

Preface

Complex systems analysis has become a fascinating topic in modern research on non-linear dynamics, not only in the physical sciences but also in the life sciences and the social sciences. After the era of bifurcation theory, chaos theory, synergetics, resilience analysis, network dynamics and evolutionary thinking, currently we observe an increasing interest in critical transitions of dynamic real-world systems in many disciplines, such as demography, biology, psychology, economics, earth sciences, geology, seismology, medical sciences, and so on. The relevance of this approach is clearly reflected in such phenomena as traffic congestion, financial crisis, ethnic conflicts, eco-system breakdown, health failures, etc. This has prompted a world-wide interest in complex systems.

Geographical space is one of the playgrounds for complex dynamics, as is witnessed by population movements, transport flows, retail developments, urban expansion, lowland flooding and so forth. All such dynamic phenomena have one feature in common: the low predictability of uncertain interrelated events occurring at different interconnected spatio-temporal scale levels and often originating from different disciplinary backgrounds. The study of the associated non-linear (fast and slow) dynamic transition paths calls for a joint research effort of scientists from different disciplines in order to understand the nature, the roots and the consequences of unexpected or unpredictable changes in complex spatial systems. Complex dynamics also challenges the findings from conventional equilibrium theory, in particular concerning multi-agent systems. Consequently, the prediction, analysis, and management of non-linear dynamic phenomena in the context of complexity analysis is of great importance for decision making in both the private and the public sector.

In this context, from a methodological viewpoint, in complex systems there is the need for a unifying framework of analysis that embraces the meaning and use of interdisciplinary concepts (such as self-organization, criticality, redundancy, resilience and sustainability). At the same time, the universality and ‘simplicity’ of network centrality and connectivity laws (such as the entropy and power laws) should be better explored.

The present volume brings together a series of original and innovative contributions in the area of complex spatial dynamics and networks. A wealth of authors – from

different disciplines – were invited to write an original piece of work centring around the non-linear dynamic nature of spatial and network systems. This book is the outgrowth of a workshop organized by IPL (Institute Para Limes), the new Institute for frontier research on complex phenomena of a trans-disciplinary nature, based in the Netherlands (for details, see www.paralimes.org). The participants came from all over the world and provided refreshing ideas on the analysis of complexity and non-linear dynamic evolution in space and in spatial networks. Their contributions and various enthusiastic ideas laid the foundation for this publication that aims to be a systematic compilation of carefully selected and refereed papers on interdisciplinary perspectives on spatial complexity and non-linear dynamic network development. The editors wish to thank Jan Wouter Vasbinder, Managing Director of IPL, for his great support in the preparation and organization of our work.

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