

Contents

<i>List of figures and tables</i>	<i>vii</i>
<i>Preface</i>	<i>xv</i>
<i>Companion website and GIS software</i>	<i>xvii</i>
1 GIS overview	1
1.1 Introduction to GIS	1
1.2 GIS for environmental applications in a historical perspective	11
1.3 Roles of GIS in environmental research, management and planning	17
1.4 A general framework for environmental problem solving with GIS	19
1.5 GIS software	24
1.6 A tour of ArcGIS for Desktop	28
1.7 Summary	34
2 Spatial data and data management	37
2.1 The nature of spatial data	37
2.2 Georeferencing systems	43
2.3 Spatial data models	59
2.4 Spatial database management	77
2.5 Summary	84
3 Spatial data input and manipulation	87
3.1 Spatial data capture	87
3.2 Spatial data transfer	101
3.3 Spatial data transformation	103
3.4 Spatial data editing	116
3.5 Spatial data quality	127
3.6 Summary	133
4 Spatial analysis	137
4.1 Scope of spatial analysis and modelling	137
4.2 Spatial query and reclassification	138
4.3 Geometric and distance measurement	147
4.4 Overlay analysis and map algebra	160
4.5 Spatial interpolation	173
4.6 Summary	187

5 Spatial data exploration with statistics	189
5.1 Exploratory spatial data analysis	189
5.2 Spatial sampling	190
5.3 Measures of spatial distributions	194
5.4 Analysis of spatial patterns	202
5.5 Detection of spatial clusters	211
5.6 Modelling of spatial relationships	217
5.7 Summary	228
6 Remote sensing data analysis	231
6.1 Nature of remote sensing data	231
6.2 Image preprocessing	245
6.3 Image enhancement	250
6.4 Image transformation	261
6.5 Image classification	267
6.6 Summary	277
7 Terrain analysis	279
7.1 Digital terrain analysis and terrain models	279
7.2 Hydrologically correct DEMs	281
7.3 Digital terrain data sources	283
7.4 Terrain attributes	286
7.5 Visibility analysis	306
7.6 Solar radiation mapping	311
7.7 Summary	319
8 Spatial visualisation	323
8.1 Cartographic representations	323
8.2 Map design	334
8.3 Multivariate mapping	345
8.4 3D mapping	357
8.5 Animated mapping	362
8.6 Summary	374
9 Spatial decision analysis and modelling	377
9.1 Multi-criteria decision analysis	377
9.2 Cellular automata	388
9.3 Agent-based modelling	393
9.4 Weights-of-evidence	405
9.5 Artificial neural networks	413
9.6 Summary	421
10 Environmental applications of GIS	423
10.1 Hydrological modelling	423
10.2 Land use analysis and modelling	427
10.3 Atmospheric modelling	436
10.4 Ecological modelling	441
10.5 Landscape valuation	450
10.6 Summary	458