Adapting and Extending Cartographic Methodology for Accessing and Presenting Multidimensional Geodata Related to Settled Areas

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Cartography aims at depicting spatially relevant information by means of unique graphical symbols. In classical Cartography, the immediate acquisition of original topographic and thematic data was an important step in the production chain and it was followed by data interpretation, generalisation, design and presentation/output. The greatest technological revolution in cartography in the 20th century was without any doubt the introduction of computer-based technologies. In the first phase from 1960 to 1995 however, this had a rather limited influence on the very nature of cartographic products. Whereas the graphical and technical quality of the products could be significantly improved, the types of maps remained more or less the same. Only the introduction of new media for accessing and presenting the data in the mid-1990ies allowed for a rethinking and extension of the cartographic communication possibilities. On one hand, the map products are more and more based on already existing topographic and thematic data collections, and on the other hand new media like DVD, Internet, and mobile devices allow a great change in map use due to new interaction and presentation techniques.

On the data side especially the Internet now provides a wealth of only minimally or very heterogeneously structured data; this in contrast to thematically, geometrically and topologically well-structured data like in GIS-based data infrastructures. More or less sophisticated data-mining methods try to compass the lack of structure by for instance deriving knowledge from context information; this however leaves a rather high degree of uncertainty regarding the relevance of the queried data. Well-defined geodata models including attributive information are clearly the best source for cartographers for deriving secondary cartographic data models out of general source data.

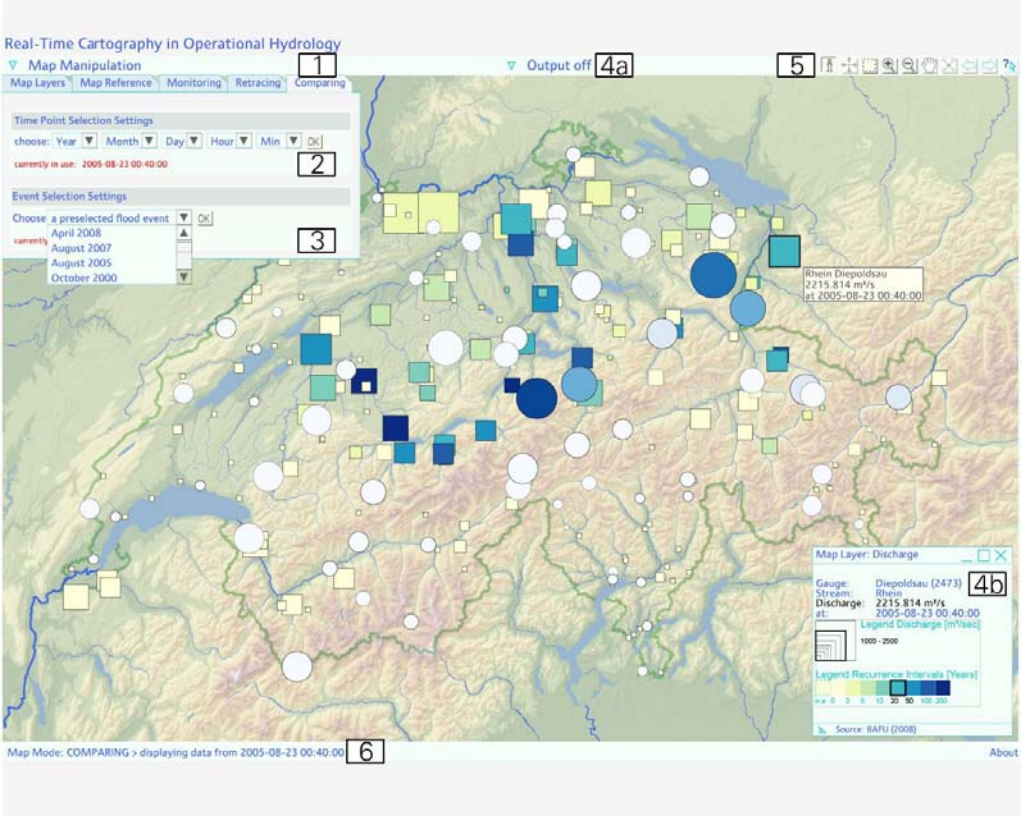
However, in the last few years, a paradigm shift away from GIS data with the classical split into geometric and semantic/thematic attributive data could be observed. This geographically-centred approach is more and more eclipsed by multidimensional data collections where beside the different data topics and together with timestamps the spatial location is just another attribute or dimensional triple/quadruple. From the GIS or cartographic view, the map space has been extended by temporal and topical dimensions; however one could now also argue that geographic reference information is just another criterium which could be included when querying this multidimensional space in such general purpose databases.

Furthermore, newly developed navigation, query, analysis, and presentation tools allow the exploration of this virtual space. The presentation of defined slices of the Space-Time-Topic-Cube on electronic maps provide an added value compared to classical database queries allowing for a better understanding of complex data composites, finally leading to a tailored and individualised output of map information.

In this synoptic article, based on concrete examples taken out from interactive atlas projects and including data related to settled areas, the conceptual steps and the workflow in order to create such interactive visualisations will be shown.

Example 1: European Atlas of Literature
This example demonstrates the setting-up of a multidimensional database including geographical reference data from scratch. In the interactive Atlas of European Literature, a database with about 50 criteria describing a corpus of about 1000 novels and novellas is currently set up. An interface allows for selection of all possible combination of thematic and spatial criteria finally leading to individual map representation which for instance show the spatial distribution of a specific literary genre or the temporal literary coverage of a specific region.

Example 2: Real-Time Cartography in Operational Hydrology
Extreme hydrological events often result in devastating damages. Providing relevant and actual data within a single application can support operational hydrologists and minimize damage. A feasible relational data model and associated automated cartographic workflows are introduced that are capable to present both real-time and historical data. The technological challenge is to search a huge existing archive and render data on the fly within an adequate computing time. The second, methodical challenge to present real-time data arises from applying cartographic principles to unknown measurement data and handling missing or faulty values. Resulting hydrological visualizations in form of thematic maps and graphs are embedded in a web-based graphical user interface. In addition to monitoring and comparing, other functionalities provide a high level of interactivity and data exploration possibilities.



Graphical user interface with comparing functionality and a map showing river discharge (square point symbols) and 24-h precipitation sums (circle point symbols) of August 23, 2005.