Book Reviews

Manual of Geographic Information Systems

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The Manual of Geographic Information Systems is the latest addition to the collection of ASPRS manuals and is specifically designed to be a resource on geographical information systems (GIS) for students, researchers, and practitioners. The volume editor, Marguerite Madden, has organized 62 chapters into eight sections, contributed by international experts representing a variety of disciplines. A team of eight ASPRS student and associate members were given the task of reviewing the Manual from the student perspective. This review is intended to help our peers get a broad overview of each section, before dedicating time for intensive reading and exploration. The rest of the review is structured as follows: A paragraph is dedicated for each section followed by a description of the DVD that comes with this Manual. Each section paragraph has an introduction, followed by comments about each chapter then a brief conclusion. While each section paragraph does not provide every detail about individual chapters, the focus was to provide salient topics only. The final paragraph provides an overall summary of the Manual.

Section 1, comprised of five chapters, is an introduction to the history, current status, and future of GIS. The common thread that ties all of these chapters together is their emphasis on the importance of the use and development of different GIS technologies. The first chapter describes what may be necessary of GIS students and professionals in the coming years to promote geographic knowledge in the global community. This is a nice way to start the book since it gives GIS students a perspective on how their subject of choice is becoming important in everyday life. The last chapter in this section is a quick reflection on the beginnings of GIS from the viewpoint of GIS pioneer Maury Nyquist. Chapters 2, 3, and 4 do an excellent job of addressing general GIS and Geographic Information Science (GIScience) terminology and can be used as a reference for both the new and the old GIS student. One particularly useful section in the second chapter is the review of the advantages and disadvantages of vector and raster datasets. Another helpful section is the discussion of GIS user communities and how GIS technologies are shared in these communities (i.e. through higher education or software training groups). The discussion of GIS education is continued in Chapter 4. Chapter 4 clearly lists and describes the many ways in which anyone can further their knowledge of the many facets of GIS technologies as well as a number of careers and opportunities to find data in the GIS field.

The second section, comprising of seven chapters, is an assemblage of several different specific study areas, primarily pertaining to how humans conceptualize spatial data. There are many different levels of understanding necessary for each of the different chapters; however, there should be something for everyone in this section. Chapter 6 gives the reader some rules and suggestions regarding representing spatial objects in a GIS. This section is useful for those needing specific help on how to represent or organize spatial data, and it may also warrant a quick skim by those who need a reminder of the rules involved in defining spatial data. Chapter 7 should be attractive to students who study qualitative spatial reasoning, or how people respond to different spatial concepts. Chapter 8 reviews different types, characteristics, and usefulness of coordinate systems and map projections typically used in GIS. This chapter is easily understandable and covers important, and sometimes tricky, subjects. The figures of each map projection, including distortion circles, are instrumental in the understanding of this chapter. Chapter 9 lists the many global databases (see Table 9-2) that have been created over many years of mapping. It is also interesting to note the challenges that come along with trying to create a global database. These considerations are especially important for GIS students and young professionals as they enter the workforce as employees who may be dealing with trying to create/maintain a global database and need to gather information from many different sources. Chapter 10 emphasizes the importance of writing, keeping, and organizing metadata used in a GIS. The writing style of the chapter is slightly distracting, as it reads like informal instructions for managers, but the appendix of this chapter has a number of useful links to different metadata tools and information that any GIS user or manager can readily use. Chapter 11 discusses geo-ontologies, which is basically the vocabulary or descriptors used in reference to different spatial relations. The discussion of geo-ontologies may be a new topic for many GIS users and therefore serves as a way of introducing this topic to the user community. The last chapter in section 2 (chapter 12) deals with integrating parcel data into different GISs. This chapter would be helpful to those in urban planning or other land management positions, since it goes into detail on different aspects of parcels as well as different cadastral systems.

Section 3, comprising of six chapters, deals with ways to assess the quality of data. It serves as a useful reference by providing an account of what must be considered before using or distributing data. A systematic approach in their explanations makes this section useful, not just for the GIS professional, but also for the GIS novice. Chapter 13 and 14 describe the many variables when considering the uncertainty and error involved in GIS data. An error budget analysis is outlined which is a step-by-step approach used to weigh the effects of various forms of uncertainty and error. Chapter 15 provides information about the sources of uncertainty including some major issues that continued on page 1264
result from the aggregation of categorical data from various sources. Chapter 16 presents the elliptical method to estimate error. Chapters 17 and 18 detail acceptable standards of sharing geographical data as well as free, open source, software packages available to produce a detailed analysis of data. It can be used more as a starting point for a GIS user who is not familiar with open source options. Overall, the section provides clear explanation of the details that need to be considered when dealing with the creation and usage of spatial data.

Section 4, comprised of seven chapters, covers theoretical and practical considerations in spatio-temporal aspects of GIS. Chapter 19 provides concise historical information on the use of time in geography as well as spatio-temporal modeling. Chapter 20 focuses on the revisions and updates in the geographic systems from a managerial perspective. This chapter includes a detailed history of the developments in the ordnance survey of Great Britain. The study demonstrates why updating and maintaining mapping systems and databases are crucial and demanding due to its social, political, and economical implications. Chapter 21 presents the complexities in managing large datasets and challenges that national and international agencies face with regards to updating and maintaining their geographical information systems. Chapter 22 provides a picture of 60 years of change in the tall grass prairie and eastern deciduous forest. An object-oriented approach is followed to obtain a forest/non-forest classification while a detailed accuracy assessment shows the power of this approach. Static and animated visualizations of the results successfully demonstrate why a spatio-temporal analysis of geographic data shouldn’t merely report statistical results. Chapter 23 discusses various visualization tools available for spatio-temporal changes using computer animation. Chapter 24 employs a suite of geospatial technologies to understand how Schistosomiasis (a parasitic disease) spreads among humans. The integration of the spatial component with the temporal dynamics of research simulations generates a well-grounded spatio-temporal model. Chapter 25 investigates 3D geo-visualization and geo-computation methodologies. Three examples of visualizing the space-time paths of human movement are provided in order to evaluate the power of geo-visualization and computation in spatio-temporal studies. Overall, the section provides a good overview of the theory behind spatio-temporal modeling in GIS and directs readers to relevant resources.

Section 5, which is the Analysis and Modeling section, consists of ten chapters. Chapter 26 explores the role of GIS in modeling ecological processes. The chapter provides examples of the applications of this methodology and describes the incorporation of error and uncertainty analysis into a decision making process. The chapter also provides a brief overview of commonly used ecological software packages and their linkages to GIS. The main objective of chapter 27 is to introduce non-experts to geographic data mining. The chapter includes links and a bibliography which provide more detailed reviews and tutorials on the subject for the interested reader. Chapter 28 introduces the reader to geo-statistics and its integration into GIS software. Techniques for quantifying spatial variation and spatial prediction methods are presented. Chapter 29 brings together the ideas on spatial data mining and geo-statistics with insightful applications and examples. Various concepts of GIS modeling, spatial analysis, spatial prediction, and spatial statistics are discussed. The application of concepts introduced in the previous chapter will help the reader gain a better understanding of the subject. Chapter 30 is an excellent conclusion to the discussion on spatial analysis. This chapter basically talks about the history and the future of GIS and spatial analysis. Chapters 31 through 33 are an excellent reference for those interested in the techniques (cellular automata, neural networks, etc.) of urban modeling. Chapter 34 discusses the use of GIS in transportation network modeling. The concluding chapter of section 5 (chapter 35) describes the application of GIS and remote sensing to characterize wildfire hazards. Overall, this section is a comprehensive overview of core concepts of GIS analysis and modeling. The chapters of this section cover a breadth of topics with varying degrees of complexity, and hence provide enough material which could be useful to both the beginner and the experienced GIS professional.

Section 6, comprised of 11 chapters, presents combined topics related to remote sensing (RS), global positioning systems (GPS), and geo-visualization. Using clear examples and descriptions, Section 6 effectively presents the fundamentals and principles of these technologies. Chapter 36 provides a history of GIS, RS, the integration of GIS and RS, geographic object-based image analysis (GEOBIA), and geo-visualization. Chapter 37 describes the characteristics of RS systems, focusing specifically on charge coupled devices (CCD), complementary metal-oxide semiconductors on satellite platforms, and digital surface models generated with data from the shuttle radar topography mission (SRTM). Chapters 38 and 39 describe principles and issues concerning location-based services and wireless-related technologies. Chapter 40 proposes multimedia decision-support tools for web-delivered 3D community decision making as potential tools for improving public participatory planning support systems. Chapter 41 explores various geo-visualization software programs like 3D Nature’s Visual Nature Studio, ESRI Arc-GIS, and Terrex TerraVista. Chapter 42 explores interactive maps that use rule-based knowledge to represent GIS data. Chapter 43 introduces examples of real-time visualization techniques for natural hazard assessments. Chapter 44 describes the limitations of 2D in representing the real world and discusses the necessity of constructing real-time visualizations in geo-spatial data. This chapter describes how visualization serves the geospatial field by mimicking the capabilities of the human brain to perform complex tasks. Chapter 45 provides specific examples of 3D visualization, such as 3D city models derived from airborne data collection. Finally, Chapter 46 focuses on 3D spatial data and reviews technologies for 3D spatial data acquisition, such as field surveying, photogrammetry, RS, and image-based 3D feature data collection with GPS.

Section 7, comprised of five chapters, documents some of the new applications that integrate GIS and the World Wide Web. Chapter 47 discusses United States National Databases, specifically The National Map which is maintained by the United States Geological Survey (USGS). The chapter tracks the changes found in the USGS mapping program which is directly related to changes and improvements in technology, specifically web development and GIS. This chapter will prove to be a vital resource when researching the advancements in sharing geo-information across the World Wide Web as well as tracking the history of the development of the USGS and its GIS capabilities. Chapter 48 discusses the integration of Internet GIS and Wireless Mobile GIS. The three types of Internet GIS services and applications of 1) data sharing, 2) information sharing, and 3) knowledge sharing are highlighted and explained. Chapter 49 covers the principles and techniques of interactive web cartography and Internet GIS. Specifically, this chapter explains how GIS information products have become accessible to a wide audience of decision makers who have little GIS skills but utilize GIS through web browsers. Examples of these applications include routing, driving directions, and weather maps. The chapter concludes with emerging and future trends in interactive web cartog-
raphy and Internet GIS which may also provide useful information to the future web-GIS developer. Chapter 50 discusses the advancement of web standards and techniques for developing hypermedia GIS on the Internet. This chapter also describes advances in web development languages, including HTML, XML, SVG, and AJAX. A case study on web-based hypermedia GIS applications is also included in the chapter. Chapter 51 is an introduction to the spatial sensor web which is a web-centric, open, interconnected, intelligent, and dynamic network of sensors. A case study is included in the chapter as well, which discusses intelligent sensor web for integrated earth sensing (ISIES). While this chapter is not a do-it-yourself or a how-to manual, it contains a wealth of knowledge for the average GIS student or a refresher and resource to the web-GIS developer. Overall, this section covers a range of topics that will assist in beginning to understand web-development and GIS integration into a variety of media.

Section 8, consisting of 11 chapters, represents a wide-ranging synthesis of geospatial applications from many different disciplines that provides the reader with a real sense of the breadth of GIS knowledge that exists to date. Chapter 52 details the importance of using GIS to address the spatial and temporal component in epidemiological data sets, in this case Lyme disease. Chapter 53 introduces the distinct development and evolution of transportation GIS theory. The author provides a solid foundation for GIS transportation data models and discusses the limitations of each model with respect to the specific needs and considerations of transportation applications. The common thread of natural resource applications in GIS is shared in chapters 54-56. GAP analysis is presented in Chapter 54 as an initial overview and is followed by several case study examples of successful implementation of GAP analysis in Florida, Washington, Montana, Utah, and Michigan. Chapter 55 includes a good working knowledge of useful coastal data sets and a broad understanding of all of the GIS applications possible within the near shore region. Chapter 56 details a case study for developing environmental indicators for the Great Lakes region. Chapter 57 provides an overview of different geospatial technology and data sets integrated for military applications. GIS resource management applications are presented in both Chapters 58 and 59. Chapter 58 describes the evaluation of mapping in Adirondack Park with a great level of detail on the history of mapping efforts in the park that may be of interest to cartography students. Chapter 59 provides the reader with a basic and comprehensive introduction to datums and coordinate systems, GPS, and the concept of scale within the context of precision agriculture and watershed management. This is an easy to read and detailed general introduction to important geospatial principles for students. Chapter 60 details the unique challenges of processing and integrating data sets to implement a GIS system to support the study of planetary bodies. It provides a description of past and current missions for collecting geospatial planetary data and gives the reader a good case study example of geologic mapping efforts. Chapter 61 provides a deeper consideration for integrating cultural data into a GIS that is unique from others in this section. Chapter 62 stands apart as most useful for the GIS educator. Useful websites for curriculum are provided in the text and the chapter outlines details of the national geospatial curriculum development efforts. Several chapters (chapter 53, 54, 58, 59) in this section provide a synoptic overview that details the framework necessary to create and implement a GIS system for a...
research project and may be particularly relevant to GIS practitioners working in an agency. The strength of this section lies in the broad synthesis of geospatial applications from diverse disciplines and will prove useful for GIS students, technicians, and educators.

The GIS Manual is accompanied by a DVD which provides supplemental material. The contents of the DVD are organized into several folders with each folder having an Adobe PDF document that provides a brief description of the inclusive material. Although the figures in the Manual are black and white, full-resolution color version of figures have been provided in the DVD. This can be a useful resource to instructors who may wish to incorporate portions of the GIS Manual into their teaching. Several private organizations (ERDAS, ESRI, IVS 3D, and SAIC), governmental agencies (NOAA, and USGS), and Universities (SDSU, UCSB, University of Plymouth, UGA, FSU, and SUNY) have contributed to the development of this DVD. The DVD material gives exposure to the most recent GIS, remote sensing, and mapping products that are available. ERDAS, Inc. has provided brochures and user manuals for some of their software packages. The basic version of the IVS 3D View3D program is provided that can be used to view files in the fiedermaus format. SAIC, Inc. has provided sample urban GIS and 3D model data of Los Angeles, California. NOAA has provided shape files of U.S. maritime zones and boundaries while USGS has provided color pictures and video clips from various research projects. SDSU has provided examples of internet GIS applications and resources. UCSB has provided links to the courses offered by Professor Michael Goodchild. The lecture and lab notes on the course webpage provide a rich resource for learning technical issues, design, and applications in GIS. The University of Plymouth, UK has provided interactive SVG maps, examples of Google Earth and Microsoft Virtual Earth, and other examples that demonstrate the web-based interactive and geographic interfaces. UGA, FSU, and SUNY have contributed to several clips of urban growth simulation which is interesting. The variety of resources in this DVD can be a source of practical understanding of the literature. Video clips are a creative way to improve the understanding of GIS. From an educational perspective, the DVD enhances and supplements the GIS Manual. There is no redundancy in the material that the DVD offers and it is an apt supplement to the GIS Manual.

This book is an enormous contribution to the GIS community and serves as a comprehensive resource to understand past applications and explore potential opportunities in the field. It will be helpful to the GIS novice and expert looking to continue their education and may also serve to inform the community of different opportunities available to develop an understanding of GIS or gain access to different forms of data. Within sections, chapters are logically organized, each chapter leading the reader to the topic of the next chapter. Key concepts are reinforced with well illustrated diagrams and maps within the Manual and the DVD. Given that there is currently no manual solely dedicated to GIS, this Manual will be a valuable reference guide to both students and experienced GIS users. Although there were a few instances in portions of certain chapters where we would have liked the authors to go into more detail, there are many more texts that are able to cover those topics in more depth. The GIS educator will benefit from the case studies as they may serve as detailed examples of how a GIS system is implemented and applied in many different disciplines. Overall, this Manual is well suited for students who possess a basic working knowledge of GIS and are interested in learning how geospatial technology is integrated to address real world problems in a variety of topic areas.