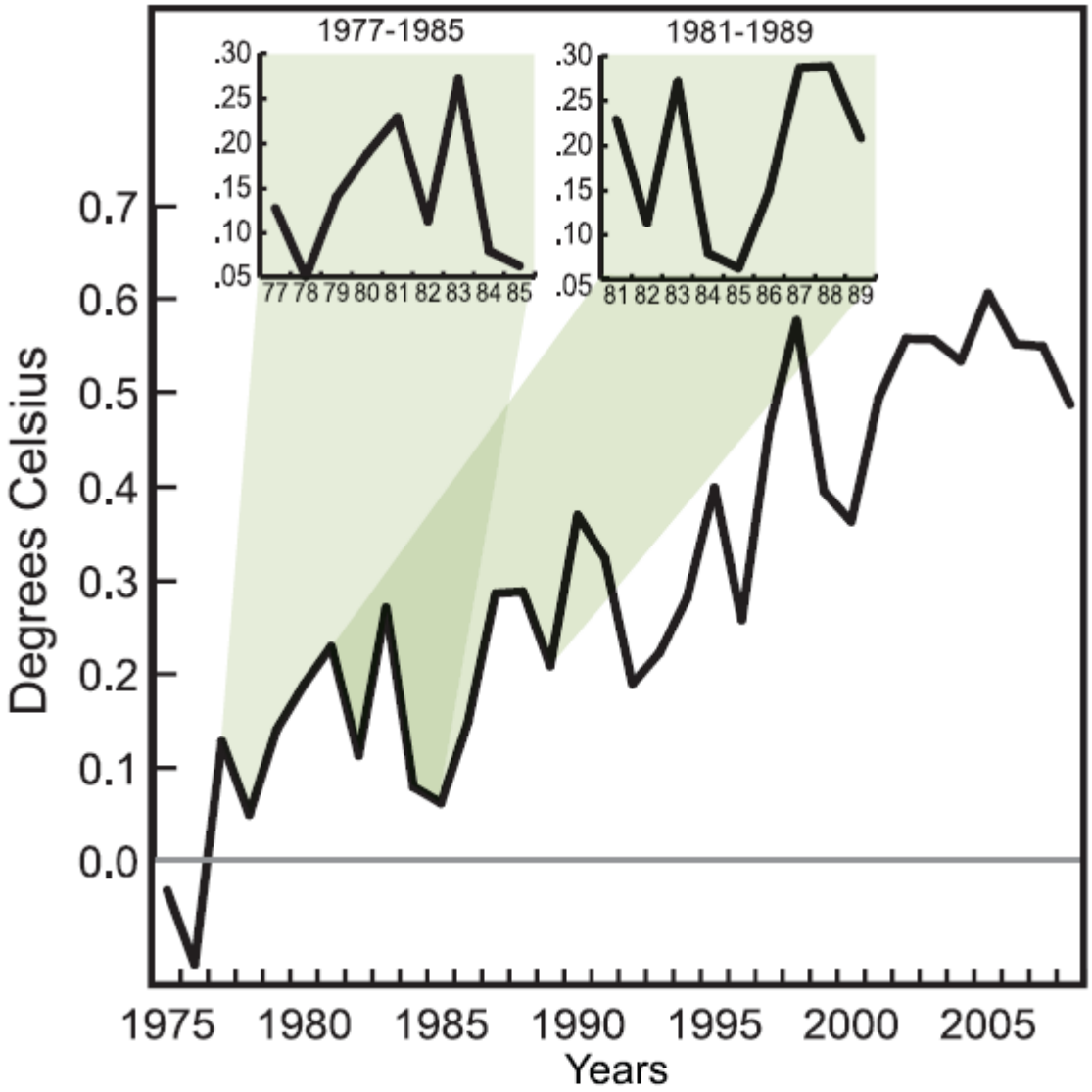
Climate Change and the Implications for Southern Alberta

Dave Sauchyn, Prairie Adaptation Research Collaborative, U of R

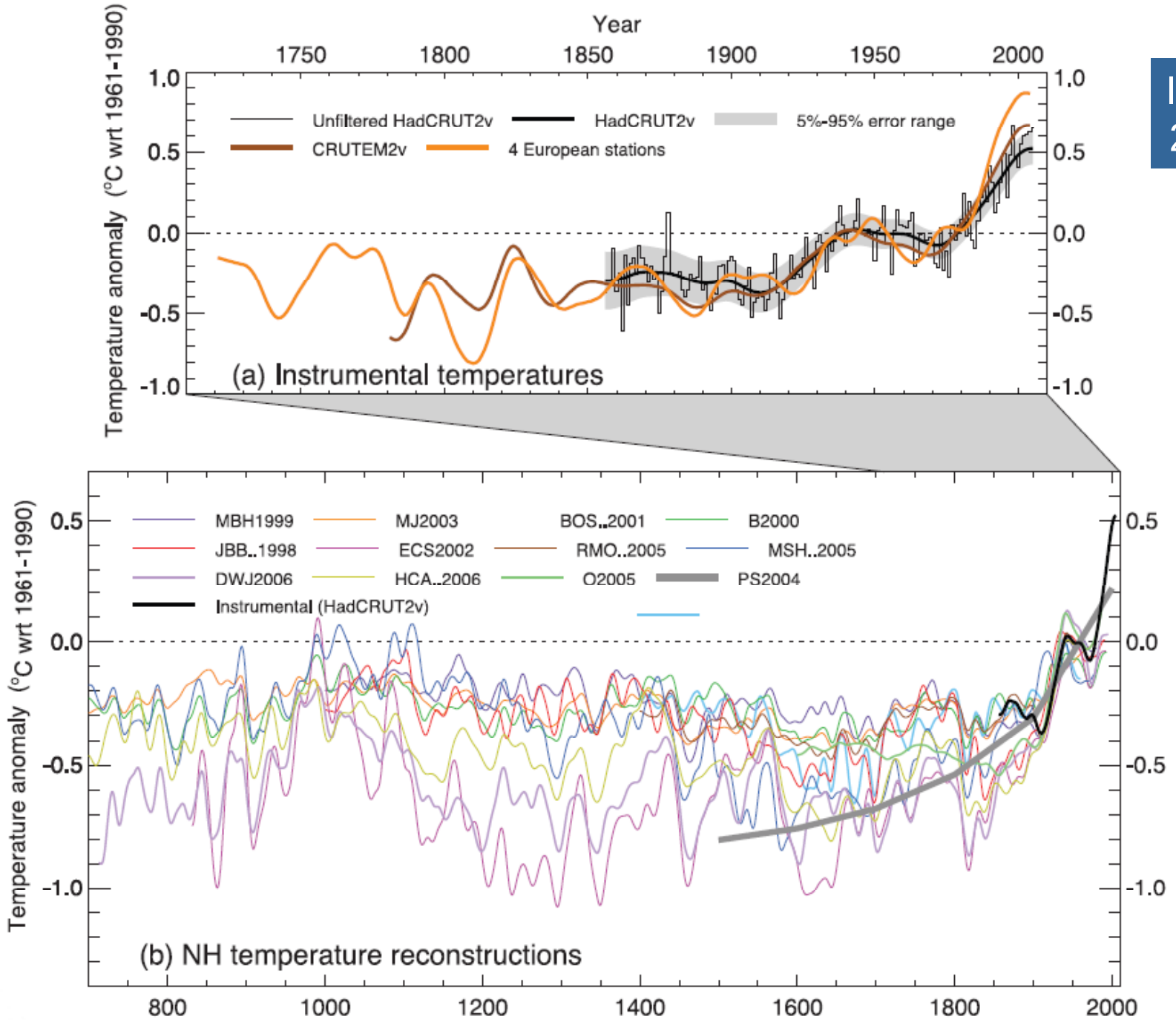
Living in the Natural Environment 2010

Cochrane, AB, February 5, 2010

Is the climate warming or cooling?

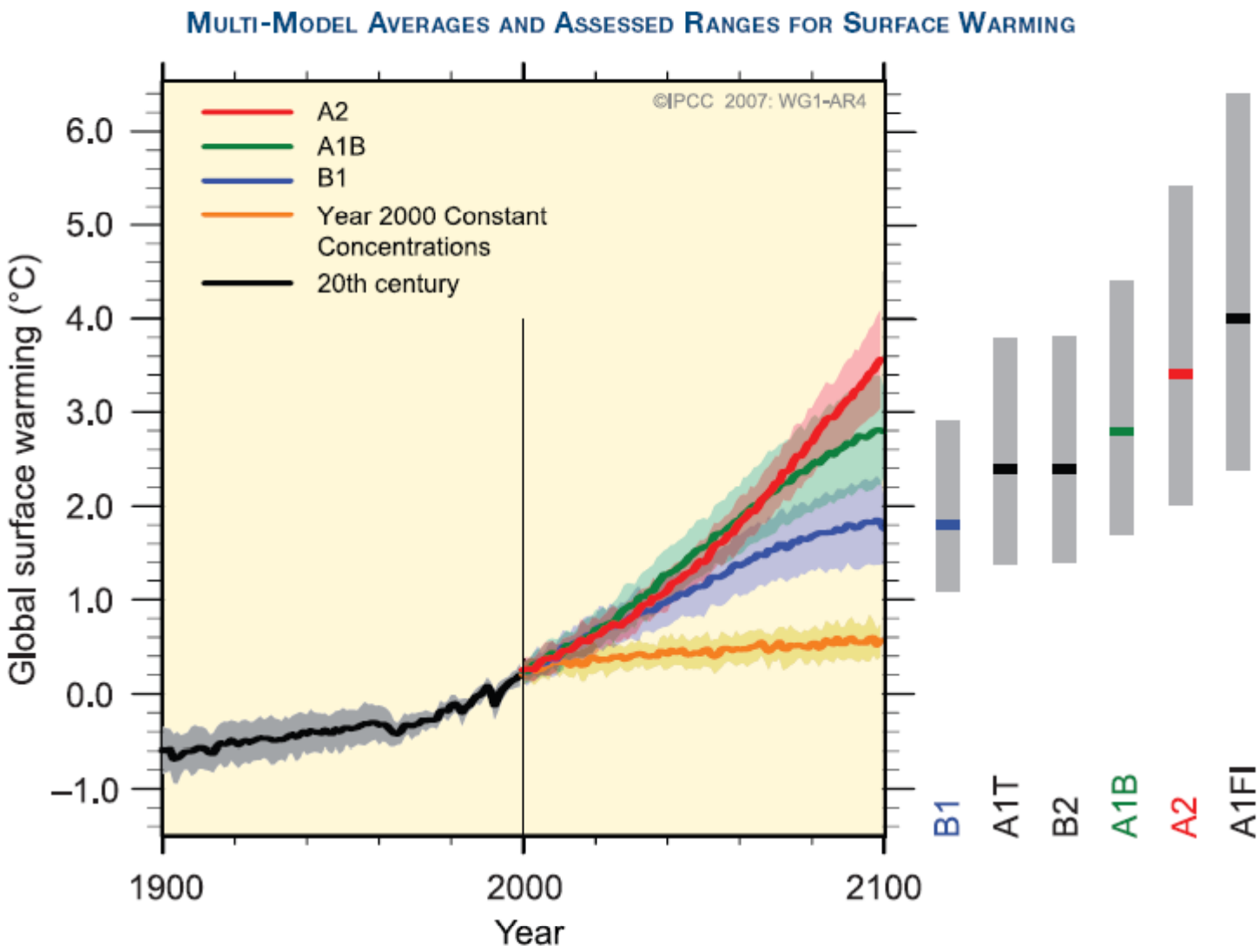


Easterling and Wehner, 2009

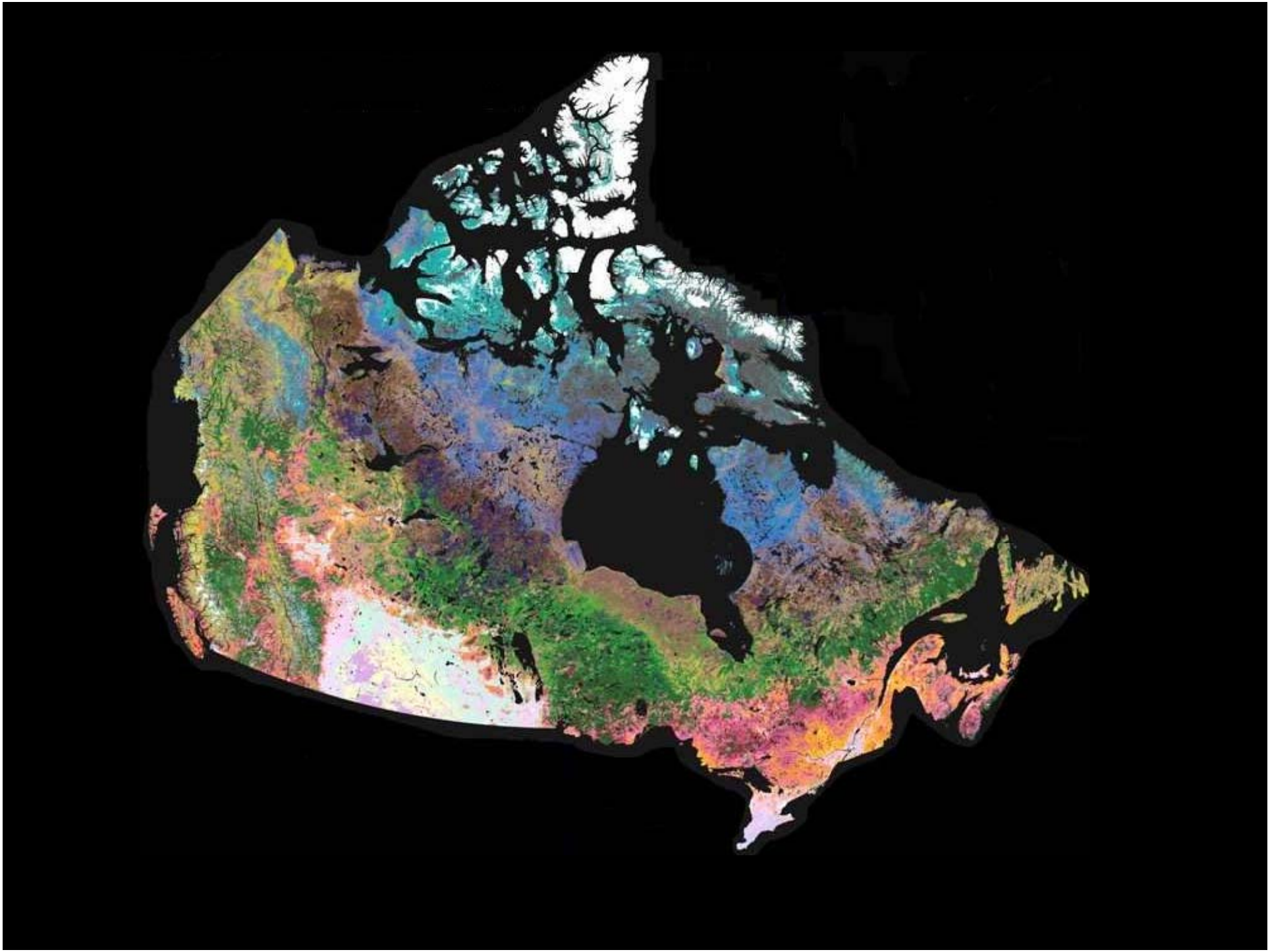

Year
1750
1800
1850
1900
1950
2000
Temperature anomaly (°C wrt 1961-1990)
1.0
0.5
0.0
-0.5
-1.0
Unfiltered HadCRUT2v
HadCRUT2v
5%-95% error range
CRUTEM2v
4 European stations
(a) Instrumental temperatures
MBH1999
MJ2003
BOS..2001
B2000
JBB..1998
ECS2002
RMO..2005
MSH..2005
DWJ2006
HCA..2006
O2005
PS2004
Instrumental (HadCRUT2v)
(b) NH temperature reconstructions
800
1000
1200
1400
1600
1800
2000

IPCC 2007

Climate Projections (IPCC 2007)



Anthropogenic warming and sea level rise would continue for centuries, even if greenhouse gas concentrations were to be stabilized.



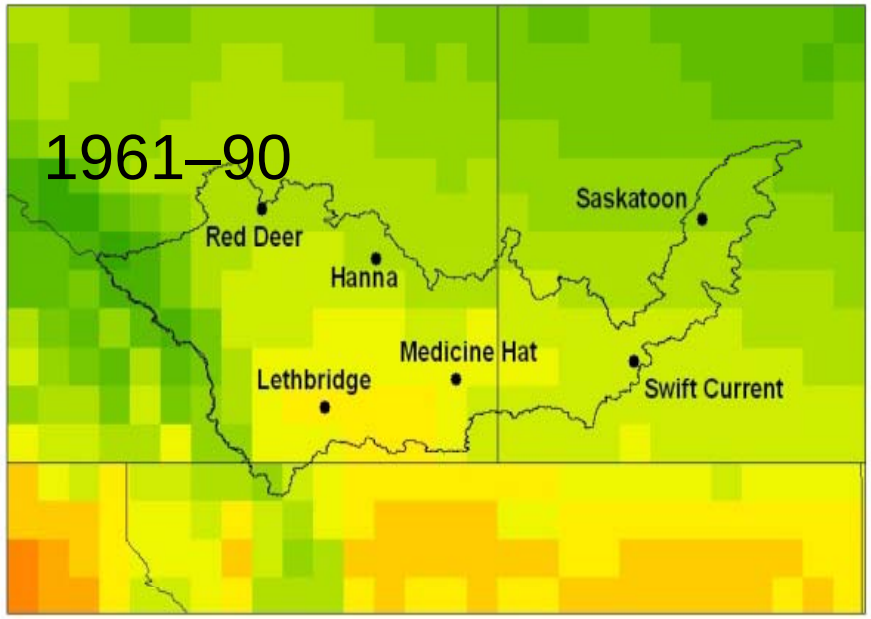
Prairie Adaptation Research Collaborative

PARC is a partnership of the governments of Canada, Alberta, Saskatchewan and Manitoba mandated to pursue climate change impacts and adaptation research in the Prairie Provinces.

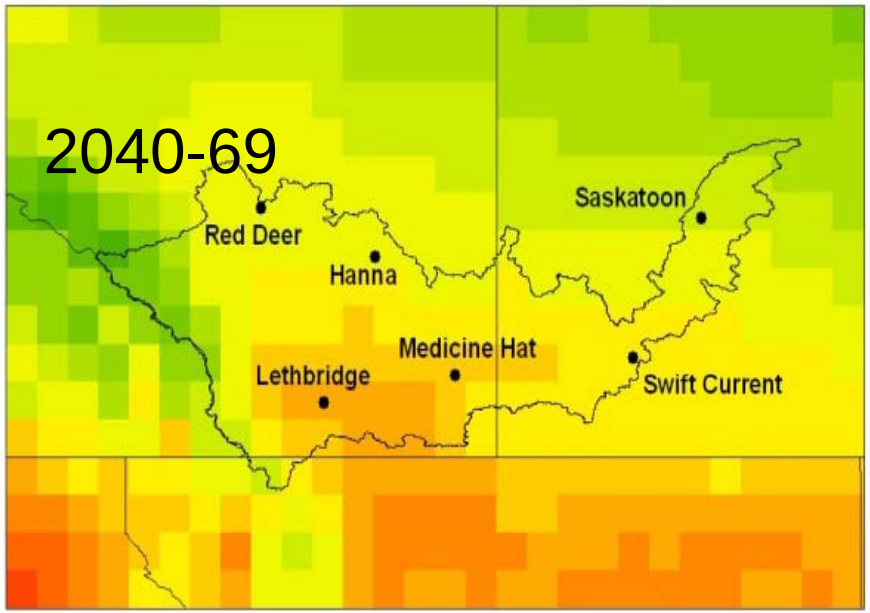
- Alberta Vulnerability Assessment Project
  - Climate Change Scenarios
  - Biophysical Impact Assessment
  - Integrated Vulnerability Assessment
- Saskatchewan's Natural Capital In A Changing Climate
  - Climate Change Scenarios
  - Assessment of Biophysical Impacts and Adaptation
- Prairies Chapter, National Assessment of Climate Change Impacts and Adaptation

- Prairies Regional Adaptation Collaborative (**Prairies RAC**)

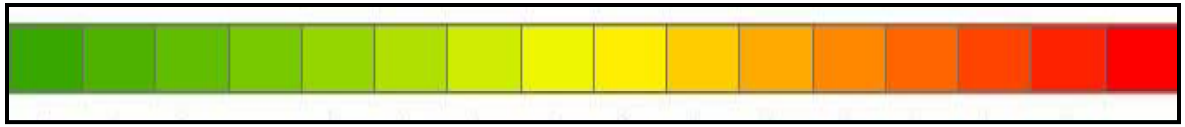
Annual Temperature



1961-1990



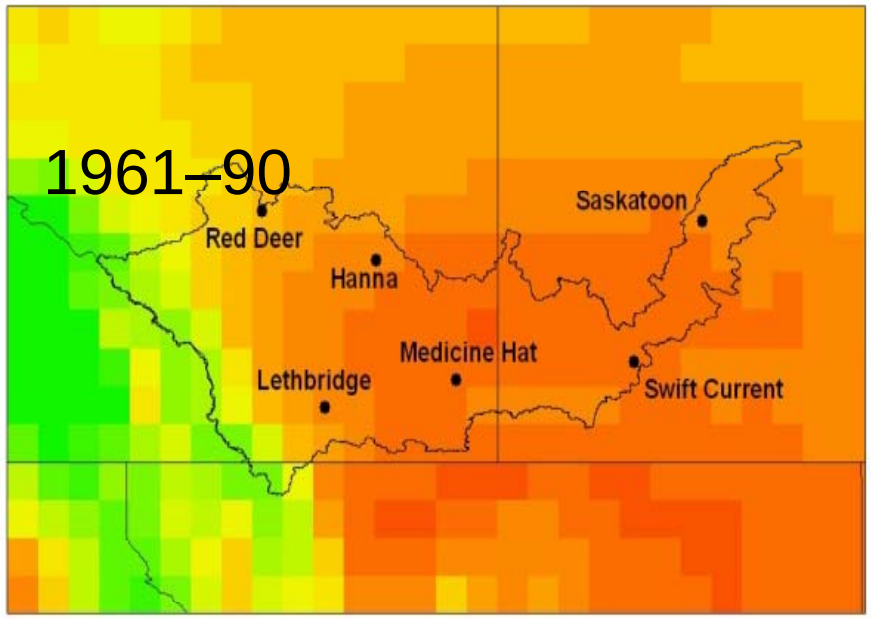
2050s



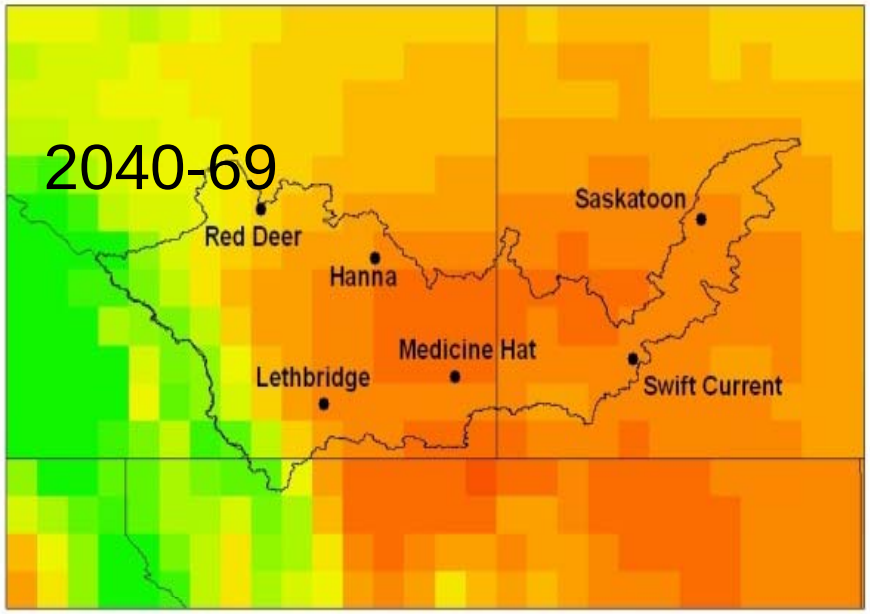
ºC -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12

These median scenarios were derived from the Canadian Global Climate Model (CGCM) version 3.1/T47 and greenhouse gas emission scenario B1(2).

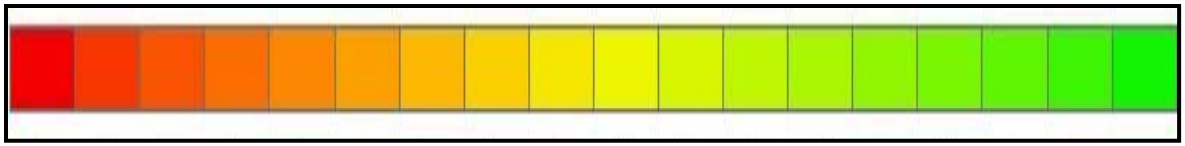
Annual Precipitation



1961-1990



2050s



mm 200 300 400 500 600 700 800 900 1000

These median scenarios were derived from the Canadian Global Climate Model (CGCM) version 3.1/T47 and greenhouse gas emission scenario B1(2).

The recent warming exceeds the global average

Future climates are outside the range of natural variability

Global warming -- it's not all bad

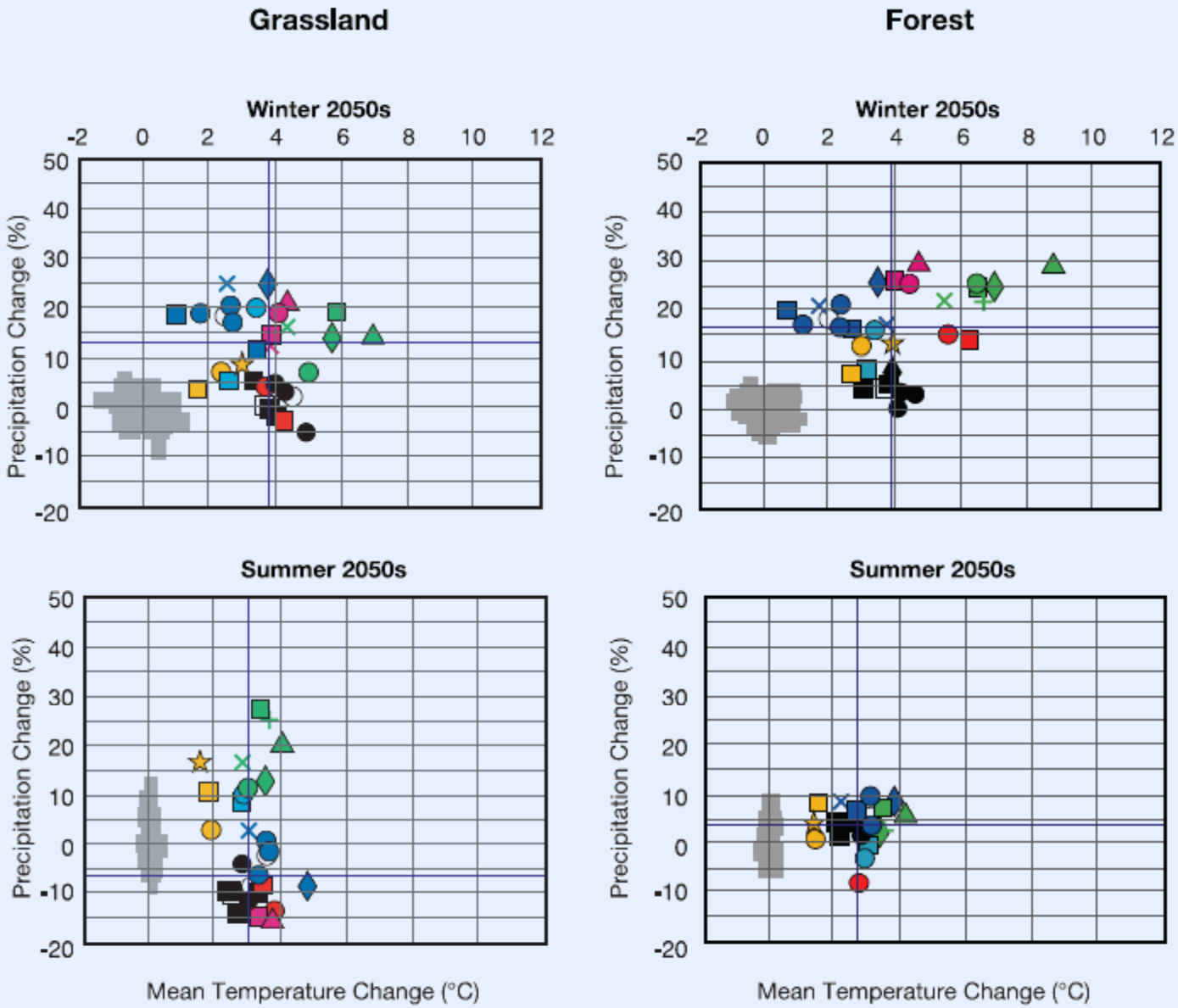
In fact, for people living in places like Edmonton, a warmer climate has plenty of benefits

David Staples, The Edmonton Journal
Sunday, November 23, 2008

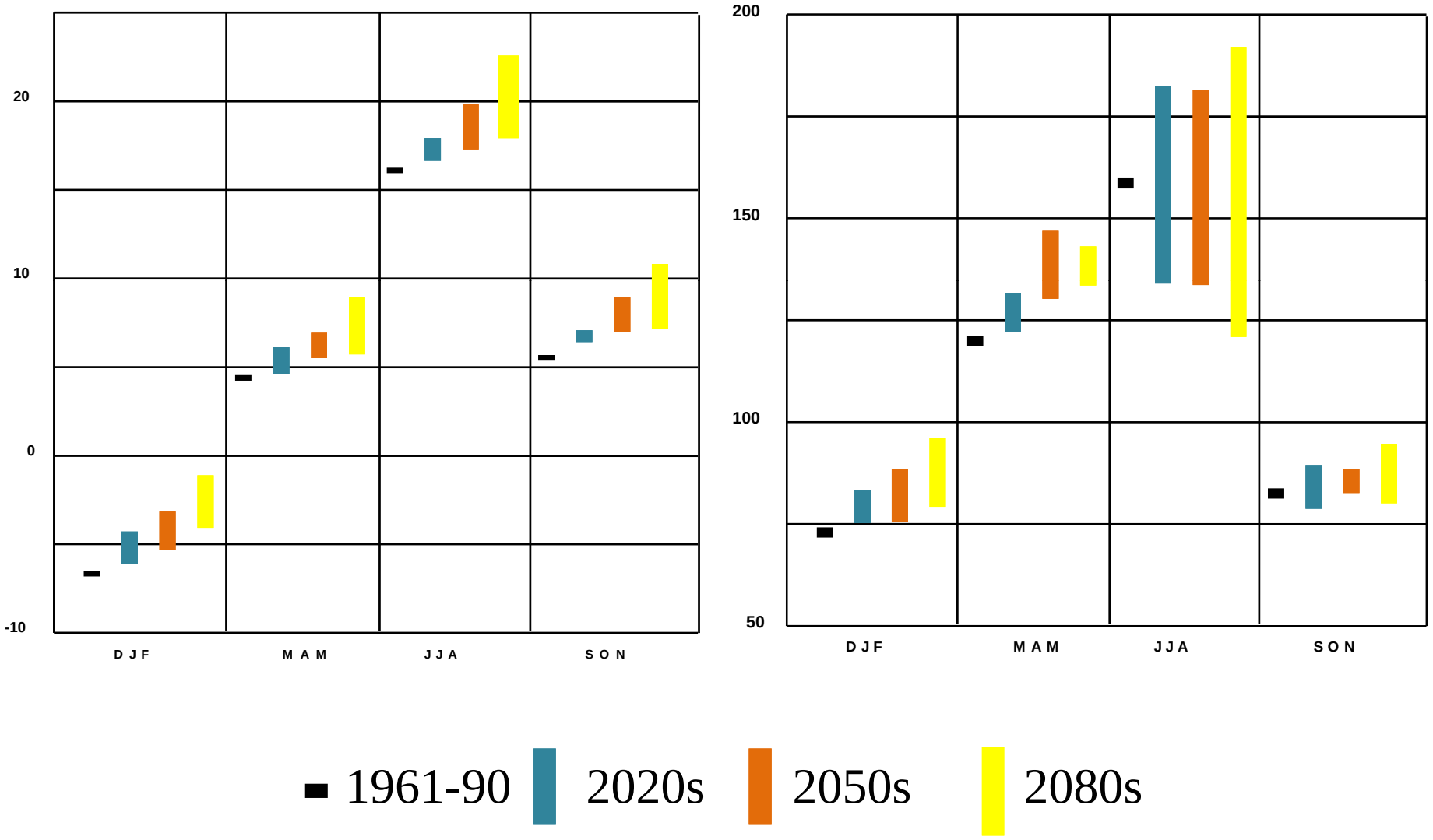
Robert Mendelsohn, an economics professor at Yale University, who says the benefits of global warming for Canada will be substantial and will outweigh the negative effects. "You're lucky because you're a northern latitude country, Mendelsohn says. **"If you add it all up, it's a good thing for Canada.“**

There will be opportunities for Canadian farmers going forward, **Sauchyn says** … "The most challenging impact of climate change is not going to be a shift in average conditions …”

Seasonal Scenarios



Temperature – Lethbridge - Precipitation

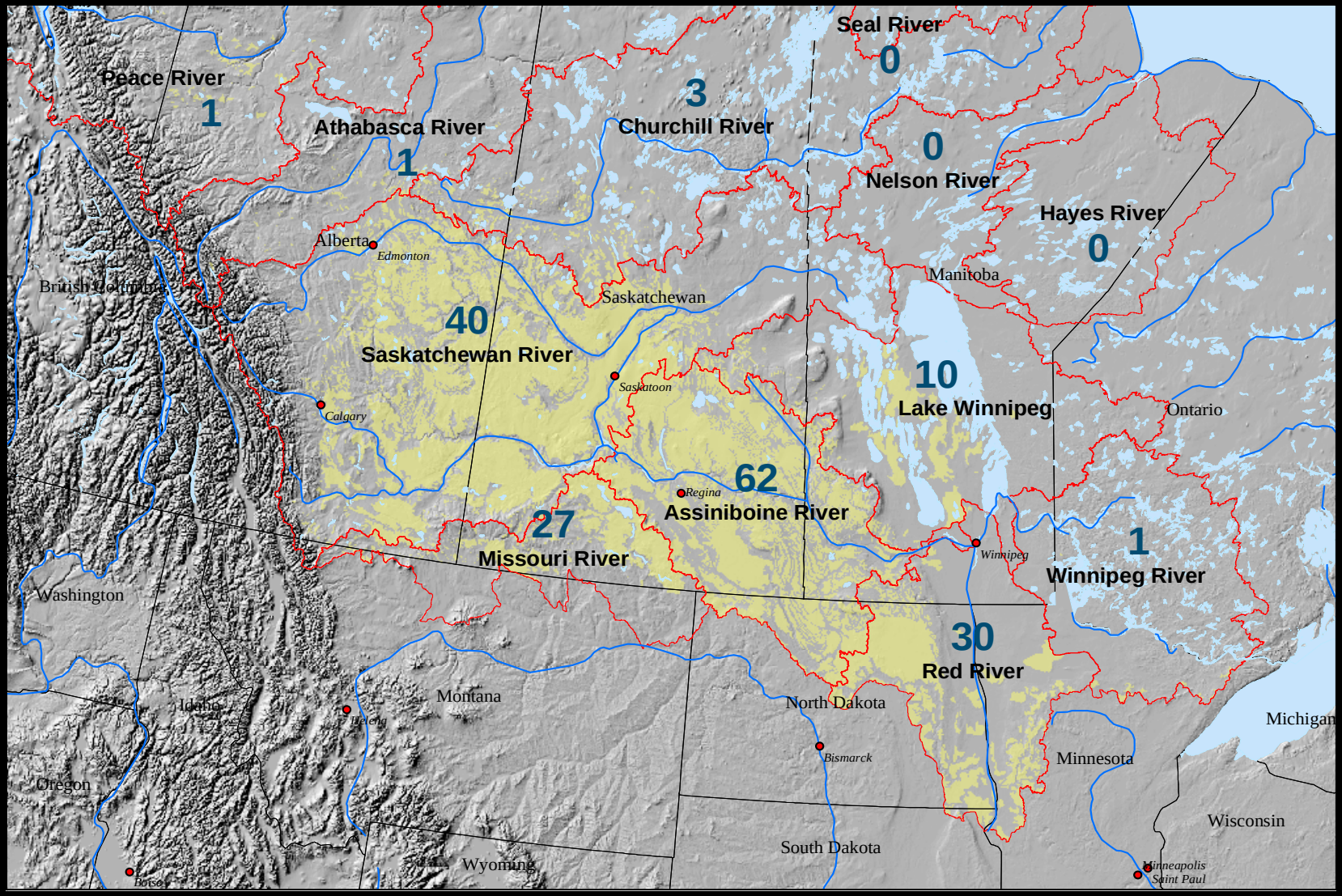


One of the most certain projections is that extra water will be available in winter and spring, while summers generally will be drier

On average, there will be slightly to significantly less surface and soil water

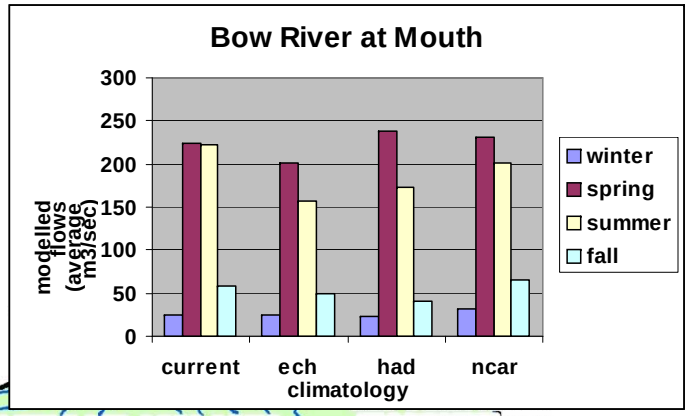
We are losing the advantage of a cold winter

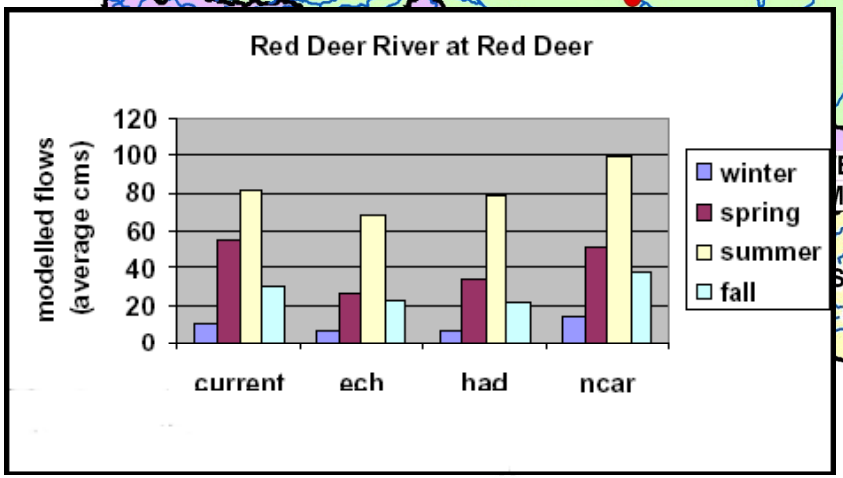
Prairie Drainage Basins (source: PFRA)

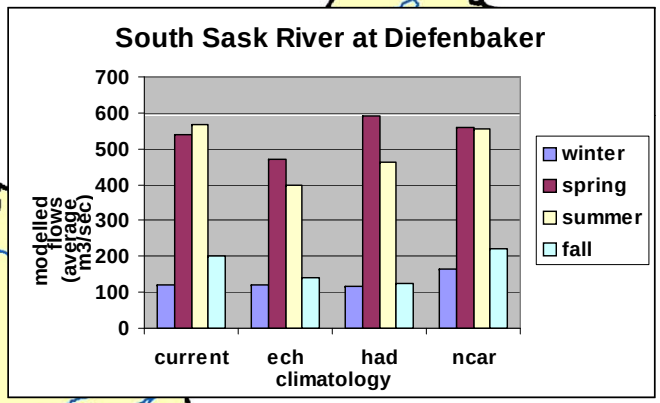


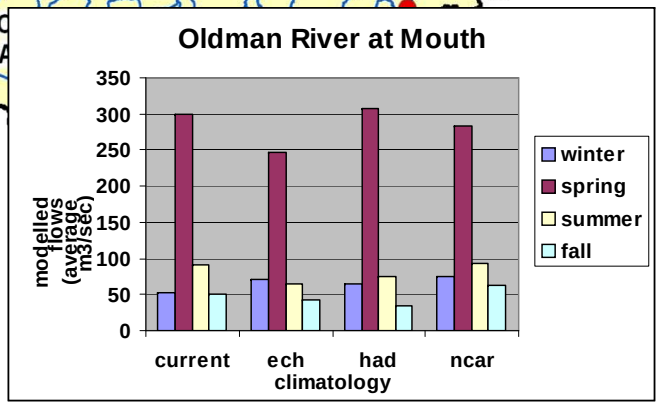
Seasonal flows, SSRB, 2039-2070 (Pietroniro *et al.*, 2006)

GCM	%Precip	+Temp	Description
echa21	-3.8	2.8	driest, warmest
echb21	-2.0	2.8	
hada21	6.4	2.3	moderately wet and warm
hadb21	0.2	2.1	
ncara21	11.5	1.7	wettest and least warm
ncarb21	9.1	1.5	

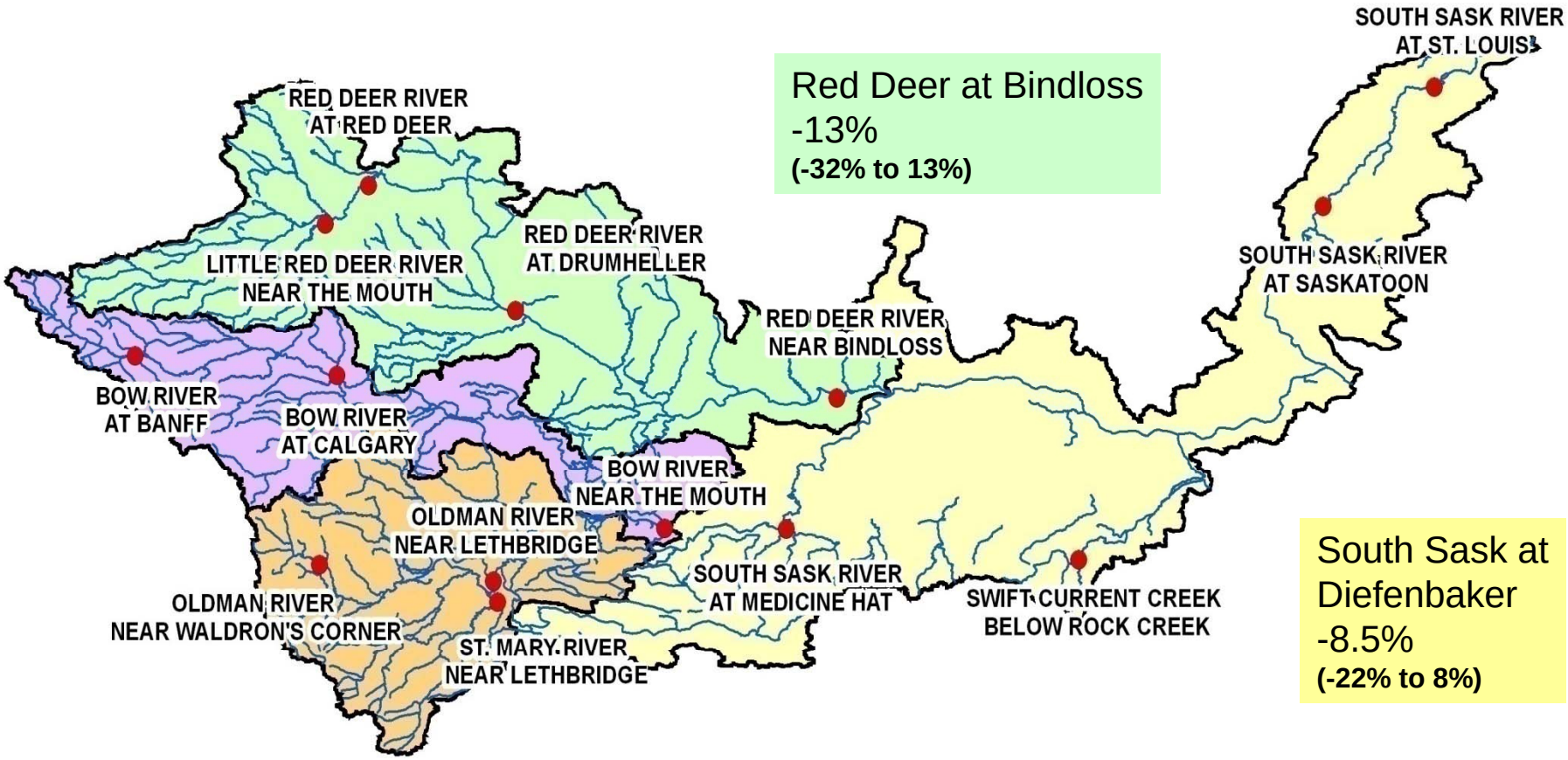








Annual flows, SSRB, 2039 – 2070 (Pietroniro *et al*., 2006)



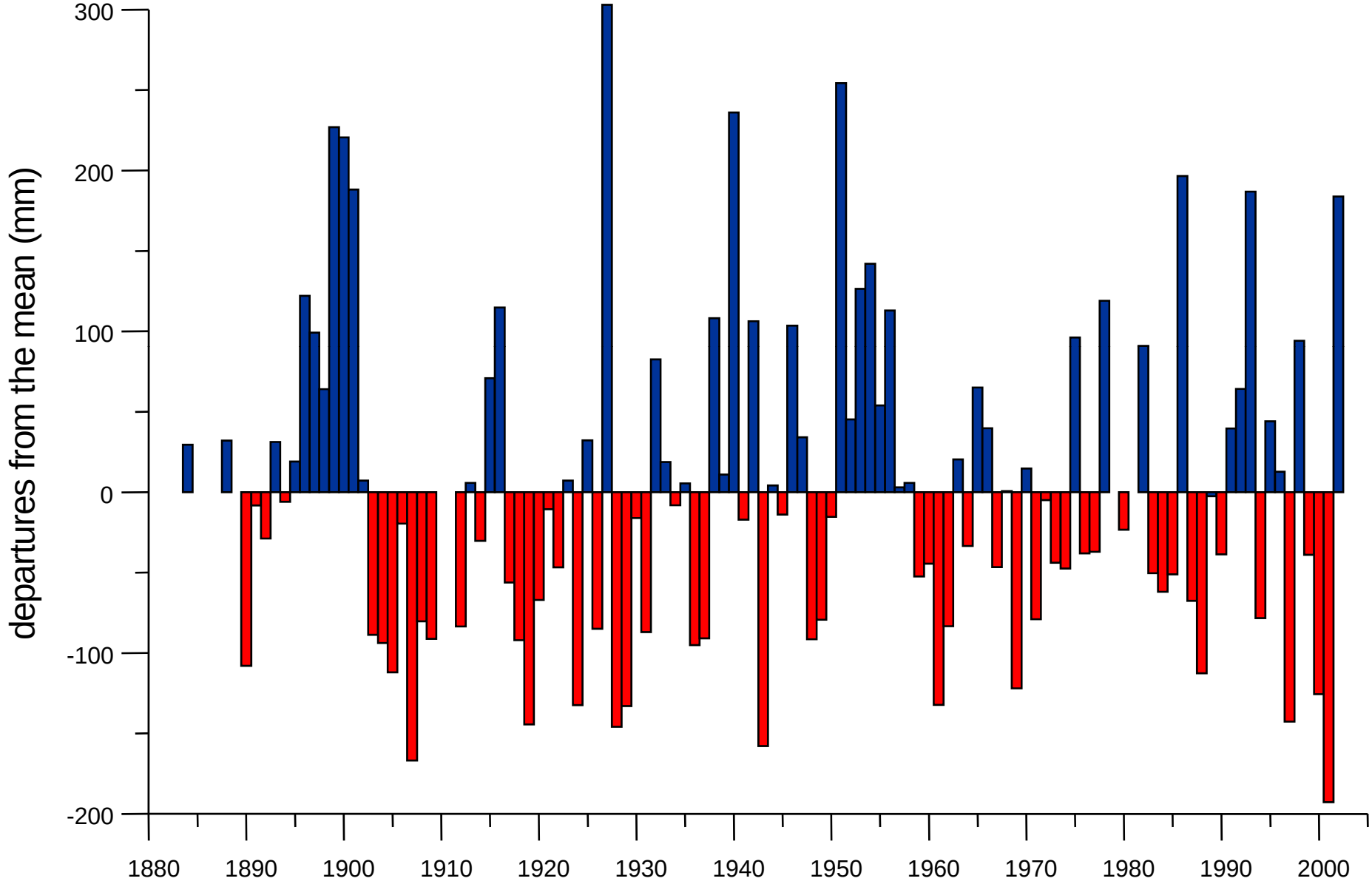
Red Deer at Bindloss
-13%
(-32% to 13%)

South Sask at Diefenbaker
-8.5%
(-22% to 8%)

Bow River at mouth
-10%
(-19% to 1%)

Oldman at mouth
- 4%
(-13% to 8%)

Annual Precipitation, Medicine Hat, 1884-2002



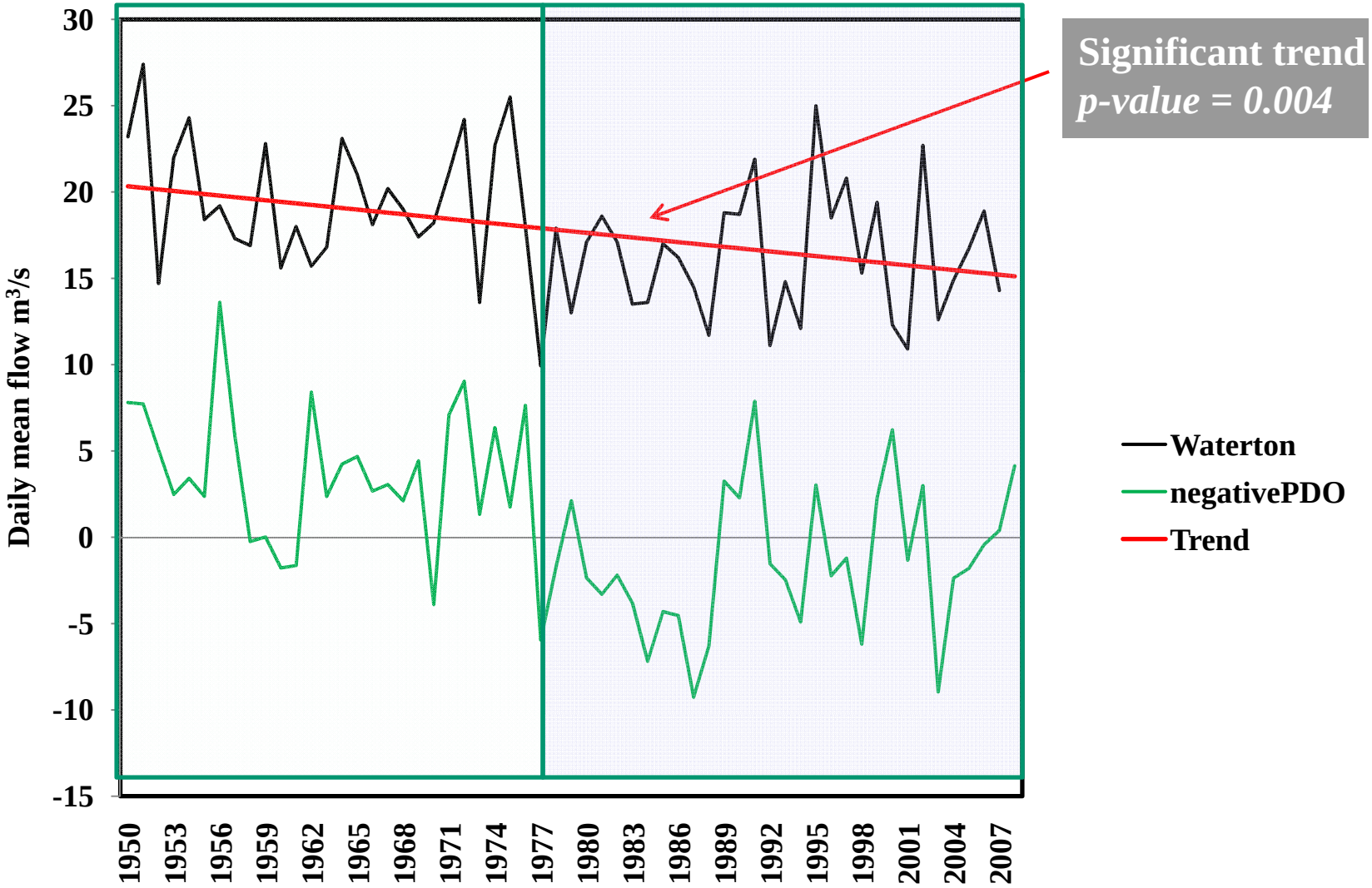
Climate Variability

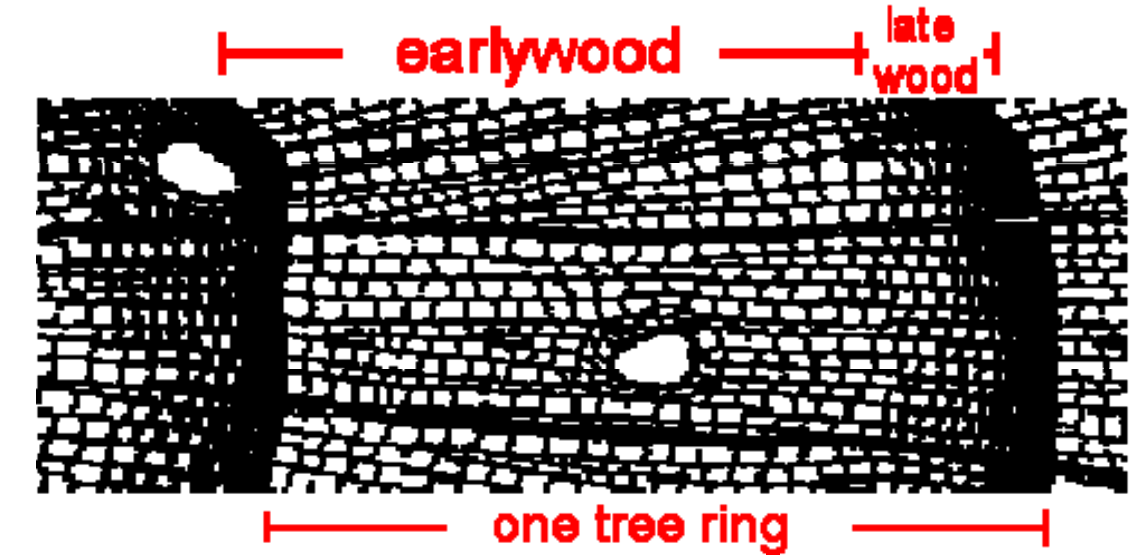
many regional climate changes can be described in terms of **preferred patterns of climate variability**

changes in the strength and phase of these patterns can lead to **larger-amplitude regional responses to forcing** than would otherwise be expected

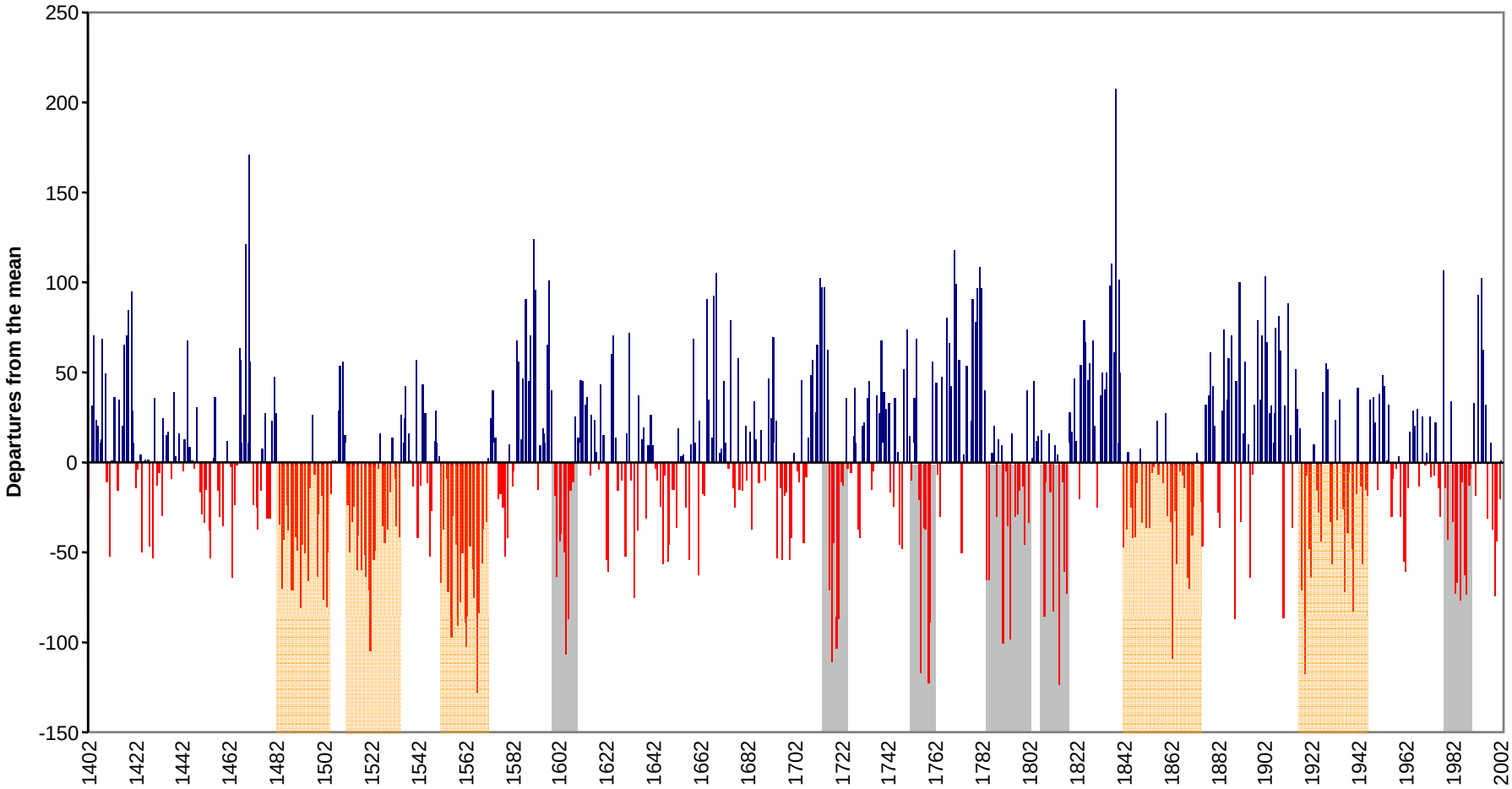
it is therefore important to consider the extent to which **observed changes are** linked to **internal variability or to anthropogenic climate change**

Waterton River near Waterton 1950-2007




earlywood
late wood
one tree ring

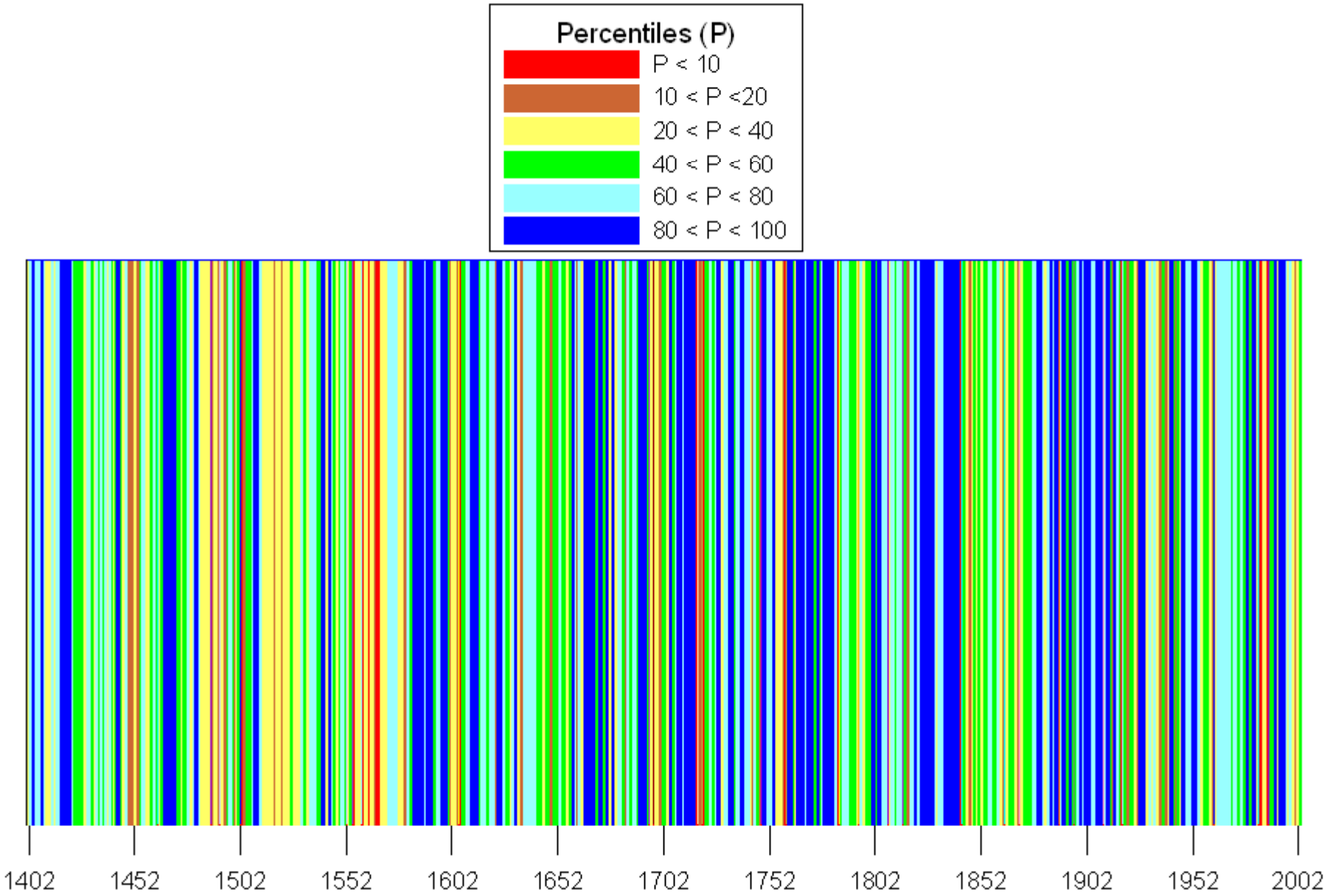
South Saskatchewan River at Medicine Hat, 1402-2004



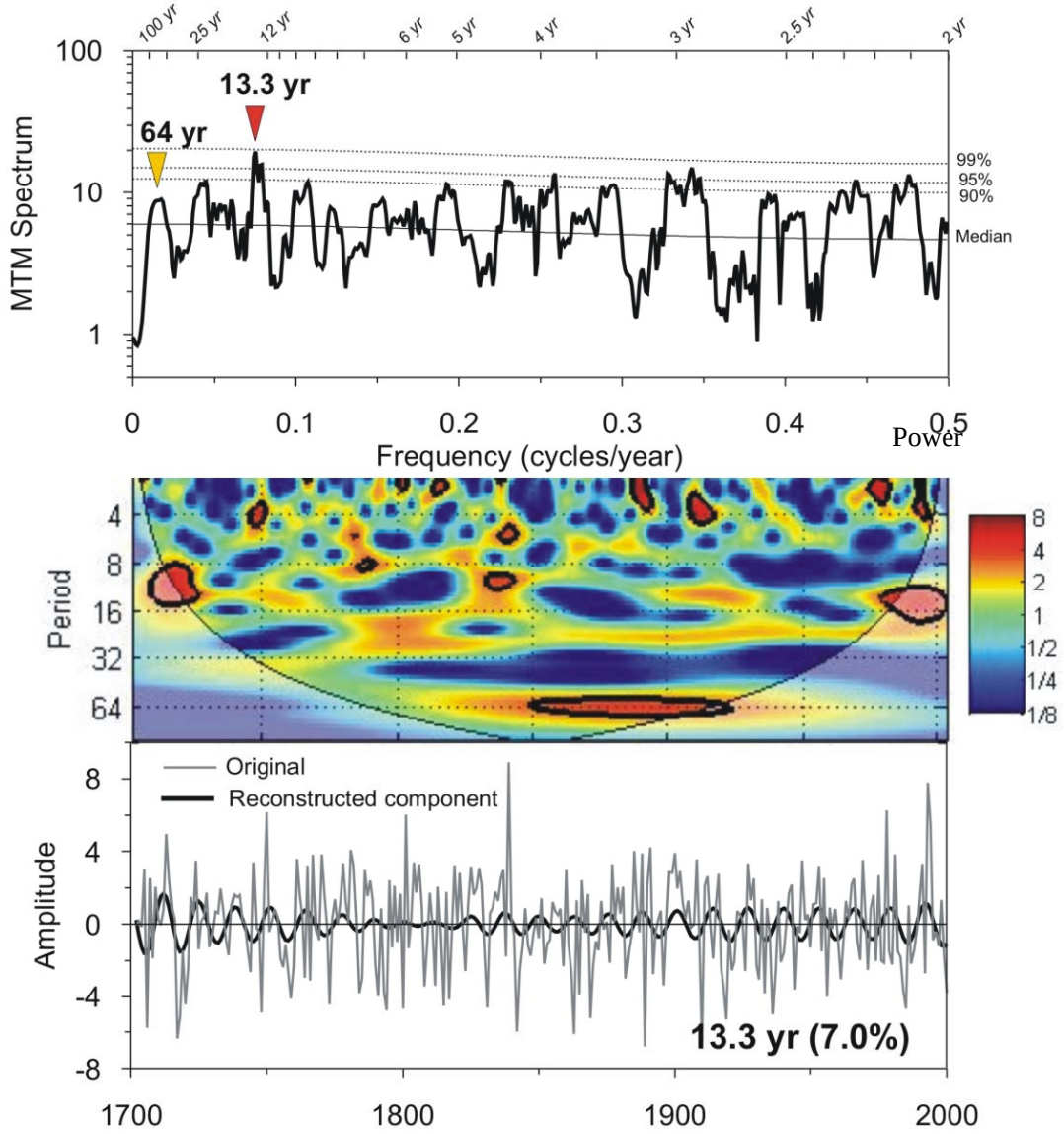
On May 2nd [1796] William Tomison wrote to James Swain that furs could not be moved as, **“there being no water in the river.”**

North Saskatchewan River at Edmonton

South Saskatchewan River at Medicine Hat, 1402-2004



Low-frequency signals in the tree rings



The tree rings capture a 13 year summer cycle and a 64 year winter cycle.

Important Climate Feedback Mechanisms

Carbon cycle: the capacity oceans and ecosystems to sequester carbon changes in warmer world; in general, it declines

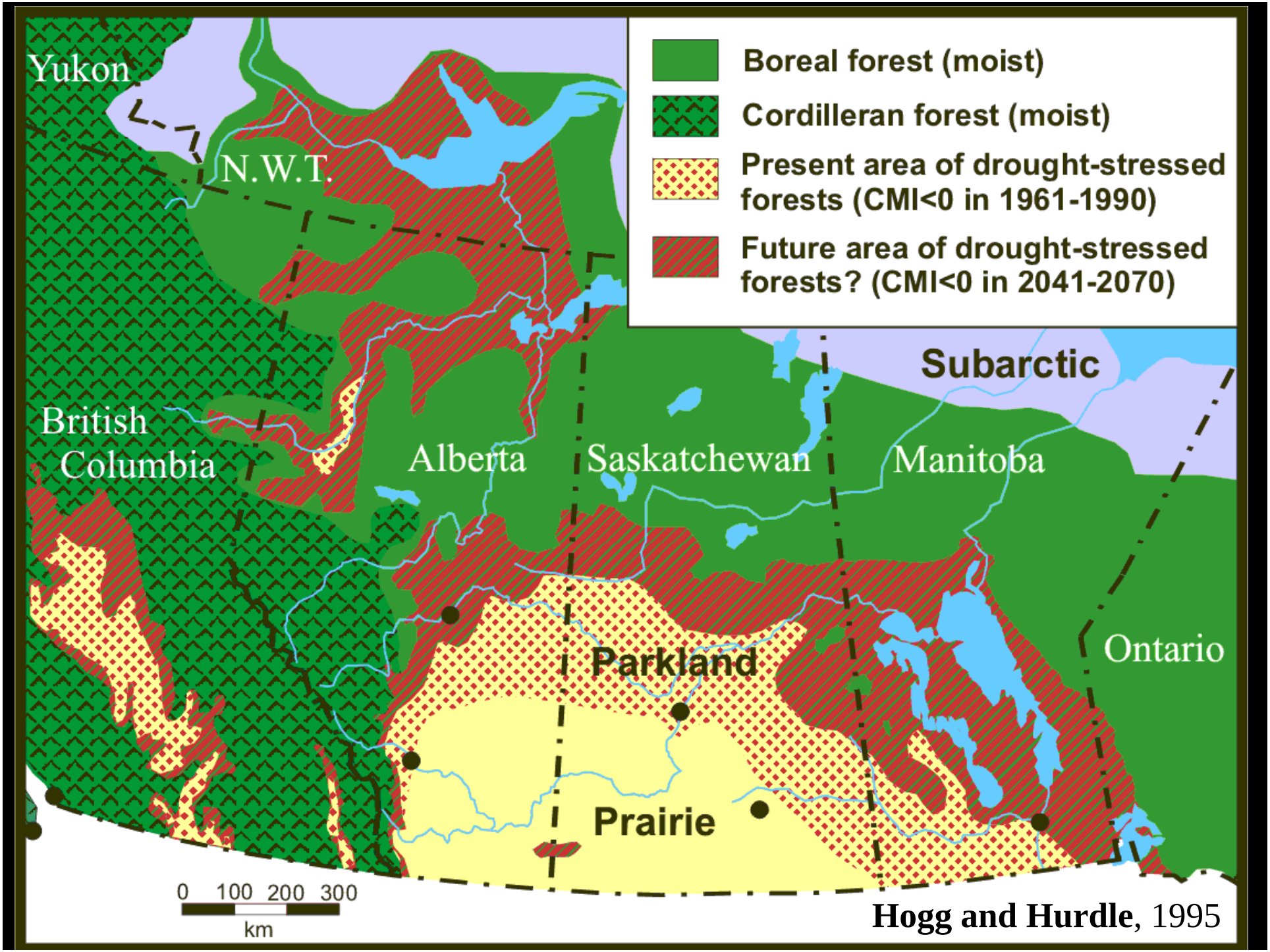
Changes in snow and ice cover: over 90% of the incident solar radiation is reflected by snow and ice surfaces

Specific humidity: increasing in a warming world; with rising amounts of water vapour in the atmosphere, there are **widespread increases in the numbers of heavy precipitation events**; BUT d**rought duration and intensity has also increased**

There will be greater variation in hydroclimate

Both drought and unusually wet years could occur with greater frequency and severity

Major ecological changes are expected.

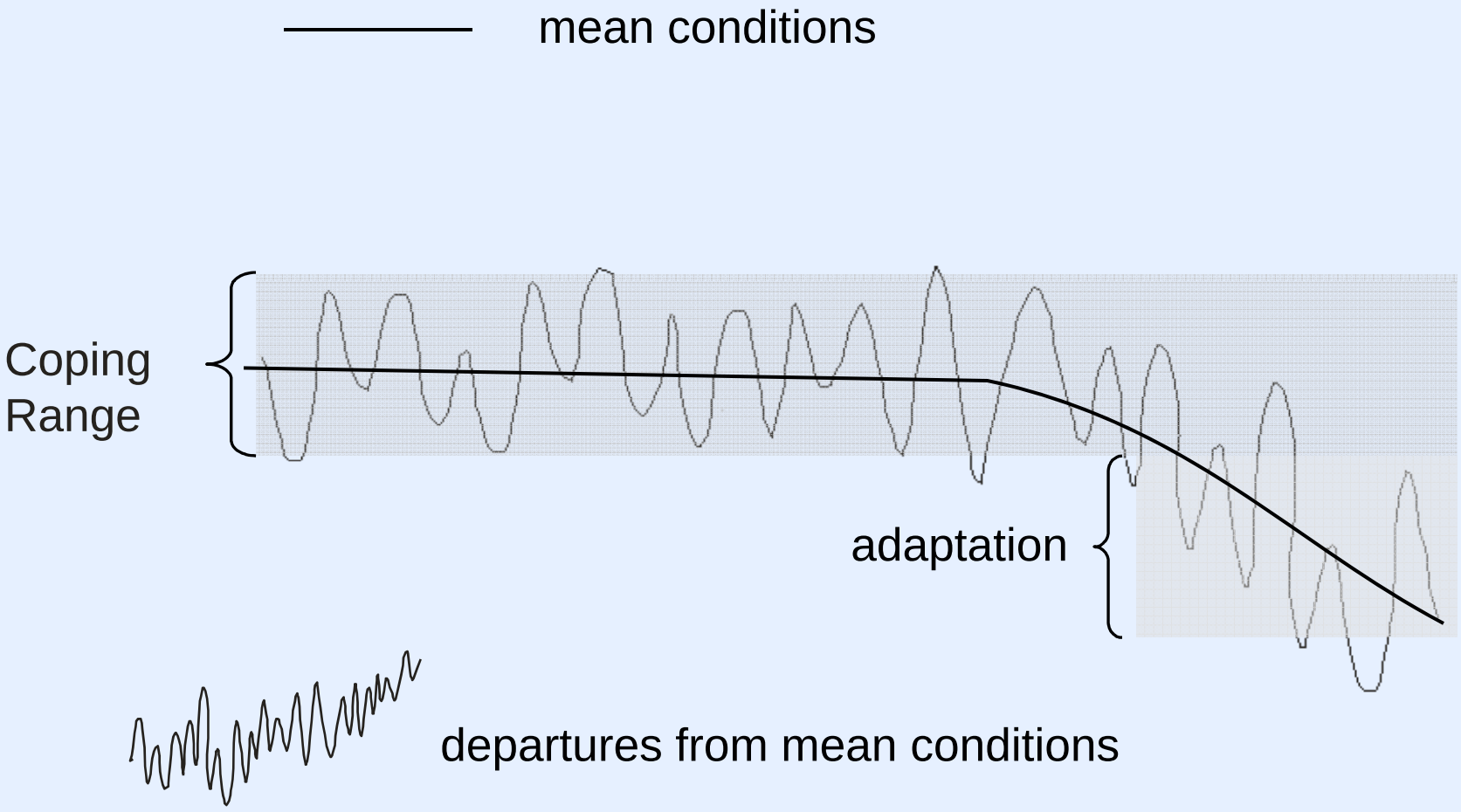

Boreal forest (moist)
Cordilleran forest (moist)
Present area of drought-stressed forests (CMI<0 in 1961-1990)
Future area of drought-stressed forests? (CMI<0 in 2041-2070)
Yukon
N.W.T.
British Columbia
Alberta
Saskatchewan
Manitoba
Subarctic
Ontario
Parkland
Prairie
0 100 200 300
km
Hogg and Hurdle, 1995

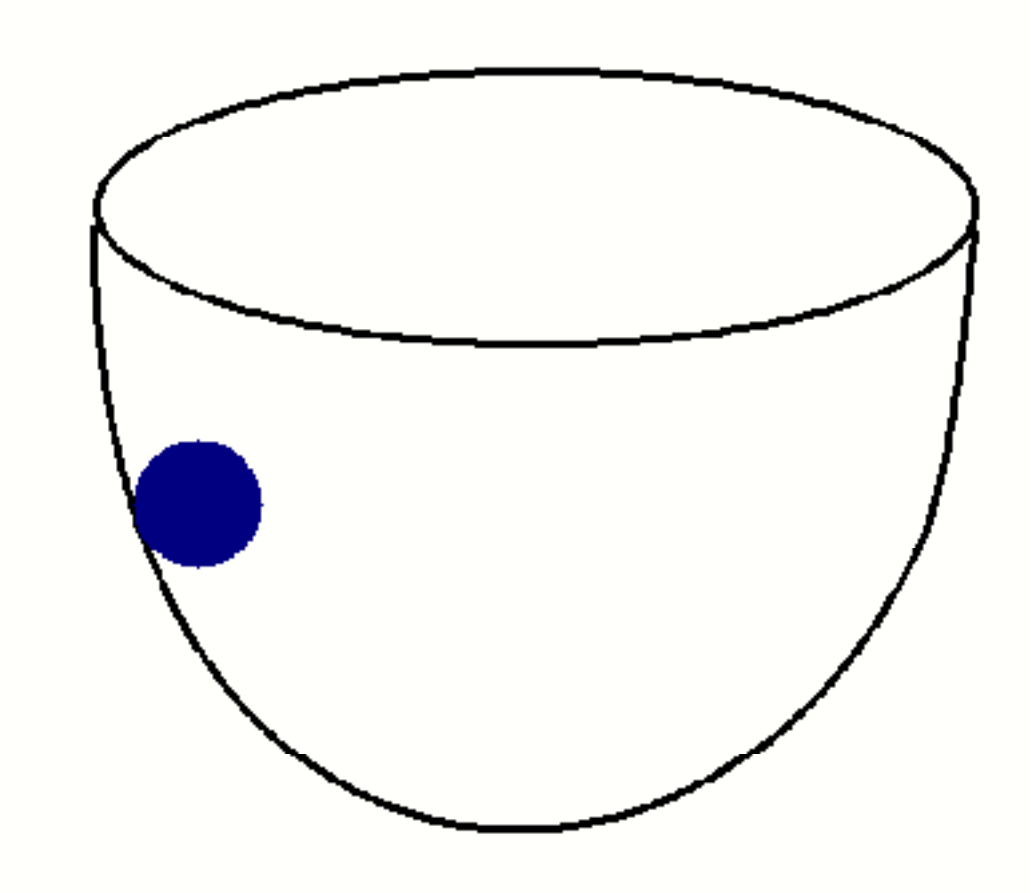
Extreme weather and climate are “wild cards” because the effects of increasing frequency and severity are generally not considered well or at all in climate change impact assessments.

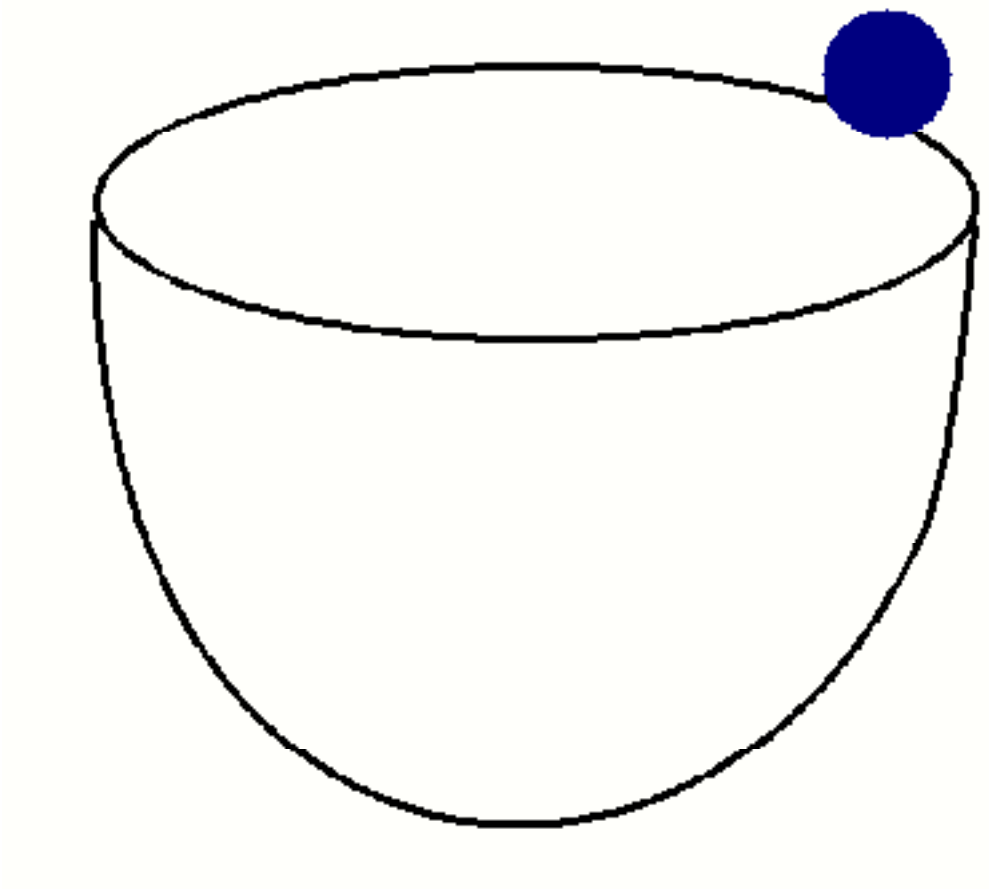
The net impacts of climate change are not clear; they depend on rates of climate change and adaptation strategies.

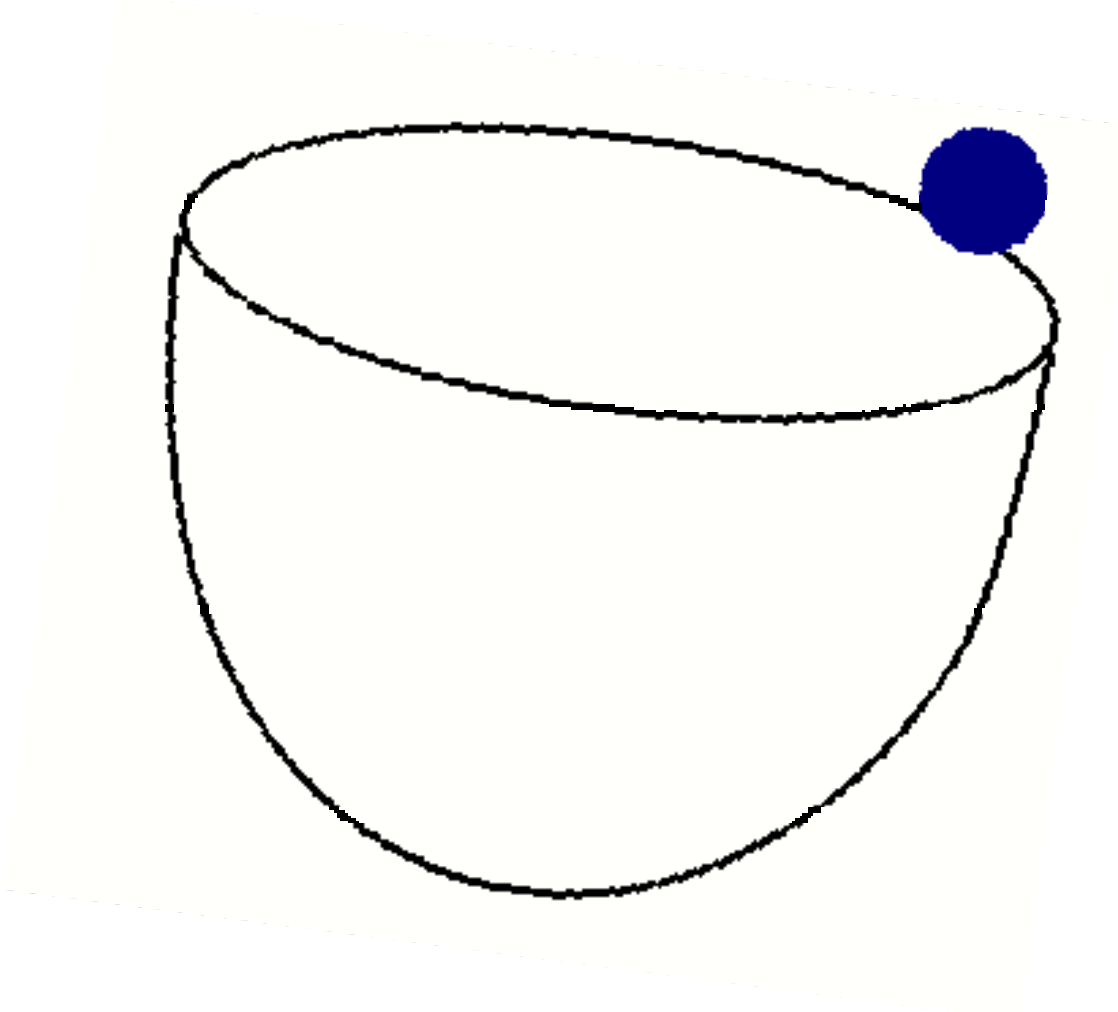
The impacts of climate change will depend on how well we adapt and how much adaptation is required.

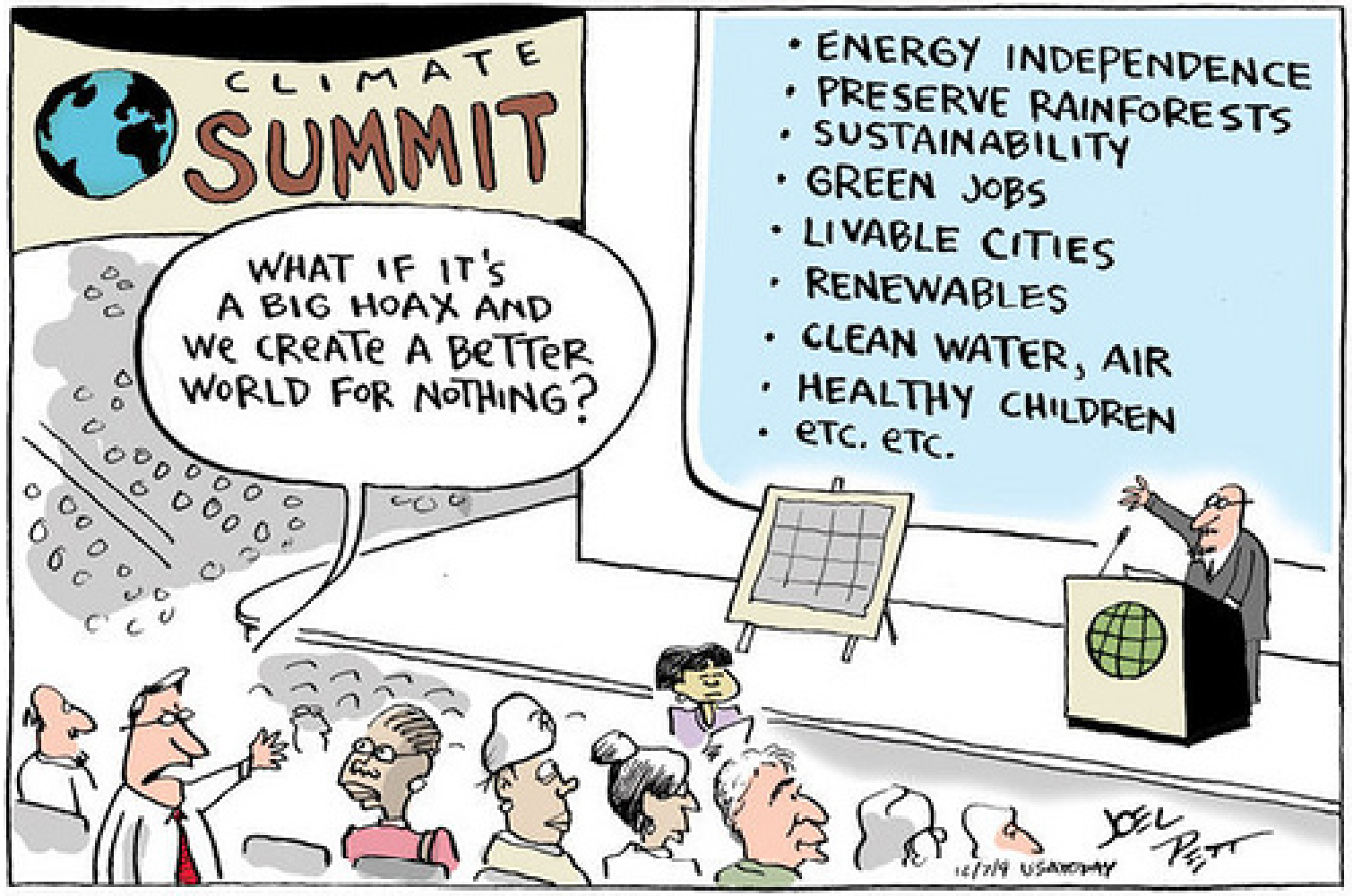
Climate Trends and Variability










CLIMATE
SUMMIT
WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?
• ENERGY INDEPENDENCE
• PRESERVE RAINFORESTS
• SUSTAINABILITY
• GREEN JOBS
• LIVABLE CITIES
• RENEWABLES
• CLEAN WATER, AIR
• HEALTHY CHILDREN
• ETC. ETC.
JOEL PETT