GUEST EDITORIAL PREFACE

Special Issue on Analysing, Modelling and Visualizing Spatial Environmental Data (Part 2)

Beniamino Murgante, University of Basilicata, Italy

Antonino Marvuglia, Public Research Centre Henri Tudor (CRPHT), Luxembourg

Mikhail Kanevski, University of Lausanne, Switzerland

Maurizio Cellura, University of Palermo, Italy

INTRODUCTION

At the beginning of the last century Patrick Geddes, one of the fathers of planning, theorized an important approach to planning based on the sequence: survey – analysis – plan (Geddes, 1904, as cited in Faludi, 1987). The main difference between the first two steps is rooted in the distinction between mapping a phenomenon and its interpretation. This approach undoubtedly has produced better plans during years, but it lacked in supporting automated combination of sectoral analyses. The first attempt in such direction has been represented by the metaphor of "layer cake," developed by Ian McHarg (1969), which represents the fundamental of overlay mapping. This approach represents a sort of bridge between simple descriptions and analysis interpretation (Murgante et al., 2011).

In the same period of McHarg's experience, a lot of planners considered the systemic approach based on von Bertalanffy's theories (1967), focused on systems as realities more complex than the simple collection of their parts and characterized by interactions of a lot of sectoral domains.

An important qualitative leap is represented by the adoption of spatial simulation models, which can improve the decision-making process predicting future scenarios (Murgante et al., 2009).

An important application domain in predicting phenomena evolution can be undoubtedly represented by urban sprawl analysis.

Urbanization growth represents one of the major environmental threats of last decades. Several approaches have been adopted in analyzing this phenomenon, mainly related to different study domains. Urban sprawl, soil consumption, settlement risk, and even the attempt to reach a distinction between urban, peri-urban, exurban, rur-urban and rural areas, are different sides of the same coin. All these terms represent the huge amount of negative aspects generated by urban expansion. Its consequences can be summarized in soil sealing, loss of productive

agricultural lands and forest cover, habitat destruction and fragmentation, waste of energy, pollution, landscape degradation. Consequently, urban growth generates environmental impacts at local, regional and global scales (Murgante & Danese, 2011).

Considering sustainability with a systemic approach, urban sprawl represents the typical case where economic, social and environmental systems have always to be considered. The concept of sustainable development is a synthesis and a balance of three factors: social justice, economic utility and environmental integrity (Giaoutzi & Nijkamp, 1993).

This concept is well represented in the logical and practical scheme of the so called Life Cycle Sustainability Assessment (LCSA), which is a more holistic evolution of the methodology known as Life Cycle Assessment, standardized by the norms of ISO 14000 series (ISO, 1998). The scheme for LCSA was proposed by Kloepffer (2008), who referred to LCSA as the sum of those which are today known as the three pillars of sustainability:

LCSA = LCA + LCC + SLCA

where LCA is ISO 14000 environmental Life Cycle Assessment, LCC is a LCA-type (environmental) Life Cycle Costing assessment (Hunkeler et al., 2008; Krozer, 2008) and S-LCA stands for social Life Cycle Assessment (Benoît & Mazijn, 2009).

More particularly the concept of urban sprawl can be considered unsustainable from three points of view (Murgante et al., 2012):

1. **Environmental:** urban sprawl is one of the hugest environmental threats;
2. **Social:** urban sprawl obliges people to travel many hours per day, leading to a total absence of social and neighbourhood relationships;
3. **Economical:** urban sprawl produces agglomeration disadvantage in localizing services and activities and in realizing interventions and infrastructures (Jacobs, 1969; Nijkamp & Perrels, 1994).

This spatial process is the main issue of the second part of special issue "Analysing, Modelling and Visualizing Spatial Environmental Data" and it has been highly analyzed, discussed and debated in great part of papers.

SPECIAL ISSUE CONTRIBUTIONS

The paper "A Remote Sensing Based Calibration Framework for the MOLAND Urban Growth Model of Dublin" by Van de Voorde et al. proposes a calibration framework based on remote sensing data for MOLAND (Monitoring Land Use / Cover Dynamics) model. The application has been developed in Dublin area, affected by an urban sprawl phenomenon. Dublin is not a particularly vast city compared to other European capitals, but its population growth, as a consequence of economic development, produced inhabitants concentration in Greater Dublin metropolitan area more or less equal to 50% percent of the Irish population. All this has led to a huge urbanization process within the countryside around Dublin. Growth rate of urbanized areas in Dublin is due to high house costs (generally it is cheaper to build new houses in the countryside than buying a flat in an urban area). This phenomenon produced growth of villages in Greater Dublin, close to transport system, road and rail networks.

Over the past decades cellular automata modeling has found many improvements in its own performance, greatly reducing its limits. Hence, today this approach is used all over the world reaching a good level of reliability. Sleuth model employs a modified Cellular Automata model to simulate the spread of urbanization across a landscape. This model has been analyzed in the paper "Forecasting High Correlation Transition of Agricultural Landscapes into Urban areas Areas: Diachronic Case Study in North Eastern Italy" by Federico Martellozzo. He describes methods and techniques to identify urban agglomeration and its variation over time, analyzing historical growth evolution and future urban expansion scenarios. The very

interesting part of this paper is the adoption of consolidated techniques as sleuth coupled with remote sensing analysis. More particularly, the employment of Landsat images is very interesting in analyzing urban expansion for historical information, which allows studying evolution during the past 20-30 years. The application has been developed in an Italian area subjected to a very great development pressure, mainly due to a huge number of small manufacturing factories.

The paper "A Linguistic Approach to Model Urban Growth" by Mantelas et al. considers another approach in analyzing urban sprawl based on a Fuzzy approach to Cellular Automata Modeling. This interesting approach represents an attempt to bridge the gap between knowledge-based rules, which are commonly qualitative and fuzzy in nature, and Cellular Automata modelling. The application shows that additional data processing and approach can be an important help in analyzing urban growth dynamics.

The paper "Service Path Attribution Networks (SPANs): A Network Flow Approach to Ecosystem Service Assessment" by Johnson et al. tackles issues concerning sustainability and landscape, at the same time considering environmental and computer science point of view. As we all know, Global efforts to preserve biodiversity have become one of the major responsibilities of governments, local authorities, researchers, academics, environmentalists and, in a wider sense, of the whole society.

The application has been developed in Vermont area characterized by a wealth of natural landscapes. Champlain Valley, Connecticut River watershed, and Northern Forest are examples of landscapes that stretch beyond Vermont to neighbouring states and provinces. After superimposition over Vermont ecological and political geography, it lays the social and economic diversity of its communities. Vermont landscapes create the foundation for cultural heritage and economic activities of its communities.

The paper "The Evidence of Links between Landscape and Economy in a Rural Park" by Perchinunno et al. investigates connections between agriculture activities, landscape and economic management of resources as key factors of success for new development models. Analysis about linkage has been carried out using statistical techniques. The paper is mainly focused on two topics: agricultural park peculiarity and threats related to economic activities, included in or close to the area. The central question consists in examining how sustainable development can provide opportunities for agricultural activities and parks. Theoretical and empirical experiences have been analyzed in order to produce a new process for local development based on environmental features, cultural heritage values and traditions taking into account the relationship between spatial and social structures.

Beniamino Murgante,
Antonino Marvuglia,
Mikhail Kanevski,
Maurizio Cellura,
Guest Editors
IJAEIS

REFERENCES

Benoît, C., & Mazijn, B. (Eds.). (2009). *Guidelines for social life cycle assessment of products*. Paris, France: UNEP/SETAC Life Cycle Initiative.

Faludi, A. (1987). *A decision-centred view of environmental planning*. Oxford, UK: Pergamon.

Giaoutzi, M., & Nijkamp, P. (1993). *Decision support models for sustainable development*. Aldershot, UK: Avebury.

Hunkeler, D., Lichtenvort, K., & Rebitzer, G. (Eds.). (2008). *Environmental life cycle costing*. Pensacola, FL: SETAC Press.

International Organization for Standardization (ISO). (1998). *14040: Environmental management – life cycle assessment – Principles and framework.* Geneva, Switzerland: Author.

Jacobs, J. (1969). *The economy of cities*. London, UK: Penguin.

Kloepffer, W. (2008). Life cycle sustainability assessment of products (with Comments by Helias A. Udo de Haes). *International Journal of Life Cycle Assessment*, *13*(2), 89-95.

Krozer, Y. (2008). Life cycle costing for innovations in product chains. *Journal of Cleaner Production*, *16*, 310-321.

McHarg, I. (1969). *Design with nature*. New York, NY: Natural History Press.

Murgante, B., Borruso, G., & Lapucci, A. (2009). Geocomputation and urban planning. In B. Murgante, G. Borruso, & A. Lapucci (Eds.), *Geocomputation and urban planning: Studies in computational intelligence* (Vol. 176, pp. 1-18). Berlin, Germany: Springer-Verlag.

Murgante, B., Borruso, G., & Lapucci, A. (2011). Sustainable development: Concepts and methods for its application in urban and environmental planning. In B. Murgante, G. Borruso, & A. Lapucci (Eds.), *Geocomputation, sustainability and environmental planning: Studies in computational intelligence* (Vol. 348). Berlin, Germany: Springer-Verlag.

Murgante, B., & Danese, M. (2011). Urban versus rural: The decrease of agricultural areas and the development of urban zones analyzed with spatial statistics. *International Journal of Agricultural and Environmental Information Systems*, *2*(2), 16-28.

Murgante, B., Danese, M., & Las Casas, G. (2012). Analyzing neighbourhoods suitable for urban renewal programs with autocorrelation techniques. In J. Burian (Eds.), *Advances in spatial planning*. Rijeka, Croatia: InTech.

Nijkamp, P., & Perrels, A. (1994). *Sustainable cities in Europe*. London, UK: Earthscan.

von Bertalanffy, L. (1968). *General system theory: Foundation, development*. New York, NY: George Braziller.

Beniamino Murgante is Assistant Professor of Spatial planning at the University of Basilicata (Southern Italy). He took his PhD in "Sciences and methods for European cities and territory" at the Department of Civil engineer of the University of Pisa and he carried out other researches in Lyon at the Laboratory for Information System Engineering directed by Robert Laurini. His main research interests are focused on the use of technologies in supporting spatial decision. He has published papers and books in the field of spatial analysis, modelling, geocomputation and planning. He has been member of scientific committees of several international conferences and he has been Chair/Co-chair of several international workshops.

Antonino Marvuglia graduated in Environmental Engineering in 2003 and obtained his PhD in Environmental Applied Physics in 2007, both from the University of Palermo, Italy. From June 2009 to June 2010 he has been a Marie Curie Post-doc fellow at the Cork Constraint Computation Centre (4C) of University College Cork (Ireland), working on a project titled CREEDS (Constraint Reasoning Extended to Enhance Decision Support). From July 2010 he is a R&D Engineer at the Resource Centre for Environmental Technologies (CRTE) of the Public Research Centre Henri Tudor (Luxembourg). His main research interests include the implementation of supporting tools for environmental assessment and management, as well as energy and environmental planning. He is a member of the Editorial Board of The Open Renewable Energy Journal.

Mikhail Kanevski received the PhD degree in plasma physics from the Moscow State University, Moscow, Russia, in 1984, and the Doctoral theses in computer science from the Institute of Nuclear Safety, Russian Academy of Science, Moscow, in 1996. Until 2000, he was a Professor with the Moscow Physico–Technical Institute (Technical University) and the Head of laboratory with the Moscow Institute of Nuclear Safety, Russian Academy of Sciences. Between 1999 and 2002, he was an Invited Professor with the IDIAP Research Institute, Switzerland. Since 2004, he has been a Professor with the Institute of Geomatics and Analysis of Risk (IGAR), University of Lausanne, Lausanne, Switzerland. He is a Principal Investigator of several national and international grants. His research interests include geostatistics for spatio-temporal data analysis, modelling and visualization, environmental modeling, computer science, numerical simulations, socio-economic and financial time series analysis and prediction and machine learning algorithms. Remote sensing image classification, natural hazard assessments (forest fires, avalanches, and landslides), and time series predictions are the main applications considered at his laboratory.
Maurizio Cellura graduated in Civil Engineering in 1988 and obtained his PhD in Applied Physics in 1994. Today he is a Full Professor at the University of Palermo, teaching applied physics and principles of industrial ecology. His research interests encompass environmental impact assessment; solid waste management and disposal; energy and acoustic planning; Life-cycle Assessment (LCA), with particular interest in building materials and renewable energy sources; industrial ecology; and dynamic simulation of the thermal behaviour of buildings. He is the National Coordinator of the Italian network of LCA on technology assessment. From 2000 to 2004 he was a member of the Italian competent body for EMAS and Ecolabel.

Maurizio Cellura graduated in Civil Engineering in 1988 and obtained his PhD in Applied Physics in 1994. Today he is a Full Professor at the University of Palermo, teaching applied physics and principles of industrial ecology. His research interests encompass environmental impact assessment; solid waste management and disposal; energy and acoustic planning; Life-cycle Assessment (LCA), with particular interest in building materials and renewable energy sources; industrial ecology; and dynamic simulation of the thermal behaviour of buildings. He is the National Coordinator of the Italian network of LCA on technology assessment. From 2000 to 2004 he was a member of the Italian competent body for EMAS and Ecolabel.