CURRENT CHANGES IN CARTOGRAPHIC VISUALISATION

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ABSTRACT

The most important changes in cartography are associated with the development of computer technology (GIS), and regarding the function and usage of maps, the accent has been given to cartographic visualisation. The paper emphasises the need for closer collaboration of informatic experts, geodesists, geographers, spatial planners and others with cartographers. The future of cartography is associated with map production, GIS, visualisation of spatial databases, and the production of detailed three-dimensional landscape presentations.

Keywords: cartographic visualisation, GIS, real and virtual maps, current changes

1. INTRODUCTION

In the last few centuries a map had two important functions: it was a medium for saving information about space and it was the image of the world that helped people to learn about the complexity of the environment. Digital mapping has brought the co-ordinates in digital form in order to establish databases and cartometric usage, and referring to the space image, a map being in digital or analogous form, intrudes itself upon us as being the most important cartographic visualisation of space [Robin95].

2. CARTOGRAPHIC VISUALISATION

There is an old proverb saying that one image is worth more than thousands of words, giving thus the simplest answer to the question why visualisation is necessary. It is an act of learning, i.e. man's capability to develop images mentally that makes the recognition of pattern and the formation of arrangement possible. Although some authors discover and connect the visualisation only with computer technology, it is no new method in computer technology or in digital cartography. The research and efforts in finding out the way how to present diminished and simplified earth's features and objects have been done even before the introduction of computers in cartographic activity, but it is quite certain that digital procedures contributed in achieving higher quality and quicker performance of such an act and have also opened some new possibilities for changes in the development and usage of map graphics [MacEa90], [DiBia92], [MacEa92], [Frang98].

It will be demanded more and more from mapping tools to be able to present a map immediately, in realistic time on the screen, in accordance with the demands and usage, respecting thereby the spatial reality, satisfactory visualisation with the elements of map graphics, emphasising the associations and similarity, and also satisfactory translation of spatial information into knowledge [Bollm96]. So far, focusing has been developed that is used for determining the contrast between objects and environment, defining thereafter the limits of clear distinctness. The accompanying effects are known as disappearing, obscuring, and similar. Furthermore, zooming has been developed almost perfectly enabling the distinction between graphic, contextual and intelligent zoom, and also the work with the sections, windows, graphs and icons [Timpf97]. There are also three-dimensional presentation, shading with various models of illumination, e.g. flat shading, the method of intensity interpolating (Gourad shading), the method of interpolating normal onto the surface (Phong shading), the method of ray-tracing and the method of radiosity, blinking and glittering, various filters, simultaneous presentation of various maps, colour transformation and other phenomena stated in the next chapter [Slocu94], [Vande94], [Kraak96]. It should not be exaggerated when using visualisation tools. One should, namely, try to achieve visual simplicity and, when it is not necessary, avoid any burdening of a user.

The development of visualisation software requires, especially for mapping purposes, the research of real needs and aim that users want to reach. The cartographers offer expert opinions for every purposeful speciality, including also the data classification, consequences of generalisation and association of map symbols, assessment of how a user understands map graphics, etc. Cartographers must have a share in scientific visualisation, as well as users and creators of tools, leaning in it on scientific and professional cognition, but also on individual skills [MacEa92]. The tools of cartographic visualisation give users the possibility to carry out extensive transformations and changes of data presentation, e.g. different observation angle, changing various conditions etc. enabling the comparison of essential facts. They would remain inaccessible or could look needless and not connected among each other [MacEa90].

In the context of spatial data management, the process of visualisation is considered as translation or transformation of spatial data from the database into a drawing (see Fig. 1). These are mostly the products similar to maps. Under spatial data management we understand gathering, saving, processing and visualisation of spatial data in the context of special applications. During the process of visualisation we apply cartographic methods and techniques. It can be observed as some kind of grammar allowing optimal creation, production and usage of maps, depending on their application [Kraak98].

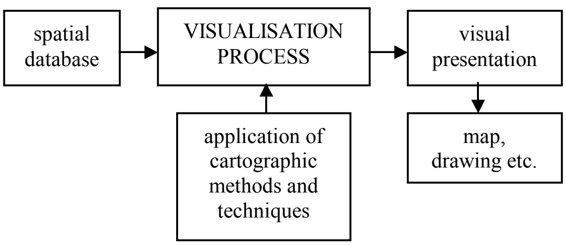

Fig. 1. Cartographic process of visualisation

Maps are the main source of information for GIS and one of the ways in visualising information generated with GIS. Cartographers are included into creation and usage of GIS. They are especially involved in the formation of necessary databases, i.e. into determination of data models, database contents, data types, data dictionary and similar, into hardware selection and software for GIS support, into selection of sources and methods for taking spatial data from maps and into selecting, developing and applying methods for visualisation of generated information on various output devices supported by GIS [Gupti95].

3. CURRENT CHANGES

It should be pointed out that the application of computers and the development of analytical cartography have brought the concepts of real and virtual maps. A lot of cartographic products have namely appeared, e.g. images on screens and digital relief models that have escaped ordinary map frames as a permanent product on the paper. According to Moellering [Moell80], [Moell91], [Moell99], there are two decisive characteristics that distinguish conventional maps in real form of a visible copy from virtual maps. The real map is a product that can be seen directly as cartographic image. Ordinary maps on the paper and images on the screen can be seen in such a way, but the files of cartographic data cannot be seen in that way. They have to be transformed first into the state of direct visibility. The other decisive characteristic is whether the product can be touched. Table 1 shows the classes of real and virtual maps obtained by means of answers yes and no as referring to the above-mentioned characteristics.

Table 1. Four classes of real and virtual maps with the presentation of all 16 possible transformations among them (according to Moellering [Moell91])

		Directly visible cartographic image		
		YES		NO
Constantly touchable reality	YES	REAL MAP: conventional map sheet, globe, orthophoto map, machine drawn map, computer output on a microfilm, block-diagram, plastic terrain model	↔	2. VIRTUAL MAP TYPE traditional field data, field book, anaglyph, film animation, hollo-gram (saved), Fourier transform-ation (saved)
		↕		↕
	NO	1. VIRTUAL MAP TYP: image on screen, cognitive map (two-dimensional image)	↔	3. VIRTUAL MAP TYPE: digital memory (data), magnetic disc or tape (data), video animation, digital terrain model, cognitive map (relation geographic information)

Conventional cartographic products, e.g. map sheets, atlases and globes that have firm, touchable reality and are seen directly as cartographic images are called real maps. The other three classes that lack one of the characteristics or both are called virtual maps. These three classes enable the extension of the definition of a map that reflects the development of modern cartography.

Thus, it can be derived that the virtual maps can contain the same information as the real ones, but in the case of cartographic bases even more than that. Hence, the cartographic databases should be considered as maps because they can contain the information of real maps and can be transformed into them, if it should be necessary. The transformations among four classes of real and virtual maps can be applied in order to define all important data processings in cartography. Thus, those 16 transformations (see arrows in the Table 1) define the operations as digitising (transforming the real map into the virtual map of the type I), presentation on a screen (transforming the virtual map type III into the virtual map type I), the production of analogous copy from the screen (transformation of the virtual map type III into the real map) or transferring the database (transforming the virtual map type III into the virtual map type III) [Moell91], [Moell99].

4. INFLUENCE ON CARTOGRAPHIC VISUALISATION

There are numerous digital databases created every day being accurately connected with the position on the Earth. These databases can be completed with digital images and sound. It has already been suggested to use unpleasant sound with the presentation of inaccurate data and pleasant sound or without sound with the usage of accurate and checked data. In some spatial presentations in the video environment the impression of uncertainty was tried to be created by obscuring the presentation or colour transfer among the classes. A cartographer will be able to take the methods from the film industry that he will use for obscuring a part of the presentation. Let us suppose that accurate data will be presented with precise and clean signs, and inaccurate and dubious data with unclear and dim signs. However, the techniques that are good for a computer screen might not be applicable for analogous graphic outputs. The analogous maps might demand a series of diagrams, each for a single datum.

There are more and more electronic maps and atlases on CD-ROMs. The greatest advantage of a multimedia atlas, as compared with the printed one, is the speed of searching: changing map scale, transferring from one part of the Earth's globe to another, searching a specific name etc. Apart from that, we are not limited by the given formats, but can choose ourselves the segment we are interested in. Furthermore, each map supplemented with our own data can be printed on paper. Of course, the multimedia atlas has also some disadvantages referring to the printed atlases. With respect to the graphic quality, the cartographic presentation on screen cannot be compared with the printed atlases, the classification of roads is insufficient, the algorithms for automatic title location is defective, etc. [Franč99a].

The influence of Internet and World Wide Web (WWW) on cartography is enormous. WWW is unrivalled in its capability to offer a great amount of information to many users at minimum prices. The expenses of maintaining the server and connection with Internet are minimal related to the prices of producing distributing CD-ROMs. Updating is quick and cheap. The atlases on CD-ROMs, as well as printed atlases become obsolete very quickly, and the atlases on WWW can always be available for users in the most updated state [Franč99b].

The development of animation has contributed remarkably to visual thinking and communication, as well as to dynamic presentation of information. The most maps either those two-dimensional or three-dimensional, are namely static and contain respectfully adequate map graphics. The animation in cartography has contributed mostly to the dynamics of a map enabling thus direct presentation of movements and changes. The map graphics necessary for expressing the dynamics is very complex and still insufficiently researched [DiBia92].

The presentation of three-dimensional objects on a two-dimensional screen has always been a special challenge. The software for visualisation contains unfailingly the tools for the presentation in 3D graphics, so that a great number of data coming from various sources in the real time could be presented in such a way that they are immediately understandable. The production of detailed three-dimensional landscape presentations, especially cities, is another challenge for cartographers. Such three-dimensional models demand more and more disciplines, e.g. regional and urban planning. Telecommunications, insurance companies, environmental and cultural monuments protection, tourism and many others [Franč99b].

There are projects in leading laboratories for the future that develop simulation and experiments in real time with stereo presentation, and there are also solutions called in a popular way virtual or simulated reality. One can thus, using special cap with two screens for stereo image and the gloves for manipulating, move in virtual space in the most various conditions. It sounds as science fiction, but some feel it already as the present time [Šimić95]. A poll carried out among top American experts predicts that until 2018 3D holographic telephones will be used, and the holographic printer till 2004 at least. It means, that 3D images will be watched in full colour without any tools, e.g. without glasses or special cap. It is presumed that such printers will use liquid crystals to expose holographic film to the light. To present some other area or phenomenon, a hologram image would be used without someone having to travel to some place [Frang98].

Referring to the quality of spatial data, the cartographers are very much interested in maintaining high quality and updated spatial data, because their products will be valid as much they are accurate for users. Namely, if a large number of users make expensive mistakes because of bad data used for analyses and visualisations, it will reflect finally on cartographic profession. On the other hand, referring to the principal of the standard ISO9000 "do not give to a user either more or less quality than he/she needs", one can notice an interesting turning-point in demands that the society puts upon cartographers. The cartographers do not have to try to create the most accurate visualisations any more. There are now reasons for systematic reduction of data quality for specific users [Gupti95].

Some examples of various possibilities in cartographic visualisation are given further in the text. Fig. 2 shows the segment of the photomap of Velika Gorica made by S. Frangeš and Z Biljecki who were rewarded for the excellence in cartography at the International Cartographic Exhibition in Ottawa. Fig. 3 shows the segment of the map presenting the Knin fortress where 3D has been tried to be connected with 2D presentation. Fig. 4 gives the 3D presentation of Medvednica, the mountain near Zagreb

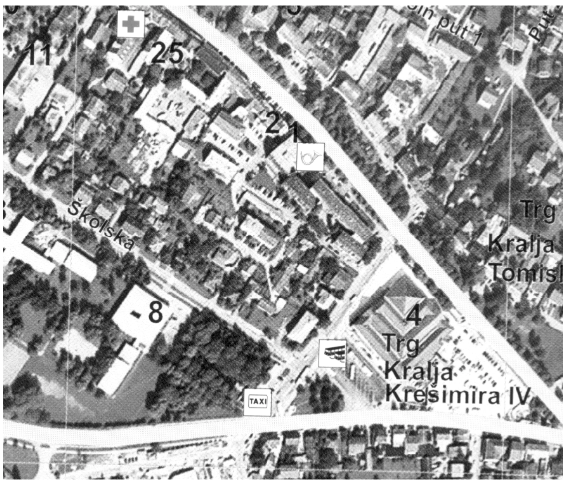

Fig. 2. Segment of the photomap of Velika Gorica made by S. Frangeš and Z. Biljecki, originally colour photomap

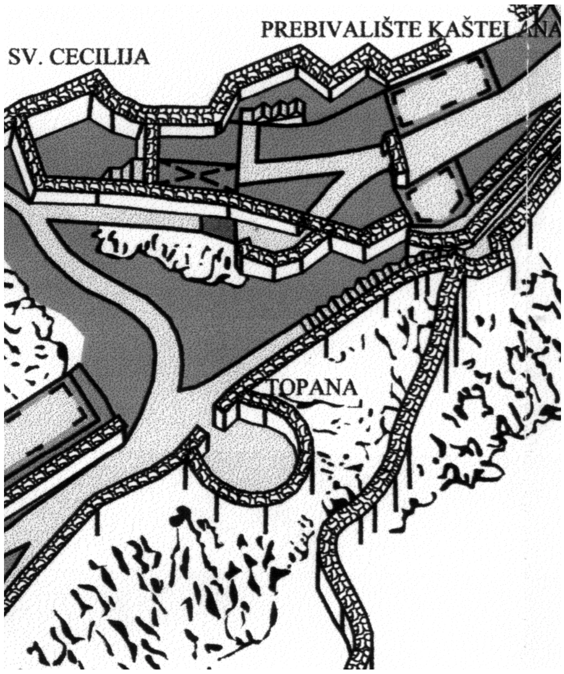

Fig. 3. Segment of the map of Knin fortress made by S. Frangeš and R. Župan, originally colour map

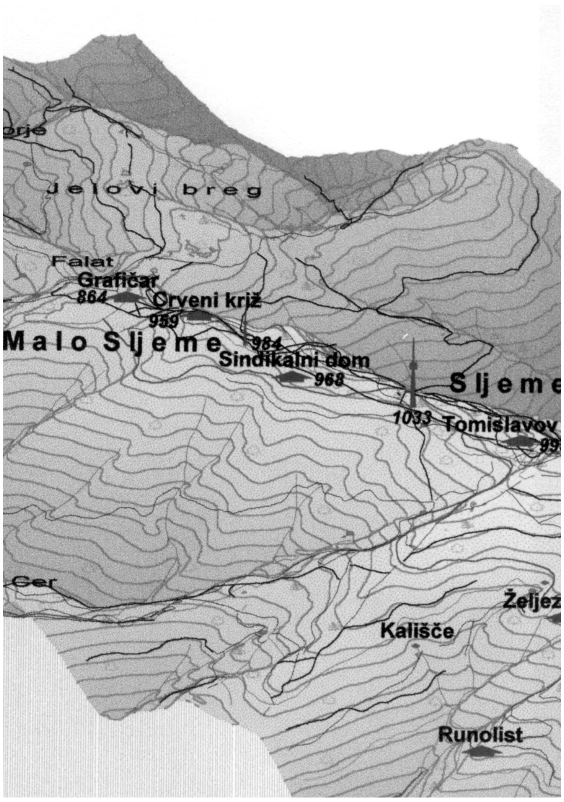

Fig. 4. Segment of the 3D presentation of the top of Medvednica made by S. Frangeš and A. Hojnik, originally colour map

5. CONCLUSION

Scientific cartography has the task to develop and research new methods of cartographic visualisation. For that purpose the knowledge about graphic presentation of geoinformation must be connected with the contemporary digital techniques of visualisation. The most powerful connections between cartography and GIS are exactly cartographic visualisation tools and their possibilities of presenting the data of synthesis and analysis derived from GIS.

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