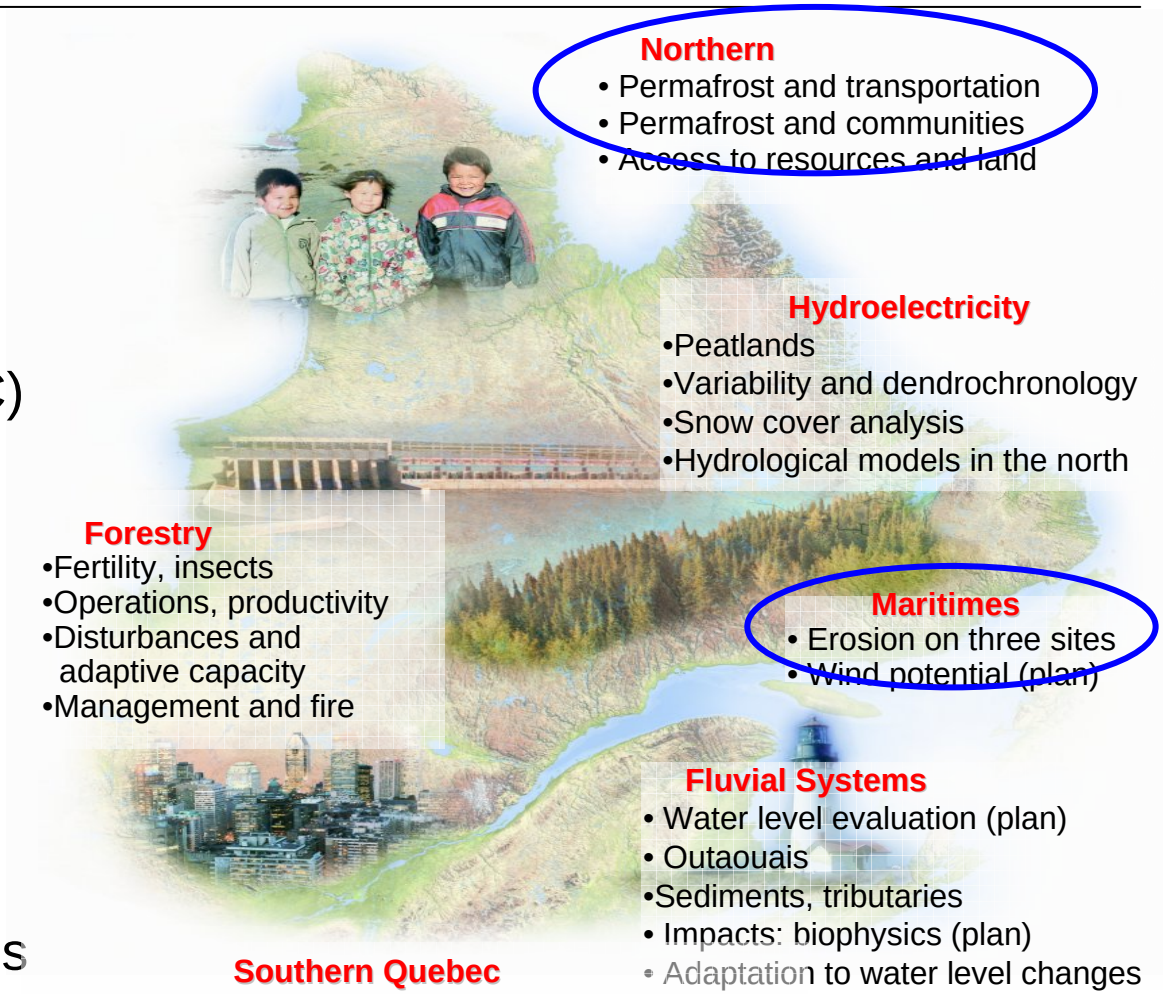
Building the capacity to understand, measure, analyse, apply and respond to a complex multi-disciplinary and highly scientific issue

Programs:

North: M. Allard (ULaval)
Hydro: R. Roy (HQ)
Forest: D. Houle (MRNF)
Coasts: F. Morneau (MSP)
Fluvial systems: JF Cantin (EC)
Health: P. Gosselin (INSPQ)
South: A. Bourque (Ouranos)

Working on many fronts to facilitate adaptation:

- Linking climate and impacts
- Evaluating vulnerabilities
- Developping needed scenarios
- Working with the actors of adaptation to facilitate good decision making



Northern
- Permafrost and transportation
- Permafrost and communities
- Access to resources and land

Hydroelectricity
- Peatlands
- Variability and dendrochronology
- Snow cover analysis
- Hydrological models in the north

Forestry
- Fertility, insects
- Operations, productivity
- Disturbances and adaptive capacity
- Management and fire

Maritimes
- Erosion on three sites
- Wind potential (plan)

Fluvial Systems
- Water level evaluation (plan)
- Outaouais
- Sediments, tributaries
- Impacts: biophysics (plan)
- Adaptation to water level changes

Southern Quebec
- Châteauguay: ground water levels, floods
- Agriculture: adaptation, land use
- Health: Allergy, hot spots and morbidity/mortality
- Economy: Evaluation guide, Tourism, Energy
- Water resources: water drinking, urban drainage
- Atlas of health vulnerabilities to climate change

Alain Bourque
François Morneau
Jean-Pierre Savard

Contributors:

ISMER UQAR Institut Maurice-Lamontagne

Fisheries and Oceans
Environment
Natural Resources

Sécurité publique Québec

OURANOS

Adapting to accelerated coastal erosion

Economic issues: **> 1 MM $ at risk within 25 years**
Safety issues: **35% of coast at risk of submersion**
Environmental issues: **Coastal marshes eroding**
Social issues: **Cost of inaction, equity issues**

North-Shore:
60 % of coasts with accelerated erosion rates (1 @ 10 m/year in last decade)

South-Shore:
Most coasts very sensible to erosion

Magdalen Islands:
Isolated islands with main roadway at risk and exceptionnal beaches and scenery bringing summer tourism and development projects

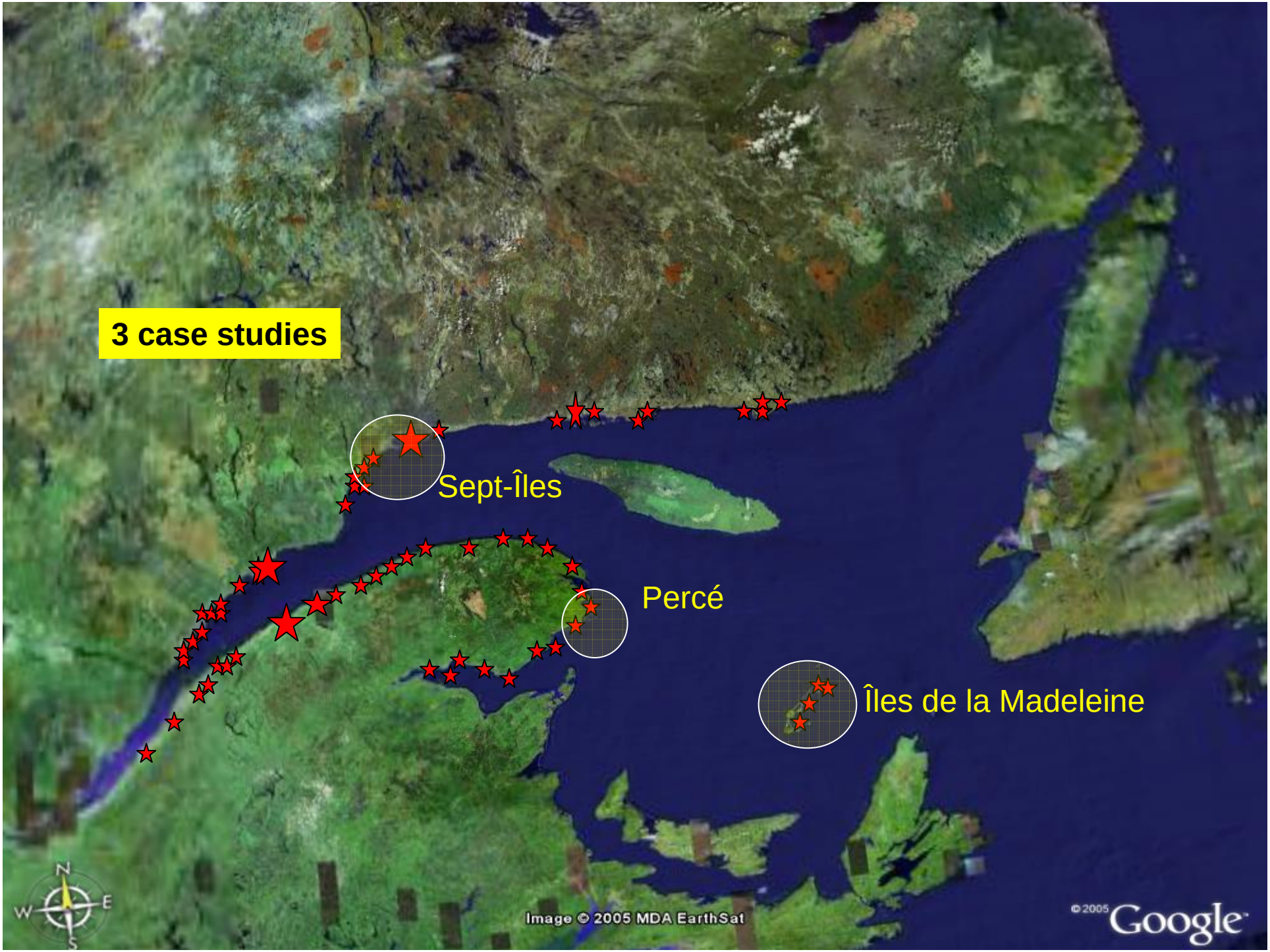
Contributors:

ISMER UQAR Institut Maurice-Lamontagne

Fisheries and Oceans
Environment
Natural Resources

Sécurité publique Québec

OURANOS


3 case studies
Sept-Îles
Percé
Îles de la Madeleine
Image © 2005 MDA EarthSat
© 2005 Google

An integrated approach

OURANOS

Past climate

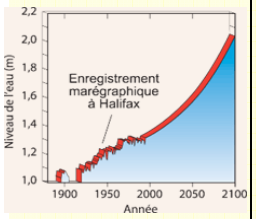
Future climate

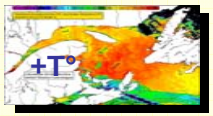
Sea level rise

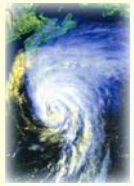
Protecting ice cover reduction

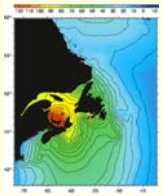
Freeze-thaw cycle increases

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

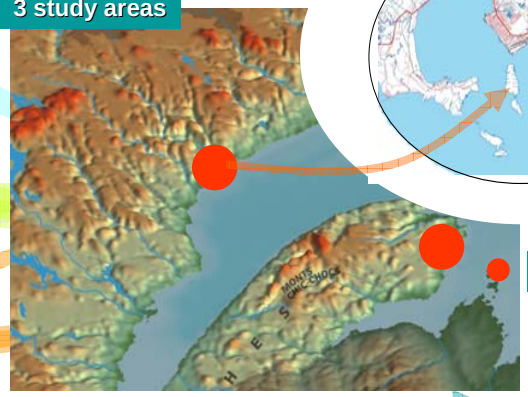
3 research groups

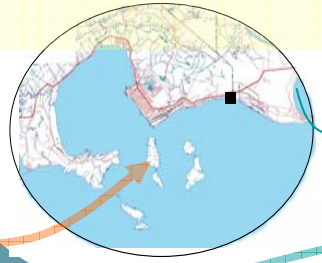
« Climate group »
Documentation of past and future climate

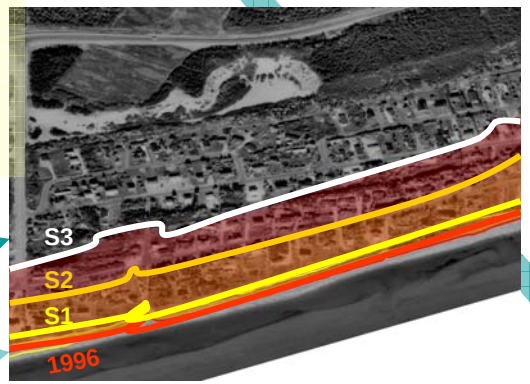
« Coastal dynamic group »
Evaluate impacts on different coastal processes and usage

« Users group »
Estimate impacts and adaptation solutions

3 study areas







projection in 2030 of scénarios for areas at risk

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

Cost/benifits analysis for Adaptation, scénarios

COORDINATION François Morneau (MSP) & Jean-Pierre Savard (Ouranos)

Climate Group

Hydrodynamics and climate modeling:

François Saucier (UQAR-ISMER), Denis Lefaivre (IML) , Xigang Xu (UQAR-ISMER), Simon Senneville (UQAR-ISMER)

Wave dynamics and storm tracks

Jean-Pierre Savard (Ouranos), Corina Rosu (Ouranos Uqam), Philippe Gachon, (Uqam, Ouranos et Env. Can.) Denis Jacob, Env. Can), Viateur Turcotte (Env. Can.), Marco Carrera (U. McGill), Guenther Patcher(Ouranos), Christian Poirier (MTQ), Yvon Ouellet (U. Laval)

Coastal Group

Coastal dynamics and human geography

Pascal Bernatchez (UQAR), Antoine Morissette (UQAR), Stéphanie Friesinger, Daniel Roberge, Steve Plante UQAR), Maude Corriveau, Yvon Jolivet, Thomas Buffin-Bélanger

Users Group

Adaptation committees (only coordinators listed)

Jean-Pierre Savard (Ouranos), Michel Chouinard et Christian Fraser (Zip Baie des Chaleurs), Louis Vigneault (MTQ, Iles-de-la Madeleine) Serge Bourgeois (Municipalité de Cap-aux Meules), Ian Crousset (Zip de Sept-Iles), Claude Bureau (Ville de Sept-Iles)

A multidisciplinary team

OURANOS

Four climatic factors relevant for coastal erosion

Anthropogenic changes

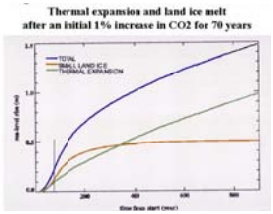
Increase in T°

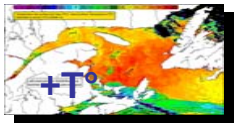
Sea level

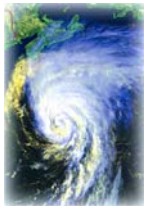
Ice cover

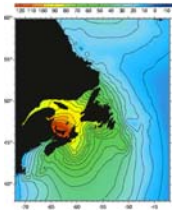
freeze-thaw cycles

Storminess









Modification in coastal processes

submersion

alteration solifluxion landslides

Amplitude/violence of waves

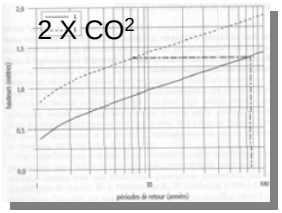
Return period of storms

Increase in coastal erosion

Environmental impacts

Damages to infrastructures and properties

Increases of high impacts event, risks



50 cm increase =
10 times more frequent

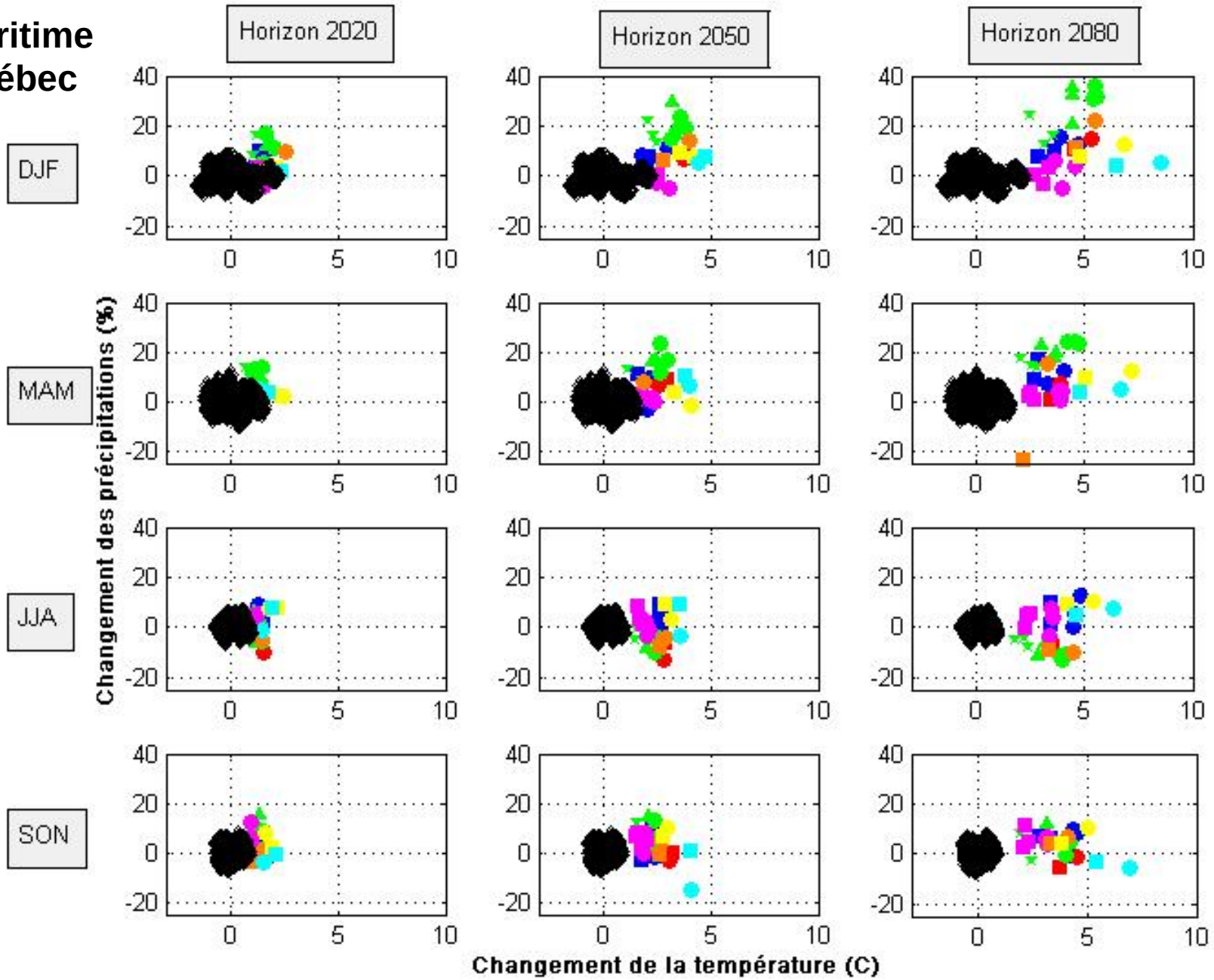
Hydro-Climate Group

A few results:
Evolution of ice cover
Storm analyses and storm surges

Picture : Municipalité de Ste-Luce
October 2005

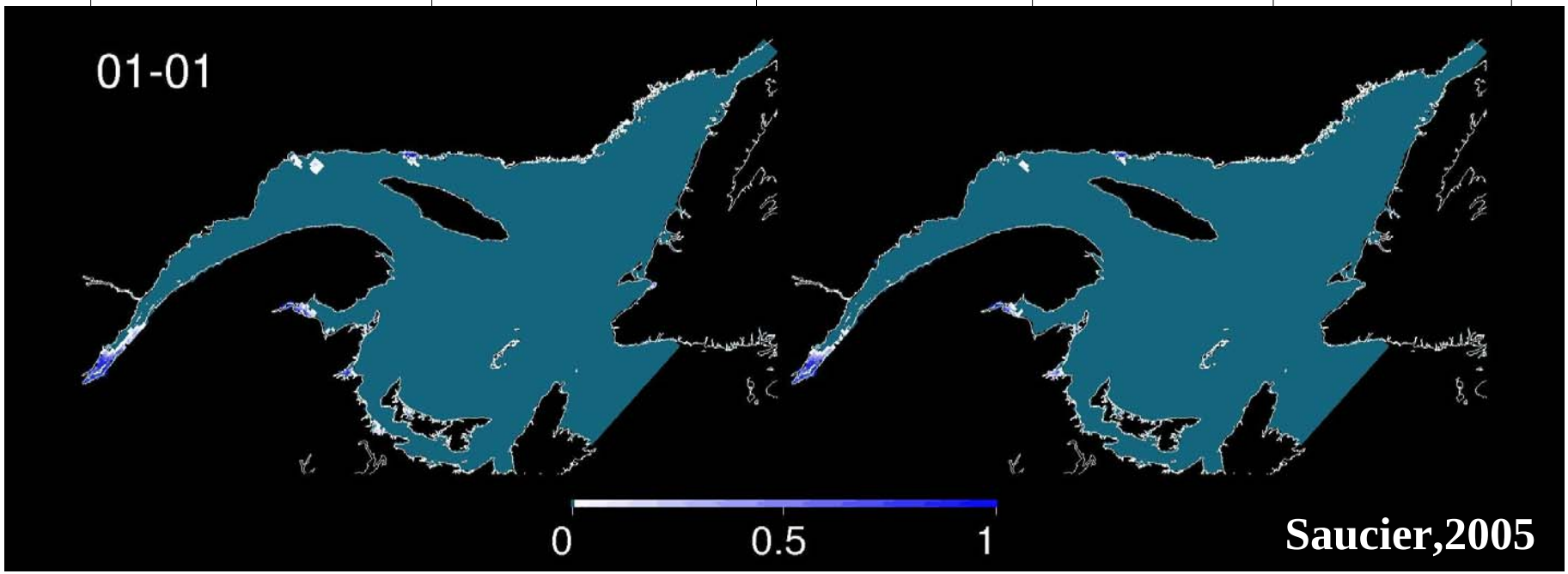
Temperature/precipitation scenarios from RCM/GCMs

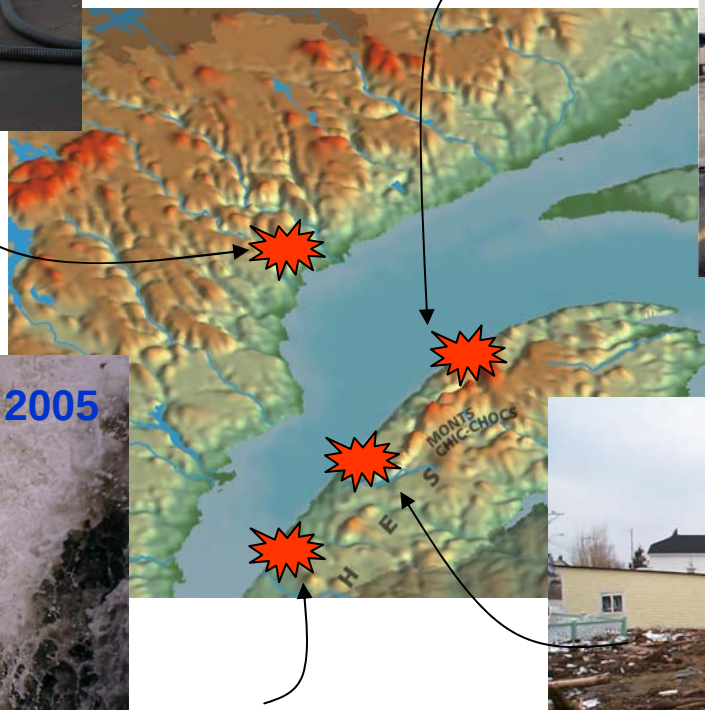
Maritime Québec



days with at least 30% of ice cover per study sites

Sites	1997-2003 (> 30%)	Warmer +2C (>30%)	Difference (days)	Variability
Sept-Îles	40.4	16.1	24.3	16.6
Percé	62.2	26.1	36.1	12.2
Martinique (Magdalen Isl.)	71	26.3	44.7	15.2
Pointes-aux Loups	57.3	15.9	41.4	14.8





Most of erosion generated by individual storms

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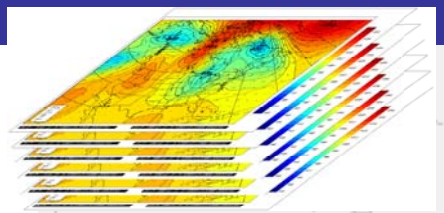
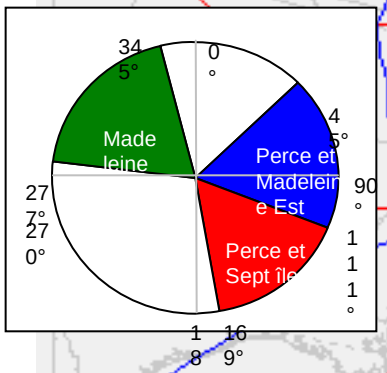
Catalog of 67 storms 2003-05 (waves > 4 m)



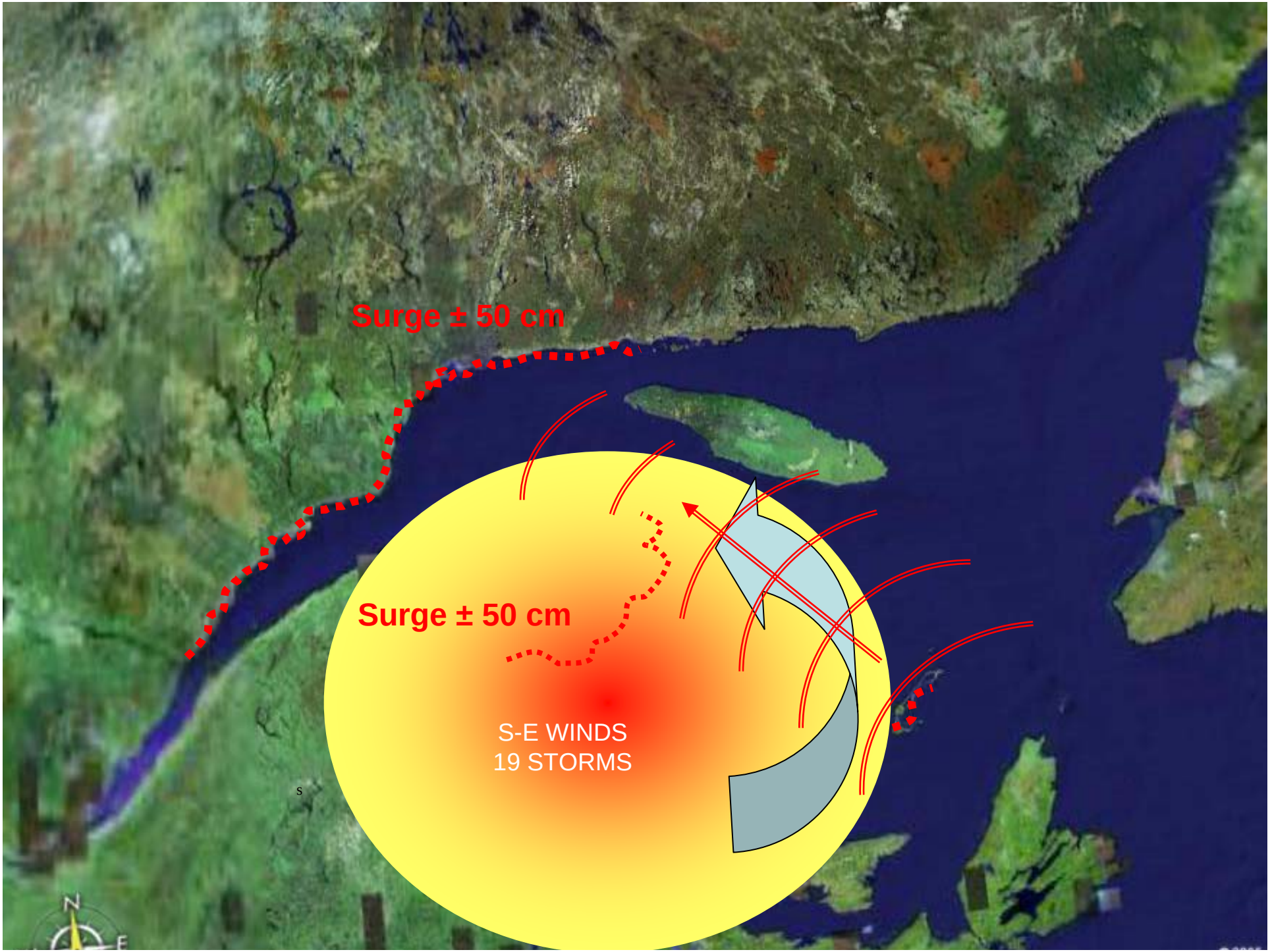
39 storms with north-west waves

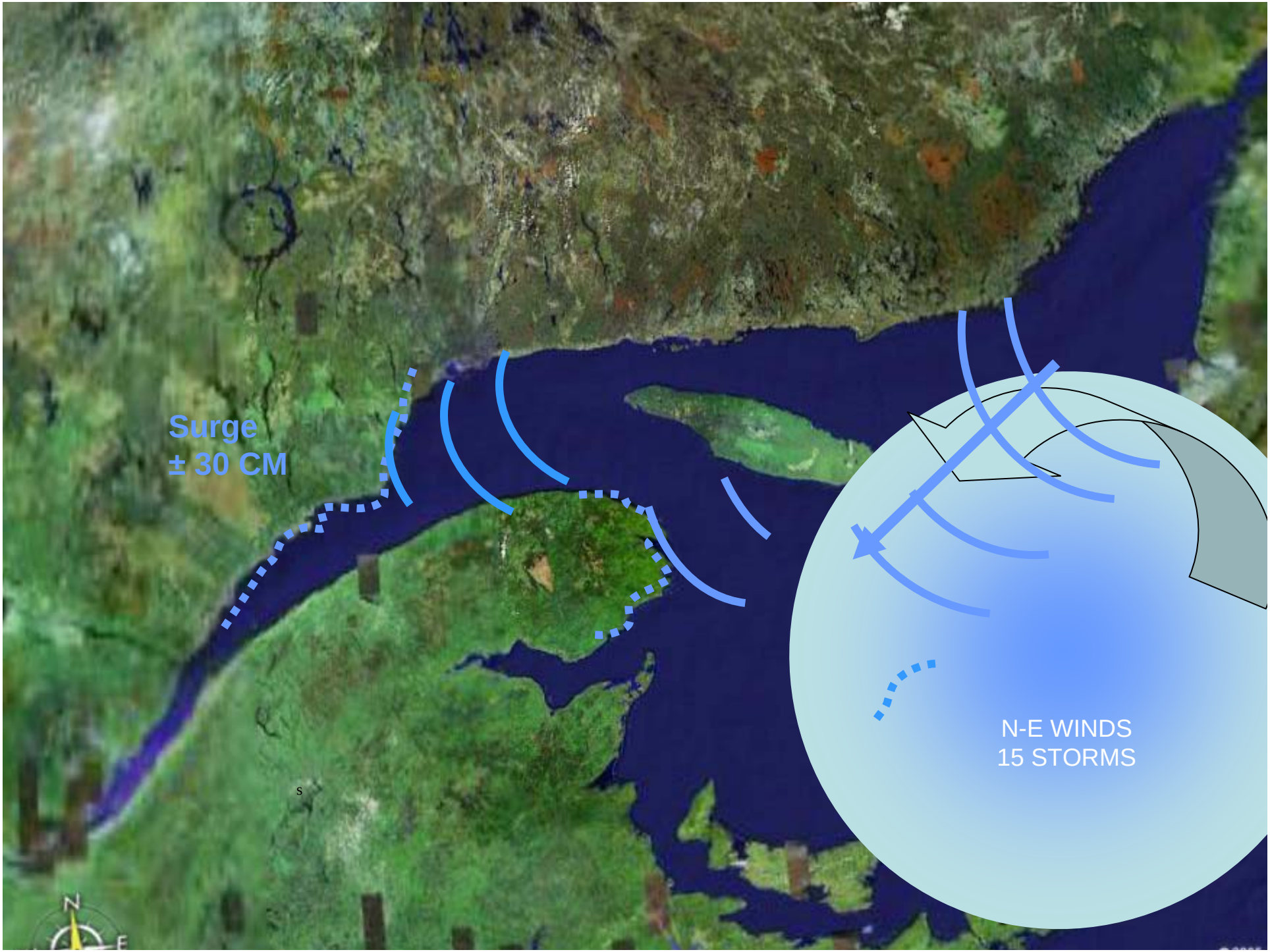
19 storms with south-east waves

15 storms with north-east waves



Development of a databank with 3 types of storms giving specific impacts using reanalyses
Model reanalyses validated with observations and impacts for 2003-2005
Climatology of storms presently beeing compared with RCM reanalyses for future scenarios
Possibility to combine effects of changes in storminess/trajectory and decreasing ice cover

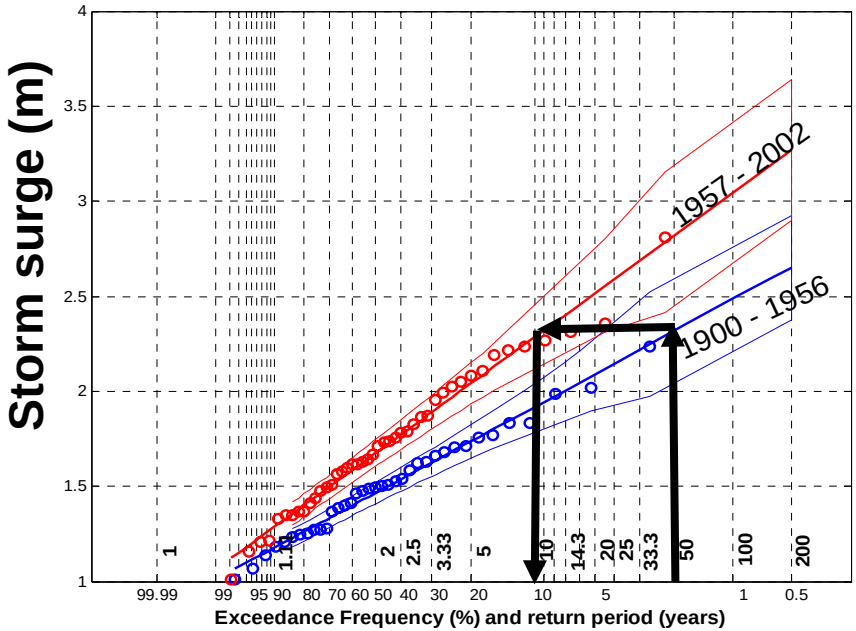

Surge ± 50 cm
Surge ± 50 cm
S-E WINDS
19 STORMS
N
E


Surge
± 30 CM
N-E WINDS
15 STORMS
N

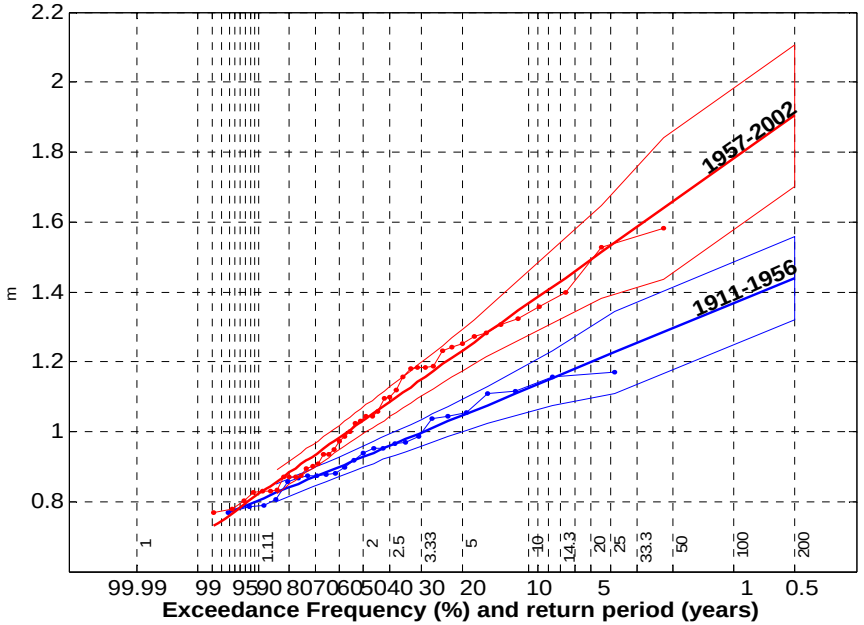

N-W WINDS
37 STORMS
Decrease:
± -5CM
s

Historical changes in storm surge frequency/intensity

Lauzon:



Charlottetown:

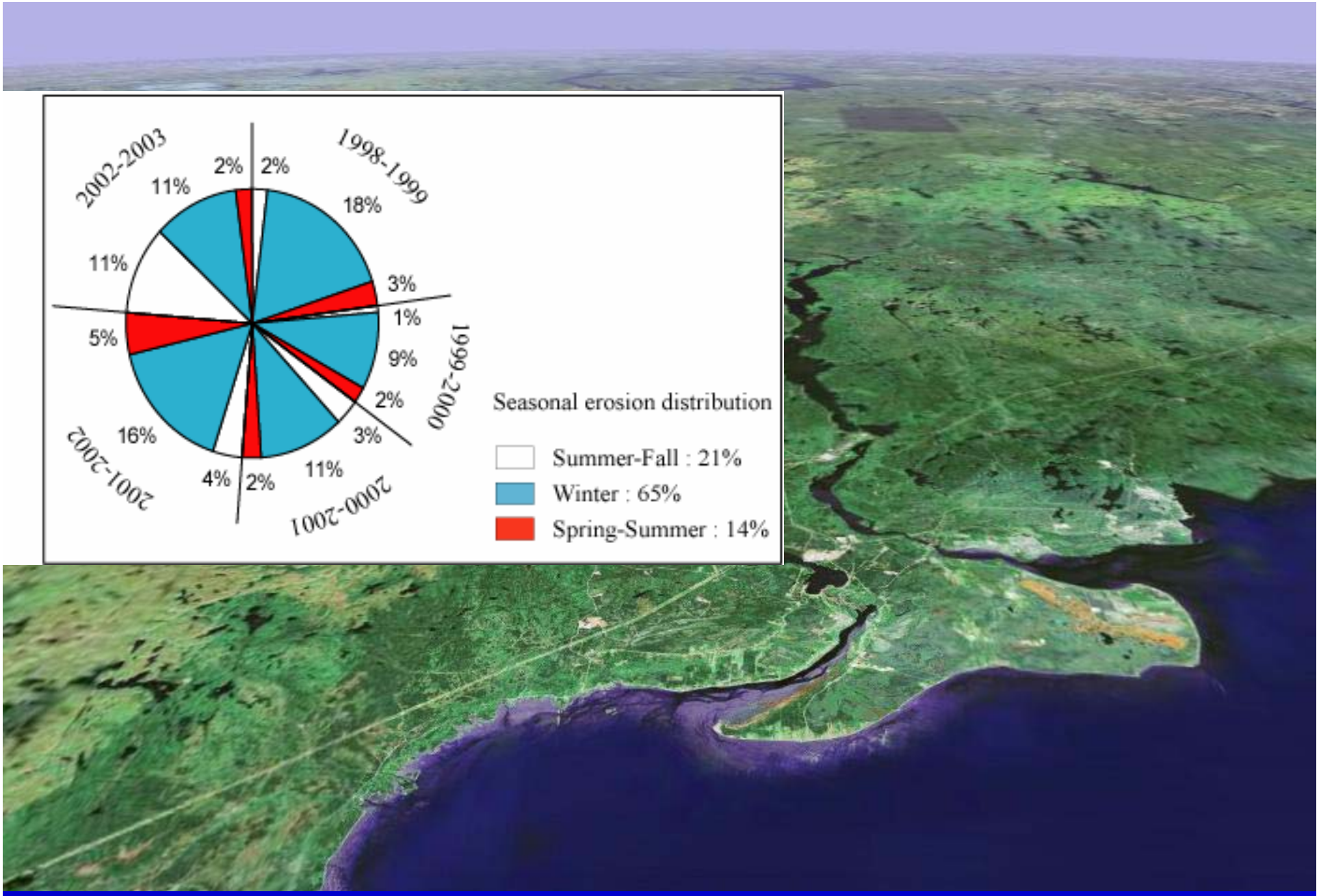


1/100 year storm surge in the 1900-1956 period is now a 1/20 year storm surge in the 1957-2002 period!

Saucier,2005

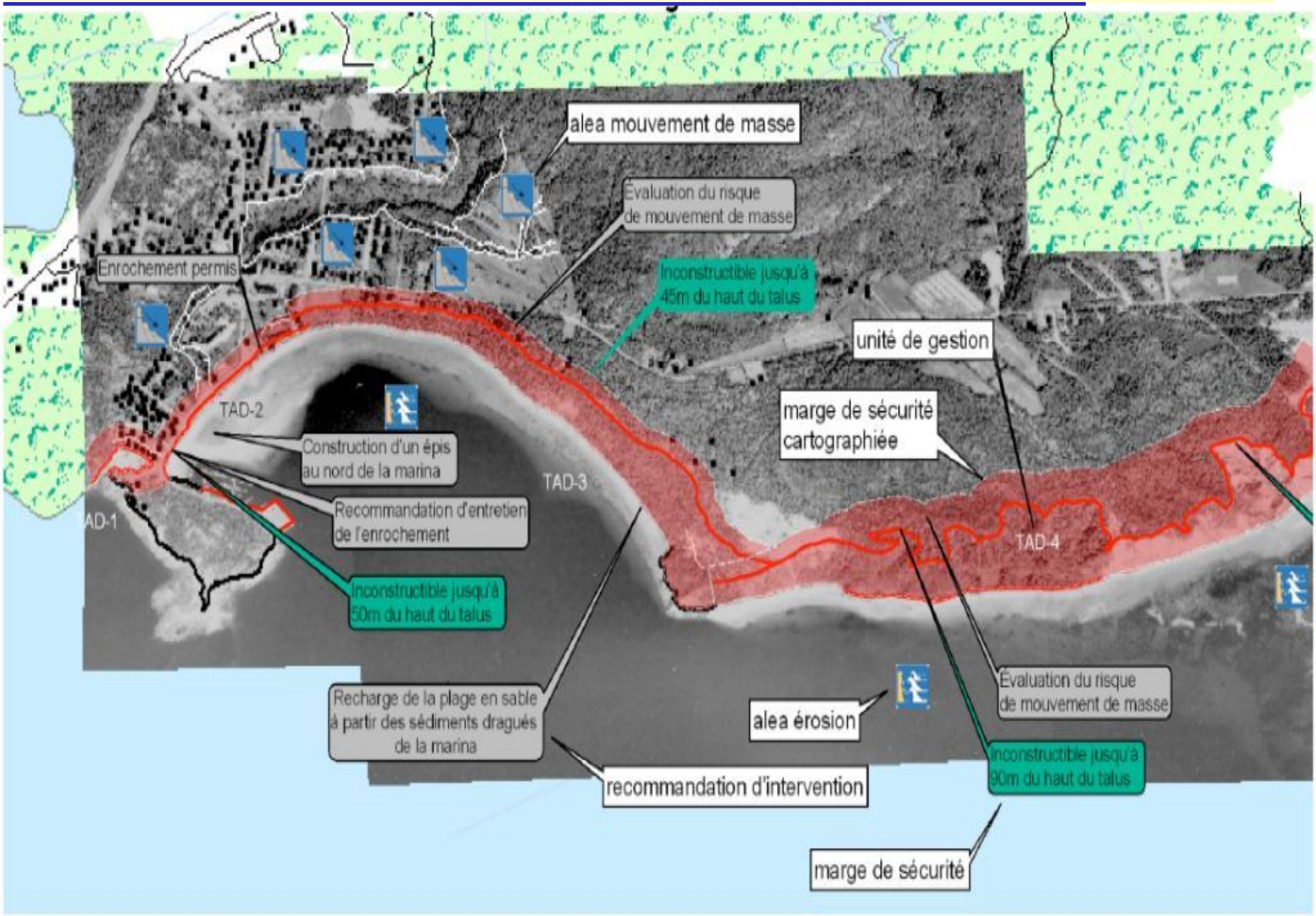
Assessing the vulnerability of coastlines (Sept-Iles)

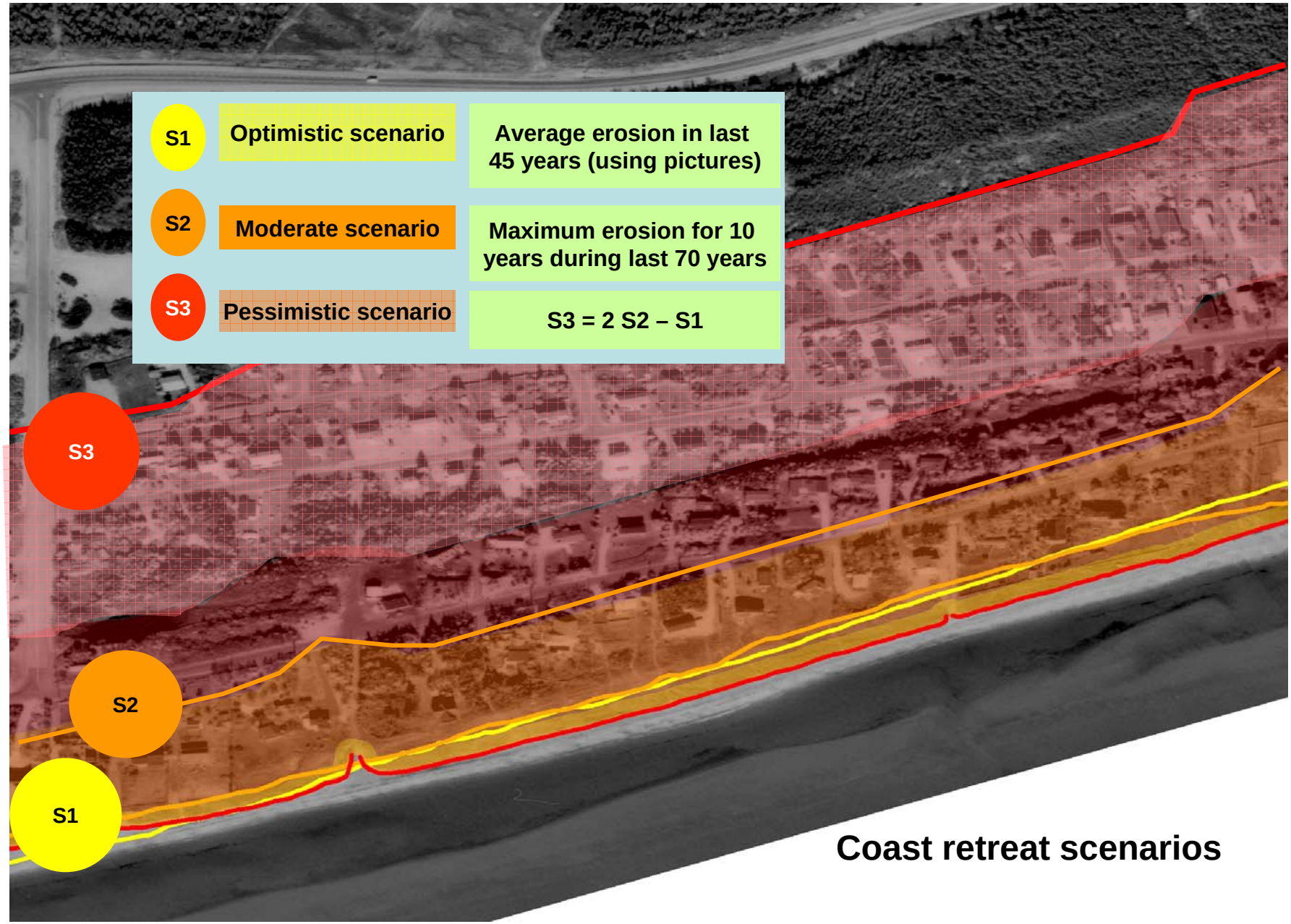
OURANOS



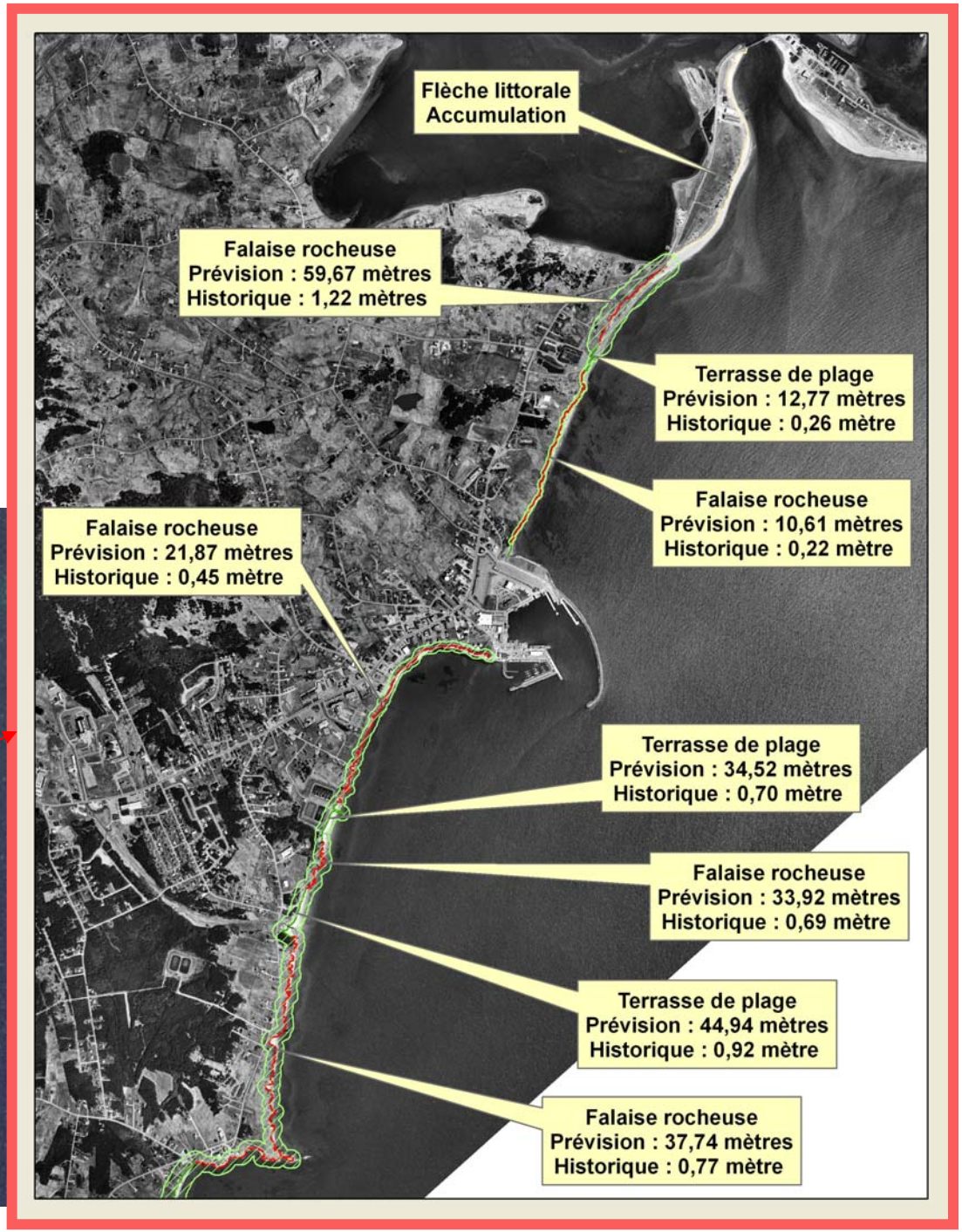
Seasonal erosion distribution (1998-2003)

Mapping of coastal risks has triggered decisions




S1
Optimistic scenario
Average erosion in last 45 years (using pictures)
S2
Moderate scenario
Maximum erosion for 10 years during last 70 years
S3
Pessimistic scenario
S3 = 2 S2 – S1
S3
S2
S1
Coast retreat scenarios

COMBINING RISK MAPPING AND SCENARIOS TO IDENTIFY CC ISSUES



Users Group

- Three workshops, one per study sites
  - Identification of coast sections and priority issues
  - Three users committee formed by consensus
  - Confidentiality agreement signed

- Four committee meetings completed:
  - Presentation of S1 and S2 scenarios and exchange on science
  - Discussions on adaptation options for each scenarios
  - Some adaptation options already implimented

Various organisations represented for three study sites:

- ZIP Côte Nord, Zip Baie-des-Chaleurs et Îles-de-la-Madeleine
- Municipalités de Sept-Îles, Îles-de-la-Madeleine et Percé
- MRC
- Pêches et Océans
- Coalition des citoyens de Sept-Îles
- Attention fragile, Îles-de-la-Madeleine
- Ministère des transport du Québec
- Ministère de la Sécurité publique du Québec
- Environnement Québec
- Ressources naturelle et faune…. etc..

An integrated approach

OURANOS

Past climate

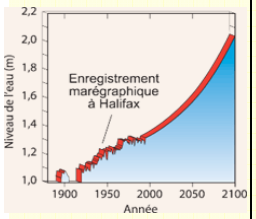
Future climate

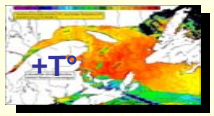
Sea level rise

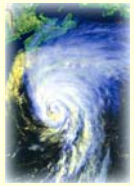
Protecting ice cover reduction

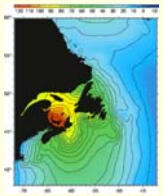
Freeze-thaw cycle increases

Increased storminess









Modification of coastal processes

submersion

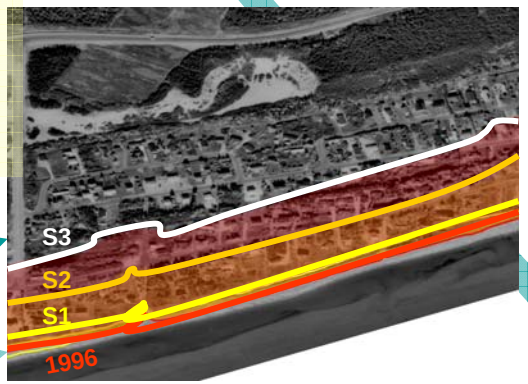
altération solifluxion landslides

Increases in wind intensity and wave height

Increases in frequency intensity of storms

Acceleration of coastal erosion

Choices of adaptation scenarios



3 research groups

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Documentation of past and future climate

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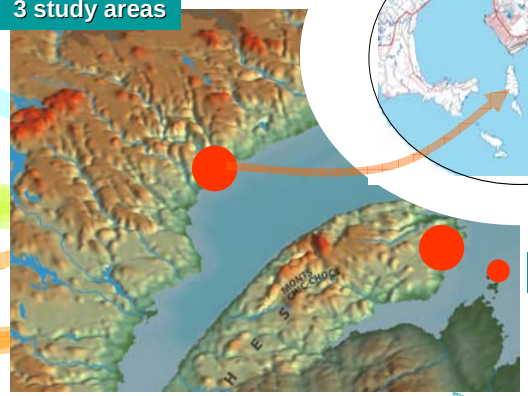
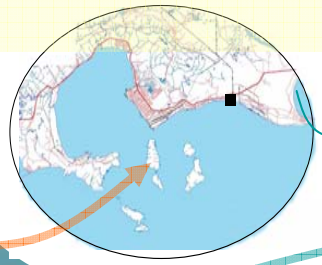
Estimate impacts and adaptation solutions

3 study areas





projection in 2030 of scénarios for areas at risk

S1	Scénario optimiste	Mean rate in last 70 years
S2	Scénario moderate	Max decadal rate since 1930
S3	Scénario pessimiste	S3 = 2 S2 – S1

Cost/benifits analysis for Adaptation, scénarios

Conclusions: 3 out of 4 climatic factors seem to explain accelerated erosion especially during the winter season, proposed initial scenarios of erosion indicate significant impacts along the coast (residents, main access road, tourism relying on specific coastal ecosystems…), users recognize integrating accelerated coastal erosion in planning is key but the challenges reside in transition period and social issues. Although minimizing costs is important, issues are more related to safety, health, well-being of communities at risks.

Thank you for your attention

bourque.alain@ouranos.ca
www.ouranos.ca