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Editorial

Introduction to the Special Issue: Coastal GIS

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This special issue of the *ISPRS International Journal of Geographic Information* about "Coastal GIS" is motivated by many circumstances. More than one-half of the world's human population lives in coastal areas (within 200 kilometers of coast) as of 2000 [1]. The trend toward coastal habitation is expected to continue in the US with the total being 75 percent by 2025, meaning that coastal human–environment interactions will likely increase and intensify [2]. Geographic information systems (GIS) are being developed and used by technical specialists, stakeholder publics, and executive/policy decision makers for improving our understanding and management of coastal areas, separately and together as more organizations focus on improving the sustainability and resilience of coastal systems. Coastal systems—defined as the area of land closely connected to the sea, including barrier islands, wetlands, mudflats, beaches, estuaries, cities, towns, recreational areas, and maritime facilities, the continental seas and shelves, and the overlying atmosphere—are subject to complex and dynamic interactions among natural and human-driven processes. Coastal systems are crucial to regional and national economies, hosting valued human-built infrastructure and providing ecosystem services that sustain human well-being. This special issue of *IJGI* about coastal GIS presents a collection of nine papers that address many of the issues mentioned above.

The issue leads off with a paper entitled Spatial Representation of Coastal Risk written by Jadidi and colleagues [3]. The paper treats uncertainty considerations within coastal risk assessment. A conceptual framework, based on fuzzy set theory, organizes characteristics of ill-defined risk zone boundaries together with the inherent uncertainty associated with such problems. The nature and level of uncertainty are described. A fuzzy representation method is developed wherein membership functions are derived, based on expert-knowledge. The proposed approach is applied to a region within Eastern Quebec, Canada, and results are presented and discussed.

In the second paper, Puniwai and colleagues take up a challenge facing many coastal managers of siting nearshore aquaculture development by integrating a range of physical, environmental, and social factors [4]. The authors provide a framework and tool that combine physical and biological parameters

along with geospatial infrastructure. The development of the tool and the underlying data included in the paper were undertaken with careful input and consideration of local population concerns and cultural practices for the state of Hawai'i as a model system.

Gourmelon and colleagues, in a paper entitled "A Dynamic GIS as an Efficient Tool for Integrated Coastal Zone Management", demonstrate the advantage of geographical information in participatory research of coastal zones as well as its potential to bridge the gap between research and coastal zone management [5]. Over a one year period, heterogeneous data (spatial, temporal, qualitative and quantitative) were gathered through interviews and stored in a spatio-temporal database. A GIS was used to create temporal snapshots of daily human activity patterns, mapping, identifying, and quantifying them with regard to potential space-time conflicts. Together, both captured data and participatory workshop activities added real value to spatio-temporal management of activities. They conclude that a dynamic GIS offers pro-active integrated management by opening a path for discussions while using management simulated scenarios.

Although sea-level rise is a world-wide phenomenon to a greater or lesser extent, Lathrop and colleagues describe why and how mitigating impacts of sea-level rise is a local decision-making challenge, often requiring site-specific solutions [6]. This fourth paper in the collection presents a case study of about a WebGIS application called *NJFloodMapper* (www.NJFloodMapper.org). The focus is on a user-centered design process that targets coastal decision-makers in New Jersey, USA. The authors show how access to and understanding of relevant geographic information concerning sea level rise and exposure to coastal inundation can be provided through WebGIS. They also consider the vulnerability of key infrastructure, populations and natural resources within NJ communities. The benefits of this particular approach are discussed within the broader context of the application of WebGIS tools, describing the extent of the adoption by coastal agency managers.

In a fifth paper, Hansen and Fuglsang describe how GIS can be used for integrated coastal zone management [7]. The BLAST project is financed by the European Union Regional Fund through the INTERREG IV North Sea Region Programme, to develop a web-based decision support system to address climate change with associated sea level rise and increased storminess. Methods for implementing the decision support system as an open source solution are described. Open source components hope to facilitate wide-spread adoption of the system.

Within the sixth paper in this special issue, McCarthy and Halls consider options for habitat change assessment, describing the pros and cons of various satellite sensor technology techniques and datasets characterizing Masonboro Island, an undeveloped area in coastal North Carolina, USA [8]. They assessed map accuracy for a variety of image classification techniques based on data sampled between 2002 and 2010 for hundreds of field-work sites. In total, 200 maps were generated and the best technique is described. Results document the dynamic nature of coastal habitats and can be used to guide future coastal habitat mapping.

The seventh paper is by Paris and Mitasova and describes a new GIS method to characterize topographic change [9]. A principle from Newtonian mechanics about a body's center of mass is applied to a geomorphic landscape on barrier islands to evaluate the metric's potential as a proxy for detecting, tracking and visualizing change. Both along-shore change and cross-shore changes are investigated. Results show that the mass center metric has the potential to be a viable proxy for

describing broad-scale barrier migration, and would be a valuable addition to the array of metrics currently available.

In the eighth paper of the special issue, Kerfoot and colleagues consider how useful coastal light detection and ranging (LiDAR), coupled with multispectral scanning (MSS), can be for characterizing the volumetric extent of mine tailings on coastal marine environments in Lake Superior, a problem common due to mining activities over the past decades [10]. Waste rock as part of shoreline tailing piles has migrated along extensive stretches of coastline, compromising critical fish breeding grounds, damming stream outlets, transgressing into wetlands and along recreational beaches, and suppressing benthic invertebrate communities. The tailing migration can be clearly revealed using a combination of LiDAR and MSS techniques.

In the ninth and final paper of the special issue, Luhtala and Tolvanen report on optimizing the use of Secchi depth as a proxy for euphotic depth in coastal waters of the Baltic Sea [11]. The potential zone for photosynthesis in natural waters is restricted to a relatively thin illuminated surface water layer, referred to as the euphotic depth, which is always a challenge to measure over broad areas. A coarser way to evaluate the underwater light penetration is to measure the Secchi depth, which is a visual measure of water transparency (turbidity). Testing multiple methods for comparing suitability of criterion on which to base coefficient measurements, they improved the accuracy of modeling euphotic depths from Secchi depths using scalable and locally calibrated methods instead of a single fixed coefficient. Implications of the improvements are discussed.

The nine papers published in this special issue of IJGI about Coastal GIS portray considerable breadth and depth of the world-wide coastal research activity underway. Although any collection of papers for a special issue of a topic must leave many important subjects unaddressed, the Guest Editor and the editorial personnel of IJGI hope readers gain a better sense of the breadth and depth of coastal GIS research through the open access to the papers in this special issue.

Conflicts of Interest

The author declares no conflict of interest.

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