A WEBGIS FOR SPATIAL DATA PROCESSING, ANALYSIS AND DISTRIBUTION FOR COASTAL INVESTIGATION AND ASSESSMENT (MISSION 908) IN JIANGSU, CHINA

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ABSTRACT:

In Section 1, the background of the research is introduced. This paper presents the results of efforts for the development and application of a web-based GIS, the Mission 908 WEBGIS, to support the coastal investigation and assessment of Jiangsu. In section 2, the design and construction of Mission 908 WEBGIS are provided. After giving the cycle of spatial data handling, the system architecture and data organization are given, then WEBGIS functions and applications are briefly described. In section 3, some discussion and conclusions are briefly listed.

1. INTRODUCTION

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 areas of Jiangsu has a 954 km-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. In the case of Jiangsu Province, a WebGIS is designed and implemented for spatial data processing, analysis and distribution of Mission 908.

"Chinese Offshore Investigation and Assessment (MISSION 908)" is a six-year (2004-2009) research plan, which is organized by State Oceanic Administration (SOA), People's Republic of China. It is the largest research special program in offshore investigation. The aim of this special program is to serve for the political decision-making, economic construction, marine and coastal management. The overall objective of Mission 908 is to find out the status, carrying capacity, sustainable development potential of Chinese offshore in early 21st century. And the ultimate goal is to serve for the planning and optimization of productivity layout in Chinese coastal areas.

In addition to the Chinese offshore investigation and assessment, the implementation of Mission 908 can be helpful to construct the spatial data infrastructure (SDI).

Much recent attention has been focused on developing GIS functionality in the Internet, Worldwide Web, or a private intranet, which is sometimes termed WebGIS. This paper presents the results of efforts for the development and application of a web-based GIS, the Mission 908 WEBGIS, to support the coastal investigation and assessment of Jiangsu.

Figure 1. Coastal Zone of Jiangsu Province

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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. The focus of the paper is to demonstrate how WEBGIS technology can be employed for spatial data collection, mapping in Mission 908 exploration.

One famous work is the WebGIS for the MER 2003 Mission. The WebGIS is the research in the Mars Exploration Rover (MER)(Li etc., 2007), which is developed by Ohio State University(OSU). Another famous work is the Oregon Coastal Atlas (www.coastalatlas.net). 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.

2. THE MISSION 908 WEBGIS

2.1 Spatial Data Handling

The general process of data handling can be described by a cycle of data acquisition, pre-processing, data processing and analysis, and coastal investigation activity planning, as illustrated in Figure 2. All the data are parts of the coastal data infrastructures of Jiangu.

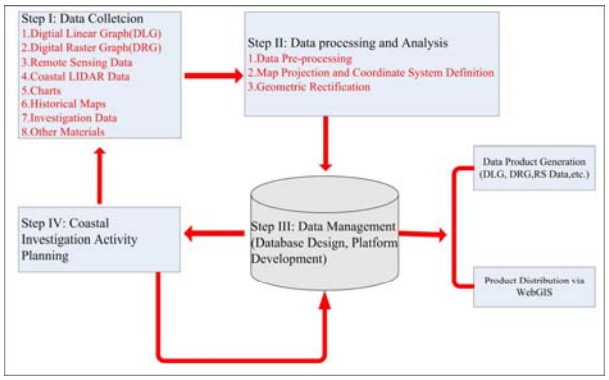

Figure2. The cycle of spatial data handling for Mission 908

Firstly, the relevant images and other data are collected, including the Digital Linear Graph (DLG), Digital Raster Graph (DRG), Remote Sensing Data (Landsat MSS, TM, ETM+; SPOT 4,SPOT 5; IRS-P5, IRS-P6 etc.), Coastal LIDAR Data, chats, historical maps, etc. Secondly, all the maps and images processed, including data pre-processing, map projection and coordinate system definition, and geometric rectification. Thirdly, after the data processing and analysis, all the images, maps and other data are archived in a server system, which is located at Hohai University (HHU), for various science analysis purposes. Fourth, the Coastal Investigation Activity Planning is designed by researchers based on the above database. And lastly, according to the Coastal Investigation Activity Planning, the investigation data can be acquired by the investigation and exploration.

The georeferenced mapping products are distributed to the research team members through a WEBGIS system, Mission 908 WEBGIS, to support route selection, science data analysis, activity planning, and topographic characterization.

2.2 System Architecture

The Mission 908 WEBGIS is designed to support Mission 908 exploration. As shown in Figure 3, 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. Thirdly, the investigation data (field data and the experimental data) are finally processed by the quasi-real-time means. 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®.

And the data in HHU coastal GIS server can be managed by a data management system developed for the Mission 908. Then based on the HHU Mission 908 data management system, a HHU Mission 908 WEBGIS is developed. During Mission 908 investigation in August 2007, the research team members can access the latest products through the WEBGIS for supporting data analysis and operations. And on the other hand, the public participation via this WEBGIS is feasible.

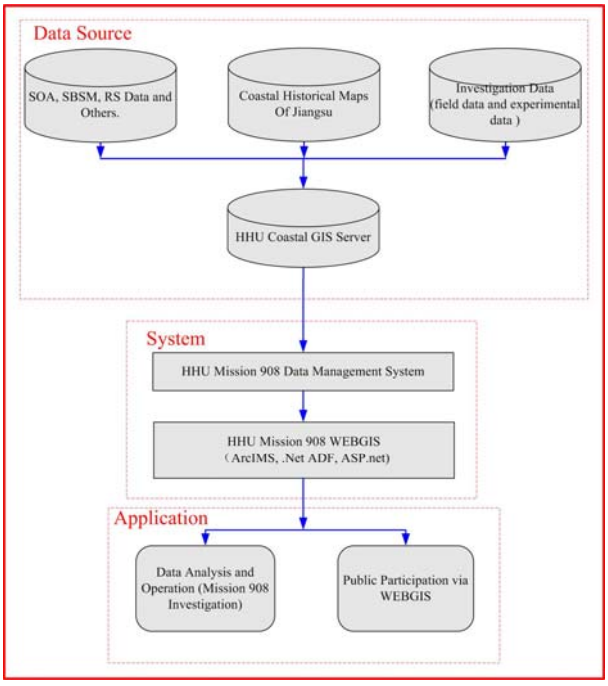

Figure 3. Data flowchart of the MISSION 908 WEBGIS

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 Mission 908 WEBGIS.

The developed WEBGIS system 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).

2.3 Data Organization

The System architecture of the MISSION 908 WEBGIS is displayed in Figure 4.

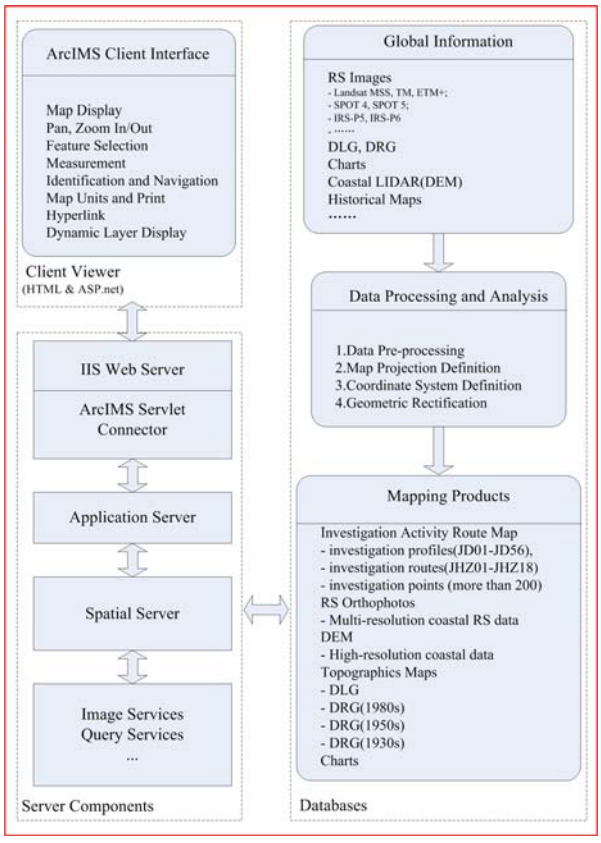

Figure 4. System architecture of the MISSION 908 WEBGIS

The database components of the WEBGIS are categorized into global information, ground information, and mapping products. Global and local spatial information and map products of the 2006-2007 investigation sites are provided through the WEBGIS. Global 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). Local spatial information contains significant landmarks, such as he predefined 56 investigation profile (JD01-JD56), investigation route (JHZ01-JHZ18) and investigation points (more than 200 points), which are collected and posted before the investigation. And the local spatial information is linked with the ground information. Ground information is supplied as traverse maps (JHZ01-JHZ18), traverse profiles (JD01-JD56) and X-Y coordinates, land use/land cover; analysis tools are also developed for effective visualization and exploration of the spatial information and products. 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 WEBGIS contains data organized in different layers that can be accessed through the Client Viewer. In the WEBGIS, all kinds of remote sensing images, DRG images, nautical charts are treated as image layers. Vector information includes DLG, landmarks. The products include thematic maps of coastal areas.

The customized HTML viewer in ArcIMS® is used in the Client Viewer to provide an interface of the Mission 908 WEBGIS in Figure 5 and Figure 6 with the basic mapping functions including map display, pan, zoom in/out, feature selection, measurement, identification, navigation. Figure 5 and Figure 6 are the global information interface. Figure 5 displays the investigation planning point, and figure 6 displays the investigation planning line (Traverse Map, JHZ01-JHZ18).

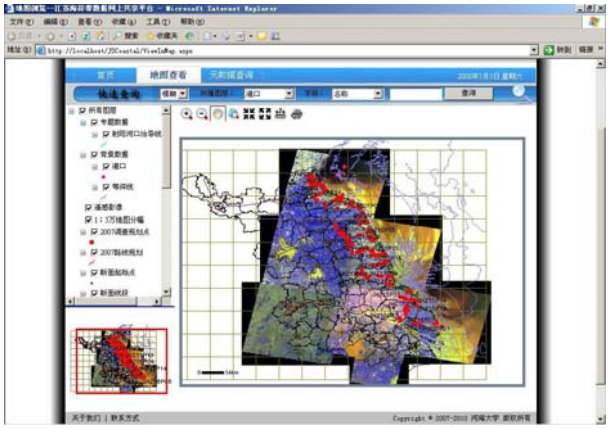

Figure 5. Global information interface and the investigation planning point

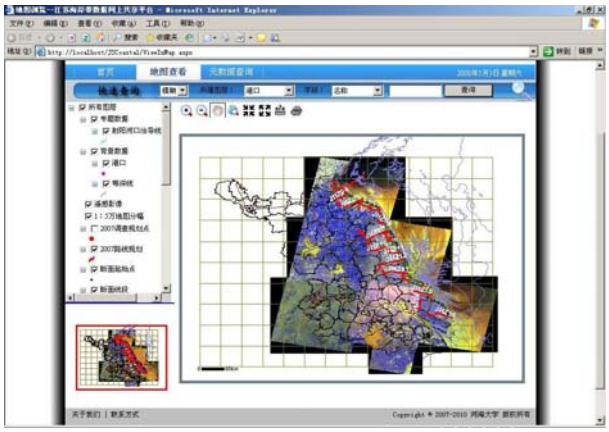

Figure 6. Global information interface and the investigation traverse maps(JHZ01-JHZ18)

2.4 WEBGIS Functions and Applications

In this research, access to the WEBGIS for coastal investigation is implemented through three components: Global Information Interface for investigation site information, Local Information Interface for the related thematic information, and text-based product search.

Figure 7 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.

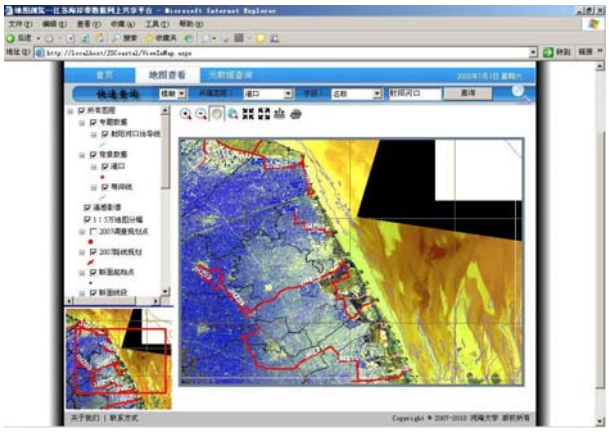

Figure 7. Local information interface of the Sheyang Estuary

According to Mission 908 team member's 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 Mission 908 WEBGIS is one of the systems used in the Mission 908 to provide topographic mapping information services. It is currently only accessible by the Mission 908 research teams. The system has been successfully applied to the 2007 Jiangsu Mission 908 and has the potential for future researches. Users can interactively access the coastal geospatial information through the Internet.

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

As the mission continues, the WEBGIS system 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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REFERENCES

ESRI, 2002. *Using ArcIMS® 4*, ESRI Press, Redlands, California.

ESRI, 2004, *Getting Started with ArcIMS®: ArcGIS® 9*, ESRI Press,Redlands, California.

Li, R., Di, K., Wang, J., Niu, X., Agarwal, S., Brodyagina, E., Oberg, E., Hwangbo, J., 2007. *Photogrammetric Engineering & Remote Sensing*, 73(6), pp. 671–680.

Oregon Coastal Atlas,http://www.coastalatlas.net/.