

Preface

Remote sensing is a very large field of study that involves many different types of sensors, platforms (videographic stations, satellites, aircraft, UAVs or drones [flying robots], etc.), and purposes (research, surveillance, warfare). Recent advances in the field focus on merging technologies in GIS (Geographic Information Systems), robotics, and numerical modeling, as these endeavors tend to reinforce each other. The coastal zone is a complex system, parts of which are difficultly accessible under the best of conditions. During inclement weather or when high-energy conditions prevail, study of coastal systems and environments often requires the acquisition of remotely sensed data that cannot be directly collected by humans. Nevertheless, even under optimal weather conditions the use of remote sensing techniques is advantageous for many reasons, not the least of which is the fact that enormous datasets can be collected over large spatial scales in relatively short time spans. Data acquisition covers a wide array of surface, intertidal, and submarine environments.

This book is not a comprehensive review of recent advances in remote sensing, as the field of study is too large to handle and such a broad view is beyond the scope of our subject area. Instead, this volume in the Coastal Research Library contains selected vignettes that make up 20 chapters. These examples of advances are considered in four parts, each with several chapters. Part I (Remote Sensing and Mapping of Coastal Biophysical Environments) contains seven chapters. The first chapter (Remote Sensing of Coastal Ecosystems and Environments), by Vic Klemas, sets the stage for the volume by providing an overview of remote sensing of coastal biophysical environments. Considered here are advances in sensor design and data analysis techniques as related to hyperspectral imagers, LiDAR, and radar systems. Chapter 2 (Advanced Techniques for Mapping Biophysical Environments on Carbonate Banks Using Laser Airborne Depth Sounding (LADS) and IKONOS Satellite Imagery) by Charles W. Finkl, Christopher Makowski, and Heather Vollmer, investigates recent advances in the mapping of seafloor environments on carbonate shelves using the example of southern Florida. Interpretation of seafloor data derived from LADS and IKONOS imagery was used to develop new cognitive mapping techniques and classification systems that are useful for

the study of large areas. Chapter 3 (Terrestrial Laser Scanner Surveying in Coastal Settings) reports on advances associated with the proliferation of commercially available tripod-mounted terrestrial laser scanner (TLS) systems that use the phase difference or the time-of-flight of emitted pulses of light to rapidly acquire high-density topographic and surface reflectance data. Chapter 4 (Advances in Applied Remote Sensing to Coastal Environments Using Free Satellite Imagery), by Cristina Lira and Rui Taborda, reports on advances associated with Landsat 8, which supports improved radiometric and spectral resolutions (compared to previous Landsat platforms). Discussed here are potentialities of these new sensors for temporal coverage, frequency of coverage, radiometric resolution, and spectral resolution. Chapter 5 (Remote Sensing and Modeling of Coral Reef Resilience), by Anders Knudby, Simon J. Pittman, Joseph Maina, and Gwilym Rowlands, reviews the state of the art of coral reef resilience mapping, based on remote sensing, spatial distribution modeling, and process modeling. Case studies illustrate coarse-scale mapping of reef exposure to climate-driven disturbances, intermediate-scale mapping of water quality and its influence on coral bleaching susceptibility, and fine-scale mapping of local factors that influence the ability of reefs to resist and rebound from climate-driven disturbance. Chapter 6 (An Assessment of Physiographic Habitats, Geomorphology and Evolution of Chilika Lagoon (Odisha, India) Using Geospatial Technology), by Ashis Kr. Paul, Sk Majharul Islam, and Subrata Jana, studies the geomorphologic changes, ecologic responses, and evolution of the Chilika Lagoon using geospatial technology with temporal image data. Lastly, Chap. 7 (Foreshore Applications of X-band Radar), by G. M. Jahid Hasan and Satoshi Takewaka, employed an X-band nautical radar system to examine along-shore propagation of low frequency run-up motion, as well as estimate the morphodynamic parameters from two typhoon events in the Pacific Ocean.

Part II (Advances in the Study and Interpretation of Coastal Oceans, Estuaries, Sea-Level Variation, and Water Quality) brings together in five chapters some disparate advances under a larger umbrella with examples from the coastal ocean, estuaries, and gulfs. Chapter 8 (Digital Ocean Technological Advances), by Xin Zhang, Xiaoyi Jiang, Suixiang Shi, and Tianhe Chi, considers the Digital Ocean (DO) as a new research domain of Digital Earth. Here, DO technological advances are introduced for (1) data sources, (2) three-dimensional ocean data integration platform, (3) dynamic tide data visualization, (4) integration and sharing of remote sensing products, (5) computational ocean model data integration service, and (6) spatio-temporal model of marine disasters. In Chap. 9 (A New Statistical-Empirical Hybrid Based Model to Estimate Seasonal Sea-Level Variation in the Gulf of Paria from River Discharge) by Carol Subrath-Ali, new insight is provided for the quantitative role of the Orinoco River in South America. This chapter reports on a vertically integrated 2D numerical modeling suite that is applied to the execution of a series of experiments to ascertain variation of coastal water levels from river discharge. The modeling advance here shows how a third order model function, which is dependent only on river discharge, can estimate the average monthly river-driven water level in the Gulf of Paria. In a similar vein, Chap. 10 (Advances in Modeling of Water Quality in Estuaries) by K.I. Ascione,

F. Campuzano, G. Franz, R. Fernandes, C. Viegas, J. Sobrinho, H. De Pablo, A. Amaral, L. Pinto, M. Mateus, and R. Neves, posits that water quality models complement studies about the status of estuarine waters. This chapter serves as an exemplar showing how advanced modeling applications can be used to perform water quality studies in Portuguese estuaries. Boundary conditions for hydrodynamics and biogeochemistry, provided by the Portuguese Coast Operational Model, are downscaled by using nested domains with increasing resolution from the regional to the local scale. Chapter 11 (Advances in Video Monitoring of the Beach and Nearshore: The Long-Term Perspective), by Ana Nobre Silva and Rui Taborda, summarizes recent developments on the use of video systems in the understanding of yearly to decadal beach morphological changes and describes the application of such a video system deployed at Nazaré, Portugal. While Chap. 12 (Advances in Application of Remote Sensing Techniques to Enhance the Capability of Hydrodynamic Modeling in Estuary), by A.K.M Azad Hossain, Yafei Jia, Xiaobo Chao, and Mustafa Altinakar, provides evidence that the application of remote sensing techniques for estuarine water quality studies can be advanced by integrating them with numerical models.

Part III (Advances in Coastal Modeling Using Field Data, Remote Sensing, GIS and Numerical Simulations) contains five chapters that consider integrated approaches to coastal modeling. Chapter 13 (Developments in Salt Marsh Topography Analysis Using Airborne Infrared Photography), by Francisco Andrade, Jackson Blanton, M. Adelaide Ferreira, and Julie Amft, shows how only recently have remote-sensing techniques become widely available to obtain high-resolution topographic data in salt marshes. These authors describe how a detailed digital elevation model (DEM) of the Duplin River (Georgia, southeastern USA) with a 1 m² resolution was constructed through the classification and analysis of a time-series of 7 IR (infrared) aerial photography mosaics taken at 1 h intervals from low- to high-water during a rising tide. In Chap. 14 (Examining Material Transport in Dynamic Coastal Environments: An Integrated Approach Using Field Data, Remote Sensing and Numerical Modeling), Richard L. Miller, Ramón López, Ryan P. Mulligan, Robert E. Reed, Cheng-Chien Liu, Christopher J. Buonassissi, and Matthew M. Brown describe an integrated approach based on field measurements, remote sensing and numerical modeling that examines the transport of dissolved (colored dissolved organic matter (CDOM), dissolved organic carbon (DOC)) and particulate material (total suspended matter (TSM)) within a complex coastal system, the Albemarle-Pamlico Estuarine System (APES), North Carolina, USA. The advanced Delft3D numerical model is used to simulate freshwater and DOC transport following major rain events. Chapter 15 (Simulated Management Systems Developed by the Northern Gulf Coastal Hazards Collaboratory (NG-CHC): An Overview of Cyberinfrastructure to Support the Coastal Modeling Community in the Gulf of Mexico), by a team composed of Robert R. Twilley, Steve Brandt, Darlene Breaux, John Cartwright, Jim Chen, Greg Easson, Patrick Fitzpatrick, Kenneth Fridley, Sara Graves, Sandra Harper, Carola Kaiser, Alexander Maestre, Manil Maskey, William H. McAnally, John McCorquodale, Ehab Meselhe, Tina Miller-Way, Kyeong Park, Joao Pereira, Thomas Richardson, Jian

Tao, Amelia Ward, Jerry Wiggert, and Derek Williamson, explains how a collaboratory was established to catalyze collaborative research via enhanced CI (cyberinfrastructure) to reduce regional vulnerability to natural and human disasters by facilitating high performance modeling to test hypotheses focused on engineering design, coastal system response, and risk management of coastal hazards. This advanced technology is used to promote collaborative environmental modeling in coastal systems. Chapter 16 (Advancement of Technology for Detecting Shoreline Changes in East Coast of India and Comparison with Prototype Behavior), by Ramasamy Manivanan, discusses how the information predicted by cross-shore and longshore impact mathematical model match the information shown by satellite imagery. Thus, satellite information can be useful for the overall calibration of the mathematical models. Chapter 17 (Advances in Remote Sensing of Coastal Wetlands: LiDAR, SAR, and Object-Oriented Case Studies from North Carolina), by Thomas R. Allen, reviews the different advancements from the use of Light Detection and Ranging (LiDAR), space-borne Synthetic Aperture Radar (SAR), and multi-sensor and object-oriented image analysis techniques, which aid the inventorying, monitoring, and management of coastal wetlands.

Part IV (Advances in the Management of Coastal Resources Using Remote Sensing Data and GIS) contains three chapters that extol the virtues of numerical simulations and satellite remote sensing tools for research and management. Chapter 18 (Numerical Simulations and Satellite Remote Sensing as Tools for Research and Management of Marine Fishery Resources), by Grinson George, discusses modeled and satellite remote sensing data that support research, technology-development, and management of marine fishery resources. Of interest here is the fact that numerical simulations and remote sensing data of the marine environment provides sufficient cues in the form of surrogate databases that support monitoring, surveillance, and management of marine fishery resources in the context of an ecosystem approach. Chapter 19 (Identifying Suitable Sites of Shrimp Culture in Southwest Bangladesh Using GIS and Remote Sensing Data), by Shak Md. Bazlur Rahaman, Khandaker Anisul Huq, and Md. Mujibor Rahman, shows how satellite imagery and GIS data (e.g. water and soil quality, shrimp culture area, method and production, source and seasonal availability of water, drainage system, water logging, disease outbreak, sanitation facility, road communication, electricity supply, land use pattern, land elevation, hazard frequency, fisheries statistics, and population census data) were collected in studies of site suitability. The advanced methodology in this study shows how to formulate shrimp culture policy for sustainable development. And in Chap. 20 (A Multi-Criteria Approach for Erosion Risk Assessment Using a New Concept of Spatial Unit Analysis, Wave Model, and High Resolution DEMs), by Helena Granja, José Pinho, and João Mendes, field data and model outputs were integrated, processed, and analyzed within a GIS interface in order to assess the vulnerability to erosion and to produce associated risk maps using a multi-criteria approach.

When discussing advancements in the remote sensing and modeling of biophysical coastal systems, researchers have made many great strides in recent years. This volume of the Coastal Research Library (CRL), while presenting a wide range of

topics related to the innovative technologies associated with the development and improvement of coastal remote sensing and modeling, also offers a look into the many parts of the world where these advancements are being implemented. For example, a new seasonal sea-level variation model is introduced along the Orinoco River in South America, the advancement of water quality models is presented for estuaries in Portugal, the use of remote sensing and GIS data is shown to further the advancement of shrimp fisheries in Bangladesh, and by incorporating Laser Airborne Depth Sounding (LADS) and IKONOS satellite imagery, a new level of mapping biophysical environments on carbonate banks is achieved in south Florida. The following chapters establish the ongoing advancements in the fields of remote sensing and modeling, as well as provide a comprehensive look into diverse coastal environments where these studies are being conducted.

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