DESIGN AND IMPLEMENTATION OF A COASTAL WEB ATLAS (CWA) FOR THE INTEGRATED COASTAL ZONE MANAGEMENT OF JIANGSU, CHINA

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KEY WORDS: Coastal, Web based, GIS; Mapping, Visualization

ABSTRACT:

In Section 1, the background of the research is introduced. The Jiangsu Coastal Web Atlas is a project that has the ambitious goal of being a useful resource for the various audiences that make up the management constituency of the Jiangsu Coastal Zone. The project is a depot for traditional and digital information which can be used to inform decision-making relating to the Jiangsu Coastal Zone. We provide background information for different coastal systems, access to interactive mapping, online geospatial analysis tools, and direct download access to various planning and natural resource data sets relating to coastal zone management. In section 2, the Jiangsu Coastal Web Atlas based on ESRI ArcIMS® is provided. After giving the system architecture and data organization, then WEBGIS functions and applications are briefly described. In the database, all the data are strictly registered in the same georeference and organized by SQL-Server, in addition to ESRI ArcSDE®. Specifically, the Coastal Web Atlas contains data organized in different layers that can be accessed through the Client Viewer. In section 3, some discussion and conclusions are briefly listed.

1. INTRODUCTION

The Internet is a valuable tool for providing access to geospatial data, both for professionals and the general public. Combined with the needs of the coastal and marine community, the development of Geographic Information System (GIS) based web mapping products has improved the usability of GIS by non-specialists. A coastal web atlas (CVS) is a collection of digital maps and datasets with supplementary tables, illustrations and information that systematically illustrate the coast, oftentimes with cartographic and decision-support tools, and all of which are accessible via the Internet. The main objective of this study is to develop a prototype model of Web-based Geographic Information System (GIS) application for efficient management of data. More than 150G coastal survey data (many data) were archived into the database and Web-based GIS system was implemented for the coastal area in Jiangsu, China.

Jiangsu is a province located along the eastern coast of China. With Yellow Sea to its east, Jiangsu adjoins Anhui and Shandong provinces in the west and north respectively, with Zhejiang province and the city of Shanghai as its neighbours in the southeast. The coastal area of Jiangsu has a 954km-long coastal line, covers 3 cities (Nantong, Yancheng, Lianyungang), about 15 counties. During the Coastal Investigation and Assessment (Mission 908) in Jiangsu, immense amounts of valuable data and pictures about ground information are collected, enabling scientists and researchers to find the status and change in the last 30 years. Figure 1 is the Coastal Zone of Jiangsu Province.

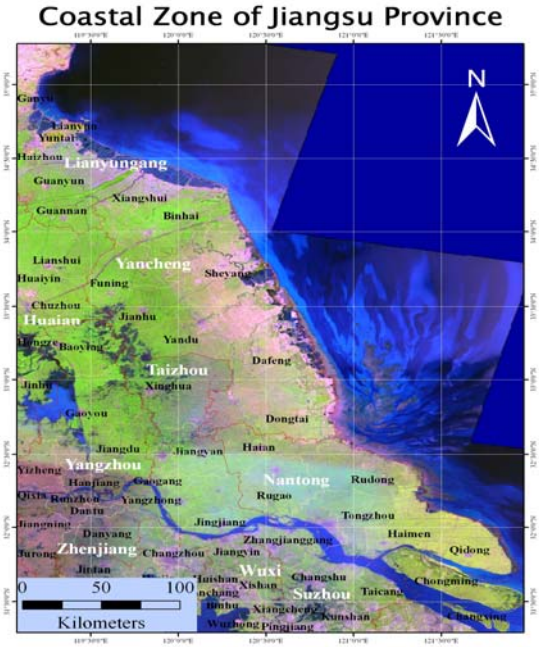

Figure 1. Coastal Zone of Jiangsu Province

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Nowadays, much attention has focused on developing GIS functionality in the Internet, Worldwide Web, and private intranets and is sometimes termed WebGIS. With WebGIS, users do not need to purchase and install expensive GIS software in order to access and work with maps and databases. Also, users do not need to become experts in sophisticated GIS applications, since the functionality is made available through a regular web browser and an integrated Viewer with a simple, user-friendly interface.

This paper presents the results of efforts for the development and application of a web-based GIS, Jiangsu Coastal Web Atlas, to support the management of coastal areas in Jiangsu. The application of Coastal Web Atlas covers a wide range of navigation, homeland security, coastal zone boundaries, environmental and living resource management, coastal hazards, minerals and energy management, cultural resource management(Mayer et al.,2004).

The Jiangsu Coastal Web Atlas is a project that has the ambitious goal of being a useful resource for the various audiences that make up the management constituency of the Jiangsu Coastal Zone. The project is a depot for traditional and digital information which can be used to inform decision-making relating to the Jiangsu Coastal Zone. We provide background information for different coastal systems, access to interactive mapping, online geospatial analysis tools, and direct download access to various planning and natural resource data sets relating to coastal zone management.

One famous work of Coastal Web Atlas is the Oregon Coastal Atlas (http://www.coastalatlas.net) In USA. The Oregon Coastal Atlas was funded primarily by the NSF Digital Government Program and is collaboration between the State of Oregon's Ocean-Coastal Management Program (government), Oregon State University (academia), and Ecotrust (nonprofit environmental organization). The heart of the atlas is an interactive map, data, and a metadata portal for coastal zone managers and coastal planners, with additional outreach sections for scientists, secondary school educators, and the general public. The portal enables users to obtain datasets, understand their original context, and use them for solving a spatial problem via online tools. Another famous work in Europe is Marine Irish Digital Atlas (MIDA) (http://mida.ucc.ie/). And in Australia, the Australian Coastal Atlas is a network of Australian Government and State/Territory nodes using a variety of interactive mapping tools to provide information about the Australian coastal areas (http://www.environment.gov.au/coasts/atlas/index.html).
These nodes are managed by the States and Territories. The national node of the Coastal Atlas has now been integrated with the Australian Natural Resources Atlas.

2. THE JIANGSU COASTAL WEB ATLAS

2.1 System Architecture

The data flow of Jiangsu Coastal Web Atlas is shown in Figure 2. Firstly, some data such as DLG, DRG, remote sensing data, coastal LIDAR data, charts are collected from SOA(State Oceanic Administration), SBSM(State Bureau of Surveying and Mapping), some remote sensing data distributor and others. Secondly, the coastal historical data of Jiangsu is digitalized, including the coastal topographic maps in 1930s and 1950s. Thirdly, all kinds of the coastal thematic data are digitalized into electronic maps. Subsequently, all the above three types of data are imported into HHU Coastal GIS Server, and the database platform is based on ArcSDE® and SQL-Server®.

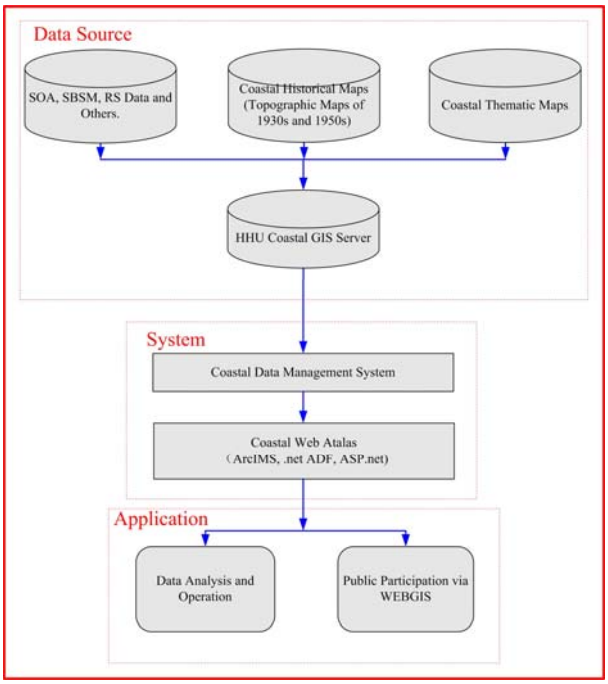

Figure 2. Data flowchart of Coastal Web Atlas

And the data in HHU coastal GIS server can be managed by a data management system. Then based on such a data management system, Coastal Web Atlas of Jiangsu is developed. Researchers can access the map products through the WEBGIS for supporting data analysis and operations. And on the other hand, the public participation via this WEBGIS is feasible.

The WEBGIS system was initially implemented in June 2007. At that time, there were several commercial products of web-based mapping and GIS software systems available, including ESRI ArcIMS® (Version 9.0 and 9.2), Intergraph Geomedia® WebMap®, and AutoDesk® MapGuide®. Most of the coastal spatial data products were either produced by ESRI software systems or in ESRI formats, and therefore, are compatible with ArcIMS®. ArcIMS® 9.2, in addition to .net ADF and ASP.net, was chosen as a web GIS tool for implementing the Coastal Web Atlas.

The developed Coastal Web Atlas consists of a Client Viewer and several server components. The interface of Client Viewer is designed using HTML, ASP.net, all of which are employed to facilitate the process of user input/request and to transfer them to the ArcIMS® server. The user input/requests are sent to the server in the ArcXML format. On the other hand, the ArcIMS® Spatial Server, ArcIMS® Application Server, ArcIMS® Servlet Connector, and Internet Information Services (IIS) Web Server are the server components used. The ArcIMS® Spatial Server processes requests for maps and related information and performs one or more map service functions such as image, feature, query, and metadata services. In this WEBGIS, image services are used for generating image-based map output according to the user request. The ArcIMS® Application Server handles incoming requests; tracks map services on the ArcIMS® Spatial Server, and hands off requests to the Spatial Server. The

ArcIMS® Servlet Connector connects the IIS Web server to the ArcIMS® Application Server. Through the IIS Web server, the Client Viewer communicates with the ArcIMS® server components. The standard HTML viewer template in ArcIMS® is used in the Client Viewer to provide an interface of the Mission 908 WEBGIS with the basic mapping functions including map display, pan, zoom in/out, feature selection, measurement, identification, navigation, and others functions(ESRI, 2002; ESRI,2004; Li et al., 2007).

2.2 Data Organization

The System architecture of the Coastal Web Atlas is displayed in Figure 3.

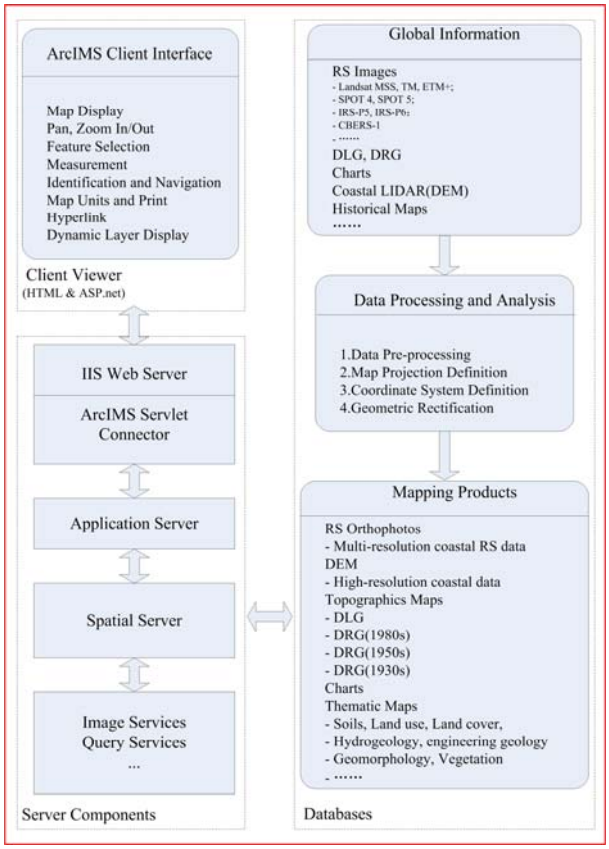

Figure 3. System architecture of Coastal Web Atlas

The database components of Coastal Web Atlas are categorized into global information, ground information, and mapping products. Global and local spatial information and map products are provided through the Web-based coastal atlas. Global and local information is the spatial infrastructure of Jiangsu coastal areas, including Multi-spectral, multi-temporal, multi-resolution image mosaics (Landsat MSS, TM, ETM+, SPOT 4, SPOT 5, CBERS-1, and IRS etc.), nautical charts, Digital Line Graphic (DLG), Digital Raster Graphic (DRG). The mapping products include 4D map products and all kinds of thematic maps. In the database, all the data are strictly registered in the same georeference and organized by SQL-Server, in addition to ESRI ArcSDE®. Specifically, the Coastal Web Atlas contains data organized in different layers that can be accessed through the Client Viewer. In the Coastal Web Atlas, all kinds of remote sensing images, DRG images, nautical charts are treated as image layers. Vector information includes DLG and thematic maps of coastal areas.

The customized HTML viewer in ArcIMS® is used in the Client Viewer to provide an interface of Coastal Web Atlas in Figure 4 with the basic mapping functions including map display, pan, zoom in/out, feature selection, measurement, identification, navigation.

Figure 4. Global information interface of Coastal Web Atlas

2.3 Functions and Applications

In this research, access to the Coastal Web Atlas implemented through three components: Global Information Interface for investigation site information, Local Information Interface for the related thematic information, and text-based product search. In order to enable spatial data, attribute data and metadata be combined to serve the different levels of users and provide more information; a coastal GIS database and a metadata database to assist the coastal web information service platform is designed and implemented.

Figure 5 is a local information interface display. When we search “Sheyang Estuary(in Chinese)”, the interface can shift from global information interface into local information interface.

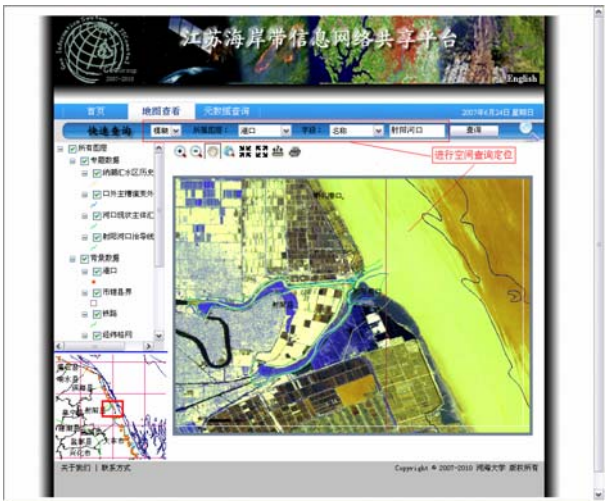

Figure 5. Local information interface of the Sheyang Estuary

According to users' requests and feedback, the most frequently used tools include visualization tools (zoom in, zoom out, pan), the measurement tool, and the product search tool. With these tools, the user can effectively perform operations that are very helpful to their work and research.

3. DISCUSSION AND CONCLUSIONS

The Coastal Web Atlas is a system to provide topographic mapping information services. It is currently only accessible by the Hohai University Intranet. The system has been successfully applied to coastal research in Jiangsu has the potential for future researches. Users can interactively access the coastal geospatial information through the Intranet.

The system including the web-based GIS functions and the coastal cartographic mapping products have been useful tools and information to scientists and engineers for their operations and analysis. It demonstrated that Coastal Web Atlas is a very effective technology for integration of multi-source spatial data to support investigation and exploration.

On the other hand, the following two aspects of questions should been paid attention. One is the common coastal zone reference frame should be defined, which is critical to construct the seamless coastal map and consistent shoreline. And the other is to the quantity and quality of coastal reference frame data should been improved, which is the spatial data infrastructure for Coastal Web Atlas.

In the future, Coastal Web Atlas will be further enhanced according to users' feedbacks and suggestions. By adding some basic advanced tools in the WEBGIS environment, the user does not need to switch to another system. Furthermore, it would be also very useful to allow the users to input their own data into the WEBGIS and to perform analysis that is more relevant to their applications.

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ACKNOWLEDGMENTS

This work has been supported by Mission 908 Program of Jiangsu Province, P. R. China. We would like to thank many younger students of Hohai University for the numerous data processing tasks, and Mission 908 Team of Hohai University for the ground truth investigation. Data and discussions with colleagues from SOA, SBSM (Jiangsu Branch), Hohai University, Nanjing Normal University are appreciated.