

Preface

Geographical information systems (GIS – the same acronym can serve as either the singular or plural form) are effective tools for reporting on the environment, modelling environmental interactions, assessing environmental impacts, evaluating the effectiveness of environmental policies and actions, and disseminating environmental information. This book introduces the concepts, methods, techniques and tools involved in using GIS for environmental analysis, modelling and decision making. It weaves theory and practice together, assimilates the most current GIS knowledge and tools relevant to environmental studies, and provides detailed examples with practical applications.

Many existing GIS textbooks provide theoretical understandings of geographical information and GIS operations, some of which are well-written and comprehensive. However, they provide little guidance on how to implement GIS tools and techniques to master their applications in environmental studies and provide little real hands-on understanding of GIS. A handful of GIS books with an environmental focus largely provide case studies or edited research chapters, which either do not provide enough coverage of GIS principles and techniques or are not accessible to students. This book aims to provide detailed and comprehensive coverage of GIS principles and techniques, and in the meantime to provide a practical guide to the implementation of these principles and techniques in environmental research, management and planning through a large number of carefully chosen examples, practicals and case studies to help readers get a real grasp of knowledge and skills. It brings the knowledge, tools and practices into one cohesive, comprehensive, concise and self-contained book accessible not only to students, but also to environmental scientists and practitioners.

For most of us, it is through examples and guided practicals or experiments that we really learn. Accordingly, the book takes a practical approach and uses examples and hands-on practicals as a means to quickly test, verify and experiment with GIS principles and techniques in an instructive and interactive way. The book comes complete with a companion website containing self-assessment questions and data for working out all the examples and practicals. It is intended for upper-division undergraduates and postgraduates in environmental science, geography, Earth science, atmospheric science, ecology and biological science. It can also be used as a reference book for researchers and practitioners in these fields who wish to use GIS as a tool for environmental analysis, modelling and decision making. In addition, it is written for instructors looking to provide a hands-on and structured course on GIS.

The book is organised into ten chapters. Chapters 1–9 cover the fundamental concepts, principles and techniques in spatial data, spatial data management, spatial analysis, spatial statistics, remote sensing data analysis, terrain analysis, spatial visualisation, and spatial decision analysis and modelling. Each of these chapters includes examples and practicals that show how the GIS principles, techniques and tools introduced can be implemented using ESRI ArcGIS (a popular GIS software system for environmental applications) and other third-party extensions to ArcGIS to address environmental issues. Although case studies are provided in the first nine chapters, Chapter 10 contains a collection of more detailed case studies organised under the themes of hydrological modelling, land use analysis and modelling, atmospheric modelling, ecological modelling and ecosystem service valuation. These case studies, although they do not cover all areas of environmental research and

practice, show some typical environmental applications of GIS with an emphasis on how GIS has been used in the analysis, modelling or solution processes. They are fully cross-referenced to relevant sections in the text and provide additional case studies to those sections.

Each chapter includes the following learning aids:

- a list of learning objectives stated at the beginning;
- full-colour maps, diagrams, tables and photos;
- boxes providing tutorial-style practical guidance on how to apply or implement the concepts and techniques of GIS with step-by-step instructions;
- a summary at the end covering the main concepts introduced;
- a set of end-of-chapter review questions, the answers to which can be found through careful reading of the chapter;
- a list of references including all publications cited in the text, serving as both source material for the chapter and a starting point for further investigation.

The content of the book is fairly modular and sufficiently flexible to support a variety of course needs. These needs are determined by the backgrounds of students, the course length, the course position in a curriculum and the course objectives. For example,

Chapter 9, 'Spatial decision analysis and modelling', is an advanced topic which is suitable for postgraduates, and can be excluded from an undergraduate course. Case studies in Chapter 10 can be used as selective reading for students according to their backgrounds.

In writing this book, I have many people to thank. First, I thank the many students who have taken my GIS courses over the past several years. Their feedback has been instrumental in organising the ideas presented in the text. My heartfelt thanks are due to Katherine Yu, who produced many of the diagrams, proofread chapters and provided constant support and frequent understanding over the years. I wish to thank the anonymous reviewers of the book for carefully reading and critiquing the work. Their input resulted in significant improvements to the quality of the final output. I would also like to thank Andrew Mould, Sarah Gilkes and Egle Zigaite, the editors, for their help, guidance, encouragement and professionalism throughout the years. Last and not least, thanks go to my family, who over the years have been neglected during my deepest concentration on writing.

Xuan Zhu
Monash University
Melbourne