is in this chapter where he discusses the concept of visualization and explains GIS organization, infrastructure, and principles.

Chapter 2, "What Does GIS Do?" briefly describes a GIS's functions: location, measurement, attribute definition, patterns and relationships, and trends. Davis provides a definition of modeling and shows how GIS is useful in this regard.

Chapter 3, "Spatial Data," discusses databases, attributes, and their manipulations. Terms such as data, information, attributes, and spatial data are defined here. Davis also describes a typical spatial database and its uses.

Chapter 4, "Raster and Vector Data," explains these two data structures, conversions between them, and their respective advantages and disadvantages. The discussion considers maps as both input and output for spatial data and display.

Chapter 5, "Topology," explains the concept of topology and its usefulness in manipulation of data containing spatial relations.

Chapter 6, "Data Entry," describes data acquisition. Several pages are devoted to remote sensing, and there is one section on digitizing and another one on database construction. Georeferencing is defined in terms of coordinate systems and map projections. Davis also presents a brief section on Global Positioning Systems and their use in data capture.

Chapter 7, "Inventory Operations," discusses extraction of basic data and information from databases, including Boolean queries, and simple coverage editing operations. Here Davis discusses measurement applications, coverage modification, dissolving, and recoding.

Chapter 8, "Basic Analysis," moves on to overlay analysis, graphic manipulation, and buffer zones. Recoding is more fully explained and used. Overlay analysis is discussed in detail, as are map algebra and matrix operations.

Chapter 9, "Advanced Analysis," discusses proximity analysis, clustering, terrain analysis, routing, and various graphic operations. This chapter starts to tie together all the previous concepts and to synthesize them for use in concrete problems, such as routing and terrain analysis.

Chapter 10, "Site Suitability and Models," applies the concepts presented in the previous chapters to a typical GIS problem: where to locate something. Here, types of GIS models, such as time-series, environmental, statistical, sensitivity, and other models are discussed.

The concluding chapter, Chapter 11, "Data Issues and Problems," addresses the fact that, without accurate data in the first place, the resulting GIS analysis is worthless. A brief glossary and an index make up the final pages of the book.

This book's strengths are its simplicity and its independence of particular GIS software. The author does an excellent job in addressing the needs of his intended audience. He explains the concepts in such a way that computers are not even needed to understand what a GIS does. This book could be used to teach a class in which all the exercises are done on paper, where students do not have access to a 'real' GIS; yet they would still gain a strong understanding of what a GIS does and how it works. This book could also be useful for schools with GIS programs, since good basic definitions of GIS concepts and methods of analysis are always welcome. In a more technologically sophisticated setting, the book should be supplemented with material applicable to the specific computer environment.

While simplicity is one of the book's strengths, it is also one of its weaknesses. In its goal for simplicity some terms lack adequate definitions. For example, the 'G' of GIS is finally linked to 'geography' on page 21, long after GIS, the acronym, has been expected to be understood. 'WYSIWIG' is referred to but is never defined, making it more difficult to understand its impact by not understanding the acronym. There is some confusion as to whether the word "data" is singular or plural. "Data is" and "data are" are used interchangeably, although Davis does address this in Chapter 3 by writing, "Technically we say 'datum is' and 'data are,' although data is commonly used as both the singular and plural form(page 59)." We do seem to be moving in the direction of "data is" and, for folks for whom English is a second language, I would think that Davis would have chosen one use and followed through with it.

These latter points, however, are minor. This book is useful to anyone interested in the basic concepts of GIS, whether a student in a GIS class or someone who is expected to quickly develop an understanding of new technology. In most university GIS lab settings, this is a good supplement to specific software manuals. For programs just starting to teach GIS, this is a good beginning text.

Raster Imagery in Geographic Information Systems.
Stan Morain and Shirley Lopez Baros, Editors. Santa Fe, New Mexico: OnWord Press, 1996. 536 pages, bw and color maps and illustrations, list of contributors, contact points, and subject index. $59.95, paper (ISBN 1-56690-097-2).

Reviewed by:
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In this book, over one hundred academics and professionals (primarily in the field of remote sensing) have come together to produce a volume illustrative of the potential for fruitful interaction between raster imagery and vector Geographic Information Systems (GIS). To justify their efforts, the editors of this book cite the increased availability and use of raster imagery in GIS problem solving and the lack of training of many GIS developers in the spectral properties of raster data. Specific goals for the book are to illustrate that "(1) raster data, especially multispectral data, have found numerous uses in vector-based GIS; (2) these raster data contain unique information about the landscapes they portray; (3) the information content can be updated frequently and economically; and (4) the hardware, software, and modeling techniques for raster data are already available for use by the GIS community (p. xviii)." With few qualifications, the editors and authors of *Raster Imagery in Geographic Information Systems* have achieved the stated objectives.

To achieve the above stated goals, the editors have organized the book into two major sections. The first section, comprised of Chapters 1-4, is a primer on the basic concepts of raster imagery. The main topics are "Image Formation and Raster Characteristics," "Image Display and Processing for GIS," "Using Scanned Aerial Photographs," and "Data Collection Systems, Formats, and Products." The editors have assumed that the readers of this book will have a minimal background in remote sensing. Therefore, the primary goal of the first four chapters is to provide the reader with a basic vocabulary and understanding of remote sensing and raster imagery concepts so that the reader can better appreciate the application of raster imagery in GIS as presented in the remainder of the book. The second section of the book, comprised of Chapters 5-9, offers a wide array of case studies in which raster imagery is presented as a central component in GIS applications. The case studies are organized as follows: Chapter 5, "Modeling Techniques," Chapter 6, "Water, Crops and Weather," Chapter 7, "Land Use and Planning," Chapter 8, "Environment and Mineral Exploration," and Chapter 9, "Forest Management." To supplement the two main sections of the volume, the book also includes the following: a 16-leaf insert with 76 color, glossy maps and illustrations; an appendix listing all 118 contributors and their affiliations; an appendix of contact points listing complete addresses for 56 of the contributors; and a detailed subject index.

In Chapter 1, "Image Formation and Raster Characteristics," Morain, Estes, Foresman, and Separr attempt to provide "a tutorial on (1) how raster data from images are created; (2) raster data property description and identification, and (3) the primary sensors and satellite systems currently being employed (p. 3)." To this end, the authors provide a very brief history of remote sensing, some basic definitions concerning data and information as viewed within the arena of information processing, and a short overview of the basic characteristics of the electromagnetic spectrum. After explaining the difference between active and passive remote sensing systems, the reader is presented with descriptions of a variety of common passive systems (electromechanical scanners, push-broom scanners, electromechanical imaging spectrometers, and solid-state imaging spectrometers). The remainder of the chapter deals with the formation and resolution characteristics of rasters.

Chapter 2, "Image Display and Processing for GIS" (written by Baros, Neville, and Messina) and Chapter 3, "Using Scanned Aerial Photographs" (by Welch and Jordan), provide very cursory explanations of the processing and preprocessing methods used in transforming digital and analog data into raster images suitable for analysis within a GIS. In both of these chapters, the authors acknowledge that a complete explanation of image processing is not possible in these brief chapters, and they suggest several sources to which the reader should turn for a more thorough treatment of the subject.

Of the first four chapters, Chapter 4, "Data Collection Systems, Formats, and Products" (by Budge and Morain), may be the most useful to the intended audience. This chapter presents, in a very straight-forward and readable manner, an outline of the primary satellite systems "currently providing operational raster data to GIS developers and modelers (p. 72)." For example, the authors provide the following information for the *Satellite Pour l'Observation de la Terre* (SPOT) system: program objectives; system characteristics (including launch dates, orbital information, and temporal resolution); sensor information (including date of operation, detectors, swath, spatial resolution, and radiometric resolution); and World Wide Web and postal addresses for information concerning commercial data available from the program. Similar information is provided for Landsat, Television and Infrared Observation Satellite (TIROS),

European Resource Satellite (ERS-1), Indian Remote Sensing Satellite (IRS), and RADARSAT. The chapter concludes by describing, in detail, specific products that are available from the various organizations operating the above-mentioned satellite systems. Of course, what makes this chapter so useful is the basic understanding of remote sensing systems that the reader obtained in Chapter 1.

The remaining five chapters consist of 53 case studies. Chapter 5, "Modeling Techniques," begins with seven case studies grouped under the subheading "Economic Applications." The cases presented include studies on franchise location, calculating least-cost paths for the siting of an oil pipeline, determining tourism potential, and monitoring timber holdings for tax purposes. One innovative study (by Jensen, Huang, Graves, and Hanning) looked at the use of digitized aerial photography in the creation of accurate, large-scale digital elevation models (DEMs). The goal of this study was to develop a method for improving intervisibility analysis within urban areas. Another study (by Byrne) incorporated raster imagery into fly-throughs with the intention of allowing the viewer to visualize the impact of a highway bypass in Australia. The remaining seven cases presented in Chapter 5 come under the subheading of "Diverse Modeling Scenarios." This sub-section seems to be a catch-all for those studies that didn't fit in any other chapter. Included in this sub-section are studies showing the benefits of raster imagery when updating vector land use files, modeling vegetation distribution, and building attribute tables for raster GIS files. Two of the studies in this sub-section are clearly cartographic in nature. These studies seek to illustrate the use of raster imagery in the creation of shaded relief images with vector overlays to produce more effective map displays.

While several of the studies in Chapter 5 represent fairly cutting-edge techniques in the use of raster imagery in GIS analysis, the majority of the studies in Chapters 6, 7, 8 and 9 consist of fairly straight-forward uses of remote sensing and GIS. The techniques presented in these chapters should be familiar to anyone with a basic understanding of remote sensing or raster imagery. These case studies, however, do represent a broad range of projects, which is entirely in keeping with the stated goals of this book. That is, these studies serve to expose the reader to a wide array of geographic problems to which raster imagery and GIS can be applied.

Chapter 6, "Water, Crops, and Weather," consists of three sub-sections. Presented under the subheading "Hydrology" are case studies on the creation and maintenance of wetlands inventories, managing water resources, mapping glaciers, and monitoring irrigated water use. In the "Agriculture" sub-section, cases are presented on the use of raster imagery and remote sensing data for the monitoring of agricultural land cover, drought patterns, irrigation water use in a desert environment, and changes in irrigated land. In the final sub-section of Chapter 6, "Meteorology," raster imagery is incorporated in GIS to monitor and analyze lightning, climate data for winter road maintenance, and global atmospheric conditions.

"Land Use and Planning," Chapter 7, begins with five case studies in the area of "Landscape Analysis." In this sub-section, raster images are utilized to monitor and map land use change, to map variations of wilderness in England, to define topographic regions in Italy, and to accurately map vegetation and land use patterns in remote areas of Chile. In "Land Use/Land Cover," the reader is presented with a detailed description of procedures for carrying out a change detection study. In addition, raster imagery is used in the updating of vector land use inventories in San Diego,California; the automation of vegetation and land use mapping in the Tijuana River Watershed; and the development of a land use/land cover map for the State of Kansas. In "Urban and Regional Planning," two studies illustrate the use of raster imagery to measure and map urban growth in Katmandu and Beirut. A third study addresses the topics of inventorying and evaluating natural resources in Tamaulipas, Mexico with the goal of developing an effective regional economic plan.

In Chapter 8, "Environmental and Mineral Exploration," and Chapter 9, "Forest Management," the editors state that "case studies are presented that illustrate the growing number of ways that raster and vector data are used to approach environmental and resource exploration issues (p. 365)." Issues addressed in these two chapters include monitoring mining operations, measuring and inventorying wetlands, managing forest reserves, modeling fire behavior, and mapping biodiversity.

In the first chapter, the authors note that GIS and remote sensing "are linked at the most fundamental levels of measurement, mapping, monitoring, modeling, and management (p. 3)." Clearly, the intended purpose of much of this book is to demonstrate the linkage between GIS and remote sensing and to promote the use of raster imagery by GIS developers. Toward these goals, the editors and authors have succeeded admirably. The extensive range of applications presented in the case study chapters are sure to stimu-

late ideas for new projects that will incorporate raster imagery and vector GIS. In the introduction, the editors also state that "if the book serves no other purpose than to put would-be GIS developers and users into contact with those who have contributed, at least one aim of the book will have been achieved (p. xix)." It is also highly likely that this goal will be achieved. Achieving the goal, however, is not necessarily a compliment to the book. While the book presents a large array of studies, each case study is given only approximately 3.5 pages, and there is no bibliography anywhere in the book. The brevity of the reports and the lack of references are likely to leave many readers very interested in the potential applications, but unsure as to how to proceed. Therefore, the contributors may indeed receive many calls. The intended audience may have been better served with fewer studies that would have gone into greater detail.

This book represents an interesting contribution to the fields of remote sensing and GIS, particularly the latter. It is very nicely produced and reasonably priced. The color plates are especially attractive and useful. The organization is clear and the goals of the volume are straight-forward and well defined. It seems clear that this volume is intended for people with a GIS background but little experience with raster imagery. Given the technical jargon used and the brevity of the case studies, the reader will need to have at least a beginning background in GIS. The book will probably find an audience among professional GIS developers. The book could undoubtedly be used in an advanced undergraduate course in applied GIS; however, it is doubtful that this book could be the sole text for an applied GIS course. Given its reasonable cost, it could be used to supplement such a course. This reviewer recommends this book, given the understanding that it is written and intended for a fairly specific audience.

The Mapping of New Spain: Indigenous Cartography and the Maps of the *Relaciones Geograficas*. Barbara E. Mundy. Chicago: University of Chicago Press, 1996. 281 pages, illustrated. Hardbound, $39.95. (ISBN 0-226-55096-6)

Reviewed by:
Raymond Craib and D. Graham Burnett
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Wallace Stevens begins each of the five stanzas of his mesmeric poem "Sea Surface Full of Clouds" with the same line: "In that November off Tehuantepec..." What follows each time is a rich evocation of the Pacific Coast of Mexico. But while each stanza describes precisely the same view of the coast before the town, the same clouds, the same sea, no two stanzas are alike; each view of Tehuantepec is unique, each view defies the pretense of the others to have shown Tehuantepec itself.

The late sixteenth century *Nahua* painter from Tehuantepec who was given the task of painting a map of his native town to be sent back to crown geographers in the Alcazar of Madrid might well have understood the poet's frustration. What Tehuantepec should he depict? Using what symbolic system? Trained in the elaborate graphic tradition of his indigenous forebears, the Tehuantepec painter could paint the elaborate pictograms of Nahuatl, with their toponymic meanings and associated spiritual traditions. He likely knew enough of the pre-Hispanic mapping traditions that he could use the iconography of clan and lineage to depict the human geography of his community in a spatial framework that was intimately linked to local topography. At the same time, the Tehuantepec artist had a mission education and was conversant, if not literate, in Spanish. He may well have helped paint devotional images for the friars, and he had certainly picked up a fair bit of Spanish pictorial conventions.

Not to mention spatial conventions. The Tehuantepec painter watched the tail end of a spatial revolution in his land; by the late 1580s, when he was at his artistic prime, more than 90% of the total surface area of his region had been ceded to the Spaniards. The rate had accelerated dramatically over the century. A livestock economy had transformed land use and tenure systems, displacing indigenous agriculture, and the booming market was real estate. All this he would have known well, because the Tehuantepec painter who was chosen to make the map that would become Tehuantepec's response to a geographical questionnaire sent out by Phillip II, hungry for knowledge of his 'New World,' was by trade a painter of cadastral plots, the 'base maps' on which colonial scribes would write in the names of the new Spanish landlords.

The Tehuantepec painter, the creator of the fabulously seductive and syncretistic depiction of Tehuantepec in the *Relaciones Geographicas*, is anonymous. But thanks to Barbara Mundy's recent Nebenzahl prize-winning book, *The Mapping of New Spain*, he (or she) is no longer a total enigma. Nor is the map he made. The cultural, political, and artistic context in which the painters of Tehuantepec, Xalapa, and more than fifty other regions in the Spanish dominion worked are the subject of this book, which takes on a set of rich and difficult texts and succeeds admirably in evok-