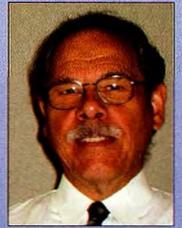


Publishing Marine Geospatial Data on the Web: the DFO GeoBrowser

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Abstract

In response to a need to integrate geospatial data from multiple locations and products, the Department of Fisheries and Oceans developed the DFO GeoPortal as a suite of standards-based geospatial services and applications. While initially implemented to support internal operations and decision-making processes, the GeoPortal was extended to support public access through the development of a new component, the GeoBrowser. This paper provides an overview of the GeoBrowser, its contents, evolution from the internal DFO GeoPortal intranet Web mapping services and shows how DFO is using it to help other stakeholders to make their data available through the Web.



Résumé

En réponse à la nécessité d'intégrer des données géospatiales d'endroits et de produits multiples, le «Department of Fisheries and Oceans (DFO)» a développé le GeoPortal en tant qu'ensemble de services et d'applications géospatiaux reposant sur des normes. Bien qu'initialement mis en œuvre afin de soutenir les opérations internes et les processus de prise de décision, le GeoPortal a été élargi en faveur d'un accès public grâce au développement d'une nouvelle composante: le GeoBrowser. Cet article donne une vue d'ensemble du GeoBrowser, de son contenu, et de son évolution à partir des services de cartographie Web intranet du GeoPortal DFO interne, et montre comment le DFO l'utilise pour aider d'autres parties prenantes à mettre leur données à disposition sur le Web.



Resumen

En respuesta a una necesidad de integrar datos geoespaciales procedentes de múltiples lugares y productos, el Departamento de Pesquerías y de los Océanos desarrolló el GeoPortal DFO como una serie de servicios y aplicaciones basados en las normas. Aunque fue implementado inicialmente para apoyar las operaciones internas y los procesos de toma de decisiones, el GeoPortal fue ampliado para apoyar el acceso público mediante el desarrollo de un nuevo componente, el GeoBrowser. Este artículo proporciona una visión de conjunto del GeoBrowser, su contenido, su evolución a partir de los servicios cartográficos del Intranet del GeoPortal DFO y muestra cómo está usándolo el DFO para ayudar a otras partes asociadas a hacer que sus datos estén disponibles gracias al Web.

The GeoBrowser may be accessed at: <http://gp2.chs-shc.dfo-mpo.gc.ca>

A previous paper published in the IHR¹, described the objectives and the architecture of the GeoPortal which are briefly summarised in the next section.

GeoPortal Overview

A wide range of organizations collect and disseminate marine data in Canada. As the hub of the marine sector in the country, the Department of Fisheries and Oceans (DFO) has recognised the need for the efficient distribution of data, as a means of providing improved access to information and resources for the planning and decision-making support of its community.

To this end, the Department of Fisheries and Oceans has developed a common marine data access point, or 'GeoPortal', that allows all DFO users, as well as marine stakeholders outside the department, to access a wide range of marine-related information. This is also part of a larger national initiative to build the Canadian Geospatial Data Infrastructure (CGDI)². The main goals of the GeoPortal initiative are as follows:

Interoperability

The Open Geospatial Consortium (OGC)³ initiatives have an ultimate goal of globally recognised standards for geospatial data. The GeoPortal is meant to be a step towards achieving this goal. All GeoPortal services and applications, including the GeoBrowser, are fully OGC compliant and therefore provide an extensive potential for interoperability between them and other applications. As the gov-

ernmental infrastructure becomes more and more OGC compliant, the GeoPortal will become part of a common departmental geospatial infrastructure. Currently, many sectors within the DFO require data from other sectors in order to deliver their core business priorities. The GeoPortal makes it much easier for these sectors to share data. Table 1 lists the international specifications that are the foundation of the GeoPortal.

Data Availability

The most basic objective of the GeoPortal project is to facilitate the free flow of marine geospatial data between the DFO and all other marine sector stakeholders. This free flow of data will reduce the monetary and personnel costs of acquisition, conversion, management and dissemination of this data. The reduction in costs is supported by the Portal's common infrastructure with standardised terminology for services and data.

Infrastructure Evolution

The GeoPortal is designed to accommodate future expansion and restructuring of the DFO Information Technology infrastructure. Experience has shown that information technology is a constantly changing environment. The need to adapt to new data and new technologies will continue to be addressed by an ongoing, open design paradigm for this initiative.

As indicated in Figure 1, which illustrates its architecture, the GeoPortal is made up of a set of Web-based geoservices that allow departmental staff to catalogue and publish their geospatial data holdings, internally and to the public, through stan-

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| <p>OGC Web Map Service (WMS) OGC Web Feature Service (WFS) OGC Catalog Interface OGC Geographic Markup Language (GML) ISO 19115 Geographic Information - Metadata Specification IHO S57 Transfer Standard for Digital Hydrographic Data HYDROGRAPHIC DATA</p> |
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Table 1: International specifications used in the GeoPortal.

¹ Delivering Marine Geospatial Data on the Web, IHR Vol 3 No. 3, November 2002, Pgs. 63 to 71

² www.geoconnections.org/

³ www.opengeospatial.org

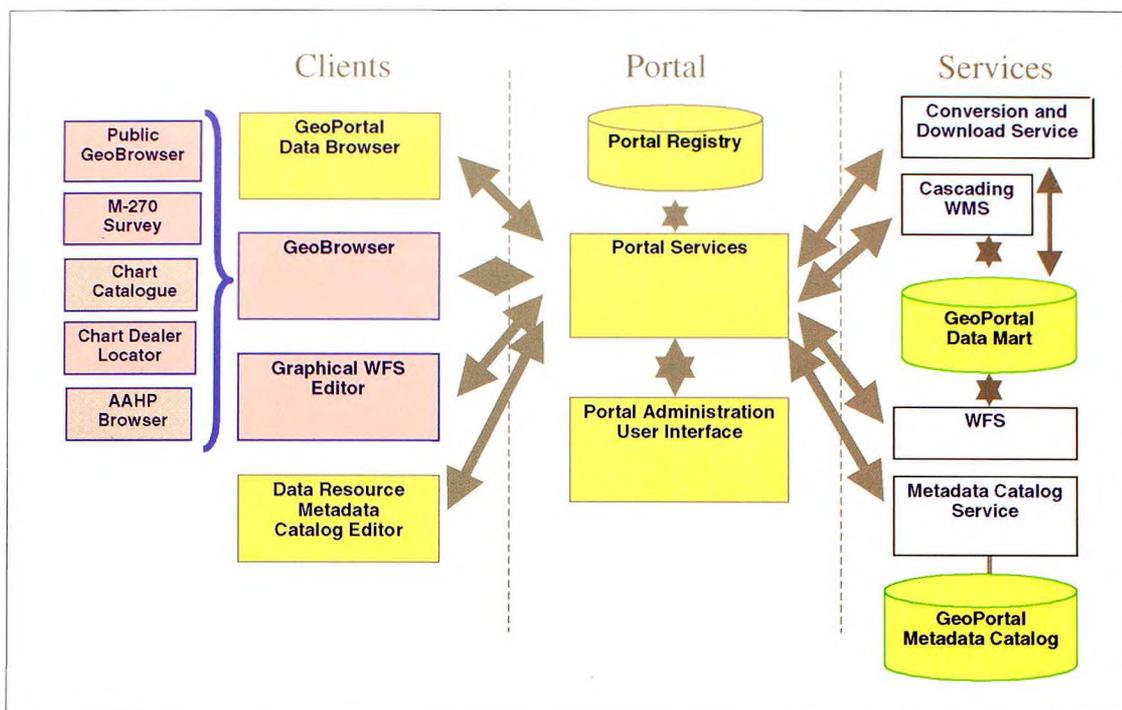


Figure 1: GeoPortal architecture.

- Metadata Catalog Service - using the M3Cat system [Intélec 2001] to provide a Web data entry capability for metadata into an Oracle database and a schema to manage the metadata.
- Cascading Web Mapping Service - using the CARIS Cascading Map Server and CARIS Spatial Fusion tools to allow for the inclusion of proprietary data such as ENC S-57 chart data, BSB raster charts and data stored in Oracle Spatial, as well as Web Maps coming from other OGC-compliant Web Map Servers.
- A Web Feature Service - using the CARIS Web Feature Server, that provides the capability to perform data manipulation (insert, update, delete, select) transactions on geospatial data, on the Web.
- Conversion and Download Service - using Safe Software's Spatial Direct tool, to allow users to download data, and translate it into one of many formats supported by Spatial Direct.
- Geospatial Data Mart - manages foundation and community specific data layers on behalf of specific DFO organizations. Examples of current layers include the Northwest Atlantic Fisheries Organization (NAFO) zones, Fisheries Management Areas, Large Ocean Management Areas, Integrated Management Areas, Marine Protected Areas, S-57 nautical chart data and digitised paper charts.
- Portal Services - secure role-based authorisation service for regulating access to information and the management of user views
- GeoPortal Data Browser - designed to allow access to all GeoPortal services and data. A Web-based application that comprises a catalog query interface, a Web map viewer interface and an interface to the download service.
- GeoBrowser - a simplified user interface designed for more casual users who do not require full capabilities of the GeoPortal.
- Graphical Web Feature Server Editing Capability - for adding and editing geospatial features.

Table 2: A summary of the GeoServices provided in the GeoPortal.

dards-based interfaces and also to discover, view, and download geospatial data holdings from various sources.

Table 2 provides a summary description of the services provided by the GeoPortal.

GeoBrowser

Of all the services presented in Table 2, one of the key enhancements made to the GeoPortal since its initial deployment has been the addition of a GeoBrowser. The initial Data Browser developed in the early phases of the project provides extensive functionality to make interactive maps from a variety of heterogeneous data sources. However, the GeoPortal requires some knowledge of map making to use and therefore a simplified GeoBrowser was also developed for general use. It is simple to use and does not require any training.

The GeoBrowser was developed as a simple, light weight (HTML only), spatial data browser for use by a broad range of users with varying mapping skills and capabilities. It removes the complexity inherent in the GeoPortal Data Browser at the expense of its flexibility of use. Over the last two phases of the project, the GeoBrowser has had extensive development that now provides many features without compromising its simplicity of operation. The GeoBrowser is currently deployed in five different forms to meet the following needs:

- Public GeoBrowser. The public GeoBrowser provides generic spatial data viewing capability to the Canadian public and DFO employees. This browser is de-ployed in two versions with the DFO version having access to data not released to the public.
- M270 Survey Locator GeoBrowser. Initially

developed for Canadian Hydrographic Service (CHS) employees only, to show limits of all CHS hydrographic surveys, this GeoBrowser is now available to the public as a specialised browser. It has the same generic functionality of the Public GeoBrowser in addition to an applet⁴ view that allows for interactive querying of multiple features using a Java applet⁴ and the WFS. Figure 2 provides a snapshot of it.

- Chart Catalogue GeoBrowser. This GeoBrowser is available to the Canadian public. It has the same functionality as the M270 GeoBrowser but it is applied against Chart data layers rather than the M270 data. A snapshot is shown in Figure 3 along with an example of the selected chart information in Figure 4.
- Scientific Observations GeoBrowser. This GeoBrowser is available to the Canadian public. It has the same functionality as the Public GeoBrowser but also includes a query interface to allow the user to filter Science Observation layers to discover specific ocean measurements.
- Graph GeoBrowser. This GeoBrowser is available to DFO employees as a demonstration browser. It has the same functionality of the Public GeoBrowser in addition to a dynamic graphing capability to draw pie charts on a map to provide statistical analysis of non-spatial data grouped by a geographic region.

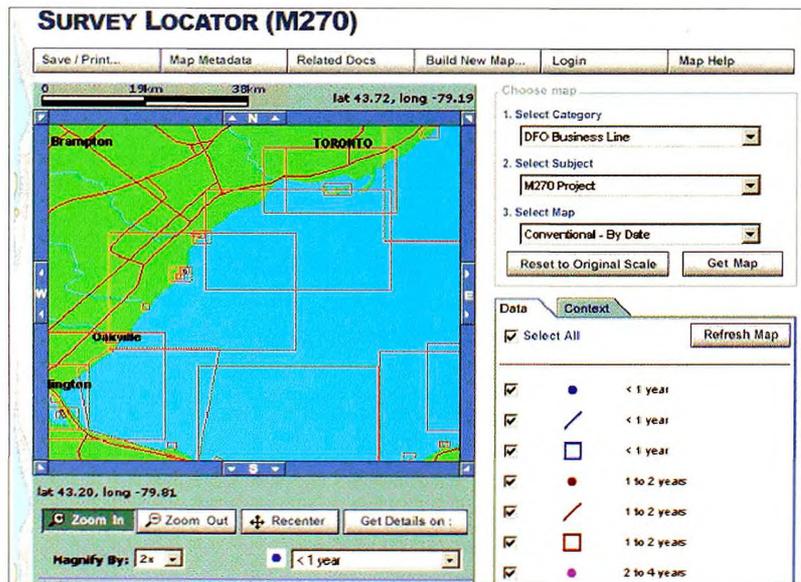


Figure 2: Snapshot of the DFO GeoBrowser showing CHS Survey Locations.

⁴ Applet refers to a small application program that is called up by the browser for very specific tasks

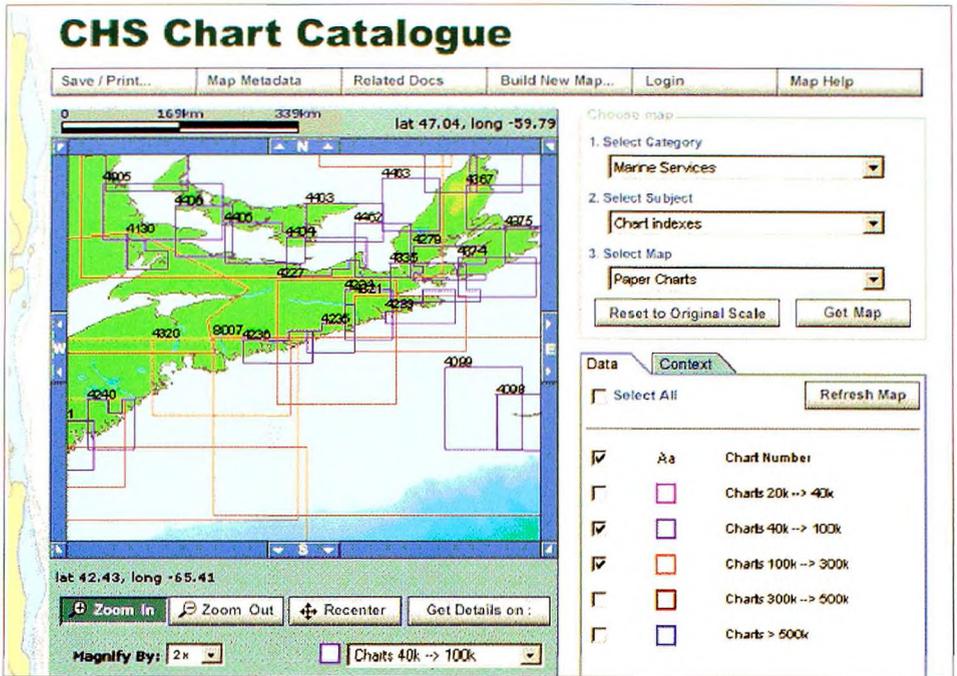


Figure 3:
Snapshot of
the public
GeoBrowser
showing CHS
Chart Limits.

| Chart Number | Chart Name | Scale(1:n) | Edition Date | Horizontal Datum | Vertical Datum | Language | Price |
|--------------|---|------------|--------------|------------------|----------------|----------|-------|
| 4233 | Cape Canso to/à Country Island | 60000 | 11-JAN-91 | NAD83 | HHWLT | B | 20.00 |
| 4234 | Country Island to/à Barren Island | 60000 | 26-DEC-97 | NAD83 | HHWLT | B | 20.00 |
| 4235 | Barren Island to/à Taylors Head | 60000 | 28-APR-00 | NAD83 | HHWLT | B | 20.00 |
| 4236 | Taylors Head to/à Shut-In Island | 60000 | 13-JUL-01 | NAD83 | HHWLT | B | 20.00 |
| 4335 | Strait of Canso and Approaches/et les approches | 75000 | 14-AUG-98 | NAD83 | HHWLT | B | 20.00 |

Figure 4: CHS catalogue report for charts shown in Figure 3.

The Public GeoBrowser

As mentioned earlier, the GeoPortal Data Browser provides many useful features but requires a small amount of effort to understand and be able to apply all of those features. The GeoBrowser was built to satisfy the need for a simple, intuitive viewer and has also been made available for general public use. In addition to the examples shown in Figures 2 through 4, Figure 5 illustrates the capability users have to select objects and get the metadata details on them while Table 3 summarises the data currently available on the public version of the GeoBrowser.

Community Portals

Key requirements for the GeoPortal project were to provide the basic data needed by various 'Community Portals' in DFO, to work with these groups in implementing the Web-based tools, and to determine how these groups would use and evolve with the GeoPortal. Although some of the community systems still use proprietary non-CGDI compliant software, and require special interfaces, they are moving towards standards based solutions. Further, as indicated in Figure 6, there are many links between the various sectors and regions with other agencies at all levels of government across Cana-

da, and significant progress is being made to satisfy the growing national requirements to share data.

Many of the Federal government agencies concerned with geospatial data, as well as a number of the key provincial agencies, have now adopted the open standards-based approach to sharing geospatial data espoused under CGDI. As these data providers/users adopt and implement the CGDI approach, it is firmly believed that a lot of the current chaos and duplication of effort will be eliminated and further, costs can be reduced, information can be found much faster, and timely decisions may be more readily made.

Future Plans

As the GeoBrowser has become more widely used, application limitations have been found and additional functionality has been requested by the user community. A synopsis of the main enhancement requirements are as follows:

- Support for Multiple Geospatial Coordinate Systems. The GeoBrowser presents data to the user in a latitude/longitude projection system. It however has no ability for the user to change coordinate systems or use non-Cartesian projections such as Polar Stereographic. In order to properly present data in Northern regions and to provide additional flexibility to the user, the GeoBrowser should support user selection of geospatial coordinate system including Polar Stereographic. This functionality is currently only supported by the GeoPortal Data Browser.
- Enhancements for Creating User Defined Maps. Part of the recent GeoPortal development was to provide users with the ability to create maps for viewing in the GeoBrowser. This was based upon merging two existing maps and selecting the desired thematic layers from those maps. This capability should be further extended to allow the user to select any layer the GeoBrowser has access to view for creation of user defined maps.
- Add functionality to support Web Map Context

GeoBrowser Public Views

<http://gp2.chs-shc.dfo-mpo.gc.ca/>

| | |
|--|--|
| <ul style="list-style-type: none"> • Foundation Data <ul style="list-style-type: none"> - Natural Resource Maps - NAFO Zones - Ocean Management Areas • Marine Support Data <ul style="list-style-type: none"> - Tidal predictions - Index of paper charts, ENC's and NRM's - Index of hydrographic surveys - Aids to Navigation - Chart dealer location | <ul style="list-style-type: none"> • Thematic Views <ul style="list-style-type: none"> - Newfoundland Coastal Resource Inventory - Gulf Traditional Fisheries Knowledge - Drifter tracks, drifting buoys, tide stations and other scientific observations - Aquatic Animal Health Zones |
|--|--|

Public views can be quickly added through interactive web interface

Table 3: Summary of the data currently available to the public.

Documents. The use of the Web Map Context specification would enhance the services available to users of the GeoPortal. The first step in its use would be to allow a user to download and save a current GeoBrowser map as a WMC document for use in other OGC-compliant Web client applications.

- Wrap World. Current WMS treat the world as a flat earth with the left edge of the map -180° and the right edge at 180°. This splits the earth down the middle of the Pacific Ocean. When looking at a world view of data (which is the case when browsing through worldwide scientific observations), this location is poor as it affects the view of data in the Pacific Ocean. The GeoBrowser can be modified to allow for seamless wrapping of the world over the 180°/-180° line.
- Integrate Spatial Translation and Download Service. The Spatial Direct Spatial Translation and Download service is only accessible to users of the GeoPortal Data Browser application. This service can be extended and incorporated as part of the GeoBrowser for selected registered users.
- Implement Styled Layer Descriptor. The existing Web Map Server supports Styled Layer Descriptors, which allow a user to specify how specific data layers should be represented in the application. Currently, users are presented with the default presentation style configured for the layer. The GeoBrowser will be enhanced to allow a user to specify certain styles for each layer.

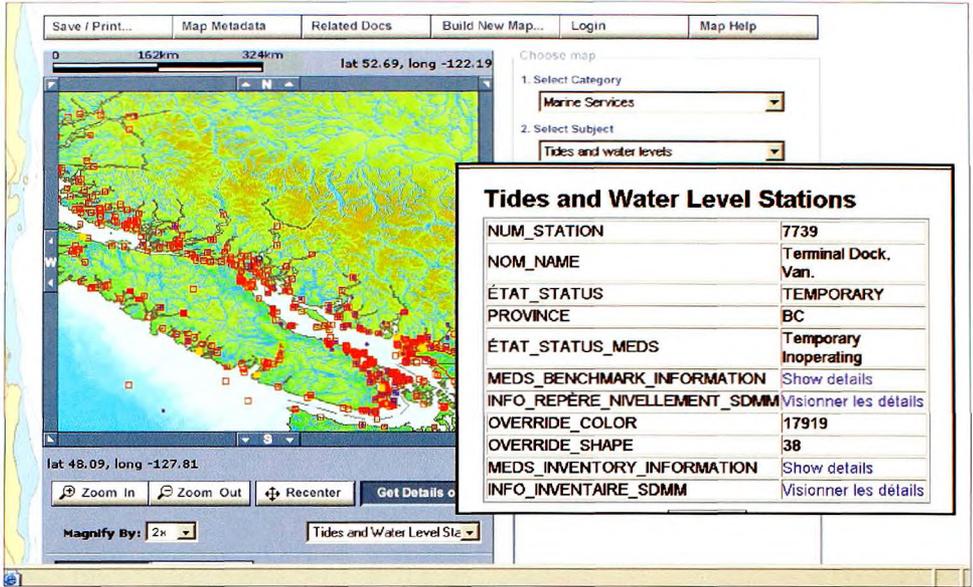


Figure 5: Snapshot of tides and water level stations with a Station Report.

Through the GeoPortal project, DFO has implemented a suite of powerful, yet easy to use tools. The GeoBrowser is one of the key components of the GeoPortal architecture, and has been designed for expandability and flexibility, allowing DFO to evolve its architecture in an iterative fashion at minimal cost. While there are always needs for

additional functionality in applications, the GeoPortal project will also focus future efforts on making more geospatial data and metadata available from the various DFO sectors in order to increase the usefulness of the wealth of data available throughout DFO. Additionally, efforts will be directed towards making an increased use of GeoPortal



Figure 6: The GeoPortal helps standardise and link DFO's geospatial data across Canada.

capabilities in DFO business applications so that the full value of geospatial information can be exploited for better decision-making.

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Biographies

Don Vachon, chief, Engineering Development, Canadian Hydrographic Service, has been involved

with the development of GIS and geospatial databases for over 25 years and is currently implementing OGC-based services in his department through the GeoPortal Project. He also a member of the Working Group on S57 extensions for Edition 4.0 which will integrate several of the TC211 components.

Michel Poulin is the director of National Programs in the Canadian Hydrographic Service. He is a graduate of the Rimouski Marine Institute in Quebec. He has now spent more than 25 years with the Canadian Coast Guard and the Canadian Hydrographic Service in various leadership roles related to Marine Safety. His current interests are focused on Marine Safety, Marketing, and Marine Geospatial Data Infrastructure.

Pierre Lafond has over twenty years of experience in management and information systems in both the public and private sectors. He co-founded Holonics in 1996 to provide data management services in the areas of Oracle technology and spatial systems. He has been heavily involved in geospatial infrastructure projects based on OGC specifications for the last five years, including managing the delivery of the DFO GeoPortal project.

Timothy V. Evangelatos retired from the Canadian Hydrographic Service in 1996 after three decades of involvement in developing hydrographic data processing systems, nautical chart production systems, geospatial standards, and electronic charts infrastructure. Now President of Terraqueous Technologies he has been active in helping to build the Canadian Geospatial Data Infrastructure (CGDI).

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