Sharing and disseminating knowledge of advanced spatial modeling. Presentation of an action carried out by the European research group s4 (spatial simulation for social sciences)

Cécile Tannier

HAL Id: halshs-01003259

https://shs.hal.science/halshs-01003259

Submitted on 10 Jun 2014

SHARING AND DISSEMINATING KNOWLEDGE OF ADVANCED SPATIAL MODELLING

PRESENTATION OF AN ACTION CARRIED OUT BY THE EUROPEAN RESEARCH GROUP S4
(SPATIAL SIMULATION FOR SOCIAL SCIENCES)

Cécile Tannier
Permanent researcher – French National Centre for Scientific Research
cecile.tannier@univ-fcomte.fr, + 33 3 81 66 54 81

Address
ThéMA - 32 rue Mégevand – F-25 030 Besançon Cedex

Summary: The European research group S4 (Spatial simulation for social sciences) gathers researchers in geography as well as in geographical information sciences coming from about 30 European research centres. One action of the European research group S4 consists in sharing and disseminating knowledge of advanced spatial modelling. We propose here to describe several aspects of this action that are of interest considering the objectives of the CAENTI. The first aim of the action is to improve the diffusion of the results of the research in advanced spatial modelling, particularly in direction of regional and urban management and planning. The second aim is the development of tools and methods to improve coherence of knowledge and experiences that is especially required in those fields characterised by a rapidly developing research as it is the case for spatial systems analysis and modelling.

Keywords: spatial modelling, spatial simulation, geography, Internet, knowledge dissemination.

Sharing and disseminating knowledge of advanced spatial modelling
Presentation of an action carried out by the European research group S4

As in many sciences, the conception and the use of spatial modelling in geography has increased during the last ten years. Such a modelling approach is called "theoretical and quantitative geography". It aims to characterise and to study the spatial distribution of different kinds of phenomena using spatial data analysis and modelling. Studied phenomena can be for example population, activities, diseases, road networks, types of landscapes... Belonging to this field of research, the European research group S4 (Spatial simulation for social sciences) gathers researchers in geography as well as in geographical information sciences coming from about 30 European research centres[1]. It has been created in January 2006, but its informal existence goes back 1978 (date of the first European colloquium on theoretical and quantitative geography).

Even if some parts of research belonging to the field of theoretical and quantitative geography could be very useful for urban and regional development and planning, at the moment, they remain mostly in the field of research. A fact is that few results are applied for answer practical concerns, in particular in France. The conclusions of a study realised in the framework of the PREDIT (French program dedicated to the promotion of research and innovation for transportation systems) illustrates this statement. The study underlines the real urgency both of a better legibility of spatial modelling research and of an increased coherence of the results of this research in order to better integrate them in the field of the territorial management. It emphasizes in particular the interest of the use of renewed and advanced mobility models for urban transportation management[2].

Regarding this statement, the European research group S4 decided to develop an action entitled "Sharing and disseminating knowledge of advanced spatial modelling". The first aim of this action is to improve the diffusion of the results of research in spatial modelling, particularly in direction of regional and urban management and planning. The second aim is the development of tools and actions to improve coherence of knowledge and experiences that is especially required in those fields characterised by a rapidly developing research as it is the case for spatial systems analysis and modelling.

Ensuing from these aims, 4 objectives govern the presented action.

First aim: diffusion of the results of the research in spatial modelling

Objective 1
Diffuse the research results to the whole scientific community interested in spatial simulation: geography, urban and regional planning, but although economy, informatics, physics, biology...

Objective 2
Disseminate methods, outputs and results to stakeholders.

Objective 3
Promote main findings among the public through a "Science and Society" approach.

Second aim: development of tools and actions to improve coherence of knowledge and experiences.

Objective 4
Ensure an optimal sharing of knowledge between the members of the S4 research group.

To answer these 4 objectives, several actions have been programmed. Some of them are in the process of being realised.

1. ACTION 1: DEVELOPMENT OF AN INTERACTIVE PLATFORM FOR GEOGRAPHY AND SPATIAL MODELLING

The S4 Interactive Platform is a web site with a double key access: for the members themselves and for an interested public (*i.e.* the whole scientific community, stakeholders, end-users and students).

http://www.spatial-modelling.info/

From a technical point of view, the *S4 Interactive Platform* is an ergonomic website characterized by a high level of user-friendliness and the ease of

---

1 European Research Groups are research networks, with no legal identity, made of public or private European laboratories, working on the same scientific theme. The *European Research Group S4* proposes to develop spatial dynamic modelling as an integrative tool for understanding, discussing and helping to manage the evolution of our complex societies. It is directed by Denise Pumain.

2 Baye E. *et al.,* Bilan de compétences des laboratoires en recherche français en matière de modélisation des déplacements de voyageurs et de marchandises, Octobre 2002, Rapport PREDIT.

navigation. The Web-designers (*grafactory.net*, Besançon) have developed a customised Content Management System, which allows a dynamic site by preserving the autonomy of the authors for the content (articles, models, links…): modifications and news are set on line in real time by the members of the S4 research group themselves without needing to go through a web master.

The *S4 Interactive Platform* is organised on the basis of seven main entries.

- *Who are we* – This first heading offers basic information about the ERG S4.

- *If you want contribute to the S4 platform* – This second heading gives practical information about how to do this.

- *Directory of links* – This third heading is dedicated to the search of other web sites that deal with spatial analysis and modelling.

- *Activities* – This fourth heading offers a set of information about the network events. The announcement of seminars, conferences and general meetings appears here.

- *Electronic Publication Platform* - This fifth heading gathers two publications. Firstly, the European Journal of Geography *Cybergeo*[3] is a purely electronic journal founded in 1996. It was the first electronic journal in geography to appear in the world and one of the first in social sciences. The journal addresses the whole domain of geography, with a special emphasis on interfacing with other sciences and developing theoretical and applied modelling. *Cybergeo* plays a central role in the S4 Research Group, enhancing both its experience and reputation through a wider and more efficient dissemination of knowledge. Secondly, the *Electronic Encyclopaedia Hypergeo* is dedicated to the definition of basic terms used in geography. The aim of *Hypergeo* is to improve the diffusion of the concepts and the theories of the actual geography, particularly in direction of students and teachers.

- *S4 Private Room* – This sixth heading is dedicated to the exchanges between the members of the ERG S4. It allows them to share information about work in progress and results obtained in each working group. Facilities for shared writing is provided.

- *Spatial Modelling Park* - In the framework of the CAENTI, this last heading represents the most interesting part of the *S4 Interactive Platform*. It requires a more detailed description.

Spatial Modelling Park

Several initiatives already exist, which aim to increase exchanges and communication about research on spatial systems modelling via Internet. As examples, we chose to quote the inventory of web sites realised by the *CSISS (Centre for Spatially Integrated Social Sciences)*[4] of the University of Santa Barbara; and also the on line disposal software for spatial analysis and simulation as proposed by the *AI-GEOSTATS, a Web service for geostatistics and spatial statistics* (Joint Research Centre - European Commission) or by the *Global Warming Resource Centre* of the US Environmental Protection Agency. Although interesting, such initiatives only deal with one precise aspect (which could be either methodological, technical or centred on a given topic) of the whole field of spatial modelling of social systems. Moreover, most part of the research developed by the S4 members is not presented on these web sites. These statements led to the decision to create the Spatial Modelling Park.

Several years before the creation of the S4 Interactive Platform, two actors of the ERG S4 have already been interested in developing comparable initiatives.

- The French Research Group *Libergeo* has developed an *Interactive database on spatial modelling*[5] which contains 21 models (1999-2003).
- The web site of the *Centre for Advanced Spatial Analysis (CASA)* of London contains a set of pages dealing with the recent advances in the research on spatial simulation models (in particular, cellular automata and multi-agent systems) developed for studying and planning urban systems[6].

At the moment, the *S4 Spatial Modelling Park* comprises four on-line services:

- The section *Spatial simulation models* is a database on spatial modelling which comprises standard description of simulation models including tools for analysing the contained data.
- The *Spatial simulation software* repository contains downloadable software dedicated to the construction of different types of simulation

---

3   http://www.cybergeo.presse.fr/

4   http://www.csiss.org/
5   http://www.mgm.fr/libergeo/modele
6   http://www.casa.ucl.ac.uk/research/index.htm

model.

- The section *Spatial analysis tools* contains the description of a set of tools most of them being downloadable.
- The section *Educational modules* is dedicated to the presentation of basic scientific models. The aim of this section is to promote and popularise research in advanced spatial modelling by giving simple modelling demonstrations and applications.

It has also been planned to develop two other services:

- Consultancy, assessment, valuation of spatial simulation tools, which will allow the users to set the performance of the models, in particular by defining their field of application.

- Technology watch, which will help users by giving information about new advances as well as about the evolution of the available contents of other resources centres. The performance of the technology watch will be ensured by using an automatic news search engine.

Even if those two services are not yet developed, they are perhaps the most important ones. Actually, the concept of the *S4 Interactive Platform* is very close to existing Internet realisations, which aim to help the development of innovative firms by providing innovation tools and user reviews about each of them. In particular, the *Virtual Environment for Innovation Management Technologies* (developed in the frame of the European VERITE network) and the *ONLI (On-Line Innovation) project* (also supported by the European Commission) were an inspiration for the Spatial Modelling Park. A fact is that the assessment and the valuation of spatial simulation models is a broad and rather unexplored field of investigation, but several members of the ERG S4 already began to work in that direction.

The actual content of the *S4 Modelling Park* is as following (see tables 1 and 2).

- 11 simulation models are described on line, 8 of them being downloadable. 13 other simulation models will soon be published on line. At the moment, their description is not yet completed and only available via the S4 private room.
- 6 spatial analysis tools are described on line, 5 of them being downloadable. 2 other tools will soon be published on line.
- 1 software dedicated to the development of a given type of simulation model (*i.e.* cellular automata) is downloadable on line.

- 6 educational modules are described on line and 1 more module will soon be published on line.

Table 1
The S4 Interactive Platform: on line spatial simulation models (July 2006)

Table 2
The S4 Interactive Platform: on line spatial analysis tools (July 2006)

Considering the general orientation of the *Spatial Modelling Park,* the development of a network policy for the preservation of intellectual property is required in order to avoid the plagiarizing of the know-how and to assure the platform's durability. A thought to this topic is work in progress. Some of the contributors to the S4 platform are in favour of the open source and free ware distribution of their software. Other contributors are not. A first possibility to preserve the intellectual property of their applications has been explored, which is the registration of a software using an *InterDeposit Digital Number*. The *InterDeposit Digital Number* is an international system for the identification of works offering the possibility of protecting any type of digital creation (music, sound, photographs, moving and still pictures, logos, texts, software, data bases, web sites, etc.) regardless of format. At the moment, one software of the S4 Platform (named *Fractalyse*) has been protected via an IDDN. The registration of the software *Fractalyse* is successful. Indeed, *Fractalyse* was potentially interesting for a scientific community not very numerous, widespread all around the world and not specific to a given scientific field. But, without any protection, the rights holders of the software would not have allowed many people to download it. Since *Fractalyse* is available on line, it is downloaded by people from all around the world belonging to different scientific fields (geographers, computer scientists, physicists...).

The S4 platform is in course of development. It means that it is the beginning of its life. Much is still to be done in order to add more contain, more description of applications, more spatial analysis tools and more software. But, the development of the platform is seen as a long time project, which should go on for several years.

An increased sharing of knowledge and know-how as a result of the development of the *S4 Interactive Platform* should generate important benefits. Especially in terms of research in the field of spatial dynamics of social systems, the consequences should be:

- enhancing the initiatives dealing with the coupling of several models,
- increasing knowledge of spatial processes through the comparison of numerous simulation results,
- the diffusion of the models throughout the different research teams of the S4 network as some other tools circulate via Internet.

The expected results are the improvement of the capabilities and the performance of the future models that will be built by research teams of different countries.

2. ACTION 2: DISSEMINATING METHODS, INSTRUMENTS, OUTPUTS AND RESULTS TO STAKEHOLDERS AND END-USERS

To attain this objective some preliminary work is required, which will involve the definition of categories of stakeholders: national governments, local and regional authorities, regional development agencies, consultancy firms specialised in regional development and spatial and urban planning, corporate location professionals, professional and business organisations, etc. Then, the transition from stakeholders to end-users comes down the definition of a potential market of end-users.

Once the preliminary work of definition has been completed, it will be possible to define actions aiming to disseminate the S4 knowledge. This requires to look at the simulation methods and models themselves. Actually, as regards the needs of stakeholders and end-users, it is of crucial importance to test the operational use of models and to improve them. Ensuing from this is a very close link with the development of the *Spatial Modelling Park* to the *S4 Interactive Platform*. The goals are indeed converging in the same direction: sharing the knowledge between communities of actors of different level (searchers, stakeholders, end-users), promoting the understanding of the models and their reuse, striving towards a better understanding of the modelling process for spatial simulation in social sciences. Hence, testing the operational use of models and improving it represents a way of both exploiting the contents of the *Spatial Modelling Park* as well as improving it.

Another kind of reflection is also required which aim is to evaluate and better define the real possibilities of the operational use of the developed modellings. Such a field of investigation is at the heart of a doctoral research currently undertaken in the research centre ThéMA (Besançon, France)[7].

The research proceeds from the statement that several factors may occur in the fact that the spatial simulation models developed by researchers can mostly not be directly used for operational purposes. Firstly, existing modellings are characterised by a lack of conceptual framework, which consequence is the very few possibilities of combining the models the ones with the others. Secondly, the user interfaces are not enough oriented toward a general use. Thirdly, the applications are operational considering a given case (either fictitious or real), but they rarely allow the introduction of data different from those originally used.

The central question of the discussed research is about the identification of the possible transfers of the scientific knowledge as well as the possible diffusion of simulation tools to the social and economic world. As a result, the way of performing such transfers is of well interest. Three steps have been defined to tackle this question.

The first step aims to determine the relevance of different types of spatial simulation modellings considering operational goals (*i.e.* urban and regional planning).

The second step deals with the modelling process itself: its formal description will give a conceptual and reusable framework, which could be used to generalise the existing modelling tools and applications. Such a reusable framework would be helpful for:
- the share of knowledge between several types of users and actors (researchers, planners, consultancy firms...),
- the promotion of the modelling tools and their reuse,
- a better knowledge of the modelling process itself considering the goal of the simulation of spatial systems.

Within the field of Information Systems Development and Knowledge Representation, some methods have been developed which could helpfully be applied to move in such direction. One of these methods is the definition of an ontology which aims to identify and to represent the knowledge in the field of spatial modelling. The second method is the formalisation of the knowledge through reusable patterns that will serve as a basis for building Product Models. Here, a pattern represents a solution advocated to solve a recurrent problem defined in a given context. Now, regarding the previously mentioned problem of the plagiarizing of the S4 know-how, combining these

---

7   S. Grandjean "*Simulations spatiales intra-urbaines -*

Rendre opérationnels les modèles issus de la recherche fondamentale", directed by P. Frankhauser and C. Tannier.

two approaches (ontology and reusable patterns for building product models) will lead to the development of a shadowing method for the models.

The third step is dedicated to the application of the tools and methods developed during the two previous steps in order to create and apply operational spatial simulation modellings.

3. ACTION 3: EVALUATION OF EFFICIENCY OF THE ACTIONS 1 AND 2

Two benchmarking actions should be usefully undertaken, but at the moment, they remain under consideration. The first action would aim to evaluate sharing of knowledge as a crucial part of the efficiency and effectiveness of the ERG S4. Its realisation could be based on the definition of quantitative and qualitative indicators and face-to-face interviews and meetings during the conferences and workshops. The second action could consist in ex-ante and ex-post evaluation of the dissemination actions also through the definition of quantitative and qualitative indicators.

Conclusion

The action "Sharing and disseminating knowledge of advanced spatial modelling", carried out by the European research group S4, participates in the development of research in geography seen as very active regarding its opening toward other scientific fields as well as the evident potentiality of using spatial modellings for urban and regional planning. But, although very promising, much is still to be done to ensure the general use of spatial modelling for operational purposes.

Table 1

The S4 Interactive Platform: on line spatial simulation models (July 2006)

Name of the model	Author(s)	Creation date of the presented version	Downloadable
CalCom: Calculating the Attractiveness of Retail Clusters	ThéMA, Besançon, France	2000	yes
SimNoise: Simulating the Impact of Noise Annoyance on Intra-urban Residential Migration	ThéMA, Besançon, France	2003	yes
CamDeus: Cellular Automata Models to Design Environmental and Urban Systems	Image et Ville, Strabourg, France	2002	no
Peuplement: Simulation of Size Differenciated Urban Growth	ESPACE, Aix-en-Provence, France	2001	yes
3D-IMA: Simulation of the Visual Impact of a Planning Project	CITERES, Ecole polytechnique de l'Université de Tours, France	2001	yes
Spatial Diffusion of an Innovation: a Multi-agent Formalisation of the Hägerstrand's modelling	ESPACE, Avignon, France	2003	no
Urban Growth Modelling using Cellular Automata: the example of the urban area of Rouen	IDEES, Rouen, France	2003	no
RamCO: An integrated assessment tool for sustainable coastal zone management	RIKS (Research Institute for Knowledge Systems), Maastricht, Netherlands	1999	yes
SimLucia: climate change and dynamic land use planning in St. Lucia	RIKS (Research Institute for Knowledge Systems), Maastricht, Netherlands	1996	yes
WadBOS: A policy support system for the Dutch Waddenzee	RIKS (Research Institute for Knowledge Systems), Maastricht, Netherlands	2001	yes
Lobster-IBM: individual based model of lobster fishing in Newfoundland	RIKS (Research Institute for Knowledge Systems), Maastricht, Netherlands	2003	yes

Table 2

The S4 Interactive Platform: on line spatial analysis tools (July 2006)

Name of the application	Author(s)	Creation date of the presented version	Downloadable
Fractalyse: Fractal Analysis of Patterns (surfaces or lines)	ThéMA, Besançon, France	2004	yes
Arpege: Robust Analyses for Geographical Explorations	ESPACE, Avignon, France	2000	yes
GéoGrapheur: Exploratory Data Analysis Module	ThéMA, Besançon, France	2001	yes
CDV: Cartographic Data Visualization	Leicester University, Great Britain - Wageningen University, Netherlands	2002	no
Map Comparison Kit	RIKS (Research Institute for Knowledge Systems), Maastricht, Netherlands	2003	yes
EcoVisie: Ecosystem visions for Flanders valleys	RIKS (Research Institute for Knowledge Systems), Maastricht, Netherlands	2001	yes