25 January 2006

Association of Professional Engineers and Geoscientists of the Province of Manitoba

Climate Change and Its Potential Impact in Manitoba

Danny Blair

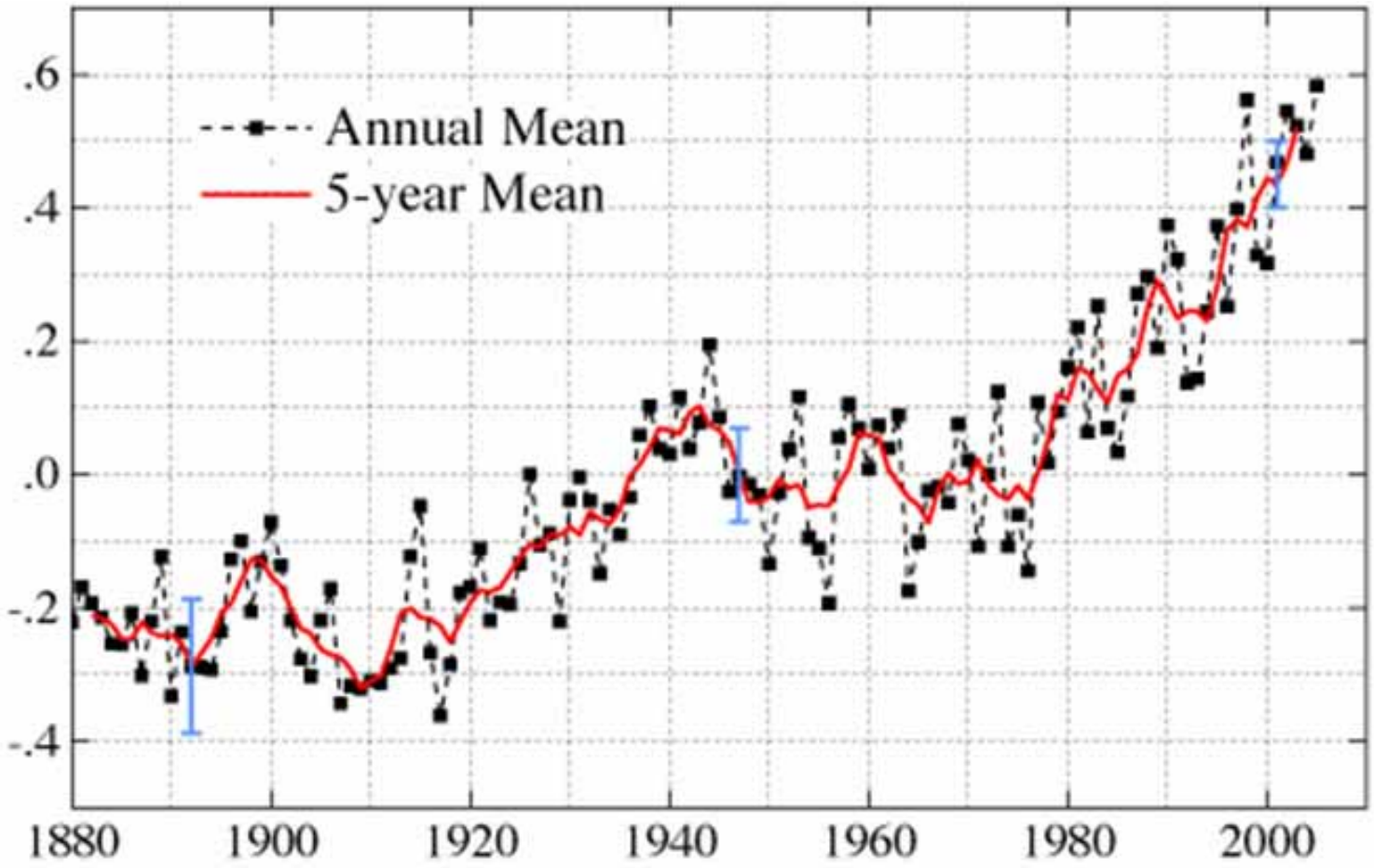
Director, Climate Studies Institute, Global College

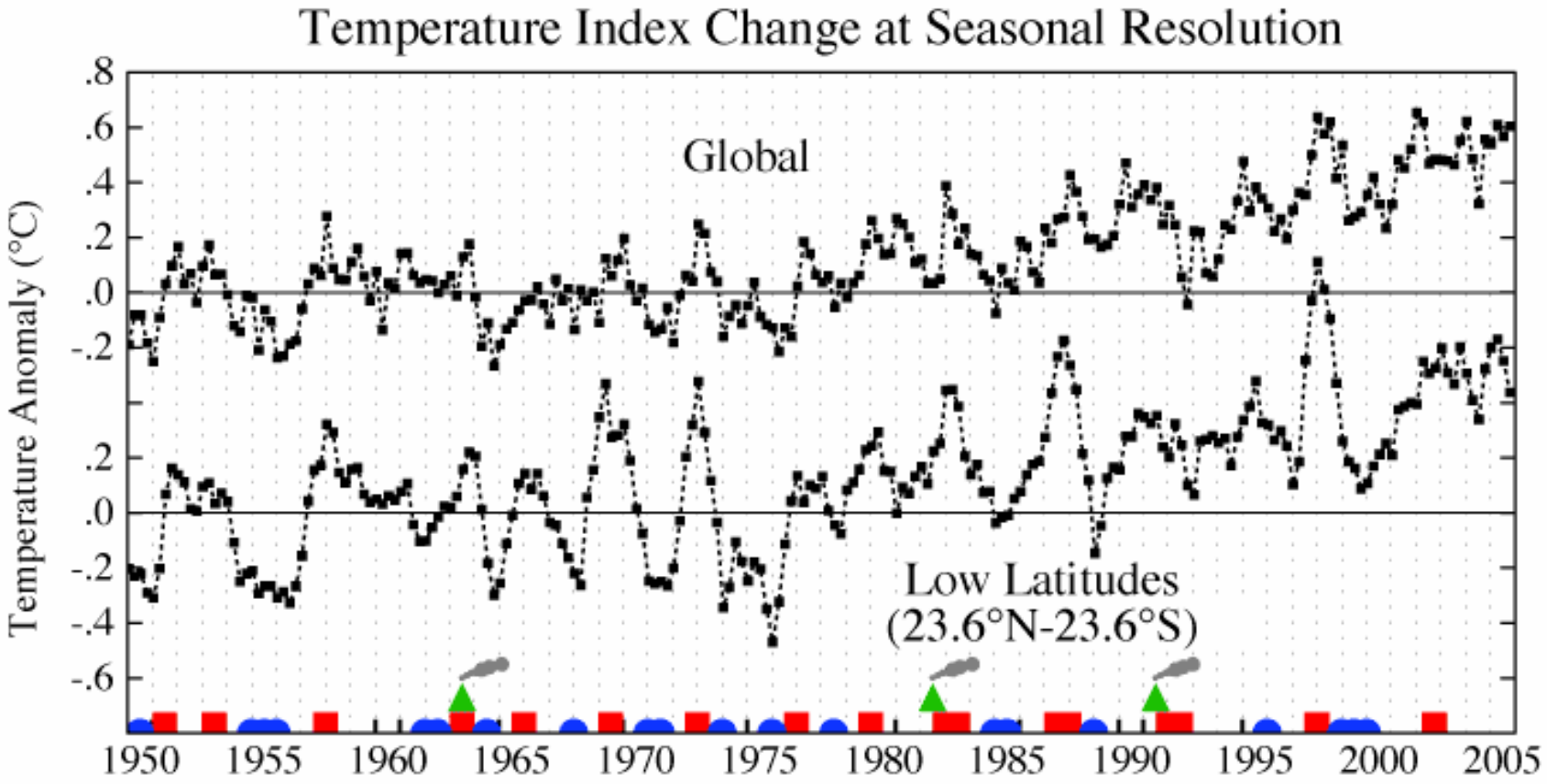
PARC-MB Hydro Climate Change Research Professor

Associate Professor, Department of Geography

University of Winnipeg

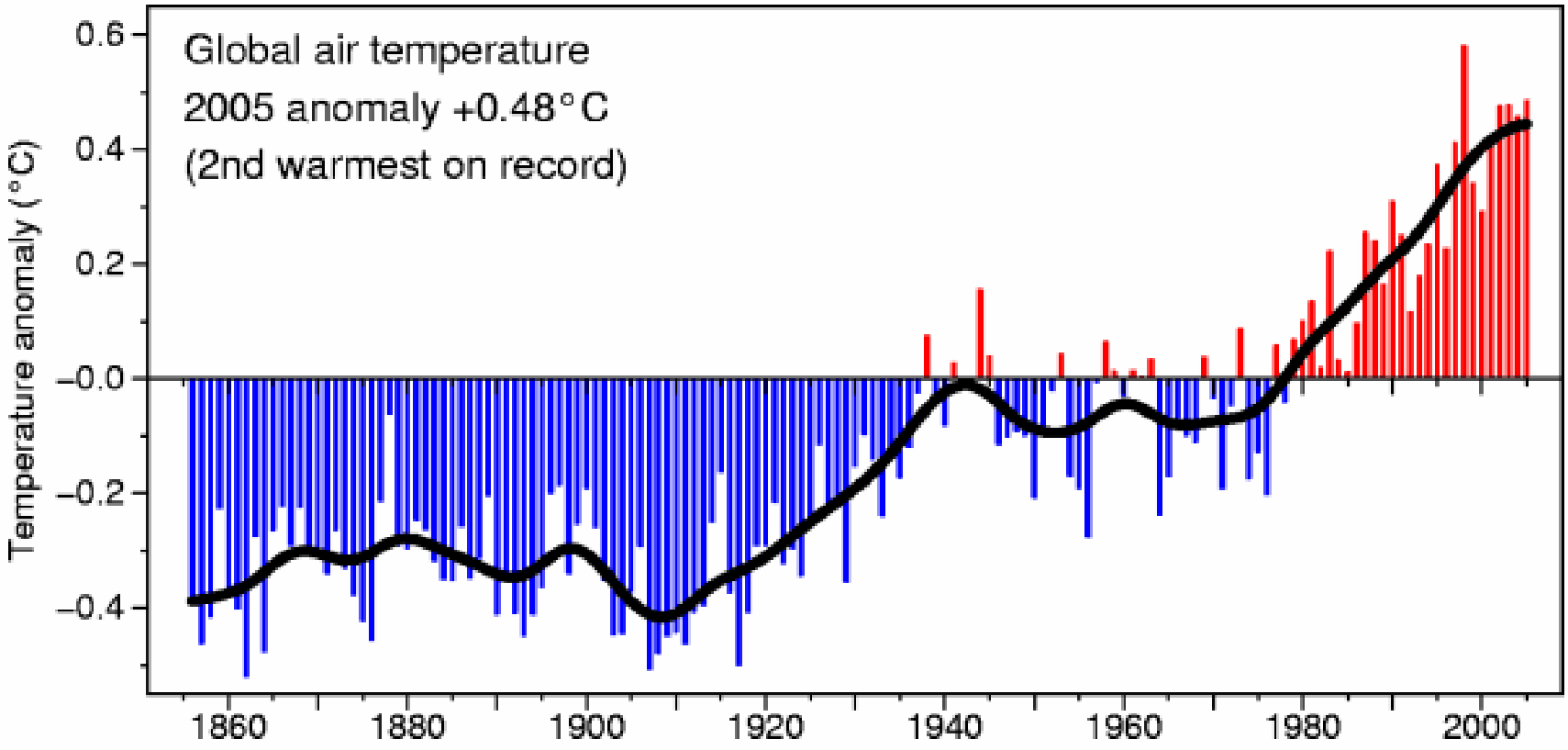
2005 was the warmest year on record




Temperature Index Change at Seasonal Resolution
Temperature Anomaly (°C)
.8
.6
.4
.2
.0
-.2
Global
.2
.0
-.2
-.4
-.6
Low Latitudes
(23.6°N-23.6°S)
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005


Goddard Institute for Space Studies

2005 was the 2nd warmest year on record



UEA NORWICH

CRU

GLOBE		NORTHERN HEMISPHERE		SOUTHERN HEMISPHERE	
1998	0.57	2005	0.65 (Nov)	1998	0.48
2005	0.48 (Nov)	1998	0.65	2003	0.33
2003	0.46	2004	0.61	2002	0.33
2002	0.46	2003	0.60	2005	0.32 (Nov)
2004	0.44	2002	0.59	1997	0.32
2001	0.41	2001	0.53	2001	0.28
1997	0.40	1995	0.48	2004	0.27
1995	0.36	1997	0.47	1987	0.27
1999	0.33	1999	0.46	1995	0.24
1990	0.30	1990	0.41	1983	0.24
2000	0.28	2000	0.39	1996	0.22

UEA NORWICH

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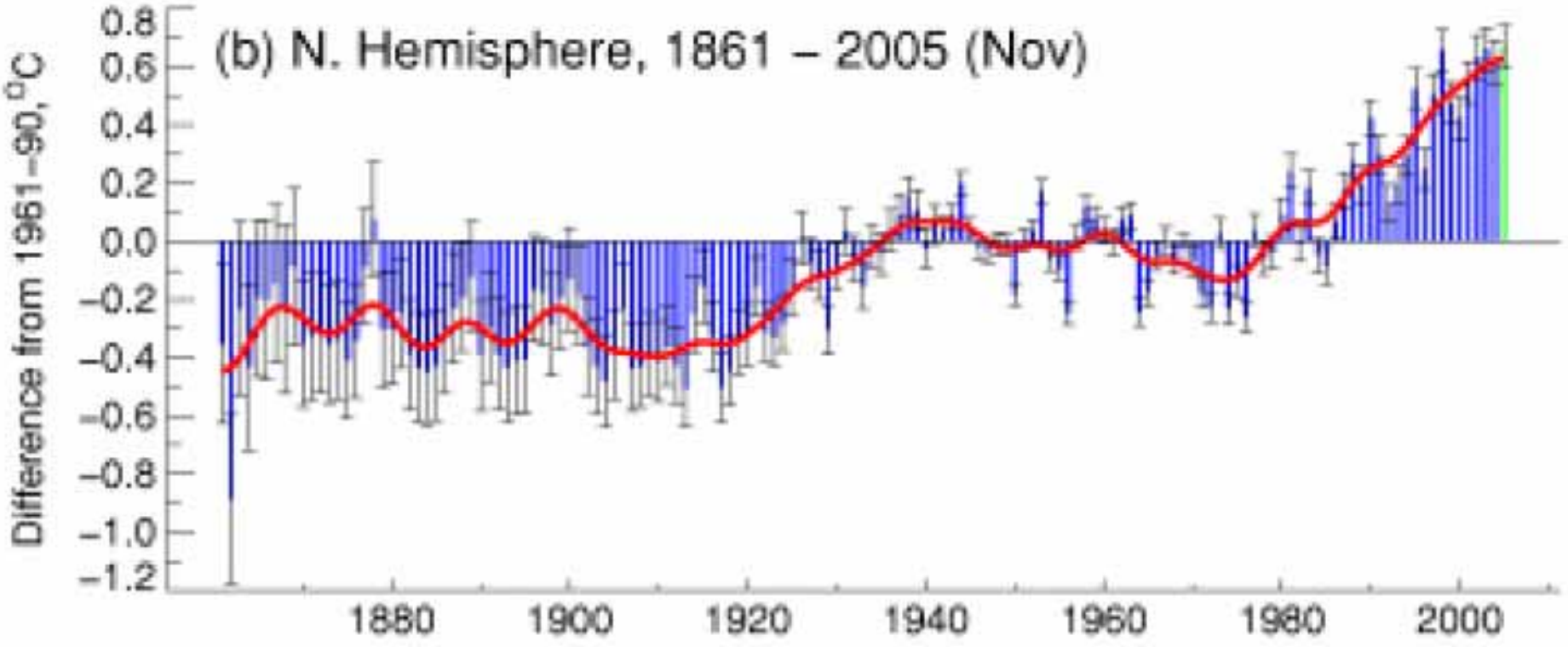

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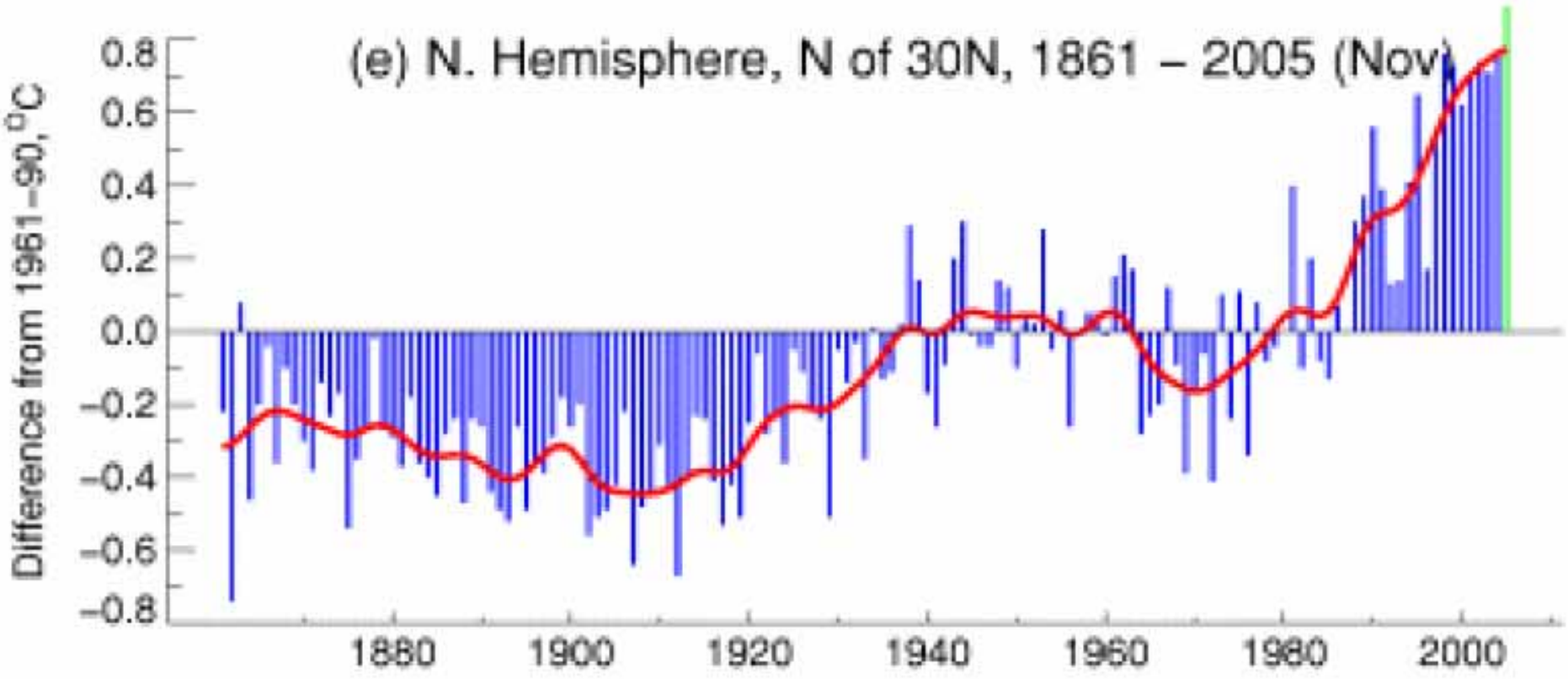

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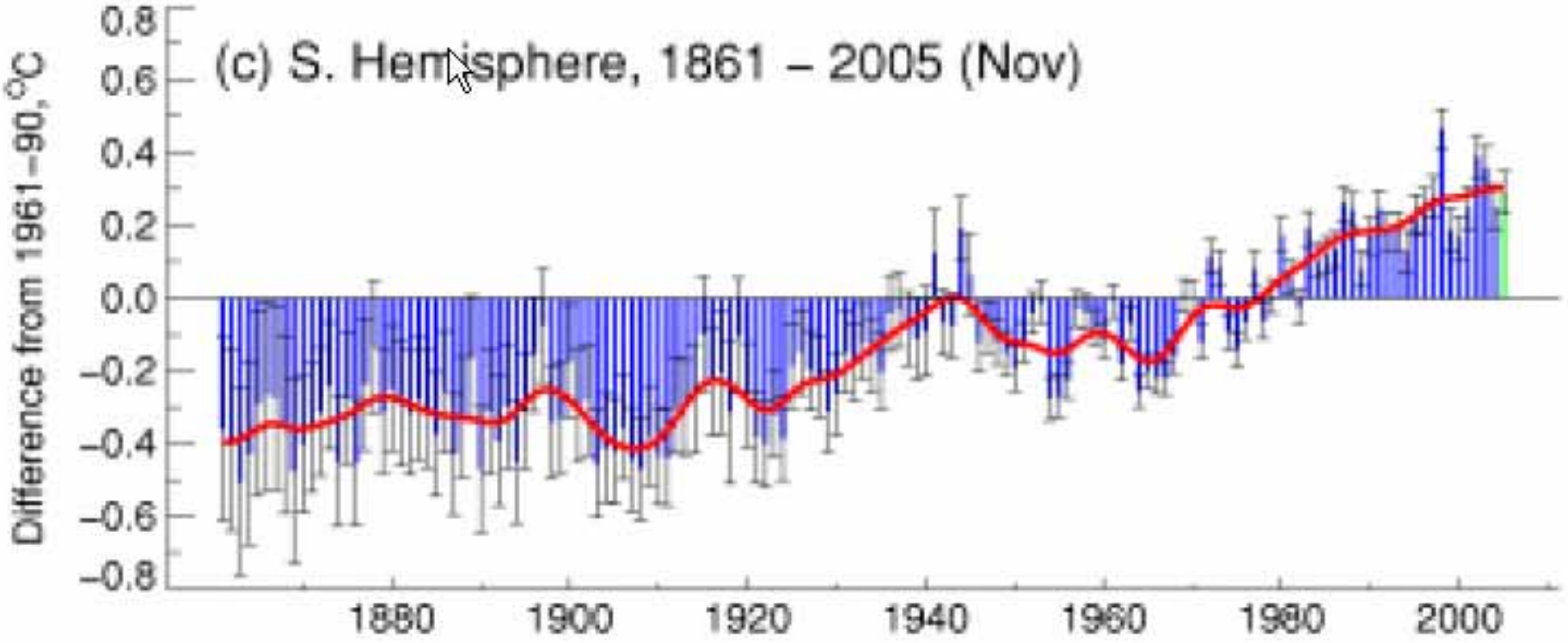

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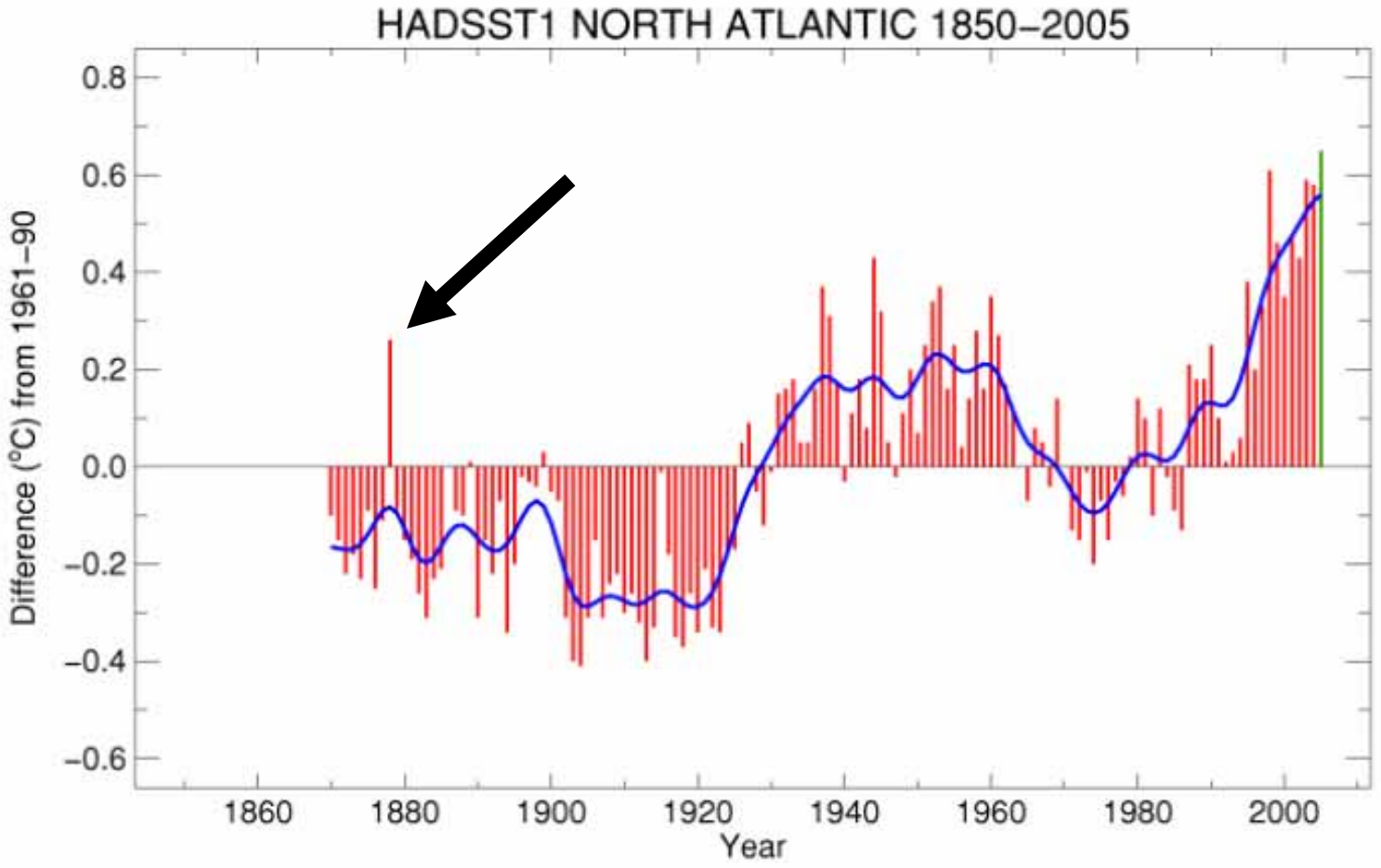
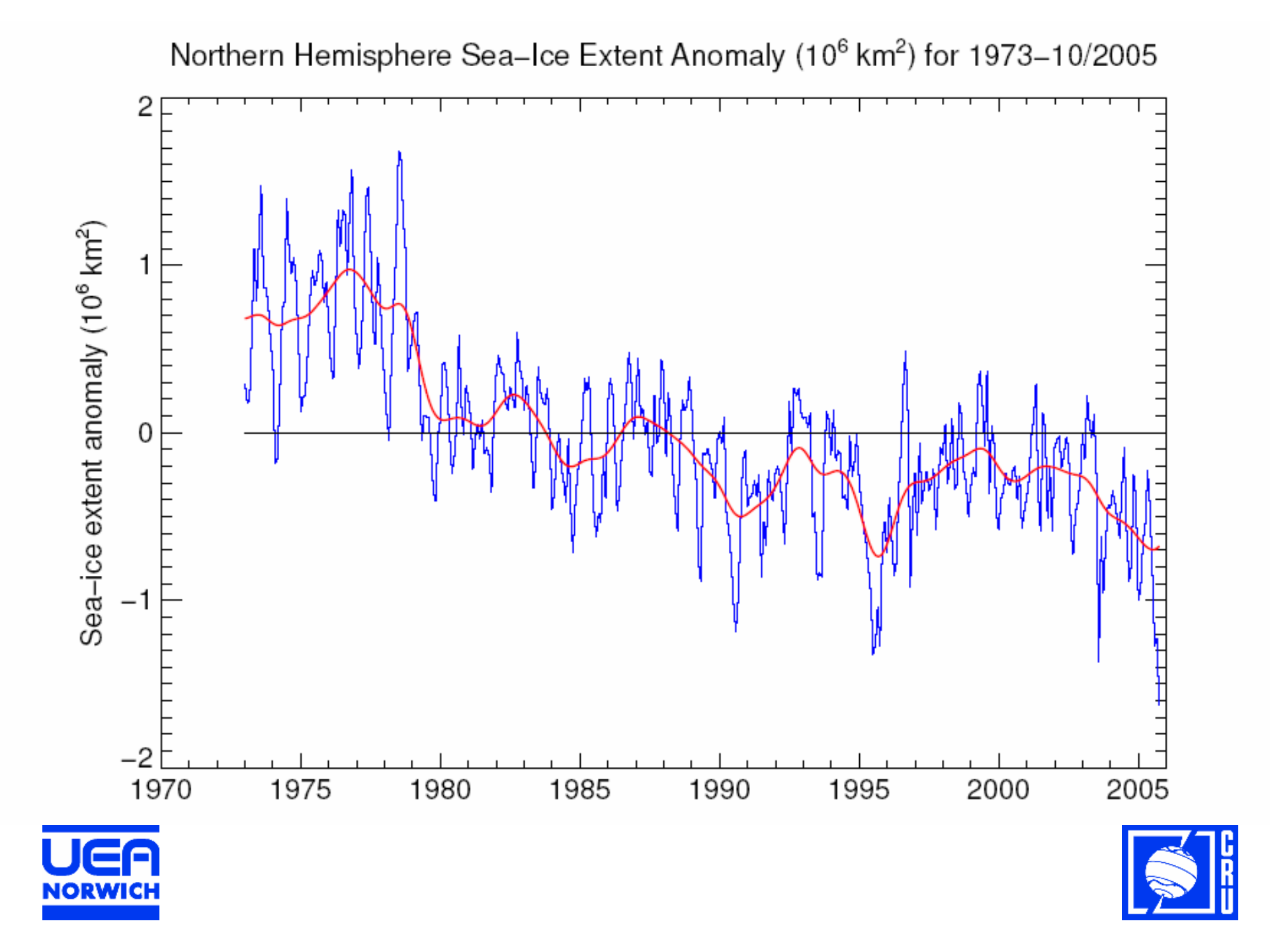
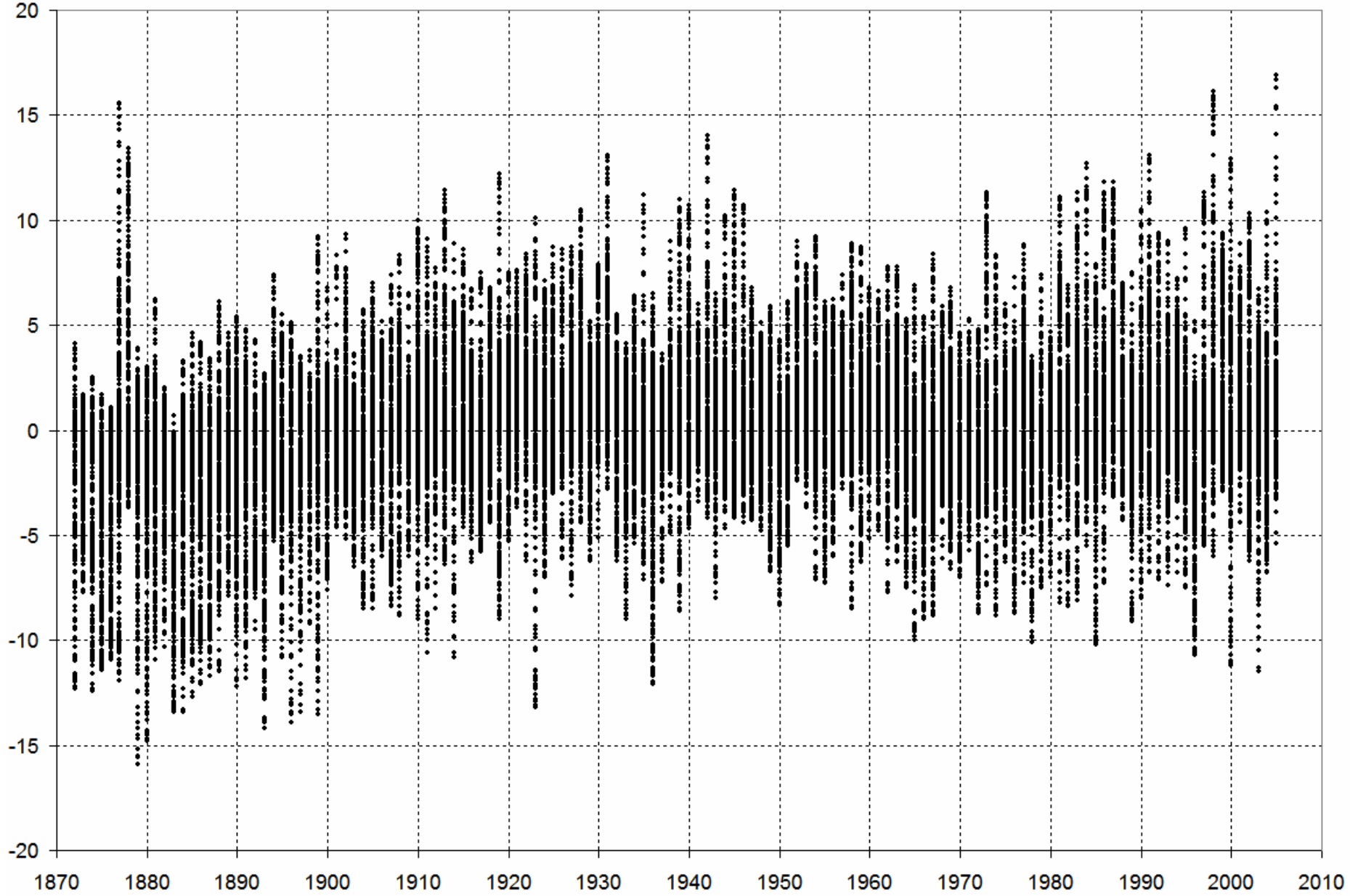
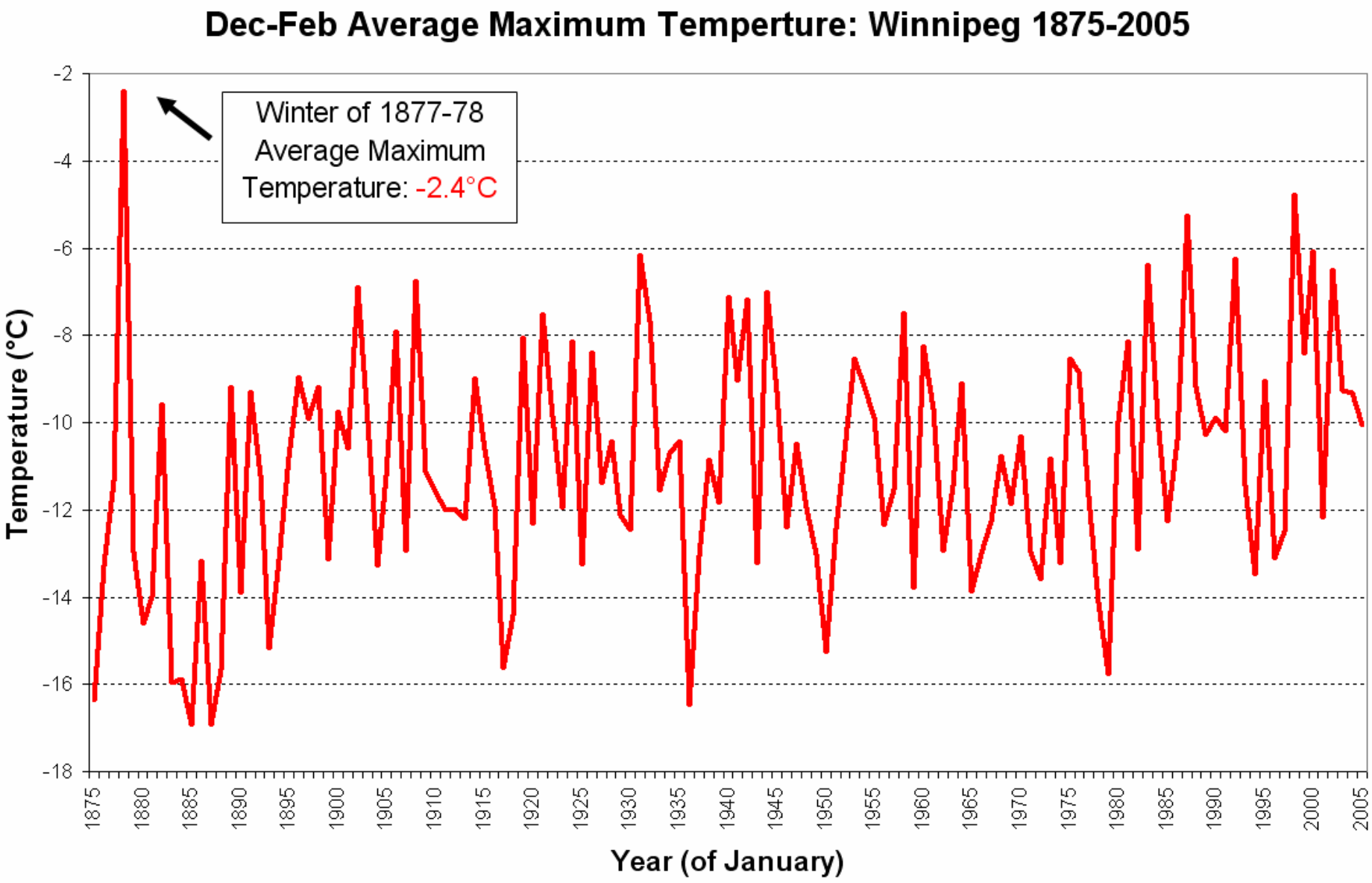
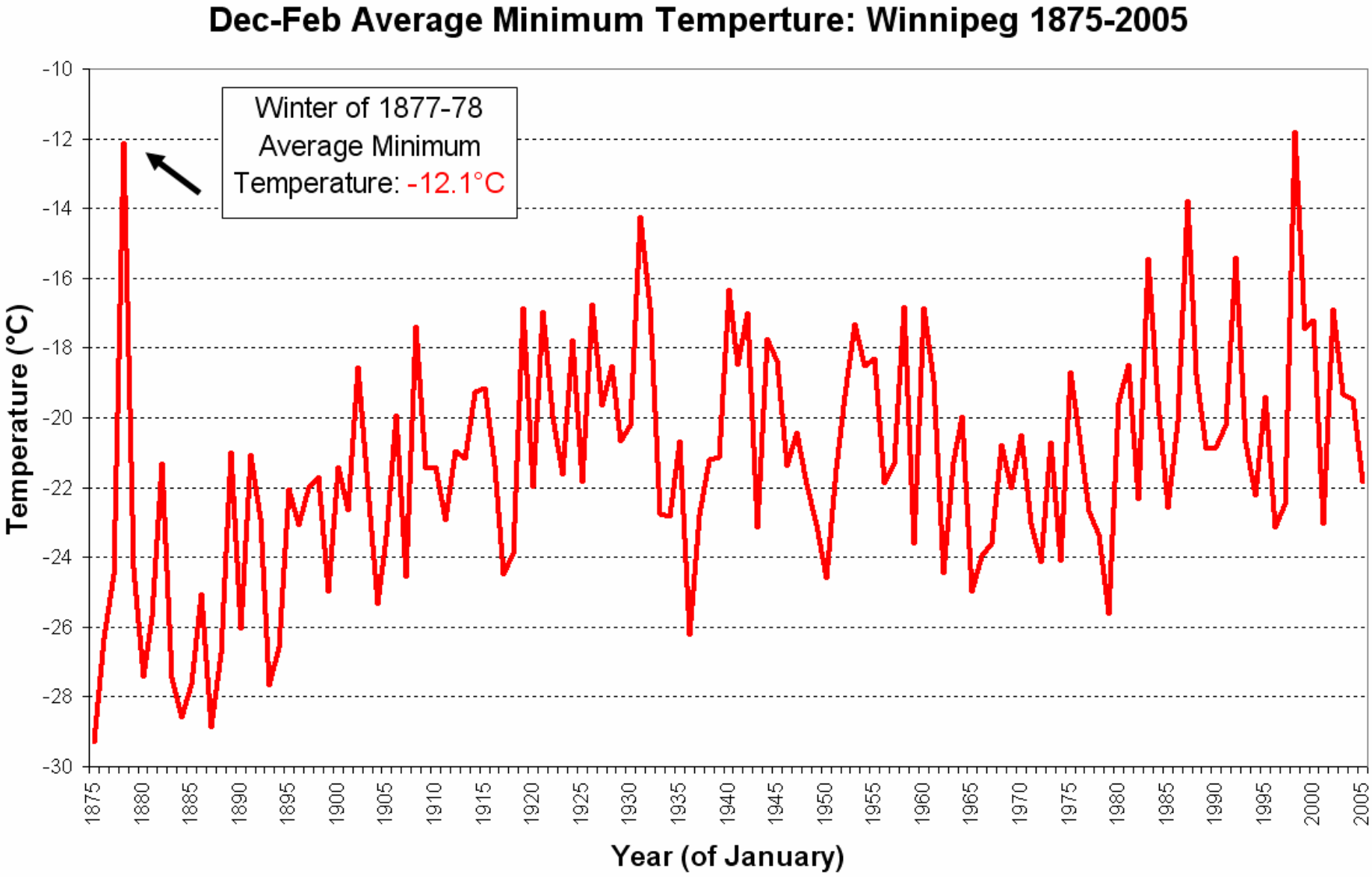

HADSST1 NORTH ATLANTIC 1850–2005
Difference (°C) from 1961–90
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
1860
1880
1900
1920
1940
1960
1980
2000
Year

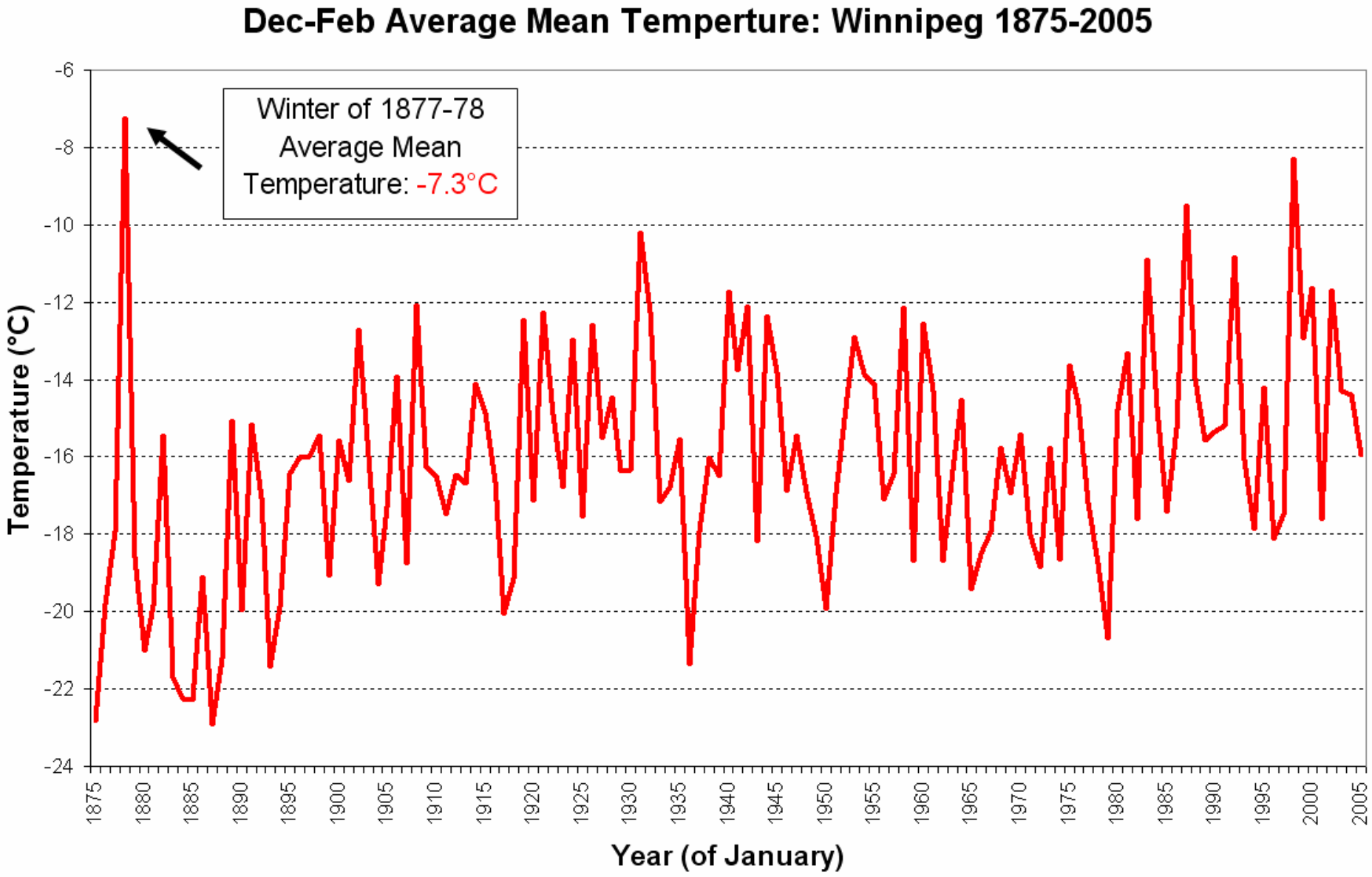

Northern Hemisphere Sea–Ice Extent Anomaly (10^6 km^2) for 1973–10/2005
Sea–ice extent anomaly (10^6 km^2)
2
1
0
−1
−2
1970
1975
1980
1985
1990
1995
2000
2005
UEA
NORWICH
CRU

21-Day Minimum Temperature Anomalies

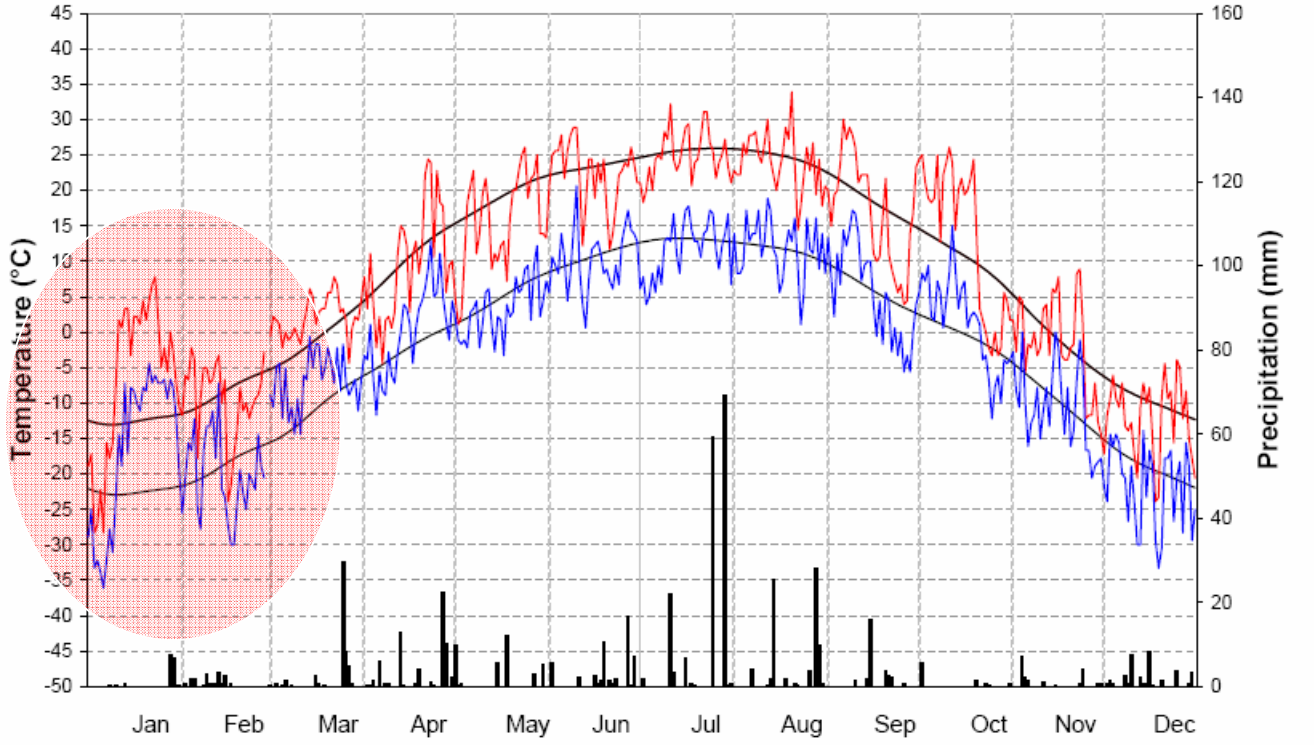



Dec-Feb Average Maximum Temperture: Winnipeg 1875-2005
Winter of 1877-78
Average Maximum
Temperature: -2.4°C
Temperature (°C)
-2
-4
-6
-8
-10
-12
-14
-16
-18
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year (of January)


Dec-Feb Average Minimum Temperture: Winnipeg 1875-2005
Winter of 1877-78
Average Minimum
Temperature: -12.1°C
Temperature (°C)
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year (of January)


Dec-Feb Average Mean Temperture: Winnipeg 1875-2005
Winter of 1877-78
Average Mean
Temperature: -7.3°C
Temperature (°C)
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year (of January)

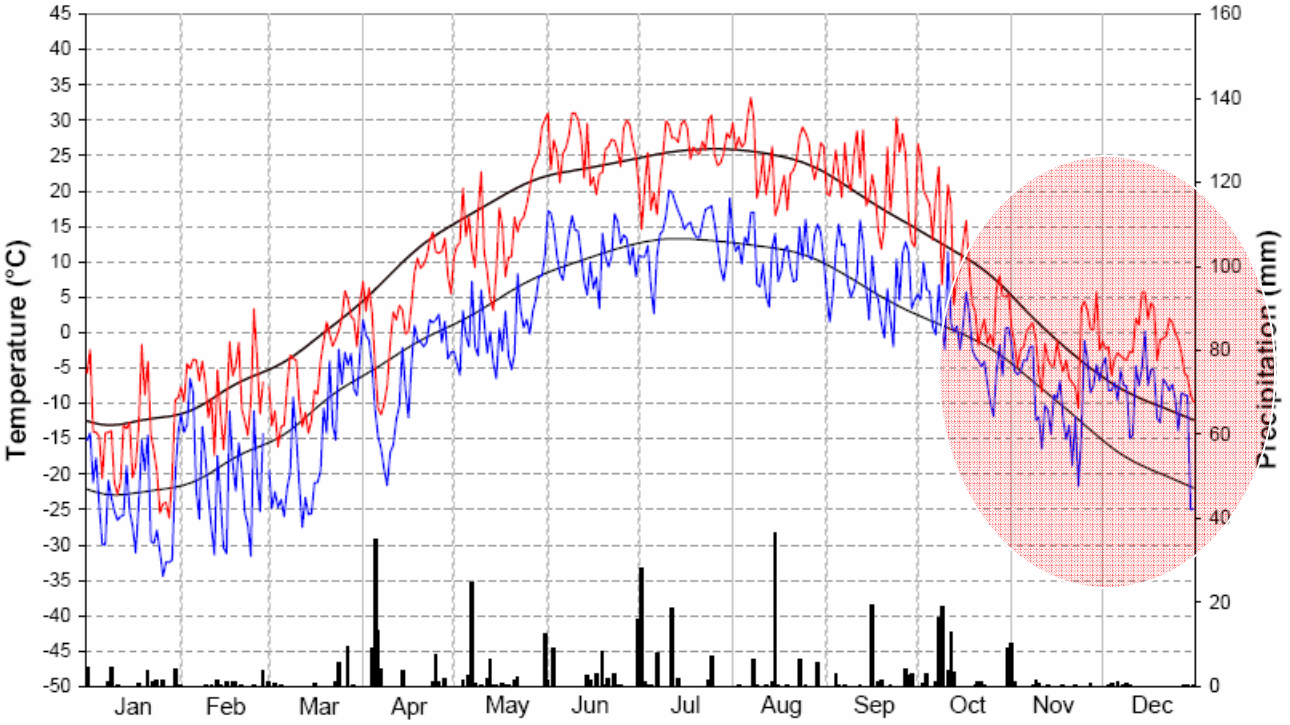
WINNIPEG DAILY WEATHER: 1942



Data courtesy of Environment Canada

Smoothed lines are 1971-2000 normals

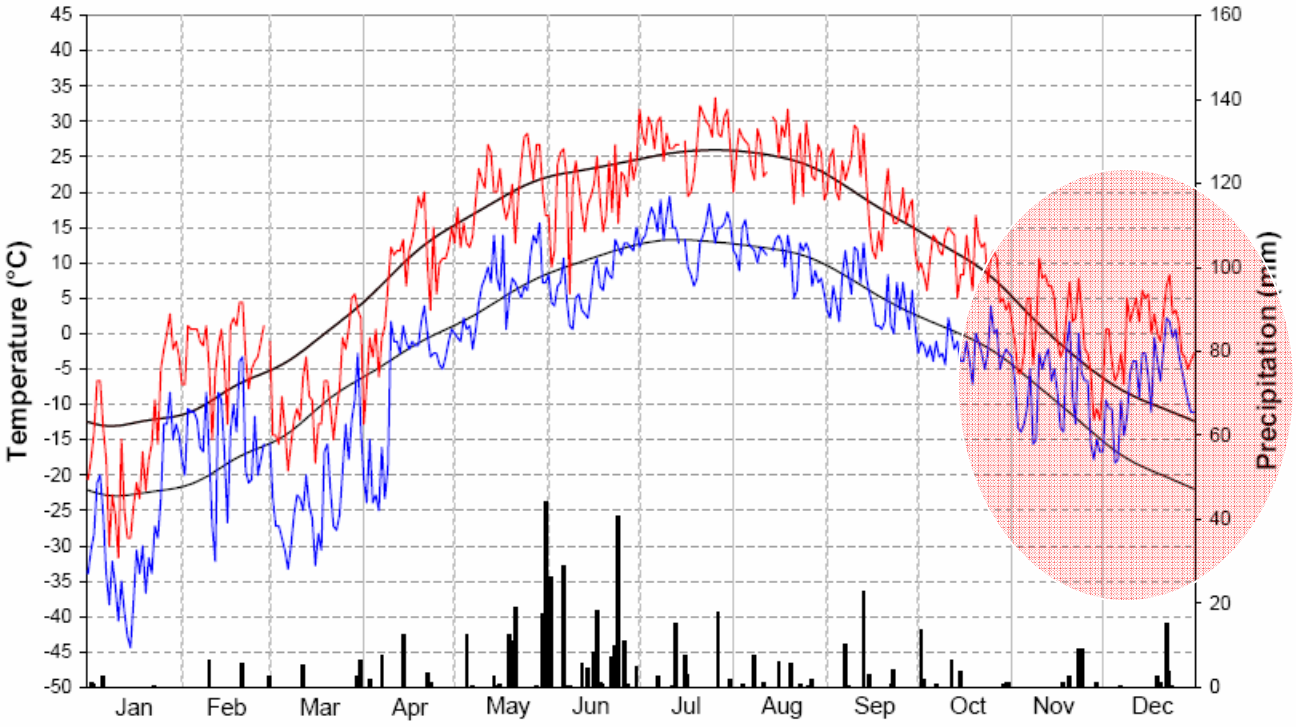
WINNIPEG DAILY WEATHER: 1997



Data courtesy of Environment Canada

Smoothed lines are 1971-2000 normals

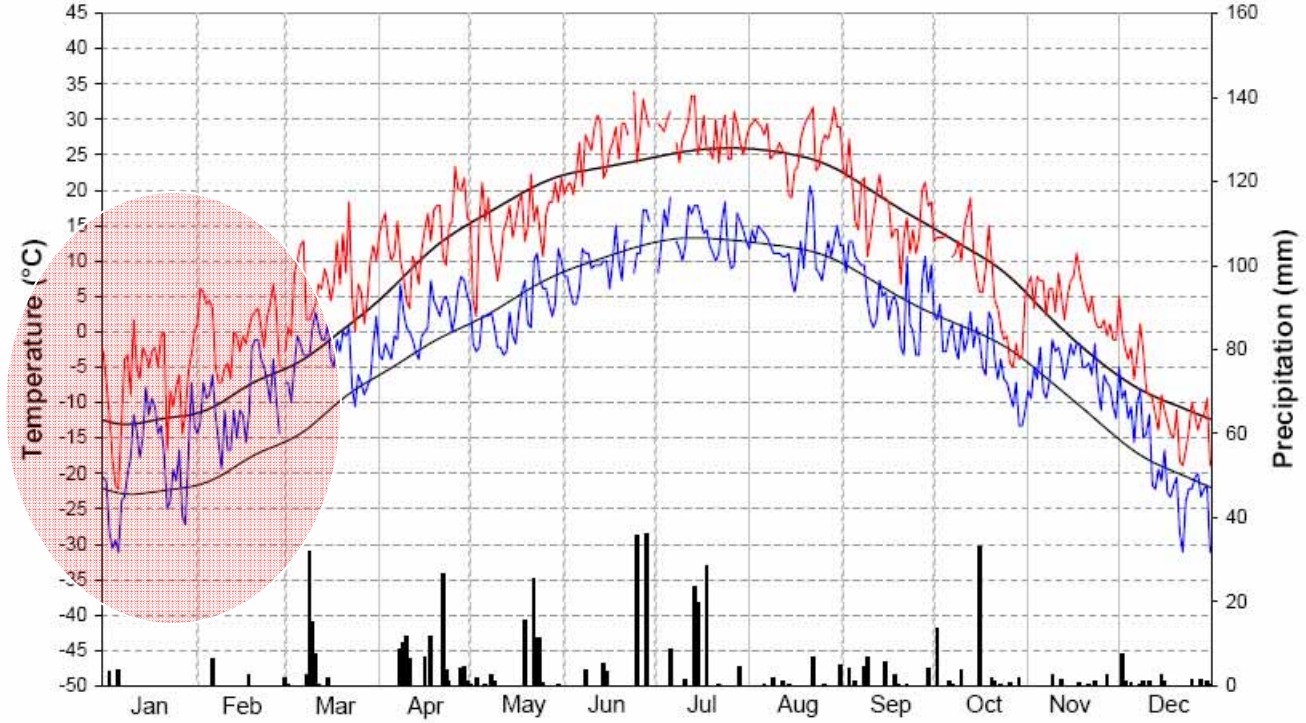
WINNIPEG DAILY WEATHER: 1877



Data courtesy of Environment Canada

Smoothed lines are 1971-2000 normals

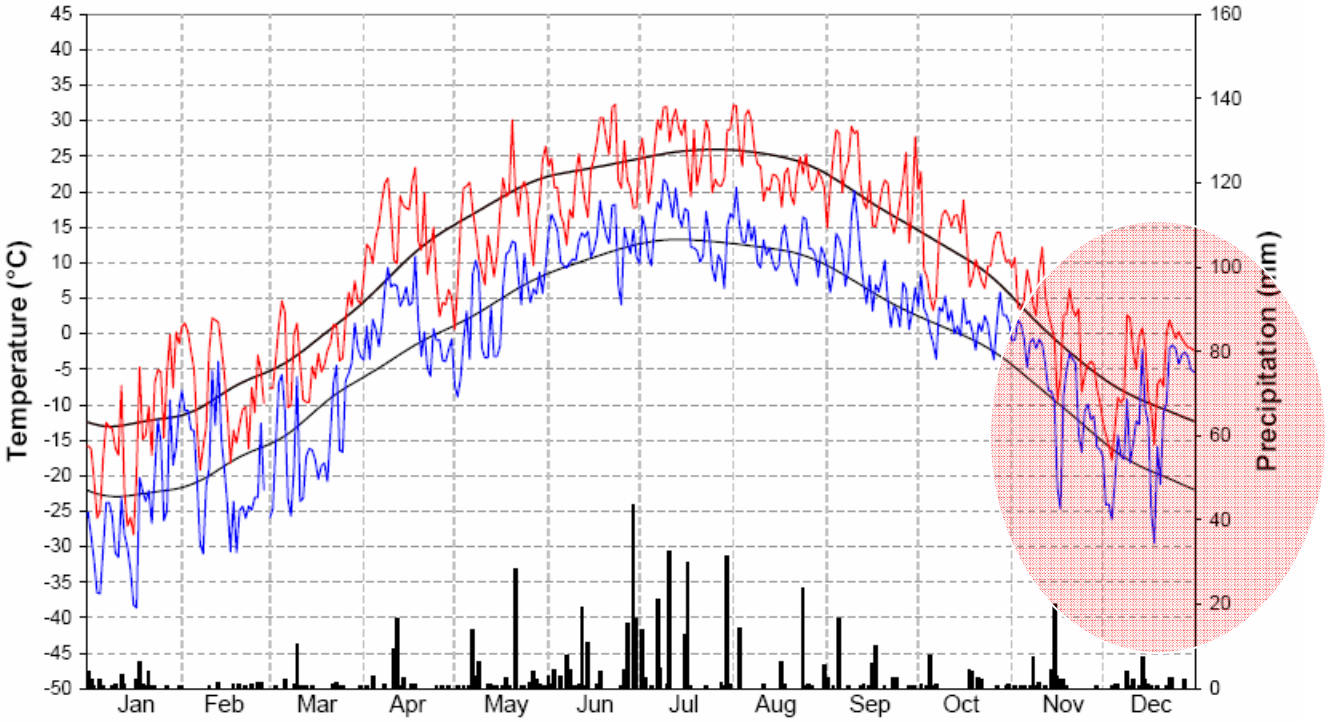
WINNIPEG DAILY WEATHER: 1878



Data courtesy of Environment Canada

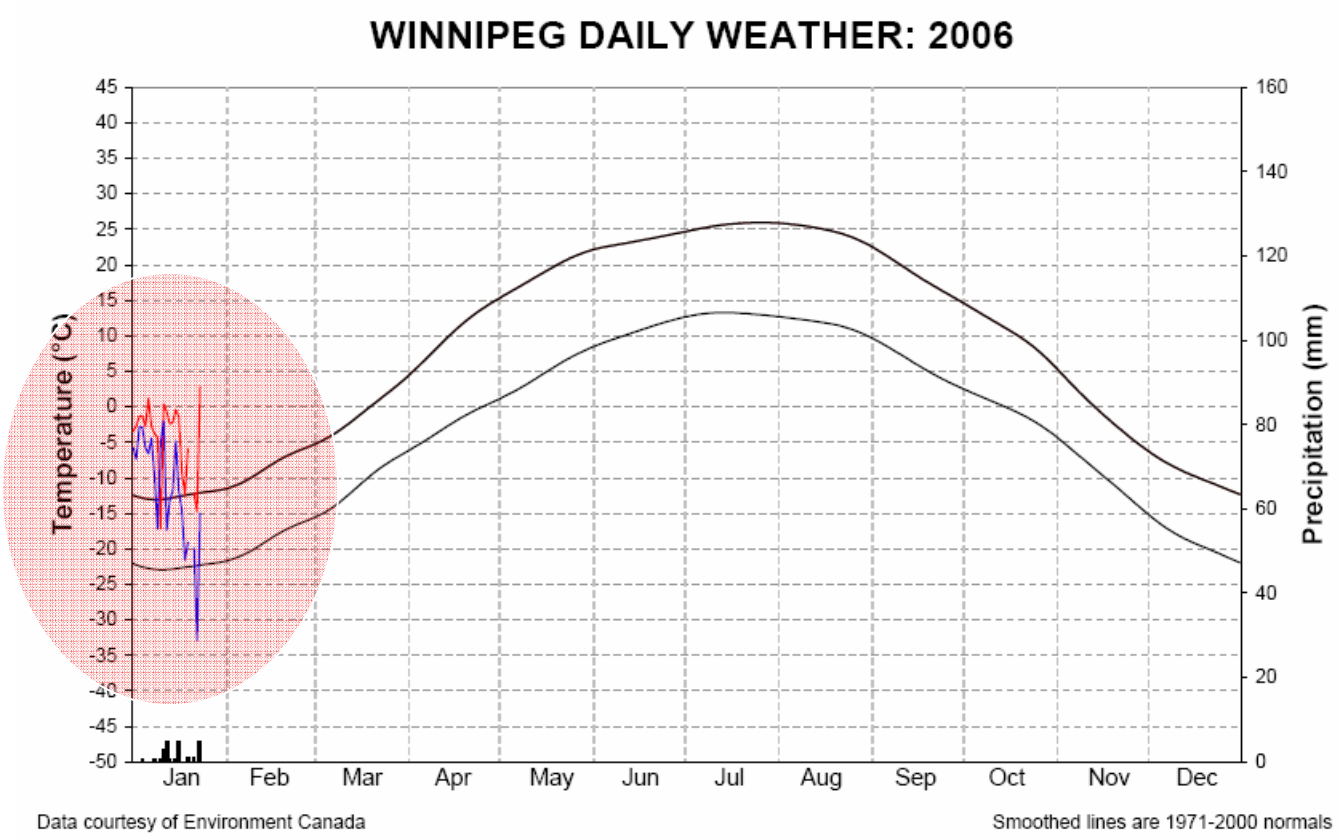
Smoothed lines are 1971-2000 normals

WINNIPEG DAILY WEATHER: 2005



Data courtesy of Environment Canada

Smoothed lines are 1971-2000 normals


WINNIPEG DAILY WEATHER: 2006
Temperature (°C)
Precipitation (mm)
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
160
140
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Data courtesy of Environment Canada
Smoothed lines are 1971-2000 normals

Yet some contrarians would have you believe that there is no problem

FRIENDS OF SCIENCE

PROVIDING INSIGHT INTO CLIMATE SCIENCE

ABOUT US

VIDEO

MYTHS/ FACTS

KYOTO/ CLIMATE NEWS

FOS NEWS

SCIENCE NEWS

SCIENCE BACKGROUND

SCIENTIFIC REFERENCES

HOT AIR FORUM

GET INVOLVED

CONTACT US

An Important Message From Our President

To read his contribution to the Sudbury Star - click here

Who needs scientists, when you've got celebrities!!!

Canada's Environment Minister calls for celebrity endorsement of Kyoto - click here.

One celebrity breaks ranks and does some homework on climate change - click here.

Minister uninvites dissenting celebrity - click here.

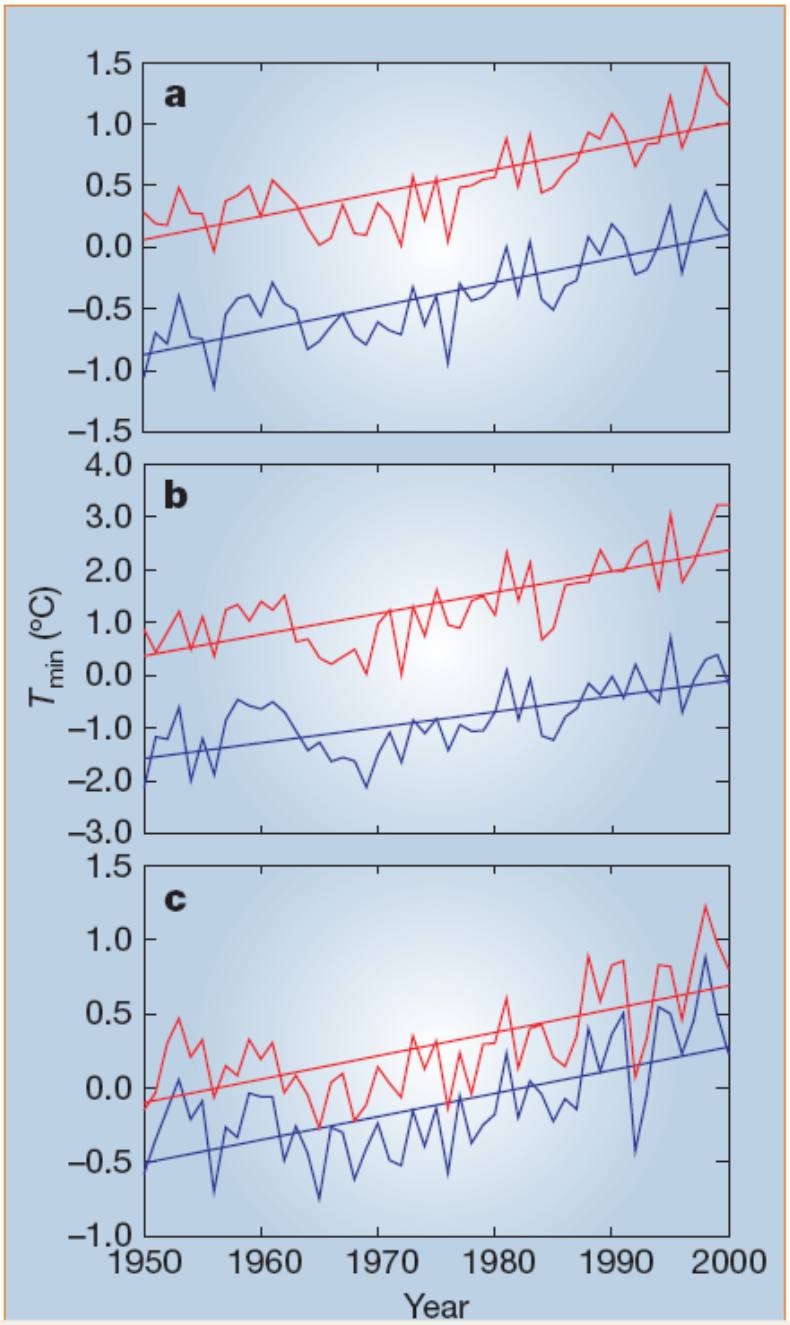
If you've heard our radio ads, thanks for visiting! Now watch the video by clicking the video link to your left.

MYTH 1: Global temperatures are rising at a rapid, unprecedented rate.

FACT: Accurate satellite, balloon and mountain top observations made over the last three decades have not shown any significant change in the long term rate of increase in global temperatures. Average ground station readings do show a mild warming of 0.6 to 0.8Cover the last 100 years, which is well within the natural variations recorded in the last millennium. The ground station network suffers from an uneven distribution across the globe; the stations are preferentially located in growing urban and industrial areas ("heat islands"), which show substantially higher readings than adjacent rural areas ("land use effects").

There has been no catastrophic warming recorded.

FRIENDS OF SCIENCE



Large-scale warming is not urban

David E. Parker

Annual

Windy

Calm

Winter

Temperatures over land have risen as much on windy nights as on calm nights.

Summer

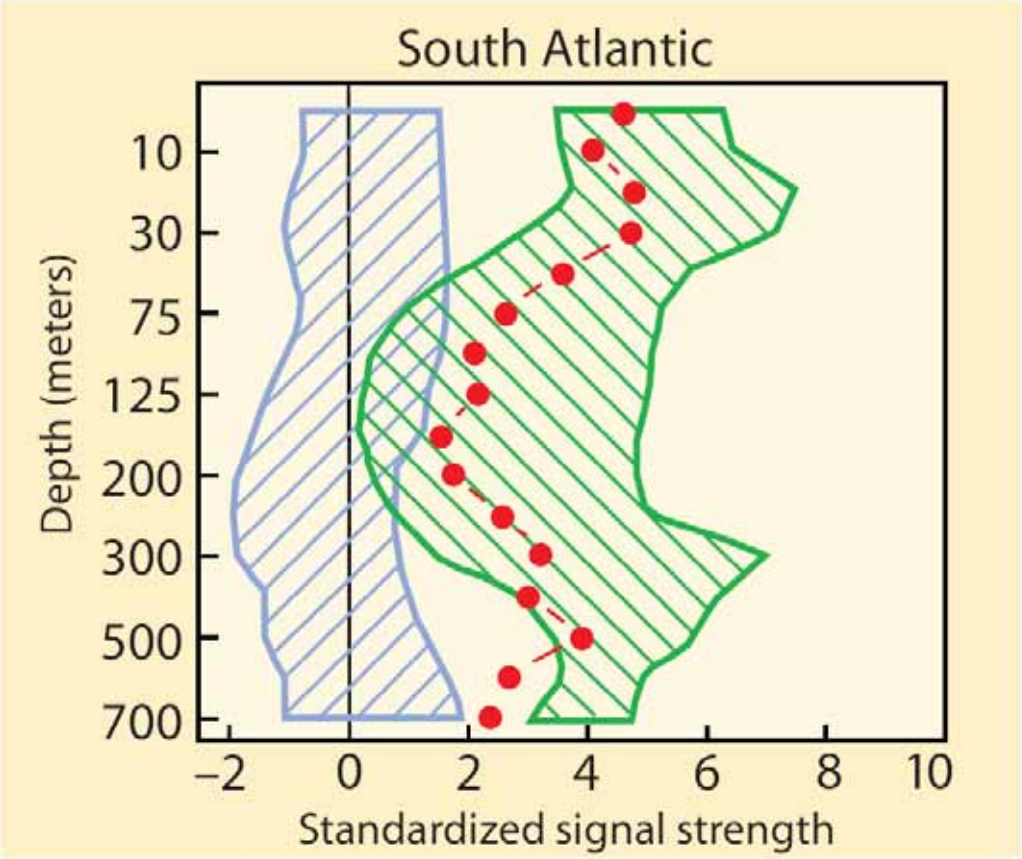
Penetration of Human-Induced Warming into the World's Oceans

Tim P. Barnett,[1]* David W. Pierce,[1] Krishna M. AchutaRao,[2] Peter J. Gleckler,[2] Benjamin D. Santer,[2] Jonathan M. Gregory,[3] Warren M. Washington[4]

A warming signal has penetrated into the world's oceans over the past 40 years. The signal is complex, with a vertical structure that varies widely by ocean; it cannot be explained by natural internal climate variability or solar and volcanic forcing, but is well simulated by two anthropogenically forced climate models. We conclude that it is of human origin, a conclusion robust to observational sampling and model differences. Changes in advection combine with surface forcing to give the overall warming pattern. The implications of this study suggest that society needs to seriously consider model predictions of future climate change.

Science 8 July 2005

"This is perhaps the most compelling evidence yet that global warming is happening right now and it shows that we can successfully simulate its past and likely future evolution"



Tim Barnett

SCRIPPS INSTITUTION OF OCEANOGRAPHY

A match. A model's warming (green) fits the actual warming (red) and exceeds climate noise (blue).

MYTH 3: Human produced carbon dioxide has increased over the last 100 years, adding to the Greenhouse effect, thus warming the earth.

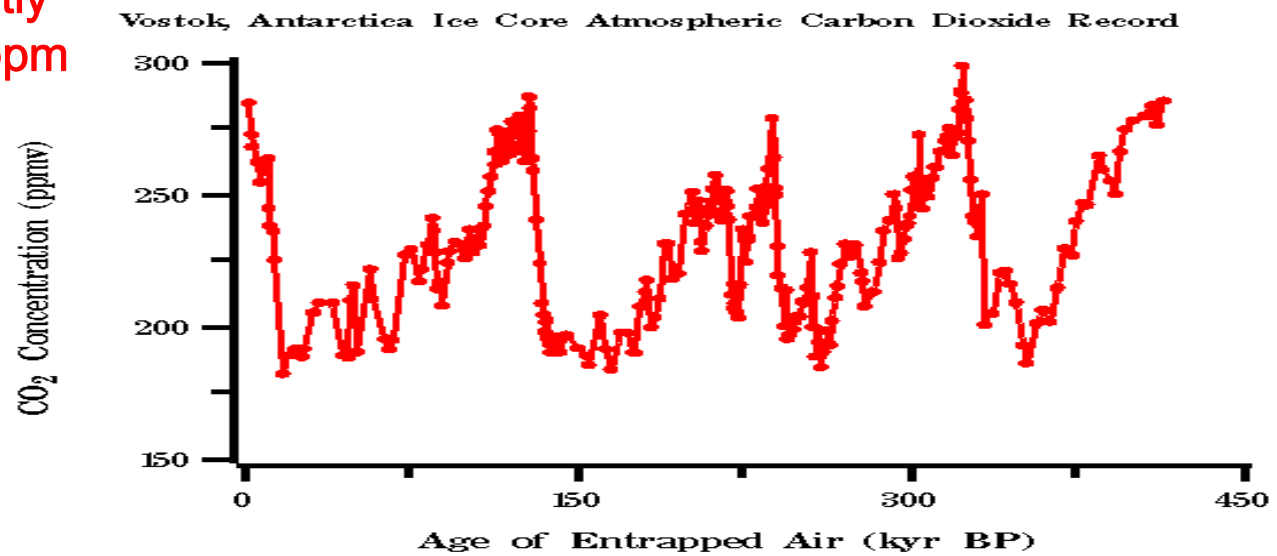
FACT: Carbon dioxide levels have indeed changed for various reasons, human and otherwise, just as they have throughout geologic time. Since the beginning of the industrial revolution the CO_2 content of the atmosphere has increased from a rate of about 0.2% per year to the present 0.4% per year. But there is no proof that CO_2 is the main driver of global warming. As measured in ice cores dated over many thousands of years, CO_2 levels move up and down AFTER the temperature has done so, and thus are the RESULT OF, NOT THE CAUSE of warming. Geological field work in recent sediments confirms this causal relationship. There is solid evidence that, as temperatures move up and down naturally and cyclically through solar radiation, orbital and galactic influences, the warming surface layers of the earth's oceans expel more CO_2 as a result.

FRIENDS OF SCIENCE

Vostok, Antarctica, Ice Core Data

Currently
~380 ppm

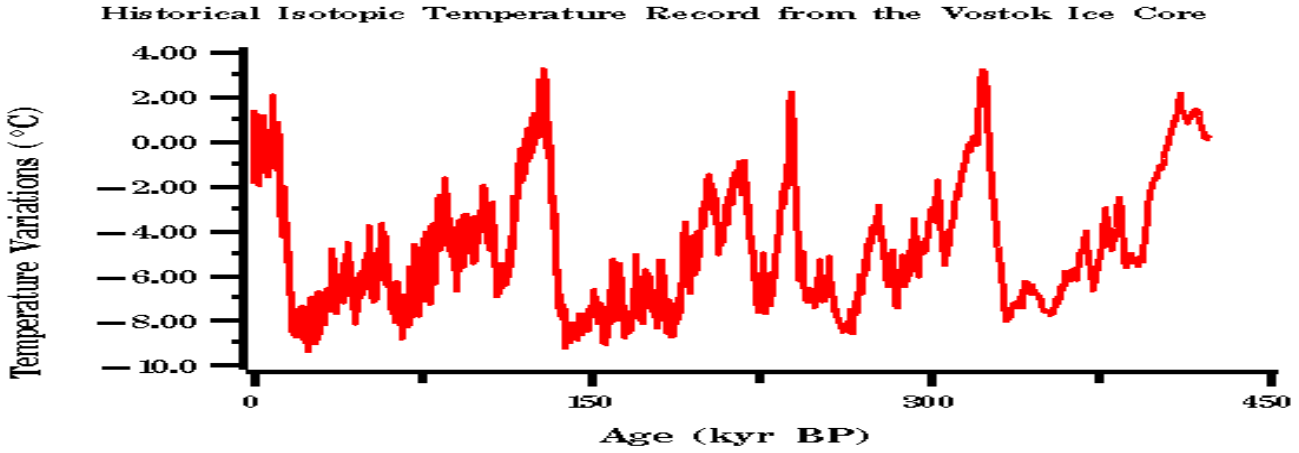
CO_2



Source: Jean—Marc Barnola et al.

T°

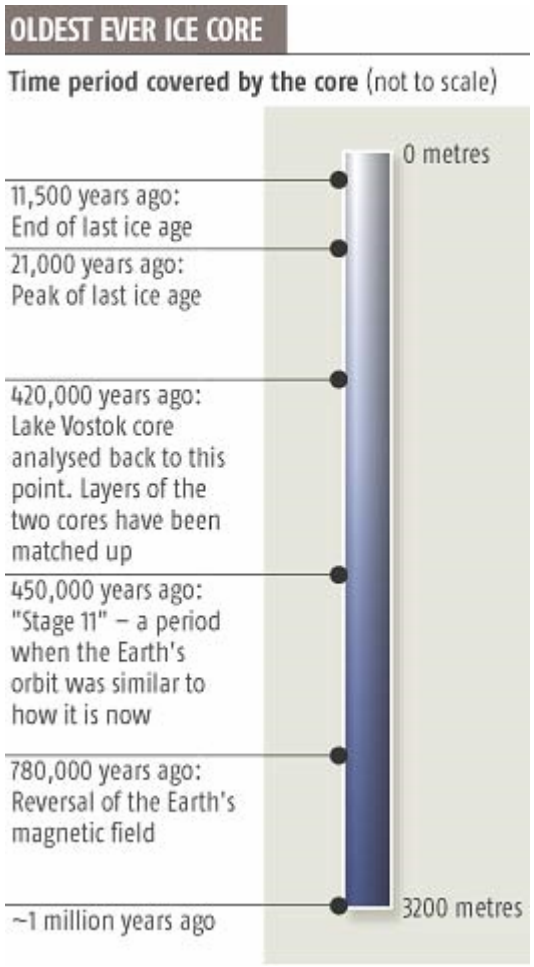
From
Isotopes

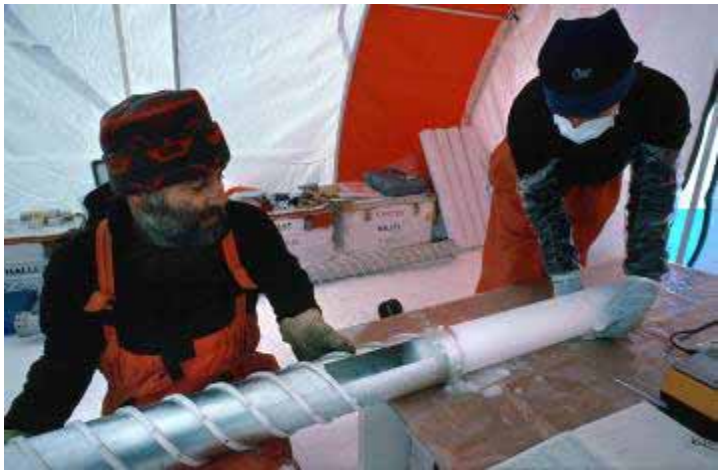


Variation with time of the Vostok isotope temperature record as a difference from the modern surface temperature value of —55.5 °C.

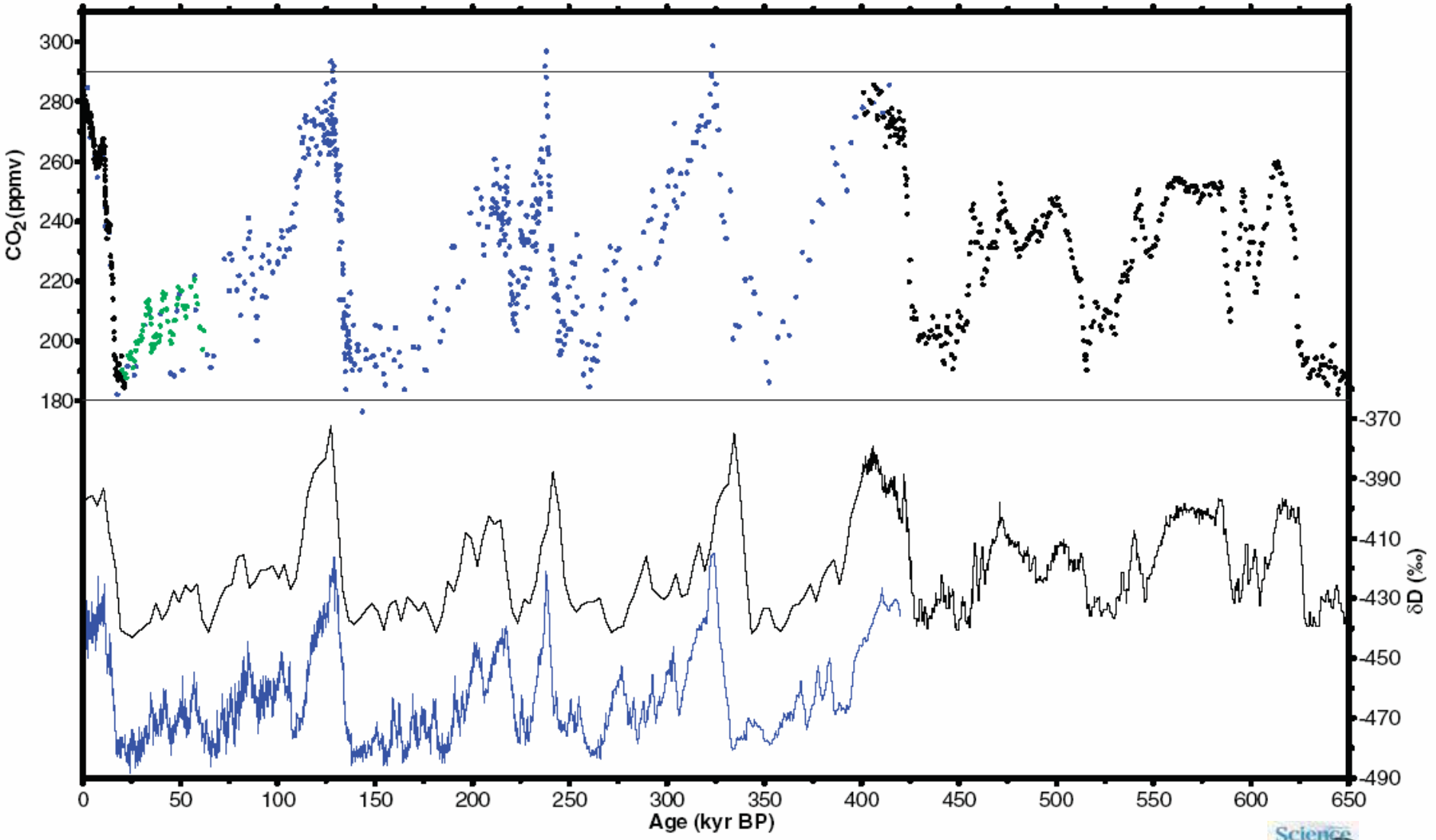
Source: Petit et al.

New ice core from Antarctica (Dome C site) dates back to at least 750,000 years!





Dome C Carbon Dioxide and Deuterium



Siegenthaler et al. 2005 (Science 25 Nov.)

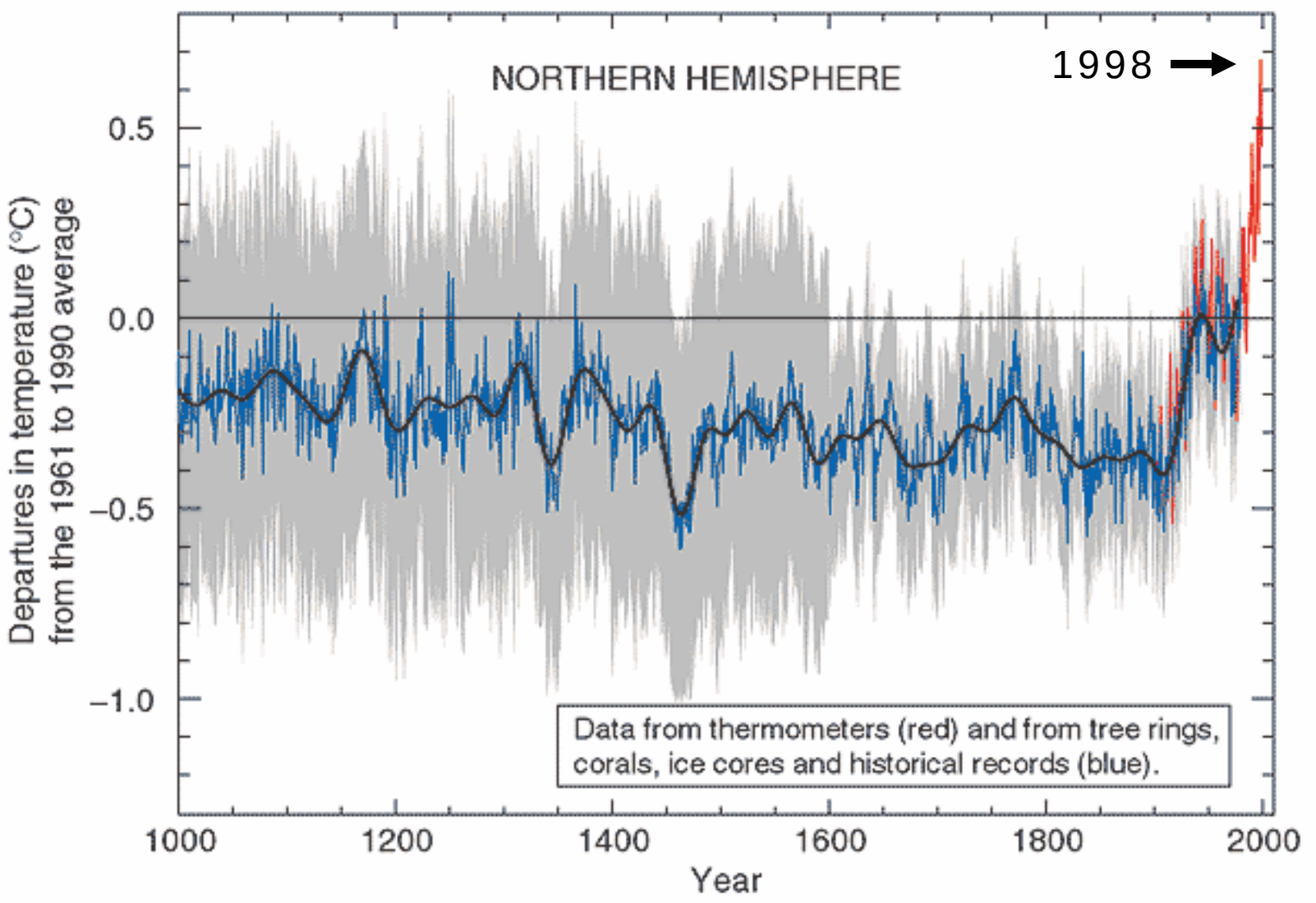
MYTH 2: The "hockey stick" graph proves that the earth has experienced a steady, very gradual temperature increase for 1000 years, then recently began a sudden increase.

FACT: Significant changes in climate have continually occurred throughout geologic time. For instance, the Medieval Warm Period, from around 1000 to1200 AD (when the Vikings farmed on Greenland) was followed by a period known as the Little Ice Age. Since the end of the 17th Century the "average global temperature" has been rising at the low steady rate mentioned above; although from 1940 – 1970 temperatures actually dropped, leading to a Global Cooling scare.

The "hockey stick", a poster boy of both the UN's IPCC and Canada's Environment Department, ignores historical recorded climatic swings, and has now also been proven to be flawed and statistically unreliable as well. It is a computer construct and a faulty one at that.

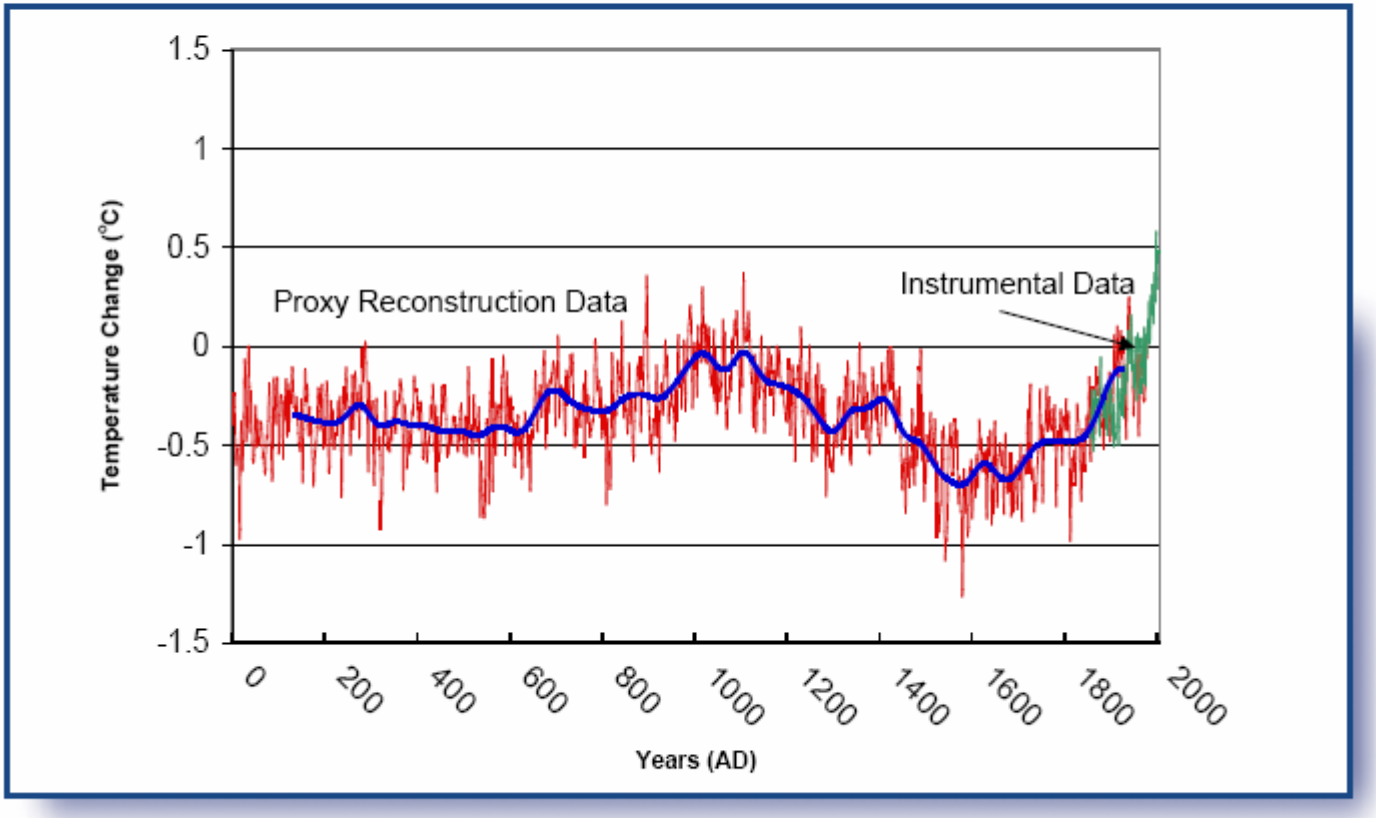
FRIENDS OF SCIENCE

The "Hockey Stick" Graph

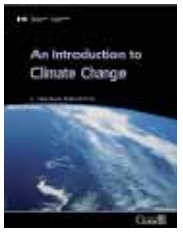


After: M.E. Mann, R.S. Bradley and M.K. Hughes, *Nature*, 392, 779-787 (1998).

Reconstruction of Northern Hemispheric mean annual temperatures for the past 2000 years based on multi-proxy data analyses



Source: Moberg et al. 2005



RealClimate

28 Oct 2005

Shameless Self Promotion

Filed under: Climate Science — group @ 8:54 am

Vote for RealClimate!

No, we're not going to abandon our policy of steering clear of political commentary, but yes, you can nonetheless vote for us!

Some of you may have noticed the new logos up in the upper right hand corner of the RC webpage. As a followup to our selection last month for the "Science & Technology Web Awards 2005" by Scientific American, we are pleased to have now made it to the final round of Deutsche Welle's 2005 Weblog Awards (for those of you not familiar with them, Deutsche Welle is sort of the German equivalent of Britain's BBC World Service).

If you like our site, please go ahead and vote for us (note: for your vote to be counted you'll need to vote in at least one of the nine "Best Journalistic Weblog" language categories and all four international categories). We have been nominated in both the "Best Journalistic Blog (English)" and "Best Weblog" categories. So if you really like us, you can even vote for us twice .

Comments (0)

24 Oct 2005

Hockey sticks: Round 2.7

Filed under: Climate Science Paleoclimate — group @ 10:03 am

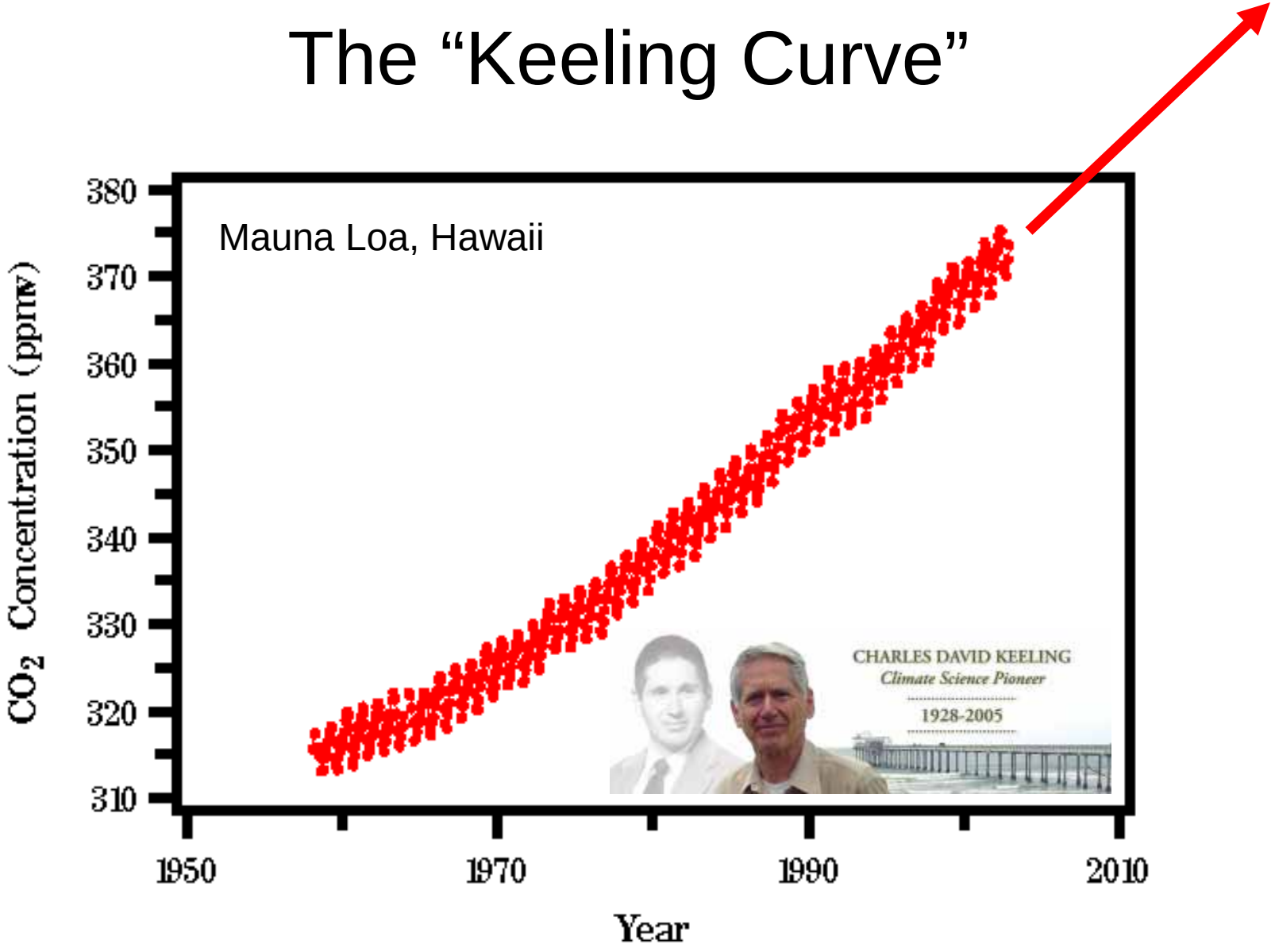
Two more teams in the seemingly endless jousting over the 'hockey-stick' have just made their entry onto the field. In the first two (of four) comments on the original McIntyre and McKitrick (2005) (MM05) paper in GRL, von Storch and Zorita, and Huybers have presented two distinct critiques of the work of M&M.

The two comments focus on the 'PC normalisation' issue raised in MM05 which we discussed previously. Specifically, von Storch and Zorita show that in a GCM model emulation of the Mann, Bradley and Hughes (MBH) method, changing the PC normalisation technique makes no difference to the eventual reconstruction (i.e. it is not the normalisation that creates the 'hockeystick'), consistent with earlier conclusions. Huybers comments that neither of the two suggested normalisations are actually optimal, and proposes a third method which looks like it gives results halfway between MBH and MM05. However, given the von Storch result, this too is unlikely to matter in the final reconstruction.

Huybers additionally makes an interesting point regarding the calculation of significance levels in MM05 and shows that a crucial step (the rescaling of variance of the proxies to match the variance in the instrumental calibration period) was missed out. Including it produces results identical to MBH.

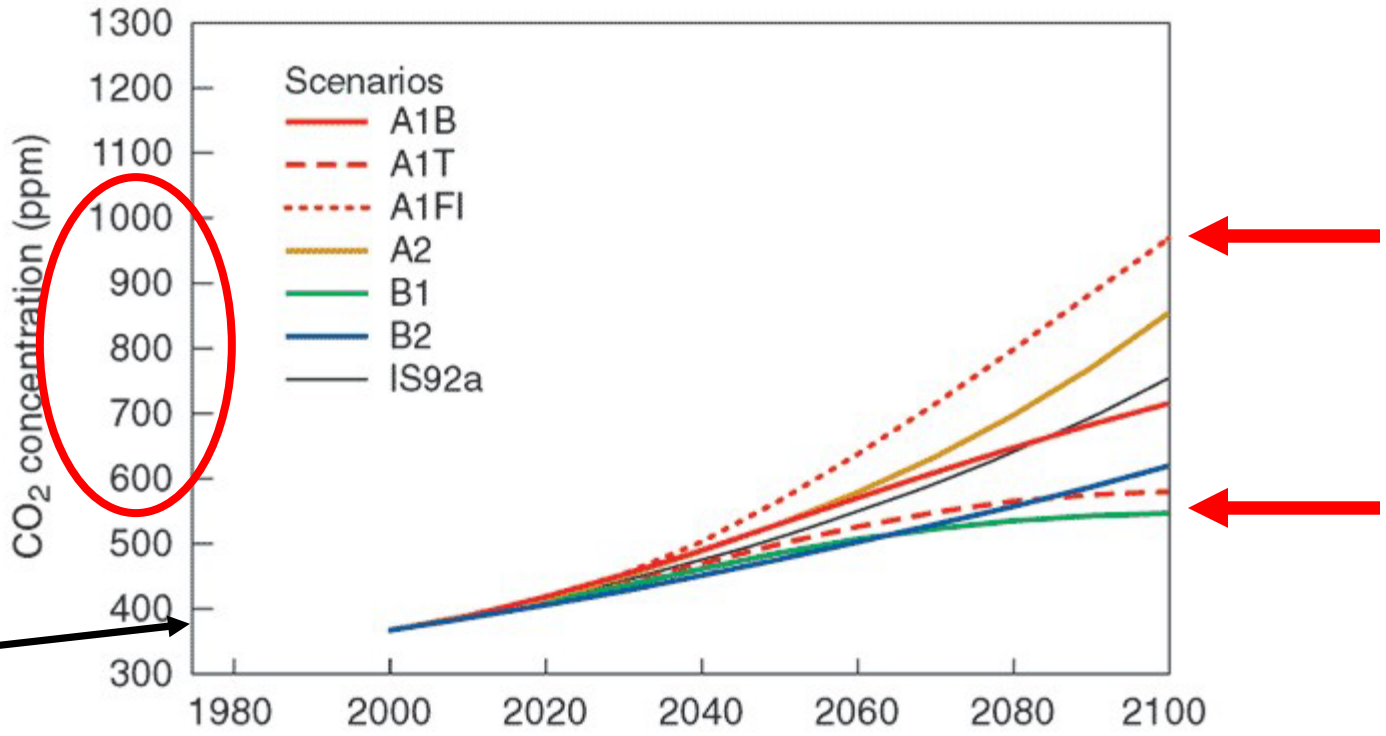
realclimate.org

The “Keeling Curve”



Source: Dave Keeling and Tim Whorf (Scripps Institution of Oceanography)

IPCC CO_2 SCENARIOS



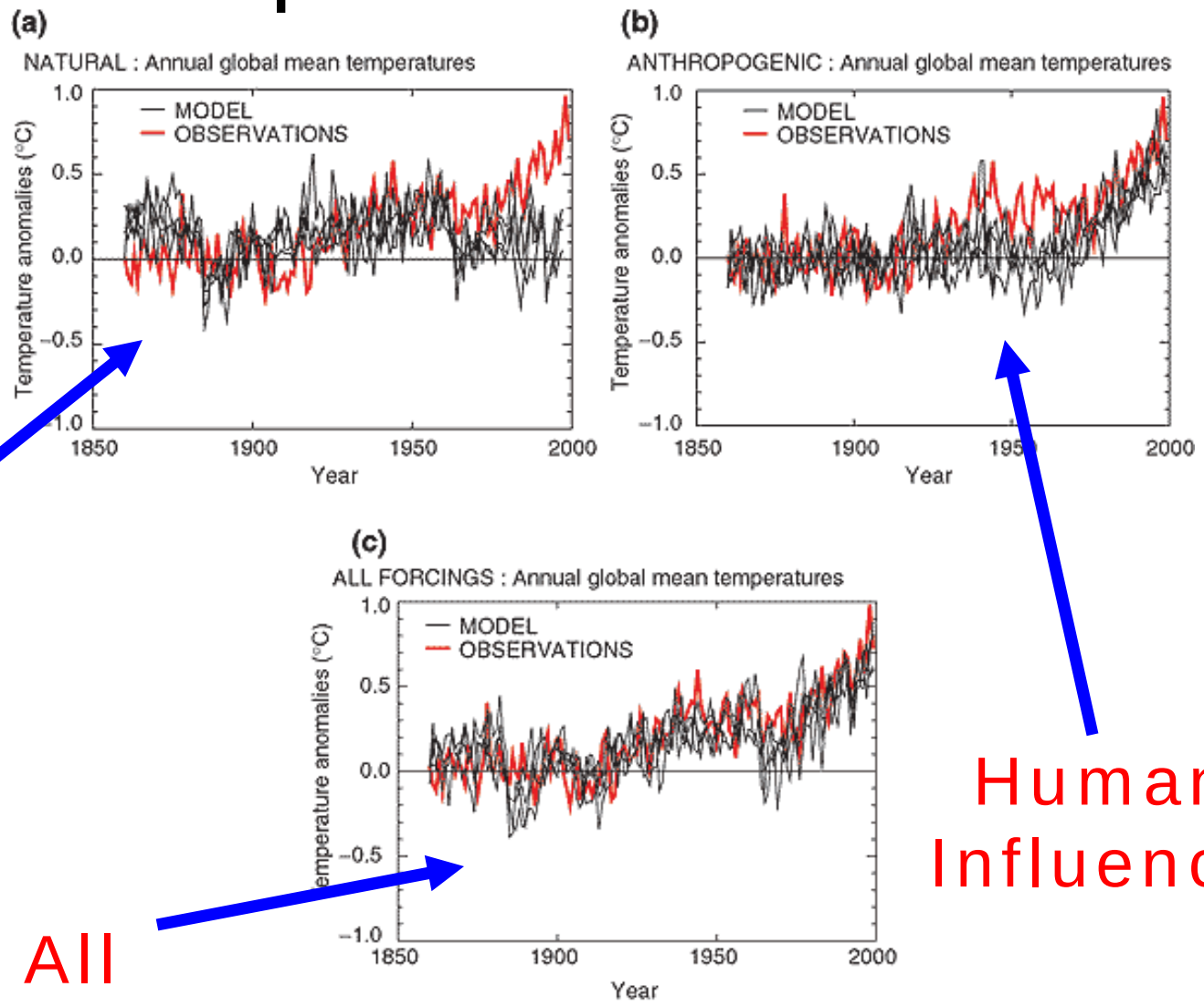
Currently
~380 ppm

Socio-economic and geophysical models are used to make projections about future carbon dioxide (and GHG) concentrations.

Climate *is* Difficult to Model

- But observed warming is consistent with expectations
- Solar variability doesn't explain much of the change
- Models are imperfect (and always will be) but they are absolutely essential

GCM Simulations vs Observed Temperatures

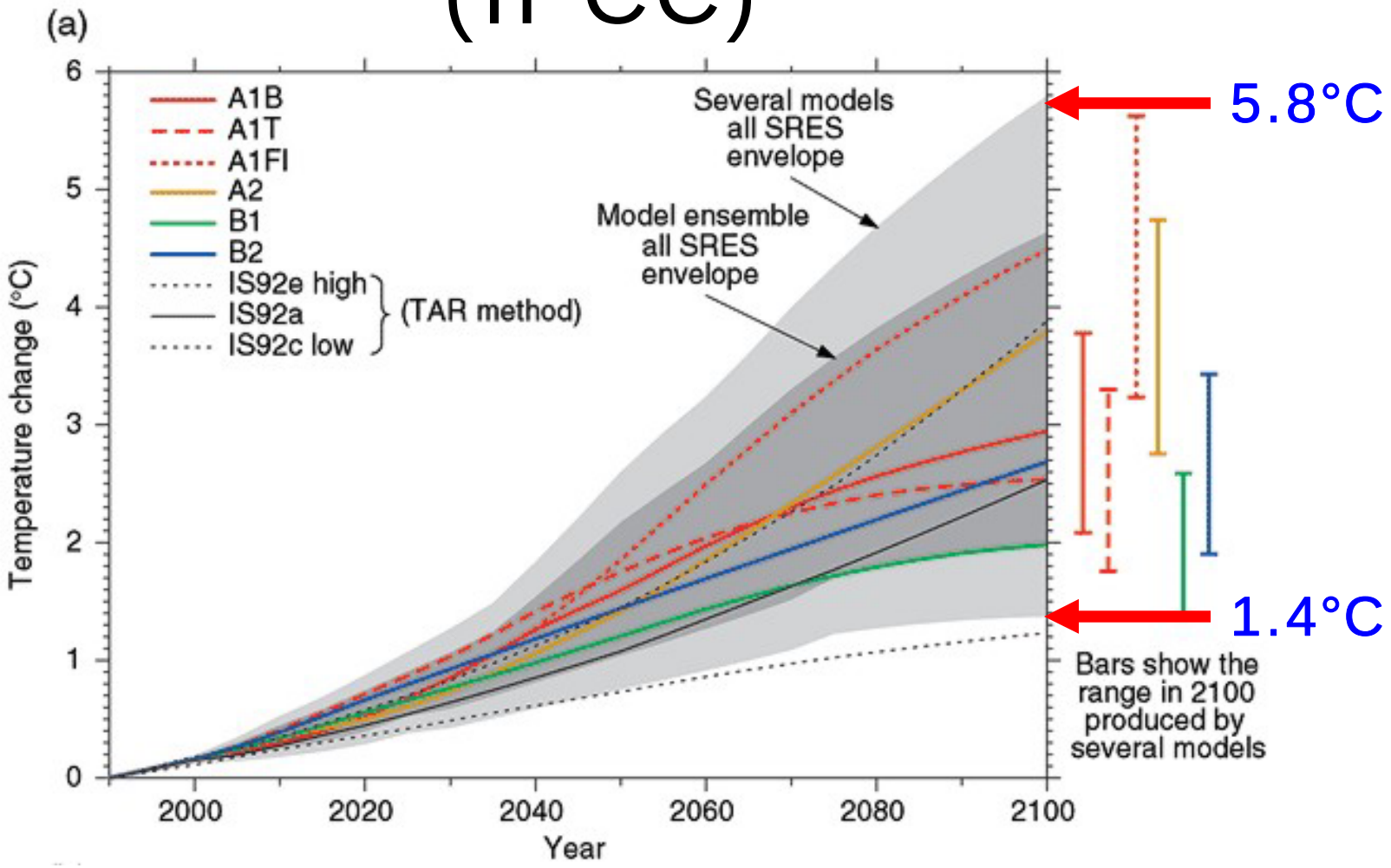


Solar & Volcanic Influence

All

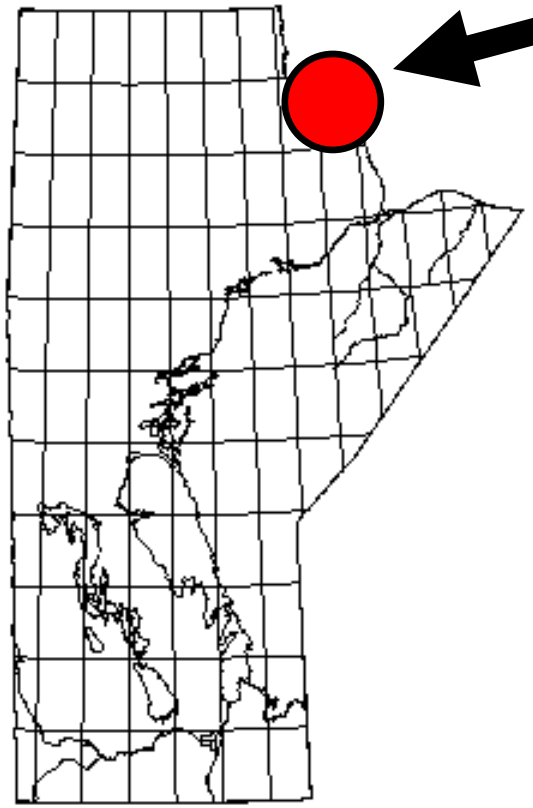
Human Influence

The Range of Global Temperature Projections (IPCC)



What do the models indicate for Manitoba?

58°45’N, 94°W



For example:

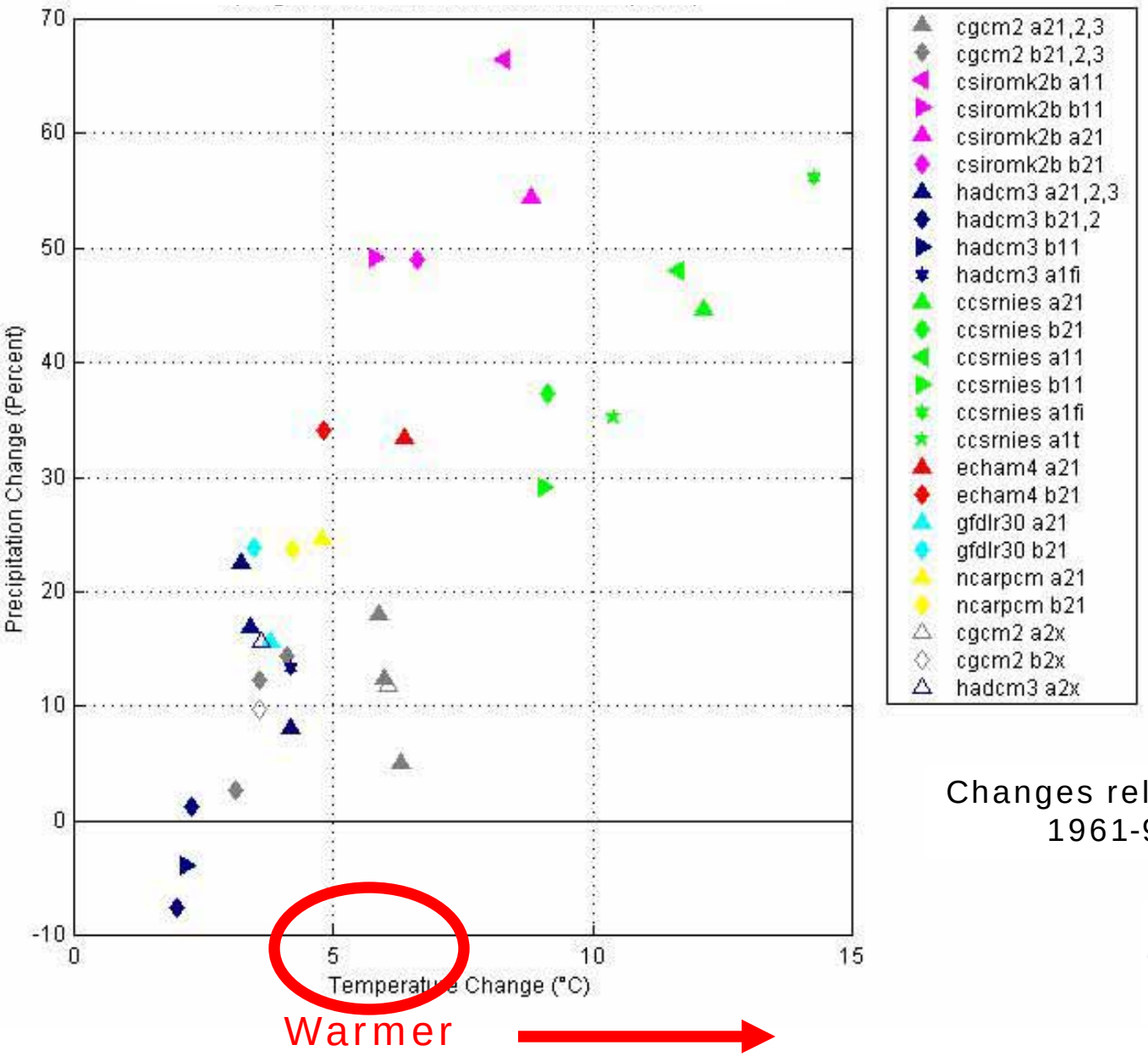
What do the models project for Manitoba?

CANADIAN CLIMATE IMPACTS SCENARIOS

Churchill area

SPRING: 2080'S

Models



Warmer

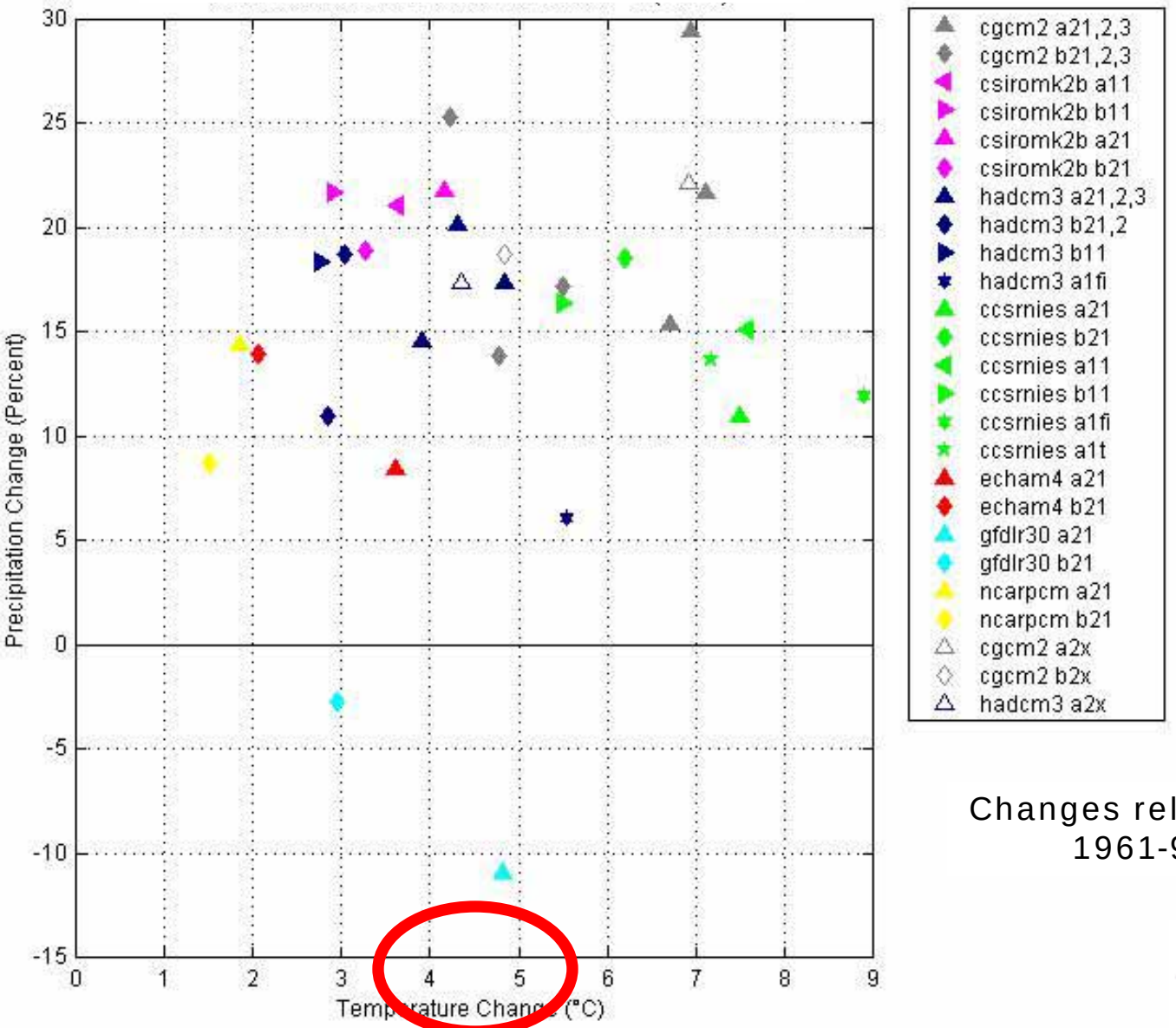
Changes relative to 1961-90

CANADIAN CLIMATE IMPACTS SCENARIOS

Churchill area

SUMMER: 2080'S

Models



Warmer

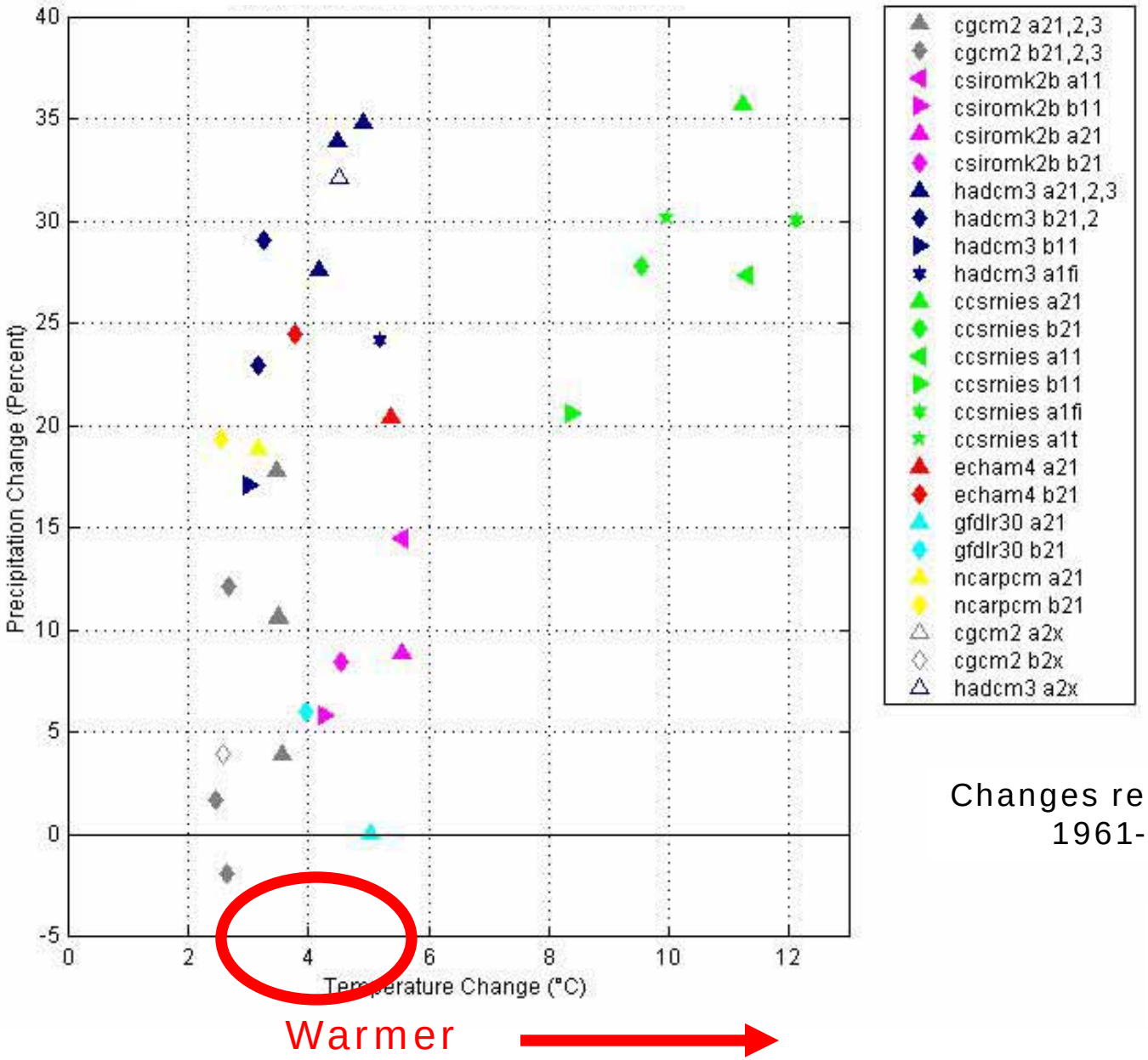
Changes relative to 1961-90

CANADIAN CLIMATE IMPACTS SCENARIOS

Churchill area

FALL: 2080'S

Models



Warmer

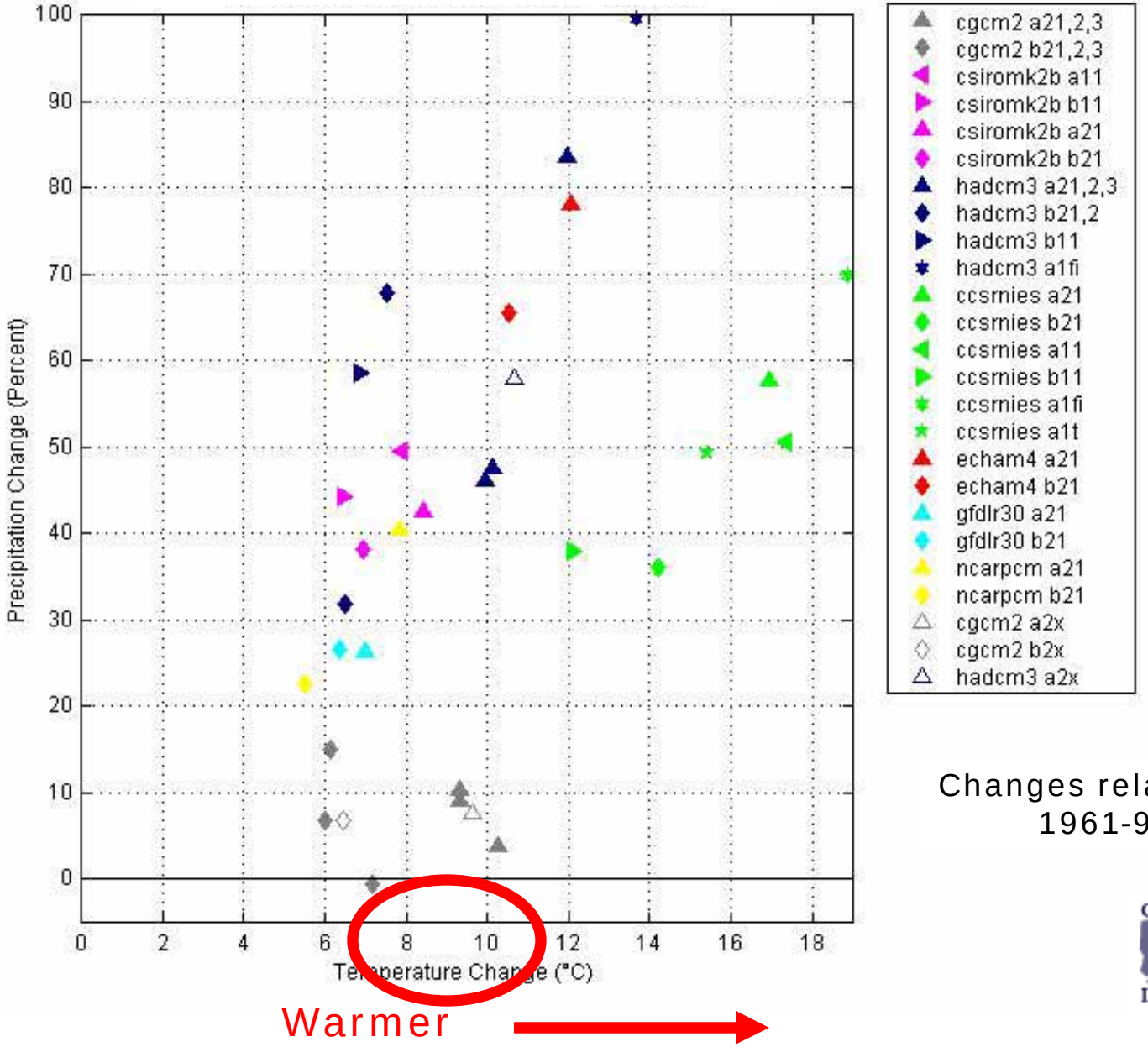
Changes relative to 1961-90

CANADIAN CLIMATE IMPACTS SCENARIOS

Churchill area

WINTER: 2080'S

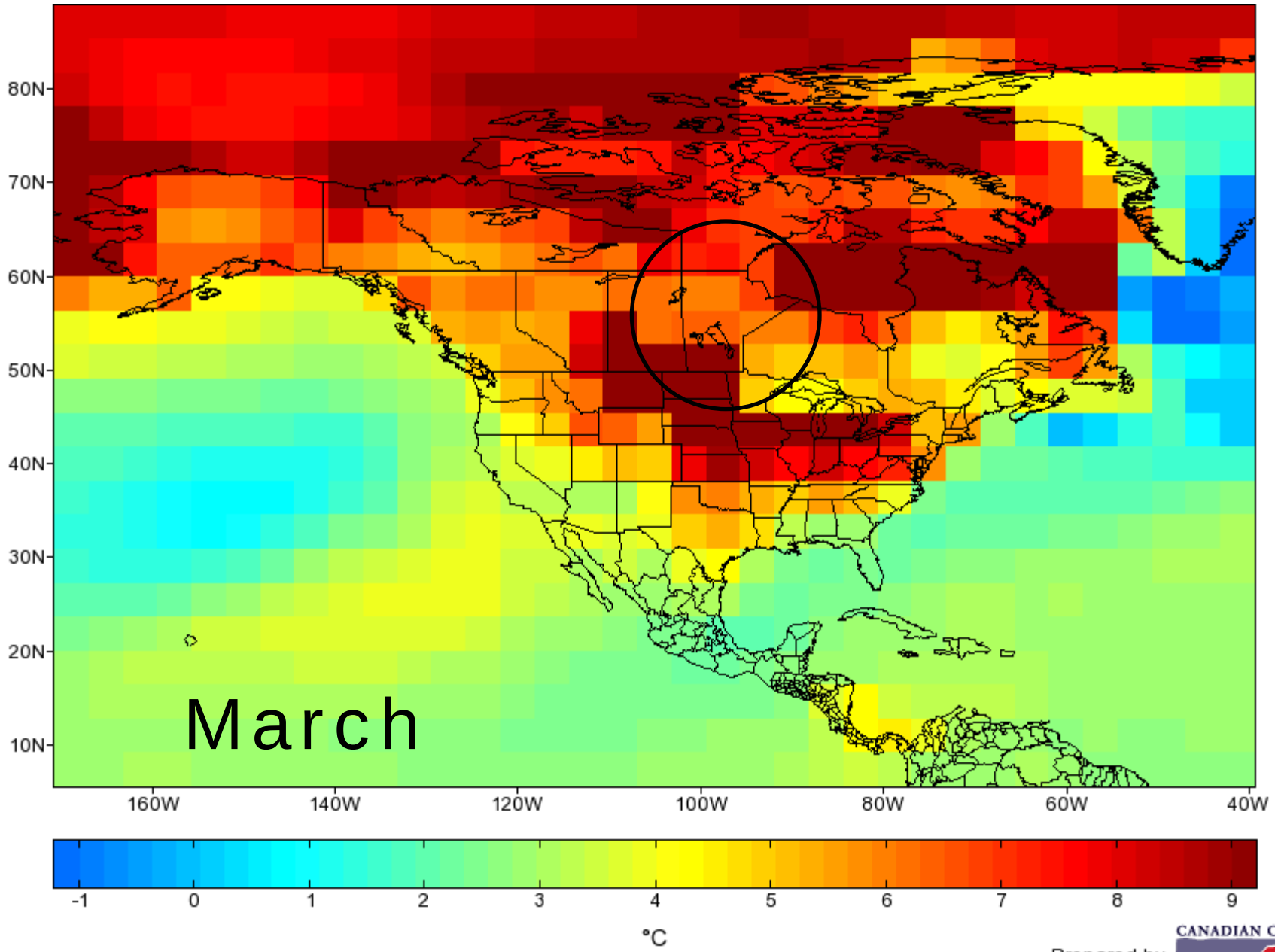
Models



Warmer

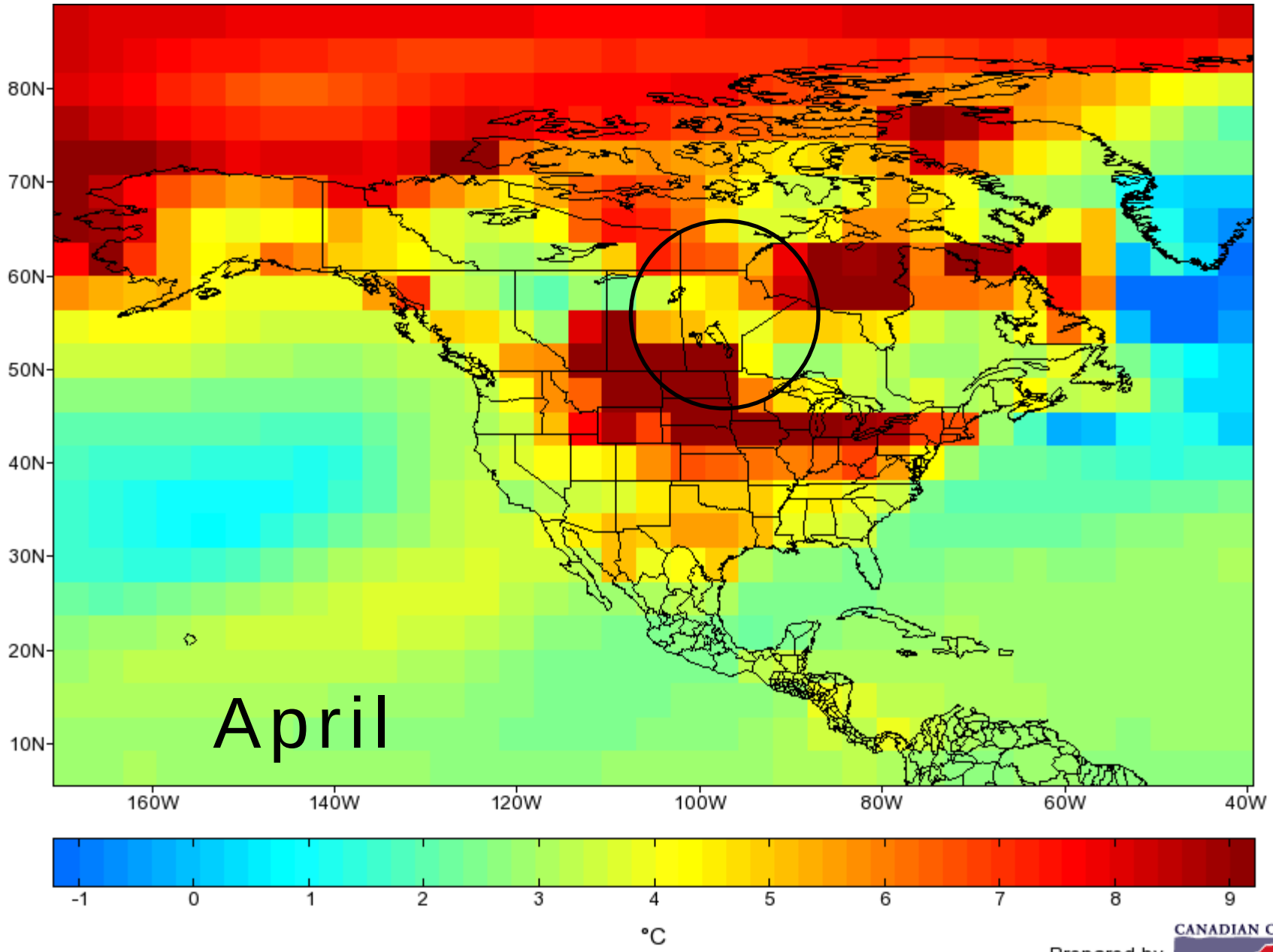
Changes relative to 1961-90

CANADIAN CLIMATE IMPACTS SCENARIOS



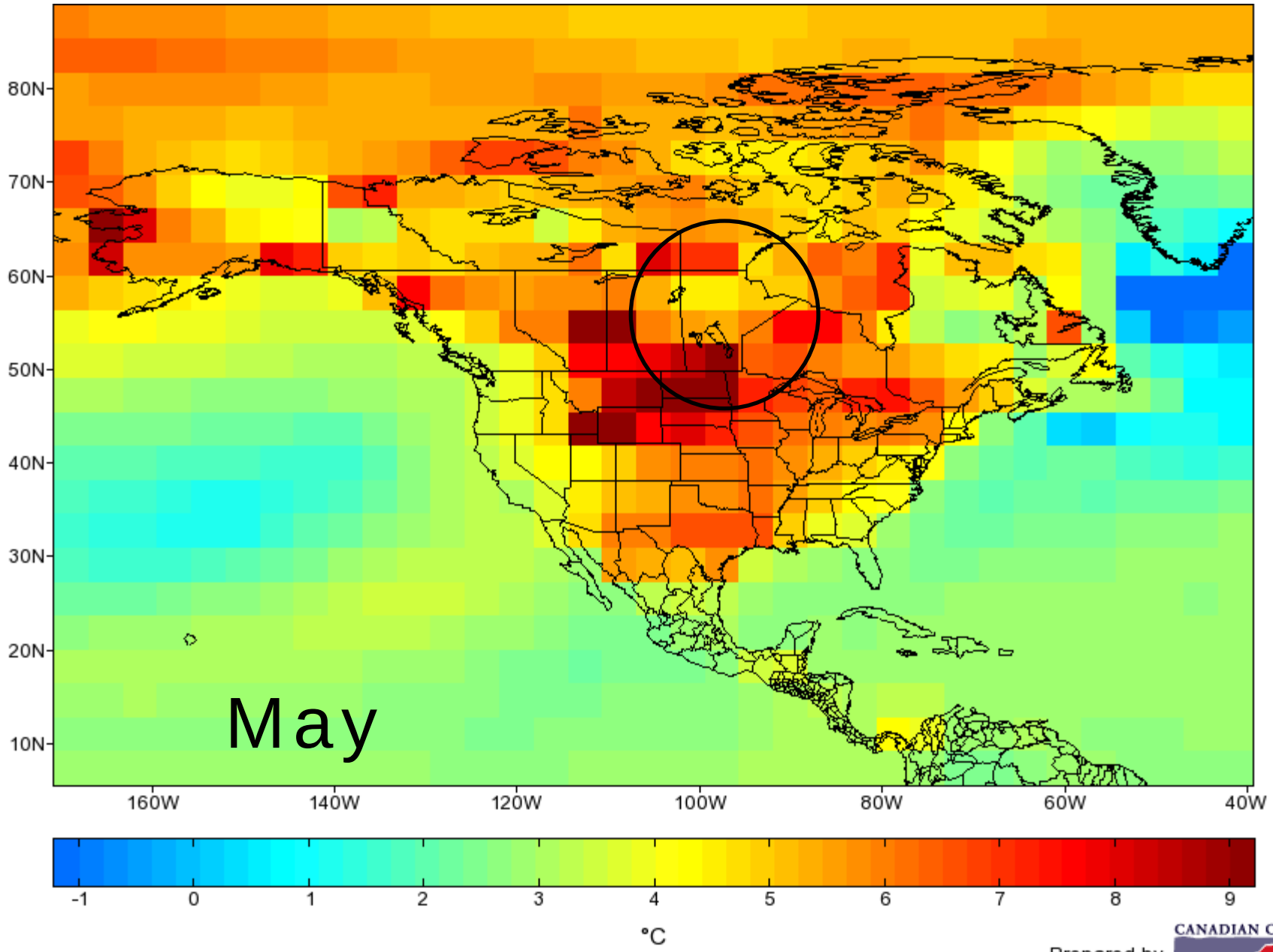
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **March**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



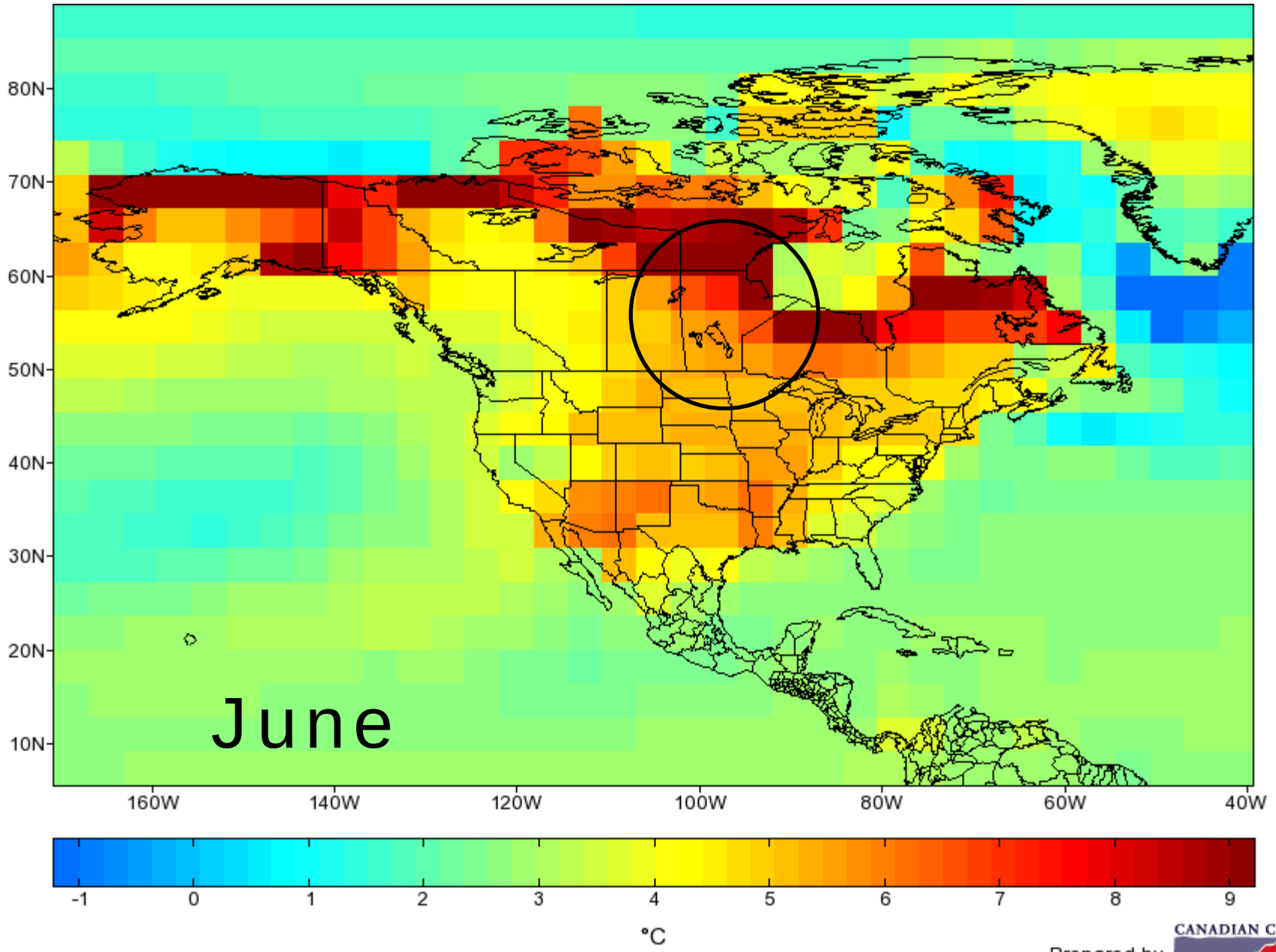
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **April**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



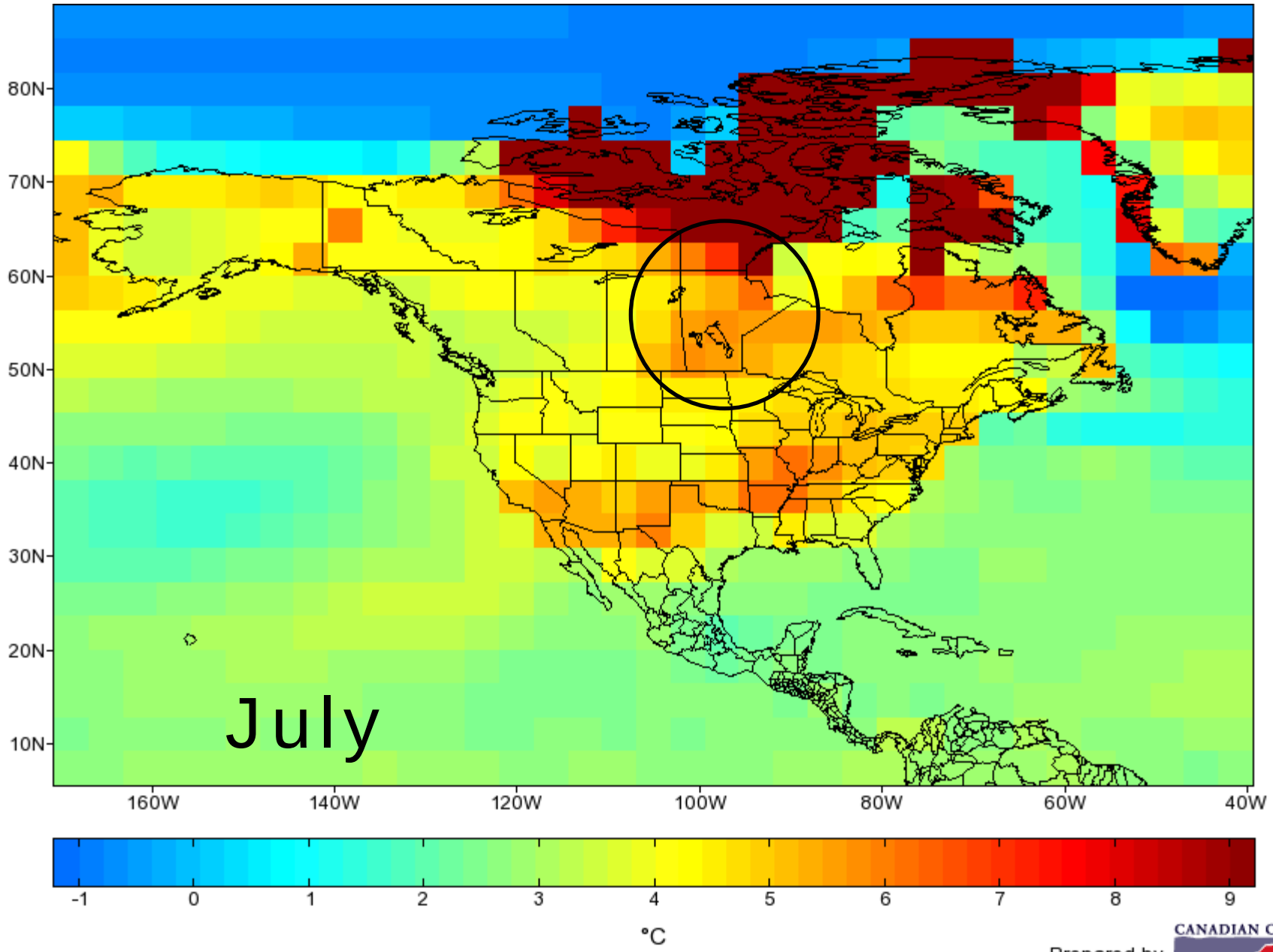
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **May**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



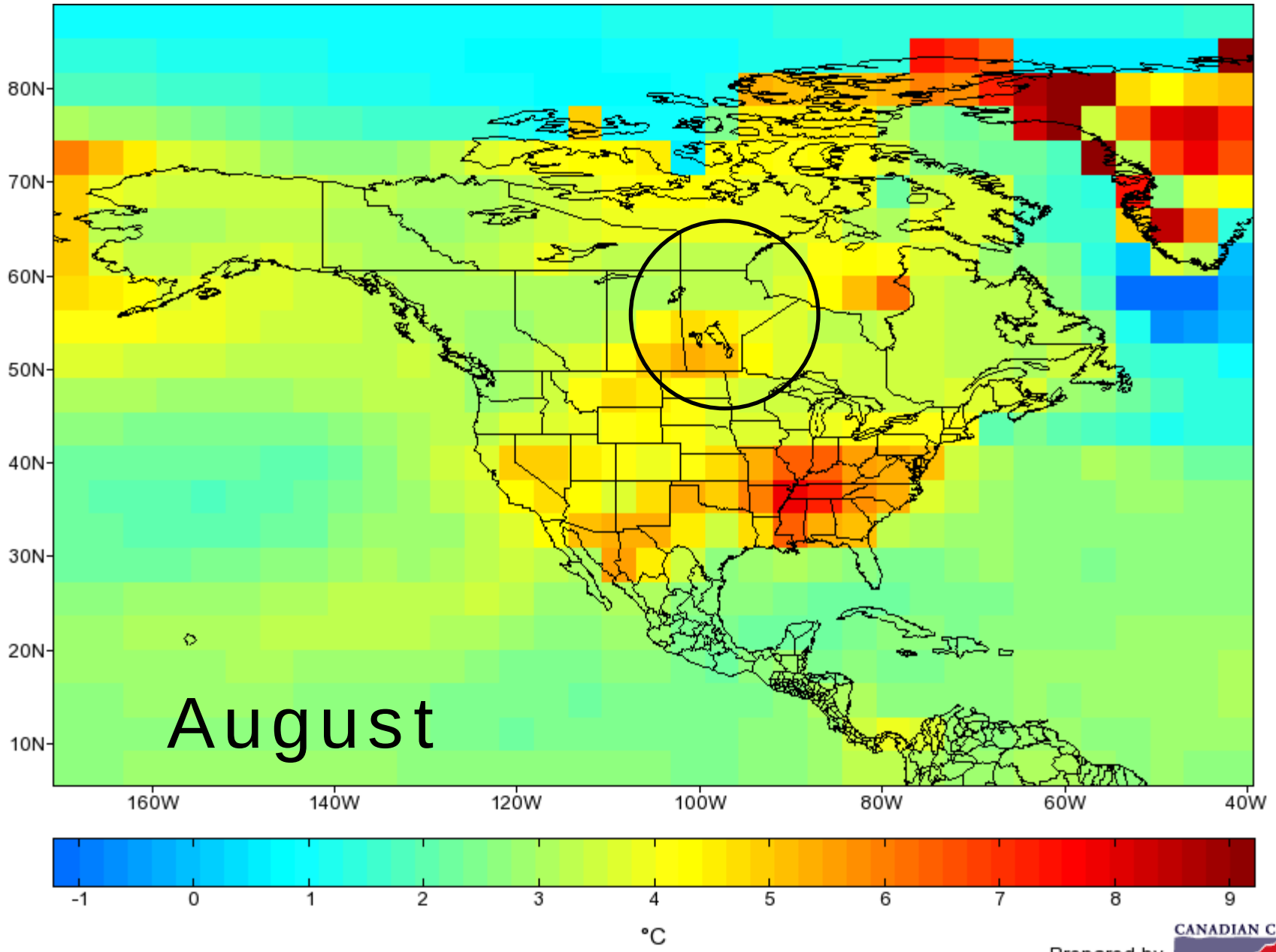
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **June**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



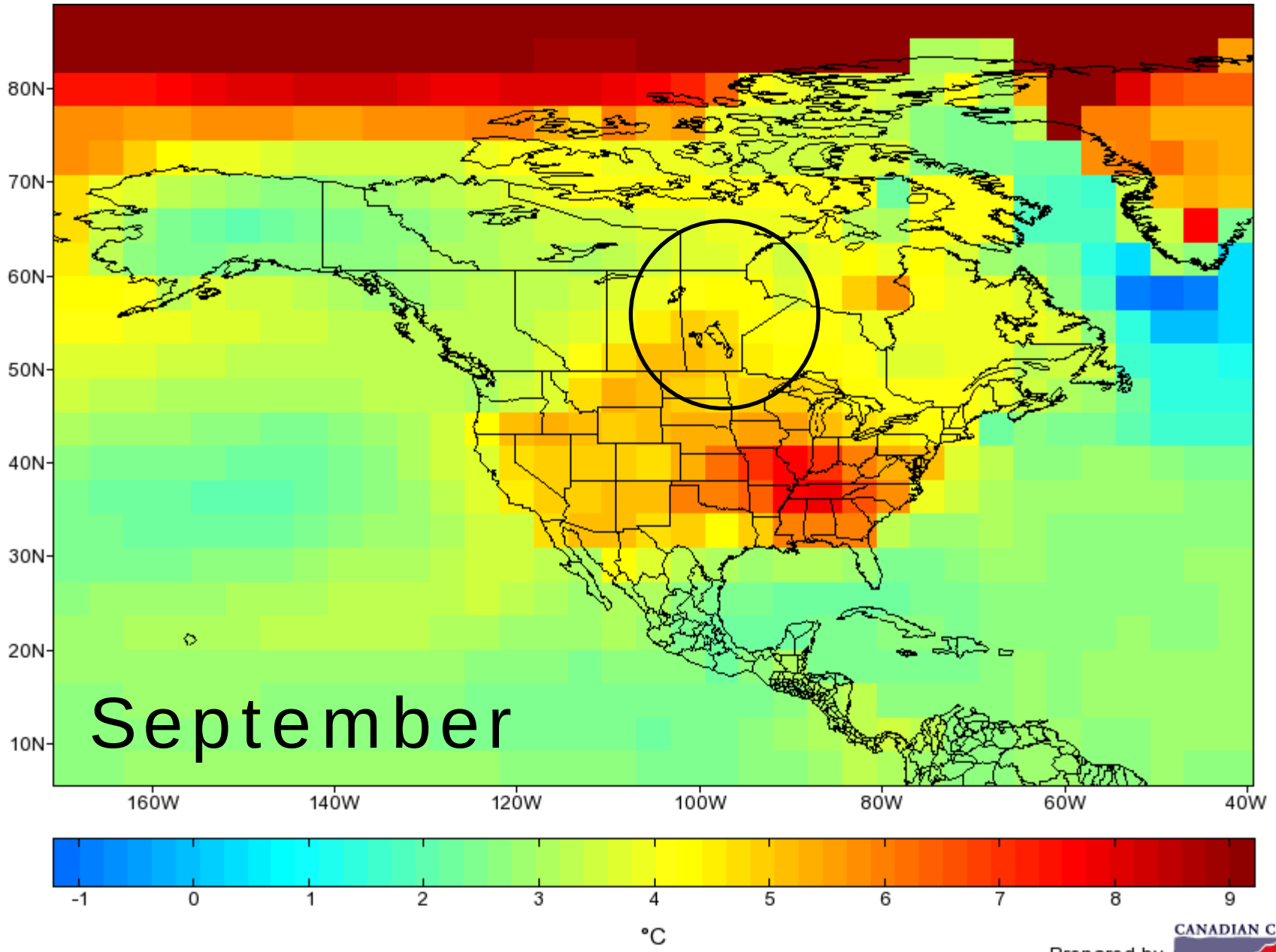
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **July**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



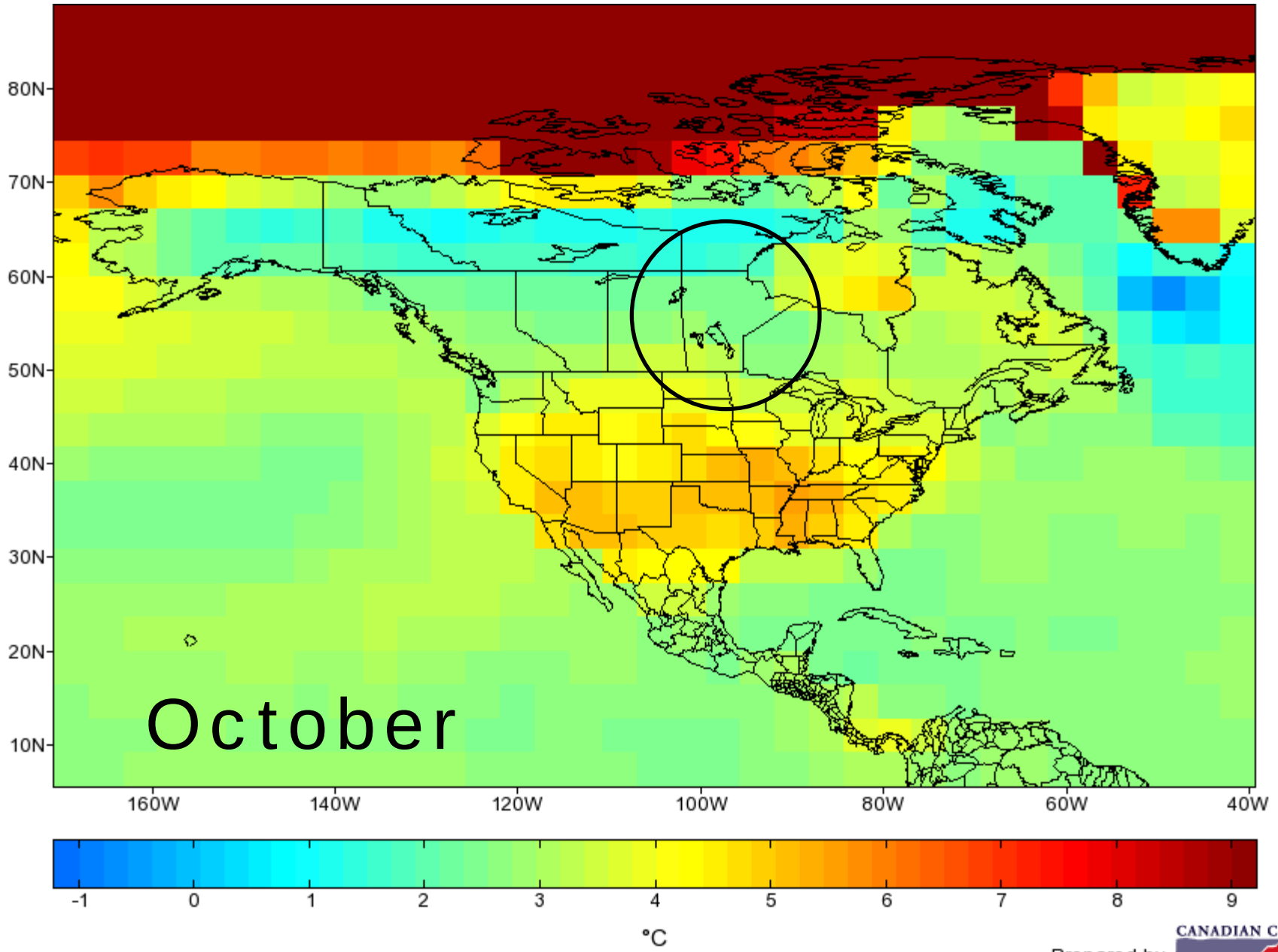
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **August**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



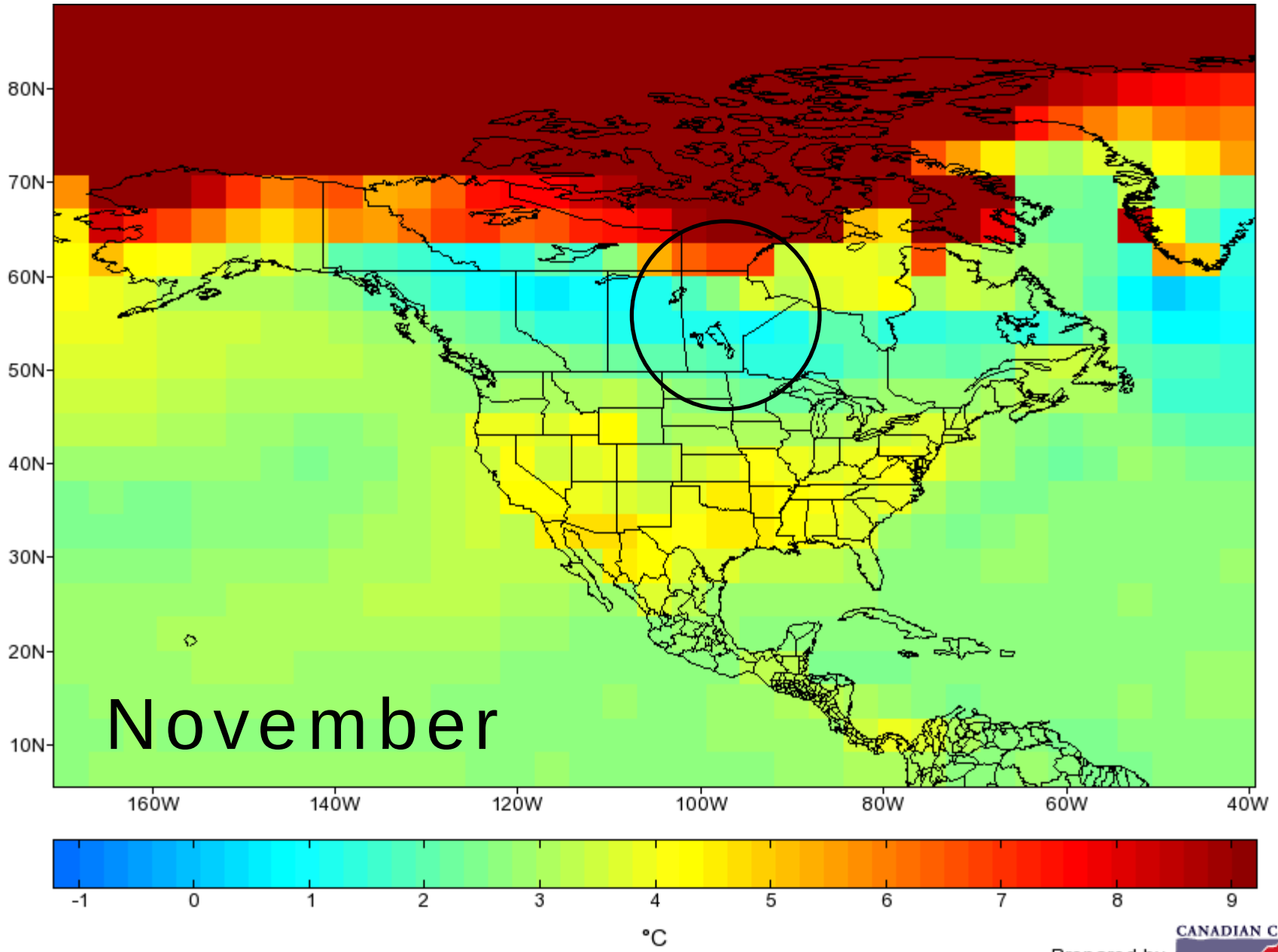
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **September**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



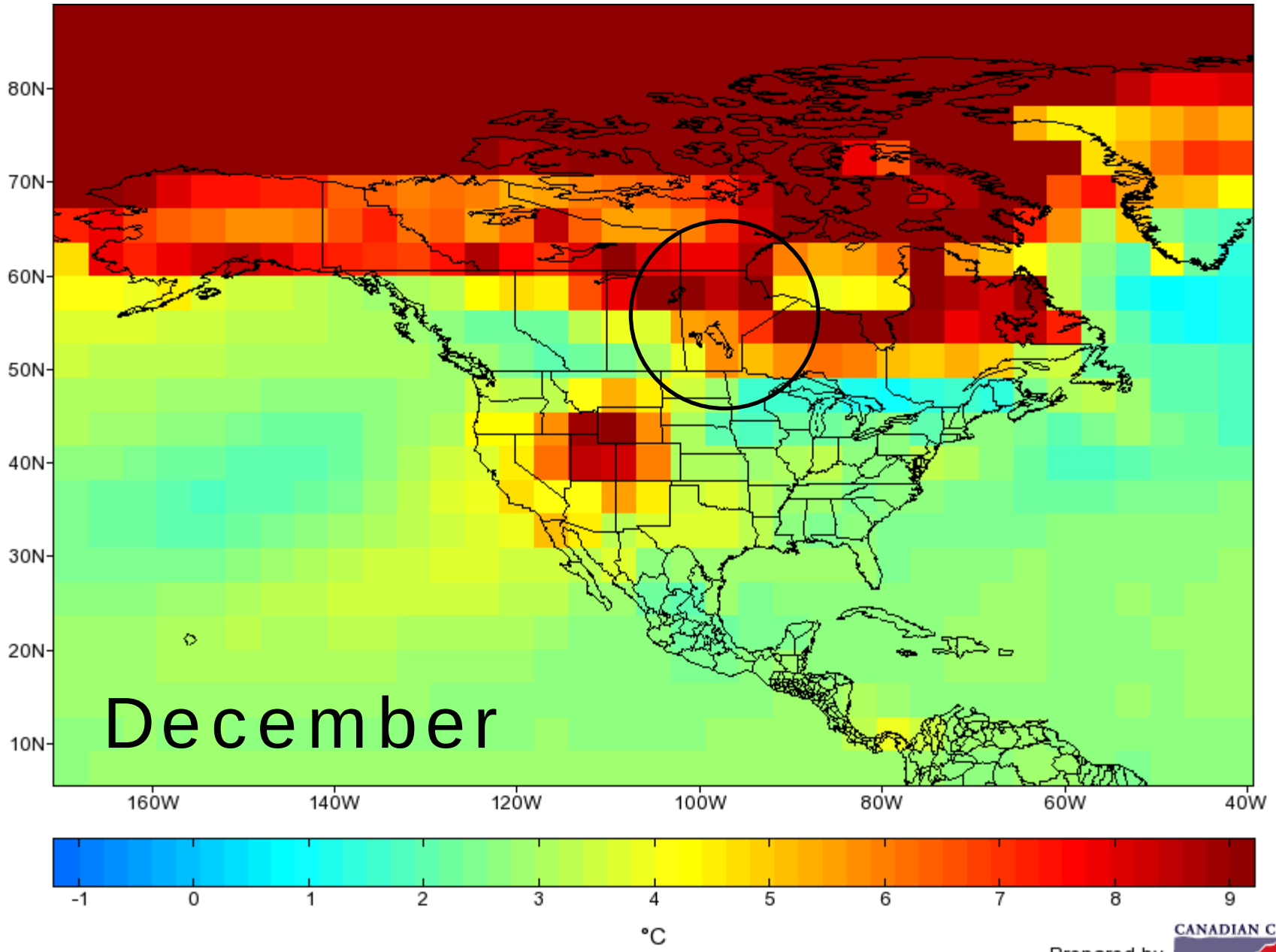
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **October**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



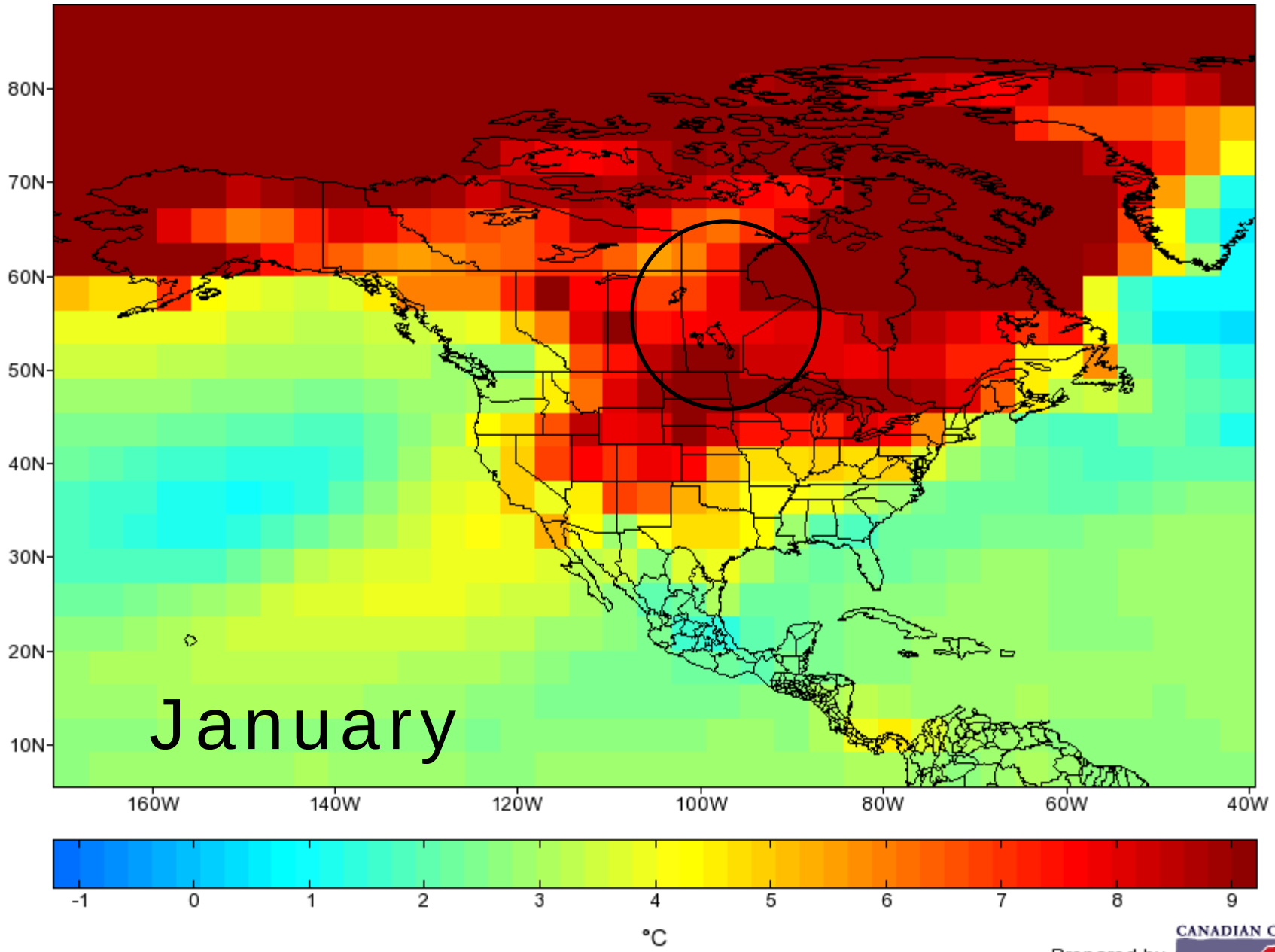
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **November**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



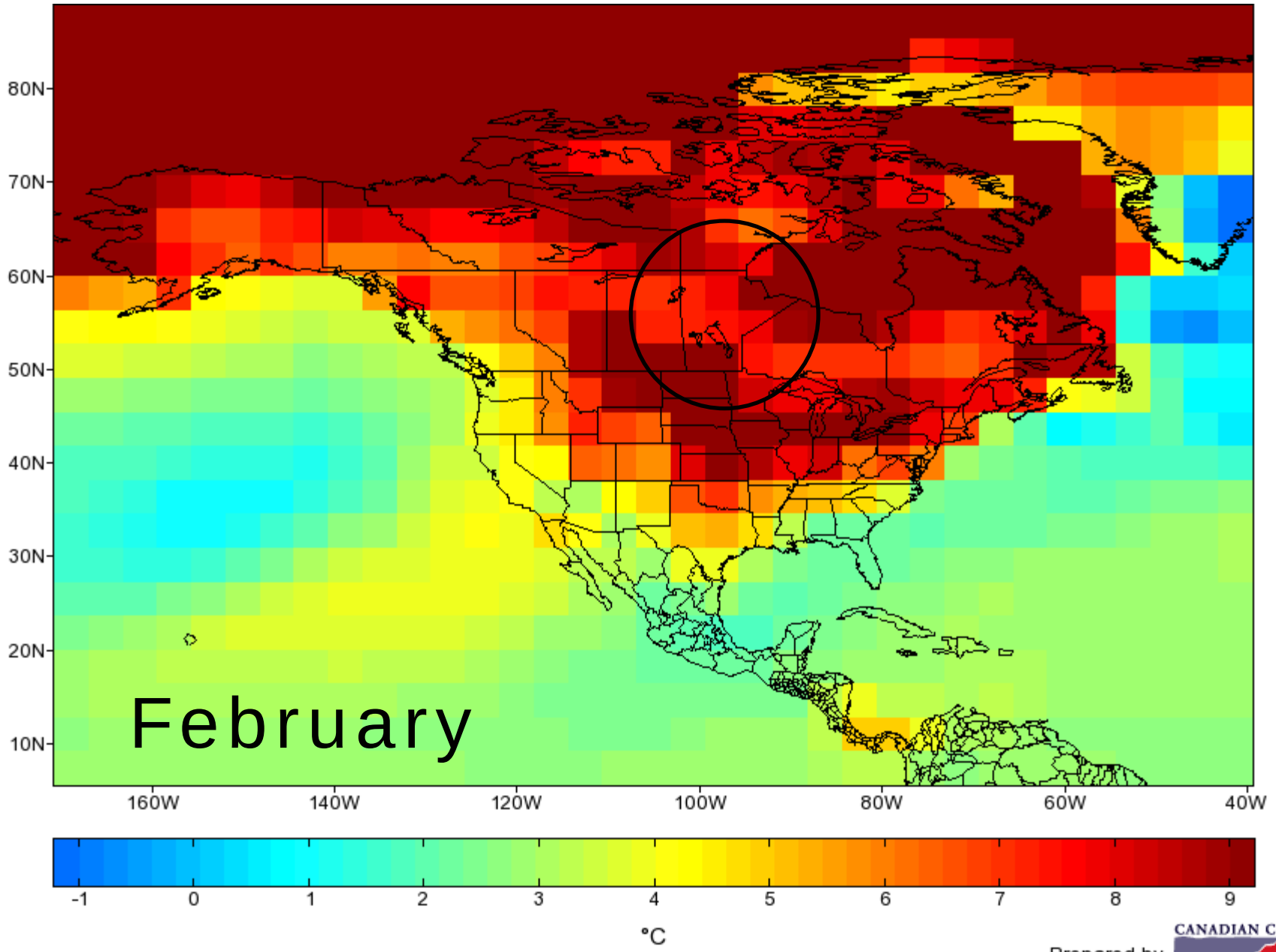
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **December**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **January**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS



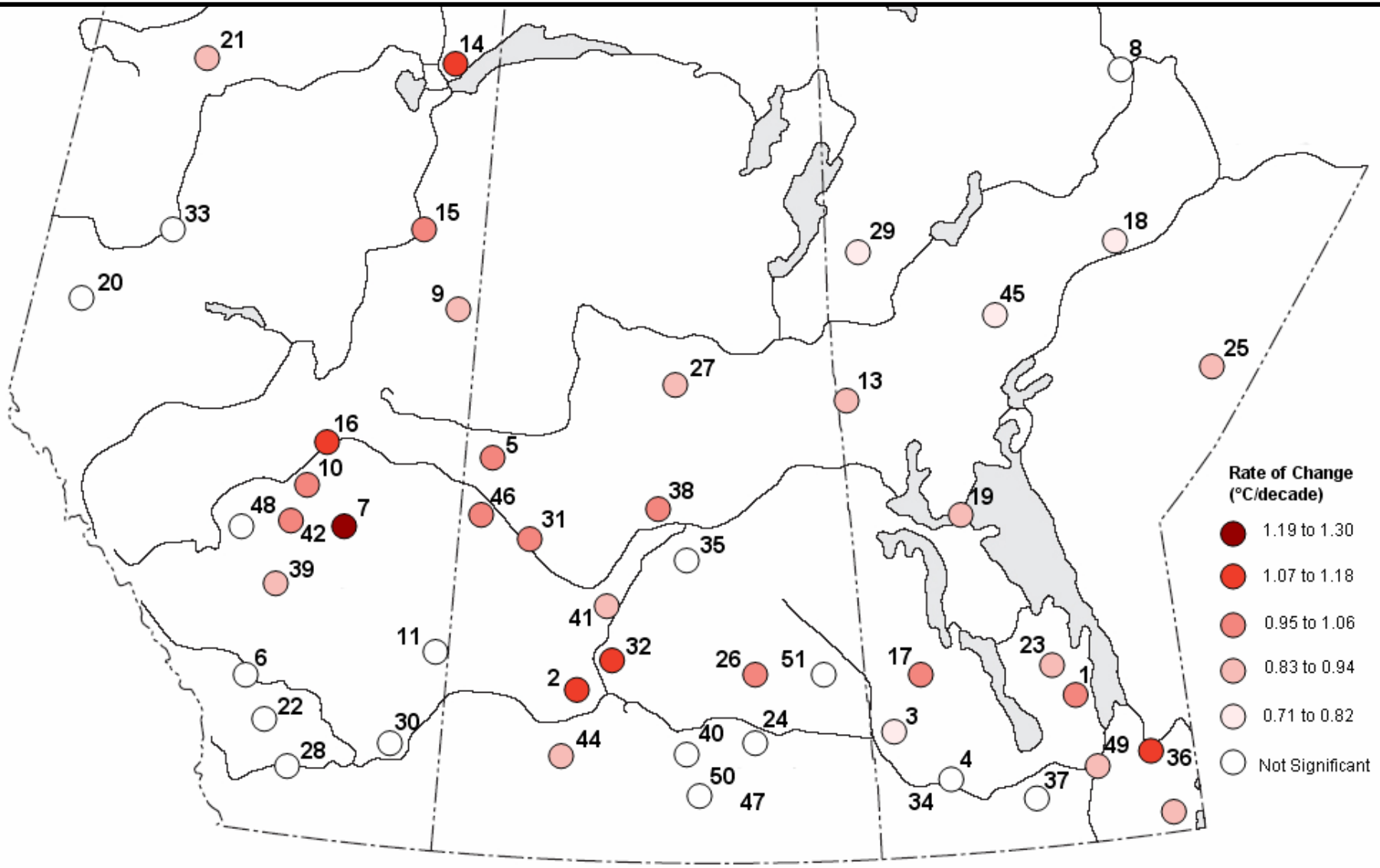
CGCM2 A21 (SRES) Mean Temperature Change - 2080s - **February**

Prepared by CANADIAN CLIMATE IMPACTS SCENARIOS

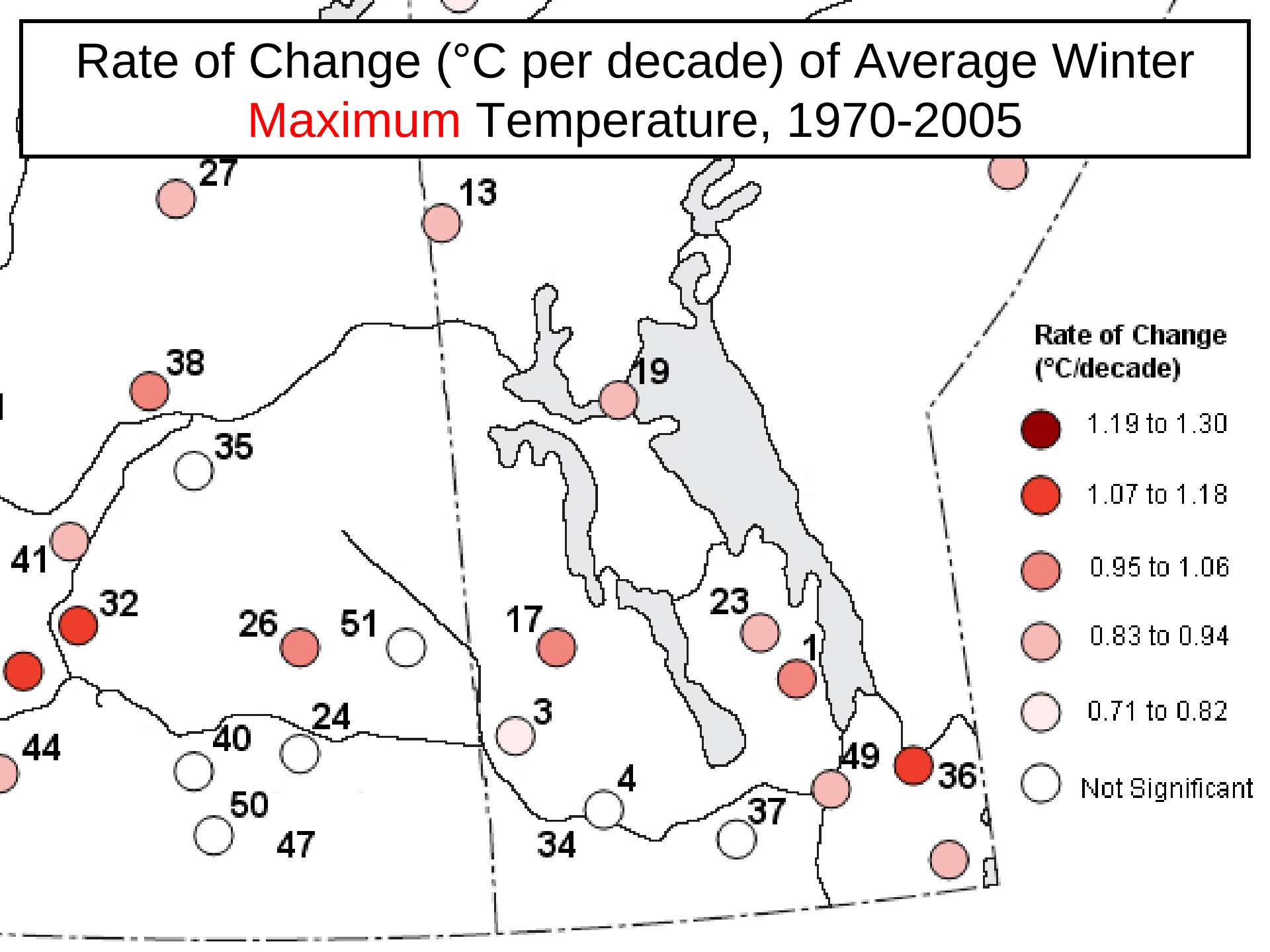
Expectations

- Shorter, warmer winters
- Wetter winters?
- Hotter summers
- Drier summers?
- More intense precipitation
- More variability?

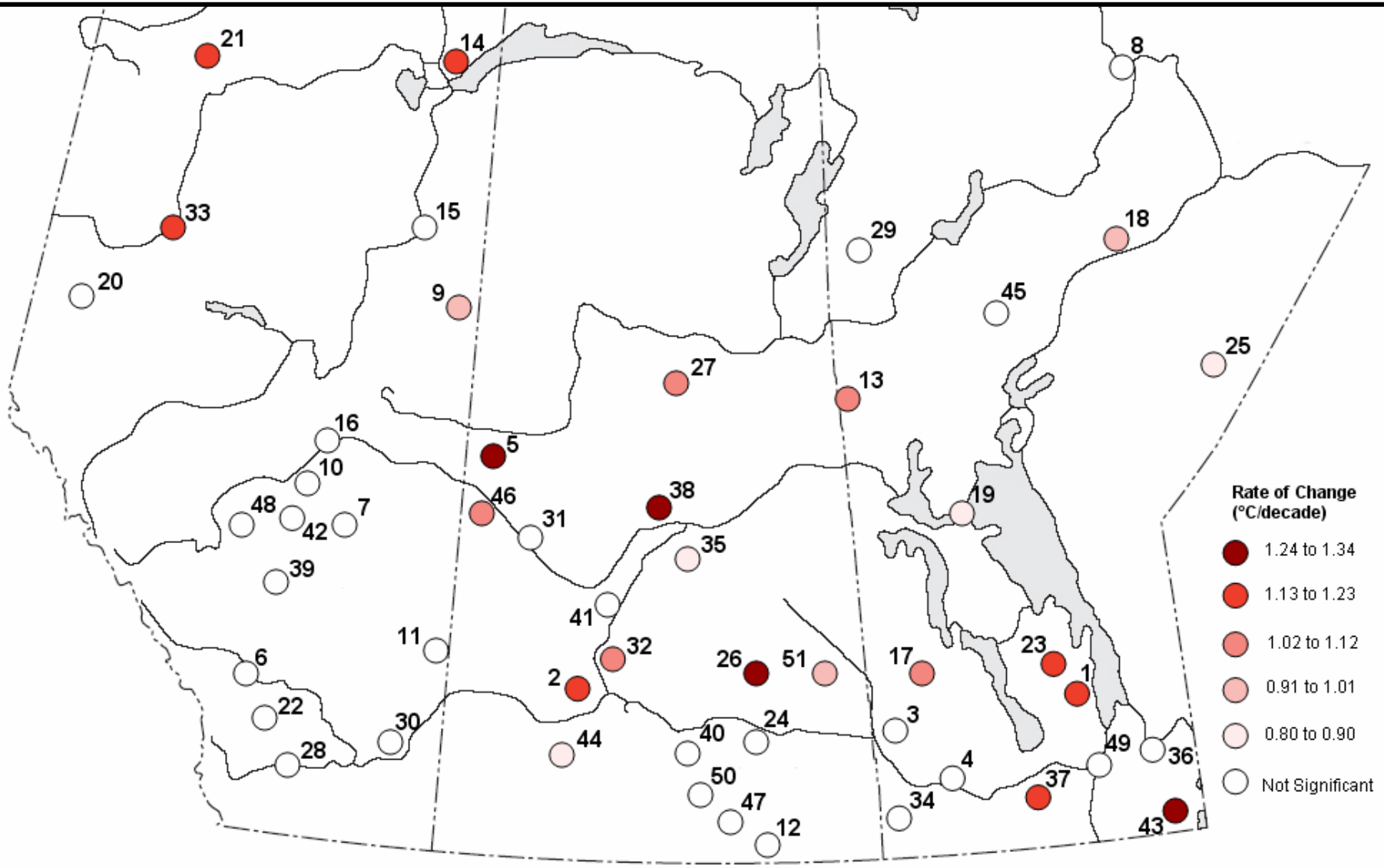
Rate of Change (°C per decade) of Average Winter Maximum Temperature, 1970-2005



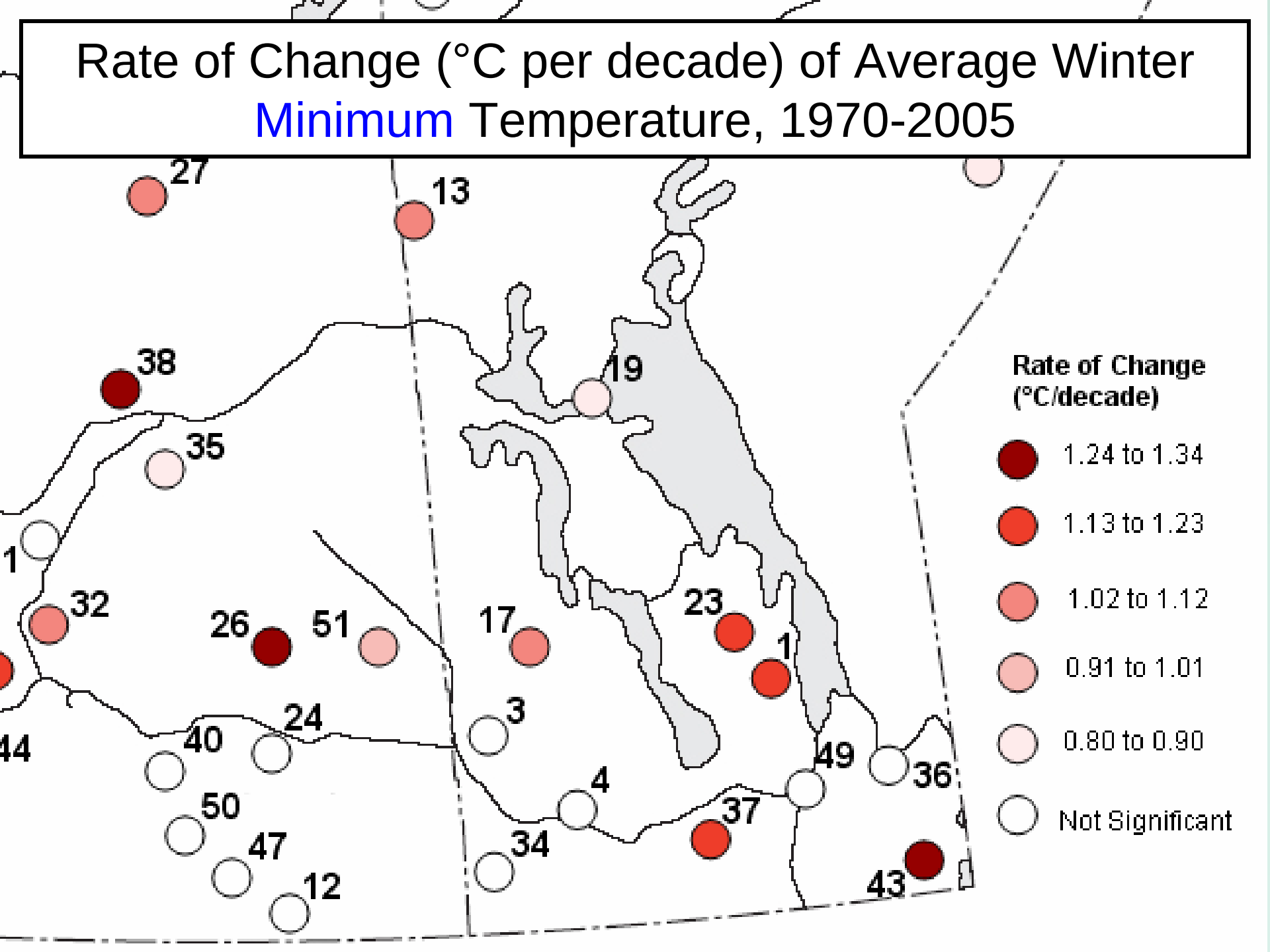
Rate of Change (°C per decade) of Average Winter Maximum Temperature, 1970-2005



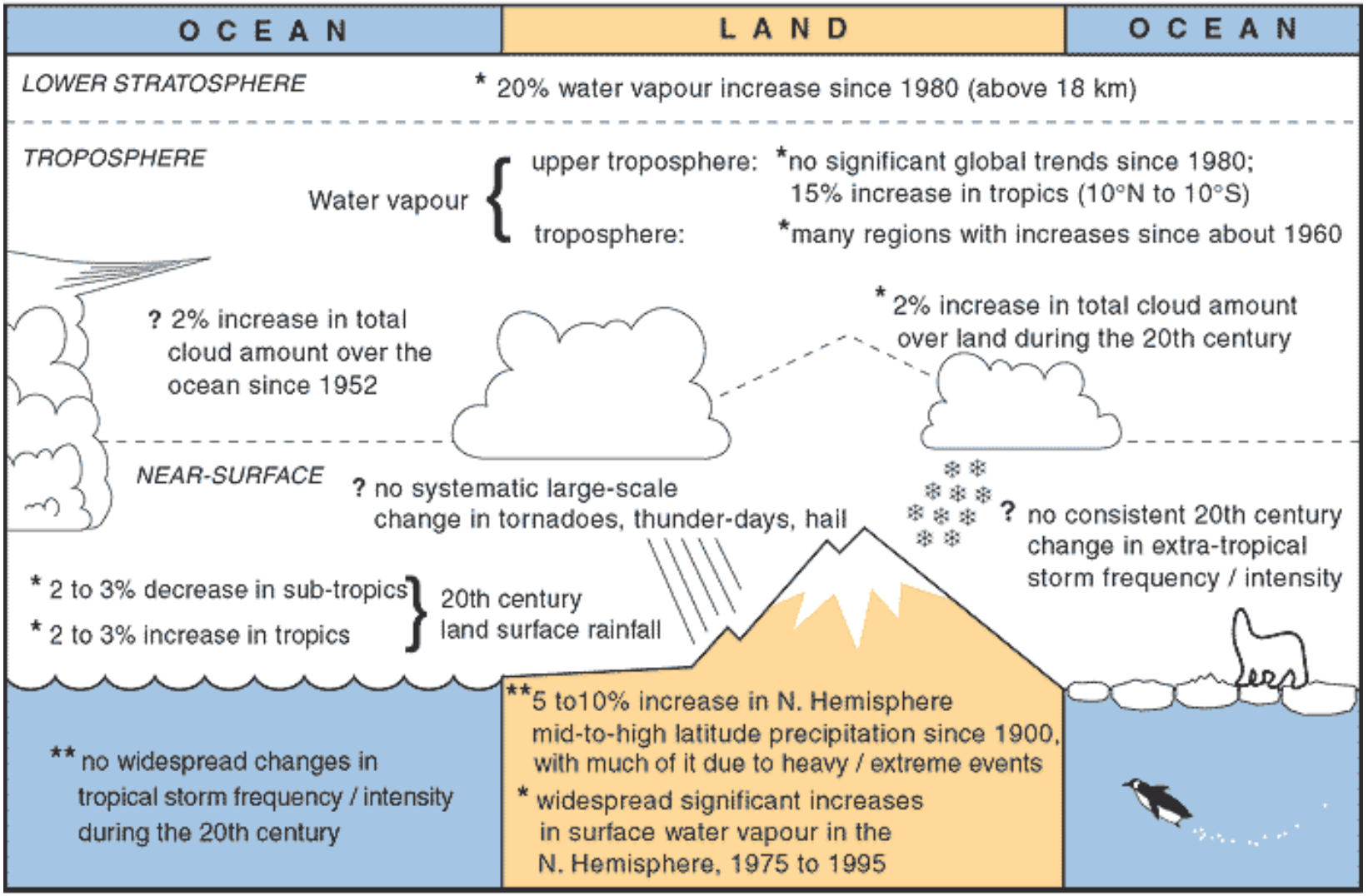
Rate of Change (°C per decade) of Average Winter Minimum Temperature, 1970-2005



Rate of Change (°C per decade) of Average Winter Minimum Temperature, 1970-2005



(b) Hydrological and Storm related Indicators

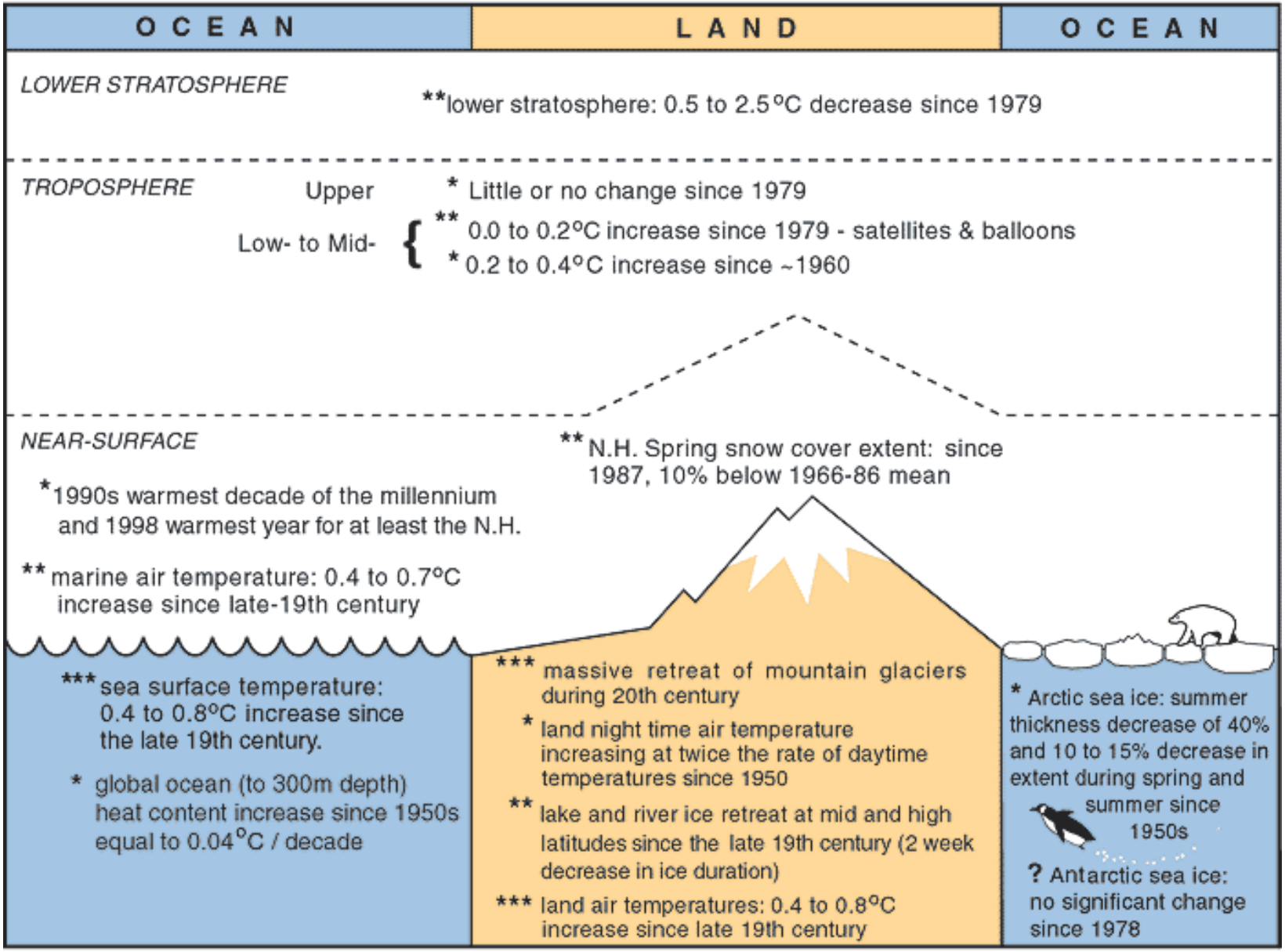


Likelihood:

*** Virtually certain (probability > 99%)
** Very likely (probability ≥ 90% but ≤ 99%)
* Likely (probability > 66% but < 90%)
? Medium likelihood (probability > 33% but ≤ 66%)

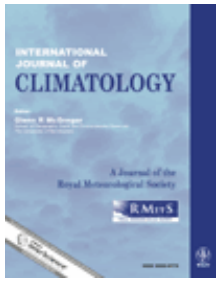
IPCC

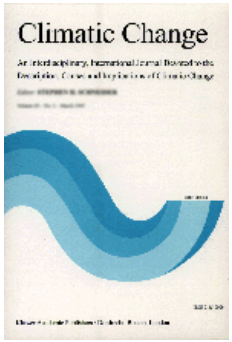
(a) Temperature Indicators



IPCC

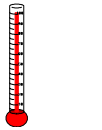
New studies documenting climate change are published almost every day





Potential Climate Change Impacts

Climate Changes



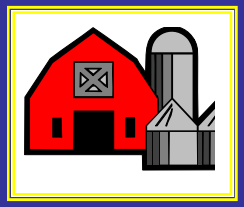
Temperature

Precipitation

Sea Level Rise

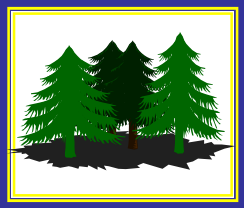
Health

Weather-related mortality
Infectious diseases
Air-quality respiratory illnesses



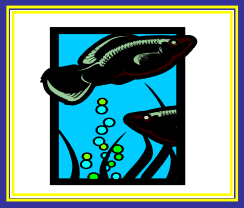
Agriculture

Crop yields
Irrigation demands



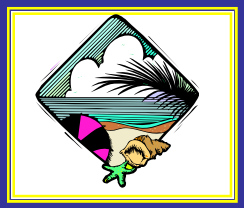
Forests

Change in forest composition
Shift geographic range of forests
Forest health and productivity



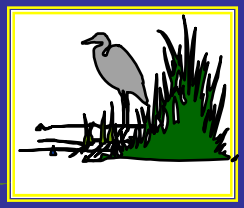
Water Resources

Changes in water supply
Water quality
Increased competition for water



Coastal Areas

Erosion of beaches
Inundation of coastal lands
Costs to protect coastal communities



Species and Natural Areas

Shift in ecological zones
Loss of habitat and species

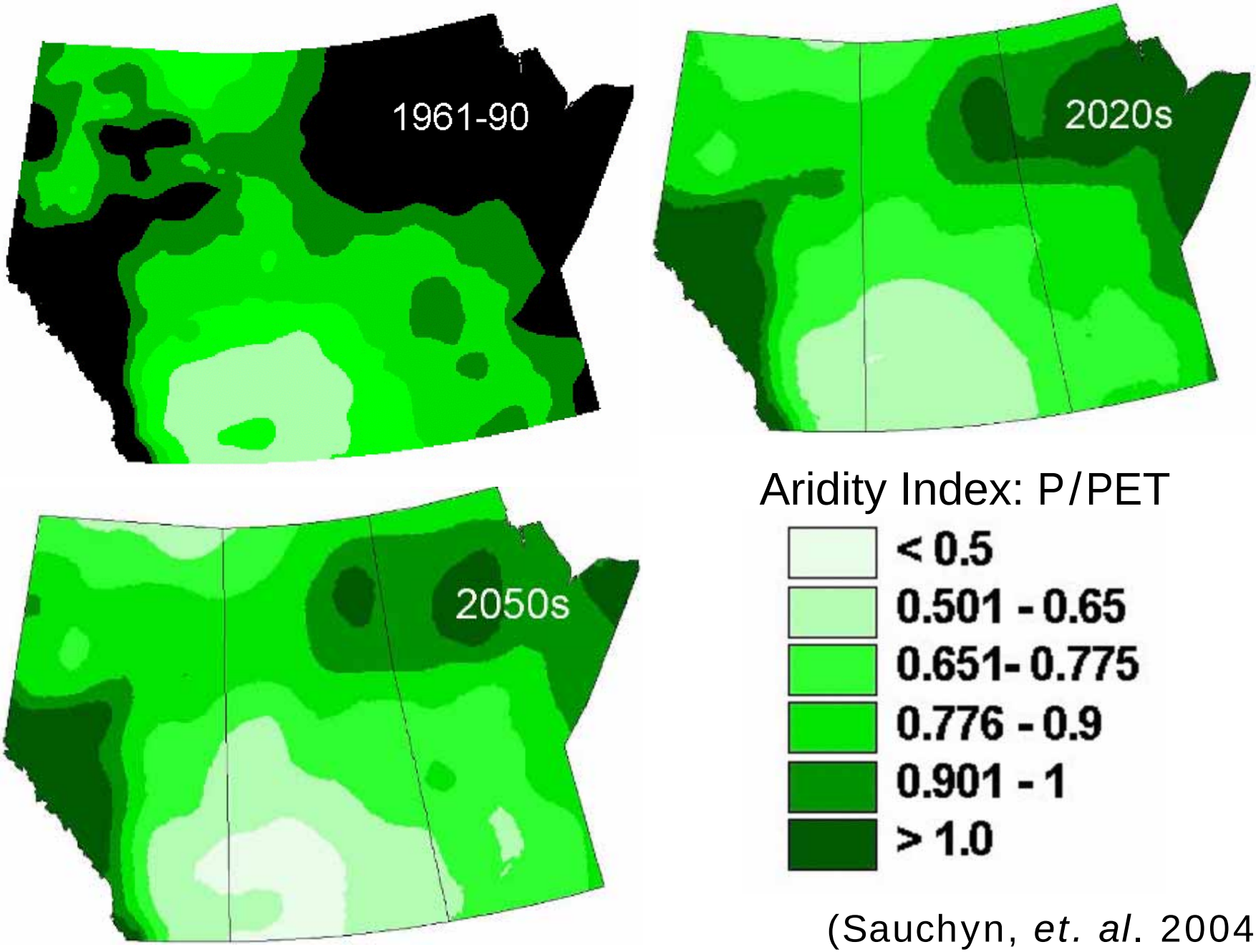
Source: EPA

Water

- Availability
- Quality
- Allocation
- Reliability
- Waste-water management

Agriculture

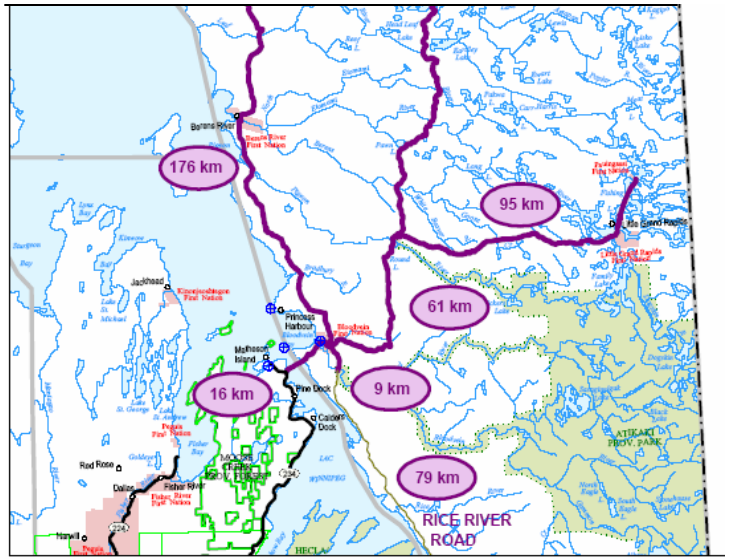
- Reliability
- Financial infrastructure
- Crop selection
- Pests
- Associated industries
- Irrigation



(Sauchyn, *et. al*. 2004)

Transportation

- More heat stress on roads
- Less snow clearing
- More freezing rain
- Less frost damage
- Enhanced erosion
- Stormwater management
- Winter roads



Using Average of Temperatures Projected by the GCMs, in the southeast of the province:

- 2020's: Roads open 3 days later, season 5 days shorter
- 2050's: Roads open 5 days later, season 10 days shorter
- 2080's: Roads open 7 days later, season two weeks shorter

Extremes

- Drought
- Local and large floods
- Thunderstorms
- Freezing rain
- Heat waves
- Forest fires

Need for Adaptation

- Minimize social impacts
- Minimize economic impacts
- Conserve resources
- Apply social justice
- Expand planning horizons
- Maximize opportunities

Barriers to Adaptation

- Understanding
- Support
- Leadership
- Jurisdictional issues
- Budgets
- Training
- Competing problems

climatechangeconnection.org

Climate Change Connection

- Manitobans & Climate Change
- How Do We Know
- What Could Happen
- Emissions & Impacts
- What We Can Do...
- kids Korner

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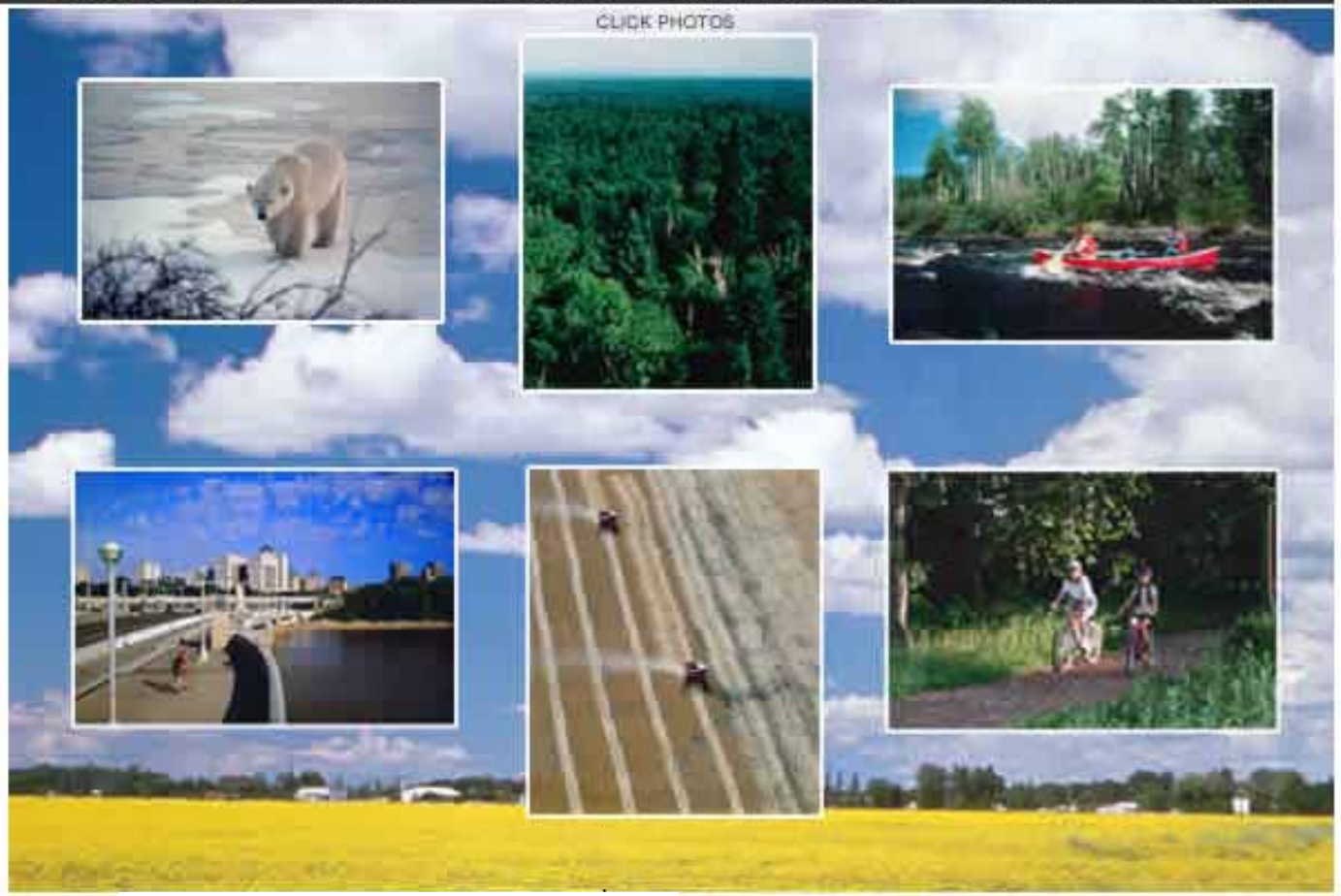

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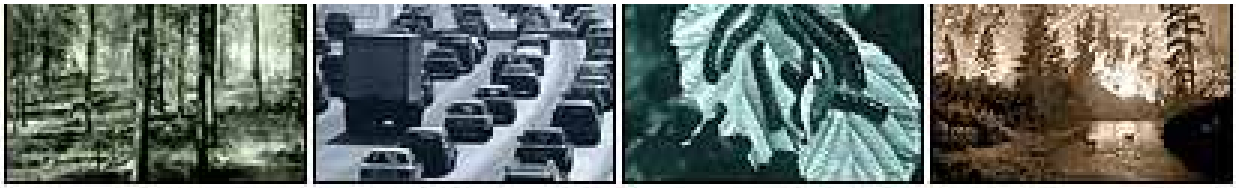

PRAIRIE ADAPTATION RESEARCH COLLABORATIVE