MANITOBA CLIMATE
RESILIENCE TRAINING

Manitoba's Changing Climate

Presented by: The Prairie Climate Centre

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Matthew Loxley
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RESILIENCE TRAINING

We acknowledge that we are gathered here today in Treaty 1 Territory, within the traditional territories of the Anishinaabe (Ojibwe), Ininew (Cree), Oji-Cree and Dakota peoples, and in the homeland of the Métis Nation

Overview of content

1. Introduction
2. Manitoban context
3. *Climate Atlas of Canada* tour
4. Climate variable breakdown
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Introduction

Why is there a dedicated course on climate change for the impacts faced in Manitoba?

Mission statement: To understand how climate change and shifts in climate variables will affect Manitobans and subsequently the choices we make

There are two main responses to how we can contend with climate change:

Adaptation is the process of adjustment to actual or expected climate and its effects, in order to moderate harm, maintain services and/or exploit beneficial opportunities[1]

Mitigation (of climate change) is the use of human interventions to reduce emissions or enhance the sinks for greenhouse gases[2]

Manitoban context

How do climate impacts in Manitoba differ from the rest of Canada?

How has Manitoba started to prepare for climate change?

Manitoba's projected future: hotter, drier, wetter, *weirder*

Another way of putting it is the forfeiture of norms as it relates to predictable climate patterns

Climate change will present itself in two ways: slow onset events and extreme weather events.

In the Cancun Agreement (COP16), slow onset events are referred to as the risks and impacts associated with: increasing temperatures; loss of biodiversity; land and forest degradation; and sea level rise[3]

Manitoba's climate has often been noted for its variability — extreme weather events are not a new phenomena for us

Since 1983, thirteen of the 20 costliest natural disasters in Canada have occurred in the Prairies[4]

Attribution is the process of evaluating the relative contributions of multiple casual factors to a change or event with an assessment of confidence[5]

DROUGHT

Recent drought episodes that have affected Manitoba and the Prairies:

- **1999 to 2004 - Canadian GDP lost $4.5 billion in 2001/02 alone[6]**
- **2017 - driest summer recorded since 1948 (70 years)[7]**
- **2021 - 43% of Manitoba was in Moderate to Exceptional Drought at the end of September; 100% of the agricultural landscape[8]**

Note: The Prairies have historically experienced droughts; climate change increases the risk

Graphic modified from Global News

fig.i *https://globalnews.ca/news/8071120/drought-statistics-canada-food-prices/*

WILDFIRES

Significant forest fire seasons in Manitoba in recent decades:

- **1989 - 3,567,947**
- **1994 - 1,428,754**
- **2003 - 918,845**
- **2013 - 1,115,415**[9]
- **2021 - 1,266,550 hectares burnt**[10]

Note: Fire reduction management practices also factor into the severity of wildfires

Graphic modified from Assembly of Manitoba Chiefs
fig.ii *https://manitobachiefs.com/amc-and-canadian-red-cross-update-on-evacuations-due-to-forest-fires-in-manitoba-first-nations/*

FLOODING

Notable flooding events on the Red and Assiniboine rivers in recent decades:

- **1997 - 25,450 evacuees and an estimated 1,000 homes damaged**
- **2009 - Upgraded prevention infrastructure saved $10 billion**
- **2011 - 1:330 year event, closure of 850 roads (inc. Trans-Canada)**
- **2014 - Over $1 billion in damages in the Assiniboine floodplain**[11]

Note: Precipitation and soil moisture throughout the entire watershed determines the scale of flooding

Graphic modified from Simran Chattha, Water Canada

fig.iii *https://www.watercanada.net/manitoba-launches-flood-protection-program-for-municipalities/*

OUT-OF-SEASON STORMS

As we experience more precipitation variability and warmer mean air temperatures, damaging events are more likely

- **2019 - 50,000 lost power, 30,000 damaged trees on public property, and cost the City of Winnipeg $10 million[12]**

Note: Winnipeg hasn't seen the full effects of the 2019 storm. Crown die-back and ongoing maintenance costs for the urban forest will continue for years to come

Graphic modified from John Woods, The Canadian Press
fig.iv *https://www.ctvnews.ca/canada/manitoba-premier-to-declare-state-of-emergency-as-snowstorm-slams-province-1.4636353*

What are the Provincial objectives?

A Made-in-Manitoba 'Climate and Green Plan' (2017)

Under the climate pillar, the adaptation imperatives are:

Climate Knowledge - understanding how Manitoba's climate is changing and how that might impact us

Sustainable and Climate-Ready Communities - ensuring they are resilient to climate change and offer sustainable living choices

Sustainable Agriculture - preparing producers to respond to climate change through revised best practices and precision farming[13]

Climate Atlas of Canada

How to navigate and extract information from the Atlas?

Where does the climate data come from?

3.1

***Atlas* funders:**

Manitoba

The University of Winnipeg

The Great-West Life Assurance Company

Environment and Climate Change Canada
Environnement et Changement climatique Canada

IISD International Institute for Sustainable Development

Public Health Agency of Canada
Agence de la santé publique du Canada

SSHRC CRSH
Social Sciences and Humanities Research Council of Canada
Conseil de recherches en sciences humaines du Canada

IVEY foundation

Health Canada Santé Canada

***Atlas* partners:**

CLIMATEDATA.CA

Canada's new climate data portal

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Prairie Climate Centre
From Risk to Resilience

CRIM

PACIFIC CLIMATE IMPACTS CONSORTIUM

HabitatSeven

OURANOS

How was the Atlas created?

- **Data from 24 Climate Models (2 carbon scenarios) obtained from PCIC research centre in Victoria, B.C.**

- **Modeled daily temperature and precipitation records from 1950-2095, for a 10 km x 10 km grid for all of Canada (~2 trillion numbers)**

- **Custom-made computer code processes, analyzes, summarizes and displays the data**

...so why the Atlas?

- **Visualizes complex data sets, methodologies and risk implications**
- **Special topics related to cities, agriculture, health, forests and science**
- **Projection summaries for major cities**
- **Documentary story-telling of climate impacts across Canada**

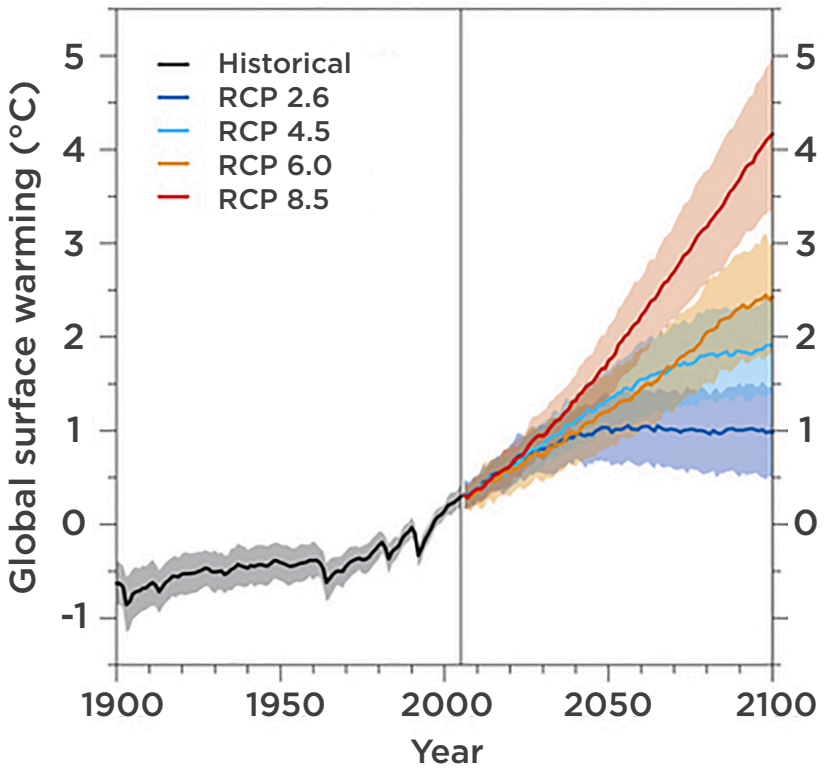
fig.v *https://climateatlas.ca/map/canada/plus30_2030_85#lat=54.96&lng=-91.96*

Emission scenarios help illustrate a range of potential futures based on varying amounts of greenhouse gases, radiative forcings, or projected rates of warming

"New sets of scenarios for climate change research are needed periodically to take into account scientific advances in understanding of the climate system as well as to incorporate updated data on recent historical emissions, climate change mitigation, and impacts, adaptation, and vulnerability".

IPCC, Scenario Process for AR5[14]

Representative Concentration Pathway (RCP) scenarios to end-of-century utilizing CMIP5 models. The *Climate Atlas* uses RCP4.5 and RCP8.5



Graphic attributed to Intergovernmental Panel on Climate Change (2013)

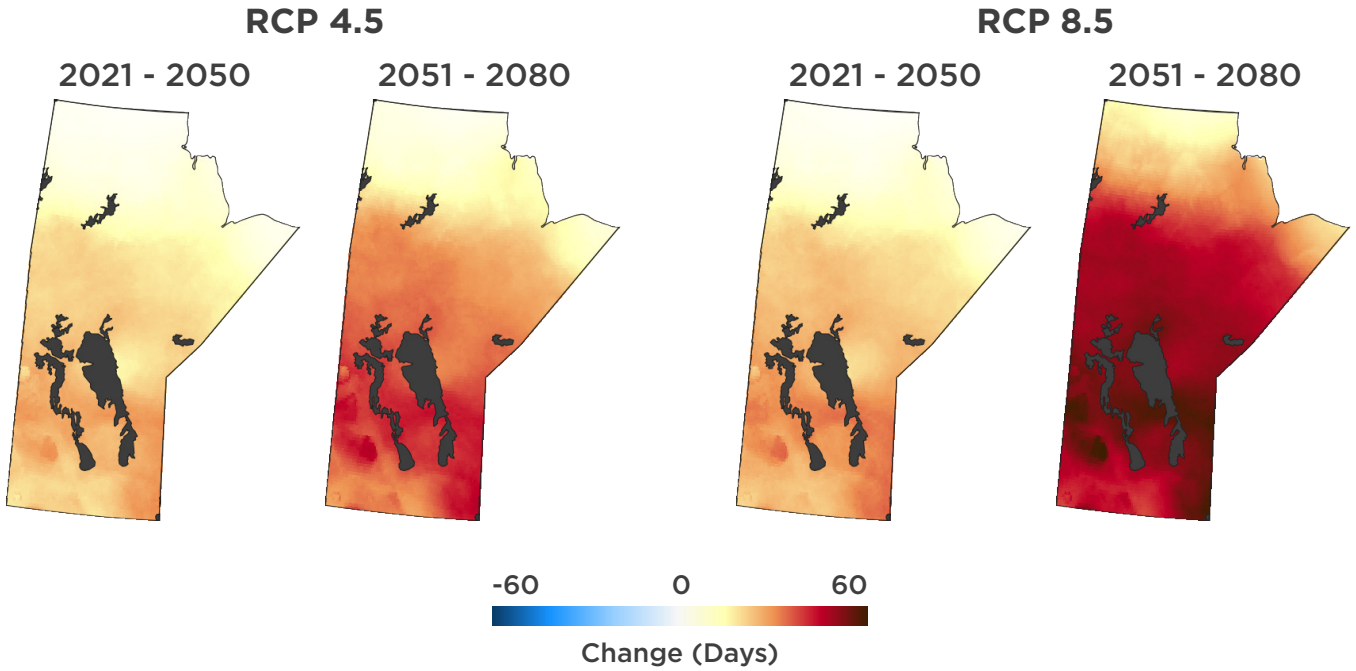
fig.vi *https://cimss.ssec.wisc.edu/climatechange/modeling/lesson13/concepts.html*

Climate variables

What are the impacts, risks, and opportunities for Manitoba?

How to apply projections in decision-making processes?

Projected change in the mean length of the hot (+30°C) season



"It is important to have a high-end baseline scenario to explore what 'could' happen. And really, forcing levels of around 8.5 W/m² are not implausible." - Detlef van Vuuren[15]

fig.vii - x *https://climateatlas.ca/map/canada/hwseason_2030_45#z=4&lat=54.37&lng=-115.93*

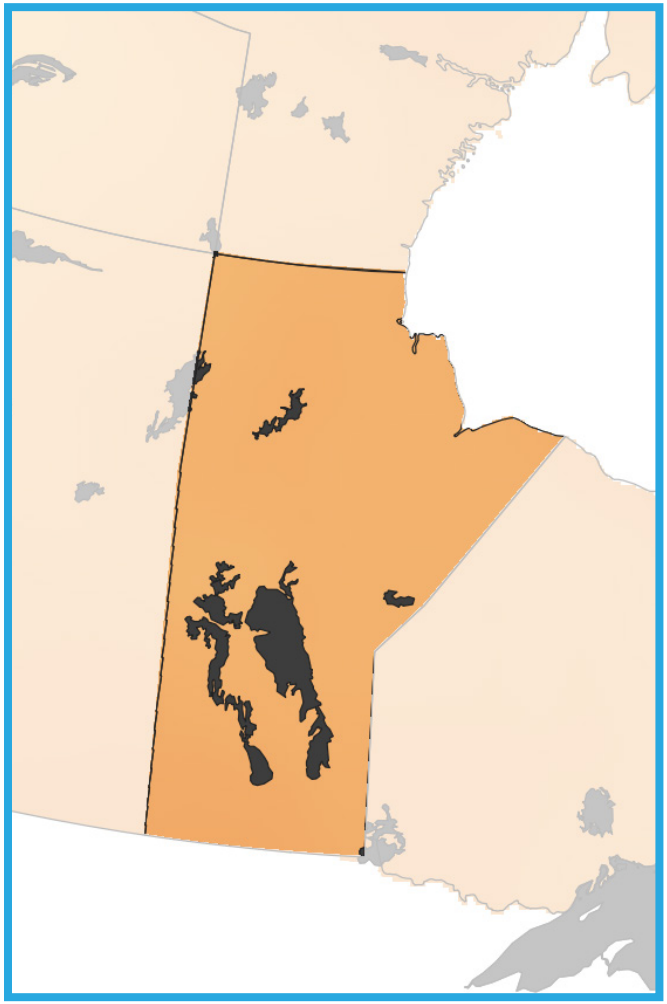
Some important changes projected to affect Manitoba communities:

- **Hotter summer temperatures**
- **Warmer, shorter winters**
- **Overall increase in precipitation**
- **Somewhat drier summers in southern Manitoba**

The associated impacts — both positive and negative — of the changing climate will differ depending on where one lives/ works in the Province

1. **Churchill,** *58.8°N*
2. **Thompson,** *55.7°N*
3. **Norway House,** *54.0°N*
4. **Dauphin,** *51.2°N*
5. **Winnipeg,** *49.9°N*
6. **Brandon,** *49.8°N*
7. **Morden,** *49.2°N*

fig.xi *Prairie Climate Centre*



Projected change in mean summer temperature (°C) in Manitoba

	1976 - 2005	2051 - 2080	Change
Churchill	10.8	15.1	+4.3
Thompson	14.8	19.1	+4.3
Norway House	16.4	20.6	+4.3
Dauphin	17.7	22.0	+4.4
Winnipeg	18.6	23.0	+4.4
Brandon	18.5	22.5	+4.5
Morden	18.9	23.4	+4.5

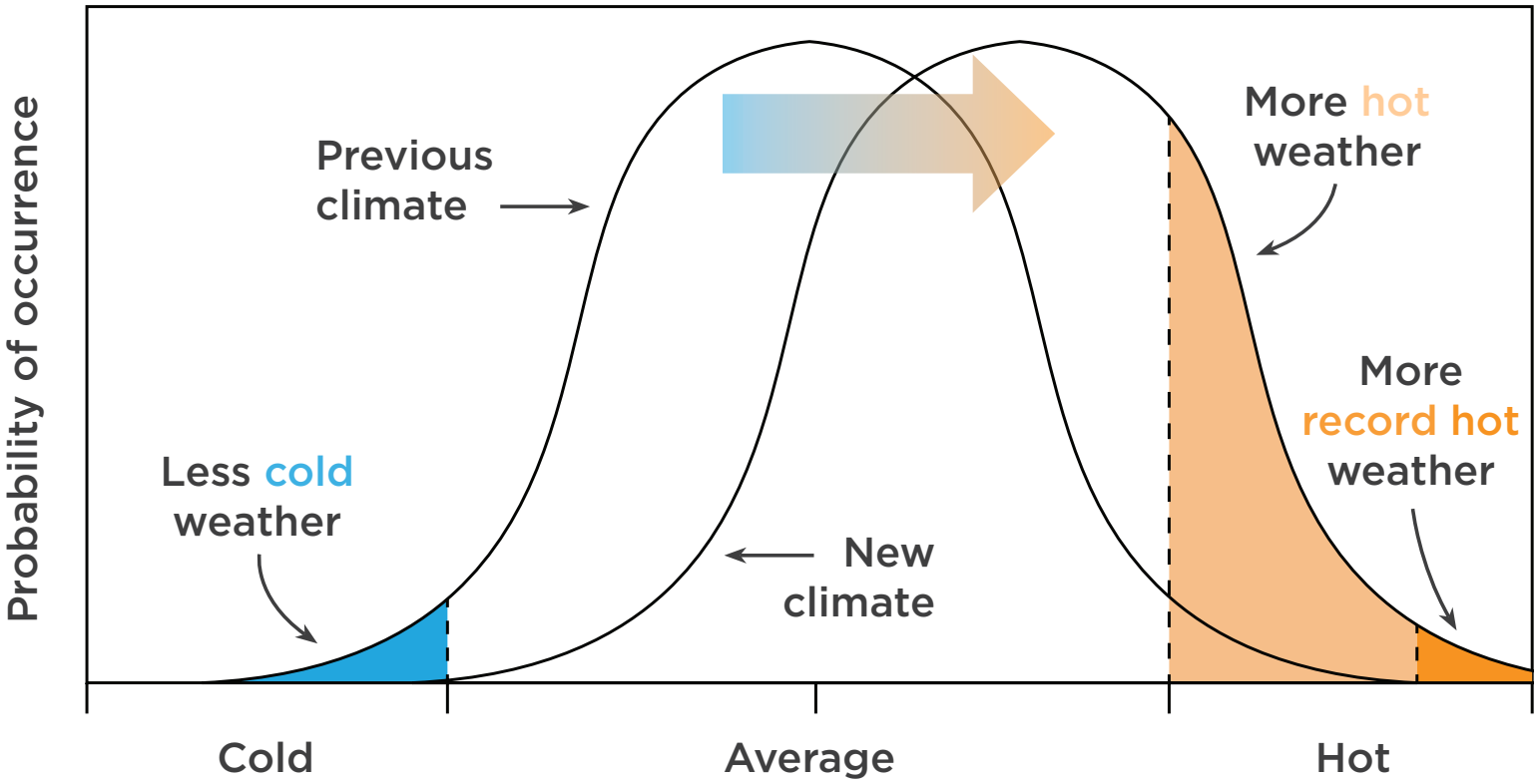
Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

-10 0 10

Change (°C)

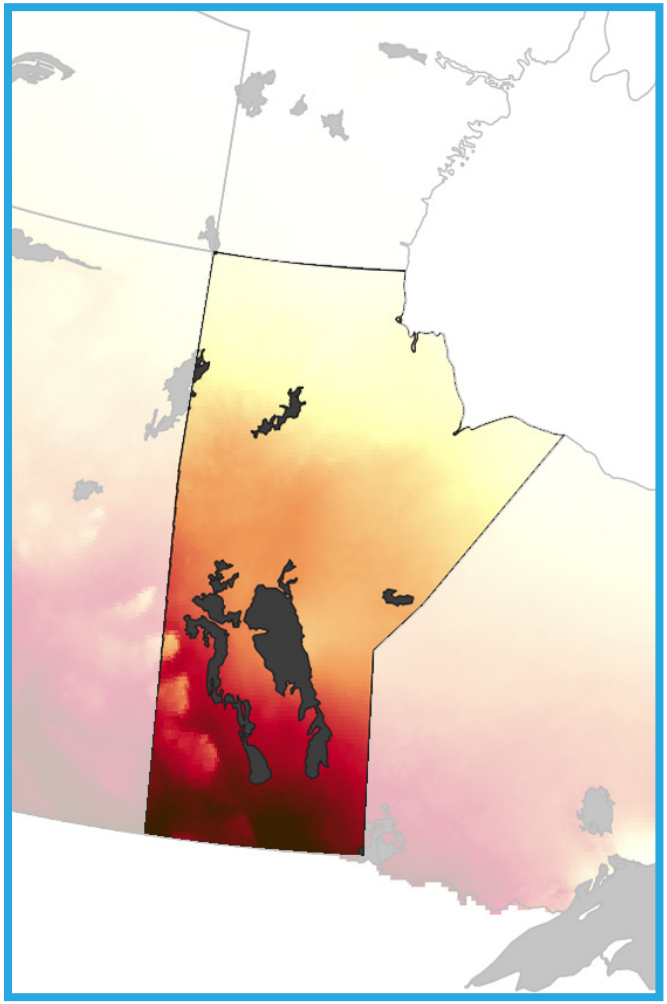
fig.xii *https://climateatlas.ca/map/canada/summer_meantemp_2060_85#deltas=true*

Effects of an increase in mean temperature



Graphic modified from Intergovernmental Panel on Climate Change (2001)

fig.xiii *https://archive.ipcc.ch/ipccreports/tar/wg1/fig2-32.htm*



Projected change in mean number of hot days (+30°C) in Manitoba

	1976 - 2005	2051 - 2080	Change
Churchill	1.0	6.8	6.8x
Thompson	3.4	21.9	6.4x
Norway House	2.2	22.2	10.0x
Dauphin	11.3	45.2	4.0x
Winnipeg	14.3	52.1	3.6x
Brandon	14.9	52.3	3.5x
Morden	17.3	56.9	3.3x

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

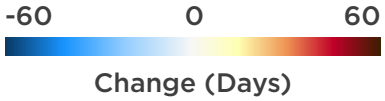
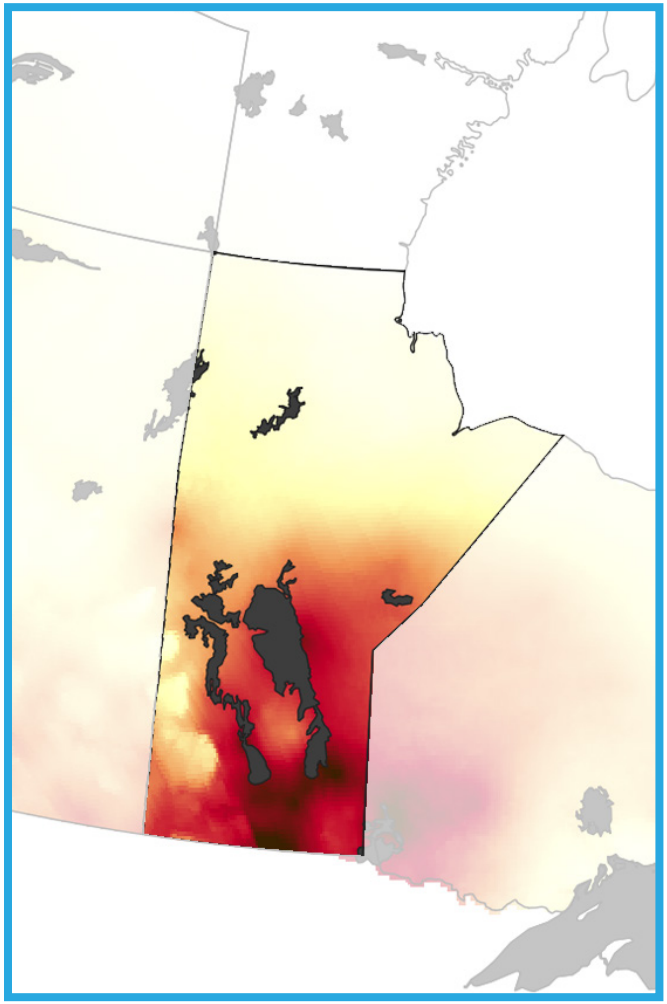


fig.xiv *https://climateatlas.ca/map/canada/plus30_2060_85#deltas=true*



Projected change in mean number of tropical nights in Manitoba

	1976 - 2005	2051 - 2080	Change
Churchill	0.0	1.5	---
Thompson	0.2	4.8	24.0x
Norway House	0.4	11.9	29.8x
Dauphin	0.6	12.2	20.3x
Winnipeg	1.6	21.1	13.2x
Brandon	0.5	13.2	26.4x
Morden	1.4	21.4	15.3x

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

-20 0 20

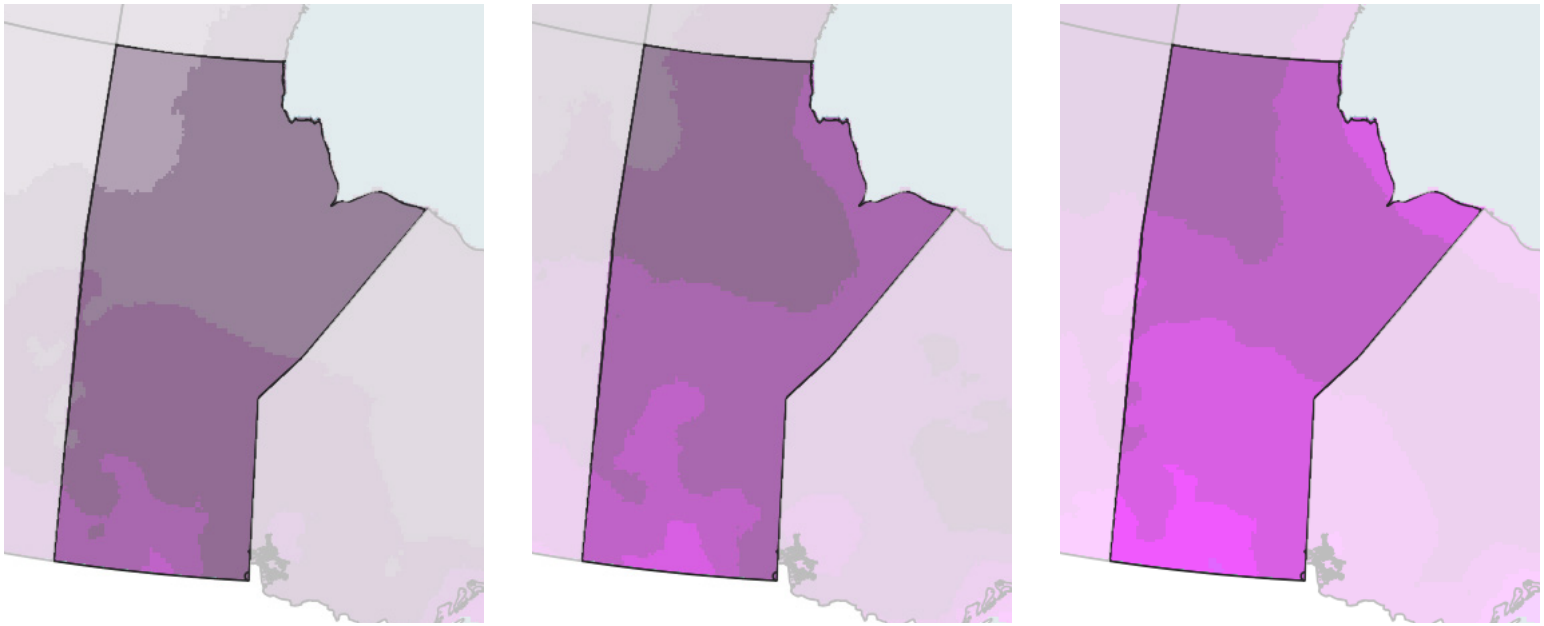
Change (Nights)

fig.xv *https://climateatlas.ca/map/canada/tropicalnights_2060_85#deltas=true*

Climate impacts associated with warmer summers and an increase in extreme heat events:

- **Drier conditions increasing the length of the forest fire season**
- **Increase in the Urban Heat Island (UHI) effect**
- **Increased energy/cooling strain for communities**
- **Increased health risks for at-risk populations**
- **Northward expansion of hardiness zones and species ranges**

Plant Hardiness Zones (US) under the RCP8.5 scenario

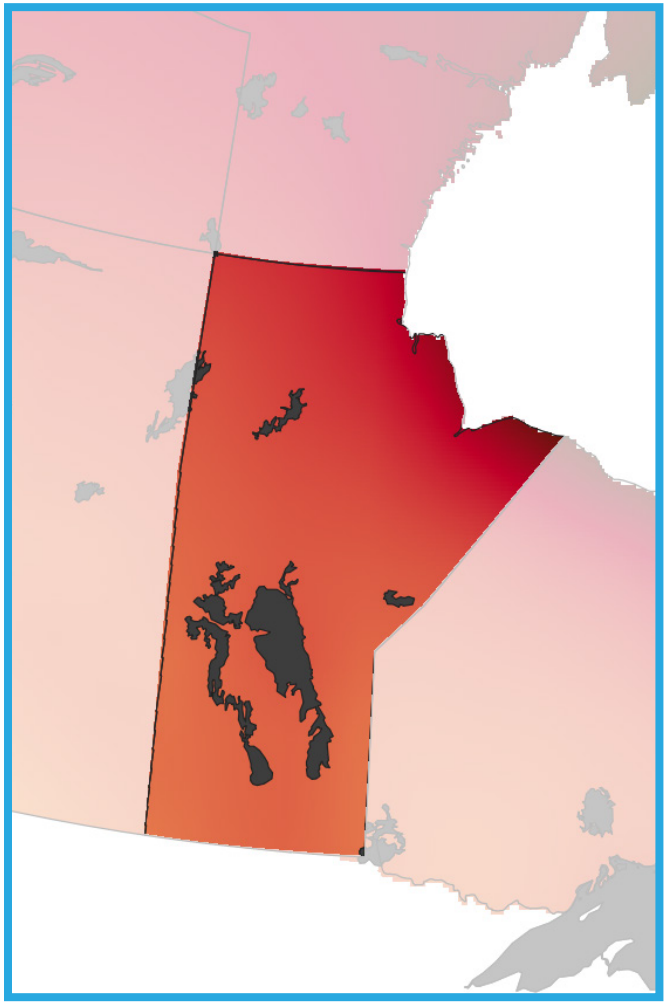


1976 - 2005 | 2021 - 2050 | 2051 - 2080

2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
-45.6 | -42.8	-42.8 | -40.0	-40.0 | -37.2	-37.2 | -34.4	-34.4 | -31.7	-31.7 | -28.9	-28.9 | -26.1	-26.1 | -23.3	-23.3| -20.6	-20.6| -17.8

Data sourced from Pacific Climate Impacts Consortium (PCIC)

fig.xvi - xviii *Matthew Loxley, Prairie Climate Centre*



Projected change in mean winter temperature (°C) in Manitoba

	1976 - 2005	2051 - 2080	Change
Churchill	-24.4	-16.1	+8.3
Thompson	-21.8	-15.4	+6.4
Norway House	-19.4	-13.3	+6.2
Dauphin	-15.1	-9.4	+5.7
Winnipeg	-15.0	-9.1	+5.9
Brandon	-15.0	-9.3	+5.7
Morden	-13.4	-7.6	+5.8

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

-10 0 10

Change (°C)

fig.xix *https://climateatlas.ca/map/canada/winter_meantemp_2060_85#deltas=true*

Projected change in mean number of winter days (-15°C) in Manitoba

	1976 - 2005	2051 - 2080	Change in days
Churchill	144.2	98.3	-45.9
Thompson	122.2	87.0	-35.2
Norway House	106.4	71.3	-35.1
Dauphin	83.3	47.9	-35.4
Winnipeg	79.1	42.9	-36.3
Brandon	82.2	45.9	-36.3
Morden	71.6	34.4	-37.3

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

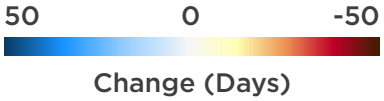
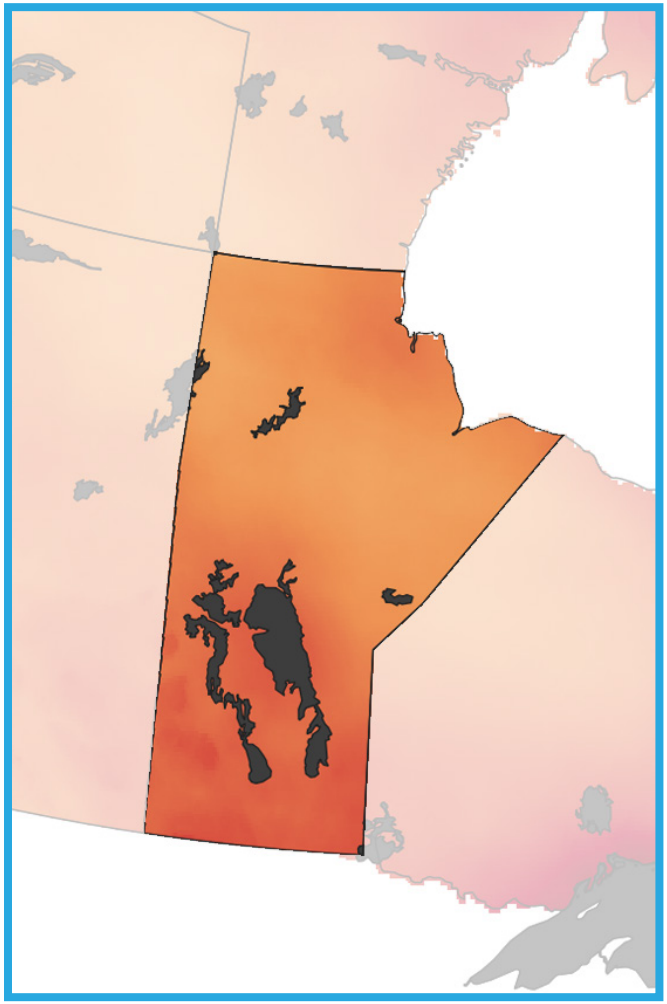


fig.xx *https://climateatlas.ca/map/canada/minus15_2060_85#deltas=true*



Projected change in mean number of icing days (0°C) in Manitoba

	1976 - 2005	2051 - 2080	Change in days
Churchill	191.8	164.7	-27.1
Thompson	154.3	130.3	-24.0
Norway House	142.4	115.2	-27.3
Dauphin	115.8	87.5	-28.4
Winnipeg	117.1	88.0	-29.1
Brandon	114.2	85.9	-28.3
Morden	109.0	79.3	-29.7

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

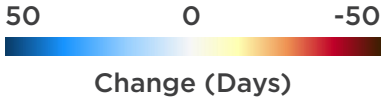
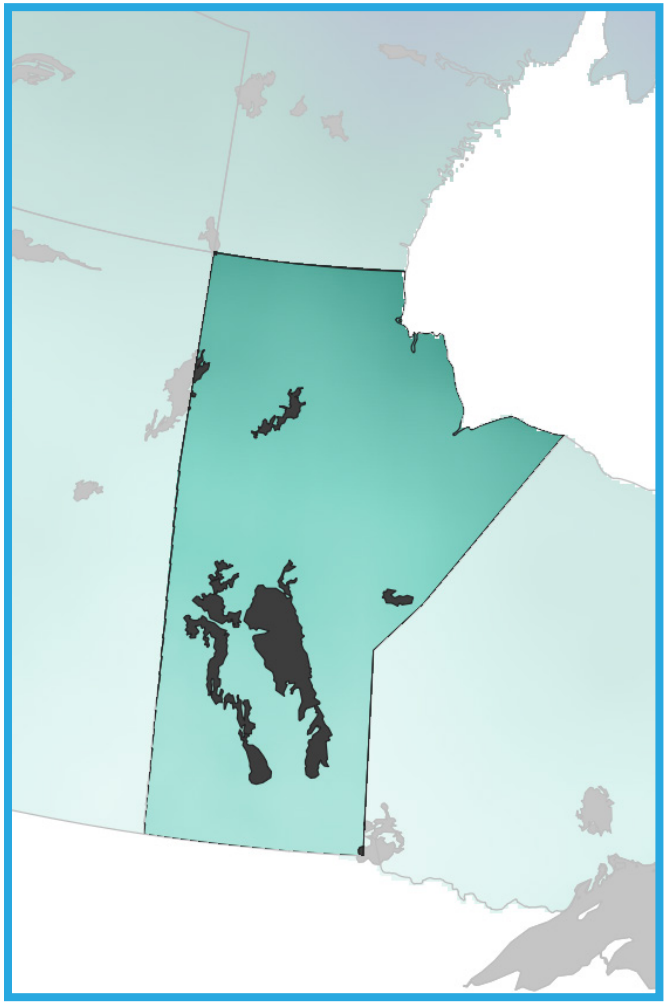


fig.xxi *https://climateatlas.ca/map/canada/icedays_2060_85#deltas=true*

Climate impacts associated with milder winter and an increase in variable weather events:

- **Degradation of permafrost**
- **Increase in freeze/thaw cycles degrading infrastructure**
- **Loss of insulating snow layer for overwintering plants**
- **Decrease in ice road season**
- **Increased risk of out-of-season storms**



Projected change in mean annual precipitation (mm) in Manitoba

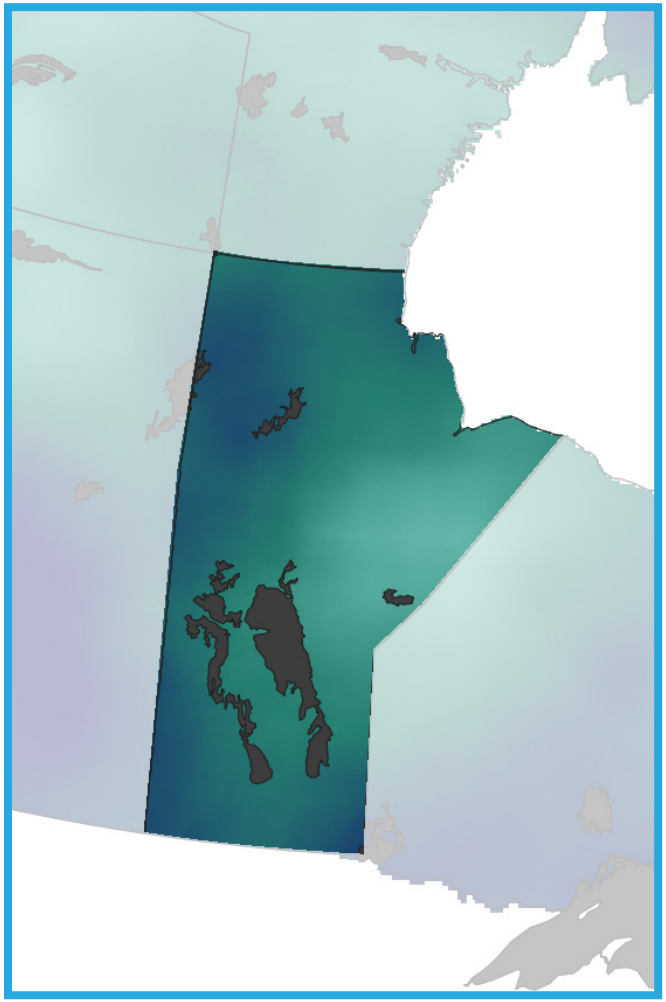
	1976 - 2005	2051 - 2080	% Change
Churchill	446	514	+15%
Thompson	494	544	+10%
Norway House	465	510	+10%
Dauphin	475	509	+7%
Winnipeg	523	557	+7%
Brandon	468	500	+7%
Morden	519	554	+7%

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

-30 0 30

Change (%)

fig.xxii *https://climateatlas.ca/map/canada/annual_precip_2060_85#deltas=true*



Projected change in mean April precipitation (mm) in Manitoba

	1976 - 2005	2051 - 2080	% Change
Churchill	24	30	+23%
Thompson	23	28	+20%
Norway House	20	24	+18%
Dauphin	22	33	+22%
Winnipeg	31	37	+21%
Brandon	28	35	+23%
Morden	32	39	+22%

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

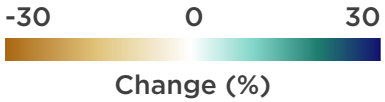
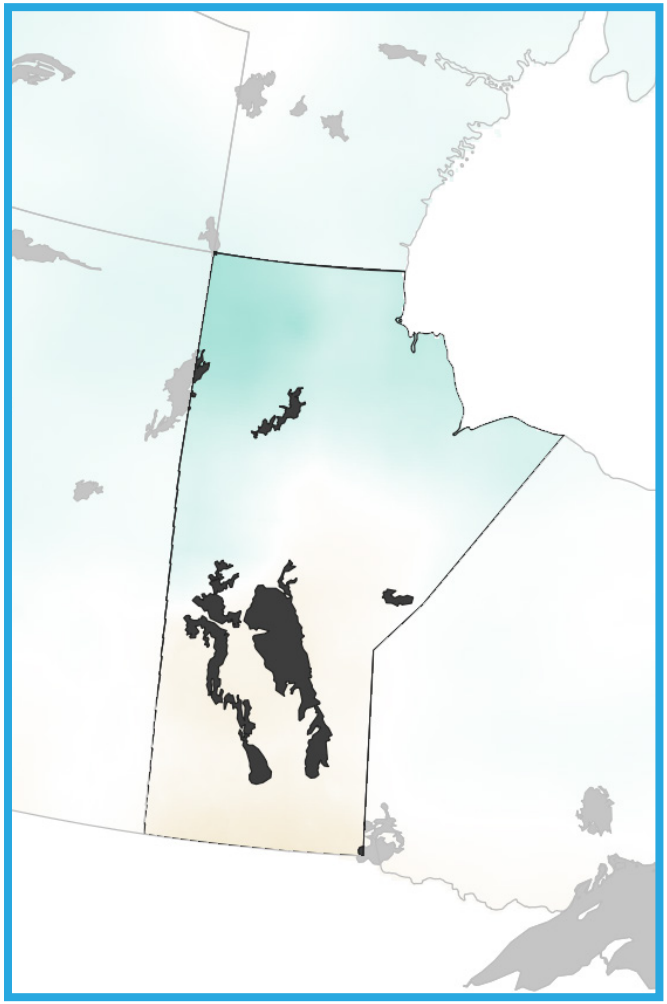


fig.xxiii *https://climateatlas.ca/map/canada/apr_precip_2060_85#*



Projected change in mean August precipitation (mm) in Manitoba

	1976 - 2005	2051 - 2080	% Change
Churchill	66	67	+2%
Thompson	70	69	-2%
Norway House	62	58	-6%
Dauphin	58	53	-10%
Winnipeg	69	64	-7%
Brandon	60	55	-7%
Morden	62	56	-9%

Map represents RCP8.5 projected temperature for 2051 - 2080, relative to the baseline period of 1976 - 2005

-30 0 30

Change (%)

fig.xxiv *https://climateatlas.ca/map/canada/aug_precip_2060_85#*

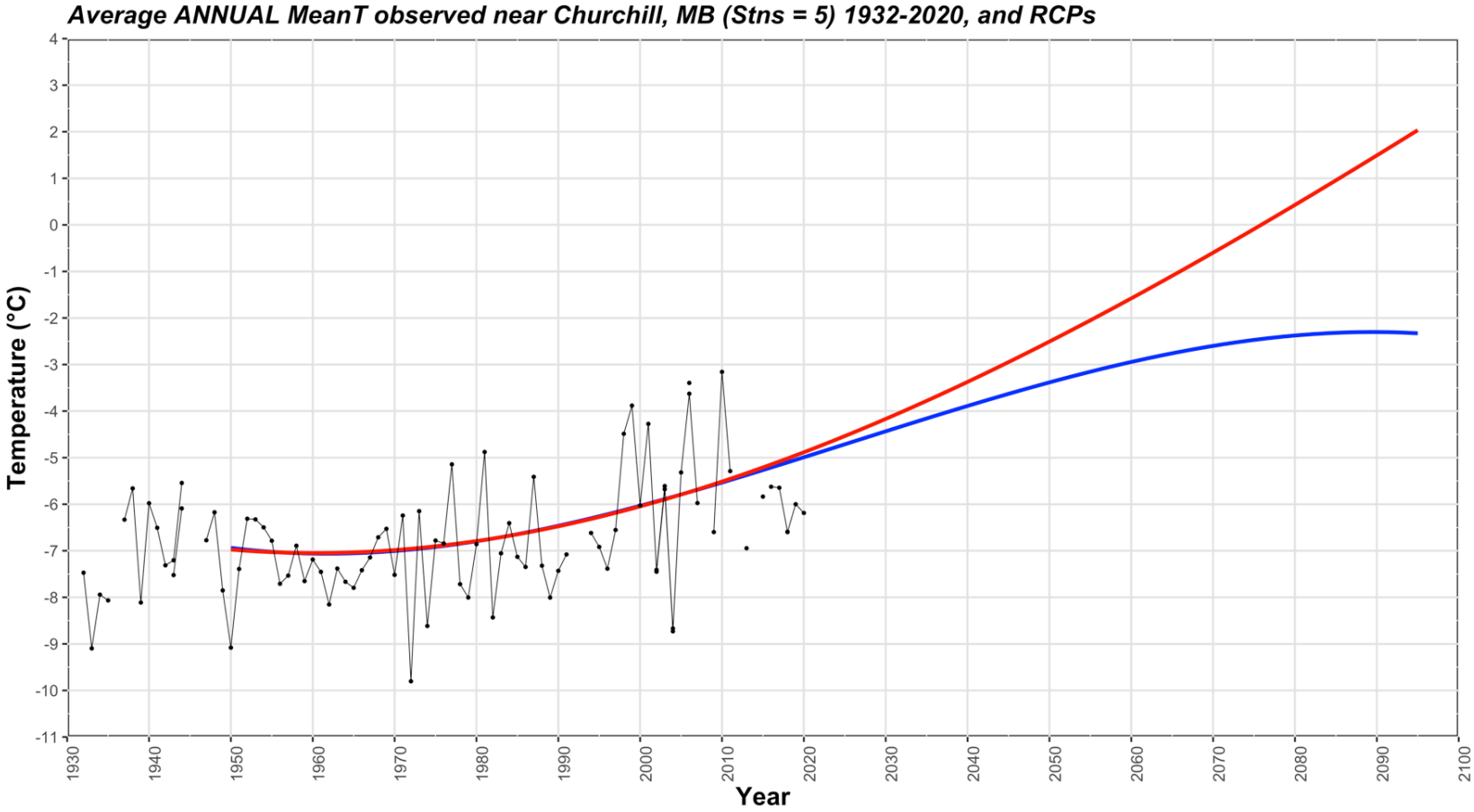
Climate impacts associated with precipitation variability:

- **Increase in frequency of extreme weather events**
- **Increase in drought risk**
- **Increase in overland flooding risk**
- **Higher demand on stormwater management infrastructures**

Observed data

What is the observational data telling us?

How well do projections fit observations?

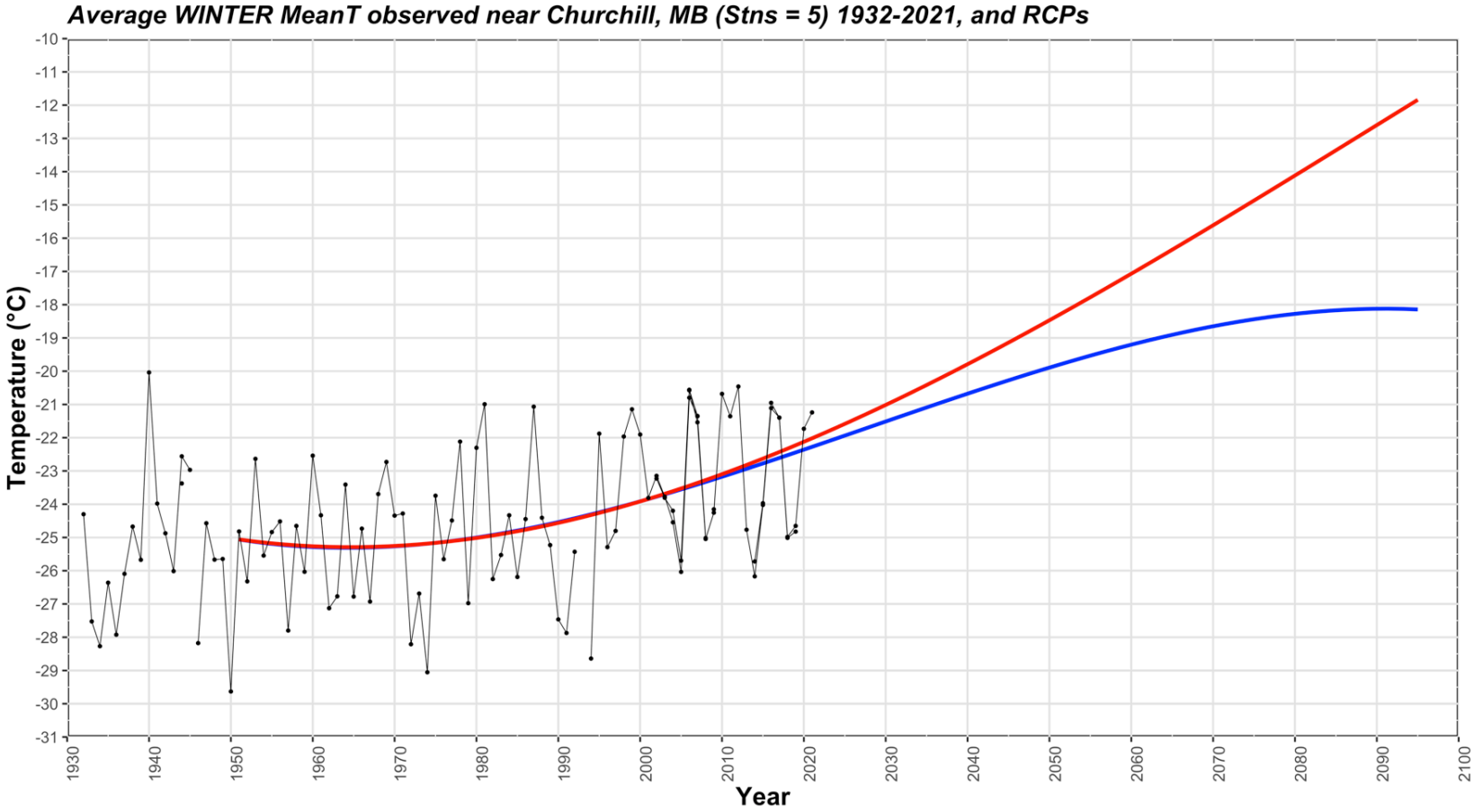


Station data source: ECCC/GHCNd

RCP4.5/8.5 data source: PCIC/PCC

fig.xxv *Dr. Danny Blair, Prairie Climate Centre*

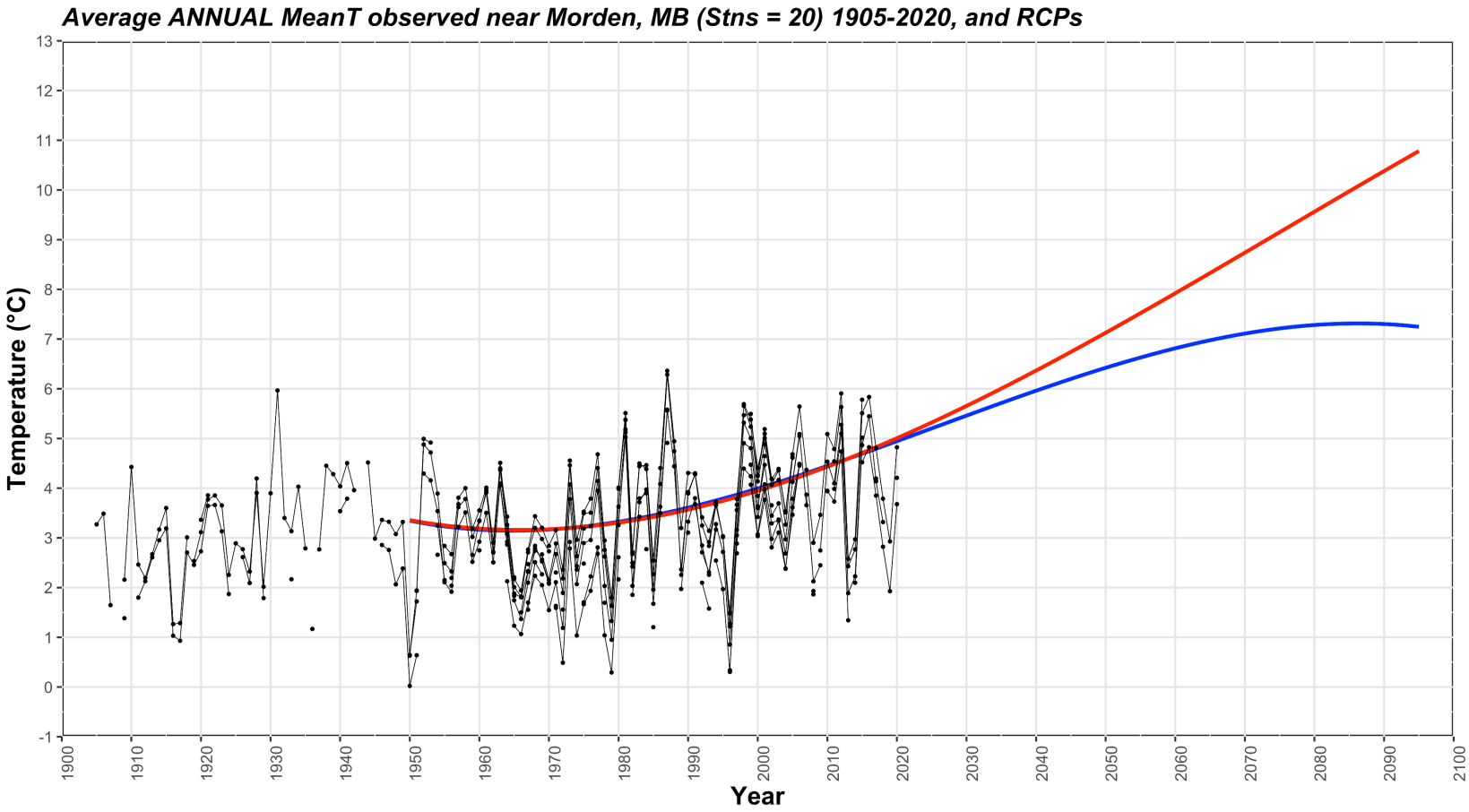
5.2



Station data source: ECCC/GHCNd

RCP4.5/8.5 data source: PCIC/PCC

fig.xxvi *Dr. Danny Blair, Prairie Climate Centre*

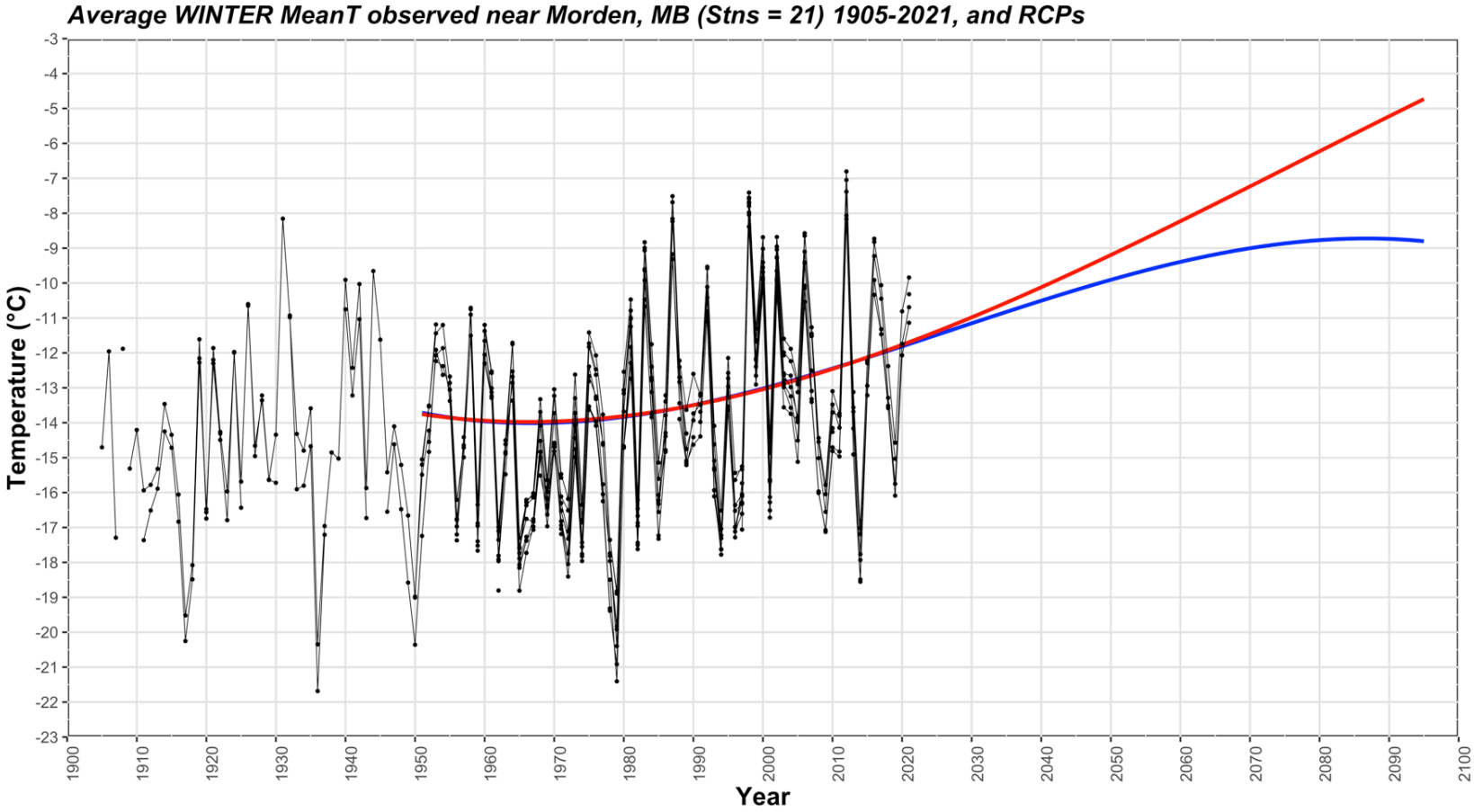


Station data source: ECCC/GHCNd

RCP4.5/8.5 data source: PCIC/PCC

fig.xxvii *Dr. Danny Blair, Prairie Climate Centre*

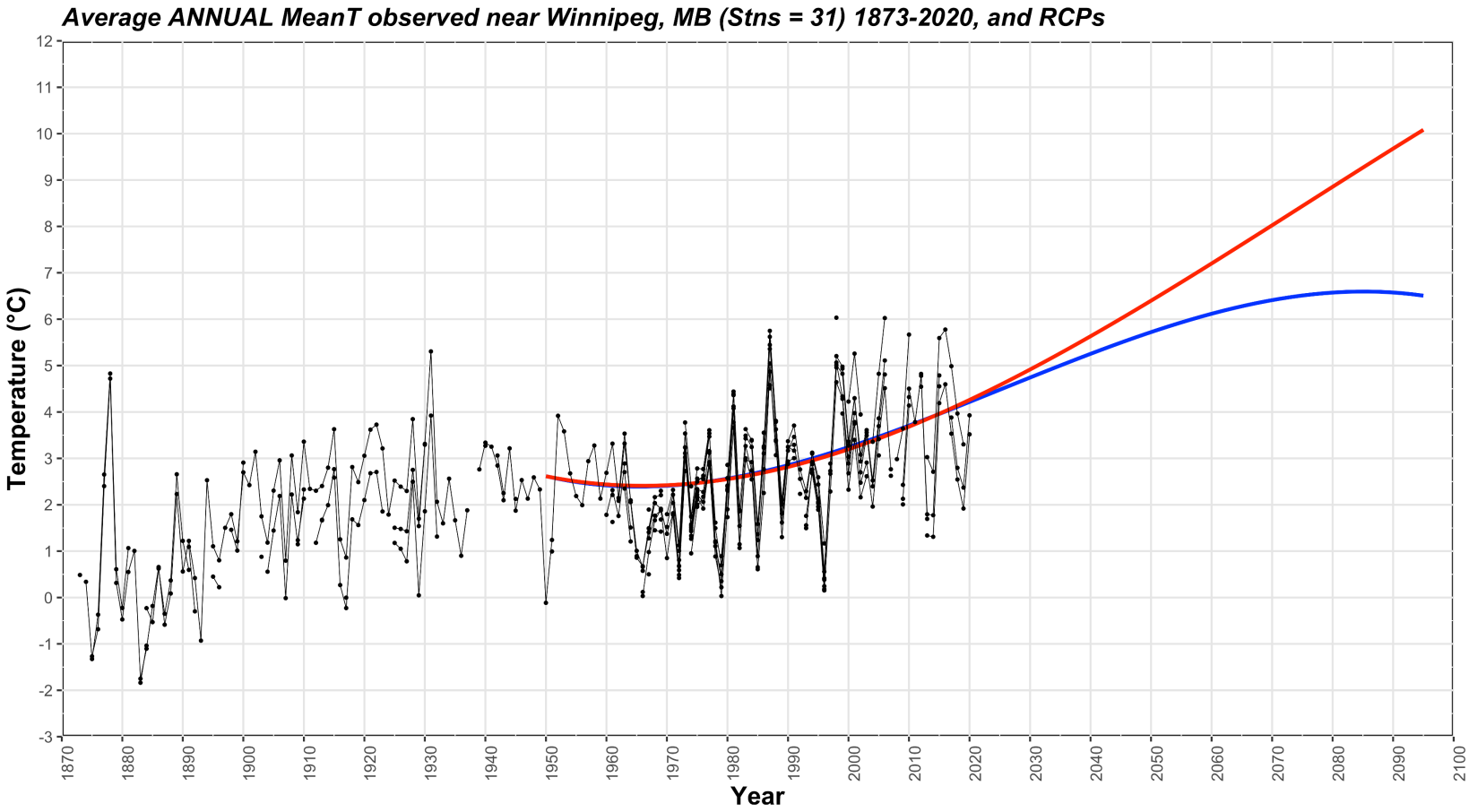
5.4



Station data source: ECCC/GHCNd

RCP4.5/8.5 data source: PCIC/PCC

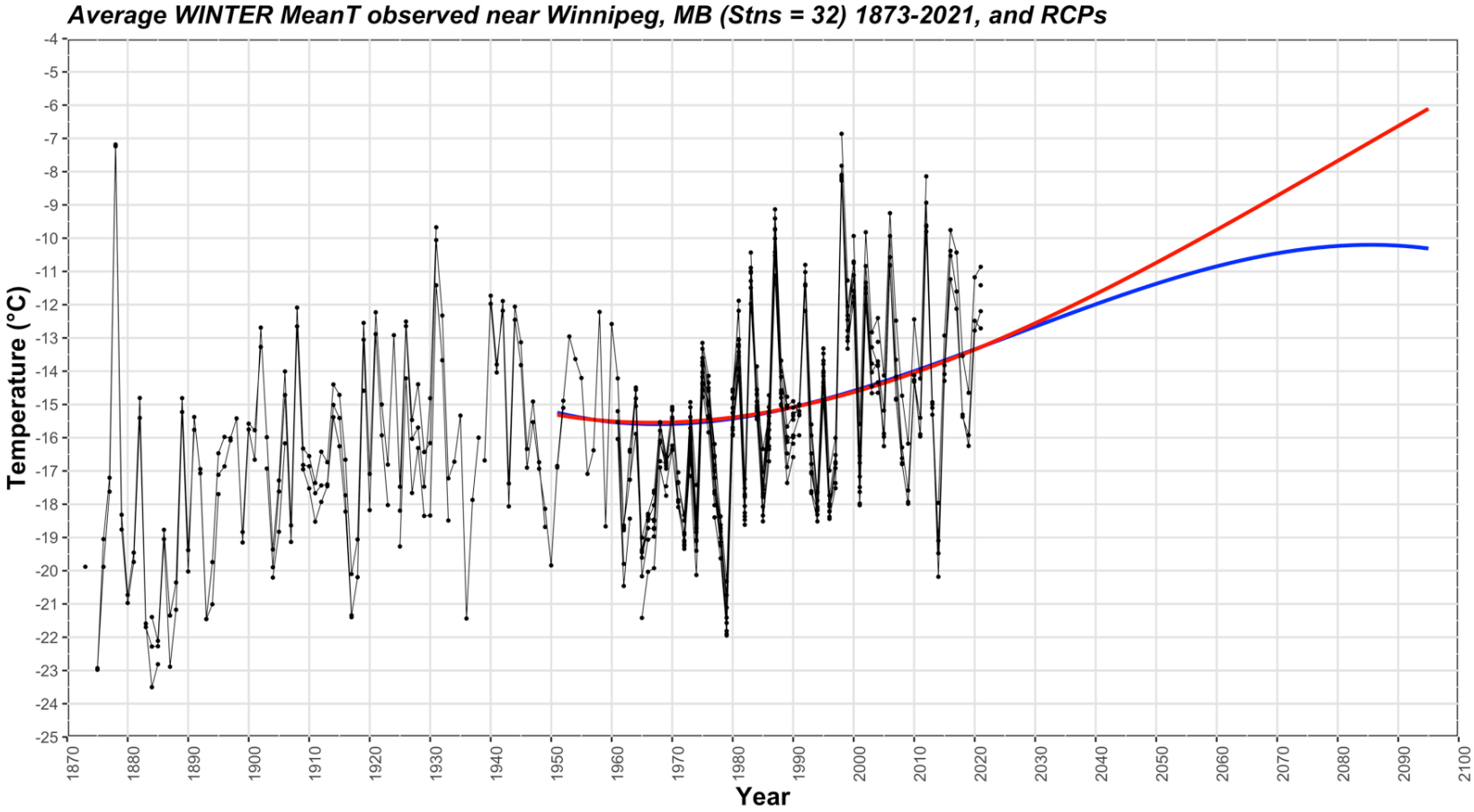
fig.xxviii *Dr. Danny Blair, Prairie Climate Centre*



Station data source: ECCC/GHCNd

RCP4.5/8.5 data source: PCIC/PCC

fig.xxix *Dr. Danny Blair, Prairie Climate Centre*

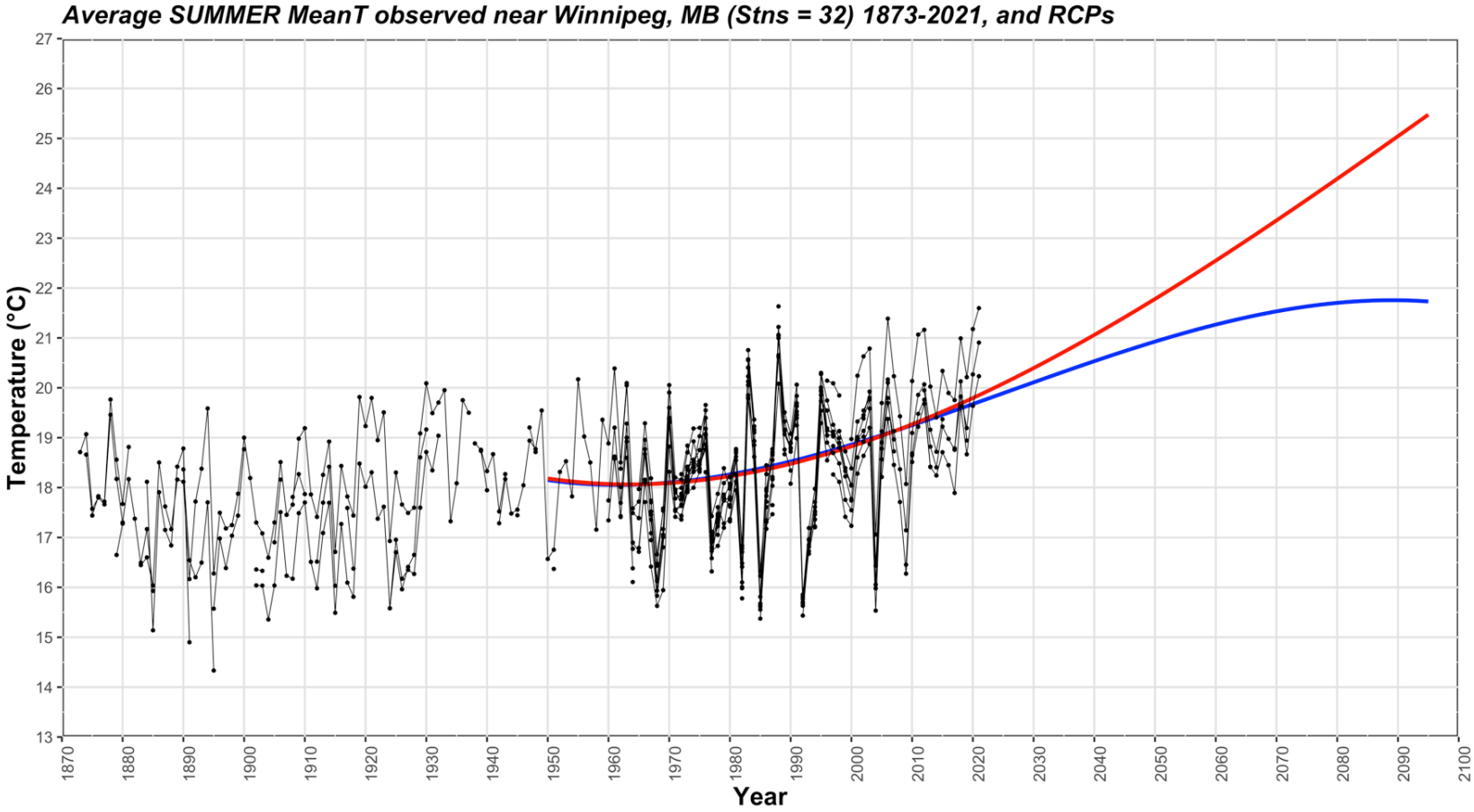


Station data source: ECCC/GHCNd

RCP4.5/8.5 data source: PCIC/PCC

fig.xxx *Dr. Danny Blair, Prairie Climate Centre*

5.7



Station data source: ECCC/GHCNd

RCP4.5/8.5 data source: PCIC/PCC

fig.xxxi *Dr. Danny Blair, Prairie Climate Centre*

MANITOBA CLIMATE RESILIENCE TRAINING

Manitoba

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ICLEI Local Governments for Sustainability CANADA

ENGINEERS GEOSCIENTISTS MANITOBA

DILLON CONSULTING

Prairie Climate Centre
From Risk to Resilience

References

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