Design and Implementation of Marine Dynamic Environmental Data Integrating and Information Sharing System of Fujian Province

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SUMMARY

A general information integrating and sharing architecture is discussed, the components of the architecture are put forward, a data integrating method based on distributed data warehouse together with a information sharing and multilevel serving method are specially described, the realization of the system is also presented.

Key words: *Integration; Distributed data warehouse; Information sharing platform; Information service*

1. Introduction

In china, nature disasters cause by marine are frequently happen each year, there are lots kinds of disasters including storm tide disaster, billow disaster, sea ice disaster, sea brume disaster and etc. For example, in regular year 2003, the loss caused by marine nature disaster came to 8.05 billion yuan, 128 people died or abscondence , up to 20 million people suffered. Marine disasters are usually caused by the water disorder or upheaval.

Marine dynamic environmental Monitoring is a task to scan and supervise the status and change of marine dynamic characters omnidirectionally at real time taking fully use of monitoring network composed of facilities locating in the air, above the water or on the ground, it is usually make up of 5 subsystems: the shore base monitoring system, surface wave radar system, submerged buoy monitoring system, remote sensing system, Shipboard Base monitoring system. Owing to multi monitoring platform, multi data themes and multi data productions, in order to analyze multi resource data and provide marine disaster prediction for government and public, there should be a set of data integrating and sharing systems to organize and manage data from multi platforms and information with multi data themes. At present, there are several notable marine monitoring systems in the world, they are NEPTUNE in Canada (The North-east Pacific Time-series Undersea Networked Experiments), ARENA in Japan(Advanced Real-Time Earth Monitoring Network in the Area), ESONET in Europe(The Europe Seafloor Observatory Network), ORION in USA(Ocean Research Interactive Observatory Networks). In recent years, an marine environmental monitoring and serving system demonstration region was also built in Shanghai, China.

The integrating and sharing mode of marine dynamic environmental monitoring information is discussed via an example of marine dynamic environmental data integrating and information sharing system in Fujian province in this paper, the system architecture, the data integrating and serving methods are brought forward too.

2. Architecture

From the point of view of information disposal and application, Fujian marine dynamic environmental data integrating and information sharing system composes of 3 subsystems: data collecting subsystem, distributed data warehouse subsystem and information sharing and serving subsystem (Figure1).

Data collecting subsystem is the headstream of other subsystem, formed by shore-base and ship-base marine observing stations, short range and long range radar stations, inshore pointing anchor buoy, seabed-base and submerged buoy platforms, Ship-loader drifting buoy, remote sensing monitoring infrastructure, and etc, real time and relay monitoring data collected from above equipments transmit to local data centers and chief data center through wire or wireless network communication mode(including DDN-Digital Data Network, CHINAPAC-Public Packet Switched Data Network of CHINA, PSTN-Public Switched Telephone Network, Ethernet Network, Geo-stationary Orbit and Polar Orbit Satellite, GSM-Global System for Mobile Communication).

Marine dynamic environment monitoring data are stored in Distributed data warehouse subsystem metadata is stored by metadata Repository, data warehouse subsystem is not only the depositary of monitoring data, data warehouses also provide data products which have been cleaned, transformed and primary processed.

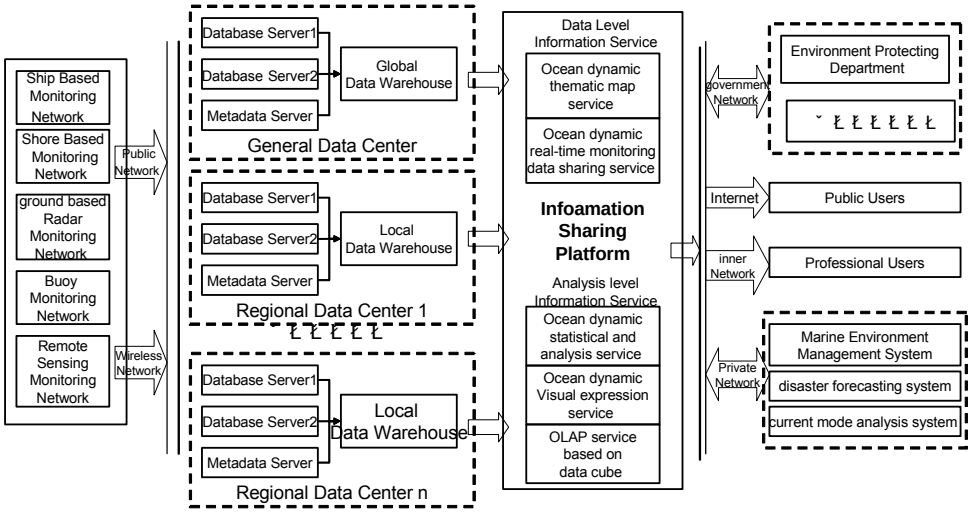

Figure1: The Architecture of the System

Information sharing and serving subsystem is a B/S based information interactive and sharing web environment, it is composed of information sharing platform and application servers on this platform. Information sharing platform connects distributed data warehouse system by standard database interface such as JDBC/JDBC-ODBC connection. In such an opening sharing environment, resources in separate databases can be easily shared by each other, a series of information services at different level (data level and analysis level) are constructed on distributed resources. Three-Tier architecture (data services tier, business logic tier, analysis and presentation tier) is adopted in subsystem.

3. Distributed Data Warehouse

The main task of data integration is to build an marine dynamic environmental distributed data warehouse, the distributed data warehouse is made up of several local data warehouses located in regional monitoring center and global data warehouse in general monitoring center.

Supervision devices are oceanic optical buoy, large-scale environment supervision buoy, high frequency ground based radar, seabed based comprehensive dynamic factors automatic supervision system, self-locating sub-water tide monitor, sea sound detection buoy, sub-water tide comprehensive

admeasuring apparatus, ship based marine environment monitoring system, regional remote sense comprehensive application system, land based marine environment supervision system and etc. data granularity in local data warehouse is different from that of global data warehouse, which also locates in the first-degree data center. Decision-making information in regional data center are always provided by local data warehouse, data resources of local data warehouse are from spot supervision apparatus and put into relational data warehouse by Extract, Cleaning, Transform and loading, each local data warehouse locates in different region and has multiply themes.

Global data warehouse is extracted from local data warehouse of each level, in which are public and integrating data. Global data warehouse are not only the accumulation of the data resources, but also the recombination, composition of data from local data warehouses.

4. Information Sharing and Service

4.1 Information Sharing Platform

Information sharing platform is a multi-level distributed sharing environment for marine dynamic environmental information throughout all marine sharing units, sharing units include government, marine observation stations, marine engineering units, marine researching organizations and marine colleges, the main function of the platform include data resource management, system maintenance, information publish, information analysis and decision making.

Information sharing platform is a B/S mode system on the base of distributed data warehouse, concentrative,

The function block of the platform are: platform management block, database management block, information publishing block, data disposal and analysis block, information presentation block (Figure2).

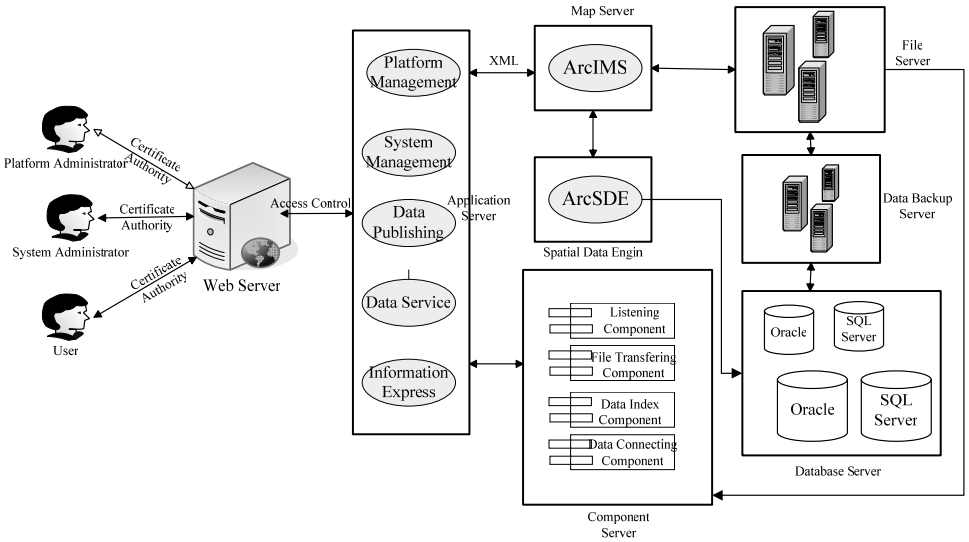

Figure2: The Architecture of Information Sharing Platform

4.2 Data Level Information Service

Data level information service provides original or primary marine dynamic environmental data and application for users, the sharing information of data level information service is to use unprocessed primary data directly, on the base of above platform, information provider can publish and update sharing data quickly, users can query, search, browse and download data across regions in a uniform platform.

(1) Marine dynamic thematic map service

Marine dynamic thematic map service provides map services which are in relation with spatial position for ocean and fisheries management unit, such as integrated analysis on wind field, wave field, current field of high-medium frequency ground based radar, integrated analysis on temperature and salinity of marine sound detection buoy, typhoon path forecasting and disaster assessment and etc.

In order to share monitoring spatial data on web, thematic map adopts ArcIMS of ESRI(Environment System Research Institute) as WebGis provider, it is convenient to publish and manage maps, users can get maps interactively on web, user can select, display, hyperlink, spatial and Attribute bidirectional Query. ArcIMS provides six basic web map services on the base of AML: vector map service, raster map service, spatial map coding service, spatial data abstracting service, spatial metadata managing service and geographic information querying service, on the other hand, ArcIMS also supports ArcMap extension service based on mxd project file, which can publish standard and complex service on web.

(2)Marine dynamic real-time monitoring data sharing service

Marine dynamic real-time monitoring data sharing service provides primary and original querying, browsing and downloading service for data intensive process of ocean technique researching unit and deeply disposing of marine information systems (such as marine disaster forecasting system, marine current mode analysis system).

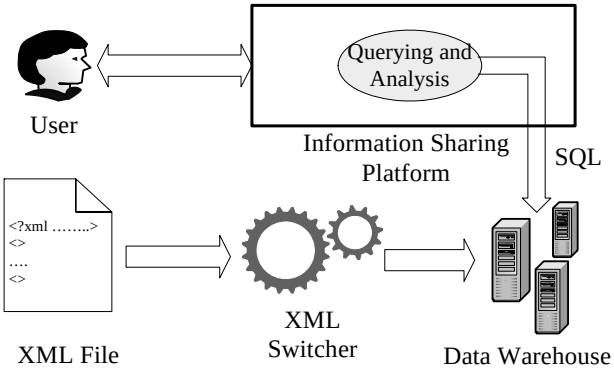

Figure3: The Transform of XML Data and Query on Data warehouse

XML(Extensible Markup Language) is an open file format, XML data is Structured and easy to be understand and extended, the separation of style from content with XML in an Interchange Format benefits for recording marine monitoring information, therefore, all real-time monitoring data are stored and transmitted by XML style except for raster image data. XML file is sent to general data

center or local data center, imported into data warehouse by a data switcher according to corresponding data theme, there are five themes in data warehouse: buoy theme, wave field, current field and wind field theme of ground based radar theme, hydrological and meteorologic theme of pointing observing station, remote sensing theme. Users can inquire about the published data using a query and download the querying result at local-storage (Figure 3).

4.3Analysis level Information Service

Analysis level information service provides multi-level analysis and prediction productions by means of statistics, numerical analysis, and provides sharing services on base of productions for operation systems and professional members, the sharing information of analysis level information service is derivative data by analysis or analysis result.

(1) Marine dynamic statistical and analysis service

Marine dynamic statistical and analysis service provides statistic and analytical sharing function for end users, statistical factors include wind speed, air temperature, air pressure, sea fog, sea rain, over sea visibility, relative humidity, sea water temperature, sea water salinity and etc. User can query, browse and download statistical data of different historical time or different time scales.

(2) Marine dynamic visual expression service

Marine dynamic visual expression service uses intuitionistic visual tools such as graphics, symbols and charts to express monitoring data (Figure).

According to data to expressed, visual expression service are classified into two types: spatial type and non-spatial type.

For spatial type, an opening and extensible symbol database is the basic step for visualization, opening symbol database is composes of map symbolic system made up of point symbols, line symbols, polygon symbols and color symbols, user can customize individual symbols by assembling symbols provided by above symbol databases.

For non-spatial type, main visual expression methods are statistical chart and table, thematic map and multimedia information, provides all kinds of planar and tridimensional chart, including Bar Chart, Pie Chart, Line Graph, Graph Chart and etc. At the same time, user can customize complex individual chart by integrating above charts according to chart color, brightness, saturation, size.

(3)OLAP(On-Line Analytical Processing) service based on data cube

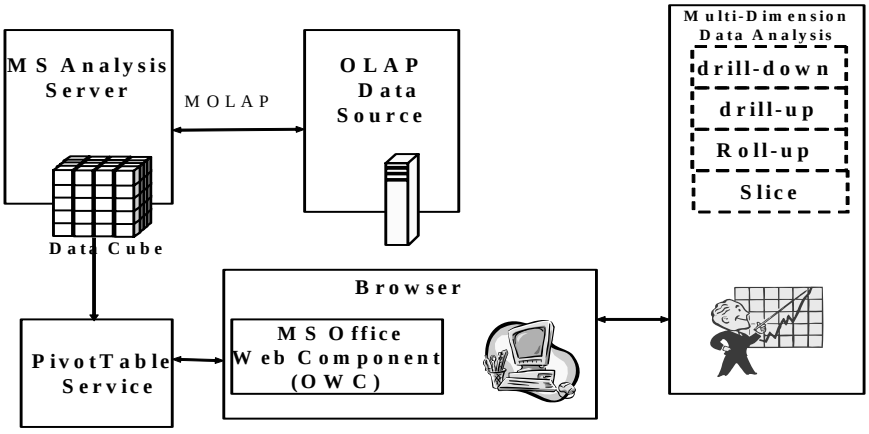

Figure 4 : The OLAP Analysis Based on B/S Mode

Simple data expression can not satisfy the task of deep information analysis on data, On-Line Analytical Processing (OLAP) is a category of software technology that enables analysts, managers and executives to gain insight into data through fast, consistent, interactive access to a wide variety of possible views of information that has been transformed from raw data to reflect the real dimensionality of the enterprise as understood by the user, OLAP is an effective deep information analytical tool. OLAP is on the base of data cubes in data warehouse. The OLAP service is deployed as a B/S mode, MS PivotTable is adopted as an OLAP server connected with data cubes, office web component(OWC) of MS office is embed in browser, PivotTable and PivotChart of OWC are used to interact with PivotTable server on server side. The data of PivotTable and PivotChart are acquired from OLAP serve, it means that local workstations need not to download dataset wholly from server, but to be updated incrementally. So, PivotTable on workstation create a MDX query and send it OLAP server, the query is executed on the server, then the querying result is sent back to workstation. Multi dimension analysis operations such as drill-down, drill-up and Roll-up can be carried out in the browser(Figure4).

5. Implementation of the System

Some interfaces of the system are as follows:

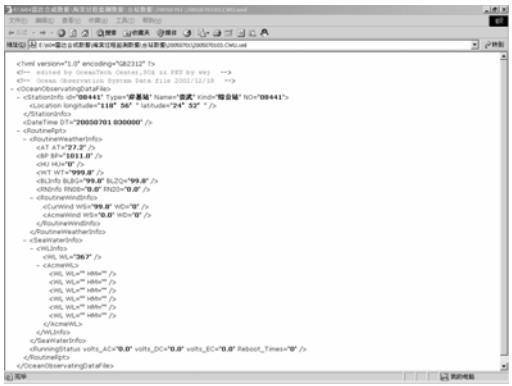

Figure5: Observatory XML Data from Monitoring station

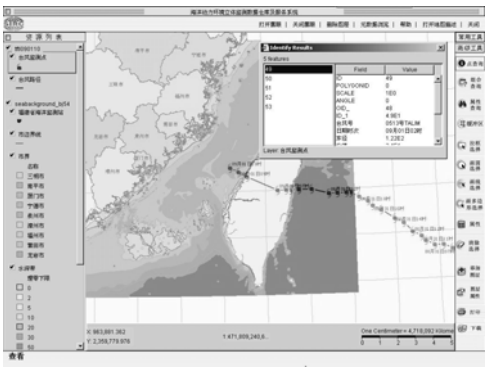

Figure6: Visualization and Analysis of Typhonic Route

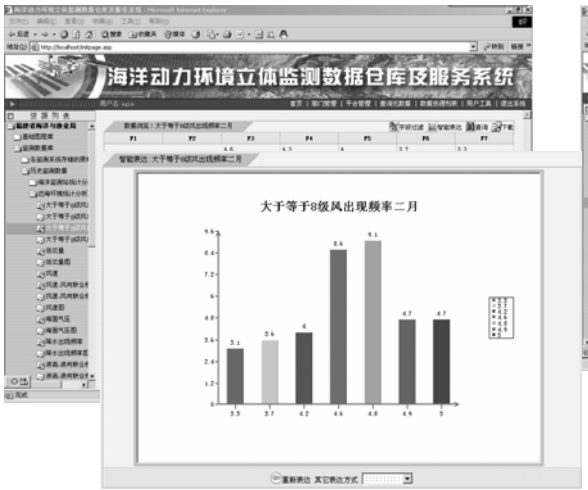

Figure7: Temperature of Ocean Surface Inverse from MODIS

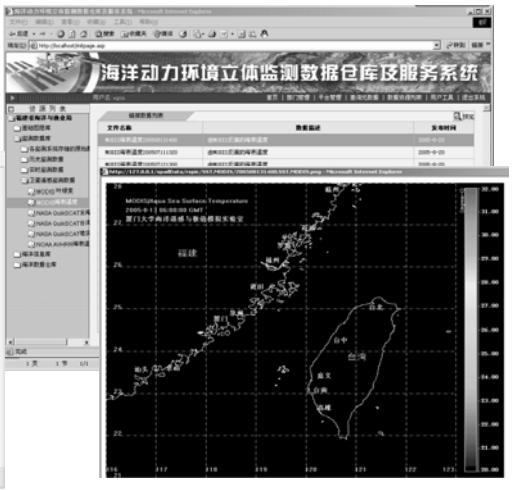

Figure8: Intelligent Express of Dynamic Histogram

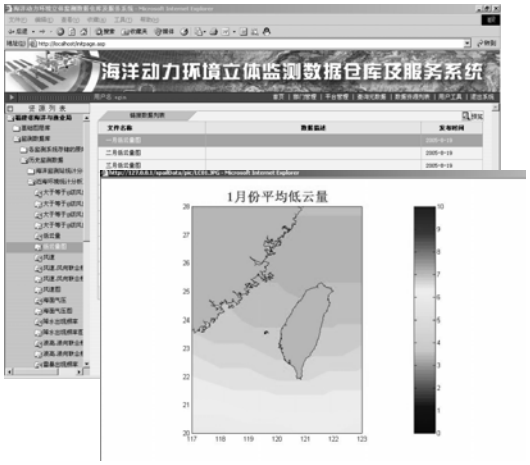

Figure9: Statistical Figure of Average Cloud Amount in January

Figure10: OLAP Analysis Based on Data Cube

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