Research on Marine Environment Information System

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Abstract. In this paper, the current situation of digital ocean environment information system is studied, including the digital ocean environment information system, the digital ocean environment information system and the digital ocean information system. The comprehensive analysis and application of display and management, marine environmental information, and the construction of a more comprehensive and rich marine environment digital earth will form a marine environment information security system suitable for marine power strategy.

1. Introduction

Digital ocean is a complex system engineering, which is a combination of various disciplines and technologies. It is the embodiment and expansion of Digital Earth theory and technology in the field of ocean to deal with and display marine problems by means of digitalization and informatization, so that people can understand and utilize marine information resources to the maximum extent. At present, the accepted definition is a virtual ocean world constructed by massive, multi-resolution, multi-temporal and multi-type space observation data and ocean monitoring data and their analysis algorithms and models. The strategy of building a maritime power requires expanding the service objects, accelerating the diversification of service support, building a new model of marine environmental information assurance, and gradually realizing the transformation from single support to comprehensive marine environment information support[1-3]. In order to improve the comprehensive support ability of marine environmental information, we should carry out the construction of marine environmental information application system based on Digital Ocean, realize the three-dimensional digital display and management of marine environmental information, the comprehensive analysis and application of marine environmental information, build a more comprehensive and rich marine environment digital earth, and realize the comprehensive and integrated application of marine environmental information. It is of great strategic and economic significance to provide technical support for marine transportation, fishing, risk prevention and lifesaving, marine rights and interests protection, and marine resources development.

2. Current situation and problems

In the field of digital ocean research, Google Earth is one of the most influential products at present. On this basis, the marine environment information content was added and Google was launched in 2009 Ocean, mainly including coastline change comparison, seabed topography, sunken ships, water surface model, scenic spots, etc., can query the information of marine environment related fields, and provide users with virtual ocean world. However, in terms of the overall construction and application service level of digital ocean, there are still some gaps, such as the insufficient capacity of marine environmental data acquisition system, the inability to effectively guarantee the continuous information updating of digital ocean, the low application ability of information fusion and the weak ability of information distribution support. Therefore, it is necessary to establish the marine
environment information application system based on digital earth, acquire and process marine geography and hydrometeorological support information through the network, distribute data and products in real time for users at all levels on demand, and integrate display on the standard basic geographic platform to directly provide information support for users[4].

3. Design of marine environment information application system

In order to ensure the rapid application efficiency of marine environmental information and achieve the goal of timely delivery and rapid application of marine geography and hydrometeorological information, the design idea of the system adopts the development ideas of popular general system construction, professional support system construction and general integration. Based on the current and future network development level in a short period of time, the distributed database technology is adopted, and the 3D digital earth with independent intellectual property rights is selected as the basic integrated platform to realize the comprehensive management, display and application of massive marine geography and hydrometeorological information[5]. The marine environment information application system consists of information collection and update, information comprehensive management and information three-dimensional Visualization, global electronic chart and other four subsystems, as shown in Figure 1.

![Figure 1. Composition of marine information support system.](image)

3.1. Information collection and update subsystem

This subsystem is composed of four subsystems: information collection, information real-time updating, mass information remote updating and information updating process monitoring. The main function of this subsystem is to collect marine geographic and hydrometeorological information from various sources, including real-time observation information, support products generated by operational system, and support products made by professionals. According to the customized request of marine geography and hydrometeorological information, the real-time distribution and update of customized information, the quasi real-time update of real-time Hydrometeorological Information, the real-time sharing and updating of all kinds of marine geography, hydrology and meteorology information in the whole system can be realized, and the remote and irregular updating of massive hydrological Meteorology and basic geographic information can be realized.

3.2. Information integrated management subsystem

This subsystem consists of three subsystems: integrated information management, integrated information processing and information extraction integration and analysis[6]. Its main functions are to process and manage the global conventional and unconventional hydrometeorological real-time observation data and historical data, process and manage various marine hydrometeorological statistical analysis products, reanalysis products, numerical forecast products and various marine information.
environment forecast and guarantee products at home and abroad, and process and manage surveying and mapping data such as basic geography, satellite remote sensing, topography and geomorphology. The real-time information obtained during the activity was quickly input, managed and applied, and the processed metadata, marine environment comprehensive data and basic geographic data were input into each thematic database for management.

3.3. Information 3D visualization subsystem
This sub-system includes six sub-systems: basic digital earth, 3D visualization of information, dynamic simulation of marine environment, mapping of marine environment situation, rapid diagnosis of information and assistant decision support of marine environment. The integration of data and international standard electronic chart, visualization display, three-dimensional spatial analysis and other functions can realize the three-dimensional visualization of information, the integration of associated multimedia information, the interactive dynamic simulation of marine environmental information, the plotting and editing of marine geography, hydrometeorological support situation information, and the production of rapid diagnosis products for mesoscale ocean and atmospheric phenomena, and the realization of multi styles Marine environment information aided decision support product production based on GIS[7].

3.4. Global electronic chart
This sub-system includes global electronic chart product library, international standard electronic chart browsing and electronic chart drawing subsystem. Combined with the global electronic chart product database, it expands the existing support service scope, and provides S-57 by remote service mode relying on network and satellite means. Electronic chart data support and distribution update, serve for various marine applications, gradually change the status quo of marine surveying and mapping support means. According to the international electronic chart data standard, the global electronic chart database is established by adopting a unified data model. Based on Oracle database system, it stores data such as electronic chart, nautical notice and nautical book list, and develops tools such as control, symbol library and browser. According to the S-52 display standard, through the analysis of the key, the interpretation of the symbolic instructions, the processing of the display generator and the establishment of the symbol library, the international standard electronic chart browsing can realize the display restoration and positioning query of the electronic chart, and achieve the stepless zoom of the display scale, global roaming, multi-scale expression of the chart elements with the change of the scale. The plotting of electronic chart can be downloaded by professionals in the way of label toolbox to realize the function of situation plotting and printing compatible with international standard electronic chart.

4. Research on Key Technologies of marine environment information application system

4.1. Vertical datum unification and conversion technology of marine environmental data
According to the standard of marine survey, the elevation datum consistent with the land topographic map is adopted for the coastal land topographic map, and the chart depth datum is used for the seawater depth. Due to the vertical deviation of several meters between the datum, the unified representation of marine geographic information is separated. The key technology to solve this problem is to construct a continuous chart depth datum field model and a sea surface terrain model, which can provide a concrete scheme and a practical conversion model for the information fusion and integration expression of chart and topographic map.

4.2. Multi ocean environment information fusion processing and display technology
According to the metadata standard of marine surveying and mapping, the marine geographic information products are loaded to form a marine geographic information platform which is composed of charts, seabed topography, sediment and other data, and can be used as a spatial measurement and
visualization tool. According to the theory and method of spatial-temporal information fusion, the integration of Marine Geology and hydrological environment, 3D, and so on are overcome. It is used for the integration, display and measurement of different marine environmental data such as chart, terrain, wave, current, temperature, salinity, etc.

4.3. Dynamic simulation of marine environmental information in 2 / 3-D scene

In order to intuitively reproduce the dynamic change law of marine environment and effectively utilize the information of marine environment, it is necessary to solve the technical difficulties of dynamic expression and simulation of spatiotemporal regular data field and spatiotemporal discrete data field, as well as the dynamic interaction of two / three-dimensional scenes in the process, so as to meet the application requirements. Therefore, based on the geographic information development library and visualization platform, using visual programming language, integrating the technical achievements and visual component library of project research, the two-dimensional / three-dimensional dynamic visualization expression and simulation system of marine environment information under the C / s and B / S architecture can be developed, which can realize the dynamic visualization expression and Simulation of marine environment information.

5. Conclusion

Digital ocean construction is a long-term strategic and forward-looking system engineering. On the basis of fully absorbing and learning from the working experience in relevant fields, we should actively carry out the research on the strategic planning of digital ocean development, and explore the marine informatization construction and application service mode. The integrated information such as geography, hydrology, meteorology and remote sensing image is processed and managed in a unified way, so as to realize the fusion display and application of all kinds of information, and provide vivid and intuitive marine environment information support.

References

[1] Pieri G, Colantonio S, D'Acunto M, et al. A Marine Information System for Environmental Monitoring: ARGO-MIS[J]. 2018.

[2] Barale V. A supporting marine information system for maritime spatial planning: The European Atlas of the Seas[J]. Ocean & Coastal Management, 2018, 166(DEC.):2-8.

[3] Peng C, Shao-Peng W, Yu-Ting L I, et al. The Development of Marine Geographic Information System under the Background of Big Data[J]. Marine Information, 2019.

[4] Li Zhao. Research on spatiotemporal data modeling and visualization service of virtual ocean environment [D]. Zhejiang University, 2010

[5] Peng C, Shao-Peng W, Yu-Ting L I, et al. The Development of Marine Geographic Information System under the Background of Big Data[J]. Marine Information, 2019.

[6] Yuesen R, Meixue L, Qinmin S, et al. The Marine Information Sharing and Release System Platform Based on WebGIS[J]. Ocean Development and Management, 2018.

[7] Li-Rong M. Security Architecture of Marine Information System[J]. Communications Technology, 2017.