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Editorial

GIS for environmental modeling: an introduction

Environmental models are representations of certain aspects of complex and ever changing environments. In the modeling process, the essence of the natural and social worlds is extracted and expressed in a formal framework, through mostly computational forms. Environmental models help us understand the principles and drivers underlying these natural and social phenomena. Based on this understanding, we seek to analyze the past, understand the present, and forecast the future states of the environment. The ultimate goal of environmental modeling is to improve the quality of the environment through better informed decision-making. Given the complexity of the environment, the corresponding models must be also quite complex. In order to address today's complex environmental problems, environmental modeling routinely requires the integration of temporal and spatial considerations.

Just as traditional environmental models are successful in modeling the temporal change of the environment, the rise of geographic information science has significantly extended such success to the spatial counterpart. Environmental problems are intrinsically spatial, and these problems cannot be effectively addressed without taking spatial variation into consideration. The integration of environmental modeling and GIS presents a challenge to both environmental and GIS scientists. This challenge is beyond a simple link between a GIS software package and a mathematical model, or extracting numerical parameters from a GIS layer and feeding them into a model. The challenge is profound. Environmental and GIS scientists must think of environment in terms of its perception and representation, the representation of both its form and function, and the representation of both spatial variation and temporal change of these forms and functions.

Efforts directed at meeting this challenge for more than a decade have resulted in a series of representation theories, analytical methods, and computation tools which address the spatial aspect of environmental modeling. The series of volumes resulting from the International Conference on Integrating GIS and Environmental Modeling (Clarke, Parks, & Crane, 2002; Goodchild, Parks, & Steyaert, 1993; NCGIA, 1996; Goodchild, Steyaert, & Parks, 1996) are but a few examples among a rich volume of insightful literature. The five papers in this special issue report current progress and perspectives in GIS for environmental modeling. Specifically, this special issue focuses on the development of conceptual and computational frameworks and innovative applications of spatial analysis to address environmental issues.

These papers cover a range of cutting edge topics in geographic information science. With respect to environment, these papers address both natural and social aspects of environment issues and their combined effects. Of the five papers, Mac-Millan et al. present a conceptual design of a hierarchical system for identifying landform-based spatial entities at multiple spatial scales from digital elevation data. Li and Revesz discuss the fusion of space and time in a high-dimension computational framework for spatial–temporal data interpolation. Feng and Flewelling address the evaluation of semantic similarity between landscape classification systems. Bunch and Dudycha explore the linkage between participatory development of management models with a spatial decision support system for rehabilitating a polluted drainage system. Lastly, Emerson and Rajagopal compare and evaluate spatial sampling strategies for monitoring hazardous waste sites. From the outset, it should be recognized that in these papers, GIS is not necessarily used as an implementation tool. Rather, it is treated as a framework of perception and representation of the environment. In this sense, this special issue seeks to contribute to the intellectual development of GIS in the context of environmental modeling.

The papers in this special issue were originally presented at the 2000 Annual Meeting of the Association of American Geographers (AAG) held at New York City, in the sessions of “GIS for Environmental Modeling”. A number of scholars participating in this meeting were invited to submit full papers to this special issue. Subsequently, these papers were evaluated through a peer review process by external reviewers. Professor Jim Pooler handled the initial peer review process and provided editorial advice for these manuscripts.

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Ling Bian
*Department of Geography,
State University of New York at Buffalo,
Amherst, NY 14261-0055, USA
E-mail address: lbian@geog.buffalo.edu*