Commentary: Plea for the Experimentation and Comparison of Dynamic Models

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Commentary

Plea for the experimentation and comparison of dynamic models

In under fifteen years the formalization of change in spatial systems has been stimulated by the transfer of theoretical elements and related methods from natural science. After the diffusion by the Brussels school (Prigogine and Stengers, 1979) and the Stuttgart school (Haken, 1977) of ideas about bifurcation theory and synergetics and their possible applications in the social sciences, many dynamic models have flourished in the field of regional and urban studies (Wilson, 1981).

Such success results from the possibility for integrating into models of spatial systems specific properties of change which were not recognized by the classical dynamic theory: nonnecessity of equilibrium, irreversibility in the course of time, unity of trajectories of a particular spatial system, changes in qualiative structure stemming from small quantitative variations of parameters in unstable situations, explication of the relationships between the behaviour of individuals at the microlevel, and the configuration of the state variables which describe the system at the macroscopic level (Allen, 1991).

In the field of geography and regional science, these ideas gave rise to a great number of papers, even to new journals (for instance, *Socio-spatial Dynamics*). Despite the high interest of some publications, one may wonder why the global 'state of the art' is still a bit disappointing. Perhaps too many contributors are discussing at a very general level the concepts of complex systems, catastrophe, bifurcation, and even chaos, in enthusiastic but sometimes approximate terms, or are elaborating mathematical exercises with nonlinear equations and simulated curves of theoretical dynamic models, but without a confrontation with the facts.

In order to take full advantage of the powerful theoretical framework and mathematical tools of bifurcation theory or synergetics, it seems not unnecessary to remind ourselves of a few principles. A theory has something to do with facts being put together in an intelligible way. Therefore, the dynamic models should not stay at the theoretical level but should bring to light something new about the facts. Neither are the mathematical models used for the description of human systems to be directly translated from the physical sciences. The fundamental concepts have to refer to social systems from the very beginning. According to Weidlich (1990) "qualitative concepts are indispensible prerequisites for setting up a mathematical quantitative model, however on the other hand, quantitative models may contribute in making qualitative concepts unique and measurable and in providing insights into a manifold of qualitative structures".

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It may seem more paradoxical to recommend applications to real data in the context of dynamic modelling: if dynamic trajectories are unique, if many futures are possible from the same past, what is the purpose of applications (Sanders, 1991)? First, we must because it is an indispensable step in the process of validation of theoretical hypothesis. Even if a good fit with one set of data is not a sufficient condition to establish the validity of a theory, it is still always necessary. Moreover, one important thing is that experimentation obliges us to make precise a point which is too often neglected in model building: its domain of applicability, that is, the range of variation which is allowed for the variables and the parameters included in the models. How many wonderful mathematical demonstrations of the emergence of a chaotic behaviour in a dynamic model would lose their appealing seduction

when it is confessed that such an effect would appear in most cases only after a few hundred or even thousand years of evolution, for a very unrealistic value of some parameter!

Even if most of those models are not yet operational, for instance for applications in planning, it can be expected that progress in this direction should not only come from theoretical research, but also from experimentation with data. The advance to be made is not so much in mathematical formalization, but in theoretical and experimental research, both about individual behaviour in space and about the links between this behaviour and the dynamic of the spatial aggregates, that is, the regularities which appear in the spatiotemporal processes that are observed at the macroscale of complex systems.

The other important thing is that experimentation leads to a more precise judgement of the efficiency of the models and thus of their usefulness. This invites a comparison of different models, which is also a too rarely practised exercise.

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