

# **GeoStar and GIS of Antarctica**

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## **Abstract**

The impact of the Antarctica, specifically the Geographic Information System, on our future becomes more profound each day. It is an urgent thing that constructs a GIS to realize Antarctic data's access, sharing and publishing on Internet. The rapid advance of networking and componentization technology is one of the most important characteristics in software development in recent year. This paper will present the features and functions of GeoStar software and the characteristics of Antarctica data. Moreover, we will introduce the Internet-based Geographic Information System of Antarctica, which includes data manage component, data acquisition component, spatial query component, mapping component and show component and etc, which can access and manage multi data source such as GeoFile, GeoDB, ARC/Info, MapInfo, DXF and MGE, Link with database including Sybase, SQL server, Oracle, dBase, Access, FoxPro and Informix, which can realize Antarctica data access, sharing and publishing on Internet and can manage multi-scales maps.

## **Keywords**

GIS, Antarctica, Internet GIS , GeoStar,DGI,DHM.

## **Introduction**

This paper presents a new Geographic Information System-GeoStar software. The main advantages of the software compared to similar software are: (1) an object-orientated spatial data management platform which has high efficiency, (2) integration of Vector database, Image database and DEM database, (3)component GIS, (4)Internet GIS which provide the method to access, publish and share GIS data on Internet. In this article, we can know how to collect data ,construct GIS database and publish distributive geographic information(DGI) of Antarctica on Internet by use of GeoStar software.

The World Wide Web is at present the most widespread electronic medium for the ordinary user. Millions of documents exist on the WWW. This enormous information corpus is one of the great advantage of the World Wide Web. Another advantage of the WWW is the distributed nature of the information. However, GIF-format or JPEG-format images are the only forms of returned spatial data on WWW. This makes it a time-consuming work to handle these images, such as zoom in, zoom out, pan and online map production, modeling and analysis services.

Java, being robust, secure, easy to use, easy to understand, and automatically downloadable on a network, is an excellent language basis for database applications. What is needed is a way for Java applications to talk to a variety of different databases. JDBC (Java Database Connectivity) is a Java API for executing SQL statements. It consists of a set of classes and interfaces written in the Java

programming language. JDBC provides a standard API for tool/database developers and makes it possible to write database applications using a pure Java API.

## **Distributed Geographic Information of Antarctica**

### **1. The actuality and importance of Antarctica data sharing.**

The requirement to Antarctica data's access, publishing and sharing on Internet increases each day with the rapid development of scientific research and groundwork surveying and mapping on Antarctica. The existing GIS data of Antarctic topographic database is almost isolated information and data is acquired, stored and analysed to meet the need of single project or program, which results in data redundancy and inefficiency of data collection and storage. The development of GIS application is base on concrete in dependent and close platform, moreover, they are conflict in data semantic, so that they can't realized data sharing between them. The increasing requirement to Antarctica information advances the development of cause of Antarctica scientific research. At the same time, human beings have the demand to acquire more and more information on Internet, especially the spatial information of Antarctica.

Compared with the traditional GIS, Internet GIS has the following benefits:

Firstly, Internet technology transfers GIS which has only been used by professional to public information system which can be used by everyone who knows about Internet in any way or any time. In other words, it make GIS enter into everyone.

Secondly, it can reduce expenditure in data promulgation and improve geographic data's share extent and avoid data's collection repeatedly by means of accessing data on Internet.

Thirdly, it can construct geographic information service network via Internet -based GIS technology by means of the facilities of information highway.

### **2. The structure of Antarctica data.**

As an integrated Internet based GIS of Antarctica, we think that it must contain the following portions:

**Web home page data:** Web home page data is the format of HTML in general. It includes hyper text, hyper media, hyper Link and etc. The current Internet information only includes the above 3H information in general without the hyper map information. The collection, updating and publishing on Internet in real time are realized basically. The question is how to organize them reasonably and high efficiency. In according to the features of Antarctica web homepage data, we think that web home page data includes the following four portions: scientific research, groundwork surveying and mapping, stations' information and online help. Antarctica surveying of China has got more and more data with the development of GPS, GIS and RS technology in recent years. Which includes the observation to crustal distortion of the whole Antarctica by means of GPS, erection the place names database by means of GIS, acquisition the satellite images of Antarctica by means of RS technology, research on the change of sea level by means of 3S technology. The above progenies provide the abundant data source for web home pages.

**Vector data and attribute data:** As we all know, the United States began to carry out the scheme "Digital GeoSpatial Data Framework" in 1994 which is used to establish the GeoSpatial database. China will establish the large scale GIS in the whole nation

in order to avoid data collection repeatedly which includes the Digital Orthograph Map (DOM) ,Digital Elevation Model (DEM) and vector data. In this framework DOM is the dominating portion. DEM is produced together with DOM. The vector data include Geodesy reference points, transportation, water system, boundary, cadastral data and etc (Li, 1998). Scientific Committee for Antarctic Research (SCAR) [Working Group on Geodesy and Geographic Information (WG-GGI)] is responsible for organizing and managing international Antarctic scientific research occupation which commit themselves to the following six portion research [or fundamental geographic datasets]

1. Antarctic Coastline Data Project
2. Antarctic Hydrographic Data Project
3. Antarctic Ice Bed Elevation Project
4. Surface Elevation Project
5. Names Project
6. Features Project.

We argue that the vector data of Antarctica must include the following information.

1. Water system maps. Which includes the coastlines, lakes, rivers, unmelted Ice area and ice shelf data.
2. Island maps. Which includes the boundary, building and etc. Island maps and water system maps constitute the framework of Antarctica geographical region and take an important role in terrain control; moreover, they are much more important factors of Antarctica GIS. Most Geographic analysis and application are referenced to them.
3. Contour maps and elevation data. Which reflects the undulation of topography and are the important data source of DEM. They are importance to study the overlay and vicissitude of Antarctic glacier.
4. Geodesy control points and place Names data. The Vector data is stored in file system and the attribute is stored in relationship database. The show component of GIS only shows the points' position and annotations.
5. Metadata: Which is referred to quantitative and qualitative description of Geographic spatial data (Kong, 1998; Lin, 1998b)and is the data to describe spatial data's contents, definition, spatial frame of reference, quality, management and etc. It is one of key technologies in geographic spatial data's description. It mainly includes mark information, data's quality information, spatial reference information, space-time information, spatial data denotation information, systematic information, distributive information, metadata reference information and etc. The metadata of this system contains the region of the map, collector, proprietor, the cover of the map, scale and accuracy, date of collection and updating, data structure and attribute, map projection and location of data and etc.
6. Image data: Which is referred the image acquired by the means of RS technology. China analysis the glacier's flow and evolvment, iceberg excursion by means of monitoring the change of south pole glacier, which adopts the MSS in 1970s,the TM in 1989 and Radar image in 1997 and etc. which provides the abundant source for image data of Antarctica.

### 3.The features of Antarctica geographic information

Distributed Geographic Information (DGI): It indicates the geographic information including map, image, data muster, analysis operation, reporter, etc which be published in distributed ways on Internet by means of networking technology. The geographic information of Antarctica has also the distributive characteristic, which contains perpendicular distribution and horizontal distribution.

Perpendicular distribution: The same region may have a different thematic geographic information which is based on the same scale. eg, King George Island region contains many layers information, such as coastline map, hydrologic map, contour map, place names map, topographic map, plants distribution map and etc. Moreover, different layers may be collected and maintained by different departments in different ways. Coast line map, contour map and etc may be collected by surveyors; plants distribution map may be collected by biologist Places names map may be collected by means of GPS technology; hydrologic map may be collected by means of RS technology. How to organize the above data high efficiency, which concerned to the organization the geographic data of Antarctica in horizontal distribution. The following map is the demonstration of the many layers.

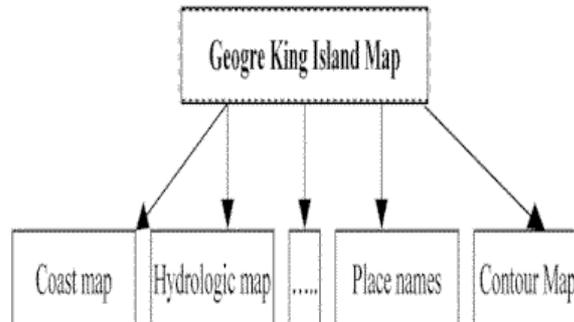


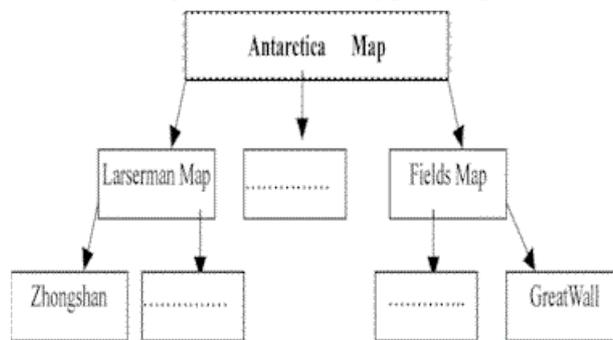
Fig.1 The Layers of King George Island Map

Horizontal distribution: eg, a whole Antarctica map which contains surface elevation, lakes, ice shelf, stations information and etc. In according to conception of hyperlink, we can take the Antarctica map as home page (or main map) and takes each island as the keyword of hyperlink which links to each home page of stations by means of the related network address. User can query any information from Antarctica map to

Fig. 2 The multi hyper maps

Laser map and to Zhongshan clicking the that we can scales query.

Different scales map projections of geographic Antarctica is



from Laser map station map by hyper link, so realize the multi-

and different : Another feature information of different scales

and different map projections. From the following table you can see that Antarctic map adopts the Oblique Azimuthal Equi-distant projection and Larsemann and Fields maps adopt the Gauss-Kruger projection and Zhongshan and GreatWall adopt the Cylindrical Equirectangular projection and their scales are different one to another.

Map Name	Projection	Scale	Format
Antarctica	Oblique Azimuthal Equi-distant	1:17250000	Arc/Info
Larsemann	Gauss-Kruger	1:10000	MapInfo

Fields	Gauss-Kruger	1:10000	MapInfo
Zhongshan	Cylindrical Equirectangular	1:2000	GeoStar
GreatWall	Cylindrical Equirectangular	1:2000	GeoStar

Tabel 1-1: The comparison of maps

Another characteristic of geographic information is heterogeneous data source. From the above table, we can see that Antarctic map adopts the Arc/Info data format and Larsemann and Fields maps adopt the MapInfo data format and Zhongshan and GreatWall station adopt the GeoStar data format.

## **GeoStar Software:**

### **1. The Characteristic of GeoStar.**

GeoStar, which contains almost all of GIS functions, is an important scientific and technological research project in China during “8<sup>th</sup> five years” and “9<sup>th</sup> five years”. GeoStar is an enterprise GIS software to managing large-scale spatial data. It can simultaneously manipulate graphic data, attribute data, image data and DEM. It can also be linked with various kinds of commercial DBMS, such as SQL Server, Sybase, Oracle, Informix, etc through ODBC. In addition, it can exchange data with currently popular GIS software and Chinese spatial data through its data-exchanging modules.

The core module of GeoStar is the platform of spatial data management, which is responsible for receiving, processing, querying, indexing and transferring spatial data. A set of API functions have been extracted. This set of common functions have been used by high level system for data collection, spatial query, spatial analysis and other applications. A common spatial database can be shared by all modules.

The major characteristic of GeoStar is that it can integrate vector data, attribute data, image data and DEM. The integration is used mainly for professional large spatial database, vector data attribute data, image data and DEM can be stored into different database respectively and can be managed in distribution through the integrated interface, the four kinds of data can be manipulated in cooperative way. Such as zooming in and out in any size, seamless roaming and performing spatial queries.

## **GIS of Antarctica:**

### **1. Comparison of existing GIS of Antarctica on Internet**

There are two traditional approaches of information architecture in constructing client - side access to distributed spatial data search and access systems on Internet: a Web client - to server gateway approach and a client - side plug - in approach. (Peng, 1997).

### **2. Model of GIS of Antarctica**

The GIS of Antarctica, built by distributed hyper map model (DHM), is made up of Web server, Client, multi - JDBC data acquisition server and multi - database server, distributed on the Internet (Fig. 3). This model address five fundamental features:

- Vector Graphic Data.
- Tasks separation.
- Computing distributed.
- Servers and Clients distributed.
- Interoperability of mutli data source

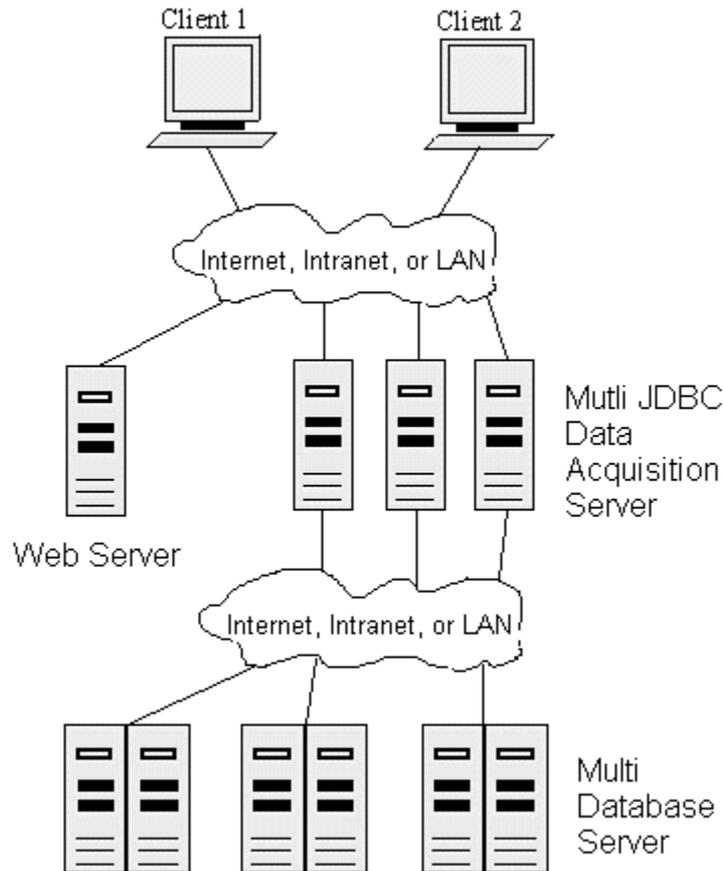


Fig. 3 Distributed Hyper Map Model

Using this model, the spatial data in clients are vector graphic data. All operations, for example zoom in, zoom out, pan and online map production, modeling and analysis services, will be finished by client machine, no need the server to take part in. It is undoubtedly new method to reduce the burden to network transportation and the server.

### 3. Features and Functions of GIS of Antarctica.

This system includes many features. First, the tasks of Web server, Clients, multi JDBC data acquisition server and multi Database server are completely separated. Web server is in charge of Web services, providing classes that the system needs to run. Multi - database server is responsible for the data services, such as data computing and data operating. Multi - JDBC data acquisition server provides the interface between multi database server and clients' machine. The other task is performed by clients machine, including show, query, mapping production and analysis. Second, computation is distributed on the Internet. Some of computing is finished on clients' machine, the other which are relative to database management is performed on multi database server. Third, the multi database server and multi JDBC data acquisition server are distributed on the Internet. Last, this model provides the interoperability of multi data source. Only by WWW, the end - users can use multi spatial data source, such as ArcInfo, MapInfo, MGE, DXF, GeoDB (Microsoft SQL server, Sybase) and GeoFile. For the vendors who provide GIS data can use any GIS software what they like. All GIS information can be published on the Internet.

This system includes many functions. Firstly, It will be available on all platforms and

operation systems where the JAVA Virtual Machine is equipped with. Users can start up this system with any WWW browser, such as Netscape Communicator and Internet Explorer. After being started, it has no relationship with the WWW browser. Secondly, this system can be operated expediently. Without installation, users can start this system when they know the IP address of this system. Thirdly, users can analyze map features and descriptive attribute information for query, spatial analysis, thematic map production, distance analysis and tabular manipulation and etc. Fourthly, this system provides the printing function. All kinds of results including mapping and tabular manipulation can be printed on the Client side printer and it is independent of the Server and the detailed printer type of the Client side. Fifthly, this system runs simultaneously in multi-languages at the same time such as Chinese, English and Japanese. Sixthly, the system produces the multi-scale graphics to be visually manipulated and users can acquire multi data source on Internet and provides the multi-media and explicatory function. Lastly, Security. Users can get data information, but can not save data information in client side.

## Example

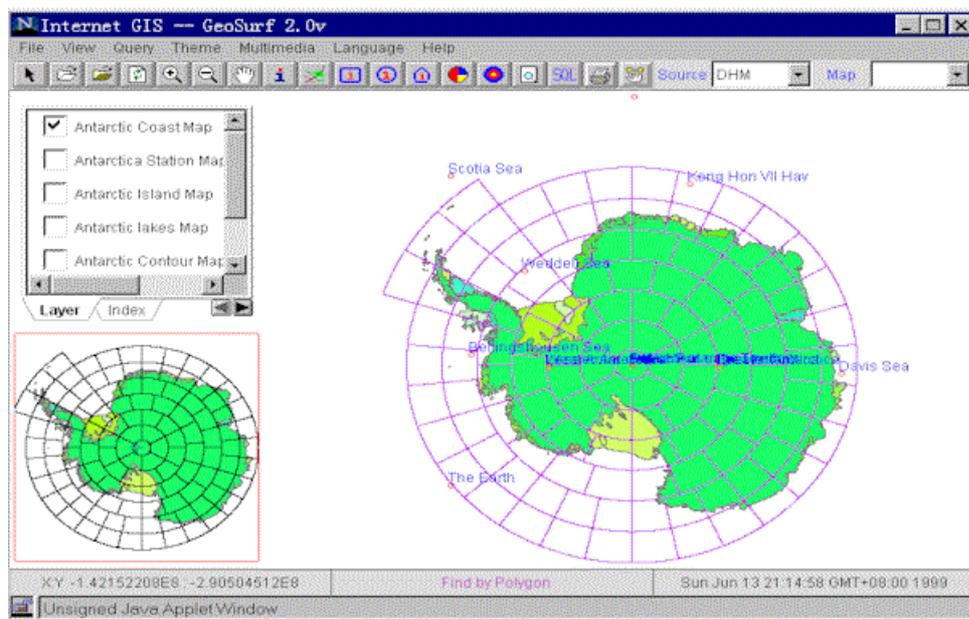


Fig .4 The Map of Antarctica

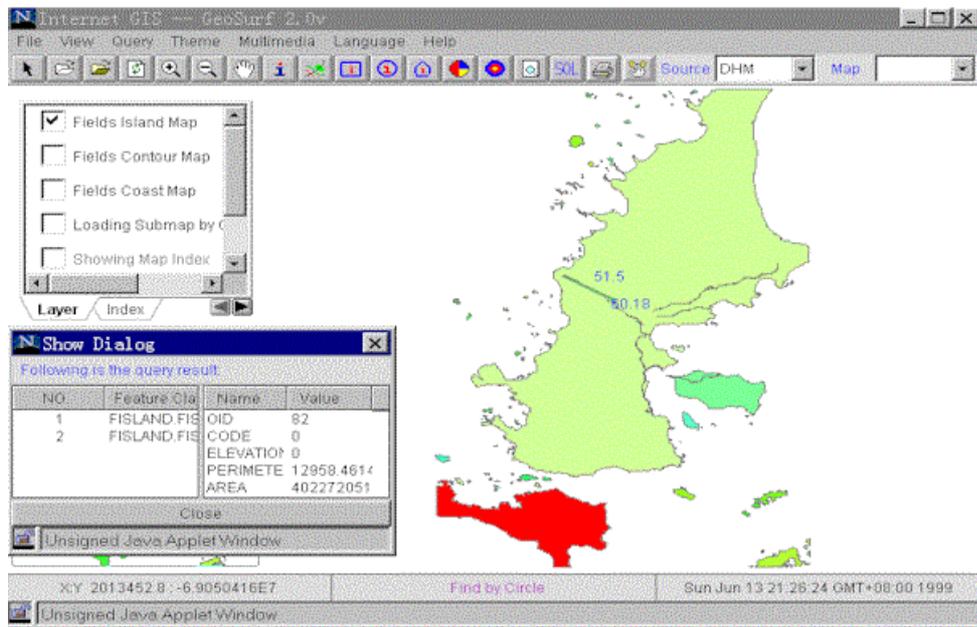


Fig.5 The map of Fields

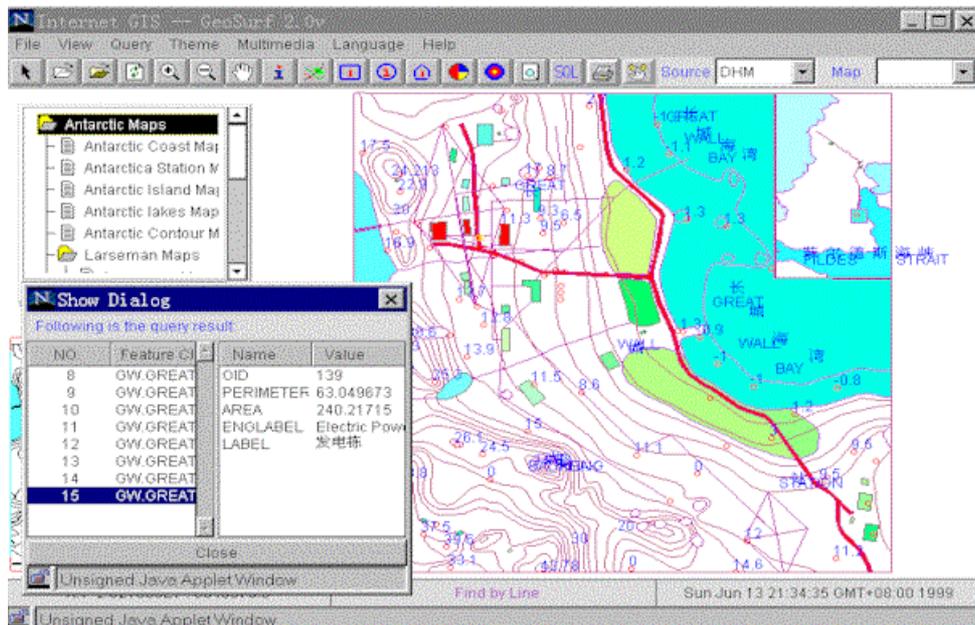


Figure .6 The map of Great Wall Station

## Conclusion and future work

From the above depiction, we can come to the following conclusions:

- Internet based GIS of Antarctica is the best combination of GIS and Internet, which can realize the Antarctic data's access, sharing and publishing on Internet online and can solve the distributed computing and interoperability of Geographic information.
- Distributed hyper map model is very effective to Internet based GIS of Antarctica.
- The characteristics are multi distributed data sources, distributed component, distributed computing and interoperability.

Internet based GIS of Antarctica is in the stage of development and has many problems to solve. eg, the visualization of spatial information, software interoperation

and spatial analysis and etc.

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