
OURANOS
A MULTIDISCIPLINARY APPROACH TO FACILITATE ADAPTATION TO CLIMATE CHANGE

A Multidisciplinary Approach to Adaptation

Welcoming remarks
André Musy, Executive Director, Ouranos

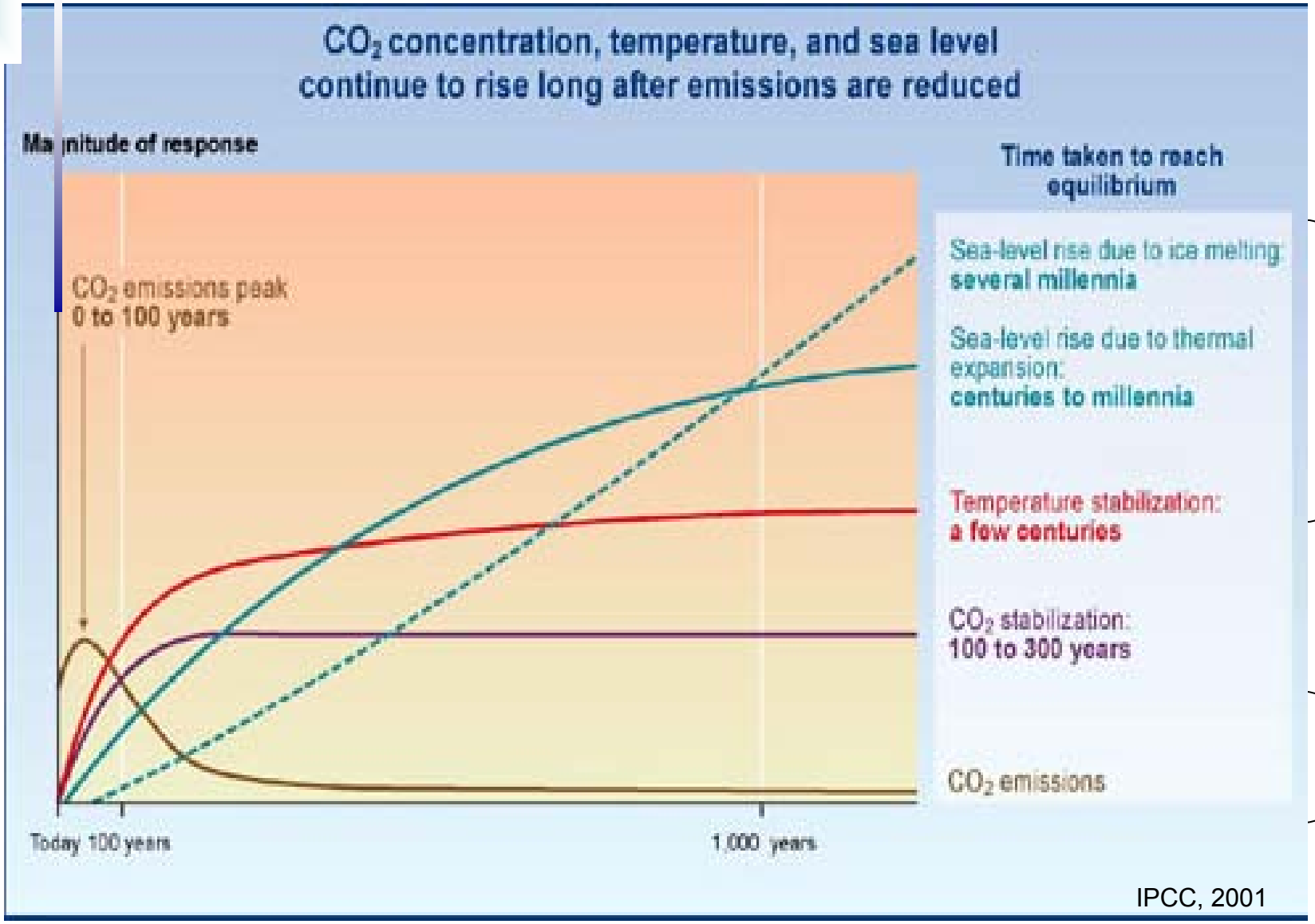
A multidisciplinary approach to facilitate adaptation to climate change : The Ouranos Model
André Musy, Executive Director, Ouranos

Applications to support adaptation to climate change for
- infrastructures in northern communities
- urban development in coastal zones
Alain Bourque, Director, Impacts/adaptation, Ouranos

Applications to support policy actions in Québec
Pierre Baril, Sous-ministre adjoint, Ministère MDDEP,Quebec

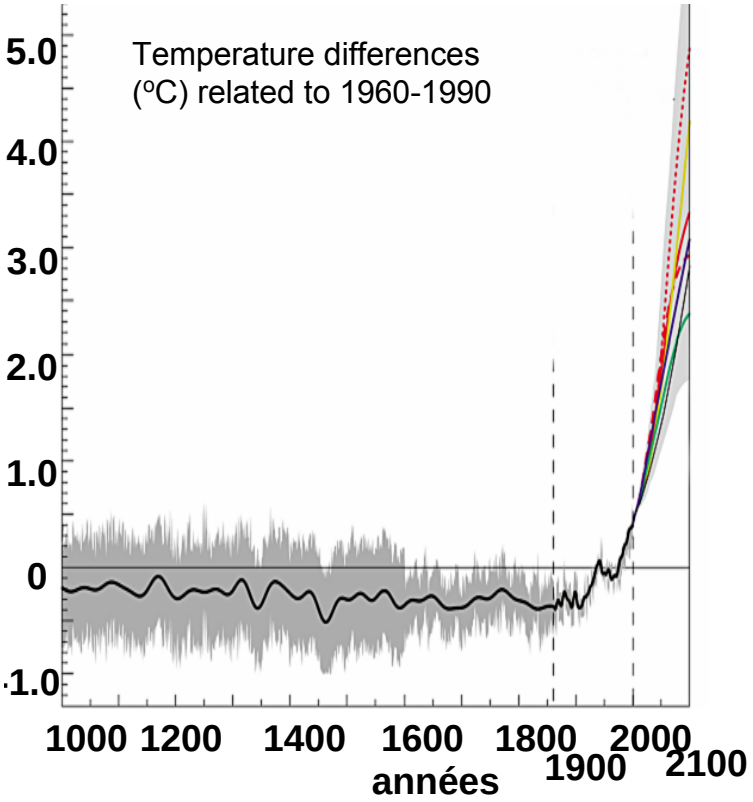
Cocktail and Discussions

GHG emission and concentration



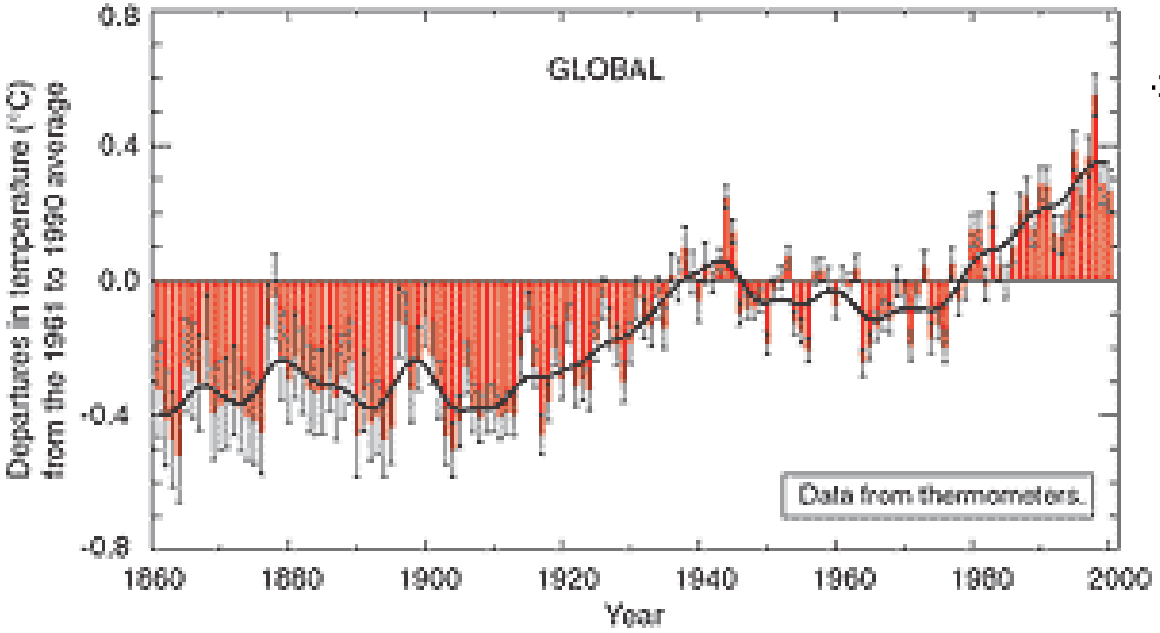
ADAPTATION MITIGATION

World temperature trends



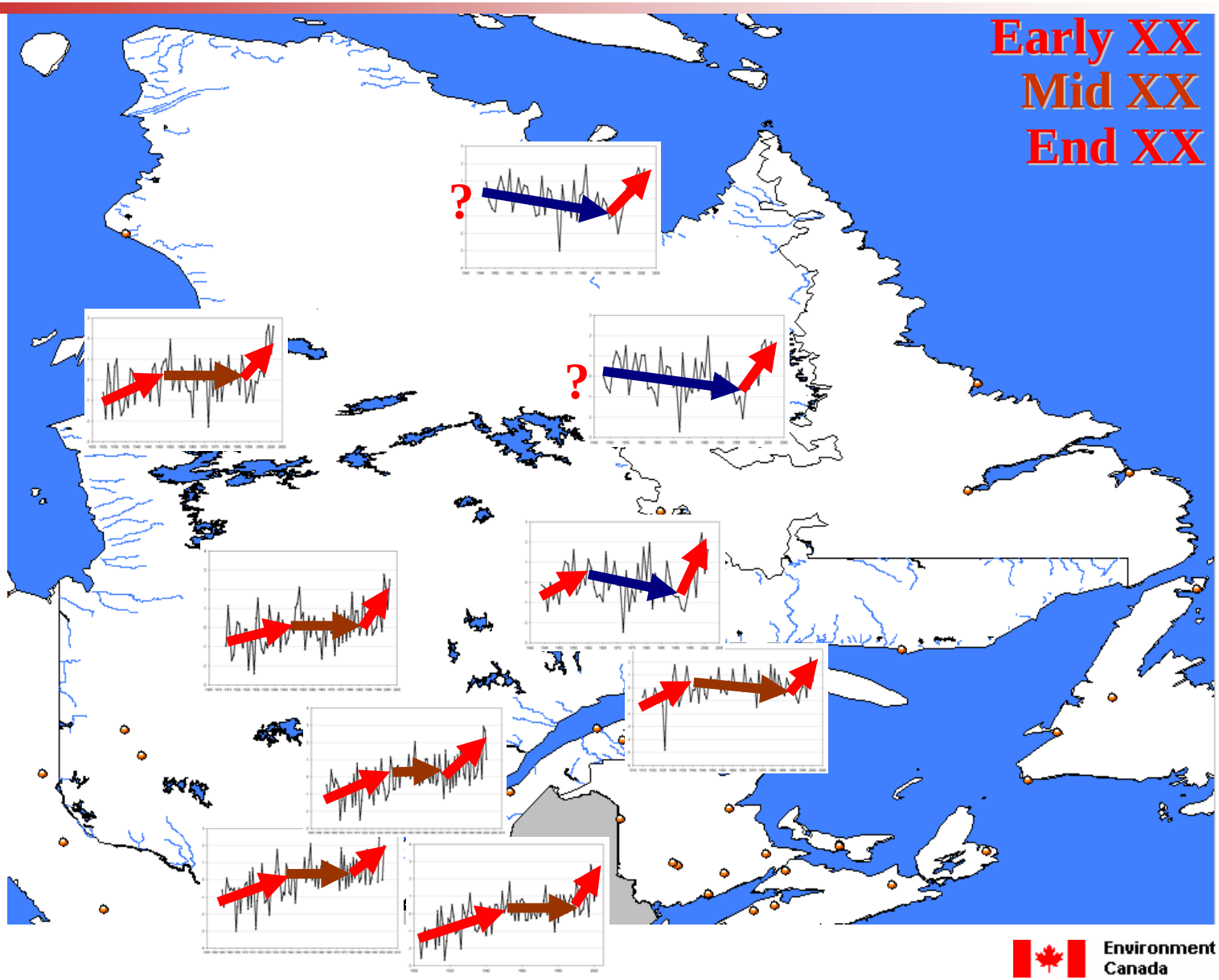
IPCC 2001

1000 - 1861 : reconstruction, Northern hemisphere
1861 - 2000 : instrumental data, global
2000 - 2001 : projections, SRES scenarios



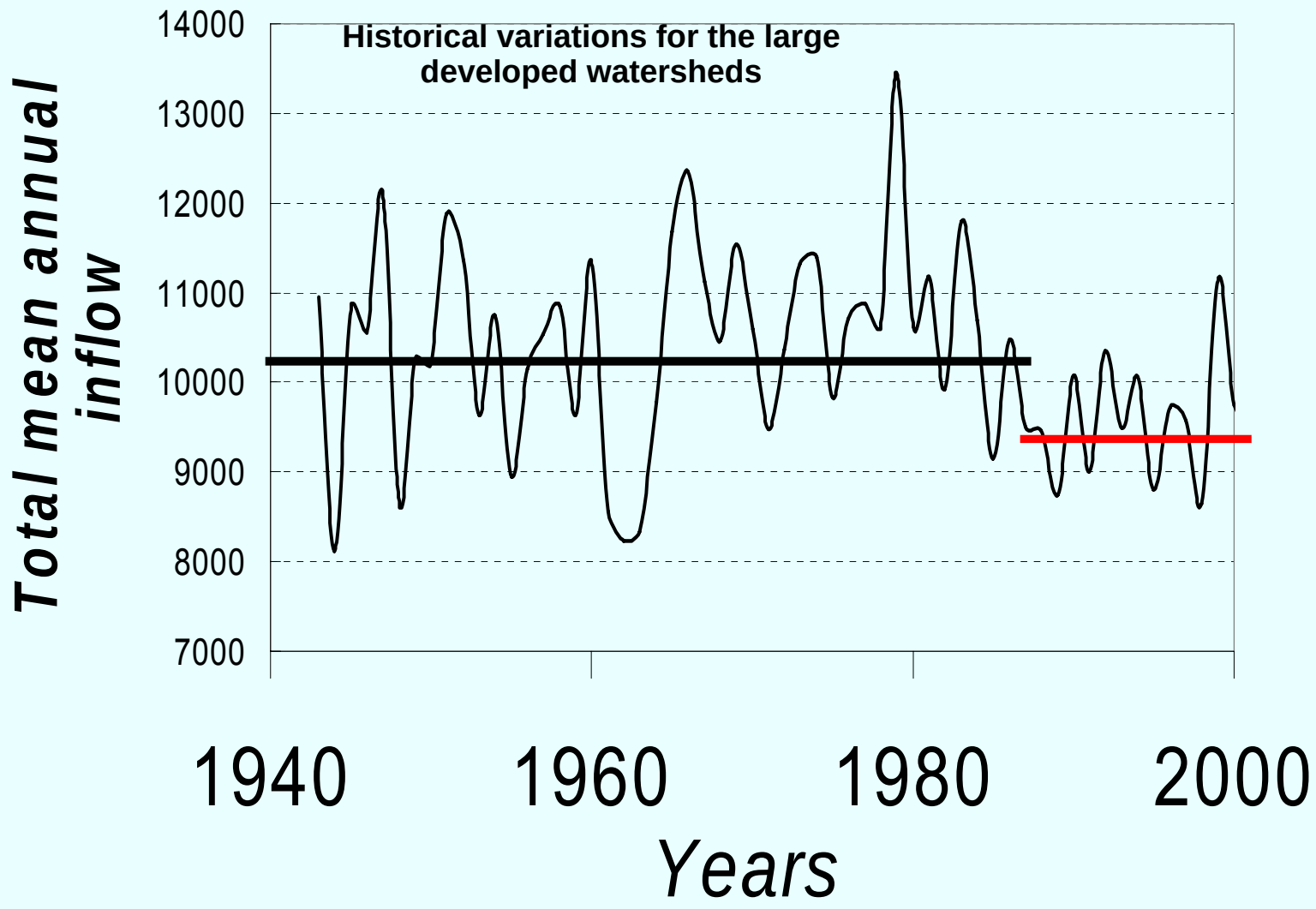
World: +0,6C (±0,2C)

Temperature trends in Quebec

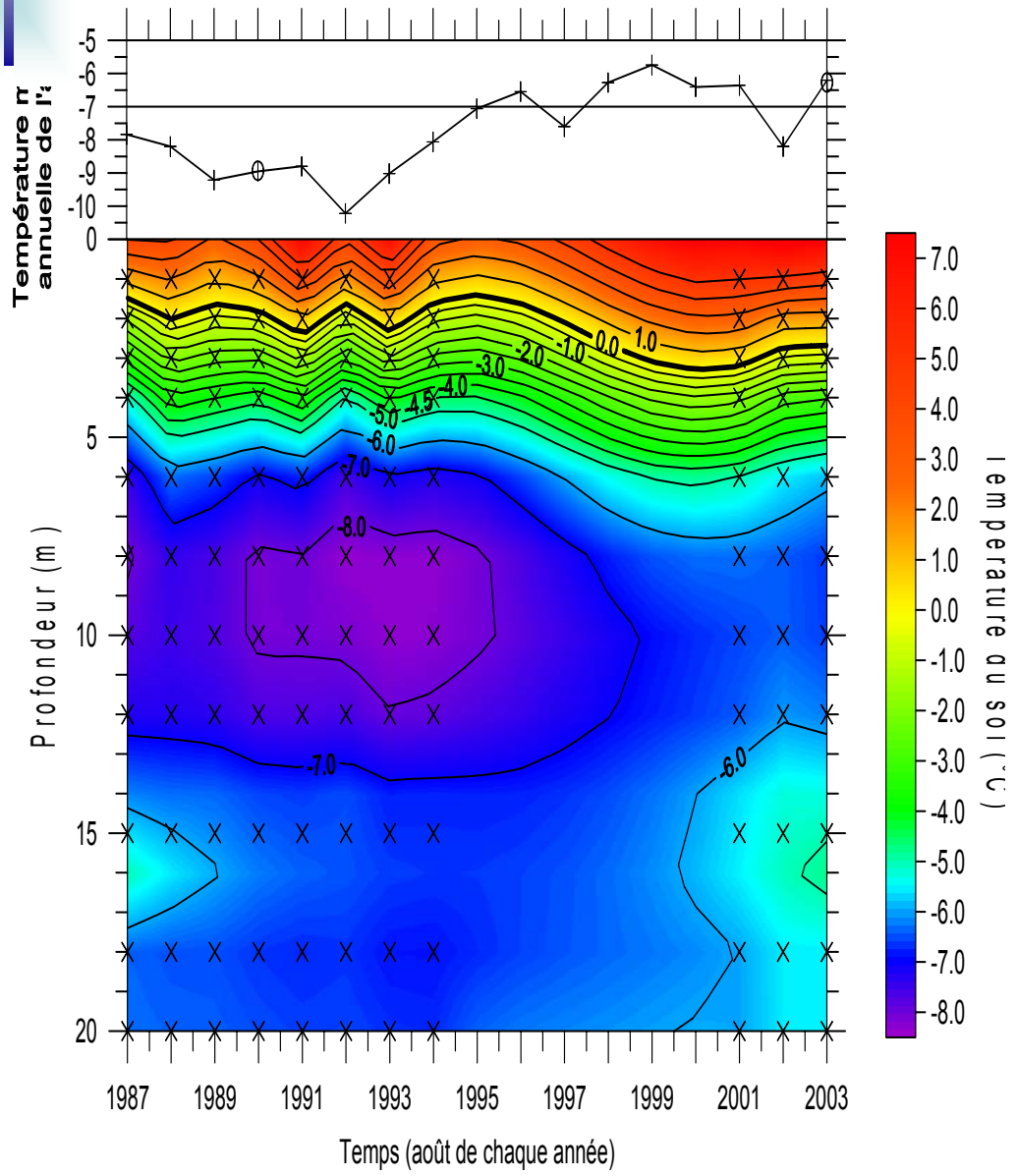


Environment Canada Environnement Canada

Hydrology and Water resource



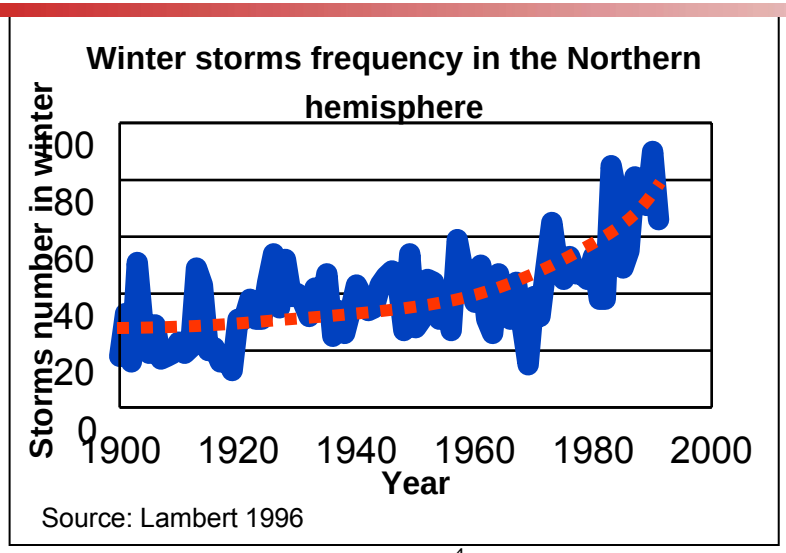
Permafrost thaw

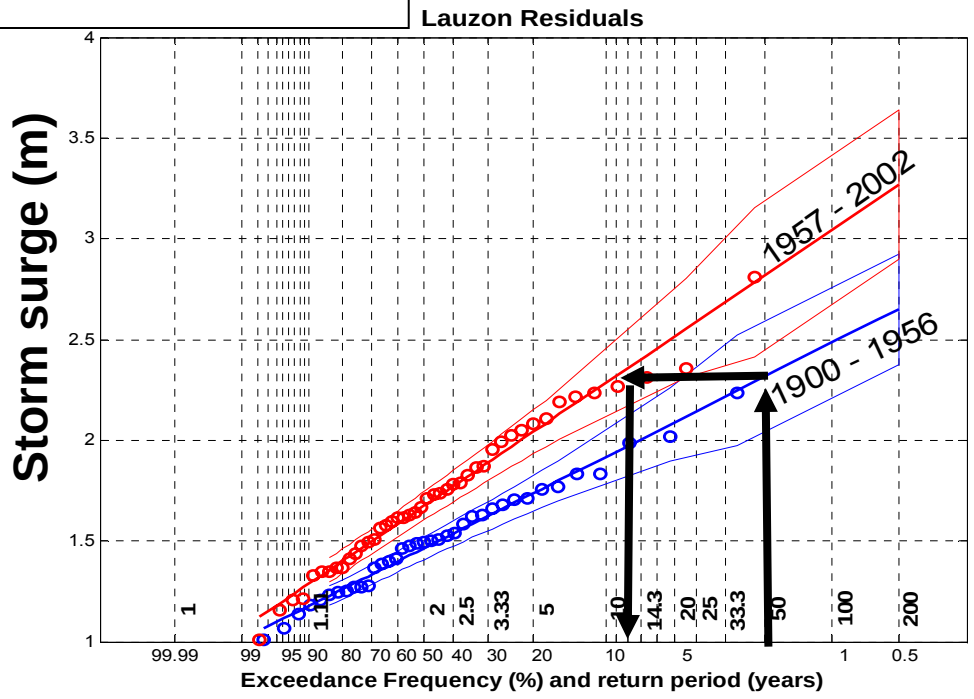


Salluit

1 to 3 degrees warming in 10 years, 10 metres depth

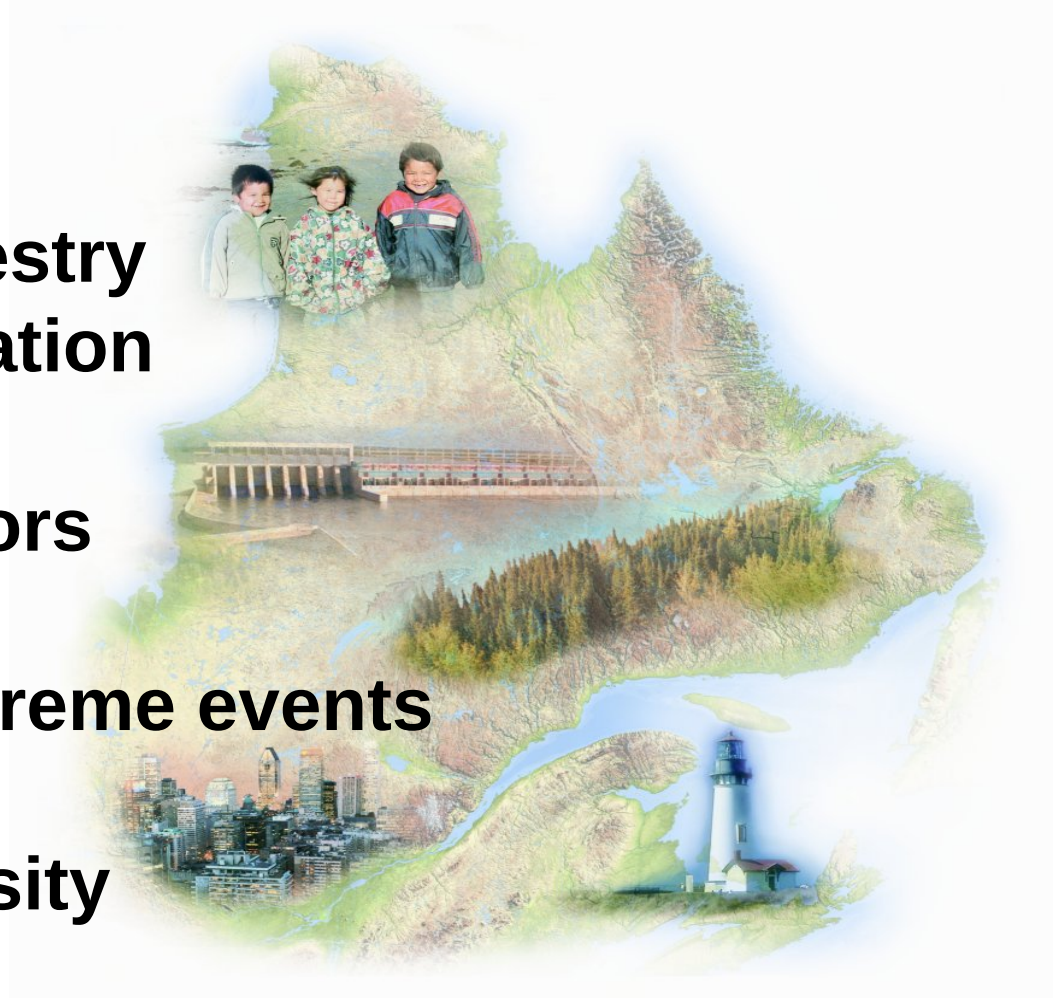
Storms and Storm surges





Societal Stakes of Climate Change (Quebec)

- **Permafrost**
- **Coastal erosion**
- **Hydropower and Forestry**
- **Urban and Transportation Infrastructures**
- **Other economic sectors**
- **Health**
- **Public Safety and Extreme events**
- **Ecosystems and Biodiversity**



Ouranos Strategic Plan, 2006

OURANOS
Consortium on Regional Climatology and Adaptation to Climate Change

MISSIONS

1. To provide the most up to date information on the evolution of climate

2. To increase our knowledge of the impacts of climate in different socio economic sectors

3. To work out strategies to reduce the effects of climate change

Consortium on Regional Climatology and Adaptation to Climate Change

MEMBERS (→ 2006)

Québec

Ministries:

1. Sécurité publique
2. Développement durable, environnement et parcs
3. Ressources naturelles et faune
4. Affaires municipales et régions
5. Transports
6. Agriculture pêcheries et alimentation
7. Développement économique, innovation et exportation
8. Santé et services sociaux

Hydro Québec

Environnement Canada
Environment Canada

UQÀM
Université du Québec à Montréal

McGill

Université Laval

Université du Québec
Institut national de la recherche scientifique

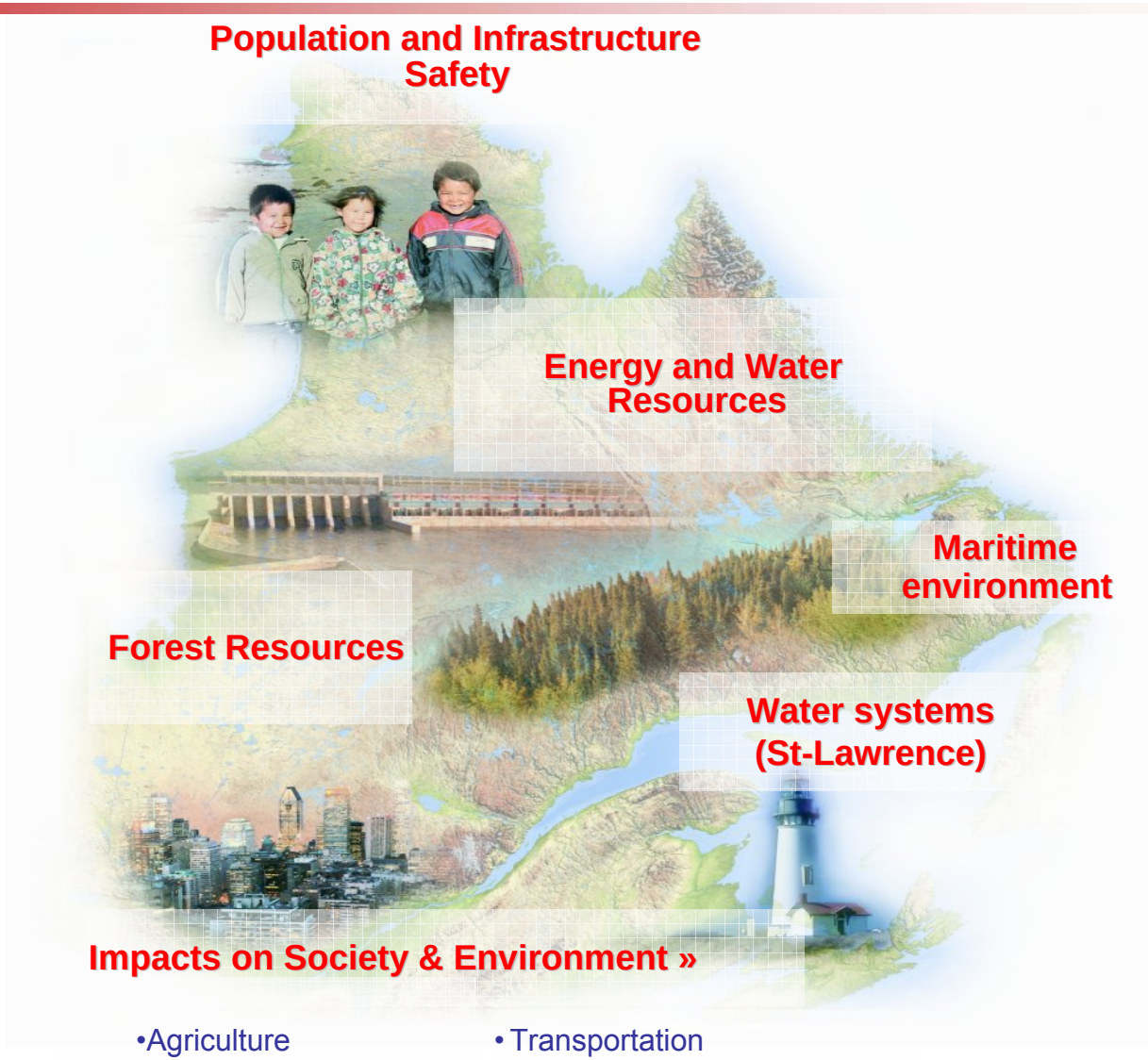
MEMBERS affiliated (2006 →)

In final negotiation : Manitoba Hydro Ecole de Technologie Supérieure

SCIENTIFIC PARTNERSHIPS

- Université de Montréal
- Université du Québec à Rimouski
- Université Sherbrooke
- Canadian Climate Impacts and Adaptation Reseacrh Network (C-CIARN)
- Centre de ressources en impacts et adaptation au climat et à ses changements (CRIACC)

The answer to deal with those stakes



- Agriculture
- Health
- Water resources
- Economy
- Transportation
- Urban infrastructure
- Natural environment

Scientific program

Available Data

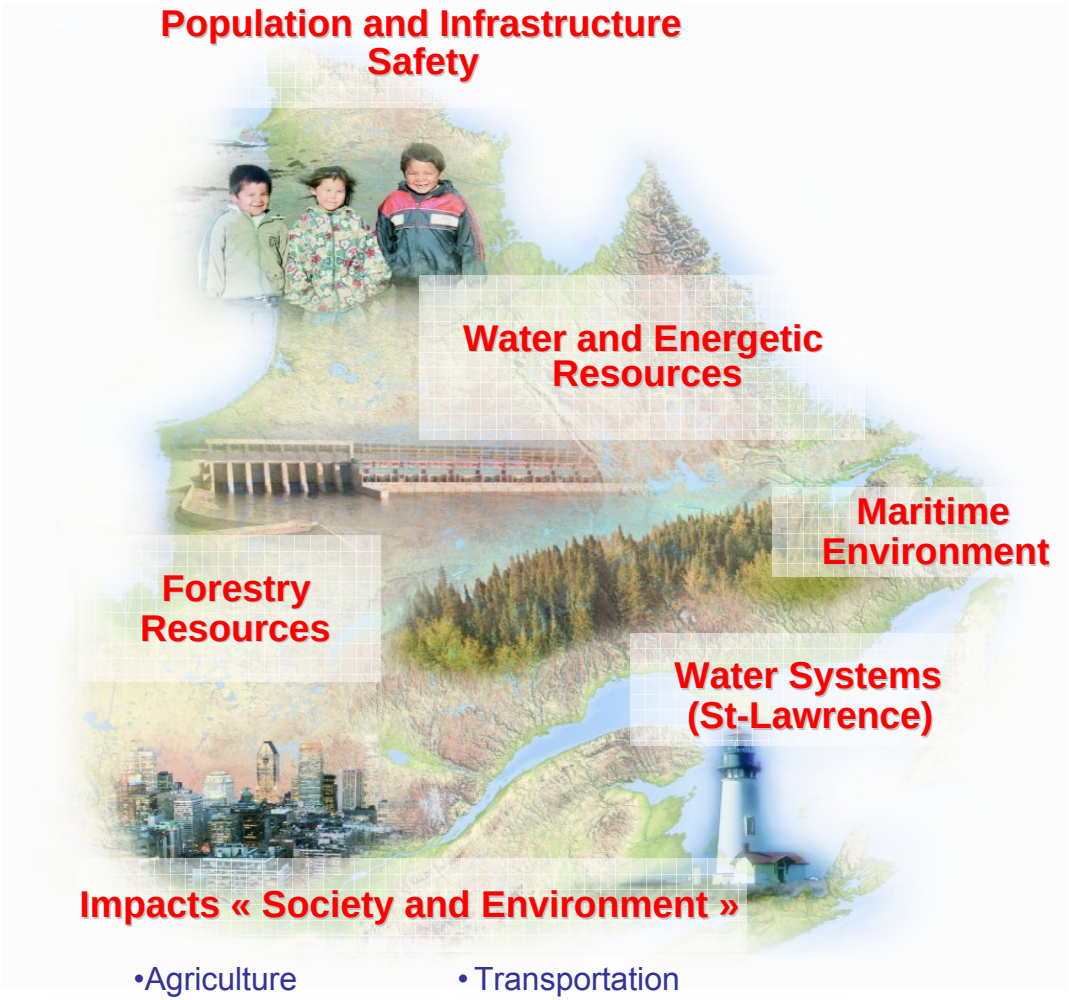
Historical and Observed Data

Hydro-climatic Research

Climate Simulations

Hydro-climatic Analysis

Available Information



- Agriculture
- Health
- Water Resources
- Economy and Society
- Transportation
- Urban Infrastructures
- Natural Environment

Scientific programs and projects

Historical and Oberved Data
- Data collection, storage, validation
- Indirect Data (satellites, dendrochronological)
- Derived products and Indicators
- Metadata

Available Data

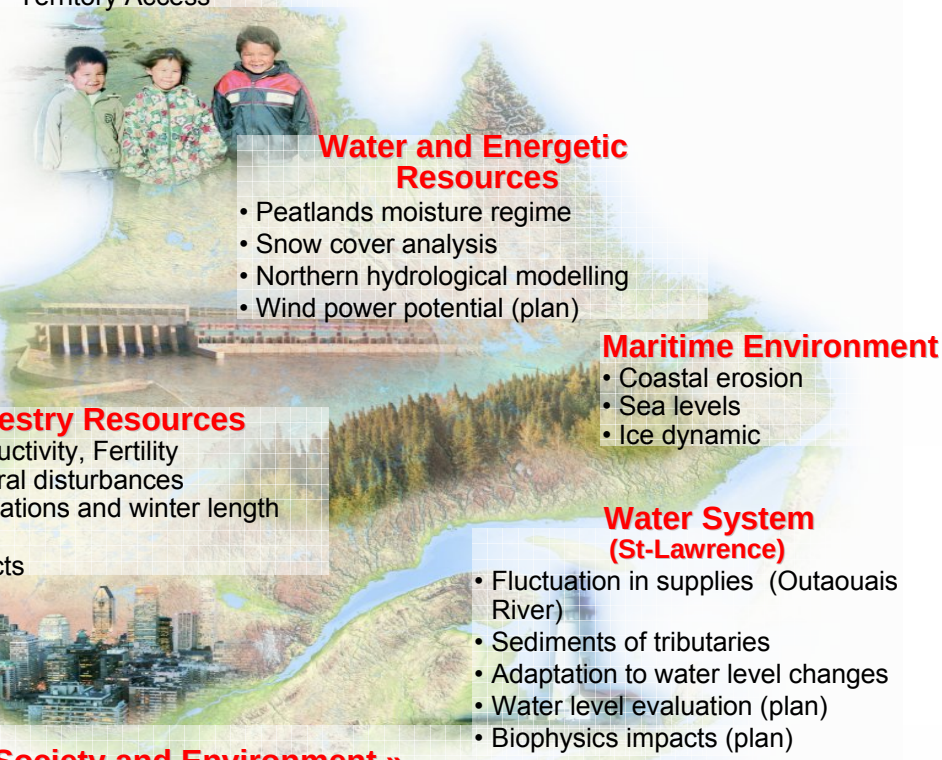
Hydro-Climatic Research
- Regional Climate Model
- Hudson Bay coupling
- .Hydrological modelling
- Extreme Events
- Statistical Analysis

Climate Simulations
- CRCM Development
- Production and Validation

Hydro-Climatic Analysis
- Hydrological and climate scenarios
- Downscaling
- Natural Variability and Extreme Analysis

Available Information

Populations and Infrastructures Safety
- Permafrost (transportation and communities
- Territory Access



Water and Energetic Resources
- Peatlands moisture regime
- Snow cover analysis
- Northern hydrological modelling
- Wind power potential (plan)

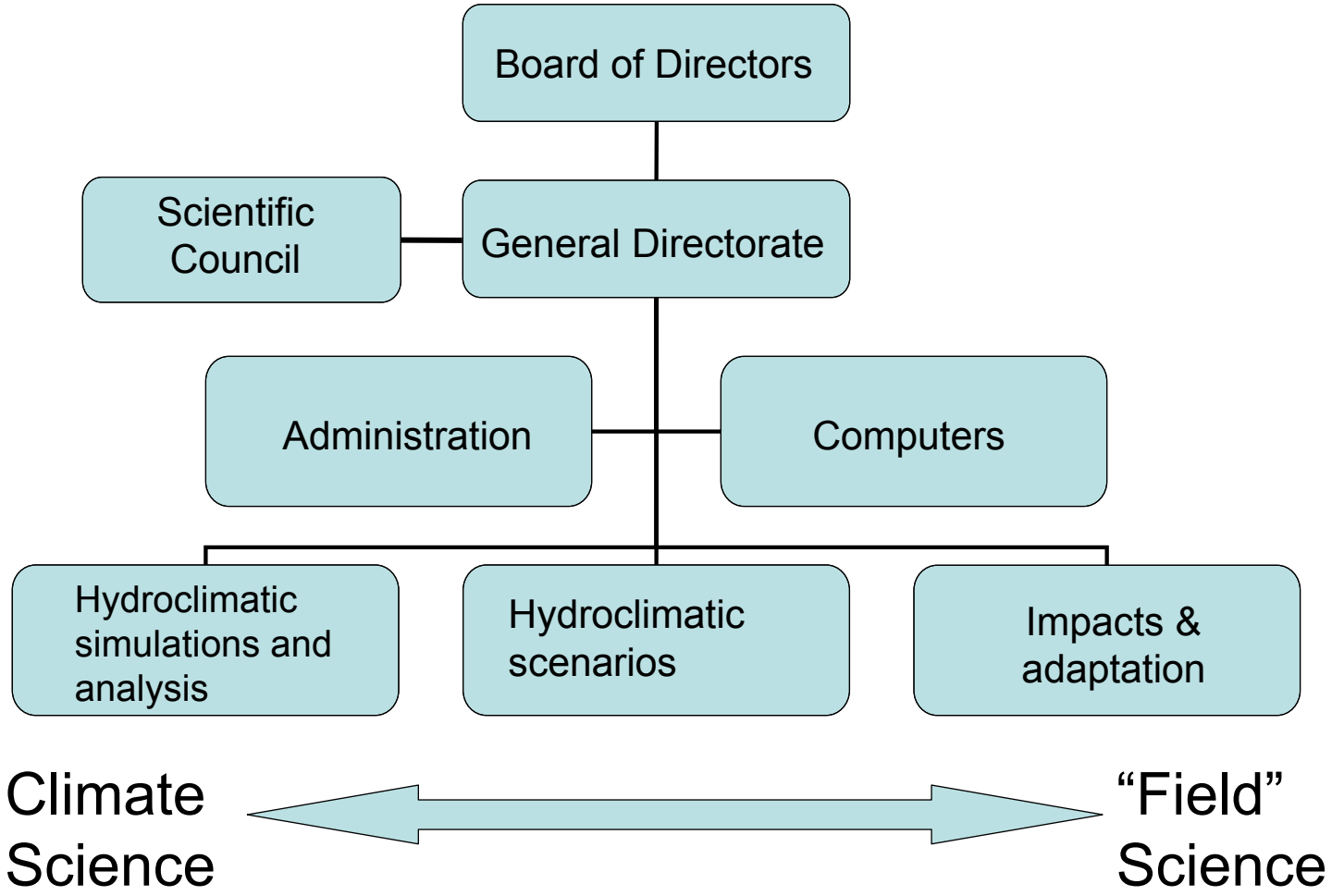
Maritime Environment
- Coastal erosion
- Sea levels
- Ice dynamic

Forestry Resources
- Productivity, Fertility
- Natural disturbances
- Operations and winter length (plan)
- Insects

Water System (St-Lawrence)
- Fluctuation in supplies (Outaouais River)
- Sediments of tributaries
- Adaptation to water level changes
- Water level evaluation (plan)
- Biophysics impacts (plan)

Impacts « Society and Environment »
- Agriculture : adaptation, Agriculture vulnerabilities
- Water Resources: Water drinking supply, ground water levels, floods and low water (Châteauguay)
- Transportation and Urban Infrastructures: urban drainage
- Health: Allergy, hot spots, vulnerabilities atlas, morbidity - Mortality
- Economy and Society: Tourism, Energy demand, Evaluation guide, Risk perceptions (plan)
- Natural environment: Ecosystems (plan)

Organization



Resources

STAFF

- 27 Ouranos employees + 30 contributes specialists by members (≈65% now confirmed)
- A network of 250 specialists (mainly over Quebec)

EQUIPMENT

- Office space for more than 100 specialists
- 3 super computers CRAY-SX-6 (~ 0,3 Tflps)
- 2 virtual libraries of large capacity (725 Tbytes)
- 1 data server with efficient communication system

FINANCE (mean per year)

- Basis budget of $5 millions CAD

  In kind contribution around $2 millions CAD

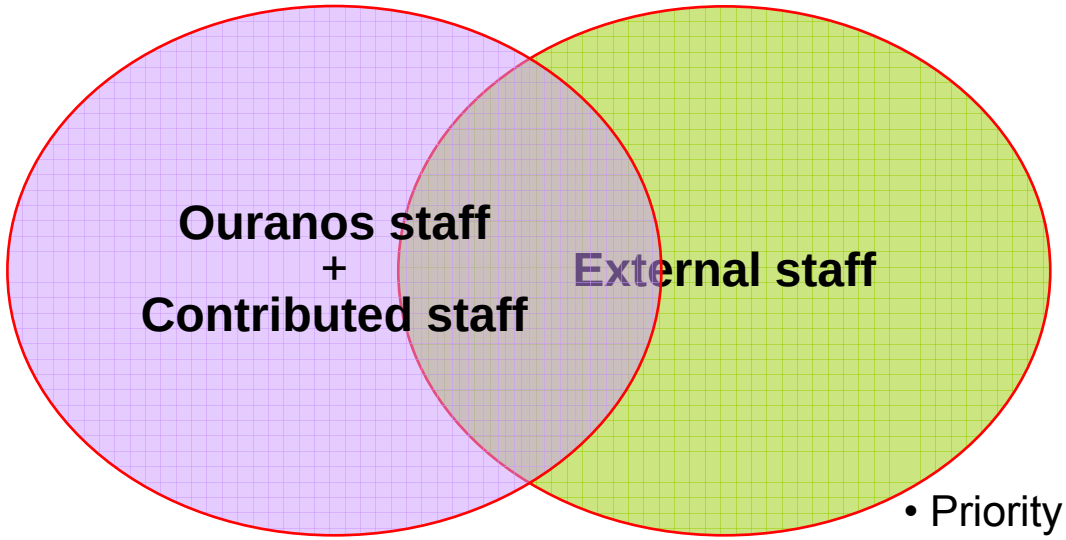
  Total budget more than $12 millions CAD (**100% leverage of basis budget!**)

Operating Mode

Program and Project management

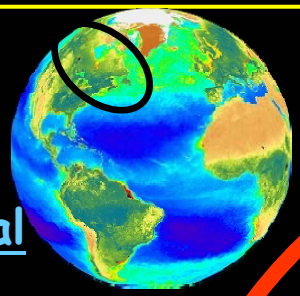
(now10 programs and 48 specific projects)

- Multidisciplinary and multi institutional teams
- Large experts and users network (~250 specialists)
- Adequate telecommunication system



- Priority for integration and exchanges
- Listen users needs
- Exchange with stakeholders

A Balanced, Integrated Strategy to Deal with Climate Change



Our international commitment:

Mitigate

Our domestic need:

Adapt

Avoid 3-4XCO2

Adapt to 2XCO2

Climate Changes

Impacts
on human and natural systems

Adaptation

Socio-economic development

Emissions
Greenhouse gases
Aerosols

Mitigation

OURANOS

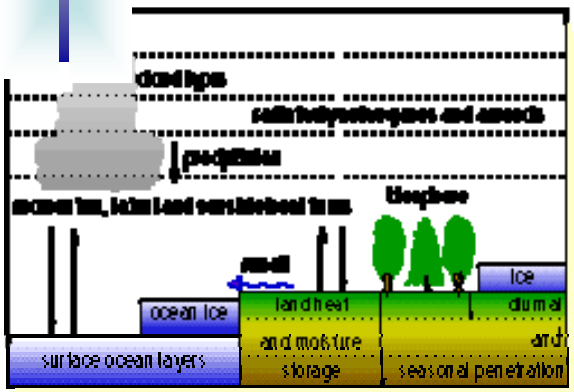
Adapted from IPCC 2001

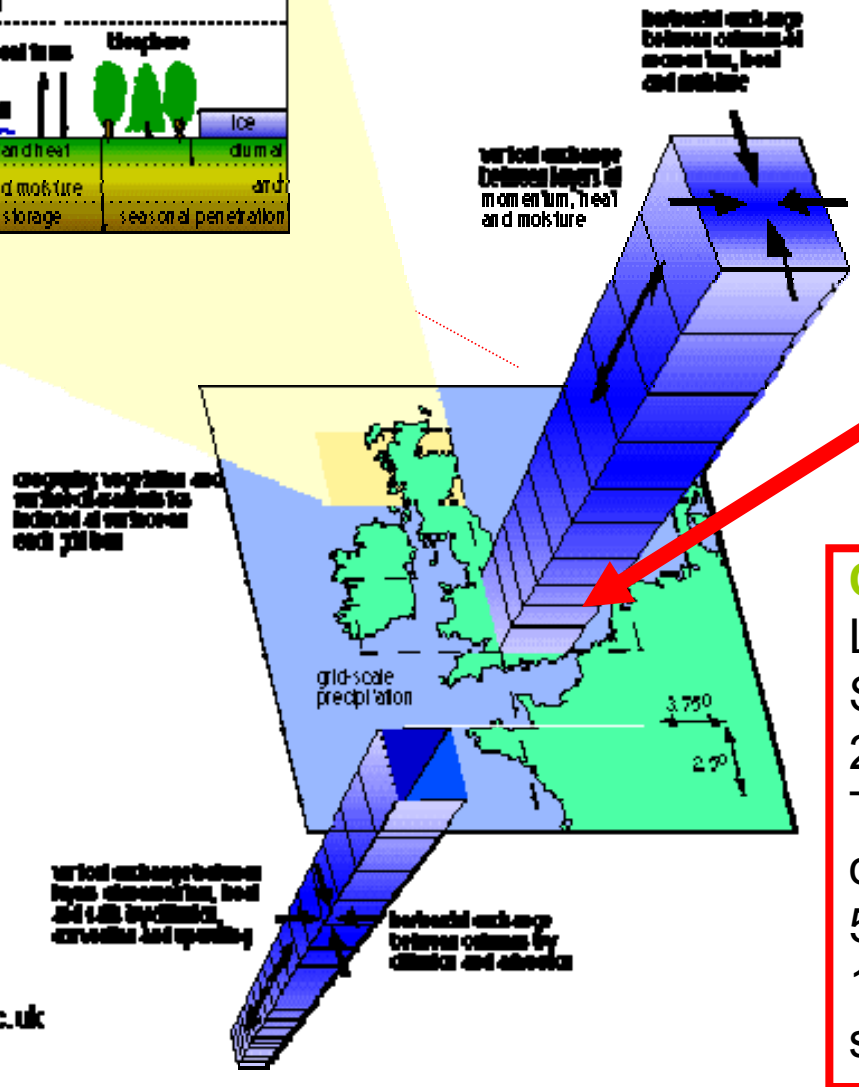
ADAPTATION strategies are constructed as function of expected impacts of Climate Change on specific stakes taking into account their vulnerability

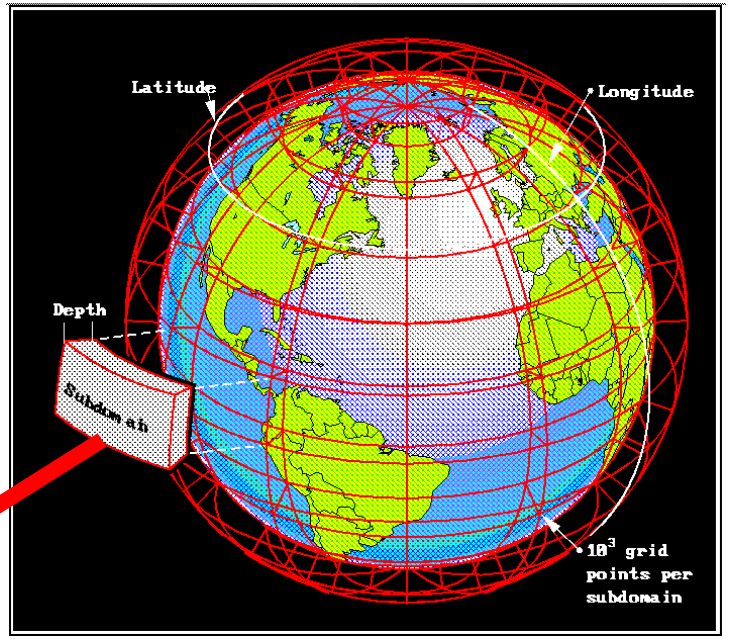
IMPACTS of Climate Change are evaluated from climatic scenarios

SCENARIOS are constructed from simulation on climate issued from climatic models (dynamic or statistic)

Climate model





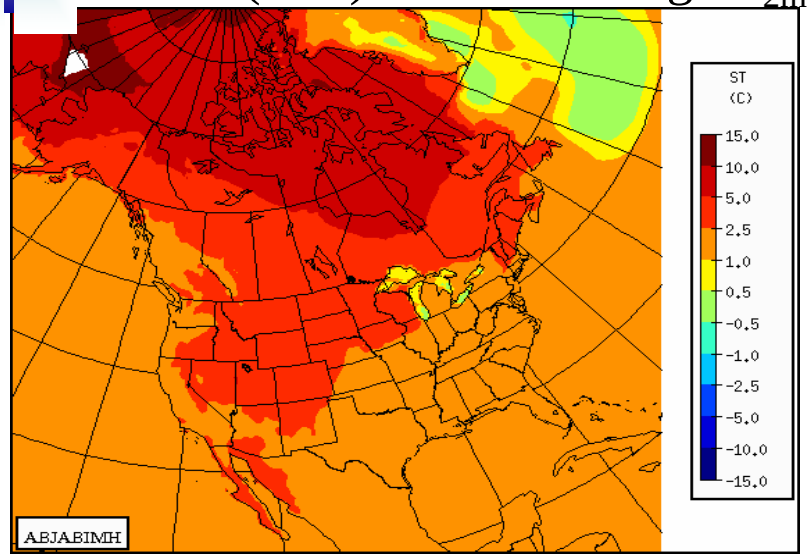


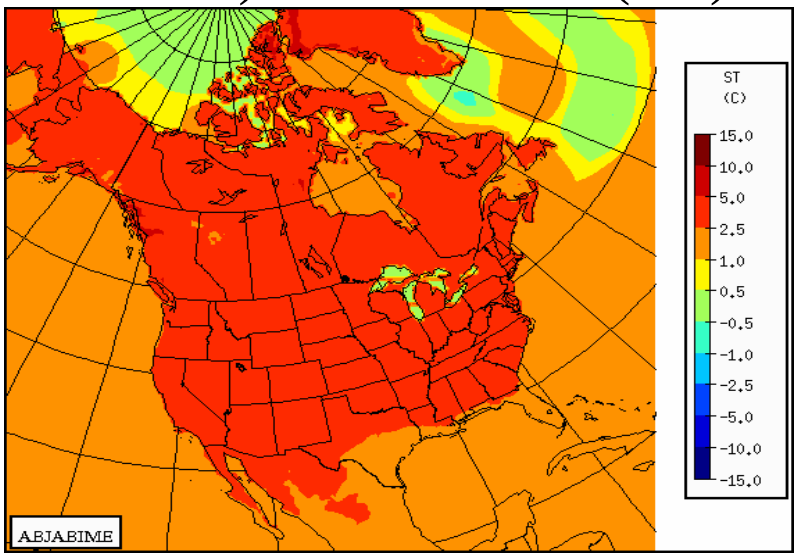
CRCM – OURANOS

Limited area (eg North America)
Spatial resolution : 45 Km
29 atmopsheric levels, top at 30km
Temporal resolution: 15 minutes, outputs every 6 hours
5h CPU/month on Cray SX-6,
10 Gb/months for 167 variables to store

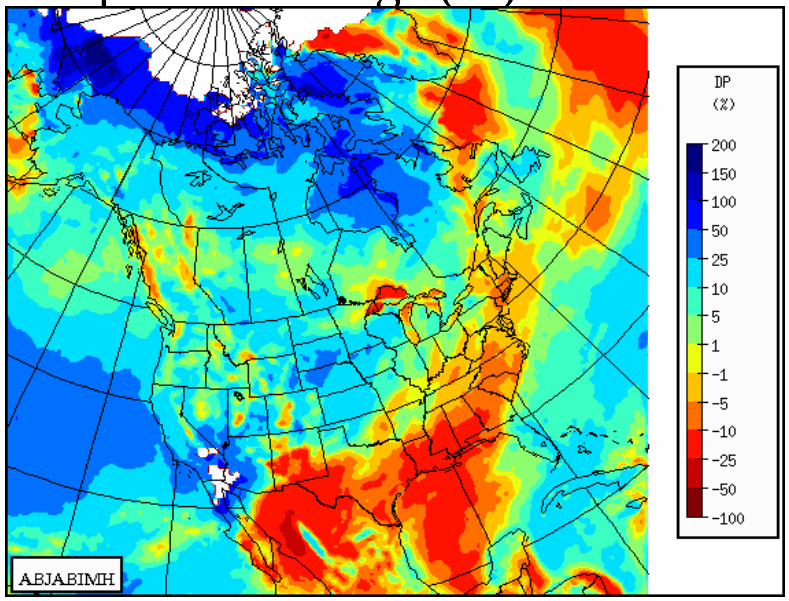
Climate projections from CRCM

Winter(DJF) Change T_{2m} (Future - Present) Summer (JJA)

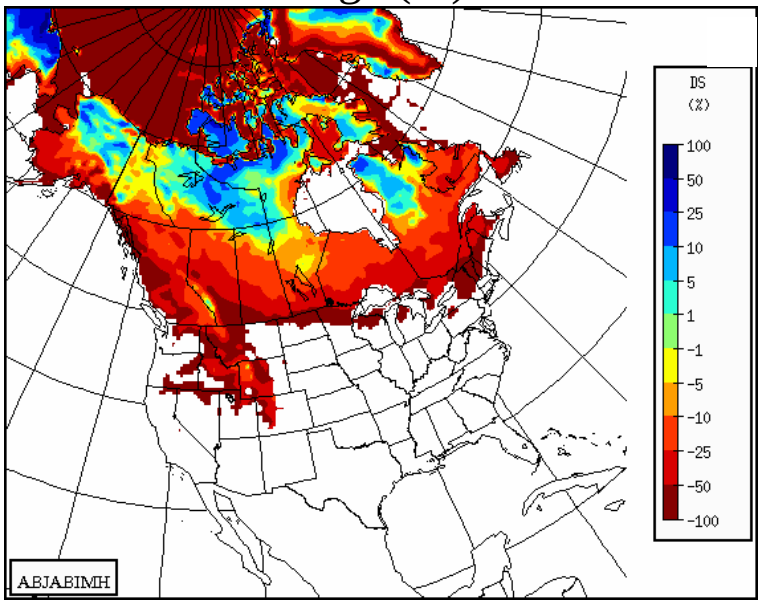




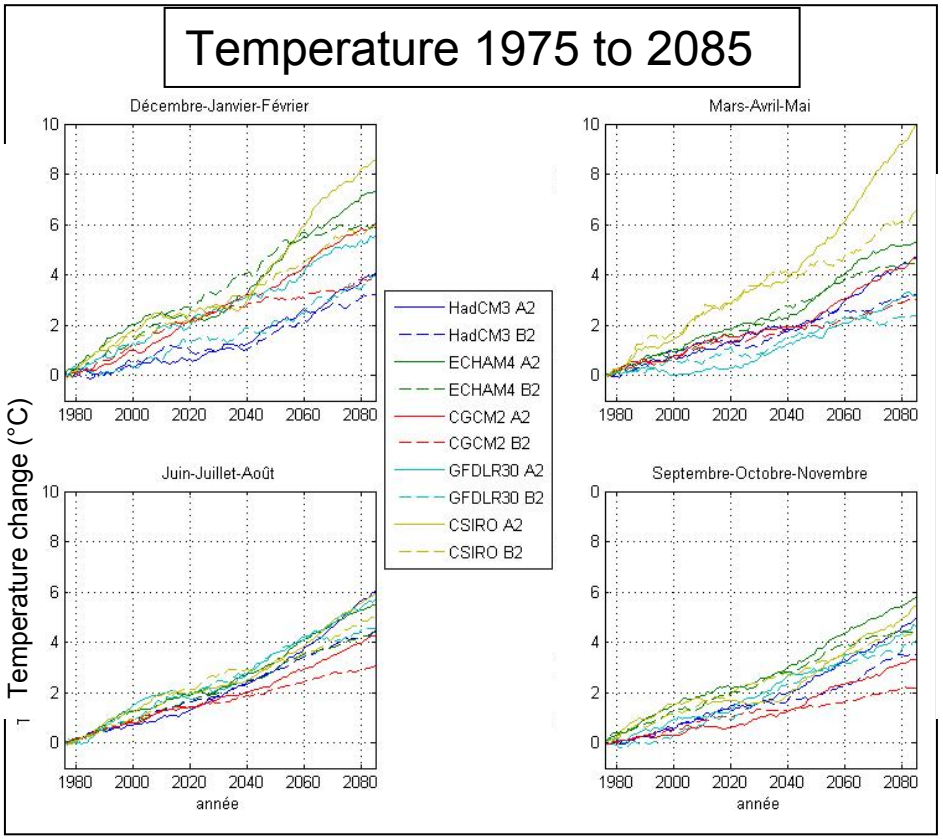
Precipitation change (%) DJF

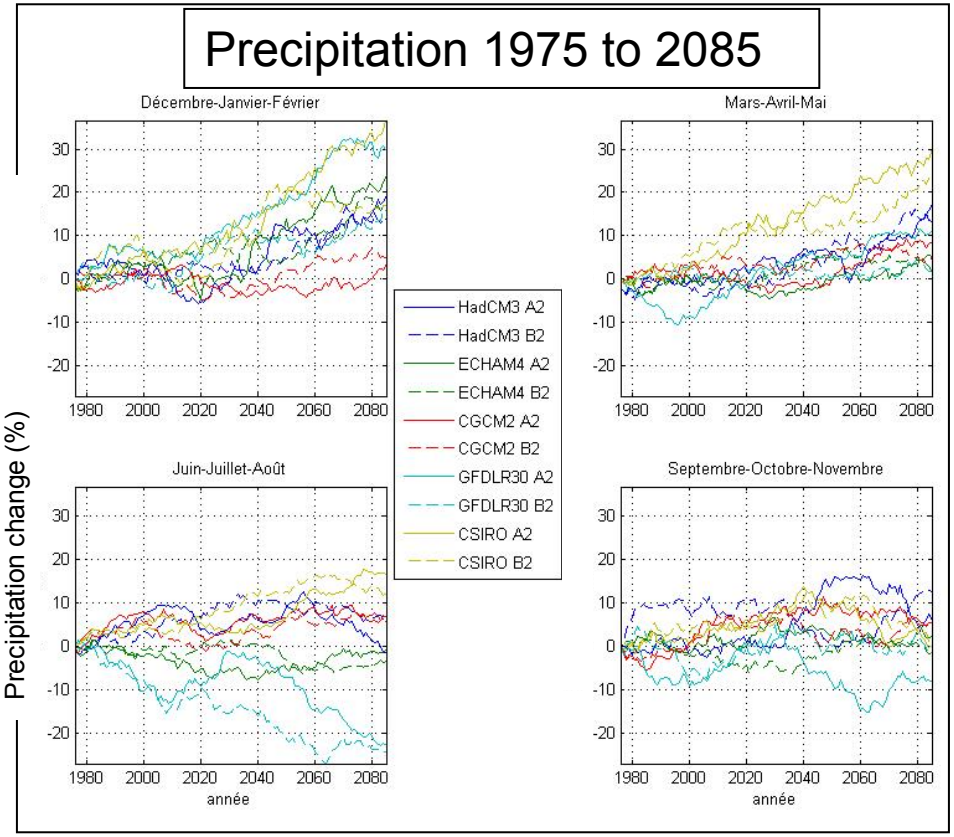


Snow cover change (%) DJF



Temperatures and Precipitations trends (Southern Quebec)



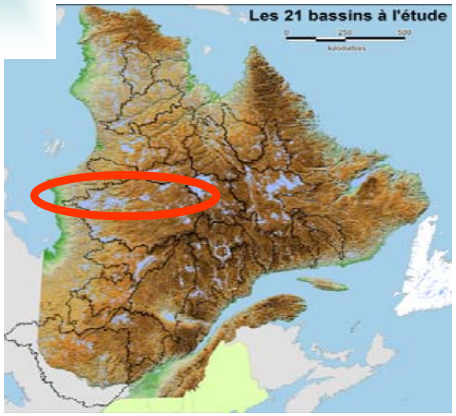


Projected Climate Change
Northern Quebec (north 56th //)

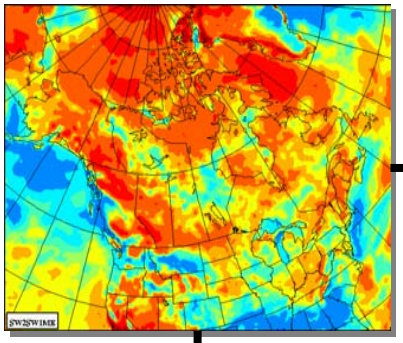
		Change 2020s	Change 2050s	Change2080s
Winter	Temp	2 to 4°C	4 to 10°C	5 to 15°C
	Pcpn	-10 to 25%	-5 to 60%	-5 to 60%
Spring	Temp	0 to 3°C	1 to 5°C	2 to 10°C
	Pcpn	0 to 15%	0 to 30%	5 to 60%
Summer	Temp	0,5 to 2°C	2 to 4°C	2 to 7°C
	Pcpn	-5 to 18%	0 to 30%	0 to 30%
Fall	Temp	1 to 2,5°C	1,5 to 5°C	2 to 10°C
	Pcpn	0 to 20%	0 to 35%	5 to 60%

Scenarios from GCM and CRCM simulation analysis

Hydrological scenarios and impacts on water resources



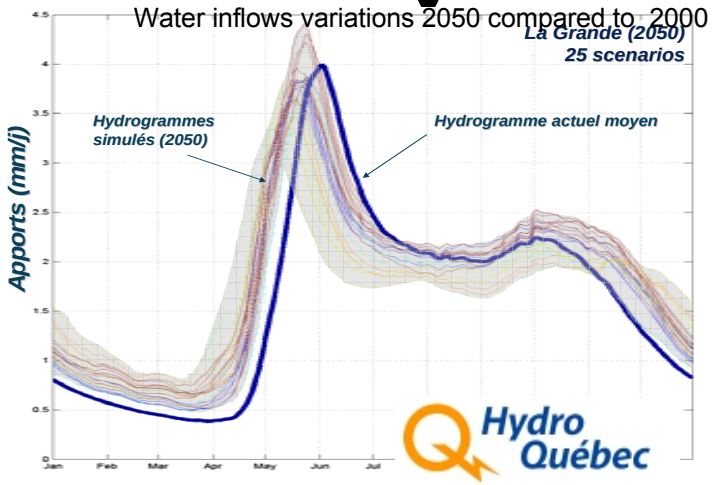
Climate projections

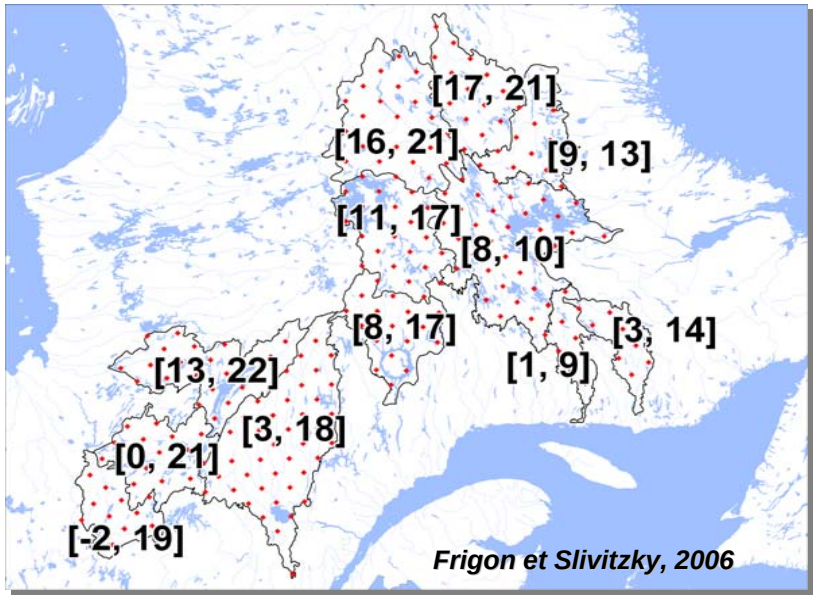


Hydrological models

CRCM flows

Water inflows variations 2050 compared to 2000





Runoff : range of average change in % between future (2041@2070) and actual (1961@1990) from CRCM climate projections

The Ouranos approach

Mitigation

Adaptation

Regulation and Incitatives

The Carbon Market

The Forest as a Carbon Sink

Hydroelectricity to Mitigate GHG

Energy Demand in Québec

Hydroelectricity has displaced oil before 1990 in Québec

CO_2 Emissions (1996)

CO_2 Emission Sources (1996)

United States | Canada | Québec

In Québec: Important gains only possible on transportation for "Kyoto" and beyond

Permafrost Is Already Thawing

Adapting the Forest

Managing Hydroelectricity

•32 GW (96%)

•185

•650

New equipments ?

Production

Coastal Erosion in the Maritimes

Southern Quebec Economy

Environment – Urban Health

UN PIC INEDIT DANS LA PERIODE CONTEMPORAINE

Nombre de décès au mois d'août depuis 1946

Août 2003

température

36 °C

Water Management

1994: "average", for the last 30 years

1999: "extreme", lower by 1 meter

... and if 1999 was the "average" ... to which "extremes" are added??

- Water management
- Link w/ Great Lakes
- Commercial Shipping
- Energy production
- Fisheries
- Ecosystems, habitats
- Tourism and leisure
- Infrastructures
- Insurance
- Flood control

- Fresh water supply
- Used water treatment
- Urban drainage
- Underground water
- Agriculture
- Water quality

Through evaporation → → Lower level (-1,3m) and flow reduction (-40%) to the St-Lawrence River

??

Regional Climate Model

Climate Science is a <u>decision support</u> tool in Quebec... and for others?

OURANOS
Consortium on Regional Climatology and Adaptation to Climate Change

To learn more

http://www.ouranos.ca

Thanks

for your attention