View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Xiamen University Institutional Repository

Ocean Observing Data Web Service and Application in Shipwreck Salvation of Taiwan Strait

Yuwu Jiang[1], Xin Zhang[2]
[1] State Key Laboratory of Marine Environmental Science
Xiamen University, 361005
Xiamen, China
ywjiang@xmu.edu.cn

Huasheng Hong[1], Tianhe Chi [2]
[2] Institute of Remote Sensing Applications,
Chinese Academy of Sciences, 100101
Beijing, China
zhangx@irsa.ac.cn

***Abstract*—In the ocean dynamical environment real-time observing system of Taiwan Strait and adjacent maritime region, multiple observing data such as remote sensing data, structured data and so on are produced by the observing net from airspace, ocean surface, underwater space and ocean bottom. The data sharing and web service is a key part to influence the application efficiency of the whole system. According to the characteristics of the oceanic dynamical environment of Taiwan Strait, the construction scheme of the observing net is introduced in this paper firstly. Then the architecture of the observing data sharing and web service system is introduced, which includes four parts, i.e. the observing data acquiring module, the data integration module, the data processing and information production development module, the data sharing and web service module. Next, the user classification system and service content classification are introduced. The users are divided into five classes and the service content is divided into 4 layers. At last, the technology realization strategy and application in shipwreck salvation decision-making support system is introduced.**

Keywords- Taiwan Strait;ocean observing data;web service; shipwreck salvation..

I. INTRODUCTION

China is one of the countries which have most serious ocean disasters in the world. In 2005 the ocean disaster resulted in 33.24 billion of economic loss to our state and 371 personnel casualty [1]. Taiwan Strait is a serious oceanic region which has special dynamical environment including storm time, oceanic wind, waves and so on. The solid observing system of Taiwan Strait and adjacent maritime region is an important part of Chinese Digital Ocean and Digital Fujian [2-3].

In the ocean dynamical environment real-time solid observing system of Taiwan Strait and adjacent maritime region, multiple observing data such as remote sensing data, structured data and half structured data are produced by the solid observing net from airspace, ocean surface, underwater space and ocean bottom [4]. The information service system is a key part to influence the application efficiency of the whole system, which can take good advantage of the technologies such as data warehouse, WebGIS and so on [5-6].

II. THE OCEANIC OBSERVING DATA ACQUIREMENT

The ocean dynamical environment real-time solid observing system of Taiwan Strait and adjacent maritime region is composed of the oceanic shore/platform observing net, the high frequency terra wave radar observing net, the buoys observing net, boat based observing net and remote sensing observing net. The observing nets form the three dimension solid observing system which observings the oceanic dynamical environment and ecological environment from underwater, ocean surface and air.

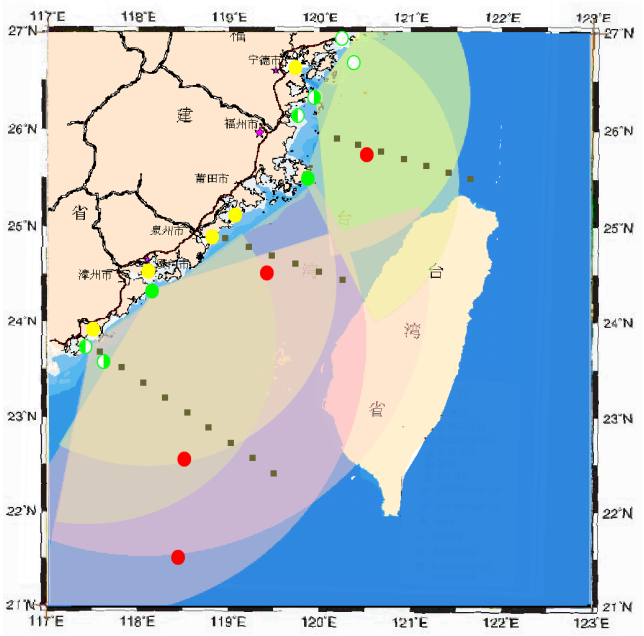

Figure 1. The location of ocean observing stations and observing region of Taiwan Strait and adjacent maritime region.

The observing result information mainly includes remote sensing image and recording information which is related with a spatial position. From the observing data format point view, it can be divided into three classes, i.e. the remote sensing image format information, the structured information and half structured information. The structured observing data can be positioned to the vector map by geo-coding tools in GIS. The two kinds of observing data must be processed in order to be used by different kinds of users. The remote sensing image format information is acquired by some image processing steps such as image rectification, image transformation, image extraction, image classification and so on. Most of the observing data exists in some different kinds of data files

This work was sponsored by Open fund of State Key Laboratory of Marine Environmental Science (Xiamen University) (No. MEL0507)

according to the different observing methods. So the first step to process this kind of observing data is to transmit it to database. Only the different kinds of observing data being stored in database tables, can they be managed and used expediently. When the observing data has being stored in database tables, they can be positioned onto the maps which have spatial reference. With the discrete observing data of the observing points, the ecological environment and dynamical environment can be seen in a discrete model. Using the geo-statistics module, the discrete observing data can be serialized to the whole oceanic region. Then the whole environmental and ecological situation can be seen on the map. The government and public can get the information through web. The location of ocean observing stations and observing region of Taiwan Strait and adjacent maritime region is shown in Figure 1.

III. MODULE AND FUNCTIONS DESIGN

To implement the ocean observing data sharing and service, the whole system is composed of four modules, i.e. the observing data acquiring module, the observing data integration module, the observing data production development module, the observing data sharing and service module.

The observing data acquiring module completes the primary processing, storage and transportation of the oceanic dynamical environment observing data. The main data transmitting method includes the wire transmitting (DDN、CHINAPAC、PSTN and so on) and the wireless transmitting (GSM、VHF/UHF). The observing data acquirement should be real-time or within no more than one hour.

The observing data integration module takes charge of the information communication between the data center and the observing facilities. This module can transmit the control command to the facilities and transport the observing data from the observing stations to the chief data center. The observing data are stored and managed by database.

The observing data production development module completes the processing to the observing data. The result outputs of this module are different kinds of observing data productions. The software architecture of this module can be a C/S software system in an intranet. The result information is to serve different kinds of users. So this module has an interface with the information sharing and service module. The different kinds of data are geo-coded onto the maps to be spatial referenced.

The observing data sharing and service module completes the observing data sharing and service through Intranet or Internet. The basis of this module is a observing data warehouse and a Geodatabase. And the software support includes a series of interoperation software packages which can be developed by web services technology and data warehouse technology. In the development of this module, the related standard and specification are the main reference. The software architecture of this module will adopt B/S structure to serve different kinds of users through Internet.

From the software module components stated above, we can see the whole service system is very complex. The development technologies include GIS, WebGIS, data warehouse, Web services, Interoperation technology, Database , XML and so on.

The user classification is the basis of the service content design. The users of this system are mainly divided into five classes, i.e. the national oceanic information center, the Internet users, the national oceanic environment forecasting center, the government information network users of Fujian province and the management sectors of the Ocean and Fishery Management Bureau of Fujian province.

For the national oceanic information center and the national oceanic environment forecasting center, the service system completes the required information submitting and information download. The communication network between the national oceanic information center and the service system center is national data communication network (CHINAPA, DDN or FR) and transmission speed is more than 64KBPS. The communication network between the national oceanic environment forecasting center and the service system center is VSAT and transmission speed is more than 32 KBPS. The communication network between the users of the Electronic Government Information Sharing Platform and the service system center is the Electronic Government Information Network of Digital Fujian and transmission speed is 100M or 155M. The management sectors of the Ocean and Fishery Management Bureau of Fujian province are in a Intranet with the service system chief center. And the Internet users enjoy the information service through Internet.

The information service content include four classes of observing information, i.e. the first class information service (the real-time observing information service), the second class information service (the statistics analysis observing information service), the third class information service (the information service in grid model) and the fourth class information service (the forecasting information service).

The first class information service (the real-time observing information service) provides the real-time oceanic observing data at some time of a observing station in the style of text or table. For a period, the system can provide the time serial graph for a day or five days. All the information service content is served based on the observing stations distributing map and interact with users with a mouse clicking.

The second class information service (the statistics analysis observing information service) content is mainly the statistics data which is renewed once a month. The information style includes the time serial graph, the plan map, the vector map of the oceanic dynamical environment and so on.

The third class information service (the information service in grid model) content is the isoline map and time serial map of the oceanic dynamical environment. The information region should cover 95% of the whole oceanic region. And the time frequency should be no more than 6 hours even within an hour.

The fourth class information service (the forecasting information service) mainly completes the tide, storm tide, oceanic wave and oceanic ecological environment forecast for the users. The purpose of these productions is to provide oceanic disaster forecast to guarantee the lives security and property security of the related people.

IV. TECHNOLOGICAL SYSTEM

When the oceanic dynamical environment solid observing information service system of Taiwan Strait is established, it mainly serves to Fujian province marine and fishery management departments and related marine research units. To greatly develop the potential value of the stereo observing information of oceanic dynamical environment, it must be integrated with the specific business of above-mentioned function departments, and form the differently professional business operation system according to different business demand and function unit need. It is necessary for web service system to offer open system interfaces, which satisfy the demand of systematic unceasing development.

The biggest characteristics of observing information web service of the Taiwan Strait and adjacent region is that every kind of marine observing information can realize the comprehensive service by unification software and hardware network platform. Before the integrated analysis service of special subject, it is necessary to make every kind of information space-melted, standardized, network-transformed, and form the information in unify under integration spatial frame, then using certain integration analysis method realizes much information to mix together and specific analysis goal.

At present, from the Web systematic three-layer architecture of typical case, expanding the ability of intermediate layer (business logic layer) that business handles server (pointing at Spatial Server for network GIS layer), can make system have more powerful analysis and decision function. By adopting the standard communication language based on XML as communication protocol and developing web service function assembly, we can expand the front handling ability (that is business logic analysis, general space analysis and application model analysis mainly), realize decision and the function service based on network.

Since marine stereo observing information web service system is to face the different social levels of government sectors and users to share government affairs information and offer information service to the social public, it is necessary for the development system to have good platform, quick operation and high stability to shield system no versatility problem etc because of the discrepancy of the various environments of software and hardware. So this system design mainly adapts the mature system, which takes JAVA as the main development language and takes XML as the standard communication language among multilayer function parts in software architecture.

V. SYSTEM REALIZATION AND APPLICATION

A. Data Sharing and Service

Different users have different requirement for the sharing and service content of the ocean solid observing of Taiwan Strait. The specialists including the users of the national oceanic information center, the national oceanic environment forecasting center, the government information network users of Fujian province and the management sectors of the Ocean and Fishery Management Bureau of Fujian province need the observing data sharing and service for analysis and study, so we implemented the regional data sharing and service through web. The data sharing and service content is from buoy, terra wave radar and so on. Figure 2. shows the data sharing interface of the buoy observing data.

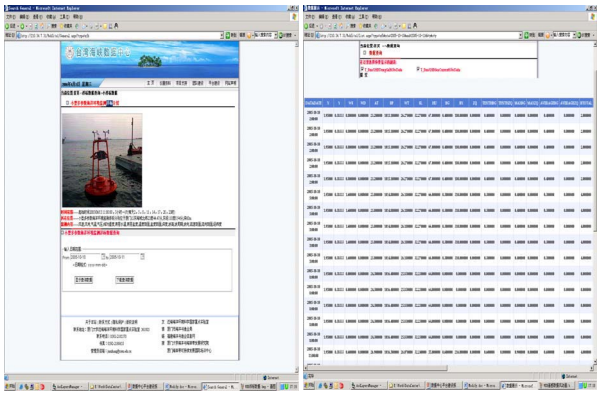

Figure 2. The buoy observing data of Taiwan Strait and adjacent maritime region sharing and service interface on web

B. Decision-making Support Service

An advanced service is the decision-making support service on web. The shipwreck rescue decision-making service has been realized and stated as follow.

The result of the ocean current numerical simulation is a grid data. As the ocean current information which includes the flow velocity on horizontal direction and vertical direction of each corner point of the grid, the flow velocity and flow direction of any point in the area can be figured out through vector computation and linear computation. Thus we can compute the floating distance of the shipwreck objects in a time interval. The principle is the same in the computation of the floating distance and location in the next time interval. So the floating trail can be computed in this way. The computation equation is shown in formulas (1). In formulas (1) the Vt1 is a vector value. As the flow velocity and flow direction is different between t1 and t2, the time interval is smaller, the computation is more accurate.

$$Dt1\sim t2 = Vt1*(t2-t1) \quad (1)$$

Using the research achievement stated above, we developed the "Shipwreck Salvation decision-making support system" whose data flow and workflow is shown in Figure3. The software includes to parts, i.e. C/S (Client/Server) and B/S (Browser/Server). The C/S software was developed using Visual Studio .Net development platform. If the accident is shipwreck, the software can forecast the floating trail of the shipwreck objects such as people, ship and so on. In Figure4, the red dash-line is a simulation trail. For the shipwreck which has oil spilling, the system can give the oil diffusing trail and the diffusing radius. The Figure 5 shows an oil diffusing procedure. As the ocean current numerical simulation need real-time data such as wind velocity and wind direction, the ocean current computation model is designed as a web service to be used to communicate with data service component

through SOAP protocol. When the result is forecasted, the result is stored in the database as case information. As the rescue procedure is located in a distributed location, it is important that the forecasting information should be promulgated as soon as possible. We developed a website which can read the case database automatically. The time can be no more than half an hour from the accident taking place to the information promulgated on web. The Figure 6 shows the function interface of the website.

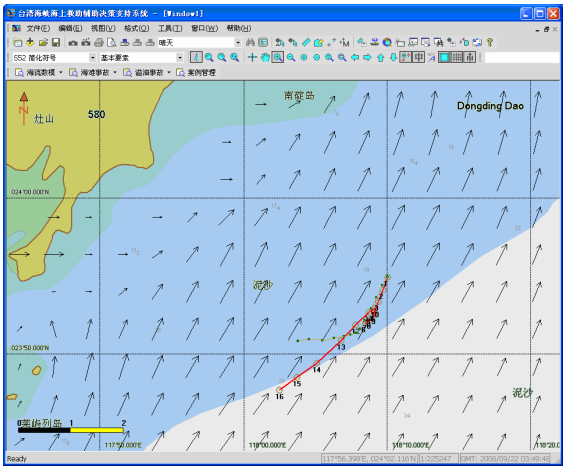

Figure 4. A numerical computation simulation based shipwreck salvation forecasting result in Taiwan Strait

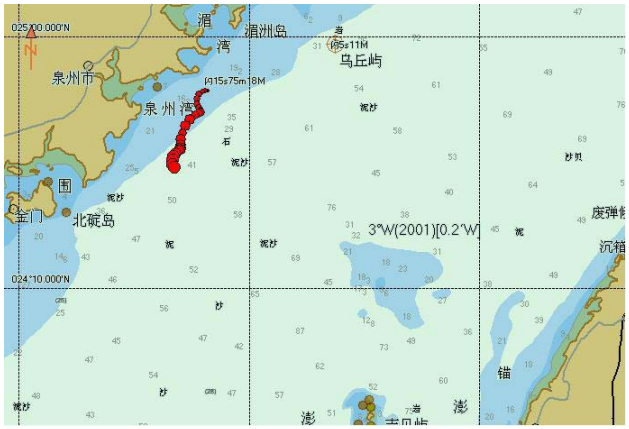

Figure 5. A numerical computation simulation based oil spilling forecasting result in Taiwan Strait

VI. CONCLUSIONS

In this paper we studied the oceanic solid observing data sharing and service on web of Taiwan Strait. Through our research, we can draw the conclusion as follow.

Figure 6. A numerical computation simulation based oil spilling forecasting result in Taiwan Strait example is released on web.

The ocean dynamical environment real-time stereo observing system of Taiwan Strait and adjacent maritime region is composed of the oceanic shore/platform observing net, the high frequency terra wave radar observing net, the buoys observing net, boat based observing net and remote sensing observing net. The observing nets form the three dimension stereo observing system which monitors the oceanic dynamical environment and ecological environment from underwater, ocean surface and air.

The oceanic dynamical environment solid observing service system of Taiwan Strait and adjacent maritime region software is composed of four modules, i.e. the observing information acquiring module, the observing data integration module, the observing data production development module, the observing information sharing and service module. The ocean observing data and information product can be served through web using web service technology. The shipwreck rescue decision-making support system is developed based on the ocean observing data and information product web service system.

This paper discussed some profiles of the whole system. There is much future work to be done in this area. Our related research is on its way.

REFERENCES

[1] Chinese Ocean Bureau, “The oceanic disaster communique of China in 2006”, http://www.coi.gov.cn/hyzh/fzjz/2002/index.html, 2006,pp.1-16.

[2] Ye Yangming and Huang Jiaqi, “The whole technology system architecture of Chinese Digital Ocean”, Vol.25（5）,2001,pp. 1-4.

[3] Wang Qinmin and Chi Tianhe. “From the concept of Digital Earth to the practice of Digital Fujian”, Vol. 2 Theory and Practice of Digital City. Guangzhou: World Books Press, 2001,pp.26-33.

[4] Chi Tianhe, Zhang Xin, Wang Qinmin and Chen Chongcheng. “Oceanic solid observing data service system”, Vol. 24(4). Journal of Huaqiao University[J], 2003,pp. :439－442.

[5] W.H.Inmon, K.Rudin, C.K. Buss. Data Warehouse.Beijing : Electronic Industry Press, 2000.

[6] Boblambert. Data Warehousing Fundamentals: What You Need to Know to Succeed.Http://www.techweb.cmp.com/iwk.htm.