# NWT Climate Change Trends and Impacts

Climate Change and Asset Management
September 15, 2022

Government of Northwest Territories



1

## Outline

1. Observed Climate Trends and Climate Change Impacts
2. Projected changes (future)



2

# Climate Change Impacts

## Are happening now, and are not hypothetical

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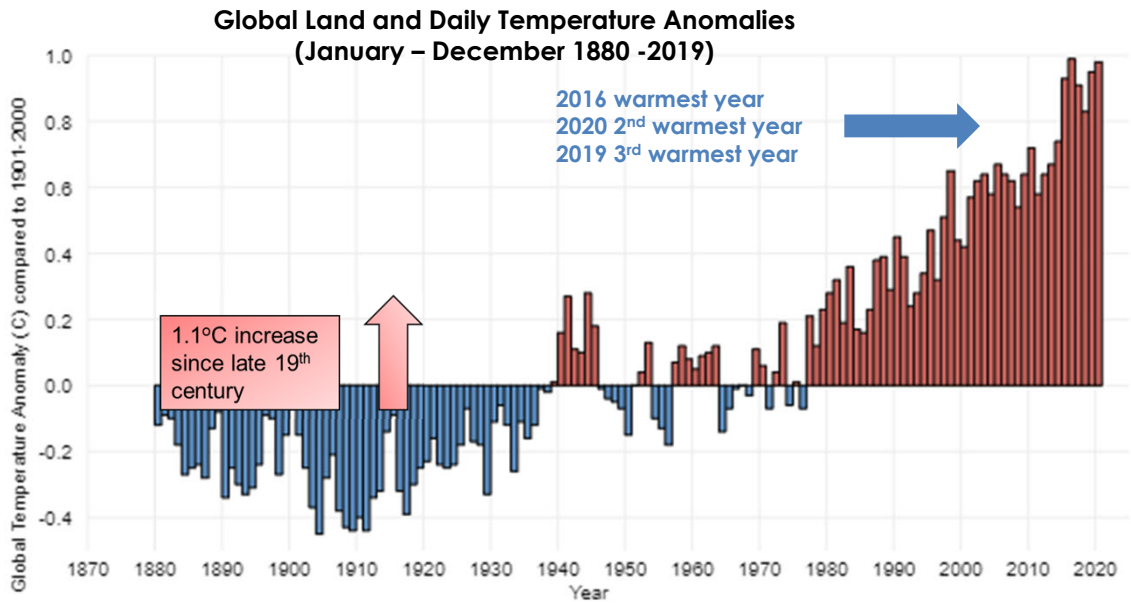
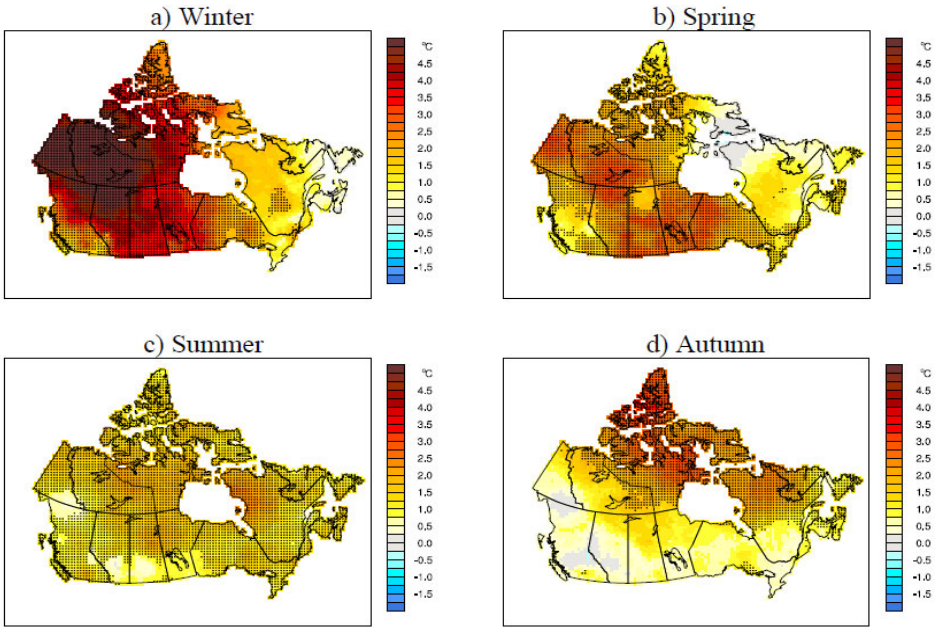
## Warming is UNDENIABLE




Source: NOAA, US Government

4

# Temperature Trends: 1948-2012




**More warming in winter**

**More warming in north**

Source: Vincent et al. *J. Climate*, 2015

1.7°C Canada, 2.3°C North

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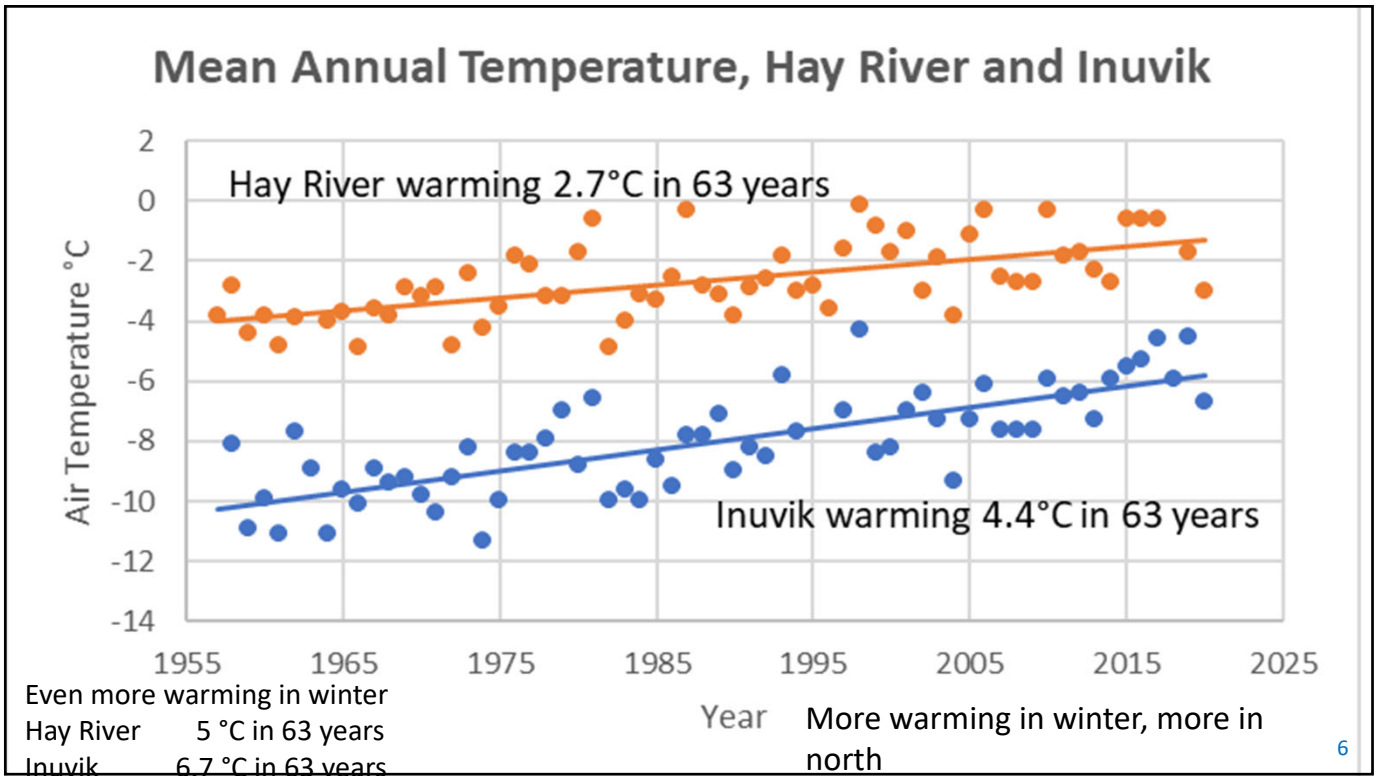


Even more warming in winter

Hay River 5 °C in 63 years

Inuvik 6.7 °C in 63 years

More warming in winter, more in north

6

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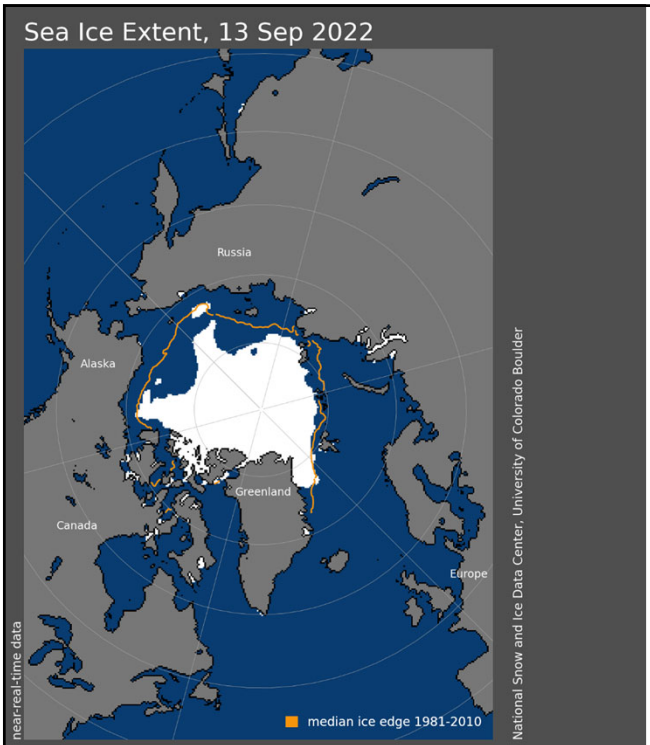


# Sea Ice Extent

- Last year 2021, the twelfth lowest in the satellite record
- This year is tracking to be lower than average as well
- 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:
- 5 weeks 1970s
- Now 13.5 weeks

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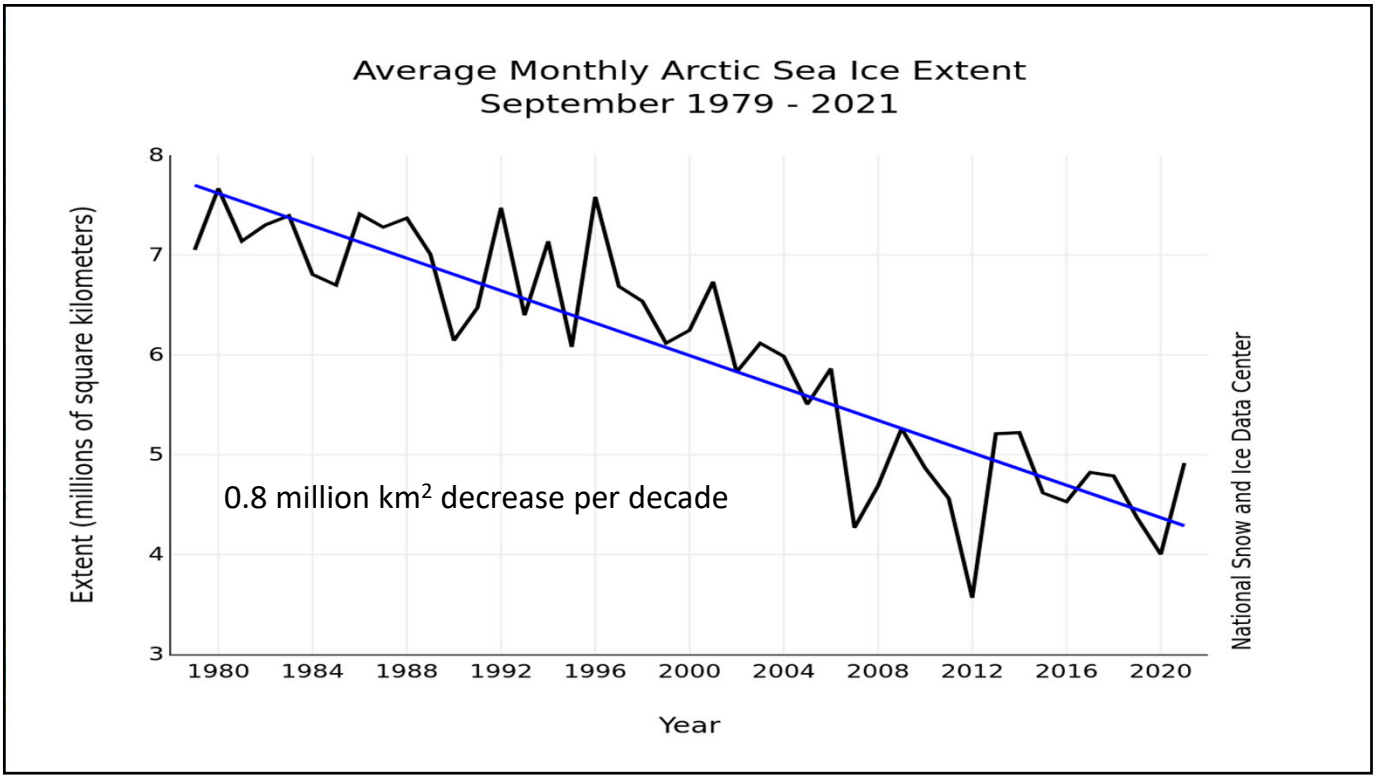


8

## Climate Change Impacts: Coastal Erosion


Active erosion at Stokes Point, Ivvavik National Park, Yukon coast

9

## Tuktoyaktuk coastal erosion:

Tuktoyaktuk Curling Rink

Loss of:

- Curling rink,
- Elementary school
- RCMP detachment

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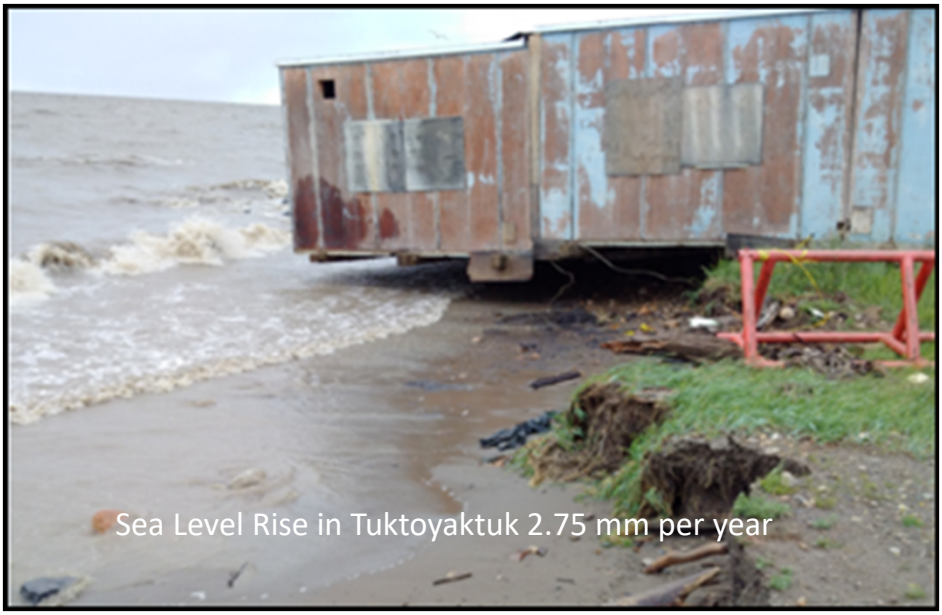
# Marine Impacts – Sea Level Rise




Source: Hamlet of Tuktoyaktuk

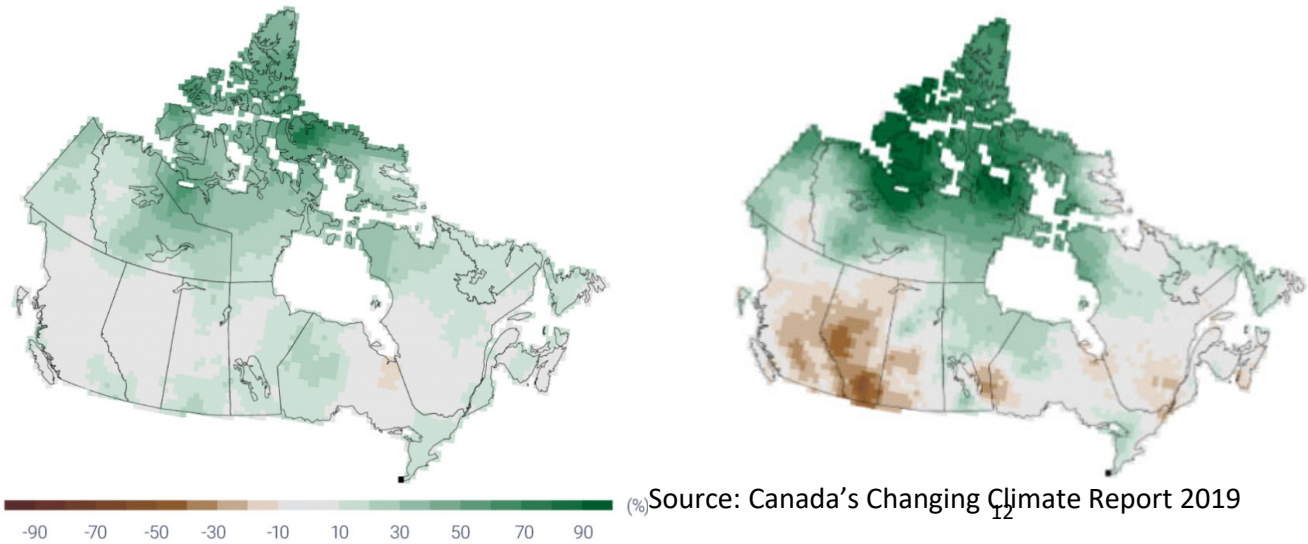
11

11

# Change in Precipitation 1948-2012

**Annual**

**Winter**



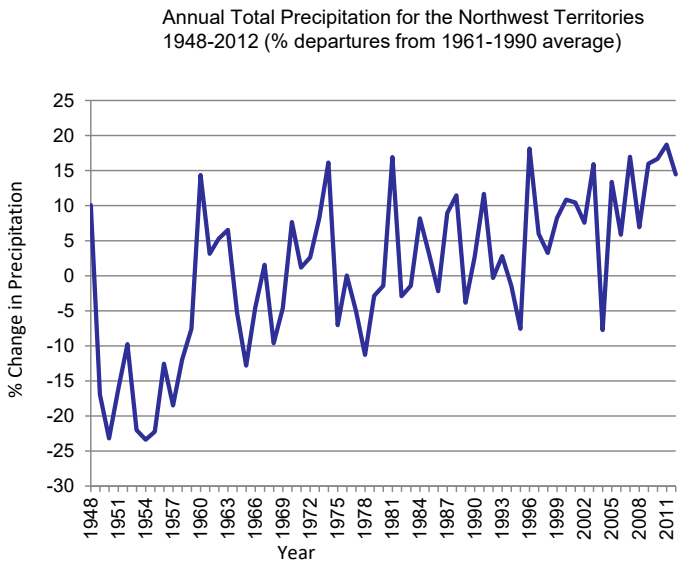

Source: Canada's Changing Climate Report 2019

12

12

# 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



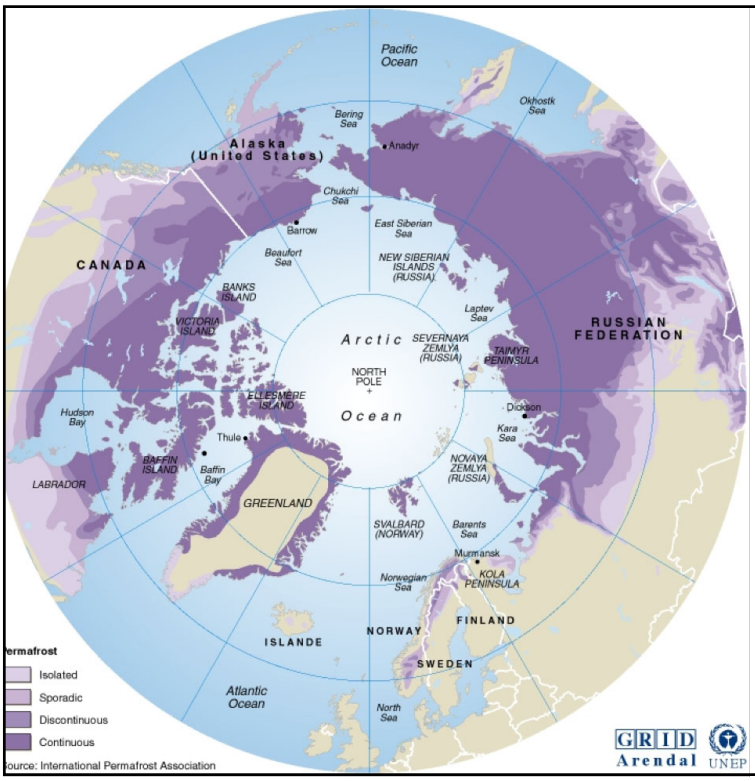

Source: ECCC

13

## Warmer, wetter, heavier and increased snow

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

14




# 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

15

15

16

# Climate Change Impacts: Permafrost Thaw

Inuvik Airport

17

# Climate Change Impacts: Permafrost Thaw

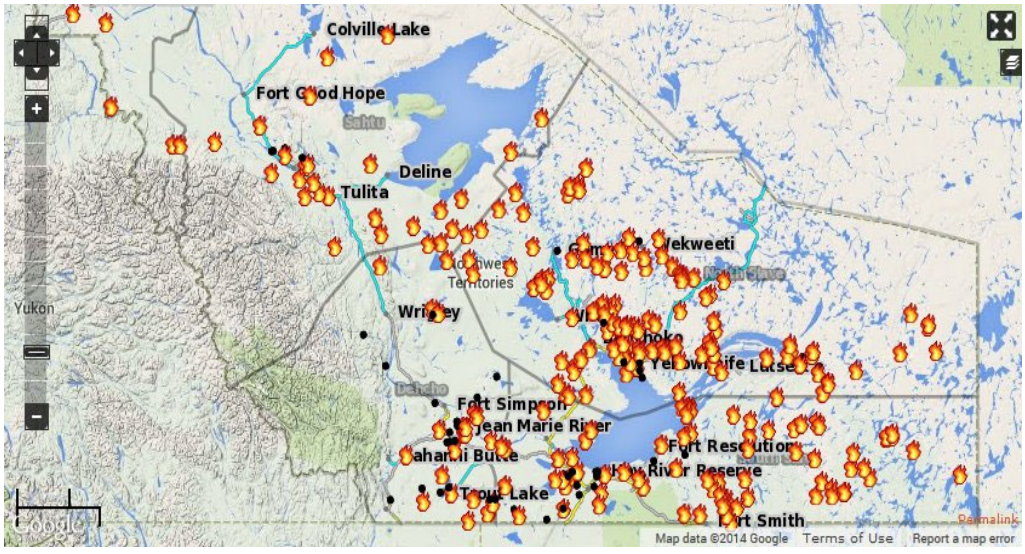
18

# Climate Change Impacts: Increasing Forest Fires

**Yellowknife, August 16, 2014**

19

# Active Fires July 30, 2014




20

# Whati, Summer 2014

-2014, 3.4 million hectares burned (more than any previous year)
-For reference on average, 2.5 million ha burn in Canada annually

21

# Drought: Snare Reservoir, June 2015


22

**Snare Rapids Head Gate and Intake, June 2015**


23

# 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

24

- **Volvo Stern Drive – typically 4 are destroyed each year in the East Arm of Great Slave Lake due to collisions with the bottom, $5000**
- **2014-15 Over 60 were destroyed due to low water**

25


26

# 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

27

# Estimate of Costs of 2014 – 2015 Drought

$56 Million dollars fire fighting costs 2014,
($33 million dollars in 2015), normal about $8 million
$15 million was required for diesel electricity generation
$5 million in evacuations

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About 76 million dollars in 2014

28

## Warmer temperatures, degrade ice shorten winter road season

Photo Credit: Sieben

29

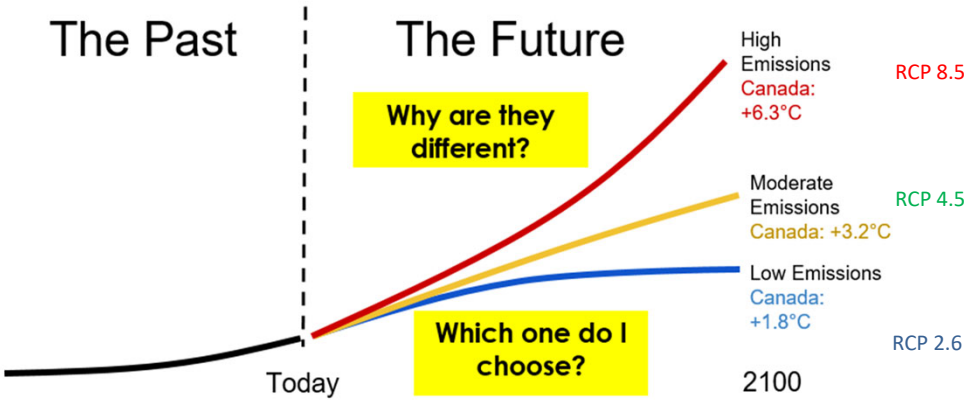
# Projections of the Future

30

30

# Climate Projections

There are multiple possible future climates or "projections"




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

31

31

# Summary of Projections

(Years 2081-2100)

| 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)

| % Change in Total Annual Precipitation | High GHG Emissions Scenario |
|---|---|
| **North*** | **+33.3 mm** |
| Canada | +24.2 mm |

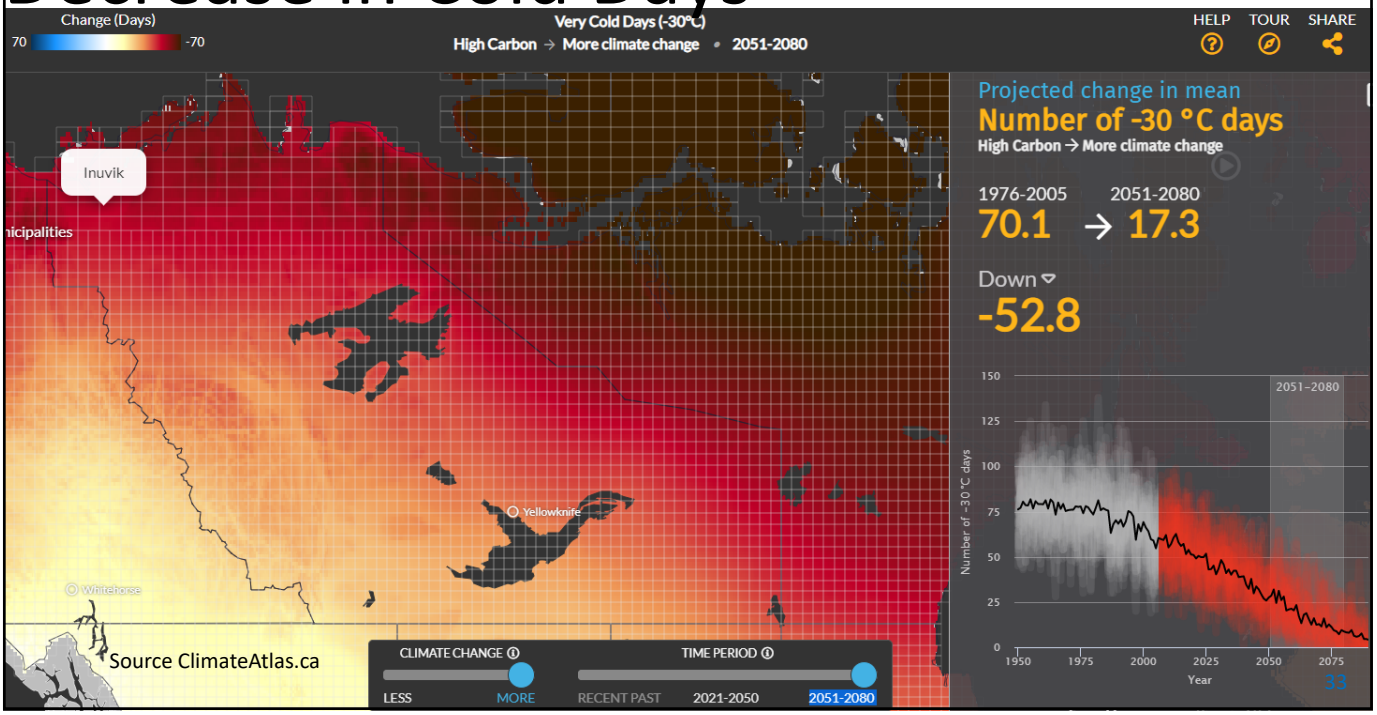
(Average change compared to 1986-2005, based on 50th percentile)

*North includes Yukon, NWT and Nunavut

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

32

# Decrease in Cold Days




33

# 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

34

34

# More summer convection storms

More Lightning

Potentially more Tornadoes

Inuvik Tornado 2012,
Fort Smith Tornado 2019

Ontariostorms.com


35

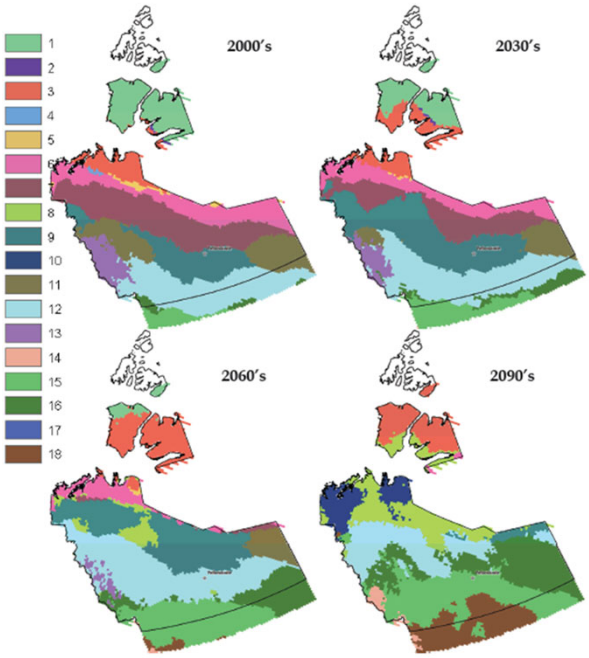



Figure III-6 – Enlargement of Figure 16, part III. Projected climes for the A2 emissions scenario

Ecosystems are changing and moving northward

36

36

# 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 warme temperatures

37

37

# Projected Changes in River Flow

- Increased annual mean flow projected for 2050s
- Increase winter flow because of permafrost thaw (more groundwater)
- earlier spring peak flow
- Increase in frequency in low and high flows events

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

38

38


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

39

39

# 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

40

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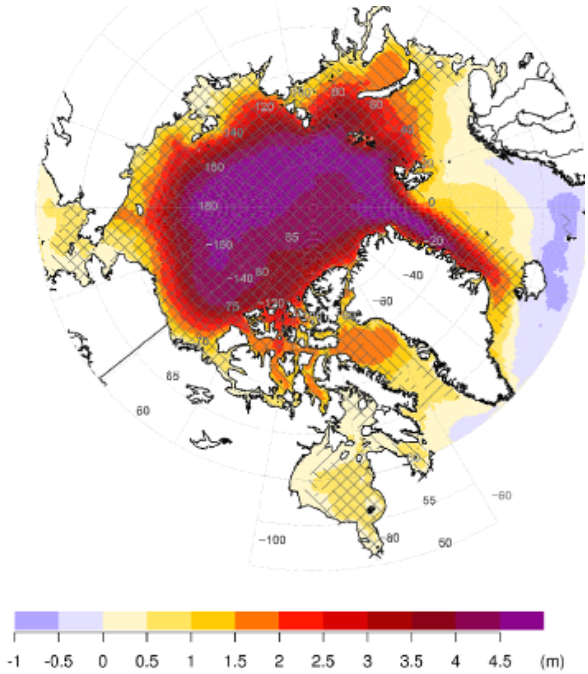
# Larger Waves Projected for Beaufort Sea




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

Wave Height (m)

41

41

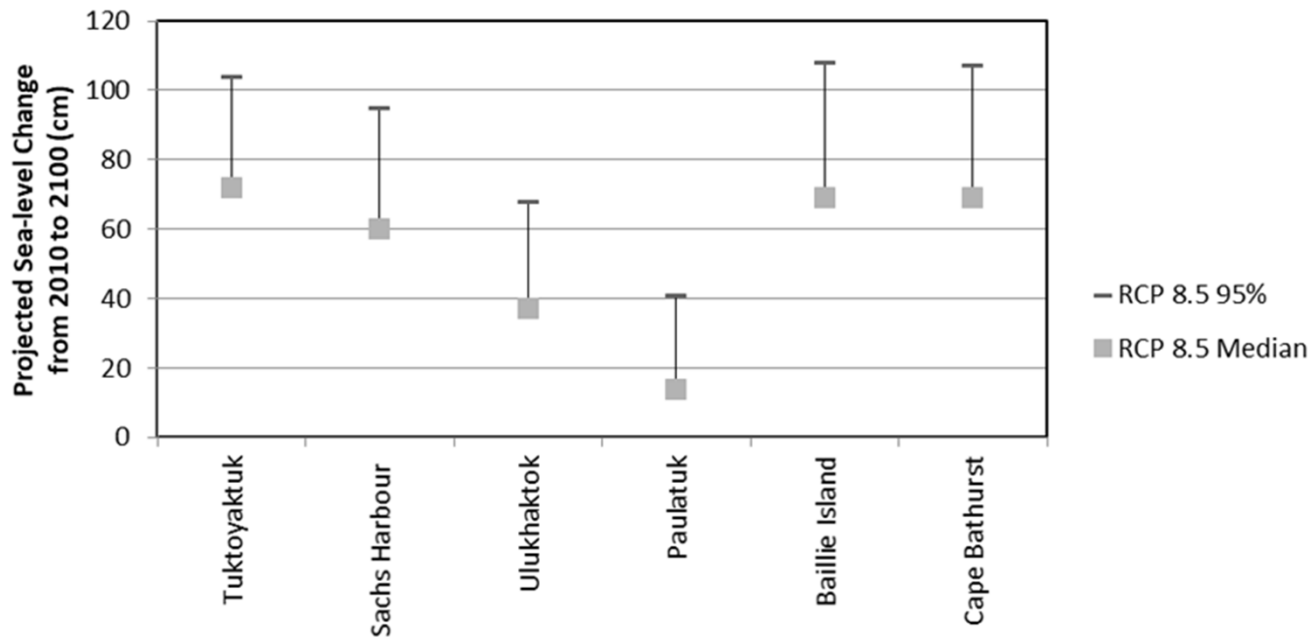
# Increase in Storm Surge with less sea ice

- 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)

42

42

# Sea Level Rise




Data Source: Thomas James (Natural Resources Canada)

43

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

# Questions, Comments, Discussion

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44