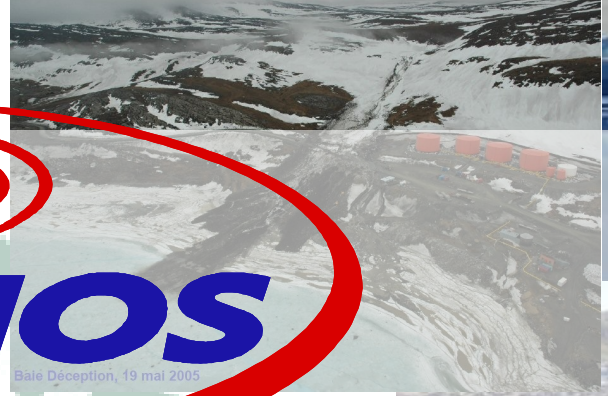
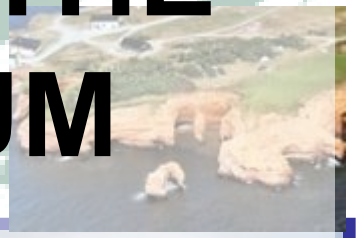
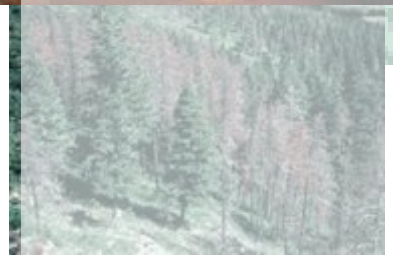
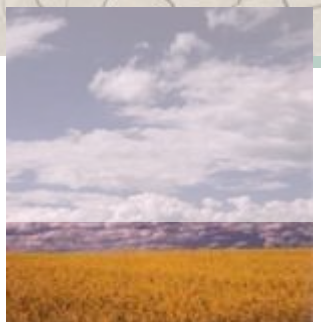
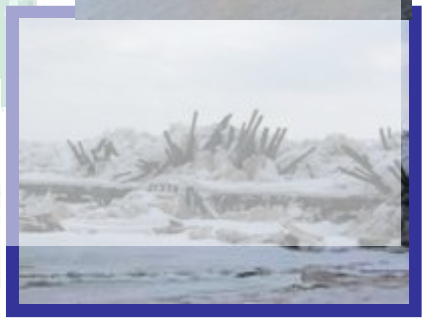




ADAPTING TO GLOBAL CLIMATE CHANGE USING A REGIONAL APPROACH: THE OURANOS CONSORTIUM

A. Bourque
J.-P. Savard

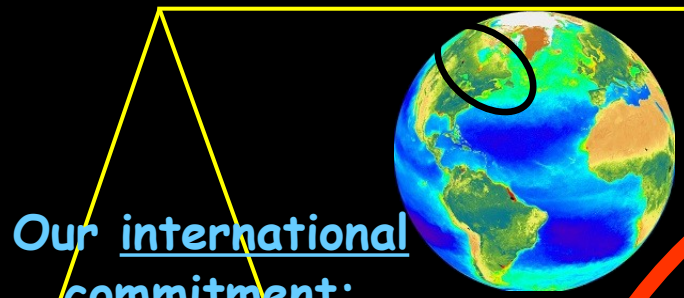







Presentation plan

- Ouranos
- Project on coastal erosion
- Participative approach
- Science results
- Conclusions

The IPCC scientific message on dealing with Climate Change



Our international commitment:

Mitigate

Our domestic need:

Adapt

Avoid 3-4XCO2

Adapt to 2XCO2

Climate Change

Impacts
on human and natural systems

Adaptation

Socio-economic development

Emissions
Greenhouse gases
Aerosols

Mitigation

OURANOS

Adapted from IPCC 2001

Events that trigger change

OURANOS

large

floods

forest fires

Climate Change

- long term trends
  - long time scale
- natural variability
  - decades, years, months, weeks
- extremes
  - days, hours

ghts, heat spells

Saguenay (1996),
26 millions m³ of water
and 9 millions tons of debris

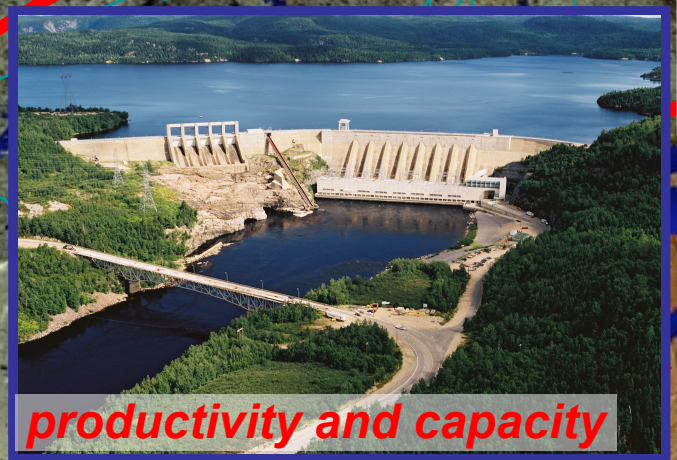
The Great Ice Storm (1998), 1,5 millions
customers without electricity for up to 30 days

Other regional issues usually coherent with CC

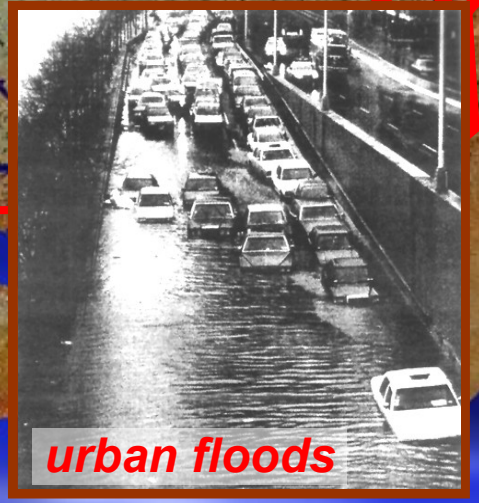
OURANOS

Arctic:
- Permafrost

Natural Resources:
- Hydroelectricity
- Forestry



Maritimes:
- Coastal Erosion



St-Lawrence Valley:
- Urban environment
- Rural environment

Making Climate Change Science Relevant for Adaptation

Ouranos
550 Sherbrooke West
Montreal, Canada
www.ouranos.ca

- **Development and coordination of interdisciplinary, applied and user driven research**
- **100+ scientists and professionals working at same location**
  Network of over 250 involved
- **Access to an extensive network of experts/users/stakeholders to answer specific questions**
- **Dedicated supercomputers for climate simulations:**
  - **SGI - 32 CPU & 3 CRAY SX-6**
- **5 M$ annual base budget (10-12 M$ with leverage)**
- **Important dates:**
  2001-02: Announcements, priorities
  2003-04: Projects, 1st symposium
  2005-06: Initial results, 2nd symposium
  2007+: First phase results, projects renewal
  2009-2014: Second phase

Mission:
To provide decision makers with:

- Regional Scale Climate Scenarios
- Evaluate Impacts of CC
- Support to Adaptation Decisions

Consortium on Regional Climatology and Adaptation to CC

MEMBERS

Québec

Ministries:

2. Sécurité publique
3. Développement durable, Environnement et Parcs
4. Ressources naturelles et Faune
5. Affaires municipales et Régions
6. Transports
7. Agriculture, Pêcheries et Alimentation
8. Développement économique, Innovation et Exportation
9. 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) (2007 →)

Manitoba Hydro

Manitoba Hydro

Ecole de Technologie Supérieure

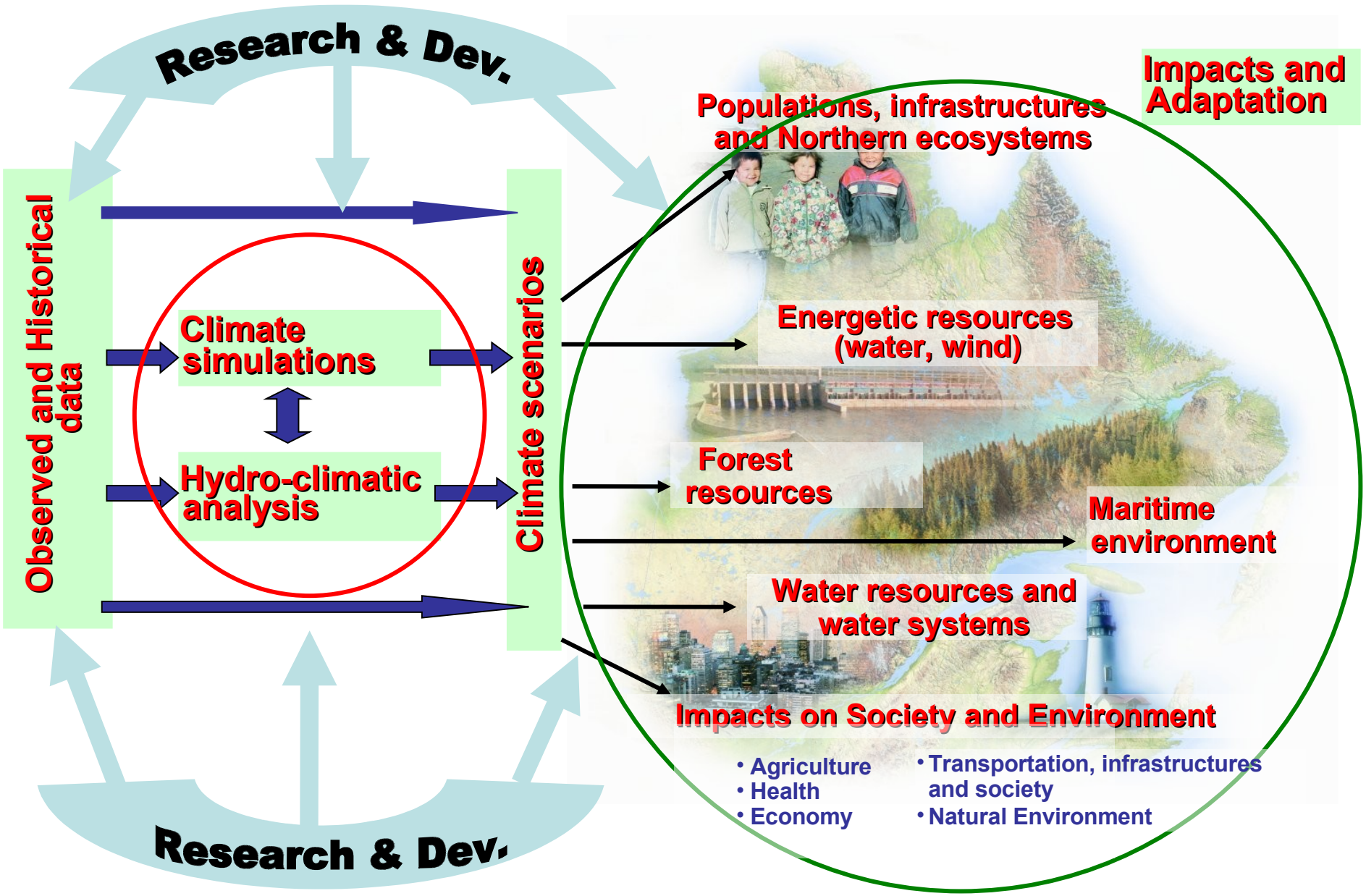
Université du Québec
École de technologie supérieure

OTHER KEY SCIENTIFIC PARTNERSHIPS

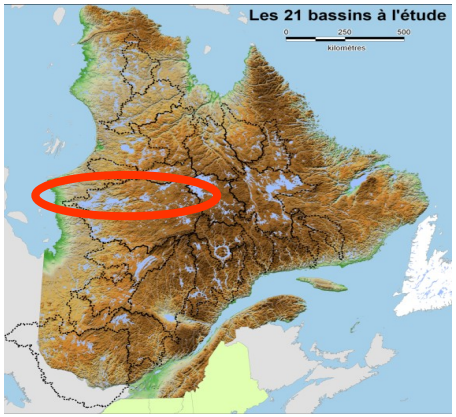
- Université de Montréal
- Université du Québec à Rimouski
- Université Sherbrooke
- University of Manitoba, Winnipeg
- Centre de ressources en impacts et adaptation au climat et à ses changements (CRIACC)
- Canadian Climate Impacts & Adaptation Research Network (→2007)

•To be noted: Significant contribution of funding organisations like NSERC, CFCAS, NRCan and operational funding

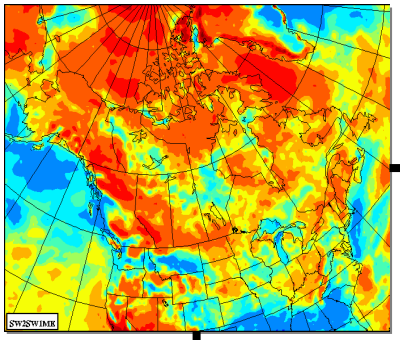
Scientific Program: Climate and Impacts/Adaptation



Hydrological scenarios and impacts on water resources

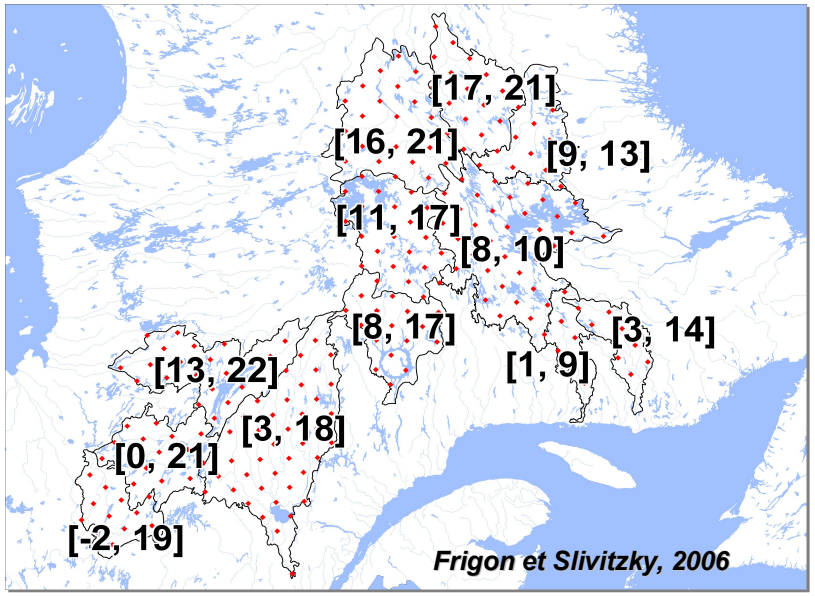


Climate projections

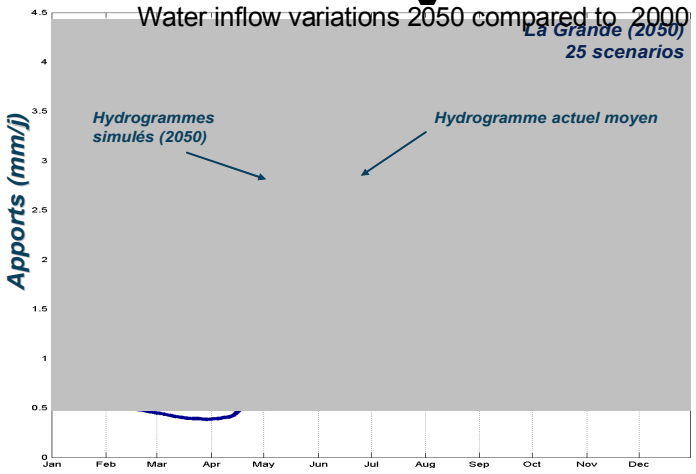


Hydrological models

CRCM flows



Water inflow variations 2050 compared to 2000



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

Hydro Québec

- 32 GW (96% hydraulics)
- 185 TWh
- sales:
  - total: 13 MM$
  - ext.: 3,5 MM$
- worth: 57 MM$

- 650 000 km²

- New equipments ?

Safety/Integrity of infrastructures?

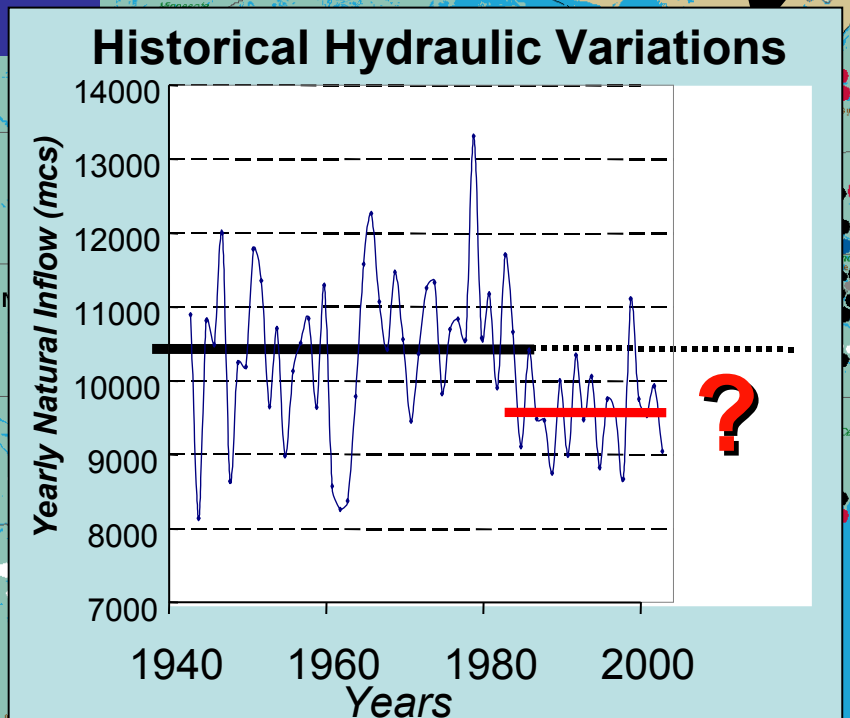
Internal market demand evolution ?

Production with existing equipment ?

80 %

QUÉBEC

Opportunity for external sales
(displacement of electricity production based on hydrocarbons)
?

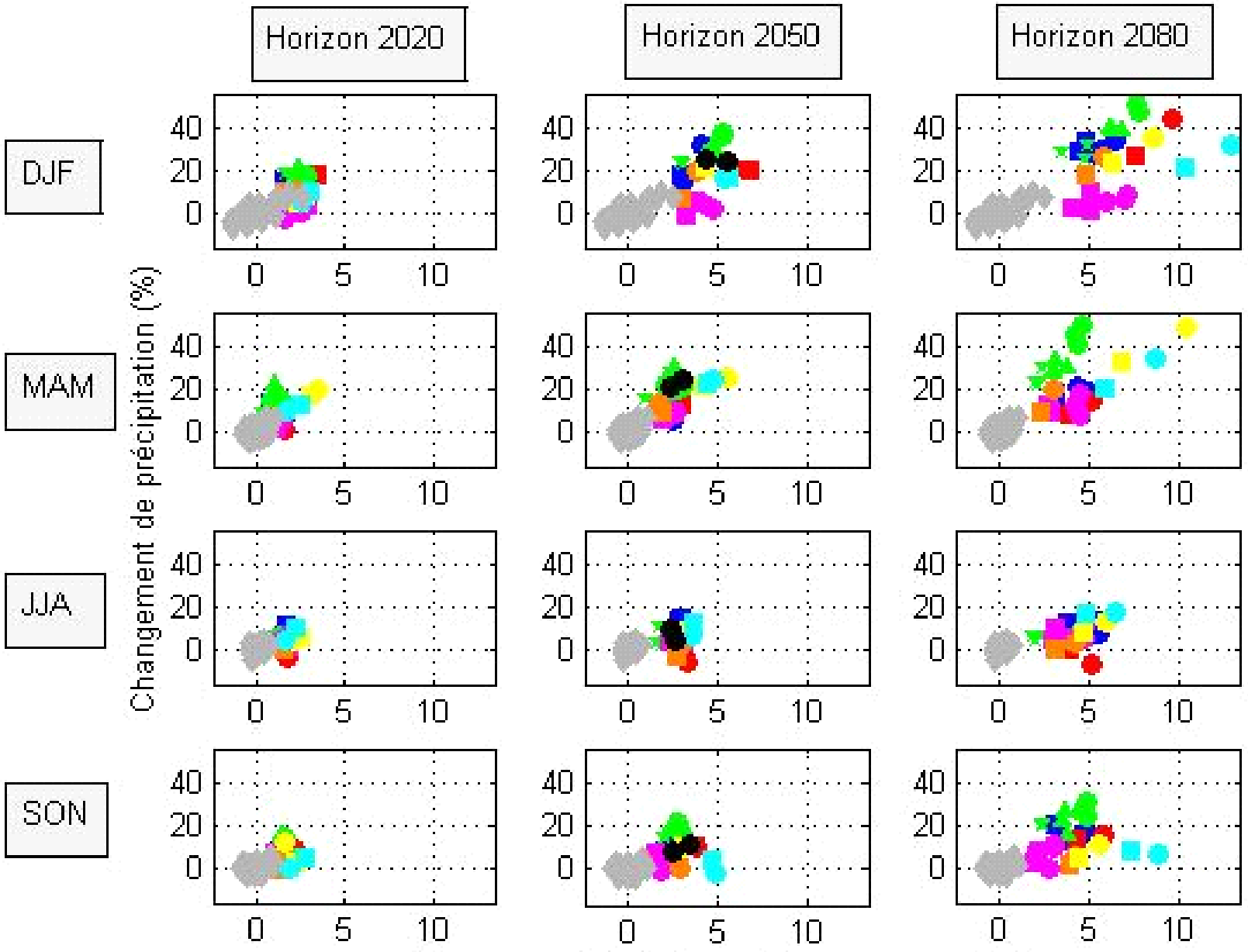


Hydro
Nuclear
Natural gas
Oil
Coal

Océan Atlantique

OURANOS

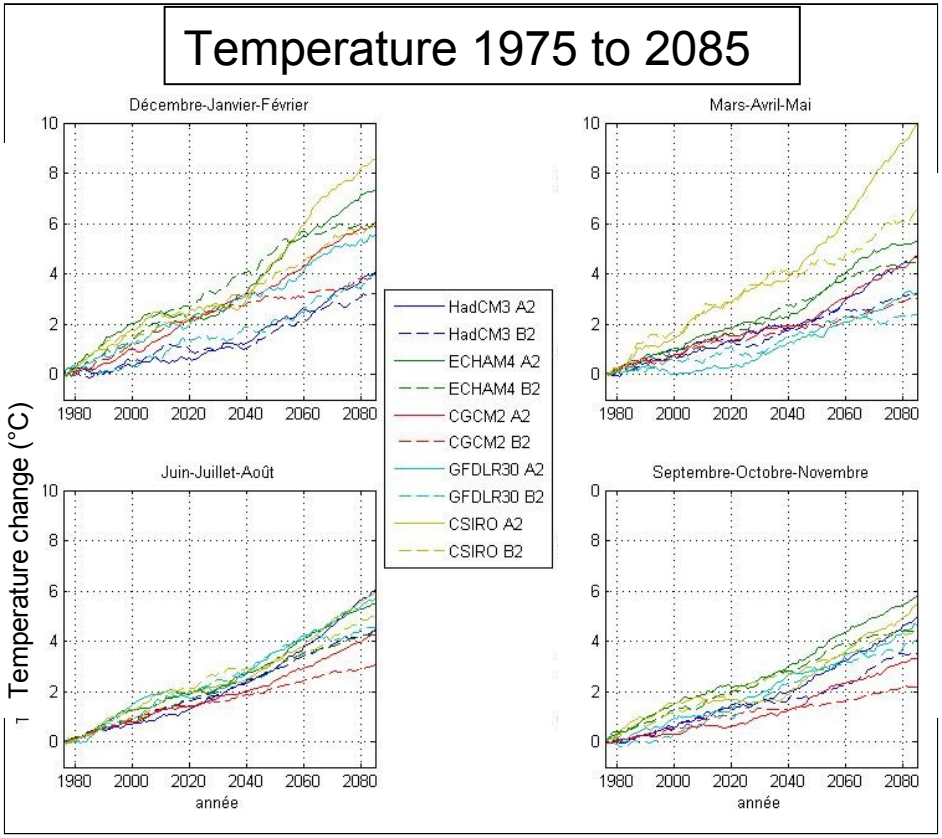
Probability approach to deal with CC uncertainties

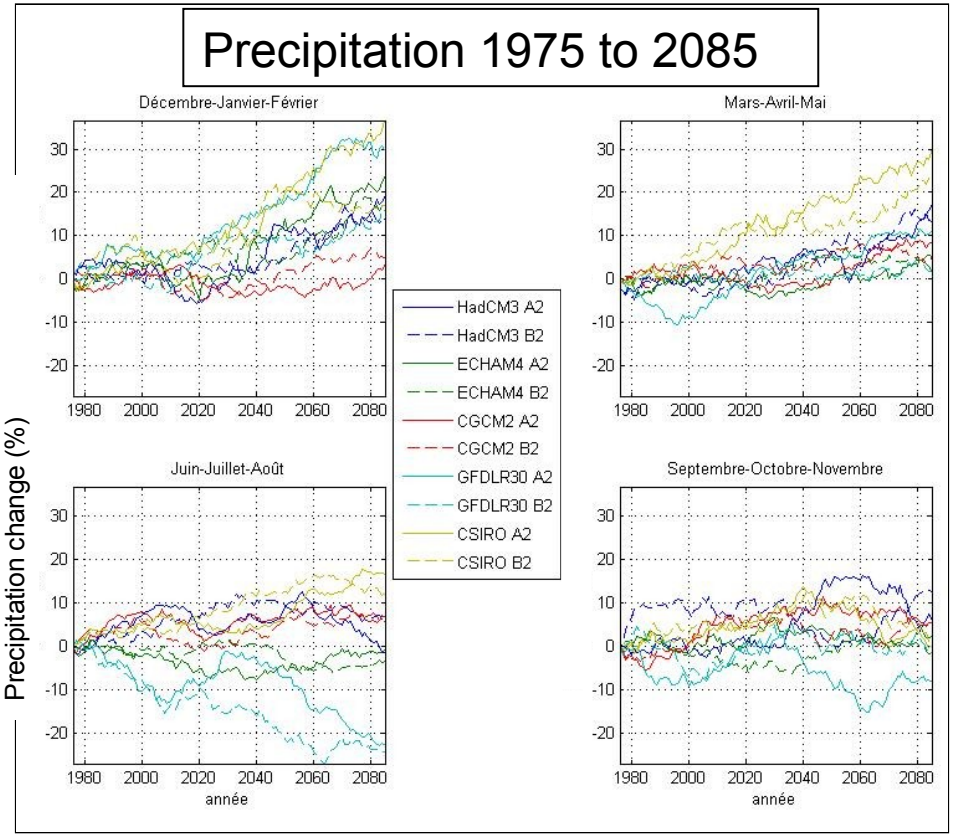


Simple seasonal scenarios

Northern Quebec

Temperatures and Precipitations scenarios (Southern Quebec)





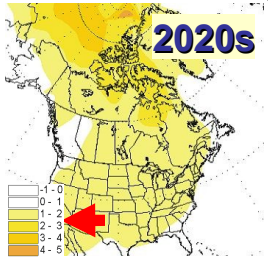
Detailed scenarios

Climate Modeling Required for Regional Adaptation

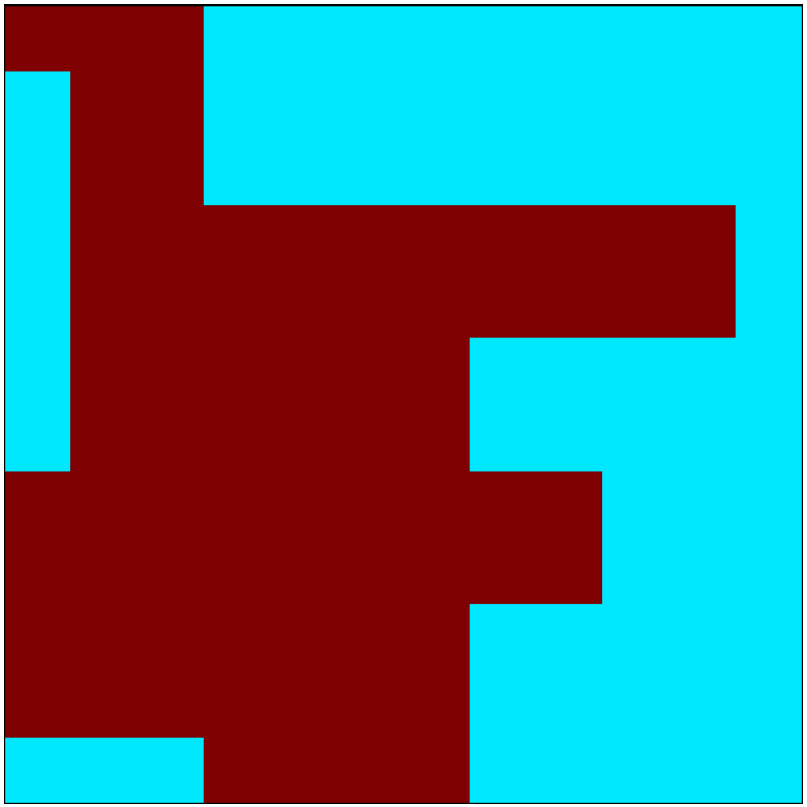
OURANOS

Quebec according to a General Circulation Model

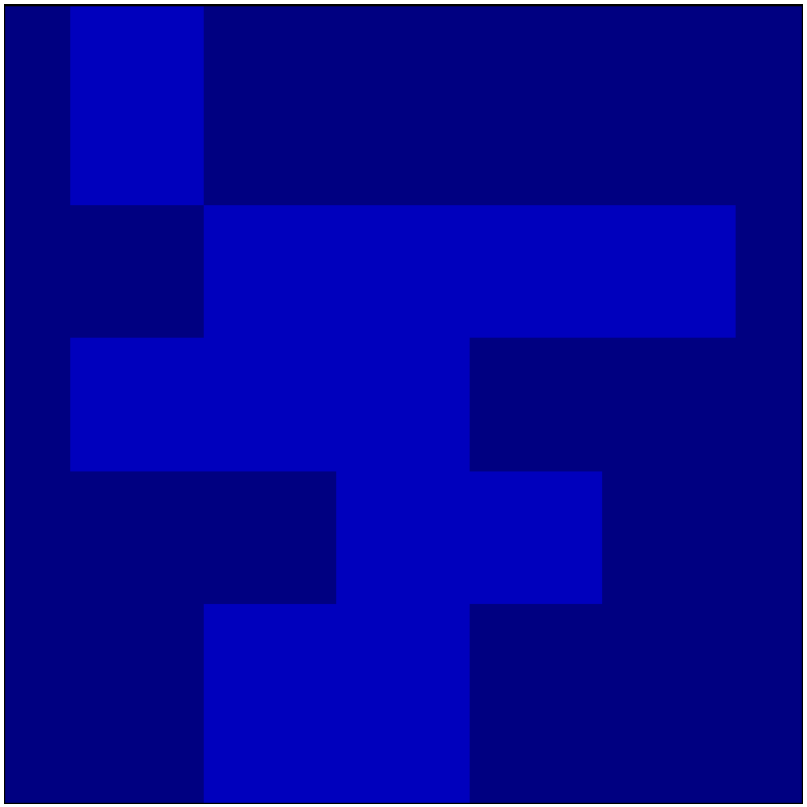
(available from Environment Canada and others)



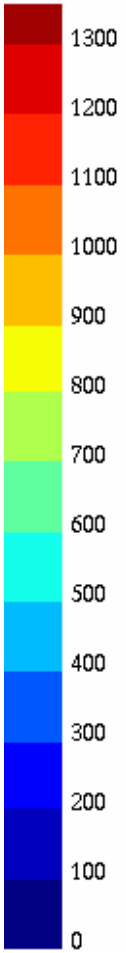
Spatial resolution: 250-400 km



Land-Water Contour



Elevation



Climate Modeling Required for Regional Adaptation

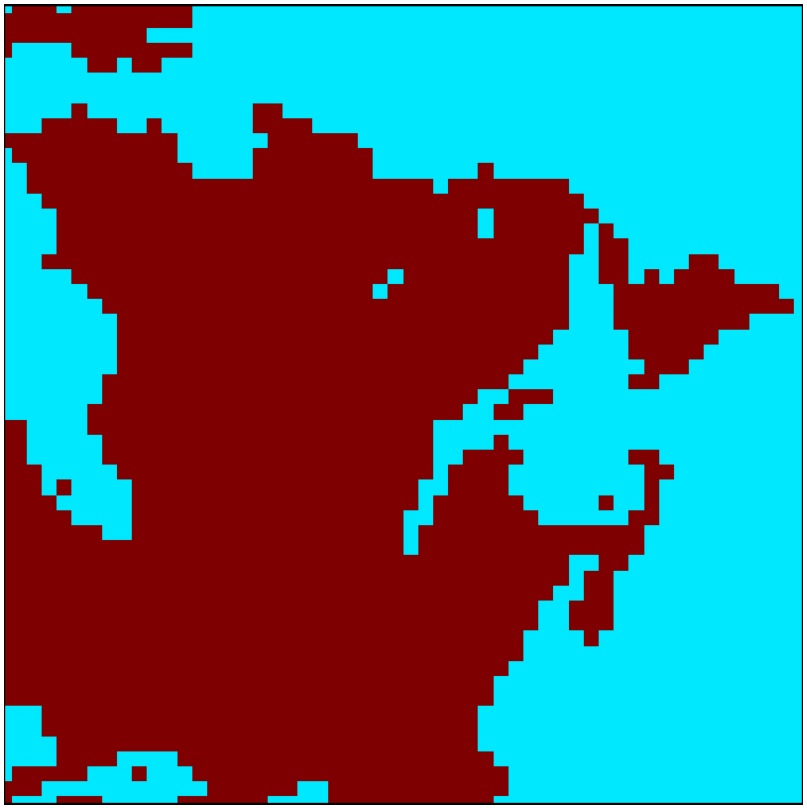
OURANOS

Quebec according to a Regional Climate Model

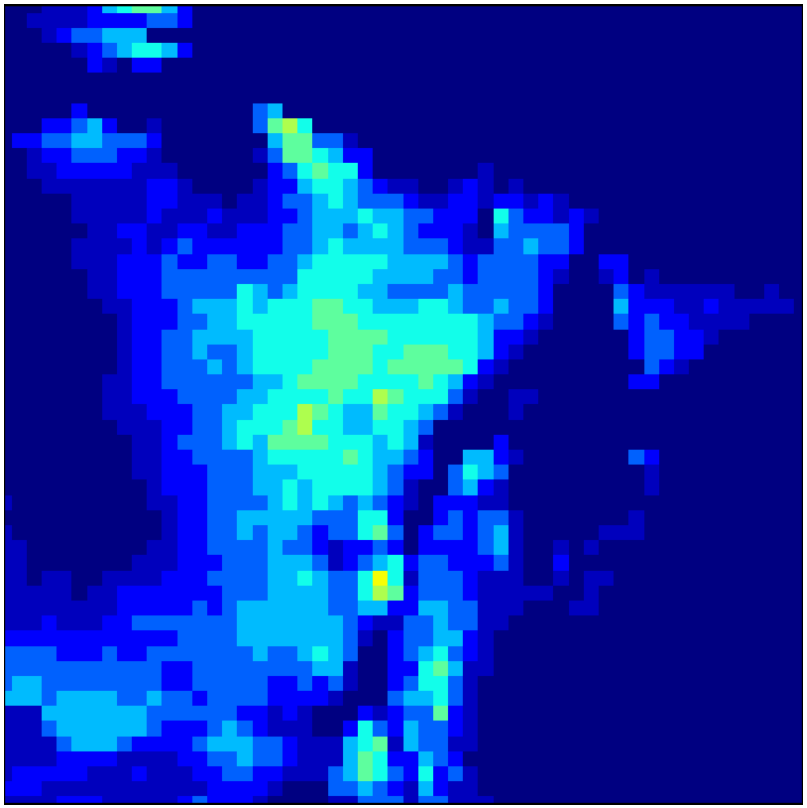
in the future: Ensemble of RCMs

(CRMC, Arpège, NARCCAP…)

Spatial resolution: 45 km



Land-Water Contour



Elevation

Regional scales needed for all

OURANOS

m

Regula

The

Perma

Adaptin

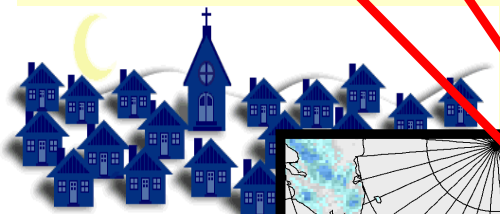
Managin

Hydroelectricity to Mitigate GHG

Energy Demand in Québec

CO_2 Emissions (1996)

Validate Wind Power Production Potential



Coastal Erosion in th

Souther

Environme

UN PIC INEDIT DANS

Nombre de décès au

55 000
50 000
45 000
40 000
35 000
30 000

Storms / winter

Water Management

1994: "average", for the last 30 years

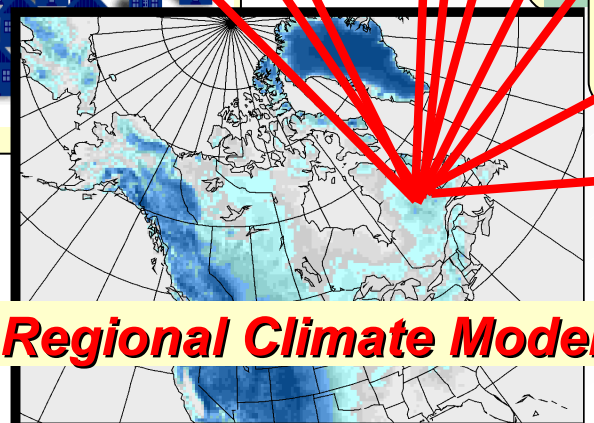
1999: "extreme", lower by 1 meter

... 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

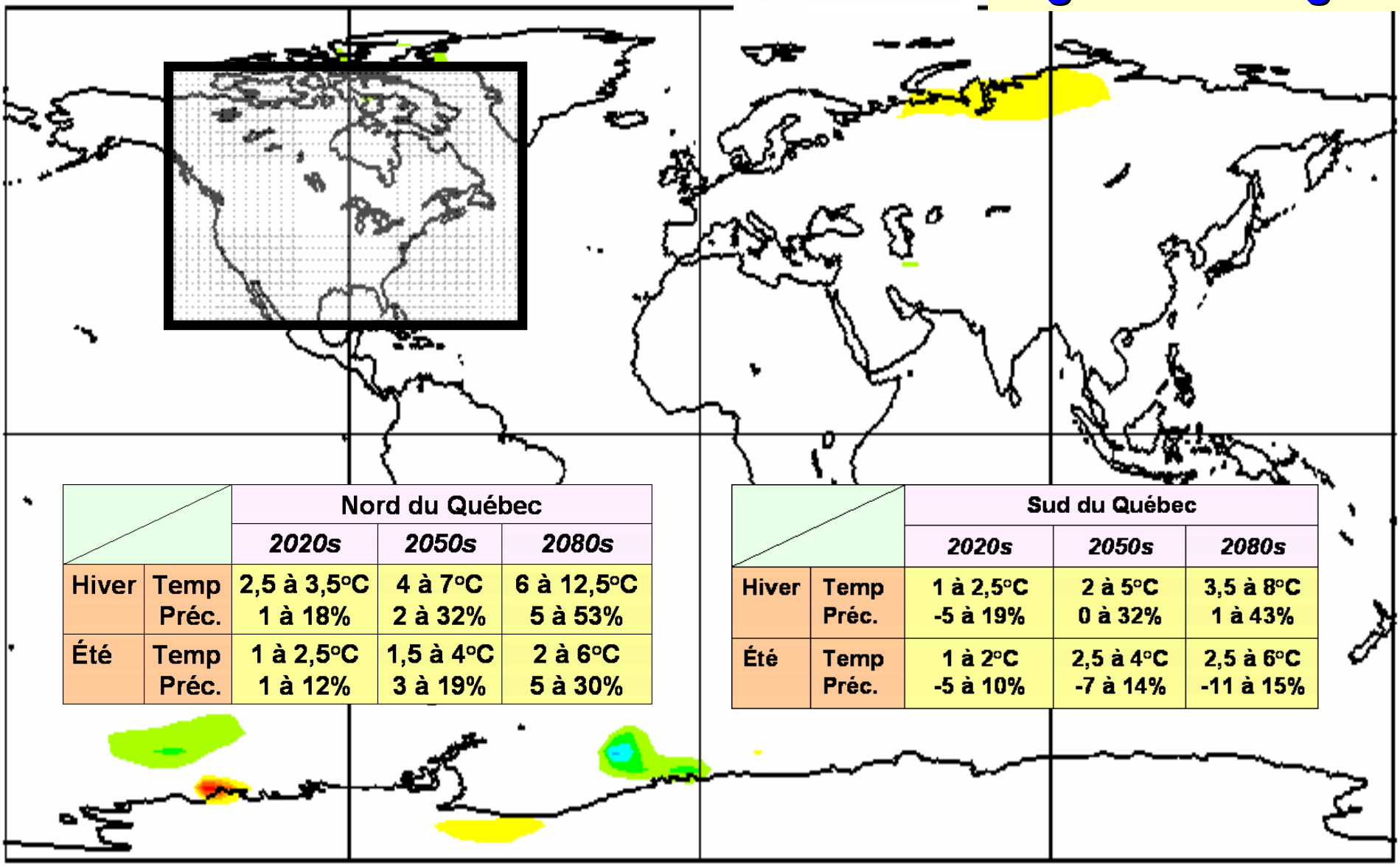
Climate Science is clearly a decision support tool for most users

Tools to estimate regional changes

CCCma Surface Temperature Change Projection for 1990

Simulated by CGCM1 (http://www.cccma.bc.ec.gc.ca)

Environnement Canada
Environment Canada

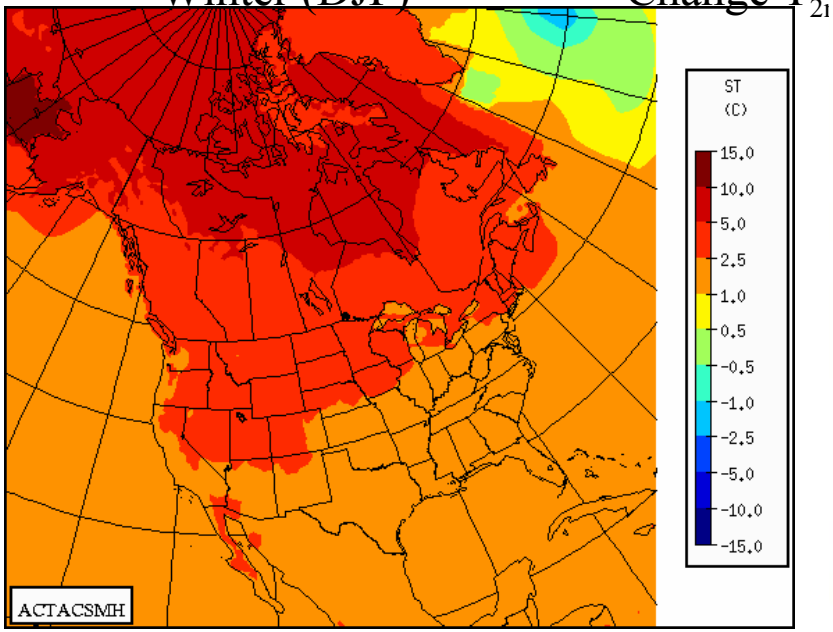


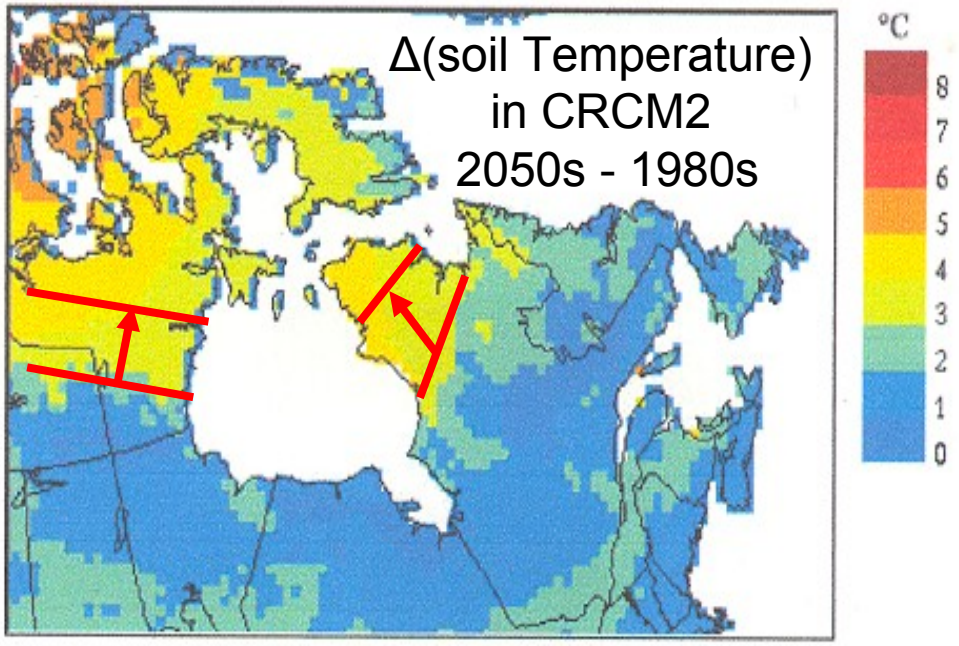
		Nord du Québec		
		2020s	*2050s*	*2080s*
Hiver	Temp	2,5 à 3,5°C	4 à 7°C	6 à 12,5°C
	Préc.	1 à 18%	2 à 32%	5 à 53%
Été	Temp	1 à 2,5°C	1,5 à 4°C	2 à 6°C
	Préc.	1 à 12%	3 à 19%	5 à 30%

		Sud du Québec		
		2020s	*2050s*	*2080s*
Hiver	Temp	1 à 2,5°C	2 à 5°C	3,5 à 8°C
	Préc.	-5 à 19%	0 à 32%	1 à 43%
Été	Temp	1 à 2°C	2,5 à 4°C	2,5 à 6°C
	Préc.	-5 à 10%	-7 à 14%	-11 à 15%

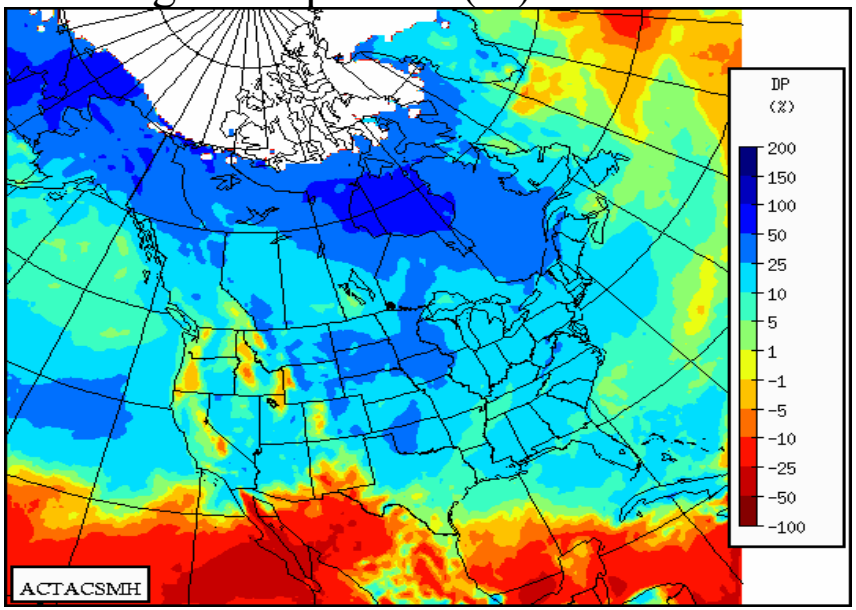
High resolution scenarios from CRCM and NARCCAP

Winter (DJF) Change T_{2m}

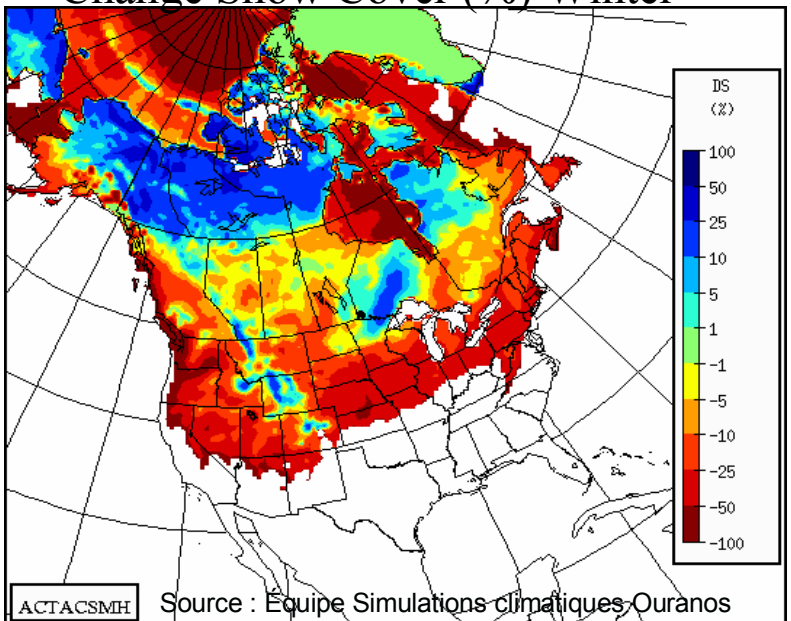




Change Precipitation (%) Winter

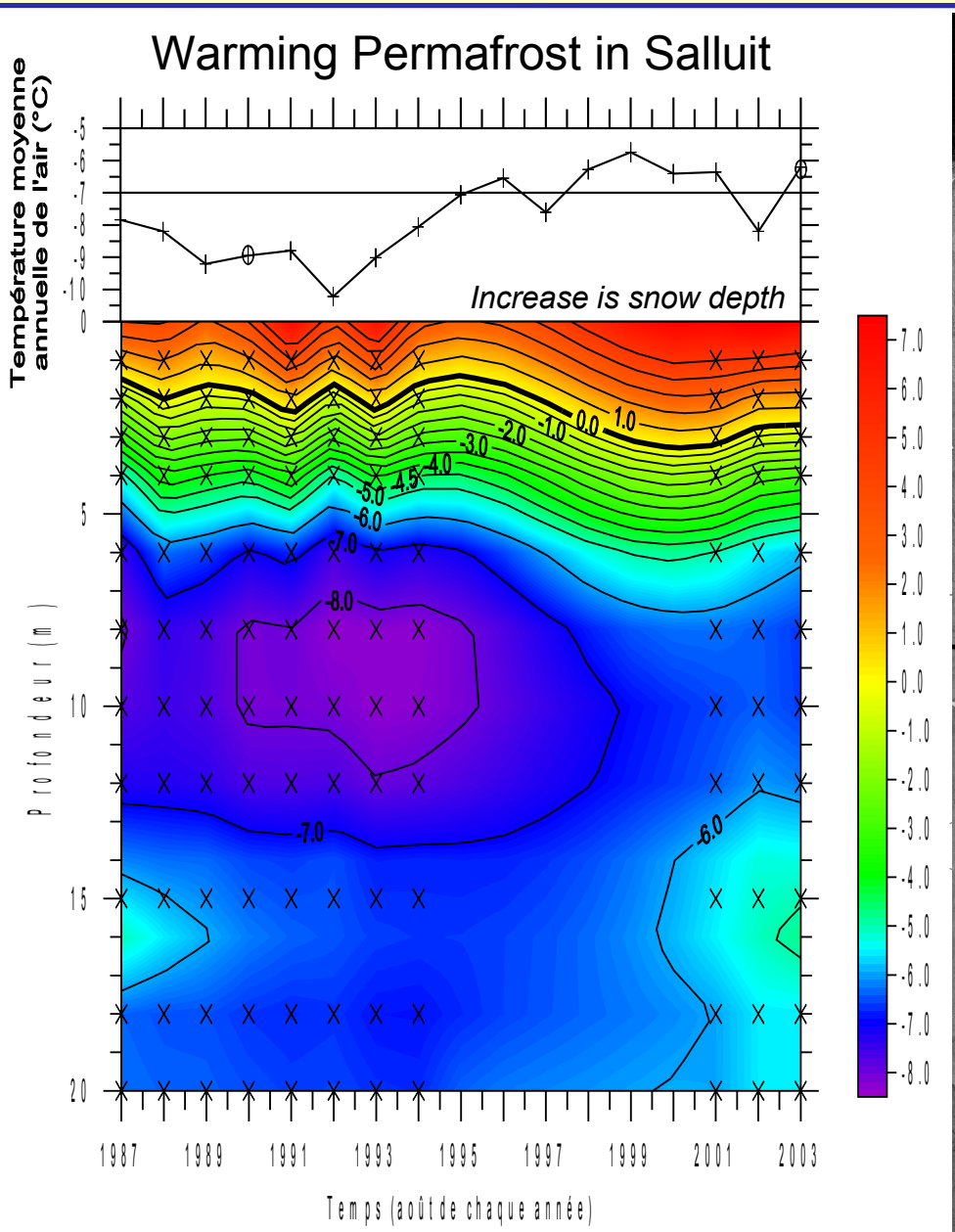


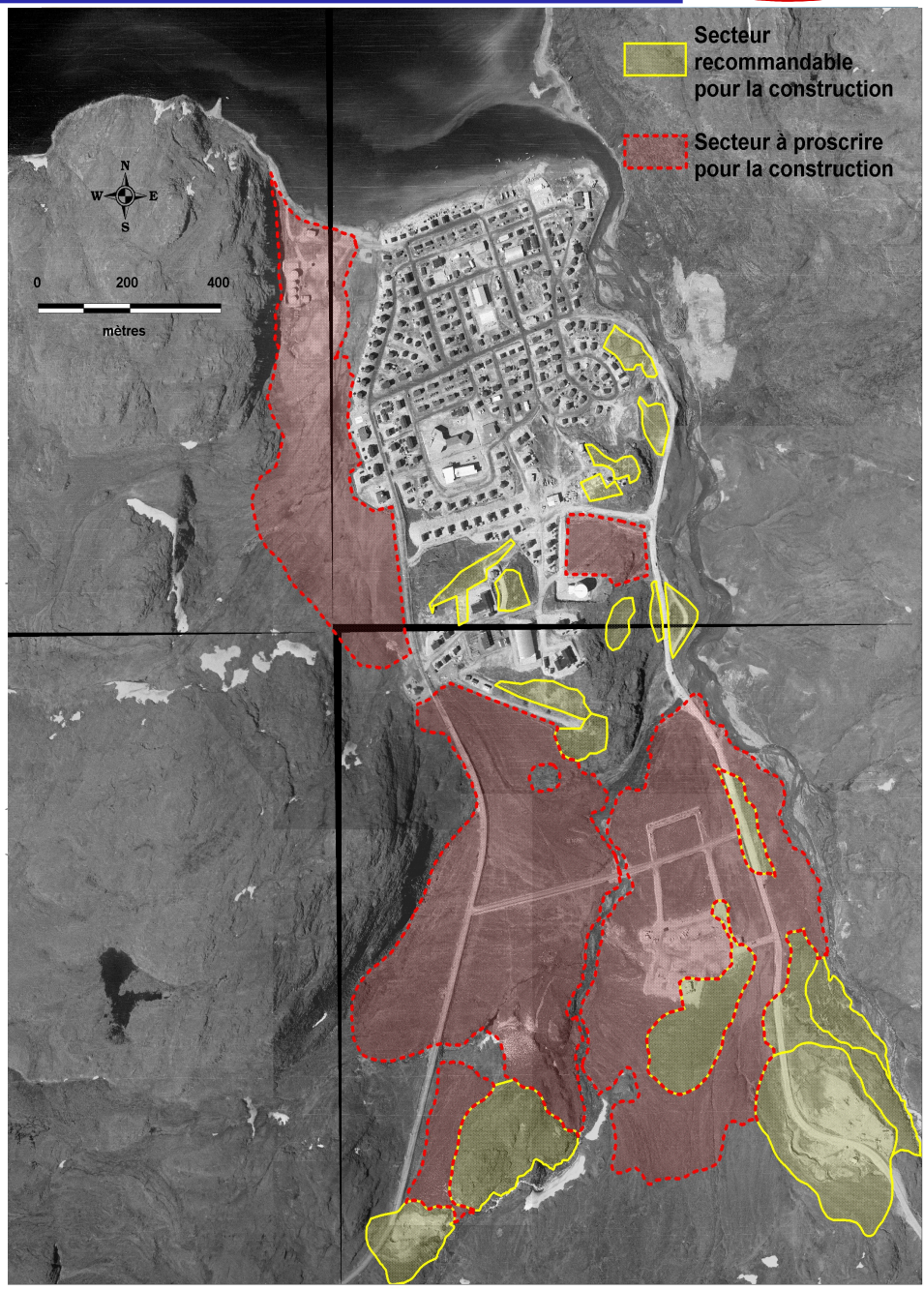
Change Snow Cover (%) Winter



Source : Équipe Simulations climatiques Ouranos

Helping northern communities develop even with CC





ULaval *et al.*

Approach for CC and coastal zones adaptation issues

OURANOS

Past climate

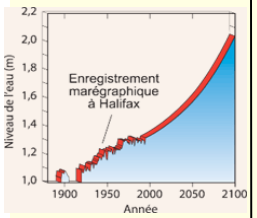
Future climate

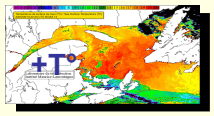
Sea level rise

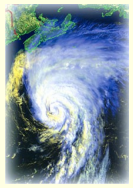
Protecting ice cover reduction

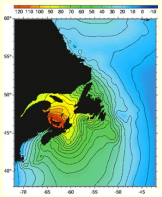
Freeze-thaw cycle increases

Increased storminess









Modification of coastal processes

submersion

alteration solifluxion landslides

Increases in wind intensity and wave height

Increases in frequency intensity of storms

Acceleration of coastal erosion

Choices of adaptation scenarios

zoning

protection

retreat

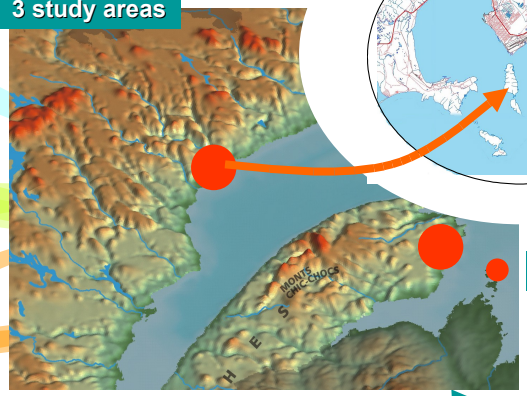
3 research groups

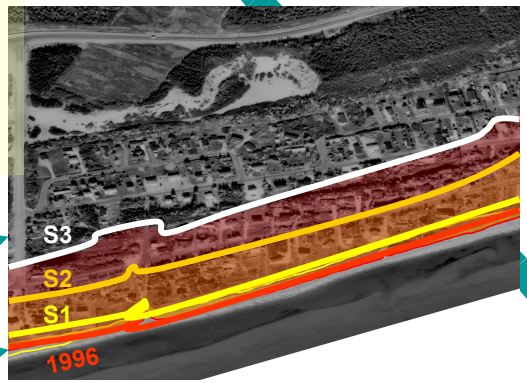
« Climate group »
Documentation of past and future climate

« Coastal dynamic group »
Evaluate impacts on different coastal processes and usage

« Users group »
Estimate impacts and adaptation solutions

3 study areas





projection in 2030 of scenarios for areas at risk

S1	Optimistic scenario	Mean rate in last 30 years
S2	Moderate scenario	Max decadal rate since 1930
S3	Pessimistic scenario	S3 = 2 S2 – S1

Cost/benefit analysis for adaptation, scenarios

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