Oceanic satellite data service system based on web

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ABSTRACT

The ocean satellite observation is more and more important to study the global change, protect ocean resource and implement ocean engineering for their large area cover and high frequency observation, which have already given us a global view of ocean environment parameters, including the sea surface temperature, ocean color, wind, wave, sea level and sea ice, etc... China has made great progress in ocean environment remote sensing over the last couple of years. These data are widely used for a variety of applications in ocean environment studies, coastal water quality monitoring environmental, fishery resources protection, development and utilization of fishery resources, coastal engineering and oceanography. But the data are no online information access and dissemination, no online visualization & browsing, no online query and analyze capability. To facilitate the application of the data and to help disseminating the data, a web-service system has developed. The system provides capabilities of online oceanic satellite information access, query, visualize and analyze. It disseminates oceanic satellite data to the users via real time retrieval, processing and publishing through standards-based geospatial web services. A region of interest can also be exported directly to Google Earth for displaying or downloaded. This web service system greatly improves accessibility, interoperability, usability, and visualization of oceanic satellite data without any client-side software installation.

Keywords: web-service, ocean satellite, web GIS, ocean color ， Google earth

INTRODUCTION

Now ocean sciences and researches access to and process the ocean data at high cost, particularly high time cost because of variety of data sources and data formats. So many countries ocean data department s and centers have established their own data service system, released publicly or semi-publicly their data to the people. American National Oceanic and Atmospheric Administration (NOAA)'s IOOS that is part of the greater Global Earth Observation System of Systems (GEOSS), include data catalog, data

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management and communication (DMAC) to enhance our ability to collect, deliver and use ocean information. [1]. NOAA oceanographic data center (NODC) provides buoy, Argo, shipboard, satellite and other datasets [2]. American National Aeronautics and Space Administration (NASA)'s Goddard Earth Sciences Data and Information Services Center (GES DISC) has developed the Goddard Interactive Online Visualization ANd aNalysis Infrastructure (Giovanni) that can provide an intuitive and responsive interface for visualizing, analyzing, and inter-comparing multi-sensor data using only a Web browser and supports many types of multi-parameter visualizations and statistical analyses [3]. Giovanni is already used by many science researches [3]–[7]. The Ocean Color web is an automated data system for browsing, download, and analyzes Ocean Color and SST data from multiple satellites sensors [8]. European's MyOcean is the project of the Global Monitoring for Environment and Security (GMES) Marine Core Service for ocean monitoring and forecasting. Five Thematic Assembly Centers, each of them deals with a specific set of observation data: Sea Level, Ocean color, Sea Surface Temperature, Sea Ice & Wind, and In Situ data that users will discover, view and get the products on line [9]. There are many other marine data service systems，for example the Marine Geoscience Data System (MGDS) [10], the Geoinformatics for Geochemistry Program (GfG) [11], the SCAR Southern Ocean Observing System (SOOS) [12], etc.

The China Second Institute Oceanography (SIO) has already established many sets of system which can get parameters of ocean color environment. The system can automatically receive and deal with datum from ten kinds of ocean color and temperature satellites, and manufacture special products of ocean environment information for customers directly or indirectly. The State Key Laboratory of Satellite Ocean Environment Dynamics (SOED) of the Second Institute of Oceanography (SIO) produces the ocean color and temperature data products, which include sea surface temperature (SST), chlorophyll concentration (CHL), suspended sediment concentration (SSC), water transparency (SDD), diffuse attenuation coefficient at 490nm (KD3), normalized water-leaving radiance at 490nm (LW3) and aerosol optical thickness at 865nm (TAU), etc..

An efficient and convenient technology for searching data becomes increasingly important and urgent with the rapid increase in the amount of data. In 2009, the integrated management system of ocean remote sensing data (IMSORS) has been Implemented and developed, the system interface as show in figure 1 [13]. However data extraction and information retrieval from such a great volume of data set always is a tedious and difficult work, so the State Key Laboratory of Satellite Ocean Environment Dynamics (SOED) of the China Second Institute of Oceanography (SIO) has designed and developed Ocean color remote sensing metadata framework, which will help to achieve an effective data discovery, management, sharing, exchange and integration as show in figure 2 [14].

The oceanic satellite data service system is a based on a web GIS system that can provide an interface for visualizing, analyzing, and inter-comparing multi-sensor data to ocean scientists and other users by the SIO SOED. The paper will detail introduce the system' architecture, key technology and applications.

THE SYSTEM ARCHITECTURE DESIGN AND DEVELOPMENT

The oceanic satellite service system architecture

The SIO SOED oceanic satellite service system is based on service-oriented four-layer architecture as show in figure 3. The lowest layer is data layer, than the data service layer, and the data support layer, the upper layer is the data application layer.

In the data layer, the data include oceanic satellite data and other oceanic data, which are managed by the oceanic database system. Oceanic satellite data mainly involve the grid data files (Level-3B) and the contour files (Level-4A) of these data produced by SIO. Level-3B data which have the spatial resolution of 1.825km and Level-4A range from 14˚N to 42˚N for latitude, and from 105˚E to 130˚E for

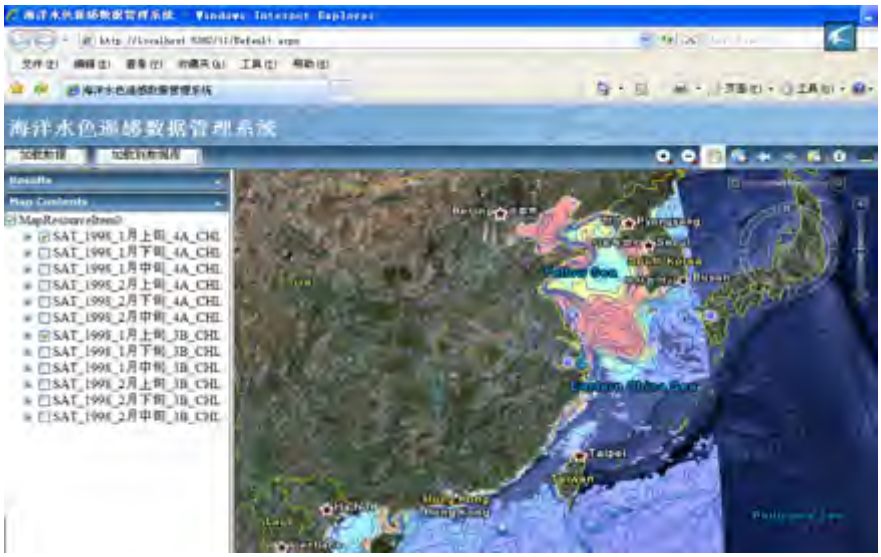

Figure. 1. the application interface of IMSORS includes three parts: toolbar, file listing area, file displaying area.

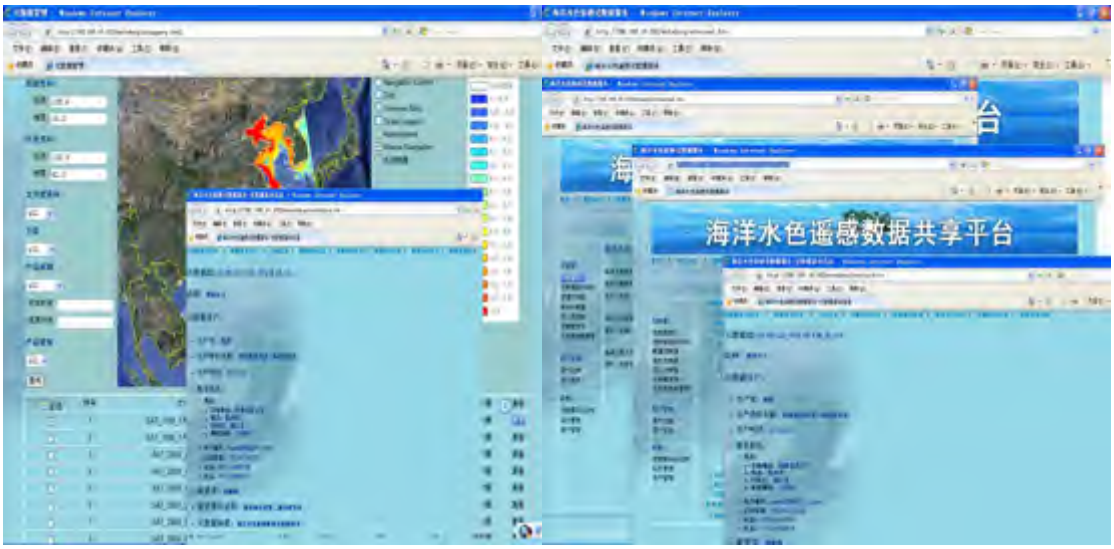

Figure 2. The application interface of the ocean color remote sensing metadata

longitude. The other oceanic data mainly include ship measured data, in-suit data and some download data from oceanic data web site. The oceanic database has also been designated as the system that will support the long-term archive requirements for oceanic data products. We design each new database include three parts: vector database, raster database, and other database. Vector database store and manage all kinds of isograms products and fundamental geographic information data. For example sea surface temperature, seawater transparency isograms products. Raster database store and manage images and some thematic maps. Otherwise some other data of marine information need be managed in the database. Ocean color metadata database management system is the important part of the oceanic data service platform. User not only can produce, revise and release the metadata, but also query, retrieve and access to the metadata from ocean color data sharing site in the user layer. Service portal provide ocean color 1A class to 4A class metadata services. The service portal offers a centralized, uniform interface to user layer and data layer as show in figure 2.

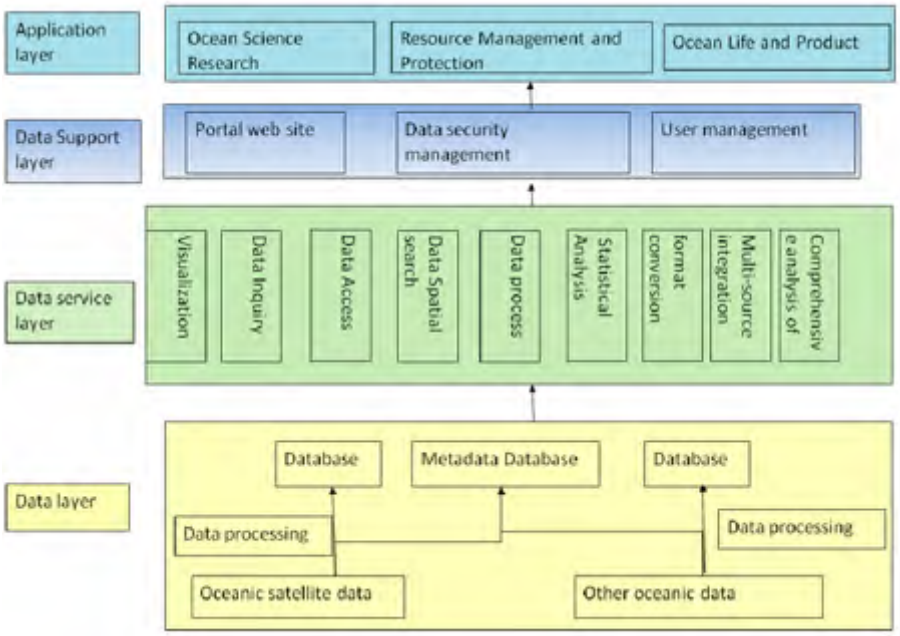

Figure. 3 Oceanic satellite data service four layers SOA architecture

The data service layer can provide oceanic satellite data visualization, inquiry, access, spatial search, process, statistical analysis, format conversion, multi-source integration and comprehensive analysis services. Some services are experienced and accessed by the user on the web interface, but some other services are invisible because they are only data service' middle processing.

The data support layer includes three parts: portal web site, data security management and user management. The data application layer mainly makes user can apply the oceanic data service system' services to finish their own researches and works.

Key technology-----Web GIS and SOA

It is very important in which the web GIS can manages oceanic satellite data by ArcSDE. The web GIS also provide users with data discovery options which flow into detailed product selection maps by online map services which may be queried using standard "region finder" tools or user defined region functions. This oceanic data service system allows users to download data as a gridded file, which is readable by ArcGIS. In addition, web GIS makes users to subset the data for a specific geographic region, time period, height range or variable prior to download. Web GIS related products provide metadata as a complement to the map viewers. The Google Earth Plugin and its JavaScript API let user embed the full power of Google Earth and its 3D rendering capabilities into their web pages. Just like in the Google Maps API, you can draw markers and lines in 3D [6]. We integrate Google earth in the IMSORS by using the Google Earth Plugin. KML/KMZ data files also provide access.

The oceanic satellite date service system is developed from interactive web interfaces utilizing database technology to standardized web services in a Service Oriented Architecture (SOA). The Service Oriented Architecture (SOA) has been gaining lots of interest in the way of seamless integration of

information systems spreading across several organizations. SOA allow clients to access the service that the provider also has to publish the service. SOA is an evolution of distributed computing based on the request/reply design paradigm for synchronous and asynchronous applications with its loosely coupled nature [15]. So the oceanic satellite data service system evolving toward a service-oriented architecture (SOA) that provides the flexibility, scalability, and generality necessary to accommodate the vast amount of change in its environment and at the same time provide interoperability with other system of the ocean environmental.

THE SYSTEM APPLICATION AND PROSPECT

The oceanic satellite service system application

The main goal in developing the oceanic satellite data service system at SIO SOED Geographic Information System (GIS) services which is to provide users with simple access to data archives while integrating new and informative oceanic satellite products.

The application the oceanic satellite data service system interface is a web site and user can query their need data, display the data, and query the attribute and location of the data. Fig 4 shows the interface page includes four parts: query parameters setting column, the results displaying, the basic oceanic geographic data, and query result. The user selects the data parameters, spatial and temporal ranges, and the visualization. The selects results are listed in the lower of web interface. If you want to learn more about the case of data, you can check in each the data result list that the data visualize in the Google Earth on the web. If you want the data source information, you can click the metadata label. Of course you can download the data with KMZ formation. The application interface of IMSORS also has simply spatial analysis.

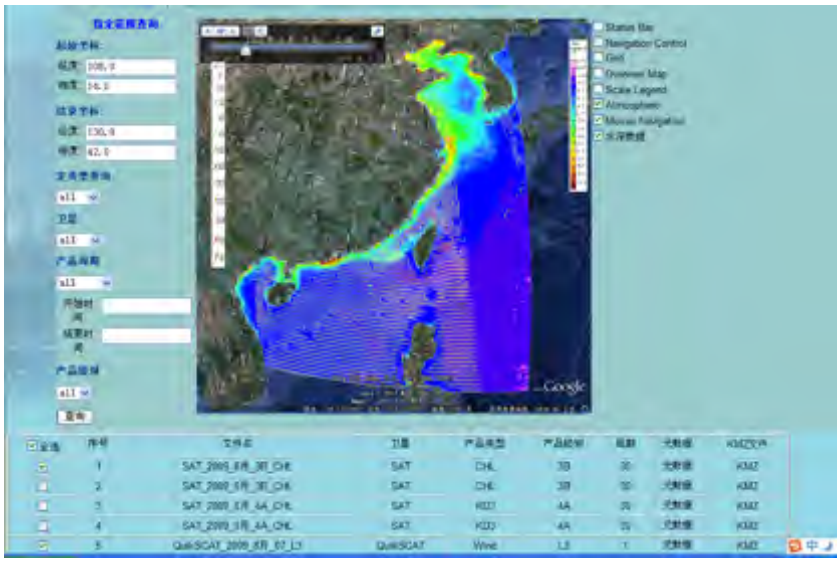

Figure. 4 Oceanic satellite data service user application interface. The data was

The conclusion and prospect

The oceanic satellite data service system use GIS to gather, neaten, analyze, and compute a baseline survey on the geological, climatic, hydrological conditions and other environmental characteristics of the ocean. User query their data and information from web site and web site return and display the results to user by Web GIS and Google Earth. Next work the service system will develop more marine data spatial analysis functions based web-GIS.

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