Development of Oceanographic Information Dissemination System; an Application of Web GIS

Senevirathne AMNKB[1], Pathirage PU[1], Wijerathne HKP[1], Kuhatheepan S[1], Kuperajah N[1], Rajapaksha JK[2] and *Abeysinghe AMKB[1]

[1]Department of Earth Resources Engineering, University of Moratuwa
[2]Oceanography division, National Aquatic Resources Research and Development Agency
*Corresponding author; e-mail: amkb@earth.mrt.ac.lk

Abstract: It is an essential requirement to promote offshore fishing activities systematically to protect the coastal fishery resources, which are in optimal level of exploitation. One of the alternatives available is to divert coastal fishing effort to offshore by providing information on offshore fishing grounds and favourable environmental parameters. Objective of this present study is to implement web GIS (Geographic Information System) as a supporting tool to transfer the satellite derived favourable environmental parameters for fish aggregations to the end user. In this study, satellite data were processed using remote sensing and GIS software and the web GIS application was developed using open source Map Server, PostgreSQL, PostGIS and Mapbender software. Four models were developed to process the raw data and processed data are uploaded weekly to the World Wide Web to enhance fishing activities. Potential fishing grounds, sea surface temperature (SST), chlorophyll (CHL), sea surface height (SSH), ocean currents, bathymetry, exclusive economic zone and fishery harbour locations are displayed in the web GIS interface. Viewing, zooming, panning, distance measuring, displaying coordinates and attributes and load WMS (Web Map Service) functions are enabled to provide a dynamic framework to the user.

Keywords: Environmental parameters, Mapbender, Map Server, Satellite data

1. Introduction

Marine fisheries in Sri Lanka can be broadly categorised into coastal and offshore fisheries (Dissanayake, 2005). According to the fisheries statistics the coastal fishery is over exploited (Rajapaksha, 2007). Thus it is essential to promote offshore fishing activities

Rajapaksha JK, *B.Sc. (Hons) (Peradeniya), M.Sc. in Oceanography (Gothenburg). Senior Research Officer, Oceanography division of National Aquatic Resource Research and Development Agency.*
Abeysinghe AMKB, *B.Sc (Hons) (Peradeniya), M.Sc(AIT), Ph.D(Saga), Senior Lecturer in Department of Earth Resources Engineering, University of Moratuwa.*
Senevirathne AMNKB, Pathirage PU, Wijerathne HKP, Kuhatheepan S, Kuperajah N, *Final year Undergraduate students in Department of Earth Resources Engineering, University of Moratuwa.*

among the stake holders. Several attempts have been made to expand the fishing more towards the offshore areas since the 1960s (Maldeniya 1998). The offshore fishing lacks information services to secure their catch in deep waters. Thus it is vital to provide adequate and accurate information on potential fishing grounds and environmental parameters for them to reduce their operational costs such as fuel and to make sure their expected catch within a short period of time.

Near real time satellites and other ocean observation data can be used to generate such information. The National Aquatic Resources Research and Development Agency, Sri Lanka (NARA) endeavours to strengthen its capacity for development of satellite based fishery forecasting system. This system provides information on favourable fishing grounds through telephone, fax, Marine SSB (Single Sideband) radio, e-mail and SMS (Short Message Service).

To distribute this information to the world wide audience, a wider approach is required. In that case web based GIS (Web GIS) provides a platform to the user through the World Wide Web. Internet based geographical data services involve management of both spatial and non-spatial (attribute) data. Data pertaining to spatial attributes can be efficiently managed using Relational Database Management System (RDBMS). The development of a Web-based system by integrating GIS and RDBMS serves two crucial purposes. Firstly, it would allow the user to operate the system without having to grapple with the underlying intricacies of GIS and RDBMS technology. Secondly, it would allow sharing of information and technical expertise among a wide range of users. The basic

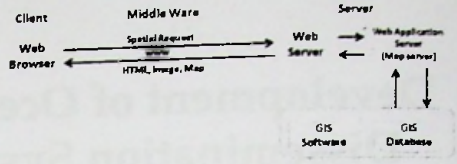

Figure 1. System architecture of web GIS

framework of the system comprises three components; client, middle ware and server (Figure 1) (Raghavan et al., 2001). The objective of the project is to provide a web based platform for collaboration and data sharing between specialists, planning agencies, citizens, and private entities.

2. Methodology

2.1 Data Processing

ArcGIS, ArcView, open source Map Server, PostgreSQL, PostGIS and Mapbender software were used in this study. SST, CHL, SSH and ocean currents data were downloaded from world databases. Downloaded SST and CHL data were in HDF (Hierarchical Data Format) and the SSH and ocean currents data were in NetCDF (Network Common Data Format). First the header files were extracted to gather metadata (variable name, image coordinates and cell size) and converted to a raster dataset using Marine Geospatial Ecology Tool (MGET). Scaling equations (1 and 2) were used to convert image pixel values in to actual temperature (Celsius degrees) and chlorophyll density (milligrams per cubic meters) values. The parameters for the scaling equations were available in the respective header files as metadata.

$$SST = input \times 0.000717 - 2.0 \quad \ldots\ldots\ldots\ldots (1)$$

$$CHL = 10^{0.000058 \times (input) - 2.0} \quad \ldots\ldots\ldots\ldots (2)$$

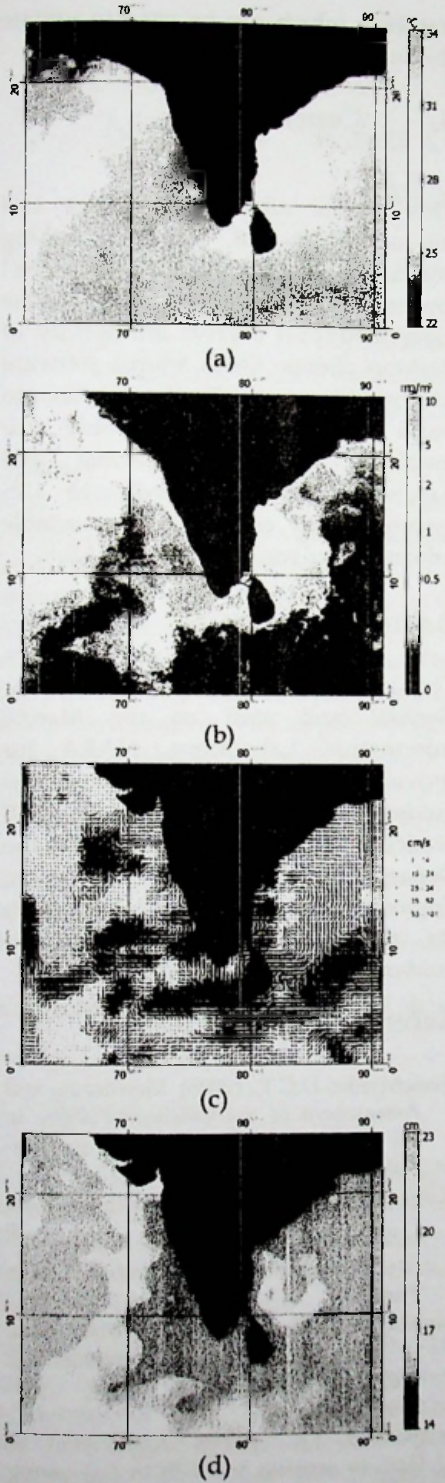

Figure 2. Processed Ocean data products for the month of January, 2006, (a)Sea Surface Temperature, (b)Chlorophyll density, (c)Ocean Currents, (d)Sea Surface Height

Then raster data was converted into a point feature layer and interpolated using Inverse Distance Weighted (IDW) method in order to minimize the cloud cover. When processing ocean currents data, speed and direction were calculated from North (U) and East (V) velocity components available in the original data set using ArcGIS extension - 'Wind Speed Tools'. Height values were readily available once the SSH data was extracted using 'Multi Dimension Tools' provided in ArcGIS. Processed data was saved in GeoTIFF and shapefile formats (Figure 2). For all the data processing, models were built using ArcGIS Model Builder.

2.2 Creating web GIS portal

In this study, Map Server for Windows (ms4w); a preconfigured Web Server environment for Microsoft Windows platforms that includes Map Server and Apache web server was used. ArcView extension 'Gix Export Tool' was used to generate map files which carry the information of map extent, map size, reference map, legend, colour, labeling etc. After that each map file was edited to define mainly the projection, data path, resampling method and URL (Uniform Resource Locator). PostgreSQL was used to create RDBMS. PostGIS component which enables geographic objects to the PostgreSQL database was also used. To create the GUI (Graphical User Interface), Mapbender software was used. It is a framework for managing spatial data services. Finally, the configured map files were linked into the GUI.

3. Results

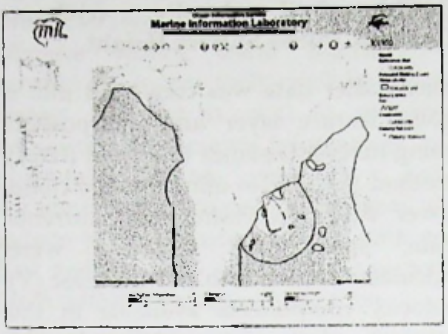

Figure 3. Developed web GIS interface

A web GIS interface was created providing user to access SST, CHL, SSH and ocean currents data. Further information on potential fishing zones, bathymetry, exclusive economic zone and fishery harbour locations are also available which were provided by NARA. Zooming, panning, distance measuring, displaying coordinates and attributes and load WMS (Web Map Service) functions are enabled to create a dynamic framework (Figure 3).

4. Discussion

Web GIS system supports to distribute oceanographic information through internet. In this study, ArcGIS and ArcView software were used with the help of other GIS extensions like MGET, Wind Speed Tools and Gix Export Tool for data processing. Finding appropriate tools from the internet was a quite challenge as they complicated the process. The map file configuration and customizing the GUI of the Mapbender were quite difficult. A small error cause bugs when uploading data. The authors propose to develop a database which can be used to update the system automatically.

5. Conclusion

This system allows interchange and interoperability of potential fishing zones, SST, CHL, ocean currents, SSH and other ocean related data, as the servers support a great multiplicity of desktop clients. Open source software can provide a cost effective solution, to build a Web GIS, as the only cost involved are with personal and hardware. The developed web GIS system greatly enhanced the available information dissemination at NARA.

Acknowledgements

The authors are grateful to Director General and staff of the Marine Information Laboratory, NARA for providing data, software facilities and guidance. We are also glad to thank all academic and non academic staff of the Department of Earth Resources Engineering, University of Moratuwa for their admirable supports and guidance throughout this project.

References

Dissanayake, D.C.T., (2005). Monitoring and Assessment of the Offshore Fishery in Sri Lanka, United Nations University-Fisheries Training Programme, p.4.

Maldeniya, R., 1998. Tuna research and data collection activities in Sri Lanka. 7th Expert Consultation on Indian Ocean Tunas.

Raghavan, V., Santitamont, P., Masumoto, S., Honda, K., (2001). 'Implementing Web GIS Applications using Open Source Software'

Rajapaksha, J.K., (2007). Application of Remote sensing and GIS in forecasting