NWT Climate Change Trends and Impacts

Climate Change and Asset Management Conference

November 29, 2022

Outline

1. Observed Climate Trends and Climate Change Impacts

2. Projected changes (future)

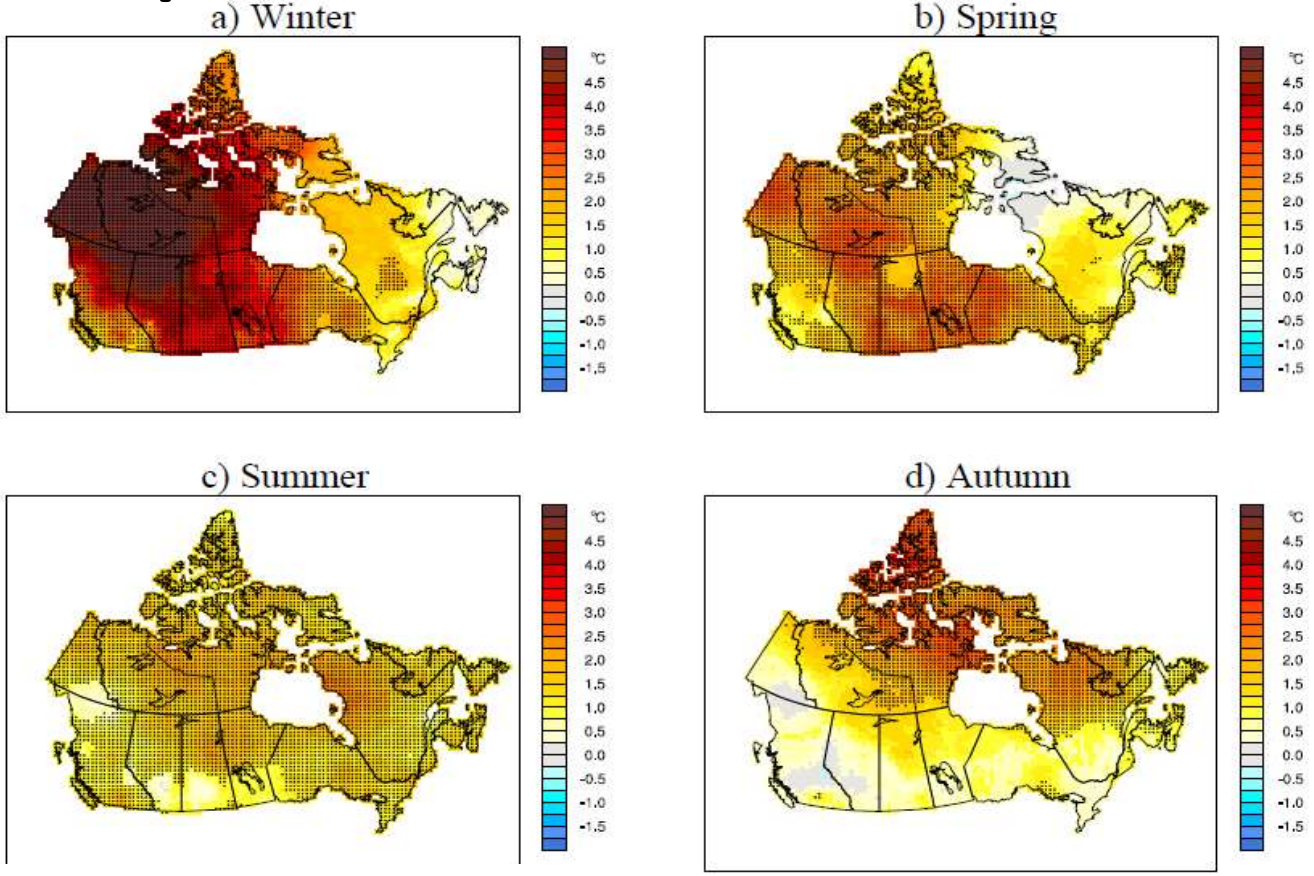
Climate Change Impacts

Are occurring now.

NWT communities are climate change experts as they are experiencing climate change impacts every day.

We are eager to learn from you.

Temperature Trends: 1948-2012



More warming in winter

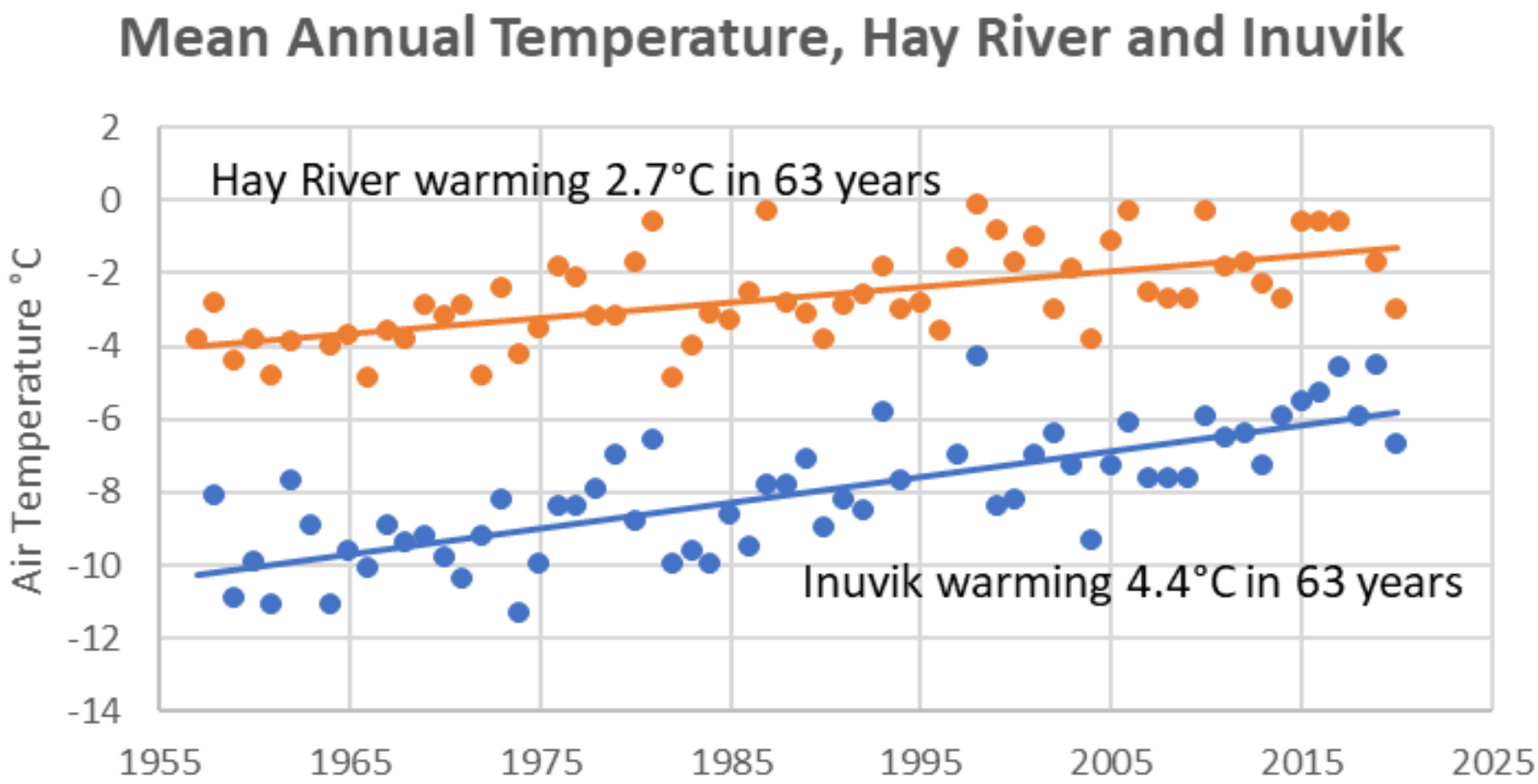
More warming in north

Worldwide

1.1°C increase since late 19th century

Source: Vincent et al. *J. Climate*
Published 2015 by the American Meteorological Society.

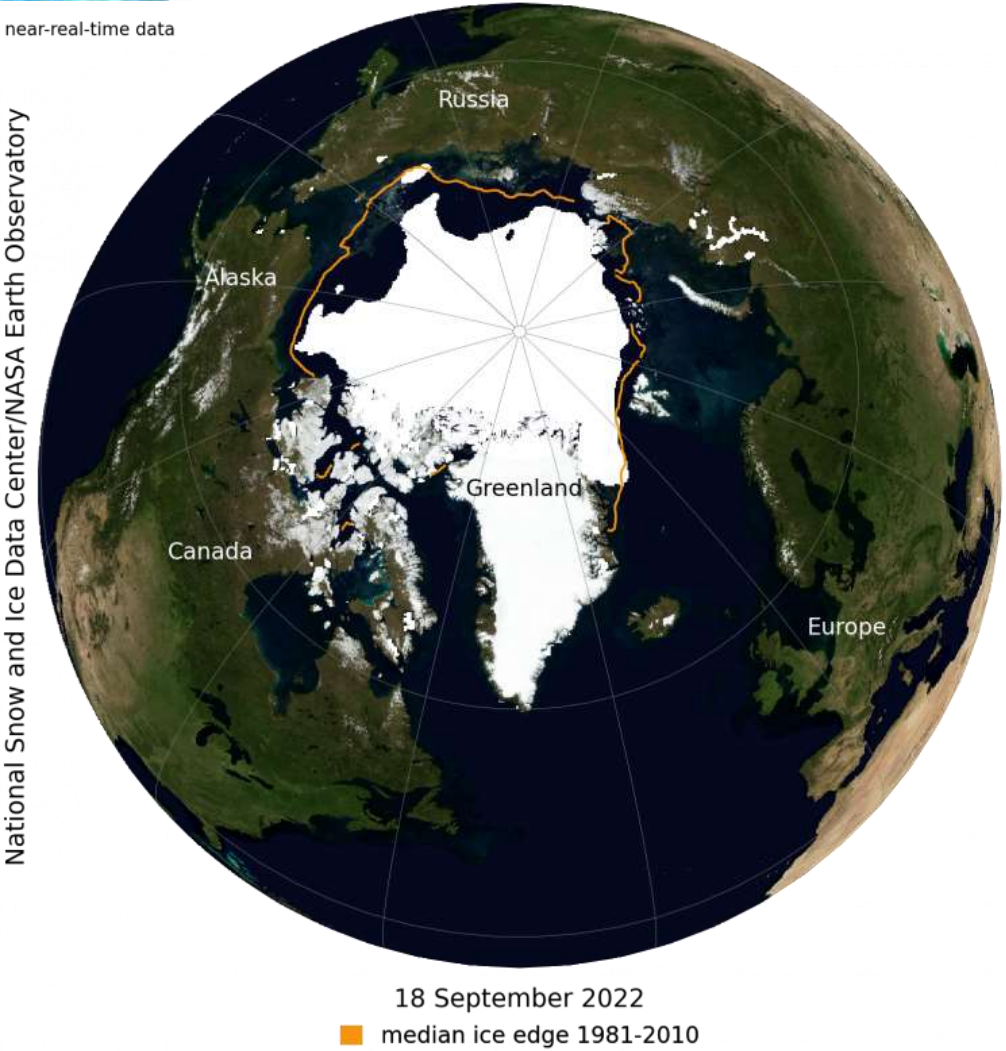
1.7°C Canada, 2.3°C North



Even more warming in winter

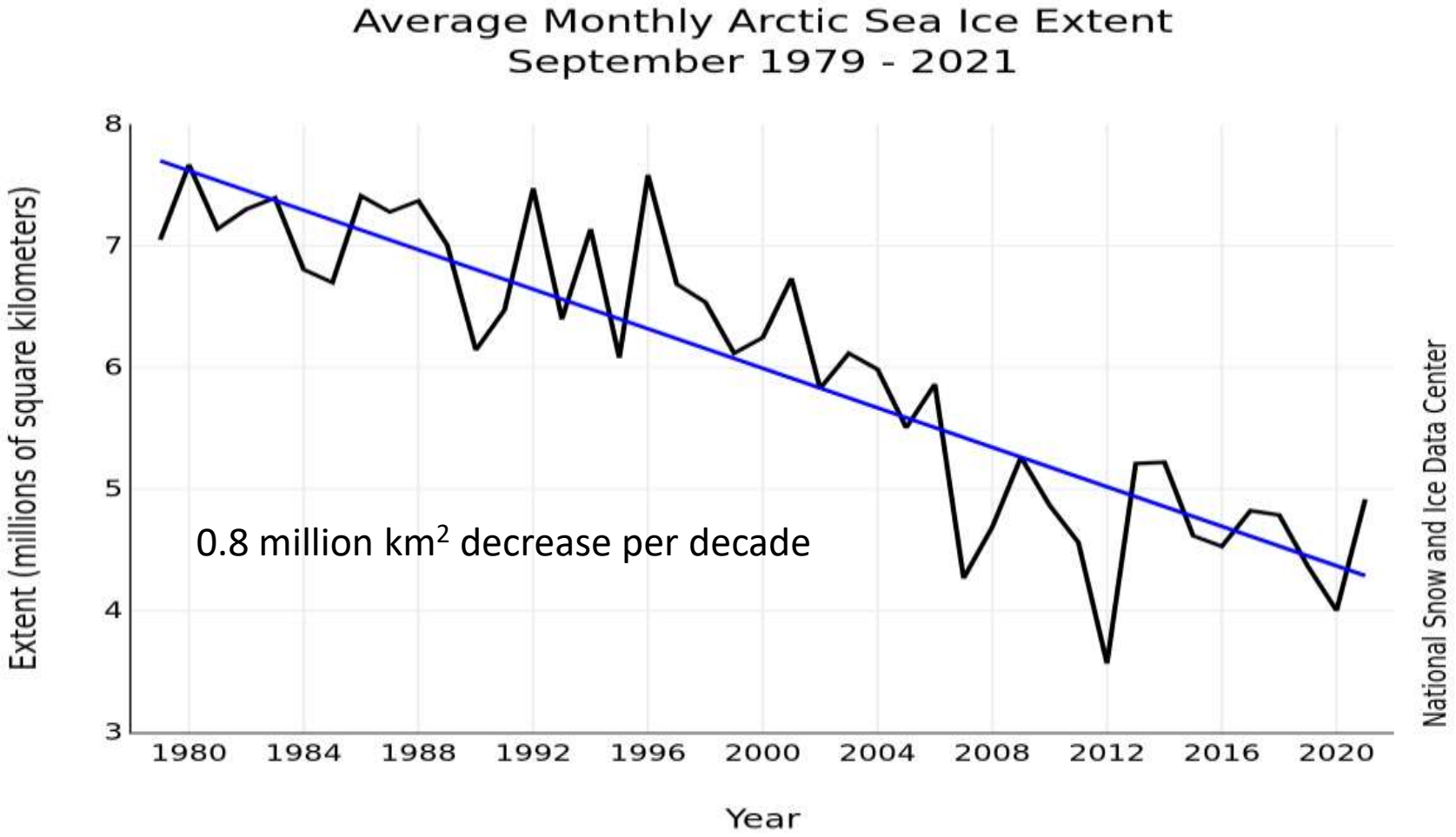
Hay River	5 °C in 63 years
Inuvik	6.7 °C in 63 years

More warming in winter, more in north



Sea Ice Extent

- 2022 minimum is tied for 10th lowest along with 2017 and 2018 in the 44 year satellite record.
- Less sea ice exposes more dark sea water which can absorb more sunlight leading to higher temperatures and more melt (positive feedback)
- Length of Beaufort Sea open water season increasing:
  11 weeks in 1979
  19 weeks in 2017


Average Monthly Arctic Sea Ice Extent
September 1979 - 2021
Extent (millions of square kilometers)
8
7
6
5
4
3
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Year
0.8 million km2 decrease per decade
National Snow and Ice Data Center

Climate Change Impacts:
Coastal Erosion

Tuktoyaktuk coastal erosion:

Tuktoyaktuk Curling Rink

Loss of:

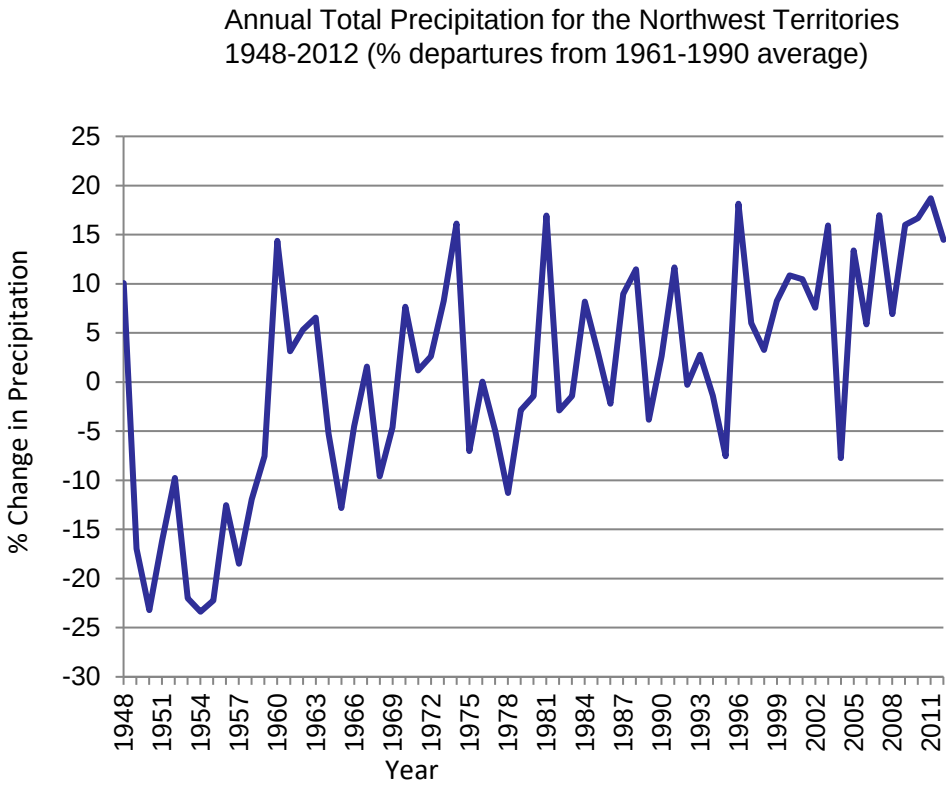
- Curling rink,
- Elementary school
- RCMP detachment

Marine Impacts – Sea Level Rise

Source: Hamlet of Tuktoyaktuk

Precipitation – Northwest Territories

- Overall trend of increased precipitation, but significant inter-annual variability
- Considerable local variability – some places have no trend
- Challenge - Limited NWT precipitation monitoring stations and changing measurement methodologies



Source: ECCC

Warmer, wetter, heavier and increased snow

2004, foyer roof collapsed of Samuel Hearne Secondary School in Inuvik

Permafrost

- ground remains frozen for two years or more
- Permafrost is the base which we build northern infrastructure
- Climate warming is thawing permafrost and impacting infrastructure

Climate Change Impacts: Permafrost Thaw

Inuvik Airport

Climate Change Impacts: Permafrost Thaw

Photo Credit NRCan

Increasing Forest Fires, increased smoke

Yellowknife, August 16, 2014

2014, could become the new normal

Whati

Drought: Snare Reservoir, June 2015

Snare Rapids Head Gate and Intake, June 2015

Low water

- 10 communities resupplied in NWT by barge
- 2014 barge cancellations due to low water (season ended one month early)
- Adaptation - Spreading loads over more barges (cost, less cargo can be moved)
- In 2014, Barges to Inuvik Fort Good Hope and Tuktoyaktuk were cancelled

2020 High Water

Yellowknife Government Dock

2015 vs 2020

- 2015 record low water levels Great Slave Lake
- 2020 record high water levels Great Slave Lake
- Example of more frequent climate extremes

Warmer temperatures, degrade ice
shorten winter road season and ability to harvest country foods

Photo Credit: Sieben

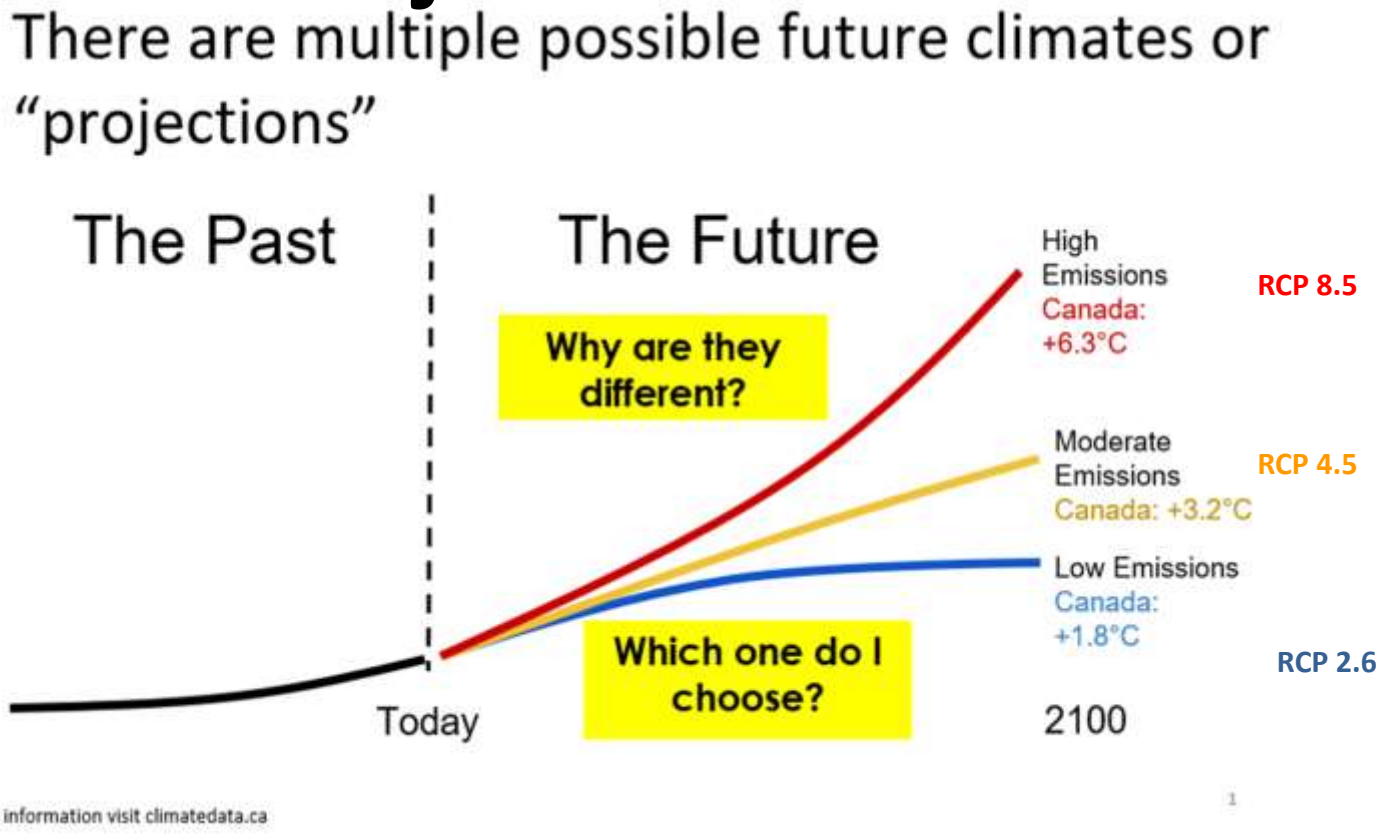
Increased River Erosion

- Warm water erodes riverbank (especially frozen ground)
- Most significant during spring flooding

Courtesy, Brandon Buggins, Fort Simpson

Projections of the Future

Climate Projections



- Climate models make projections based on various emissions 'scenarios' (levels of human-caused GHG emissions)

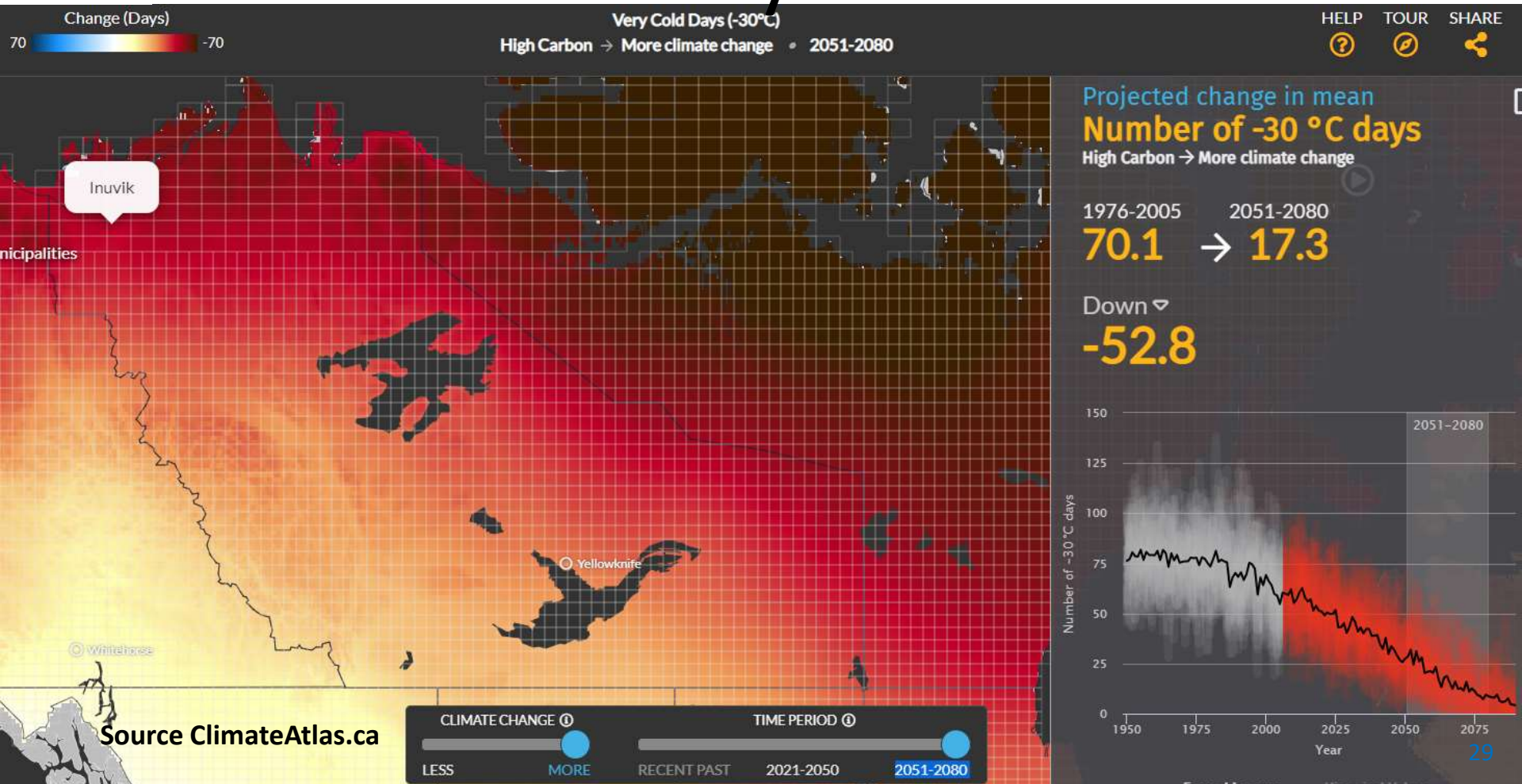
Summary of Projections

Change in Mean Annual Temperature	High GHG Emissions Scenario
North*	**+7.8°C**
Canada	+6.3°C

(Average annual change compared to 1986-2005, based on 50th percentile)

- Temperature and precipitation are both projected to increase Canada-wide
- However, the north is projected to increase faster in both temperature and precipitation

Decrease in Cold Days



Source ClimateAtlas.ca

Fort Smith

Climate Change Report

CANADIAN CENTRE FOR CLIMATE SERVICES

VARIABLE	RECENT PAST[†] 1976-2005	MODERATE EMISSION FUTURE[*] 2051-2080	HIGH EMISSION FUTURE[*] 2051-2080
AVERAGE ANNUAL TEMPERATURE	-2.2 °C	1.1 °C	2.7 °C
AVERAGE SUMMER MAX TEMPERATURE	21.4 °C	23.8 °C	25.4 °C
AVERAGE WINTER MIN TEMPERATURE	-26.2 °C	-21.2 °C	-18.9 °C
NUMBER OF -30 °C DAYS PER YEAR	40	19	11
NUMBER OF ICING DAYS[‡] PER YEAR	153	137	128
DATE OF FIRST FALL FROST	SEP 13	SEP 28	OCT 7
DATE OF LAST SPRING FROST	MAY 26	MAY 16	MAY 11
TOTAL WINTER PRECIPITATION	62 mm	72 mm	76 mm
TOTAL ANNUAL PRECIPITATION	359 mm	406 mm	415 mm

[†] Modelled historical values are taken from the BCCAQv2 dataset. Historical gridded data derived from observations are available on ClimateAtlas.ca.

[*] The moderate (RCP 4.5) and high (RCP 8.5) climate change scenarios are only two possible future climate scenarios.

[‡] Icing days are days where the maximum temperature does not go above 0 °C. Definitions for the other variables are available on ClimateAtlas.ca.

The climate is changing and poses risks to all Canadians. Climate information, traditional and scientific, can help us navigate these risks. This handout provides a sample of the scientific climate data available and provides guidance on how to work with scientific climate information.

Regional Impacts and Adaptation Examples

Changing Winters

Increased Precipitation *Warmer temperatures* *Fewer below-zero days*

Continued warming and thawing can lead to...

- Shortened winter road and shipping seasons
- Threatened structural integrity of buildings

Increased winter precipitation can lead to...

- Increased snow load on infrastructure
- Increased demand for snow removal

Shorter and less reliable ice seasons can lead to...

- Reduced safety of traditional hunting routes
- Coastal erosion
- Increases in marine shipping

Adaptation Examples...

- Integrate best management practices from Standards Council of Canada's Northern Infrastructure Standardization Initiative
- Monitor and adapt foundations (e.g. steel piles, screw jacks) built on thawing permafrost
- Revised winter road loads and considerations to construct all season roads and/or alternative methods of transportation
- Access to real time information on ice thickness to promote safety
- Improved methods to determine ice freeze-up time periods

Ecosystems and Health

Hotter summers *Longer frost-free season* *Warmer all year*

Possible Regional Impacts...

- Increase in forest fire risk for certain regions
- Loss of barrier to invasive species with reduced extreme winter temperatures
- Possible increase in vector-borne diseases
- Changes to ecosystems and wildlife, with possible effects on country foods

Adaptation Examples...

- Implement 'FireSmart' practices in communities and around homes
- Increased awareness regarding invasive species and vector-borne diseases
- Measures to improve food security

Canada

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Canada.ca/climate-services

https://climatechange.toolkitnwtac.com/

Future: Inuvik and Hay River

- Warmer

	Change in Mean Annual Air Temp with high GHG 2100 (relative to 81-2010)	Change in Mean January Air Temp with high GHG 2100 (relative to 81-2010)
Inuvik	About 9˚C ↑	About 14.6˚C ↑
Hay River	About 7.4˚C↑	About 14.1˚C ↑

- Wetter

About 85 mm wetter, 25% in Hay River, 31% wetter in Inuvik
With warmer temperatures, increase rain vs snow especially in fall/spring

Increase air temperature will increase surface water temperature

More summer convection storms

More Lightning

Potentially more Tornadoes

Inuvik Tornado 2012,
Fort Smith Tornado 2019

Ontariostorms.com

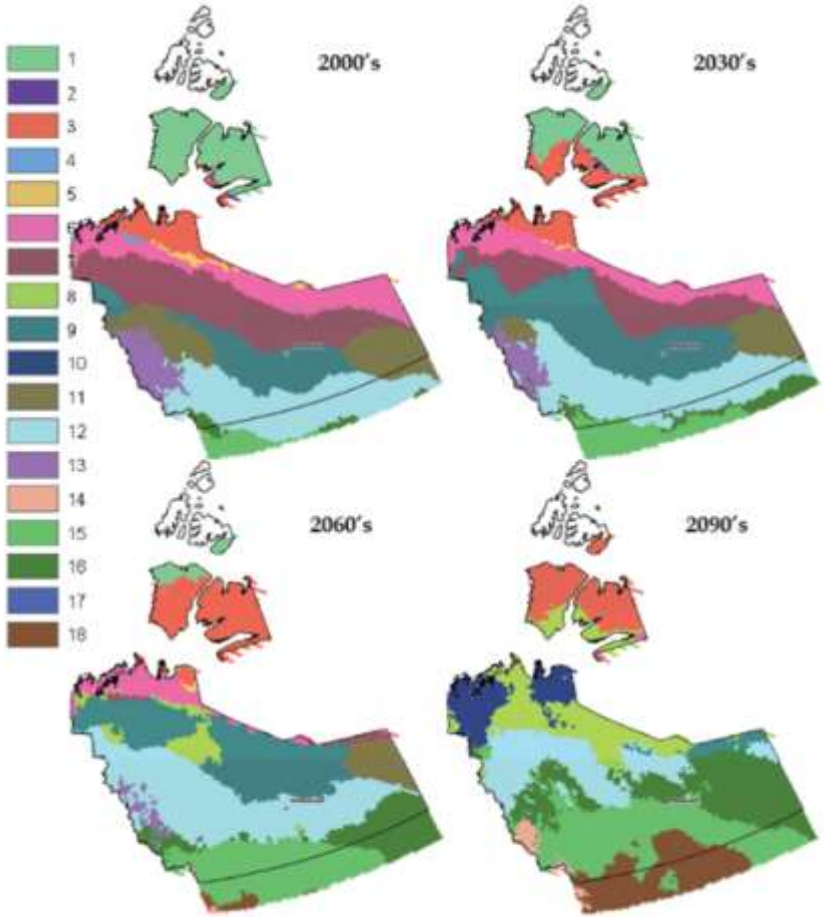


Figure III-6 — Enlargement of Figure 16, part III. Projected climes for the A2 emissions scenario

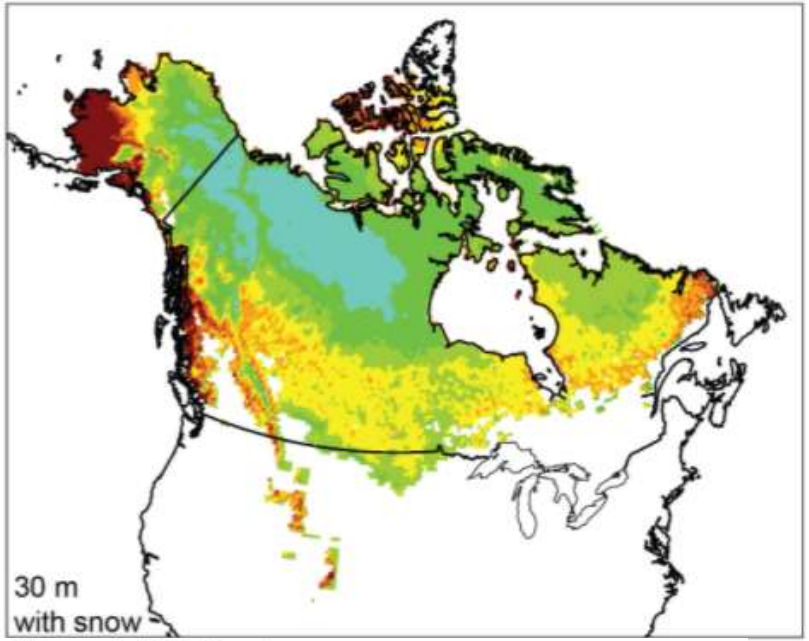
Ecosystems are changing and moving northward

Lake Ice Projected to Decrease

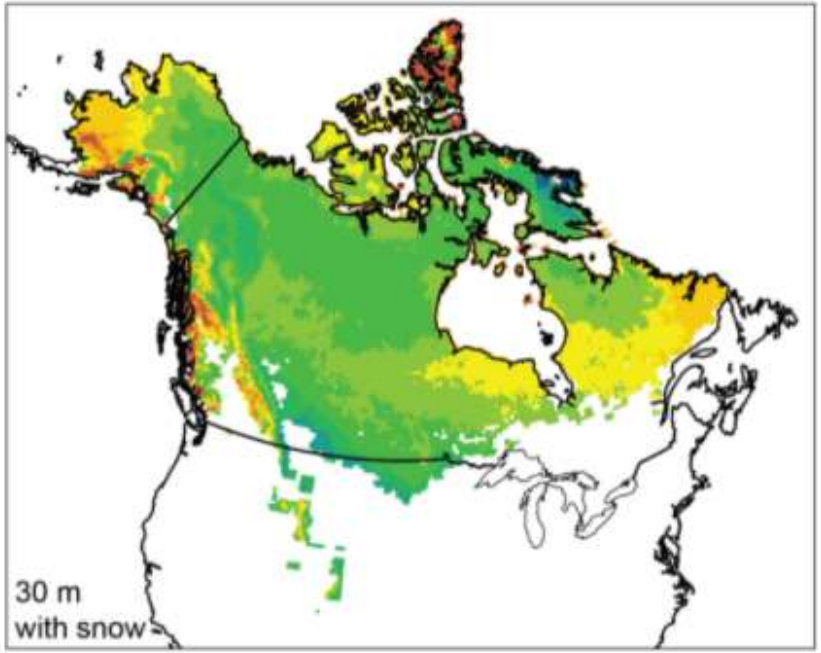
2071 -2100 versus 1981 -2010

This will limit the ability to travel on ice, country food harvesting

Change in **Ice Cover** Duration



Change in **Mean Ice Thickness**



Laura Brown U Toronto

Projected Lake Levels

- Projections suggest that water levels on Great Slave Lake and Great Bear Lake will likely drop, due to:

- Increased evaporation due to longer ice-free season and warmer temperatures

Projected Changes in River Flow

- Increased annual mean flow projected for 2050s
- Increase winter flow because of permafrost thaw (more groundwater)
- Increase in droughts and floods

Source: Potras et al. 2011, Canada's Changing Climate Report

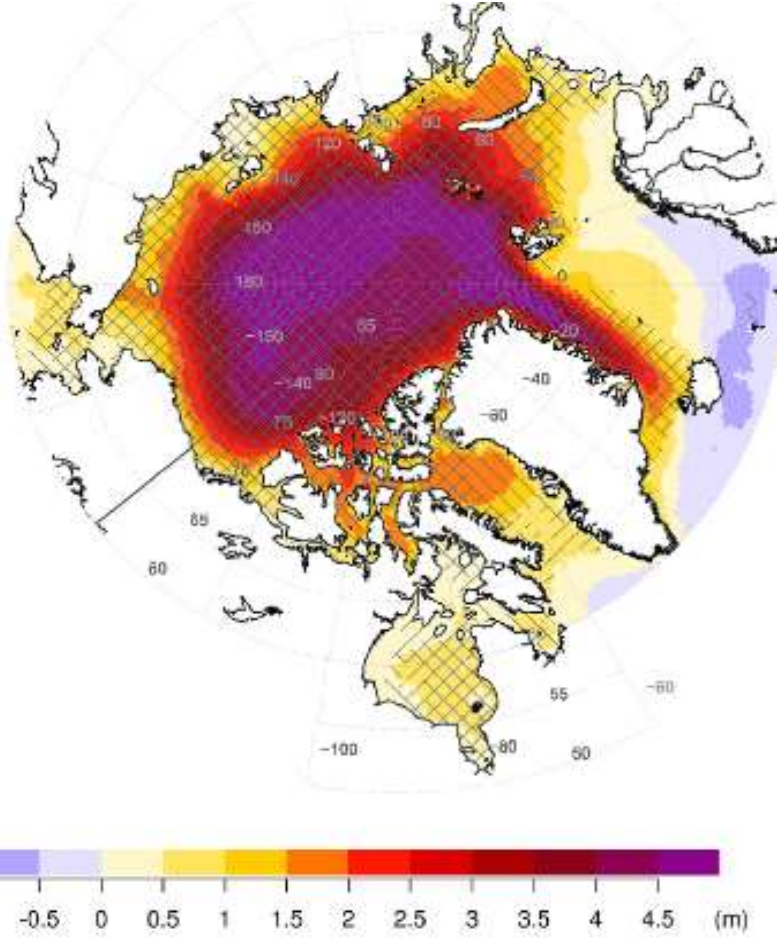
While flooding is natural, we expect this to become more common.

Decrease in Sea Ice

- The first ice-free Arctic summer year will occur this century and as soon as the 2030s
  Source: Peng et al. 2020

- Beaufort Sea Ice is projected to decrease by over 80% by end of century
  Source: Canada.ca/climateservices

Larger Waves Projected for Beaufort Sea



2081–2100 relative to 1979–2005

- Less ice
- 1 m increase in wave height near coast, up to 5 m offshore

Source:
Prat and Wang, 2020
Geophysical Research Letters

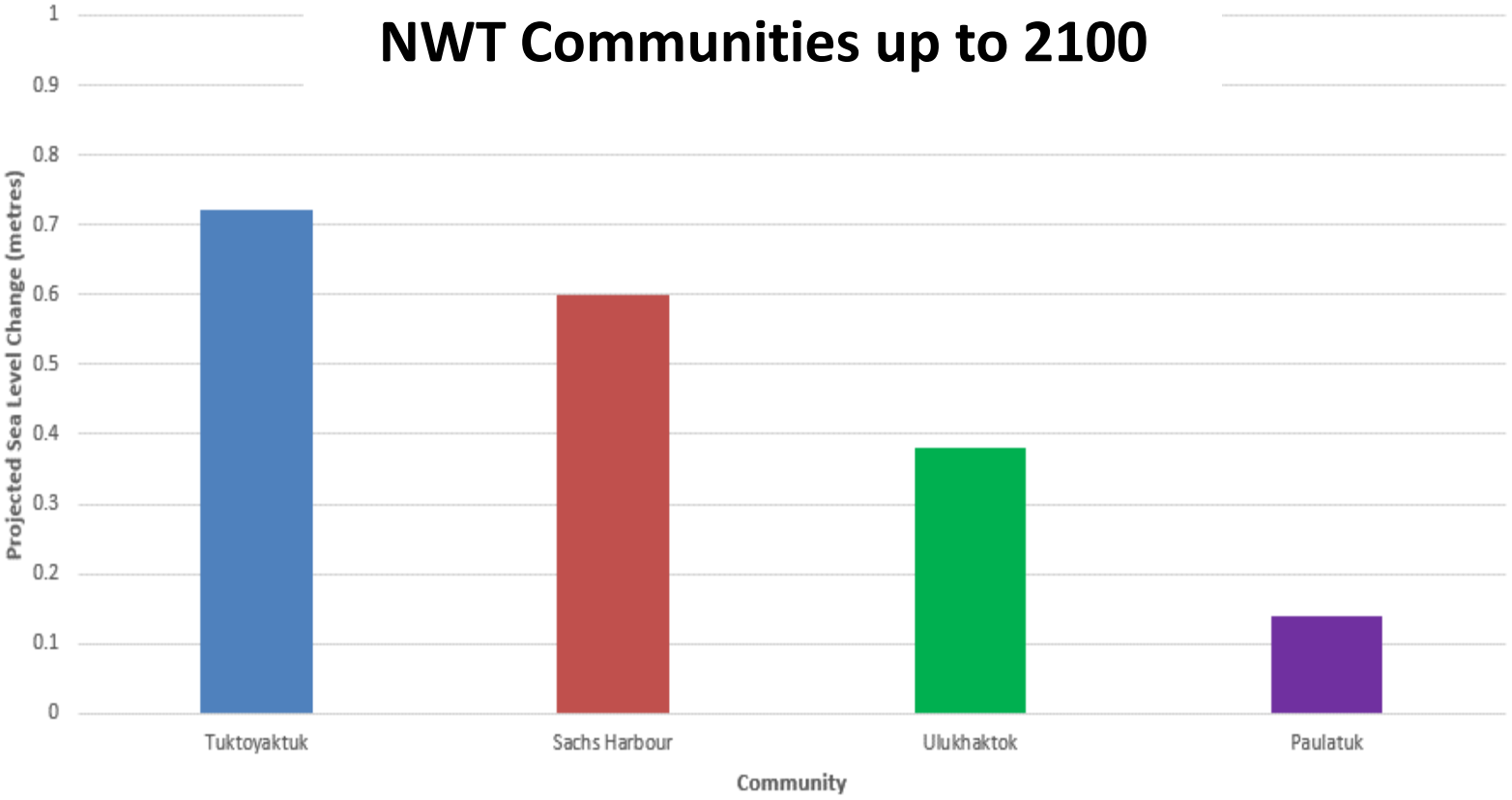
Wave Height (m)

Increase in Storm Surge with less sea ice

- Storm surges are an increase in sea level at the coast due to winds from storm conditions pushing water onto the shore

- When there is less sea ice, storm surges are larger (greater rise in sea level during the surge)

Projected Change in Sea Level for NWT Communities up to 2100



Mársı | Kinanāskomitin | Thank you | Merci | Hąį’ | Quana | Qujannamiik | Quyanainni | Máhsı | Máhsı | Mahsì

Questions, Comments, Discussion

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