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Thematic Cartography for the Society

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Thematic Cartography for the Society

Introduction

Thematic cartography is one of the most communicative branches of science. It is a large part of cartography focusing on natural phenomena, and social, political, and economic issues, combining visualisation and exploration methods, and targeting and supporting different groups of users. It opens opportunities for the geo-information society to show its irreplaceable and unique role as the backbone of the information/knowledge based society. It is a tool for decision making and is one of the most suitable ways to show the results of geospatial analysis in a readable visualisation manner. Thematic cartography can support many different disciplines by presenting the knowledge that is obtained from the processing of geoinformation data. Such knowledge transfer is made through maps or cartographical products which gather, manipulate, analyse and visualise information extracted from geodata. Thematic cartography is not simply mapping, but a process which provides users with greater knowledge, in the form of cartographic products: 2D and 3D maps and models of the reality, animations, interactive and web-accessed maps.

In the last decade a broad discussion was initiated about the importance of the user and the need to move from product-oriented to user-oriented cartography. The advances in computer science, computer graphics, machine-human interaction, web and mobile technology have convincingly shown that digital application can be tailored to the needs of the user. Thematic cartography is one of the spatial presentation tools which has long traditions in this direction. Combining newly available technologies with the strength of cartographic theory and practice will allow fast development of user-oriented products in contracts to the traditional application-oriented products. This book provides evidence of how thematic cartography can be used in various areas of society.

The chapters of this book are organised in five parts as follows: User-Friendly Internet and Web Cartography; User-oriented Map Design and Production; Context-Oriented Cartographic Visualisation; Sensing Technologies and their Integration in Maps; Cartography in Education.

1 User-Friendly Internet and Web Cartography

Thematic maps have been always created for the users and with the help of the users. The internet and the world wide web provide new possibilities to make this connection closer and faster. This platform for publishing opens opportunities for everybody to visualise geospatial information through maps. Very often we find maps and cartographic models published on the internet to be of very low quality, insufficient accuracy and of non-professional creation, with a lack of scale, inappropriate map projection, an incorrect symbol system or legend, and content that is difficult to understand. Cartographers need to address these problems and provide users and map-makers with information about map creation and publication for the internet. The validation of information represented on maps originating from volunteers is also very important. The capacity of the internet for publishing is so great that it is sometimes difficult for users to estimate the quality of information, and to choose legible and accurate cartographic information. Cartography has the goal therfeore to provide a user-friendly internet is a platform for developing the most appropriate and useful maps for everybody, everywhere and every time.

The new web-based cartography has the potential to provide society and users with an integrated platform for easy and understandable analyses, spatial data sharing and visualisation. Web cartography can be seen as a part of a spatial decision support system. Mildorf et al. show how an enormous quantity of data coming from different sources could be harmonised, and the result of the processed data offered to the user through thematic maps and web-mapping. For this aim open source tools are used and integrated in an open data platform.

The internet possibilities of modern thematic cartography are of great importance for extending the scope of traditional cartography and this is well-represented in this book. One of the chapters describes a web-oriented geoinformation system for protection against forest fires. Barakovskiy and Zharikova present fire risk maps support urban planners and disaster managers in the prevention phase. Solyman et al. present a methodology for building an integrated web map solution to access the effect of the sea level rise scenarios on the northern coast of Egypt. Meier et al. propose a method for the implementation of density maps as a useful alternative for visualising information on mobile handheld devices. This can help users explore their environment while on the move. The preparation of such maps illustrates also the fact that different specialists need to work together to successfully fulfill the needs and expectations of society.

2 User-Oriented Map Design and Production

Thematic cartography deals with, and makes its products for a variety of users. Several commissions in the International Cartographic Association (ICA) focus on users: for example the commission on cartography and children, education and training, maps and graphics for blind and partially sighted people, maps and society, mountain cartography, planetary cartography, and others. In its research agenda, the ICA aims to present geographic information to society in a user-friendly and understandable visual and tactile way (www.icaci.org).

The major goal of thematic maps is to create relevance and understanding for users. Cartographers need to present geospatial information, in the most clear, readable and appropriate way, to different groups of users with different cultures, religions, ages, genders, etc. Cartography research has published a substantial number of articles about user oriented map production and design over the years. This book also provides several innovative examples.

Dukaczewski presents an approach for designing simple and complex animated maps for users from different age groups, using an appropriate selection of static and dynamic visual and sound variables.

Al-Ghamdi proposes optimisation of the selection of the number of choropleth map classes which could help the GIS user to make better thematic maps. Cartographers use widely GIS because GIS provides them with techniques which allow easy and fast compilation of thematic maps. An example of such work is presented by Kurowska et al., where the universal principles for creating thematic maps supporting the planning process are developed.

Over the last 50-60 years GIS has become one of the most important tools for cartographers in finding solutions to different tasks in society, administration and government. Bartoněk et al. present and analyse the possibilities of optimising the sub-processes and contexts required to determine terrain surface types above gas pipelines in the Czech Republic. They found that in cartographic work, 54% of the time taken to complete a task is still spent on manual work, 23% of the time is fully automated in data preparation and another 23% in data processing.

Rotanova and Lovtskaya discuss the creation of cartographic and thematic databases using GIS, and making a contribution to the SDI of the Ob basin system in Russia.

The usefulness of thematic cartography is demonstrated in the study of Perez-Gomez and Ibanez. They show that thematic maps, 3D models, and zonal statistical analysis are useful alternative methods and techniques when dealing with geodiversity.

Tikunov et al. investigate attempts to systematise elements that form the power of the state, and bring them into one formula. They introduce a general geographic size index (GSI) which includes only three components: area, population and economic strength. GSI demonstrates the real picture of government power and illustrates the dynamics of its change. The results are demonstrated through GSI graphs and maps.

Very often a large team of different specialists needs to work together to produce good thematic products that fit the needs of specific users. A good example of this is the compilation of the Academic Atlas of Czech History which constitutes a unique multidisciplinary publication (Janata et al.).

User-oriented map design and production cannot be performed without the user. Specialists from different domains need to work together with users, and map design and production must involve access to all necessary data with respect to the tasks society needs to perform and the challenges that different groups of society will face.

3 Context-Oriented Cartographic Visualisation

Context-oriented cartography is part of so-called 'ubiquitous mapping' which comes from the idea of pervasive computing and pervasive maps. Ubiquitous mapping is one of the biggest challenges in contemporary cartography and geoinformatics, and arose because of the perceived advantages of an 'information society'. Mapping should be done by everybody, at any time, and everywhere with all possible technological tools.

The main objective of visualisation is to present the salient features of a spatial context in a manner that is easily and quickly assimilated by a human being. The problem lies in the volume of information and the consequential information overload, leading to a user missing vital aspects in their analysis. In a dynamic situation, the problem is compounded by the real-time stream of data that has to be rapidly surveyed by the user for patterns and anomalies without being overwhelmed.

Researchers have discovered and confirmed the cognitive styles of users with different skills, abilities, education and cultural background and different ages, which is especially important in dynamic geovisualisation (e.g. in disaster management) for creating adaptive and context-based map concepts.

Cognitive style or 'thinking style' is a term used in cognitive psychology to describe the way individuals think, perceive and remember information, or their preferred approach to using such information to solve problems. The two main streams of cognitive style are holistic or analytic, and information about both could give practical input to cartographers. Some people find maps preferable, others prefer orthoimages. This preference can play an important part in cartography and map using, especially in disaster situations. Several chapters in this book are devoted to this topic.

Yilmaz et al. investigate different means of geovisualisation in a virtual environment, using human perception. Zheng and Zheng's research describes Open StreetMap data for Chinese territory. They investigated which parts of the biggest cities have the most complete information and which areas of China have less detailed information.

Hu et al. developed a dynamic map environment with three directions: integration of the virtual geographic environment with volunteered knowledge construction, the connection of the dynamic environment to everyday life, and the provision of a comprehensive social experience of daily communication.

Todd developed a common visual symbolic language to represent eco-regions. This will help to represent the biophysical complexity of regions in a simplified form and will also help users making land use decisions.

A simplification of 3D Maps with multiple LODs of buildings is shown in the research of Noskov and Doytsher. They propose a method for compiling a three dimensional scene with automatic LOD generation of objects. This research contributes to improving visualisation performance by reducing the computing time and the required computer resources.

One of the most important subjects of thematic cartography is mapping for the needs of early warning and disaster management. Many authors direct their attention here. A good example of cooperation between scientists from different countries (Bulgaria and Germany) and comparative analyses of different territories (Bulgaria and USA) is the chapter written by Boyanova et al. Such common efforts will bring cartography to the level where it can be used for fast decision making. Cartographic products and analyses are presented for use towards this aim.

4 Sensing Technologies and their Integration with Maps

The integration of sensing technologies and thematic cartography expands the abilities of research and development to support decision makers and the geoinformation-oriented society. Such integration will benefit from being process-oriented, and from mapping of the required territories that uses better resolution maps and more attributes in databases. The economic value of thematic maps for end-users can thus be found. This will come from more detailed spatial information, higher accuracy and additional content which can be extracted from the range of cartographic products made on the basis of this process of integration. Cartographers need to know the end-user requirements so as to present individual objects and phenomena on their maps.

Rocchini et al. describe the integration of sensing technologies with maps and estimate potential hotspots of diversity, allowing effective management and conservation of the landscape. Sensing technologies in combination with cartography have another common target: to describe the results of climate change. Hidayati et al. analyse image transformation and land use cover according to temperature trends shown by Landsat imagery, and find a 0.99ºC rise in average temperature in twenty years in an Indonesian city.

Another chapter considers environmental data visualisation. Lienert describes the linking of real-time sensor data with spatial data infrastructures for web-based visualisation. This responds to the growing expectations of society for spatial data access from sensors. It is achieved through the creation of mobile device-based maps on a public web-based platform.

One of the most important and interesting topics of thematic cartography is the creation of environmental noise maps. This topic is well covered by Duda who uses crowd-sourcing for the creation of such maps. Such approach leads to many questions about the quality of data and its validation but Duda believes that crowd-sourcing a promising low-cost and quick method, which will further develop.

5 Cartography in Education

One of the greatest goals of cartography is in producing maps for education. From a young age students deal with and use maps in a variety of courses in their study. The use of cartography in education processes continues into university and the various courses for specialists from science, government and regional institutions. Cartographers try to use the latest achievements of technology and give their users modern materials using the internet, mobile devices, and animated and multidimensional representations.

Maps for education are becoming more important than ever. Students are familiar with computers and social media. Using games for education is already a trend in many countries. These developments have also influenced the types and content of maps.

Rodionova et al. show that thematic cartography gives users a great deal of new information about the surfaces of celestial bodies, and they describe in detail the mapping of extra-terrestrial objects. Their research is also connected to education and the university teaching of cartography.

School cartography is considered by Reyes Nunez. His research is about the use of cartograms as one of the newest methods of representation in thematic cartography, and in maps compiled for students.

Ormeling describes different types of distortion in cartography: hill-shading, classification, generalisation, and map projections. He recommends "more warnings attached to maps regarding these drawbacks, and [that] the unsuitability of the use of these maps for specific purposes, such as making measurements, should be clearly stated. It should be easy to attach such warnings to the maps, especially to their digital files". The same warnings should be addressed to mapmakers who are not cartographers.

As the chapters in this book illustrate, cartography is a discipline which has always taken into consideration the needs and the requirements of users. This unique role should be further strengthened by close cooperation with specialists from other disciplines so as to be able to provide the best products for society.

We hope that this volume will be useful reading for researchers, practitioners and students. We are grateful to the contributors for their commitment and hard work. We greatly appreciate the support of all of the members of the International Organising Committee of the 5th Jubilee International Conference on Cartography and GIS and are thankful for their time and valuable comments, which have contributed to the high quality of this volume.

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This book is the result of a collaborative effort of 71 researchers from Bulgaria, China, Czech Republic, Egypt, France, Germany, Hong Kong, Hungary, India, Indonesia, Israel, Italy, Netherlands, Poland, Russia, Saudi Arabia, Spain, Switzerland, Turkey, Ukraine, and the USA.

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Contents

Part I
User-Friendly Internet and Web Cartography

Open Data Platform for Data Integration, Visualisation and Map Design

Tomas Mildorf, Jan Jezek, Otakar Cerba, Christian Malewski, Simon Templer, Michal Sredl, Karel Charvat[1]

Abstract The current trend in the EU is to open access to public sector information which is provided either for free or for marginal cost, and reuse it in various applications. Information technologies enable people to access, process and analyse spatial data from various sources, help to design on-demand maps and provide information for decision makers. However, the provision of data varies across different authorities, and combining heterogeneous data is not an easy task. We present an Open Data Platform that enables people to integrate, harmonise and visualise spatial planning and other data. The platform connects to the approach of real cartography and aims to enable non-cartographers to correctly design maps and gain new information in a user-friendly way based on modern technologies and robust data storage. This chapter mainly tackles the issues of heterogeneous data integration, harmonisation and visualisation. Ongoing research aims to explore new methods of data reuse and cartographic visualisation, following the trends of modern cartography.

1 Introduction

Spatial data is a key part of knowledge about the relationships between phenomena on the Earth. Spatial data links various kinds of information and provides the means for data interpretation and visualisation. The availability of spatial data is

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thanks to significant improvements in initiatives such as INSPIRE[2] or Open Data[3], and access to actual and clearly licensed data is becoming easier. Spatial data is available not only for viewing purposes but also for reuse, and can be published as machine readable, which opens the field for innovative services based on linked data[4].

The current trend in the EU is to open access to public administration information. Information is provided either for free or for marginal costs. In addition to EU legislation supporting this process, such as the EU Directive on the Re-Use of Public Sector Information (PSI Directive), there are other European initiatives, including, for example, the European Interoperability Framework (EIF). All related legislation and initiatives aim to provide information in an interoperable way that is suitable for reuse (Mildorf et al. 2013). As identified in recent studies, for example by Koski (2011), the release of public sector information for reuse can be of considerable benefit to economic growth.

The information value of data increases when different data sources are connected or linked together. New information can be then derived through data mining. The ability to effectively integrate, interpret and visualise many different datasets is one of the major challenges for modern cartography and geoinformatics.

There are several platforms that focus on data access and interpretation, such as the World Bank[5] or the World Factbook[6]. Such platforms focus on the visualisation and comparison of data from particular countries or groups of countries. We present a platform that specialises in spatial planning data used for, or resulting from, spatial planning activities and their reuse.

Spatial planning "gives geographical expression to the economic, social, cultural and ecological policies of society. It is at the same time a scientific discipline, an administrative technique and a policy developed as an interdisciplinary and comprehensive approach directed towards a balanced regional development and the physical organisation of space according to an overall strategy." (Council of Europe 1983). Spatial planning data, as understood by the authors, includes mainly land use data, as defined by the INSPIRE Directive: "the territory characterised according to its current and future planned functional dimension or socio-economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational)." (European Commission 2010). As well as land use data, spatial planning data encompasses statistical data, hydrography, flood areas, protected sites, transport networks, cadastral parcels and other data used for spatial planning activities.

[2] http://inspire.jrc.ec.europa.eu/

[3] http://opendefinition.org/

[4] http://linkeddata.org/

[5] http://data.worldbank.org/

[6] https://www.cia.gov/library/publications/the-world-factbook/