

READINGS

BOOK REVIEWS

MID-LATITUDE ATMOSPHERIC DYNAMICS: A FIRST COURSE

Jonathan E. Martin, 2006, 336 pp., \$178.00, hardbound, Wiley, ISBN 978-0-470-86464-7

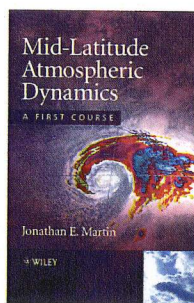
The book *Mid-Latitude Atmospheric Dynamics* is a marriage of two of the author's grand passions: synoptic meteorology and teaching. The result is a student-friendly yet rigorous textbook that accomplishes what no other textbook has done before: while the quasigeostrophic (QG) and potential vorticity (PV) frameworks have long been established in the meteorological literature, this is the first textbook that uses these frameworks to diagnose frontal disturbances at a level readily accessible to undergraduate students.

The text is concise, precise, easy to read, and by no means exhaustive. It flows coherently within and across chapters. It is clearly structured, each chapter starting with its objectives and ending with a set of problems. It is written as if the author was teaching this material at his campus in Madison, Wisconsin. Having taught synoptic meteorology, I am inclined to detail and refine at several locations in the book, but Jonathan Martin intentionally paints the big picture. Details and tangents that may lead to confusion are sacrificed in favor of elegant derivations and clearly explained concepts. Clearly, the choice of materials and the explanations have benefited from years of teaching experience. This book can rightly be called a primer or first course. The text is written to be understood, both mathematically and conceptually.

The math is clean, the assumptions are clearly stated, and—especially in the first half of the book—the derivations are as stepwise as they would be on the blackboard. The book starts with a chapter on frequently used mathematical tools that in typical courses are assumed to be on the students' fingertips. This introduction serves as a nice refresher for all and subtly weaves in meteorological concepts. Students can hone their math skills through problems at the

end of each chapter. But neither the problem sets nor the text emphasize math competency; they emphasize conceptual understanding. Many students struggle to interpret the physical meaning of terms in an equation, such as the omega equation. Martin explains such interpretations superbly, and often graphically. Most of the figures were specifically drafted for this book, in such a way that minimizes redundant information. Many of the figures masterfully merge real data with conceptual ideas. The figures are of sufficient quality for overhead projection in the classroom, and they are clearly explained in their captions and in the text.

The first five chapters essentially are an introduction to atmospheric dynamics, and thus they can be used to understand atmospheric processes at any scale, on any planet. Chapter 2 deals with the forces acting on an air parcel on the rotating Earth. The fundamental equations of motion are developed in chapter 3, and these are expressed in isobaric and isentropic coordinates in chapter 4. The latter chapter also deals with thermal wind balance and with natural coordinates and balanced flows. Chapter 5 introduces circulation and the vorticity equations. The first five chapters are the building blocks for the last four chapters; however, they are similar to the first four chapters of Holton's *Introduction to Dynamic Meteorology* (fourth edition, 2004), the book that has been the main staple in its field for more than three decades. In fact there are several other textbooks that cover this material in essentially the same logical sequence [e.g., chapters 2–7 in Lynch and Cassano's *Applied Atmospheric Dynamics* (2006)]. Thus, the coverage of these topics may appear redundant. The author does put his own spin on these topics, simplifying them a bit compared to Holton and applying them to real weather rather than to some analytical expression for weather. I



suspect that the thought occurred to the author to write a textbook just covering the material in the last four chapters, building on the existing literature on introductory dynamic meteorology, and starting with the QG approximations. I think he made the right choice, because, as a result, the last four chapters have remained more fundamental and aimed at the same audience.

It is in the last four chapters where Martin's meteorological genius is most evident. This genius clearly bears the influence of James Holton, Richard Reed, James Moore, and Brian Hoskins. The last four chapters deal with the dynamics of midlatitude cyclone life cycles. The topic is close to the author's heart and mind, as is evident from his publication record, yet his treatise is well-balanced, hardly slanted toward his own research.

Chapter 6 diagnoses synoptic-scale vertical motion using Sutcliffe's development theorem and the QG omega equation—the latter with some original analysis of the Q-vector. Chapter 7 discusses fronts, frontogenesis, and the frontogenetic circulation. It also covers the Sawyer–Eliassen equation, upper-tropospheric folds, and symmetric instability. Chapter 8 describes the life cycle of typical extratropical cyclones and explains development mainly from a QG perspective, although it also

highlights the significance of diabatic heating. And chapter 9 explains the same, but from a PV perspective.

Most of these topics are also covered in Bluestein's *Synoptic–Dynamic Meteorology in Midlatitudes: Volume II: Observations and Theory of Weather Systems* (1993), but Martin's book is more concise, more coherent, more comprehensible, and better illustrated. The text is particularly well illustrated in the last four chapters.

This book is ideally suited for a two-semester undergraduate sequence covering dynamic meteorology and synoptic meteorology. The first course would use the first five chapters, and thus students could do without the more theoretical and stuffier corresponding chapters in Holton. The second course, for which there really has been no good textbook until now, would use the last four chapters. The textbook provides ideas for lab sessions, especially for the second course. Many concepts are illustrated in the book with data for one particularly intense winter cyclone off Japan. One useful exercise in the lab or the classroom would be a similar analysis of a case in the reader's own backyard. The author claims in his preface that the text is suitably challenging for first-year graduate students, and I agree: my students were pleased with the use of the second part of the

NEW PUBLICATIONS

BRITISH WEATHER AND THE CLIMATE OF ENLIGHTENMENT

Jan Golinski, 2007, 284 pp., \$35.00, hardbound, University of Chicago Press, ISBN 978-0-226-30205-8

This title reveals how a new sense of the national climate emerged in the eighteenth century from the systematic recording of the weather, and how it was deployed in discussions of the health and welfare of the population. By studying the Enlightenment through the ideas, beliefs, and practices concerning the weather, the book counters the claim that Enlightenment progress set humans against nature, instead revealing that intellectuals of the age drew characteristically modern conclusions about the inextricability of nature and culture.

AN INTRODUCTION TO ATMOSPHERIC THERMODYNAMICS (SECOND EDITION)

Anastasios A. Tsonis, 2007, 187 pp., \$55.00, paperbound, Cambridge University Press, ISBN 978-0-521-69628-9

This book, authored by a highly respected researcher in this field, introduces the reader to the basics of atmospheric thermodynamics. This new edition has been brought completely up to date and reorganized to improve the quality and flow of the material. Each chapter contains worked examples and student exercises appropriate for short undergraduate courses taken as part of an atmospheric science, meteorology, physics, or natural science program.

MIKE LYNCH'S MINNESOTA WEATHERWATCH: A COMPLETE GUIDE FOR WEATHER-OBSSESSED MINNESOTANS

Mike Lynch, 2007, 160 pp., \$25.95, hardbound, Voyageur Press, ISBN 978-0-7603-2863-7

This book is a guide to forecasting in Minnesota. A broadcast meteorologist for over 25 years, the author of this title delves into the mechanics of the atmosphere and scientific forecasting methods, then shows how the observation of plants, sky color, stars, animals, lakes, and other natural phenomena in the state can help one predict the weather. The book also includes Minnesota weather history and lore as well as a state weather almanac. It includes over 100 color photographs.

text for a two-credit graduate-level synoptic meteorology course.

In summary, I highly recommend this textbook. For instructors, this is a great book if they don't have their own class notes—one can teach straight from the book. And for students, this is a great book if they don't take good class notes—one can learn straight

from the book. This is a rare attribute of advanced textbooks.

—BART GEERTS

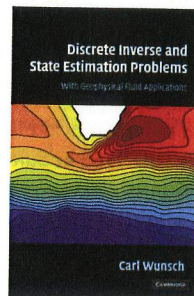
Bart Geerts is an associate professor in the Department of Atmospheric Science at the University of Wyoming.

DISCRETE INVERSE AND STATE ESTIMATION PROBLEMS WITH GEOPHYSICAL FLUID APPLICATIONS

Carl Wunsch, 2006, 371 pp., \$125.00, hardbound, Cambridge University Press, ISBN 0-521-85424-5

The bootstrapping merger of observations and models is at the heart of the scientific method. In this spirit, the geocentric conception of the solar system was superseded by the heliocentric, Newtonian view, for example. The laws of gravitation and mechanics swept away the Ptolemaic notions of epicycles and eccentrics, with Kepler's painstaking analysis of Tycho Brahe's astronomical observations and the subsequent fit to Newton's theory proving decisive. The iterative pattern of data collection, hypothesis refinement, and synthesis of data and hypothesis—either to infer unobserved variables, or to test hypotheses—is perfectly demonstrated by

the Copernican Revolution, but, in truth, it is nearly universal in science.



Traditional undergraduate curricula in physics and applied mathematics tend to emphasize well-posed, linear problems with a single solution that is known to exist without pathological sensitivities. Familiarity with these “forward problems” is essential for aspiring graduate students in physical science. It is insufficient—perhaps even misleading—preparation for typical research problems, however, and certainly does not reflect what happened in the Copernican Revolution. Instead, “inverse problems” are much more common where some, or all, of the

RADIATION AND CLIMATE

I. M. Vardavas and F. W. Taylor, 2007, 492 pp., \$130.00, hardbound, Oxford University Press, ISBN 978-0-19-922747-1

This book describes in detail the basic physics used in radiative transfer codes that are a key part of climate prediction models. The basic principles are extended to the atmospheres of the Earth and the other planets, illustrating the greenhouse effect and other radiation-based phenomena at work. Several chapters deal with the techniques and measurements for monitoring the Earth's radiation budget, and thus tracking global change and its effects. The book is the first to link the theoretical and experimental aspects of atmospheric radiation to the contemporary climate problem.

HURRICANE AUDREY: THE DEADLY STORM OF 1957

Cathy C. Post, 2007, 319 pp., \$24.95, hardbound, Pelican Publishing, ISBN 978-1-58980-458-6

Hurricane Audrey formed deep in the Gulf of Mexico in June of 1957. The first hurricane to be tracked by radar, it took direct aim at the small towns along coastal Louisiana, moving due north for four days. The coastal communities of southwest Louisiana were poised to evacuate, but then something went horribly wrong, resulting in over 500 deaths. After interviewing several families who struggled for survival during the storm, the author of this book is able to provide a firsthand historical account of the days before, during, and after the hurricane.

EYE TO THE SKY: EXPLORING OUR ATMOSPHERE

Steven Businger, 2007, 243 pp., \$42.99, paperbound, Novus Publishing, ISBN 978-0-9787831-1-2

This title gives students of diverse academic backgrounds an opportunity to explore and understand, firsthand, the underlying physical principles of our everyday atmospheric environment through the art of making and interpreting observations. It features a variety of exercises that rely on analysis of provided weather observations. These activities foster understanding of the wide range of observations made about our atmospheric environment, with an emphasis on recognizing patterns and anticipating the future state of the atmosphere.