

Remote Sensing of Coastal Aquatic Environments

Remote Sensing and Digital Image Processing

VOLUME 7

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REMOTE SENSING OF COASTAL AQUATIC ENVIRONMENTS

Technologies, Techniques and Applications

edited by

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A comparison of data acquired at 50m (left) and then resampled to a spatial resolution of 1km that is typical of many satellite-based instruments (right) - also see p. 54, figure 3.

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PREFACE

Coastal waters are important ecological systems and vital assets for many nations. Estuaries, bays, and coastal margins are among the most productive natural systems on Earth. Coastal productivity supports multiple trophic levels as well as recreational and commercial fisheries. Coastal waters are active areas for the processing of nutrients and carbon and therefore play a roll in the flux, cycling, and fate of atmospheric CO₂. Coastal waters link land and ocean systems primarily through the discharge of rivers. Rivers serve as a major conduit for the delivery of significant amounts of dissolved and particulate materials from terrestrial environments to the coastal ocean. As a consequence, human activities within a watershed can be expressed within coastal waters by changes in water quality and overall system response. Because the majority of the human population lives within 60 km of a coast, coastal waters are critical areas for recreation, commerce, and national defense.

Coastal waters are also complex, dynamic environments. A vast array of coupled biological, chemical, geological, and physical processes occur over multiple time and space scales. The optical environment of coastal waters is particularly complex. The propagation and utilization of light within the water column varies over time and space scales corresponding to changes in concentrations in optically active materials (e.g., phytoplankton, colored dissolved organic matter, and suspended particulates).

There is considerable interest in studying coastal waters to gain a better understanding of Earth system processes for climate change research or environmental factors for management decisions. Unfortunately, the dynamic nature of coastal waters renders most traditional field measurements and sampling protocols ineffective in capturing the range and variability of many coastal processes. In contrast, remote sensing from aircraft and space-based platforms offers unique large-scale synoptic data to address the complex nature of coastal waters. The utility of remote sensing to a wide range of disciplines is well documented. However, to apply remote sensing to a particular application, especially within a dynamic coastal environment, new users are often challenged to find appropriate reference material to gain an adequate understanding of remote sensing in a quick and effective manner.

The motivation to write this book was borne from our early experiences, and frustrations, to use remote sensing to address research problems in our major disciplines, which are related to coastal marine processes. We were faced with the challenge of learning a new technology laden with new and confusing terminology, data, and methods of processing and analysis. Although we were primarily interested in the application of remote sensing to our research, we were forced to learn even basic principles by scouring countless technical manuals, reports, and often-cryptic scientific papers. Simply, a book on the use of remote sensing for coastal aquatic environments did not exist. Hence, the major goal of writing this book was to produce a valuable resource for students, researchers, and decision makers involved in various studies of coastal waters that are interested in applying remote sensing to their work. However, a book such as this cannot be totally comprehensive and cover all aspects of the remote sensing of coastal waters. The primary focus of this book is on optical remote sensing using passive instruments, with a major emphasis on the visible and near-Infrared regions of the electromagnetic spectrum. A discussion of active instruments is largely omitted.

This book is presented as a series of chapters to address the technologies, techniques, and applications of remote sensing related specifically to the study of coastal aquatic environments. Although each chapter was written to 'stand on its own', the content of each chapter was carefully selected to provide an integrated approach to basic terminology and principles. This book is therefore intended as a comprehensive reference on the subject as well. We also encouraged an overlap in discussions of key topics between chapters. However, the authors were asked to cast their discussion of these topics within the context of the main theme of their chapter. In this way, the reader is provided different ways of considering the same concept or application and we hope that this approach will help clarify some difficult topics and accelerate a reader's understanding of key concepts. The book is loosely organized into three sections corresponding to the main theme of a chapter: technologies (Chapters 2 – 4); techniques (Chapters 5 – 10); and, applications (Chapters 11 – 14). Chapter 1 provides an excellent overview of the basic terms and principles of radiative transfer theory to serve as a foundation for the book.

We are indebted to all the authors that contributed to this book. We were extremely fortunate to enlist recognized leaders in coastal remote sensing that enthusiastically embraced the goal of this challenging project, despite their full schedules and monumental workloads. Everyone worked very hard and was motivated to create a book that we all wished was available when we began to explore the exciting world of remote sensing.

As with many efforts to produce a book, friends and relatives often endure the thrills and disappointments that the authors encounter along the way. This book is no exception. Our families provided endless support and encouragement and always reminded us of the contribution that we could make. Richard Miller is forever grateful to his wife Jo Ann for her countless contributions, his daughter Virginia for raising the bar with her academic achievements and piercing discussions, and most importantly, his son Richard Jr. for forfeiting time with his dad so that he could work endless hours on this project. Carlos Del Castillo thanks his wife Mayra for her patience and help during many long hours of writing and reviewing chapters. Brent McKee thanks his family (Becky and Buck) for their encouragement, support and understanding during the long hours and late nights of this project.

The work by Miller and Del Castillo on this book was accomplished outside their official duties with the National Aeronautics and Space Administration (NASA). Hence, the views, opinions, and findings contained in this chapter are those of the authors and should not be construed as an official NASA or U.S. Government position, policy, or decision.

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