Preface

This is an important book that fills a critical niche. We are living in an unprecedented time of change in the condition of our coastal environments. We are also living in a period of exceptionally rapid advancement in technologies to support geospatial data acquisition, imaging, and computing. This volume brings together the world's expert scientists and the best available data to measure and monitor coastal environments. The volume also demonstrates how decision-makers and resource managers are using these data to address complex issues in coastal zone management. A number of overarching themes establish a context within which the chapters in this volume should be read.

Coastal environments are complex: A large portion of the world's population lives near coasts. Coasts are a vital geographic region in terms of transportation, commerce, and trade. Coasts are dynamic and complex; for example, the quality of our coastal marine ecosystems is largely a result of human activity on land. Point and nonpoint pollution, sedimentation, and changes in freshwater flow all have profound impacts on marine ecosystems. As a number of the chapters in this book attest, land-use changes in coastal watersheds are an important driver of marine ecosystem condition. Thus, our ability to measure existing land-use changes and to model future land-use changes has immediate value to coastal resource managers. The sensors, data, and technologies that allow us to map land-use changes are themselves changing quite rapidly and this book brings together the state-of-the-art in this technically complex arena.

Climate change impacts will be profound in coastal environments: The debate is over; the question is not whether climate change is happening or not, the questions are how much and in what form climate change will manifest itself. Coastal ecosystems will be impacted in many ways. Sea level rise will be an obvious impact, and the inundation modeling that LiDAR data permit are critical for coastal zone managers. These models tell us where we have vulnerable infrastructure, habitats at risk, and potential dispersal corridors for salt marshes and other coastal habitats that will have to migrate inland or drown. There are indications that high-intensity storms will be more frequent under conditions of climate change. Again, accurate terrain data, high-resolution imagery, and detailed land-use data are essential to understand what is at risk under conditions of a 5–7 m storm surge. There is no doubt that coastal submerged, tidal, and terrestrial habitats will see significant changes as near-shore waters warm, freshwater flows become irregular, patterns of coastal erosion and accretion are altered, and coastal waters become more acidic. Within the lifetime of our current students, we anticipate significant negative impacts on the growth and calcification rates of coral reefs, the continuation of a global trend for increasing numbers and areal extent of harmful algal blooms, and other threats to coastal water quality and to coastal marine ecosystems. The chapters in this volume bring together the best experts to discuss how remote sensing data and technology are brought to bear on managing our coastal ecosystems in the context of climate change.

All scales—temporal and spatial—are relevant in coastal ecosystems: Patterns and processes that drive coastal ecosystems occur rapidly at local scales as well as gradually at broad scales. It is important that we be able to map and monitor patterns and processes at the time intervals and spatial resolutions that changes require. Topics addressed in this volume such as salt marsh dieback, breaching of barrier beaches, annual shifts in the extent of submerged aquatic vegetation, and increases in impervious surfaces in coastal watersheds require constant vigilance at fine scales by coastal managers. Remote sensing technology is the only practical way to map and monitor these phenomena. Furthermore, regional changes in sea surface temperature, ocean productivity, and patterns of sediment flux occur over broad scales, and remote sensing data and methods are the most efficient way to track changes over large areas. Our ability to process the massive datasets that are required to monitor large areas of coastal ecosystems or dense datasets where pixel sizes are expressed in centimeters is becoming less and less of an issue.

Remote sensing of the coastal waters is a challenge: The coastal environment is the boundary between the land and the ocean, and remote sensing of the coastal environment straddles the technical boundary of land and ocean satellite remote sensing. Satellite radiometers optimized for remote sensing of terrestrial environments, as well as those for the open ocean, are not well suited for quantitative remote sensing of phytoplankton biomass, sediment, and other constituents of coastal waters. Remote sensing of coastal waters requires high spatial resolution to resolve characteristically small features, as well as daily or higher frequency coverage to understand many of the important coastal processes of these dynamic regions. The ideal satellite radiometer, for measurements of coastal waters, would, for example, have Landsat spatial resolution or, better, revisit times comparable to wide-swath instruments such as MODIS-Aqua, and many narrow spectral bands with high signal-to-noise ratios. The MERIS instrument on ESA's ENVISAT is an important step in this direction, but 300 m pixel resolution is still too coarse to resolve many of the important fine-grain features of coastal waters. The future promises many exciting advances in new and improved sensors for use by researchers and resource managers as well as improved geoprocessing tools and computing technology to study coastal ecosystems. This important volume by Wang and his colleagues establishes the current state-of-the-art in coastal remote sensing.

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