PREFACE—Geotechnologies applied to coastal studies

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Jarbas Bonetti • Rafael Medeiros Sperb •
Antonio Henrique da Fontoura Klein

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Introduction

Presently the status of our coastal systems is subject to growing public awareness and numerous concerns, such as the need for erosion control measures, sea level rise adaptation, biodiversity loss reduction, overfishing regulation, pollution control, and coastal development planning. In all of these situations, data analysis and spatial modeling play a crucial role in guiding decision making processes to deal with the challenges.

This is a difficult task, however, since many interactions occur in a relatively narrow zone, associated with the inputs of land, ocean and atmospheric compartments in a non-linear way. The complexity of coastal systems has long been recognized by many authors (e.g. Carter and Woodroffe 1994; Haslett 2000; Masselink and Hughes 2003) and, even now many coastal processes are still poorly known and understood due to the lack of a theoretical background, scarcity of data and/or analytical tools to handle with them. However, advances are being made.

On the one hand, numerical modeling has grown during the last few years due to an improvement in both the knowledge of coastal dynamics and computer processing capabilities (Bonetti et al. 2013). Similarly, computer based spatial analysis, supported by Geographic Information Systems (GIS), has also gained wider acceptance. This alternative is usually associated with the integration of a set of themes and

multivariate descriptors so that they can be combined to answer specific questions, and to spatially represent the physical, environmental, social and infrastructure characteristics of a portion of coastal space.

The actual use of GIS systems in the coastal community can not only be associated with their continuing rapid technological development, but also with the increasing availability of open databases and the opportunities of data distribution that the Internet provides. This has stimulated the use of GIS for solving practical issues, by integrating and analyzing large amounts of data in computer systems, in a way that finds a parallel in the birth of GIS itself back in the mid-1960s.

Geographic Information Systems have long been providing effective solutions to different problems on land (that sometimes may be equivalent to the ones found at the coast). However, the difficulties of adapting data models and solutions primarily designed to deal with 2D objects, with sharp boundaries and in a relatively stable temporal dimension continue, although coastal and marine customized tools progressed rapidly, as already illustrated by Wright (2002) and Breman (2002) a decade ago.

Even though many advances have been made since the considerations formulated by authors in the 1990s (e.g. Bartlett and Wright 1999), many concerns associated with the application of GIS in coastal and marine studies persist. Some aspects mentioned at that time, such as the need for operational coastal data collection, metadata standardization and “peopleware” investment have experienced considerable progression. On the other hand, others like dynamic coastline representation, 3D modeling, time series analysis of spatial data and coupling with numerical models still need substantial improvements for the proposed solutions to move beyond being experimental.

Since publication in 1993 of an annotated bibliography of literature on GIS applications in the coastal zone (Bartlett 1993), and latterly the pioneer book published by Wright

J. Bonetti (✉) • A. H. da Fontoura Klein
Geosciences Department, Coastal Oceanography Laboratory,
Federal University of Santa Catarina, Florianopolis, SC, Brazil
e-mail: jarbas.bonetti@ufsc.br

R. M. Sperb
Applied Computer Laboratory, Vale do Itajai University, Itajai, SC,
Brazil

and Bartlett (1999), the bibliography in the field of marine and coastal GIS has been growing exponentially, with contributions from all around the world that provide essential insights and examples to inspire the development of practical projects based on geoinformation analysis. Some of them arose from research networks (e.g. Wright and Scholz 2005) and others from scientific meetings and conferences (e.g. Bartlett and Smith 2005).

Some of these thematic events became perennial and now are recognized as reference moments for the related community to meet and share ideas and recent developments. The present volume derives from one of those events and contains selected articles from the CoastGIS edition that was held in Brazil in 2009.

The CoastGIS conferences

The CoastGIS Conference series began with what was planned as a “one off” conference held at University College Cork, Ireland, in 1995, hosted by Darius Bartlett of UCC, aided by Ron Furness (Australian Hydrographic Service). The goal then—and now—was to focus on how information technologies, including Geographic Information Systems (GIS), are used in coastal zone management, science and research. Over the years new topics were added to the list of themes covered by the conferences, including marine and coastal spatial data infrastructures (SDIs), marine spatial planning, public participation in coastal decision making and socioeconomic issues.

The CoastGIS conferences were conceived and structured to foster an increase in knowledge of GIS and related information technologies among technical people and for researchers in the fields of marine science and coastal zone management. Over the years, as coastal/marine researchers and managers have become more IT literate, especially in regard to GIS and, now, online web services, the conferences continue to provide a showcase for new developments in information management and dissemination technology as well as a learning experience for all involved in coastal zone decision making—researchers, technicians and managers in educational institutions, public authorities and commercial firms.

Another important goal of CoastGIS events is to present examples of best practice in using the technology to foster better evaluation and better understanding of human impacts on the coastal zone, to provide support to organisational development in this field, including development and improvement of new information services, and to improve the educational framework for both students and professionals working in the coastal or marine area.

CoastGIS’ 09 was held in Itajaí, located in the South of Brazil, together with the “V Congress on Coastal Areas

Planning and Management for Portuguese Speaking Countries” and with the “Seminario de Difusión de la Red Iberoamericana en Teledetección Aplicada a la Prevención de Riesgos Geológicos Litorales”. During three days an international audience of coastal researchers, managers and practitioners presented and discussed geospatial technologies and their benefits for coastal studies. In total, 458 people from 16 countries attended this meeting and 168 research contributions were presented.

Selected papers

This Special Issue of the Journal of Coastal Conservation: Planning and Management dedicated to the CoastGIS’ 09 presents selected examples of GIS applications with different aims (methodological development, assessment, management, habitat mapping) and target environments (beaches, fjords, reefs) around the world’s coast.

Silva and Taborda described a Beach Morphodynamic Model tool (BeachMM) that integrates the state of the art in wave/morphological numerical models (SWAN and XBeach) within a standard GIS platform (ArcGIS), aiming to streamlining the process related to beach modeling. The tool was applied to an exposed beach located at the Portuguese western coast.

Lins-de-Barros and Muehe applied the smartline approach to coastal vulnerability assessment with the inclusion of social data to a segment of the Eastern coast of Rio de Janeiro State, Brazil. The results show that this methodology is appropriate for the recognition of coastal segments with varying degrees of vulnerability to erosion and flooding and for the appraisal of the resulting social risk.

Copeland et al. paper focused on marine habitat mapping (i.e. production of benthic substrate and habitat maps) for a subarctic fjord environment at Gilbert Bay, Labrador, Canada. Multibeam sonar-derived bathymetry, seabed slope and acoustic reflectance (backscatter) were combined using supervised classification methods and GIS with ground-truthed benthic sampling in order to derive maps of the substrates and main benthic habitats. The study confirmed that the zoning plan for the MPA, which was designed to protect spawning and juvenile fish habitats for a local genetically distinct population of Atlantic cod, afforded highest levels of protection to areas with highest habitat diversity.

Carvalho and Kikuchi presented the ReefBahia, an integrated GIS approach for coral reef conservation in Bahia, Brazil. Datasets of geological, physical, biological and social criteria were integrated and processed in a personal Geodatabase, where gathered information allowed coral reef and associated habitats mapping and environmental characterization adopting AGRRA protocol. The usefulness of GIS-based tools for the task of reef conservation has been highlighted especially within

the National System of Conservation Units (SNUC) framework, as ReefBahia has been designed to serve as a decision-support tool not only for policy makers and authorities but also for communities and reef researchers.

Freitas et al. analyze the current state of public participation and the extent to which spatial data and geographic information tools are used by stakeholder groups to facilitate access to information and to support communication in water quality management on the Great Barrier Reef coast in Australia. Results revealed that reliance on the natural resource management officer, established networks and personal relationships, and provision of property-scale spatial information are important aspects of a meaningful public participation process.

Finally, Meiner presented an analysis of spatial data management priorities for the assessment of Europe's coasts and seas. He identified that European policies governing the coastal and marine environments now widely include the ecosystem-based approach, a strategy for the integrated management of activities on land, at sea and of living resources that promotes conservation and sustainable use and which addresses the combined effects of multiple pressures. He pointed out that an integrated environmental assessment of coastal zones and maritime space needs the focus on sustainability of coastal and maritime activities and will require compatible data that could be organised following some assessment priorities: 1) development and pollution pressures that impact coastal and marine areas; 2) ecosystems and services provided by the coastal and marine areas; 3) vulnerability to environmental change

(incl. climate) and need for adaptation; and 4) policy responses and maritime space management (e.g. ICZM and Maritime Spatial Planning).

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