READINGS

BOOK REVIEWS

AN INTRODUCTION TO ATMOSPHERIC RADIATION (SECOND EDITION)

K. N. Liou, 2002, 583 pp., $79.95, hardbound, Academic Press, ISBN 0-12-451451-0

Whether or not one likes a certain geophysical book largely depends on one's background. The field of radiative transfer and atmospheric radiation, in particular, combines people with a wide range of mathematical skills, from theoretical astrophysicists and nuclear physicists to meteorologists and ecologists. There is always a delicate balance between physical explanations and their mathematical interpretations. This balance is very personal and is based on one's background. I came to the field of atmospheric radiative transfer as a mathematician with little knowledge of atmospheric physics. After being in the field for more than a decade, I still have gaps in my atmospheric science education. Thus I assess a radiative transfer book from two main criteria: how well does it describe the material that is familiar to me (the radiative transfer equation and its numerical solutions), and how well does it help me to fill the gaps in my personal knowledge? So, I present this review from the perspective of a former mathematician working in the field of atmospheric radiation.

After being asked to review the book, my first intention was to compare the new edition with the previous one (Liou 1980). In doing so, one can clearly follow the progress made in the field of atmospheric radiation over the past two decades. If there are few changes (as in fundamental radiative transfer), or no changes at all (as in Maxwell's equations), then the field has not seen much development. To the contrary, the many differences between the two editions illustrate areas of major progress in the field, as is evidenced in thermal infrared radiative transfer and even in the creations of completely new fields like three-dimensional radiative transfer or light scattering by nonspherical particles. Obviously, the major changes happened not in the theory, which is at least half a century old, but in data quality and completely new measurements (mostly due to new satellite data) with higher accuracy and more reliability. The new edition illustrates this progress well.

Let me provide a few examples from the book. Chapter 4, "Thermal Infrared Radiative Transfer," looks like a completely new chapter. In addition to more physical explanations of basic concepts, the section on fundamentals of infrared radiative transfer has been substantially improved and a new correlated k-distribution method for the computation of spectral transmittance in inhomogeneous atmospheres has been added. An example given partly as an exercise clearly explains a numerical procedure for simple calculations. Some numbers have also been updated; for instance, the Earth's albedo is now reported as 30%, as opposed to 31% in the first edition. Reading this chapter also helped me fill in some of my educational gaps in longwave radiation.

Another example is chapter 6, which describes principles of radiative transfer and numerical methods. I am very familiar with this material and was able to compare it with other atmospheric radiative transfer books from previous reading (van de Hulst 1980; Lenoble 1993; Thomas and Stamnes 1999). Personally, I like the manner in which chapter 6 is written. It starts with a brief history of radiative transfer, covers the Discrete Ordinates Method as an exact solution, and only then presents approximations for radiative transfer. This makes sense, since the two- and four-stream approximations can be deduced from the Discrete Ordinates Method. In the atmospheric radiation class I taught last year, I tended to follow a different but more traditional path: start with a single-scattering approximation, go through successive orders of scattering, and then spend a significant amount of time on the two-stream and Eddington's

approximations based on a very thorough discussion in Thomas and Stamnes's book. In general, this chapter complements other radiative transfer books more than it competes with them.

My final example is in chapter 7, "Applications of Radiative Transfer Principle to Remote Sensing." Not surprisingly, this chapter contains more than 80% new material, such as remote sensing of aerosols, land surfaces, cloud optical depth, cloud-top pressure, and particle size. Detailed descriptions of some of these new remote sensing techniques covered in this book are available only in scientific papers. This includes state-of-the-art algorithms currently used in retrievals from the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Multi-angle Imaging Spectroradiometer (MISR) on board NASA's Earth Observing System *Terra* satellite. Data and examples are taken from very recent field campaigns and satellite measurements. Ground-based data are taken from the Department of Energy's Atmospheric Radiation Measurement (ARM) sites, polarization measurements are from POLDER, and data from HIRS, AVHRR, GOES, etc., are also utilized. Overall, I found this chapter a nice composition of old theoretical research papers on atmospheric radiative transfer and new measurements. It can also serve as a very useful addition to a well-established remote sensing book by Stephens (1996) for a class on atmospheric remote sensing.

In addition to the correction of a number of misprints found in the first edition and major changes and updates, there are several small improvements that help to better understand the material. Also, the new edition provides a means by which it is faster and easier to find what you need when the text is used as a handbook. For example, the table of contents now lists chapter subsections, wavelengths are added to the wavenumbers as a double axis, and new, more illustrative figures come with better-edited captions. Even old figures have been improved—they are now more realistic and updated (e.g., a more accurate ratio in the phase function between forward and backward scattering or a new updated sunspot cycle). Some confusing notation has been changed (although not everywhere) and clarified (e.g., cloud optical thickness, upward and downward radiation, etc.). As far I could tell, the book is refreshingly free of errors and misprints; the few I managed to find are of little consequence.

The book is easy to read, though it definitely requires good introductory courses in physics and calculus. What also makes it special is the instructor's manual that accompanies the book and is available for faculty. This manual contains the solutions to all problems (several of which are really challenging) set in each of the eight chapters. Though the book includes an appendix with answers to selected problems, I believe the instructor's manual will be an invaluable re-

NEW PUBLICATIONS

ATMOSPHERE–OCEAN INTERACTIONS. VOLUME 1

W. Perrie, Ed., 2002, 316 pp., $215.00, hardbound, WIT Press, ISBN 1-85312-892-9

Recent intense scientific research devoted to the understanding of atmosphere–ocean interactions resulted from a demand for improvements in operational forecasts for marine storm tracks and storm intensities, and their climatologies. This volume presents a survey of several of the key mechanisms that are important for marine storms and their development. The chapters focus on basic considerations of marine storms in atmosphere–ocean systems, coupled model simulations of marine storms, and longer timescales, including climate change scenarios.

AIR POLLUTION SCIENCE FOR THE 21ST CENTURY

J. Austin, P. Brimblecombe, and W. Sturges, Eds., 2002, 350 pp., $140.00, hardbound, Elsevier Science, ISBN 0-08-044119-X

This book contains a collection of authoritative reviews and essays on the science and application of air pollution research at the start of this century. It covers a wide range of subjects, including indoor air quality, atmospheric aerosol measurements, the origin and health implications of atmospheric particles, the transport sector's influence on air quality, and the relationship between greenhouse gases, aerosols, and surface temperature.

ENCYCLOPEDIA OF GLOBAL CHANGE (2 VOLUME SET)

Andrew S. Goudie, Ed.-in-Chief, 2001, 1440 pp., $275.00, hardbound, Oxford University Press, ISBN 0-19-510825-6

This is a comprehensive, interdisciplinary reference on Earth's physical, chemical, and biological systems—and the interaction between social, political, and economic forces and the physical state of our planet. It brings together over 300 articles about the interconnected elements of change affecting Earth today and reveals the many forces and trends that are acting upon Earth and its people, including Earth systems, human factors, resources, and responses.

source to anyone teaching a course in this topic. Overall, I highly recommend this new edition, not only to students and instructors, but also to any researchers involved in atmospheric radiation.

—Alexander Marshak

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REFERENCES

Lenoble, J., 1993: *Atmospheric Radiative Transfer*. A. Deepak, 532 pp.

Liou, K. N., 1980: *An Introduction to Atmospheric Radiation*. Academic Press, 392 pp.

Stephens, G. L., 1996: *Remote Sensing of the Lower Atmosphere: An Introduction*. Oxford University Press, 523 pp.

Thomas, G. E., and K. Stamnes, 1999: *Radiative Transfer in the Atmosphere and Ocean*. Cambridge University Press, 517 pp.

van de Hulst, H. C., 1980: *Multiple Light Scattering: Tables, Formulas, and Applications*. 2 Vols., Academic Press, 299 pp.

REMOTE SENSING OF ATMOSPHERE AND OCEAN FROM SPACE: MODELS, INSTRUMENTS AND TECHNIQUES

Frank S. Marzano and Guido Visconti, 2002, 256 pp., $85.00, hardbound, Kluwer Academic, ISBN 1-4020-0943-7

This collection of lectures given at the International Summer School in L'Aquila, Italy, provides a broad overview of space-borne remote sensing techniques, at both the microwave and visible-infrared bands, and by both active and passive sensors, for the retrieval of atmospheric and oceanic parameters. Topics discussed include instrument potential and limitations, inversion methods, and assimilation techniques into numerical weather forecast models.

FUNDAMENTALS OF HYDROLOGY

Timothy Davie, 2002, 196 pp., $100.00, hardbound, Routledge, ISBN 0-415-22028-9

This is a comprehensive introduction to how freshwater moves on and around the planet and how humans affect the quantity and quality of water available to them. The three main topics discussed are the processes of the hydrological cycle, an assessment of the important hydrological parameters (such as streamflow and water quality), and management of water resources for maximum environmental benefit.

ENCYCLOPEDIA OF ATMOSPHERIC SCIENCES (SIX VOLUME SET)

James R. Holton, John Pyle, and Judith A. Curry, Eds., 2002, 2780 pp., $1199.00, hardbound, Academic Press, ISBN 0-12-227090-8 (set)

This authoritative resource covers all aspects of atmospheric sciences, including both theory and applications. Nearly 350 articles—from acoustic waves to the World Climate Research Program—and over 1900 figures and photographs are presented, many in full color. It is an ideal resource for academia, government, and industry in the fields of atmospheric, oceanic, and environmental sciences. It is written at a level that allows undergraduate students to understand the material, while providing active researchers with the latest information in the field.