A Study on Developing GIS based Marine Resource Management System

Moonjin Kwon[1], Kyehyun Kim[2], Cholyoung Lee[3]

Dept. of Geoinformatic Engineering, Inha University
253 Yonghyun-dong, Nam-gu, Incheon, South Korea
Tel: (82)-32-875-4413 Fax: (82)-32-863-1506

[1] Master Course (Presenter), Department of Geoinformatic Engineering, Inha University, mjkwon@inhaian.net

[2] Professor, Department of Geoinformatic Engineering, Inha University, kyehyun@inha.ac.kr

[3] Ph.D Course, Department of Geoinformatic Engineering, Inha University, khsakura82@inhaian.net

Abstract

As existing resources such as coal and oil are being exhausted, many of the alternative energy studies have been proceeding. Recently, marine resource management has become increasingly important because the use of methane hydrate as an alternative energy source is on the rise. Therefore, it is necessary for us to make a systematic marine resource management plan for establishing marine dominion and ensuring resource development in a proper way. In this paper, we introduce the Marine Resources Management System (MRMS) using a GIS. We integrated a dispersed database and then designed database with consideration of yearly updating information of marine resources. Base data included various maps of, for example, sea depth and territorial boundaries. This system has a resource management function and an effective visualization display. We used spatial-position and attribute data of various formats. As a result, we develop MRMS which make possible for spatial information search and spatial analysis using spatial information. And we also suggest scientific marine resources management method. In the future, this system can provide public service by supporting web service and building 3D DB.

Keywords: GIS, Marine GIS, Spatial Analysis, Resource Management

1. Introduction

The recent discovery of methane hydrate, that is a natural resource of high enough efficiency to replace existing natural resources, is drawing public attention. Methane hydrate, also called burning ice, has a large amount of gas within the crystal structure of water ice, and the total deposit amount is known to be two times of total fossil energy. In addition, $1m^3$ of methane hydrate can generate $172m^3$ of methane gas, and it is regarded as eco-friendly energy source because its discharge of carbon dioxide is 70% less than that by gasoline.

Accordingly, developed countries in science such as the US, Japan, and the EU, and other countries like China and India, which necessitate securing energy, are doing a lot of researches to develop methane hydrates. Korea began related researches in late 1990s as well and they presume considerable amount of methane hydrates are deposited in East Sea including Ullung basin. Because of the research result, they are generally deposited in the continental shelves and slopes of more than 500m depth. Political or diplomatic disputes over territorial waters are arising to secure more of such natural resources and Korea needs to secure measures for this as well.

According to these needs, in this paper, Marine Resource management System based on GIS was developed to provide detail information such as extracting correct location and amount of marine resource, laws of the sea, etc, and to provide systematic management of marine resource and scientific information.

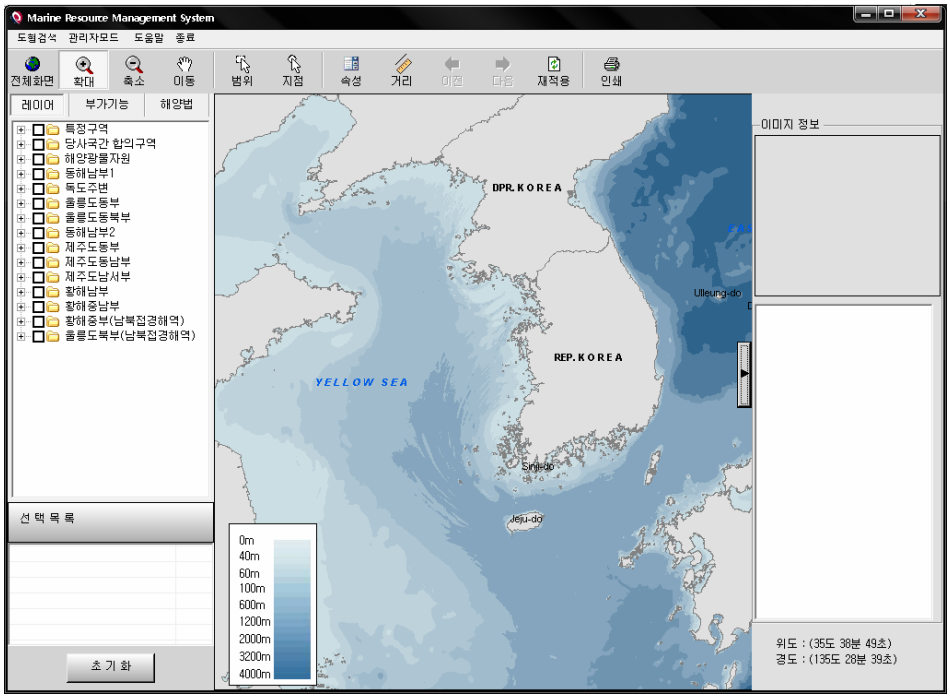
2. MRMS

The system developed has priority in providing effective location and attribute information of marine resources around the Korean peninsula and such information data relating to resource management is provided in txt and jpeg. Spatial analysis function is provided as well to acquire synthetic spatial information of marine resources Korean peninsula. Furthermore, management of resources to secure maximum development licenses is essential because of

the legal authorities are different depending on the classification of territorial sea, EEZ (Exclusive Economic Zone), continental shelf etc.

2.1 Development of MRMS

MRMS was developed using VisualBasic.NET 2005, ArcObjects component and Microsoft Office Access. Figure 1 is MRMS main window and this shows the first screen when the system is executed. The main window display Korea's land boundary, neighborhood country, East Sea, South Sea, Yellow Sea. As much as sea deeper, color also appears darker and RGB value is lower. Basically, RGB values are different depending on whether it is a border between Korea and other neighboring countries or depth of water in the East, South, or West Seas and the higher the depth, the darker the blue.



<Figure 1> MRMS Main Window

The screen composition consists of menu bar, tool bar, layer list, main map, attribute window, select list, and legend window. The system supports the basic functions: map handling, attribute check, measuring distance, searching marine resources using scope and location, etc.

2.2 Main function

Major functions of the system consist of display of a variety of spatial information, easy map handling, information search of various marine resources, measurement and search information, drawing layers, and addition or deletion of the data, etc.(Table 1)

<Table 1> Major functions of MRMS

Function	Content
Map Control	- Display a information, Control a window - Mouse Control : Zoom Up/Down, Full Extent, Pan
Attribute View	- Display attribute data using image, graph, text data - TXT, JPEG file
Measure	- Measure of the distance after click two point on mouse - Unit : km
Search	- Figure search : Draw a free figure and search all the marine resources - Range search : Click one point and input a range and search all the marine resources
Draw	- Make a shape file for spatial analysis (Draw point, line, polygon)
Add/Delete	- Add/Delete Spatial data & Attribute data

3. Spatial analysis function of MRMS

Using various functions above provided by MRMS, simple search and management of marine resources are possible. Locations and deposition forms of marine resources are visually identified because the geographical locations of the marine resources are visually displayed. In addition, the list of marine resources is also possible for development and the drilling can be verified due to a distribution chart for marine resources, territorial sea, EEZ and joint development zone, etc. can be displayed.

The system provides the function for various spatial analyses because of submarine spatial analysis is crucial in the management of marine resources.

The relation between spaces for each resource can be verified by using management, analysis, or duplication analysis function for basic spatial data and attributes. User can arbitrarily draw point and line polygons to analyze various scenarios and marine spatial analysis results, which can be acquired through the function of searching marine resources.

4. Results and Conclusion

Marine Resource Management System was developed in this study to manage marine resources in recognition of the need of marine resources management around the Korean peninsula. Through this system, basic marine resource management and analysis were enabled and systematic analysis and management of marine resources have become possible using space analysis functions. Furthermore, it turned out that 3-dimensional information display is required to establish organic coordination among organizations having marine data and achieve effective display of marine spatial information.

This marine resource management system is a good development case, which could effectively display complex marine spatial information combination with GIS and sea data. This will be the foundation for the development of specialized systems in various fields and more upgraded system will be developed through continuous data updating and research works.

Accordingly, future studies should include measures to manage tremendous amount of database and continuous updates, and applications of this to various research fields must be considered as well. This will lead to develop further functions such as decision-making system based on cost-benefit analysis, planning marine exploration and drilling using 3-dimensional spatial information, and web service of marine disaster prevention system to prevent oil pollution or red tide, etc.

References

1. Yun-Soo CHOI & Young-Tae IM & Yoo-Jeong HWANG & Yoo-Jung LEE, A Study on GIS DB Building Plan for Maritime Boundary Determination, The

Korean Association of Geographic Information Studies, Vol.11 No.4, 2008, pp.41-50

2. Hee-Yeon Lee, Geographic Information System, Bobmunsa, 2007

3. ESRI, Introduction to Programming ArcGIS Using .NET Framework. Korea ESRI Education Center, 2009

Moonjin Kwon

2008 - Bachelor of Engineering

- Department of Electronic Engineering, Daegu University, S.Korea

2008~present - Master Candidate

- Department of Geoinformatic Engineering, Inha University, S.Korea

Kyehyun Kim

1982 - Bachelor of Engineering

- Department of Resources Engineering, Hanyang University, S.Korea

1989 - Master of Engineering

- Department of Hydrology Engineering, Arizona University (Tucson), USA

1993 - Ph.D of Engineering

- Department of Civil and Environment Engineering, Univ. of Wisconsin (Madison), USA

1995~present - Professor

- Department of Geoinformatic Engineering, Inha University, S.Korea

Cholyoung Lee

2003 - Bachelor of Engineering

- Department of Mineral&Resource Engineering, Inha University, S.Korea

2008 - Master of Engineering

- Department of Geoinformatic Engineering, Inha University, S.Korea

2008~present - Ph.D Candidate

- Department of Geoinformatic Engineering, Inha University, S.Korea