



Newsletter of the Plan géomatique du gouvernement du Québec

Editorial Committee

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News for Our Subscribers

Since coming online in January 1998, GÉOinfo has informed you about various scientific aspects in the field of geomatics. Our editorial staff has helped you discover new facets of geomatics related to a broad and fascinating range of applications.

This year, however, GÉOinfo is changing its approach. GÉOinfo will continue its mission of delivering specialized news, but through a new dynamic interactive site of geographic information that you consult online. Consequently, this is the last time that GÉOinfo will appear in its familiar form.

Our subscribers will naturally be the first to find out when the site becomes accessible and the new presentation is ready.

Watch your e-mail for news!

GÉOinfo Editorial Staff

GEOdiffusion 2003: The Unmissable Event in Business Geomatics

Luc Gravel

GEOdiffusion 2003 is the second edition of a conference on Web-based distribution of geographic information organized by the Québec firm Korem. The event, which took place at the Château Frontenac from December 2 to 4, 2003, brought together nearly 200 people, mainly from the public, banking, real estate, insurance, and geomatics services sectors.

Financial support came from the Ministère du Développement Économique et Régional et de la Recherche and Pôle Québec-Chaudière-Appalaches (an industrial promotion agency), in addition to from Korem, the event's main organizer. Moreover, MapInfo, the world's third-ranking producer of geomatics software, was directly involved in organizing the event.

The offering at the two-day conference included a selection of presentations from Québec departments and various companies as well as more technical papers. The event ended with a debate about trends in the geomatics market.

The Mobilizing Effect of GEObroadcasting

Geobroadcasting (or Web mapping) particularly affects the new marketing practices of companies interested in the geographic characterization of customers. Cellular telephony, carriers, and the restaurant industry are prime users of the Web.

The various presentations given during GEOdiffusion 2003 brought out a number of major issues. First of all, data quality and shareability have improved along with system user-friendliness and processing capacity. Web tools are often the entryway to geomatics for departments and organizations unfamiliar with this approach. The Web is used both to disseminate geographic data and to combine multisource data.

Greater Government Use of Geobroadcasting

Sabby Nayar, MapInfo's Market Manager for the Government Sector, stated that the three levels of government in the United States account for 30% of the geomatics market. The main applications involved relate to *homeland security* with various services to track telephone calls, terrorist acts (anthrax), and sources of drinking-water contamination or virus proliferation. Likewise, the ability to determine the size of emergency-response intervention sites and to locate threatened homes and businesses is another sought-after application. For their part, police and fire departments use Geobroadcasting to monitor events and adapt their intervention strategies.



During the opening cocktail in the chapel of the Musée de l'Amérique française, Susan Kheog, United States Consul General in Québec, highlighted the business partnership between Korem from Québec and MapInfo from New York.

Several Quebec departments involved in socioeconomic issues use Geobroadcasting. The provincial Department of Justice uses the Web locate courthouses. The provincial health department (MSSS) created a Web site that provides synoptic maps based on data collected daily throughout the entire health-care network. Adding the geographic component to the decision-making process provides for more rapid and accurate reading of phenomena and behaviors related to health care.

The Ministère de l'Emploi, de la Solidarité Sociale et de la Famille has put online a locator service listing day cares in Québec. This highly user-friendly system that is continually updated replaces a print version published annually, which contained information that quickly became outdated. The high user traffic rate (11,000 users per month) clearly demonstrates the effectiveness of Web-based products for delivering services to the general public.

Tourisme Québec continues improving the BonjourQuébec.com site by adding more and more items of interest to tourists. Québec's department of education, meanwhile, continues refining its applications related to school-bus transportation and school localization.

Lastly, in mid-November 2003, the Institut de la Statistique du Québec (ISQ) published an online directory of statistical information for both specialists and the general public. The Base de Données des Statistiques Officielles du Québec (BDSO) contains statistics complementing those held by Statistics Canada in an interactive mapping environment. BDSO, which started in 1999, represents joint action between 23 departments and agencies.

Departments involved in territory management, such as the Ministère des Transports (MTQ), are also very concerned by GEObroadcasting. The distribution of regional geographic-road data across the MTQ Direction de Québec's intranet makes it possible to get valuable information to those who directly intervene on the territory. Many road data are spatially referenced. This information system relies on aerial photographs and digital videos in addition to maps. Viewing the terrain on-screen can often prevent unnecessary field trips and this kind of archive is immensely useful.

Moreover, during the 1998 ice storm, Hydro-Québec's geomatics unit acquired a corporate geographic information system (GIS) that integrates multisource data from various government and paragonovernmental organizations. These data serve as a foundation for locating Hydro-Québec's major networks (distribution, transmission, telecommunications) as well as for production facilities (dams, power stations, reservoirs). This data set, distributed internally on DVD, is accessible to Hydro-Québec staff on the Internet.

A Constructive FORUM

The second edition of GEOdiffusion ended with a debate on the technological positioning of the geomatics industry. The discussion, which brought together David Sonnen (Integrated Spatial Solutions Inc.), George Moon (MapInfo), and



During his presentation, Sylvain Roy (Hydro-Québec) impressed us by having us navigate across the vast world of this Crown corporation's corporate data, all on a single DVD!

Joe Francica (Directions Magazine), spent a great deal of time on interoperability, which refers to the openness between systems and platforms.

Since there is one user of geospatial data for every 200 users of databases in general, no one should be surprised that Oracle, the market leader in database management systems (DBMS), is spearheading the Geobroadcasting market. As a result, it's becoming increasingly evident that certain basic functionalities in geomatics are and will be increasingly handled by DBMSs and not GISs. The management and manipulation of geospatial data are therefore on a downward trend, but the market for custom products is doing quite well.

You won't want to miss the next edition of GEOdiffusion, slated to be held in Québec in December 2004.

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Rosie Jobin
 Director, Communications
 Korem inc.



During the lunch conference, Michael Hickey, MapInfo Corporation's Chief Operating Officer, highlighted geomatics solutions aimed at consolidating the competitive position of businesses.

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Québec's Multimodal Network Model The Cornerstone of the Québec Transportation Model

André Babin et Louis Rousseau

The Réseau multimodal modélisé du Québec (RMMQ for Québec multimodal network model) was initiated by Transports Québec in 1998. This project for an integrating transportation modeling environment has reached a level of maturity that enables us to glimpse the vast fields of application hinted at from the outset.

The network modeling tools (the backbone of many transportation planning activities) range from analyzing and forecasting transportation demand to assessing transportation projects and policies, including the determination of their economic and environmental impacts. Staff at the Ministère des Transports (MTQ) has gained adequate mastery of these tools in processing urban and regional problems. On the other hand, extending the model across Québec remains a major challenge, in which RMMQ plays a pivotal role.

Multiple Applications

While, for the moment, RMMQ only includes road and ferry transportation, it still offers a multitude of applications, such as those listed below.

- Calculation of the shortest route in time or distance (see Figure 1);
- Online querying of intercity travel times and road distances;
- Automated description of itineraries based on the calculated routes.
- Production, for Tourisme Québec, of travel time maps (isochronous contours) for comparative analysis of regional accessibility.
- Production of time and distance matrices for comparative analysis of accessibility to service points within the provincial health and social services network.
- Development of the Québec trucking network model to validate and analyze data from the 1999 Canadian Trucking Roadside Survey (see Figure 2).

figure 1



Exemple de plus court chemin en temps entre Saint-Alexis-des-Monts et certaines municipalités québécoises, calculé au moyen du RMMQ.

figure 2



Affectation sur le réseau routier nord-américain des déplacements de véhicules lourds (Enquête canadienne sur le camionnage, 1999)

Overview of the Topological Approach

There's nothing new under the sun...or almost. In fact, RMMQ borrows from geomatics, topology, and computer modeling to build a consistent representation of Québec's transportation system, thus allowing the application of calculation methods specific to operational research.

The geospatial data are regenerated in an oriented graph of nodes and arcs strictly assembled according to topological rules (see insert *topological constitution of a transportation network*) enhanced with descriptive attributes for the nodes or links. They can then be used with operational research algorithms in order to process a specific transportation problem (searching for the optimal route, loading demand into the network, calculating isochronous contours, etc.).

This base network is superimposed on a zone system resulting from complete tessellation of Québec's territory. Each zone is represented by a node constituting the centroid, which is, in turn, connected to the network by access links. The zonal system is used to spatialize phenomena associated with transportation demand, including the generation and attraction of trips, which correspond, respectively, to the origin and destination locations.

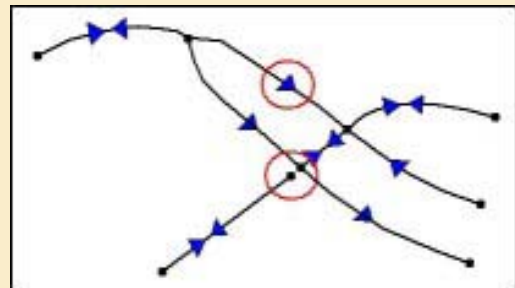
The spatial system selected for RMMQ contains more than 1 600 zones, corresponding to Québec municipal entities. In major urban areas as well as large multipolar municipalities, the delimitation is further refined into neighborhoods and districts essentially based on traffic zones in MTQ's urban transportation models (see *Modelling: A Prime Planning Tool within the Ministère des Transports du Québec* in the November-December 2003 issue of GÉOinfo).

(http://www.pggq.gouv.qc.ca/geoinfo/num/dec03/dec03_1.htm)

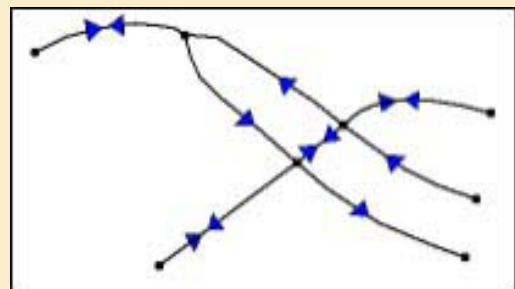
Lastly, a compromise was made between the geometric accuracy of the reference data and simplification of the network representation in a single theoretical graph, thereby increasing the efficiency of algorithmic processing. A substantial reduction in superfluous nodes was achieved with geometric generalization. The resultant network model remains complex (see the insert *RMMQ v2 Road*

Topological Constitution of a Transportation Network

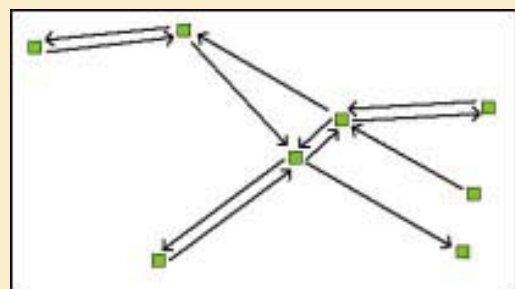
A Geobase Representing the Network



Towards an implicit network form (principles of connexity and directivity)



Towards an explicit form of the modeled network (arc-node network)



Component), but it is quite readable and close to traditional mapping, while ensuring acceptable calculation times.

This exercise only represents the tip of the iceberg, since the value added to the codified network essentially lies with node and link attributes themselves. Indeed, the amount of attribute information available relates directly to the variety of questions and the refinement of the problems that can be submitted. In addition to functional classification and odometric data, RMMQ now includes traffic counts, posted speed limits, and the Quebec trucking network classification.

Development Potential

While RMMQ has generated many successful applications, a significant amount of development remains to be done to achieve its true potential. Adding other transportation modes and new attributes will enhance its multimodal features and extend its field of application to the generalized simulation of people and commodities transportation demand through all the modal components of the transportation system. Considerable efforts will be required to constitute origin-destination matrices and encode the transportation cost structures within the model.

RMMQ has, however, already very clearly demonstrated the timeliness of having a “topologically intelligent” data structure to inventory and represent transportation networks. While this entails constraints and requirements, it also provides real benefits. RMMQ is proving to be quite valuable in analyzing road accessibility, simulating and optimizing itineraries, and assessing major transportation projects.

RMMQ v2 Road Component



NODES	
Centroids	1 625
Intermodals	81
Ferries	145
Roads	29 459
Total:	31 310
LINKS	
Access	3 402
Ferries	226
Roads	72 784
Total:	76 412

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Maps on Demand? Just Ask for Them.

Eveline Bernier

If they intend to respond to user demands, producers of map data must increasingly diversify their products. Currently, however, producers are not equipped with systems that are flexible enough to respond to the demand. The GEMURE project (Generalization and Multiple Representations for On-Demand Map Production and Delivery) is investigating this problem. One of its applications for the general public is recreation and tourism.

Responding to Producer Needs

Today's producers of geospatial data must satisfy varied demands from many users, which means that they must create and maintain different map products. Many of them now have as many systems as products. Obviously, keeping such systems up-to-date rapidly becomes costly and laborious.

Ideally, an organization should have only one database from which all of its map products can be derived. There are two solutions to this situation. First, maintain a minimum of data (generally, the most detailed) and generate products as required using automated generalization algorithms. Second, maintain all the map representations for each object so as to create a multiple representation database (MRDB).

Unfortunately, the current state of the automated generalization renders the first solution unviable. Moreover, on-demand production cannot be implemented on the Internet where response time must be nearly instantaneous. While the second solution appears to be the only option for the time being, it generates significant amounts of data, requires the creation of links between the various representations of the same object, and makes updating more complex.

The three-year GEMURE project is an attempt to respond to the needs of producers of geospatial data. Led by a team of GEOIDE researchers, GEMURE is looking to develop new methods and tools that better support the combinations of cartographic generalization operations with multiple representations for easier on-demand cartographic information delivery, whether for Web mapping or paper products.

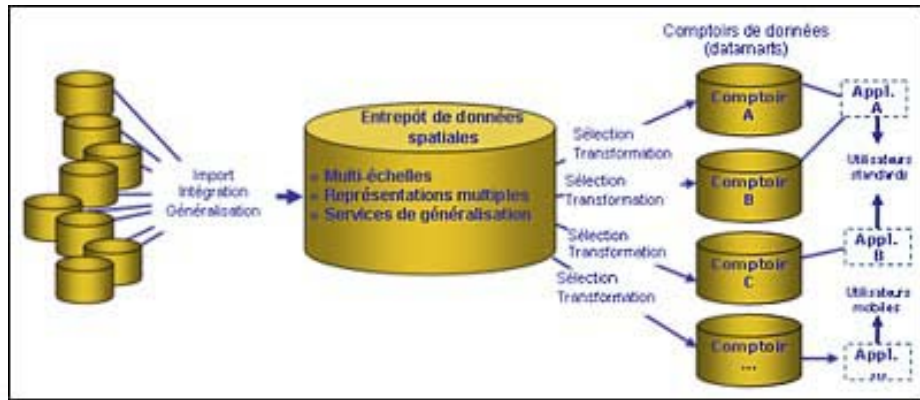
GEMURE: A Data Warehouse Architecture

GEMURE's work is based on an N-tiered architecture in which a data warehouse manages all the multiple representations and offers certain automated generalization services. The warehouse is fed either from independent system sources whose data are imported and integrated so as to generate as automatically as possible the multiple representations of the same object or from new modes for capturing multiple representations.



Phase II Outcomes

This project comes under Phase II of the GEOIDE Network, whose mission is to act as a catalyst within the Canadian geomatics community. By taking advantage of Canada's capabilities in research and development, we are contributing to the development of strategic alliances, thereby consolidating and strengthening the geomatics industry.



N-tiered architecture with a data warehouse combining map generalization and multiple representations

Certain data will be extracted from this generic warehouse to create targeted, optimized subsets per application (referred to as datamarts). For example, there could be a datamart to produce on-the-fly maps of the road network at any scale. Another could produce on-the-fly topographic maps at scales ranging from 1:2 000 to 1:250 000. Still another could handle requests for driving directions from tourists using cell phones or personal digital assistants (PDAs) online, and so on. It's possible to create as many datamarts as there are anticipated groups of applications.

Two applications really stand out among those developed during the course of this project and will benefit from datamarts: on-demand mapping and the management of recreational and tourist spaces.

On-Demand Mapping

The first application being developed is based on the use of multiple representations. It consists of a cartographic tool that makes it possible to obtain maps on-demand over the Internet with a degree of flexibility that has never been seen before. The map is created according to user needs, whether they are semantic, geometric, or graphic.

Among other things, users may select the object classes to be displayed at different levels of detail, such as all buildings, only residential buildings, or only single-family dwellings. They may also determine the level of geometric detail: representation as a point, line, simplified polygon, or detailed polygon. Lastly, users can select the graphic symbols for use when displaying objects.

Moreover, once the view has been created, users may change the geometries used for an object class or individually change the geometry of a given object. For example, a user may want to highlight a building for use as a reference point on a map. This can be done by selecting the building and choosing to represent it as the detailed polygon attached to it, while all the other buildings would be represented with less detail by points.

Tool for Managing Recreational and Tourist Spaces

You're in downtown Québec and wondering where to find a restaurant specializing in international cuisine in the neighborhood. What do you do? Nothing could be easier with SIGERT (Intelligent Systems for Tourism based on Cartographic Generalization and Multiple Representation).

SIGERT, an information system designed for recreational and tourism purposes, enables Internet users to create custom geographic maps that highlight the various tourist attractions in a given area. In addition, the map can be consulted from a variety of platforms such as office computers, PDAs, and even cell phones.

Objects on the map can be presented at different semantic levels. For example, the user might want to display all restaurants or only those serving international cuisine. The Web interface was developed using the recent .Net technologies and the application is based on a datamart specific to the recreational/tourism field in GML (*Geography Markup Language*) format. The resultant maps are displayed in SVG (*Scalable Vector Graphics*) format on an Internet browser.

One of the characteristics of this application is that it exploits a multiagent system in order to solve problems related to overpopulation that can occur when displaying a map with excessively high object density. When that happens, the objects become agents that are aware of their environment and know how to act or, more specifically, how to generalize themselves. In the events of special conflicts, the agents must compete against one another for representation on the final map. In order to make the map readable, agents may have to disappear, be moved, or have their shape and size modified.

Applications such as this one for the general public allow us to predict that cartography still has the ability to dazzle us.



Example of a map produced by SIGERT

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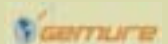
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Partners

Ministère des Ressources naturelles, de la Faune et des Parcs, Québec
 Natural Resources Canada — Centre for Topographic Information in Sherbrooke
 National Defence — Defence Research and Development Canada in Valcartier
 Intergraph Canada

Highly Qualified Personnel

15 students (BSc, MSc, and PhD)
 3 postdoctoral fellows
 4 research assistants



Taking Geomatics Beyond Our Shores

Marc Journault

In Quebec, the Saint Lawrence River, its estuary, the gulf, and northern waters give rise to a multitude of economic, social, and recreational/tourism activities in both freshwater and marine environments. Geomatics plays an essential role in the management, exploitation, and development of waterbodies and the seafloor.

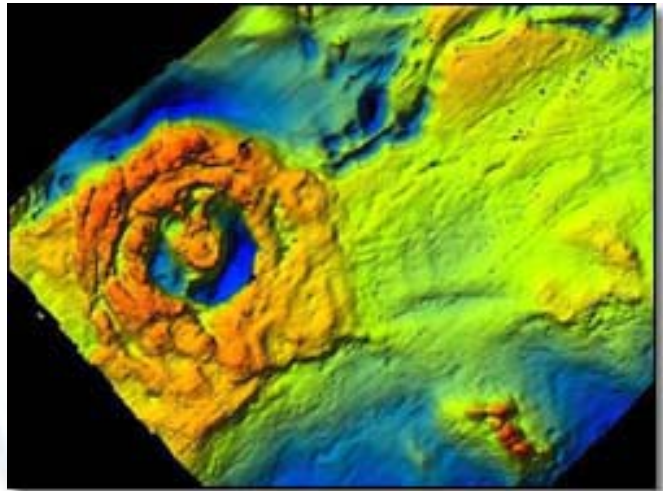
In order to fulfill its mandate, Fisheries and Oceans Canada (DFO) has developed extensive expertise in marine geomatics. Whether for marine services, fisheries management, fish habitat protection, or technology development, Fisheries and Oceans Canada (DFO) works with business, the academic sector, volunteer organizations, and the various levels of government.

Marine geomatics is a specialized sector of geomatics that makes use of vertical reference systems, hydroacoustic data-acquisition systems, dynamic positioning systems, and systems for managing and integrating large volumes of spatially referenced data.

Promising Partnerships for the Future of Geomatics

Due to its geographic location, the Rimouski area offers an exceptional natural framework that is favorable for the development of marine sciences. Through their combined efforts, private-sector firms, government agencies, and economic development agencies of the federal, provincial, and municipal governments established the Technopole Maritime du Québec (TMQ), the Centre Interdisciplinaire de Développement en Cartographie des Océans (CIDCO), and Innovation maritime (a technology-transfer center). Involved in fields of geomatics and marine technologies, these agencies actively and concretely participate in developing marine geomatics in the country. Government agencies

contributing to this expansion include: Institut Maurice-Lamontagne, CÉGEP de Rimouski, Institut Maritime du Québec, Université du Québec à Rimouski, and Institut des Sciences de la Mer.



Seafloor near Sept-Îles

Signing of the Canadian Geomatics Accord

DFO must exchange spatially referenced data on a daily basis with other public agencies and various private-sector organizations, in particular, businesses, associations, and nongovernmental organizations. In order to facilitate information exchange, DFO officially ratified the Canadian Geomatics Accord, which was an initiative of the Canadian Council on Geomatics (CCOG). In carrying out its geomatics projects, DFO holds to principles aimed at joint use of spatially referenced information systems and adheres to the approach advocated in the Canadian Geomatics Data Infrastructure (CGDI). This means that the data are shared and managed based on the recognized fields of expertise of each organization.

The paragraphs below provide an overview of how and where Fisheries and Oceans Canada uses geomatics and

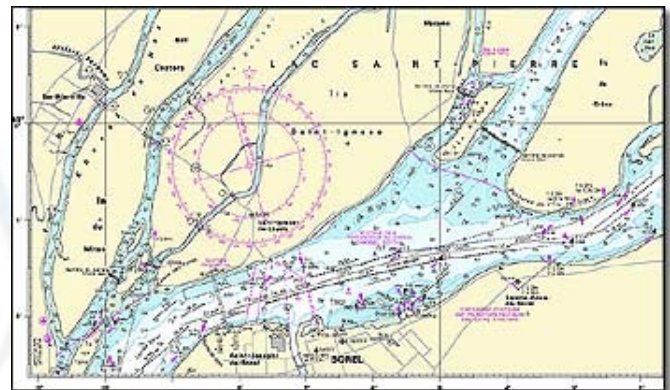
produces framework data, which should give the reader a clearer idea of the subject and marine geomatics.

Marine Mapping

The Canadian Hydrographic Service (CHS) is responsible for producing and updating of bathymetric data and for the production of nautical charts. For the marine community, these data are like what topographic maps are to land. Sixty-five marine maps provide coverage of Québec's territory from Montréal to Blanc-Sablon. CHS also produces electronic nautical charts in S-57 format, which is an International Hydrographic Organization standard. To acquire the data, CHS carries out detailed surveys of the seafloor with modern hydroacoustic systems and performs bathymetric surveys of the Saint Lawrence's navigable channel on a permanent, broad basis (official information on water levels and tides) available on the Internet and in tide tables. CHS manages a network of vertical control benchmarks accessible to all along waterways and operates a digital network of permanent water level gauges. With partners from the private sector and education community, DFO has developed and implemented a dynamic positioning system with very high vertical and horizontal positioning accuracy based on GPS technology (satellite global positioning system).

Marine Safety

The Canadian Coast Guard (CCG) is recognized across the country for its activities in the areas of buoyage, icebreaking, vessel traffic control, and search and rescue. In fulfilling its mandate, CCG manages a network of differential global positioning system (DGPS) reference stations accessible to all. The availability, reliability, and integrity of this network covering navigable waters is controlled and monitored. CCG also applies the provisions of the *Navigable Waters Protection Act* to prevent the construction of structures that would hinder vessel traffic. Consequently, plans for all structures contiguous to navigable waters must be submitted for approval. Taken as a whole, the submitted plans constitute an extremely valuable source of information in keeping cartographic databases current. Whether for cataloguing ice information, managing vessel traffic, maintaining navigation channels, or managing navigation lights, CCG had to develop and implement a set of interoperable systems of spatially referenced information. The Marinfo system provides access to valuable information for shipping, in particular, the navigable status of the Saint Lawrence Seaway.



Example of a marine map: detail of the Sorel area

Fish Habitat Protection

DFO is responsible for applying the provisions of legislation to preserve and protect fish habitats. With this end in view, it has developed a spatially referenced information system for the Integrated Coastal Zone Management of the Saint Lawrence and Northern Québec. The Fish Habitat Management Information System (FHMIS) provides an overview of coastal ecosystems and can be used to produce thematic maps. In the near future, the FHMIS Internet portal will provide access to comprehensive data about the physical and biological characteristics of aquatic habitats as well as the distribution of allocations of fisheries resources.

Acquisition and Dissemination of Knowledge in the Marine Sciences

Through monitoring, remote sensing, and physical and ecosystem modeling programs, DFO helps develop climate change indicators, study biodiversity, and assess the status of living resources throughout the estuary and the Gulf of St. Lawrence. The findings of this kind of scientific research are disseminated by the St. Lawrence Observatory (OSL) Internet portal. Its applications and display services provide real-time access to dynamic maps.

Fisheries and Aquaculture Management

The Canadian Shellfish Sanitation Program is jointly administered by DFO, Environment Canada, and the Canadian Food Inspection Agency (CFIA). In accomplishing this, the latter use a geomatics system that makes it possible to display and analyze spatial information about pollution sources, shellfish beds, and shellfish growing areas. DFO operates a major system for managing fishery activities that brings together a complete range of catch statistics, permits, and fishing vessels. A geographic position is associated with a significant number of data from the system, which could eventually use the information and make it available while maintaining confidentiality. DFO has the responsibility of coordinating the actions of a multitude of stakeholders in the records for applications for aquaculture permits. Site location is part of the information that must be managed and shared. In addition, geomatics techniques and a spatially referenced information system will be used.

Port Management of Small Vessels and Buildings

DFO owns 163 harbors, of which 71 are for recreational purposes and 92 for fishing, such as Harrington Harbour and Rivière-au-Renard. Management of most of these fishing harbors is in the hands of local harbor authorities, while the department handles management of land and infrastructure. For the purposes of its programs, DFO is also building owner. The data inventory used to manage all these properties derives from traditional information systems. Shifting these systems to geomatics would yield greater data consistency and shareability.

Concerted efforts by the private sector, the educational community, and governments will definitely help position geomatics in a new niche: marine activities.

Reference Sites

Nautical charts:

<http://www.cartes.gc.ca/chs/en/products/>

Tides and water levels:

<http://www.lau.chs-shc.dfo-mpo.gc.ca/english/Canada.shtml>

Differential global positioning system (GPS) corrections:

<http://www.ccg-gcc.gc.ca/dgps/>

Marine information:

<http://www.marinfo.gc.ca>

Saint Lawrence Observatory:

<http://www.osl.gc.ca>

Fishery statistics:

http://www.dfo-mpo.gc.ca/communic/statistics/main_e.htm

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NUMÉRIMAGE

From Image to Information...

Gino Desrosiers, Chantal Seuthé and Manon Carignan

That was the theme of the 11th congress of the Association Québécoise de Télédétection, held jointly with the 25th Canadian Symposium on Remote Sensing from October 14 to 17 at the University of Montréal.

In their opening remarks, co-chairs François Cavayas (University of Montréal) and Marc D'Iorio (Geological Survey of Canada) stated that, in the last 30 years, private-sector geomatics has made incredible progress in acquiring data and producing quality images. These two fields, which cover all the useable portions of the electromagnetic spectrum, provide a wealth of information about the atmospheric environment, oceans, landmasses, and the cryosphere. But what use is being made of these data in the fields of geoscience and engineering? Can remote-sensing data be better integrated into daily operations and play an enhanced role in land and resource management? More than 300 participants gathered together to discuss these major questions and to learn about new developments.

Dynamic Round Table

A round table held at the end of the first open-house day was undoubtedly one of the best opportunities to respond to current questions and attempt to account for the hindrances to democratization of remote sensing.

This forum generated interesting exchanges.

After more than 25 years of development of remote sensing in Canada and despite the high-level of performance of Earth observation instruments, remote-sensing images are still not used widely enough. One of the factors accounting for this situation is without a doubt that conventional methods,



Marc Laurendeau, journalist with Radio-Canada (far right), was happy to serve as moderator during the round table. The group of stakeholders was comprised of (from left to right): Bob Ryerson, Director General of the Canada Centre for Remote Sensing; Mark Dougherty, Director of Spatial Operations with the European Space Agency; Pascal Yacouvakis, radio and television meteorologist with Radio-Canada; Bruno Duchesne, President and Chief Executive Officer of the Center for the Development of Geomatics, and Pierre Vincent, Executive Vice President of Viasat GeoTechnologies.

such as aerial photography, remain firmly integrated in work processes. Moreover, there is no guarantee that the programs for receiving and distributing images will continue. While the cost of remote-sensing data calculated per square kilometre is not very high, significant investments are often required because the images are used for immense territories. Efforts in remote sensing have long been turned towards understanding phenomena to advance the science of Earth observation. Remote-sensing products and applications must now be made more accessible and their use democratized. It's not the data themselves that have a commercial value, but rather the information derived from them.

It takes time for an application to attain maturity. Remote sensing's 25-year history in Canada isn't long in the greater scheme of things, especially when the substantial investments in the area of applications is considered. Québec must therefore extend its commitment to developing this high technology. Operations involving territory inventory and monitoring would definitely benefit, over and above the

strategic value of Earth observation. The potential of remote-sensing images has been demonstrated. Moreover, Québec has developed successful applications such as the topographic mapping of the North with SPOT imagery, mapping of agricultural land use, and monitoring of forest interventions and disturbances carried out with Landsat.

A Session on the Future RADARSAT-2

RADARSAT-2 was showcased at the Canadian Symposium on Remote Sensing. Scheduled for launching in 2005 by the Canadian Space Agency (CSA), this satellite will have novel capacities compared to all other radar satellites and even with respect to RADARSAT-1, which is currently operational. Indeed, in addition to offering enhanced spatial resolution of up to 2.5 m, RADARSAT-2 will produce polarimetric images. Although increasing analysis complexity, quadruple polarization opens the door to many fields of application.

Seven of the 18 projects funded by CSA were presented for the first time. These projects, which are just getting underway, will look at the new possibilities offered by RADARSAT-2 using simulated airborne data and data from the European Envisat satellite.

Some of these projects are designed to enhance operational applications, such as detecting ships and icebergs, mapping flood zones, and calculating snow water equivalent values. Others will reexamine applications that didn't work with RADARSAT-1 and that might with RADARSAT-2, such as monitoring crops and mapping land use, vegetation, and surficial deposits. Two projects tackle new problems in the environmental field: disease risk and protected areas. Lastly, one project will explore the opportunities of polarimetry from a more theoretical perspective and may pave the way to major applications. The preliminary results from these projects are expected in fall 2004.

Ministère des Ressources Naturelles, de la Faune et des Parcs On Hand

In addition to being able to attend the many conferences open to them, participants had the opportunity to talk to representatives from industry as well as government departments and agencies who were presenting their services and new products.



The commercial exhibit, as always, attracted a great number of visitors.

The Ministère des Ressources Naturelles, de la Faune et de Parcs (MRNFP) took advantage of the event to present its exhibit entitled "La géomatique, un parcours vers la connaissance" (geomatics: a journey towards knowledge). In keeping with the tone of the conference, MRNFP put the spotlight on the Mosaïque du Québec (mosaic of Québec), an online information product about territory components based on satellite imagery. The more experienced participants were not left out because department specialists presented the many possibilities for integrating map data into image data.

The event had support from a number of quarters, including financial support from the Ministère du Développement Économique et Régional et de la Recherche and the sponsorship of the Ministère des Ressources Naturelles, de la Faune et des Parcs.



Maxime Bélanger (left), remote-sensing specialist with the Ministère des Ressources Naturelles, de la Faune et des Parcs, explains the Mosaïque du Québec to visitors.

With Distinction...

The Association Québécoise de Télédétection (AQT) took advantage of its eleventh conference to honor the work of its members with four awards.

Prix du gouvernement du Québec (Quebec government book prize)

This prize aims at encouraging the use of French at scientific events organized in Quebec. It is awarded for the best French-language poster presented during the association's conference.

The Prix du Gouvernement du Québec was awarded to **Yves Voirin**, with the Centre d'application et de recherche en télédétection (CARTEL) at the University of Sherbrooke, for his poster on *assessing a knowledge-based system for automatically identifying disturbed areas in Labrador*. Voirin received a check for \$250 as his award.

AQT Prize

This prize awarded for the best French-language poster presented by a student during the association's conference.

This year's winner was **Amani Massalabi**, with the Centre d'application et de recherche en télédétection (CARTEL) at the University of Sherbrooke for his poster on *detecting and using*

shaded areas on very high spatial resolution images of urban areas: application to Sherbrooke IKONOS images. Massalabi received a check for \$250 as his award.

Prix Industrie 2003 (industry prize)

This year, AQT wanted to highlight the dynamism of Québec's remote-sensing industry through a special award, in particular, the efforts of the private sector in developing Québec remote-sensing expertise and the industry's presence in international markets.

The 2003 award recognized the innovative strength of Viasat GeoTechnologies, whose Executive Vice President, **Pierre Vincent**, received a bronze by the Québec artist Rusdi Genest.

Honorary Mention

This award is given to a member of Québec's remote-sensing community in recognition of its contribution to the association's activities as well as to the advancement and maintenance of the field's dynamism in the province.

This year's recipient is **Christian Prévost**, with the Canada Centre for Remote Sensing. Prévost's interpretative qualities and remarkable contribution to the dissemination of information within the community of specialists deserve recognition. Prévost received a work by the Québec artist Guy Labbé, specifically, an oil painting created in 2003, entitled *Qui Saura où Je Suis Passé*.

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NUMÉRIMAGE

Canada-Quebec Agreement on the Development of RADARSAT Data

This article presents the results of a project carried out for the Canadian Space Agency's Earth Observation Application Development Program (EOADP) and the Canada-Quebec Agreement on the use of RADARSAT data. This agreement was initially signed in 1998 and renewed for three years in June 2002. It is co-managed by the Canadian Space Agency, the Ministère du Développement Économique et Régional et de la Recherche, and of the Ministère des Ressources Naturelles, de la Faune et des Parcs.

Remote Sensing... A Source of Information for Monitoring Indicators of Sustainable Forest Management

Chantal Seuthé

The concept of sustainable forest management has figured among priorities of the Québec government since the promulgation of the Forest Act in 1996. Monitoring sustainable forest management indicators (SFMI) is therefore an important activity for forest managers. Since there are no silvicultural intervention update programs for private forests, there are few tools for monitoring ecoforest indicators over time. Nevertheless, Landsat 7 satellite images have made it possible to monitor 9 out of 14 priority indicators over a 10-year period with quite acceptable accuracy. A real feather in the cap for remote sensing!

Sustainable Management: A Definite Value for Forest Management

The monitoring of sustainable forest management indicators aims at informing the public as fairly as possible about the state of Québec's forests, their management, and current forestry practices. It also strives to define policies that do not comply with the requirements of sustainable development. On privately-owned property, the Ministère des Ressources Naturelles, de la Faune et des Parcs (MRNFP) takes part in protecting and developing forests by transferring budgets to regional development agencies, one of whose mandates is to implement a system for monitoring SFMI.

Remote sensing stands out as an excellent option for fulfilling this mandate at acceptable cost. Indeed, it was in context that the firm TECSULT jointly developed a project with the Syndicat des Producteurs de Bois du Saguenay-Lac-Saint-Jean (SPBSLSJ). Satellite images, mainly Landsat images with a resolution of 15 m, were studied to determine if their content could be used to measure and monitor SFMI. Saguenay-Lac-Saint-Jean and Bas-Saint-Laurent were selected as pilot areas.

Information Delivered by Satellite Images

Fourteen indicators were identified as being priorities under a memorandum of understanding between MRNFP and four regional development agencies. Satellite images can provide relevant information for establishing 9 of these 14 indicators:

- Area and percentage of the various land categories.
- Area and percentage of softwood, mixed, and broadleaf ecosystems.
- Area and percentage of the development stages of softwood, mixed, and broadleaf ecosystems.

- Degree of forest ecosystem fragmentation and of connection between forest ecosystem components.
- Level of forest regeneration in cutover areas.
- Total area cutover.
- Proportion of wooded areas along watercourses.
- Area and proportion of wooded areas within sensitive areas.
- Area and proportion of wetlands.

Landsat TM5 and ETM7 images were used for the most part. The indicators were monitored over a period of about 10 years (1990-2001) at two-or three-year intervals. The Landsat 7 images proved to be especially appropriate for two reasons, starting with their low cost. In addition, they have been captured systematically and stored in archives going back to 1990, which provides for historical monitoring. Many of the selected indicators can be directly measured from the imagery's contents.

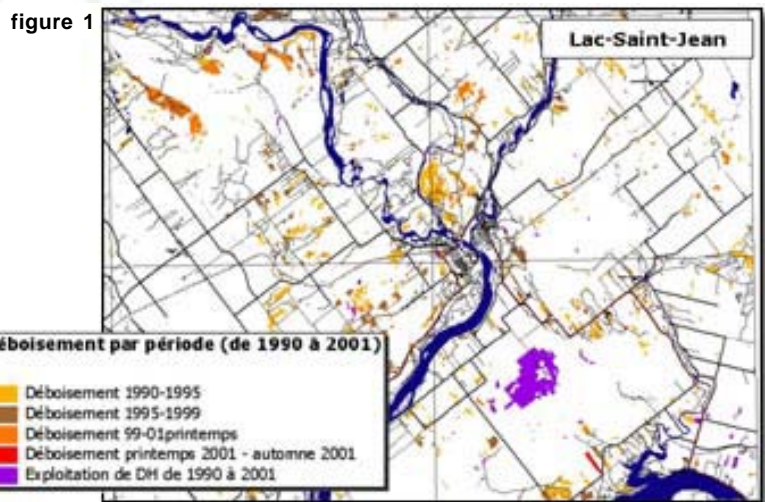
Others can be deduced by combining this information with other specific layers of information, such as the ecoforestry map. Experiments have been carried out with other types of satellite images in order to determine their capacity to furnish certain indicators: a very high-resolution image (IKONOS, 1 to 4 m) to measure the width of wooded areas along watercourses, a hyperspectral image (Hyperion, 30 m), and a radar image (RADARSAT, 30 m) to characterize wetlands.

An Automated Extraction Method

A monitoring and change-detection computer program was developed to automate most operations. This method uses multirate Landsat and the 1990 ecoforestry map. The program was designed with five modules:

- 1 Cutover detection
- 2 Regeneration characterization
- 3 Updating the ecoforestry map
- 4 Evolution of forest types
- 5 Development stages

Each of these modules produces different layers of information used to measure the indicators. For example, in the first module, cutover areas are automatically extracted from Landsat spectral bands (see figure 1). Moreover, the updating of the ecoforestry map (third module) for the major categories of land is carried out using the results from the first two modules.



Example of output from the deforestation-detection module

The layers can also be integrated into a geographic information system (GIS) in order to produce maps, present information as tables, graphics, or diagrams (see figure below), or provide additional information by combining different layers.

Satisfactory Results

The method used is mainly based on automatically detecting deforestation over time and on monitoring regeneration in comparison to the initial state provided by the ecoforestry map. The best results appear to be provided by keeping the interval between images to three years or less. Otherwise, the cutover areas lose their distinctive spectral characteristics. Moreover, the method used didn't take into account canopy shading and relief, which, given Landsat's medium resolution, resulted in the deforestation being slightly underestimated. In addition, the method seems to overestimate mixed canopy. Lastly, changes in land use (such as deforestation for agricultural purposes) are difficult to detect without performing a field survey.

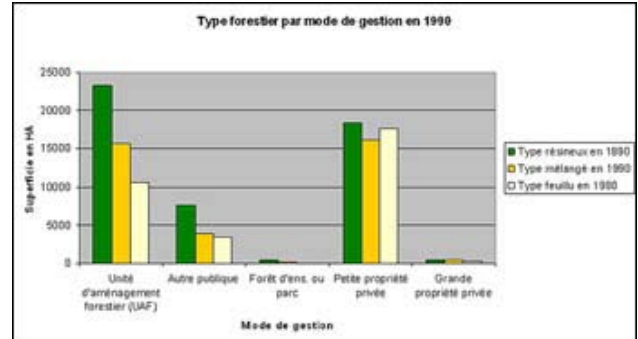
All in all, Landsat 7 images have been deemed to adequately accurate for monitoring SFMIs. Because of the archives, these images are the only data source that can be used to reconstitute the temporal sequences in southern Québec.

Out of the other images studied during this project, the very high-resolution IKONOS image is the most promising for the future compared to Landsat. The cost of these images is still too high to be a realistic option.

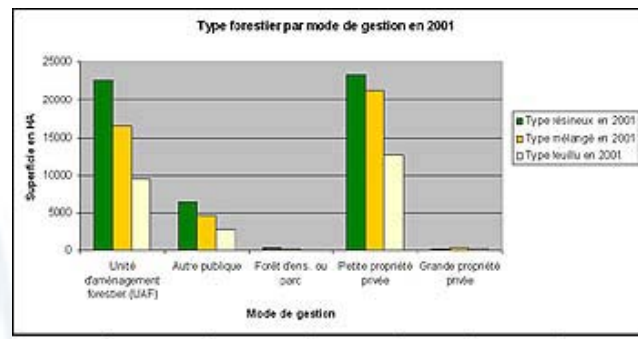
From the User Standpoint

The computer hardware provided during this project is now used by the Syndicat des Producteurs de Bois du Saguenay-Lac-Saint-Jean (SPBSLSJ) for different applications. In order to better organize silvicultural work over the territory, the layer for updating the total harvesting and stands undergoing regeneration is used to reconstitute a history of intervention. This close examination of the information in satellite images enables SPBSLSJ to validate outcomes, which is essential for the work that follows.

The project covered only a small part of the area served by



Classes	Unité d'aménagement forestier (UAF)	Autre publique	Forêt d'int. ou parc	Petite propriété privée	Grande propriété privée	TOTAL
Type résineux en 1990	22221	7211	445	18224	311	50982
Type mixte en 1990	15524	2242	111	11111	411	29323
Type feuillu en 1990	12221	2222	33	11111	211	25988
Autre en 1990	11471	2122	154	72111	53	116482
TOTAL	51927	19422	613	12424	1027	122913



Classes	Unité d'aménagement forestier (UAF)	Autre publique	Forêt d'int. ou parc	Petite propriété privée	Grande propriété privée	TOTAL
Type résineux en 2001	22112	6122	22	22211	211	51128
Type mixte en 2001	15524	4211	111	21222	242	43994
Type feuillu en 2001	12221	2222	33	11111	111	25988
Autre en 2001	11111	25122	222	61122	7221	95988
TOTAL	61127	19422	613	12424	1027	122913

Diagram illustrating the area of forest types in 1990 and 2001 by management approach (ha)

SPBSLSJ. The agency would like to extend the model that was developed to cover the entire territory and to better assess its costs. This major intervention among privately owned forests in Saguenay-Lac-Saint-Jean can now count on a state-of-the-art management tool.

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