

THE DESIGN AND IMPLEMENTATION OF A WEB SERVICES-BASED APPLICATION FRAMEWORK FOR SEA SURFACE TEMPERATURE INFORMATION

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KEY WORDS: Web Services, Sea Surface Temperature Information, GIS, Framework

ABSTRACT:

Based on the study of the sea surface temperature data and application, this research put forward a Web Service-based application framework for sea surface temperature information, which can solve the problems in heterogeneity, distribution, and efficiency triggered by networking. An application prototype was successfully designed based on the framework, namely: The Application Service Platform of Sea Surface Temperature Information in the South China Sea. It can integrate heterogeneous sea surface temperature data services and application services, and provide users with transparent, “one-stop” Web applications on sea surface temperature. Users can access the platform to search and fetch valuable information and value-added applications. On the platform, all of the heterogeneous and distributed sea surface temperature information is encrypted, decrypted, monitored, and hence interchangeable according to international standards. The results confirm the feasibility of the application of Web Services to sea surface temperature information integration, and this study can also be referenced by other marine information.

1. INTRODUCTION

With the developing of network, techniques, especially the grid and the Web service, and with the increasing of multi-source sea surface temperature data, which come from remote sensing or investigation, Implementation the Web-based analysis of long time series sea surface temperature data, has become an urgent demand of ocean information services. Because of the dynamic and multiple characters of ocean data, such as Argo data, sea surface temperature field data, Ocean Current data field data and so on, the traditional method of data integration and visualization cannot meet the people’s needs of accessing spatial information in anywhere at any time and getting the changing information of sea elements dynamically. And thus, the real-time analysis and evaluation of sea phenomenon quantitatively with high accuracy cannot be executed.

The sea surface temperature field data has been applied in a more widespread domain, and the researchers have proposed many application models of sea surface temperature field data, the traditional applications of these models have some drawbacks, the limit of accessible users and centralization of most of all resources on the local machine. Due to the limit of resources and performance in traditional applications, it is very difficult to realize reuse and sharing of these models. This research proposed the sea surface temperature field data application service framework based on the Web Services technology, which can realize the interoperate of data and models in the distributed environment flexibly. The services included in this framework can be accessed directly by URL. Due to the loose coupling of the Web Services, they can also be integrated in other applications. Study on the demand of Web-based visualization of sea surface temperature field data, the dynamic visualization method and the long-distance localization inquiry method of spatial and temporal process of the sea surface temperature field based on the framework were proposed in this paper.

2. THE WEB SERVICES-BASED APPLICATION FRAMEWORK OF SEA SURFACE TEMPERATURE FIELD INFORMATION

2.1 Web Services architecture

A Web service (also Web Services) is defined by the W3C as "a software system designed to support interoperable machine-to-machine interaction over a network". Web services are frequently just Web application programming interfaces (API) that can be accessed over a network, such as the Internet, and executed on a remote system hosting the requested services.

The system architecture of Web Services was shown in Figure 1.

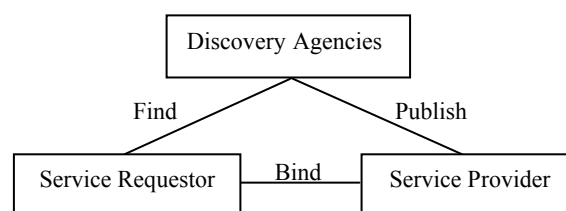


Figure 1. Architecture of Web Services

Software agents in the basic architecture can take on one or all of the following roles:

1. Service requester -- requests the execution of a Web service.
2. Service provider -- processes a Web service request.
3. Discovery agency -- agency through which a Web service description is published and made discoverable.

A software agent in the Web services architecture can act in one or multiple roles, acting as requester or provider only, both requester and provider, or as requester, provider, and discovery agency. A service is invoked after the description is found, since the service description is required to establish a binding.

The figure above illustrates the basic Web services architecture, in which a service requestor and service provider interact, based on the service's description information published by the provider and discovered by the requester through some form of discovery agency. Service requesters and providers interact by exchanging messages, which may be aggregated to form MEPs.

2.2. The application framework for sea surface field information

In the multi-domain sea Surface temperature field data research, many application models have been designed, however, these application models are heterogeneous caused by many of reasons (in detail). Moreover, in the distributed environment, it is very difficult to achieve the transparency application. The researchers always choose to develop independent applications, or to integrate and share heterogeneous and distributional applications through manual methods. The Web service can solve above difficult problems, in the distributed environment, the Web Services-based applications can be reused and used transparently.

The Web Services-based application framework for sea surface field information can integrate the distributed and heterogeneous data and applications. Sea surface temperature application models are encapsulated into web services based on the application framework for sea surface field information. Web Services integrate Web-based applications using the XML, SOAP, WSDL and UDDI open standards over an Internet protocol backbone. XML is used to tag the data, SOAP is used to transfer the data, WSDL is used for describing the services available and UDDI is used for listing what services are available.

Figure 2 is the Web Services-based application framework for sea surface field information. Firstly, the sea surface temperature data is encapsulated as Web service, the uniform interface of data access is the foundation of application services. Secondly, the sea surface temperature field application models are encapsulated as Web Services. Finally, these data services

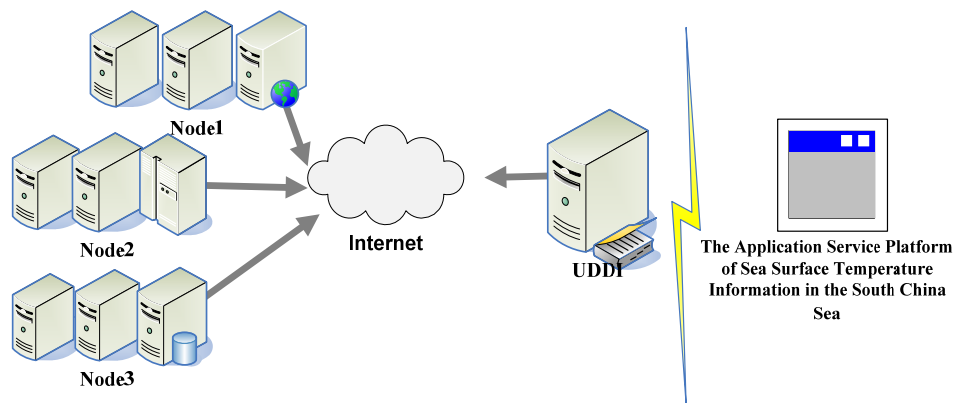


Figure 2. the Physical Framework for Application services of Sea Surface Temperature Data

3.2. The realization of data services and model services

The South China Sea is selected as the focus area (105°30' ~122°15' E, 3°~26°30' N), the sea surface temperature data of HDF format is selected as object of study, the data

```
<service name="SeaTemperatureDataServer1">
<soap:address location="http://*/arcgis/services/SeaTemperatureDataServer1/MapServer" />
</service>
```

and application model services were registered using the UDDI interface. The programming interface for UDDI consists of four parts: an inquiry (search) API, a publishing API, a delete API and an update API.

3. THE VISUALIZATION OF SEA SURFACE TEMPERATURE FIELD DATA

3.1. The Physical Framework of prototype application

The experimental environment consists of three web services nodes, a web services resource management center and an application service platform of sea surface temperature information in the South China Sea. Node 1(provide web services of sea surface temperature data), node 2(provide web services of sea surface temperature data) , node 3(provide web services of application models) and the application service platform of sea surface temperature information are arranged in the institute of geographical sciences and natural resources research Chinese academy of science. The web services resource management center is arranged in the Northeastern University. In node 1, node 2 and node 3, all the web services are deployed on the IIS 6.0. In addition, ArcGIS Server should be installed in all nodes. Furthermore, the ArcGIS Server ADF should also be installed in the node that has the application services.

Figure 3 is the physical framework for application services of sea surface temperature information. The framework contains three nodes, a web services resource management center and an application service platform of sea surface temperature information. The three nodes are host of the sea surface temperature information, they provide the sea surface temperature data services and the application models services, and all the web services can be registered in the web services resource management center. Finally, the application service platform of sea surface temperature information in the South China Sea provides unification application.

preprocessing flow is shown in Figure 4. The sea surface temperature data distributes separately in two data nodes. All the data are preprocessed according to the data preprocessing flow. The WSDL document segment of sea surface temperature data services as following:

```
<service name="SeaTemperatureDataServer2">
<soap:address location="http://*/arcgis/services/SeaTemperatureDataServer3/MapServer" />
</service>
```

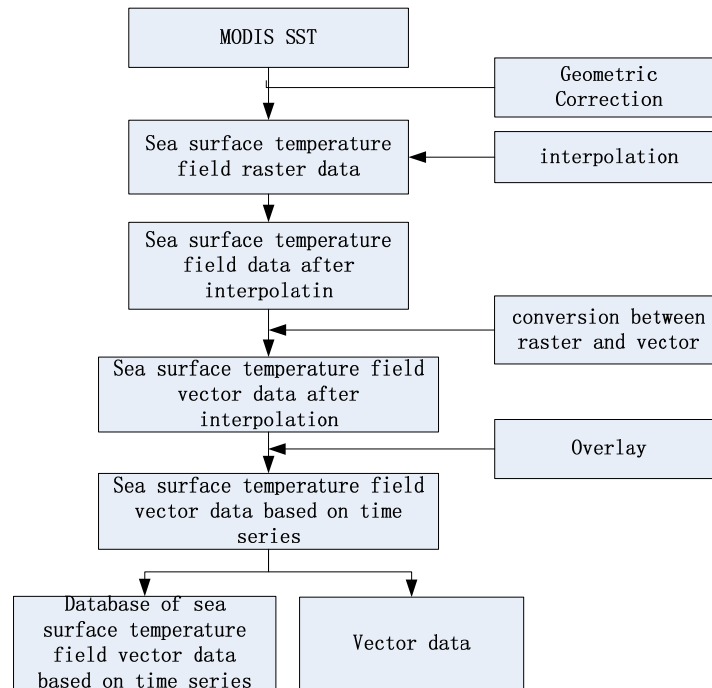


Figure 3. The pre-processing and organization flow of sea surface temperature field data

The point process network visualization method aims at the spot objects in spatial. In network environment, the marine environment information dynamic process of a spot object in marine can be expressed by curve with time as abscissa and marine environment information as ordinate.

The surface process network visualization method takes the marine environment element field as the research object. The two above-mentioned sea surface temperature field data visualization models are encapsulated as service. The WSDL of this Web Service is:

```
<service name="SeaTemperatureService">
<soap:address location="http://*/ SeaTemperature/ SeaTemperatureService.asmx " />
</service>
```

The sea surface temperature field data services and model services can be registered in the web services resource management center, which is built based on UDDI(Universal Discovery Description and Integration). The resource management center is the yellow pages of Web services. As with traditional yellow pages, you can search for a provider that offers the services you need, read about the service offered and contact someone for more information. You can, of course, offer a Web service without registering it in resource

management center, just as you can open a business in your basement and rely on word-of-mouth advertising but if you want to reach a significant market, you need UDDI so your customers can find you. The “one stop” marine environment information service can be provided based on the resource management center. The registration information of sea surface temperature information services, which were registered in the resource management center, as follow

Name	Type	Location	Provider	Publish time	Valid time
SeaTemperatureDataServer1	Map Service	Node 1	Heyw	2009-2-12	Working day
SeaTemperatureDataServer2	Map Service	Node 2	Heyw	2009-2-20	Working day
SeaTemperatureService	Web Service	Node 3	Heyw	2009-2-18	Working day

Table 1. the Registration Information of Sea Surface Temperature Information Services

3.3. The Application examples

In the prototype application, the integration of data and application is realized with dynamic loading the Web services.

The user may search the data services and model services through the name of service provider, the service name as well as the data spatial scope, and then load them in the platform.

With the above integrated the sea surface temperature data service, the user may produce the curves of sea surface temperature data and the profile curves of sea surface temperature data and the dynamic visualization of sea surface temperature data, these functions can be realized through the SeaTemperatureService.

Figure 4 is the 2D visualization of sea surface temperature field data (provided by IGSNRR, CAS, in South China Sea (105°30'–122°15'E, 3°–26°30'N)) is carried out by the chrome/gray method. Figure 5 is the profile curve of sea surface temperature data, in the curve system the vertical axis is the value of sea surface temperature, the horizontal is position and the different colours represent time. Figure 6 is the dynamic visualization of sea surface temperature data, each figure in this system represents the value variety at one time, so we can set an interval for all the figures to display in order of time.

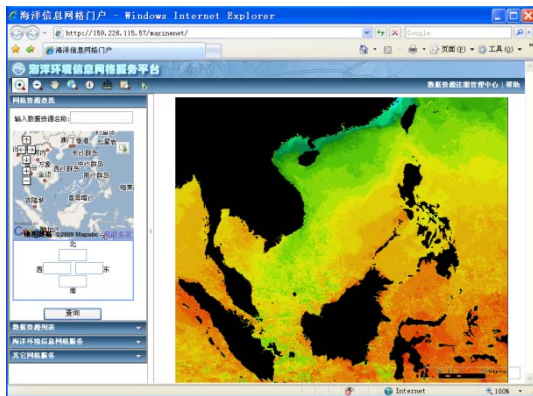


Figure 4. the Integration of the Sea Surface Temperature

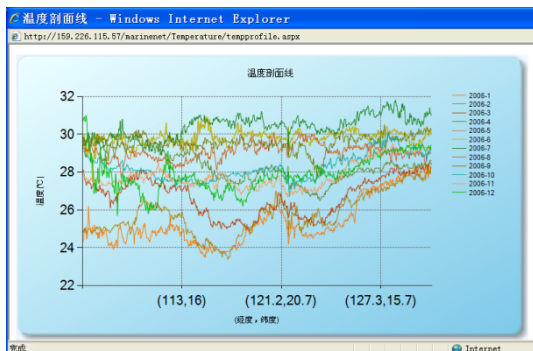


Figure 5. the Profile Curve of Sea Surface Temperature Data

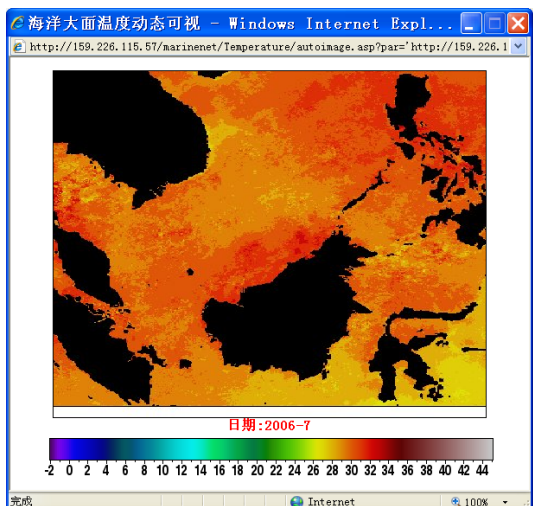


Figure6. the Dynamic Visualization of Sea Surface Temperature Data

4. CONCLUSION

Although the gradual and further application of the sea surface temperature data, but the study about the integration and sharing of the sea surface temperature data just begun, and many problems need to be solved and consummated immediately. Based on the researches of the current application status and characteristic of sea surface temperature information, this article put forward a Web Service-based application framework for sea surface temperature information. Web service was used to solve the problems in heterogeneity, distribution, and efficiency triggered by networking, and to realize the sea surface temperature data share in different application fields. A prototype application was successfully designed based on the framework, namely: The Application Service Platform of Sea Surface Temperature Information in the South China Sea. It can integrate heterogeneous sea surface temperature data services and application models services, and provide users with transparent, “one-stop” web applications on sea surface temperature field information. Users can access the platform to search and fetch valuable information and value-added applications. Through the platform, all of the heterogeneous and distributed sea surface temperature information can be encrypted, decrypted, monitored, and then interchanged according to international standards. This research demonstrates the typical application of grid Web Services technology. The results confirm that Application Service Platform of Sea Surface Temperature Information is feasible in data integration and sharing. Furthermore, this study can also be referenced by other marine information.

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