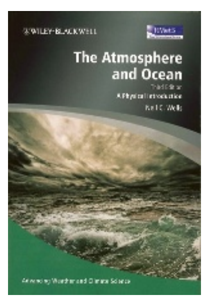
# READINGS

BOOK REVIEWS

## THE ATMOSPHERE AND OCEAN: A PHYSICAL INTRODUCTION (THIRD EDITION)

Neil C. Wells, 2012, 424 pp., $99.95, paperbound, Wiley-Blackwell, ISBN 978-0-470-69468-8

The ocean and atmosphere are in constant interaction, creating phenomena ranging from gentle waves on the beach to destructive hurricanes. It is now widely recognized that El Niño is not an oceanic phenomenon, nor is the Southern Oscillation an atmospheric one. Together they are the result of ocean–atmosphere interaction. The phrase "El Niño/Southern Oscillation (ENSO)" was coined to reflect their coupled nature. Through atmospheric teleconnections, this phenomenon of the tropical Pacific Ocean has far-reaching effects around the globe, causing floods and droughts in Asia and the Americas. The physical understanding of ocean–atmosphere interaction led to skillful predictions of climate anomalies in many parts of the world at leads of one season or longer, a triumph of science on par with weather forecasts. As the globe is warming due to anthropogenic changes in atmospheric composition, predicting regional climate change is an indispensable step toward mitigation and adaptation. Recent studies show that ocean–atmosphere interactions are key to spatial variations in ocean surface warming, which in turn affect regional changes in precipitation and tropical cyclones.




The desire to understand and predict climate calls for treating ocean and atmosphere as a coupled system. This textbook is among the few that aim for a joint treatment of physical oceanography and meteorology at the undergraduate level. Ocean and atmospheric motions share the same geophysical fluid dynamic framework, and there are several books offering a unifying treatment of ocean and atmospheric dynamics (e.g., Vallis's *Atmospheric and Oceanic Fluid Dynamics*). There are also books on ENSO and amazing dynamics of ocean–atmosphere coupling (such as Philander's *El Niño, La Niña, and the Southern Oscillation*). These books tend to serve graduate and upper-level undergraduate students. At the introductory undergraduate level, physical oceanography and meteorology are generally taught as separate subjects. Excellent textbooks include Talley et al.'s (2011) *Descriptive Oceanography* and Wallace and Hobbs's (2006) *Atmospheric Science*. *The Atmosphere and Ocean* tries to combine the two into one integrated course as an introductory survey for undergraduate majors in ocean–atmospheric sciences, and for graduate students who have undergraduate majors other than oceanography or meteorology. In principal, this book can also serve nonmajor introductory courses, but instructors probably prefer other textbooks that have color illustrations and a ready-to-use PowerPoint slide package. Instructors using this textbook would probably need to supplement it with their own homework problems. Each chapter has two exercise problems with answers at the end of the book. For student exercises, the problems are probably best listed at the end of each chapter, separate from the answers.

Aside from the obvious fact that liquid water is heavier than air, the ocean and atmosphere have many other important distinctions. The ocean is nearly incompressible, while the atmospheric temperature varies greatly with pressure, decreasing with height at 10°C $km^{-1}$ in the absence of water vapor. Latent heat of water vapor condensation fuels atmospheric deep convection, while salinity determines density in cold subpolar seas where densest waters form and fill the vast deep ocean of the world. Treating the ocean and atmosphere together and highlighting their differences are the strength of this book. For example, in a single chapter on radiation (pages 60 and 77), the book offers insightful comparative explanations for why the clear sky and a clean ocean look blue—material one usually has to find in two textbooks and then synthesize.

The book includes many figures highlighting important observational results, a welcome feature for students who will go on to major in ocean–atmospheric sciences. It is hard to find another book that includes figures for both the net radiative cooling rate of the atmosphere (page 74) and ocean tide distribution over the Atlantic (page 242). The discussions of instruments and observing systems are comprehensive and up to date. Of the twelve chapters, two are on dynamics and ocean–atmospheric motions. Space limitations prohibit detailed, systematic derivations, so the book takes a helpful approach of introducing important dynamic principles without derivation and then focusing on the applications to explain important phenomena. The discussion of the conservation of absolute vorticity and Rossby waves is an example. The vorticity discussion is then expanded to include divergence, leading eventually to a balance equation between the meridional advection of planetary vorticity and vortex tube stretching. I wish that the author had spelled out the common terminology for this balance, since the Sverdrup balance is a term so basic to ocean circulation dynamics that many students using this book will encounter it in their further studies.

Textbooks, especially for introductory surveys, are packed with facts. Their explanations and mutual connections are not always made clear. The section on ocean tides conveys the excitement of scientific advances: Newton's astronomical theory revealed the origin of ocean tides but strong spatial variations in the dominant period, magnitude, and phase of tides led to the development of Laplace's tide wave theory and harmonic analysis for practical tide forecast. The enhanced amplitude of the M2 tide toward the coast and the anticlockwise phase rotation around the amphidromic point over the North Atlantic are used to illustrate the effect of the coastally trapped Kelvin wave. The discussion of ocean surface waves in the same chapter is also concise and informative. The author's own research covers ocean tides and storm surges, but the book presents a respectful discussion of atmospheric radiation and precipitation processes comparable to an introductory meteorological survey in other textbooks.

An important impetus of learning oceanography and meteorology in one course is to forge a coupled view and appreciate the interaction of ocean and atmosphere. Thus, chapter 11 ("Atmosphere–Ocean Interaction") is supposed to be the climax that synthesizes and rakes in the benefits of studying the ocean and atmosphere together. The chapter falls short in providing a compelling account of rapid and exciting advances in ocean–atmosphere interaction research over the past three decades, which motivates

## NEW PUBLICATIONS

### SIMULATING NATURE: A PHILOSOPHICAL STUDY OF COMPUTER-SIMULATION UNCERTAINTIES AND THEIR ROLE IN CLIMATE SCIENCE AND POLICY ADVICE (SECOND EDITION)

A. C. Peterson, 2012, 208 pp., $59.95, paperbound, CRC Press, ISBN 978-1-4665-0662-4

**Referring to empirical results from science studies and political science, this title addresses questions about the types of uncertainty associated with scientific simulation and about how these uncertainties can be communicated. It includes discussion of the assessment reports and workings of the IPCC, and this second edition reflects the latest developments in climate change policy.**

### LIVING IN A DANGEROUS CLIMATE: CLIMATE CHANGE AND HUMAN EVOLUTION

R. Hetherington, 2012, 256 pp., $27.99, paperbound, Cambridge University Press, ISBN 978-1-107-69473-6

**This title explores how a changing climate has affected human evolution and society, addressing such questions as: Why did all other Homo species go extinct while Homo sapiens became dominant? How did agriculture, domestication, and the use of fossil fuels affect humanity's growing dominance? Do today's dominant societies contribute to our current failure to meet the hazards of a dangerous climate? The book links scientific knowledge and perspectives of evolution, climate change, and economics in an accessible manner.**

### SEVERE AND HAZARDOUS WEATHER: AN INTRODUCTION TO HIGH IMPACT METEOROLOGY (FOURTH EDITION)

R. M. Rauber, J. E. Walsh, and D. J. Charlevoix, 2012, 612 pp., $125.95, paperbound, Kendall Hunt, ISBN 978-0-7575-9772-5

**This fully illustrated textbook explores the complexities and power of severe weather and explains how hazardous weather events develop and evolve in our atmosphere. This new edition has been updated to reflect new scientific findings and recent major weather events. A new web interface supports student learning with study aids and animations, and provides instructors with pedagogic tools and teaching support.**

a joint treatment of these two media in the first place. The chapter starts with a weak discussion about air-mass transformation across sea surface temperature gradients, without mentioning recent results from satellite observations that reveal sharp transitions across major oceanic fronts. There is much discussion about sea surface temperature anomalies in extratropical oceans that implies their importance for atmospheric circulation, ignoring the current view that such an ocean-to-atmospheric influence is weak on the basin scale in the extratropics. ENSO, the poster boy of ocean–atmosphere interaction, did not get star treatment. The chapter does not even mention the positive feedback of Bjerknes and the role of upper-ocean heat content adjustments in phase transition between El Niño and La Niña. Overall, the material in this chapter appears somewhat dated and reflects the state of knowledge in the early 1980s, with the decadal variability section as a notable exception. I recommend a rewrite of this chapter in the next edition to allow readers to enjoy the full benefits of the coupled ocean–atmosphere view that this book intends to foster.

The book is in its third edition—previous editions were published in 1986 and 1997. Chapters 10 ("Mathematical Modelling") and 12 ("Climate Change") were newly added to the current edition. The interest in these topics is obvious: numerical models are an essential tool for research, data assimilation, and prediction, while anthropogenic climate change represents one of the greatest challenges facing humanity. These chapters could be made more exciting. The modeling chapter could highlight the amazing skills of numerical simulation and weather prediction to motivate students to go through technical details of numerical calculation. The climate change chapter could use some exciting examples from recent research to illustrate the importance of the ocean and its interaction with the atmosphere.

Undergraduate and graduate courses on physical oceanography and meteorology have matured over the past decades, as marked by the publication of several authoritative textbooks that offer a systematic treatment of either subject. Treating these two subjects together in a single-semester course remains experimental. This book is commendable for attempting such an approach to educate a new generation of scientists armed with a unifying view of the ocean and atmosphere. It is a unique book for those who seek knowledge of not only ocean or atmosphere but also their commonality, distinction, and interaction.

—Shang-Ping Xie

*Shang-Ping Xie is the Roger Revelle Professor at the Scripps Institution of Oceanography, University of*

ENVIRONMENTAL HAZARDS AND DISASTERS: CONTEXTS, PERSPECTIVES AND MANAGEMENT

B. K. Paul, 2011, 334 pp., $149.95, hardbound, Wiley-Blackwell, ISBN 978-0-470-66002-7

**This book focuses on manifested threats to humans and their welfare as a result of natural disasters. It uses an integrative approach to address sociocultural, political, and physical components of the disaster process. Human and social vulnerability as well as risk to environmental hazards are explored within the comprehensive context of diverse natural hazards and disasters. It also includes chapters on topics such as the application of GIS in hazard studies, resiliency, disasters and poverty, climate change, and sustainability and development.**

A DICTIONARY OF CLIMATE CHANGE AND THE ENVIRONMENT: ECONOMICS, SCIENCE AND POLICY

R. Q. Grafton, H. W. Nelson, R. Lambie, and P. R. Wyrwoll, 2012, 496 pp., $210.00, hardbound, Edward Elgar, ISBN 978-1-84980-387-8

**This title defines more than 3,700 words used across the fields of climate change, environmental economics, environmental sciences, and environmental studies. It features introductory primers to major topic areas; recommended reading for particular topics and specific words or concepts; and seven appendices, including a catalog of scientific symbols, units, and conversions, as well as a listing and description of selected environmental treaties.**

INTRODUCTION TO EARTH AND PLANETARY SYSTEM SCIENCE: NEW VIEW OF EARTH, PLANETS AND HUMANS

N. Shikazono, 2012, 177 pp., $79.95, paperbound, Springer, ISBN 978-4-431-54057-1

**This book explores material science, the interaction between subsystems, and nature–human interactions. Chapters focus on the constituent materials of the Earth and planets (rocks, water, carbon dioxide, etc.); interactions among subsystems (atmosphere, hydrosphere, geosphere, biosphere, humans); dynamics of the Earth system (plate tectonics, plume tectonics, global geochemical cycles including the Earth's interior); nature–human interaction (e.g., disasters); and the origin and evolution of the Earth and planetary system.**

*California at San Diego, where he teaches and studies ocean–atmosphere interactions and climate variability and change.*

**FOR FURTHER READING**


Philander, S. G. H., 1990: *El Niño, La Niña, and the Southern Oscillation*. Academic Press, 293 pp.

Talley, L. D., G. L. Pickard, W. J. Emery, and J. H. Swift, 2012: *Descriptive Physical Oceanography: An Introduction*. 6th ed. Academic Press, 560 pp.

Vallis, G. K., 2006: *Atmospheric and Oceanic Fluid Dynamics: Fundamentals and Large-Scale Circulation*. Cambridge University Press, 745 pp.

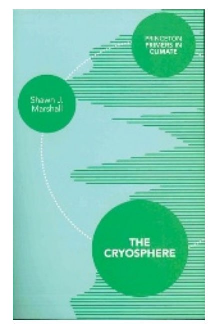
Wallace, J. M., and P. V. Hobbs, 2006: *Atmospheric Science: An Introductory Survey*. 2d ed. Academic Press, 504 pp.


## THE CRYOSPHERE


Shawn J. Marshall, 2011, 312 pp., $24.95, paperbound, Princeton University Press, ISBN 978-0-691-14526-6


This book provides a comprehensive and up-to-date discussion of the cryosphere as a whole. This point in itself is unique, as various books/textbooks on the market touch on one or multiple aspects of this topic, but to my knowledge few touch on all aspects of this particular sphere. The author introduces each chapter with a glimpse into the history of each particular topic, providing good context for the history of study within the field of cryospheric science. The final chapter, dealing with climate change and the cryosphere, is also unique in the sense that it includes the most current data for such metrics as Arctic sea ice, glaciers, and ice sheets.

***Audience.*** This book would appeal to students at the graduate level who are embarking on a project related to the cryosphere, or to any scientist who wants a quick refresher on the governing equations related to snow, sea ice, or land ice. For a more comprehensive understanding, the annotated bibliography offers numerous suggestions for further reading. As for the casual reader, knowledge of basic mathematics or physics is necessary to understand a number of the equations presented, as only basic explanation of such equations is described.




This book would be suitable for use in college courses at the masters or Ph.D. level. I would be hesitant to use this book in an undergraduate setting, due to the dense nature of information contained and also the lack of emphasis on illustrations and figures. For an undergraduate class, I feel the topic of the cryosphere in its entirety is too large, especially if knowledge of calculus up through differential equations is necessary to interpret the equations presented. If more emphasis were placed on the illustrations and the author had included problem sets and potential further discussion questions at the end of each chapter, I think this book would be more suitable for an advanced undergraduate course.

***Strengths.*** This book does an excellent job of touching on most topics and aspects of the cryosphere. In particular, many textbooks on the market today only deal with terrestrial or marine