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Guest Editorial

Marine and Coastal GIS: Science or Technology Driven?

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This 4th Special Issue on Marine and Coastal Geographic Information Systems (M&CGIS) is arranged in two parts. Part I contains articles on scientific applications of M&CGIS, and Part II addresses technical advancements. This division reflects the interesting point that we have observed and it is discussed in this editorial: What is the driving force of M&CGIS?

In the Call for Papers of the 4th special issue of M&CGIS, we proposed a new emphasis, environmental and ecological applications. We intended to present this important area of M&CGIS that has been somewhat overlooked in the previous special issues on M&CGIS. As a response to our call, this special issue received more papers on scientific applications than any of the three previous ones. Cowell and Zeng present a GIS-based approach to integrating uncertainty theories for modeling coastal hazards of climate changes. Franklin et al. describe a benthic habitat GIS mapping project that helps address the issue of declining trends in coral reef habitats and reef fish stocks. Wang et al. introduce the results of integrating remote sensing and GIS for mangrove studies along the Tanzania coast. Paul et al. provide an overview of the U.S. Environmental Protection Agency's efforts in the use of GIS for estuarine environmental monitoring and assessment in the northeast region of the United States. Wilber and Iocco's work demonstrates an application of GIS for understanding bathymetric changes in relation to dredging activities and sedimentation in the Lower Bay complex of New York Harbor. On the other hand, as in the three previous special issues, a set of strong technology-oriented papers is presented. Wright et al. present a prototype of a Virtual Research Vessel, a computational environment and toolset that allow marine scientists and educators to have simultaneous access to data, maps, and numerical models. Jacob et al. address a technical issue: how to utilize a variety of existing environmental models to develop a marine information system for different applications. New techniques using IKONOS satellite imagery for 3-D shoreline extraction are reported

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by Li et al. Finally, Lee and Shan's article describes research efforts in combining LIDAR elevation data and IKONOS imagery to improve remote sensing classification of coastal land covers.

The first three M&CGIS special issues of this journal, published in 1995, 1997, and 1999, predominantly focused on the technical topics of GIS as related to coastal and marine environments. Similarly, recent relevant books such as *Marine and Coastal Geographical Information Systems*, edited by Wright and Bartlett (1999), are devoted mostly to the technical aspects of M&CGIS. How do we explain the apparent dominance of the technical emphasis in M&CGIS? It could be attributed to the following two major factors. The digital techniques employed in coastal and marine mapping and charting naturally initiated the early development of M&CGIS. Furthermore, the early adoption of GIS in oceanography and coastal studies marked wide technical applications of the tools of digital charting and survey products (Li and Saxena 1993; Wright 1999). Consequently, papers contributing to the technical topics became traditional contents in early M&CGIS publications, such as those in *Marine Geodesy*. Another aspect, the necessity of considering the high dimensionality and dynamic nature of the coastal and marine environment, has made the use and development of M&CGIS significantly lag behind that of land-based GIS. Therefore, the development of fundamental spatiotemporal technical solutions has been a major task of M&CGIS, as discussed in Lockwood and Li (1995).

The need of M&CGIS techniques in science and science-driven applications was realized in parallel to the evolvement of the GIS technology itself. Pioneering uses of GIS concepts and primary tools in marine and coastal environments can be traced back to the late 1970s and the early 1980s (Wright and Bartlett 1999). However, these projects mostly focused on data manipulation and mapping associated with early information management systems (Bartlett 1999). It was until the late 1980s and the early 1990s that documented M&CGIS efforts, focusing on scientific issues, were published and attracted the community's attention (e.g., Bartlett 1988; Hansen et al. 1991; McNiff et al. 1992; Ji et al. 1993; Roscigno et al. 1993). These and other reported efforts mostly used existing commercial GIS capabilities for solving marine and coastal environmental problems and were largely published in a variety of conference proceedings and governmental reports.

In the last decade, as more advanced GIS techniques were made available and motivated by the needs of environmental research and management such as those listed in the Call for Papers, science-driven studies and applications of M&CGIS became a trend. It is difficult to make a complete list of these research efforts because of the wide variety of publication vehicles and relevant science disciplines involved. The rapid adoption of the technology by the science community and the increasing number of science-driven applications of M&CGIS have been attributed mainly to the fundamental advancement of GIS technology; demonstrated benefits of GIS at research institutions, government agencies, and the private sector; and the availability of an increasingly large amount of marine and coastal geospatial data. Up to this point, it is very clear that there is a need of M&CGIS from the science community that demands a great deal of advancement of the technology. Some of such technical challenges were answered by the R&D community and the private sector, while a lot of them still remain research topics.

Apparently, M&CGIS as a discipline will benefit from research and application efforts driven by both technology and science. These two directions of M&CGIS advancement will coexist. With this special issue, we intend to introduce the most recent research results of M&CGIS in science-driven applications and present technical tools made newly available. The special issue series should also provide a forum for M&CGIS developers and application users to discuss their issues, common interests, and future directions.

Finally, we would like to thank the contributors to this special issue for their thoughtfulness in authoring the articles. We are inspired by their innovative work and professional enthusiasm. We thank all reviewers for their promptness in providing valuable comments to the manuscripts. We also thank the Editor-in-Chief for his continuous support and encouragement in publishing the M&CGIS special issue.

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