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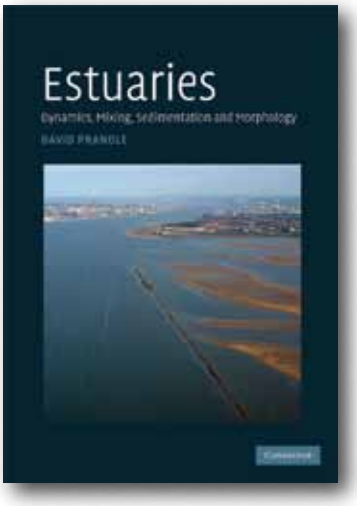
Estuaries: Dynamics, Mixing, Sedimentation and Morphology

By David Prandle, Cambridge University Press, 2009, 236 pages, ISBN 978-0-521-88886-8, Hardcover, $130 US

REVIEWED BY ALEXANDER YANKOVSKY



For instructors or students of physical oceanography at the graduate level, choosing a textbook is a pleasant exercise and often a matter of taste rather than necessity when it comes to open-ocean processes. Choices become somewhat limited or even problematic regarding books on estuarine dynamics, and the arrival of *Estuaries: Dynamics, Mixing, Sedimentation, and Morphology* by David Prandle has been met with high expectations. The author's contribution to the field is substantial by any standard, which warrants an interest in this volume by students and experienced researchers alike, as well as by engineers, managers, and other practitioners dealing with the estuarine environment. Prandle compiles and revisits many of his previous results, and includes complementary discussions of other relevant studies. Although individual chapters are written in a "stand-alone" style, the same theoretical framework is applied throughout the text so that the reader can navigate among different chapters and subjects relatively easily. The book's title accurately represents its content: a wealth of information on tidal and residual circulation in estuaries, mixing processes between riverine discharge and oceanic water, and how these dynamics affect sediment balance and shape estuarine morphology.

The book consists of eight chapters. Some chapters conclude with a summary and guidelines for applications, or with appendices discussing relevant theoretical and modeling issues. Each chapter has an extensive reference list. Chapter 1 introduces the essentials of tidal dynamics, saline intrusions, and sedimentation in estuaries, and outlines challenges along with research approaches to address them. Chapter 2 recognizes tidal dynamics as a principal driving mechanism of estuarine circulation. The author introduces well-known shallow-water equations and proceeds with a linearized solution for tidal wave propagation in the converging estuary where the principal balance is between inertia, the pressure gradient, and bed friction terms. Sections addressing the linearization of the quadratic friction term and the generation of higher harmonics and residuals are very well written and exceptionally insightful. Unfortunately, only a cursory description of nonlinear tidal dynamics is included; the chapter would benefit from a more detailed discussion of nonlinear tides in the estuary, perhaps in the framework of the Korteweg-de Vries equation.

Chapter 3 describes the vertical structure of tidal currents using a wide range of parameters. First, Prandle formulates a two-dimensional analytical model for time-dependant estuarine currents driven by the axial barotropic pressure gradient and vertical turbulent friction. He then extends the model to three dimensions by including the Coriolis force. Although useful, the section dealing with three-dimensional structure of tidal currents is more relevant to shelf dynamics (rather than estuarine); the development of tidal ellipses in the estuarine channel is inhibited by the presence of lateral boundaries and only a very few estuaries in the world are wider than the barotropic Rossby radius. At the same time, the author omits a much-needed discussion of the transverse structure of estuarine residual currents.

Chapter 4 is a true masterpiece. It introduces a classification scheme for estuarine circulation based on the intensity of mixing processes, presents analytical solutions for each distinctive type of longitudinal circulation, and provides a scaling analysis of the governing processes. The net effect of tidally induced mixing and the resulting saline intrusion are parameterized in terms of readily available characteristics such as a riverine discharge (or a mean velocity), tidal amplitude, and channel geometry. The robustness of the analytical results and scaling analysis is demonstrated with numerical experiments. This chapter is written with great clarity and physical intuition, and alone can easily propel this book to the list of bestsellers in this field.

Chapter 5 presents basic concepts of sediment transport, deposition, and erosion in estuaries, focusing on the effects of tidal currents but neglecting the contribution of wind waves. Chapter 6 summarizes material from Chapter 2 through Chapter 4 and revisits the essentials of synchronous estuary dynamics, now focusing on their effect on estuarine morphology. Scaling arguments derived in the previous chapters are applied to determine the major characteristics of estuarine bathymetry (e.g., depth at the mouth, estuarine length, rate of funneling) as a function of riverine discharge, tidal amplitude, and the bed friction coefficient. Also, a bathymetric zone of estuaries is demarcated in terms of tidal amplitude and depth. These theoretical considerations are then applied to a variety of real-life estuaries (mostly from the UK). Other useful topics discussed in this chapter include minimum depths and flows required for estuarine functioning, as well as spacing between estuaries. The principles of tidal and residual circulation are used to quantify estuarine sediment balance in Chapter 7. Sediment flux is partitioned into river flow, saline intrusion, and tidal current constituents; the simplifying assumption of a synchronous estuary yields the conditions for zero net flux (that is, bathymetric stability) as a function of tidal amplitude and depth. Again, simple analytical expressions derived in this chapter are applied to quantify sediment regimes of several European estuaries. The concluding Chapter 8 discusses strategies for sustainability and challenges under rapidly changing environmental conditions, including rising sea level and severe storms caused by global warming.

As good and timely a contribution as it is, this book has the potential to evolve into a truly outstanding text if it extends to areas where the author has not contributed himself. The derivations are often elegant and, in most cases, straightforward, but not always seamless between sections or chapters. The book is likely to be used by teaching faculty although it falls short as a textbook because some important topics are missing. Nevertheless, the author's distinctive style of distilling complicated dynamics into simple analytical expressions and governing parameters with a wide range of applicability will find many enthusiastic readers and followers in the years to come.

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Oceanology: The True Account of the Voyage of the Nautilus

By "Zoticus de Lesseps," Templar Company Ltd., Candlewick Press, 2009, 34 pages, ISBN: 978-0-7636-4290-7, Hardcover, $19.95 US.

REVIEWED BY CLARICE M. AND CHARLES S. YENTSCH

Oceanology: The True Account of the Voyage of the Nautilus is whimsical and fun, yet treats oceanography with the respect and evidence-driven conclusions of *The Oceans* by Sverdrup, Johnson, and Fleming (1942). This "ologyworld" book (see http://www.ologyworld.com/ for additional "ology" books) mentions on the back cover that it is suitable "for ages 6 and up." We saw this statement and purchased the book at the History of Diving Museum as a gift for a child's sixth birthday. We were so taken by the book that we returned to the museum the following day to get a copy for ourselves. It is now on our bookshelf next to Jules Verne's classic *20,000 Leagues Under the Sea* and Matthew Maury's *Physical Geography of the Sea* (1855) and *Manual of Geography* (1870).

The book, beautifully illustrated with many action pullouts and booklets (tiny books within the book), starts with the publisher's note: "A sea-stained notebook documenting an extraordinary undersea journey, purportedly written by one Zoticus de Lesseps, was recently lent to the publisher. The book appears to be the account of a real voyage, which is surprising, considering the year that the journey apparently took place. Until now, it has been understood that undersea exploration of this nature was not possible in 1863. Despite this volume having every appearance of authenticity, the publisher has been unable to verify the existence of a Zoticus de Lesseps