

IGU COMMISSION C00-18 MODELLING GEOGRAPHICAL SYSTEMS 2004-2008 REPORT

1. Background

The Commission on Modelling Geographical Systems has been a focus for those members of the international community who share an interest in using mathematical and statistical models in geographical systems analysis, geographical systems theory, geographical systems dynamics, geographical decision (or decision support) systems, GIS and remote sensing. This synthesis has aided and enhanced research on mathematical modelling, statistical methods and other technological advances. In addition, the specific systems orientation of the Commission has enabled a new emphasis to be placed on more applied outputs that have relevance to geographers engaged in evaluating a variety of policy arenas. A specific theme at the 2004 Conference in Glasgow was relevant, testable and reproducible modelling. The theme developed for 2004-2008 was looking at the history of the development of theoretical and quantitative geography (the so-called 'quantitative revolution'). This resulted in special sessions run by CMGS at the 2006 Brisbane conference.

Geographical systems analyses have contributed significantly to the understanding of, for example, the space economy, transportation and urban planning (especially retailing and consumer behaviour), global environmental change, spatial epidemiology and health care delivery and the evolution of theoretical and quantitative methods. The promotion and publication of these ideas have been facilitated by our strong links with the editorial boards of the following international journals: *Geographical Systems*, *Geographical Analysis*, *International Journal of GIS* and *Papers in Regional Science*. The papers from Glasgow appeared in a special edition of *Geographical Systems* in 2005 and the papers presented at Brisbane the 'Legends in Theoretical and Quantitative Geography' are in press with *Geographical Analysis*. The CMGS has been a continuous member commission of the IGU since 1962 and seeking to renew its membership from 2008 to 2012 under the leadership of the provisional new chair Professor Yee Leung from Hong Kong.

Early stages of the "quantitative revolution" in geography viewed as a diffusion process

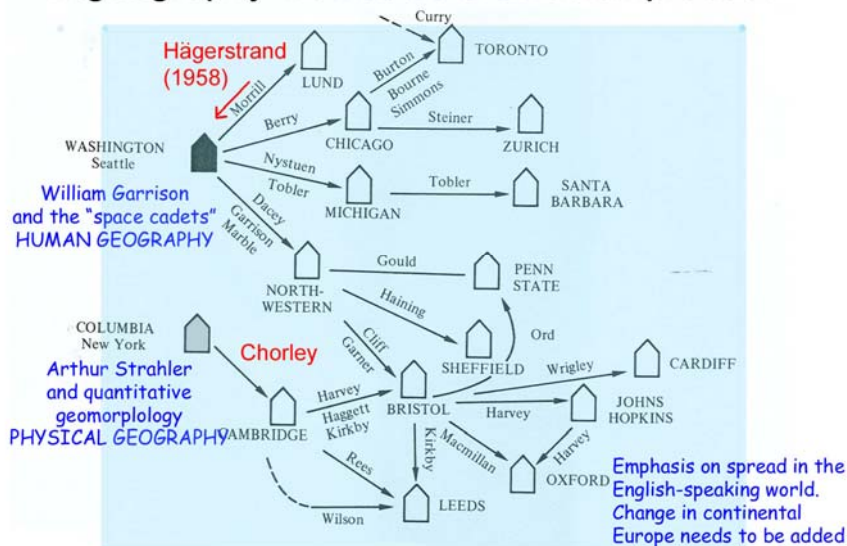


Figure 1 Diffusion of the quantitative revolution from Peter Haggett's 'Legends' presentation Brisbane IGU Conference 2006

2. Membership

A) Steering Committee

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B) Number of Commission Members on Email

Australia	6	Germany	5	Norway	1	Tunisia	1
Austria	6	Greece	1	Poland	1	UK	51
Belgium	5	Ireland	1	Portugal	2	USA	71
Canada	33	Israel	3	Russia	2		
China	2	Italy	6	South Africa	3		
Denmark	1	Japan	7	Spain	1		
France	4	Netherlands	14	Sweden	7	TOTAL	239
Finland	1	Nigeria	1	Switzerland	3	COUNTRIES	27

3. Meetings

A) 2004 Glasgow

There were a number of well attended sessions (average 32 participants per session) developing a number of selected themes (see Appendix). A number of papers were selected for a special volume in *Geographical Systems*. Collectively, they aim to implement this relevant, testable and reproducible modelling perspective to look at a range of complex applied problems and the statistical techniques that are required to underpin them. In a way, the papers represented a more sophisticated form of geographical modelling, yet there was still the essence of the quantitative revolution within their conception. Theoretical and statistical templates for analysis are still required for rigorous analysis. Understanding these templates and applying them to relevant geographical problems was very much the theme of these papers. They were based on models that ask relevant, testable and reproducible questions. What are the benefits of a locally weighted regression template? When should this be applied in preference to globally weighted regression? How can AIDS models better describe the processes of diffusion in a variety of contexts so there is a more robust template? How can susceptible forest resources be identified to prevent the proliferation of pests. How does time spent gambling at electronic gaming machines affect the time behaviour of participants? Does distance still matter in Internet spatial interaction? What these papers tried to establish were more robust templates for spatial and temporal analysis of geographical phenomena on all scales.

B) 2006 Brisbane

The sessions were well attended averaging 40 participants per session (see Appendix). The 'Legends' sessions in the Brisbane Town Hall drew attendance levels of over 100 per session. It was a rare occasion to have many of the 'founding fathers' of the quantitative revolution in geography reflecting on the past and giving their thoughts on the future of these techniques within the discipline. These sessions represented the fruition of an ambitious idea which would have been virtually impossible to achieve without the financial support of the Australian Research Council Research Network in Spatially Integrated Social Sciences (ARCRNSISS).

The idea of holding 'Legends' sessions came after Barry Boots and Robert Baker put together a series of papers in a special edition of *Geographical Systems* from the IGUCMGS Conference in Glasgow in 2004 and Professor Peter Haggett, who was present, provided a retrospective overview of the papers and reflections of how the discipline had evolved since the 1960s. The seminal work by Chorley and Haggett (1967) in *Models in Geography* was a catalyst and confirmation that models should be an integral part in the evolution of geographical knowledge. This Glasgow connection of the present with the past seemed to be a very valuable exercise as Peter was one but a series 'names' pivotal in the evolution of quantitative revolution in geography from the 1960s and 1970s. The idea was to invite not only Peter but others influential scholars to present papers and participate within a forum on the development of theoretical and quantitative geography. Brisbane provided the fruition of this idea.

4. Networking

CMGS organised joint sessions with the British and Irish Section of the Regional Science Association in Glasgow 2004. The sessions explored a variety of geographical modelling systems assisting in the understanding of regional development processes. In Glasgow, further joint sessions were undertaken with the Quantitative Methods Research Group of the RGS-IBG. The themes presented in separate sessions were multi-scale modelling in physical and human geography. In Brisbane 2006, the CMGS organised joint sessions with commission C04.30 Monitoring Cities of Tomorrow on the theory and practice of understanding processes in urban systems. For the 'Legends' sessions in Brisbane, significant financial sponsorship was obtained from the Australian Research Council Research Network in Spatially Integrated Social Science (ARCRNSISS). This allowed for the sessions to be held in the Brisbane Town Hall and the subsidisation of travel and accommodation costs to the distinguished participants.

5. Publications

The papers and letter presented at the Brisbane Legends sessions have been assembled and refereed and will appear in a special edition of the international journal *Geographical Analysis*. The creation of the journal in 1969 was one of the significant consequences of the theoretical and quantitative revolution in geography in the 1950s and 1960s. Therefore, it is timely that the reflections of some of the original participants appear in the same journal nearly forty years later.

Special Edition of Geographical Analysis (forthcoming 2008)

Contents

Edited by Robert Baker and Robert Stimson

Introduction to the Issue

A 'Caesarean', 'Augustan' or 'Justinian' World View of Theoretical and Quantitative Geography?

Robert G V Baker

The Legends Papers

The Local Shape of Revolution: Reflections on Quantitative Geography at Cambridge in the Fifties and Sixties.

Peter Haggett

From Spatial Analysis to Geospatial Science

Brian J.L. Berry, Daniel A. Griffith and Michael R. Tiefelsdorf

Behavioral Geography and the Theoretical/Quantitative Revolution

Reginald G. Golledge

Geography, Space and Science: Perspectives from Studies of Migration and Geographical Sorting

William A.V. Clark

Demographic Modeling of the Geography of Migration and Population: A Multiregional Perspective

Andrei Rogers

A History of the Concept of Spatial Autocorrelation: A Geographer's Perspective

Arthur Getis

Statistical Perspectives on Geographic Information Science

Michael F. Goodchild

Research Notes and Comments

Is Geography (still) a Science?

Richard Morrill

Research Notes and Comments (continued)

Quantification: Are We Turning Full Circle ?
Ron Johnson

The Spirit of Quantitative Geography
Peter Haggett

6. Archival Contributions

Copies of the above publication (when available) will be transmitted to the Villa Celimontana.

7. Continuation

A) Name

Commission on Modelling Geographical Systems (unchanged).

B) Mission

The Commission will serve as a focus for those who share an interest in the development of geographical systems theory for analysing societal and environmental problems. Our mission is to promote research on mathematical modelling, statistical methods and other relevant advances like remote sensing and information technologies. In addition, the Commission emphasises the importance of applied research with outputs that have relevance to those engaged in the policy arena in both human and physical geography.

The Commission, therefore, emphasises the following general areas of concern:

- geographical systems theory and analysis;
- geographical decision support systems and decision theory;
- geographical systems dynamics;
- the interface between GIS, remote sensing and spatial modelling;
- geographical data mining and knowledge discovery; and
- applications of systems models to policy making and evaluation.

C) Steering Committee

The provisional new Chair (Yee Leung) will continue to lead the commission and Stewart Fotheringham, Jinfeng Wang, Graham Clarke, Manfred Fischer, Therese Steenberghen and Ali Bennisar have agreed to continue to serve as steering committee members from 2008 to 2012. We are currently seeking four new committee members (TBA) to fill vacancies through retirement of Art Getis, Barry Boots, Atsuyuki Okabe and Robert Baker.

D) Planned Work

Meetings

A special conference is planned for 2009 for members to give papers towards a new 'Models in Geography' project based on the same format as the seminal work of Chorley and Haggett in 1967. In addition to the regional conference to be held in 2010, the Commission plans to organize workshops and special-topic conferences throughout 2008-2012.

Publications

The Commission is strongly committed to the encouragement of scholarly publication derived from the work of its members and their contributions to symposia. Theoretical and empirical research will be published as special issues in journals and edited volumes in books.

Networking

The Commission plans to organize sponsored sessions with the Pacific Regional Science Conference in 2009, and with other organizations in the years to follow. Collaborations with other Commissions will also be made to capitalize on our capabilities in formulating formal and practical approaches to solve problems relevant to the missions of the Commissions concerned.

Funding

A special conference for 'New Models in Geography' project is planned for North Queensland in 2009 and in principle agreement has been reached for sponsorship by the Australian Research Council Research Network in Spatially Integrated Social Sciences (ARCRNSISS).

Membership

The Commission intends to further expand its membership by actively engaging geographers in our initiatives and activities, and to become members of the Commission.

E) Scholarly Importance

The IGU Commissions and Study Groups on Theoretical and Quantitative Geography have had a long history of excellence and scholarly evolution since 1962. To date, geographical systems analyses have contributed significantly to the understanding of human societies and the natural environment. In addition, to this applied perspective there is a theoretical imperative to improve and refine geographical systems theory and to document the evolution of theoretical and quantitative geography. The IGU Commission on Modelling Geographical Systems is uniquely placed to develop these themes. Our proposals for 2008 - 2012, therefore, are intended to continue and encourage both relevant, testable and reproducible modelling and, in particular, the contribution that quantitative technique makes to the advancement of spatial and temporal knowledge, as well as the solutions to pressing problems in human and physical systems.

Robert Baker
Chair
CMGS (2005-2008)

8. Appendices: Conference Presentations

(not listed in previous reports)

IGU COMMISSION ON MODELLING GEOGRAPHICAL SYSTEMS 30th International Geographical Congress (IGC), Glasgow, 15th – 20th August 2004

Programme

Geographical Modelling and Regional Development 1

Chair: Robert Baker (University of New England, Australia)

Time: Tuesday 17th 7.30 – 8.50

Abstract (2 sessions): The sessions have been organised for the CMGS by Graham Clarke (University of Leeds) on behalf of the British and Irish Section of the Regional Science Association International. They explore how a variety of geographical modelling systems assist the understanding of regional development processes. The topics emphasised include land-use and transportation dynamics and the regional impacts of employment processes.

R Bradshaw R Abrahart (University of Nottingham) *Neural-Network Modelling Of The Regional Development Process In Spain (1711)*

Rinas Kashbrasiev, Vladimir Tikunov (Russian Federation) *Cartographic Modelling of Spatial Equilibrium Processes in the Russian Economy (2088)*

(14 Attendances)

Geographical Modelling and Regional Development 2

Chair: Graham Clarke (University of Leeds)

Time: Tuesday 17th 9.00 – 10.20

G Allan (University of Strathclyde), L Ferguson, C Jones, P G McGregor, M Munday, A Roberts, J K Swales and K Turner *The Barnett Formula and the Welsh Economy (2081)*

D. Strauch, P. Mieth, R. Moeckel, M. Wegener (German Aerospace Center) *Integrated Land-Use Modelling And Transportation System Simulation (1367)*

(24 Attendances)

Systems Modelling 1: Spatial Statistics

Chair: Yee Leung (Chinese University of Hong Kong)

Time: Tuesday 17th 10.30 – 11.50

Abstract (2 sessions): Sessions organised by Richard Thomas (University of Manchester). Session 1 examines recent advances in the specification of spatial statistics. The plenary address considers the general nature of the relations between local and global spaces and their implications for drawing statistical inferences. This review is complemented by papers that examine the specifics of newly proposed spatial tests. Session 2 is primarily concerned with applicability and operability of process based epidemic models to understanding the diffusion of HIV/AIDS. Statistical approaches to characterising insect epidemics are also discussed.

Plenary Address (40 minute presentation) Barry Boots (Wilfrid Laurier University) and Atsuyuki Okabe (University of Tokyo) *Local statistical spatial analysis: inventory and prospect (1730)*

Steven A. Roberts (Wilfrid Laurier University) G. Brent Hall & PH Calamai *A pre-categorical spatial data meta-model (1737)*

Yukio Sadahiro (Tokyo University) *Buffer operation on spatial data with limited efficiency (1404)*

(48 Attendances)

Systems Modelling 2: Epidemic Models
Chair: Barry Boots (Wilfrid Laurier University)
Time: Tuesday 17th 14.00 – 15.20

Tomoki Nakaya (Ritsumeikan University, Kyoto, Japan), Katsumi Nakase, Ken Osaka & Nobuhiko Okabe *A Spatio-temporal Model of the HIV/AIDS Epidemic in Japan Based on the National HIV/AIDS Surveillance* (1734)

Jinfeng Wang (Chinese Academy of Sciences) *Operability of mathematical model in Geo-sciences: investigating epidemic model family as case study*

T. Nelson (Wilfrid Laurier University) and B. Boots *Identifying insect infestation hot spots: an approach using conditional spatial randomization* (812)

(38 Attendances)

Data Mining and Knowledge Discovery
Chair: Atsuyuki Okabe (University of Tokyo)
Time: Tuesday 17th 15.30 – 16.50

Abstract: Session organised by Yee Leung (Chinese University of Hong Kong). Data mining is concerned to develop effective methods for extracting information from large spatial data bases. The topics covered by the presentations include the discovery of optimum classification rules, reconciling spatial and temporal data sets and combining decision tree methods with cellular automata to predict urban growth.

Yee Leung (Chinese University of Hong Kong) *Toward the rough set approach to spatial data mining*

S. Fuest, M. Natschke (Kisters AG, Germany) *Spatio-Temporal Data Management And The Advantages In Coupling WISKI And GIS* (291)

(34 Attendances)

Space-Time Analyses
Chair: Yee Leung (Chinese University of Hong Kong)
Time: Tuesday 17th 17.00 – 18.20

Abstract: Session organised by Robert Baker (University of New England, Australia). The papers consider both theoretical and empirical issues in the representation of space-time phenomena. The former include the specification of new concepts like virtual space and weak gravity interaction while the latter include the analysis of unemployment, urban growth and the utilisation of gambling venues and the internet.

Robert Baker (University of New England, Australia) *Modelling Global Internet Dynamics* (1740)

Robert Baker (University of New England, Australia) *Applications of the Gravity Inequality to Geographic Flows* (1742)

Robert Baker and D Marshall (Australian National University) *Modelling the Structure of the Weekly Trip Behaviour to Gambling Venues* (1743)

(32 Attendances)

Multi-Scale Modelling in Physical Geography
Chair: Martin Charlton (University of Newcastle-upon-Tyne)
Time: Wednesday 18th 7.30 – 8.50

Abstract (2 sessions): The sessions have been organised for the CMGS by Garry Higgs (University of Glamorgan) on behalf of the Quantitative Methods Research Group of the RGS-IBG. Scale effects permeate the interpretation of all spatial data. Typically, these might be effects of the zoning system on the enumeration of spatial variables or the need to scale up point estimated parameters to describe properties of a given area. The papers explore these and similar issues as they arise in both physical and human geography with regard to designs that address more than one spatial scale. Landscape processes and crime and accident statistics are emphasised in the applications.

Nicholas J. Cox and Ian S. Evans (University of Durham) *Size and scale in the landscape: from morphometry to modelling* (1744)

Sarah J Lindley (University of Manchester) *Scale related uncertainty in the derivation of air quality data surfaces* (1748)

(17 Attendances)

Multi-Scale Modelling in Human Geography

Chair: Gary Higgs (University of Glamorgan, QMRG Sessions)

Time: Wednesday 18th 9.00 – 10.20

Martin Charlton (University of Newcastle-upon-Tyne) Tate NJ , Jarvis CH, Brunsdon C and Fotheringham, AS *Spatial Interpolation Methods - some matters of weight*

David Ashby (University College London) *Towards multi-scale modelling in the analysis of crime and policing performance* (1031)

K. Lee (Sungshin Women's University, Seoul) M. Y. Choi *A Medical Facility Location-Planning Model Based On The Scale Invariant Distribution Function* (1003)

(35 Attendances)

Business Meeting

Time: Wednesday 18th 14.00 – 15.20

Average Audience per session 32 and 242 attendances in the IGU Modelling Sessions

Sessions CMGS CO4.29 IGU Regional Conference, Brisbane July 3rd-7th 2006

TUESDAY 4th MORNING 9.00-10.00 CMGS Members Meeting

TUESDAY 4th MORNING 10.30-12.10

Statistics in Spaces Chair: Barry Boots

The effect of zone design on statistical relationships in geography

Robin Flowerdew and David Manley, University of St Andrews

Structural Equation Modelling of Quantitative Data: Concept and Applications in Human Geography

Christine Tamásy, School of Geography & Environmental Science (SGES)

The University of Auckland, New Zealand

Describing the Global Time-space Evolution of the Internet with Phase Regression between 2000 and 2004

Robert Baker and Troy Mackay, University of New England

TUESDAY 4th AFTERNOON 13.30-15.10

Simulation of Spaces: Chair:Thérèse Steenberghen

The benefits of applied spatial analysis for business and service planning

Graham Clarke and Mark Birkin, School of Geography, University of Leeds

Simulation of pedestrian movement in shopping streets segments

Aloys Borgers, Inger Smeets, Astrid Kemperman, Harry Timmermans, Eindhoven University of Technology, The Netherlands

Visualization of cities: integrating three-dimensional city models with GIS

Narushige Shiode, Department of Geography, The State University of New York, Buffalo

TUESDAY EVENING 4th 15.40-17.20

Nature in Spaces Chair: Paul Frazier

Exploring spatial-temporal change in mountain pine beetle infestation

Trisalyn Nelson and Barry Boots, Department of Geography, University of Victoria, Canada;
Department of Geography, Wilfrid Laurier University, Waterloo, Canada

Predicting the distribution and abundance of two saltmarsh plant species

Canran Liu, Paul Frazier and Lalit Kumar, University of New England, Australia

Time-space modelling sunspots and extreme droughts in eastern Australia Robert Baker,

University of New England, Australia

WEDNESDAY 5th

Legends Sessions IGU Regional Conference, Brisbane Town Hall July 5th 2006: Co-sponsored by IGU CMGS and ARCRNSISS (see *Geographical Analysis* papers above)

**THURS MORNING 6th 8.20-10.00 Joint Commission Session CO4.29 CMGS and C04.30
Monitoring Cities of Tomorrow**

Monitoring Urban Systems: Theory and Applications 1 8.20-10.00: Chair Barry Boots

Exploring the role of accessibility as a force driving land use change in an urban environment

Yang X, Florida State University

Spatial analysis in urban geography

Murayama Y, University of Tsukuba

The influence of socio-demographic characteristics and urban form on travel behaviour of Canadian older population in the Hamilton CMA: Evidence from a multilevel model analysis

Paez A and Mercado R, McMaster University

Land use analytical system using internet GIS

Abe T and Yamaguchi N, Japan Women's University and Niigata University of International and Information Studies

Issues and challenges of urban landscape dynamic modelling

Chen D, Queens University

THURSDAY MORNING 6th 10.30-12.10

Reviews of Spatial Science: Chair: Robin Flowerdew

Computation in geography: the quantitative revolution and beyond Yee Leung, The Chinese University of Hong Kong, Hong Kong

Generalized Network Voronoi Diagrams: A Review

Atsuyuki Okabe, Center for Spatial Information Science, University of Tokyo, Japan

Constants in Chaos or Chaos from Constants: A Review of Dynamic Spatial Interaction Modelling

Robert Baker, University of New England, Australia

THURSDAY AFTERNOON

Time in Spaces 13.30-15.10 Chair: Graham Clark

Revisiting space-time geography: conducting cluster analysis in a space-time dimension

Narushige Shiode and Shino Shiode, Department of Geography, The State University of New York, Buffalo; Center for Spatial Information Science, University of Tokyo, Japan

Time-space modelling of traffic accident concentrations

Thérèse Steenberghen, Catholic University of Leuven, Belgium

Time-space similarity modelling virtual internet origin-destination trips

Robert Baker, University of New England, Australia

THURSDAY EVENING: 15.40-17.20 : Chair Aloys Borgers

Behaviour in Spaces

Developing motifs search methods to identify skeletal information embedded in homogeneous activity patterns

Chang-Hyeon Joh¹, Theo A. Arentze² and Harry J.P. Timmermans^{2,1} Department of Geography, Kyung-Hee University, Seoul; Eindhoven University of Technology, The Netherlands

The Use of Mental Maps and Activity Spaces to Explain Changes in Mobility Behaviour after the Adoption of Free Public Transport.

Thérèse Steenberghen and Stefaan Vande Walle, Catholic University of Leuven, Belgium

A Spatial Analysis Framework for Reducing Uncertainties in Human Health Risk Assessment

Nina Siu-Ngan Lam, Louisiana State University

**FRIDAY MORNING 10.30-12.10 Joint Commission Session CO4.29 CMGS and C04.30
Monitoring Cities of Tomorrow**

Monitoring Urban Systems: Theory and Applications 2: Chair Yuji Murayama

Ambient particulate matter air pollution variability within an urbanised native forest environment.

Wilson J¹, Zawar-Reza P² and Cavanagh J,³ ¹University of Canterbury, ²University of Canterbury; ³Landcare Research, Manaaki Whenua

The spatial structure of intra-urban shelter in the snow-covered area: A geographical study in northern Japan

Soma E and Hashimoto Y, Hokkaido University

Regional characteristics of the migration by sex and age classes in metropolitan area: a geographical study in Sapporo City

Numata N and Hashimoto Y, Hokkaido University

Visualization and analysis of urban taxi demand survey data

Taguchi K, Yokohama National University

Modeling and simulating crowd behavior for large events in urban cities

Shi J, Lin H and Xu B, The Chinese University of Hong Kong