



NWT CLIMATE TRENDS AND IMPACTS

NWTAC CLIMATE CHANGE FORUM AND CHARRETTE YELLOWKNIFE OCT 29-31, 2018

CANADIAN
CENTRE FOR
CLIMATE
SERVICES









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Northern Climate Services Liaison
CCCS-ECCC

OUTLINE

1. TRENDS

2. IMPACTS

3. PROJECTIONS OF FUTURE





Trends

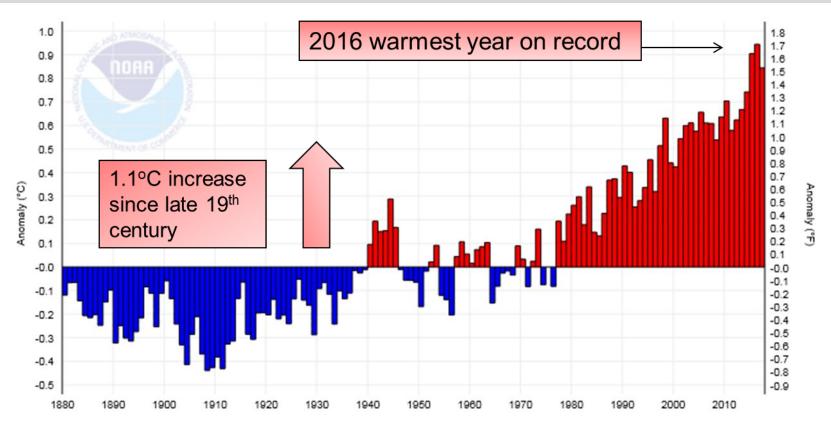






WARMING IS UNEQUIVOCAL

Global Land and Ocean Temperatures Anomalies (January – December 1880-2017)



* IPCC Fifth Assessment





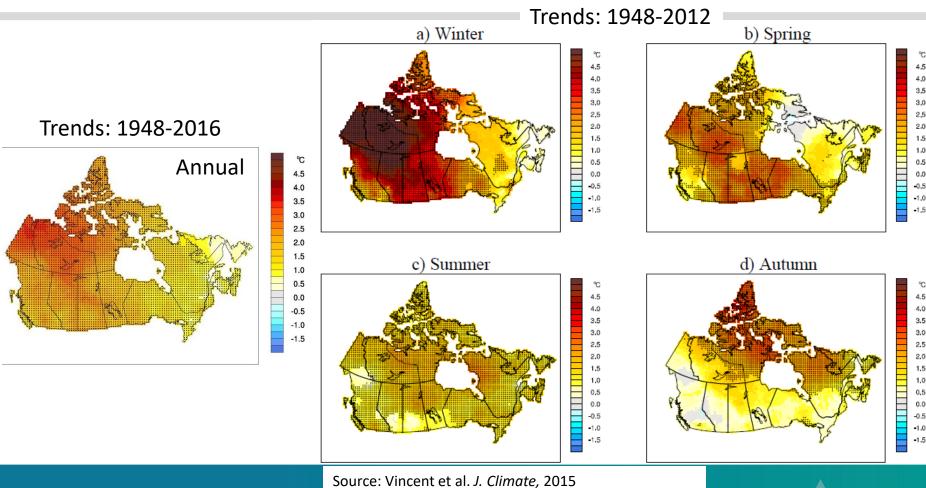
Northern Canada is warming faster than most other regions of the world







TEMPERATURE TRENDS ACROSS

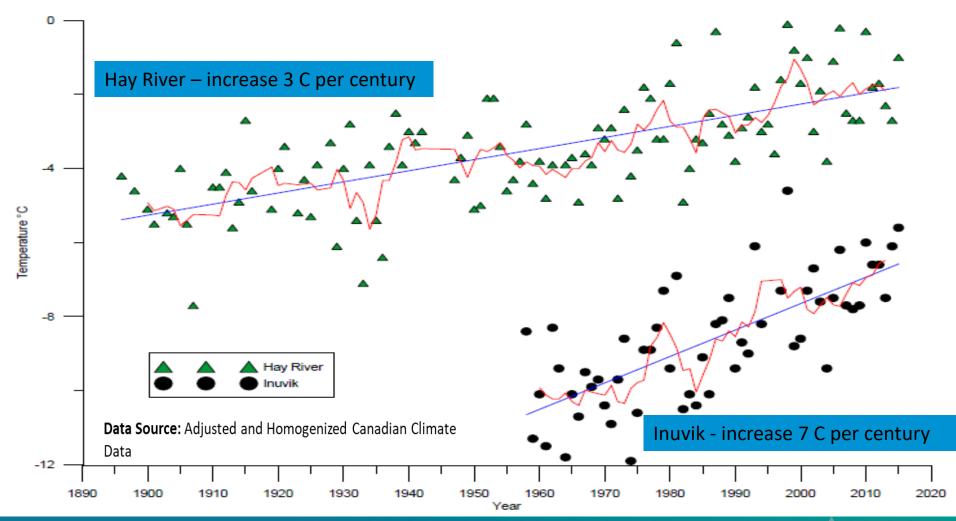






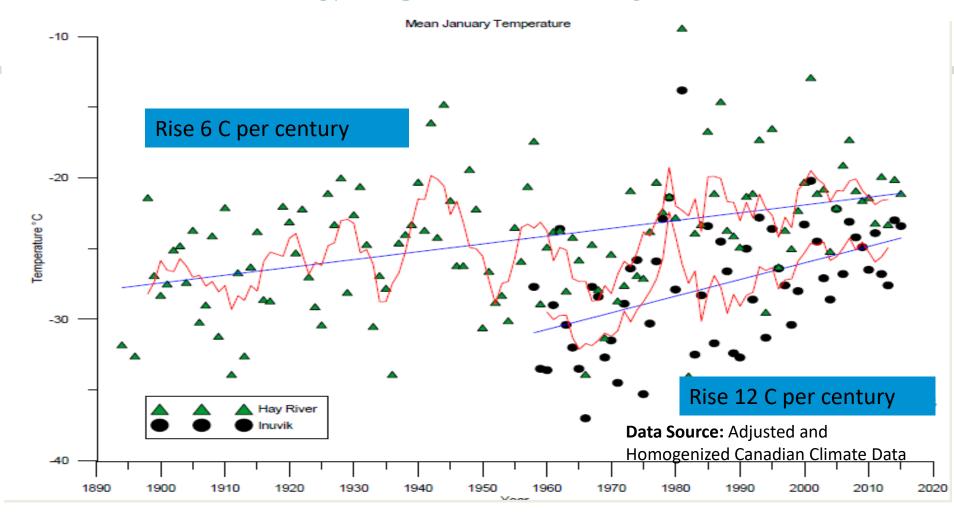


HAY RIVER & INUVIK MEAN ANNUAL TEMP





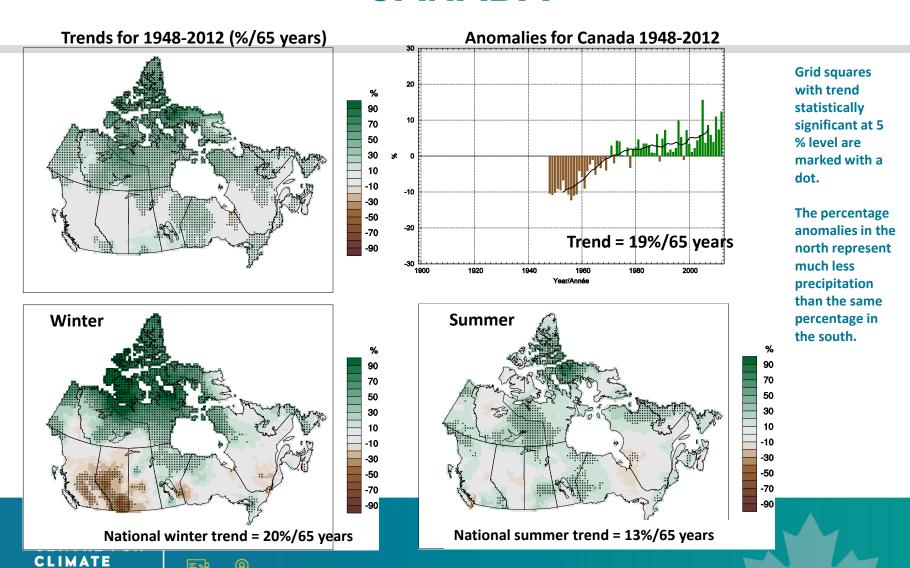
HAY RIVER & INUVIK MEAN JAN TEMP







PRECIPITATION TRENDS ACROSS CANADA

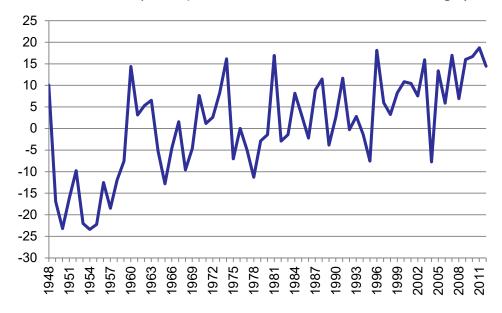


SERVICES

PRECIPITATION – NORTHWEST TERRITORIES

NWT shows significant inter-annual variability with a marked trend of increased precipitation

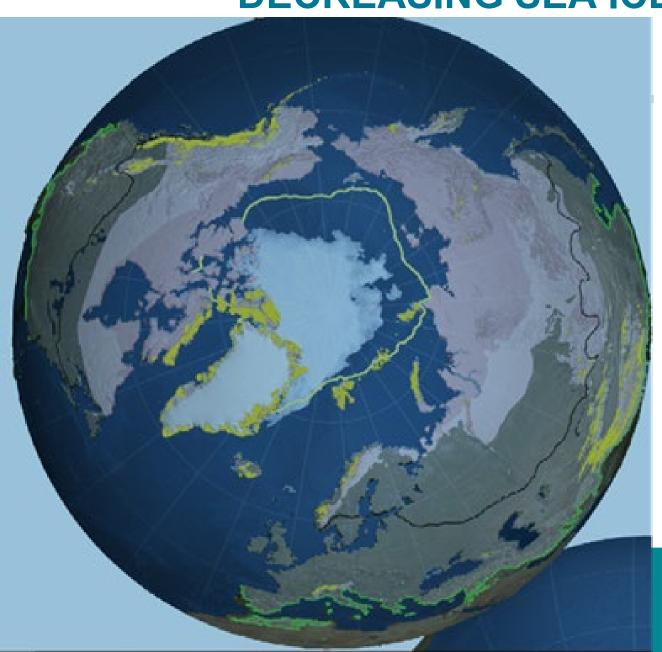
Annual Total Precipitation for the Northwest Territories 1948-2012 (% departures from 1961-1990 average)







DECREASING SEA ICE



Sea Ice Extent

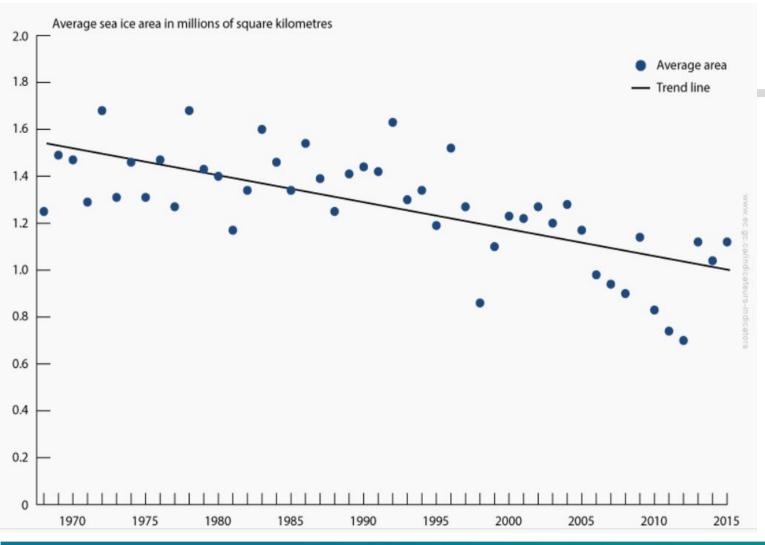
Sept 2012

Source: IPCC

5th Assessment Report



SEA ICE IN CANADA



Decreasing trend of 6.9% per decade in multi-year sea ice area between 1968 and 2015

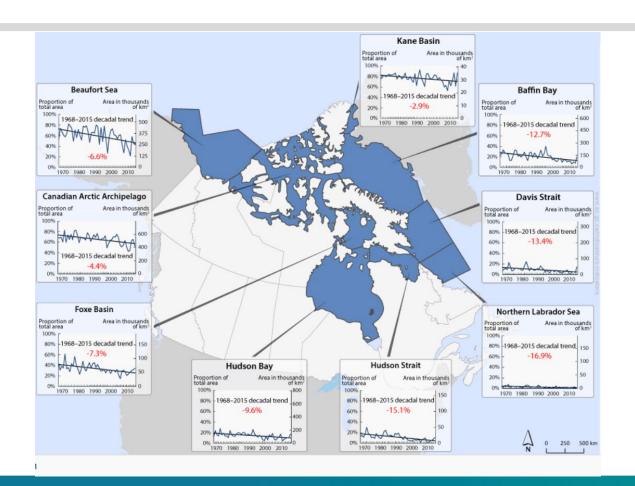
> Source: Government of Canada Environmental Indicators







SEA ICE



Decreasing trends in sea ice area for each of the nine subregions in Northern Canadian waters between 1968 and 2015

Source: Government of Canada Environmental Indicators











Impacts







COASTAL EROSION



Photo Credit: Hamlet of Tuktoyaktuk

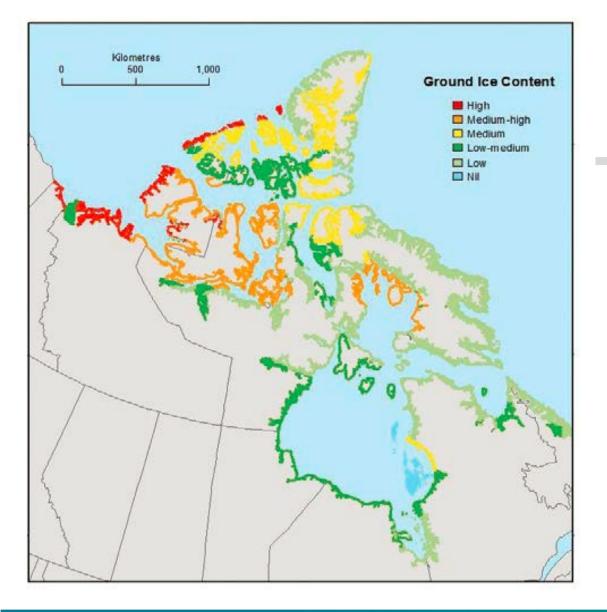
19 July 2016

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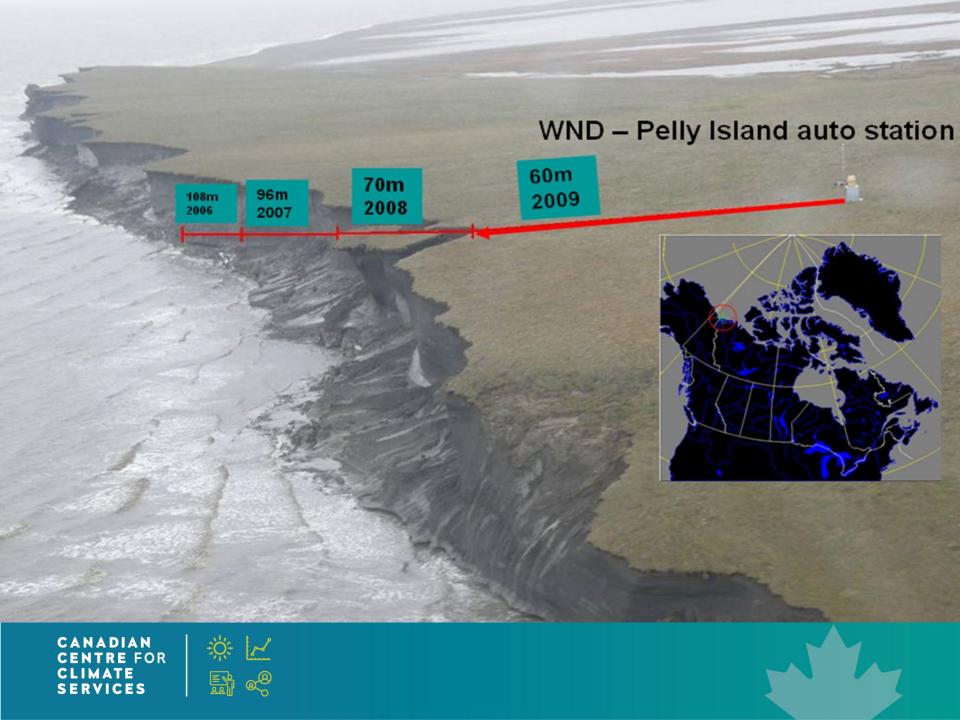
GROUND ICE CONTENT

Source: NRCan Canada's Marine Coasts in a Changing Climate











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COASTAL EROSION AND SEA LEVEL RISE: BIODIVERSITY



Hairy Braya – NWT species at risk: threatened First NWT Species at Risk Recovery Strategy Released

Erosion of up to 10 meters per year







WARMER TEMPERATURES DEGRADE ICE AND SHORTEN ICE ROAD SEASON







PERMAFROST THAW







PERMAFROST THAW



West of Fort McPherson

Scott Zolkos, University of Alberta, 2016

CANADIAN CENTRE FOR CLIMATE SERVICES





WINTER OVERLAND FLOW: IMPACT ON **WINTER ROADS**



15 km East of **Gordon Lake**

2015

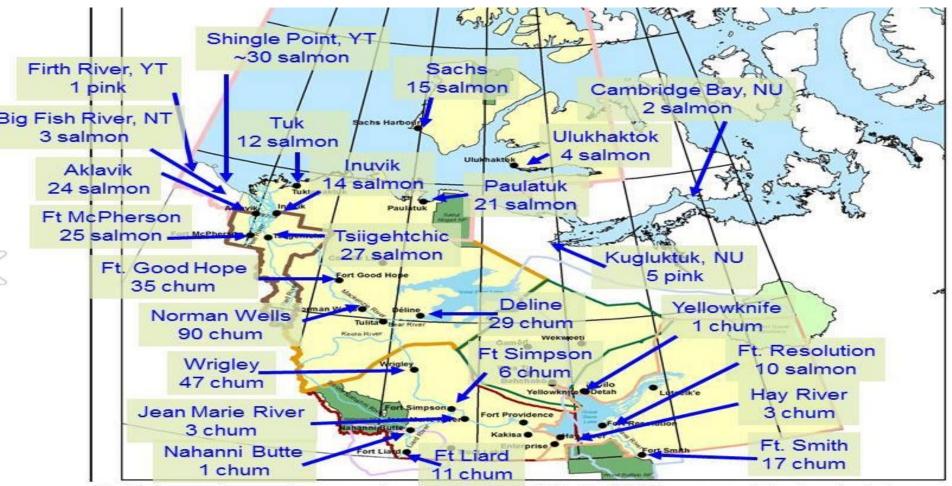
Peter Morse, GSC, **NRCan**







OPPORTUNISTIC SPECIES



Preliminary data on harvested salmon in the NWT in 2016 as part of the Arctic Salmon community-based monitoring program. This information is used to track the distribution

Source: Karen Dunmall, U Manitoba. www.arcticsalmon.ca



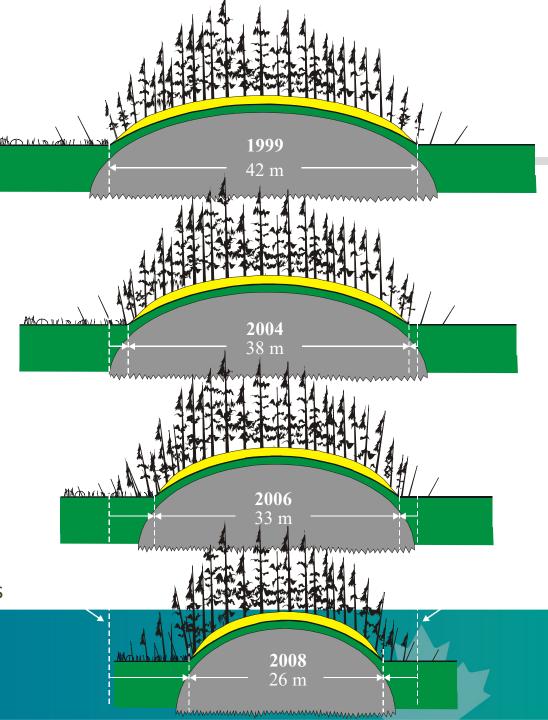


PLATEAU SHRINKAGE



Masaki Hayashi, U of C Bill Quinton, WLU

Approximately 40 % decrease in discontinuous permafrost over 60 years



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WARMER, WETTER, HEAVIER SNOW



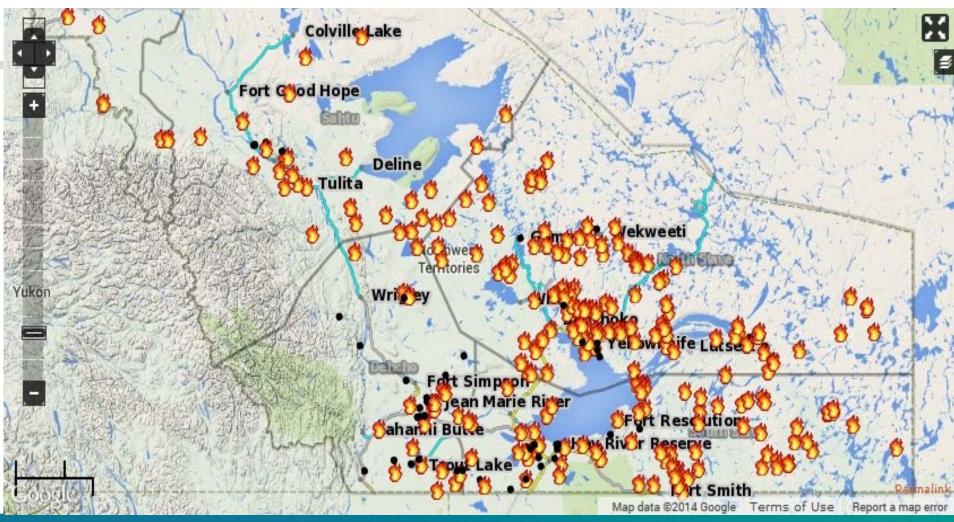
2004, foyer roof collapsed of Samuel Hearne Secondary School in Inuvik

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ACTIVE FIRES JULY 30, 2014







INCREASING FOREST FIRES



Air Quality Yellowknife, August 16, 2014

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WHATI, SUMMER 2014



SNARE RESERVOIR, JUNE 2015



SNARE RAPIDS HEAD GATE AND INTAKE, JUNE 2015



Projections of the Future

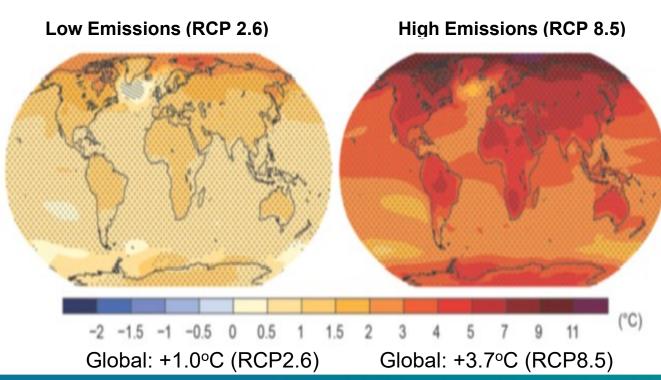






THE STORY OF TEMPERATURE - GLOBAL





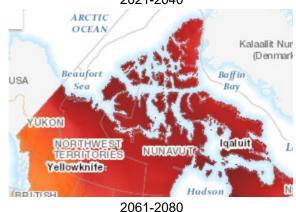
- Temperature change is not uniform.
- Projected warming is higher at high northern latitudes, and greater over land surfaces than oceans.

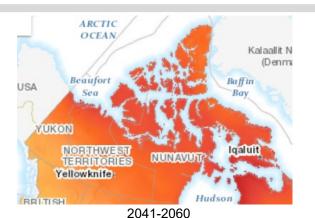


FUTURE PICTURE OF WINTER TEMPERATURE – NWT

HIGH EMISSIONS SCENARIO









Mean temperature change (°C)

-2.5

13





FUTURE PICTURE OF TEMPERATURE – NWT

Projected warming is higher at high northern latitudes

End of century (2081-2100)

Average annual change	RCP2.6	RCP4.5	RCP8.5
NWT	+2.3°C	+4.1°C	+8.4°C
Canada	+1.8°C	+3.2°C	+6.3°C

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

End of century (2081-2100)

Average winter change	RCP2.6	RCP4.5	RCP8.5
NWT	+3.1°C	+5.4°C	+12.3°C
Canada	+2.4°C	+4.2°C	+8.2°C

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

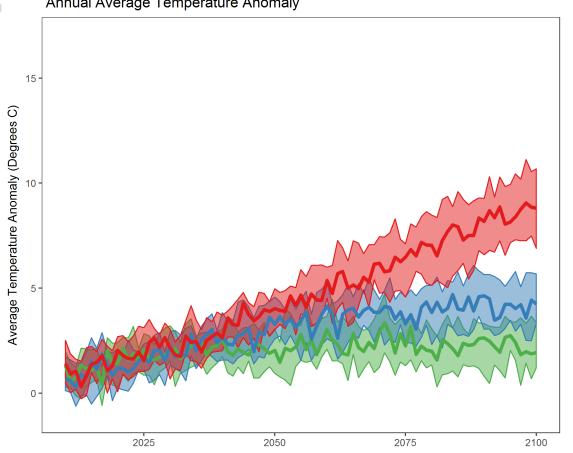






PROJECTED CHANGE IN MEAN ANNUAL AIR TEMPERATURE: INUVIK REGION, **NWT**

Annual Average Temperature Anomaly



Key messages:

Across scenarios, total median change ranges from ~ 2°C to ~ 5°C by 2050, and from $\sim 2^{\circ}$ C to $\sim 8^{\circ}$ C by 2100.

scenario rcp26

rcp45

rcp85

Inter-model variability relatively low

Data Source: CMIP5 ensemble



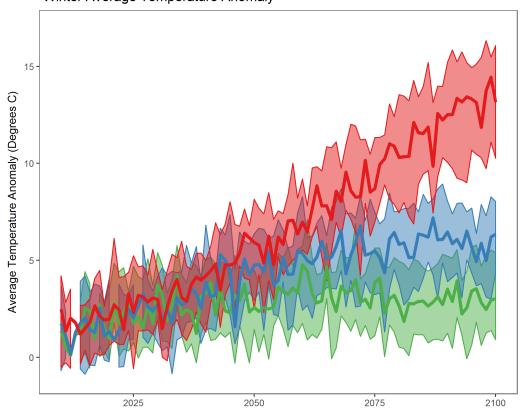






PROJECTED CHANGE IN MEAN WINTER AIR TEMPERATURE: INUVIK REGION, NWT

Winter Average Temperature Anomaly



scenario

rcp45

rcp85

Key messages:

Wintertime warming could be much more pronounced than annual warming

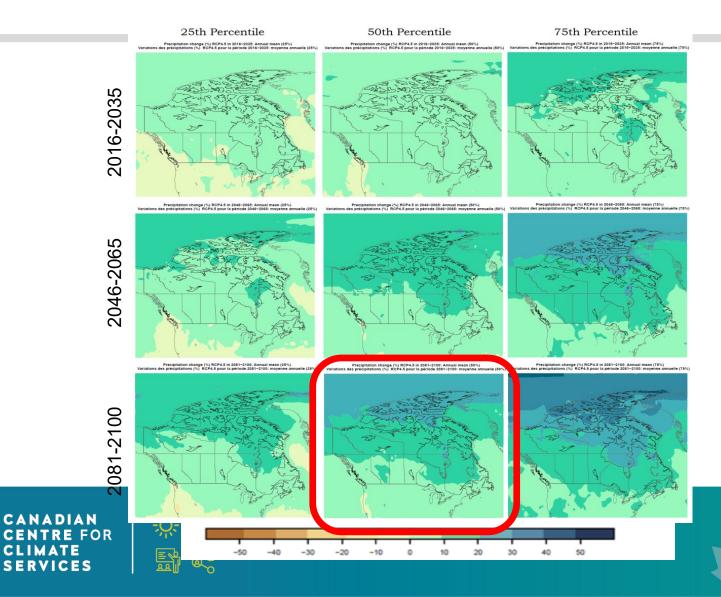
Across scenarios, total median change ranges from ~ 2°C to ~ 6°C by 2050, and from ~ 2°C to ~ 13°C by 2100.

Data Source: CMIP5 ensemble



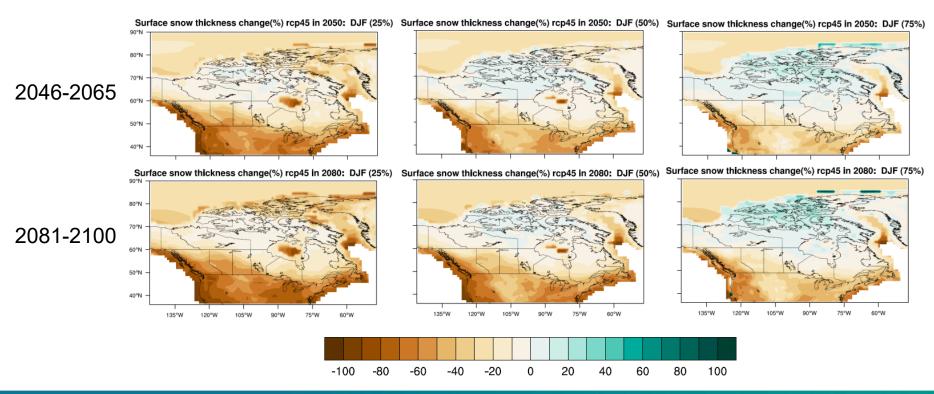


FUTURE PICTURE OF PRECIPITATION – CANADA (MID EMISSONS RCP 4.5)



FUTURE PICTURE OF SNOW DEPTH - CANADA

Surface snow thickness percent (%) change, RCP4.5 for Winter (DJF)



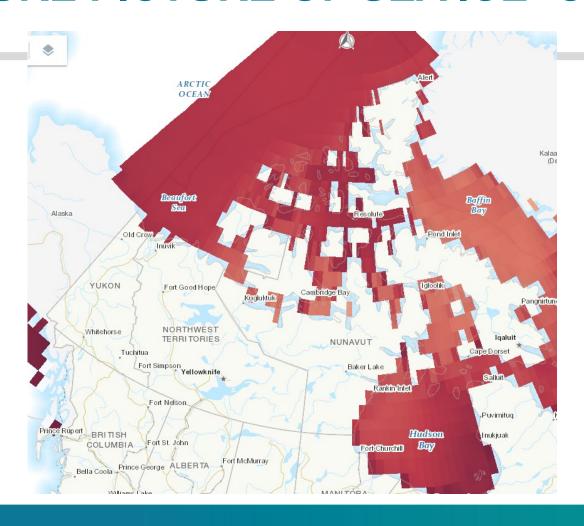






FUTURE PICTURE OF SEA ICE- CANADA





Annual sea ice thickness % change under a high emissions scenario 2081-2100









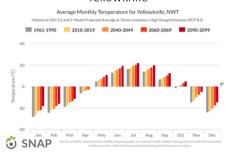
NORTHERN CANADA Example: Kugluktuk, NU 170%

Generally, winter precipitation is increasing in Canada's north, and decreasing in the south.

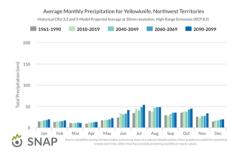


Product Type: High-level message using specific example (with stylized graph)

Yellowknife



average historical mean monthly temperature from 1961-1990 (grey), and modelled mean nthly temperatures (yellow, orange and red) under a high CO₂ emission scenario (RCP 8.5) for the nmunity of Yellowknife extending to the decade 2090-2099.



Examples of Climate Visual Products

(on wall to vote on)

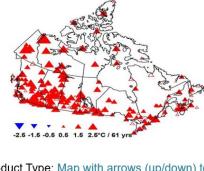
Climate Atlas Report



Climate Change and Canada's Cities

1979-2006 3021-2000					2001-2000			
Verbride	Period	Mean	(au	Rein	High	Low	Reim	HØ
redphallon (mm)	Amount	282	268	323	417	286	344	436
redphallon (non)	Byring	43	24	44	85	38	44	96
hedpfielden (mm)	- Demonstration	102	10	907	179	84	411	187
redphallon (mm)	M	83	71	466	144	71	412	196
recipitation (mm)	With	84	27	63	M	41	88	110
han Temperatura (%)	Amusi	47	44	2.2	8.4	-24	6.2	3
han Temperature (%)	Maring	44	41	4.2	8.2	4.7	a	2.7
han Temperatura (%)	- Name	163	158	188	98.4	48.6	17.8	36.3
han Temperatura (°C)	M	-2.8	4.3	4.1	2.0	4.8	2.5	6.7
tean Temperature (%)	Winter	-048	214	468	48.8	-23.4	413	:124
ingled Highle	Amount				,		4	40
lary had days (1907C)	Annual	0		4			4	47
lary mobil days (-SEFC)	Amuel	81	- 13	38	N.		14	38
ide of Last Riving Freed	Annual	May 26	May 10	May 23	June 2	Eq.(May 15	May 3
de of First Fell Fresh	Amusi	Sep. 18	Sep. 0	Sep. 28	Oili	Sep. 30	Ost. 8	04.1
real Free Statem Mayel	Amend	100	483	436	148	100	145	180

		1979-2006		2021-2000			2051-2080	
Verbille	Period	Mean	Low	Rose	High	Low	Rein	HO
Freightler (nm)	Annual	202	238	311	400	344	336	410
Precipitation (mm)	Birting	43	28	44	83	28	80	82
Freightler (nm)	-	102	86	108	180	84	100	186
Precipitation (mm)	M1	83		463	163		106	168
Precipitation (mm)	Winter	84	38	66	M.	- 48	44	88
Bloom Temperature (%)	Amount	47	4.7	4.6	44	-34	43	1.2
Blue Temperature (%)	- Spiriting	44	44	44		- 4	4.2	(3
Bloom Temperature (%)	-	163	13.8	187	17.8	94	18.4	96.0
Blue Temperature (%)	M1	-2.6	44	4.8	2.4	-24	0.8	3.8
Bloom Temperature (15)	White	-04.8	261	21.8	168.7	361	/16.6	:16.0
Traphol Marin	Amount				2			
Way hat days (+SE*C)	Amount			4			2	49
Way sold days (-SPC)	Amount	84	17	31	86	- 44	23	46
Date of Last Spring Front	Amount	Key 28	May G	May 23	June 2	May 10	May 21	June 2
Date of First Full Front	Amount	Sep. 11	Rep. 0	Sep. 27	06.4	Sep. 14	Sep. 30	06.8
Front Free Season (days)	Amount	108	183	CM	141	-	434	110

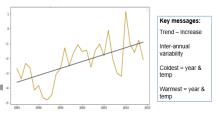


roduct Type: Map with arrows (up/down) to

2001 - 2010: Departure from 1961 -1990 (baseline)



act Type: Map showing change by colour



Global Climbal McGela (GCMs) are used to depict how the climbal in likely to change in the future. Since no consideration must be considered common, it is important to use many GCMs to expeture a range of possible conditions. The GCM data we used were obtained from the Pucific Climbal Impacts Consistent (PCIC). PCIC collected impressive and precipitation data produced by 12 different models and used advanced statistical techniques to create high-vession dispression of the data for all of Canada (for more information visit pacifications).

What are the RCP 8.5 and RCP 4.5 future climate scenarios?

One of the most important important inputs into OCM all mulations of the filture climate is the expected concentration of greenhouse gases (IOHCs, expectable, control cuidade) in its estimations are set and of human existing, in the scientific literature thate filture OHM concentrations are used to exclude Representative Concentration Pathways (FOCH, The High Cubbon cereation (FOCH 6.5) assumes but we control control control control control control of the Surviva of Sur

How are the minimum, mean, and maximum calculated?

We used an ensemble of 12 different GCMs to analyze the future climate. The mean values are the average values of this ensemble over the 1978-2005, 2021-2050 and 2051-2060 periods. The maximum model projectio (high) and the minimum model projectio (why) are provided to indicate the full range of modelled values.

The Climate Atlas of Canada

The Climite Alies of Caredo (climatediss.cs) is an interactive bod for clitters, researchers, businesses, and community and polition is indexto to learn shout climate change in Caredo. It combines climate sciences, resping and storyiding to bring the global issue of climate change closer to home, and its designed to implies local,

Nachalmar

Prairie Climate Centre

This graph shows projected monthly mean temperature and precipitation totals. Lines are temperature and vertical bars are precipitation. Dashed lines/hatched bars represent the

976-2005 baseline period, while solid lines/bars ar

Informed, more resilient, and increasingly committed to

The information disseminated by the Praid's Climate Centre – Including but not metidated to maps, soldies, statistics and interpretations — It provided as a public service. It is provided without any warrendy or representations, express or implies, as to its accuracy or completeness. Any produces you place upon the information containing them is your united expenditely and stirtly any provided on the information containing them is your united praidility and stirtly any provided on the Praid's Climate Centre his fall for any loss or damage relationers, including without finitiation, indirect or consequential loss or disregal, white from solicious poor his date or devided primation.

'roduct Type: Graph with key messages

rchange	Low emissions (RCP2.6) 2081-2100	High emissions (RCP8.5) 2081-2100
	+2.3°C	+8.4°C
	+1.8°C	+6.3°C

based on 50° percentile

inge	Low emissions (RCP2.6) 2081 -2100	High emissions (RCP8.5) 2081-2100
	+3.1°C	+12.3°C
	+2.4°C	+8.2°C
	(compared to 1986-2005.)	based on 50° percentile

ct Type: Table (summary of data)

CCCS IS LOOKING FOR FEEDBACK ON POSSIBLE CLIMATE INFO PRODUCTS

Sample formats of climate information that could help you in your planning are on the wall at back of room

- Please tell us which ones you like
- Comment on what you like and dislike
- Share your role and why you need climate information





TOMORROW AT LUNCH WILL PROVIDE A TOUR OF OUR NEW WEBSITE





MERCI / THANK YOU

For more information:

www.canada.ca/climate-services

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1-833-517-0376

