Create A 3D Digital Model of The Seabed Using Autocad

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Abstract

In the article are describes a methodology for creating an exemplary digital 3D model for the coast and for the sea spaces of Bulgaria, as well the obtained results by the study. The created product is useful for the risk assessment during floods, abrasion and land slide on sea and river coasts.

Keywords: Vector model; Seabed; AutoCAD; Depth contours (Isobaths); Geo information; Software

General Information for the Digital Models

Geographic information systems (GIS) are a means of integrating different types of information about some area of the Earth's surface or of the seabed with spatial geographic data. For example, in studies of phenomena, related to environmental protection in the coastal zone - landslides, abrasion and erosion, it is necessary to integrate geographical, geodesic, physical, chemical, geological, biological, and socio-economic data for the environment. The application of geographic information systems and technologies for creating 3D vector digital models are extremely useful in the study of:

i.   The spills of large rivers

ii.   For monitoring of the coastline dynamics

iii.   For the study of coastal dunes

iv.   For the predicting floods in low-lying coastal and lakeside areas.

All this is extremely important for the protection of the people, flora, and fauna in coastal areas. Now such studies are almost not done, or if they are done, they are partial and incomplete. This applies even more to the bottom of the state's maritime spaces – for the internal sea waters, the continental shelf, the territorial sea (the 12-mile zone), the contiguous zone (the 24-mile zone) and the exclusive economic zone. Various software products are used to create such digital models – Arc GIS, Global Mapper, Ozi Explorer, etc. GIS technology can also be used for specific studies such as resource management and regional and territorial planning. Geodesic measurements and technologies in an applied aspect are related to define of X, Y and H coordinates of points on the Earth's surface, above the Earth and on the seabed. They are used to populate the GIS data for:

a)   Digital modeling of the territory

b)   Topographic plans and maps

c)   Thematic mapping

d)   Territorial and settlement structure

e)   Transport facilities

f)   Geo-protection facilities

g)   Coastal risk zones

h)   Navigation by land, air, and water

i)   Surface modeling and their application in various fields.

Regardless of the technical limitations existing in the recent past - level of surveying tools, technologies and computing means, now geo-data from 10-15 years ago is current and, in many cases, useful. Now that is no longer enough. The requirements for accuracy are higher, the terms for obtaining geodata are shorter, and their application in various fields is much greater. GIS design can be seen as a heterogeneous software-technical environment oriented for a specific subject area. The main spatial data technologies belong to ESRI, Oracle, AutoCAD. The main components of GIS are hardware, software, data, methods and people.

In GIS are stored and converted vector and raster data. Raster data is based on a uniform grid of cells (pixels) whose location is determined by row and column numbers. Vector data represents objects as points, lines, and contours (polygons). The point object is described by coordinates (X, Y, H). For the topological data information is also maintained about the spatial relationships between the objects.

Methodology for Creating a 3D Model of the Seabed

On the basis of a two-dimensional (2D) digital model of the seabed, was built an exemplary 3D digital model without circumstantial detailing. The three-dimensional model (3D) was created with a small step of X and Y parameters. Digital models of the relief of the seabed were used as the basis for the creation of the model, compiled from data from multi-beam sonar systems. The data has a resolution of 14 m. They cover the entire coastal zone of Bulgaria up to depths of 20 m. Data for the digital model of the relief of the seabed are used from a project MARSPLAN II, in which participates Nikola Vaptsarov Naval Academy. Bathymetric contours (isobaths) from the shore (0 m depth) to 2000 m depth are interpolated from navigational and topographic maps and plans at various scales. The isobaths are discretized with steps of 0 m, 20 m, 50 m, 100 m, 200 m and 500 m and 2000 m. The digital model is compiled in greater detail up to the 100 m isobath (the boundary of the continental shelf). The basic software product AutoCAD 2017 was used. The model is shown in (Figure 1). In (Figure 2) are shown the profiles of the seabed along parallels of latitudes 42o, 42o30', 43o and 43o30'. They are with violet, red, blue and yellow colors. Here you can clearly see the methodology how was built the 3D model of the seabed. On (Figure3) is shown only the 3D model of the seabed along the parallels of latitudes 42o, 42o30', 43o and 43o30'. From the profiles in (Figure 2) and (Figure 3), it is clearly seen that the depths increase smoothly up to the isobath with a depth of 100 m, after which they increase sharply [1-14].
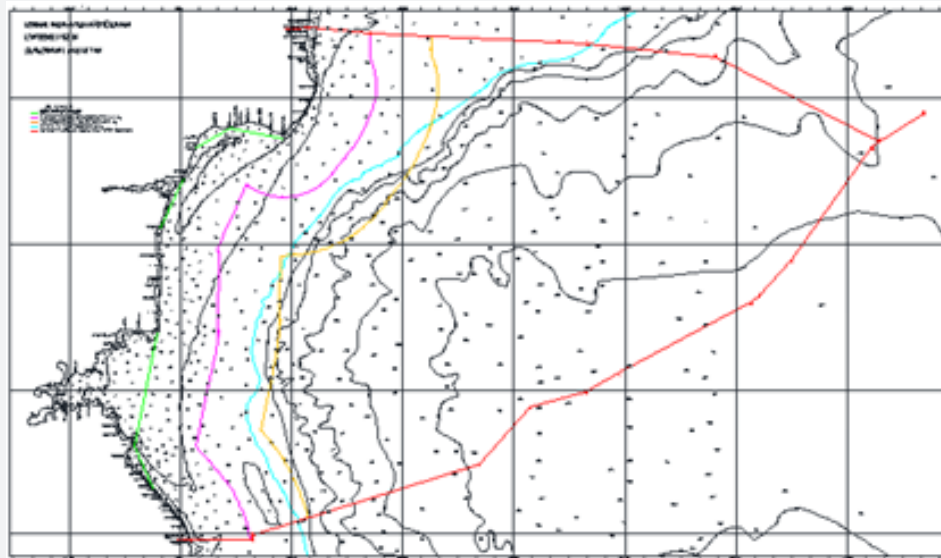

Figure 1: Borders. Green color – the Internal Sea waters, violet color – the Territorial Sea (12 n. m.), orange color - the Contiguous zone (24 n.m.), blue color - the Continental shelf (isobath 100 m), red color - the Exclusive economic zone of Bulgaria.
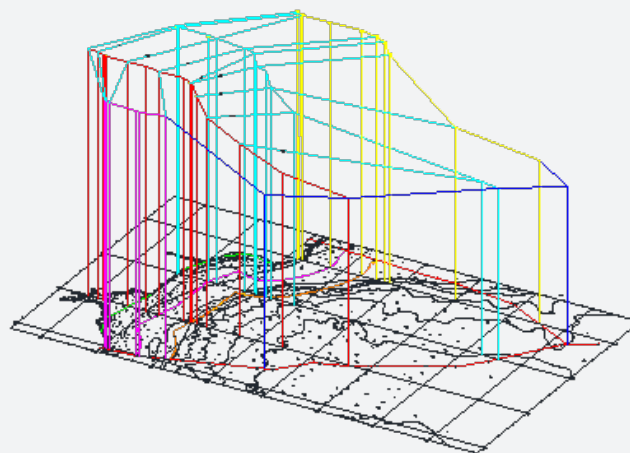

Figure 2: Methodology for building the 3D model of the seabed. The profiles of the seabed along parallels of latitudes 42°, 42°30', 43° and 43°30'.
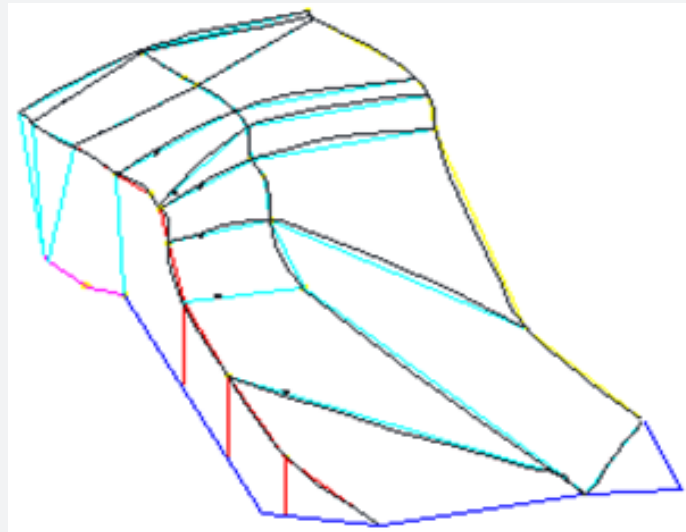
Figure 3: The 3D model of the seabed along parallels of latitudec 42°, 42°30', 43° and 43°30'.

Conclusion

To obtain a quality digital model of the seabed, it is best to be vector. The advantages of vector data over raster data are many: it is easier to attach descriptive information to a given object, no data conversion is required, the graphical representation is of much better quality. More than 38 000 points were entered to create the digital model of the seabed presented in the article. The more important conclusions that can be drawn are:

i.   the created model recreates the seabed with sufficient accuracy for the needs of the research and for practice.

ii.   the methodology is applicable to various underwater objects.

iii.   the degree of accuracy can be increased by working with a smaller step for the coordinates of the detail points.

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