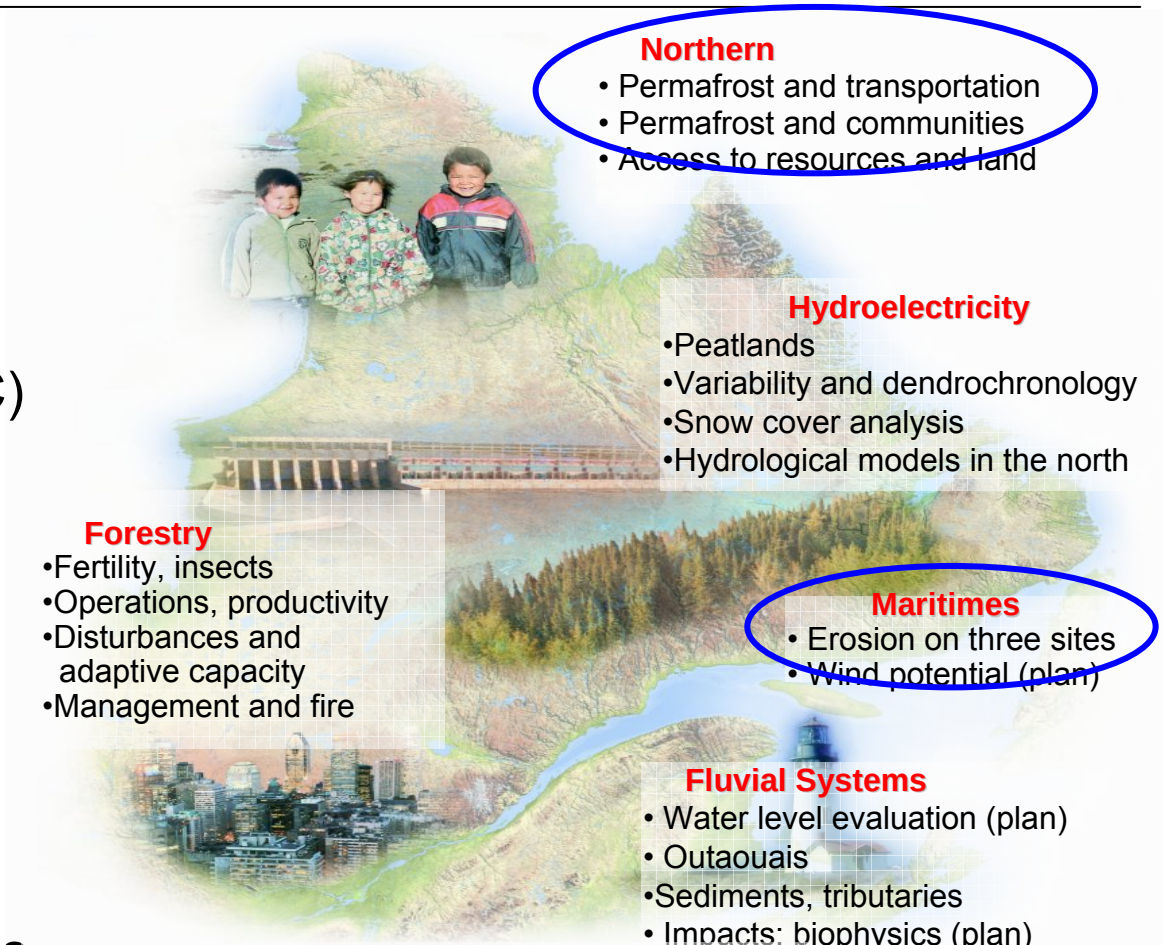
Building the capacity to understand, measure, analyse, apply and respond to a complex multi-disciplinary and highly scientific issue

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

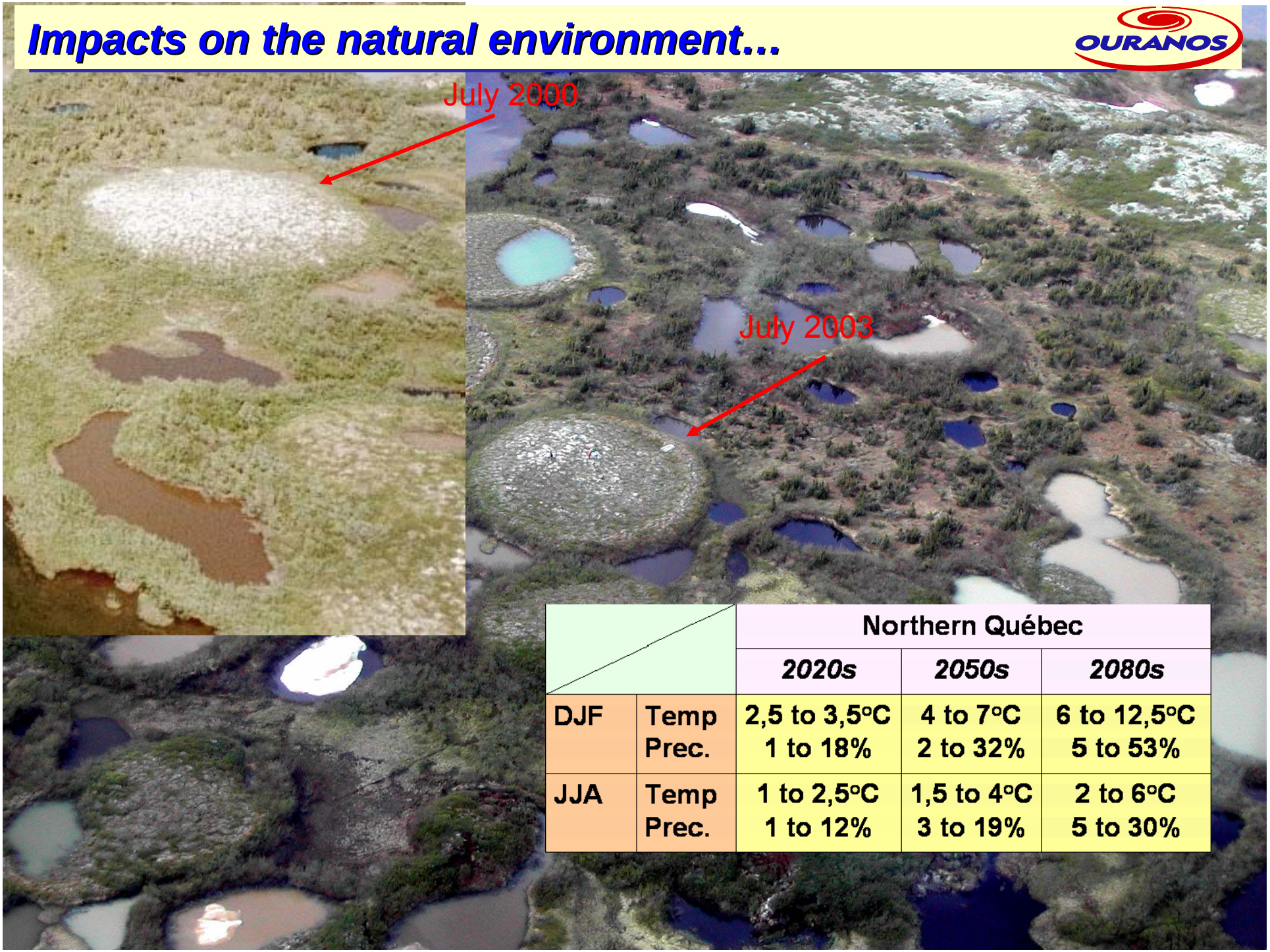
Forestry
- Fertility, insects
- Operations, productivity
- Disturbances and adaptive capacity
- Management and fire

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

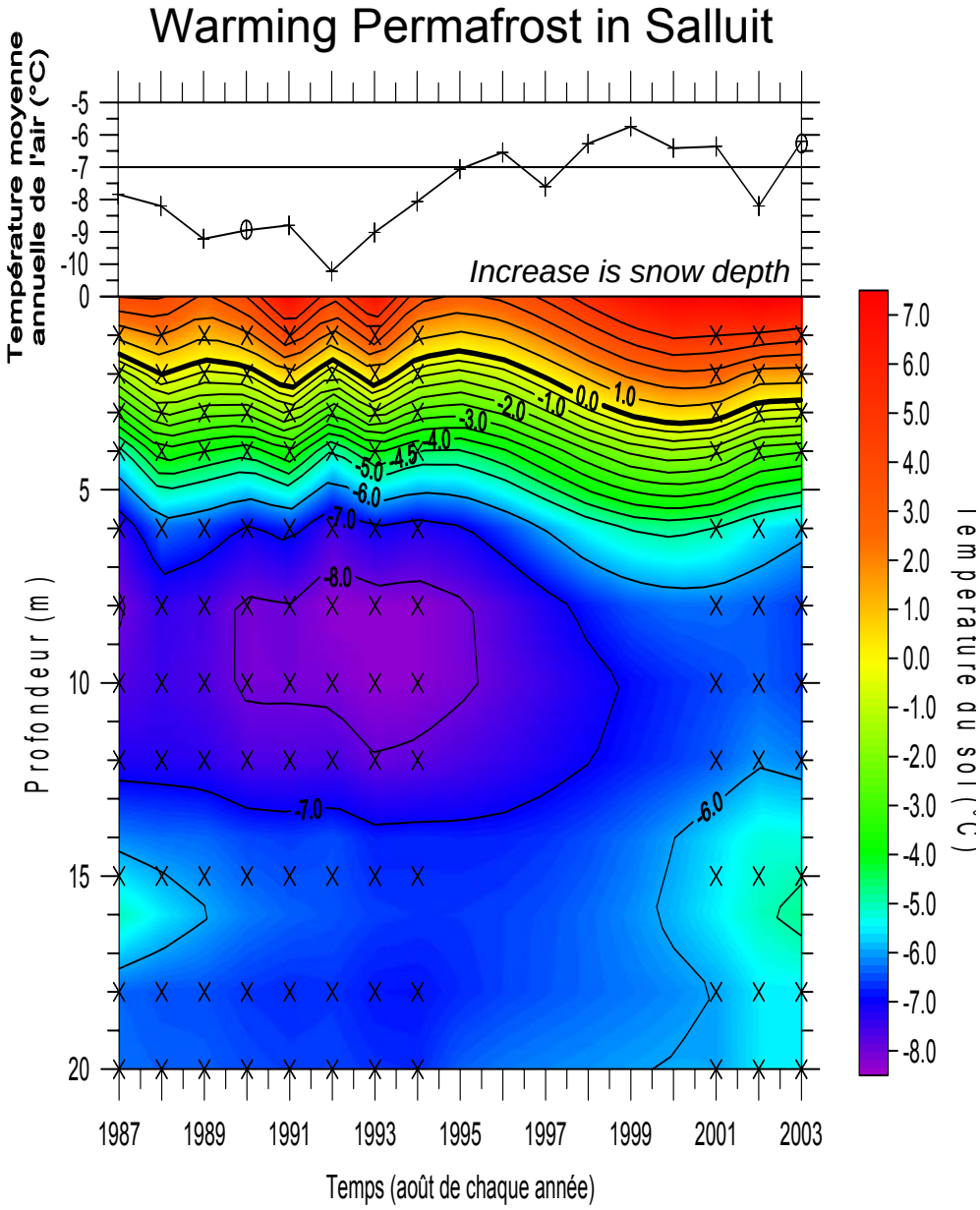
Impacts on the natural environment…

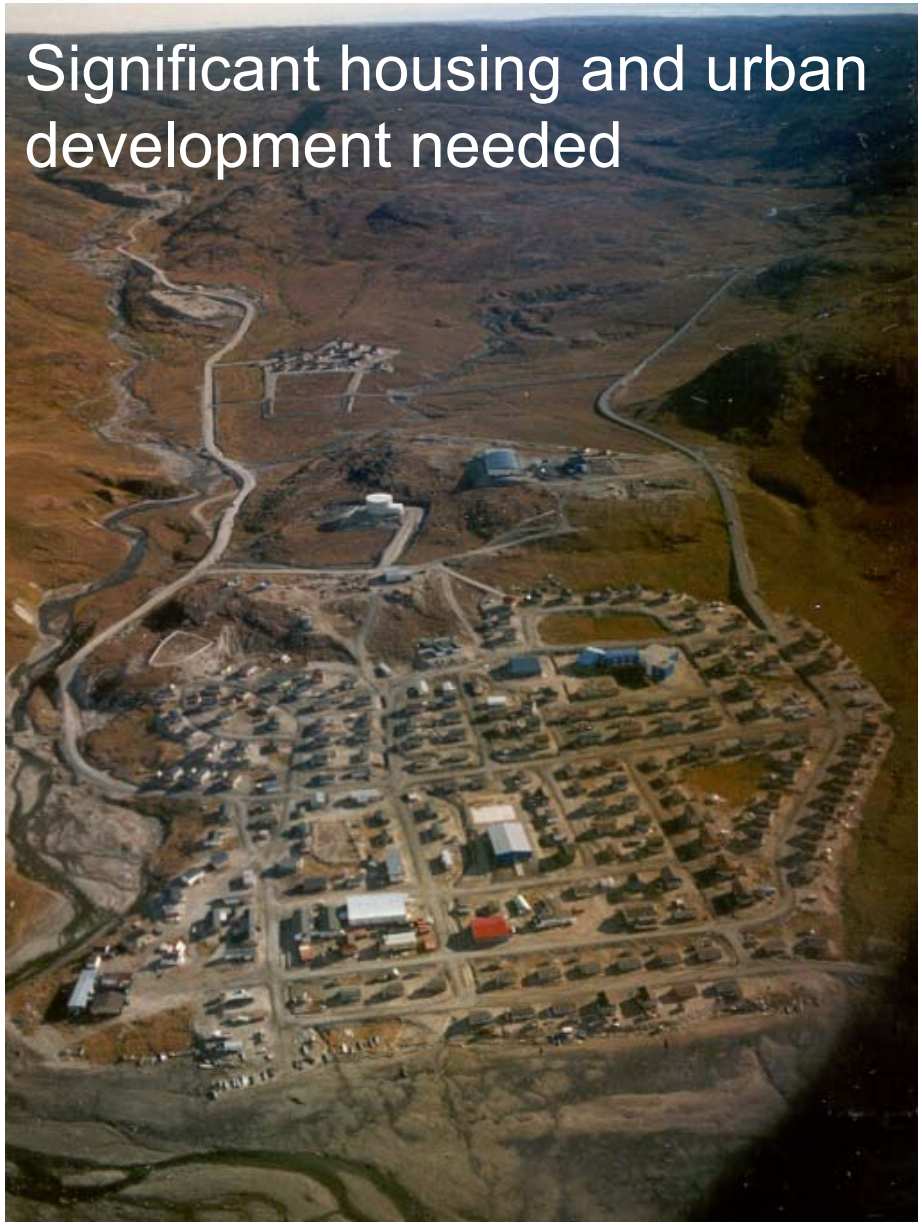


		Northern Québec		
		2020s	*2050s*	*2080s*
DJF	Temp Prec.	2,5 to 3,5°C 1 to 18%	4 to 7°C 2 to 32%	6 to 12,5°C 5 to 53%
JJA	Temp Prec.	1 to 2,5°C 1 to 12%	1,5 to 4°C 3 to 19%	2 to 6°C 5 to 30%

… affecting the built environment in communities

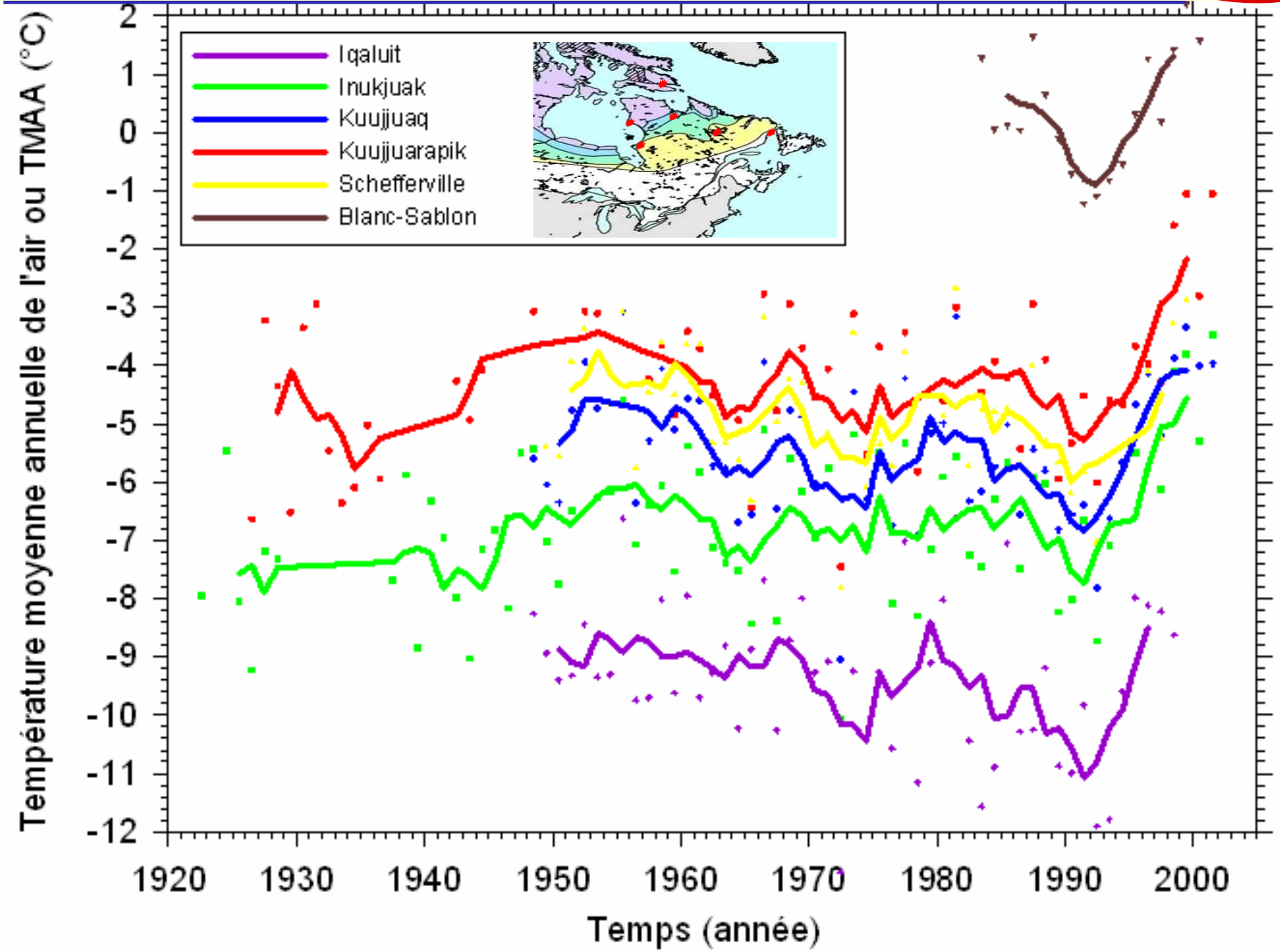
Case study to assess impacts and adaptation options



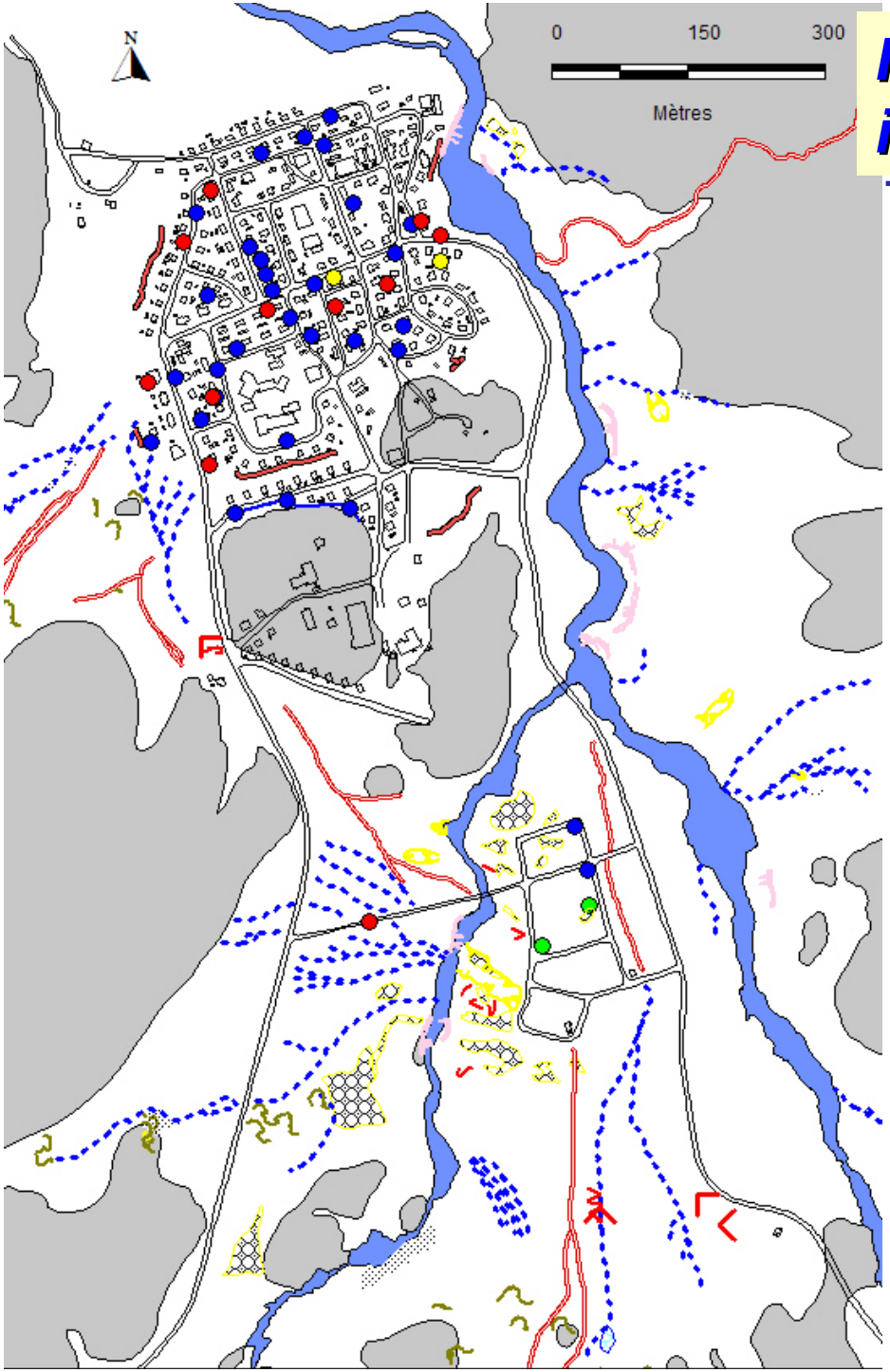


ULaval *et al.*

Similar trends over all northern Quebec communities



Indications: climate and human induced degradation



Légende

- Mauvais drainage
- Érosion thermique
- Tassement
- Érosion du remblai
- Drainage diffus
- Ravin d'érosion thermique
- Glissement de terrain
- Berges en érosion
- Traces de VTT
- Fissures de tension
- Lobe de gélifluxion
- Mauvais drainage
- Érosion thermique
- Champ d'ostioles
- Niche de nivation
- Frost blister
- Réseau hydrographique
- Affleurements

Mapping of surface and underground caracteristics

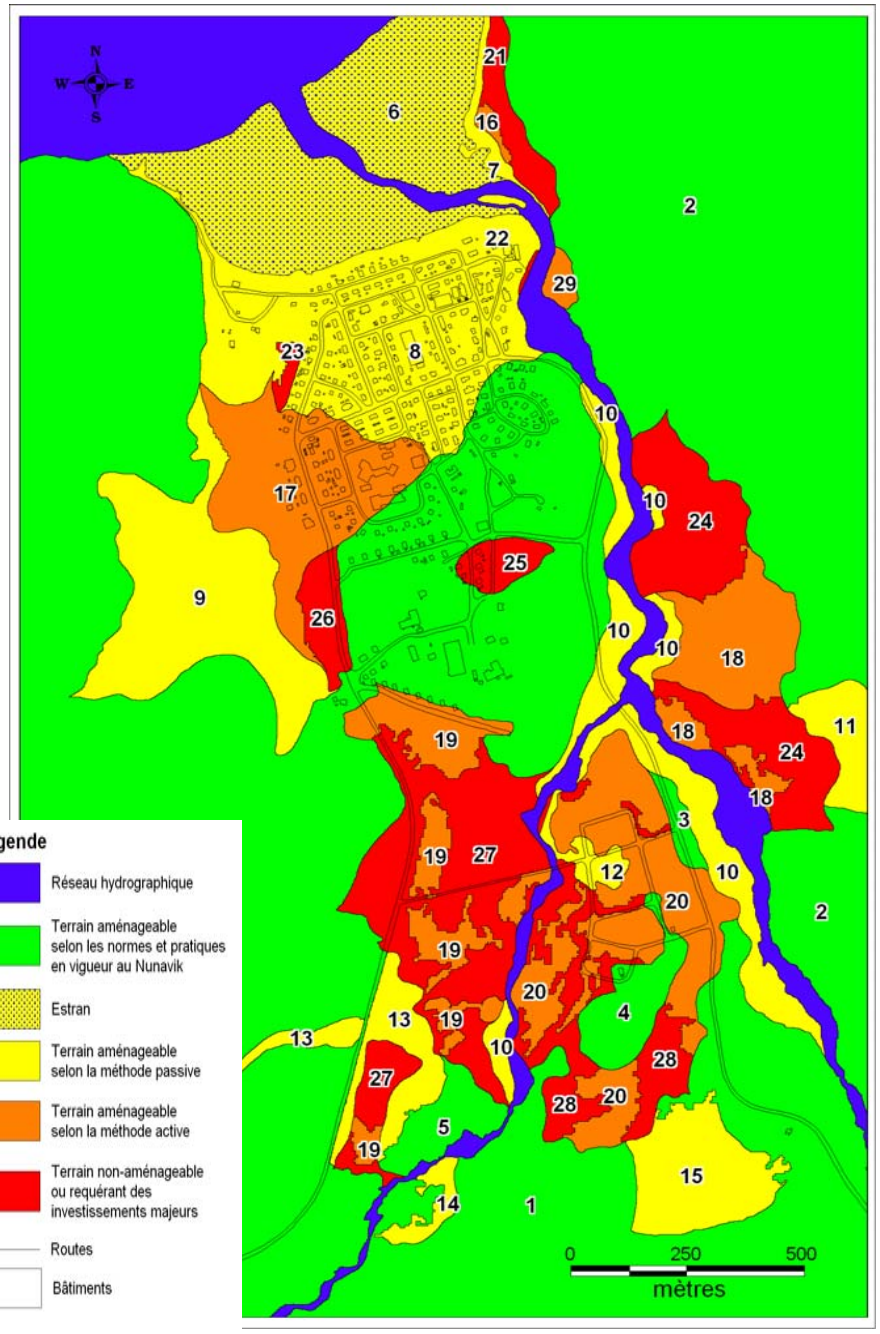
OURANOS

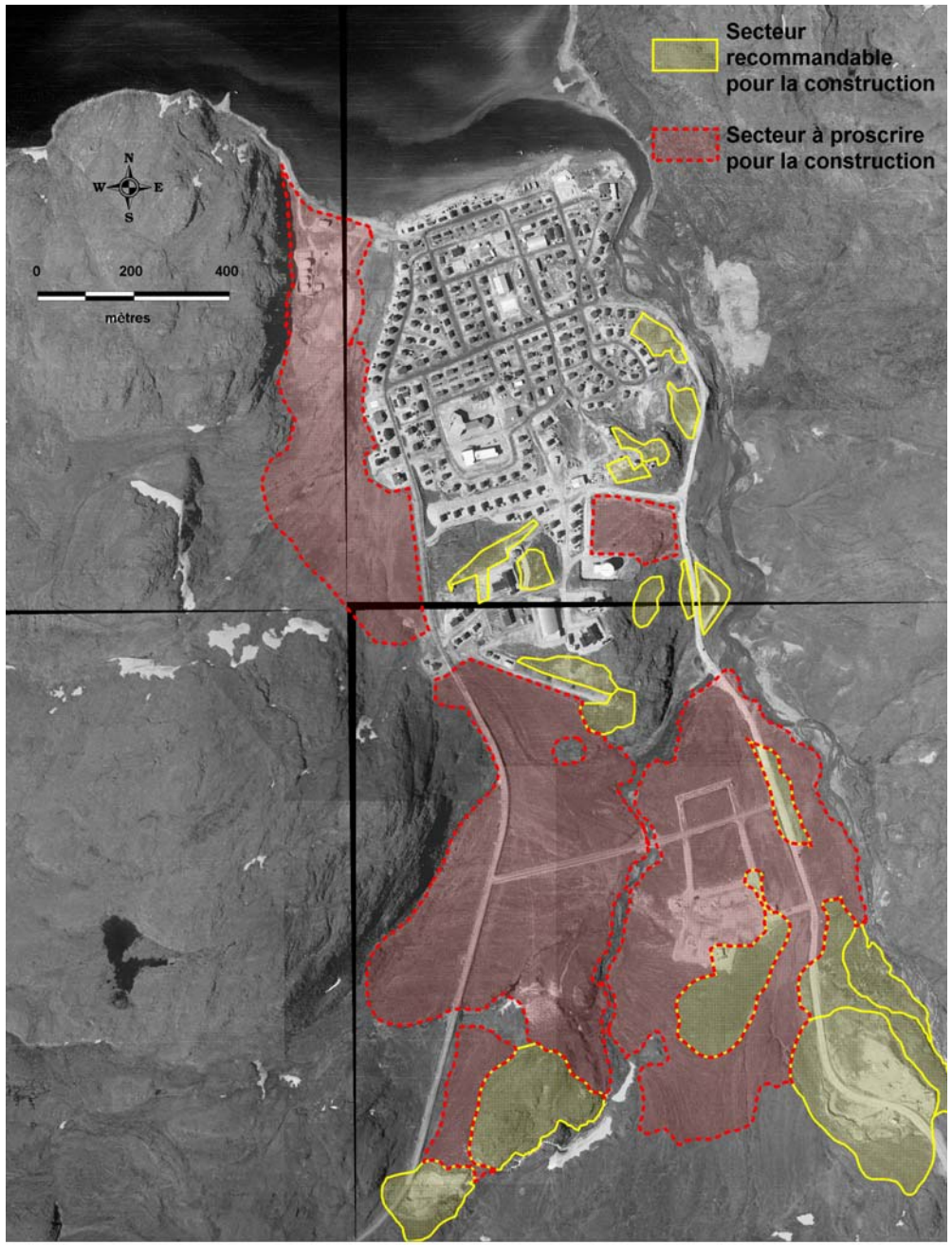
Overlapping relevant maps in a GIS to assess

- Vulnerability to landslides
- Vulnerability to subsidence
- Vulnerability to thermal erosion

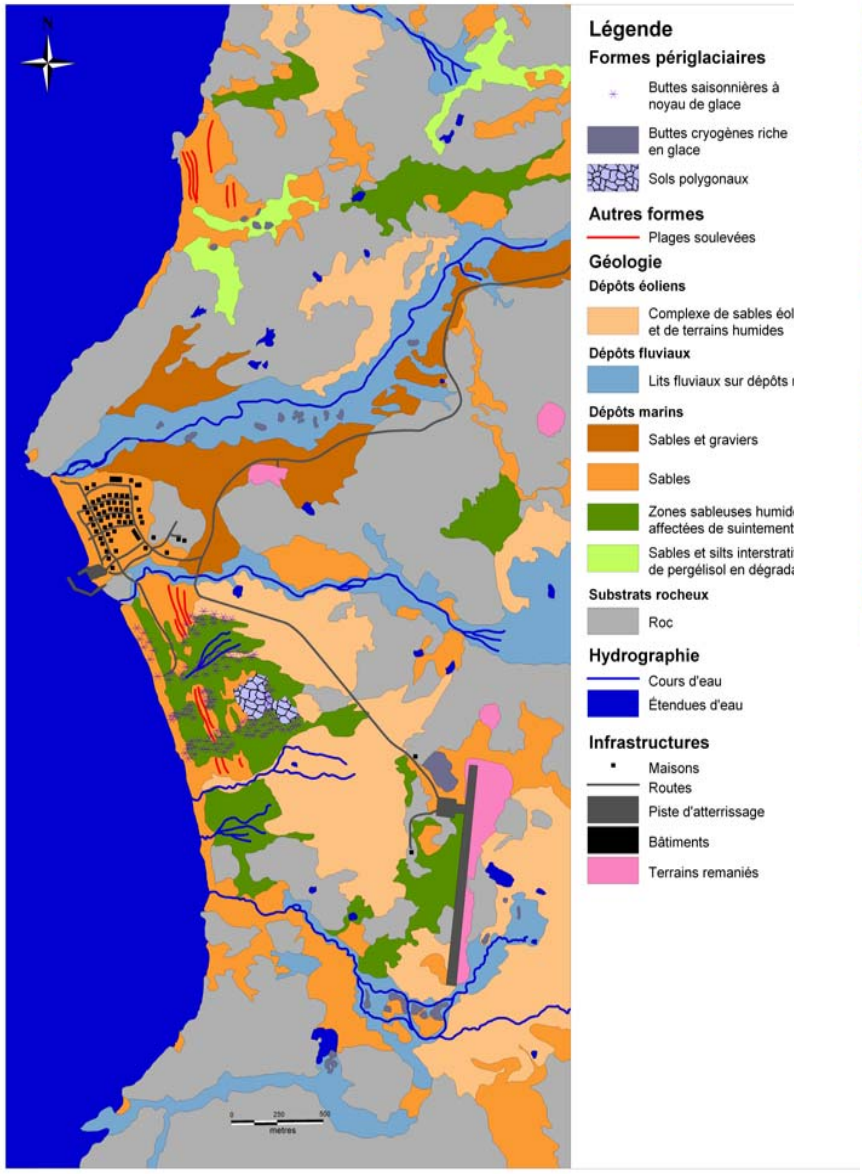
→ Vulnerability map useful for current and future infrastructures

Maps for maintenance and planning of infrastructures

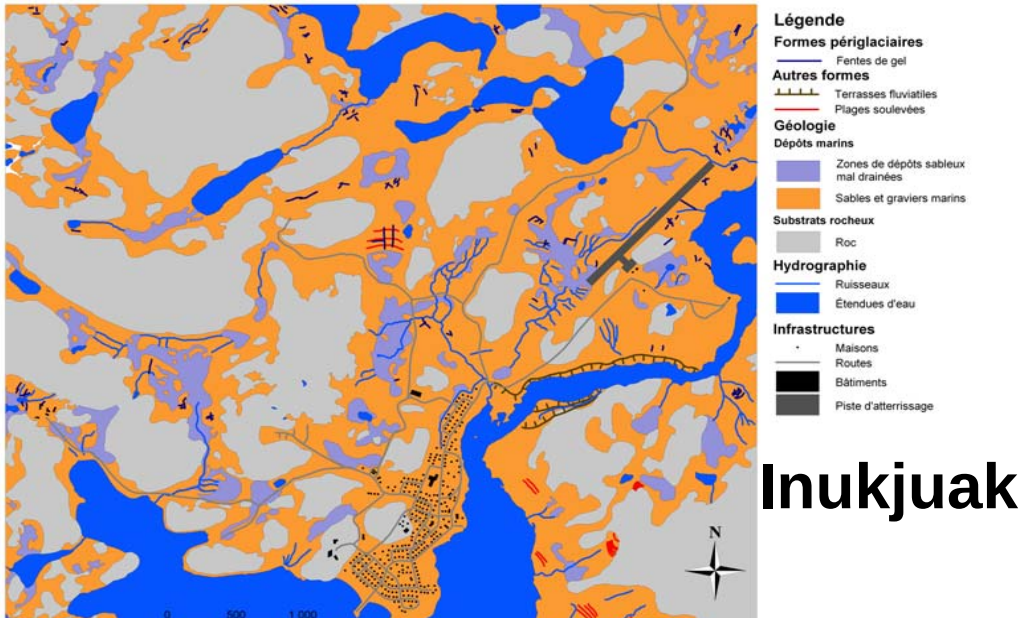




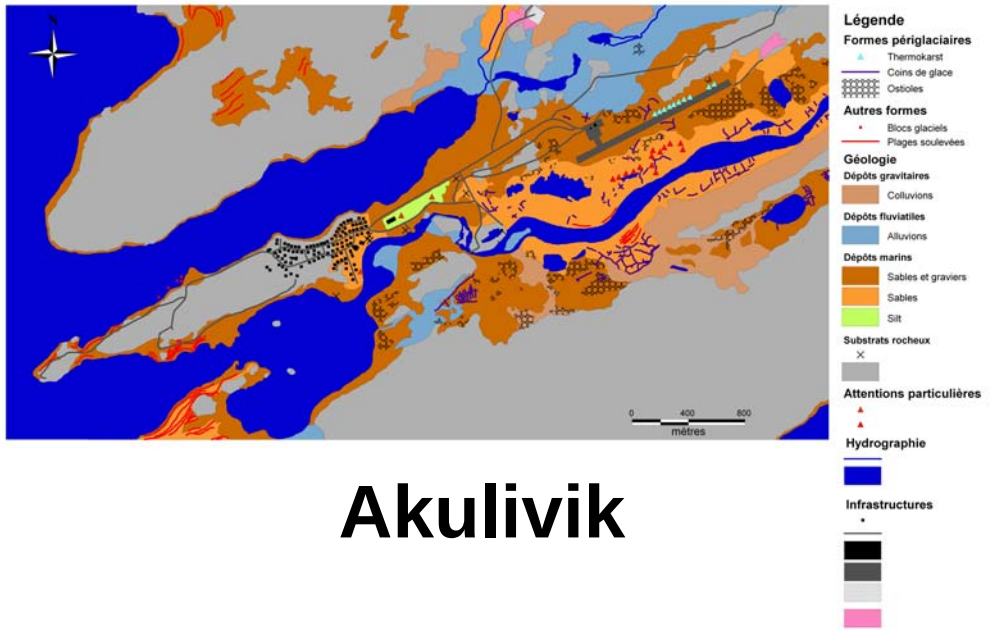
Applying for other communities: A first evaluation



Umiujaq

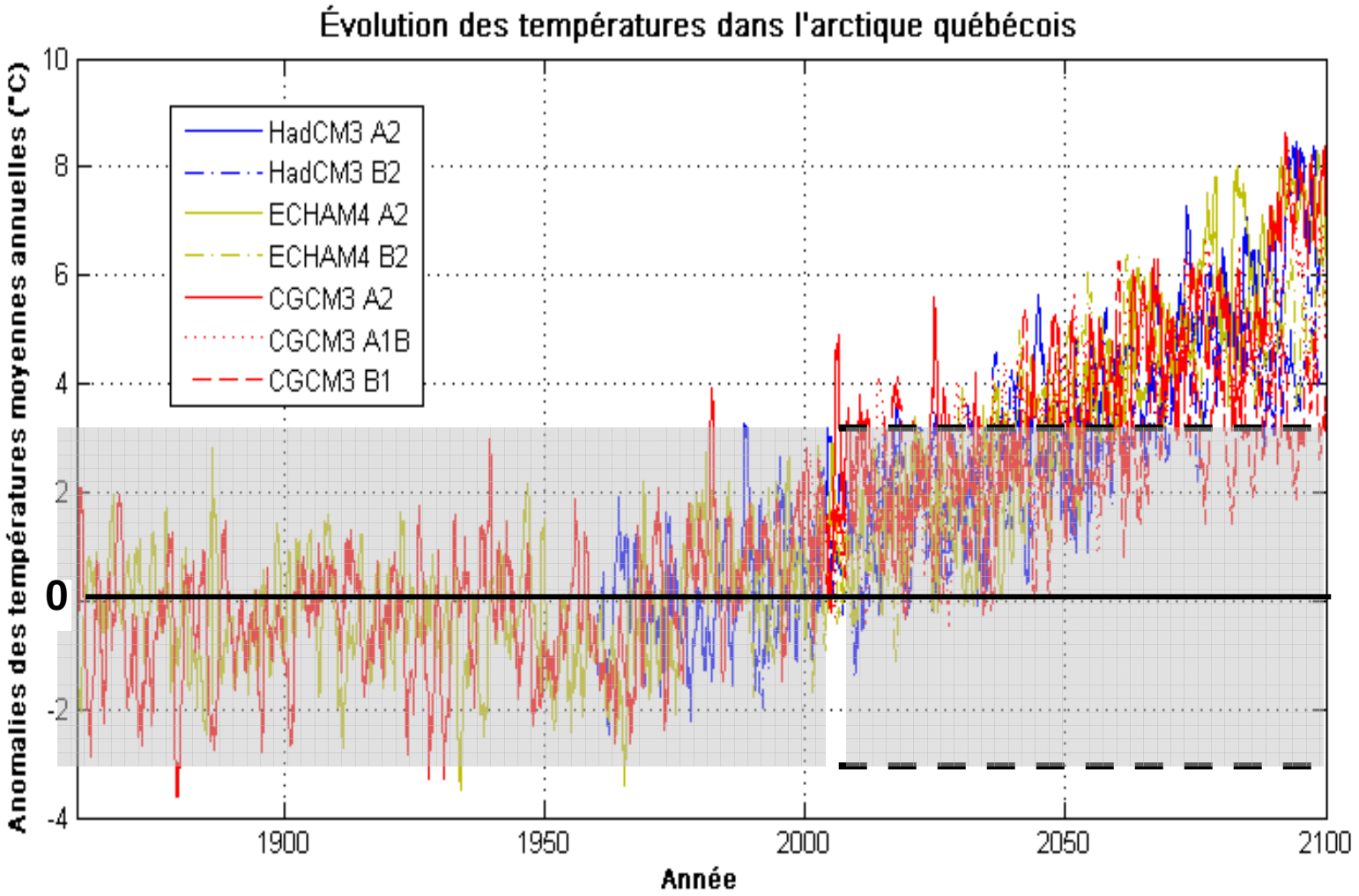


Inukjuak



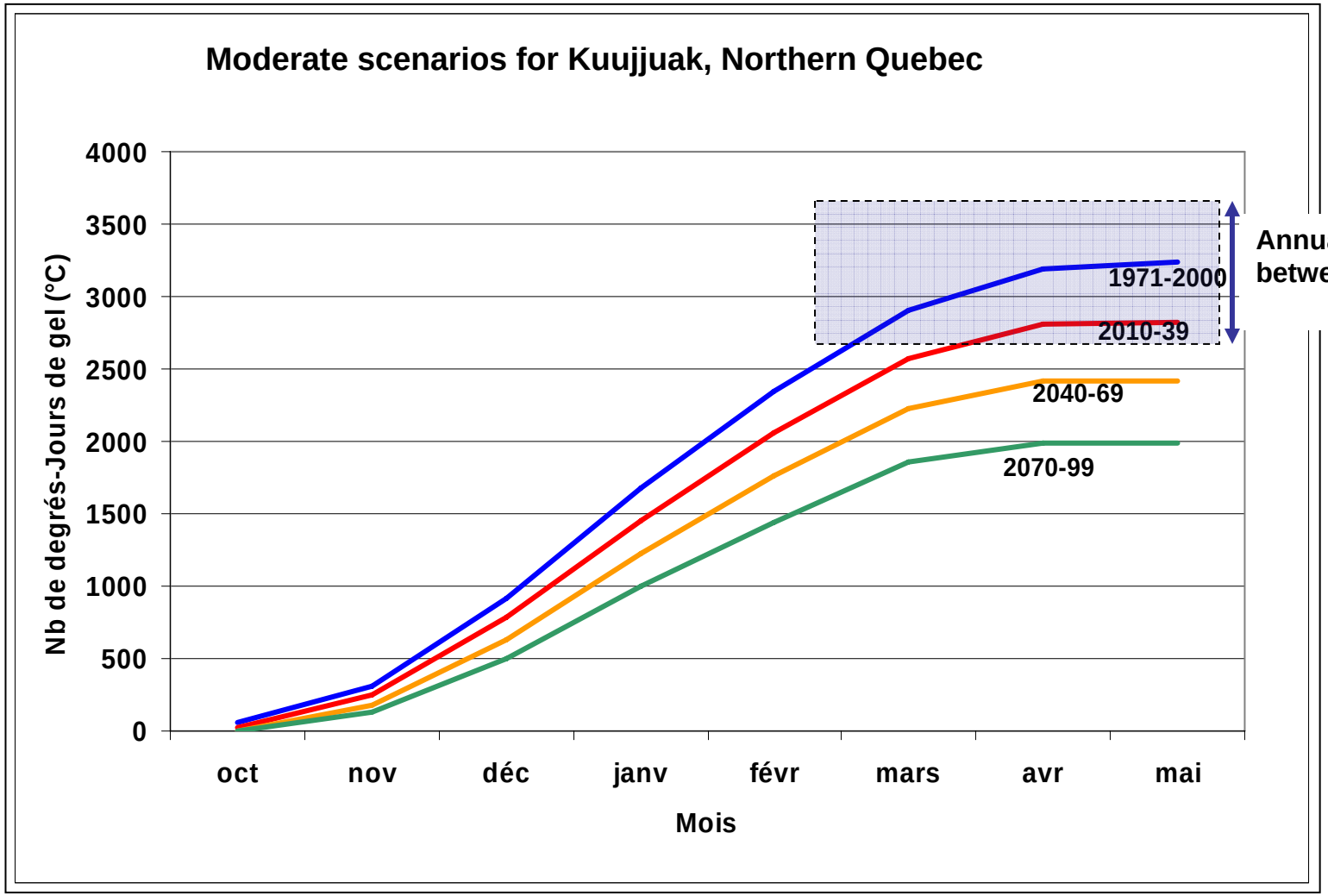
Akulivik

Building climate scenarios to assess rate of impacts



Evolution of freezing degree days during cold season

Permafrost and ice (lake, rivers) will have « less cold » to form during cold season



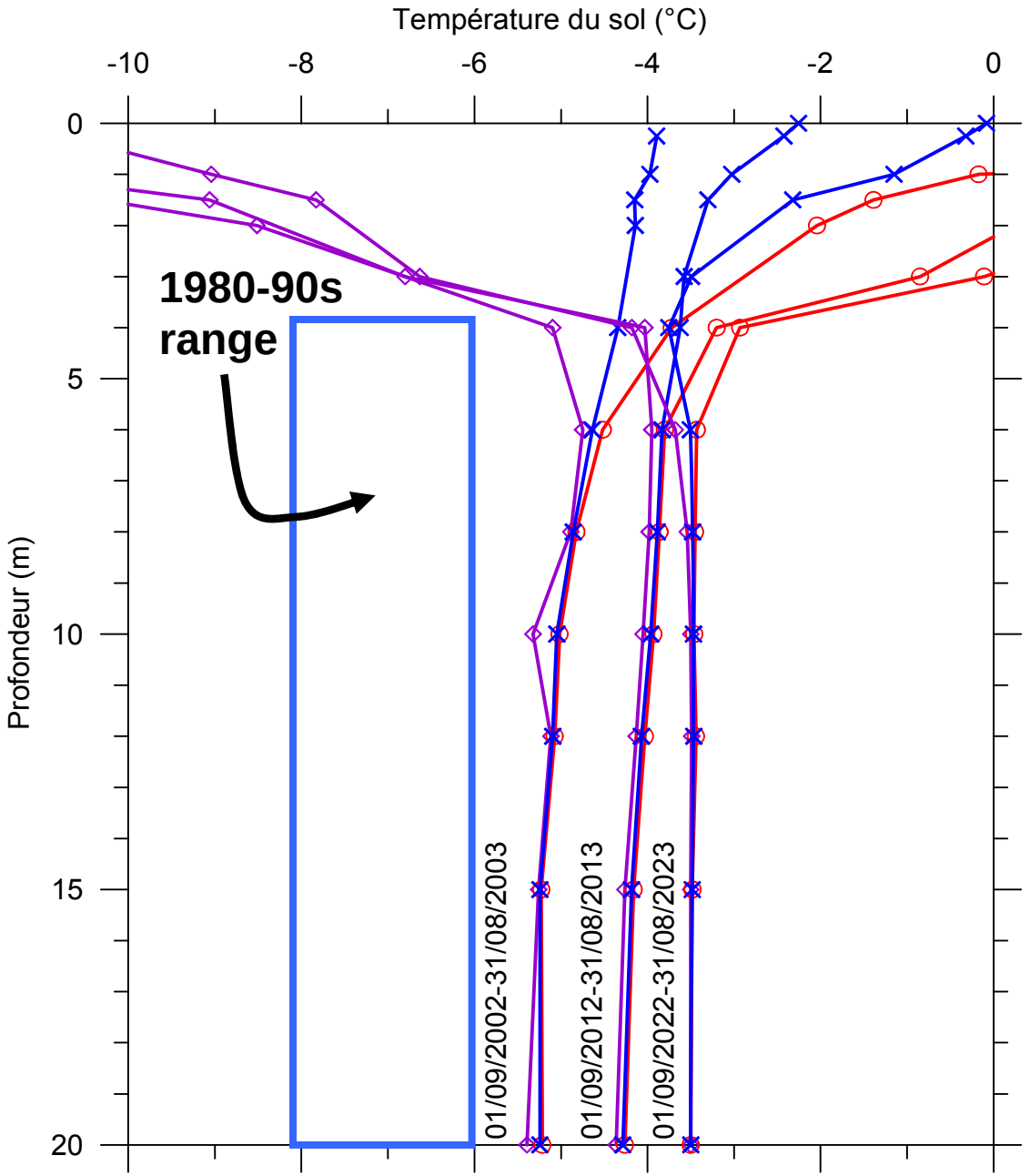
… at a point where the 2040-69 average will not have been witness during 1971-2000!

Similar trends over all northern Quebec communities

Permafrost under Salluit towards the 2010-2040 horizon:

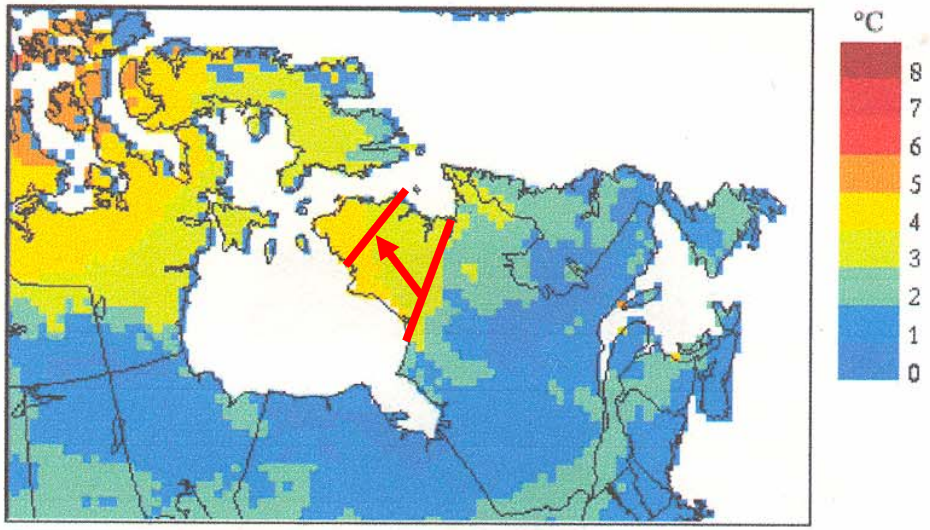
- Unfrozen surface layer would reach more than 2 meters at the end of summers
- Freezing moves to january
- Profile is 1,7C warmer than today and 3,3C warmer than 1980s
- Unsure on how bad high risk areas will react: subsidence? landslide? Role of water and increased snowfall?

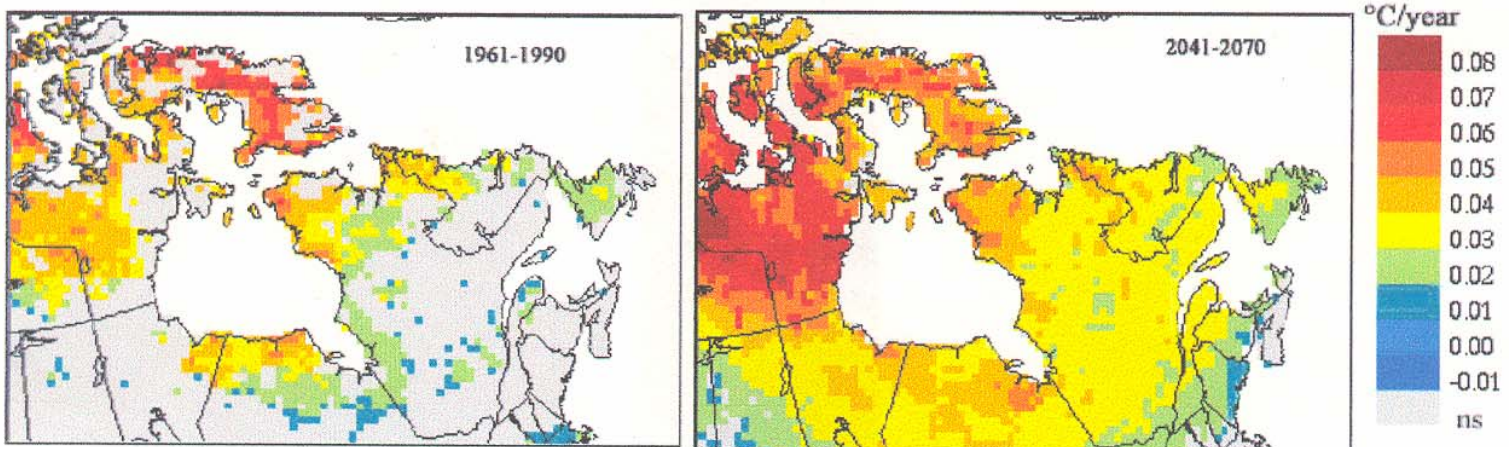
Tone Model used (L.Goodrich)



RCMs to produce permafrost warming scenarios?

Δ(soil Temperature)
in CRCM2
2050s - 1980s



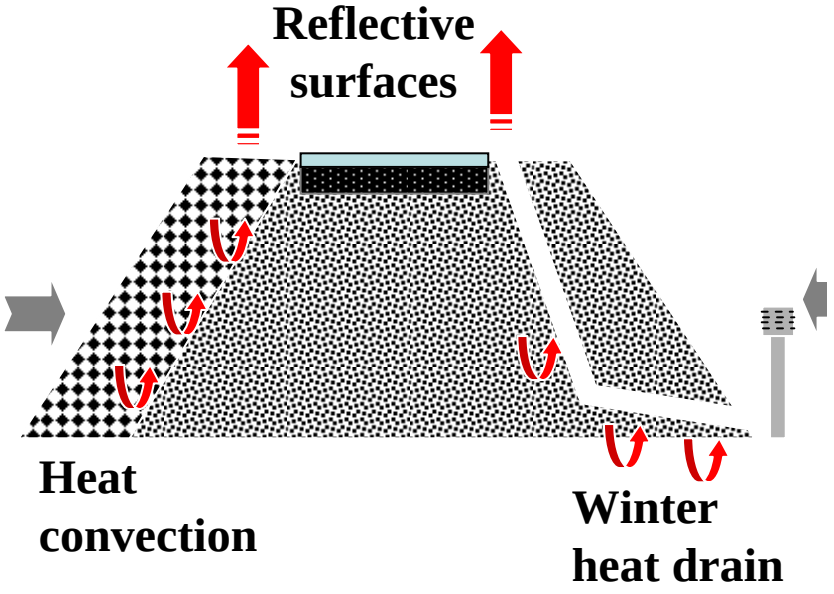


Soil Temperature Trend 1961-1990 Soil Temperature Trend 2041-2070

(using CRCM2 including change of phase, 90% statistical significance shown)

Sushama, Laprise et Allard, JGR, 2006

Real role of good/bad practices on speed of impacts



Conclusions: Temperature and snowfall are increasing, permafrost is degrading, portions of communities are at risk, others are on less vulnerable grounds, good practices delay or minimize impacts, good planning minimize risks but information and tools must be available and used by involved users

Thanks for the implication of: Université Laval, Sécurité Publique Québec, Transport Québec, Natural Resources Canada, Transport Canada, ArcticNet, Makivik, Kativik Regional Administration, Communities like Salluit… and you!

Consensus
We need action:
Mitigation and Adaptation