Preface

There are already many textbooks on remote sensing, many of them admirable in their own way; so why another? Our prime motivation was our feeling that many of the current texts do not appear adequately to reflect the increasing interest in remote sensing (RS) of vegetation and the rapid development of new tools for such studies. As in many areas of research, a substantial proportion of new work is presented at conferences and in the subsequent volumes of their proceedings. These, however, are not widely available to most students and researchers. Even papers published in the primary literature are dispersed over a number of different journals, and may not be easily digestible, especially at undergraduate level. It is the role of a textbook to distil the available essential information and to put it in context, as well as to direct the reader to further sources of information on the subject.

Although there are many texts that cover the basics of radiation physics, image manipulation and analysis, and also many specialist texts on plant and ecosystem functioning, we felt that it was important to present an integrated approach to bring information relating to remote sensing of vegetation together in one place. Our interpretation of remote sensing for the purposes of this book has been broad, including not only airborne and satellite sensing, but also close-range 'in-field' sensing (sometimes referred to as 'proximal sensing') and even small-scale or laboratory 'remote' sensing as that is widely used for calibration and validation studies. Wherever possible we have treated results and applications at all scales, though for some topics it is more convenient to separate them. Separation is particularly appropriate where measurements at a particular scale have specific properties only available at that scale; for example close-range 'in-field' imaging provides access to within and between leaf variability that can provide specific information (e.g. for extraction of canopy structure from shaded/unshaded areas in an image, Section 8.6.3), while the larger spatial scale of most satellite images has particular value in derivation of spatially averaged quantities for management of large areas of land or for political purposes.

Remote sensing (RS) is not really a specialist subject in its own right, but one that brings together a wide range of disciplines, including physics, maths, and computing as well as the environmental sciences and biology. The aim of this book is to provide a rigorous, yet fairly simple, grounding in the relevant basic physics and plant physiology to allow the reader to choose from and critically assess the plethora of new techniques that are becoming available for the remote study of vegetation (and other surfaces). We have throughout kept the mathematical derivations to a level accessible to most upper undergraduates, emphasizing the meaning rather than the mathematics. This is an approach that we have used in our teaching and that one of us has previously adopted with some success in a previous text (Jones, 1992).

Although our main objective has been to describe the application of remote sensing to the study of plants and vegetation canopies, for completeness, and for the convenience of the reader, we have included both a fairly comprehensive introduction to much of the basic radiation physics, image analysis, and remote sensing technology, and an outline of the physiological basis of key aspects of plant functioning that might be amenable to remote sensing. Even though there are good

introductory texts in each of these fields, an understanding of these aspects is so fundamental to the effective use of remote sensing data for vegetation studies that we have felt it critical to bring it all together into one place. We also strongly believe that in order to be able to obtain the most benefit from a subject, it is essential for the user to have a thorough understanding of the principles involved, rather than to just apply techniques and procedures by rote. With the increasing availability of free satellite data, and indeed the pressures for more data to be made available free to users, there have been concerns expressed (Mather, 2008) that this is likely to lead to the proliferation of unconsidered or indeed erroneous results. Correct interpretation of RS data to provide useful information requires a good understanding of the ways in which these data are obtained and especially of the inherent limitations.

The book is aimed at senior undergraduates and at new postgraduates to help them appreciate the ways in which remote sensing can be used for the study and monitoring of vegetation. Throughout, we have tried to guide the reader to further detailed information that appears in textbooks and published papers that are relevant to that particular aspect, but at the end of each chapter there is a 'further reading' section that suggests suitable texts for particular aspects of that chapter. Some chapters include boxes, in which are collected relevant definitions or explanations so as not to break up the text. There are a number of appendices, listing, for example, the symbols used in the text, abbreviations and acronyms, some current remote sensing systems, etc. Also included, where appropriate, are some questions to help the reader appreciate some of the quantitative material, and their answers.

The first part of the book covers fundamental principles of remote sensing, biological properties and detecting systems. Then follow several chapters that consider how we can extract useful information from the, mainly spectral, remote sensing data. Finally, after considering possible ways in which errors may creep into the interpretation, we look at a few applications in more depth in order to illustrate how the principles we have been discussing may be applied to the study of vegetation properties. Although we include information on a number of current observing systems (e.g. Appendix 3), as the technology is rapidly changing, we have not tried to be exhaustive but rather to give examples of the most common types. Because of the generality of the principles described we hope that the resulting book will be applicable in fields beyond purely vegetation studies.

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