Reviews

Field Methods in Remote Sensing
By Roger M. McCoy
New York: Guildford Press, 2005.
159 pages, Hardbound, ISBN: 1-59385-080-8

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Field Methods in Remote Sensing is a very useful text for those who are new to the process of field data collection in remote sensing. Relatively few remote sensing-related field techniques books exist and this book provides a good first step overview. It discusses the many considerations involved in field work with reflected radiation, including the process of performing field work and the techniques and methodologies available.

The author's primary objective is to enable an individual with a remote sensing background to collect field data necessary for a suite of remote sensing projects. The text is aimed at three broad categories of readers including (1) students with a remote sensing background but limited field skills, (2) professionals with field skills, but needing help in applying those skills to remote sensing projects, and (3) teachers aiming to supplement a remote sensing course with a practical field component.

The author also highlights several additional objectives, including an introduction to basic methods for the measurement of vegetation, soil, water, and snow for different projects, and a useful bibliography for addressing specialized methods.

This text is targeted at a gap present in many remote sensing analyses: namely, the role and importance of field data collection. As the author explains, the details of field data collection process and procedure are often omitted from final product reports and methodology. *Field Methods in Remote Sensing* aims to address this gap by highlighting or surveying a suite of techniques for various scenarios and situations, enabling the reader to understand the different methods available for different field data collection needs. While this is not a *walk you through, step-by-step guide*, it provides an overview of many pertinent topics.

Chapters 1 through 5 focus on procedures and methodologies for use when collecting field data for all materials, while the remainder if the text deals with field techniques for use when considering specific materials.

The many practical considerations involved in performing fieldwork are discussed, and the critical need to outline the various steps of the project; including pre-fieldwork planning and identification of final project objectives, are presented. Potential problem areas and scenarios requiring consideration, such as sampling considerations (representative-ness and sufficiency, heterogeneity versus homogeneity), scaling up, locational error, the use of GPS, and the problems posed by insufficient knowledge regarding the phenomenon being sensed are examined, as is the use and limitations of aerial photos and thematic reference materials, especially with respect to training data. In addition, a discussion of field work type – quantitative vs. observational – with respect to the statement of objectives and goals is presented. Practical considerations, including the need for task lists and checklists of supplies and equipment, are not forgotten, either. A fieldwork project objective example, including initial project definition, and considerations for the collection of pre- and post-overflight data, is also included.

Selection of an appropriate sampling strategy is addressed through a discussion of considerations regarding the appropriateness of various strategies for different situations, highlighting both strengths and potential limitations that may be encountered. The various sampling strategies that are explained and diagramed include: simple random, stratified random, systematic, systematic unaligned, clustered, and purposive or judgmental sampling. A discussion of the number of training sites to select with respect to accuracy assessment and variability of surface under study is also presented.

The role of GPS is covered, including a brief history of GPS as well as the mechanics of GPS-ing: satellite constellation factors, single point vs. differential collection, and a discussion of error sources. Pre-field work GPS topics include map considerations and coordinate systems, the use of collection planning procedures, and calibration with known targets such as benchmarks. *In the field* topics covered include error source assessment, initialization of the unit, calibration with known targets, and other practical considerations.

The GPS chapter is, however, somewhat limited and this should be considered by the reader. For example, under the discussion of differential correction there is no mention of real-time vs. post-processing differential correction. In addition, neither the use of multi-point collection to increase locational accuracy, or the importance of using collection planning software as a way of increasing time-efficiency in the field get the attention

they deserve. There is also only limited reference to the use of external antennas to lift a receiver up through the canopy as a way of addressing signal problems, while the process of initializing a unit in an open area before entering an obstructed area is not even mentioned. Finally, a discussion of the European Galileo constellation and achievable accuracy from this new reference system could be useful to the reader in the near future.

The chapter covering field spectrometry, by contrast, is particularly useful. A theoretical background on electromagnetic radiation principles is provided, and a step by step guide to the collection of field spectra is included. It is supplemented with a discussion of the assumptions involved in performing field spectrometry.

The various field techniques and considerations for specific phenomenon – primarily vegetation, soil, water, snow – are discussed in several chapters. The discussion of vegetation-related field techniques includes an overview of the spectral response of vegetation at different portions of the electromagnetic spectrum as well as the primary drivers of these responses. Attention is drawn to the need to focus on plant characteristics that are both measurable and that drive spectral responses, as well as to the most appropriate techniques and considerations regarding timing of vegetation cycles and the collection of field data. A discussion of various collection methods – line transect and pace methods, the use of quadrants, and collection for weight/volume analyses – is also presented.

The topic of soil field techniques includes an overview of the spectral response of soil at different portions of the electromagnetic spectrum and with different moisture and mineral contents. Also highlighted are the various soil properties that can be measured (color, texture, roughness, moisture content) as well as a summary of the techniques. The process of transforming soil field data into a map is addressed, as are considerations regarding the selection of soil sample sites.

One shortcoming is that while the text provides a useful and informative explanation of soil properties (texture, moisture, organic matter) particularly with respect to image interpretation, it does not consider the soil parameters such as soil color and texture from a sensor perspective or in a spatial context.

The use of field techniques for analyzing water is covered in the text, and includes an overview of the reflective properties of water in different states and with different turbidities, dissolved particles, algae, sediments etc. Techniques and methodologies discussed include those for analyzing water transparency, sediment composition, and water body depth.

When considering field techniques for measuring snow, consultation of additional source material would be advised as there is limited coverage in this book. While spectral properties and characteristics as well as the measurement methods available for assessing depth, areal extent, and water equivalence for snow are discussed, a comparison of the spectral characteristics of snow compared to cloud would be particularly helpful (perhaps with a graph highlighting these characteristics). Furthermore, a clarification regarding specific snow characteristics that can be differentiated by a sensor would also be useful. Is it, for example, possible to differentiate *old snow granular fine-grained* from *old snow granular coarse-grained* using a satellite-based sensor?

Finally, the unique situations encountered when mapping and monitoring urban environments are given a (somewhat limited) discussion. Specifically, the combination of multiple surface phenomena – vegetation, soil, water, bare, impervious – encountered in the urban context are addressed and the techniques available for use when producing land use maps, performing socioeconomic analyses, and performing urban hydrology assessments are highlighted. A great addition to this chapter would be a figure incorporating the spectral response of high density residential, low density residential, industrial/commercial land use. The sampling component of this chapter could, as well, be expanded with a discussion of the use of spatial enhancement techniques in mapping urban environments.

Conclusion

As mentioned above; *Field Methods in Remote Sensing* is a very useful text and it provides a good first step overview. However, the text might more appropriately have been titled: 'Field Method Considerations'. Several of the chapters leave the reader with the understanding that in order to collect worthy field data, additional sources will need to be consulted. Unfortunately, many of the sources (both citations and data sources) used throughout the book appear outdated. Online data servers are one rapidly evolving source of data that should be included in this text. For example, according to the author, ordering of TM data is accomplished by contacting EOSAT when, in fact, many online servers such as GLCF, TRFIC, EOS-WEBSTER, GLOVIS, and EarthExplorer now exist, all offering these data.

While this book may not go into great depth on the various topics covered, it does provide an extensive bibliography allowing the reader to further delve into the subject. A suite of useful field sheets are also included at the back of the book that can be used in various field collection scenarios.

Field Methods in Remote Sensing definitely addresses many of the issues and considerations that will be

encountered during the process of field data collection. It is an easily readable book and explains the many concepts in a concise manner. This is not, however, a recipe book: it cannot be taken into the field and a plan directly executed from it. This is a good quick reference guide but not an all-encompassing text.

Remote Sensing for GIS Managers
Edited by Stan Aronoff
Redlands, California: ESRI Press, 2005.
xiv, 487 pp., 505 figures, 33 tables, footnotes, bibliographies, index
$69.95. Hardbound
ISBN 1-58948-081-3

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Upon seeing the title of this book and noting its editor, this reviewer, as a GIS manager with a background in remote sensing, knew that this tome would likely be worth reviewing. The field of GIS management has had Stan Aronoff at its helm since his publication of *Geographic Information Systems: A Management Perspective* in 1989. In his introductory chapter, he sets out the following plan for the book: "*Remote Sensing for GIS Managers* provides an introduction to remote sensing history, technology, and applications tailored to the needs of GIS managers and practitioners" and "introduces remote sensing with the goal of promoting its use in the production of useful geospatial information" (p. 7). This review will analyze how well he met those basic goals.

The book is divided into 13 chapters with three appendices, and while 15 authors contribute to the work, much of the book has Aronoff's signature. He is the single author of seven of the first nine chapters, plus two of the appendices; he co-authors two additional chapters and is one of the twelve contributors to the applications chapter. Except for the introductory and concluding chapters, all chapters have separate bibliographies and most have internet addresses for further information. As the editor, Aronoff has done a decent job of cross-referencing topics between his and others' chapters.

Chapters two and three deal with remote sensing history and basics, respectively. Aronoff expresses the valid concern that many "GIS users are often unaware that much of the data they use is generated using remote sensing technology or that much more information can be obtained from these sources" (p. 9). Fortunately, he addresses these concerns here and throughout the following chapters. In discussing the background of remote sensing, he doesn't bother to 'reinvent the wheel' regarding illustrative figures, but, instead, borrows extensively from authors of remote sensing college textbooks. He seems especially indebted to editions of Lillesand and Kieffer's classic work, *Remote Sensing and Image Interpretation* (2nd and 4th eds.).

The fourth and fifth chapters cover remote sensing image characteristics. Aronoff notes the confusion between ground sample distance (GSD) for digital imagery versus ground resolving distance (GRD) for aerial photography, and how GSD changes with resampling while GRD changes with enlargement or reduction of the photos. Within chapter four, he covers the four concepts of resolution: spatial, spectral, radiometric and temporal. A discussion of costs important to managers includes costs per unit area, for mosaicking, and for attaining visual thresholds necessary for mapping at various scales. He also relates the importance of positional accuracy to national map accuracy standards.

Chapter five, by Aronoff and Petrie, points out the importance of orthorectified imagery in a GIS environment. Here, they delve into the characteristic differences of digital versus film frame camera sensors while discussing different camera formats and stereo aerial photography. They outline the usefulness of aerial videography as well.

Line scanners are discussed in chapter six, with Aronoff outlining the differences between whisk-broom (across path) versus push-broom (along path) scanners and between multispectral versus hyperspectral scanners. This review is followed, in chapter seven, by an overview of current and historic, low to high resolution, satellite-based scanners with descriptions of each and of their data products. Aronoff finishes this chapter with a section, of import to managers, on the suitability for use of, and future of, high resolution imagery.

Chapters eight and nine cover the active sensors: radar, lidar and sonar. Aronoff and Petrie provide the principles of radar, including polarimetry, interferometry, penetration capabilities, elevation generation/accuracy assessments, and seafloor mapping from radar altimetry. They also point out the differences between imaging and non-imaging radar, and between real and synthetic aperture radar. The characteristics of lidar operations, sensors, imagery, and applications are described and followed with a discussion of sonar principles encompassing side-scan, acoustic lens, single beam, and multi-beam imaging systems as applied to bathymetric mapping.

At this point in the book, a problem with organization appears. Appendix A, by Petrie, which deals with rectification and geo-referencing of optical imagery, is found at the end of the book but might seem instead to fit better as a chapter here in the main text. This