Geographic and Mapping Information Systems: A historical overview, new developments and challenges for Belgian Coastal and Marine Research

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Geographic Information Systems (GIS) are systems of computer hardware, software and procedures, designed to support the capture, management, manipulation, analysis, modelling and display of spatially referenced data for solving complex planning and management problems (FICCDC, 1988). Since a decade GIS has been widely used in marine and coastal research. Nevertheless, in the foregoing twenty years computer hardware and software was already available for geographic applications (in the limited sense of planimetric and bathymetric positioning) and for modeling purposes. Those location computer applications were mainly ‘home-made’ tools developed by centers as MUMM and some academic laboratories.

Also in 1980’s people saw the separate development of raster and vector-GIS. The first as a technique closely linked to matrix maps, remote sensing and computer cartography (see e.g. the work of Tomlin) and the second as an outcome of the integration of DBMS and advanced CAD-techniques using more complex topologies.

A second generation of GIS in the 1990’s introduced developments in topological structures, and an integration of vector and raster tools; the same period saw the development of a lot of extensions on the basic tools and, later on, larger facilities for customization and developing new applications. The implementation of more complex topologies and new algorithms today has been made possible by larger memories and faster computers.
Parallel with the development in the 1990’s of more powerful techniques of data collection of the marine surface and of the sub-bottom, new topological models were described in vector GIS, especially for geographical surfaces, such as TINs (triangular irregular networks). But the new challenges in GIS are now to switch from 2D and 2.5D to real 3D data structures and algorithms. In a raster oriented GIS pixels become in 3D voxels and in vector GIS TINs become 3D TENs, (tetrahedral networks) using tetrahedrons as building blocks for 3D volumes instead of triangular surfaces generating a 2.5D surface.

In the 2000’s the use of remote map serving using intranet and internet is a reality. Constraints on an integrated use of different datasets spread over the internet are more to be attributed to administrative and legal restrictions than to real technical problems. Further developments in GIS would be the use of a real 3th and later on 4th dimension, the involvement of expert and knowledge systems in GIS and integration with other techniques such as VR. Introduction of 3D GIS instead of 2.5D and expert and knowledge features in geographical information science and systems are also in marine and coastal research the challenges for the upcoming decade.