

*An introduction to atmospheric radiation.* By K. N. Liou. Academic Press. Second edition, 2002. pp. xiv + 583. Price \$79.95 (hardback). ISBN 0 12 451451 0.

In recent years global warming and remote sensing have emerged as important topics in atmospheric science. What these topics have in common is atmospheric radiation. The second edition of this book is a timely contribution that can bring students and researchers to the forefront of atmospheric radiation.

The book is divided into eight chapters. The basic physics of molecular absorption and scattering, and solar insolation, are covered in the first three chapters. The standard theory of radiative transfer is treated in chapter 6, with updated material on polarization and radiative transfer in three dimensional inhomogeneous clouds. The author adds a bit of historical background, and that is well appreciated. This approach at least indicates that the modern way of thinking about the physical concepts did not erupt fully formed without some effort, so the reader will understand the basis for the developed theories. The author explicitly provides details of difficult mathematical derivations, sometimes as exercises at the end of each chapter. The technical mathematics, numerical tables and answers to problems are summarized in eight appendices. This makes the book particularly useful for researchers who have not had the benefit of formal training in atmospheric radiation.

At the heart of any book on atmospheric radiation are gaseous absorption and scattering by particulates, subjects that are covered in chapters 4 and 5, respectively, with the author's insights into the correlated- $k$  distribution and scattering by non-spherical particles. There are many illustrations, some based on the author's own pioneering work.

For practical applications of atmospheric radiation, the highlights of the book are the last two chapters. Chapter 7 has nearly 100 pages on the application of radiative transfer to remote sensing. Both passive and active (lidar) remote sensing techniques are discussed. The wide range of topics usefully includes, for example, cloud removal in temperature retrieval. The last chapter, chapter 8, contains nearly 80 pages on the application of radiative transfer to climate. In addition to the usual heating and cooling rates, this chapter includes one-dimensional climate models, greenhouse effects of carbon dioxide and other trace gases, climate effects of aerosols and contrails, and how radiation is incorporated in general-circulation models.

At the end of each chapter is a short list of related books and monographs for further reading. There is one important reference missing from the end of Chapter 7—*Inverse methods for atmospheric sounding: Theory and practice* by C. D. Rodgers (World Scientific Publishing Co., 2000) appeared after Liou's book went to press.

It would be hard for a book of this magnitude to escape criticism. My colleagues and I have a few objections. The statements about line broadening are, strictly speaking, limited to the infrared. The ultraviolet line widths are affected by many other kinds of effects. For example, a pre-dissociation broadening occurs in ultraviolet spectra. To derive the Elsasser model from the Mittag-Leffler theorem is unnecessary. A simpler method uses the Poisson sum formula described in *Atmospheric radiation: Theoretical basis*, by R. M. Goody and Y. L. Yung (Oxford University Press, second edition 1989). The new method provides a natural generalization to the Voigt shape factor. MODTRAN is in the index, but not FASCODE. The line-by-line code is more fundamental than the band-model code. Also, HITRAN is in the index, but not GEISA or the JPL microwave index. These databases are very useful to anyone attempting research in atmospheric radiation.

In summary, Liou's book is broad and rigorous. It covers the topics well from fundamental principles to applications. A student who has mastered the book will be well prepared to start research in atmospheric radiation. A research worker who needs a quick review of the basic physics behind the state-of-the-art radiative codes used in climate models and remote sensing will find this an invaluable reference.

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