IAUC Newsletter

International Association for Urban Climate

www.urban-climate.org

Issue No. 5
June, 2004.

President's Column

On behalf of the board and members of IAUC, I would like to thank Professor Helmut Mayer for his services to the IAUC. Professor Mayer was selected as a representative in the first round of board elections and he has been an important contributor to our activities in the last five years.

As you will see from the newsletter, we now have a number of regular features (see contents). I would encourage you to contact the appropriate column-editor(s) if you want to submit materials in a particular area. Also, I would appreciate any suggestions as to other topics you would like to see regular contributions made in? Please contact me and/or Gerald Mills (IAUC Newsletter editor gerald.mills@ucd.ie) with ideas.

One suggestion is to include a section on "Urban climatologists in the news – newspaper, TV, radio, magazine interviews". Of interest would be who was featured, where, on what issue. Or other short news items (paragraphs) on new projects, grants obtained, new websites that may be of interest would be featured. If you would be interested in becoming the feature editor for such a newsletter section, please contact me! In the meantime, if you have a short item that you would like to see included please send to me.

As many of you are aware, IAUC member Dr Rob MacDonald (Canada) died recently under tragic circumstances. Rob was a highly accomplished researcher and a wonderful colleague. This is a great loss to the urban climate community. A formal obituary will be published in the next newsletter. I am sure I speak for many of us, when I say that our thoughts are with his family, friends and colleagues.

Sue Grimmond
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President, IAUC

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Newsletter Contributions

The IAUC Newsletter is published bi-monthly. The next publication will occur in early August. Any items to be considered for the August edition should be received by July **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) .

Urban Software

ENVI-met V3.0

A MICROSCALE URBAN CLIMATE MODEL

www.envi-met.com

One of the most difficult aspects of studying the urban climate system is that it is composed of dozens of sub-systems that are linked to each other through exchanges of energy, mass and momentum. Yet, this is precisely what makes its study so fascinating. Its study requires an understanding of fluid dynamics and thermodynamics including radiative and non-radiative transfer processes in a very complex environment. Depending on the spatial scale that one approaches the study of this urban system, the list of relevant sub-systems can be greatly extended.

The numerical model ENVI-met presented here is designed to investigate the urban climate system from the microscale perspective. ENVI-met is a three-dimensional non-hydrostatic model for the simulation of surface-plant-air interactions within urban environments. ENVI-met is a three-dimensional model based on grid cell geometry. The horizontal resolution of the model is between 0.5 m and 5 m for a single grid cell. For the total model size, a dimension of 250 x 250 x 25 grid cells is the limit for recent computers. This allows the model to cover an area from 100m x 100m to 1 km x 1 km in extent. In other words, ENVI-met is not designed to simulate a complete city, the typical application for ENVI-met is rather a single building system or a section of the city.

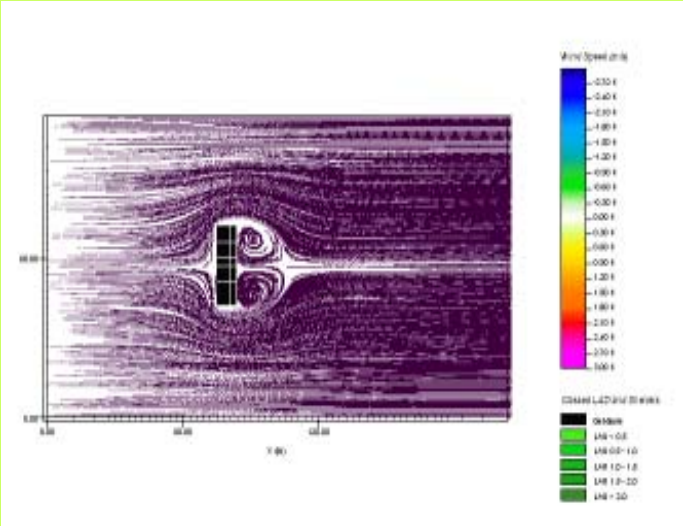
The good news is that inside this area, you can construct almost anything you like as long as you stick to the rectangular grid: complex building structures, wild parks and anything between. Moreover, ENVI-met is **FREE**!. You can download it from the web page www.envi-met.com and use it for whatever you want (except of re-selling of course).

In the next few paragraphs, I'll try to outline what kind of model ENVI-met is and what you can do with it. I'm not going into much detail here. If you want to know more, look at the webpage where examples and papers are available.

Figure 1: ENVI-met is a three-dimensional model designed for use in complex urban environments. Its components allow the simulation of wind, temperature, humidity and pollution fields around complex forms. This figure illustrates a visualisation of flow around an obstacle.

ENVI-met is composed of three separate software packages:

- ENVI-met Editor that allows the user to create unique 3-D forms
- ENVI-met itself which allows the user to perform a simulations under given conditions, and
- LEONARDO that allows the user to visualise the results of the simulation (as shown opposite.



Urban Software

What kind of model is it?

Very basically, ENVI-met is a 3D coupled computational fluid dynamics (CFD) and energy balance model. In other words, it calculates the wind flow around the different urban structures as well as all variables associated with energy balance and atmospheric transfer processes (calculation of shadows, reflection, turbulence transfer, plant evaporation just to name a few). Moreover, it is a prognostic simulation model, which makes it different to other, steady-state models. ENVI-met simulates (at least) a complete diurnal cycle in order to include all the heating and cooling processes taking place in the urban environment.

Putting this all together, you might get the impression that this model is hard to handle and difficult to understand. On one hand, you are right. It is a numerical model and the fact that it can be run on the PC in your living room does not make it easier than similar models that could only be run on a supercomputer in the dark cellars of the university just a few years ago. On the other hand, you do not need to understand the whole model to use it. During the last five years of development, we have learned a great deal from users so that the current version of the model solves a lot of problems automatically. From several M.Sc and PhD thesis I know that most of the users get along quite well after the usual initial phase of confusion. ENVI-met comes along with a comprehensive online help and often tells you where to look when things go wrong. In addition, ENVI-met's step-back-technology watches the model run and can even return it to a safe mode when things go wrong.

What are the basic properties of ENVI-met?

The core features of ENVI-met are:

- A full 3D calculation of all atmospheric processes
- Use of a 1.5 order turbulence closure model
- Sophisticated calculation of radiative transfer and shading inside the urban structures
- Ability to handle any combination of buildings and plant, including terraces, arcades or plants on roofs
- Use of a 1st order pollutant dispersion model for inert gases and particles including sedimentation and deposition
- Option to calculate biometeorological parameters such as Tmrt, PMV/PPD

What are the contents of the ENVI-met package?

The ENVI-met Editor: The editor is a visual tool to construct the so-called *Area Input Files* which contain the description of the urban area you are going to investigate. Here, you build houses, plant trees, define different surfaces, set sources, etc. (Figure 2). In addition to the editor, a configuration editor helps you compile the settings for the individual simulation run including defining things the meteorological situation or other model settings.

Figure 2: An example of the editor used to create simulation files for ENVI-met.

Simulation with ENVI-met: The main program is the least interesting part of the model system. It does nothing but perform the simulation. Depending on your computer and your task this might take from a few hours up to a few days…The best is to leave the computer alone with its task…

Visualisation with LEONARDO: When the simulation is finished, you will find an impressive amount of data on your PC. LEONARDO is a visualisation tool to create nice 2D and 3D maps, even animations, out of the ENVI-net results (Figure 1 & 3).

How can I get ENVI-met?

You simply have to go to the website and register yourself to the ENVI-met user group at Yahoo. After doing so, you will receive a welcome message containing the password (!) you need to start the setup program that you download from

the website. Additionally, you will find a lot of more things on this site including papers about ENVI-met.

ENVI-met is freeware, but I do not spread the source code in order to avoid dozens of ENVI-met subversions all producing different results. If you want the source code or have anything else in mind, feel free to contact me under michael@envi-met.com. Have fun !

P.S: Don't miss to meet the climBOTs on www.botworld.info !

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Lab. Image et ville,
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FR-67000 Strasbourg

Readings

Lahme, E.; Bruse, M. (2003): **Microclimatic effects of a small urban park in densely built-up areas: Measurements and model simulations**. ICUC5, Lodz 1-5- September 2003, 4 pages

Jesionek, K.; Bruse, M. (2003): **Impacts of vegetation on the microclimate: Modelling standardized building structures with different greening level**. ICUC5, Lodz 1-5- September 2003, 4 pages

Bruse, M. (2003): Stadtgrün und Stadtklima- Wie sich Grünflächen auf das Mikroklima in Städten auswirken, LÖBF-Mitteilungen, 1/2003, 66-70, 5p, in German

Bruse, M. (2003): **Assessing Urban Microclimate using Multi-Agent Simulations: A new approach to answer an old problem?**, ICUC5, Lodz 1-5- September 2003, 4 pages

Bruse, M. (2000): '**Simulating microscale climate interactions in complex terrain with a high-resolution numerical model: A case study for the Sydney CBD Area**' in:, Biometeorology and Urban Climatology at the Turn of the Millennium, WMO/TD No. 1026, World Meteorological Organisation, Geneva, CH, ISBN 92-63-01026-9, 6 pages

These readings and others are available at the ENVI-met website www.envi-met.com

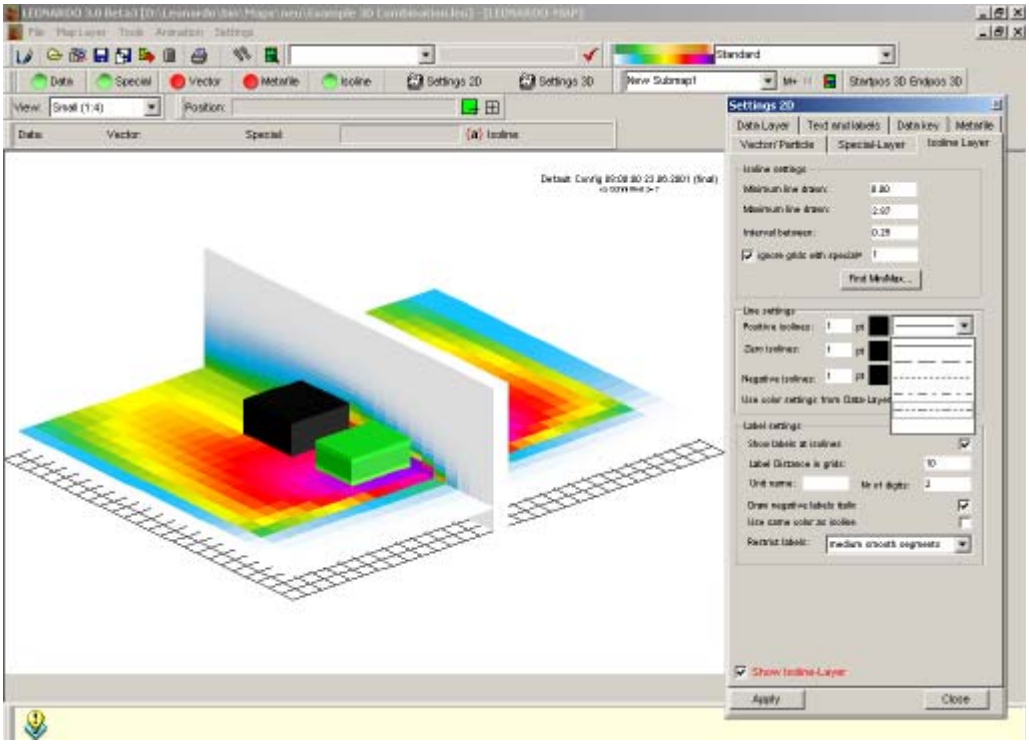

Figure 3: An example of the LEONARDO Interface showing the grid-cell structure of the model.

Urban Project Report

The Climate of Urban Street Canyons Göteborg, Sweden

The street canyon forms the basic geometric unit of the built environment. This geometry plays a large role in determining local climate in terms of momentum and energy exchange, as well as influencing pollutant dispersion, all critical issues for human health and comfort in cities.

In December 2002 the Göteborg Urban Climate Group (www.gvc.gu.se/ngeo/urban/URBAN.HTM) launched a project called "The Climate of Urban Street Canyons" in the city of Göteborg Sweden (Figure 1)

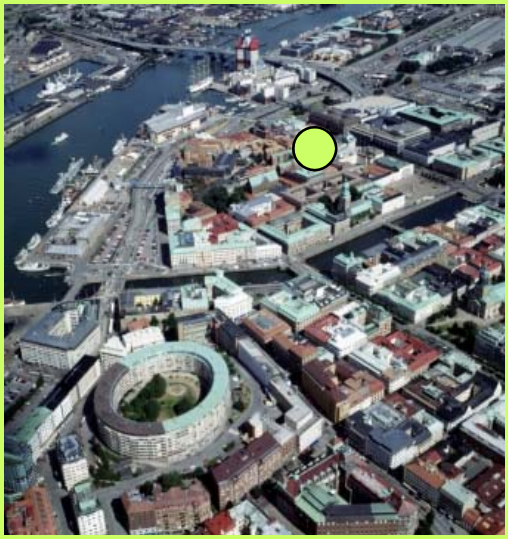

Figure 1. Oblique aerial photo of central Göteborg. The canyon site is located at the position of the yellow circle.

A canyon and a rooftop mast were installed (Figure 2) in a canyon that has an aspect ratio (H/W) of ~ 2.1 and is approximately 50 m long. The masts were instrumented with sonic anemometers (RM Young 81000) in vertical profiles, as well as across the width of the canyon (Figure 3). In total there are 14 sonics being logged at 10 Hz. Additionally thermocouples (TC) for surface (18) and air temperature (14, co-located with the sonics) and component radiometers (5, Kipp & Zonen CNR1) are used to study the canyon thermal and radiative patterns. Continuous data acquisition began in June 2003 when the rooftop mast was extended and a top level sonic was added at slightly greater than twice the height of the canyon top.

Figure 2a. Performing an inter-comparison of the sonic anemometers prior to field observations.

Figure 2b. Installing the canyon mast.

One of the principle objectives of the study is to look in detail at the dynamics of vortex formation and circulation within an urban canyon. Although the vortex circulation is easily visualized by the casual observer, the first measurements of such a circulation were made by Albrecht (1933). Dabbert et al. (1973) reported single helical vortices from observations in St. Louis (H/W=1.5 and 2) as occurring when winds were within ±60° of perpendicular. Wind tunnel modeling by Chang *et al*. (1971) suggested under certain conditions double vortices may develop. Since then single vortices in canyons have been observed or inferred in a number of studies (Nunez and Oke 1977, DePaul

Figure 3.
The instrumented rooftop and canyon masts.
The rooftop mast extends to twice the height of the canyon and measures the turbulent fluxes at four levels. The canyon mast measures the turbulent fluxes at four levels within the canyon. At the lower three levels measurements are made at three positions along horizontal supports, representing east, west and central locations. The sonic anemometers were interrogated at a rate of ten times per second.

and Shieh 1986, Nakamura and Oke 1988, Arnfield and Mills 1994, Louka *et al*. 2000). More recently, fluid channel, wind tunnel and numerical modeling have suggested that under some conditions double counter rotating vortices may develop for canyons with H/W ≥ 2 (e.g. Baik *et al.* 2000) and even more vortices in the presence of canyon surface heating (Kim and Baik 2001). These circulations are important because they will restrict the mixing of lower canyon air with the overlying atmosphere and possibly creating high pollutant concentrations down near street level.

Given the aspect ratio of the canyon under investigation, it seems possible that under the right conditions we might observe double vortices. However, the differences between models and the physical world are many. In particular, the conditions which should give rise to the multiple stacked vortices, consistent light winds and weak turbulence so that the canyon winds are driven only by the shear stress layer at the top, do not frequently exist. Also there exist local flow modifications due to the roof shapes, obstructions and local topography so that above canyon streamlines are not horizontal.

Most commonly on average, for ambient winds directed across the canyon top (±60° of perpendicular) we observe a well developed single helical vortex that penetrates much of the depth of the canyon (Figure 4). The pattern and magnitude of the circulation depend on the consistency of the flow and ambient wind direction, particularly with respect to the noted modifications to local flow.

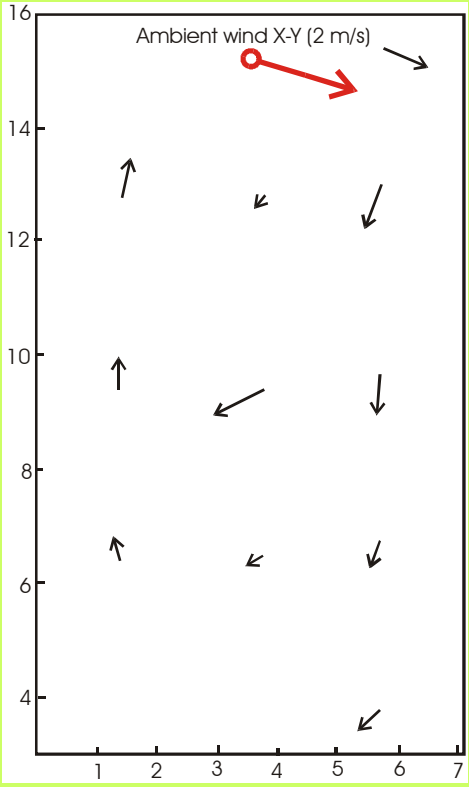

Figure 4. Cross-section of the canyon with height on the y-axis and distance from the west wall on the x-axis. The ambient wind is shown by the red arrow and the within canyon winds are scaled by a factor of 2, so that 2 m = 1 m/s. Note that the y-axis does not go to zero.

Examining canyon mean wind fields over periods of minutes may sometimes present a misleading picture. Over short time periods, on the order of seconds, decoupled upper and lower canyon circulations and double vortices develop but are rapidly dissipated by the penetration of wind through the stress layer. Thus the mixing process seems to be complex and may be dominated by the intermittent penetration of winds through the shear layer even under the most consistent flow and weak turbulence. However, since the lowest measurement level across the canyon width is above 0.4H (due to local traffic regulations), more

persistent secondary vortices below this height would not be captured by the measurements. A recent flow visualization study shows that such circulations exist and that flow within the lowest reaches of a canyon can be decoupled from the above canyon flow for longer time periods. An animation of the real-time canyon wind field can be viewed by following the link at www.gvc.gu.se/ngeo/urban/Activities/GOTE-DUCT.htm.

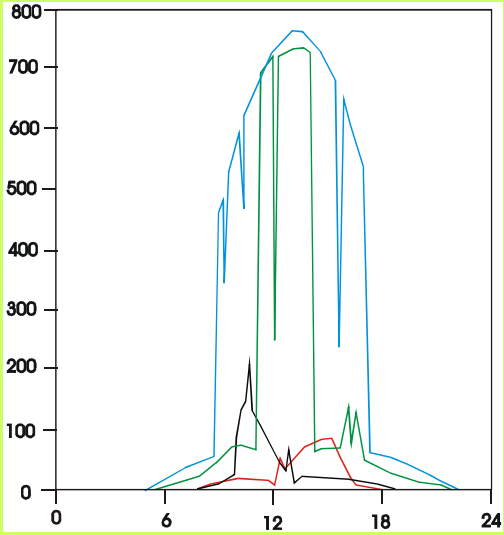

Figure 5a: Shortwave radiation (Wm^{-2}) for a single clear sky day in summer (15 July 2003). The curves represent measurements in the centre of the canyon at 12m (blue) and 6m (green). The remaining curves are for those radiometers facing the west (black) and east (red) walls at 6m.

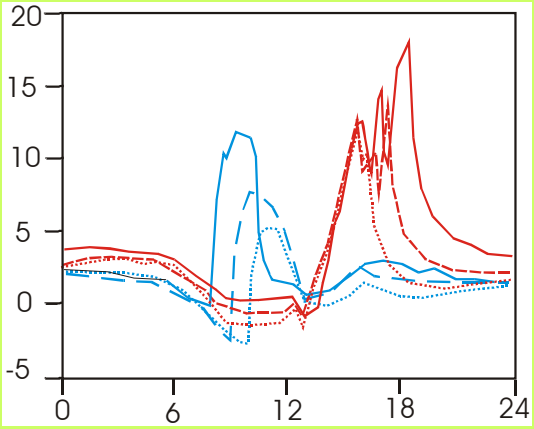

Figure 5b. Wall surface temperature for 15 July, 2003. Temperature data (^{o}C) are plotted as the difference from the air temperature in the center of the canyon. The blue lines refer to the west wall and the red lines to the east wall. The sequence of lines is full, dashed and dotted representing heights of 12m, 10m and 8m within the canyon.

The thermal and radiative responses of the canyon to different forcings are also under investigation. These processes are critical to understanding the energy exchange dynamics between the city landscape and the atmosphere. Here the approximate north-south orientation of the canyon and the high latitude of Göteborg are important. This canyon orientation results in strong diurnal differences in surface temperatures between the walls and also between canyon air and wall temperature. For much of the winter very little solar radiation reaches the canyon walls, therefore wall temperatures are related to losses of anthropogenic heat from internal building heating. Figure 5 shows diurnal patterns of radiation and temperature within the canyon for a clear sky day in summer. The temperature measurements were made on similar brick surfaces so these patterns are influenced primarily by solar and canyon geometry rather than materials.

These data provide an excellent resource from which to study flow and energy exchange in urban canyons. This was put into practice in November 2003 when the canyon and data provided the framework for a graduate level course in micrometeorological applications (Figure 6). Based on preliminary results new instrumentation has been installed. More case studies are planned for summer of 2004 following which the instrumentation and masts will be removed in August.

The project is financially supported by the Wallenberg foundation (Knut och Alice Wallenbergs Stiftelse) and Formas (the Swedish Research Council for Environment, Agricultural Sciences).

Project team: Ingegärd Eliasson, Sven Lindqvist, Brian Offerle and Sue Grimmond.

Figure 6. Examining the instrument layout during a micrometeorology course

Corresponding Author: Brian 'Oaf' Offerle, Physical Geography, Earth Science Department, Göteborg University. [email: oaf@gvc.gu.se].

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The team behind the Göteborg Urban Climate Group's project "The Climate of Urban Street Canyons". From left to right: Hans Alter, Sue Grimmond, Ingegärd Eliasson, Fredrik Lindberg, Brian Offerle and Sven Lindqvist.

IAUC Committee Reports

Bibliography

Thanks to everyone who sent in references to their recent papers. We were delighted to have received so many responses!

Please send any further papers published since January 1 2004 for inclusion in the next newsletter to j.salmond@bham.ac.uk. 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:

We look forward to hearing from you soon!

Jennifer Salmond
University of Birmingham
j.salmond@bham.ac.uk

RECENT PUBLICATIONS

(Languages are specified where the publication is known to be in a language other than in English.)

Baker, L. A., A. J. Brazel, et al. (2002). "Urbanization and warming of Phoenix (Arizona, USA): impacts, feedbacks and mitigation." Urban Ecosystems **6**: 183-203.

Compagnon, R. (2004). "Solar and daylight availability in the urban fabric." Energy and Buildings **36**(4): 321-328.

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Feleksy-Bielak, M., M. Tomaszewska, et al. (2004). "Indices of meteorological conditions of pollution dispersion for station Cracow-Czyzyny, for the years 2000-2002." Reports of Institute of Meteorology and Water Management, Warsaw **XXVII (XLVIII)**(1): 13-20. Polish, Summary – English, Russian

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Awards Committee

Luke Howard Award

In a 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.

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).

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
Wilhelm Kuttler (Germany), 2008
Gerald Mills (Ireland), 2007
Yasuto Nakamura (Japan), 2005
James Voogt (Canada), 2006

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

IAUC Committee Chairs

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

Board Changes

Voting for the Board replacement has ended on 26 May. It is my great pleasure to inform you that Wilhelm Kuttler (University of Essen, Germany) has been elected to the Board of IAUC for a 4-year period with immediate effect.

Professor Kuttler (above) will replace Helmut Mayer (University of Freiburg, Germany) whose term has come to an end.

The Board would like to take this opportunity to thank Professor Mayer (above) for his many contributions to the association as one of the inaugural board members. The Board would also like to thank all the other candidates who have generously agreed to stand for this position.

Matthias Roth
Secretary, IAUC
geomr@nus.du.sg

Conferences

REMINDER
THE NATURAL CITY SYMPOSIUM
June 23-25, 2004,
University of Toronto.

Over 90 speakers from around the world will discuss how urban and natural environments must be integrated in order to promote sustainability. The conference aims to foster a dialogue between a variety of disciplines, including philosophy, political science, the arts, environmental science, architecture, engineering and many more. The conference will feature keynote speaker, Robert F. Kennedy Jr, who will present a talk entitled "A Contract with Our Future", Wednesday, June 23rd, 2004 from 7:30-9pm at Convocation Hall with opening remarks by Mayor David Miller, City of Toronto. Tickets for this event may be purchased separately for $35, $10 for students with valid ID (students may purchase up to 2 tickets) by calling 416-978-3475.
Updated agenda and registration information for the conference are available at: http://www.utoronto.ca/divenv/NaturalCity or call (416) 978-3475 or (416) 978-7077; or email natural.city@utoronto.ca. This conference is being convened by the Division of the Environment, Institute for Environmental Studies at the University of Toronto, and the World Society for Ekistics.

IAHS Scientific Assembly,
3-9 April 2005
Foz do Iguaçu (Brazil).

The full Scientific Program is available on the IAHS Web Site, and the on line registration will be available within a few days. Abstract dead line for pre-published events (S1-S6) is the 31 May. Abstracts for all others events is the 31 of December. The Scientific Program is available on the IAHS Web Site at http://iahs.info and has been published in the IAHS Newsletter 79.

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).

International conference
Applications of Geographic Information Systems in Climatological Studies
Research Center for Geographical and Social Sciences Studies (RCGSSS) March 2005
Isfahan, Iran.

The purpose of the conference is to provide a forum for discussion on applications of geographic information systems and geostatistical tools in climatological studies. All contributors are requested to submit an abstract of 200-500 words. The abstracts should include the title, the names of the principal author and all co-authors, their addresses, telephone and fax numbers, email addresses. Presenting authors please include a brief vita for the purpose of introduction. Deadline for submission is September 1, 2004. Please send the abstract to porcista@geog.ui.ac.ir

Conferences

Land Surface Albedo and its Impact on Surface Climate 9-13 January 2005 San Diego.

A Joint Session of the 19th Conference of Hydrology and the 16th Symposium on Global Change and Climate Variations and part of the 85th Annual Meeting of the American Meteorological Society.

This session aims to bridge the gaps among remote sensing, climate modeling, and climate change experts by providing an opportunity to exchange information and hold in-depth discussions on albedo measurements, simulations, and the impact of albedo on land surface energy and hydrological processes.

The natural heterogeneity of land surfaces result in albedos which vary spatially and temporally. Monitoring land surface albedo variations from remote sensing techniques and simulating these in a climate/land surface model are always challenging endeavors. Furthermore, the role of the albedo feedback in global climate processes still needs to be investigated more fully. With the recent progress in deriving albedo from satellite observations, as well as community-wide climate/land surface model developments, the time is ripe to discuss how to apply the best available albedo datasets into climate models and to help both the remote sensing and climate modeling communities understand what accuracy is needed and what uncertainties still remain in the data.

The abstract submission deadline is 2 August 2004 and the AMS Online abstract submissions page is at: http://ams.confex.com/ams/Annual2005/19Hydrology/papers/index.cgi

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

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. 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.