

NEW EARTH OBSERVATION MAPPING & MONITORING INITIATIVES IN THE CANADIAN ARCTIC

AUBÉ, Guy

Earth Observation Applications and Utilizations, Canadian Space Agency, 6767 Route de l'Aéroport, Saint-Hubert, Québec, J3Y 3Y9, Canada. Email: guy.aube@asc-csa.gc.ca.

Keywords: Mapping, Earth Observation, Canadian Arctic, Canadian Space Agency

Abstract

The North is an essential part of Canada's identity and an area of growing importance internationally. Today we see an ever-increasing number of demands on the Arctic coastal zones, ocean and their resources. While traditional fishing and transportation continue to be of prime importance, they are now joined by other uses or issues, such as oil and gas exploration, world-class mineral mining, aquaculture, eco-tourism, search and rescue operations, critical infrastructures management, etc. The North is the front line of climate change impacts and adaptation. It's also the place where it's critical to share Northerners' experiences and knowledge with our circumpolar neighbors. With over \$20 billion in annual economic activity, Canada's coastal zones and their resources are significant contributors to the overall Canadian economy. Our need for tools for prediction, mapping and monitoring short and long-term environmental changes in the Canadian Arctic has never been greater. Improved, up-to-date environmental data is needed to plan for environmentally and economically sound growth and to develop more sustainable practices to protect our Arctic waters and lands. Space-based Earth Observation (EO), such as Radarsat-1, Radarsat-2 and Envisat, provides us with unique and essential information to understand how our coastal environments work, allowing, for instance, more accurate mapping, environmental monitoring, safety operations, emergency responses, forecasts and predictions, etc. Canada is among the world leaders in EO applications and utilizations. Over the last decade, the Canadian Space Agency (CSA) has been involved in the support of scientific initiatives, demonstration projects and operational activities related to northern mapping and monitoring. Through the Government Related Initiatives Program (GRIP) and the Earth Observation Application Development Program (EOADP), the CSA and its public and private sector partners have fostered the development of EO information and services to map, monitor, understand and manage the Canadian Arctic. The CSA understands the tremendous role and value that space-based EO systems and information have regarding new cartography and monitoring activities and its environmental and socio-economic impacts and benefits. The proposed presentation will provide a brief description of EO initiatives mapping and monitoring initiatives affecting Canada's North, focusing on existing EO programs, coordinated activities and assets.

Our Cultural Challenges In The Circumpolar World

The North is an essential part of Canada's identity and an area of growing importance internationally. Today we see an ever-increasing number of demands on the Arctic coastal zones, ocean and their resources. While traditional fishing and transportation continue to be of prime importance, they are now joined by other uses or issues, such as oil and gas exploration, world-class mineral mining, aquaculture, eco-tourism, search and rescue operations, critical infrastructures management, etc. The North is the front line of climate change impacts and adaptation. It's also the place where it's critical to share Northerners' experiences and knowledge with our circumpolar neighbors.

Our Economy: The High Cost of Uncertainty

With over \$20 billion in annual economic activity, Canada's coastal zones and their resources are significant contributors to the overall Canadian economy. Our need for tools to predict and monitor short and long-term environmental changes in the Canadian Arctic has never been greater.

How Can Space-Based EO Help?

Improved, up-to-date environmental data is needed to plan for environmentally and economically sound growth and to develop more sustainable practices to protect our Arctic waters and lands. Space-based Earth Observation (EO), such as Radarsat-1, Radarsat-2 and Envisat, provides us with unique and essential information to understand how our coastal environments work, allowing, for instance, more accurate mapping, environmental monitoring, safety operations, emergency responses, forecasts and predictions, etc.

What Are The Socio-Economic Benefits?

Science and technology is crucial to building a strong economy that provides higher living standards. As technologies mature, they become more about benefits. Developing information, products and services on our coastal zones and oceans based on EO helps the Government of Canada (GoC) to increase socio-economic benefits:

- Reducing loss of life and property from disasters;
- Understanding environmental factors affecting health;
- Improving management of energy resources;
- Understanding and adapting to climate variability;
- Improving weather forecasting and warning;
- Improving the management of coastal and marine ecosystems;
- Supporting sustainable aquaculture;
- Understanding, monitoring and conserving biodiversity.

Our Culture: An History Of Space-Based EO Applications

Canada is among the world leaders in EO applications and utilizations. Since 2000, the Canadian Space Agency (CSA) EO Applications and Utilization Division (EOAU) have managed over 200 projects and distributed over \$45M in funding to Canadian OGDs, industry and universities.

Our Programs

Government Related Initiatives Program (GRIP)

The GRIP focuses on developing government use of space-based land, ocean, and atmospheric observation systems and services. It supports the development and demonstration of new applications that increase the benefits and effectiveness of GoC services for Canadians through use of EO information sources and raises awareness within the GoC of the uses and benefits of Canadian supported EO missions.

Partners	GRIP projects related to northern & coastal mapping
DFO	Building satellite data into operational oceanography
DFO	Building ocean color into DFO operations
DFO	RADARSAT-2 full polarization retrievals of ocean waves and winds
DFO	Applications of MERIS FR imagery in Canada
DFO	Estimating primary production in the Canadian Arctic using ocean color imagery
DFO	Development and application of EO tools for delineating frontal regions in Canadian waters
DFO	Validation of sea ice signatures using EO

DND	Spaceborne Ocean Intelligence Network (SOIN)
DND	Support to maritime defence and security operations
DND	Impacts of the marine environment on ship detection
DND	Data fusion within POLAR Epsilon
EC	Integrated Satellite Tracking of Pollution (ISTOP)

Earth Observation Application Development Program (EOADP)

The EOADP aims to promote the development of applications within the industry that will maximize the utilization of EO satellite data generated by CSA-supported missions. It strength partnerships with Canadian industry well suited to capitalize on space-based EO technologies to develop innovative products and services.

Partners	EOADP projects related to northern & coastal mapping
Hatfield Group	Radarsat-2 aquaculture mapping and coastal management
Enfotec	IceVu / IceNav - Virtual Marine Radar Integration Pilot Project
VPI	Marine ENvironmental moniTORing of Ocean Winds (MENTOR)
C-CORE	Iceberg and ship detection
Noetix	Discriminating open water from sea ice with C-band SAR
MDA	Multi-Polarimetric SAR Product for operational sea ice monitoring

Our Coordination Activities

In order to strength Canada's operational coastal and ocean observing activities, CSA has invested energy in strategic coordination committees to better coordinate and plan for the optimal use of resources and information and knowledge sharing.

CEOMS

The Coordinated Exploitation of EO for Marine Security (CEOMS) provides an exhaustive understanding of EO needs and requirements for operational users among the GoC Marine Surveillance and Security Community.

EOMSCC

The Earth Observation Marine Surveillance Coordination Committee (EOMSCC) coordinates and promotes integrated use of space EO for the GoC marine safety, security and environmental mandates. It ensure coordination of existing and future resources and equal sharing among all marine stakeholders, facilitate the development of an integrated and cost-efficient use of EO resources and enable integration of operational ocean and coastline surveillance; promote the benefits of the GoC integrated use of Space borne EO for marine surveillance to the Canadian policy makers, public, strategic organizations and working groups; support GoC priorities linked with sovereignty, surveillance, security and intelligence.

IOCCG

The International Ocean Colour Coordination Group (IOCCG) promotes strong international co-operation and co-ordination in the distribution, calibration, validation and utilization of ocean-colour data from various ocean-colour sensors. The overall objective is to encourage long-term continuity of satellite ocean-colour data sets.

Our Integrated Initiatives

SAFARI

CSA supports the Societal Applications in Fisheries & Aquaculture using Remote-sensing (SAFARI) initiative, whose aim is to accelerate the assimilation of satellite EO data into fisheries research and ecosystem-based management on a world scale, by facilitating the application of rapidly evolving EO technologies to fisheries management issues.

MORSE

Remote sensing satellites can provide a cost effective means of obtaining EO information in the vast, barren and often inaccessible Arctic areas and their coastal zones. To this end, CSA and ESA have initiated an interagency activity to develop and demonstrate the use of EO data for monitoring coastlines and coastal processes in the Arctic. The joint MORSE will foster the assessment, development, and exploitation of the broad spectrum of capabilities offered by existing CSA, ESA and ESA third party satellite missions. MORSE will: open a dialogue with End-Users to understand their needs and requirements; demonstrate how space based measurements can contribute to and support Arctic coastal issues and activities through new and innovative EO applications; provide institutions and companies access to new EO products and services; foster the development of Canadian and European EO expertise that is directly linked to and in support of climate change, environmental security, economic development, sovereignty, and the people in the Arctic.

Our Assets

RADARSAT-1 is a sophisticated EO satellite developed by Canada to monitor environmental changes and the planet's natural resources. It provides Canada and the world with an operational radar satellite system capable of timely delivery of large amounts of data in all weather and through cloud cover, smoke and haze.

RADARSAT-2 is Canada's next-generation commercial radar satellite and offers powerful technical advancements that will enhance marine surveillance, ice monitoring, disaster management, environmental monitoring, resource management and mapping in Canada and around the world.

The ***RADARSAT Constellation*** is the evolution of the RADARSAT Program with the objective of ensuring C-band data continuity, improved operational use and improved system reliability over the next decade. The baseline mission includes three satellites, but the constellation is designed to be scalable to six satellites.

Data collected by R1 is transmitted directly to a Data Reception Facility. The receiving stations provide: complete and reliable real-time coverage around the world; consistency in format for high-quality products; timely delivery of the requested data. The R1 network now comprises 33 Data Reception Facilities. R2 ground segment systems are housed in CSA facilities in Longueuil, Quebec, and Saskatoon, Saskatchewan, in CCRS facilities in Gatineau, Quebec, and Prince Albert, Saskatchewan, and MDA headquarters in Richmond, British Columbia. This extensive network also includes reception, archiving, and processing facilities in facilities all over the world.

Through the Co-operation Agreement between the Government of Canada and ESA, Canada chose to participate in the **ENVISAT** environmental satellite program. ENVISAT will complement R1 and assure data continuity between R1 and R2.

References

Canadian Group on Earth Observations - Socio-economic benefits areas, 2008
Canadian Space Agency Strategy, 2007

Indian and Northern Affairs Canada - The North, 2008

Morse Concept Paper, 2008

National Security Policy, 2004

Oceans Action Plan, 2007

Plan to identify and defend northern resources, 2008

Speech from the Throne, 2007

Science and Technology Strategy: Mobilizing S&T to Canada's Advantage, 2007