

The Modeling Process in Geography

From Determinism to Complexity

Edited by
Yves Guermond

) **WILEY**

Table of Contents

Foreword. The Taste for Measuring and Modeling	xi
Nicole MATHIEU	
Preface	xxiii
Acknowledgements	xxv
Chapter 1. The Place of Both the Model and Modeling in HSS	1
Patrice LANGLOIS and Daniel REGUER	
1.1. Models and modeling: definitions.	2
1.2. The mathematical concept of a model.	5
1.2.1. The semantic conception.	5
1.2.2. The empirical concept	6
1.2.3. Links between the mathematical model and its object	7
1.3. Is there a specificity of HSS?.	7
1.4. Modeling: explain to understand?.	11
1.5. Bibliography.	13
Chapter 2. From Classic Models to Incremental Models	15
Yves GUERMOND	
2.1. The geographic "object".	16
2.2. Lessons from the "classic models".	16
2.3. Introduction to dynamics and auto-organization.	22
2.4. From auto-organization to complexity.	26
2.5. Spatial agents.	30
2.6. Incremental modeling	32
2.7. Bibliography.	35

Chapter 3. The Formalization of Knowledge in a Reality Simplifying System	39
Francoise LUCCHINI	
3.1. Formalizing a complex cultural system using a series of perspectives	40
3.1.1. An initial perspective on culture and the city: the French example.	40
3.1.2. A simplification of the cultural system in place in France that is transposable to other countries.	44
3.1.3. Culture: possible measures.	44
3.1.4. Culture in a centralized state: a French diagnostic turned towards the elaboration of a transposable investigation protocol.	45
3.1.5. The necessary re-formulation of knowledge to overcome the successive and qualitative steps of advancement.	50
3.2. Differentiation of the system of cities by culture: contribution of the spatial analysis for testing the "global cultural model".	51
3.2.1. A methodological investigation to define the cultural potential of British and French cities and their competitive capacity.	51
3.2.2. A comparative intra-urban study of two cities: similar disparities at the heart of the urban areas of Rouen and Brighton.	60
3.3. Alternative formalizations.	63
3.3.1. Measuring urban cultural potential.	64
3.3.2. A way to better define the global operation of the cultural system	68
3.4. Conclusion.	69
3.5. Bibliography.	69
Chapter 4. Modeling and Territorial Forecasting: Issues at Stake in the Modeling of Reunion's Spatial System	71
GillesLAJOIE	
4.1. Introduction.	71
4.2. A few major theoretical breakthroughs for modeling spatial complexity.	72
4.3. Modeling and territorial forecasting of the socio-spatial system of Reunion	78
4.3.1. Spatial complexity and social urgency in Reunion or future deviations.	78
4.3.2. The trend scenarios or the probable future.	83
4.3.3. Catastrophic scenarios/unacceptable futures.	85
4.3.4. Reformist scenarios/desirable futures.	87
4.4. Modeling of Reunion's socio-spatial system.	90
4.4.1. Graphic modeling of Reunion's complexity.	90
4.5. Towards a modeling of the dynamics of Reunion's system.	93
4.6. Conclusion.	97
4.7. Bibliography.	98

Chapter 5. One Model May Conceal Another: Models of Health Geographies	101
Alain VAGUET	
5.1. Modeling in order to surpass descriptions?	102
5.2. Mode of the models and models in vogue.	104
5.2.1. Modeling of healthcare provision	106
5.2.2. The models put to comprehension and action testing	109
5.3. Conclusion.	111
5.4. Bibliography.	111
Chapter 6. Operational Models in HMO	113
Jean-Francois MARY and Jean-Manuel TOUSSAINT	
6.1. Buffer and barycenter to determine the location of cardiac defibrillation.	114
6.2. Thiessen's accessibility formula	117
6.3. Accessibility: the direct added-value of the GIS	121
6.4. A regional database of road accessibility devoted to emergency.	123
6.5. The reallocation projects and their consequences.	126
6.6. Relocation of a medical clinic: simulation of a new accessibility.	131
6.7. Bibliography.	134
Chapter 7. Modeling Spatial Logics of Individual Behaviors: From Methodological Environmentalism to the Individual Resident Strategist	137
Michel BUSSI	
7.1. Reconsidering spatial determinism: modeling versus local development	138
7.2. Ecological methodology.	142
7.2.1. Individualism and ecology.	142
7.2.2. What place does geography have in the systemic approach to societal phenomena?	144
7.2.3. The collective dimension of individual facts: the intra-urban example.	146
7.3. Towards a post-industrialist behavior	149
7.3.1. Self-organization and segregation	149
7.3.2. Space/individualism: two interpretations.	151
7.4. From neighborhood effect to the theory of the citizen-resident-strategist	152
7.5. Bibliography.	157
Chapter 8. Temporalities and Modeling of Regional Dynamics: The Case of the European Union	161
Bernard ELISSALDE	
8.1. Integrating time and temporalities into spatial models.	162
8.1.1. A renewed approach to time.	162
8.1.2. Temporalities and complex systems.	164

8.1.3. A necessary introduction of polytemporality into modeling	166
8.2. Introduction of complexity theory in the interpretation of regional inequalities in Europe.	168
8.2.1. The European Union: regional convergences or divergences?	172
8.2.2. Which interpretive models?.	173
8.2.3. The evolution of regional inequalities in Europe.	175
8.2.4. Evaluating the issue of possible catch-up and convergence.	180
8.2.5. Hypothesis of the neighborhood effect	184
8.3. Conclusion	186
8.4. Bibliography.	188
 Chapter 9. Modeling the Watershed as a Complex Spatial System:	
A Review.	191
Daniel DELAHAYE	
9.1. Shape indices for measuring various forms of a watershed.	192
9.2. Organization of the networks.	193
9.2.1. Genesis of hydrographical networks.	193
9.2.2. Researching network laws.	194
9.2.3. Towards a law concerning reach distribution.	197
9.3. Synthesis concerning the shape and organization indices.	200
9.4. From morphometry to complex systems.	202
9.4.1. Methodological framework	202
9.4.2. Results from the simulation.	209
9.4.3. Applications and the contributions of the cellular automaton	210
9.5. Conclusion.	213
9.6. Bibliography.	213
 Chapter 10. Understanding to Measure or Measuring to Understand?	
HBDS: Towards a Conceptual Approach for the Geographic Modeling	
of the Real World	
Thierry SAINT-GERAND	
10.1. A forgotten face of the geographic approach.	217
10.1.1. The causality in question.	218
10.1.2. The concept in the light of the technique: "collisions" and misadventures of a couple in disharmony.	219
10.1.3. The conceptual modeling of the geographic phenomena: a necessary prerequisite, why and how.	221
10.1.4. The GIS: a special spatial information system.	223
10.1.5. The geographic object: logic makes the entity.	225
10.2. Formalizing a spatial reasoning in databases. *	226
10.2.1. Operational structures for the geographic modeling of the real world.	226
10.2.2. Preliminary research into the data structuring methods: a historical overview.	227

10.2.3. A methodology adapted to research: hypergraphic modeling byBouille.	231
10.2.4. Spatial concepts and planar law for a hyper(geo)graphic reasoning	235
10.3. Example of thematic application: the industrial risks at Notre- Dame-de-Gravenchon (lower Seine valley).	246
10.3.1. Identifying the specific and central concepts.	248
10.3.2. To identify the peripheral concepts.	248
10.3.3. Formalizing the spatial synthesis of danger.	250
10.4. Back to the sources.	252
10.5. Bibliography.	253
Chapter 11. Complexity and Spatial Systems	255
Patrice LANGLOIS	
11.1 The paradigm of complexity.	255
11.2. The systemic paradigm: from the combinatorial to emergence.	260
11.2.1. The systemic triangle.	260
11.2.2. The whole is greater than the sum of its parts.	262
11.2.3. The whole is less than the sum of its parts.	262
11.2.4. The whole as a structure of its components.	263
11.2.5. The whole as an emergence of its parts.	266
11.3. Moving towards a more formalized definition of the notion of a spatial system	266
11.3.1. First definition of a system	266
11.3.2. Geographic objects.	267
11.3.3. Interactions.	270
11.3.4. The functioning of a system.	272
11.3.5. A formal definition of a spatial system	274
11.4. Bibliography.	275
Chapter 12. Cellular Automata for Modeling Spatial Systems	277
Patrice LANGLOIS	
12.1. The concept of the automaton and its modeling.	277
12.2. A little bit of history.	278
12.3. The concept of the finite state automaton.	279
12.3.1. Mealy and Moore automata.	280
12.3.2. An example of Moore's automaton.	281
12.3.3. Moore's automaton simplified.	282
12.3.4. Logic gate AND: an example.	282
12.3.5. Threshold automata, window automata	283
12.3.6. The automaton and the stochastic process.	284
12.4. The concept of the cellular automaton.	285
12.4.1. Level of formalization.	285
12.4.2. Presentation of the concept	286
12.4.3. The formal definition of a cellular automaton.	287

- 12.4.4. The cellular network 287
- 12.4.5. The neighborhood operator and cell neighborhoods 287
- 12.4.6. Input pattern 288
- 12.4.7. The local rule of the transition of the cell 288
- 12.4.8. Configuration and global transition mechanism 289
- 12.4.9. Configuration space: attractor, attraction basin,
Garden of Eden 289
- 12.4.10. 2D cellular automata 290
- 12.4.11. The game of life: an example 291
- 12.5. CAs used for geographic modeling 293
 - 12.5.1 Diffusion simulation 295
 - 12.5.2. The SpaCelle model 297
 - 12.5.3. Simulation of surface runoff: RuiCells model 304
- 12.6. Bibliography. 306
- 12.7. Websites. 307

**Chapter 13. Multi-Agent Systems for Simulation in Geography:
Moving Towards an Artificial Geography. 309**
Eric DAUDE

- 13.1. Introduction 309
- 13.2. From global to local description of structures and spatial dynamics. . . 310
 - 13.2.1. Spatial analysis in practice. 310
 - 13.2.2. Artificial geography in practice. 311
- 13.3. Multi-agent systems. 313
 - 13.3.1. Environment 314
 - 13.3.2. Agents in the environment 315
 - 13.3.3. Method of communication between agents 316
 - 13.3.4. Multi-agent systems and geography. 317
 - 13.3.5. A typology of MAS models. 318
- 13.4. Artificial geography: simulations of structures and spatial dynamics . . 319
 - 13.4.1. Emergence and evolution of spatial structures. 320
 - 13.4.2. Exploration of dynamics in space. 324
 - 13.4.3. Practices, representations and organization of space. 326
- 13.5. Conclusion. 329
- 13.6. Bibliography. 329

Conclusion 335

Yves GUERMOND

List of Authors 337

Index 339