

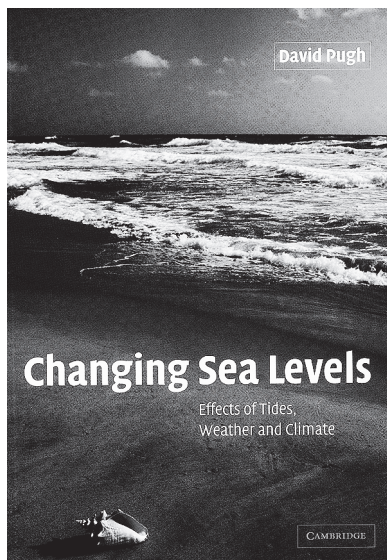
REVIEWS

CHANGING SEA LEVELS: EFFECTS OF TIDES, WEATHER AND CLIMATE *by David Pugh, 2004. Cambridge University Press, Cambridge, UK. 265 pp. ISBN 0-521-53218-3, \$50.00 (Paperback).*

Tides, storm surges, global warming, and ice ages are among the many physical phenomena that control the sea level in any given coastal area, affecting the lives of the people, animals, and plants living there. Current understanding of sea level and how it changes is a result of centuries of scientific and technical advances that over time have drawn on a range of disciplines. David Pugh has done an admirable job of synthesizing this work in a relatively short book, *Changing Sea Levels* (265 pp.). Given its impressive breadth and depth of coverage, it remains quite readable and a valuable resource for those with a general interest in the earth sciences.

The topic that is covered most extensively is tides. Pugh begins with Newton's first and second laws applied to the relative motion of the earth, moon, and sun. In Chapters 2–3, he provides a simple quantitative framework for understanding the basic physical cause of tides, gravitational pull among these three bodies, and then goes on to lay out a more complete solution to the equations that can be used to predict the actual tide level at a given place and time. It should be possible for most upper-level undergraduate science students with some background in math and physics to follow the material in these chapters, though perhaps not “undergraduate students of all levels” — the intended audience of this book as stated in the Preface. Some of the more involved solutions are mercifully relegated to an appendix, but subjects such as harmonic analysis which is covered in Chapter 3 require an understanding of advanced mathematics. Two additional chapters on tides cover more fluid dynamics, again in a relatively simple quantitative framework, which provides physical insight into such curious tidal phenomena as moving amphidromes and tidal bores. (Pugh also provides a glossary of terms at the end of the book which defines these respectively as: “a point in the sea where there is zero tidal amplitude due to canceling of waves” and “a tidal wave which propagates as a solitary wave with a steep leading edge up certain rivers.”)

The second half of the book, Chapters 6–9, covers the effects of weather and climate on sea level. This is where the book veers from the traditional textbook style to a broader scientific text, likely to be of more interest to a general audience. In Chapter 7, the author discusses the potential effects of global warming on mean sea level and the inherent uncertainties in detecting and predicting these effects. He extensively cites the 2001 report of the Intergovernmental Panel on Climate Change (IPCC) which notes that the average rate of global mean sea level rise over the twentieth century was 1–2 mm yr⁻¹. This may seem like a small amount, but if sea level rises at this rate over a long period of time, it adds up. Moreover, the IPCC reports that extreme weather events may also increase in



likelihood as the earth warms in the future, which would add storm surge to slowly rising mean sea levels. Given this information, Pugh attempts in Chapter 8 to put himself in the shoes of a coastal manager by assessing the risks that such future changes may pose. He again provides a simple quantitative framework for risk assessment in terms of cost-benefit, though he rightly notes that economic metrics are only one variable affecting real-world policy, where cultural, psychological, and political factors heavily influence decision making under uncertainty.

Though the subject of sea level change encompasses wide-ranging timescales, disciplines, and applications, Pugh does not shy away from tackling it in its entirety. He touches on topics as diverse as tsunamis and the tidal influence on the mating habits of fiddler crabs, and delves into topics as esoteric as the Law of Gravitational Attraction and fluid mechanics. In addition to being well-constructed, the book is also timely. There is growing evidence that the ice sheets of Antarctica and Greenland have been undergoing significant changes in recent decades, indicating that sea level changes, even potentially catastrophic ones, are likely to be part of our future. Many coastal ecosystems are already showing dramatic signs of ongoing rapid change. Readers of *Changing Sea Levels*, including students, educators and policy makers, will be better prepared to understand those changes in the broader scientific context that is provided by this book.—Amy Clement, *Division of Meteorology and Physical Oceanography, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149.*