Research on Disaster Prevention and Mitigation System Construction Based on Marine Business Work

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Abstract. As global climate change intensifies, the po Marine business work, disaster reduction, disaster prevention, spatial analysis, risk synthesisability of marine disasters becomes greater and greater. In order to reduce the damage caused by marine disasters and to be able to shoulder the responsibility of major powers in facing marine disaster risks, China needs to establish China’s domestic marine disaster prevention and relief system and international cooperation mechanism for disaster prevention. On this basis, a preliminary idea for establishing a disaster risk assessment system was proposed. After the system is completed, the spatial analysis function based on GIS, combined with the disaster risk assessment database, can quickly, practically and accurately provide special disaster risk results for disaster prediction and prediction of relevant departments and select effective and scientific disaster prevention, mitigation and relief Measures provide the basis.

1. Introduction

Doing a good job in the prevention of marine disasters is the basic task of the government to fulfil its social management and public service functions, and is an important part of building a harmonious society. How to strengthen the management of marine disasters, reduce the impact of marine disasters on economic construction and people’s lives, and allow the achievements of marine disaster prevention and reduction to benefit the improvement of people's material and cultural living standards is a new historical responsibility facing the development of marine disaster prevention and reduction. Marine disaster prevention and mitigation is an important part of the national disaster prevention and mitigation system. The report of the Eighteenth National Congress of the Communist Party of China clearly stated that "strengthening the construction of disaster prevention and mitigation systems." Improve the disaster prevention and mitigation system."

However, the regional marine disaster prevention and mitigation information support technology is a systematic project. It lacks the consideration of system science and the integration of holism and reduction theory from the perspective of the combination of macro and micro to carry out research on integrated theories and methods. China’s digital ocean has made considerable progress and several research results from the construction of information infrastructure to key technology research and development, but how to play a greater role in regional disaster prevention and reduction requires further theoretical and methodological research. This article aims to analyse the research status of natural disaster assessment systems at home and abroad and the theoretical methods of disaster risk assessment. At present, the foundation for establishing a disaster risk assessment system is mature, and
on this basis, the preliminary design of the disaster risk assessment system is proposed and the system is preliminary Development [1].

2. The current situation and theory of disaster prevention and mitigation in China's marine business

2.1. Current situation analysis
Scholars at home and abroad have carried out a series of studies on marine disasters, especially in the field of natural disaster risk. The researches on marine disasters mainly focus on single types of marine disasters, especially the typical marine disasters with great damage. Storm surges are the most common. In addition, there are typical marine disasters such as red tides and sea ice. The initial research on disasters is to understand the internal causes of disasters, and it is expected to grasp the basis of disaster information. Therefore, research is mainly conducted on the causes of disasters, and most of the methods are mathematical statistics. With the deepening of research, the focus of research has also expanded, and people are more concerned with the risk of facing disasters. As a result, research on disaster risk has begun to increase. In modern times, due to climate change and environmental changes, the disaster risk is more severe. Many disasters often occur together, forming a disaster chain, which is powerful and huge for social life. Therefore, it is expected that the research on disasters can start from various aspects and be comprehensively analysed. Turning to high-precision, quantitative evaluation of multi-space-time ruler dimensions, at the same time, the interaction between marine disasters and human economic society has also received increasing attention.

The "Natural Disaster Decade" aims to reduce the loss of life and property damage caused by natural disasters such as floods, storms, tsunamis, and earthquakes, as well as the social and economic chaos caused by the joint actions of all countries in the world. The establishment of the Disaster Reduction Committee is a major driving force for our national defines disaster reduction work, which has greatly promoted the development of relevant theoretical research. Academia both at home and abroad agree that the improvement of disaster prevention and mitigation capability is an important safety guarantee for the sustainable development of a country. To achieve this goal, the assessment of disaster prevention and mitigation capability becomes particularly important, which is to reduce disaster losses and improve recovery speed. Key link.

Since the 1990s, coastal zone vulnerability assessment has become a key area of concern for developed Western countries. The Netherlands and the United States were the first to conduct a comprehensive study and analysis of the possible impact of sea level rise on coastal areas. The United Nations established the Intergovernmental Panel on Climate Change (IPCC) to address climate change issues, focusing on the study of coastal zone vulnerability assessment research. At the same time, the third working group of IPCC, the Coastal Zone Management Group (IPCC-CZMS), was established to promote coastal countries to pay attention to the possible impact of climate change on the coastal zone. The United Nations Coastal Zone Management Team has carried out active and effective work in the world. A framework for vulnerability assessment was first proposed within the scope, a conventional (CM) assessment method for coastal zone vulnerability assessment was issued, and exploratory research was carried out in nearly 50 coastal areas in different countries, although the conventional assessment method has a cross-regional horizontal comparison. It has obvious advantages, but the method of universal applicability to different environments still has major shortcomings. The most prominent shortcomings are the operation and the insufficient understanding of the policies of different countries or regions in economic understanding. In the past five years, according to the IPCC report on climate change, only 24 countries or regions in the world have agreed and adopted the conclusions based on the vulnerability assessment framework; in response to the embarrassing situation, the IPCC continued to publish applications to improve the assessment framework. The adaptive technical guidance scheme in different regional environments and designing a set of
reasonable evaluation methods and steps are of great application value to the vulnerability assessment of natural, economic, urban and other systems caused by climate change [2].

2.2. Theoretical analysis of catastrophe of marine disaster prevention and mitigation

We start by knowing the mutation institution to learn and understand the basic principles of mutation theory. Figure 1 is a simple model used for teaching by the mathematician Zaman. The required tools and production process are very simple. Find two identical rubber bands. The unstretched length of the rubber band is the unit length. Cut a disc with a radius of half of the unit length on the jammed paper. First, push the pin through the centre of the disc to fix the disc on a suitable base plate. The disc can rotate around the centre at will, and then use the push pin to make the needle point upward Fix it at the Q point on the circumferential edge of the disc, and use a rubber band to put it on the Q point pin. Then use a pushpin to fix the other end of one of the rubber bands on the bottom plate at a distance R of two-unit lengths from O. The remaining end P of the other rubber band can move freely, stretch the rubber band to different degrees and move back and forth, and record the changes of the disk. Dimensions are approximate values for reference and do not need to be very precise.

![Figure 1. Siman mutation simplified mechanism](image)

The position of the catastrophe mechanism at any time is determined by the variable e, no matter where P is, the mechanism will move to minimize the energy stored in the rubber band. The potential energy of the system is:

\[
V(\theta) = \frac{1}{2} \mu \left[ (r_1 - 1)^2 + (r_2 - 1)^2 \right]
\]  

Among them, \( r_1 \) and \( r_2 \) are the lengths after the rubber band is stretched, the pair is the elastic modulus. Consider first the special case of P moving along the axis of symmetry. Due to the symmetry, there is a balanced position at \( e = 0 \).

\[
r_1^2 = s^2 + \frac{1}{4} + s \cos \theta
\]
\[ r_z^2 = 4 + \frac{1}{4} - 2 \cos \theta \] (3)

Catastrophe theory is an analysis of the potential system. The current state of the system is usually expressed by a potential function, where “potential” refers to the system's ability to use a particular trend, the relationship and role of various factors and subsystems within the system, and the role of the external environment. It plays a decisive role in the size of “potential”; in catastrophe theory, there are two kinds of potential function variables: internal variables and control variables. Internal variables refer to the existing state and behaviour variables of the system, and control variables refer to the external environment; any system state can be represented by a potential function, but whether the state variables and control variables unify determines any state of the system. The critical point is classified according to the system's potential function as the characteristic of catastrophe theory, and the discontinuous state near the critical point is studied. The stability of the coastal city system can be used as a state variable. Based on the above analysis of the causes of marine disasters in coastal cities, the causes of the coastal city system stability caused by marine disasters include three aspects: people, things, and coastal city environment. As the control variables, the urban environment of things, things and coastal cities is used to study the mechanism of marine disasters in coastal cities and analyse them. The state variable is one and the control variable is three. The mutation form is dovetail mutation. The potential function of the dovetail mutation model is:

\[ V(x) = x^3 + ux + vx + wx \] (4)

Among them, the state variable is x, the control variables are u, v, w, the equilibrium surface of the system potential function is

\[ 5x^4 + 3ux^2 + 2vx + w = 0 \] (5)

Simultaneous (4) and (5)

\[
\begin{cases}
V(x) = 5x^4 + 3ux^2 + 2vx + w \\
V'(x) = 20x^3 + 6ux + 2v
\end{cases}
\] (6)

In this way, the equation of the set of divergent points of the swallowtail mutation is obtained.

3. Establishment of marine disaster prevention and mitigation system

(1) Construct a modern marine forecasting standard system. Mainly includes: ocean observation (including ocean observation facilities, ocean observation specifications), ocean forecast (including conventional forecast of marine environment, mid- and long-term forecast of marine environment, refined forecast of ocean, release of ocean forecast). (2) Establish a mature early warning standard system for marine disasters. It mainly includes: types of marine disasters (including sea ice, waves, storm surge, tsunami, sea temperature, etc.), and the activation and release of marine warnings. (3) Establish a sound management system for marine forecasting and disaster prevention and reduction. Mainly include: marine forecast quality management (including marine forecast business terminology, marine forecast business classification, marine forecast data specifications), marine disaster emergency management (marine disaster emergency response, marine disaster prevention and mitigation facilities and maintenance), marine disaster assessment management (assessment Technical methods, ecological loss assessment, economic loss assessment), marine disaster risk assessment and zoning, compilation of marine disaster bulletins, etc. The specific architecture diagram is shown in Figure 2.
4. Standardization System for Marine Forecasting and Disaster Prevention

4.1. Overall system objectives
The database is the basis of natural disaster risk assessment. It is necessary to establish a spatial database, attribute database and image database including satellite remote sensing image data, environmental background data, socio-economic data, historical disaster situation data, etc. to provide a basis for disaster risk assessment. In order to carry out timely, effective and accurate red tide disaster risk assessment, the system's spatial data, attribute data and image data must be able to be easily and easily managed, maintained and expanded without re-planning the platform. The red tide disaster assessment system adopts the C/S model structure, and its overall design is shown in Figure 3:

Figure 2. Standardization system for ocean forecasting and disaster prevention and mitigation

Figure 3. Overall structure of marine disaster risk assessment system
4.2. System function analysis

4.2.1. Information sharing and service environment module. The construction of a regional disaster prevention and mitigation information service system as a social information application system must use information sharing and service environment as the basic guarantee to coordinate the relationship between many participating entities. Without information sharing and service environment, it is impossible to achieve full sharing of disaster prevention and reduction information, information update and integrated application among multiple departments of society, and emergency linkage, coordinated command and coordinated decision-making among multiple departments in the process of disaster prevention and reduction [3].

The sharing and service environment refers to an environment that realizes the full circulation and sharing of disaster prevention and mitigation related information with the objective of disaster prevention and mitigation information services based on regional informatization development planning and government macro-control, and in accordance with specific rules and laws. The construction content needs to include policy environment, data sharing and service, network environment, data integration environment, decision model sharing standards and specifications, integration of user classification system and so on. Through the construction of sharing and service environment, the integration, continuity, integration and business of system construction are guaranteed [4].

4.2.2. Spatial data infrastructure. Spatial data infrastructure is the basic spatial framework of the regional disaster prevention and reduction information service system, serving the integration and integration of multiple types of disaster prevention and reduction information resources. The main spatial data infrastructure data system content is shown in Table 1.

| type of data                      | Data content                                                      |
|----------------------------------|------------------------------------------------------------------|
| Multiscale basic geospatial data | It mainly includes DLG, DOM, DEM, DRG space information of different scales such as 1: 5000 and 1: 10000, as well as space historical archive information, etc. |
| Spatial positioning data         | High-precision position control network data, elevation control point data |
| Multi-resolution ground observation data | Remote sensing data with different spatial resolutions such as Yami, Mi, Ten Mi, 100 Mi, and Kilometre |

4.2.3. Information infrastructure. It mainly includes hardware support facilities and information resource infrastructure. Through the real-time monitoring network, information transmission network, remote control system and other networks and information resources and other hardware to support the construction of environmental infrastructure, provide basic support for information services.

4.2.4. User classification. The user classification system provides the basis for demand decision-making for the development of the service system. Through the classification of application modes of different user groups, the business operation and practicality of the entire system are guaranteed [5].

4.2.5. Decision model integration. The regional disaster prevention and mitigation information service system will involve different types of disasters (floods, droughts, typhoons, storm surges, major river basin pollution accidents, sudden marine accidents, sudden public health events, etc.). Its unique law of occurrence and development. For the occurrence of disasters, the prediction and forecast of development laws and process simulation, the support of decision-making models is required, including the development and control of models, the development of models and system interfaces, and the establishment of a model library and knowledge base. Taking the Taiwan Strait's emergency
decision-making as an example, after a ship's collision, stranding, and sinking at sea, it is necessary to simulate and calculate its dynamic drift trajectory to serve emergency responders' accurate positioning. Professional ocean current, wind field and other numerical prediction models can realize the function and service content of quickly predicting the drift trajectory of people or objects.

4.2.6. Service chain for business processes. The regional disaster prevention and mitigation information service system provides disaster prevention and mitigation management and decision support applications for government management departments, which need to be closely integrated with the functional business processes of the management department. To build a service chain for government disaster prevention and reduction management business processes, it is necessary to build a business process service chain based on data flow and information flow, combined with the duties of business personnel, to realize the application of business, process and intelligence. Analysis of suggestions for disaster prevention and mitigation

4.3. Improve the comprehensive defines mechanism of marine disasters
Effectively strengthen the mutual cooperation among various regions and departments, ensure the linkage from top to bottom, and work together to solve the outstanding problems encountered in the work of disaster prevention and mitigation in a timely manner. Actively promote cooperation among regions, departments and localities, departments and enterprises, and continuously deepen cooperation areas and levels. Reasonable allocation of various disaster prevention and mitigation resources, strengthening the sharing of marine disaster prevention information resources, extending engineering and non-engineering disaster prevention and mitigation measures from land to sea, building land-sea coordination, three-dimensional linkage, rapid response, and powerful marine disasters Comprehensive defines mechanism [6].

4.4. Strengthen the innovation of marine disaster prevention technology
Effectively strengthen the science and technology and standard research of marine disaster law, disaster conditions, occurrence mechanism, prediction and forecast, risk assessment, defines countermeasures and the impact of various marine disasters on economic and social development, disaster prevention engineering standards. Carry out marine disaster prevention and emergency simulation experiments, speed up the application of scientific and technological achievements in marine disaster prevention work, and vigorously improve marine disaster prevention capabilities. Carry out in-depth evaluation of the impact of extreme weather events on economic and social development, ecological environment, and other countermeasures to achieve a new breakthrough in marine disaster monitoring and forecasting [7].

4.5. Actively carry out foreign exchanges and cooperation to increase international influence
China should increase its participation in the global ocean observation program. On the one hand, it can cooperate with international marine satellites to provide global ocean observation resource information and highlight the status of a major country; on the other hand, cooperate with international satellite research and development departments in the field of marine satellites to maximize the use of international scientific and technological and data resources By means of carrying, introducing, digesting and joint research and development, China Marine Satellite Technology and application level will be improved to promote the construction and development of China Marine Satellite System. At present, there are many large-scale international plans for ocean observation, including the Global Ocean Real-Time Observation Network, the Global Ocean Carbon Observation Plan, the European Ocean Observation Data Network, and the Global Ocean Observation System. Among them, China participated in the most representative global ocean observing system, and initiated and organized the Northeast Asia Ocean Observing System under this framework. These plans are of great significance for the integration of global resources and the formation of long-term, continuous ocean stereoscopic
observations, which will greatly enhance human understanding of the ocean and increase human ability to resist marine disasters [8].

5. Conclusion
Facing the needs of China's smart ocean construction, research the theory, methods and technologies of ocean space-time big data analysis and mining. Based on the monitoring data acquisition system that has been constructed, the research on data analysis, knowledge mining, and law discovery will be strengthened to maximize the potential value of the data and serve for disaster prevention and reduction decisions. Facing a variety of application environments and needs such as regional comprehensive applications, explore the application model of vertical sharing of multi-level government departments coupled with wide-area collaboration. Realize "horizontal multi-level sharing" and "vertical information bidirectional service".

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