

CONTEMPORARY ISSUES IN ESTUARINE PHYSICS

Estuaries are areas of high socioeconomic importance, with 22 of the 32 largest cities in the world being located on river estuaries. Estuaries bring together fluxes of fresh and saline water, as well as fluvial and marine sediments, and contain many biological niches and high biological diversity. Increasing sophistication of field observation technology and numerical modeling have led to significant advances in our understanding of the physics of these systems over the last decade.

This book introduces a classification for estuaries before presenting the basic physics and hydrodynamics of estuarine circulation and the various factors that modify it in time and space. It then covers special topics at the forefront of research, such as turbulence, fronts in estuaries and continental shelves, low inflow estuaries, and implications of estuarine transport for water quality.

With contributions from some of the world's leading authorities on estuarine and lagoon hydrodynamics, this volume provides a concise foundation for academic researchers, advanced students and coastal resource managers.

Arnoldo Valle-Levinson received a PhD from the State University of New York at Stony Brook in 1992 before going on to work at Old Dominion University (Norfolk, VA). He joined the University of Florida (Gainesville, FL) in 2005, where he is now a Professor in the Department of Civil and Coastal Engineering. His research focuses on bathymetric effects on the hydrodynamics of estuaries, fjords and coastal lagoons. Professor Valle-Levinson is the recipient of a CAREER award from the US National Science Foundation, a Fulbright Fellowship for research in Chile, and a Gledden Fellowship from the University of Western Australia. He has worked extensively in several Latin-American countries, where he also teaches courses on estuarine and coastal hydrodynamics. He is also an associate editor for the journals *Continental Shelf Research* and *Ciencias Marinas*.

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A. VALLE-LEVINSON
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Preface

This book resulted from the lectures of a PanAmerican Advanced Studies Institute (PASI) funded by the United States National Science Foundation and the Department of Energy. The topic of the PASI was “Contemporary Issues in Estuarine Physics, Transport and Water Quality” and was held from July 31 to August 13, 2007 at the Unidad Académica Puerto Morelos of the Mexican National University (UNAM). One of the requirements was that the PASI had to involve lecturers and students from the Americas, with most from the United States. The institute was restricted to advanced graduate students and postdoctoral participants. Because of the requirements, this book includes authors who work in the United States but tries to be comprehensive in including aspects of estuarine systems in different parts of the world. The book, however, reflects regional experiences of the authors and obviously does not include exhaustive illustrations throughout the world. Nonetheless, it is expected to motivate studies, in diverse regions, that address problems outlined herein.

This book should be appropriate for advanced undergraduate or graduate courses on estuarine and lagoon hydrodynamics. It should also serve as a reference for the professional or environmental manager in this field. The sequence of chapters is designed in such a way that the topic is introduced in terms of estuaries classification (Chapter 1). This is followed by the basic hydrodynamics that drive the typically conceived estuarine circulation consisting of fresher water moving near the surface toward the ocean and saltier water moving below in opposite direction (Chapter 2). This chapter also presents the implications of estuarine circulation on salinity stratification. The chapter sequence then deals with processes that modify the basic circulation pattern, such as tides. The theoretical framework for tides in different systems is treated in Chapter 3. The effect of tides on estuarine circulation is presented at intratidal and subtidal time scales in Chapter 4. Chapters 5 and 6 deal with effects of bathymetry on estuarine hydrodynamics. The effects of lateral bathymetry and lateral circulation on estuarine circulation are explored in

Chapter 5. Chapter 6 depicts the circulation driven by tides and winds under varying bathymetry, to compare with the results of Chapter 3 for tides. The rest of the chapters deal with selected topics related to estuarine physics: turbulence is studied in Chapter 7; fronts in estuaries and continental shelves are covered in Chapter 8; processes in low-inflow estuaries are discussed in Chapter 9; and water quality implications are presented in Chapter 10.

The effort of putting this book together was made possible by the interest and dedication of the chapter authors, whose gathering at the PASI was supported by funding from the United States National Science Foundation, under project IOISE-0614418. Special recognition to David Salas de León and Adela Monreal, from the National University of Mexico (UNAM), for their tremendous contributions and original ideas in the organization of the PASI. Mario Cáceres, David Salas Monreal, Gilberto Expósito and Miguel Angel Díaz were extremely helpful with the logistics during the PASI. Particular gratitude to the Academic Unit of UNAM in Puerto Morelos, Brigitta Van Tussembroek, Director of the Unit at the time of the PASI, for allowing the use of their facilities for this activity.