GEOINFORMATION SUPPORT FOR ANALYSIS OF MARINE ECONOMIC ACTIVITIES OF RUSSIAN REGIONS

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Abstract: The article is devoted to the presentation of an approach to solving the problems of geoinformation analysis of modern sea economic activity of Russian regions, based on a comprehensive study of the structure and functioning of their marine economic complex. The tools for geoinformation analysis of economic activity and spatial organization of productive forces in the Russian coastal regions is proposed. The composition of indicators and the main characteristics of spatial databases of the specialized geoinformation system are considered. The current GIS project "Marine Economic Complex of Russia" will allow analyzing the dynamics of socio-economic and spatial development, as well as conducting operational monitoring of the economic activities of maritime regions.

Keywords: marine industry, geographic information systems, geoinformation analysis, maritime regions, Russia

1 Introduction

The factor of the seaside location has a great influence on the formation of economic specialization and spatial organization of economic activity in regions [Dupont et al, 2020; Eberhardt et al, 2013]. In our times, characterized by complex problems and challenges for socio-economic development, increased political tension, increasing competition for economic resources, the influence of this factor is growing up. This leads to growing attention to the study of the maritime economic sector [Böhnke-Henrichs et al, 2013], and its role in ensuring economic growth, strengthening integration and cooperation relationships between countries and regions [Strategiya prostranstvennogo razvitiya prostranstvennogo razvitiya Rossijskoj Federacii na period do http://static.government.ru/media/files/UVAlqUtT08o60RktoOXl22JjAe7irNxc.pdf].

The development of economy of the Russian maritime regions is largely due to their special transport and geographical location, huge resource potential, as well as promising opportunities to ensure the effective functioning of interregional and, especially, international transport routes and international transport and logistics systems.

The conspicuous Eurasian vector of the transport and logistics system development of the Russian maritime regions necessitates the construction of international transport highways and logistics centres, which will allow to form sufficient infrastructure to expand the Eurasian direction of international economic relations in Russia in future [Transportnaya strategiya Rossijskoj Federacii na period do 2030g. [Elektronnyj resurs] URL: https://www.mintrans.ru/documents/3/1009].

2 Problem Formulation. Outlook Study of Marine Economic Activity for The Maritime Regions of Modern Russia

The growth of marine economic activity in Russian regions is largely focused on solving the problems of developing economic relations with the countries of Eurasia. The huge natural resource and labour potential, positive economic dynamics allow us to give a high assessment of the prospects for the international trade growth in the Eurasian countries, and the formation of large international markets for goods, services and capital in them.

Problems of development of the Eurasian economic cooperation are largely determined by transport and economic factors [Gafurov et al, 2014: Druzhinin, 2016]. The leading role in ensuring Russian Eurasian economic cooperation should be played by sea transport and the developing systems of port economy in Russian coastal regions, which is largely due to their importance as a factor in the formation of a promising transport and logistics system in Eurasia.

Throughout the all post-Soviet period, the country's seaports were an important driver of the national economy and, at the same time, the main growth points of the Russian maritime economy. In 1994-2018, their cargo turnover had increased by 7.8 times, exceeding 816 million tons (up to 80% of this volume is accounted for export-import operations) [Vardomskij, 2019]. Expanding the participation of Russian producers in the dynamically developing markets of the Eurasian states, as well as realizing the country's Eurasian transit potential, should be implemented, inter alia, by creating stable functioning sea transport routes, as well as by increasing the capacity of the Russian Federation's seaports, including the ports of the Far-Eastern, Baltic, Arctic, Azov-Black Sea and Caspian basins.

A major role in the development of maritime activities will play the regions where port systems of the Northern Sea Route are localized. These systems have demonstrated the increased economic activity [Vardomskij, 2019] in recent years and have great potential for trade turnover growth between European Union countries and the Far East, especially China, Japan, and Republic of Korea.

The growing importance of the Northern Sea Route is due to the improvement of shipping conditions, the development of port infrastructure, the growth of economic cargo turnover in the ports of the seas of the Arctic sector of Russia, as well as due to the length of the route, which is several times shorter than the routes of the main trade routes "Far East – Europe" through the Suez or Panama Canals. The shorter route length of the Northern Sea Route provides an advantage in time for cargo delivery, reducing fuel costs and freight costs. An additional factor in increasing the attractiveness of the Northern Sea Route is the increase in its capacity due to global warming and growing opportunities for clearing the way by the icebreaker fleet.

The system of Chinese infrastructural megaprojects on the territory of Eurasia creates additional opportunities for the development of marine economic activities in Russian regions. It includes seven" belts " - transport, energy, trade, information, scientific and technical, agricultural and tourist [Bocharnikov, 2019: Liu, 2017: Song et al, 2013]. As part of this initiative, it is planned to support a number of international transport routes, most of which are not focused on the transport and logistics network of the Russian maritime regions. At the same time, the development of marine economic activity in the regions in the Northern Sea Route objectively contributes to the formation of a common economic space for both individual groups of Eurasian countries and the single Eurasian economic space too [Song et al, 2013: Panasyuk, et al, 2013].

Among new factors of the development of economic and transport and logistics activities in the Far North regions, we should also note the project "Northern latitudinal way" - a 707 - kilometer railway line under construction along the route Ob - Salekhard - Nadym - Novy Urengoy-Korotchayevo. The projected volume of transportation on this main railway line will be 23.9 million tons [Podpisano rasporyazhenie pravitel'stva RF po stroitel'stvu Severnogo shirotnogo hoda [Elektronnyj resurs] URL: https://news2.ru/story/551385/]. The completion of its construction will increase the economic potential of the maritime regions and ensure the growth of cargo turnover in their port systems by increasing the volume of cargo transported from the regions of Russia.

3 Methods

The complexity and lack of knowledge of various aspects of the state and prospects of development of marine economic activity in the Russian maritime regions necessitates the use of a wide range of analytical research methods – from simple quantitative analytical methods, methods of geoinformation analysis to methods of spatial statistics, spatial econometrics and methods of spatial (aquatic and territorial) socio-economic systems modelling.

In recent years, issues of developing a systematic approach to strategic planning and management of marine economic activities have become of great importance [El-Sabh et al, 1998]. In the conditions of intensive development of production and transport systems of the maritime regions, potential risks of conflicts in environment management, generated by anthropogenic threats to aquatic and territorial natural complexes, are growing. This implies the use of adequate analytical tools and a special computer environment for solving problems of analyzing the dynamic of marine economic activity in maritime regions. This possibility is provided by specialized geoinformation systems in combination with standard and special software packages for solving problems of statistical and spatial analysis of aquatic and territorial ecological-economic and socio-economic systems. Modern GIS have a wide analytical functionality and allow you to simply expand it on the basis of special project software, contributing to improving the quality and efficiency of analysis.

Analytical research carried out within the framework of the project "Eurasian vectors of marine economic activity in Russia: regional economic projections" is based on the development of the spatial databases system and the system of GIS- and web-maps formed on its basis. As part of the project, the development and implementation of a specialized geoinformation system "Marine Economic Complex of Russia" is envisaged.

4 Results And Discussion

The purpose of development of the geoinformation system "Marine Economic Complex of Russia" is to conduct comprehensive geoinformation analysis of the structure and functioning of the marine(sea) economic complex of its maritime regions. GIS will allow you to search for spatial and temporal constant patterns of development marine economic activity in new and existing regional systems on basis of analysis of social and economic space of the maritime regions, as well as to conduct operational monitoring of their economic activities.

Among the future tasks of GIS analysis of the marine economic activity systems in the maritime regions are:

- Analysis of the economic and geographical location of individual operational territorial units and their systems.
- Elementary spatial analysis problems: visualization of OTUs, analysis of their attributes, composition of thematic cartographic representations, graphs and diagrams, based on the attributes of homogeneous OTE systems - GIS layers.
- Spatial statistics (spatial distribution analysis, spatial structures analysis).
- Analysis of density and accessibility of economic space.
- Analysis of internal and external environment of OTU systems.
- Analysis of dynamics of the main OTU properties and their group properties.
- Network analysis.

The solution of GIS problems is based on fixing the systems of operational territorial units and the relationships between them. OTU is an atomic object of analysis. The OTU systems selected for GIS analysis not only determine the content of the cartographic base and spatial databases, but also the features of the applied analytical methods, the nature and format of the analysis results.

The core of the OTU system and, accordingly, the GIS spatial databases are formed by computer representation of such spatial formations as:

- seaport and its components;
- hinterland of the port or economic growth center of the maritime region;
- a municipality where marine economic activity is localized.

Their ensembles and combinations form GIS constructs of a higher level of spatial hierarchy, with a more complex structure. Among these are:

- maritime regions where information about ports, hinterlands, and municipalities is summarized;
- coastal sectors of marine economic activity;
- countries;
- world regions.

Information at the regional level, country level, or group of countries level serves as the basis for the software construction of individual spatial databases or is formed by the GIS itself as part of processes for solving analytical problems.

Economic activities carried out within individual seas (transport, fishing, oil and gas production, etc.) initially have a marked industry orientation and are not focused on the development of inter-industry cooperation and integration. Therefore, its results do not immediately form regional and interregional economic complexes and clusters. Only with the growth of economic and social relationships and the achievement of an optimal combination of main branches of economic specialization, joint marine economic complex on regional and interregional level is formed.

These circumstances, as well as the level of socio-economic development of the maritime regions, have largely determined the content and structure of the GIS spatial databases system. They include spatial data on individual industries and emerging marine economic complexes in Russian regions, their international economic relationships, as well as on vertical socio-economic relations between municipalities and regions.

GIS databases include the following groups of indicators:

1. The Russian Maritime industry and its regional localization

a) Main indicators of marine industry sectors

1.1. Seaports and maritime navigation.

1.2. Extraction of marine bioresources (including marine fisheries) and aquaculture.

1.3. Extraction of mineral raw materials (oil, gas) on the sea shelves and coasts.

1.4. Shipbuilding and ship repair; construction of equipment for development of shelf resources.

1.5. "Waterside" tourism and recreation.

1.6. Naval forces and their infrastructure.

1.7. Scientific and educational structures of "marine" orientation.

b) Indicators of economic sectors that are interconnected with the branches of the marine economic complex

1.8. Port industry (export-oriented or dependent on imports of raw materials, components, etc.).

1.8.1. Automotive industry.

1.8.2. Liquefaction and regasification of natural gas, other types of hydrocarbon processing.

1.8.3. Chemistry.

1.8.4. Food industry.

2. Economy of the maritime regions: structure, dynamics, comparative studies with the inland territories of Russia and average Russian indicators.

3. foreign Economic activity and international trade relations of the Primorye regions of Russia.

4. Demographic and social processes in the Primorye regions.

As known, the Register of seaports of the Russian Federation includes 67 ports that are united in eight sea basins and located on the shores of 12 seas of three oceans and the Caspian Sea.

When developing the structure of the GIS spatial database system "Marine Economic Complex of Russia", all the objects of analysis - the maritime regions, their municipalities, ports and port components were grouped on the basis of their geographical location into five sectors:

a) Arctic Sector, including the Republic of Karelia, Arkhangelsk oblast, Murmansk oblast, Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Krasnoyarsk Krai, Republic of Sakha (Yakutia).

b) Baltic Sector, including Kaliningrad region, Leningrad region, and Saint Petersburg

c) Black Sea Region Sector: The Republic of Crimea, Krasnodar Territory, Rostov Region, Sevastopol

d) Caspian Sector: The Republic of Kalmykia, Astrakhan Region, The Republic of Dagestan

e) "Pacific Russia" Sector: the Chukotka Autonomous Region, Kamchatka Territory, Primorsky Territory, Khabarovsk Territory, Magadan Region and Sakhalin Region.

The structure of spatial databases and the cartographic base of the GIS " Marine Economic Complex of Russia " are focused on seven levels of the spatial hierarchy - from the Eurasian level to the port locality (Table 1).

Table 1 Levels of the spatial hierarchy of the spatial databases of the GIS in scientific project "Eurasian vectors of marine economic activity in Russia: regional economic projections»

	Level name	**Databases (DB)**	**Map framework**
0	Eurasia (Russia and neighbouring countries)	√	√
1	Russia (Russian regions)	–	√
2	Maritime sectors of marine economic activity	Formed by the spatial databases of the maritime regions	√
3	Maritime regions	√	√
4	Port hinterland or hinterland of an economic growth centre	Formed by the spatial databases of municipalities and ports	Formed on cartographic base of municipalities and port
5	Municipalities where marine economic activity is localized	√	√
6	Ports and their parts	√	√

The key-note level is sublevel 3 "Maritime regions", which serves as a link between sublevels 2 and 4, 5 and 6.

The developed structure of GIS spatial databases will allow to switch to any of the selected maritime sectors with automatic construction of map layers defined for a given map scale. This makes it possible to conduct an intersectoral and interregional analysis of economic processes in the coastal regions, to conduct a comparative analysis with the inland territories of Russia and the average Russian indicators.

Of particular interest is the micro-level analysis and mapping, focused on the construction of GIS maps of ports and adjacent territories that are most fully involved in the processes of marine economic activity. The formed spatial databases assume future storage of information about each terminal of a port, which makes it possible detail analysis and assessing the degree of development of its economic relations.

A fragment of the "Pacific Russia" Sector map is shown in Fig. 1.

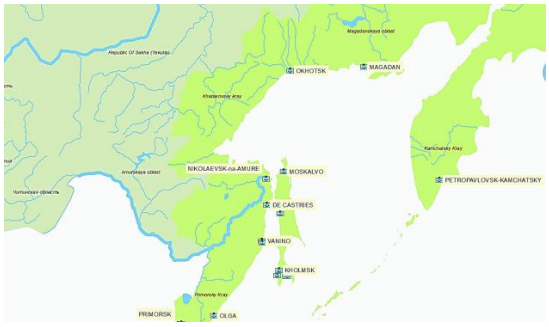

Fig. 1: Fragment of the "Pacific Russia" Sector map

5 Conclusions

The current geopolitical situation of Russia is increasingly determining the importance of its marine economic complex. By developing maritime economic activity, the country strengthens the multi-vector nature of its foreign economic policy, increasing the stability of economic growth [Druzhinin, 2016]. Activation of marine economic action is currently manifested, first of all, in strengthening the geoeconomic (including transport, fishing, offshore energy production, etc.) presence of Russia in the coastal territories of the country.

The solution of a number of modern geoeconomic problems in Russia is directly related to acceleration of the formation of large marine economic complexes, which allows to identify perspective territories within which new areas of concentration of productive forces will be formed, ensuring development of the economies of both individual Russian regions and countries of Eurasia. This determines the fundamental importance of solving the problems of both economic and spatial analysis of regional and interregional marine economic systems, creating prerequisites for detailed research of coastal territories using modern GIS technologies.

The geoinformation analysis of social and economic development problems of the country's maritime regions, carried out within the framework of development of the GIS project "Marine Economic Complex of Russia", will allow a deeper assessment of their economic growth potential, prospects for

participation in the development of the Eurasian economic space and international economic relations of the Eurasian countries.

Developed specialized geoinformation system will contribute to effective solution for a wide spectrum problem of spatial and economic analysis of state and dynamics of marine economic systems of coastal regions. GIS will also help to assess the extent of their involvement in interregional and international economic relations, allowing to identify and assess the intensity of economic relations both at regional and international level.

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