air pollution episodes in European cities (lead by J. Kukkonen, FMI)
- WP 2: Assessment of different existing approaches to forecast UAP episodes (lead by R.S. Sokhi, UH)
- WP 3: Testing the quality of different operational meteorological forecasting systems for urban areas (lead by B. Fay, DWD)
- WP 4: Improvement of parameterisation of urban atmospheric processes and urban physiographic data classification (lead by A. Baklanov, DMI)
- WP 5: Development of interface between urban-scale NWP and UAP models (lead by S. Finardi, Arianet)
- WP 6: Evaluation of the suggested system (UAQIFS) to uncertainties of input data for UAP episodes (lead by N. Bjergene, DNMI)
- WP 7: Development and evaluation of population exposure models in combination with UAQIFS's (lead by M. Jantunen, KTL)
- WP 8: Implementation and demonstration of improved Urban Air Quality Information and Forecasting Systems (lead by L.H. Slørdal, NILU)
- WP 9: Providing and dissemination of relevant information (lead by A. Skouloudis, JRC)
- WP10: Project management and quality assurance (lead by A. Rasmussen, DMI).

<u>Project Implementation</u>: The project will proceed through the steps listed in BOX 2. The completion of each separate objective will provide valuable results.

The current status and recent achievements of FUMAPEX are published in the following papers and reports.

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BOX 2

PROJECT IMPLEMENTATION

Classification of air pollution episodes focusing on relevant meteorological variables.

- Identification and classification of various types of air pollution episodes in cities located in different European climatic and geographic regions.
- Key pollutants relevant to EU Air Quality Directives and Daughter Directives (EC/96/62; EC/99/30) will be selected for different regions/city characteristics.
- Classification of meteorological conditions leading to pollution episodes and identification of the more relevant meteorological parameters to define these conditions in various European climatic regions.
- Compilation and analysis of existing datasets of concentration and meteorological data measured during pollution episodes in different European climatic and geographic regions.

Improvement of the quality of urban meteorological forecasting for urban air pollution and population exposure models.

- Improvement of urban weather forecasts and calculation of key meteorological parameters for pollution episodes. A hierarchy of NWP models from large scale global circulation models to local-scale obstacle-resolving meteorological models will be employed.
- Improvement of boundary layer formulations/ parameterisations and physiographic data description for urban areas.
- Development of assimilation techniques with satellite remote sensing data in NWP models.
- Development of interfaces to connect NWP to UAP models.

Verification of the improved NWP, UAP and PE models

- Evaluation of improved urban meteorological forecast models based on urban air pollution episode.
- Estimation of sensitivity of UAP models to uncertainties in meteorological input data.
- Evaluation of the impact of the improved output of the UAQ models on simulations of an urban population exposure (PE) model.

Application of UAQIFS and emergency systems

- Integration of the improved NWP, UAP and PE models into UAQIFSs. Implementation of the new improved UAQIFS in air quality forecasting mode to be applied in four target cities, in urban management or public health and planning mode in one selected target city, and of the emergency preparedness system in one selected target city.

Six target city candidates for the improved systems implementations are the following: Oslo (Norway), Turin (Italy), Helsinki (Finland), Castellon/Valencia (Spain), Bologna (Italy), Copenhagen (Denmark).

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Country Report

Urban Climate Research in Mexico

This report deals briefly with the development and present activities in the field of urban climatology in Mexico. This area of research had its start in the early 1970's with descriptive accounts of the most relevant climate changes observed in large cities and particularly in Mexico City [3].

In recent times, two conferences focusing on the urban climate in the tropical environment provided the stimulus for further work in urban climatology in Mexico. In 1984, the Technical Conference on Urban Climatology and its Applications with Special Regard to Tropical Areas sponsored by WMO and the National Meteorological Service took place in Mexico City. In the early 1990's, the International Symposium on Urban Climate, Air Pollution and Planning occurred in Guadalajara and was sponsored by the Mexican Meteorological Society and the TRUCE (Tropical Urban Climate Experiment) Group of the WMO. One specific objective of the first phase of the TRUCE project was the compilation of available knowledge related to urban climates particularly in tropical regions. In conformity with this plan the first author as a member of the TRUCE Group prepared a series of bibliographies in the 1990's that were published [5, 6].

At present there are small university groups (composed of one researcher and one or two students) of urban climatologists working in the cities of Puebla, Mexicali, Jalapa and Mexico City. Most of this work relates to temperature, wind, humidity and precipitation patterns derived from surface (screen) level observations. Temperature time trends at a single station have been used to determine the long-term evolution of urban heat islands [4, 11]. Since the mid-1980's Mexico City has been the site of four energy budget studies, at both suburban and central city sites. The suburban sites were at the Observatory [8] and the university reserve [1] (Figure 1). The city sites were located in the densely built central area [9, 10]. Surface energy balance measurements have also been performed in the desert city of Mexicali, which is located on the U.S. Mexico border [2]. Recently a simulated climate response to historical land use changes in the Mexico City region has been attempted to determine in what measure the observed long-term warming trend of the urban area could be attributed not only to the increasing urbanization of the capital city but also to the drastic reduction of the once extensive lacustrine system that existed in the valley of Mexico during the first half of the 20th century [5].

Ongoing research focuses on characterization of heat-waves in fast growing large cities of Northern Mexico, long-term temperature trends observed in large conurbations in Mexico as well as bioclimatic maps of the country using such indices as PMV, PET, etc.

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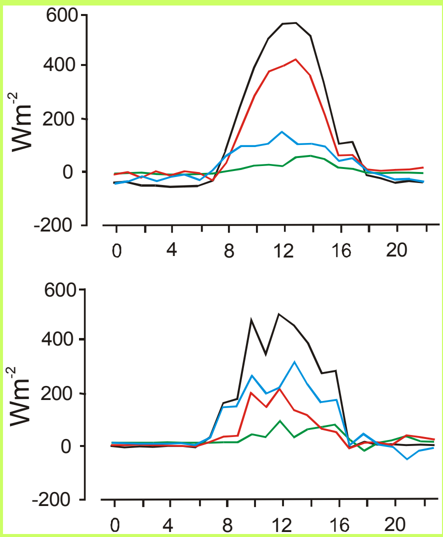

Figure 1. Energy balance components at a suburban vegetated site in Mexico City. Redrawn from [1]. The colours represent net radiation (black), sensible (red), latent (blue) heat fluxes and heat storage (green). The graphs represent the dry (upper, May 16) and wet (lower, June 28) season.

Conferences

European Meteorological Society
4th Annual Meeting
Nice, France
26-30 September 2004.

Dear Colleagues, we hereby would like to draw your attention to the 4th Annual Meeting of the European Meteorological Society (EMS) and especially Session AW12: **Urban meteorology, climate and pollutant dispersion**.

Deadline for receipt of abstracts: 23 May 2004
Deadline for pre-registration: 30 June 2004
Further information can be found at: www.emetsoc.org/EMS4 and www.emetsoc.org/ECAC

Possible topics for the session AW12: Development, validation and implementation of models for urban areas and street scales; Mesoscale meteorology and air quality modeling; Theoretical and experimental work to understand urban processes and feed-backs with larger scale processes/circulations: Meteorology/microclimate induced by cities and conurbations; Contribution of emissions/concentrations from conurbations to the regional and global loading; Long-range transport between cities and regional/continental scale (i.e. both ways); Analysis of air pollution episodes affecting conurbations; Short distance dispersion modeling over urban/heterogeneous condition; Integrated systems for urban meteorology, air quality and population exposure forecasting. The session is sponsored by COST 175, FUMAPEX, CLEAR, EURASAP, and WMO/GURME.

We are looking forward to seeing you at this meeting and would very much appreciate if you could forward this message to your colleagues.
Sylvain Joffre, the section convenor, Alexander Baklanov and Ranjeet Sokhi, section co-convenors.

The National Center for Atmospheric Research in collaboration with Johns Hopkins University announces a summer colloquium in July 2004 on Climate and Health.

Interested students (graduate students preferred) can find details about the colloquium and how to apply at the following web site: www.asp.ucar.edu/colloquium/2004/CH/

Linda Mearns, NCAR, co-organizer.

Street Emission Ceilings (SEC) pilot model within the 9th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes

June 1-4, 2004 in Garmisch-Partenkirchen (Germany).

If you are interested in joining this special meeting (exact date and time is not fixed yet) please contact Professor Nicolas Moussiopoulos directly via his email address: moussio@eng.auth.gr. For further information about the whole conference please see the conference website www.harmo.org/harmo9
The Conference Secretary:
INTERPLAN
Congress, Meeting & Event Management AG
Elke Jaskiola, Projectmanager

JOINT CONFERENCES ON REMOTE SENSING OF URBAN AREAS

Call for Papers - May 2004

These joint conferences follow-up on URBAN 2003 at Berlin, Germany, Technical University and URS 2003 conference at Regensburg University, Germany. They will be joint under one umbrella in Tempe, Arizona, in March 2005. For the first announcement and a more detailed description of the conferences please see: www.urban-remote-sensing.org

Set a bookmark on this page and visit us frequently. We will keep you also informed about changes and the Call for Papers, which is scheduled for May 2004.

Date and location: The joint conferences will take place in Tempe, Arizona at the Arizona State University, Center for Environmental Studies during March 14 - 16 2005. Tempe is located in the beautiful heart of Arizona, the center of the Valley of the Sun. It also belongs to the Phoenix metropolitan area which has numerous cultural and sporting events. Grand Canyon and a great number of world wide known National Parks are just a few hours away.

Matthias Moeller

IAUC Committee Reports

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A quick reminder: please send references for any urban climate related papers which have been published in the last couple of months for inclusion in the next newsletter to me. As before, please mark the header of your email with 'IAUC Publications 2004'. In order to facilitate entering the information into the data base please use the following format:

Author:
Title:
Journal:
Volume:
Pages:
Dates:
Keywords:
Language:

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Teaching Resources

This Committee has completed its first 'resource' on the Urban Canopy Layer Heat Island (UHI). It is appended to this newsletter and available at the IAUC website (www.urban-climate.org). This topic was chosen as one for which there is a lengthy history and would provide a 'template' for further teaching resource materials. The content is substantially a review of the UHI phenomenon, concentrating on its description and our understanding of its formation. It attempts to provide a historical perspective on studies of the UHI and to draw on material from across the globe. As this is the first of a series that will be published we are anxious to receive any feedback on its content and format.

Any comments on the Teaching Resource materials can be sent to me for distribution to, and discussion with, the other members of the committee

We will now pursue the path outlined in the IAUC newsletter by identifying topics, approaching experts in the area and pursuing a regular publication schedule. A threefold division of materials is envisaged:

- Urban Climate: State of the Field (e.g. The urban heat island)
- Urban climate tools (e.g. Biometeorological Indices)
- Climate and urban design (e.g. Case studies)

Gerald Mills
University College Dublin
Gerald.mills@ucd.ie
Committee Chair

Board Members & Terms

President: Sue Grimmond (USA), 2007
Secretary: Matthias Roth (Singapore), 2007
Janet Barlow (UK), 2007
Ariel Bitan (Israel), 2006
Bob Bornstein (USA), 2005
Krzysztof Fortuniak (Poland), 2007
Helmut Mayer (Germany), 2004
Gerald Mills (Ireland), 2007
Yasuto Nakamura (Japan), 2005
James Voogt (Canada), 2006

Non-Voting members of the Board:
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Past President: Tim Oke, Canada.
Local Organizer ICUC5: Kazimierz Klysik Poland.
Local Organizer ICUC6: Sven Lindqvist, Sweden.

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Chair Bibliography Committee: Jennifer Salmond
Chair Membership Committee: Janet Barlow
Chair Teaching Resources: Gerald Mills
Chair Awards Committee: Bob Bornstein
WebMasters: James Voogt

IAUC Board Report

Call for Nominations

As announced in the last newsletter (Feb 2004, No. 3, p. 11), the term of one current member of the Board of the International Association for Urban Climate (Helmut Mayer, Meteorological Institute, University of Freiburg, Germany) will be ending shortly. Accordingly, the Board is seeking nominations for a replacement.

Please note that board membership consciously attempts to seeks to represent the dBoard seeks representation seeking wide representation of geographical regions, both genders and fields of study.

The procedures for Board elections are available at the IAUC website www.urban-climate.org (follow "Board Actions" on the main navigation menu and then the link to "IAUC Board Procedures and Terms"). To see the present composition of the IAUC board, follow the "Board Members" link from the same website.

The nomination process will be conducted as described below.

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

- Email the IAUC Secretary indicating the name of your nominee.
- Name **TWO** other persons who support the nomination. These persons must also email the Secretary indicating their support of the nominee within the nomination period.
- The nominee should also email the Secretary indicating her/his willingness to stand. The nominee should also provide her/his affiliation and country. Optionally, the nominee may supply a short statement that will be shared with the membership at the election (if there is one). That statement must not exceed 250 words, a limit that will be rigorously applied (longer statements will be truncated after the 250th word).

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

- Email the IAUC Secretary indicating that you are nominating yourself.
- Also name **THREE** other persons who support your nomination.
- These persons must also email the Secretary indicating their support for your nomination within the nomination period.
- The nominee should also provide his/her affiliation and country. Optionally, you may supply a short statement that will be shared with the membership at the election. That statement must not exceed 250 words, a limit that will be rigorously applied (longer statements will be truncated after the 250th word).

Also please note the following:

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

b. All required information, as outlined in (1) or (2) above, must be received by the Secretary within one month, i.e. by Tuesday, April 13th, 11:59 pm (UTC + 8 hrs).

c. E-mails should be sent to the Secretary at email address geomr@nus.edu.sg. DO NOT use the 'reply' function of your mailer to contact the Secretary. Receipt of nomination e-mails will be confirmed. No other method of communication will be accepted.

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

e. If more than one nomination is received, an election will be conducted via email or the web, with the candidate receiving the highest vote count being deemed to have been elected. If an election is necessary, the exact procedure will be described in an email to the current membership.

Matthias Roth
Secretary, IAUC

IAUC Committee Reports

IAUC Board Procedures and Terms

The IAUC Board Procedures and Terms were reviewed during the last Board meeting held on 31 August, 2004 in Lodz, Poland (during ICUC-5). A synopsis of the major changes adopted is given in the following:

1. Past-President and Past-Secretary have been added as non-voting members to the Board which increases the number of Board members by 2 to 14 (Paragraph A.1).
2. Time for nomination and election of new Board members has been set to March/April each year (Paragraph B.2).
3. The Secretary is elected at the same time as the President (Paragraph C.2).
4. The number of support e-mails for self-nomination has been increased by 1 to 3 to obtain the same number of independent support e-mail as for nominated candidates (Paragraph E.2).

To see the complete revised version of the IAUC Board Procedures and terms please click on Board Actions on the IAUC webpage (www.urban-climate.org).

Awards Committee

Luke Howard Award

In the previous IAUC newsletter, the terms of the Luke Howard Award were announced. This award is to be given annually 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. The deadline for the receipt of nominations nomination was March 31.

However, the committee has subsequently come to the view that the interval between the announcement of the Award and the nomination deadline was insufficient. A new deadline for nominations is now set for **October 1, 2004**. Members will be reminded in forthcoming newsletters on the nomination process.

Newsletter Contributions

The IAUC Newsletter is published bi-monthly. The next publication will occur in early June. Any items to be considered for the June edition should be received by **May 31, 2004.**

In the following list are those individuals that will compile submissions in various categories. Contributions should be sent to the relevant editor:

Conferences: Jamie Voogt (javoogt@uwo.ca)
Websites: Gerald Mills (gerald.mills@ucd.ie)
Bibliography: Jennifer Salmond (j.salmond@bham.ac.uk)
Urban Projects: Sue Grimmond (grimmon@indiana.edu)

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.

If members have suggestions on the content or format of the newsletter, please contact the editor, Gerald Mills (gerald.mills@ucd.ie) .

ICUC-6
Sixth International
Conference on Urban Climate
Göteborg, Sweden
June 12th - 16th, 2006

The IAUC members have selected Göteborg (Gothenburg), Sweden as the site for the sixth International Conference on Urban Climate. Further details will become available at the conference website www.gvc.gu.se/icuc6, which is also accessible via the IAUC website (www.urban-climate.org).

IAUC Teaching Resources
The Urban Canopy Layer Heat Island

The urban heat island (UHI) is the most studied of the climate effects of settlements. The UHI refers to the generally warm urban temperatures compared to those over surrounding, non-urban, areas. It is important, however, to distinguish between the 'types' of UHI (for example, one defined by surface or air temperatures) as the observations and responsible processes will differ.

Surface heat islands have been detected using satellite and aerial imagery. At sufficient heights, the urban surface that is 'seen' consists of contributions from roofs, streets, car-parks, etc. At lower heights, observations from an oblique viewpoint will contain contributions from walls and the UHI assessment will depend on how representative these observations are. However, most UHI studies examine air temperatures in urban areas. If these are observed in **Urban Boundary Layer** (UBL) above the average height of the buildings (Figure 1), the sampled air has interacted with the rough 'surface' below. More commonly, UHI studies have focussed on air temperatures within the **Urban Canopy Layer** (UCL), below the roof tops in the spaces between buildings (Figure 1). It is this UHI and the responsible processes that are discussed here.

The Canopy Layer UHI

The UHI is typically presented as a temperature difference between the air within the UCL and that measured in a rural area outside the settlement (ΔT_{u-r}). Research strategies have examined the temporal and spatial characteristics of ΔT_{u-r} by using observations at fixed sites (representing urban and rural locations) and measurements made on mobile platforms (using cars and bicycles) [15]. In both cases, the selection of sites and routes is critical to establishing the form and behaviour of the UHI. Moreover, the choice of the non-urban, rural, sites is crucial.

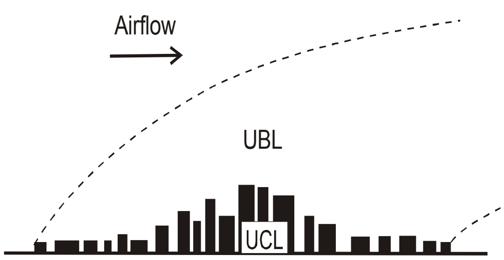

Figure 1: A vertically exaggerated cross-section of the urban atmosphere and its two main layers. The slope of the UBL is between 1:100 and 1:200 in reality.

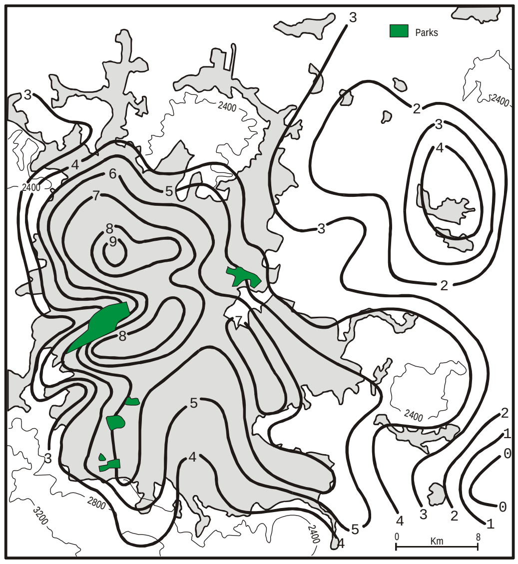

Figure 2: Mean minimum temperature for November 1981 in Mexico City. Redrawn from [4].

Description: Every settlement is capable of generating an UHI, regardless of its size. Observations for a host of UHI studies display common characteristics. ΔT_{u-r} reveals itself as a pool of warm air with largest values closest to the urban centre (Figure 2). At the urban edges, temperature changes are rapid, thereafter, ΔT_{u-r} increases more slowly. However, in the vicinity of green parks lower temperatures are observed (Figure 3). The strength of the UHI is referred to by the maximum difference recorded. The magnitude of ΔT_{u-r} is greatest at night, under clear skies and with little wind. Under such conditions, surface cooling is associated with radiation exchange. While exposed rural sites cool rapidly after unset, urban sites cool more slowly. The difference between urban and rural sites grows with time after sunset and reaches a maximum difference after about 4 hours (Figure 4). The maximum ΔT_{u-r} value recorded is usually found in the centre of the settlement is generally larger for bigger settlements.

Relevance: The UHI has a significant and unintended impact on the climate experienced in cities. However, whether it is desirable or not will depend on the background climate. Warmer

Figure 3: Isotherms in Chapultec Park on December 3, 1970 (5:28 to 6:48), with clear sky and calm air. Redrawn from [5].

night-time temperatures will require less (more) domestic heating (cooling) in cold (warm) climates. In colder climates, fewer snowfall and frost events will occur and surface snow will melt earlier (altering the surface hydrology). In warmer climates, the UHI, particularly when accompanied by other urban effects (such as poor air quality) may produce stressful conditions [7].

The UHI has relevance for the study of regional and global climates that rely on accurate

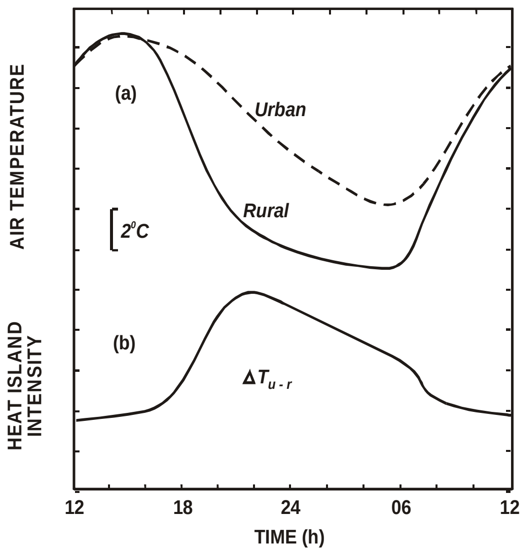

Figure 4: Typical temporal variation of urban and rural air temperature under clear skies and weak airflow. The UHI is produced by the difference between the cooling rates. Redrawn from [13].

assessments of climate. The global network of stations is unevenly distributed; most are located in the developed world, over land, and near urban areas. As settlements have grown in extent, stations located nearby may have been affected. Thus, the urban temperature 'effect' needs to be removed so that global trends can be examined [1].

History: The study of the UHI encapsulates the history of the field of urban climatology, which since the late 19th century can be divided into periods characterised by different research approaches. The earlier period was dominated by a descriptive approach that began with Luke Howard's pioneering examination of London's climate [2]. This type of research continues and there is now a large body of data on UHI characteristics from cities globally.

From the late 1960's onwards, research shifted toward an understanding of the processes that produce urban effects through the application of micrometeorological theory. The explicit recognition of the scales of urban climate (Figure 1) has become an essential part of research design, which is now characterised by the measurement and modelling of energy, mass and momentum fluxes [9]. The UHI is treated as a response to changes in surface geometry and materials and in atmospheric composition. Concurrently, an 'experimental' approach has developed that isolates elements of urban form whose unique effects can be explored. For example, the climate of city streets is examined by considering the properties of symmetrical 'canyons' characterised by their length, building height (H) and street width (W) and orientation [10]. This approach has permitted the discovery of general relationships linking street geometry and climate effect.

The formation of the UHI can now be understood from the viewpoint of the energy balance of an urban area.

The UHI energy balance: The surface energy balance accounts for all the exchanges of energy. These include radiative fluxes (both shortwave (K) and longwave (L)), turbulent sensible (Q_H) and latent (Q_E) fluxes with the atmosphere and energy stored or withdrawn from the substrate (ΔQ_S). An additional term that must be considered in the urban setting is the heat added by human activities (Q_F). However, with few exceptions, Q_F is a small component of the urban energy balance.

$$Q^* + Q_F = Q_H + Q_E + \Delta Q_S$$
$$Q^* = K\downarrow - K\uparrow + L\downarrow - L\uparrow = K^* + L^*$$

Net radiation (Q^*) is composed of radiation arriving at (↓) or exiting from (↑) a surface each component of which can be sub-divided into radiative sources and sinks. For example, incoming radia-

Table 1: Suggested causes of canopy layer Urban Heat Island [12]		
Energy Balance term	Urban features	Urban effect
Increased K^*	Canyon geometry	Increased surface area and multiple reflection
Increased $L{\downarrow}_{sky}$	Air pollution	Greater absorption and re-emission
Decreased L^*	Canyon geometry	Reduced sky view factor
Q_F	Buildings & traffic	Direct addition of heat
Increased ΔQ_S	Construction materials	Increased thermal admittance
Decreased Q_E	Construction materials	Increased water-proofing
Decreased (Q_H+Q_E)	Canyon geometry	Reduced wind speed

tion at a surface can be divided into that derived from the sky and that from the surrounding terrain,

$$L{\downarrow} = L{\downarrow}_{sky} + L{\downarrow}_{terrain}$$

The contributions from these sources will depend on both their emittance and the proportion of the 'view' of the surface occupied by those sources.

Each energy balance term will be altered in the urban environment and contribute to the formation of the UHI (Table 1). The lower albedo of many urban materials results in greater absorption of solar radiation during the daytime (Table 2). Multiple reflections within the canopy layer lowers the albedo of the urban 'surface' (when viewed above the rooftops) still further. Lower average wind speed within the UCL suppresses turbulent exchanges while impervious, unvegetated surfaces hinder evaporative cooling. However, it is important to recognize that the physical geography of individual settlements may not fit this pattern. For example, urban areas in desert areas may be wetted through irrigation.

Much can be learned by examining 'ideal' meteorological conditions for UHI formation. ΔT_{u-r} is greatest at night, under clear and calm skies. In these circumstances, the energy balance can be approximated as,

$$L^* = \Delta Q_S$$

This suggests that the UHI can be examined as the result of differential surface cooling governed by rates of radiative exchange and of heat storage.

Although urban materials are known to have a high thermal admittance (ability to store and release heat), there is little evidence that urban areas are distinguished by their thermal properties [2]. As typical urban materials are impermeable, their moisture content and thermal properties do not vary greatly (Table 2). Outdoor materials (e.g. asphalt road and parking lots) are thick and in contact with a solid substrate. However, building materials are selected for their strength, and are formed into a relatively thin envelope that separates indoor and outdoor air. Much of the diurnal heat exchange is confined to this layer, which has a large specific heat capacity but a limited volume. As a result, the replacement of natural cover by urban materials is not a sufficient explanation for the formation of the UHI.

Under clear night-time skies, the rate of surface cooling is driven by net longwave radiation loss. The magnitude of this loss is proportional to its exposure to the sky, which may be measured as the proportion of the viewing hemisphere that is occupied by sky; this is the sky view factor (ψ_{sky}). Thus, the three dimensional structure of the urban area (its geometry) is a good measure of

Table 2: Properties of materials

Material	ρ	C	k	μ
Dry clay soil	1.60	1.42	0.25	600
Saturated clay soil	2.00	3.10	1.58	2210
Asphalt	2.11	1.94	0.75	1205
Dense Concrete	2.40	2.11	1.51	1785

Thermal properties of selected materials: Density (ρ) in kg m^{-3} x10^3; heat capacity (C) in J m^{-3} K^{-1} x 10^6; thermal conductivity (k) in W m^{-1} K^{-1} and; thermal admittance (μ) in J m^{-2} $s^{-1/2}$ K^{-1}. Compiled from [13].

Surface	α	ε
Asphalt	0.05-0.20	0.95
Concrete	0.10-0.35	0.71-0.91
Urban areas	0.10-0.27	0.85-0.96
Soils: wet to Dry	0.05-0.40	0.98-0.90
Grass: long to short	0.16-0.26	0.90-0.95

Radiative properties of selected materials: Albedo (α) and emissivity (ε) are non-dimensional. Compiled from [13].

night-time radiative loss (Figure 5). Oke [11] has shown that under these ideal conditions the maximum observed UHI is found in the central, densest part the settlement and that it is strongly correlated with ψ_{sky}, which can be approximated as the ratio of building height to street width (H/W). This formulation is suitable for ideal conditions

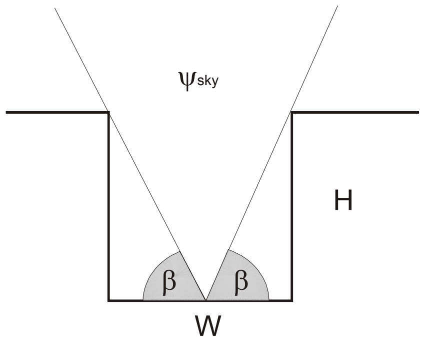

Figure 4. A depiction of the sky view factor in a symmetrical street canyon, described by its width (W) and its height (H), $\psi_{sky} = \cos \beta$. [12]

and city centres, where the surfaces are dry and materials can be assumed to be largely the same.

Measuring the urban effect: Ideally, the urban effect would be assessed from a continuous set of observations that begin prior to urban settlement [5]. Over a stable climatic period, the unique contribution of the urban area could be extracted. However, most UHI studies are based on comparisons between observations made at existing 'urban' and 'rural' sites. This places a great onus on the selection of these sites.

Lowry [7] identifies three components in a set of measurements (M):

1. The 'background' climate (C),
2. the effects of the local climate (L) and
3. the effects of local urbanization (E).

Values of M are observed, but the contributions of C, L and E are not. Moreover, these are likely to vary with time depending on the frequency and duration of weather types experienced. The situation is further complicated in that we cannot, at the outset of a UHI study, identify the spatial limits of the urban effect (Figure 6). In the absence of pre-urban observations, the urban effect may be only be estimated. Observational studies of the UHI must give careful consideration to the selection of measurement sites and to the 'background' climate that is likely to enhance or diminish ΔT_{u-r} and the spatial extent of the urban effect.

Applied Climatology: The UHI is an unintended outcome of urbanization. Climate-conscious urban design seeks to modify climate processes to

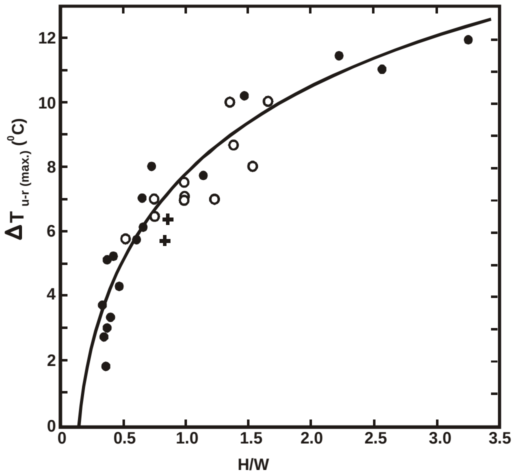

Figure 5. Relation between the maximum heat island intensity ($\Delta T_{u-r(max)}$) and the height to width ratio (H/W) of the street canyons in the centres of the settlement (Based on observations for 31 cities in N. America (•), Europe (○) and Australasia (+)). Redrawn from [11]. The relationship can be expressed as

$$\Delta T_{u-r(max)} = 7.45 + 3.97 \ln(H/W)$$

or

$$\Delta T_{u-r(max)} = 15.27 — 13.88\ \psi_{sky}$$

achieve a particular end. For the UHI, a starting point would be a consideration of the energy balance to decide which term(s) could be readily altered (Table 1). Figure 5 indicates that the maximum potential value for ΔT_{u-r} can be managed by modifying the geometry of the UCL (that is, the building heights and street widths). However, opportunities for changing the physical form of existing settlements are rare.

Another approach is to select surface materials

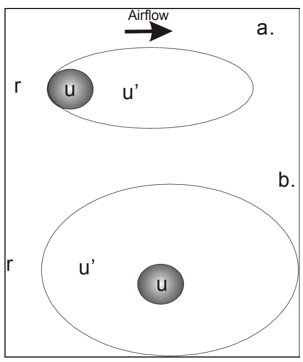

Figure 6. The urban effect is present in the urban area (u) and in a surrounding area (u'), whose shape and size depends on synoptic conditions. In a., the shape and size of u' is regulated by a particular weather event. In b., u' is defined by the sum of all weather events, that is, the climate of the area. Redrawn from [7].

with desirable properties. Increasing the surface albedo will reduce the amount of heat stored during the daytime and limit the surface-air sensible heat flux [14]. Increasing the vegetated area of the city will have a similar effect, as much of the available energy at the surface will be expended as latent (rather than sensible) heat energy. In addition, the leafy canopy will shade surfaces during the daytime. However, at night this canopy will limit radiative heat loss from the surface and could contribute to the night-time UHI.

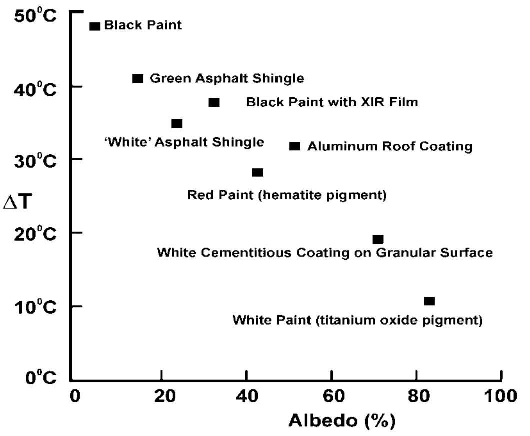

Figure 7. The relationship between the surface-air temperature difference (ΔT) and the albedo of selected paints and roofing materials facing the sun. Redrawn from [14].

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