CLIMATE CHANGE AND CONSEQUENCES FOR NUNAVIK COASTS

This tool summarizes the potential climate change impacts related to actual and projected natural hazards combinations on Nunavik's marine and coastal environment. Changes to the coastline will occur following the duration, frequency, intensity and contact area of the hazards (storms, waves, storm surges, water levels and ice conditions). The safety of infrastructures and navigation in large and small boats will be compromised.

GENERAL TRENDS IN NUNAVIK

- 4 to 5°C by 2050 and 4 to 7.5°C by 2100
- 20 to 35% by 2050
- 40 to 90 cm – depending on the community by 2100

HAZARD , IMPACTS AND ACTIONS

MAJOR IMPACTS
- Coastline shifting near infrastructure

Around **2050**

ADAPTATION ACTIONS
- Move at-risk infrastructure inland resettlement outside at-risk area
- Build infrastructure on stilts or renovate existing infrastructures
- Install embankments, grading, levelling or protective walls at the boundary between water and land

MAJOR IMPACTS
- Unsafe travel on landfast ice – Longer moving ice periods

Later ice formation and end earlier ice melting, currently and will continue into **2050** et **2100**

ADAPTATION ACTIONS
- Travel on ice later in fall and beginning of winter
- Stop travelling on ice earlier in winter

MAJOR IMPACTS
- Infrastructure damage
- Goods transhipment interruption – maritime transport more risky (example: Hudson Strait)

Later ice formation and end earlier ice melting, currently and will continue into **2050** et **2100**

ADAPTATION ACTIONS
- Reschedule goods transhipment

MAJOR IMPACTS
- Coastline shifting – water receding over large distances – Vessels grounding

Gradually more significant around **2100**

ADAPTATION ACTIONS
- Move navigation channels
- Map coastline dynamics

MAJOR IMPACTS
- Washout of protective structure bases

Mainly in fall and winter around **2100**

ADAPTATION ACTIONS
- Move or build protective infrastructure in deeper water

LEGEND

HAZARDS

- Relative sea level (land uplift + fall in global sea level)
- Positive storm surge
- Negative storm surge
- Wave
- Wind
- Temperature
- Total precipitation (rain + snow)
- Snow
- Moving sea ice
- Storm

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KNOWLEDGE SPECIFIC TO THE THREE MARITIME AREAS

	Sandy beaches and dunes © A. Boisson, 2019 	Glacial cirque along the coast between Kangiqsujuaq and Quaqtaq © A. Boisson, 2019 	Rock-dominated coast intensely eroded by frost weathering1 © A. Boisson, 2019 
COASTAL DYNAMICS **Currently, and heightened in the future**	In the south, sedimentary and sandy coasts advance toward the sea	Rocky coasts Low erosion sensitivity	Sedimentary and sandy coasts are advancing towards the sea
WINTER PRECIPITATION **In 2050**	More than 25 to 45%*	No data	No data
RELATIVE SEA LEVEL **In 2100**	Land uplift by 1.4 m** from Kuujjuarapik to Puvirnituq	land uplift as fast as global sea water level (60 to 80 cm***)	No data
POSITIVE STORM SURGE **Between 2050 and end of 2100**	More frequent and 10 to 20 cm higher than between 1989 to 2009, reaching close to 1 m	Maximum height reached less than 1 m above the relative sea level. – Low impacts because tide is greater than 1 m	Maximum height reached less than 1 m above the relative sea level. – Low impacts because tide is greater than 1 m
NEGATIVE STORM SURGE **Between 2050 and end of 2100**	• Water level decrease, close to 1 m • More frequent in February and March	Minimum height reached less than 1 m below the relative sea level. – Low impacts because tide is greater than 1 m	Minimum height reached less than 1 m below the relative sea level. – Low impacts because tide is greater than 1 m
ICE CONDITIONS **By 2050**	• In December, almost nonexistent ice cover between Ivujivik and Inukjuak • Ice formation delayed and one month longer • Early ice melt and three weeks longer • Ice thickness decrease by 30 to 50% as compared to the end of 20th century	• 40 to 60% decrease in ice concentrations in December along coastline from Ivujivik to Kangiqsualujjuaq • Offshore icebergs and floes presence all year long, coming from Arctic ocean	• 40 to 60% decrease in ice concentrations in December along coastline from Ivujivik to Kangiqsualujjuaq • Longer ice presence, in formation as early as October

* % = percent; ** m = meter; *** cm = centimeter

[1] Processes of rock degradation induced by repeated freezing and thawing of groundwater in cracks

DISCLAIMER: THESE RESULTS ARE PROJECTION OUTCOMES; THEY INVOLVE UNCERTAINTIES WHICH INCREASE WITH TEMPORAL DISTANCE.

COMMITTING TO ADAPTATION IN ORDER TO REDUCE RISKS THROUGH A BETTER UNDERSTANDING OF HAZARDS

Strengthening knowledge on storms (waves and winds), water levels and ice changes and following the evolution of Nunavik's coast by improving the measurement device network would allow for the identification of the most at-risk areas. Once identified, the most at-risk areas could be considered during coastal planning, which in turn would enhance the protection of the population and infrastructures.

The Arctic is warming twice faster than the rest of the planet. Therefore, we must expect a more rapid occurrence of the impacts anticipated in the North, and in Nunavik especially. One way to decrease the serious repercussions of these impacts in Nunavik is to reduce the vulnerability of the natural environment, infrastructure and communities. There are already a number of ways to improve stakeholder skills, as well as the capacities of stakeholders to take concrete action aimed at reducing vulnerabilities, using, for instance, Nunavik specific construction standards or the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Engineering Protocol (**pievc.ca**).

Within this dynamic climate context, although scientific knowledge remains incomplete and continues to be developed on several promising research avenues, the results presented here can help regional planning and development to protect inhabitants and coastline.

More complete information can be accessed by reading the Knowledge Synthesis, Technical Synthesis, and the webinar presentation in pdf format on **Ouranos.ca** website.

LEGEND

IMPACTS
- Immersion / Submersion
- Erosion
- Coastline shifting
- Mobility on ice (sea and river ice)

RISKS
- Increase
- Decrease
- Stable

OTHER
- Measurement device
- Governance