Environmental Information Management
and Analysis:
Ecosystem to Global Scales

Edited by
William K. Michener,1 James W. Brunt,2
and Susan G. Stafford3

1 Joseph W. Jones Ecological Research Center
Route 2, Box 2324
Newton, GA 31770

2 Department of Biology
University of New Mexico
Albuquerque, NM 87131-1091

3 Department of Forest Science
Oregon State University
Corvallis, OR 97331-7501
Contents

List of figures
List of tables
Preface
Contributors

SECTION I A RESEARCH PERSPECTIVE
1 Integration of scientific information management and environmental research
   Susan G. Stafford, James W. Brunt and William K. Michener
2 Grand challenges in scaling up environmental research
   James H. Brown
3 Sustainable Biosphere Initiative: Data management challenges
   James R. Gosz
4 Multiple roles for GIS in global change research: Towards a research agenda
   Dennis E. Jelinski, Michael F. Goodchild and Louis T. Steyaert

SECTION II SCIENTIFIC DATABASES AND INFORMATION SYSTEMS
5 Scientific information systems: A conceptual framework
   Donald E. Strebel, Blanche W. Meeson and Alan K. Nelson
6 Development and refinement of the Konza Prairie LTER Research Information Management Program
   John M. Briggs and Haiping Su
7 Forest health monitoring case study
Contents

Charles I. Liff, Kurt H. Rüters and Karl A. Hermann
8 Bigfoot: An earth science computing environment for the Sequoia 2000 Project
James Frew
9 Representing spatial change in environmental databases
John L. Pfaltz and James C. French

SECTION III QUALITY ASSURANCE/QUALITY CONTROL
10 Automated smoothing techniques for visualization and quality control of long-term environmental data
Scott E. Chapal and Don Edwards
11 Spatial sampling to assess classification accuracy of remotely sensed data
Greichen G. Moisen, Thomas C. Edwards, Jr and D. Richard Cutler
12 Metadata required to determine the fitness of spatial data for use in environmental analysis
Nicholas R. Chrisman

SECTION IV DATA SHARING ISSUES
13 Circumventing a dilemma: Historical approaches to data sharing in ecological research
John H. Porter and James T. Callahan
14 Sharing spatial environmental information across agencies, regions and scales: Issues and solutions
John Evans
15 Standards for integration of multisource and cross-media environmental data
Rodney L. Slagle

SECTION V DATABASES FOR BROAD-SCALE RESEARCH
16 Alternative approaches for mapping vegetation quantities using ground and image data
Jennifer L. Dungan, David L. Peterson and Paul J. Curran
17 Global biosphere requirements for general circulation models
Bruce P. Hayden
18 Evaluation of soil database attributes in a terrestrial carbon cycle model: Implications for global change research
Christopher S. Potter, Pamela A. Matson and Peter M. Vitousek
19 Designing global land cover databases to maximize utility: The US prototype
Bradley C. Reed, Thomas R. Lovelands, Louis T. Steyaert, Jesslyn F. Brown, James W. Merchant and Donald O. Ohlen
20 Global environmental characterization: Lessons from the NOAA-EPA Global Ecosystems Database Project
John J. Kineman and Donald L. Phillips

SECTION VI ENVIRONMENTAL MODELLING AND GEOGRAPHIC INFORMATION SYSTEMS
21 Integrating geographic information systems and environmental simulation models: A status review
Louis T. Steyaert and Michael F. Goodchild
22 Data management and simulation modelling
Thomas B. Kirchner
23 GIS and spatial analysis for ecological modelling
Richard J. Aspinall
24 Linking ecological simulation models to geographic information systems: An automated solution
Martha B. Coleman, Tamara L. Bearly, Ingrid C. Burke and William K. Lauenroth
25 Comparison of spatial analytic applications of GIS
David P. Lanter

SECTION VII NEW ANALYTICAL APPROACHES
26 GIS development to support regional simulation modelling of north-eastern (USA) forest ecosystems
Richard G. Latrhop, Jr, John D. Aber, John A. Bognar, Scott V. Ollinger, Stephane Casset and Jennifer M. Ellis
27 Remote sensing and GIS techniques for spatial and biophysical analyses of alpine treeline through process and empirical models
1.1 A new dynamic between science and technology has forced evolution of the way in which environmental information is now managed and analysed.

1.2 Analytical and storage capabilities accessible from the future user's desktop.

5.1 The information system management council should bring together representatives of the scientific community, funding agency management and information system staff for frank, open, direct and frequent interactions.

5.2 The analogy between data publication and publication of scientific research results.

5.3 Three personnel scenarios for handling 50 data sets, each of which requires 26 weeks of human effort to achieve maturity.

5.4 Two factors that can increase the cost of handling data sets long after they are collected or submitted.

5.5 Data flow diagram illustrating how data matured in the FIFE information system.

6.1 Konza Prairie research experimental design.

6.2 Data requests to Konza Prairie LTER data manager from 1984 to 1993 from non-Konza LTER investigators.

7.1 Location of 1992 FHM detection monitoring activities.

7.2 Location of 1992 FHM pilot and demonstration activities.

7.3 FHM information management system data flow.

8.1 The Sequoia 2000 layered architecture.

9.1 Area as a function of some variable \( x \).

9.2 The derivative of the function of Figure 9.1.

9.3 Pixels from three images of shrub thickets.

9.4 Pixel differences of images shown in Figure 9.3.

9.5 Approximating ellipses for areas shown in Figure 9.3.

9.6 Vector field denoting change of a spatial boundary.

9.7 Observed area values and the finite difference structure.

10.1 Flow diagram of the components of research data management taken from the North Inlet LTER, illustrating the integral importance of quality assurance.

10.2 AIC versus the number of model parameters for Method I (parametric) (a), Method II (seasonal semiparametric) (b), and