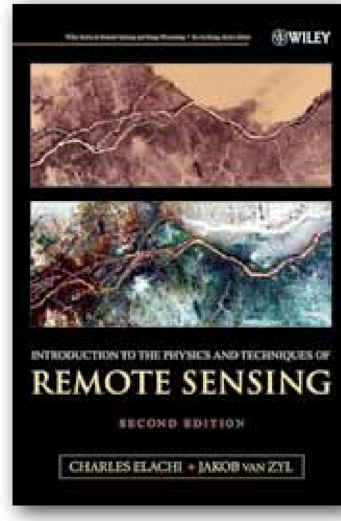
Introduction to the Physics and Techniques of Remote Sensing



By Charles Elachi and Jakob van Zyl, Wiley, 2006, 584 pages, ISBN 0471475696, Hardcover, $145 US

REVIEWED BY HOWARD A. ZEBKER

Introduction to the Physics and Techniques of Remote Sensing is an excellent reference or first-year graduate text on remote sensing. Concentrating on the principles underlying remote sensing and descriptions of many operational remote sensing systems, the text provides the reader with the necessary background to understand and interpret remote-sensing data and is amply illustrated with example image data. The only real weakness in the book is relevant to the present context—not much space is devoted to ocean and ice remote sensing. This limitation is not a weakness for readers looking for a fundamental understanding of the physics of remote sensing in general, but may be of consequence for oceanographers seeking a direct application of these principles to their area of expertise.

Nonetheless, the text presents all of the major physical effects that relate processes of the Earth system to satellite-observable quantities. The early chapters describe the nature of electromagnetic radiation and its interaction with matter. Various regions of the spectrum are discussed, from ultraviolet, visible, and near infrared wavelengths that characterize reflected solar energy, to longer wavelengths in the thermal infrared portion of the spectrum dominated by Earth's emission, to microwave wavelengths sensitive to surface structure. Short sections for parts of the spectrum outside of these regions are included for completeness, but as these are not so often used in remote-sensing studies, they are appropriately terse.

Descriptions of the observable phenomena include most of the basic equations needed to quantify the measurements and relate them to the physical properties of the area under study, although the depth of explanation varies from section to section. Many times the equations are simply stated, without a lengthy derivation and occasionally without reference. This terseness can be a little frustrating for the reader interested in fully understanding the phenomenon. In other instances, more information than is required is presented. For example, when describing blackbody radiation, the authors go into a fair amount of detail on equipartition of energy and the derivation of Planck's equation, while the jump from Maxwell's equations to detailed properties of wave observables such as polarization and Doppler shifts is abrupt for a reader starting out in E&M. Yet, for the most part, the authors strike an appropriate balance for those interested in how to use remote sensing to learn about the Earth and planets.

The text is well organized and systematic in the treatment of various remote-sensing methods, progressing through the spectrum from short to long in discussions of solid surface remote sensing over a series of four chapters. When each chapter requires additional background material, it is included so that many chapters can stand alone with few references to the theory presented earlier. This is a useful approach for working scientists using the book as a reference, but perhaps less helpful for students looking to grasp the full field. A similar multi-chapter development is used for atmospheric remote sensing, starting with radiative transfer theory and then addressing sensing systems and methods from long to short wavelengths. It is a bit confusing as to why material is organized in order of increasing wavelength for solid surfaces and decreasing wavelength for the atmosphere, but each section taken on its own is logically presented.

Of the book's 12 chapters and four appendices, only one chapter is expressly related to ocean remote sensing. For any audience other than the present, this would not be a significant issue. Because so much remote-sensing activity was developed for oceanographic applications, and because the ocean community remains one of the largest users of remote-sensing data, the scant attention here to the 75 percent of the Earth covered by water is perhaps surprising. Yet, the principles so well described for solid Earth and atmospheric applications apply to the ocean as well, and readers willing to spend the extra time can benefit from the material as presented. Unfortunately, important methods for ocean study, such as sonar and satellite bathymetry systems, are not discussed, and the methods that are presented are illustrated with land and air applications rather than those for ocean science. What is missing for the present audience is a discussion of the special issues related to sensing the ocean surface and depths, including a review of the major needed observables. Readers needing to put remote sensing within the oceanographic context immediately might look for a review more centered on their specific set of problems.

One of the major strengths of the book is the plethora of example data and systems used to collect remote-sensing observations of the Earth and of other planetary bodies. While this tends to date the book and requires updates—the current text is a second edition of a text published in 1987—the descriptions are a valuable reference for historical data sets and give a sense of the progress made in the field since remote sensing first became widely used 40 years ago. Again, most of the examples are for land remote sensing and arguably many major applications of significance have been over the ocean and atmosphere.

Production values in this text are somewhat mixed. There is a nice set of color plates inserted in one section that shows off the acquired images well. It is of course difficult to quantify, but the visual appeal of remote sensing data is one of its real strengths. Examination of a color scene more often than not suggests analysis methods that might be hard to discern by staring at mathematical equations on a page. The rest of the text contains many figures that likely for cost reasons are reproduced in black and white, severely limiting their instructional value and making it more difficult to appreciate their value. But in these days of $200 textbooks, the authors have made a reasonable decision as to how much material to include in color.

In summary, this book is an excellent reference work and could easily be the primary textbook for a graduate course in remote sensing. All of the fundamental physics is here, along with a bit of chemistry. Mathematical relations coupling the physical processes to remote-sensing observables are given, even if not always fully described, and explain why existing systems are designed as they are. The full range of topics covered is beyond the needs of any specific discipline, yet the material is all relevant and very handy to have all in one place. Yet, the text gives rather scant attention to the ocean, so it may not be the first choice for ocean scientists looking to apply remote sensing to their work. Too many practical details of ocean remote sensing are omitted for this book to serve as the primary oceanographic reference. For professionals in the field and for students, where a thorough understanding of the physics and math underlying the acquisition and analysis of remote sensing data is required, this book satisfies the need well.

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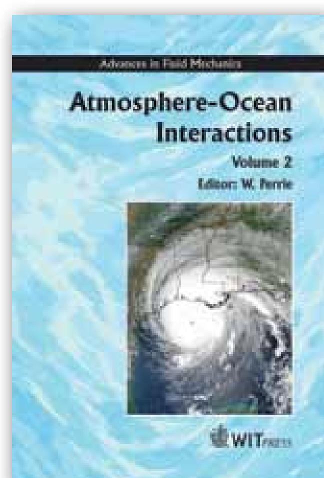
Atmosphere-Ocean Interactions (Vol. 2)



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REVIEW BY PETER WADHAMS

This multi-author work is the latest (vol. 39) in an *International Series on Advances in Fluid Mechanics* published by WIT Press, the publishing arm of the Wessex Institute of Technology, near Southampton, UK. The stated objective of the series is to bring advances in the field, made by exceptional researchers, to the attention of the broad international community by means of volumes of invited contributions. Its purpose therefore seems to resemble that of *Annual Review of Fluid Mechanics*, but how does it shape up? First, *Atmosphere-Ocean Interactions (Volume 2)* is much shorter (224 pages compared with 600 or so for ARFM).