

THE USE OF GIS IN THE PREPARATION OF BATHYMETRIC MAPS FOR PUBLICATION

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Abstract. *This article discusses the possibilities of processing and preparing maps for the publication of bathymetric maps, which allows us to significantly change the traditional approaches in the field of preparing maps for publication, laid down in the 70s and 80s of the last century. This provides a new approach to create the basis for the regulatory and technological base of production. To complete the tasks, it is necessary to complete the main stages of work:*

- to study the main provisions of the guiding documents in the field of hydrography and marine cartography;

- to analyze the existing hydrographic data;

- to study the basic methods of converting bathymetric data;

- to improve technological processes:

- convert analog data to digital form;

- create a database of bathymetric data for the water area;

- generate digital models of the bottom relief for a given water area;

- prepare maps for publication using GIS technologies.

The article focuses on the technology of creating a database of bathymetric data, as one of the main components in the formation of basic marine geospatial data and mechanisms for constructing bathymetric models of the bottom relief, the development of hypsometric scales of the bottom of water areas, the production of color samples according to the test in the preparation of bathymetric maps for publication.

Keywords: *bathymetric maps, bathymetric data base, preparation of maps for publication, GIS technologies, digital maps, relief model, hypsometric scale, colorful sample, color test.*

The purpose of the article is the step-by-step creation of digital bathymetric maps, a database of bathymetric data by improving technological processes, as well as the preparation of maps for publication using GIS technologies, the development of a hypsometric scale for bathymetric maps. The technology of preparing for the publication of bathymetric maps using the traditional method, compared with the use of computer technology, entails an increase in production efficiency and product quality, as well as accelerated the process of bringing bathymetric maps to the consumer. The painstaking manual labor of preparing maps for publication has been replaced by a complex of preparing maps for publication using GIS technologies.

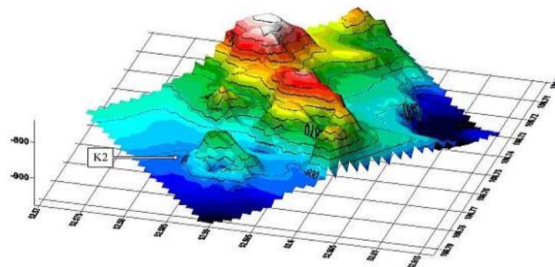
Bathymetric maps are geographical maps that display underwater terrain using isobaths, usually supplemented by depth markers. The coloring of the underwater relief is given according to the steps of heights. Bathymetric maps are the basis for physical and geographical study and

special mapping of reservoirs. They are used in mineral exploration and fishery planning and as an important aid in navigation.

With the traditional method of creating such maps, manual labor was used, there were large material costs, the process was laborious and took a long time to get the final result, but with the introduction of new technologies and programs, the time for creating bathymetric maps and bringing them to the consumer was reduced.

Modern computer methods make it possible to reduce costs compared with traditional ones, improve the quality of cartographic products, and significantly shorten the production cycle.

In addition, it became possible to perform three-dimensional modeling of a map of water areas (Pic. 1), which allows to improve the visibility and readability of such maps, as well as to choose a way to show phenomena, in Pic.1, a quantitative background method was used to create a relief of the bottom of the water area [9]. Therefore, the compilation and preparation of maps for publication currently needs to be carried out through the integrated use of all means of computer cartography [1].



Pic.1. 3D modeling using the quantitative background method

Marine cartography, as the science of mapping and exploring the depths of water areas, the application of isobaths, the value of depths, as well as individual objects of the bottom of water areas through cartographic images, is one of those areas where the introduction of computer technology entails significant changes in technology. With the introduction of new technologies and the creation of digital bathymetric maps, it has become necessary to create databases of bathymetric data, without which there is no possibility of converting analog maps into digital ones.

Heterogeneous data is used to create a database of bathymetric data, sometimes the data may be from the last century, which complicates the work process. It is worth noting that the most important element in creating a database is the primary data, since the further result depends on it.

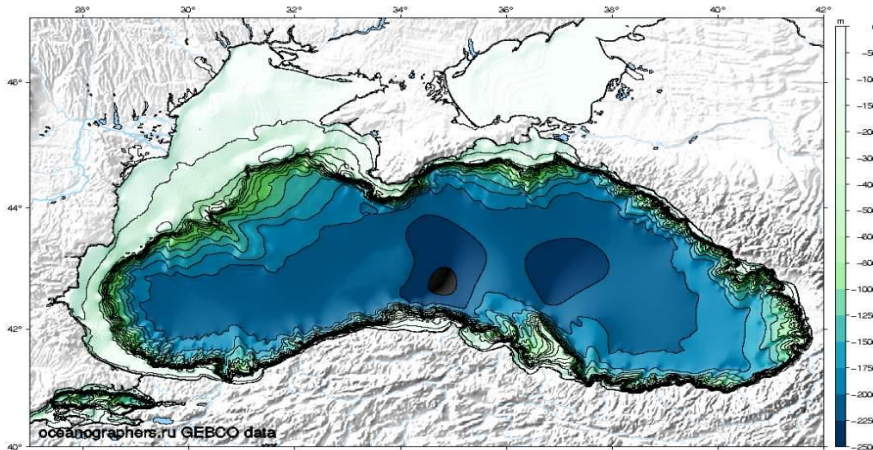
The data includes:

- the results of the bottom relief survey obtained using an echo sounder, hand lot, basting, and other depth measuring instruments and presented in the form of analog reporting tablets;
- digital bathymetric data of hydrographic surveys performed using modern single-beam and multipath echo sounders, multichannel and laser bathymetric systems, radar and other types of surveys.

To create a bathymetric database, it is necessary to collect information. The process begins with obtaining a study scheme for the surveyed area. The study scheme is a sheet of a map that displays the mapping areas by the years of hydrographic work.

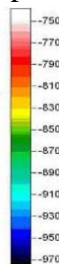
The next step is a visit to the foundation, where atlases with detailed descriptions of hydrographic works, reports and acts of expertise are studied and analyzed.

Most of the data is contained in traditional forms, so the tablets need to be rasterized. The data must be systematized and brought to a single form, after which the data is analyzed and a decision is made which data should be discarded and which should be selected for further work.



Pic. 2. Selection of the hypsometric scale of the bottom of the water area

The choice of hypsometric scales for bathymetric maps is of great importance for their readability and clarity (Pic. 2). In traditional cartography, manual labor was used to perform a hypsometric scale of depths of water areas to color the layout of masks by depth and, accordingly, these masks were made on a photocopy frame on transparent plastic, i.e., the consumption of materials for the manufacture of each layer increased according to isobaths [10]. With the use of computer technology to prepare maps for publication, the consumption of materials has been reduced, the complexity in the manufacture of positives for bathymetric maps has decreased.



Pic. 3. Hypsometric scale of the bottom of the water area, including the topography of the seabed

In addition to painting the isobaths of the bottom of the water area themselves, it is possible to show the relief of the bottom of the water area with the appropriate color scale (Fig.3). All colors are selected on the computer, automatically according to the test color scale (Fig.4).



Fig.4. Test object (color scale), according to which you can select the desired shade of color

In the process of creating a map in the publishing software environment, appropriate transformations must be performed for each type of imported data.

1. Creating isolines. Drag our raster into the Input raster, specify the shape file at the output, and the interval through which the isolines will be drawn (usually this is the same interval as in the previous paragraph). Click Ok - the isolines are ready. You can sign them by double-clicking on the contour layer in the left window, selecting the Labels tab. (Fig. 5).

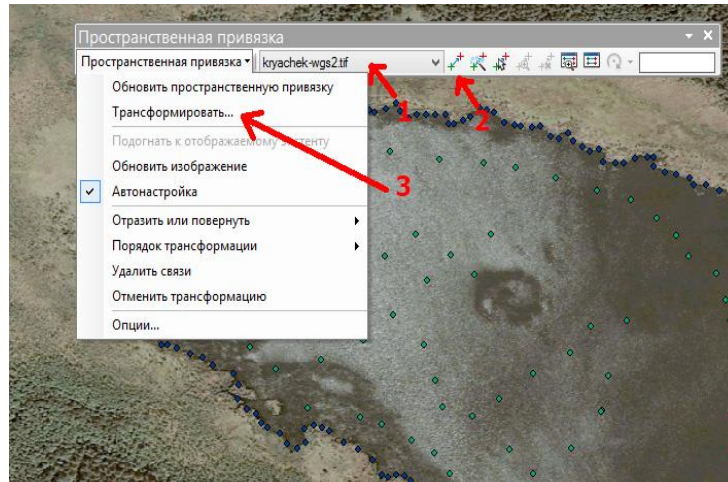


Fig. 5. The depth points were plotted using an echo sounder to create isolines

2. After applying isobaths to the depth marks, it is necessary to color depending on the depth of the water areas (Pic. 6). Double-click on the raster in the left window, the Layer Properties window opens, go to the Symbols tab. In the left field, select Classification, click on the Classification button, specify the Specified interval in meters in the drop-down menu - after which interval to decorate the surface. Click Ok. We select from the color palette the colors that are needed to color the layers highlighted by the isobath (Pic. 4). Here you can also choose a color scheme from the suggested ones. Click Ok. And he decorates the isobaths and the relief of the bottom of the water area with the selected colors (Pic. 6).

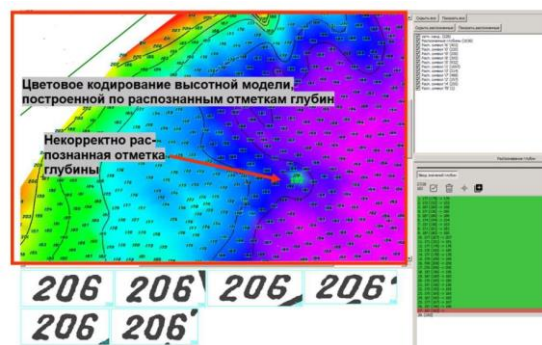


Fig. 6. Coloring of isobaths according to the depths of the water area

3. Create a map for publication. Go to the layout view: *Layout-View*. We scale and move the map for a better view. We make signatures. Insert the degree grid: double-click on the word *Layers* in the left menu, bookmark the *Grid*, click *New grid*. Next, we arrange it according to the points. Through the *Insert* menu item, we insert a legend, a scale ruler, a hypsometric school, and the bathymetric map is ready to transfer it for preparation for publication.

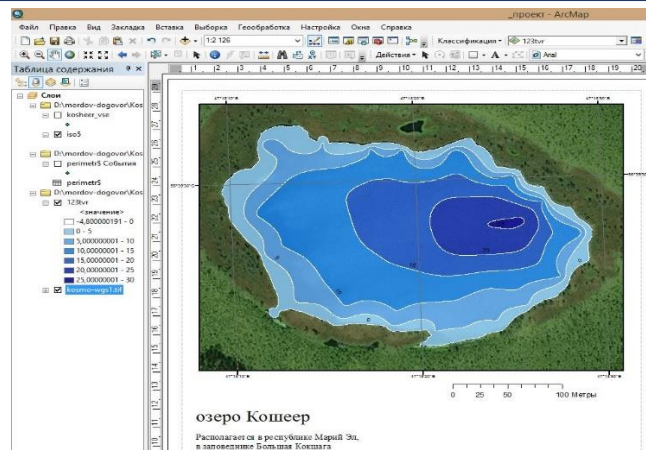


Fig. 7. A colorized image of the water area according to isobaths

All the processes of preparing maps for publication are performed on a computer, dividing into positives by colors of the published map.

4. The final stage of preparation for the publication of the projected map is the production of a colorful sample, which in traditional cartography was performed manually, in this way it was difficult to choose color shades to perform the hypsometric scale of the bathymetric map. With the introduction of computer technology, they began to perform a color test, which transmits all shades of colors. Digital color testing is performed using a color printer, which must have sufficient spatial and color resolution, a wide color coverage area and an integrated color management system that calibrates the system for a real offset printing process.

The development of tone design graphs, which are an electronic library of colors, selects the colors that need to be used to color isobaths and the bottom relief of water areas.

Performing a colorful sample when preparing a map for publication has three main goals:

1. Timely implementation of color correction of the image.
2. Presentation of the result of the work to the control editorial office or to the customer before printing the print run in order to coordinate the content and design of the card.
3. Transfer as a control sample to the printing process to ensure that the printed prints correspond as closely as possible to the authors' intention.

With the introduction into production in preparation for the publication of bathymetric maps, it became possible to produce color samples on a computer based on a test, where the colors necessary for replicating maps of water areas are selected. When transferring to the circulation, the selection of colors is guided not by the colorful sample, but by the color test, which is included in the set of the card for its further printing [6].

With the introduction of computer technology, the processes of compiling, designing and entering grids and fills have been combined. This eliminates the duplication of graphic works inherent in traditional manual technology. Computer publishing systems allow you to carry out a full cycle of work at one workplace to create design and publishing originals of the card with the possibility of making corrections to the computer original of the card without compromising its quality.

In traditional technology, production work on the creation and preparation of a map for publication is usually carried out in the following production units: editorial, technical editorial, drafting, design, retouching, copying, proboprinting and photo departments, a photo set section [9]. With the elimination of the processes of manual photodetection, the input of grids and fills, the photo processes are completely eliminated and the corresponding production units. Combining

the drafting and design stages and changing the ways they are conducted, the elimination of copying on plastics partially change the functions of the mapping and copying departments. New processes are emerging: scanning, electronic photo output, as well as the production of color samples for the preparation of maps for publication, which helps to reduce the time required for the technological process [5].

Performing a color test for the manufacture of hypsometric scales gives an accurate selection of shades of color when creating bathymetric maps. It is also possible to track the appearance of moire by using a color-proof impression, evaluate the quality of manufacturing photoforms, check special settings made during computer color separation: overlapping colors, etc., as well as make corrections to the computer version of the color test. The advantages of computer technologies are, first of all, high accuracy and quality of graphic works, a wide variety of design possibilities, a significant increase in labor productivity and reduction of production costs, and an increase in the printing quality of cartographic products. Therefore, the compilation and preparation of maps for publication must be carried out through the integrated use of computer cartography tools.

The trends in the development of the printing industry that have emerged in recent years also allow us to draw certain conclusions about the prospects for the development of the card publishing industry. The development and improvement of digital printing technologies, the tendency to increase the colorfulness of publications, a constant decrease in circulation (up to the printing of single copies), the need for urgent printing and printing with variable data, the use of smaller print formats and other features contribute to a gradual reduction in the scope of offset printing and an increase in digital printing volumes [7].

REFERENCES

1. Berlant A.M. Cartography. – M.: Aspect Press, 2003. – 477 p.
2. Vasmut A.S. Electronic maps and computer technology of their compilation, Geodesy and cartography. 1991. - № 7. - 40-44p.
3. Vostokova T.V. Card design. M.: Publishing house of Moscow State University, 1985. - 200 p.
4. Glushakov S.V., Knabe G.A. Computer graphics: Study course – M.:, 2001. – 500 p.
5. Izbitsky E., Mkhitarova E. Instructions on computer technology of typing and layout, Printing. № 6. - 1999. - C. 40-44 p.
6. Kopylova A.D., Filin V.N., Fylatov V.P., Stephanov S.I. Edition of maps – M.: Kartgeocenter–Geopubl, 1995. –253 p.
7. Malykov B.N., Poshyvaylo Y.G. Compilation and preparation of maps for the publication of maps and atlases using computer technology,-Monograph. -Novosibirsk: 2002. - 92 p.
8. Pasko O.A., Dykyn E.K. Workshop on Cartography Tomsk: Tomsk Polytechnic University Publishing House, 2012. – 175 c.
9. Salishchev K.A. Cartography. 3rd edition. - M.: Publishing House of Moscow State University, 1990. - 400 з.
10. Sergunin E.G. Publishing maps. M.: Nedra, 1980. - 384 c.
11. Tykunov V.S. Modeling in cartography: Workshop on Cartography Tomsk: Tomsk Polytechnic University Publishing House, 1997. -405 p.