
Geographic Objects with Indeterminate Boundaries



EDITORS

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GISDATA II

SERIES EDITORS

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The GIS Data Series

Editors' Preface



Over the last few years there have been many signs that a European GIS community is coming into existence. This is particularly evident in the launch of the first of the European GIS (EGIS) conferences in Amsterdam in April 1990, the publication of the first issue of a GIS journal devoted to European issues (*GIS Europe*) in February 1992, the creation of a multipurpose European ground-related information network (MEGRIN) in June 1993, and the establishment of a European organization for geographic information (EUROGI) in October 1993. Set in the context of increasing pressures towards greater European integration, these developments can be seen as a clear indication of the need to exploit the potential of a technology that can transcend national boundaries to deal with a wide range of social and environmental problems that are also increasingly seen as transcending the national boundaries within Europe.

The GISDATA scientific programme is very much part of such developments. Its origins go back to January 1991, when the European Science Foundation funded a small workshop at Davos in Switzerland to explore the need for a European level GIS research programme. Given the tendencies noted above it is not surprising that participants of this workshop felt very strongly that a programme of this kind was urgently needed to overcome the fragmentation of existing research efforts within Europe. They also argued that such a programme should concentrate on fundamental research and it should have a strong technology transfer component to facilitate the exchange of ideas and experience at a crucial stage in the development of an important new research field. Following this meeting a small coordinating group was set up to prepare more detailed proposals for a GIS scientific programme during 1992. A central element of these proposals was a research agenda of priority issues grouped together under the headings of geographic databases, geographic data integration, and social and environmental applications.

The GISDATA scientific programme was launched in January 1993. It is a four-year scientific programme of the Standing Committee of Social Sciences of the European Science Foundation. By the end of the programme more than 300 scientists from 20 European countries will have directly participated in GISDATA activ-

ities and many others will have utilized the networks built up as a result of them. Its objectives are:

- to enhance existing national research efforts and promote collaborative ventures over coming European-wide limitations in geographic data integration, database design and social and environmental applications;
- to increase awareness of the political, cultural, organizational, technical and informational barriers to the increased utilization and inter-operability of GIS in Europe;
- to promote the ethical use of integrated information systems, including GIS, which handle socio-economic data by respecting the legal restrictions on data privacy at the national and European levels;
- to facilitate the development of appropriate methodologies for GIS research at the European level;
- to produce output of high scientific value;
- to build up a European network of researchers with particular emphasis on young researchers in the GIS field.

A key feature of the GISDATA programme is the series of specialist meetings that has been organized to discuss each of the issues outlined in the research agenda. The organization of each of these meetings is in the hands of a small task force of leading European experts in the field. The aim of these meetings is to stimulate research networking at the European level on the issues involved and also to produce high quality output in the form of books, special issues of major journals and other materials.

With these considerations in mind, and in collaboration with Taylor & Francis, the GISDATA series has been established to provide a showcase for this work. It will present the products of selected specialist meetings in the form of edited volumes of specially commissioned studies. The basic objective of the GISDATA series is to make the findings of these meetings accessible to as wide an audience as possible to facilitate the development of the GIS field as a whole.

For these reasons the work described in the series is likely to be of considerable importance in the context of the growing European GIS community. However, given that GIS is essentially a global technology most of the issues discussed in these volumes have their counterparts in research in other parts of the world. In fact there is already a strong UK dimension to the GISDATA programme as a result of the collaborative links that have been established with the National Center for Geographic Information and Analysis through the United States National Science Foundation. As a result it is felt that the subject matter contained in these volumes will make a significant contribution to global debates on geographic information systems research.

*Ian Masser
François Salgé*

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Preface



In November 1993, an Italian working in the UK (Max Craglia), a Swiss working in Austria (Andrew Frank), an Englishman working in the Netherlands (Peter Burrough) and a Frenchman working in France (Benoit David) met in Paris to plan the European Science Foundation GISDATA Workshop on 'Concepts and Languages in GIS'. This task force, which had been steamrollered into existence by Max Craglia, the GISDATA Research Coordinator, laid the foundations for a fascinating workshop that was held the following June in Baden, just south of Vienna.

The idea emerged for a meeting that would bring together a broad mix of researchers to confront the problems of dealing with real geographic phenomena that cannot easily be forced into one of the two current standard data models, namely, exact objects or continuous fields. Subsidiary aims were to explore the problems of perception and description of distinct and less distinct spatial phenomena, both natural and anthropogenic, in the context of different national and scientific cultures and means of communication. Researchers from 12 European countries and the USA (including two representatives from the United States, NCGIA) participated. The disciplines included computer science, human and physical geography, soil science, remote sensing, surveying and photogrammetry, geology and linguistics.

Current models in GIS are only useful if positions in space are known, or if it is assumed that space and spatial processes are continuous. However, spatial reasoning does not always require knowledge about position (it is topology that matters most), space and processes are not always continuous, and objects often have indeterminate boundaries. Although in the past there has been a tendency to force reality into sharp objects, there is now an increasing recognition of the need to develop appropriate new methods to represent complexity. A starting point is to distinguish between uncertainty in the description or measurement of crisp objects from uncertainty in phenomena which, by their very nature, are difficult to define (such as baldness). Human beings can cope very well with abstract concepts, while computerized systems do not. Therefore, it is important to elicit and formalize mental models. However, these models are influenced by the perception of the individual, his/her background and culture. The discussion thus needs to focus not only on uncertainty and complexity, but also on the extent to which these concepts vary

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for different people and cultures. In this respect, the key concern is not on what the world is, but how people see the world and how they deal with it, how they measure it. To understand the different perceptions of reality, language is critical as it is an expression of how we experience space. With this in mind, the aim of this meeting was to elicit the underlying assumptions and perceptions of reality of different groups by analyzing how they formalize or describe a common issue, then to develop a taxonomy of models, to identify current limitations of GIS in dealing with objects with no sharp boundaries, and to stimulate research to overcome these limitations.

Before the meeting we wrote a position paper which was circulated to all participants well in advance. That paper is not included in this volume, but has been published in the *International Journal of Geographical Information Systems* (1995, 9(2): 101–16) as an extended, reviewed Guest Editorial entitled 'Concepts and paradigms in spatial information: Are current geographic information systems truly generic?'. All participants responded to the invitation to write a reply to the position paper from the point of view of their own discipline and experience. These papers were circulated to all participants before the meeting so that they could form the focus of discussion. An important part of the meeting was the 6 km walk from Baden to Gumpoldskirchen through urban, park and rural landscapes, which gave everyone the opportunity to test ideas in practice before consuming much wine at the *heurige* and a good meal. Enthusiasts walked back in the dark, continuing the discussions.

The papers were reviewed and rewritten during the summer of 1994 and form the substance of Parts 2–6 of this book. Our contributions have been two introductory chapters (Part 1) which review ideas, methods and concepts in defining, delineating and operating with indeterminate geographical objects in both natural phenomena (Chapter 1, Burrough) and anthropogenic situations (Chapter 2, Frank). These chapters set the scene for the rest of the book and provide essential supporting material and references for the reader. We have also provided a short introduction to each Part in order to draw out some of the main points that we have perceived as being noteworthy and important. Part 7 was written after the main text was complete to show that the ideas presented here do indeed relate to reality.

We believe that the material included in this book presents a fascinating cross section of up-to-date opinion from many different but related disciplines and cultures on the problems of describing 'geographic reality' and capturing that reality for applications using GIS. The different chapters raise many issues that can form the basis of future research programmes: ideas have emerged that must surely affect the way geographic data are collected and stored in future if future GIS are to deal successfully with multi-scale, polythetic phenomena in 4D space-time.

We are particularly grateful to Max Craglia and the ESF GISDATA programme for stimulating and financing this work, and to the US NCGIA for support for two participants. Most thanks are due to the participants who wrote, discussed, reviewed and rewrote chapters with enthusiasm and care within a remarkably short timespan. Thanks are also due to Peter Fisher and his team of international reviewers for their efforts to get the position paper reviewed within a few weeks just before the meeting

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GISDATA 2

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François Salgé



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and Andrew U Frank