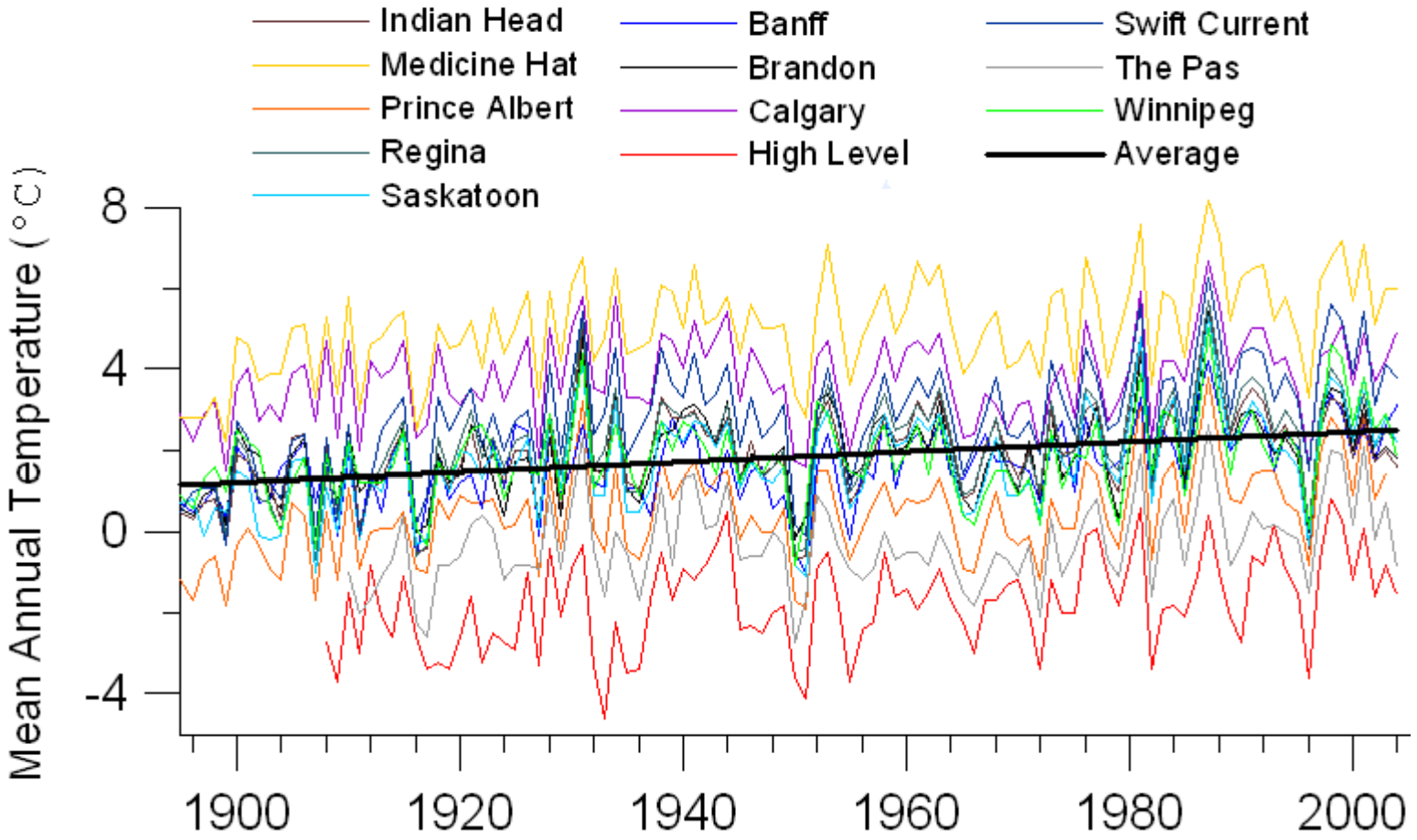
Climate change, Trends and Variability

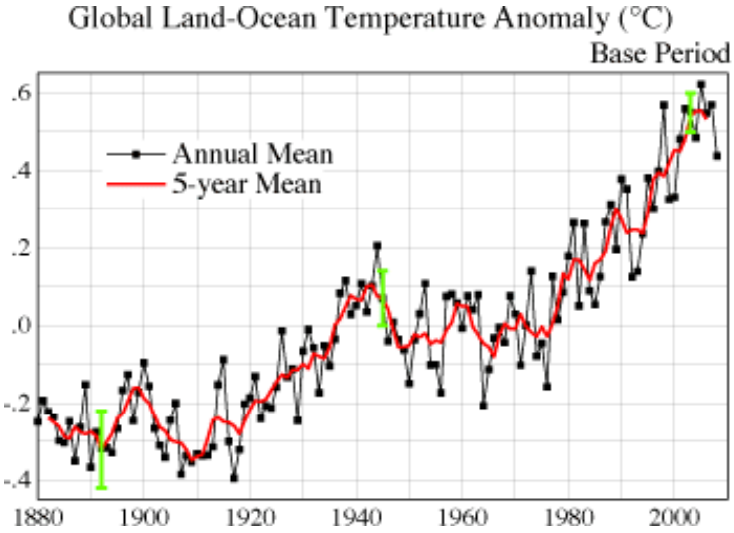
Dave Sauchyn, Prairie Adaptation Research Collaborative

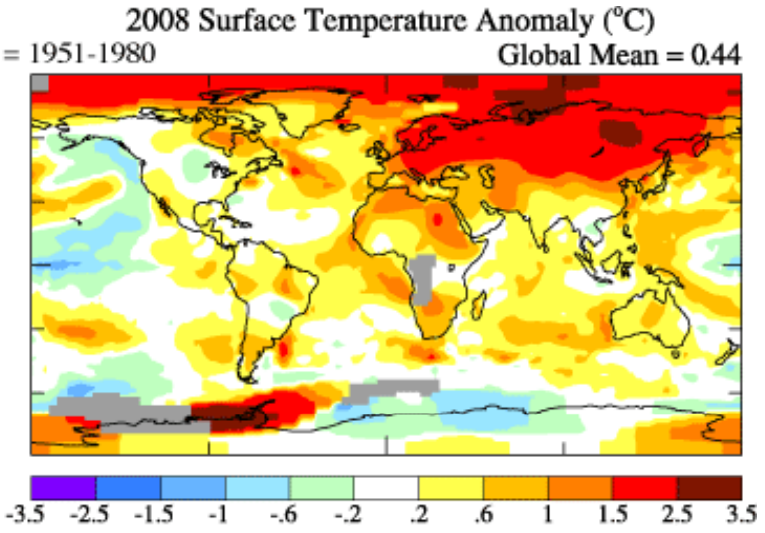
"Best Management Practices: For the Agricultural Climate of Tomorrow"
Parkland Conservation Farm, Vegreville, AB, March 26, 2009

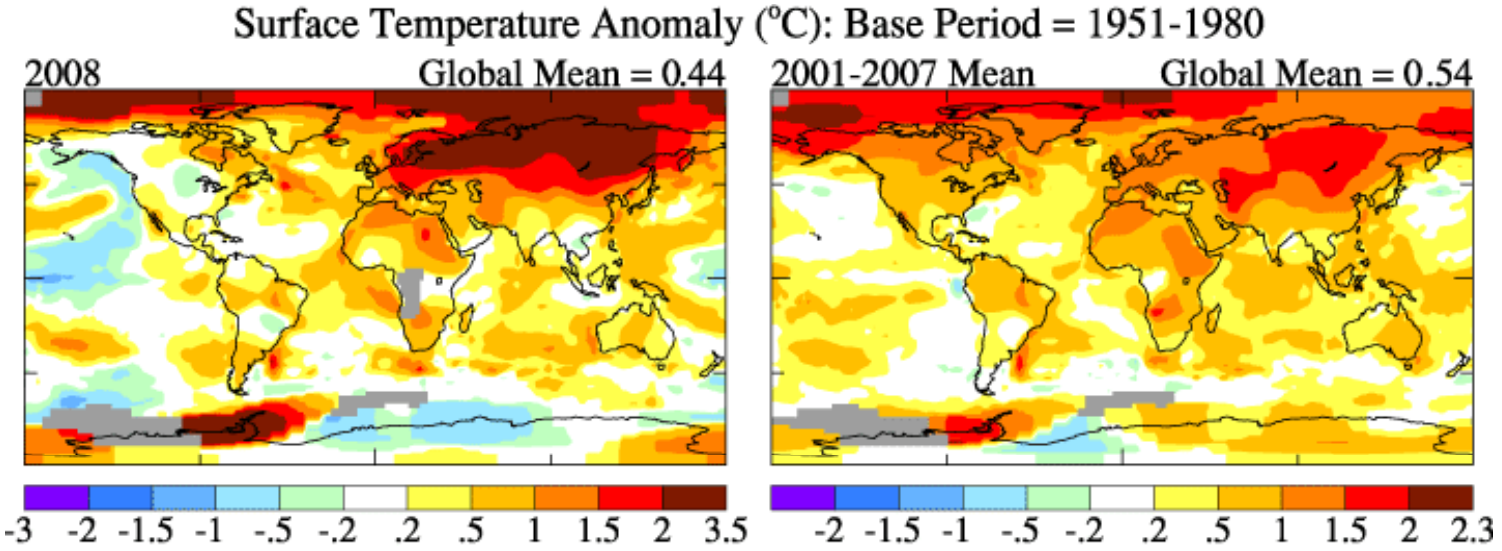


Trends in mean annual temperature since 1895 for 12 climate stations spread across the Prairies. The average increase in mean annual temperature for the 12 stations is 1.6°C.

Global Temperatures: Departures from 1951-80

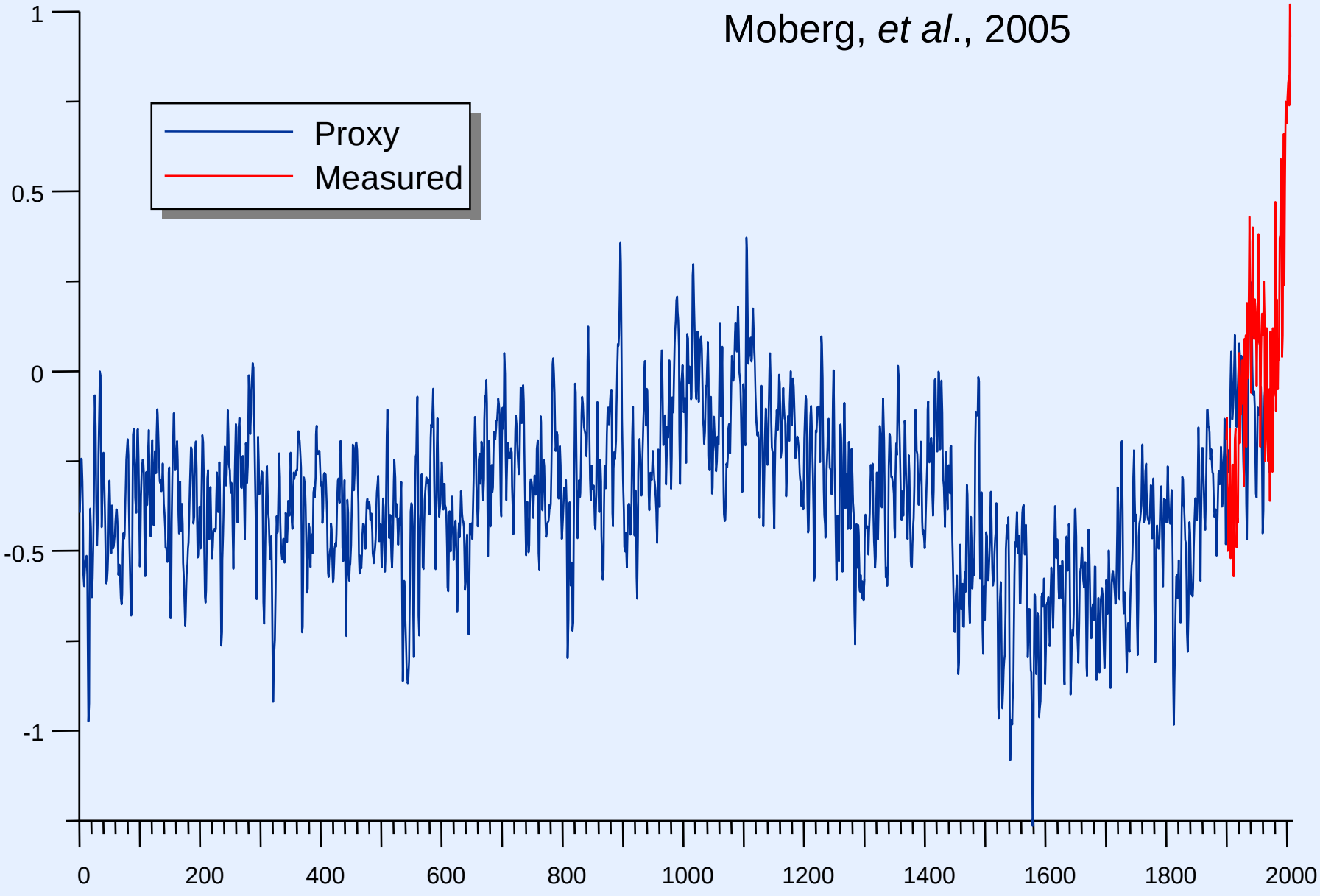




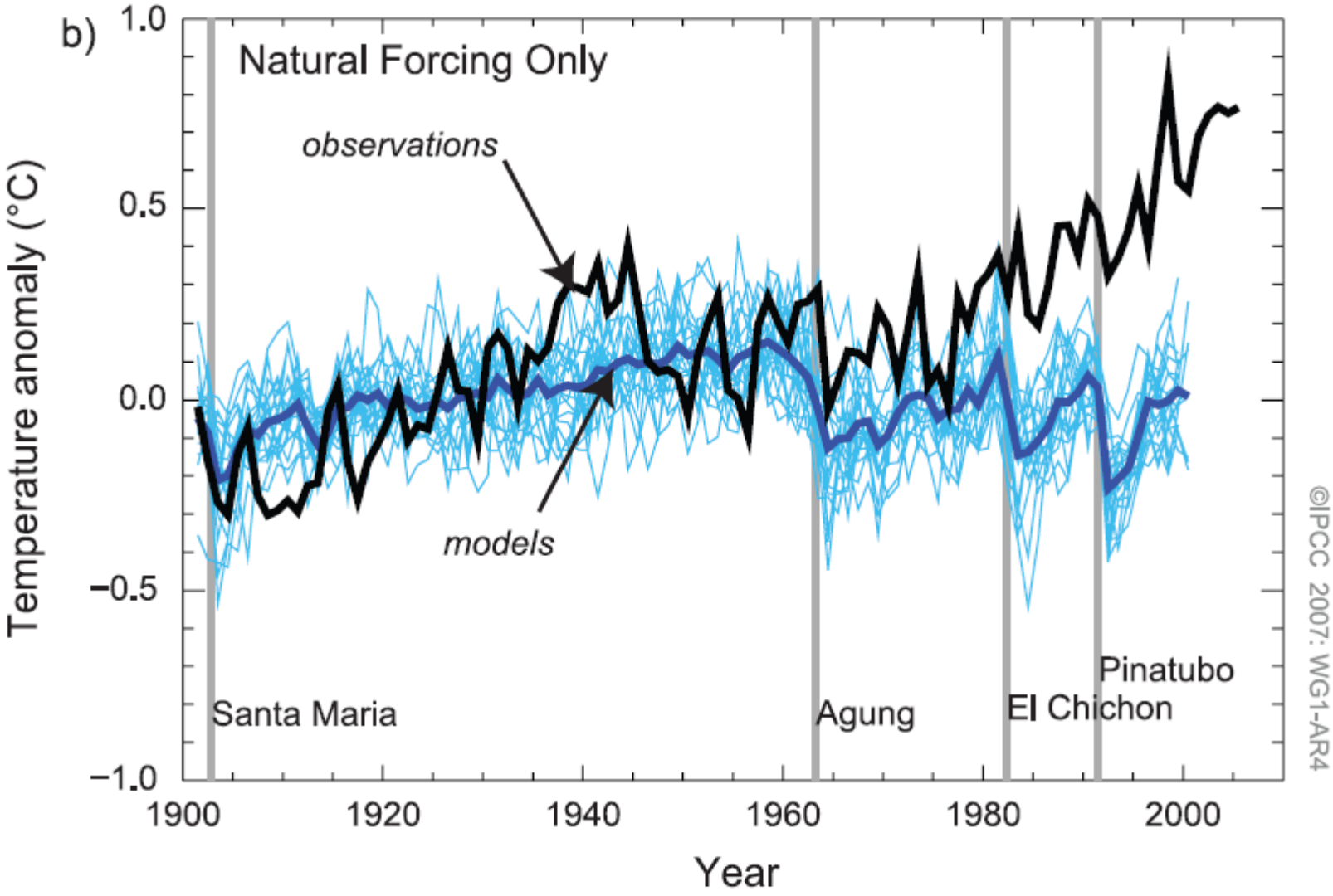


http://data.giss.nasa.gov/gistemp/

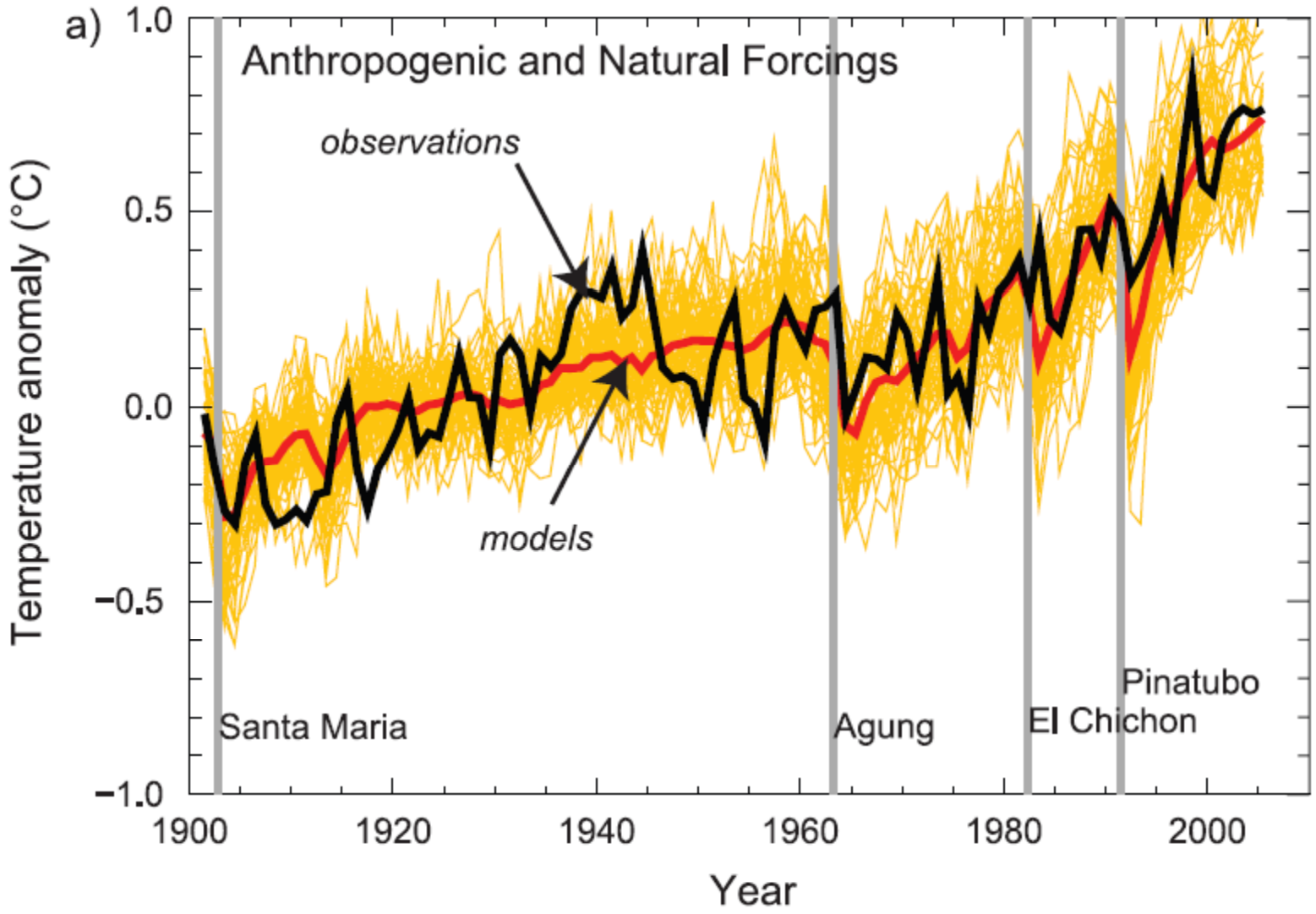
Northern Hemisphere Temperature, Past 2000 Years



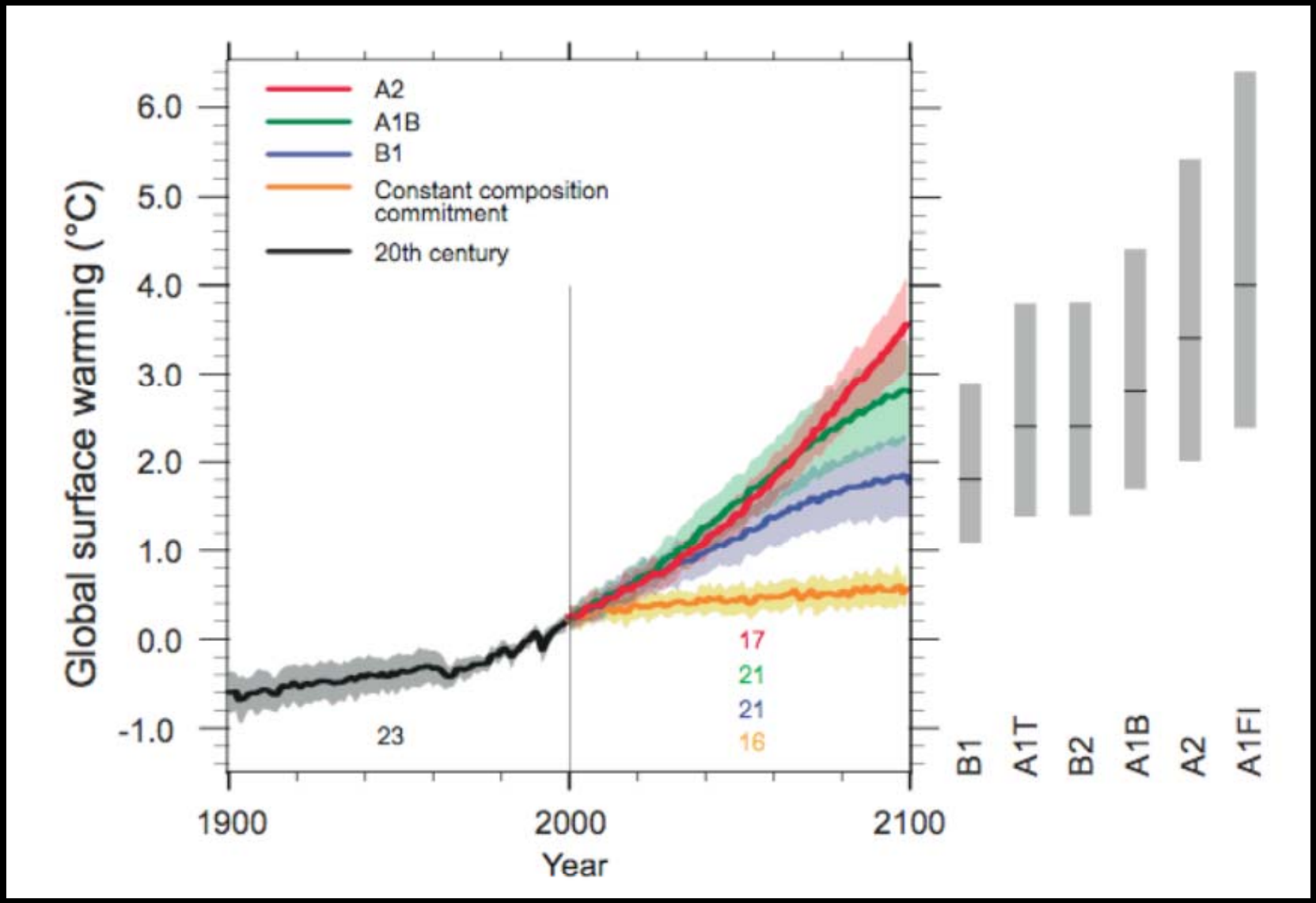
Climate Modeling – Natural Forcing Only



Climate Modeling – Anthropogenic and Natural Forcing



Climate Projections (IPCC 2007)



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

FROM IMPACTS to ADAPTATION

Canada in a Changing Climate 2007

VIVRE AVEC LES CHANGEMENTS

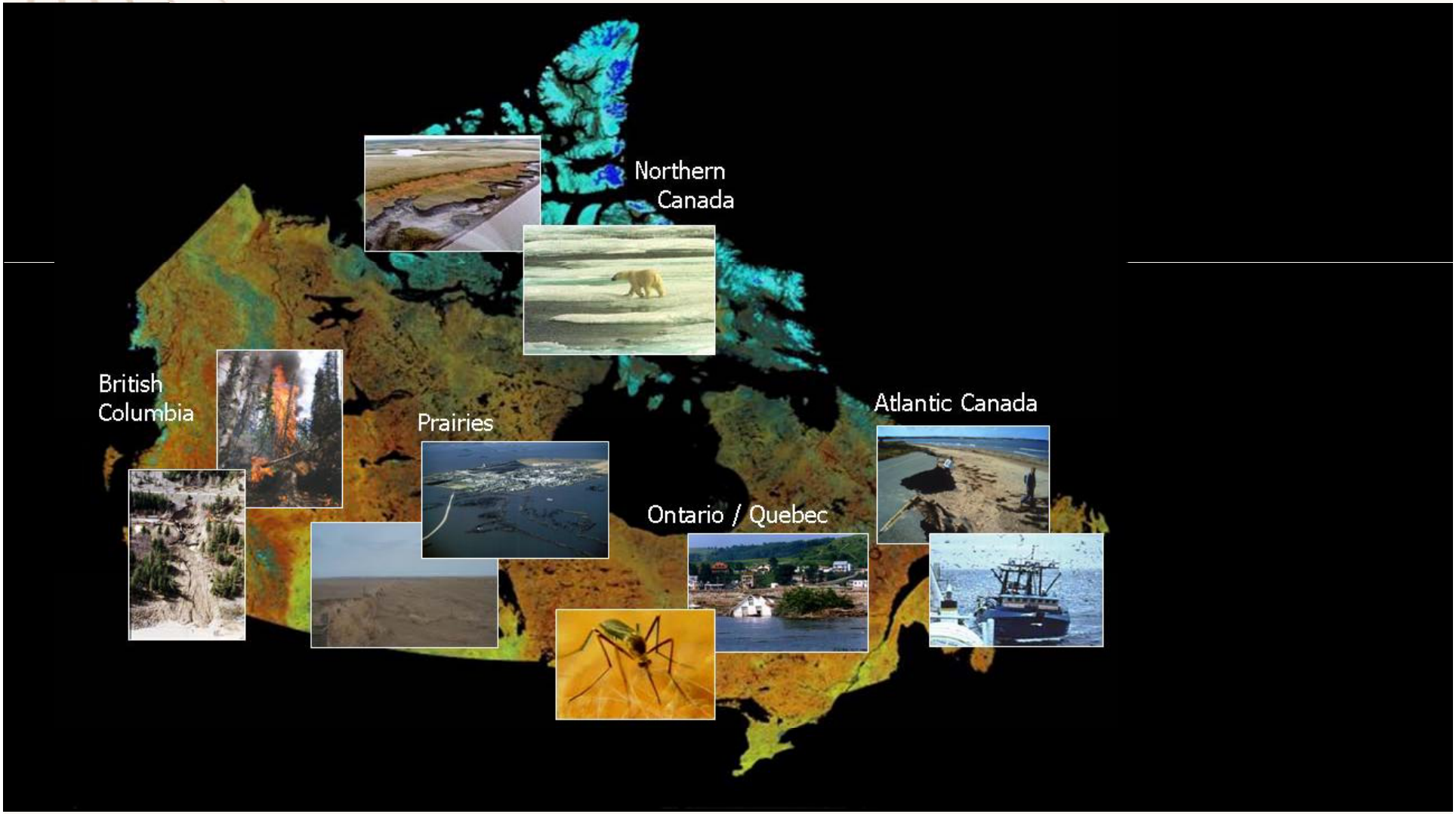
climatiques au Canada : édition 2007

Government of Canada Gouvernement du Canada

Canada

Conclusions: impacts

Impacts of greatest concern vary between regions



The **Prairie Adaptation Research Collaborative** 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.

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CHAPTER 7
Prairies

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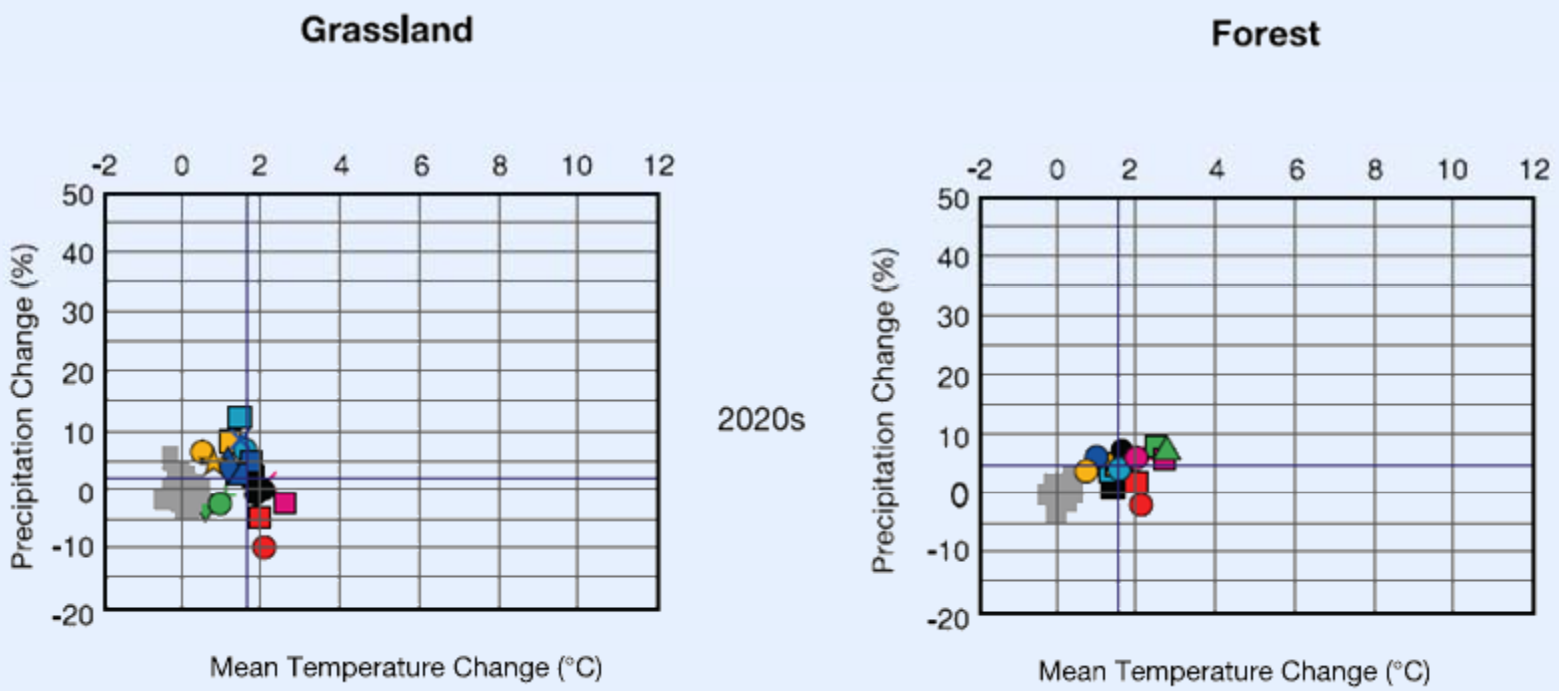
The recent warming exceeds the global average

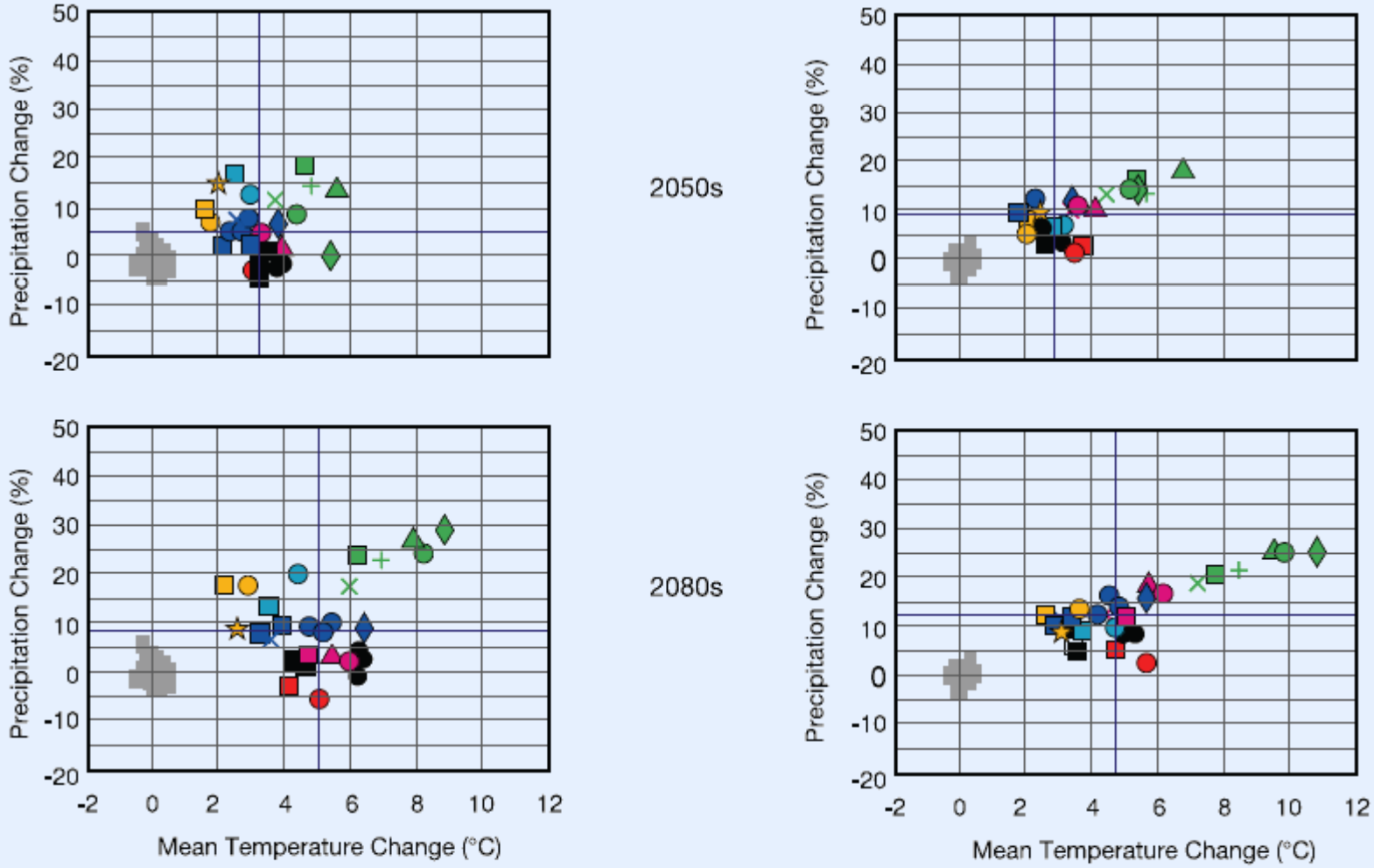
Future climates are outside the range of natural variability

Projected changes in mean annual temperature and precipitation

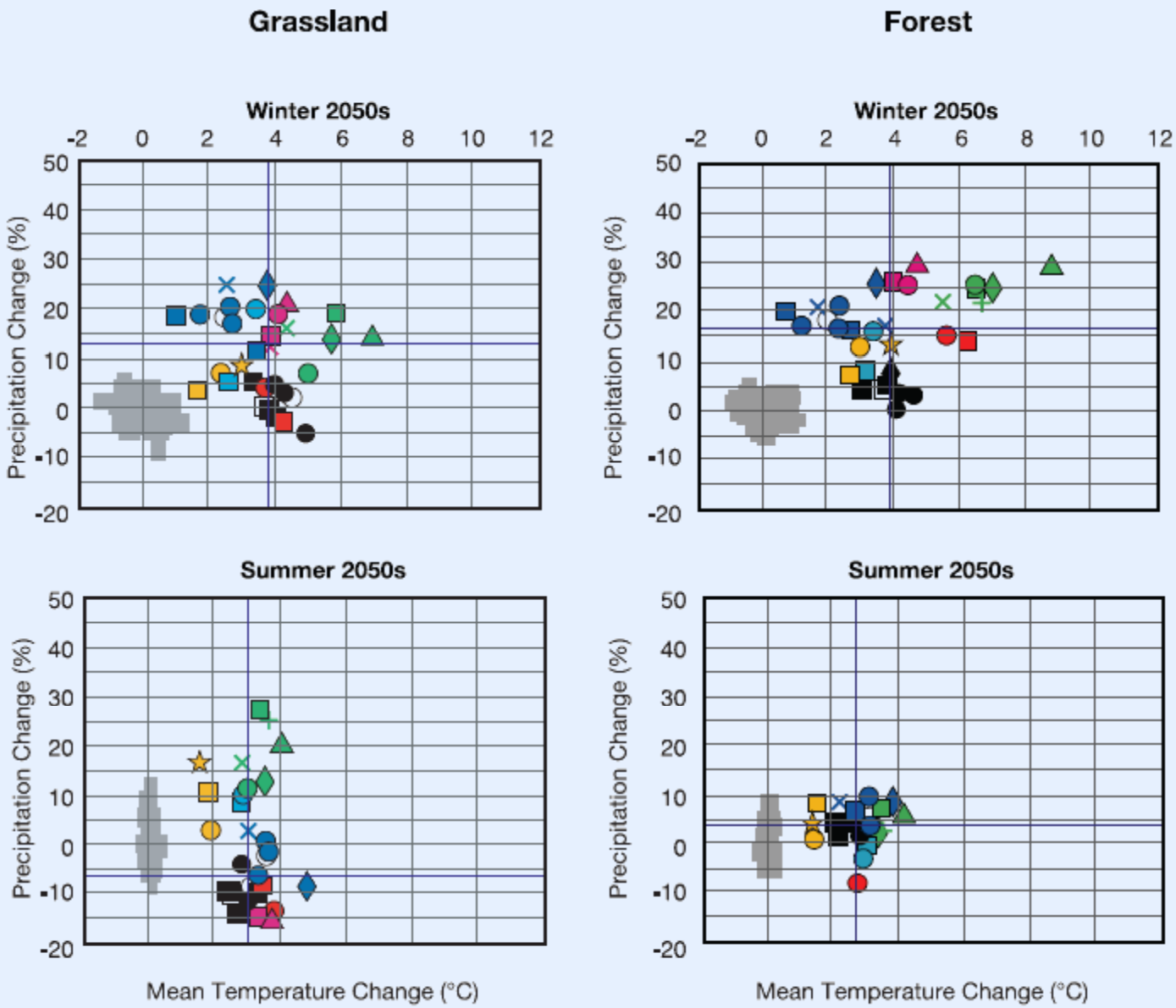


The grey squares indicate the ‘natural’ climate variability simulated by a long control run of the CGCM2.

Projected changes in mean annual temperature and precipitation

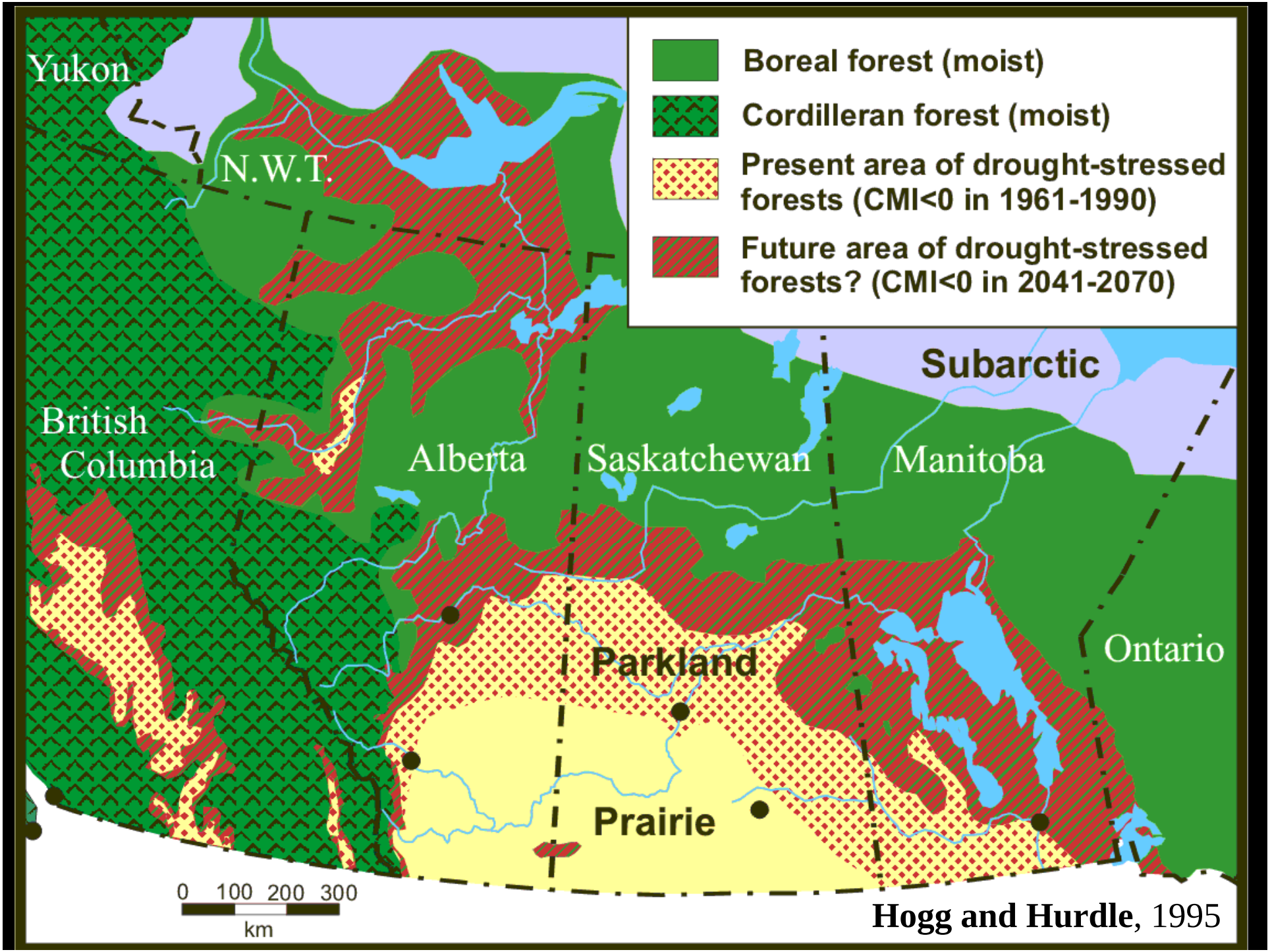


Seasonal Scenarios



We are losing the advantage of a cold winter

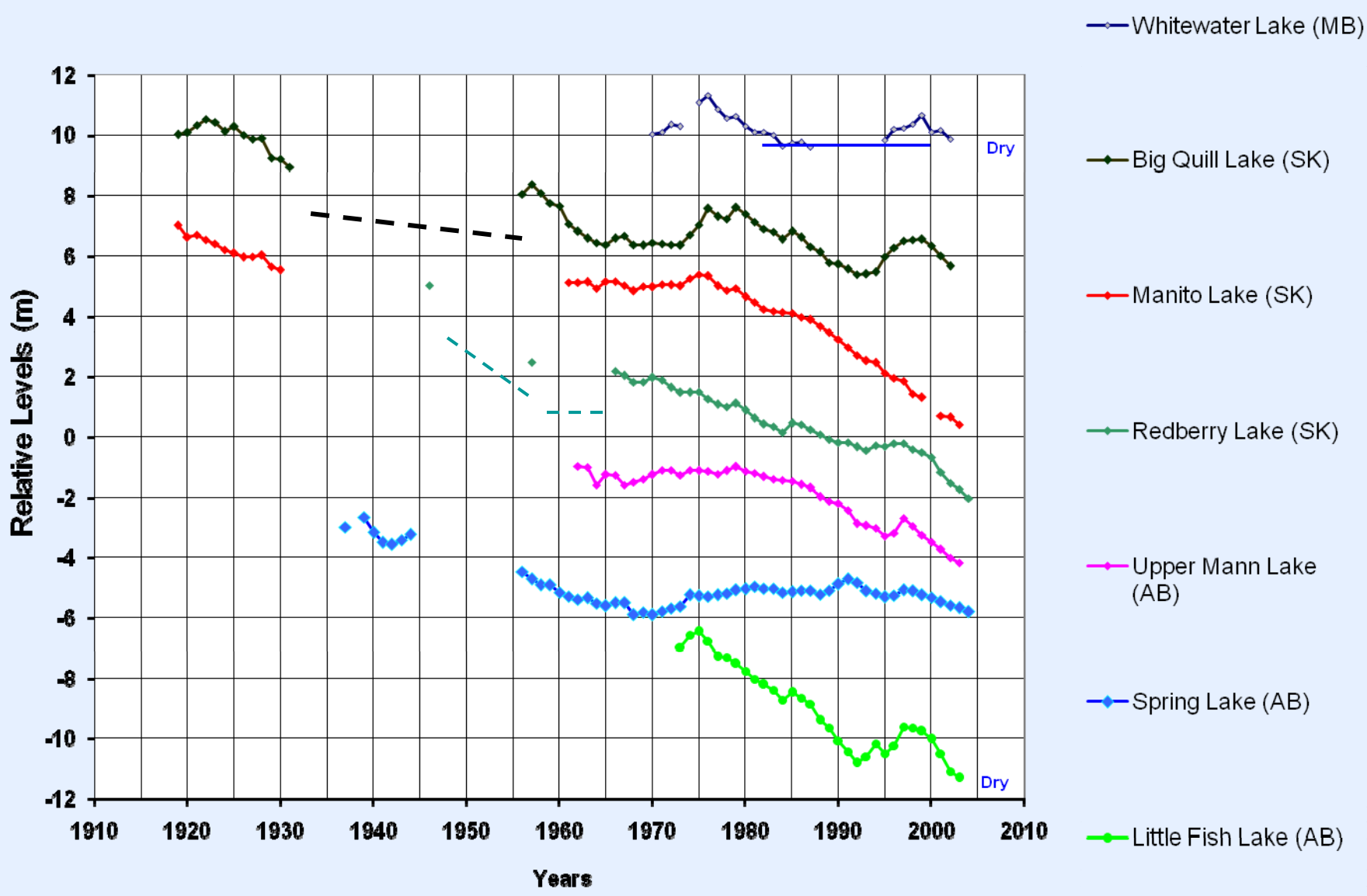
Major ecological changes are expected.


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

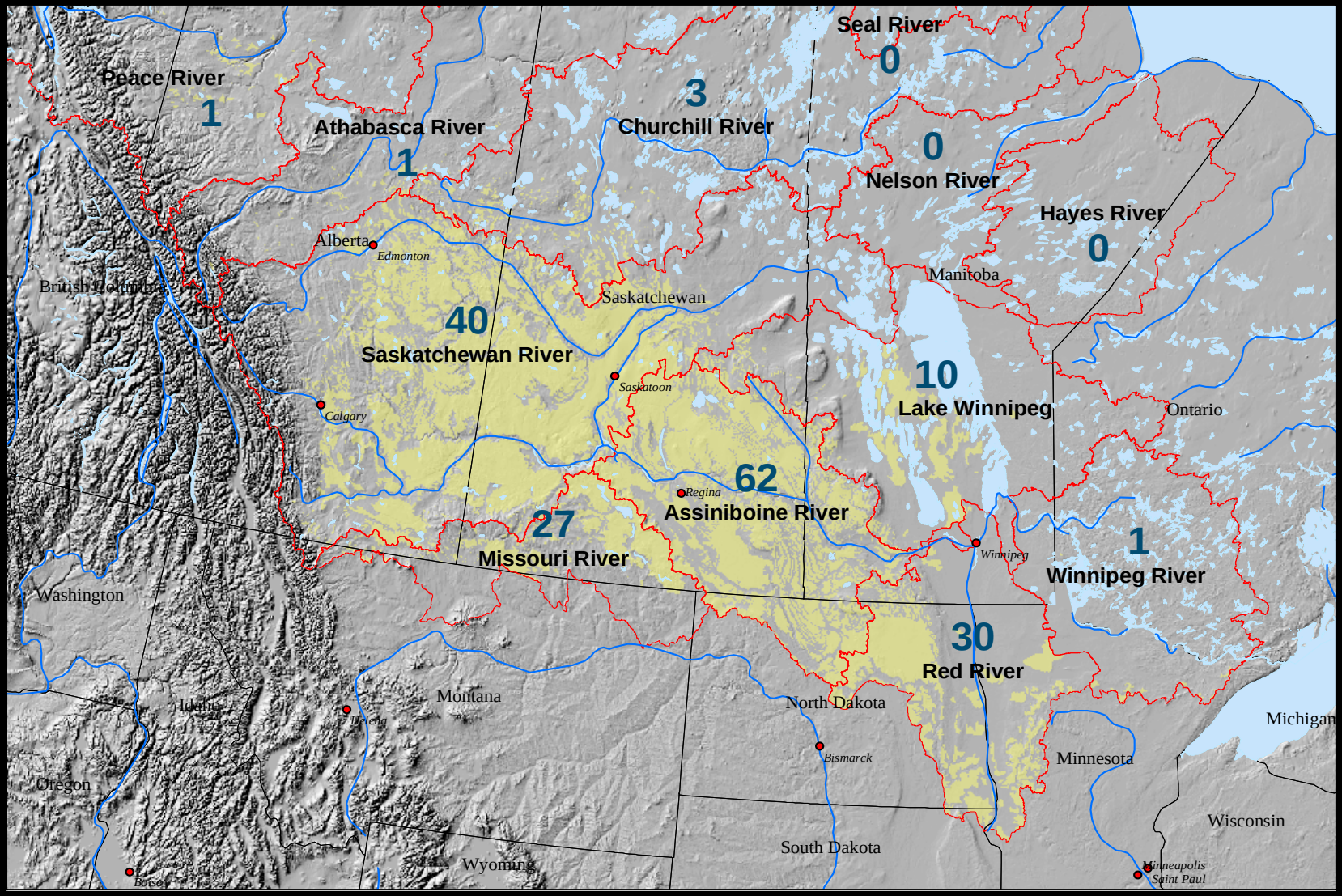
One of the most certain projections is that extra water will be available in winter and spring, while summers generally will be drier

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

Closed-basin lake level changes, 1918-2004 (van der Kamp *et al.*)

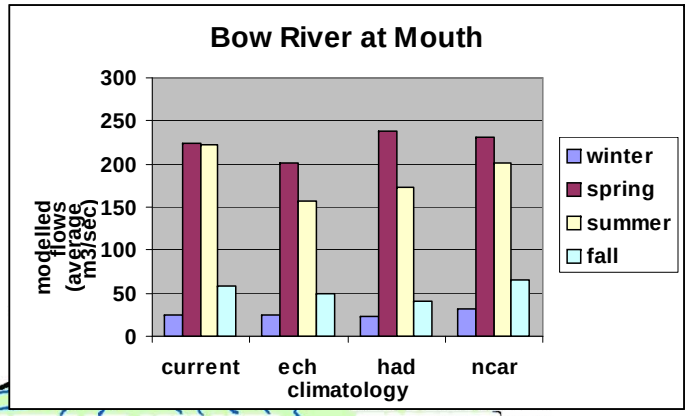


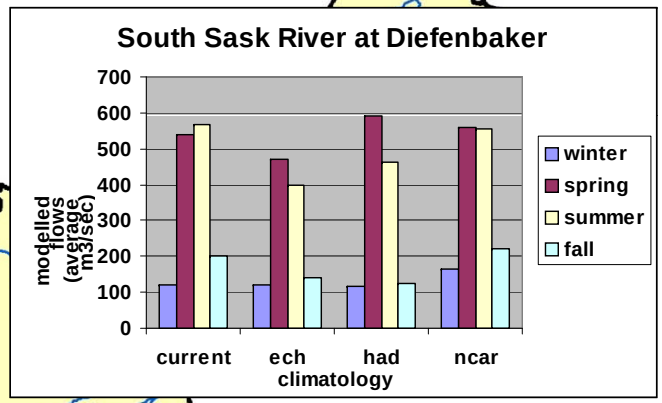
Prairie Drainage Basins (source: PFRA)

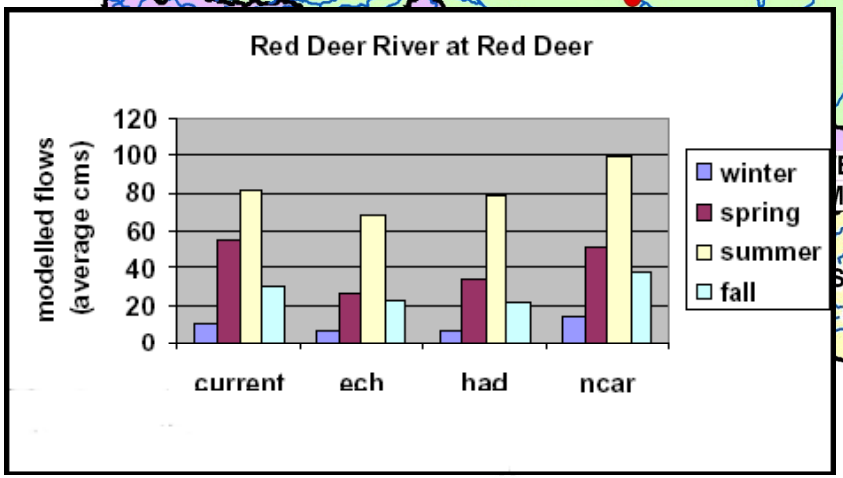


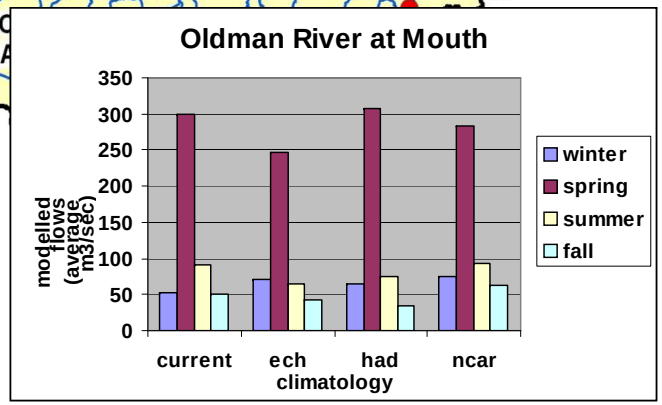
Seasonal flows, SSRB, 2039-2070 (Pietroniro *et al.*, 2006)

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	

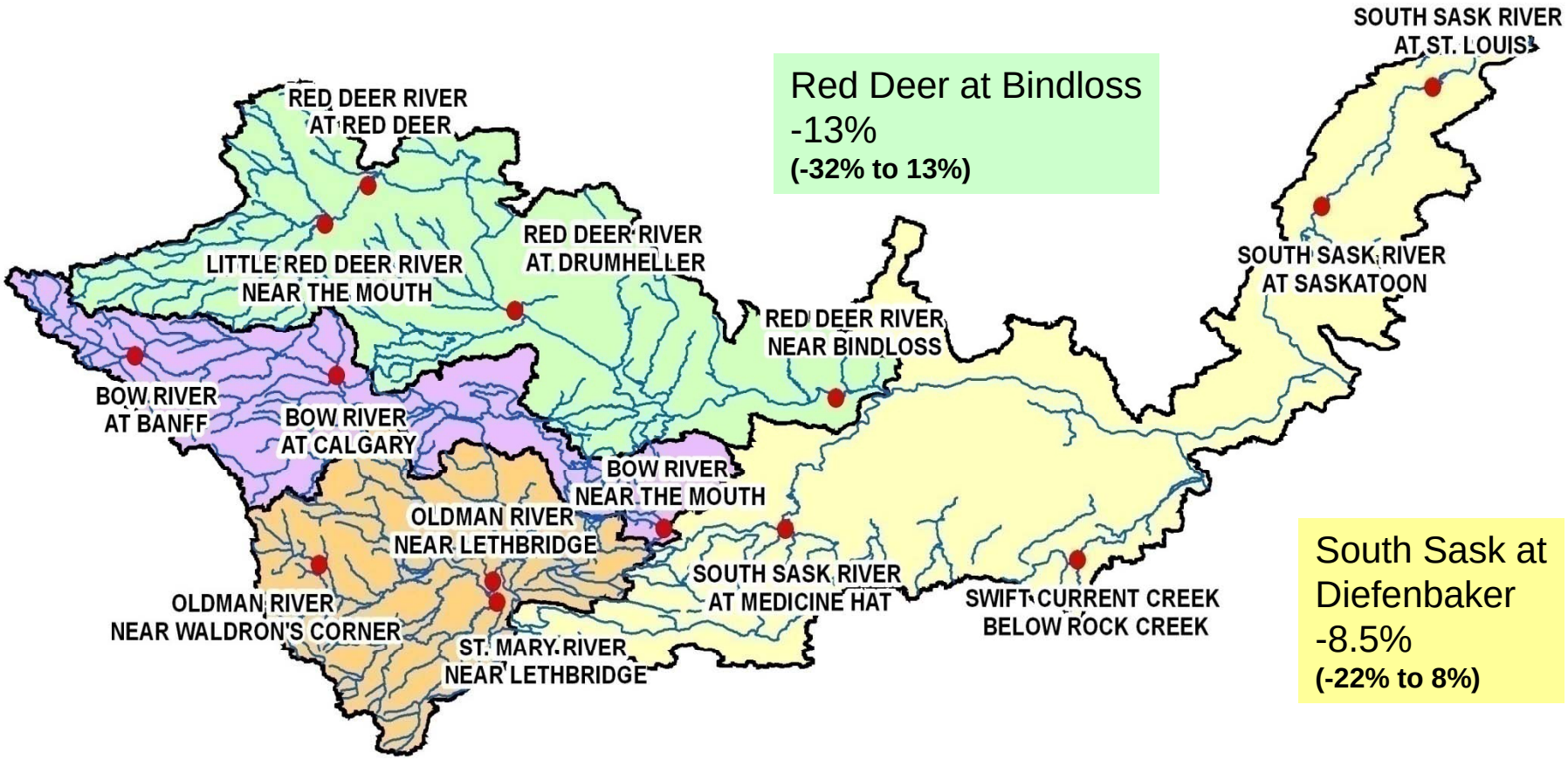








Annual flows, SSRB, 2039 – 2070 (Pietroniro *et al.*, 2006)



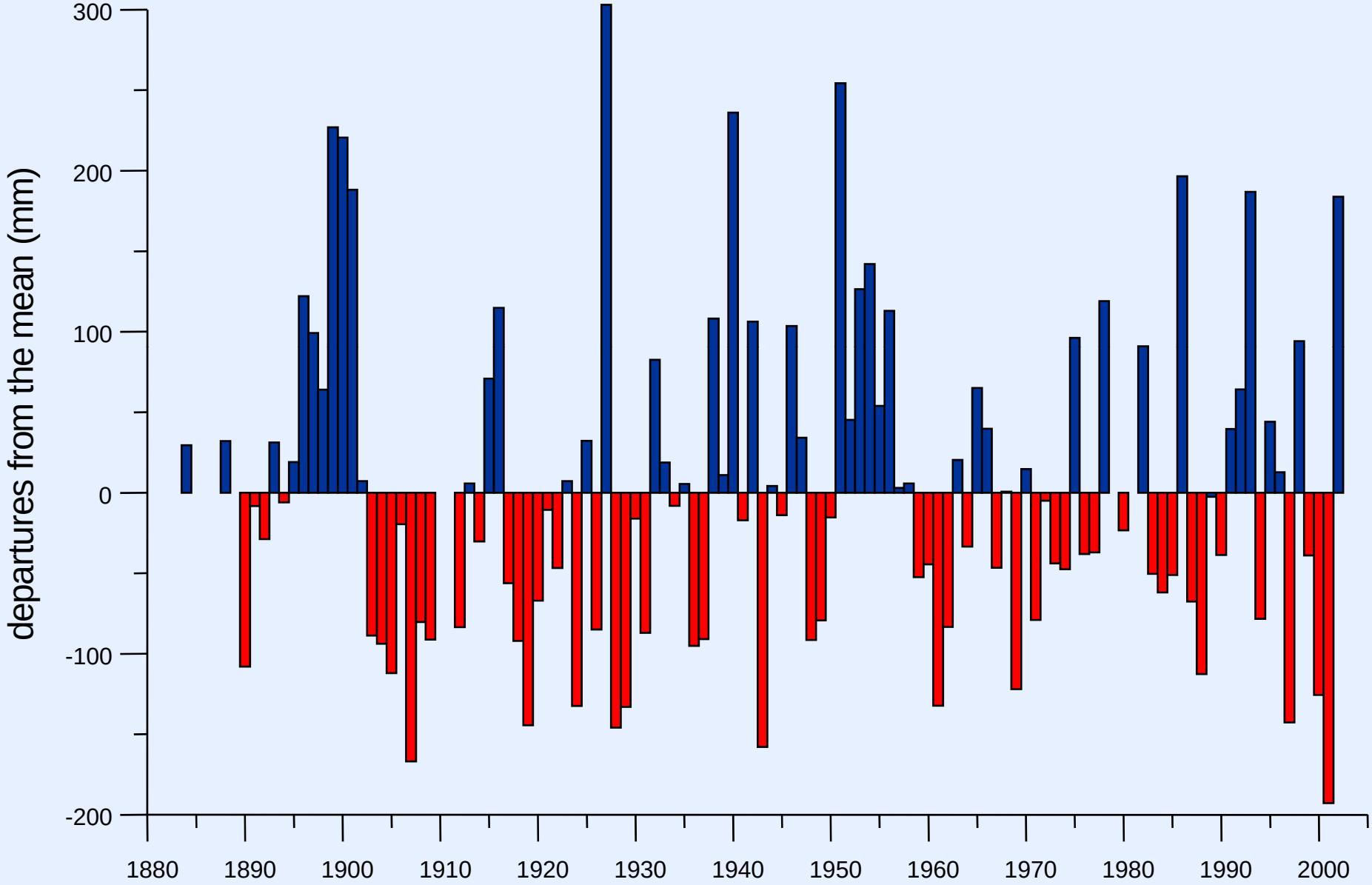
Red Deer at Bindloss
-13%
(-32% to 13%)

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

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

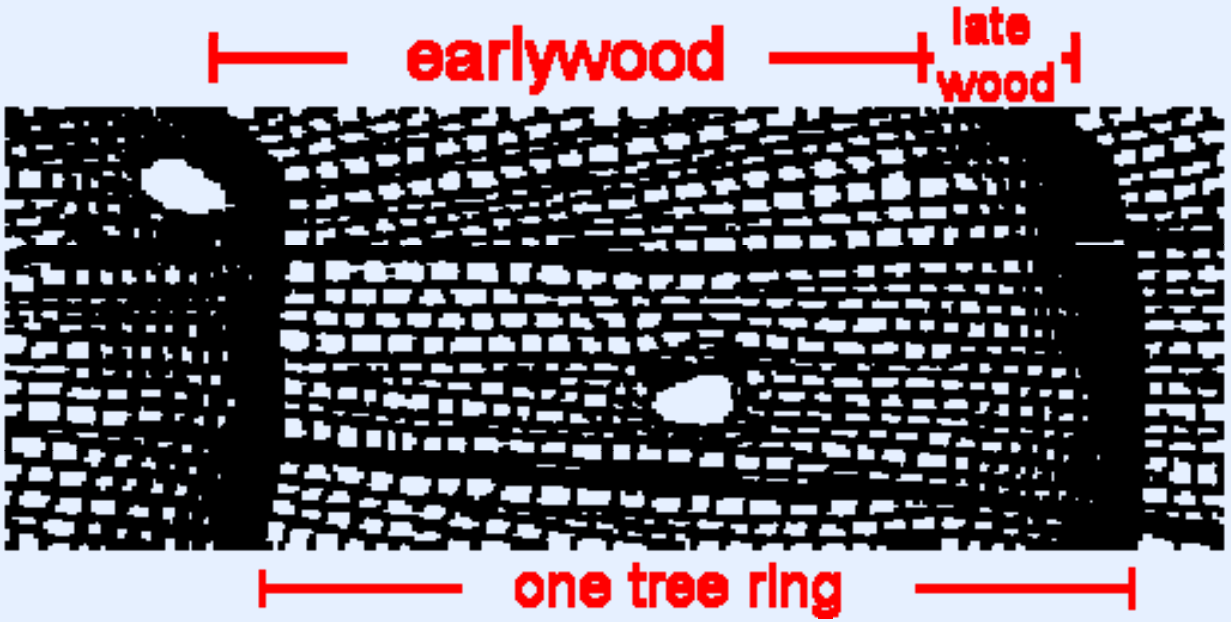
Oldman at mouth
- 4%
(-13% to 8%)

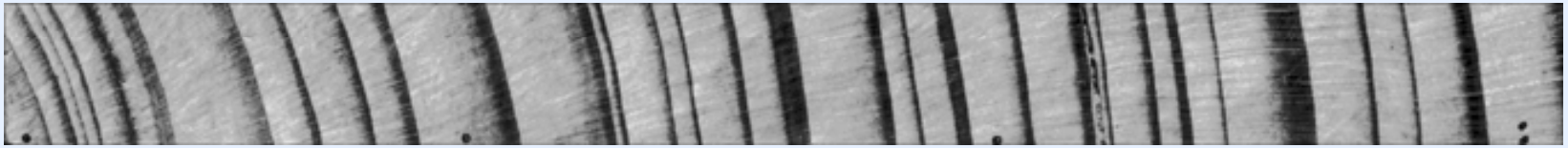
Annual Precipitation, Medicine Hat, 1884-2002



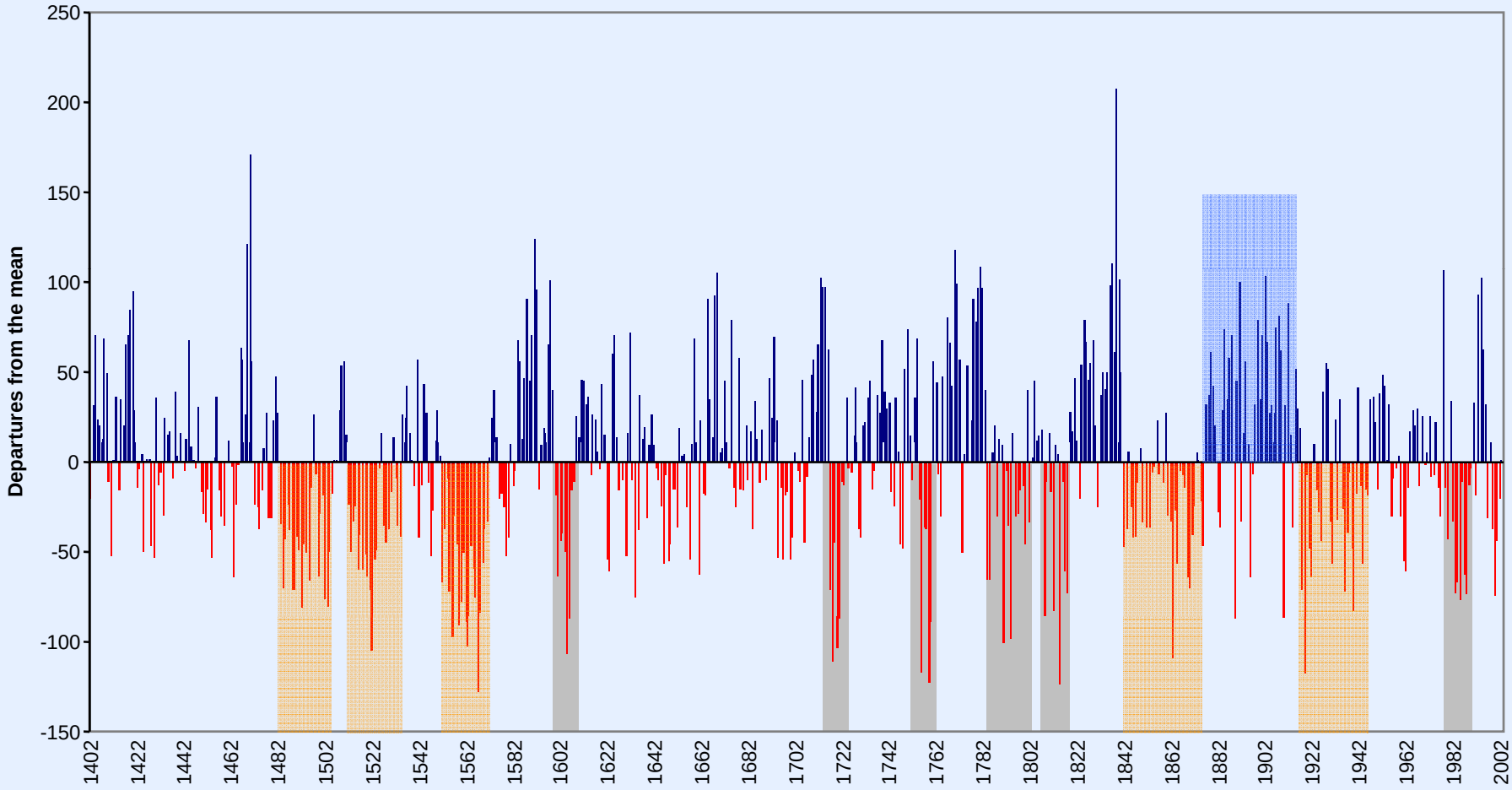
There will be greater variation in hydroclimate

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


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

Most impacts are adverse because we are not presently adapted to the larger range of climate conditions projected

Resources and communities are sensitive to climate variability

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

Adaptation: adjustments in practices, processes, or structures of systems to projected or actual changes of climate (IPCC, 2001).

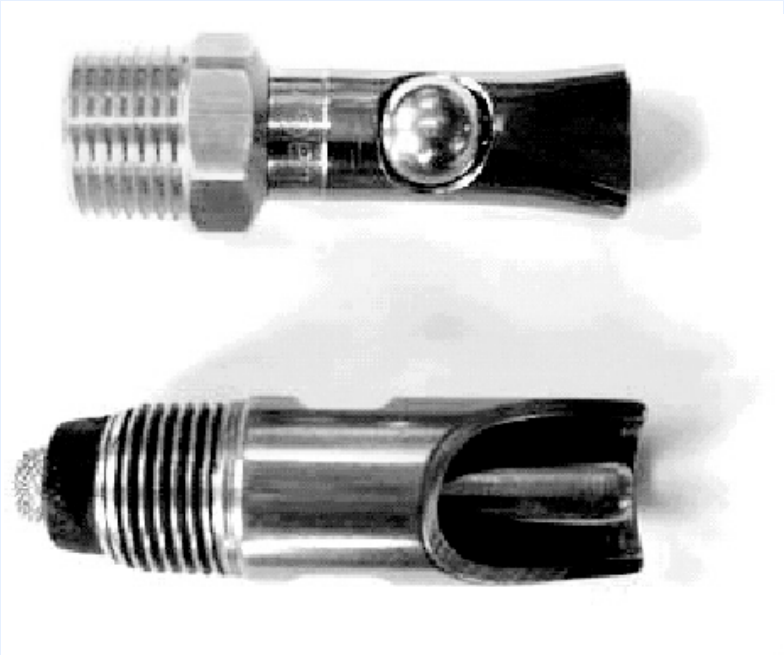
Adaptive Capacity

Determinant	Explanation
Economic resources	Greater economic resources increase adaptive capacity Lack of financial resources limits adaptation options
Technology	Lack of technology limits range of potential adaptation options Less technologically advanced regions are less likely to develop and/or implement technological adaptations
Information and skills	Lack of informed, skilled and trained personnel reduces adaptive capacity Greater access to information increases likelihood of timely and appropriate adaptation
Infrastructure	Greater variety of infrastructure can enhance adaptive capacity, since it provides more options Characteristics and location of infrastructure also affect adaptive capacity
Institutions	Well-developed social institutions help to reduce impacts of climate-related risks, and therefore increase adaptive capacity
Equity	Equitable distribution of resources increases adaptive capacity Both availability of, and access to, resources is important

JV Farms, High River, Alberta

ball-bite drinker

standard drinker



- one-year trial, from August 2004 to July 2005, the ball-bite drinker sections of the barn used 35 per cent less water that the standard drinker sections
- no detrimental effects on the animals or facility management
- decrease in water usage led to many secondary benefits

Adaptation to water shortages in 2001-02, Hannah, AB

- hauling water
- shallow (seasonal) and deep (permanent) water pipelines
- access to Sheerness Power Generating Station water pipeline
- calls for second pipeline from Red Deer River
- culled and moved livestock
- careful range management
- off-farm income mostly from oil
- historic adaptation measures with establishing the Special Areas (e.g. > 2,000 dugouts)

Wittrock et al. 2006

Beaver Creek Watershed Group

"We are really the ones who manage the land every day and the positive actions we take today will ensure that our children have healthy riparian areas and clean water. Hopefully they will grow up understanding what it seemed to take us forever to learn."

Dixon Hammond

Adaptive Capacity is High

Response to climate change is an opportunity build resilience, adaptive capacity and sustainable practices and systems

Planned adaptation is a component of adaptive management and sustainable economic development

Parkland Conservation Farm

is committed to increasing awareness and adoption of sustainable agriculture practices that conserve soil, water and wildlife habitat. We achieve these goals through demonstration, discovery and education of youth, farm managers and the general public.