The Centre is engaged in the sustainable development of Quebec in the fields of water sciences, geo-resources, and the environment.
The Centre Eau Terre Environnement contributes to the INRS mission of research, education, and the transfer of scientific and technical knowledge through its work on the integrated management, conservation, and sustainable development of water and earth resources. The Centre is addressing major environmental issues of current concern to the world’s governments, such as the need for reasonable and safe use of water and earth resources, the necessity to prevent environmental risks, and the need to respect natural ecosystems. The Centre is dedicated to finding practical solutions, focusing in particular on natural processes of remediation and new environmental technologies. The Centre’s vision is based on a strong environmental commitment and a rigorous and innovative scientific approach. Its research is at the forefront of scientific and technological advances facilitating the establishment of good practices in protecting and developing natural resources.
I am pleased to present the 19th annual report of the Centre Eau Terre Environnement of the Institut national de la recherche scientifique for the year 2007-2008. The mission of the Centre is to conduct pure and applied research and train highly qualified professionals in the fields of water sciences, georesources, and the environment. Our objective is to contribute to the sustainable development of Quebec’s natural resources. The Centre’s mission also includes sharing knowledge and technology transfer. This annual report outlines the outstanding events and activities of the Centre Eau Terre Environnement during 2007-2008.

The scientific program of the Centre is divided into four main research fields: hydrology, waste decontamination and reuse, aquatic and terrestrial biogeochemistry, and geological sciences. Within each field, the main research projects carried out in 2007-2008 are briefly described in the report.

In 2007-2008, the International Polar Year (IPY) provided a good opportunity for Centre Eau Terre Environnement researchers to work actively with the national and international scientific communities. INRS researchers participated in seven major IPY projects. Another international research initiative, the Potrok Aike Maar Lake Sediment Archives Drilling Project (PASADO), officially began in 2008. Pierre Francus leads the Canadian contribution to this important study.

This year’s report contains a map highlighting the Centre Eau Terre Environnement’s presence throughout the world, including active research sites and the countries of origin of researchers, students, and collaborators. More than 25 guest professors and researchers from around the world came to the Centre this year.

Some outstanding events of the year

In June 2007, the arrival of six new professor-researchers greatly enhanced the Centre’s research expertise. In hydrology, Karem Chokmani (remote sensing) and Sophie Duchesne (urban hydrology), in waste decontamination, Satinder Kaur Brar (biological detoxification) and Patrick Drogui (electrochemistry), and in geosciences, Erwan Gloagen (hydrogeophysics) and Pierre-Simon Ross (volcanology and applied geology).

In October 2007, we completed construction of a new building to house the heavy-duty laboratories of the Centre. Located in the Metropolitan Quebec Technology Park, this research facility contains high-tech equipment that will enable the scaling of technologies developed at the INRS.

In November 2007, a celebration was organized for Dr. Jean-Pierre Villeneuve to mark the end of his term as the Centre’s director. It was an opportunity both to highlight Dr. Villeneuve’s achievements for the Centre and to recognize the strength of the research teams that he helped to build over the years.

In December 2007, the Centre acquired a research station at Sacré-Cœur, not far from Tadoussac at the mouth of the Saguenay River. This research station will facilitate research on boreal rivers and also serve as an educational facility.

In April 2008, the Centre consolidated its collaboration with Morocco by contributing to the creation of the Institut supérieur des hautes études en développement durable (ISH-EDD). This institute will bring together North African and European partners within training programs in water sciences.

In May 2008, the INRS hosted the 76th ACFAS Congress. The conference theme, “Knowledge meets 400 years of history”, was linked to the 400th anniversary of Quebec City. This annual meeting is the most important scientific event in Quebec. It was a great success this year, with more than 4400 participants. Professor Villeneuve was the president of the congress.

Other notable events of 2008 included the very successful 9th Earth and Environmental Sciences Day, hosted in March at the Centre Eau Terre Environnement. The 20th anniversary of the Journal of Water Science, which is co-edited by the Centre, was also celebrated in 2008.

This report thus highlights the main achievements of the Centre Eau Terre Environnement during 2007-2008. Credit for those achievements belongs to the entire hard working Centre Eau Terre Environnement community, including some 40 professor-researchers, more than 200 graduate students and postdoctoral fellows, and the staff of the Centre, all of whom contributed their share to the success of our establishment.

I would like to sincerely thank everyone who contributed to this report through his or her activities.

The Director,

Yves Bégin
Multidisciplinary research

The Centre Eau Terre Environnement is a leader in environmental research. The Centre’s multidisciplinary research on environmental technologies, cutting edge methods of detecting environmental changes in ecosystems, innovative approaches to integrated management of resources, and numerical modeling of underlying natural and environmental processes bring together important scientific knowledge on the environment. Its research teams study water and earth resources with the aim of contributing to an informed and sustainable use of these resources.

The scientific program of the Centre Eau Terre Environnement is divided into four main research fields: hydrology, waste decontamination and reuse, aquatic and terrestrial biogeochemistry, and geological sciences. These fields share many common strategic axes, such as risks related to extreme natural events or contamination of human origin, the impact of climate change on resources and their use, and the adaptations necessary to respond to these changes; the management of hydrological and mineral resources and resulting regional planning; and restoration and decontamination technologies for urban and natural environments.

Hydrology research and ongoing projects

Canada has approximately 6% and Quebec nearly 2% of the world’s fresh water resources. Management, decontamination, and protection of this vital resource are thus priority research subjects at the INRS. Work is carried out in hydrology, hydrogeology, biogeochemistry, water quality, and environmental technologies. The Centre Eau Terre Environnement hosts the most important group of university experts in water research in Canada.

Research in hydrology focuses specifically on predictive statistics (flood and ice jam prediction, impact of climate change on occurrence of extreme hydrological events, tools to assist in the design of hydrotec- tric structures, etc.); watershed hydrology (infrastructure, impact of climate change on water supply, contamination by runoff, etc.); environmental hydrodynamics (flood risk, impact of climate change on the forest environment, erosion, etc.). The Centre’s aquatic research also has a northern physical oceanography component. A research team specializes in the study of circulation and evolution of the sea surface layer and tides in order to better understand the physical processes involved and their impact on marine life and habitats.

Several of Taha B.M.J. Ouarda’s research projects concern the impact of and adaptation to climate change. A project of the Ouanos Consortium (Consortium on Regional Climatology and Adaptation to Climate Changes) in collaboration with Quebec’s National Institute of Public Health explored the relationships between climate and mortality in order to find the best statistical explanatory model. Quebec’s Ministry of Sustainable Development, Environment and Parks is interested in the impact of climate change on groundwater. Taha Ouarda thus conducted a preliminary study on the development of a groundwater level monitoring network.

Another project of this researcher, financed by Environment Canada, seeks to determine the relationships between suitable climatic variables, their evolution, and hydrological extremes (floods, low water levels). The resulting knowledge and tools will be useful for developing adaptive strategies for water resources in Canada.

Within the Hydrology and Climate Working Group of the International Joint Commission on the management of the Great Lakes, Taha Ouarda is working to identify changes that have occurred in the characteristics of the lakes and their watersheds (lake levels, precipitation, flows, evaporation, etc.) to determine the links with explanatory variables and to study the relationships between Great Lakes levels and various indices of low frequency climatic oscillations. This researcher also continues to improve the software REGIONS (Regionalization of Extreme Hydrological Events) by integrating the latest methodologies developed by the research team of the Chair in Statistical Hydrology. This project is financed by Hydro-Québec, which uses this software.

Lastly, Taha Ouarda has undertaken a study for the Canadian Coast Guard re-evaluating the under- keel clearance (UKC) standard for ships using the St. Lawrence shipping channel in order to propose a new statistical methodology for modeling UKC that complies with the rules and enables rational modeling of risks. UKC integrates a variety of components, of which the most important is the squat, the additional sinkage caused by a ship’s movement.

In collaboration with the research institute of Hydro-Québec, Anne-Catherine Favre is developing a methodology for multivariate frequency analysis to be used to determine the design flow of a hydraulic structure. The ultimate goal is to apply this methodology to the annual maximum levels of the Romaine River.

Another research project of Anne-Catherine Favre seeks to integrate ensemble weather forecasts from Environment Canada with short-term hydrological forecasts in order to account for the uncertainty of weather data. Short-term hydrological forecasts are necessary to manage surface waters effectively, especially in crisis situations such as floods.

As part of an international partnership (collaboration with the ENSEMBLES project of the European Community: www.ensembles-eu.org), André Saint-Hilaire and Taha B.M.J. Ouarda work on developing scena- rios of climate change at high spatial resolution. Their work consists of evaluating quantitatively the uncertainty associated with scenarios generated within a probabilistic framework in order to offer extra information to the users on scenario probabilities.

André Saint-Hilaire is interested in river habitats. His research increases our knowledge on variables such as thermal regime and concentration of solids in suspension by developing stochastic estimation models. He has worked on multivariate geostatistical modeling for water temperature.

This researcher also seeks to minimize the environmental impacts of peatland harvesting by developing approaches to reduce the sedimentary load produced by these activities.
Watershed Hydrology

Within the GÉODE Network (Geomatics for Informed Decisions), Monique Bernier leads the FRAZIL project (Integrated Expertise Towards the Development of an Ice Jam Related Flood Warning System) with the collaboration of Taha B.M.J. Guirat. The project’s goal is to develop a mapping software solution meeting the specific needs of ice-jam-related flood prevention, dam management, and control of winter navigation.

Monique Bernier also seeks to integrate information derived from radar polarimetry (ENVISAT, RADARSAT-2) in decision support systems for the monitoring of snow cover, soil freezing, and flood and ice jam forecasting.

Within the National Agri-Environmental Standards Initiative, Alain Rousseau collaborated with Environment Canada in developing an approach for hydrological modeling to be used for determining agri-environmental performance standards for pesticides using the GIBSI (Gestion Intégrée des Bassins versants à l’aide d’un Système Informatisé) model developed at the INRS and the SWAT (Soil and Water Assessment Tool) model developed by the USDA. Pesticide standards are defined as the concentration levels that can be reached by using good management and agricultural practices and the technologies available. The GIBSI model has been applied to four Canadian watersheds. The long-term results will contribute to the understanding and prevention or reduction of environmental and human health threats posed by toxic substances.

In the Bras d’Héritier (BH) sub-basin, beneficial management practices (BMPs), such as buffer strips, reduced manure management, and crop rotation, have been implemented. This project, carried out in collaboration with Agriculture and Agri-Food Canada seeks to use the GIBSI model to characterize water quality after implementation of BMPs in the BH and to generate prototype software based on GIBSI to examine the economic and environmental compromises of BMPs in the BH and in the watershed scale for the Beauvrajne River (Chaudière-Appalaches region). Hydrological modeling is carried out by Alain Rousseau and his team.

Hydrological modeling has also been used by this researcher and his team to evaluate changes in river flows after forest harvesting in relation to the developmental stages of forest cover and harvest effects on chemical substance balance in the Montmorency Forest.

Finally, Hydro-Québec via Ouranos is interested in pursuing the development and adaptation to the boreal context of the hydrological model HYDROTEL in order to better understand and predict the historical and future hydrological behaviour of its northern basins for planning hydroelectric production. This project is carried out by a team of INRS researchers including Alain Rousseau.

For more information


Urban Hydrology

Like other research areas, urban hydrology is addressing the impact of climate change. Alain Mailhot and his team currently have several research projects specifically focused on this issue. At the request of Quebec’s National Institute of Public Health, this research team carried out an analysis of predictions for future precipitation and water flows in southern Quebec in order to determine potential risks associated with drinking water supply.

Climate change will likely modify the recurrence and intensity of heavy rainfall events and thus increase the risk of overflow in urban drainage networks and the risk of flooding in urban environments. In collaboration with the Ouranos Consortium, Alain Mailhot and his team developed an approach integrating climate change into the design and planning of urban drainage infrastructure renewal. Various adaptation strategies are also being considered in order to maintain the functionality of drainage infrastructures in the face of climate change. One such project is currently underway in Montreal to study and simulate different adaptation strategies and analyze implementation conditions in a urban context.

Sophie Duchesne is a new researcher-professor at the INRS. Her research interests relate to the development of mathematical models and adaptation of existing algorithms (flow simulations, water quality, infrastructure behaviour), and the use of methods based on these models, to improve management of water resources and infrastructures. Her current work focuses on modeling the ageing of sewage lines to plan repair and replacement work. One of her particular interests concerns the management and modeling of rainwater in urban environments.

For more information


**http://dx.doi.org/10.1016/j.jhydrol.2007.08.019**

Environmental hydraulics

Normand Bergeron participates in the Geoosar II project of the GÉODE Network. Geoosar II is continuing integrated modeling of juvenile Atlantic salmon movement and physical habitats in fluvial and estuarine environments. It seeks to understand how temporal and environmental variations influence salmon behaviour and reproduction.

In collaboration with Quebec’s Ministry of Natural Resources and Wildlife, Normand Bergeron carried out an evaluation and monitoring of fish for a multi-species fish ladder on the Feu stream at Lachenaie (Montreal region). This researcher also continues his work to improve knowledge about river shapes and processes that affect the winter habitat of salmon.
An environmental consulting firm using the MODELEUR/HYDROSIM simulation software conceived at the INRS has contracted with Yves Secretan to use his expertise in 2D Hydrodynamic and habitat modeling.

An international project

Country: Mexico
Official language: Spanish
Partner: Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional (CINVESTAV)
Funding: International Development Research Centre (IDRC)

Funding for research cooperation between Canada, Latin America and the Caribbean enabled the multidisciplinary expertise of the Centre Eau Terre Environnement and the National Polytechnic Institute of Mexico to be brought together. The objective was to use software developed at the INRS to analyze data on three coastal lagoons of the Yucatan peninsula collected over several years by Mexican researchers. Yves Secretan collaborated in the development of numerical models to analyze current dynamics, simulate contaminant transport, and evaluate habitat quality and availability for these lagoons. The results will help in decision making for the sustainable management of these ecosystems, which are unique in terms of biodiversity but are currently threatened by human activities. This collaboration will contribute to creating a contact network between Mexican and Canadian researchers and institutes.

One subsection for the collaboration scientific between Canada, America Latina and the Antillas has permitted the puesto en común de los partidos multidisciplinarios del Instituto Politécnico Nacional de Mexico y del Centre Eau Terre Environnement. El objetivo era de juntar la información sobre tres lagunas costeras de la península del Yucatán que fue recogida desde muchos años por los investigadores mexicanos a la información obtenida por modelización en el INRS. Yves Secretan ha colaborado al desarrollo de modelos numéricos que permitan analizar la dinámica de las corrientes de las lagunas, simular el transporte de los contaminantes y evaluar la calidad y la disponibilidad de los hábitats. Los resultados podrían ayudar a mejorar la gestión sostenible de los ecosistemas de las lagunas únicos en términos de biodiversidad y amenazados por la actividad humana. Esta colaboración favorecerá la ampliación de las redes de contactos entre investigadores mexicanos y canadienses.

For more information


http://dx.doi.org/10.1029/2007JC004262

Waste decontamination and reuse research and ongoing projects

The Centre’s waste decontamination and reuse research seeks to develop environmental mineral processing technologies (extraction of metals from contaminated soils, fly ashes, and hazardous waste). The recommended approach seeks to reduce costs and improve environmental results by increasing the metal recovery percentage in the industrial production cycle.

In a contract with the National Research Council Biotechnology Research Institute, Guy Mercier and Jean-François Blais study the combination in a single process of metal extraction by chemical leaching and PAH (Polycyclic Aromatic Hydrocarbons) extraction using a new non-toxic and biodegradable surfactant. A previous project had already highlighted the promising potential of this new technology.

Mario Bergeron and his team continued the development of a new production process for silicon tetrachloride, SiCl4. This chemical compound is the base of a new production process for silicon for use in solar panels and solar cells. This research team also works on technologies for soil and sediment decontamination.

Oceanography

Yves Grattan is part of a research team interested in modeling ecosystem responses to climate change in the Canadian Arctic archipelago. He specifically studies tidal and wind effects on the mixed layer, as well as the transport of fresh water, heat, ice, and nutrients in this archipelago. Yves Grattan was one of the project leaders in phase I of the research of the ArcticNet Network, which was completed in March 2008. His project studied the physical and biological coupling between the ocean, sea ice, and the atmosphere in the High Arctic. Yves Grattan is also conducting other research on mid-scale physical processes and their impacts on the biological production of the Canadian Arctic.

Hydrometallurgy and environmental mineral processing

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Biomass and waste reuse

With the objective of reducing greenhouse gases and reducing waste, Guy Mercier and Jean-François Blais are exploring the energy production potential of various sludge and waste materials and trying to determine the optimal mixtures for use in biomass boilers. They are documenting available technologies for drying these materials and calculating the energy budget of different approaches in consultation with liquid and solid waste producers.

Guy Mercier and Jean-François Blais are collaborating with Patrick Droisel on many research projects in partnership with industry. In one of these projects, they are developing technological solutions for the treatment of two important wastes of the aluminum industry, red mud and waste containing PAH. These researchers are working on physical and chemical separation processes that destroy or extract the inorganic and organic contaminants in order to make these wastes acceptable in landfills. They are also exploring ways of reusing the fluorine and treated residues. Another goal is to develop a process to transform red mud into a soluble coagulant usable for wastewater treatment.

This same research team has also been contracted to develop a new treatment technology using biofiltration for agroalimentary wastewater. The objective is to evaluate the reuse potential of sludge from wastewater and organic solid residue treatment for producing high-quality composts.

For more information


http://dx.doi.org/10.1029/2007JC004262
Satinder Kaur Brar is a new researcher-professor at the INRS. Her research interests relate to wastewater treatment, soil decontamination, bioprocesses, and transformation of sewage sludge and agricultural waste into value-added products. She has undertaken work on wastewater toxic organic compounds and the possible reuse and decontamination of sewage sludge. In partnership with industry, this researcher has begun a project to develop a biopesticide containing a baculovirus of the codling moth (a major pest of apple orchards). The goal is to obtain a viral insecticide in powder form that is safer and less expensive to export than liquid pesticides.

The Greater Moncton Sewerage Commission has mandated this researcher to carry out an evaluation of greenhouse gases production during sewage sludge treatment and reuse in order to integrate this component into their management strategies.

Savitri Kaur Brar is a new researcher-professor at the INRS. Her research interests relate to wastewater treatment, soil decontamination, bioprocesses, and transformation of sewage sludge and agricultural waste into value-added products. She has undertaken work on wastewater toxic organic compounds and the possible reuse and decontamination of sewage sludge by enzyme production based on solid-state fermentation. She collaborates with other organizations to develop value-added products, such as microencapsulations, microemulsions, granules, powders, etc.


http://dx.doi.org/10.1016/j.hydromet.2008.02.004

Rajeshwar Dayal Tyagi continued his work on the decontamination of sewage sludge using a biological process and the development of new processes for producing value-added products from decontaminated or fresh sludge. In partnership with industry, this researcher has begun a project to develop a biopesticide containing a baculovirus of the codling moth (a major pest of apple orchards). The goal is to obtain a viral insecticide in powder form that is safer and less expensive to export than liquid pesticides.

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Another technology conceived at the INRS is a treatment process for pig manure (LiSOX) that concentrates phosphorus into a solid that is economically transportable. Guy Mercier, Jean-François Blais, and Rajeshwar Dayal Tyagi in which various electrolytic treatments are studied to increase metal recovery and destruction of organic contaminants during the decontamination of industrial wastewater and solid residues. They are developing a decontamination process for chromated copper arsenate treated wood, for example.

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Working again toward the improvement of these processes, Jean-François Blais has undertaken an industrial partnership project in collaboration with Guy Mercier, Patrick Drogu, and Rajeshwar Dayal Tyagi in which various electrolytic treatments are studied to increase metal recovery and destruction of organic contaminants during the decontamination of industrial wastewater and solid residues. They are developing a decontamination process for chromated copper arsenate treated wood, for example.

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Research in biogeochemistry focuses on contaminant dispersion and assimilation and the effects of trace metals on aquatic organisms in order to detect environmental changes in lake ecosystems. Environmental geochemistry (source identification, transport and elimination of contaminants from aquatic environments by sedimentation, etc.), limnology (bio-optics, carbon fluxes, limnology, etc.), and ecotoxicology are the main research areas.

For more information


http://dx.doi.org/10.1016/j.asr.2008.02.004

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For more information


http://dx.doi.org/10.1016/j.gca.2007.10.014

Aquatic and terrestrial biogeochemistry research and ongoing projects

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For more information

Pierre Lartigue continued his research on the influence of biophysico-chemical processes on the evolution and transport of organic compounds in soil and groundwater at the local (agricultural field) and regional (watershed) scales. This research aims to further our understanding of contamination from diffuse sources and to apply the knowledge obtained to predict the transport of organic compounds within hydrosystems and treat soil contamination.

In collaboration with Quebec’s Ministry of Natural Resources and Wildlife, Claude Fortin and Alain Rousseau seek to evaluate the consequences of forest harvesting on the chemical composition of alkaline lakes in the Chics-Chocs Wildlife Reserve (Gaspesie region) by following the physicochemistry of six lakes, three of which have had part of their watershed harvested.
**Limnology**

Isabelle Laurion collaborates with an environmental association devoted to protecting Lake Saint-Charles (APEL) on a limnological study in the upstream part of the Saint-Charles River watershed to try to determine the causes of the cyanobacterial blooms observed in the lake. Isabelle Laurion and her team evaluate the performance of in vivo fluorometers for monitoring cyanobacteria in lakes and examine interference factors. They are also interested in the factors that influence the recruitment of benthic forms of cyanobacteria dormant in the sediments.

In addition, Isabelle Laurion is interested in the effect of thermokarst ponds created by permafrost melting on carbon fluxes and greenhouse gas emissions in northern environments. She participates with Pierre Francus in a team project within the ArcticNet Network to acquire the necessary knowledge and tools to monitor the evolution of the thermokarst ecosystems already affected by climate change.

**Ecotoxicology**

Peter Campbell continued to develop a model to predict the bioavailability of trace metals in aquatic organisms in natural environments. This model takes into account metal speciation, environmental factors, and the contribution of particulate metals to the bioaccumulation.

Peter Campbell is conducting several research projects in collaboration with Claude Fortin. In one of them, they work on developing molecular probes for evaluating quantitatively the bioavailability of trace metals dissolved in water in natural environments.

The goal is to study the in situ response of aquatic organisms to help validate laboratory models.

Claude Fortin continued his research on characterizing the exposure of aquatic organisms to metals and the toxicological effects of metals in relation to bioavailability. As part of a team project, he also studied the capacity of cultivated algae to modify metal speciation in a controlled environment. The team’s objective is to develop a new approach to evaluate the toxicity of metals in algae.

One of the main objectives of Landis Hare’s research activities is to develop biological and geochemical models to predict the contamination level of lakes from that of several species of aquatic invertebrates.

**For more information**


http://dx.doi.org/10.1016/j.aquatox.2007.02.019

Patrice Couture’s research program examines the mechanisms of metal toxicity in wild fish. Noxious effects have already been shown in yellow perch in lakes contaminated by mining operations and smelters.

On this subject, Patrice Couture and Peter Campbell are working in collaboration with industry to develop functional genomic tools to measure the response of yellow perch to stresses caused by metal contamination.

Within the aquatic ecosystem group of the MITHE (Metals in the Human Environment) Strategic Network, Landis Hare leads and Peter Campbell, Patrice Couture, and Claude Fortin participate in a project on the transfer of trace metals within aquatic food chains. The processes driving the transfer of metals toward higher trophic levels are studied with field and laboratory experiments.

For more information


http://dx.doi.org/doi:10.1016/j.aquatox.2007.10.003
Geosciences research and ongoing projects

Geosciences research is highly diversified at the INRS. A unique example of a partnership between a university and a governmental organization, the Quebec Geosciences Centre groups scientists from the Centre Eau Terre Environnement and the Quebec division of the Geological Survey of Canada (GSC-Quebec). The joint objective is to develop efficient analytical methods for sedimentary environments and associated natural resources (fossil fuels and minerals). Environmental geosciences activities relate to the study of current geological processes and their environmental impacts and to the reconstruction of past environments using biological indicators. Climate change impacts are at the heart of the research in environmental geology. Hydrogeology also occupies an important place. For example, in collaboration with the Department of National Defence, INRS researchers have been studying groundwater contamination on Canadian military bases for several years. Geophysical applications in archaeology are also of interest.

- Geological environments and natural resources

Richmond Minerals Inc. is involved in mineral exploration in the south-western part of the Grenville geologic province. It has contracted Lyal Harris to test for the presence of an iron oxide-copper-gold hydrothermal system in the Bondy gneiss complex (Mont-Laurier region).

Lyal Harris also continues his research activities on geological structures in extensional tectonic regimes and sedimentary basins with irregular margins by using numerical and physical modeling techniques and field studies.

Marc Richer-Laflèche has several research activities financed by JAG Mines Ltd. Detailed lithostratigraphic studies of limestone rocks and bituminous shales, as well as geophysical surveys, were carried out as part of a geochemical and geophysical analysis of the Ordovician sedimentary formations of the Lake Saint-Jean basin. This researcher also continued to work on a detailed geochemical study of fossil fuels, trace metals, and natural radioactivity in forest soils of the Témiscouata region. The data obtained in these two study regions will be used to check the fossil fuel potential of the basins. In a new project, Marc Richer-Laflèche also examined Ordovician rocks of the Baie-Saint-Paul and La Malbaie area in the Charlevoix region. A geochemical study enabled evaluation of the lithological characteristics and oil and gas potential of this area.

Michel Malo continued his research on the tectonics of orogenic fronts in the Appalachian Mountains. His goal is to analyze the crust deformation mechanisms in orogenic fronts to understand their influence on the development of the porosity and permeability of rocks that could contain fossil fuel reservoirs or ore deposits.

Within the DIVEX Network (Diversification of Mineral Exploration in Quebec), Michel Malo documents the geological and metallogenetic parameters of the Robert gold deposit on Goldcorp’s Éléonore property (James Bay region).

In collaboration with the Geological Survey of Canada, Michel Malo continues his research on the tectono-stratigraphic and structural context of the Appalachian Mountains in the Bas-Saint-Laurent region. Field data, compilation of recent work, and study of public seismic profiles will be used to support data on bedrock maturation and evaluation. The goal is to complete the coverage between Quebec City and the eastern limit of the Gaspésie region and to define areas of interest for fossil fuels.

For more information


http://dx.doi.org/10.1139/E07-012

Pierre-Simon Ross is a new researcher-professor at the INRS. His research interests relate to ore deposits associated with volcanic or magmatic activity such as volcanogenic massive sulphide deposits, porphyries, and kimberlites and their geological environments. In a multidisciplinary study on the Blake River group in the Abitibi region, he is studying mafic to intermediate volcaniclastic units in order to better understand the volcanic architecture and facilitate exploration for volcanogenic massive sulphide deposits. Many of these ore deposits are found in the Blake River group and hence mineral exploration is very active.

- Environmental geology

In collaboration with the Roche Consulting Group, Bernard Long participated in a seismostratigraphic analysis based on very high-frequency seismic reflection data for an expansion project of the port of Cotonou, Benin. This study sought to determine precisely the superposition of the different sedimentary faces (channels, abandoned arms, progradation zones) in the current entry pass of the lagoon and several ancient ones. In Quebec, this researcher has been working to determine the position of the bedrock roof and various older stratigraphic sequences in order to map the present compact sediments and those currently being altered in an area where new harbor structures are projected.

Within the GEODE Network, Bernard Long leads the FUDOTERAM project (An Integrated Geomatics Project in Coastal Zone: Terrestrial, Airborne and Marine Data Fusion) in collaboration with the University of New-Brunswick at Fredericton and York University. The expected project result is the development of a reliable tool to assess and quantify coastal erosion and map the sedimentology and biology of the pre-coastal zone.

In the GA-Tscan laboratory, this researcher and his team study sedimentary transport under steady flow and by gravitational movement.

Honorary professor Michel Lecterc has been mandated by Québec’s Ministry of Public Security to develop a new methodology for remediation solutions to coastal erosion. This model, built on a thirty-year horizon, incorporates a variety of economic approaches, including cost-benefit analysis in present values and multicriteria analysis. It takes into account different hypotheses relative to erosion, vulnerability, and climate change.

This researcher has carried out this type of analysis for the municipality of Pointe-aux-Outardes (Mansiougan region) in close collaboration with the firm Aquapra (for coastal engineering and numerical modeling of tides and waves) and the Ouranos Consortium (for climate change). The objective was to obtain a comparative assessment of different scenarios of erosion risk reduction in this municipality. Although solutions respecting the morpho-sedimentary balance of the coastal environment were preferred, retreat options were not excluded. The recommended approach included consulting and involving the local population and participative management. More than 100 municipalities of the Côte-Nord and Gaspésie regions of Quebec are at risk of coastal erosion.

For more information


http://dx.doi.org/10.1016/j.tecto.2007.06.002

Pierre-Simon Ross
An international project

Country: Chad

Official languages: French and Arabic

Partners: Geologists of the University of Cologne (Germany), paleoenvironmentalists from Gent University (Belgium), and a consortium of experts from Germany, France, Sweden, Canada, and the USA.

Funding: Deutsche Forschungsgemeinschaft (DFG) and Fund for Scientific Research of Flanders

As part of an international consortium of experts, Pierre Francus contributed to a multidisciplinary analysis of paleoenvironmental indicators in sediment cores extracted from Lake Yoa in northern Chad. This lake is one of very few in the Sahara that have been protected against desiccation by continuous groundwater inflow. The sediments of Lake Yoa are finely laminated. An analysis by micro X-ray fluorescence, conducted at the ITRAX in the laboratories of Pierre Francus, enabled determination of how the sediments were deposited and discrimination of each of the 6000 annual laminations (varves) using the ITRAX scanner of the GIRAS laboratory. The international study concluded that the drying of the Sahara was in fact a gradual process that occurred between 5600 and 2700 years ago, in response to a gradual decrease in tropical monsoon rainfall. This new environmental reconstruction of the Sahara environment strongly contrasts with the generally accepted hypothesis that the “green Sahara” which existed between 10 000 and 6000 years ago had already ended abruptly.

Paleoenvironments

Paleoenvironments can be studied using annually laminated sediments (varves). This is the area of expertise of Pierre Francus, whose research program focuses on the integrated study of current sedimentary and limnological processes in lakes of the Canadian High Arctic. Analysis of long-varved sediments in the Canadian High Arctic, The Holocene

For more information


http://dx.doi.org/10.1177/0959683607085907

Hydrogeology

Within the Ouranos Consortium, Alain Rousseau and his team are collaborating on a new study on the impact of climate change and anthropogenic activities on groundwater levels and aquifer recharge in Canada. This study uses historical data series on base flow and well hydrographs to estimate temporal trends. These estimates will be combined with existing hydrogeological, climatic, and hydrological models to simulate scenarios of aquifer recharge in different regions of the country and under various climatic conditions.

Claudio Paniconi worked on modeling the interactions between surface water and groundwater at the scale of the sub-basin for the Châteauguay River. This research is part of the second phase of a project of the Ouranos Consortium. The goal is to improve hydrological mechanistic models in order to make them sensitive to interactions with groundwater and to develop new technologies of calibration and data assimilation. In parallel, Claudio Paniconi continued his research on the use of numerical models based on Richards’ equations in hydrological analyses.

Claudio Paniconi also collaborated with Richard Martel and René Lefebvre on vari and column tests analyzing the design, implementation, and operation of an underwater collection system using horizontal wells.

The organization responsible for waste management in the Chutes-de-la-Chaudière region has mandated

Pursuant to agreements with the Department of National Defence, Richard Martel analyzed the evolution of different metals and contaminants in groundwater, many of them specific to military installations. Sites in Ontario and Alberta, as well as the Valcartier military base, were studied in this project.

This researcher also offers scientific and technical support relative to the TCE (trichloroethylene) contamination problem in the area of the Valcartier military base.

René Lefebvre to characterize the hydrogeological context of an old landfill site now covered. The site leachate is managed by natural attenuation. This project will guide future environmental management of the site. In other related research activities, René Lefebvre is working to spatially characterize and represent the heterogeneity of complex aquifer systems. Innovative approaches to detailed hydrogeological characterization are being used, in particular direct push sounding and geophysical surveys. The objective of these efforts is to contribute to a better understanding of contaminant flow and transport in aquifers.

René Lefebvre carried out numerical modeling of gas flow within the waste rock pile of the Sullivan mine in British Columbia, owned by Teck Cominco. This modeling helped explain how oxygen-deprated air filled a sampling shaft and caused four fatalities in May 2006. These results enable a better understanding of the interactions between atmospheric conditions and gas transport in waste dumps, thus providing guidance for a new set of safety measures for these sites.

This researcher also offers scientific and technical support relative to the TCE (trichloroethylene) contamination problem in the area of the Valcartier military base.
Erwan Gloaguen is a new researcher-professor at the INRS. His research interests relate to the integration of geophysical methods using geostatistical approaches. In one of his projects in collaboration with René Lefebvre, he is interested in assessing hydrogeological properties for environmental or shallow geotechnical applications. The objective is to better represent the heterogeneity of aquifers and to develop approaches to geostatistical integration of hydrogeological and geophysical data to represent the 3D distribution of hydraulic conductivity in quaternary deposits.

In a project financed by the company Vale Inco, Erwan Gloaguen seeks to improve 3D geological models of ore deposits. This researcher also has projects on the development of new methods of geostatistical simulation based on multivariable analysis of wavelet coefficients from similar models and on the downscaling and fusion of macro and micro-CT data for reconstructing bone structure in 2 dimensions and at various scales.

Geophysical applications in archaeology
Marc Richer-LaFlèche continued his archaeometry work in several projects located within Quebec City. For example, he used methods of electromagnetic induction and high-resolution georadar to locate archaeological artefacts on the site of a 17th century Jesuit house in Sillery and in three other sites that have been occupied since the 16th century in Cap-Rouge. Another part of his research activities consisted of developing a method of laser ablation analysis applicable to archaeological materials in order to study ceramics of all origins. As a result, a database of spectral data from common and fine ceramics found abundantly in the archaeological contexts of the last four centuries in the St. Lawrence valley was built. Using a spectrophotometer, it is possible to characterize ceramic production and in some cases identify the mineral phases present in the paste. This technique was used for various collections. This researcher also completed an archaeometric and geochemical study of the Îlot des Palais collections.

Scientific collaboration
Quebec Geosciences Centre (QGC)
www.cgg-qgc.ca
The Centre Eau Terre Environnement of the INRS and the Quebec division of the Geological Survey of Canada (QGC-Quebec) are partners in a scientific collaboration agreement. The intent is to facilitate collaboration among researchers in the fields of regional geology, geosources, and environmental geosciences. Researchers of the QGC focus their activities on important socio-economic issues, increasing knowledge related to groundwater, minerals and fossil fuels, natural hazards, and climate change.

Research chairs
- NSERC/Hydro-Québec Industrial Research Chair in Statistical Hydrology

www.ete.inrs.ca/activites/groupes/chaire_hydrol/
Chairholders (Phase III: 2004–2009): Tahar B.M.J. Guirguis (75%) and Anne-Catherine Fayre (25%)
Collaborators: André Saint-Hilaire and Bernard Bobée

The phase III research program covers four main topics. Two of these (“Developing tools to assist in the design of hydroelectric structures” and “Analysis and modeling of time series”) are in line with the work of the previous phases, whereas the two new ones (“Environmental statistical hydrology” and “Statistical hydrology in northern environments”) meet the industrial partner’s priorities on topics that have been little explored yet.

- Canada Research Chair in Hydrological Variable Assessment
Chairholder: Tahar B. M. J. Guirguis

The chair’s focus is on the study of watercourse flow variations based on hydrological data and statistical models. Hydrological variations are assessed both at the local level (for a specific watercourse) and at the regional level. At the local level, one of the objectives is to improve the assessment of rare events, such as flooding and low flows, required for the design of hydraulic work, while the assessment of hydrological variables on a regional basis can be used to compensate for the insufficient number of measuring stations. This research work will help to meet the challenges associated with climate change impact on water resources.
The Centre Eau Terre Environnement's research is integrated into many inter-institutional groups in Quebec. Monique Bernier is co-director of the Centre for Northern Studies (CEN), whose scientific objective is to improve our understanding of the dynamics of cold- and frost-dominated environments. Yves Bégin, Pierre Francus, Isabelle Laurion, and Taha B.M.J. Ouarda are also members of the CEN. Jean-François Blais, Peter Campbell, Patrice Couture, Claude Fortin, Charles Gobeil, and Rajeshwar Dayal Tajgi are all members of the Inter-institutional Ecotoxicology Research Centre of Quebec (Centre interinstitutionnel de recherche en écotoxicologie (CIRE): www.ecotox.quebec.ca). Norman Bergeron and André Saint-Hilaire are both members of the Inter-institutional Research Centre on Geochemistry and Geodynamics (GRIL): www.gril-limnologie.ca). Bernard Gratton is a member of the Inter-institutional Oceanograpy Research Group of Quebec (Groupe interinstitutionnel de recherches océanographiques du Québec (GEOIDE): www.bio.ulaval.ca/cirsa/). Pierre Francus, Isabelle Laurion, and Taha B.M.J. Ouarda, Claudio Paniconi, and Alain Rousseau are all members of the Inter-institutional Strategic Network on Climate Change in the Arctic (CICAT): www.divex.ca).

The MITHE Strategic Network is a collaboration of academia, government, and industry. The Network conducts research in support of science-based environmental and human health risk assessments for metals in water, soil, and food.

The ArcticNet Network brings together scientists and managers in the natural, human health, and social sciences and their partners to study the impact of climate change in the coastal Canadian Arctic. Over 100 ArcticNet researchers from 27 Canadian universities and 5 federal departments collaborate with research teams from 11 countries.

The ArcticNet Network brings together many of the country’s leading experts of the geomatics community from 50 universities, 80 companies, and 36 government agencies and departments. GEOIDE’s mission is to consolidate and strengthen the Canadian geomatics industry, while making optimum use of Canada’s research and development resources.

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analyze the trends in some of the variables that define attributes to this project by using Bayesian methods to

www.ete.inrs.ca/projets/pasado/PASADO-Canada/

• A new international collaboration initiative: PASADO

www.ete.inrs.ca/projets/pasado/PASADO-Canada/
The Petrok Aike Maar Lake Sediment Archives Drilling Project (PASADO) is an international initiative within the framework of ICDP (International Continental Drilling Project). PASADO Canada was officially started in 2008. Pierre Francis leads this Canadian contribution to the study of past climate and the evolution of a maar crater (explosive volcano) in Laguna Petrok Aike, Southern Patagonia, Argentina. Ten Canadian researchers from eight universities are involved, including another INRS researcher, Pierre-Simon Ross.

Sharing knowledge

Publications

• Journal of Water Science

www.rse.inrs.ca/index.php?page=accueil

This publication is an international electronic journal publishing original research papers in pure and applied water science, notably in the areas of hydrology (surface and groundwater), water quality, hydrobiology, ecotoxicology, potable water and wastewater treatment, and water resources management. It is co-edited by the Groupement d’Intérêt Scientifique des Sciences de l’Eau (France) and the Centre Eau Terre Environnement. The journal celebrated its 20th anniversary in 2008.

Co-director: Peter Campbell
Editorial board members: Jean-François Blais and Alain Mailhot
Scientific board member: Bernard Bobée

• Scientific publications and communications

The complete listing of the 2007–2008 scientific publications and communications of Centre Eau Terre Environnement researchers is available online at


Meetings and seminars

• 76th ACFAS Congress

www.acfas.ca/congress/2008/pages/faits_saillants.html

In 2008, the INRS hosted the 76th ACFAS Congress from May 5th to 9th in Quebec City. The conference theme was “Knowledge meets 400 years of history”. The ACFAS and INRS celebrated the International Year of Planet Earth with a series of four public meetings on current environmental issues, followed by a panel discussion including all of the guest speakers. Other activities linked to the 400th anniversary of Quebec City were organized for the general public, for example a tour of geological and historical sites of the city and a meeting titled “400 years of science in Quebec City.”

Congress president: Jean-Pierre Vileneuve
Scientific committee members: Monique Bernier (president), Patrice Couture and Claude Fortin (life and health sciences), Michel Malo and Anne-Catherine Favre (physics, mathematics, and engineering)
Organizing committee chair: Sophie Duchesne

Earth and Environmental Sciences Day

www.inrs-ete.uquebec.ca/conf/jste2008

On 28 March 2008, the Centre Eau Terre Environnement hosted the 9th edition of this joint Université Laval and INRS event, organized alternately by graduate students in earth and environmental sciences from these two academic institutions. This conference day is an excellent opportunity for graduate students to present their research results to an informed audience.

• Centre Eau Terre Environnement seminar program

www.ete.inrs.ca/index.php?page=1_6archives

The Centre holds scientific seminars throughout the year related to its different research fields. The complete listing of the seminars held in 2007 and 2008 is available online.

Public outreach activities

INRS researchers regularly give interviews and contribute to articles in the media (newspapers, radio, television, Internet) within their specialty field.

For example, the scientific program Découverte at Radio-Canada television broadcast a report on 30 March 2008 focusing on the Canadian RADARSAT-2 satellite, which enables better ice observations. The program highlighted the work of Monique Bernier and her team on the use of satellite data to characterize the nature and thickness of river ice, a very useful tool for preventing ice jams and floods. The report is available online on the Radio-Canada website.

In March 2008, the documentation and information service of the INRS launched a new series of information bulletins called Capsules INRSciences, which are designed to highlight in easily understood language and format the quality and diversity of research carried out by INRS students. The bulletins are available online on the INRS website.

The Centre Eau Terre Environnement student environmental committee was among the exhibitors at the 4th Symposium of Earth and Environmental Sciences held in Place Laurier (Quebec City) on 29 April 2008 as part of Earth Day activities.
Research excellence

Centre Eau Terre Environnement researchers and students received several awards and scholarships this year for the excellence of their research.

Professors Satinder Kaur Brar, Jean-François Blais, and Rajeshwar Dayal Tyagi received the 2008 Rudolph Hering Medal Award of the American Society of Civil Engineers (ASCE) for an article titled “Aerobic Biofiltration Processes - Advances in Wastewater Treatment” published in 2006 in the journal Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management (Volume 10, Issue 4, pp. 264-276).

At the International Water Association Specialist Conference held in Moncton in June 2007, Rajeshwar Dayal Tyagi received the Specialist Medal for Residuals Research awarded by the Specialist Group on Sludge Management to a researcher whose previous work has advanced both fundamental understanding and practical application in sludge, biosolids, and/or residuals management.

Koukou Adjalle, a PhD student in water sciences, received in 2008 one of the two Wladimir A. Smirnoff scholarships. The objective of this award is to promote research in the field of biological control of forest insect pests. Koukou Adjalle’s research project is focused on developing an alternative formulation for BT (Bacillus thuringiensis) from agri-food industry wastewater and sewage sludge. He is supervised by professor Rajeshwar Dayal Tyagi.

The steering committee of the Triilateral Agreement Canada/Netherlands/Sweden on Defence Science and Technology Cooperation awarded a NATO Achievement Award to professor Richard Martel.

Finally, professor Taha B.M.J. Ouarda was among 22 Quebec personalities profiled in the special issue for the 400th anniversary of Quebec City of the magazine Actualité published in December 2007. Professor Ouarda was cited for his contribution to statistical hydrology research, a field in which he is a world expert.

The Centre’s vision is based on a strong environmental commitment and a rigorous and innovative scientific approach.
Training of highly qualified personnel

The students of the Centre Eau Terre Environnement of the INRS are in direct contact with real and concrete problems in water and earth sciences. Six graduate programs are offered. The inter-university Master’s and PhD programs in earth sciences result from a collaboration with the Geology and Geological Engineering Department of the Université Laval. The students are registered in either institution but are trained by both. This collaboration has several advantages for the students: a wider choice of research subjects, a more extensive list of courses and an access to the services offered by both institutions. Students also benefit from the partnership between the INRS and the Geological Survey of Canada, which substantially increases the number of potential research advisors.

The Centre’s graduate programs: www.ete.inrs.ca/index.php?page=4_1

Water sciences programs
• PhD in water sciences

Several scientific disciplines are required to understand problems in water resources and aquatic environments, and a real and complete multidisciplinary approach is necessary to find solutions. This program is designed to train specialized researchers able to define and solve these problems and hence to meet society’s needs in this domain. Students in this program will widen and deepen their general knowledge in water sciences while specializing in one of the specific fields of study.

• Master’s in water sciences

The INRS is the only institution in Quebec to offer a Master’s in water sciences. This program enables students to acquire the specialized knowledge necessary to study the problems associated with this fundamental resource. In the thesis program, students can demonstrate their originality and aptitude for research while specializing in one or two fields of interest, selecting from a choice of three courses.

• Professional Master’s in water sciences

The Master’s program without thesis is designed to train professionals in executing and managing water science projects. Through the general knowledge and specialization obtained, graduates are able to make a significant contribution to solution finding and decision making in this area. This program also seeks to meet the continuing education needs of water science professionals.

Earth sciences programs
• PhD in earth sciences

This program offers advanced specialization in various fields of fundamental and applied geology and geological engineering. The program is designed to train students to conceive and set up original research projects, to lead projects on their own, and to excel in professional research or university teaching activities.

• Master’s in earth sciences

In the Master’s thesis program, students acquire advanced general knowledge, deepen their knowledge in a specific field, are introduced to scientific research, and are trained in the professional practice of geology, hydrogeology, or geological engineering.

• Master’s in earth sciences – Environmental technologies

This program with essay leads to a Professional Master’s degree specializing in environmental technologies. In most jobs, employees are confronted with environmental problems. Practical approaches for problem solving are interdisciplinary and require diversified knowledge from a whole set of disciplines.

Personality

Claudie Beaulieu comes from Dolbeau in the Lac Saint-Jean region. She did several undergraduate internships with Professor Taha Ouarda’s team before joining the INRS Master’s program in water sciences in 2003, where she continued working with Professor Ouarda’s team. Her colleagues quickly noticed that she was an excellent researcher and an untiring, always smiling worker. She collaborated on no less than 21 publications and presentations, about 15 as first author. She subsequently received a PhD scholarship from the FQRNT. Specializing in Bayesian statistical methods, she has worked on a diverse range of projects, including corrective methods for biased climatic data sets to improve the quality of precipitation and global change prediction models, climatic conditions favorable to the propagation of the West Nile virus in Quebec, and modeling of ships’ squat (the additional sinkage caused by their movement) in the St. Lawrence shipping channel. Claudie will soon complete her PhD and undertake a postdoctoral fellowship at the prestigious Princeton University in New Jersey. Her present colleagues will not miss her for too long, however, since she will be returning often as a collaborator.
As part of its mission to conduct research and train highly qualified personnel, the INRS welcomes postdoctoral fellows within its research teams. Postdoctoral scholarships are available.

INRS postdoctoral fellowships:
www.inrs.ca/Francais/index.jsp?page=StagesPostDoc

Each summer, the Centre Eau Terre Environnement offers undergraduate internships, an excellent opportunity for students to gain a research experience in the fields of water, environmental sciences, and natural resources in a highly stimulating scientific environment.

The Centre’s summer internships:
www.ete.inrs.ca/index.php?page=1_5

Finally, a research station located at Sacré-Cœur (Saguenay region) offers to INRS research teams a work and educational facility for seminars, training courses, study projects, and scientific meetings in a natural environment. The station is also available for inter-university collaborations.

The Centre Eau Terre Environnement of the INRS is located in downtown Quebec City on the urban campus of the Université du Québec. Its research teams have access to state-of-the-art laboratories (ITRAX scanner, scanning electron microscope, ultra-clean laboratory, plasma-atomic emission spectrophotometer, etc.).

In addition, a new $60-million laboratory building has just been opened. It is located in the Metropolitan Quebec Technology Park and will be used to conduct research in partnership with the private sector and other partners. This new building contains high-tech equipment unique in Canada, including CAT scan and environmental biotechnologies laboratories. These facilities will enable the scaling of technologies developed at the INRS.

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High-quality research infrastructure

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Shared services laboratory

The shared services laboratory located in the downtown building comprises a general laboratory and several specialized laboratories in microbiology, radiostopes, chemical analyses, sample preparation, microscopy, trace metals, etc. The operating mode of this laboratory is unique in that all equipment and instruments bought by professors using their grants are pooled and are available to everybody. This enables optimal use of all resources. A complete range of high-tech instruments is thus at the disposal of everyone involved in experimental research at the I NRS.

Research laboratories

State-of-the-art laboratories are available to INRS researchers in both the downtown building and the new laboratory building in the Metropolitan Quebec Technology Park.

The new multidisciplinary CAT-scan laboratory of the INRS is a unique facility in Canada. It comprises a CAT-scan room, a data storage and treatment unit, a sedimentology laboratory, and hydraulic, bismedimentology, and hydrology equipment. Work in hydrogeology is supported with high-tech equipment such as a geological drilling rig, sounding equipment, and a new data acquisition system using electrical tomography, which enables environmental characterization of aquifers. The INRS biogeochemical research team has also obtained a new, state-of-the-art technology park.

For more information on the Centre Eau Terre Environnement research laboratories:
www.inrs-ete.uquebec.ca/index.php?page=laboratoires

Centre Eau Terre Environnement community

professor
research technician
research associate
research officer
postdoctoral fellow
PhD
Master’s
intern
others

Of all of the above colors, left or graduated during the year

Research and teaching

Research teams

Jean-Christian Auclair
Mario Bergeron
Marie Letourneau
Alan Langlas
Gérald Derron
Jorge Enrique Medina-Lopez
François Larouche
Maxime Bergeron
Normand Bergeron
Francis Bénédé
Marc-André Poulot
Patricia Johnston
Mylene Levassure
Jean-Nicolas Bujold
Joanie Côté
Jérôme Dubé
Francis Gauthier
Véronique Tremblay
Graté Wagner
Élisabeth Simard
Véronique Tremblay
Monique Bernier
Mohamed Niang
Yves Gauthier
Lisa-Marie Pâquet
Mireille Almagir
Maria Gissasoka
Rebecca Filion

Imen Gherboudj
Kim Huong Hoang
Stéphane Mermoz
Hugo Drouin
Karine Labrecque
Audrey Lessard-Fontaine
Charles Gigrac
Aurelien Gouletc
Pierre-Étienne Lard
Jean-François Blais
Myriam Chartier
Isabel Beauceshe
Samuel De La Rochefroidr
Amélie Jalin
Dilekane Kombla
Stéphanie Lafond
Lan Huong Tran
Mélanie Asselin
Mélanie Pinatton
Véronique Turcotte
Sandra Bernard
Medard Boula
Vanessa Catherine
 OMITANE GABOURNE
Athena Ben Khaled
Marian Mouchersoud
Louis-César Pasquier
Jean-Philippe Pavard
Halima Saghdi
Marie-Cristine Simard
Med Ali Souissi
Satinder Kaur Boa
Bernard Bobée (emeritus)
Ouediane Samoud
Peter Campbell
Isabelle Papineau
Fabien Perron
Sophie Cooper
Kristin Mueller
Frédéric Maloney
Yuan Tremblay
Jasminne Caire
Anne Créma
Kareem Choikmani
Ahmed Houcine
Benjamin Raphali-Amanich
Patrice Couture
Charles Gauthier
Dominique Lapointe
Vincent Brunet
Nicolas Garceau
Sophie Gentles
Berangère Leclercq
Angela Sacchi

Analytical Geochemistry (Joint lab INRS–GSC–Quebec)
Stable Isotope Geochemistry (Delta-Lab)
Hydrobiology
Dendrochronology and Dendrogeomancy
Digital Cartography and Photogrammetry Laboratory (LCNP)
High-Resolution Paleoclimatic Analysis (LAPAHR)
Environmental Technologies (Decontamination)
Biodiagnose of Wastewater and Sewage Sludge into High-Value-Added Products
Bio-Optics and Microbial Ecology
Ultra-Trace Geochemistry
Geochemistry, Imagery, and Radiography of Sediments (GIRAS)
In situ Decontamination of Soil and Groundwater (Joint lab INRS–DRDC–Valcartier)
Trace Metal Measurements in Aquatic Samples
Multidisciplinary CAT Scan
Physical, Digital, and Geophysical Simulation
Direct Push and Rotary Percussion Sounding System
Remote Sensing and Geomatics

Nanomeasurements in Aquatic Samples
High-Resolution Paleoclimatic Analysis (LAPAHR)
Environmental Technologies (Decontamination)
Biodiagnose of Wastewater and Sewage Sludge into High-Value-Added Products
Bio-Optics and Microbial Ecology
Ultra-Trace Geochemistry
Geochemistry, Imagery, and Radiography of Sediments (GIRAS)
In situ Decontamination of Soil and Groundwater (Joint lab INRS–DRDC–Valcartier)
Trace Metal Measurements in Aquatic Samples
Multidisciplinary CAT Scan
Physical, Digital, and Geophysical Simulation
Direct Push and Rotary Percussion Sounding System
Remote Sensing and Geomatics
Invited researchers and professors

From foreign countries

Toddy Arbarter, British Antarctic Survey (United Kingdom)
Khalidou M. B., Centro Interamericano de Recursos del Agua (CIRA, Mexico)
Olivier Bantin, Université d’Aix-Marseille (France)
Andreas Barth, Universität Stuttgart (Germany)
Francoise Behr, Institut français de pétrole (France)
Ritik Ben Cheikh, École nationale d’ingénieurs de Tanta (Tunisia)
Aim A. Cézanneau, Instituto Politècnico Nacional (Mexico)
Bernard Chocot, Institut national des sciences appliquées de Lyon (INSA, France)
Daniel Costa, Institut français de recherche pour l’exploitation de la mer (IFREMER, France)
Jean-Pierr Dedieu, CNRS (France)
Carlos Díez Delgado, CIRA (Mexico)
Jaime M. Garias Sabo, CIRA (Mexico)
Jean-Louis Géring, Institut national polytechnique de Lorraine (France)
Stuart Lane, University of Leeds (United Kingdom)
Michel Lege, CEMAGREF (France)
Camille Lejail, UMOI – CNRS & Université de Nancy I (France)
Jean-Louis Monot, Institut national polytechnique de Lorraine (France)
Emmanuel Naffrechoux, Université de Savoie (France)
Éric Potter, Institut d’électronique et de télécommunications de Rennes (France)
Louis Prieur, Laboratoire d’odonatalogie de Villefranche (France)
Éric Saucy, CEMAGREF (France)
Marie-Odile Simonnot, Institut national polytechnique de Lorraine (France)
Jaume M. Vergès, Instituto de Ciencias de la Tiera (Spain)
Nan L. Watchman, Australian National University (Australia)
Tran Minh Y, Volcanane Academy of Science and Technology (Vietnam)
Fatou Zidane, Université Hassán II (Morocco)

Du Canada

Marc Amyot, Université de Montréal
Philipe Archambault, Institut Maurice-Lamontagne
Simon Bambé, ÉcoNovo Experts-conseils
Husam Berroussas, Centre de recherche industrielle du Québec
Louis Bernatchez, Université Laval
Gilles Bouchard, Ministère du Développement durable, de l’Environnement et des Parcs (MDDEP)

Invited researchers and professors

From foreign countries

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Aim A. Cézanneau, Instituto Politècnico Nacional (Mexico)
Bernard Chocot, Institut national des sciences appliquées de Lyon (INSA, France)
Daniel Costa, Institut français de recherche pour l’exploitation de la mer (IFREMER, France)
Jean-Pierr Dedieu, CNRS (France)
Carlos Díez Delgado, CIRA (Mexico)
Jaime M. Garias Sabo, CIRA (Mexico)
Jean-Louis Géring, Institut national polytechnique de Lorraine (France)
Stuart Lane, University of Leeds (United Kingdom)
Michel Lege, CEMAGREF (France)
Camille Lejail, UMOI – CNRS & Université de Nancy I (France)
Jean-Louis Monot, Institut national polytechnique de Lorraine (France)
Emmanuel Naffrechoux, Université de Savoie (France)
Éric Potter, Institut d’électronique et de télécommunications de Rennes (France)
Louis Prieur, Laboratoire d’odonatalogie de Villefranche (France)
Éric Saucy, CEMAGREF (France)
Marie-Odile Simonnot, Institut national polytechnique de Lorraine (France)
Jaume M. Vergès, Instituto de Ciencias de la Tiera (Spain)
Nan L. Watchman, Australian National University (Australia)
Tran Minh Y, Volcanane Academy of Science and Technology (Vietnam)
Fatou Zidane, Université Hassán II (Morocco)

Du Canada

Marc Amyot, Université de Montréal
Philipe Archambault, Institut Maurice-Lamontagne
Simon Bambé, ÉcoNovo Experts-conseils
Husam Berroussas, Centre de recherche industrielle du Québec
Louis Bernatchez, Université Laval
Gilles Bouchard, Ministère du Développement durable, de l’Environnement et des Parcs (MDDEP)
Some statistics about the Centre

In the Centre there are in 2007–2008:

39 researcher-professors
11 emeritus and honorary professors
23 associate professors
64 invited researchers and professors
80 Master’s students: 29 in earth sciences and 51 in water sciences
109 PhD students: 31 in earth sciences and 78 in water sciences
12 students in the Professional Master’s program
16 postdoctoral fellows
86 undergraduate and graduate interns
109 articles published in scientific journals
47 published scientific communications
233 oral and poster presentations
13 books and book chapters
41 research reports (public et private)
16 PhD theses
20 Master’s theses
10 internship reports of the Professional Master’s program
6 graduate studies programs
5 research chairs
And many research units (laboratories, groups, networks, etc.)
## Revenues and expenses of operating fund (x $1000)

**For the financial year ending May 31, 2008**

### Revenues

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount $1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total institutional revenues</td>
<td>9 188</td>
</tr>
<tr>
<td>Other revenues</td>
<td>2 642</td>
</tr>
<tr>
<td>Research grants</td>
<td></td>
</tr>
<tr>
<td>- NSERC</td>
<td>2 046</td>
</tr>
<tr>
<td>- FQRNT</td>
<td>517</td>
</tr>
<tr>
<td>- Other sources</td>
<td>2 393</td>
</tr>
<tr>
<td>Total grants</td>
<td>4 956</td>
</tr>
<tr>
<td>Research contracts</td>
<td>7 890</td>
</tr>
<tr>
<td><strong>Total revenues</strong></td>
<td>24 676</td>
</tr>
</tbody>
</table>

### Expenses

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount $1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and teaching</td>
<td>18 213</td>
</tr>
<tr>
<td>Support for research and teaching</td>
<td></td>
</tr>
<tr>
<td>- General administration fees</td>
<td>1 554</td>
</tr>
<tr>
<td>- Investments (furnishings and equipment)</td>
<td>114</td>
</tr>
<tr>
<td>- Documentation and editing</td>
<td>417</td>
</tr>
<tr>
<td>- Administration of Centre</td>
<td>286</td>
</tr>
<tr>
<td>- Computer service</td>
<td>228</td>
</tr>
<tr>
<td>- Laboratories</td>
<td>607</td>
</tr>
<tr>
<td>- Land and buildings</td>
<td>1 999</td>
</tr>
<tr>
<td>- Heavy-duty laboratories</td>
<td>190</td>
</tr>
<tr>
<td>- GSC agreement</td>
<td>157</td>
</tr>
<tr>
<td><strong>Total support for research and teaching</strong></td>
<td>5 552</td>
</tr>
<tr>
<td><strong>Total expenses</strong></td>
<td>23 765</td>
</tr>
</tbody>
</table>

### Excess of revenues over expenses

- 911

### Transfer to capital fund

- 463

**Net excess of revenues over expenses**

- 448

---

## Centre reserves (x $1000)

**For the financial year ending May 31, 2008**

### Operating fund reserve

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount $1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accumulated surplus on 31 May 2005</td>
<td>1 711</td>
</tr>
<tr>
<td>Operating surplus on 31 May 2006</td>
<td>540</td>
</tr>
<tr>
<td>Operating surplus on 31 May 2007</td>
<td>970</td>
</tr>
<tr>
<td>Total surplus</td>
<td>3 669</td>
</tr>
</tbody>
</table>

### Capital fund reserve

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount $1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unused balance on 31 May 2005</td>
<td>745</td>
</tr>
<tr>
<td>Balance transferred 2005-2006</td>
<td>550</td>
</tr>
<tr>
<td>Balance transferred 2006-2007</td>
<td>900</td>
</tr>
<tr>
<td>Adjustment 2005-2006</td>
<td>1 442</td>
</tr>
<tr>
<td>Unused total balance on 31 May 2006</td>
<td>3 637</td>
</tr>
<tr>
<td><strong>Use of funds to finish reimbursing Édifice Québec</strong></td>
<td>-2 853</td>
</tr>
<tr>
<td>Unused balance forecasted on 31 May 2007</td>
<td>784</td>
</tr>
<tr>
<td>Unused balance on 31 May 2008</td>
<td>131</td>
</tr>
</tbody>
</table>

### Reserve for research space - Édifice Québec

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount $1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unused balance</td>
<td>567</td>
</tr>
<tr>
<td>Balance transferred 2005-2006</td>
<td>741</td>
</tr>
<tr>
<td>Unused balance on 31 May 2006</td>
<td>1 306</td>
</tr>
<tr>
<td>Balance transferred 2006-2007</td>
<td>370</td>
</tr>
<tr>
<td><strong>Use of funds to finish reimbursing Édifice Québec</strong></td>
<td>-1 678</td>
</tr>
<tr>
<td>Balance transfer forecasted 2007-2008</td>
<td>550</td>
</tr>
<tr>
<td>Actual balance transferred in 2007-2008</td>
<td>245</td>
</tr>
<tr>
<td><strong>Use of funds to finish reimbursing Édifice Québec</strong></td>
<td>-245</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
</tr>
</tbody>
</table>
### University expenses by function (x $1000)

For the financial year ending May 31, 2008

<table>
<thead>
<tr>
<th></th>
<th>Salaries, benefits and scholarships</th>
<th>Field work, travel, supplies and material</th>
<th>Professional, contractual and public services; rent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and teaching (operation)</td>
<td>4 345</td>
<td>93</td>
<td>929</td>
<td>5 367</td>
</tr>
<tr>
<td>Research and teaching (research)</td>
<td>2 807</td>
<td>705</td>
<td>9 334</td>
<td>12 846</td>
</tr>
<tr>
<td>General administration fees</td>
<td>715</td>
<td>55</td>
<td>784</td>
<td>1 554</td>
</tr>
<tr>
<td>Investments (furnishings and equipment)</td>
<td>0</td>
<td>0</td>
<td>114</td>
<td>114</td>
</tr>
<tr>
<td>Documentation and editing</td>
<td>321</td>
<td>1</td>
<td>95</td>
<td>417</td>
</tr>
<tr>
<td>Administration of Centre</td>
<td>241</td>
<td>27</td>
<td>18</td>
<td>286</td>
</tr>
<tr>
<td>Computer service</td>
<td>369</td>
<td>2</td>
<td>-143</td>
<td>228</td>
</tr>
<tr>
<td>Laboratories</td>
<td>468</td>
<td>1</td>
<td>138</td>
<td>607</td>
</tr>
<tr>
<td>Land and buildings</td>
<td>386</td>
<td>5</td>
<td>1 608</td>
<td>1 999</td>
</tr>
<tr>
<td>Heavy-duty laboratories</td>
<td>0</td>
<td>1</td>
<td>189</td>
<td>190</td>
</tr>
<tr>
<td>GSC agreement</td>
<td>79</td>
<td>15</td>
<td>63</td>
<td>197</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9 731</strong></td>
<td><strong>905</strong></td>
<td><strong>13 129</strong></td>
<td><strong>23 765</strong></td>
</tr>
</tbody>
</table>

**Research, teaching, land and buildings, and others: $23 765 000**

- Others: 15%
- Land and buildings: 8%
- Research and teaching (operation): 23%
- Research and teaching (research): 54%

**Other functions: $3 553 000**

- GSC agreement: 5%
- Heavy-duty laboratories: 5%
- Laboratories: 17%
- Computer service: 6%
- Administration of Centre: 8%
- Documentation and editing: 12%
- Investments (furnishings and equipment): 3%
- General administration fees: 44%