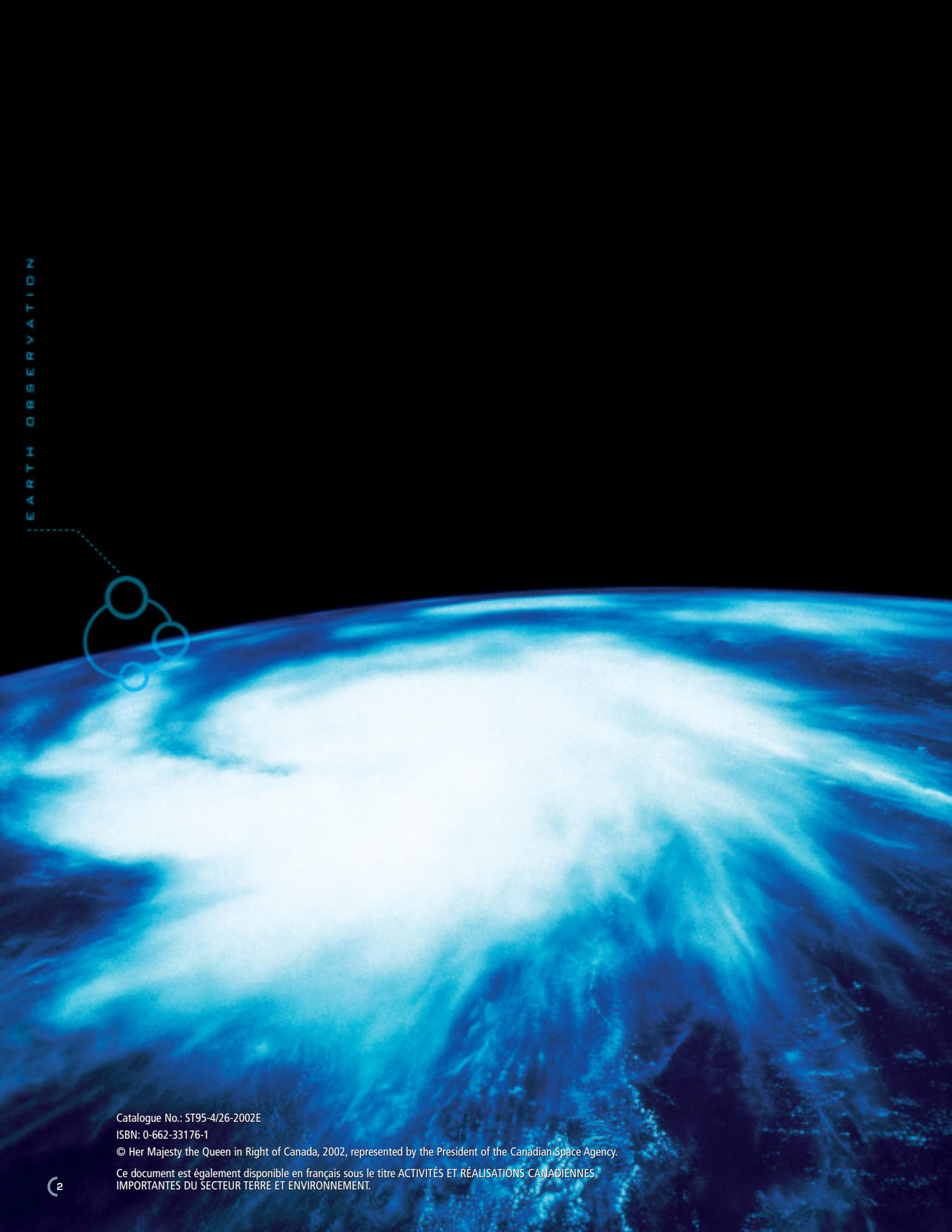
Canadian Space Agency | Agence spatiale canadienne

CSA ASC

SIGNIFICANT CANADIAN EVENTS AND ACHIEVEMENTS

IN THE EARTH AND ENVIRONMENT FIELD

Canada



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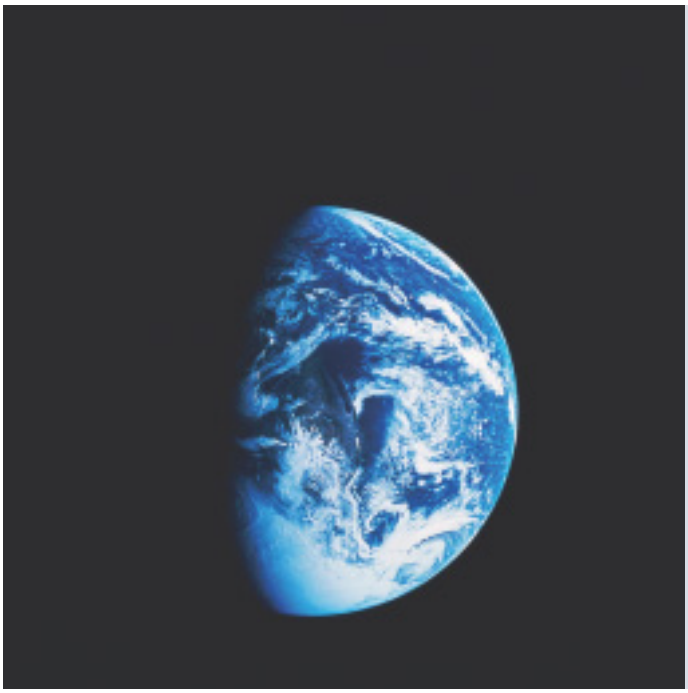
1.0 INTRODUCTION

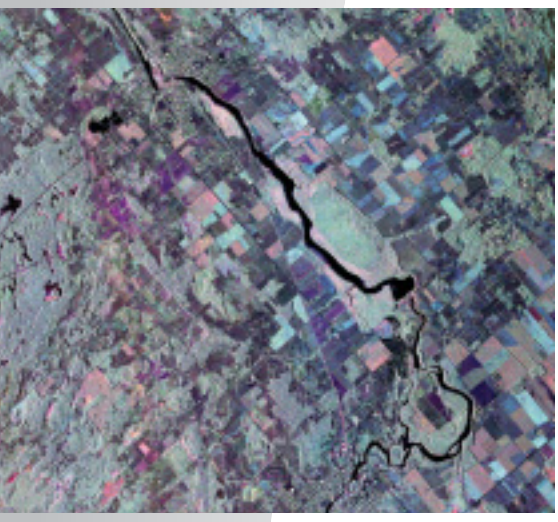
The year 2002 marks the thirtieth anniversary of the creation of the Canada Centre for Remote Sensing (CCRS). In the same year the United States launched ERTS-1, later to be renamed Landsat-1, the first remote sensing satellite. Under the tutelage of the Canadian Advisory Committee for Remote Sensing, representing all key stakeholders from both federal and provincial agencies and the University community, the CCRS and later the Canadian Space Agency (CSA) led the way in developing a dynamic, large-scale program geared to making Earth observation data and information an operational tool for resource and environmental managers in Canada.

Launched seven years ago, RADARSAT-1 is still the only commercial Synthetic Aperture Radar (SAR) satellite in operation. Canadian and international scientists along with commercial users, in all fields and applications, from agriculture to ice detection to mineral exploration, have benefited greatly from the timely and reliable availability of its data. RADARSAT-2, which is set to launch in March 2004, will further increase Canada's ability to provide precise imaging to meet the evolving needs of users such as relief agencies and disaster management organizations.

The Canadian Earth observation community involves a broad spectrum of active organizations, including those within the federal and provincial governments, universities, and industry. At the federal level these departments, all of whom have made major contributions to this report are — in addition to CSA — Natural Resources Canada's CCRS and Pacific Forest Centre, Environment Canada's Meteorological Service of Canada, and the Department of Fisheries and Oceans. We would like to express our gratitude to all the contributing organizations for their valuable input and their dedication, without which this report could not have been so comprehensive. To learn more, please consult their websites; the links can be found in section 4.



2.0 MAJOR MILESTONES IN 2002



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Canada's RADARSAT-1, the world's first operational Synthetic Aperture Radar Earth Observation (EO) satellite, was launched in 1995 and continues to provide timely and reliable data to a growing cadre of environmental and resource managers worldwide.

The RADARSAT-2 mission's Critical Design Review (CDR) was successfully completed in May 2002, thus providing a high level of confidence that the mission, scheduled for launch in March 2004, will meet its expectations.

Manufacturing, integration and verification of Canada's SCISAT-1 satellite and its scientific instruments were completed in the summer of 2002. This small satellite with its associated Atmospheric Chemistry Experiment instrumentation (ACE) will be launched in spring 2003.

The CCRS's Ground Segment Infrastructure has been upgraded and is ready to receive, process and archive ENVISAT ASAR data when the satellite becomes operational.

The Canadian Government recently announced details of $500 million worth of initiatives that will help reduce Canada's greenhouse gas emissions. Initiatives target key areas including transportation, energy, technology, industry, commercial and residential buildings, forestry and agriculture.

The Quebec Government launched OURANOS, a consortium on climatology and adaptation to climate change, involving over 250 persons in multidisciplinary research teams.

The Canadian Forest Service (CFS), with support from the Canadian Space Agency, initiated partnerships with provinces and territories for the production of a 2000 land cover Map of the forested areas of Canada as part of the Earth Observation for Sustainable Development of Forests initiative (EOSD).

The Canadian Forestry Service and the Canada Centre for Remote Sensing of Natural Resources Canada (NRCan) have completed a Land Cover map of Canada for 1998. This product takes advantage of the improved capabilities of the SPOT 4/VEGETATION sensor.

The International Charter on Space and Major Disasters launched, in January 2002, an innovative website, hosted by the Canadian Space Agency, to facilitate the work of rescue teams dealing with the worst disasters.

Three CEOS meetings took place in Canada this year: the 1st meeting of the Atmospheric Chemistry Subgroup of the CEOS Working Group on Calibration and Validation (WGCV), the 19th meeting of the full WGCV and the annual meeting of the CEOS Working Group on Training and Education (WGEdu), all under the auspices of the Canada Centre for Remote Sensing.

The CCRS also took the chair of the CEOS Working Group on Information Systems and Services (WGISS) in November 2001 for a two-year term.

The 22nd International Geoscience and Remote Sensing Symposium (IGARSS) and the 24th Canadian Symposium on Remote Sensing (CSRS) were held in Toronto.

Representatives of the Canadian Space and EO communities played key roles in the organization and leadership of both symposia.

During the World Summit on Sustainable Development in Johannesburg, Canada's Prime Minister, the Right Honourable Jean Chrétien, announced that the Canadian Parliament will be asked to vote before the end of the year on the ratification of the Kyoto Accord. At the Summit, the Prime Minister also unveiled the RADARSAT-1 Mosaic of Africa, which was presented to the Mayor of Durban during an event supporting the Sustainable Cities Initiative.

3.0 SIGNIFICANT CANADIAN EVENTS AND ACHIEVEMENTS IN THE EARTH AND ENVIRONMENT FIELD

3.1 SPACE SEGMENT

3.1.1. RADARSAT PROGRAM

3.1.1.1. RADARSAT-1

Overview

RADARSAT-1 was developed by Canada to monitor environmental change and the planet's natural resources; it is a sophisticated Earth observation satellite equipped with a versatile Synthetic Aperture Radar (SAR) instrument. It was launched in 1995 and became operational in February 1996, providing Canada and the world with an operational radar satellite system for the timely delivery of large amounts of data. It also provides useful information to both commercial and scientific users in the fields of agriculture, cartography, hydrology, forestry, oceanography, ice studies and coastal monitoring.

As the world's first fully commercial and civilian SAR Earth observation satellite, RADARSAT-1 is an important and reliable source of environmental and resource information; it facilitates the mapping and planning of land use and supports the monitoring of disasters such as oil spills, floods and earthquakes. For instance, RADARSAT-1 is providing the first routine surveillance of the entire Arctic region, offering daily coverage regardless of weather conditions. This information is useful to shipping companies in North America, Europe and Asia, and to government agencies with ice reconnaissance and mapping mandates. SAR is also a valuable tool for mapping the Earth's structural features such as faults, folds and lineaments. These features provide clues to the distribution of ground water, mineral deposits, and oil and gas in the Earth's crust.

2002 Activities and Accomplishments

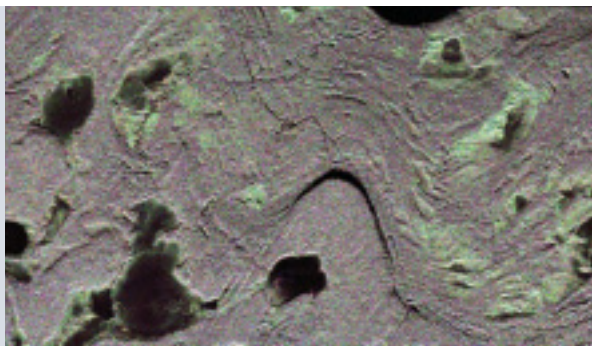
Fully two years beyond its five-year design lifetime and in its sixth year of operation, Canada's RADARSAT-1 satellite continues to perform on schedule, delivering unique, high-quality SAR data products to commercial, operational and scientific clients worldwide.

Last year, the Province of Newfoundland and Labrador became a strategic partner in the RADARSAT-1 program when it signed a data agreement with CSA, thereby completing the series of Memoranda of Understanding with all Canadian provinces for the purchase of radar imagery from the satellite. This past fiscal year also saw NASA and NOAA extend their agreement with CSA for the use of RADARSAT-1 data, for example by the US National Ice Center, which works closely with the Canadian Ice Service. Another notable accomplishment was the successful completion of RADARSAT-1's stereo coverage of the Earth's entire land surface, which makes the RADARSAT-1 archive the world's largest database for radargrammetric data information.

A key achievement of the RADARSAT-1 Operations Planning group was assuming responsibility for the Canadian Government Order Desk (CGOD) in Saint-Hubert, Quebec on June 25, 2001. By accessing a CSA FTP site, Canadian government users can now order RADARSAT-1 images more efficiently, as well as more easily select data products and obtain information on the RADARSAT-1 system.

The upgrade of the RADARSAT-1 Canadian Data and Processing Facility (CDPF) was completed this year.

Milestones completed in 2001 included the incorporation of a physical model for the Doppler Centroid Estimator, as well as the Automatic Gain Control Saturation Correction algorithm, which will improve visual quality and reduce radiometric variations within both single beam and ScanSAR



CV-580 C/X-SAR image acquired for geologic mapping over the Anticosti Island. Multi-polarized data provides information on the distribution and orientation of lineaments and increases the potential of SAR systems for geological and structural mapping. © CCRS

images. Particularly noteworthy was the delivery and acceptance by RADARSAT International (RSI) of a new MacDonald, Dettwiler & Associates Direct Archive System (DAS) and a Product Generation System (PGS), which operates the RADARSAT-1 SAR processing module. The DAS/PGS combination will function as a backup to the existing CDPF when fully integrated into the RADARSAT-1 ground segment.

In 2001, the Thailand and Brazil ground stations achieved product certification, expanding the global coverage capabilities of the RADARSAT-1 Program and boosting the total number of RADARSAT-1 ground stations to eighteen. The year also marked the signing of a second station agreement in South America. The certification of the Argentina ground station is underway.

For the first time, CSA's Satellite Operations directorate and RSI hosted the RADARSAT Network Stations' Meeting at CSA headquarters in Saint-Hubert, Quebec. Representatives from almost all of the eighteen RADARSAT-1 ground stations – which together provide real-time coverage of three quarters of the world's landmass – participated in the three-day meeting in October 2001.

3.1.1.2. RADARSAT-2

Incorporating state-of-the-art technology, RADARSAT-2 will provide the most advanced commercially available radar imagery in the world, meeting the emerging needs of the global EO market. It will offer all of the imaging modes and products now available on RADARSAT-1, as well as enhanced imaging capabilities such as three-metre resolution, full

polarization and dual-side imaging. RADARSAT-2, is the product of a unique public-private partnership between the Canadian Space Agency and MacDonald, Dettwiler and Associates Ltd. (MDA).

Space Segment

Over the past several years, the RADARSAT-2 sub-contractors, Alenia Aerospazio (Italy), EMS Technologies (Quebec) and AEC-Able (California) have been designing and preparing for the manufacturing and construction of the spacecraft bus, payload and Extendible Support Structure respectively. The results of their efforts were presented at each of their Critical Design Reviews (CDRs) in late 2001 and early 2002.

Additionally, initial tests were performed on an Engineering Model (EM) column of the SAR antenna. It was demonstrated that the EM column can generate several beam shapes and that there is good agreement between the predicted and measured patterns. These results indicate that we can expect the RADARSAT-2 SAR antenna to be fully compliant with the mission requirements and that the satellite will be able to provide high quality data.

Ground Segment

Significant progress was also achieved on the Ground Segment, which is being designed and built by MDA. The Ground Segment CDR was held in early May 2002. RADARSAT-2 will use part of the existing RADARSAT-1 ground infrastructure, although changes will be made to some elements to meet new requirements and support simultaneous operation of RADARSAT-1 and -2.

Mission Status

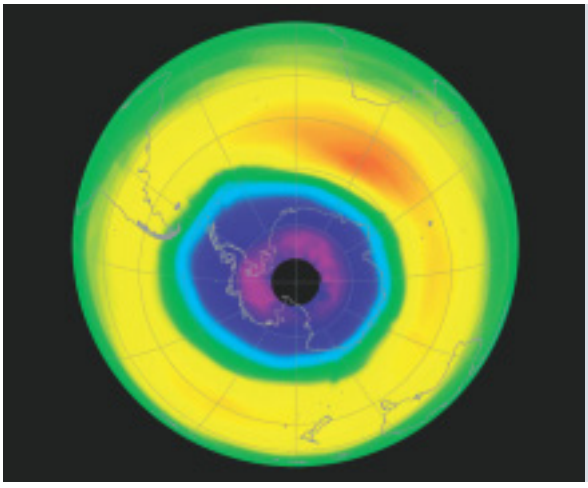
The achievement of the various sub-systems CDRs led to the Mission Critical Design Review (MCDR) in May 2002. During the MCDR, the entire system design for RADARSAT-2, developed by the industry team led by the prime contractor, MacDonald, Dettwiler & Associates, was presented in order to ensure that all technical issues were appropriately addressed. The MCDR established that the final design of the space and ground systems and their subsystems did meet mission specifications. These include performance and operational requirements, assessments of spacecraft and systems assembly completion, integration and testing plans and procedures. The MCDR also verified that the design had reached the requisite maturity level to move from the design phase to the implementation phase, where hardware manufacturing and software development can be completed.

Successful completion of the MCDR provided a high level of confidence that the RADARSAT-2 mission will meet its expectations. The main spacecraft elements will be delivered to the Canadian Space Agency's ISO 9002 certified David Florida Laboratory in Ottawa in early 2003 for assembly, integration and testing. The RADARSAT-2 launch is set for March 2004.

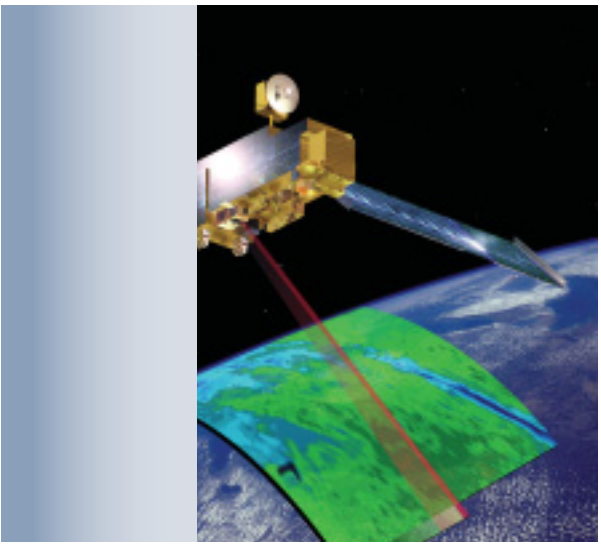
More information on the RADARSAT-2 Program can be found at: <www.radarsat2.info>.

3.1.2. SPACE SCIENCE PROGRAM

Space science activities in Canada cover a wide range of interests, from studies of the universe, the solar system, the solar-terrestrial relations and Earth's atmosphere, to the physical and biological processes that occur in space. These activities are carried out through strong partnerships with the Canadian scientific community, industry, and government laboratories, as well as through cooperative programs with international partners. These partnerships provide support to the researchers and scientists in academia and government laboratories. They also provide opportunities for graduate students, in both science and engineering, to pursue studies in a wide range of space-related areas. Many of the projects are international in scope, exposing both the seasoned scientist and graduate students to a unique research environment. Collaboration in planning space research activities with the research community is coordinated through an advisory committee structure.



ERS-2 GOME 2000 (© ESA)



3.1.2.1. MOPITT ON NASA'S TERRA

Canada's Measurements Of Pollution In The Troposphere (MOPITT) instrument is flying aboard NASA's Earth Observation System (EOS) Terra spacecraft, measuring the global distributions of carbon monoxide (CO) and methane (CH_4) in the troposphere. MOPITT is Canada's first major instrument to measure pollution of the earth's atmosphere from space. It is also the Canadian Space Agency's biggest contribution to the NASA Earth Observation System.

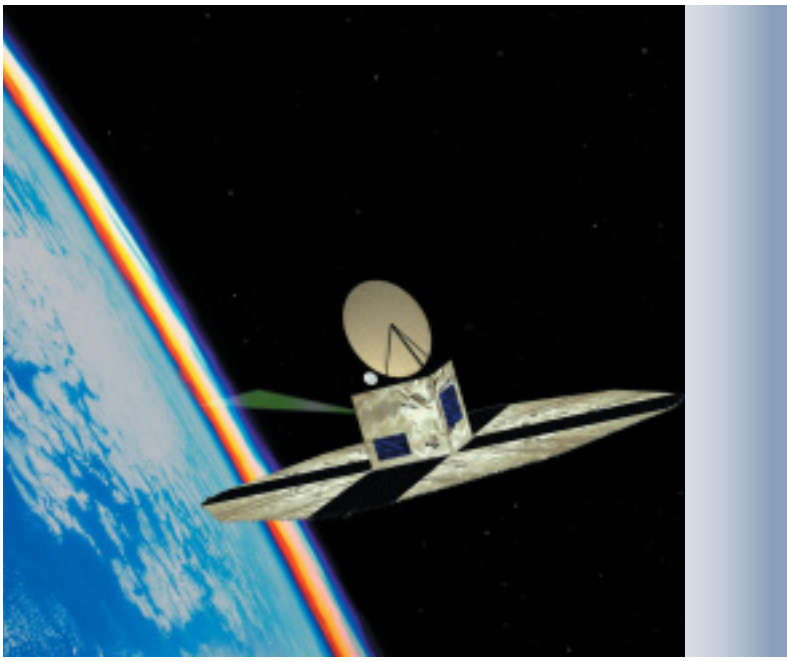
Over two years' worth of scientific data has been gathered, allowing CO monitoring on a global basis for an extended period of time. The data clearly shows large-scale transport of pollutants from continent to continent and strong seasonal and hemispherical variations in the source strengths. In 2002 the MOPITT Program completed a significant effort to validate the CO data products that has resulted in new science processing algorithms. All data collected to date has now been re-processed with the new algorithms and is available to the general scientific community from the Langley Data Acquisition and Archiving Center (DAAC).

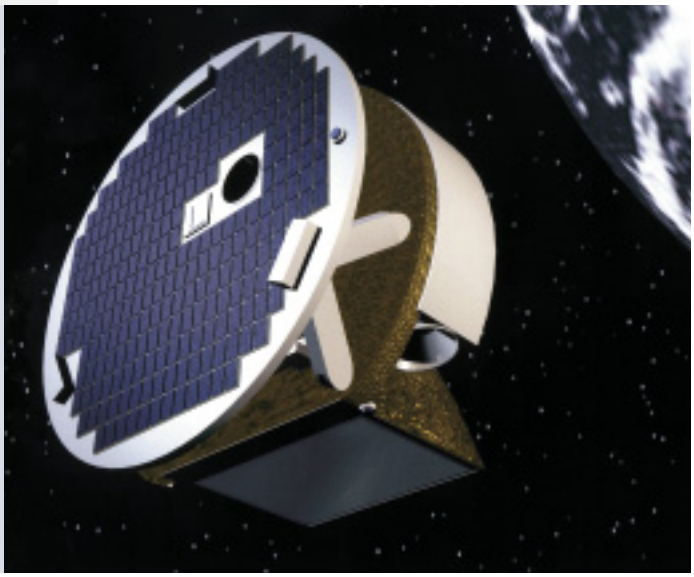
3.1.2.2. OSIRIS ON SWEDEN'S ODIN

Odin is a Swedish-led international satellite mission involving Canada, Finland and France that is addressing a number of important issues in astronomy and atmospheric sciences. The two instruments designed to achieve the scientific goals of the mission are the Canadian Optical Spectrograph and Infrared Imager System (OSIRIS) and the Swedish Sub-Millimetre Radiometer (SMR). The Canadian Space Agency is contributing the OSIRIS instrument, which will provide scientists with detailed data relating to ozone depletion, especially with respect to the situation at high latitudes, including Canada.

OSIRIS is collecting a unique set of data and producing maps of ozone concentrations every 1.5 km of altitude in the stratosphere and the mesosphere. These altitude maps are produced daily, providing greater and more detailed data than previously possible. Work is in progress to confirm the new maps through detailed comparison with data collected by other ground- or space-based sensors.

This scientific venture will have a major impact on the atmospheric science community in Canada, allowing it to develop the capacity to play an even greater role in future projects dealing with the scientific, environmental, economic and social aspects of the atmospheric ozone problem.





3.1.2.3. SCISAT-1 / ATMOSPHERIC CHEMISTRY EXPERIMENT — ACE

SCISAT's Atmospheric Chemistry Experiment (ACE) is a Canadian small satellite mission that will measure and help understand the chemical and dynamical processes that control the distribution of ozone in the stratosphere, especially at high latitudes. A comprehensive set of simultaneous measurements of trace gases, thin clouds, aerosols and temperature will be made by solar occultation from a high-inclination (74°), circular low earth orbit (650 km). The ACE instruments are a Fourier transform infrared spectrometer, a UV/visible/near IR spectrograph and a two-channel solar imager, all working in solar occultation mode. Data analysis will be performed by scientists at Canadian universities and the Meteorological Service of Canada as well as by scientists at NASA and in France and Belgium.

Manufacturing, integration and verification of the satellite and its scientific instruments were completed this summer; with overall system environmental testing and final instrument characterization expected to be complete this fall. The small satellite will be launched in spring 2003 on a NASA-provided Pegasus XL launch vehicle.

3.1.2.4. CLOUDSAT

Canada is contributing key radar components to the Cloud Profiling Radar of NASA's CloudSat satellite. CloudSat will fly in formation with EOS Aqua and CALIPSO (formerly PICASSO-CENA) and will measure the vertical structure of clouds and cloud properties from space. CloudSat seeks to overcome shortcomings in the treatment of cloud processes in climate models and the lack of the observational constraints needed to accurately characterize these processes or to validate models.

The CloudSat mission will provide the first global survey of the synoptic and seasonal variations of cloud vertical structure, and frequency of occurrence. These measurements will represent a significant advance over present observation capabilities. Satellite launch is planned for April 2004.

3.1.2.5. SWIFT ON GCOM-A1

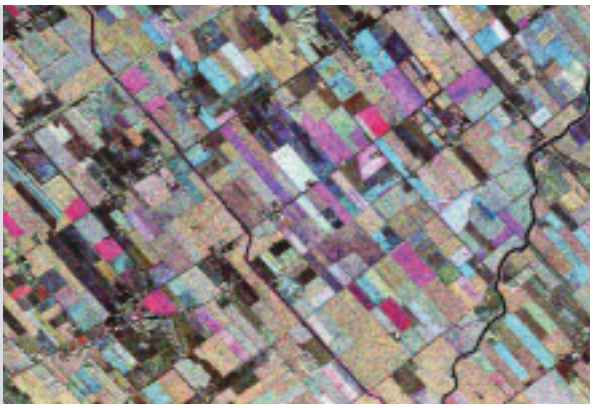
Phase A activities are in progress at NASDA, ESA and CSA for the potential flight of the Stratospheric Wind Interferometer For Transport studies (SWIFT) instrument on board the NASDA GCOM-A1 satellite. SWIFT will provide global profiles of winds (with an accuracy of 5 m/s) and ozone densities (with an accuracy of 10%) within an altitude range of 20 to 45 km.

SWIFT will further the understanding of the stratosphere in an important area, namely the link between dynamics and chemistry that occurs through transport of chemical species, especially ozone. It will also provide a unique characterization of the dynamics of the tropical stratosphere, and will improve the quality of stratospheric analysis products in the tropics, where they are currently very deficient. Furthermore, the provision of wind data in the lower stratosphere could enhance the performance of medium-range numerical weather forecasts. In the longer term, the SWIFT mission will open a way to establish expertise in direct measurements of stratospheric winds from space.

3.2. TECHNOLOGY, APPLICATIONS AND MARKET DEVELOPMENT

3.2.1. EARTH OBSERVATION APPLICATION DEVELOPMENT PROGRAM (EOADP)

The Canadian Space Agency's Earth Observation Application Development Program (EOADP) supports industry initiatives to develop applications and markets. The program encourages the use of satellite data generated by space missions in which Canada is a participant. CSA's goal is to enhance the level of expertise and competitiveness of the Canadian industry while stimulating innovation.



CV-580 C/X-SAR multi-polarization composite image of agricultural fields south of Ottawa (© CCRS, 1998). Diversity of polarization, incidence angles and spatial resolutions offered by RADARSAT-2 will provide valuable information for agricultural management such as, crop identification, soil conservation methods and soil moisture.

The program favours projects that demonstrate the ability to strategically position the Canadian EO industry through the development of either commercial applications or applications to fulfil government requirements. The program is aimed at private companies, who are nonetheless encouraged to create partnerships with potential end users as well as with research and non-profit organizations.

The program is now in its third year of operation and has awarded over 49 contracts to industry for supporting applications for EO data in Canada and abroad in areas as diverse as forestry and agricultural resource monitoring, mineral exploration and water resource management. These illustrate the widespread need for EO data, both in Canada and around the world, and the effectiveness of partnerships that combine resources and expertise from the public and private sectors.

An important feature of many of the EOADP applications is the development of new interpretative methodologies, new ways of analysing data and integrating it into knowledge systems, and new ways of drawing on several sources of data to create innovative value-added information products. EOADP is also promoting partnerships with Canadian businesses that are in a good position to capitalize on space-based EO technologies – businesses willing and able to take on the risks of innovation and the commercial development of knowledge-based products.

One of EOADP's 2002 achievements was the signature the Canada-Quebec agreement, a collaborative agreement with the Province of Quebec to support the development of commercial EO value-added technology in the province, by Quebec companies. EOADP hopes to sign similar agreements with other Canadian provinces in the future.

3.2.2. GOVERNMENT RELATED INITIATIVES PROGRAM (GRIP)

The Government Related Initiatives Program (GRIP) fosters the use of space-borne remote sensing information by federal government departments to enhance their efficiency and effectiveness and showcase Canadian technology.

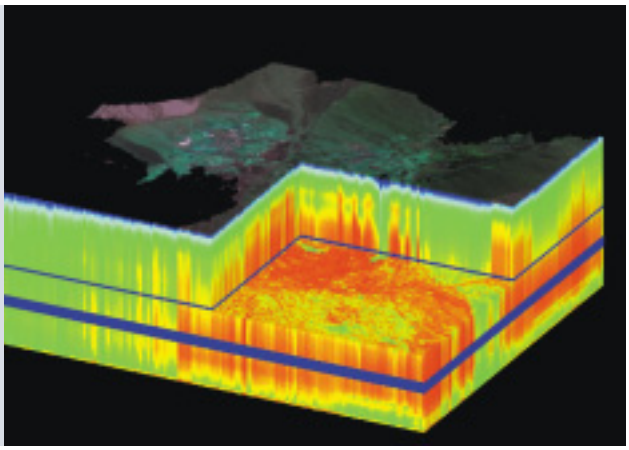
Land, water and air are aspects of our planet that can be measured, mapped and monitored with space-borne instruments. Through the Government Related Initiatives Program, the Canadian Space Agency supports Canadian government departments in their development of EO applications and operations for monitoring Canada's land and water resources including weather phenomena such as precipitation and soil moisture. The program also contributes to atmospheric remote sensing activities by government researchers.

The study of Earth's environments and climate systems is multidisciplinary and requires collaborative efforts by specialists in a wide range of fields. GRIP also supports Canadian government departments in national and international co-operative projects aimed at advancing knowledge and communicating the results to the Canadian public.

Examples of GRIP projects are:

- Developing space-based technologies for studying the cryosphere (CRYSYS);
- Monitoring sustainable development of forests (EOSD);
- Understanding the interaction between land-based ecosystems and climate change;
- Monitoring the evolution of coastal zones and their ecosystems;
- Monitoring the marine environment and its interaction with global climate;
- Agricultural crop monitoring.

Projects supported by GRIP are described in other sections of this document.



3.2.3. HYPERSPECTRAL IMAGING

3.2.3.1. HYPERSPECTRAL APPLICATIONS DEVELOPMENT

The Canada Centre for Remote Sensing is leading a collaborative pre-competitive research effort to develop new techniques in the processing, visualization, and analysis of hyperspectral data by focusing on the development of calibration and data pre-processing methods, procedures for extracting information, and related information products. The Hyperspectral Applications Development Program at the CCRS is strongly focused on issues of concern to the Earth Sciences Sector: sustainable development of natural resources, Northern development, and a clean environment. It is currently focusing on the development of algorithms and related information products in:

- Exploration geology;
- Environmental monitoring and assessment;
- Precision farming;
- Wetlands;
- Geobotany and
- Forestry.

For more information visit:
<www.ccrs.nrcan.gc.ca/ccrs/misc/issues/hypersp_e.html>

2002 Activities and Accomplishements

- Implementation of a reflectance-based vicarious calibration in Imaging Spectrometer Data Analysis System for the radiometric re-calibration of airborne and space-borne hyperspectral sensors in an operational setting;
- Radiometric and spectral calibration of the SWIR Full Spectrum Imager;
- Acquisition and evaluation of Hyperion data and related ground reference information for the six application areas listed above.

3.3. GROUND SEGMENT AND INFRASTRUCTURE DEVELOPMENT

3.3.1. SATELLITE GROUND SEGMENT INFRASTRUCTURE

Overview

In addition to an operations coordination centre in Ottawa, the CCRS operates two satellite ground stations, the Prince Albert Satellite Station in Prince Albert, Saskatchewan and the Gatineau Satellite Station in Cantley, Quebec. Together, the two stations are able to receive data covering the entire North American continent. Operating in a multi-mission environment, these stations receive Earth observation data from several satellites and have accumulated an archive in excess of 315 terabytes dating back to 1972. Data is made available to support near-real-time applications such as ice monitoring, forest fire monitoring and mapping, as well as non-real-time applications such as climate change and land use.

Gatineau Satellite Station in Cantley, Quebec

Canadian Interest and Objectives

The CCRS Ground Segment Infrastructure acquires remote sensing data required to generate knowledge and information critical to resource use and decision making on local, regional, national and global scales.

In addition to its primary role in providing data related to land resources and climate change contributing to sustainable land management in Canada, the CCRS Ground Segment also serves as the Canadian ground segment component of RADARSAT-1 in partnership with CSA and RADARSAT International Inc. and will play the same role for RADARSAT-2.

The stations also serve as part of the ESA ERS National Station network.

2002 Activities and Accomplishments
Upgrades have been completed to the Ground Segment Infrastructure to receive, process and archive ENVISAT ASAR data – a major milestone. Operations are expected to commence later this year when ESA commissions ENVISAT for operations. Development work is proceeding as schedule on the CCRS Ground Segment upgrades required to support RADARSAT-2.

3.3.2. CANADIAN EARTH OBSERVATION NETWORK (CEONET) CGDI ACCESS

Overview
CEONet provides a discovery service for satellite imagery, such as RADARSAT, as well as for related geospatial products and services. Every day, over 1200 users access CEONet and its underlying services.

CEONet is the primary discovery mechanism of the Canadian Geospatial Data Infrastructure (CGDI) program and has now been renamed "GeoConnections Discovery Portal (GDP)" in as much as the full cost of its operation and enhancement is now being borne by GeoConnections, the Canadian Government program developing the CGDI.

The RADARSAT catalogue and browse data of RADARSAT International are accessible worldwide through GeoConnections. Access to RADARSAT and other Earth observation data as well as in-situ data allows the Canadian value-added industry to develop new products and services using RADARSAT data and market these internationally.

The Public Agency Content and Connectivity (PACC) and CGDI Development Network programs have facilitated the establishment of partnerships to support the continued growth of CGDI access services. Ongoing partnerships include:

- Provincial agencies (Newfoundland and Labrador, Ontario);
- Federal agencies (Fisheries and Oceans);
- National programs (Forestry – NFIS, Geoscience – Canadian Geoscience Knowledge Network);
- Regional programs (Atlantic Coastal Zone);
- Private sector (Compusult, Cubewerx, DM Solutions, Galdos, 3i, Holonics, MDA, Open GIS Consortium, PCI).

Activities and Accomplishments
The next GDP release is scheduled for this year and the underlying software will be made available free of charge to any GeoConnections partner. The suite of access services is expanding from "discovery" to visualization, data access and value-added services. Communications and training material in support of the new services are being developed in cooperation with the Technology Advisory Panel and the GeoConnections secretariat.

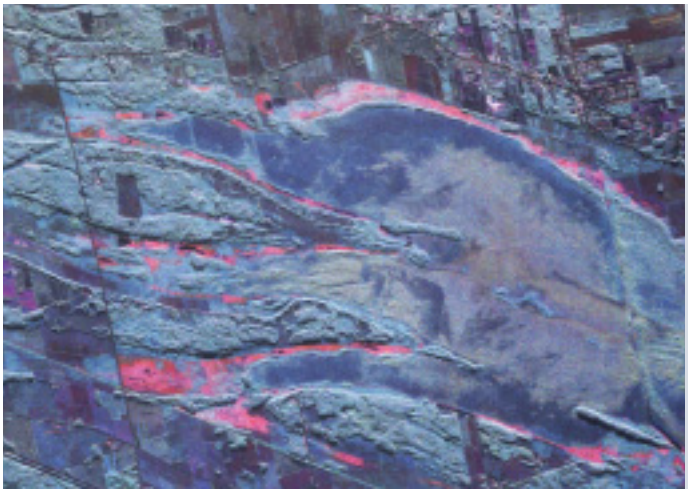
Access presentations and training sessions continue for new stakeholder communities, at major conferences, and in co-operation with industry (e.g. ESRI, OGC) and North American spatial data infrastructure (SDI) programs. The GDP was a featured presentation at the North American spatial data infrastructure workshop in Denver, Colorado last June. Concepts from the GDP are likely to be incorporated into an equivalent US Discovery Portal. A regional meeting of the CGDI Development network was held in Victoria, British Columbia, in May.

Upcoming key activities include the provision and integration of access services for the Geobase national data frameworks initiative through new partnerships with provincial and federal departments and agencies, national programs and the private sector.

The GeoConnections Discovery Portal is accessible at <http://ceonet.ccrs.nrcan.gc.ca>.

3.3.3. PREPARING THE CANADIAN EARTH OBSERVATION COMMUNITY FOR RADARSAT-2

RADARSAT-2's extended capabilities, which will permit SAR (Synthetic Aperture Radar) imaging modes with high spatial resolution, with selective co- or cross-polarization, and with full quadrature polarization, will present a challenge to the community as new concepts and methods of analysis and data processing are required.



Wetland mapping using CV-580 C/X-SAR multi-polarization composite image over the Mer Bleue Bog (© CCRS, 1995). Multi-polarization SAR images will allow more accurate land mass discrimination and identification of cartographic features, in order to extract information on the spatial distribution and temporal evolution of land use and land cover.

The CSA, in collaboration with the CCRS, initiated a suite of activities in early 2001 that will continue into the first years of RADARSAT-2 operations. The program's objectives are to help the Canadian EO community (academia, industry, and government departments) master the concepts, develop the tools, and explore the potential of RADARSAT-2 data.

Some key activities this year, in preparation for the use of polarimetric data in particular, are:

- Acquisition of polarimetric data using Environment Canada's Convair-580 C-band SAR to simulate RADARSAT-2 products with simultaneous collection of ground validation data in order to support application R&D and provide documented data sets to the Canadian EO community;
- On-line posting of a RADARSAT-2 applications report and annual supplements (see <http://www.ccrs.nrcan.gc.ca/ccrs/rd/sci_pub/bibpdf/13103_1.pdf>);
- Development of tools and a workstation for extracting and analyzing the information content of polarimetric SAR data.

One-day workshops on RADARSAT-2 polarimetry and potential applications were organized by the CCRS at the 23rd Canadian Remote Sensing Symposium in August 2001, and at IGARSS in June 2002.

3.4. CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

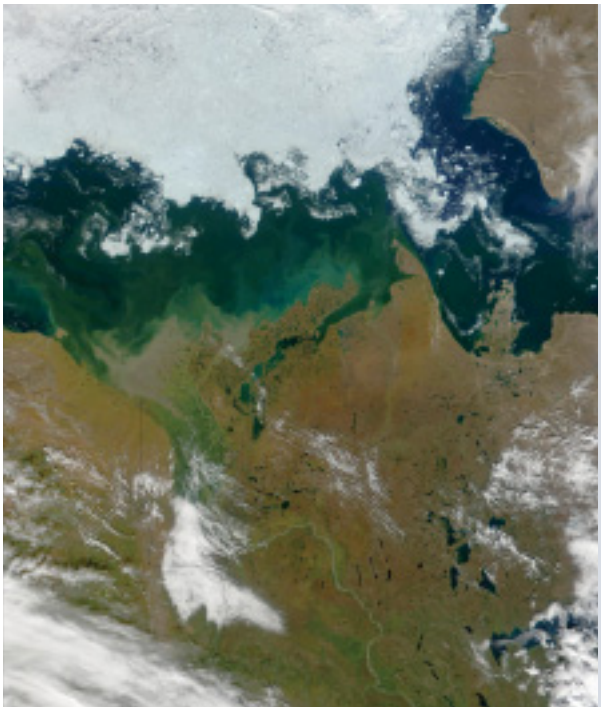
3.4.1. FEDERAL GOVERNMENT INITIATIVES

Overview

The Government of Canada launched recently its $500-million Action Plan whose objective is to reduce Canada's greenhouse gas (GHG) emissions by some 65 megatonnes by 2010. The initiatives target biological sinks and key emitting sectors — transportation, energy technology, industry, commercial and residential buildings, forestry and agriculture — that account for 90 percent of Canada's GHG emissions.

Canada, however, cannot solve the global climate change problem single-handedly. The reduction in GHG emissions will require the cooperation of all countries, both developed and underdeveloped. A key area to GHG reduction is the shifting of energy demand from high carbon fossil fuels toward lower carbon and renewable sources.

Canadian activities in Earth observation are expected to continue to play a key role in the monitoring of GHG emissions, both in Canada and internationally.



Mackenzie River and Mackenzie Bay, northern Canada, MODIS
(Credit: MODIS Land Rapid Response Team, NASA/GSFC)

3.4.1.1. METEOROLOGICAL SERVICE OF CANADA

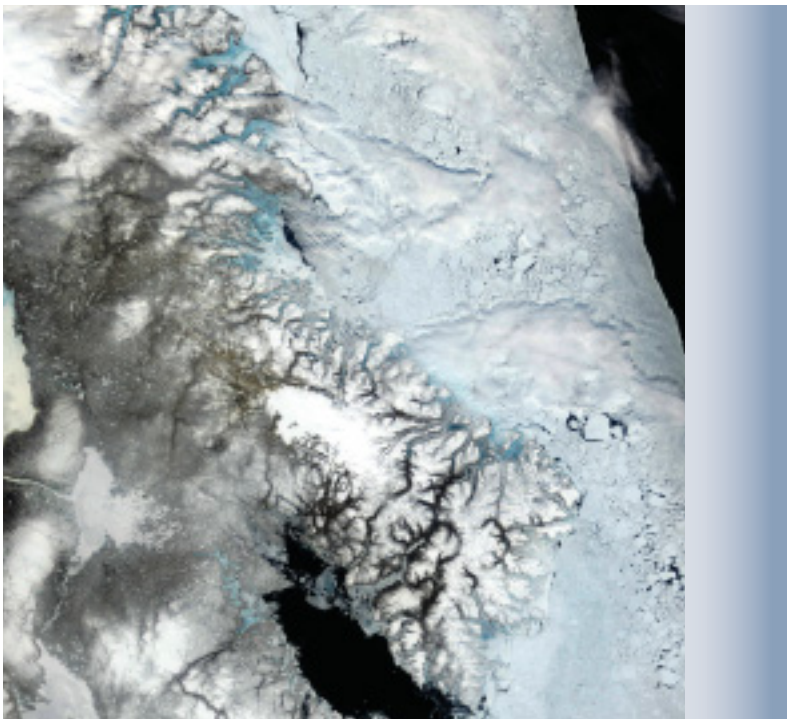
For a large northern country such as Canada, satellite remote sensing is becoming increasingly important for systematic observations of the climate system. The Climate Research Branch (CRB) of the Meteorological Service of Canada (MSC) conducts research on the application of satellite data sets and development of new methodologies for extracting information on climate variables, with a specific emphasis on the cryosphere (i.e. snow cover, lake and sea ice) and cold climate processes. In 2002 the CRB continued to generate weekly snow cover (snow water equivalent, or SWE) maps for Western Canada from near-real-time Special Sensor Microwave/Imager (SSM/I) passive microwave satellite data, which were distributed by e-mail to water resource and agricultural agencies and posted on the Canadian Cryosphere website (<www.socc.ca>). These map products and monthly maps showing deviation from normal SWE conditions were especially important during the winter of 2001/02 for monitoring the snow cover conditions in areas of the Western prairie provinces that were under threat of drought due to low soil moisture. The weekly SWE maps were also used during the winter of 2001/02 to evaluate the reliability of new snow cover products from the MODIS sensor on the NASA Terra satellite for Canadian regions and provide validation feedback to the NASA MODIS team responsible for the snow and ice data products.

Soil moisture is a critical variable for climate, weather forecasting and hydrological models with land surface/atmosphere interaction schemes. Over the past several years CRB scientists have worked with international colleagues to prepare for a future satellite mission to generate operational soil moisture data. In 2002, MSC partnered with the Canadian Space Agency and the Canada Centre for Remote Sensing to develop a Canadian contribution to a US-led proposal to the NASA Earth System Science Pathfinder Program for a satellite mission, provisionally called Hydros, focused on retrieval of global soil moisture and land surface freeze/thaw state.

The incorporation of satellite data sets into the initialization and verification of climate models is another research thrust of the Climate Research Branch. Knowledge of the spatial distribution of surface water and its characteristics is important in understanding and modelling the interactions between the land surface and the atmosphere. The use of Advanced Very High Resolution Radiometer (AVHRR) data to document the latitudinal variability of seasonal lake water temperature cycles for boreal water bodies of varying sizes and configurations was a specific CRB achievement in 2002.

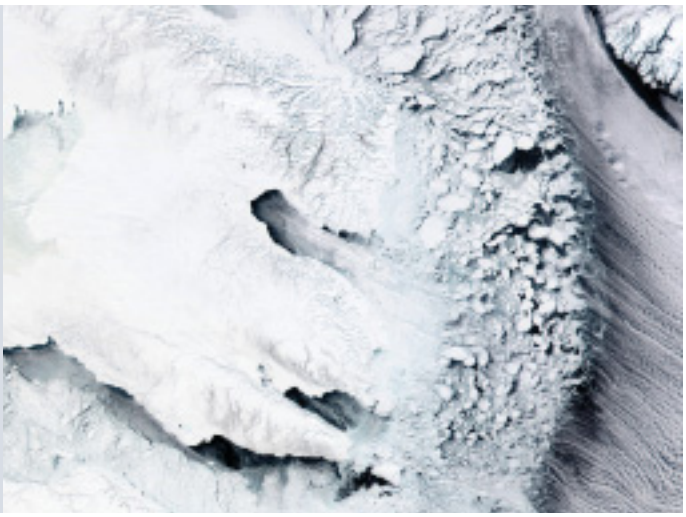
3.4.1.2. CRYSYS: CRYOSPHERE SYSTEM IN CANADA

CRYSYS is an Interdisciplinary Science Investigation in NASA's Earth Observing System Program, hosted and funded by Canadian agencies and universities, led by the MSC. One of the main objectives of CRYSYS is to develop capabilities for improved satellite-based measurement, monitoring and understanding of cryospheric variables over a range of spatial and temporal scales. An overview of the CRYSYS project and science goals can be obtained online at: <www.crysys.ca>. CRYSYS activities also contribute to the "Cryosphere and its Response to Climate Change" of the Government Related Initiatives Program (GRIP) in the Earth and Environment Service Line (Surface Environment) of the Canadian Space Agency.



Baffin Island, Canada, MODIS image
(Credit: MODIS Land Rapid Response Team, NASA/GSFC)

In 2002, 12 research projects were supported in Canadian universities with topics ranging from development of improved automated sea ice classification for RADARSAT data, to modelling of glacier surface melt. A major effort was made in 2002 to expand Canadian cryospheric data holdings at the Canadian Cryosphere Information Network (CCIN) being developed at the University of Waterloo in partnership with the Canadian Space Agency and the private sector (Noetix Ltd., Compusult Ltd. and SGI). The other major focus of CCIN activities was the development of web-based interactive data display capabilities for near-real-time monitoring of Canadian cryospheric conditions during the winter of 2002-2003.



Baffin Bay and Davis Strait, MODIS image
(Credit: MODIS Land Rapid Response Team, NASA/GSFC)

Examples of other significant achievements in 2002 include:

- The CRYSYS and CSA-supported GLIMS (Global Land Ice Measurements from Space) Regional Centre for the Canadian Arctic Islands at the University of Alberta mapped the distribution of surging glaciers in the Canadian High Arctic for the first time by comparing Landsat imagery with 1959/60 aerial photography.
- The development of a Canadian lake and river ice database at Université Laval.
- Evaluation of RADARSAT ScanSAR Narrow imagery for estimation of snow water equivalent over northern Quebec by scientists at INRS-Eau (Université du Québec).

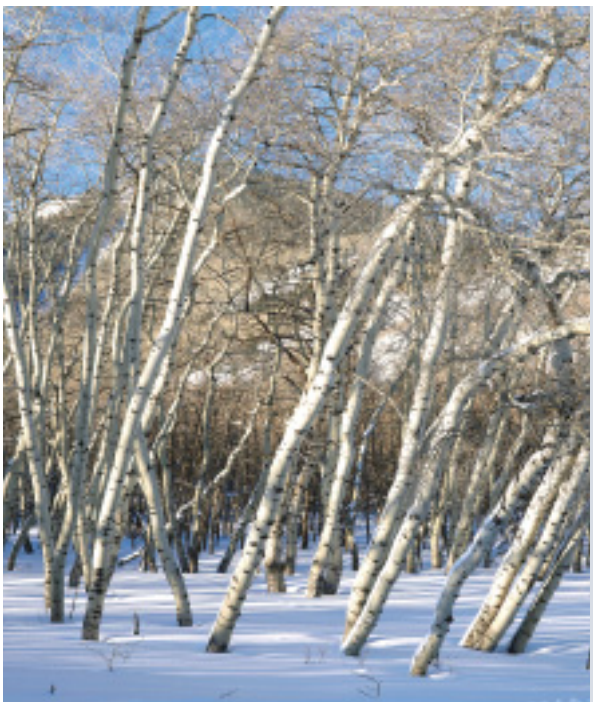
3.4.1.3. NATIONAL CARBON AND HYDROLOGICAL CYCLES

National scale carbon and water budgets are at the heart of Canada's climate change initiatives, including the Canadian government Climate Change Action Plan 2000, the Climate Change and Ecosystem Impact project of CSA/CCRS, the Climate Change Action Fund (CCAF), and the Panel on Energy Research and Development. As an active participant of these major national initiatives, the CCRS established a wide-ranging project called the "Integrated National Carbon and Hydrological Cycle Study" in which satellite Earth observation data is integrated with ground-based measurements to quantify the spatial variations and temporal dynamics in carbon and water cycles.

2002 Activities and Accomplishments

- Methodology for retrieving vegetation structural parameters from multi-angular data. Investigated structure from LIDAR data in collaboration with the Canadian Forest Service.
- In-situ validation of Landsat Leaf Area Index algorithms for monitoring defoliation in collaboration with the Canadian Forest Service.
- Process-based ground temperature model for simulating ground thermal dynamics and permafrost thaw in partnership with Geological Survey of Canada (GSC).

Other activities include: participation in the Mackenzie GEWEX (Global Energy and Water Experiment) Study and Statistics Canada's climatic water resource accounting; Canada-wide 1-km water body coverage from National Topographic Data Base Maps and satellite-driven flux models for estimating Canadian water accounts in collaboration with Statistics Canada.



3.4.1.4. GLOBAL OBSERVATION OF FOREST COVER (GOFC)/GLOBAL OBSERVATION OF LAND DYNAMICS (GOLD)

The Global Observation of Forest Cover and Land Dynamics (GOFC-GOLD) is a coordinated international effort to develop and implement a suite of Earth observation programs using both space-borne and in-situ data. GOFC-GOLD is designed

to help provide information needed to study global change, associated for example with the carbon cycle, as well as for improved natural resources management. Originally established as a pilot project by CEOS, GOFC-GOLD is now a Global Terrestrial Observing System Panel. It addresses three core themes: land cover characteristics and changes; fire monitoring and mapping and biophysical processes.

The GOFC/GOLD office was relocated to the Canadian Forest Service's Pacific Forestry Centre in April.

The GOFC/GOLD website can be accessed at: <www.fao.org/gtos/gold.html>.

3.4.1.5. EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT (EOSD) OF FORESTS

The Canadian Forest Service, in partnership with the Canadian Space Agency through the Government Related Initiatives Program (GRIP), is using space-based Earth observation technologies to create products for forest inventory, forest carbon accounting, monitoring of sustainable development, and landscape management. The Earth Observation for Sustainable Development of Forests (EOSD) initiative is working in partnership with the provinces and territories to develop a land cover map of the forested area of Canada.

2002 EOSD accomplishments include:

- New EOSD website launched: <www.pfc.cfs.nrcan.gc.ca/eosd/index_e.html>;
- Complete circa 1990 orthorectified Landsat-5 Thematic Mapper (TM) coverage of Canada was acquired;
- Second version of EOSD land cover mapping methods was produced and distributed to partners;
- Software for radiometric calibration and atmospheric correction (ACE) of TM and Landsat-7 Enhanced Thematic Mapper (ETM+) imagery;
- Spatially partitioning Canada with the Landsat Worldwide Referencing System: <www.pfc.forestry.ca/eosd/cover/wrs_e.html>
- National Topographic System (NTS) Map Sheet Manager: <www.pfc.forestry.ca/profiles/wulder/NTS_Manager/nts_manager.html>.

LANDSAT frame capturing Victoria and Vancouver, B.C.
(© Canadian Forest Service)

3.4.2. PROVINCIAL GOVERNMENT INITIATIVES

3.4.2.1. QUEBEC – OURANOS

OURANOS, a consortium on climatology and adaptation to climate change, was launched in 2002. Its mission is to develop, structure and undertake a collective project to analyze and search for solutions to climate change adaptation issues in the North American context. In addition to greenhouse gas emission reductions, the creation of OURANOS constitutes an additional means of addressing climate change and a tool for adaptation to new regional situations stemming from global warming.

A partnership that is truly unique and without precedent in Canada, OURANOS involves over 250 persons in multi-disciplinary research teams from universities, governmental and para-governmental organizations, in disciplines that have traditionally worked apart: climate sciences, statistical analysis, characterization, impact and adaptation studies. The merging of isolated teams of scientists under OURANOS will pull in relevant scientific data and information needed by decision makers to plan responses to the rapidly evolving climate situation.

OURANOS is funded by several federal departments and agencies, as well as departments and agencies of the Quebec government. The Université du Québec à Montréal; McGill University; Université Laval and the Institut national de la recherche scientifique are also members of the Consortium.

3.5. RESOURCE MANAGEMENT

3.5.1. FORESTRY

Overview

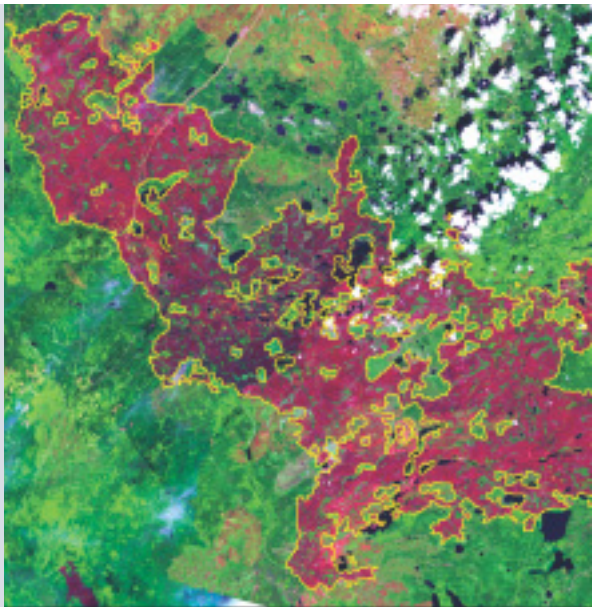
Canada's forests cover some 45% of Canada's total landmass, or 418 million hectares. Forests play an essential role in Canada's economy and contribute to Canadians' high quality of life. Canada is in the unique position of having 93% of its forest under public ownership. Forests make a significant contribution to global cycles by filtering air and water, regenerating soils and preventing erosion.

Forestry is the largest industry in Canada, supporting 373,000 direct jobs and contributing over $37 billion to our balance of trade. Canada's forests also support a multibillion-dollar recreation and tourism industry.

Sustainable management of forests continues to be one of the key environmental issues in Canada in the early 21st century. Canada is committed to a balance of economic, social and environmental demands on its forests. Canada has a National Forest Strategy and is a party to the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity and the Montreal Process on criteria and indicators for sustainable forest management.

Description of Canadian interest and objectives

Canada requires forest measuring and monitoring systems that are responsive to key policy drivers related to climate change and will report on sustainable development of Canada's forests both nationally and internationally. A next-generation measuring and monitoring system is being developed to address key policy issues by identifying and bringing together the best available remote sensing data, geographic information and inventory data. Remote sensing from space will play an essential role in obtaining timely and accurate information on forest cover, biomass, change, and health. Forest remote sensing stimulates the development of information systems and methods for creating these products. These technologies can then be exported by Canadian industry, or used to provide services to the national and international communities.



Semi-Automated LANDSAT Forest Burn mapping, House River, Alberta
May/June 2002
(© Forestland Information Group, CCRS, NRCan)

In terms of Canada's new plot-based National Forest Inventory, satellite data will be used to enhance the inventory beyond the one-percent sample and assess change. In Canada's North satellite imagery will be used to provide key National Forest Inventory attributes. In terms of the United Nations Framework Convention on Climate Change, remote sensing will play an important role in quantifying the impacts of management, land use, and land use change.

3.5.1.1. CANADIAN LAND COVER INITIATIVE (CLCI)

The CLCI is an open initiative to reach consensus on national land cover standards and to integrate land cover mapping initiatives. It is supported by federal agencies involved in monitoring and reporting on land cover and land use. It also involves representation from provincial government and non-governmental organizations.

2002 CLCI Activities

A workshop sponsored by GeoConnections (an initiative to make Canadian geospatial information available on the web), was held in Ottawa at the end of February 2002 and was attended by various governmental and non-governmental agencies.

3.5.1.2. FOREST BURNED AREA MAPPING

The Canadian Forest Service and the CCRS are collaborating to develop methods to provide consistent, national-level burned area maps at fine and coarse spatial resolutions, to be used as input for carbon budget modelling. National burned forest estimates require consistency and reliability to minimize budget errors in the national carbon model. The initiative will enhance the level of national mapping information in relation to change detection and more specifically to burned forest mapping, and therefore increase the accuracy of estimates of greenhouse gas emissions from burned forest.

2002 Accomplishments

- Validation of burned areas mapped from SPOT-VGT using Landsat TM/ETM+ burned forest products;
- Maintenance and improvement of the FireM3 (Fire Monitoring, Mapping and Modelling) website: <http://fms.nofc.cfs.nrcan.gc.ca/FireM3/>, and daily updates with AVHRR active fire products across Canada.

3.5.2. AGRICULTURE

The promotion of sustainable farming practices is critical in ensuring continued crop productivity and a secure food source. In addition, decisions about how agricultural land is managed will directly impact the health of surrounding ecosystems. Those who manage the land — farm producers — require timely and up-to-date information on soil and crop conditions in order to properly apply sound management practices. For the last three years the Canada Centre for Remote Sensing has been involved in collaborative research with the Indian Head Agricultural Research Foundation (IHARF). IHARF is a non-profit foundation sponsored by more than 20 agri-businesses including such multi-national companies as Monsanto. IHARF was established to research farming methods to improve crop productivity and promote sustainable farming practices. This research is also aimed at helping farm producers better manage crop inputs such as fertilizers and herbicides in order to not only maximize profitability, but also to minimize environmental contamination.

In 2002 the CCRS and IHARF teamed up with Agriculture and Agri-food Canada, Canadian universities (McGill, Ottawa and Lethbridge) and Canadian industry (Noetix Research Inc.) to investigate the use of remote sensing image products for farmland management. The CCRS led four two-week field campaigns over the 2002 growing season during which satellite hyperspectral (Hyperion), multispectral (QuickBird, Ikonos, Landsat, SPOT) and radar (RADARSAT-1) data were acquired coincident with ground data collection. The 2002 campaign used satellite imagery acquired prior to planting, to map management zones within test fields. Different nitrogen management trials were applied within these zones. Imagery acquired during the growing season will be used to monitor crop response and to determine whether variations in crop nitrogen and chlorophyll can be mapped from space. With crop response maps in hand, farmers and the agriculture service industry can make more informed decisions about chemical inputs during the current growing season and can plan management strategies for the following season.

3.5.3. ENERGY

Through contracts awarded to Canadian companies by CSA's EOADP program, and with the scientific guidance of the CCRS, Canadian companies are exploring the use of hyperspectral, RADARSAT and data fusion techniques for oil and gas exploration and the environmental assessment of proposed pipelines both in the Western Sedimentary Basins of Western Canada and in northwestern China.

Through the Innovation Acceleration Centre of NRCan's Earth Sciences Sector, CCRS scientists are training both Canadian and Chinese geologists in the processing and interpretation of hyperspectral and high-resolution SAR images for hydrocarbon exploration.

Hyperion image over agricultural fields, Indian Head, Saskatchewan; June 21, 2002
(© Hyperspectral Application Development Program, CCRS, NRCan)

3.5.4. WATER

Fisheries and Oceans Canada uses remotely sensed data in a large number of research and operation applications related to water, sea ice and the detection of marine mammals. Those directly related to water can be categorized into two general classes: Environmental Monitoring, which relates either to mapping the state of the ocean or developing appropriate tools for using data collected from space, and Ocean Climate,

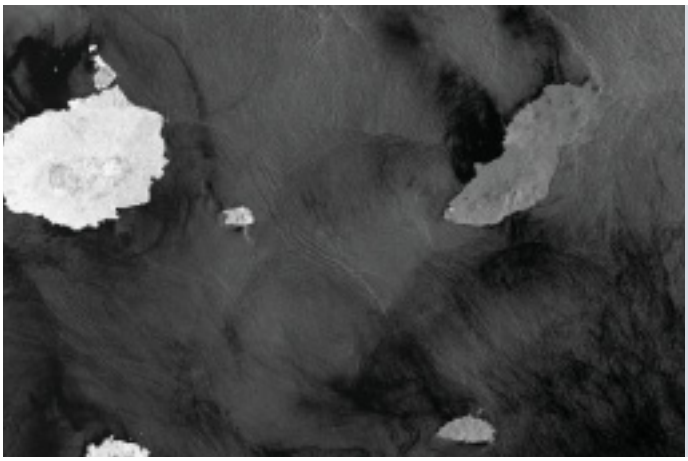
which relates to the role of the ocean in the Earth's climate and is principally directed towards estimating primary productivity (i.e. the production of plant life) and estimating the amount of greenhouse gases sequestered into the deep ocean.

Ocean temperature and salinity have been routinely measured, in situ, since the earliest oceanographic expeditions, and they comprise the two most basic physical variables that define the state of the ocean. For the past 30 years, Sea Surface Temperature (SST) has been monitored operationally from space, but the concomitant capability to assess Sea Surface Salinity (SSS) has not existed. The capability to measure SSS from space now exists, and Fisheries and Oceans is preparing for the launch of salinity satellites by determining how SSS can be assimilated into global and regional ocean circulation models and by studying the effects of cold water and ice on sensor sensitivity.

Satellite altimetry is used to map sea level from space on Canada's east and west coasts. Sea level change will be one of the most evident effects of climate change and is one that directly affects a number of coastal activities. Coupled with information on the thermal and saline structure of the ocean, sea level data can be used to infer the transport of heat and salt, both of which are key pieces in the study of climate change.

Altimetric data is also being used in conjunction with high-resolution coastline and wind data, by RADARSAT, to better predict storm surges and coastal flooding on Canada's east coast. Wind information derived from RADARSAT allows studying the effects of winds on the accuracy of abundance surveys of fish eggs and larvae and ultimately on the estimation of fish stock abundance in the coastal zone.

In a joint project with industry, Fisheries and Oceans has evaluated the solar stimulated fluorescence signal from phytoplankton chlorophyll as observed by SeaWiFS and MODIS for estimating chlorophyll, identifying water masses, and assessing the efficiency of the chlorophyll fluorescence process. This project is being expanded to include the ENVISAT/MERIS satellite imager, which will soon begin to produce similar imagery with higher spatial resolution, allowing work nearer to the coast.



Oil spill off the coast of Ecuador, near the Galapagos Islands on January 16, 2001
RADARSAT-1 data (© Canadian Space Agency 2001. Received by the Canada Centre for Remote Sensing. Processed and distributed by RADARSAT International.)

3.6. DISASTER MANAGEMENT

3.6.1. INTERNATIONAL CHARTER

The International Charter on Space and Major Disasters was set up in the framework of the United Nations' UNISPACE III Conference in 1999 and has been in force since November 1, 2000. Canada signed the Charter on October 20, 2000; the current members are the Canadian Space Agency, the European Space Agency, the French space agency (CNES), the Indian Space Research Organization (ISRO) and the US National Oceanic and Atmospheric Administration (NOAA). The Charter is the expression of a collective resolve to put space technology at the service of rescue authorities in the event of a major disaster. The Charter is open for signature by space agencies and satellite operators anywhere in the world. All partners undertake to cooperate on a voluntary basis, with no exchange of funds between them.

The Charter provides a unified system of space data acquisition and delivery to those in need when natural or human-made disasters strike. Authorized users from around the world can call a single number to request mobilization of RADARSAT and other satellites to obtain data on a disaster occurrence.

Program Activities

In response to disasters on four continents, the Charter was activated nine times in 2001. These included a second wave of seismic shocks and accompanying landslides in El Salvador, flooding of the Saone River in France, oil spills off the coasts of Lebanon and Denmark, flooding of the Lena River in Siberia and Nias Island in Indonesia, the volcanic eruption of Mount Etna in Italy, and flooding of the Moselle and Meuse Rivers in Germany and France. In all of these disasters, the Charter partner agencies (ESA, CNES and CSA) successfully delivered multi-satellite data and data products to those in need – demonstrating the operational ability of those agencies to rise to the challenge of playing a coordinated role in the timely acquisition, processing, and delivery of vital information.

Two Charter Evaluation Workshops were held during the past year. The workshop in October 2001 examined the operating and activation procedures with Charter project managers and

the relationships with value-added companies. The January 2002 workshop in Paris reviewed the Charter's achievements over the previous 14 months. This most recent session also considered the capabilities of new EO satellite systems including SPOT, ENVISAT, RADARSAT-2, Cosmo-Skymed/Pleiades, as well as space telecommunications services such as the REMSAT pilot project and the CNES New Stentor Services (NSS) test project.

As part of the efforts dispatched to assist rescue teams dealing with the most severe disasters, members of the International Charter on Space and Major Disasters launched in January 2002 an innovative website at the Charter Evaluation Workshop in Paris. This website is hosted by CSA. The address of the website is: <www.disasterscharter.org>.

The International Charter on Space and Major Disasters website provides guidelines on how to request and deliver data. Full information on rescue and civil defence bodies is available on the website, including updates on procedures, disasters covered and pertinent links to non-governmental organizations, civil protection agencies, international organizations involved in disaster mitigation and humanitarian assistance, and individual partner agencies.

The existence of the website means that requesters based in areas where major disasters strike will be better prepared to take advantage of the Charter.

3.7. CANADIAN INTERNATIONAL INVOLVEMENT

3.7.1. COMMITTEE ON EARTH OBSERVATION SATELLITES (CEOS)

General

CEOS was created in 1984 in response to a recommendation from a Panel of Experts on Remote Sensing from Space, under the aegis of the Economic Summit of Industrialized Nations Working Group on Growth, Technology and Employment. This Group recognized the multidisciplinary nature of space-based Earth observation and the value of coordinating international mission plans.

Canada, represented by the Canadian Space Agency, is a charter member of CEOS, along with France, India, Brazil, the United States (NASA/NOAA), the European Space Agency and Japan (NASDA/STA). The Canada Centre for Remote Sensing is an Associate member of CEOS. There are presently 20 CEOS members and 18 Associates.

Canada's main contribution to CEOS continues to be as an active leader and member of the four Working Groups established to help CEOS meet its primary objectives.

3.7.1.1. WORKING GROUP ON CALIBRATION AND VALIDATION (WGCV)

Canada's long-standing activity in calibration and validation and participation in the CEOS Working Group on Calibration and Validation (WGCV) continued in 2002. With its end-to-end remote sensing model, Canada's perspective is that calibration and validation provide confidence in information derived from Earth observation and are essential to successful quantitative use of remote sensing data.

In 2002, the CCRS hosted the 1st meeting of the CEOS WGCV Atmospheric Chemistry Subgroup and the 19th meeting of the CEOS WGCV (WGCV-19) in Ottawa.

3.7.1.2. WORKING GROUP ON INFORMATION SYSTEMS AND SERVICES (WGISS)

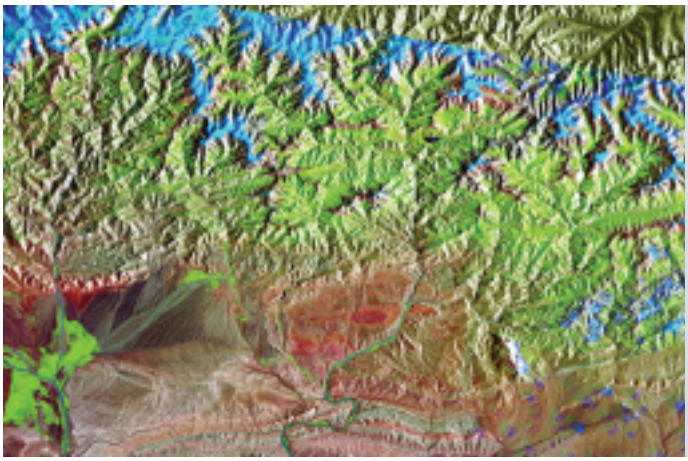
Within the overall context of the CEOS strategy, the WGISS aims to stimulate, coordinate, and monitor the development of the systems and services that manage and supply the data and information from participating agencies' missions. The Canada Centre for Remote Sensing participates in the WGISS technical initiatives, such as the International Directory Network, to which it provides monthly metadata updates on Canadian geospatial organizations, products and services. Canada has always been an active participant in WGISS, and last year was no exception.

The CCRS took the chair of WGISS at the Kyoto Plenary in November 2001 for a two-year term, chaired the WGISS meeting in Tokyo in February 2002, attended the WGISS Subgroup meeting in Frascati, Italy, in May 2002 and participated in a WGISS demonstration at the World Summit on Sustainable Development in Johannesburg.

3.7.1.3. AD HOC WORKING GROUP ON DISASTER MANAGEMENT AND SUPPORT (WGDMS)

The CEOS Working Group on Disaster Management and Support supports natural and technological disaster management worldwide by fostering improved utilization of existing and planned Earth observation satellite data. The WGDMS focuses on developing and refining recommendations for the application of satellite data to selected hazard areas: drought, earthquake, fire, flood, ice, landslide, oil spill, and volcanic hazards.

The WGDMS supports the work of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) in pursuit of decisions taken at UNISPACE III, under the United Nations International Strategy on Disaster Reduction (ISDR) and the International Charter for Space and Major Disasters.



Composite of Landsat-7 eTM+ and RADARSAT-1 SAR imagery collected over the Kuche area, Tarim Basin, China, in 2001 and 1999, respectively. (© USGS,CSA/CCRS/RSI; processing: RIPED)

In 2002, the CCRS continued to co-chair the landslide and flood teams of the WGDMS, contributed to the 2002 final report and is participating in the development of the IGOS-Partner program for geohazards. The WGDMS Flood and Geohazard team summary reports were published and presented at a special session on the Disaster Management Support Group at IGARSS '02, co-chaired by NOAA and the CCRS.

3.7.1.4. WORKING GROUP ON TRAINING AND EDUCATION (WGEDU)

At the CEOS 15th Plenary in Kyoto, the Strategy of the WGEdu and 3-year action plan were adopted. The WGEdu was given a 3-year mandate to implement the action plan.

In May 2002 the annual meeting of the working group was held in Ottawa, Canada, hosted and chaired by the Canada Centre for Remote Sensing. At this meeting a draft version of the specific activities, responsible agencies and an implementation schedule were developed.

The CCRS is coordinating an effort to make CEOS agencies' educational and training materials more accessible and visible to the international EO training world. The design for an access portal has been completed in cooperation with AIT/NADSA and EUMETSAT.

3.7.2. CANADA-ESA COLLABORATION

General

The first Canada-ESA cooperative agreement was signed over 23 years ago in 1979 and was last renewed in 2000 for another 10 years. Canada is the only non-European country to participate in ESA programs. The agreement provides the framework for Canadian companies and other organizations (universities, research institutes and various government departments) to collaborate in space-related activities with their European counterparts. In terms of industrial benefits, over $350M in contracts were awarded to Canadian companies through ESA programs.

Canada currently participates in the following ESA programs:

- Earth observation: ENVISAT, Earth Observation Preparatory Program (EOEP), GMES;
- Satellite communication: ARTES-1, -3, -5 and ARTEMIS;
- Satellite navigation: GalileoSat Definition Study;
- Planetary exploration: AURORA.

In addition, Canada participates in the General Support Technologies Program (GSTP) and the mandatory General Budget.

3.7.2.1. ENVISAT

ENVISAT is the follow-on to ESA's earlier Earth observation satellites, ERS-1 and ERS-2, in which Canada had a significant participation. It constitutes a major contribution to the effort of space agencies worldwide to provide the data and information required to further the understanding, modelling, and prediction of environment and climate change.

Participation in ENVISAT provided opportunities for Canadian companies to offer their expertise for its design and construction, in particular the expertise in Synthetic Aperture Radar acquired from Canada's RADARSAT program. The list of major Canadian participants is as follows:

- EMS Technologies provided antenna expertise for ASAR in addition to switch assemblies and on-board electronic sub-systems;
- ABB Bomem contributed to MIPAS and MERIS;
- COM DEV provided microwave components for the MWR;
- MDA, with its expertise as leader of development of the ground segment, contributed to the Payload Data Segment.

Canadian end users will also benefit from Canada's involvement in ENVISAT. As a participating member, the CCRS concluded a data distribution agreement with ESA to distribute ASAR data to Canadian government departments. For more information on ENVISAT, consult the website: <www.envisat.esa.int>.

3.7.2.2. EARTH OBSERVATION ENVELOPE PROGRAMME

ESA's Living Planet Program has been introduced to address the overall ESA future Earth observation activity after the ENVISAT program. It consists of two main components: the research-oriented Earth Explorer missions and the operational service-oriented Earth Watch missions. These missions are implemented via two programs: the Earth Observation Envelope Programme (EOEP) and the Earth Watch (EW) Program. The Earth Explorer missions are completely covered within the EOEP. Details on ESA's Living Planet Programme can be found at: <www.esa.int/export/esaLP/>.

The first phase of EOEP (EOEP-1) covers the 1998-2002 period, through which two Core and three Opportunity missions have been selected. Planning and implementation scenario for the second phase of EOEP (EOEP-2) have been formulated. Three Core missions are selected for phase A study. Canada is particularly interested in SPECTRA and WALES. Active participation by the Canadian industry is expected for the Atmospheric Dynamics Mission (ADM: now renamed AEOLUS) selected as one of the EOEP-1 Core missions whose objective is to measure global wind profile using LIDAR. The data generated is of strong interest to the Meteorological Service of Canada (MSC).

Within the Opportunity missions of EOEP-1, Canada proposed SWIFT (Stratospheric Wind Interferometer for Transport studies) as a cooperative mission between ESA and CSA. Through collaboration with NASDA, SWIFT was selected as one of the payloads to fly on NASDA's GCOM-A1. Canada is well positioned for this type of mission with a strong heritage going back to WINDII (Wind Imaging Interferometer), launched on board NASA's Upper Atmospheric Research Satellite (UARS) in 1991.

3.7.2.3. GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY

Global Monitoring for Environment and Security (GMES) is a European initiative to develop an "Information Infrastructure for Spatial Data." GMES was launched in 1998 as a joint initiative of the European Union (EU) and the European Space Agency. Combining space, land-based and airborne technologies, GMES will help develop innovative tools and applications to generate the information/knowledge that will assist decision and policy makers. For further information on ESA's GMES, see: <http://gmes.jrc.it/>.

The ESA component of GMES, implemented within the Earth Watch program, is known as the GMES Service Element (GSE). The European Space Agency approved the GSE program in November 2001, with a total budget of € 83 million over the 2002-2006 period. Canada is one of the 14 participating countries.

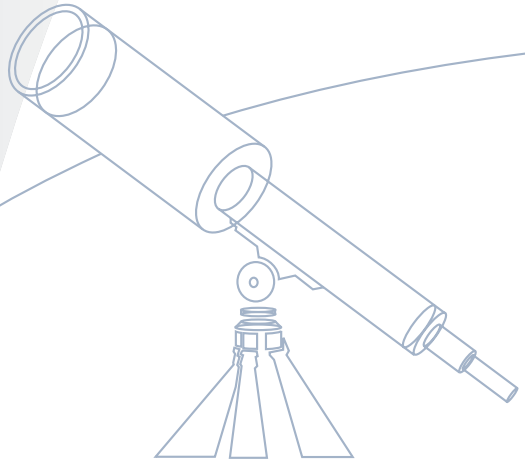
3.7.2.4. IGARSS

The 22nd International Geoscience and Remote Sensing Symposium and the 24th Canadian Symposium on Remote Sensing (CSRS) were held in Toronto, Ontario from June 24 to 28, 2002. The theme of IGARSS 2002 / 24th CSRS, "Remote Sensing: Integrating Our View of the Planet," reflected the power of integrating multiple sources of satellite and airborne imagery with geographic information and the expertise of many disciplines.

Topics of the symposia covered a broad selection of the most current specializations within the fields of geoscience and remote sensing, organized under six headings: Applications of Remote Sensing; Missions, Programs, Societal Issues and Educational Initiatives; Geoscience, Modelling and Processes; Data Processing and Algorithms; Electromagnetic Problems; and Instrumentation and Techniques.

Dr. Marc Garneau, Canada's first astronaut and the President of the Canadian Space Agency, made a presentation at the plenary session on the first day of the conference.

IGARSS 2002 was the largest IGARSS symposium, IGARSS 2003 will be held July 21-25, 2003 in Toulouse, France. For additional information on IGARSS and the Geoscience and Remote Sensing Symposium, please visit the following website: <http://ewh.ieee.org/soc/grss/>.



4.0 LIST OF CONTRIBUTING CANADIAN DEPARTMENTS

CANADIAN SPACE AGENCY
<www.space.gc.ca>

AGRICULTURE AND AGRI-FOOD CANADA
<http://aceis.agr.ca>

DEPARTMENT OF FISHERIES AND OCEANS
<www.dfo-mpo.gc.ca>

NATURAL RESOURCES CANADA
<www.nrcan-rncan.gc.ca>

- CANADA CENTRE FOR REMOTE SENSING
  <www.ccrs.nrcan.gc.ca>
- CANADIAN FOREST SERVICE
  <www.pfc.forestry.ca>

ENVIRONMENT CANADA
<www.ec.gc.ca>

- CANADIAN ICE SERVICE
  <www.cis.ec.gc.ca>
- METEOROLOGICAL SERVICE OF CANADA
  <www.msc-smc.ec.gc.ca>

5.0 ACRONYMS

A	
ACE	Atmospheric Chemistry Experiment
ADM	Atmospheric Dynamics Mission (now AEOLUS)
AIT	Asian Institute of Technology
AO	Announcement of Opportunity
ARTEMIS	Advanced Relay and Technology Mission Satellite
ARTES	Advanced Research in Telecommunications Systems
ASAR	Advanced Synthetic Aperture Radar
AURORA	ESA Space Science Mission
AVHRR	Advanced Very High Resolution Radiometer
C	
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite
CCAF	Climate Change Action Fund
CCIN	Canadian Cryosphere Information Network
CCRS	Canada Centre for Remote Sensing
CDPF	Canadian Data Processing Facility
CDR	Critical Design Review
CENA	NASA ESSP Mission
CEONet	Canadian Earth Observation Network
CEOS	Committee on Earth Observation Satellites
CFS	Canadian Forestry Service
CGDI	Canadian Geospatial Data Infrastructure
CGOD	Canadian Government Order Desk
CLCI	Canadian Land Cover Initiative
CloudSat	NASA Earth System Science Pathfinder Mission
CNES	Centre National d'Etudes Spatiales – French space agency
COPUOS	Committee on the Peaceful Uses of Outer Space (United Nations)
Cosmos-Skymed / Skymed Pleiades	ESA Earth Observation Satellite
CRB	Climate Research Branch of the MSC
CRYSYS	Variability and Change in the Cryospheric System in Canada
CSA	Canadian Space Agency
CSRS	Canadian Symposium on Remote Sensing
D	
DAAC	Data Acquisition and Archiving Centre
DAS	Direct Archiving System
DMSG	Disaster Management Support Group
DORIS	Doppler Orbitography and Radio positioning Integrated by Satellite
E	
EM	Engineering Model
ENVISAT	ESA Environmental Satellite
EO	Earth Observation
EOADP	Earth Observation Application Development Program
EOEP	Earth Observation Envelope Programme
EOS	Earth Observing System
EOSD	Earth Observation for Sustainable Development of Forests
EROS	Earth Resources Observation System Satellite
ERS	European Remote Sensing Satellite
ERTS	Earth Resources Technology Satellite
ESA	European Space Agency
ESSP	Earth System Science Pathfinder
ETM	Enhanced Thematic Mapper
EU	European Union
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EW	Earth Watch

F

FireM3	Fire Monitoring Mapping and Modelling
FTP	File Transfer Protocol

G

GCOM-A1	Global Change Observing Mission-A1
GDP	GeoConnections Discovery Portal
GEWEX	Global Energy and Water EXperiment
GHG	Greenhouse Gas
GLIMS	Global Land Ice Measurements from Space
GMES	Global Monitoring for Environment and Security
GOFC	Global Observation of Forest Cover
GOLD	Global Observation of Land Dynamics
GRIP	Government Related Initiative Program
GSC	Geological Survey of Canada
GSE	GMES Service Element
GSTP	General Support Technology Programme
GTOS	Global Terrestrial Observing System

I

IGARSS	International Geoscience and Remote Sensing Symposium
IGOS	Integrated Global Observing Strategy
IHARF	Indian Head Agricultural Research Foundation
Ikonos	US Commercial high Resolution EO satellite
INRS	Institut National de la Recherche Scientifique (Université du Québec)
IR	Infrared
ISDR	International Strategy on Disaster Reduction (United Nations)
ISRO	Indian Space Research Organization

L

LAI	Leaf Area Index
LIDAR	Light Detection and Ranging

M

MCDR	Mission Critical Design Review
MDA	MacDonald, Dettwiler & Associates Ltd.
MERIS	Medium Resolution Imaging Spectrometer
MIPAS	Michelson Interferometer for Passive Atmospheric Sounding
MODIS	Moderate Resolution Imaging Spectroradiometer
MOPITT	Measurements of Pollution in the Troposphere
MOU	Memorandum Of Understanding
MSC	Meteorological Service of Canada
MWR	Microwave Radiometer

N

NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NFI	National Forest Inventory
NFIS	National Forestry information System
NOAA	National Oceanic and Atmospheric Administration
NRCan	Natural Resources Canada
NSS	New Stentor Services
NTS	National Topographic System

O

OGC	Open GIS Consortium
OSIRIS	Optical Spectrograph and Infrared Imaging System

P

PACC	Public Agency Content and Connectivity
PGS	Product Generation System
PICASSO	NASA ESSP Mission

Q

QuickBird	US Commercial High Resolution EO satellite

R

RADARSAT	Canadian Synthetic Aperture Radar Satellite
REMSAT	Real-Time Emergency Management via Satellite
RSI	RADARSAT International Inc.

S

SAR	Synthetic Aperture Radar
ScanSAR	RADARSAT SAR Scanning Mode
SCISAT	Space science satellite
SDI	Spatial Data Infrastructure
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SMR	Swedish Sub-Millimetre Radiometer
SPECTRA	ESA EOEP Mission
SPOT	Système pour l'observation de la Terre
SPOT-VGT	SPOT Vegetation Sensor
SSM/I	Special Sensor Microwave/Imager
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
SWE	Snow Water Equivalent
SWIFT	Stratospheric Wind Interferometer For Transport Studies
SWIR	Short Wave Infrared

T

TM	Landsat Thematic Mapper

U

UARS	Upper Atmosphere Research Satellite
UNISPACE	United Nations Conference on the Exploitation and Peaceful Uses of Outer Space
UV	Ultraviolet

W

WALES	ESA EOEP Mission
WGCV	Working Group on Calibration and Validation
WGDMS	Working Group on Disaster Management Support
WGEdu	Working Group on Training and Education
WGISS	Working Group on Information Systems and Services
WINDII	Wind Imaging Interferometer

X

XL	Extra Long Range Launcher


EARTH OBSERVATION