DEVELOPMENT OF AN ELECTRONIC NAVIGATIONAL MODEL OF THE BULGARIAN BLACK SEA COAST

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Abstract: The development of electronic navigational models of the world's oceans is a priority for many countries for sustainable and safe navigation. The compilation of vector electronic navigational charts formed electronic navigation model that is used in ECDIS. The application of electronic navigation model in Bulgarian shipping is still limited.

This paper suggests an opinion on developing electronic navigational model of the Bulgarian Black Sea coast.

The proposed version of the electronic navigational model of the Bulgarian Black Sea coast is made up of a compilation of vector electronic navigational charts as standard S 57 and fully complies with the standard S 100.

To develop electronic navigation model is necessary for electronic navigational charts to be unified projection and various coordinate systems of the respective reference ellipsoid.

Bulgaria is a pioneer in the development of electronic navigational charts and the development of electronic navigation model for the Bulgarian Black Sea coast ahead.

The proposed electronic navigation model is consistent with the developed in the Hydrographic Office of the Navy of the Republic of Bulgaria electronic navigational charts.

Keywords: *electronic navigation model, electronic navigational charts, ECDIS, standard S57, standard S100.*

Introduction:

The development of electronic navigational models of the world's oceans is a priority for many countries for sustainable and safe navigation. The compilation of vector electronic navigational charts formed electronic navigation model that is used in ECDIS.

One of the major requirements of the international convention SOLAS is the conversion of marine charts from hard copies to digital ones. All hydrographical services are required to unify their navigational information for water basins with navigational importance and to harmonize all of their coordinate systems and projections. In accordance to those requirements navigational models for the different countries and continents have to be developed. Seafaring safety is highly reliant of the accuracy of and unity of the charted regions.

The aim of this study is to develop a complex electronic navigational model of the Bulgarian Black Sea coast.

In order to achieve this following problems have to be solved:

1. Synthesis of a methodology for development of a navigational model of the Black Sea coast.
2. Synthesis of a logical model of the electronic navigational model of the Black Sea Coast.
3. Analysis of the problems related to the development of the navigational model of the Black Sea Coast.

In line with the association of Bulgaria to the integrated marine and river polices of Europe, electronic navigational atlases and navigational charts for the Bulgarian section of the Black Sea and the Danube River are being developed. An electronic navigational model for safe seafaring is however still not in development.

A common characteristics of all existing electronic models for the marine environment is that they are dedicated to specific problems such as: traffic monitoring of naval and air vessels; oil spills; real time hydrological, meteorological and climate changes; evaluation of the dynamic of the different types of environments (air, water and solid – sea floor and coastline); transfer of slits from rivers; etc. Another characteristic relates to the specifics of the environment and the area at which hydro-technical equipment is placed, where for each different object of the earth surface a different model for the same problem has to be developed.

In dependence of every different case, when the resources of the national marine spaces are used different set of parameters of the marine environment will be required. The integration of all parameters that describe the environment into an information systems accelerates the processing and sorting of large data quantities.

Review of the scientific literature shows growth in worldwide interest towards the optimization of ecological marine information acquired by employing various technological means. Bedritskiy [2] presents a model for optimization the remote and traditional method for monitoring the status and pollution of the marine environment of the Russian territorial waters of the Sea of Azov and Black Sea. Research of different authors' show [1, 5, 12, 13, 15] that systematical and detailed study of the patterns and dynamics of pollution diffusion allows for better mapping of the ecological environment, including prognosis for the dynamic at which different pollutants are speared.

Many countries such as the USA, Russia, the UK, Holland use electronic navigational charts (ENC) as a basis when developing GIS compatible models for pollution in marine objects with navigation importance (for example oil spills). The International Hydrographic Organization, as well as other institutions develops geospatial standards that serve ECDIS and GIS. The S-100 [7] (ratified by the IHO in 2010) for example, unifies all electronic charts and databases used in the aforementioned informational systems, as well as additional military layers and other vector models that simulate various processes and events in sea and river basins.

Bulgaria uses standards S-57 [8] and ISO/TC 211 [9], although their complete application and realization is still lacking. Software and hardware equipment for development and reading of thematic marine charts and more specially those of ENC on standard S-100 is not available which contributes to the further lag of Bulgaria from the international requirements.

The hydrographic service at the Bulgarian Navy has begun the application the S-57 standard that is used to develop ENCs that are applied at the electronic chart display and information system. Those charts are necessary for both military and commercial purposes.

University geographical informational system is widely applied when utilizing the resources of the World Ocean. Examples of this include: modeling of the sea floor through barometrical measurements related to the exploitation of marine resources [4]; Modeling of oil in marine and river environment; Integration of seismological and topographic for modeling tsunamis and prognostics related to there are of effect [3]; Control of critical water basins; Following the habitat and migration of hydrobionts [10]; Prognostics of the development of specific areas such as archipelagos, coral reefs, etc. [11]; development of system for early warning, system aiding operation of search and rescue, applications for prediction of the spread of oil and gas spills in water areas [16]; Development of software systems for aiding marine, river and areal navigation [6], etc; Satellite and ground based tracking of processes in the atmosphere and ocean [14].

All those systems are based on the same development principle: input, processing and use of databases of values of factors and parameters of the environment.

Problems related to the transnational exchange of information for ecological pollutions of water areas with navigation significance in Europe are insufficiently addressed. In last year's strategies for integrated marine, river and areal policies of Europe are developed.

Systematical analysis of scientific literature shows that for the development of mathematical model the following is required:

- Data bases that can be digital or graphical – vector, raster, satellite and radar images;
- Meta data that provide mathematical basis on which the model is developed;
- Digital data bases that have to be coded as objects and attributes based on the specific requirements of the software;
- When data bases different from those readily available at ENC are used, they should be adapted as such;
- After a complete set of ENCs and other thematic nautical charts are available the electronic model for the Bulgarian Black Sea coast can be developed.

The methodology for developing electronic navigational model of the Bulgarian Black Sea coast is presented in Fig. 1

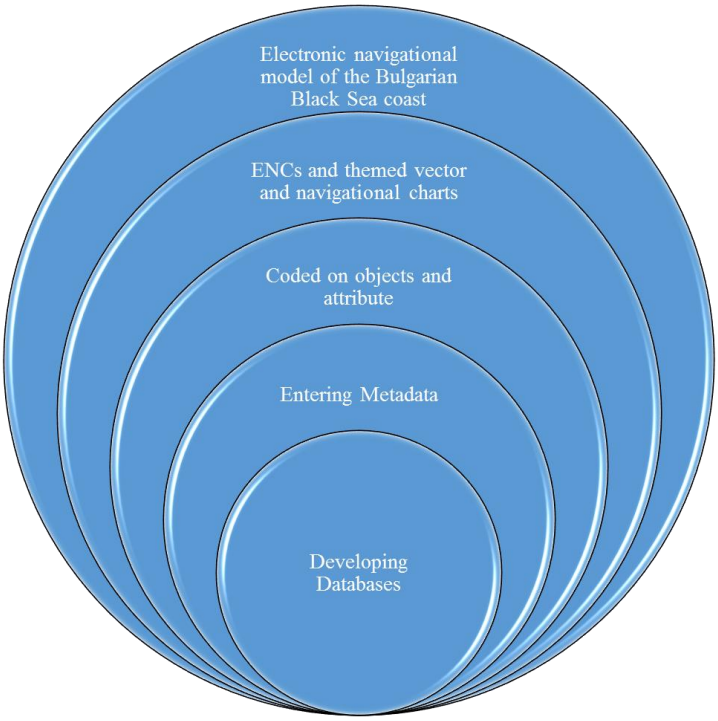

Fig. 1. Methodology for the development of electronic navigational model of the Bulgarian Black Sea coast

As a result of the methodology developed electronic navigational model of the Bulgarian Black Sea coast, which includes a set of ENCs, nautical themed cards (hydro-meteorological, hydrological), hydrodynamic models, satellite and radar images.

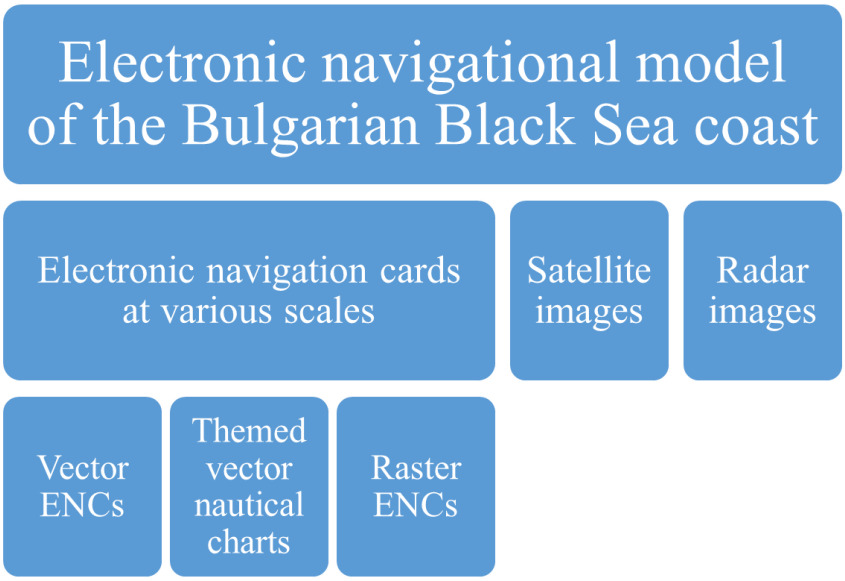

Fig. 2. Electronic navigation model of Bulgarian Black Sea coast

Suggestions electronic navigational model of the Bulgarian Black Sea coast was put into an ecological water-transport information sub-national body of water for the Republic of Bulgaria [Disertaciq].

Bathymetric compilation of electronic cards of Bulgarian water bodies with navigation matter is presented in Fig. 3.

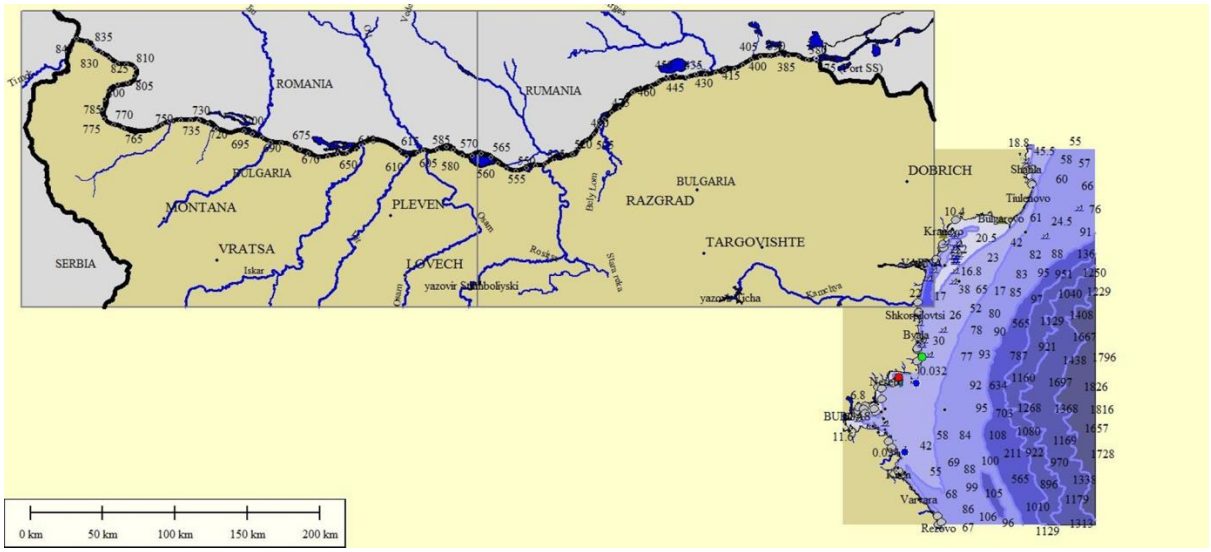

Fig. 3. Compilation of maps of national aquatic spaces with navigation matter

Despite that during the development of the model only chars in ellipsoid WGS'84 are used differences between the different charts are noted. The main problems presented during the development of the navigational model for the Bulgarian Black Sea coast are:

1. During the development of the electronic navigation model often differences in the compilation of charts from different coordination systems are present.

2. During the development of the electronic navigational model differences of the depth in charts form different coordinate systems and different chart zero are present.

3. During the development of the electronic navigational model often there are differences in compilation of charts from different projections.

The aforementioned problems occur internationally during the introduction of chart models in the system of ECDIS. Those problems are only solved partly on Bulgarian territory as well as internationally. The third problem presented above can be solved when all charts are developed without a project in reliance with the given ellipsoid.

Conclusions

1. The developed electronic navigational model of the Bulgarian Black Sea coast is integrated in an unified ecologic marine-transport subsystem of the national water area of Bulgaria.

2. The electronic navigational model of the Bulgarian Black Sea Coast can be applied for the development of the Blue Economy.

3. The electronic navigational model of the Black Sea coast can be applied in a scientific aspect for research and development activities related to the preservation of the marine environment.

References

1. Arkhipov, B., C. Koterov, V. Solbakov D. Shapochkin, Y. Yurezanskaya, Modelirovanie rastekaniya oil and spread zagryazneniy in Morskoi among besetochnым method Meteorology and gidrologiya, M, 2007, kn.6, p. 44 -59.

2. Bedritskiy, A., C. Asmus, V. Krovotыntsev O. Lavrov, A. Ostrovskiy, Sputnikovыy monitoring zagryazneniya rosiyskogo sector Chernogo and Azovskogo plague in 2003-2007 yy., Meteorology and gidrologiya, M, 2007, vol. 11, p. 5-13.

3. Dawn, J., Arc Marine, GIS for a Blue Planet, Redlands California, 2007.

4. Arsenault, M., S. Williams, J. Reid, Ch. Jenkins, Geologic Characterization of U.S. Shelf Areas Using us SEABED for GIS Mapping, Habitat Delineation, and Assessing Marine Sand and Gravel Resources, Ocean Globe, Redlands California, 2010, p. 179 – 193.

5. Dereliev, P., V. Vasilev, K. Kolev, Influence of the Piracy, armed Robberies and Terrorism on the Security in the Black Sea Region, Contanta Meritime Univercity Annals, Anul. IX, Vol. 11 C, 2008, p. 33-42.

6. Parlichev, D., Engineering - biological method for shore - eco - tsunamizashtita, SENS'2006 Second Scientific Conference with International Participation SPACE, ECOLOGY, NANOTECHNOLOGY, SAFETY, in 2006.

7. http://www.iho.shom.fr, IHO Geospatial Standard for Hydrographic Data, Publication S-100.

8. http://www.iho.shom.fr, IHO Transfer Standard for Digital Hydrographic Data, Publication S-57.

9. http://www.isotc211.org/, ISO/TC 211 Geographic Information/Geomatics, Standards Guide, 2009.

10. Konsulov, A., Black Sea Biological Diversity Bulgaria, New York, 1998.

11. Kordza dze, A., D. Demet rashvili, About Coupled Regional Modelling System: the

Black Sea–Atmosphere, Journal of Environmental Protection and Ecology 12, No 1, 2011, p. 317–326.

12. Kvitek, R., P., Iamprietro, California's Seafloor Mapping Progect, Ocean Globe, Redlands California, 2010, p. 75-87.

13. Lavoie, F., K. Cove, Integrated Database Production Environment, Hydro International, L, January, 2007.

14. Moggert-Kägaler, F. GIS Analisys Softuare, Hydro International, L, Octomber, 2008.

15. NOAA, Oil in the sea III, W, The National Academies Press, 2003.

16. Palazov, A., H. Slabakov, H. Stanchev, Bulgarian Black Sea monitoring programme, Maritime Industry, Ocean Engineering and Coastal Resources – Guedes Soares & Kolev (eds), London, 2008.