

# **E** The International **M**ETRICS **ENVIRON****S**ociety - TIES

## Newsletter

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### **1. A Message from the President**

Peter Guttorp

#### **TIES and ISI**

The discussion of whether TIES should become a section of the ISI is continuing. As I mentioned in the previous newsletter, the first formal step from our side will be to vote on a proposed set of statutes at our Portland (Maine) meeting in June. There will be an opportunity for members who are unable to participate in the Portland meeting to vote on the proposed statutes before the meeting. The draft statutes are currently being reviewed by the TIES Board of Directors, and will be made available to the membership (together with our current by-laws for comparison) at the TIES discussion board in mid May for further discussion. The voting will begin in early June, and all e-mail votes need to be received by our Secretary, Rick Katz, by June 21.

#### **TIES/Spatial Accuracy 04**

There are over 100 contributed papers, and 22 invited papers at the Portland meeting. The Spatial Accuracy Symposia have a tradition of fairly large poster sessions, so I would expect more attendants than those counted above. A quick scan of the abstracts, available at the meeting web site,

[http://www.nrcse.washington.edu/ties/events/ties2004/  
default.html](http://www.nrcse.washington.edu/ties/events/ties2004/default.html)

indicates about equal numbers from each of the two groups organizing the meeting. The preliminary program is available elsewhere in this newsletter. The TIES President's Invited Speaker is Alison Cullen from the Evans School of Public Affairs at the University of Washington, and the J. S. Hunter lecturer is Richard Smith from the Statistics Department at University of North Carolina.

### TIES Discussion Board

I am very pleased with the way the TIES discussion board, located in the TIES web pages at:

[http://www.stat.washington.edu/cgi-  
bin/discus\\_TIES/discus.cgi](http://www.stat.washington.edu/cgi-bin/discus_TIES/discus.cgi)

has taken off. As I look at the current state of the board, in the roughly three months we have had it available there have been 36 postings to the general audience part of the board, and 12 to the part of the board where only members can post. It always takes time for new technological approaches to take off. I am hoping that we can make this a valuable resource for the membership and interested non-members. In particular, please consider

- posting job announcements, postdocs, studentships etc.;
- posting your recent manuscripts and software;
- posting interesting conferences (most of which will probably also show up at the TIES web site Events page).

If the TIES community will regularly make our current work available online, this can provide an excellent way of seeing what new directions and ideas are in the works. By itself, I would find this a most useful scientific tool.

### Teaching statistics to environmental scientists

I recently participated in an interesting event in Glasgow, UK, organized by TIES members Marian Scott and Ron Smith. It was a workshop aimed at postdoctoral fellows and senior graduate students in the environmental sciences. For a week, statisticians demonstrated the application of modern statistical methods to problems in environmental sciences, and let the participants try out the methods in a computing lab using current software packages, with the statisticians on hand to help with software difficulties

and explain the interpretation of the analyses. While some of the descriptions of modern statistical tools may have been beyond the technical skills of some of the participants, they all seemed very excited to realize that these tools exist, and often can address their particular scientific questions. The workshops (a second one for the same participants will take place in September) were developed by the Royal Statistical Society Environmental Statistics Study Group, and partly funded by the UK National Environment Research Council and Engineering and Physical Sciences Research Council. More details are available at

[www.ma.hw.ac.uk/icms/ems/evaluation/index.html](http://www.ma.hw.ac.uk/icms/ems/evaluation/index.html).

It is an idea I intend to try to implement elsewhere.

### TIES local sections

A suggestion brought forward on the bulletin board is to consider local sections of TIES. While our membership currently is too small to have viable local sections, it may be worthwhile to have TIES connect up with national statistical and/or environmental scientific societies, and create a framework that will be helpful and supportive for various kinds of local initiatives. In addition, it may be worthwhile to think about having regional meetings of TIES, in addition to our regular international meetings. If we become a section of ISI, having ISI satellite meetings connected with the regular ISI sessions is a natural vehicle for this type of meeting (which is possible even if we only remain as ISI affiliate – the TIES meeting in Athens in 1999 is an example of such a meeting).

### New Board members

It is a pleasure to welcome the slate of new members of the TIES Board of Directors. President-elect is David Brillinger from University of California at Berkeley, USA. The new secretary is Daniela Cocchi from University of Bologna, Italy, and she is replaced as European Regional Director by Peter Challenor from University of Southampton, UK. Paul Sampson of the University of Washington in Seattle, USA, will take over as Publications Officer. Two more new Regional Directors are Lelys Guenni, University Simón Bolívar in Caracas, Venezuela, and Montserrat Fuentes, North Carolina State University, USA. Bronwyn Harch, CSIRO, Australia, has agreed to do another term as treasurer. I am grateful for the hard work of the Directors whose terms expire this summer: Rick Katz at NCAR, USA; Ray Correll, CSIRO, Australia, and Tony Olsen, EPA Corvallis, USA. This

is my last column as President of TIES. I am appreciative to the Society for giving me the opportunity to try to implement some of my ideas, and am looking forward to see what direction the new President, Anders Grimvall of Linköping University, Sweden, will be taking us.

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## 2. TIES News

### 2.1. New Members

Richard Katz

Welcome to the new members who have joined TIES between November, 2003 and May, 2004. Conferences, the web page and promotion of TIES by current members continue to be the major means by which individuals are learning about the Society.

Abellan, Carlos	Spain
Abellan, Juan J.	Spain
Armero, Carmen	Spain
Bayarri, Maria J.	Spain
Bermudez, Jose D.	Spain
Botella, Paloma	Spain
Chiu, Grace S.	USA
Conesa, David V.	Spain
Georgitis, Kathryn M.	USA
Gomez-Rubio, Virgilio	Spain
Iniguez, Carmen	Spain
Lopez, Rut	Spain
Lopez, Antonio	Spain
Malmberg, Anders	Sweden
Martinez-Beneito, Miguel	Spain
Noble, David	Canada
Olsen, Lena Ringstad	Norway
Perez, Jordi	Spain
Rodriguez, Paz	Spain
Toe, Adama Makoum	Burkina Faso
van Gelder, P.H.A.J.M.	The Netherlands
Zacarias, Orlando Pedro	Sweden

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### 2.2. Member's News

- April 1, 2004 the Statistical Society of Canada (SSC) announced the formal establishment of the program of the SSC Accreditation for professional statisticians who practice in Canada. Two levels of accreditation, the Professional (P. Stat.) and Associate (A. Stat.), are being offered. TIES members **Jeannette O'Hara-Hines** and **Sylvia Esterby** were among the initial 18 individuals to receive P. Stat. designation and have also been

appointed by the SSC to serve on the initial committees; Jeannette on the Initial Accreditation Committee and Sylvia on the Initial Accreditation Appeals Committee. Details are available at

<http://www.stat.sfu.ca/~cschwarz/pstat>

- The Swedish Association of Graduate Engineers (CF) has appointed **Peter Guttorp** as their Environmental Professor during 2004/05. This professorship is awarded to an internationally known researcher in order to stimulate and catalyze Swedish environmental research. It is funded from the CF Environmental Fund. He will be located in Lund in southern Sweden, working with **Ulla and Jan Holst**, and will also be working with **Anders Grimvall** and his group in Linköping.
  - International Statistical Institute (ISI) membership elections announced during 2003 included TIES members **Montserrat Fuentes** (Spain), **Peter Guttorp** (Sweden) and **Sylvia Esterby** (Canada).
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### 2.3. Society News

#### TIES ELECTIONS

In March, the TIES Election Committee announced that no further nominations were received in addition to the ones submitted by the Election Committee for the seven eligible positions on TIES Board of Directors in 2004. Thus the seven nominees were elected by acclamation. The Election Committee members were Peter Guttorp (USA), chair, Rognvald Smith (UK) and David Fox (Australia). Elections are held every two years. Officers are elected for two year terms, and Regional Directors for four year terms. The terms of the Regional Directors are staggered so that only one Regional Director from each Region is elected in a given election. The following Directors continue on the Board for the indicated terms:

**President:** President-Elect, Anders Grimvall (Sweden) becomes President (01/09/04-31/08/06)

**Regional Representatives**  
(01/09/02-31/08/06):

**North America:** Jeanette O'Hara Hines, Canada

**Europe:** Gudmund Host, Norway

**Other Regions:** Jacky Galpin, South Africa

The newly elected members for the TIES Board of Directors are:

- President-Elect:** David Brillinger,  
Univ. of California at Berkeley, USA  
(01/09/04-31/08/06)  
President (01/09/06-31/08/08)
- Secretary:** Daniela Cocchi,  
University of Bologna, Italy  
(01/09/04-31/08/06)
- Treasurer:** Bronwyn Harch,  
CSIRO, St. Lucia, Australia  
(01/09/04-31/08/06)
- Publ. Officer:** Paul D. Sampson,  
University of Washington, USA  
(01/09/04-31/08/06)

#### Regional Representatives:

- North America:** Montserrat Fuentes,  
North Carolina State Univ., USA  
(01/09/04-31/08/08)
- Europe:** Peter Challenor,  
University of Southampton, UK  
(01/09/04-31/08/08)
- Other Regions:** Lelys Guenni,  
Simon Bolivar University, Venezuela  
(01/09/04-31/08/08)

#### El-Shaarawi Award 2004

The Abdel El-Shaarawi Young Researcher's Award [AE-SYRA] is given annually "in recognition of outstanding contributions to environmetric research".



The 2004 recipient is Dr Lance Waller, Associate Professor of Biostatistics, Rollins School of Public Health, Emory University. Dr Waller has a sustained

record of outstanding contribution to environmetric research, dating back to his dissertation under Professor Bruce Turnbull at Cornell where he studied statistical methods for disease clustering. Not only has Dr Waller made important contributions in terms of statistical methods for the spatio-temporal modeling of disease and environmental data, but he has become a leading figure in the application of these methods in areas such as epidemiology, geography and geographical information systems. His contributions to the area of environmental justice are also noteworthy.

#### Meet the in-coming members of TIES Board of Directors.

(Terms begin September 1, 2004)

#### President-Elect

**David R. Brillinger** was born in Toronto, Canada. He obtained a B.A. in Pure Mathematics from the University of Toronto in 1959, then an M.A. (1960) and Ph.D. (1961) from Princeton, both in Mathematics.

After a post-doctoral year at the London School of Economics he was simultaneously Lecturer in Mathematics at Princeton and member of Technical Staff at Bell Telephone Laboratories for two years. He next moved to a Lectureship, then Readership at the London School of Economics. In 1969 he was appointed Professor of Statistics at the University of California, Berkeley, where he remains today.

He has been a Member of TIES since 1991, he is currently a Deputy Editor of Environmetrics, and he was a Section Editor of the Encyclopedia of Environmetrics.

His current interests include: risk analysis (earthquakes, fires, floods, space debris), exploratory data analysis, conceptual mathematical modelling, applications of statistics in wildlife biology, neuroscience and engineering.

His web page address is:

<http://www.stat.berkeley.edu/~brill/>

#### Secretary

**Daniela Cocchi** has a Ph.D. in Sciences (Statistics), Université Catholique de Louvain, Louvain-la-Neuve, Belgium, Diplome Speciale en Statistique, Université Catholique de Louvain, Louvain-la-Neuve, Belgium and Laurea in Scienze Statistiche e Demografiche, Università di Bologna, Italy. She is Full

Professor of Statistics, Faculty of Statistics, University of Bologna (Nov. 1994 to present) and Coordinator of the PhD program in "Statistical methods for scientific research" at the Dept. of Statistics "Paolo Fortunati", University of Bologna.

Her research interests are in the areas of methods for finite population sampling and statistical models for environmental problems. In finite populations her results concern Bayesian solutions for hierarchical super-population models and small area inference. With reference to environmental problems, her scientific production is about the development of hierarchical models and methods for air quality indicators. She is the GRASPA group coordinator (see <http://www.graspa.org>).

Services to Scientific societies and journals:

2000-2004: TIES Regional representative for Europe.

2001-2002: Member of the Scientific Program Committee and local organizer of TIES2002, Genova.

1998-2002: Elected member, Board of the Italian Statistical Society (SIS).

2001-2002 Head of the Program Committee, XLI Scientific Meeting of the Italian Statistical Society, SIS2002

2003-2004: Member of the Program Committee, XLII Scientific Meeting of the Italian Statistical Society, SIS2004

Associate Editor (2000-) of Environmetrics

Associate Editor (2003-2006) of "Metron",  
<http://www.metronjournal.it/home.html>

### Treasurer

**Bronwyn Harch**, is a Statistician in CSIRO Mathematical & Information Sciences (CMIS). She graduated from Griffith University with B.Sc. in Australian Environmental Studies (Honours) in 1992 and obtained her Ph.D. in Biometry from The University of Queensland in 1996.

Most of Bronwyn's consulting and research focuses on the application of statistics to environmental and biological problems. In many projects Bronwyn often finds herself as a member of a multi-disciplinary team focused on natural resource problems that include for example, scientists from numerous disciplines and various organizations, data base managers, policy makers, council representatives, and community groups.

Bronwyn's current research focuses on the integration of uncertainty into the decision making associated with natural resource management. In particular:

- spatio-temporal sampling design in dendritic systems
- application of statistical methodology to detect spatial extent & temporal persistence of environmental impact/s
- reporting of ecosystem health from monitoring programs via innovative visual representations

Bronwyn is currently the Treasurer of TIES and is also the President of the Queensland Branch of the Statistical Society of Australia Inc. Bronwyn has also achieved Accredited Statistician status within Australia and is an elected member of the Environment Institute of Australia and New Zealand.

Her webpage address is:

[www.cmis.csiro.au/Bronwyn.Harch](http://www.cmis.csiro.au/Bronwyn.Harch)

### Publications Officer

**Paul D. Sampson** is a Research Professor of Statistics at the University of Washington, Seattle, WA, USA. He was granted Sc.B. and Sc.M. degrees in Applied Mathematics from Brown University and Ph.D. in Statistics from the University of Michigan.

As director of the department's statistical consulting programs he has been involved in a variety of applications of statistics to environmental problems. His main focus for many years has been on the modeling and analysis of spatio-temporal environmental monitoring data and the introduction of the spatial deformation approach to modeling of nonstationary spatial covariance structure. Research on the development of this methodology for application to tropospheric ozone has been funded by grants and contracts from the Electric Power Research Institute (EPRI) and the U.S. Environmental Protection Agency (EPA). He served as Assistant Director of the EPA-funded National Research Center for Statistics and the Environment, 1996-2002, and he currently manages the TIES website and newly introduced TIES Discussion Forum.

### Regional Representative, North America

**Montserrat Fuentes** is an Associate Professor in the Statistics Department at North Carolina State University (PhD in Statistics from University of Chicago in 1998) and a visiting faculty member in the

Center on Global Change at Duke University. Fuentes has also an associate status in the Marine, Earth & Atmospheric Sciences Department at NCSU. She spent a six-month postdoctorate in the National Center of Atmospheric Research (NCAR) before joining NCSU. She received the Abdel El-Shaarawi Young Research's Award in recognition of outstanding contributions to Environmetric research (2003). She is also member of the Regional Advisory Board (RAB) for the Eastern North American Region (ENAR) of the International Biometric Society, and an Associate Editor for the journals Biometrics and Environmetrics. Fuentes is a member of the U.S. Environmental Protection Agency Science Advisory Board.

Fuentes's research program has mainly focused on fundamental applied problems in the broad area of environmental sciences. She has maintained her own research group, currently with eight Ph.D. graduate students working on projects sponsored by the National Science Foundation (NSF), the US Environmental Protection Agency (EPA), the US Department of Transportation (DOT), the National Oceanic and Atmospheric Administration (NOAA) and the US Department of Defence (DOD).

Fuentes has worked on spatial statistics and applications to atmospheric pollution, meteorology and health effects from pollution. Fuentes has developed new statistical methods that she applied to air pollution problems in collaboration with the air quality modelers and scientists at EPA and NCAR. The main applications have concentrated on monitoring network design, spatial interpolation of environmental processes, evaluation of air quality numerical models, assessment of uncertainty in air quality prediction, mortality effects from fine and coarse particles, and statistical assessment of geographic areas of compliance with air quality standards.

### **Regional Representative, Europe**

**Peter Challenor** is Head of Satellite Remote Sensing in the James Rennell Division for Ocean Circulation and Climate at the Southampton Oceanography Centre in the UK. The SOC is a collaborative research centre between the University of Southampton and the Natural Environment Research Council and is the largest centre for oceanographic research in the UK. Peter gained his first degree in mathematics from the University of Exeter and then obtained an MSc in Biometry from Reading. He then joined, what was at that time, the Institute of Oceanographic Sciences to work on extreme waves and wave climate in general.

Peter's interests expanded to include satellite remote sensing of the oceans in particular radar altimetry, and recently he has become interested in the problem of estimating the uncertainties in the predictions of models of the Earth's climate. His current research interests include uncertainty in dynamical models of the climate, satellite remote sensing, the combination of data and numerical models, and the statistics of extremes. He is a committee member for the Environmental Statistics Study Group of the Royal Statistical Society.

### **Regional Representative, Other Regions**

**Lelys Guenni** was born in Caracas the 22nd of September, 1958. She graduated from Universidad Simón Bolívar as a bachelor in Mathematics in 1980 and obtained an MSc (with Honours) in Hydrology and Water Resources Planning in 1982. Lelys worked for 5 years at the National Center of Agricultural Research in Venezuela in the area of Agricultural Climatology and Crop Modeling. She obtained a Ph.D. in Environmental Sciences from Griffith University, Australia (1992) in the area of stochastic simulation of weather variables for agricultural applications. She has been teaching full time at the Universidad Simón Bolívar since 1994 in probability and statistics at undergraduate and graduate levels.

Her areas of interest are spatial and temporal modeling of climate data, climate risk and impact assessment methods and environmental statistics. She has been involved in different national and international projects and scientific committees: She was a member of the Science Steering Committee (SSC) of the Core Project BAHC (Biospherical Aspects of the Hydrological Cycles) of the IGBP (International Geosphere Biosphere Program); Chair of the Venezuelan Committee of the LBA project (The Large Scale Biosphere-Atmosphere Experiment in Amazonia) and Chair of the Venezuelan Committee of the International Goosphere-Biosphere Program.

At present she is leading a project on modeling vulnerability and risk of population to extreme precipitation events in Venezuela, funded by the National Fund for Science and Technology (FONACIT). She has been developing a similar project on a continental basis for the whole South American continent jointly with the Water System Analysis group of the University of New Hampshire (USA) with the support of the UNESCO office at Montevideo, Uruguay.

### 3. Environmetrics Conferences

#### 3.1. TIES Forthcoming Conferences

#### TIES 2004/SPATIAL ACCURACY 2004

*The joint meeting of  
the 15<sup>th</sup> Annual Conference of the International  
Environmetrics Society  
and  
the 6<sup>th</sup> International Symposium on Spatial Accuracy  
Assessment  
in Natural Resources and Environmental Sciences.*

For the first time, the annual TIES conference and the biennial Spatial Accuracy Symposium will hold a joint meeting reflecting their mutual interest in the quantification of environmental and natural resources processes and the uncertainty associated with them. The meeting will take place in Portland, Maine, USA from June 28 to July 1, 2004. The invited program includes:

##### **The TIES President invited Lecture:**

Allison Cullen, University of Washington, U.S.A - "The role of quantitative and precautionary analysis in environmental decision making".

##### **TIES Stuart Hunter Lecture:**

Richard L. Smith, North Carolina State University, U.S.A. – "Bayesian kriging and Bayesian network design."

##### **Spatial Accuracy Invited Speaker**

Kim Lowell, University of Laval, Canada – "Estimating boundary existence and width from a single forest map."

##### **Spatial Accuracy Invited Speaker**

Pierre Goovaerts, Biomedware, Inc., USA – "Modeling uncertainty about pollutant concentration and human exposure using geostatistics and a space-time information system: Application to arsenic in groundwater of southeast Michigan."

There will be invited paper sessions on the subjects:

- Current directions in space-time process modelling (organizer: Jim Zidek)
- Space-time predictions (organizer: Gerard Heuvelink)
- Environmental standards and assessment of goal achievement (organizer: Anders Grimvall)

- Forest wildfire (organizer: Ronald E. McRoberts)
- Issues of spatial scale in environmental data analysis (organizer: Marian Scott)
- SPRUCE Invited Paper Session: Monitoring Environmental Standards (organizer: Richard L. Smith)

For a more detailed program see the last pages of this Newsletter. About registration, accommodations and social events see the Conference website:

[http://www.nrcse.washington.edu/ties/events/ties2004/  
default.html](http://www.nrcse.washington.edu/ties/events/ties2004/default.html)

Abstracts for posters are solicited on important quantitative aspects of environmental and natural resources problems with emphasis on spatial data, spatial analyses, and spatial accuracy assessments. Posters on any aspect of environmental, natural resources, and spatial assessments will be considered. Abstracts of not more than 200 words that include title, 3 to 5 keywords, and names, affiliations, and contact information for the contact author should be sent via regular mail, fax, or e-mail (preferably) by 01 May 2004 to:

Ronald E. McRoberts  
North Central Research Station  
USDA Forest Service  
1992 Folwell Avenue  
Saint Paul, Minnesota 55108 USA  
Fax: +651-649-5174      E-mail: rmcroberts@fs.fed.us

#### 3.2. Other Forthcoming Conferences

The Ninth International Meeting on Statistical Climatology (9IMSC) will be held in Cape Town, South Africa during 25-28 May 2004. These meetings have been organized by a group of independent climatologists and statisticians since 1979.

The purpose of the IMSC meetings is to bring together climatologists and statisticians to exchange concepts and problems. Climatologists present statistical problems in climatology (including meteorology and related fields) and consider the methods that are currently used to deal with these problems. Techniques tailored by climatologists for the specific needs of climatology are also presented. Statisticians, on the other hand, present new, state-of-the art techniques developed within mathematical statistics and other scientific fields. By discussing the needs of

climatology and the possibilities offered by modern statistics, synergistic effects are obtained, advancing the methodological basis of climatology and helping statistics to focus on relevant problems.

For information see: <http://www.csag.uct.ac.za/IMSC/>

**The XXIInd International Biometric Conference, IBC2004**, sponsored by the International Biometric Society, will be held in parallel with the Australian Statistical Conference from 11 to 16 July 2004 in Cairns, Queensland, Australia.

It is expected that the joint conference will attract over 700 delegates and include eminent international speakers, leading researchers and participants from both Australia and overseas. Delegates will be able to attend sessions of either conference, ensuring a rich and varied scientific program.

An array of social events and tours are also being planned, to take advantage of beautiful North Queensland. For further information, to submit an abstract for presentation or to register for the conference, please visit:

[www.ozaccomm.com.au/cairns2004](http://www.ozaccomm.com.au/cairns2004)

### 3.3. Reports on Related Events

#### **Regional Conference on Climate Variability and Waterborne Disease: An Interdisciplinary Team Tackles an Interdisciplinary Issue**

Andrea Pelletier, MPH  
*Tufts University, USA*

Determining the role of weather in incidence of waterborne disease outbreaks has become a concern for environmental and public health communities. Heavy rainfall and runoff have been implicated in waterborne disease outbreaks in the United States and elsewhere. Waterborne infection due to climate variability, however, is a potential public health priority that is very difficult to measure due to the limitations of surveillance systems nationwide. Improving surveillance as well as applying the appropriate statistical methods for practical applications is fundamental to addressing this issue. This was the focus of the April 8, 2003 conference in which researchers and practitioners from various areas of study came together to address the question of how to improve regional surveillance of waterborne illness. Given the interdisciplinary nature of tracking human

disease, gathering experts from different fields including statistics, public health practice, water safety and environmental theory was critical to meeting the conference goals. Three main objectives of the conference included addressing data-sharing issues under new Health Insurance Portability and Accountability Act (HIPPA) regulations; determining ways to apply statistical modeling to public health practice; and developing methods to improve waterborne disease surveillance both locally and regionally.

Elena Naumova, Associate Professor at Tufts University School of Medicine, opened the conference with a challenge to participants as she recently made linkages between climate variability and waterborne infection incidence and described future directions in this area of research. Alfred DeMaria, State Epidemiologist at the Massachusetts Department of Public Health, provided an overview of waterborne disease surveillance systems both nationally and statewide. He presented waterborne disease reporting data and discussed issues surrounding various surveillance approaches.

One topic of discussion centered around how different types of water (i.e., ground water versus surface water and recreational water versus drinking water), different water treatment systems, geographical land use, differences in water consumption (i.e., bottled versus tap) and health status of the population would affect waterborne disease. The need to distinguish between drinking versus recreational water due to the different regulations and intervention opportunities around waterborne pathogens was also emphasized. The potential effect and mechanisms of different types of a precipitation event, e.g., light rain versus heavy rain, on waterborne diseases was discussed. It was determined that these factors should be taken into consideration when interpreting water, climate and waterborne disease data collectively.

The general consensus was that there is a need for surveillance systems capable of detecting small outbreaks in a timely manner. It was recommended to improve communication regionally by creating a reporting network. Dr. DeMaria added to this discussion by stressing the value of overlaying different methods of surveillance to detect small outbreaks. He recommended a networking system where emergency room data, private practitioners, pharmacies, and laboratories link waterborne disease data to improve chances of detecting a pattern in gastrointestinal illness. Researchers from Tufts

University School of Medicine proposed to add testing sewage for waterborne pathogens to detect increased levels of these pathogens in humans. Employing this tactic would provide laboratory confirmed, geographically isolated, and real-time data on waterborne diseases. With these data, statistical modeling techniques could be employed to determine whether an association exists between climate variability and waterborne diseases patterns.

This collaboration of experts developed several valuable ideas. Agreements were reached on how to address data sharing issues in the face of new HIPAA regulations. Various ideas were suggested concerning how to utilize experts from different disciplines to develop the most productive systems for tracking waterborne illness. Some of these ideas are implemented in the system for monitoring infections developed by Ian MacNeill (University of Western Ontario, Canada) and Elena Naumova. The work of Nina Fefferman (Tufts University, PhD candidate) has shown that using an estimation of the probability of short-term immunity via recursive combinatorial modeling can be applied to predict periodic fluctuation in endemic levels of disease. It has been also shown that ambient temperature can be used as a tool to forecast gastrointestinal infections. All three of these studies were presented at the TIES Conference in Johannesburg 2003.

In summary, a solid foundation was laid for interdisciplinary collaboration toward improving waterborne disease surveillance systems regionally. The conference was sponsored by Tufts University School of Medicine and the Massachusetts Department of Public Health.

## 4. Environmetrics Forum

### Online TIES Discussion Forum

Paul Sampson

*University of Washington, USA*

With an interest in spreading awareness of environmetric activity world wide, and facilitating communication among TIES members, an online Discussion Forum was added to the TIES website this past January. Our success in meeting these goals, and making TIES a more dynamic society in the process, depends on the extent to which members take advantage of this facility by contributing information and discussion.

The Discussion Forum can be found via a link from the TIES website, or directly at

[http://www.stat.washington.edu/cgi-bin/discus\\_TIES/discus.cgi](http://www.stat.washington.edu/cgi-bin/discus_TIES/discus.cgi)

It is organized according to a number of top-level topics. Some, such as the topic on the “*TIES/ACCURACY 2004 Conference*” and “*Environmetrics/Environmental Statistics Journal Tables of Contents*”, are primarily informational. Members are encouraged to post their own news and announcements under the headings of “*Research and Employment Opportunities*” and the catch-all topic, “*General Announcements and Discussion*”. Actual discussion is beginning to take place under the heading of “*TIES Discussion*”, where posting is restricted to TIES members. We hope to see further discussion take place on the posts beginning to appear in “*Preprints and Software*”. We are also considering introducing a “*Consulting*” topic where members may post questions and solicit advice on environmetric problems, methods, software, etc. The current interface to these main topics is shown in the following image.

Topic	Posts	Pages	Last Post	Last Poster
<a href="#">TIES/ACCURACY 2004 Conference News and Discussion</a>	5	1	03-01-04 10:45 pm	Admin
<a href="#">Environmetrics / Environmental Statistics Journal TOCs</a>	9	8	03-18-04 10:10 am	Admin
<a href="#">Research and Employment Opportunities</a>	7	8	04-20-04 09:35 am	Admin
<a href="#">Environmental or Environmetric News Links</a>	6	7	01-26-04 10:40 pm	Paul D Sampson
<a href="#">General Announcements and Discussion</a>	9	6	03-29-04 01:32 pm	Admin
<b>TIES member-restricted topics:</b>				
<a href="#">Current TIES Newsletter</a>	1	1	01-28-04 11:04 pm	Paul D. Sampson
<a href="#">TIES Discussion (posting: TIES members only)</a>	7	4	03-19-04 12:25 pm	Montserrat Fuentes
<a href="#">Preprints and Software (posting: TIES members only)</a>	4	5	02-20-04 02:01 am	Claudia Libiseller

Most of the informational and discussion topics on this message board are open to the public. However, some topics provide services restricted to members of The International Environmetrics Society. For membership information, go to the [TIES membership page](#).

We encourage all readers of this board, whether or not you are a member of TIES, to become a registered user by clicking on the "Profile" icon at the top of this page. There are many personal preferences that you can set (all default settings ensure your privacy). Perhaps most important and useful is the fact that you can enable automatic email notification of postings to topics and/or discussion threads of interest to you.

While most of the Discussion Forum is open to the public, reading and/or posting privileges to the “*TIES Newsletter*”, “*TIES Discussion*” and “*Preprints and Software*” topics are currently provided as a benefit of membership in TIES. All current TIES members are registered users of the Discussion Forum, which enables them to set a variety of preferences on their

interaction with the Forum. All member registrations were set up with the most secure/private options selected, but we encourage members to include personal information in their Discussion Forum "profile" and to select the option permitting that information to be accessible to other registered TIES members via the "Member List". We strongly encourage members to edit their profiles (by clicking on the word "Profile" in the menu at the top of the Discussion Forum) to select to receive automatic email copies of posts to any or all of the main topics. Email messages from the Discussion Forum include direct links back to the posted message to facilitate follow-up comments and discussion. Questions about user accounts and profiles, or any other aspect of the operation of the Discussion Forum, can be directed to the administrator, Paul Sampson.

([pds@stat.washington.edu](mailto:pds@stat.washington.edu)).

## 5. Research Projects and Programmes

Teresa Alpuim, Editor

In this section of TIES Newsletter members are invited to describe the Environmetrics research projects they are involved with. It is our aim, not only to show the many different ways quantitative methods are being applied to Environmental Sciences, but also to give knowledge about who is working on what problems. We believe that this will contribute to increased scientific interchange between TIES members. Contributions should be sent to Teresa Alpuim, email: [talpuim@fc.ul.pt](mailto:talpuim@fc.ul.pt). Academic programmes related to environmental problems are welcome, too.

## Statistics of Weather and Climate Extremes Web Page and Toolkit

Rick Katz

*National Center for Atmospheric Research, USA*

The newly designed Statistics of Weather and Climate Extremes web page,

[www.esig.ucar.edu/extremevalues/extreme.html](http://www.esig.ucar.edu/extremevalues/extreme.html)

is intended to serve as a general resource for information about applying the statistical theory of extreme values to weather and climate and its impacts. The web page also serves as a gateway to the Extremes Toolkit,

[www.esig.ucar.edu/extremevalues/evtk.html](http://www.esig.ucar.edu/extremevalues/evtk.html)

an effort to develop software for applying this statistical methodology to weather and climate extremes in a form more accessible to the broader atmospheric and atmospheric impacts community.

The software is programmed in the open source statistical language R, making use of functions for extreme value analysis,

[www.maths.bris.ac.uk/~masgc/ismev/functions.html](http://www.maths.bris.ac.uk/~masgc/ismev/functions.html)  
written by Stuart Coles, a statistician at the University of Bristol, UK. Graphical user interface dialogs make it easier for scientists not familiar with R to access the software. An in-depth accompanying tutorial,

[www.esig.ucar.edu/extremevalues/tutorial.pdf](http://www.esig.ucar.edu/extremevalues/tutorial.pdf)

or

[www.esig.ucar.edu/extremevalues/tutorial/](http://www.esig.ucar.edu/extremevalues/tutorial/)

provides an introduction to scientists who may be unfamiliar with extreme value methods.

For more information, contact: Rick Katz (email: [rwk@ucar.edu](mailto:rwk@ucar.edu)) or Eric Gilleland (email: [ericg@ucar.edu](mailto:ericg@ucar.edu)), Environmental and Societal Impacts Group, National Center for Atmospheric Research, Boulder, CO USA.

## 6. Forthcoming Papers in Environmetrics

Abdel El-Shaarawi, Editor-in-Chief

- J. Roca-Pardiñas, W. González-Manteiga, M. Febrero-Bande, J.M. Prada-Sánchez and C. Cadarso-Suárez.: "Predicting Binary Time Series of SO<sub>2</sub> using Generalized Additive Models with Unknown Link Function".
- Rebecca A. Buchanan, Loveday L. Conquest, Jean-Yves Courbois: "A Cost Analysis of Ranked Set Sampling".
- Patty L. Kitchin: "Measuring the Amount of Statistical Information in the EPT Index."
- Omar Eidous: "Bias Correction for Histogram Estimator Using Line Transect Sampling".
- Gintautas Dzemyda: "Visualization of Correlation based Environmental Data".
- W. G. S. Hines, R. J. O'Hara Hines, B. Pond, M. E. Obbard: "Allowing for Redundancy and Environmental Effects in Estimates of Home Range Utilization Distributions".
- Bruce Smith: "Sea Level Characteristics in the Bay of Fundy/Gulf of Main".

- S. Grunwald, K. R. Reddy, S. Newman and W. F. DeBusk: "Spatial Variability, Distribution, and Uncertainty Assessment of Soil Phosphorus in a South Florida Wetland".
  - Kaushik Ghosh and Ram C. Tiwari: "Bayesian Density Estimation using Ranked Set Samples".
  - Ronald E. Gangnon and Murray K. Clayton: "Likelihood-based tests for localized spatial clustering of disease".
  - Bruno Sansóy and Lelys Guenni: "A Bayesian Approach to Compare Observed RainfallData to Deterministic Simulations".
  - Michelle Casey, Chris Gennings, W. Hans Carter, Jr., Virginia C. Moser and Jane Ellen Simmons: "Ds-Optimal Designs for Studying Combinations of Chemicals Using Multiple Fixed-Ratio Ray Experiments".
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## 7. Recently Published Books

Liliana Gonzalez  
(liliana@cs.uri.edu)

The objective of this section of the Newsletter is to provide a list of recently published books of interest to members of our society. I encourage every one to send me information about books they think should be listed in this section in future issues of the Newsletter.

- **Beltrami, E.** *Mathematical Models for Society and Biology*. E. Beltrami. Academic Press, 2001.
- **Buckland, S. T., Anderson, D. R., Burnham, K. P. and Laake, J. L.** *Distance Sampling: Estimating Abundance of Biological Populations*. Chapman and Hall, 2003.
- **Cann, A. J.** *Maths from Scratch for Biologists* Wiley, 2002.
- **Crawford-Brown, D. J.** *Mathematical Methods of Environmental Risk Modeling*. Kluwer, 2001.
- **David, H. A. and Edwards, A. W. F.** *Annotated Readings in the History of Statistics*. Springer, 2001.
- **Davis, J. C.** *Statistics and Data Analysis in Geology*. 3<sup>rd</sup> Edition. Wiley, 2002.
- **Denison, D. G. T., Holmes, C.C., Mallick, B. K. and Smith, A. F. M.** *Bayesian Methods for*

*Nonlinear Classification and Regression*. Wiley, 2002.

- **Elston, R. C., Olson, J. M. and Palmer, L.** (Eds.). *Biostatistical Genetics and Genetic Epidemiology*. Wiley, 2002.
- **Everitt, B. S.** *The Cambridge Dictionary of Statistics*. 2<sup>nd</sup> Edition. Cambridge University Press, 2002.
- **Everitt, B. S.** *Medical Statistics from A to Z. A Guide for Clinicians and Medical Students*. Cambridge University Press, 2003.
- **Fotheringham, A. S., Brunsdon, C. and Charlton, M.** *Geographically Weighted Regression: The Analysis of Spatially Varying Relationships*. Wiley, 2002.
- **Heyde, C. C. and Seneta, E.** (Eds.). *Statisticians of the Centuries*. Springer, 2001.
- **Hosmer, D. W. and Lemeshow, S.** *Applied Survival Analysis: Regression Modeling of Time to Event Data*. Wiley, 2002.
- **Jolliffe, I. T.** *Principal Component Analysis*, 2<sup>nd</sup> Edition. Springer, 2003.
- **Kantardzic, M.** *Data Mining: Concepts, Models, Methods, and Algorithms*. Wiley-IEEE Press, 2002.
- **Kedem, B. and Fokianos, K.** *Regression Models for Time Series Analysis*. Wiley, 2002.
- **Kleinbaum, D. G. and Klein, M.** *Logistic Regression, A Self-Learning Text*. Springer, 2002.
- **Last, J. M.** (Ed.). *A Dictionary of Epidemiology*. 4<sup>th</sup> Edition. Oxford University Press, 2001.
- **Lawless, J. F.** *Statistical Models and Methods for Lifetime Data*. 2<sup>nd</sup> Edition. Wiley, 2002.
- **Linders, J. B. H. J.** (Ed.). *Modelling of Environmental Chemical Exposure and Risk*. Kluwer, 2001.
- **Lindsey, J. K.** *Nonlinear Models for Medical Statistics*. New Edition. Oxford University Press, 2001.
- **Little, R. J. A. and Rubin, D. B.** *Statistical Analysis with Missing Data*. 2<sup>nd</sup> Edition. Wiley, 2002.
- **Mastebroek, H. A. K. and Vos, J. E.** *Plausible Neural Networks for Biological Modelling*. Kluwer, 2001.

- **Møller, J.** (Ed.). *Spatial Statistics and Computational Methods*. Springer, 2003.
  - **Selvin, S.** *Epidemiologic Analysis. A Case-Oriented Approach*. Oxford University Press, 2001.
  - **Titterington, D. M.** and **Cox, D.** (Eds.). *Biometrika - One Hundred Years*. Oxford University Press, 2001.
  - **Townend, J.** *Practical Statistics for Environmental and Biological Scientists*. Wiley, 2002.
  - **van der Laan, M. J.** and **Robins, J.** *Unified Methods for Censored Longitudinal Data and Causality*. Springer, 2003.
  - **Ward, A. D., Trimble, S. W.** and **Wolman, M. G.** *Environmental Hydrology*. 2<sup>nd</sup> Edition. Lewis Publishers, 2003.
  - **Woolson, R. F.** and **Clarke, W. R.** *Statistical Methods for the Analysis of Biomedical Data*. 2<sup>nd</sup> Edition. Wiley, 2002.
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## 8. Book Reviews

Liliana Gonzalez, Editor

I call for volunteer reviewers in every issue of the Newsletter. But in the last issue only one of our members contacted me requesting a title for review. Nick Hamm from the University of Bristol kindly volunteered to review *Spatial Statistics and Computational Methods*, edited by J. Møller and published by Springer-Verlag. His review will appear in the November issue of the Newsletter.

Once again, I **encourage you all to take part in this section of the Newsletter**. We must have volunteers in order to have a book review section and there are plenty of books to choose from! A long list of titles is provided in the section “Recently Published Books” but you are not restricted to this list. Ask for any title you are interested in reviewing and I will contact the publishing company to request a complementary copy of the book to be sent to you.

Lastly, I wish to sincerely thank Philip Dixon for providing us with the review we are including in this issue of the Newsletter. I also like to extend my gratitude to Dee Halzack, marketing@compmech.com, North American Distributor for WIT Press, for providing Philip with a complementary copy of the book reviewed in this issue.

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## Spatial Statistics Through Applications

by

J. Mateu and F. Montes (Eds)

Wessex Institute of Technology (WIT) Press, Southampton, UK, 2002, Hardcover, 368 pp, US\$185, £119.00, Euro178.50, ISBN: 1-85312-649-7.

**Reviewer:** Philip Dixon, Department of Statistics, Iowa State University, USA. Email: pdixon@iastate.edu.

Good applications have many uses: as examples for teaching, as test beds for comparison of methods, and as motivation for new theory. The connection with applications is especially strong in spatial statistics. Realistic examples are prominent in many texts and there are books of case studies, e.g. Griffith and Layne (1999). So, how useful is a book promising more applications? Do these applications motivate new theory? Could they be used in teaching? My opinions are mixed because the chapters in this edited volume are mixed. The best chapters are wonderful examples of novel applications that motivate new theory or methods. The rest of the book includes review chapters, case studies applying extant methods, and chapters that develop a method or prove a theorem then provide a short illustration. Most of the chapters are based on original data; one chapter reanalyzes a pair of classic data sets.

The book gives equal coverage to the two major areas of spatial statistics: continuous random fields and spatial point processes. The chapters illustrate exploratory data analysis, frequentist inference, and Bayesian inference. The authors come from six different countries, although most are at British or Spanish universities. The applications are primarily environmental: air quality, temperature, extreme wind speed, rainfall extrema, and the relationship between road traffic and asthma. The remaining applications include clustering of cancer cases, using marked point processes in image analysis, and a point process approach to spatial economics. The mathematical level is varied but generally moderate, i.e. accessible to a MS student in statistics. Some chapters have almost no mathematics (e.g. the exploratory analysis of cancer clustering) while other chapters require some advanced probability theory. The mathematical approach is generally informal.

The book is most definitely a collection of chapters. Each chapter stands independently and has its own list of references. There are no cross references from one

chapter to related ideas in other chapters. There is no index. To the book's credit, there is little repetition of introductory material from chapter to chapter.

For the record, the book includes a forward by Al Stein, a short introduction by the editors and 13 chapters arranged into three parts:

#### **Part I: General and Methodological Issues**

- 1) A spatial perspective on decision-making methods and processes, B. Cornélis
- 2) Perfect simulation in spatial statistics, E. Thönnes
- 3) Spatial point processes: an overview, P. Gregori and J. Mateu

#### **Part II: Environmental Applications and Climate Issues**

- 4) Spatial interpolation of environmental processes, M. Fuentes
- 5) Nonparametric nearest neighbor variogram estimation. K. Yu and J. Mateu
- 6) Semi-parametric statistical approaches for space-time process prediction. Some applications. M. Febrero-Bande, González-Manteiga, F.J. Alonso and J.M. Angulo
- 7) Extreme value analysis of wind speed in Great Britain. M. Cortina-Borja, V. Houlot, M. Eagle and S. Williams
- 8) Modelling extreme rainfall events. M.A. Ancona-Navarrete and J.A. Tawn
- 9) Statistical methods for field analysis used in climatology. P. Ribera, L. Gimeno, R. García, E. Hernández and S. Venegas

#### **Part III: Epidemiology and Point Process Issues**

- 10) Bayesian approach for investigating the relationship between road traffic pollution and asthma among children. Y. Zhang, K. Yu, and K. Rennolls
- 11) Analysis of cancer mortality via spatial point processes. G. López-Abente, and C. Ibáñez.
- 12) An application of marked point processes to the extraction of linear networks from images. R.S. Stoica, M.N.M. van Lieshout, X. Descombes and J. Zerubia

- 13) Statistical tools for spatial economics. M. Albert, V. Orts, and J. Mateu.

For the most part, the titles describe chapter contents, except that chapter 5 is more about nonparametric smoothing than nearest-neighbor estimation and the statistical tools in chapter 13 are restricted to point process approaches.

The book production is good. All chapters have the same font and citation format. I found no mistakes in the equations and only a few typos. Unfortunately, page numbers in the table of contents are consistently off by 2 after the first chapter.

So, will this book come off my bookshelf often? I'm afraid not often, but it will not collect dust. I would have trouble using the applications in teaching because I prefer to start with the original data. Data sets are not included with the book and there is no indication whether any data set is publicly available. If you are satisfied with the published analyses, most chapters provide very nice examples or case studies for graduate level classes in spatial statistics or advanced inference. Chapters 3 and 4 include very nice reviews of spatial point processes and geostatistics. I may use these as assigned readings in a graduate level spatial statistics course. The usefulness of a chapter for research depends on individual interest. For me, Chapters 8 and 10 were especially useful. Someone interested in image analysis could be interested in chapter 12.

#### **References**

- **Griffith, D.A. and Layne, L.J.** *A Casebook for Spatial Statistical Data Analysis, a compilation of analyses of different thematic data sets.* Oxford, Oxford University Press, 506 pp, 1999.

## **9. TIES Board of Directors**

The following are the names of the elected members of TIES Board of Directors. All terms are from September 1, 2002, to August 31, 2004, except the 4-year terms of the regional directors.

#### **President:**

Peter Guttorp  
(peter@stat.washington.edu)

#### **President-Elect:**

Anders Grimvall  
(angri@mai.liu.se)

**Secretary:**

Richard W. Katz  
(rwk@ucar.edu)

**Treasurer:**

Bronwyn D. Harch  
(Bronwyn.Harch@csiro.au)

**Publications Officer:**

Teresa Alpuim  
(talpuim@fc.ul.pt)

**Regional Representatives (date term ends):****North America:**

Anthony R. Olsen (31/08/04)  
(Olsen.Tony@epamail.epa.gov)

Jeanette O'Hara Hines (31/08/06)  
(johara@uwaterloo.ca)

**Europe:**

Daniela Cocchi (31/08/04)  
(cocchi@stat.unibo.it)

Gudmund Host (31/08/06)  
(gudmund.host@nr.no)

**Other Regions:**

Raymond L. Correll (31/08/04)  
(Ray.Correll@csiro.au)

Jacky Galpin (31/08/06)  
(jacky@galpin.co.za)

For questions regarding membership and other benefits contact:

Peter Guttorp (peter@stat.washington.edu)

or

Bronwyn Harch (Bronwyn.Harch@csiro.au.)

**TIES Newsletter** is a publication of the International Environmetrics Society (TIES). It is published semiannually, or whenever the need arises, by The International Environmetrics Society and distributed to TIES members as part of their annual dues.

Objectives of the Newsletter include (but are not limited to):

- To keep TIES members informed of what is happening within the Society;
- To cover news in latest developments in theory and applications of environmetrics;
- To be a forum for discussion of a broad range of issues which are of interest to members of TIES and are consistent with the objectives of the Society.
- To facilitate communication between environmental scientists and statisticians about research problems of mutual interest.
- To provide details about upcoming conferences and workshops related to Environmetrics;
- To announce members' news that are worthy of notice or recognition (e.g., awards, prizes and honors received, promotions, appointments, etc.)

Communications, (e.g., contributions, comments and suggestions) regarding this publication should be addressed to the TIES Newsletter editors:

Teresa Alpuim  
(talpuim@fc.ul.pt)

or

Sylvia Esterby  
(SREsterby@ouc.bc.ca).

The Editors would like to encourage TIES members to submit items for publication in the Newsletter. We would like to have a very comprehensive publication that is of interest to our members by including items such as members' and regional news, Environmetrics and related conferences, research projects and programmes, book reviews, letters to the editor and articles of general interest.

We would like to thank the members who responded to our call and contributed to this issue. It is our hope that the Newsletter will be a valuable platform for discussion and exchange of ideas among us. We will be happy to hear your views about the contents and style of this issue. We hope that you will be a reader as well as a contributor.

<b>TIES Webpage:</b>	<a href="http://www.nrcse.washington.edu/ties">http://www.nrcse.washington.edu/ties</a>
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**PROGRAM**

**The joint meeting of**  
**The 15<sup>th</sup> Annual Conference of The International Environmetrics Society**  
**and**  
**The 6<sup>th</sup> International Symposium on Spatial Accuracy Assessment**  
**In Natural Resources and Environmental Sciences**

Portland, Maine, USA

June 28-July 1, 2004

**MONDAY – 28 June 2004**

9:00-9:45     Spatial Accuracy Invited Lecturer

“Estimating boundary existence and width from a single forest map”

Kim Lowell, University of Laval, Canada

10:30-12:10   Invited: Environmental standards and assessment of goal achievement

Contributed 1: Land use/land cover change

Contributed 2: Accommodating spatial dependence

1:30-3:10     Invited: Space-time predictions

Contributed 3: Sample design

Contributed 4: Monitoring environmental contamination and pollution

3:45-5:25     Contributed 5: Water quality

Contributed 6: Uncertainty in environmental and spatial data

**TUESDAY – 29 June 2004**

9:00-9:45     TIES President's Invited Lecture

“The role of quantitative and precautionary analysis in environmental decision making”

Alison Cullen, University of Washington, USA

10:30-12:10   SPRUCE Invited: Monitoring environmental standards

Contributed 7: Map uncertainties, limitations, and applications

Contributed 8: Tests and distributions

- 1:30-3:10    Invited: Where are the fires?  
              Contributed 9: Modeling and analyzing spatial and temporal structure  
              Contributed 10: Methods and techniques
- 3:45-5:25    Contributed 11: Climate change and reconstruction  
              Contributed 12: Environmental monitoring and prediction

**WEDNESDAY – 30 June 2004**

- 9:00-9:45    TIES J. Stuart Hunter Lecture  
              “*Bayesian kriging and Bayesian network design*”  
              Richard L. Smith, North Carolina State University, USA
- 10:30-12:10    Invited: Current directions in space-time process modeling  
              Contributed 13: Aquatic ecosystems  
              Contributed 14: Positional uncertainty
- 1:30 -        Social: Harbor cruise and lobster bake

**THURSDAY – 01 July 2004**

- 9:00-9:45    Spatial Accuracy Invited Lecturer  
              “*Modeling uncertainty about pollutant concentration and human exposure using geostatistics and a space-time information system: application to arsenic in groundwater of southeast Michigan*”  
              Pierre Goovaerts, Biomedware, Inc., USA
- 10:30-12:10    Invited: Issues of spatial scale in environmental data analysis  
              Contributed 15: Creating, evaluating, and using land cover maps  
              Contributed 16: Meteorological applications
- 1:30-3:10    Contributed 17: Spatial data quality  
              Contributed 18: Spatial accuracy assessment  
              Contributed 19: Ecological and environmental sustainability
- 3:45-5:25    Contributed 20: Ground and riverine water  
              Contributed 21: Ecosystem diversity and abundance

