New trends and developments in cartography

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Introduction

Like many other disciplines cartography is in a stage of transition. Cartography deals with representation of geographic phenomena, both real and virtual. In his key note address at the International Cartographic Conference in Beijing professor Gao Jun presented a new approach to the definition of map. By mapping we understand a transformation from one form to another, which is well known to mathematicians. Let then a map be a result of a mapping and consider these terms in a geo-spatial context. In this way we find that both geographic databases and virtual realities are results of a mapping process, that is a transformation from reality to a digital representation. Roughly, professor Gao classified maps as visual maps (printed maps and screen maps) and virtual maps (digital geographic data and virtual reality images). Cartography is the discipline dealing with maps and mapping.

In fact this transition to "computer cartography" started long time ago. It is worth noting, however, that the pace of change towards an electronic future is variable across the world. While it can be argued that we are all being technology driven in the same direction, we will not all arrive at the ‘destination’ at the same time (a point made through anecdote by David Rhind in Ottawa, 1999). Even in so-called advanced (commercially-driven) societies there can be differences in the graph of change.

Geo-spatial Data Infrastructure (GDI)

The term National Spatial Data Infrastructure (NSDI) suddenly became hot on the 14th of April 1994, the day after President Clinton´s executive order, in which he instructed the federal agencies of the US to co-operate and share data as part of the Information Technology Strategy of the US (a more efficient administration to a lower cost).

Since then many initiatives have been taken to introduce the concept at different levels from municipalities to the globe. With GDI we understand the basic legal and geodetic frameworks as well as fundamental data sets, standards and technological facilities for sharing and using the data. Note, that I am using the term geo-spatial, since spatial is a more wider term.

In accordance with the definition of maps I want to argue that more attention must be paid to how geo-spatial data gathered in databases are to be used and visualised. When databases are

designed we will in the future also more carefully evaluate the data model and consider how objects are formed and depicted at different scales.

Towards a Cartographic Research Agenda (2nd plenary session ICC 2001, Beijing)

Cartographic research can be defined as the research that explains or improves taking cognisance of spatial data from maps, and ensures that these maps/visualised spatial data give an adequate idea of the patterns/trends of the abstracted attributes of nature as needed for decision making. When provision and use of visualised spatial data for decision support can be termed the main object of cartographic research, the **number of dimensions** of this object can directly be extended:

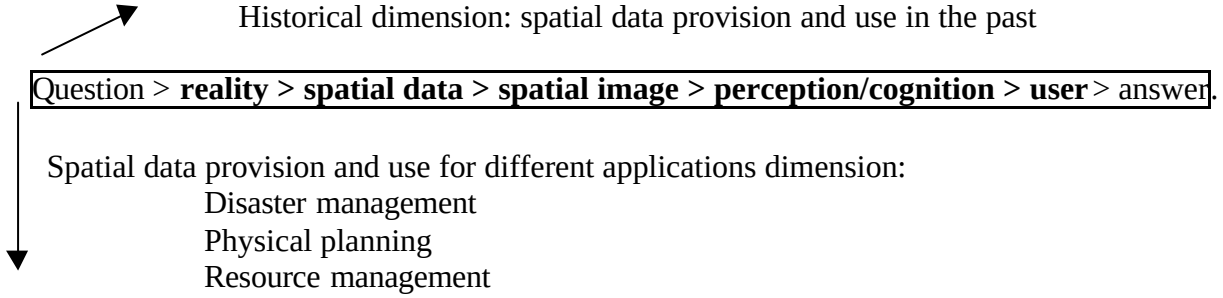

Figure 1 – the dimensions of cartographic research

Although many examples of these various different applications have been presented recently, they do not constitute the prime research interests as such as those would be the provision and use of visualised spatial data irrespective of their topical contents. We risk a duplication of our research efforts if we solve the same or similar problems for different fields of application. This would adversely affect our limited research potential.

There is no typical research process in cartography but, instead, a typical research theme, which mainly has to do with the spatial information transfer process as modelled by us above. Each of the constituent parts of this research model and any combinations of items or links can be subjects of research. Some frequently occurring approaches are:

*a) **psycho-physical or cognitive research***

reality > **spatial data > spatial image > perception/cognition > user**.

When the above tract is studied, this will allow one to compare the results of various different mapping methods against each other (or of different symbols or different variations within symbols). An example could be: what is the best way of visualising terrain heights for correlating heights with land use classes: layer zones, hill shading or contour lines or spot heights?

*b**) map use research***

reality > spatial data > **spatial image > perception/cognition > user**.

This could have as its theme how different spatial images influence the spatial decision making process, or how to design maps in order that specific decisions are taken

*c) **modelling research***

reality > spatial data > spatial image > perception/cognition > user

Modelling reality is a cognitive action. Here the issue is which model is the most appropiate for a specific application. Generalisation, 3D representation and projections all are examples of modelling aspects of reality.

*d) **data extraction research***

reality > spatial data > spatial image > perception/cognition > user.

Within this tract falls research in Remote Sensing for automated map production and map revision.

*e) **linkages research***

reality >> spatial data >> spatial image >> perception/cognition >> user.

Spatial information transfer may suffer from an excess of noise contained in the links in the spatial information transfer model. Perception aspects like colour blindness can be a cause for not succeeding in the spatial information transfer proves. When cartographers have insufficient means of comparing the data model to reality, this also can cause noise.

Research into the effect of map use strategies can lead to optimising the route/tract **map>perception>map user**. In order to start here, one has to know what map users actually do when they read information from maps. What hardware and software sits in our perception systems and how can we best use that for information transfer?
Geographical names form one of the linkages between reality and spatial data

*f) **quality research***

reality > spatial data > spatial image > perception/cognition > user.

Each of the elements, reality excepted, can be inadequate from a quality or fitness for use point of view. Research mainly has been focused on data quality here (also on the tract reality>data) and on informing the map user about this quality (the **parallel tract** metadata>mapped metadata>perception>map user). In this field the question that need to be solved is: which are the best indicators for spatial data quality needed in specific map use situations, and which are the most efficient ways of visualising these indicators.

These approaches of course would have their historical and applied dimensions as well. The whole field of the spatial information process probably is studied by the cartographic theoreticians.

Research Issues we would like to spearhead

In our research overview, under the heading modelling research, GIScience should be able to forecast the reliability of the data output on the basis of the inaccuracies in the data input and the processing procedures within geographic information systems. Prof Meng indicates digital object models constitute the central part of research and development in GIScience.
ICA should also try to boost this research, that will provide the new origins of map making, according to Prof Meng, by providing a platform for discussing these issues, that is why we plan to extend our scope to GIS/ reintegrate GIS into our field of interest (depending on one's viewpoint) , to be reflected in a names change that we will put to the General Assembly in 2 years time: The International Society for Cartography and Geographic Information Science

Prof Grünreich has indicated the need for research in order to establish and update reliable, timely and user-oriented geographic information infrastructures.

Prof Meng in another publication (1997) asked for the development, in generalisation research, of intellectual data structures, objective evaluation procedures for generalisation results and development of cognitive considerations and cost/benefit studies.

Feature extraction and pattern recognition research need to be developed in order to speed up the revision or production of topographic data files. But one of the most promising fields looks to me to be cognition. At least it has been mentioned by two of the ICA commissions, and one of them has presented a research agenda for cognitive and usability studies in geovisualisation (Slocum e.a., 2001).

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