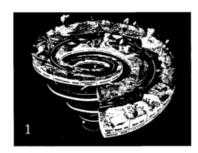
Contents



Foreword

Preface

Acknowledgments



Part 1: Introduction and History

Why Model? 2

Which Model?

6 History of Models

Models That Matter



Part 2: Methods

12 Modeling Overview

14 Modeling Goals

Modeling Framework

18 Model Design and Run

20 Model Visualization

22 Model Validation

24 Model Classes Overview

Expert-Based Models

Descriptive Models

Predictive Models

32 Dynamical Equations (1687)

34 Probability Theory (1713) 36 Control Theory (1868)

Epidemic Models (1927)

Cellular Automata (1940s)

42 Game Theory (1950)

44 Continuous-Field Models (1952)

46 Network Models (1959)

48 Agent-Based Models (1980s)

50 Machine Learning Models (1990s)



Part 3: Models in Actio

Model Substrates Overview

56 Population: Health and Education

Natural Resources: Water, Food, and Energy

60 Climate and Weather: Pollution and Flooding

Transportation: Land, Maritime,

Digitization: Computing and Communication

66 Urbanization: Segregation and Migration

Model Questions Overview

70 Domains Overview

Scales Overview

Micro: Education

Micro: Science

78 Micro: Technology

80 Micro: Policy

82 Meso: Education

Meso: Science

Meso: Technology 86

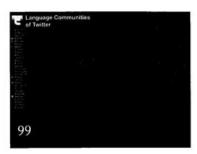
Meso: Policy 88

90 Macro: Education

Macro: Science

Macro: Technology 94

Macro: Policy



Part 4: Science Maps in Action

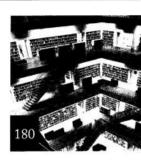
- 100 Places & Spaces: Mapping Science
- 102 Eighth Iteration (2012): Science Maps for Kids
 - 104 Geologic Time Spiral: A Path to the Past
 - 106 Movie Narrative Charts (Comic #657)
 - 108 Metropolitan Museum of Art Family Map
 - 110 Left vs. Right Political Spectrum
 - 112 Gapminder World Map
 - 114 Knowledge Web
 - 116 Manga Universe
 - 118 The Fundamental Interconnectedness of All Things
 - 120 Language Communities of Twitter
 - 122 Khan Academy Library Overview

- 124 Ninth Iteration (2013): Science Maps Showing Trends and Dynamics
 - 126 NASA Views Our Perpetually Moving Ocean
 - 128 Hurricanes & Tropical Storms— Locations and Intensities since 1851
 - 130 State of the Polar Bear
 - 132 Pulse of the Nation
 - 134 Map of Complexity Science
 - 136 Visualizing Trends and Dynamics: 30 Years of Scientific Development
 - 138 The Hewlett Foundation Grant Visualizer
 - 140 Who Really Matters in the World—Leadership Networks in Different-Language Wikipedias
 - 142 Identifying Emerging Topics in Science and Technology
 - 144 Science Phylomemy
- 146 Tenth Iteration (2014): The Future of Science Mapping
 - 148 Being a Map of Physics
 - 150 Map of the Internet
 - 152 PREDICT HealthMap
 - 154 ORBIS
 - 156 Money
 - 158 The Linguistic Context of Citations
 - 160 Visual Funding Portfolios
 - 162 Mapping Graphene Science and Development: Focused Research with Multiple Application Areas
 - 164 Exploring the Relationships between a Map of Altruism and a Map of Science
 - 166 Interstitial Organizations as Conversational Bridges



Part 5: Envisioning Desirable Futures

- 170 Modeling Opportunities
- 172 Reducing Human Bias
- 174 Managing Risks
- 176 Building Capacity
- 178 Actionable Forecasts



180 References & Credits210 Index