Extent and Impacts of Hydroclimatic Variability in the Northern Interior

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Prairie Adaptation Research
Collaborative
University of Regina

Manitoba Hydro
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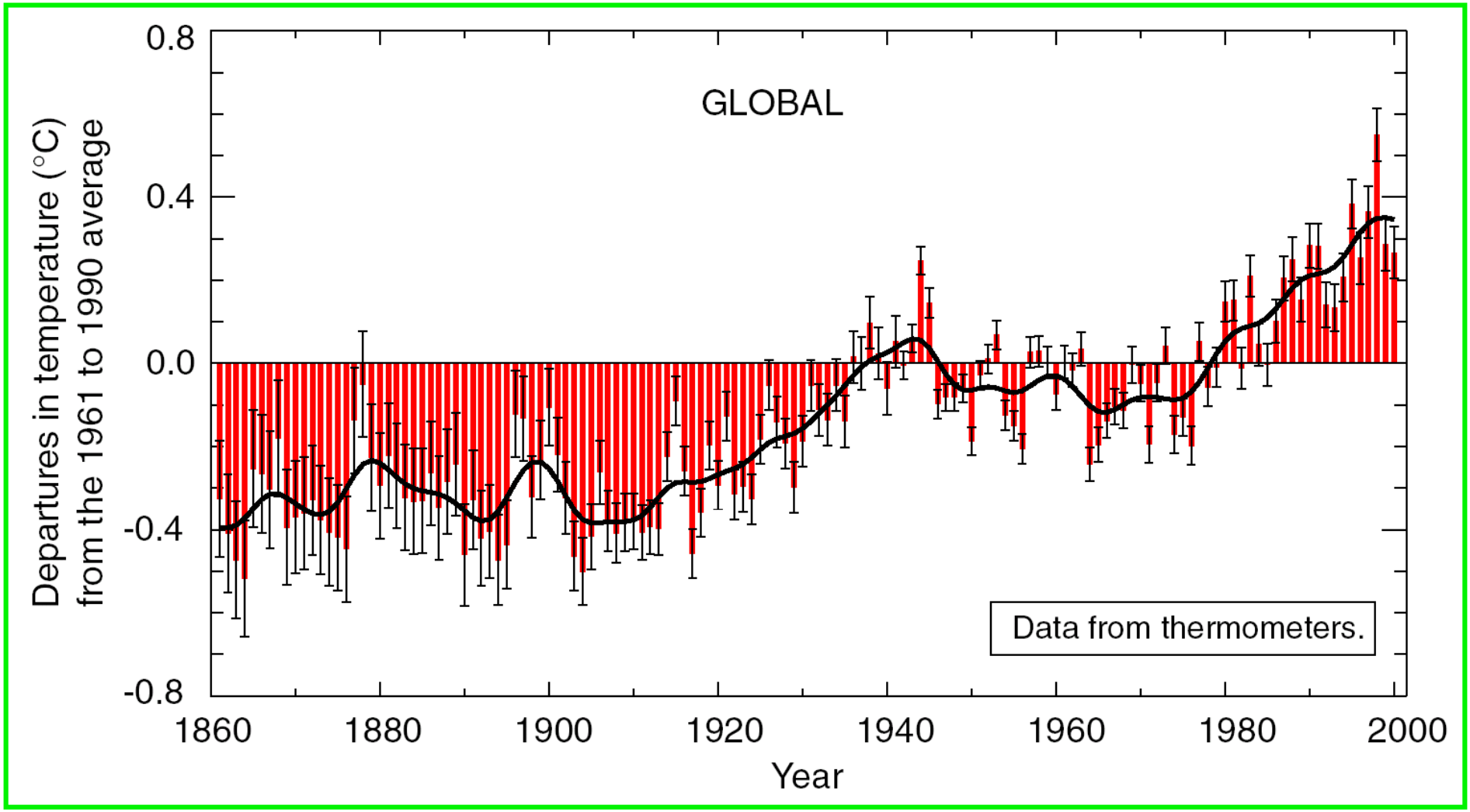
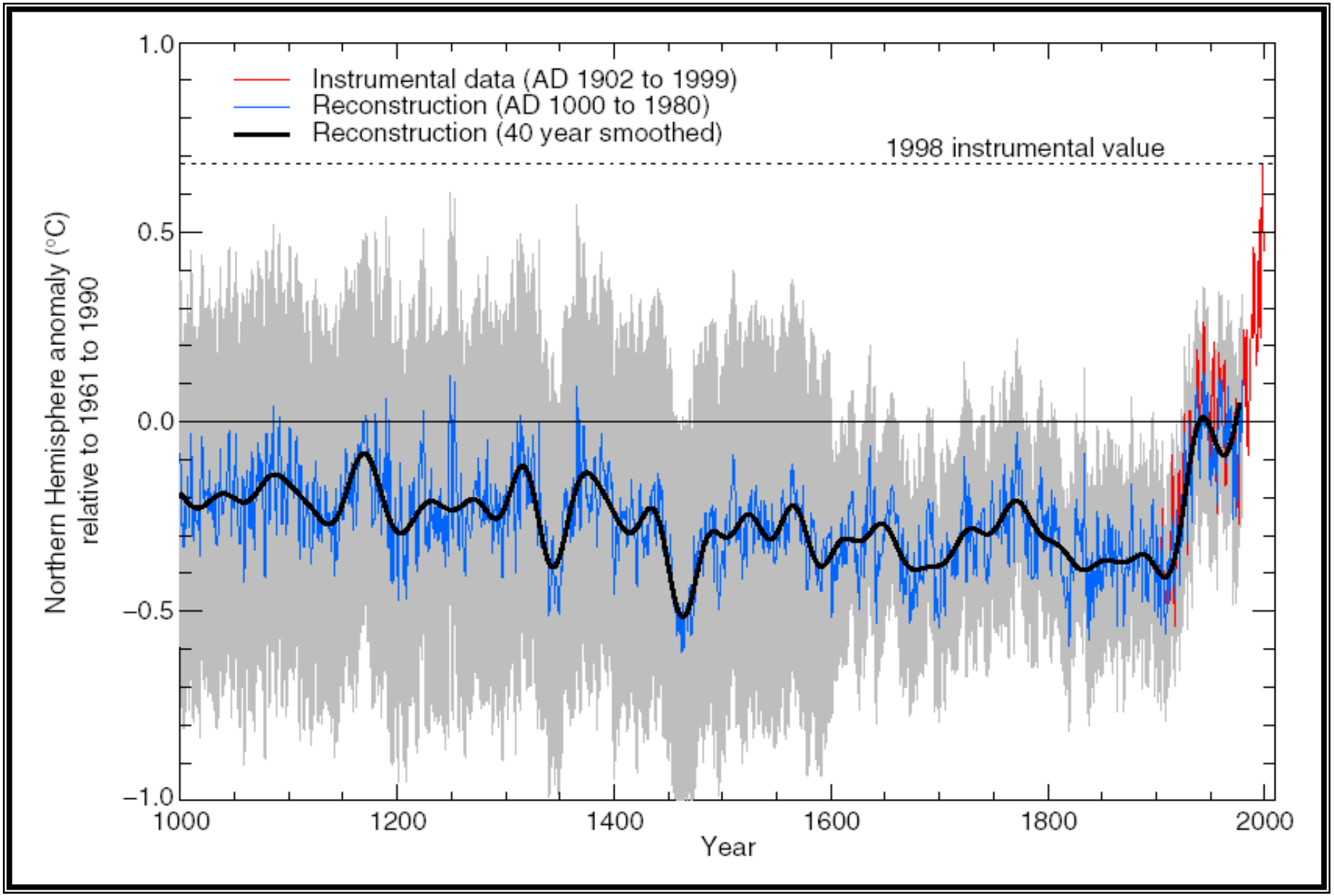
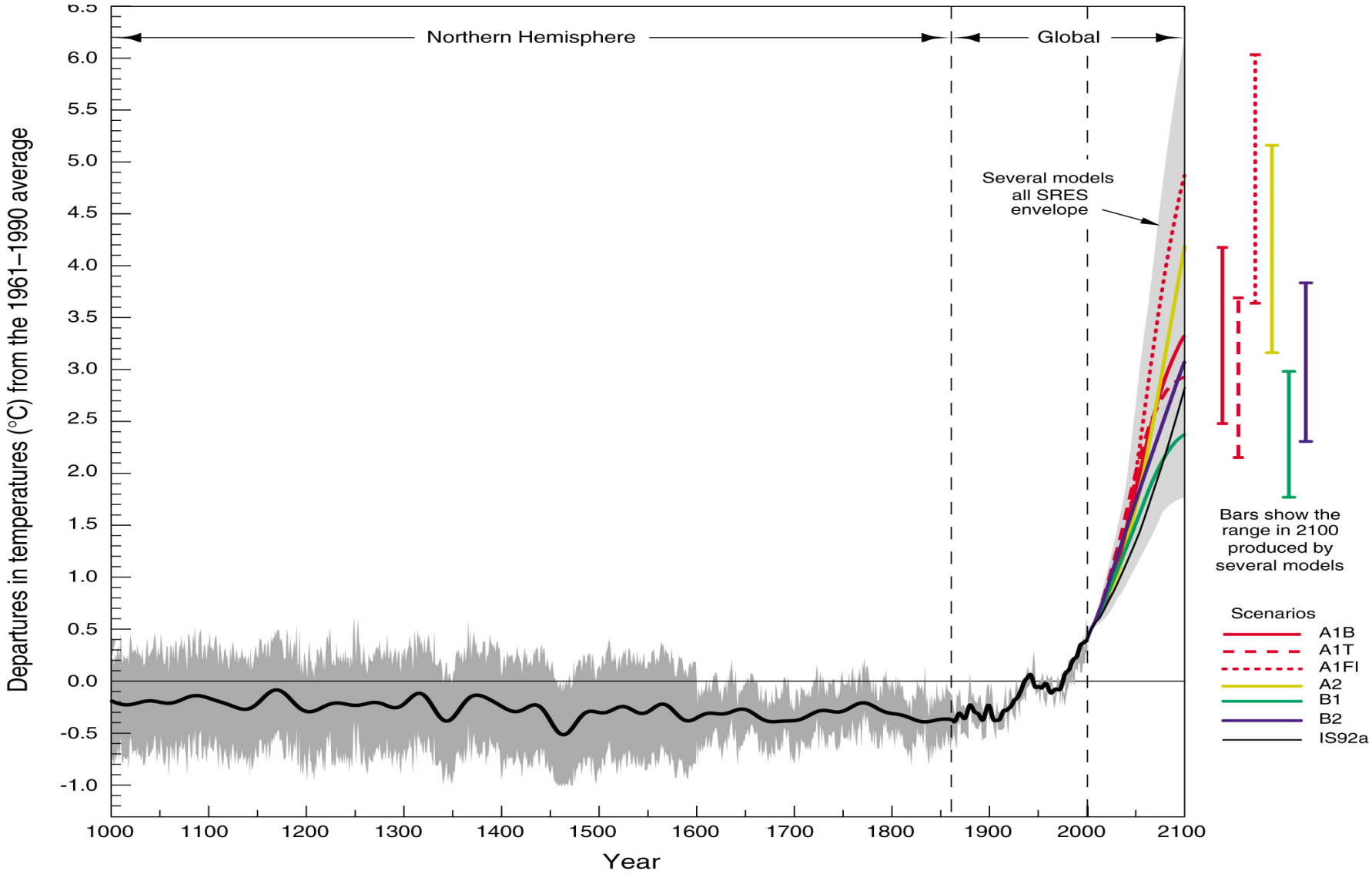
Global Measured Temperatures, 1861-2000

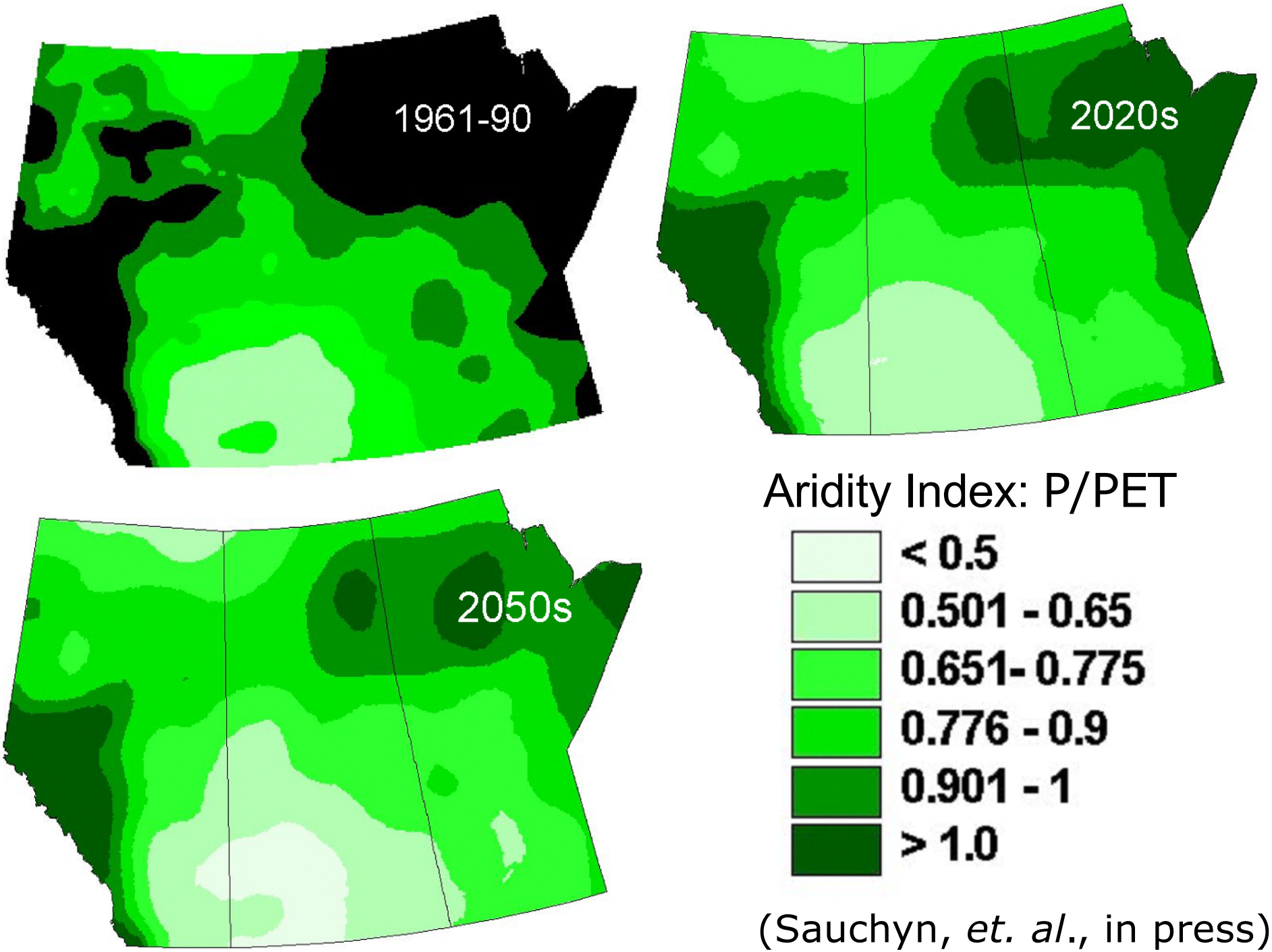




Mann, *et al*., 1999

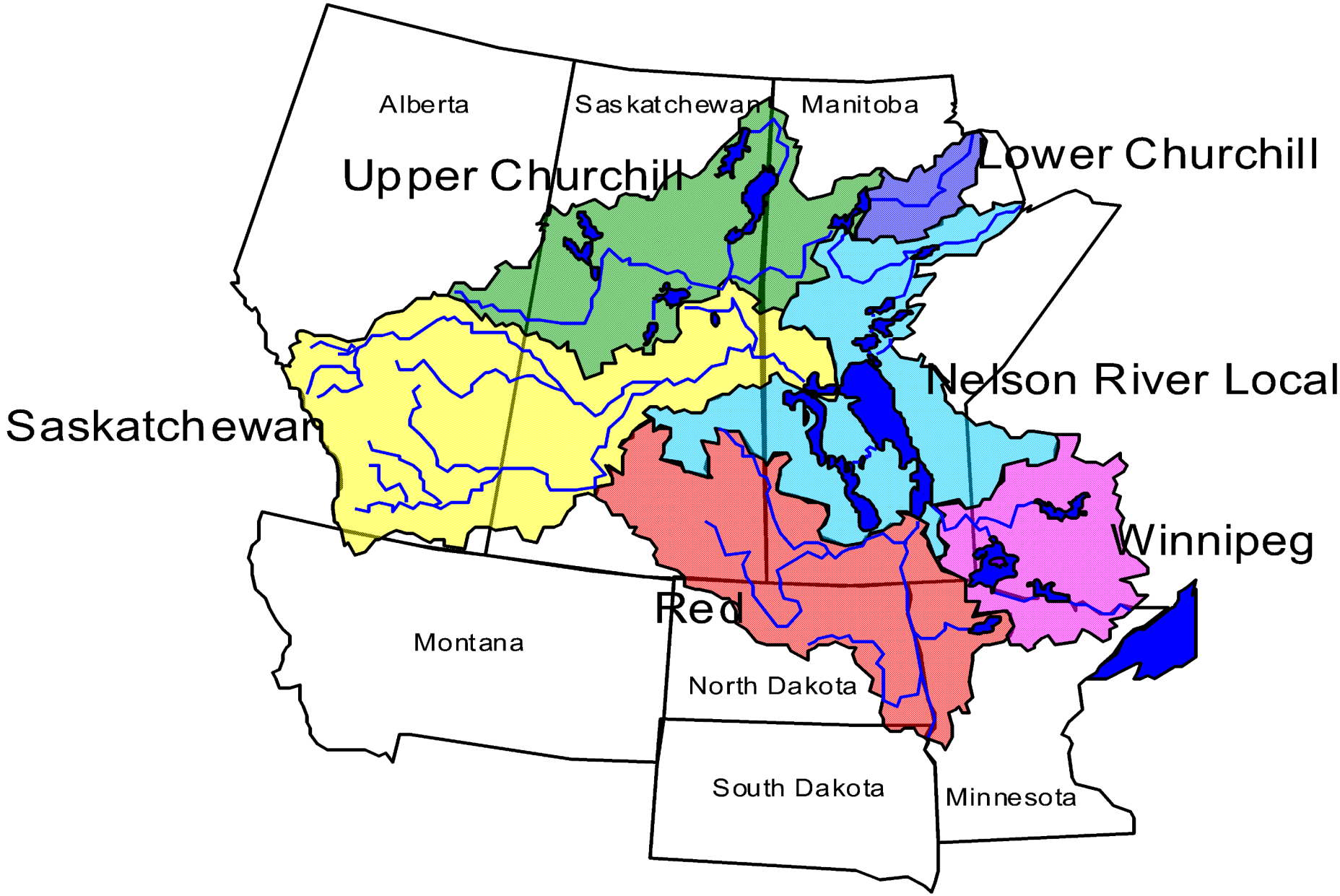
Past and Future Temperatures

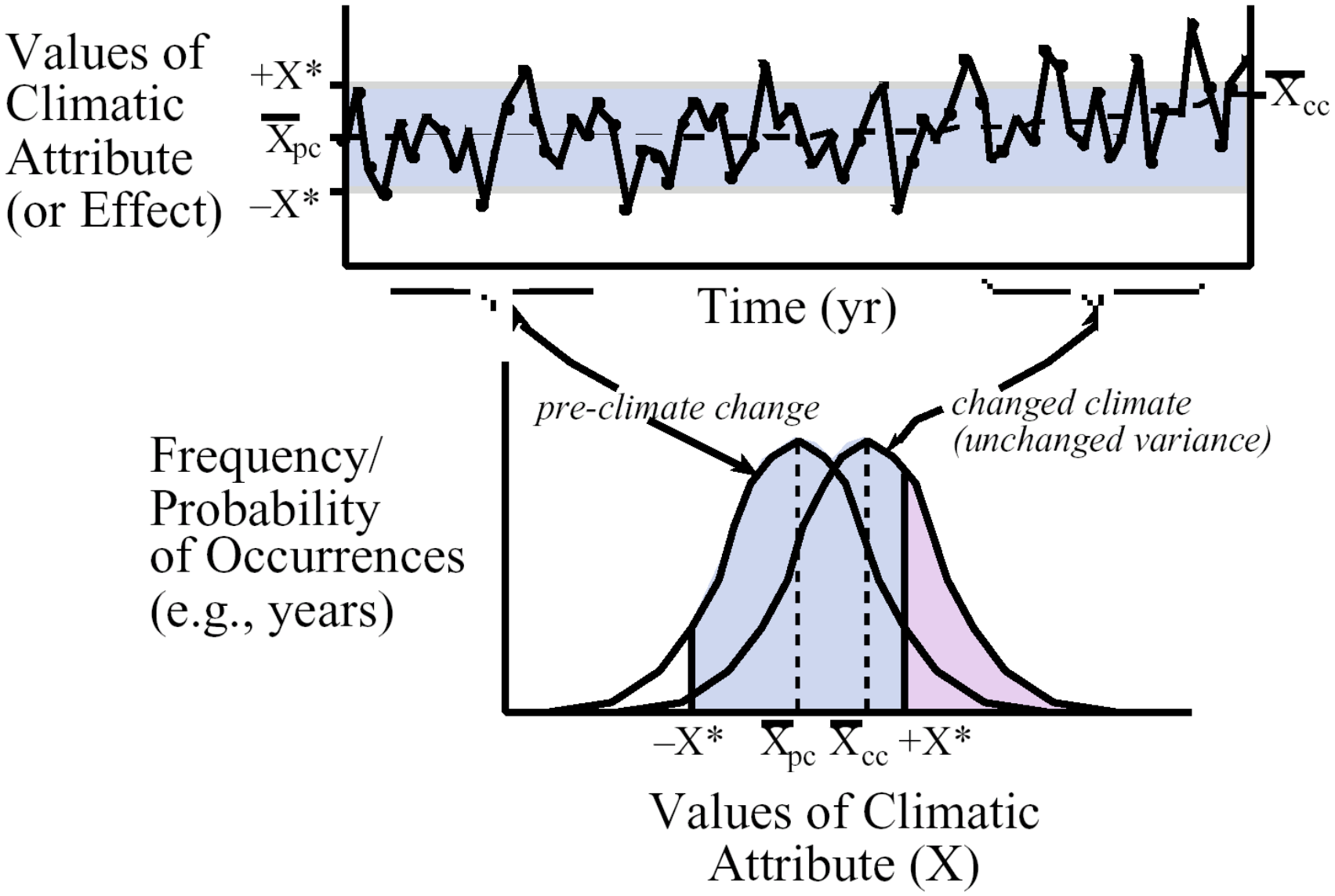




(Sauchyn, *et. al*., in press)

Nelson - Churchill Drainage Basin



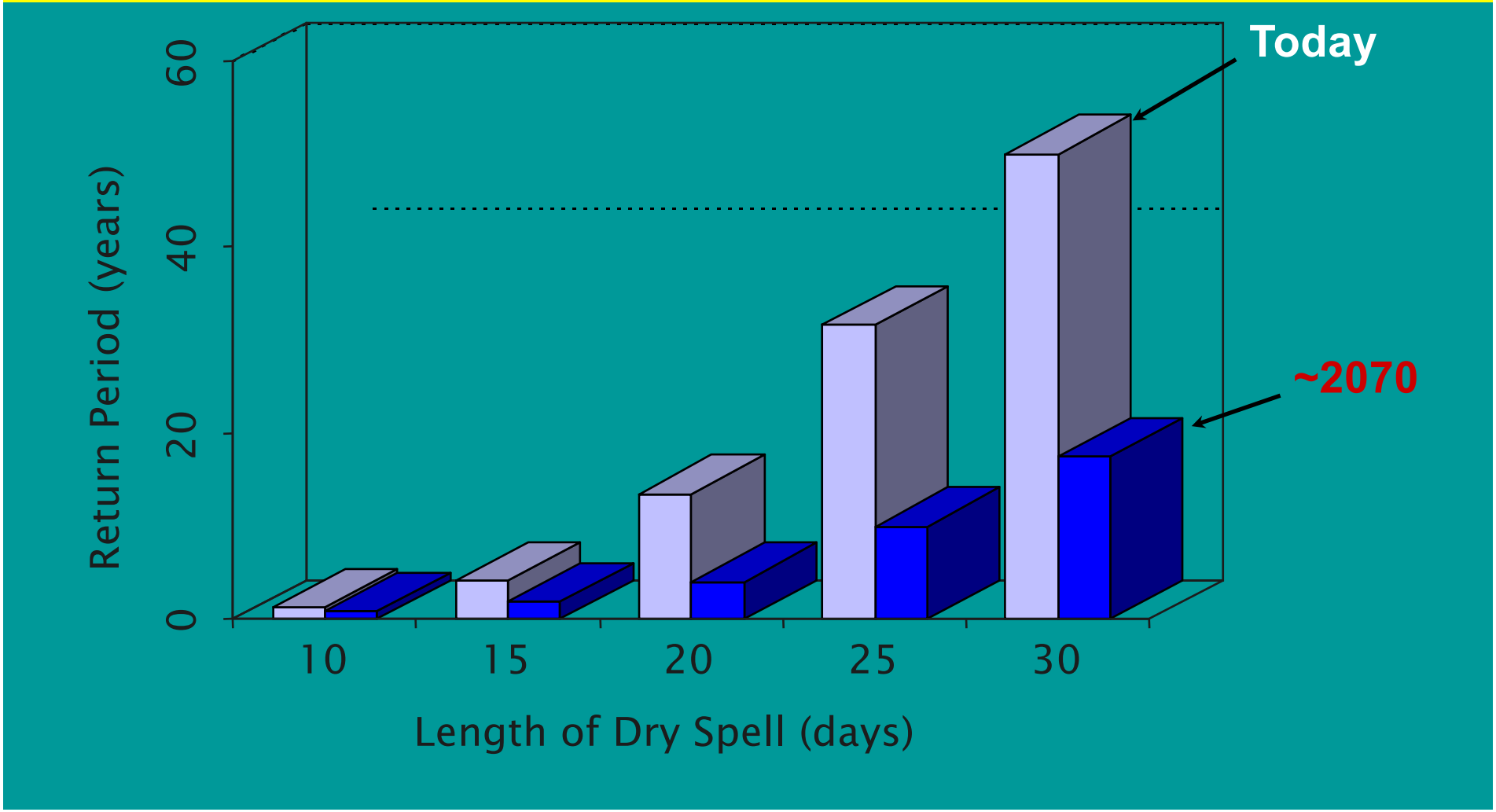


– – – Trend in mean value of X (20-yr running mean)

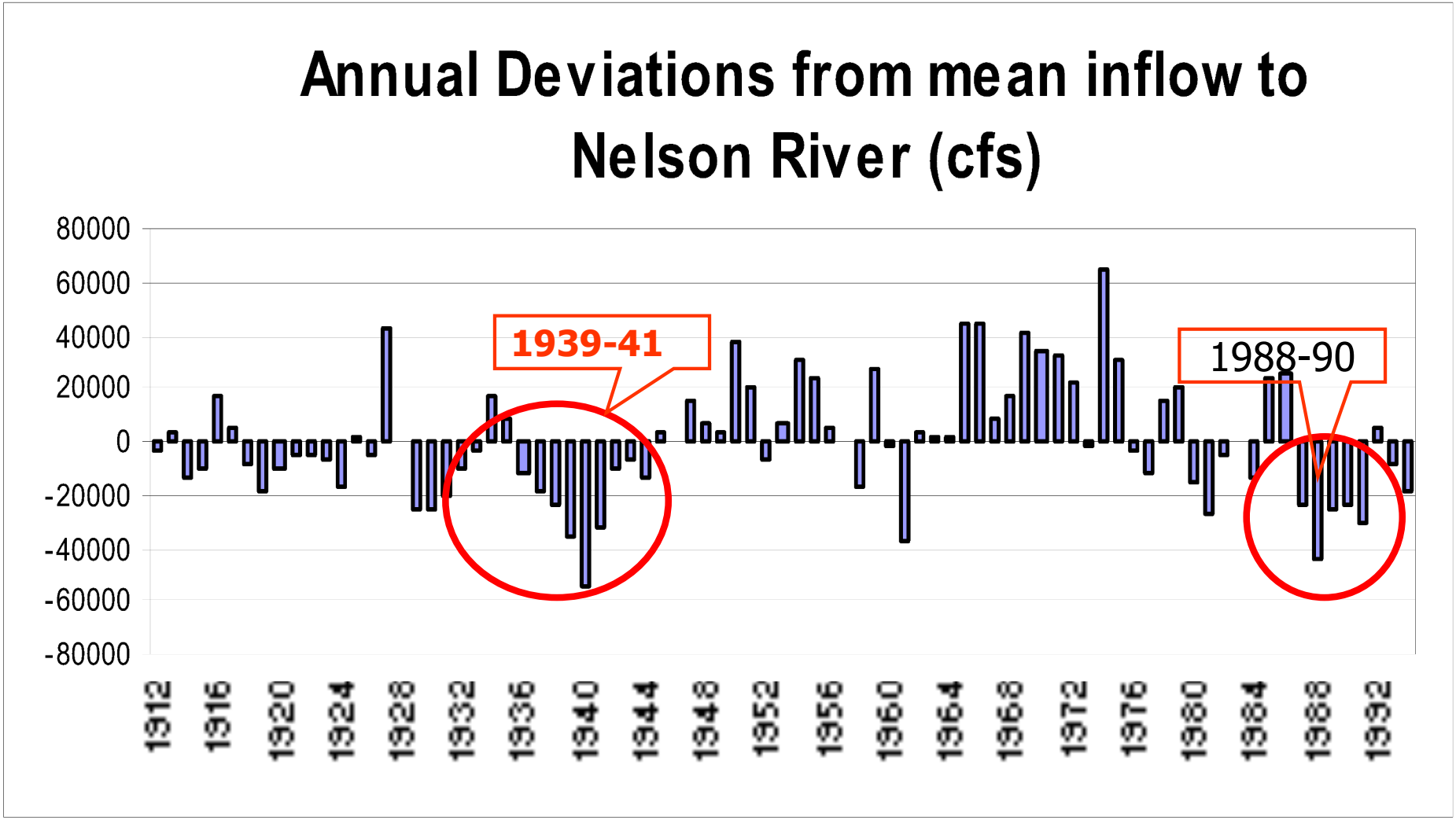
Climatic Variability

A projected increase in climate variability, including more frequent drought and major hydroclimatic events, is the most challenging climate change scenario. Social and biophysical systems respond to extremes of climate and to short-term departures from average conditions long before they respond to long-term trends in temperature or precipitation. More extreme climate anomalies are more likely to exceed natural and engineering thresholds beyond which the impacts of climate are much more severe.

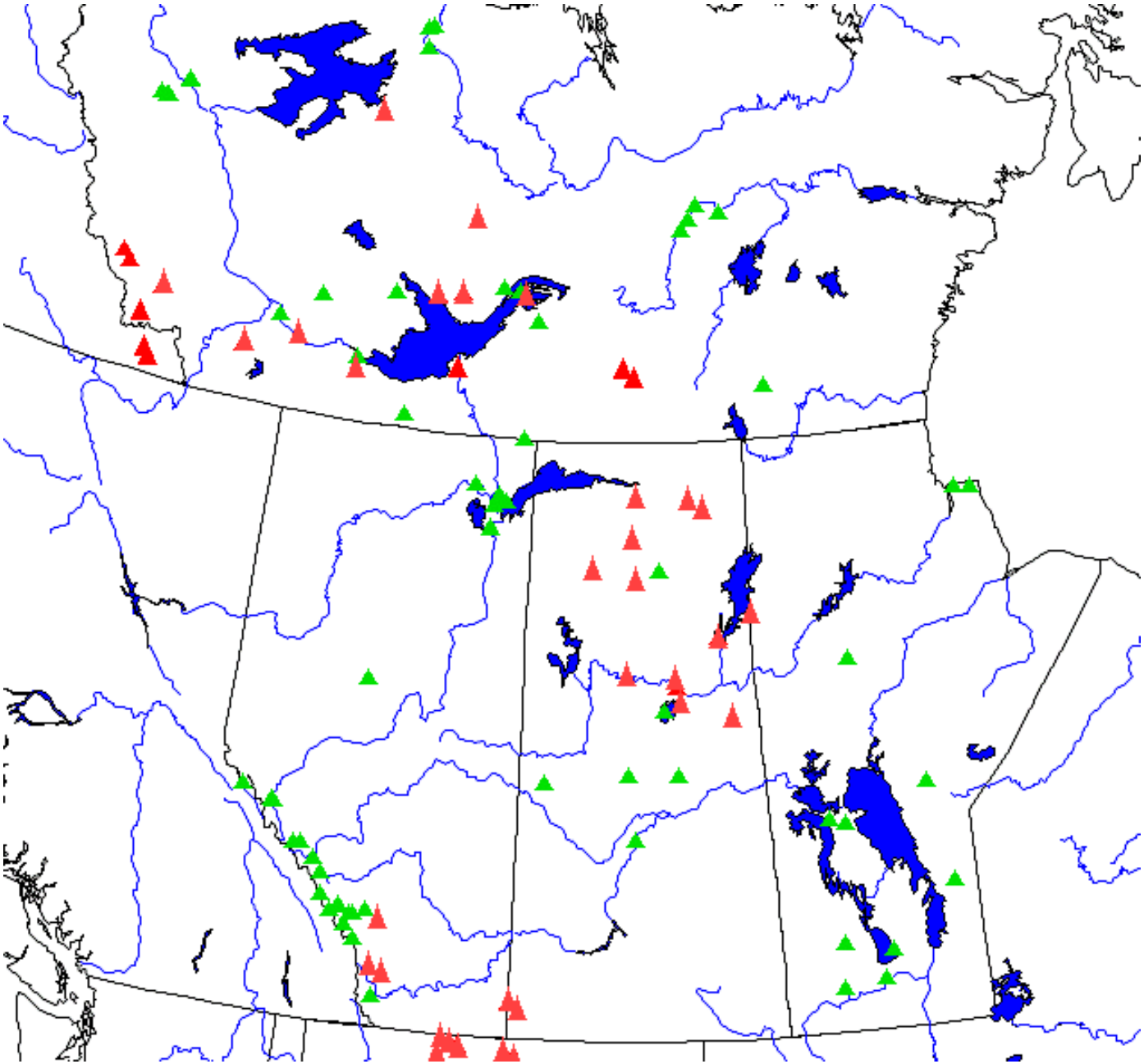
Increasing Frequency (Decreasing Return Period) of Dry Spells of a Specific Length



Drought of Record



Tree-Ring Chronologies



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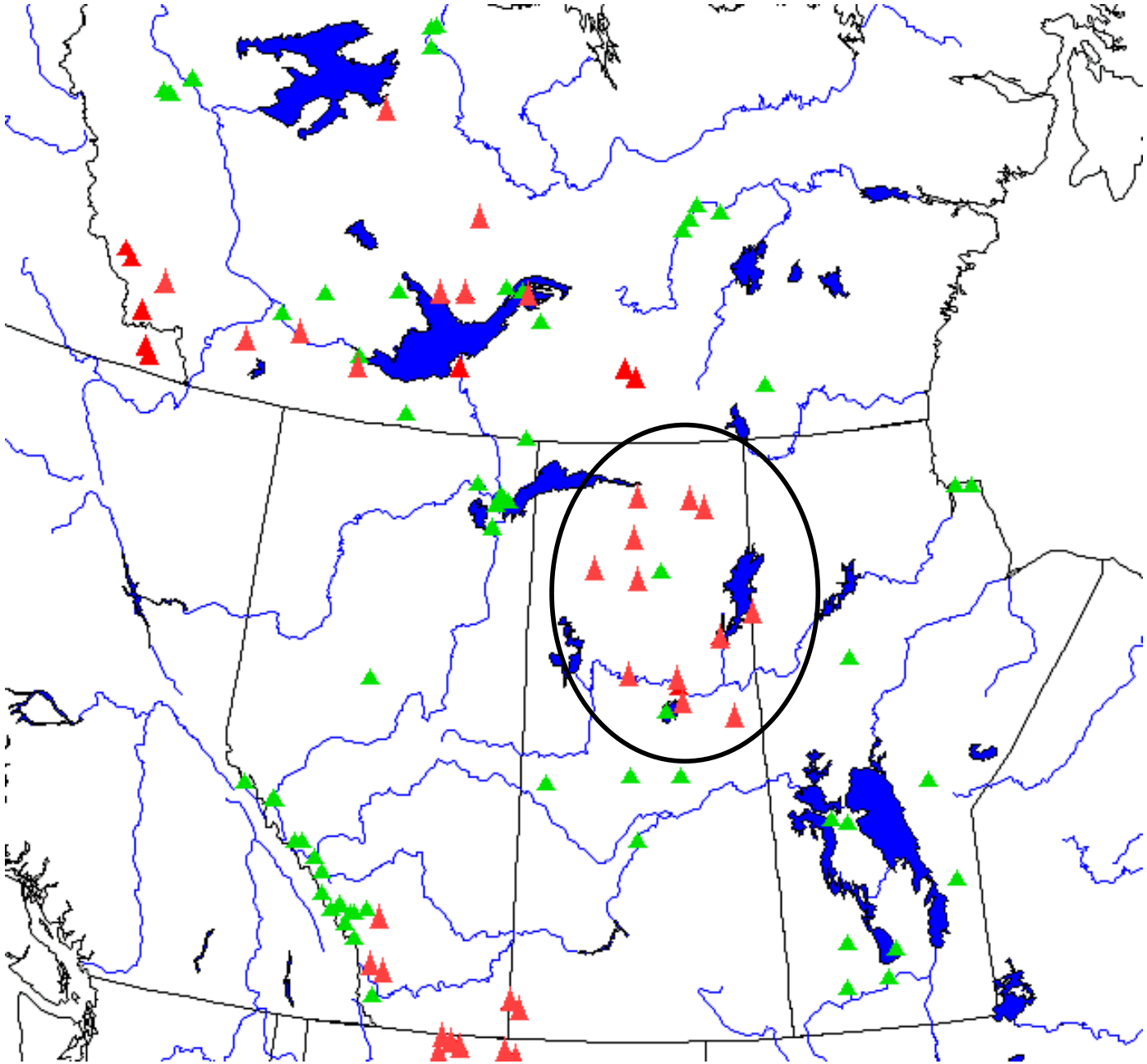
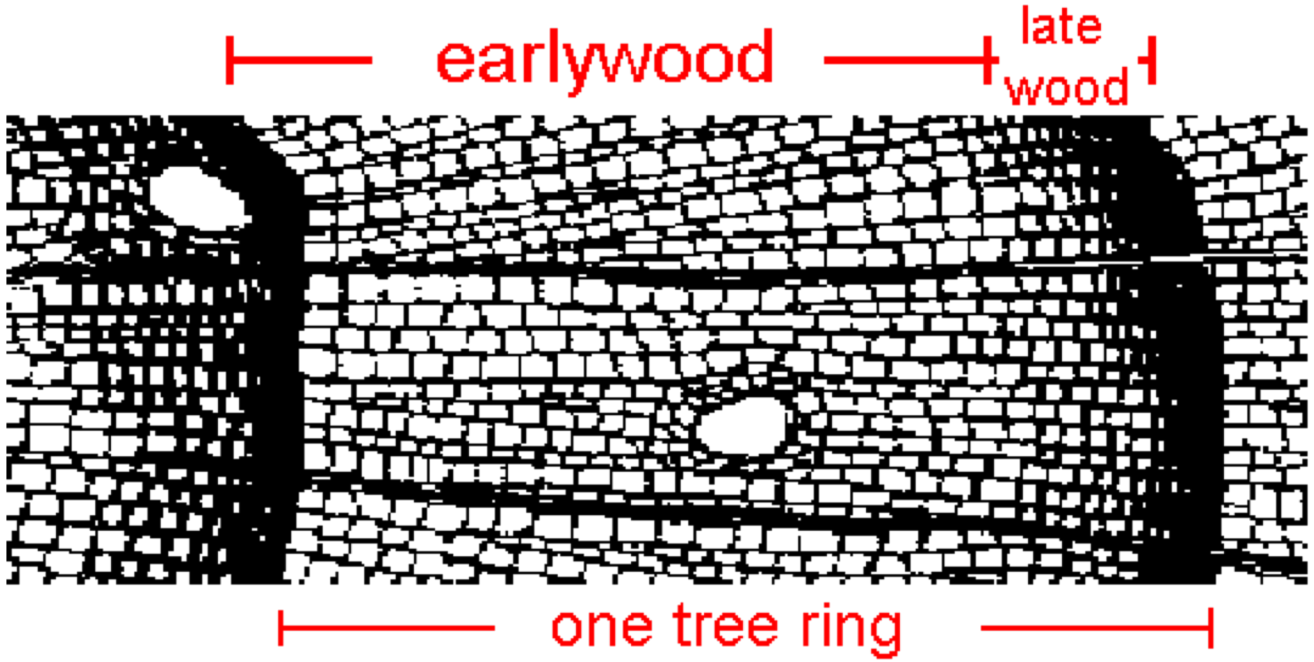
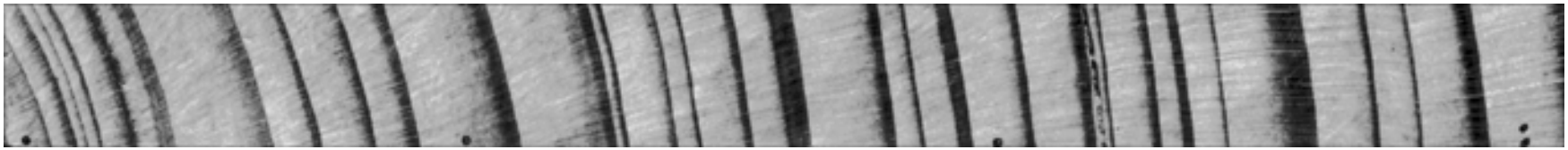
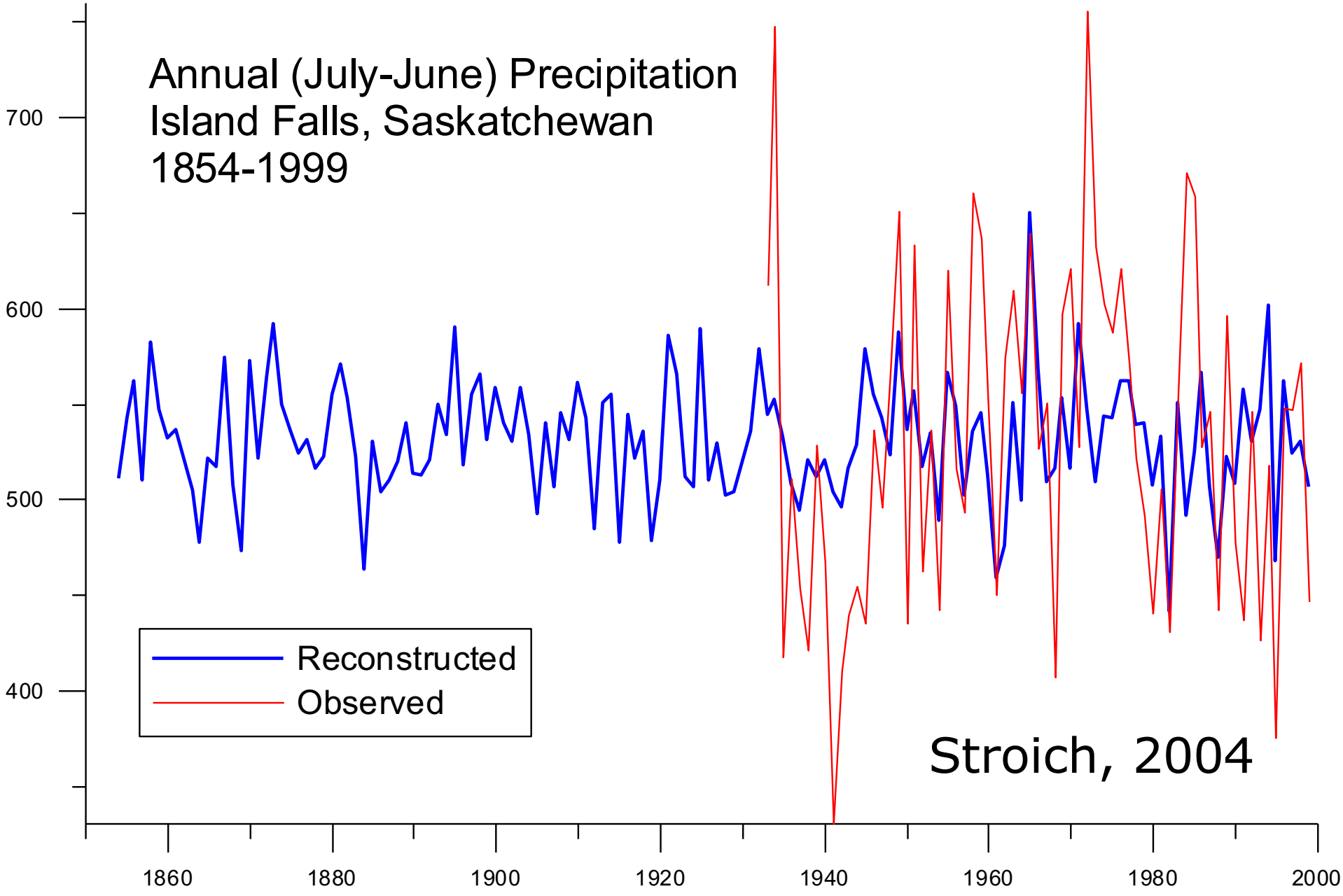
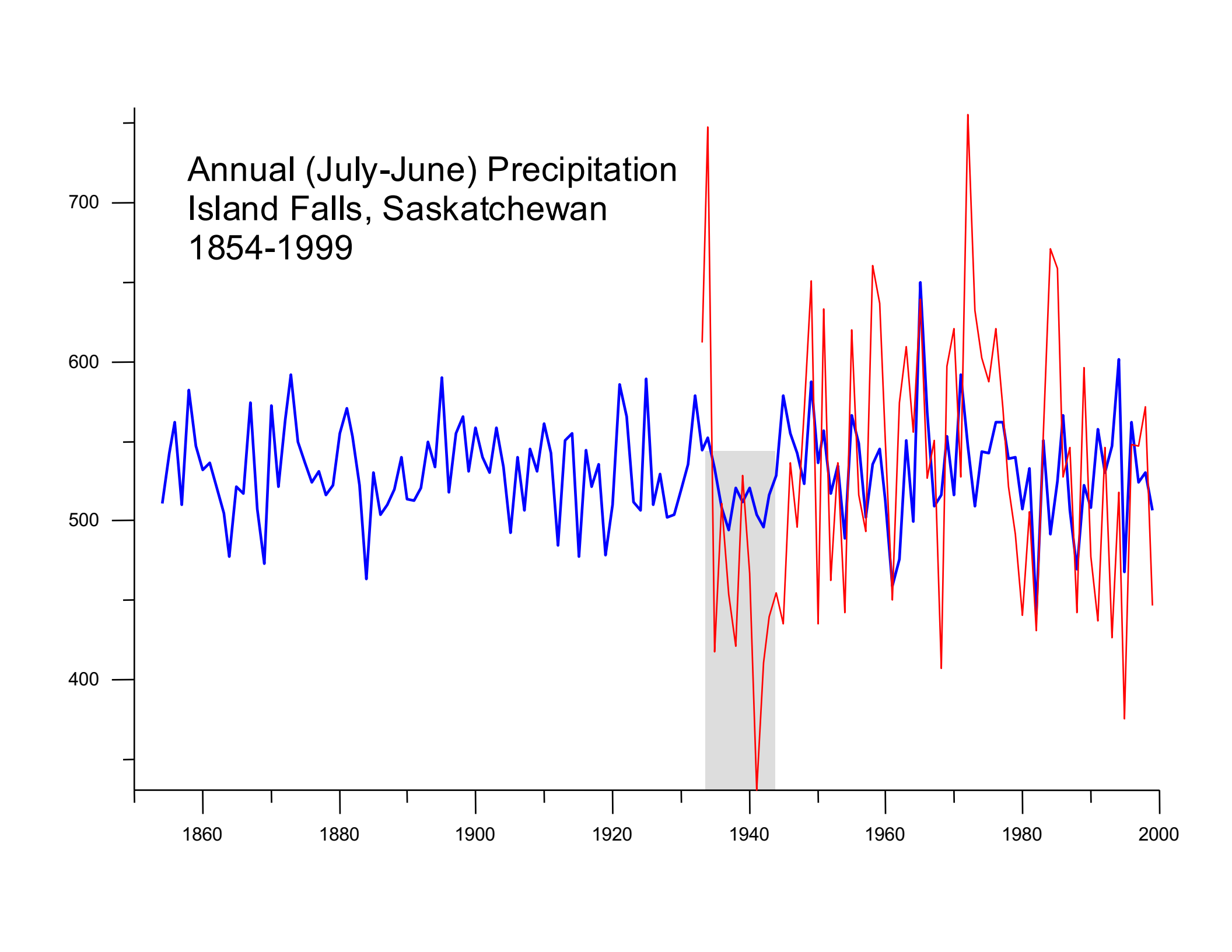



earlywood
late wood
one tree ring




Annual (July-June) Precipitation
Island Falls, Saskatchewan
1854-1999
700
600
500
400
Reconstructed
Observed
Stroich, 2004
1860
1880
1900
1920
1940
1960
1980
2000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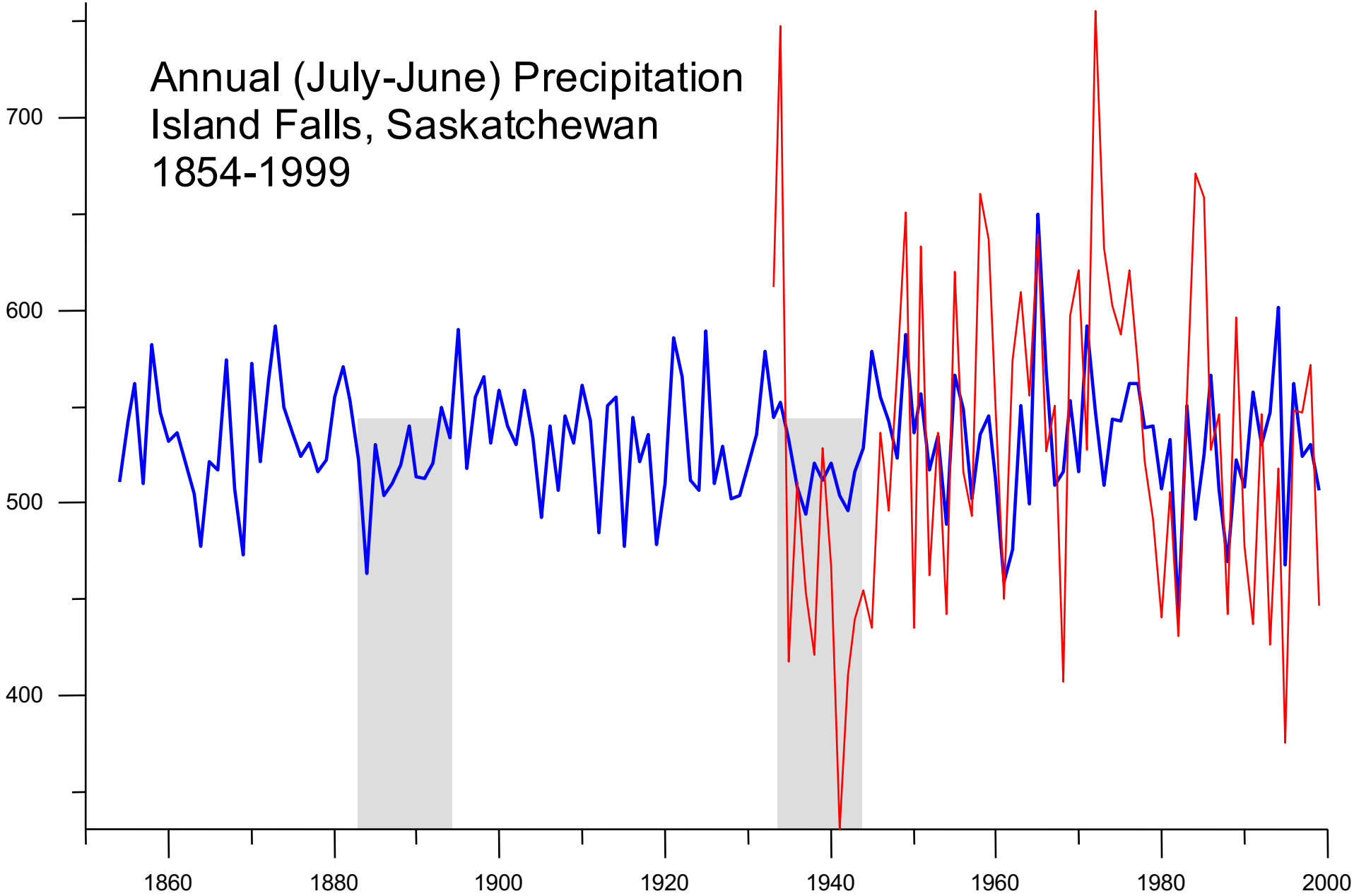
Annual (July-June) Precipitation
Island Falls, Saskatchewan
1854-1999
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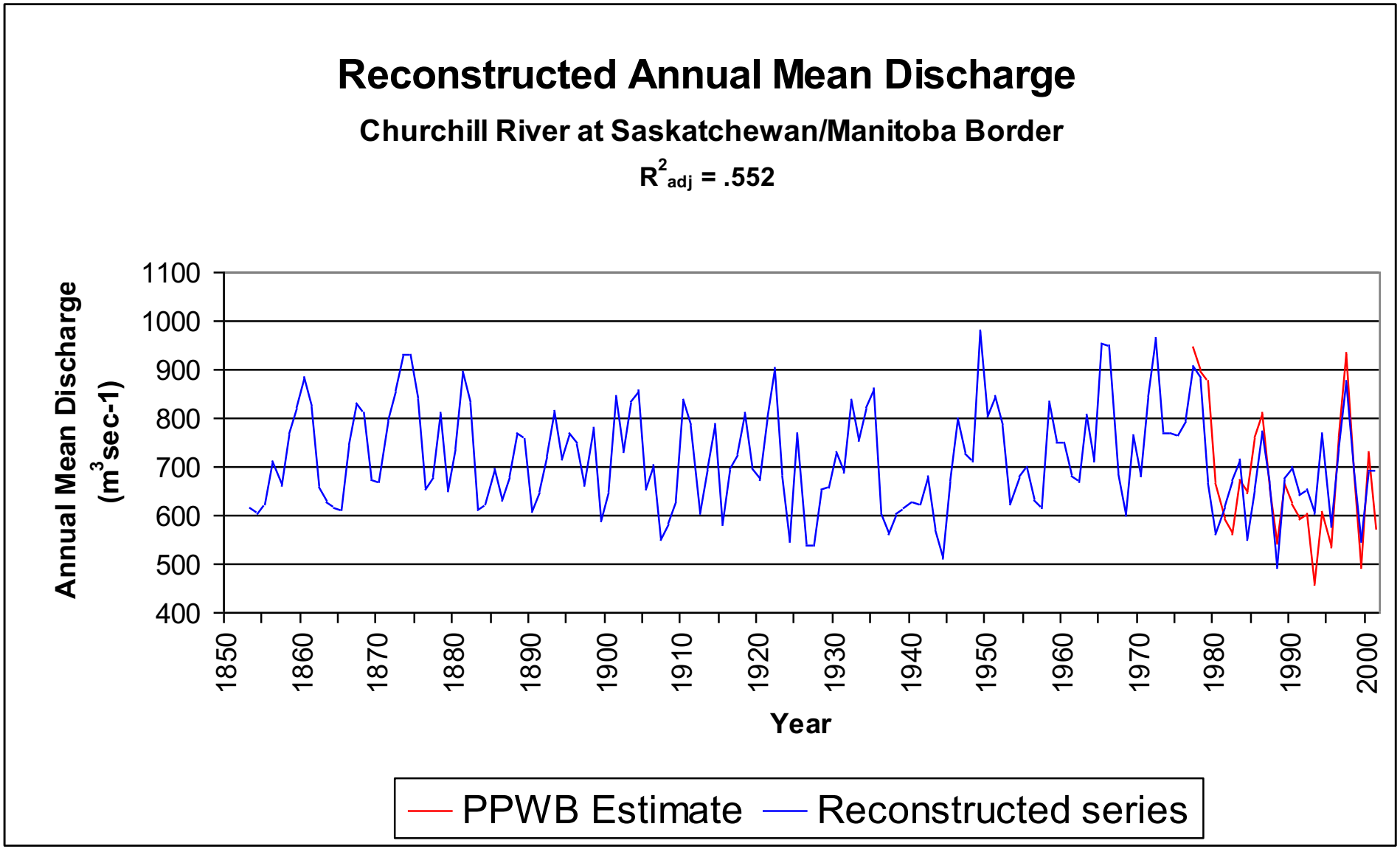
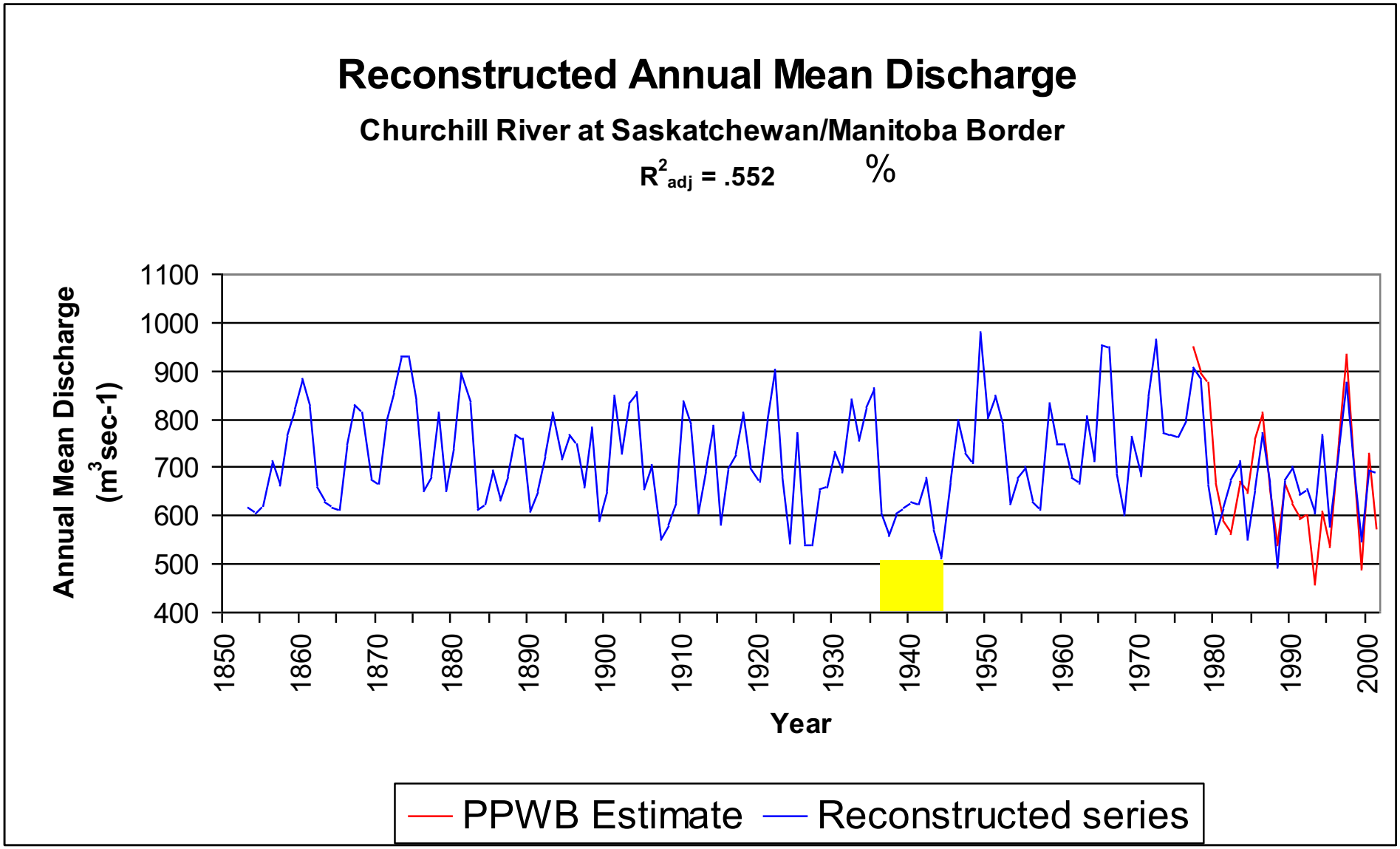
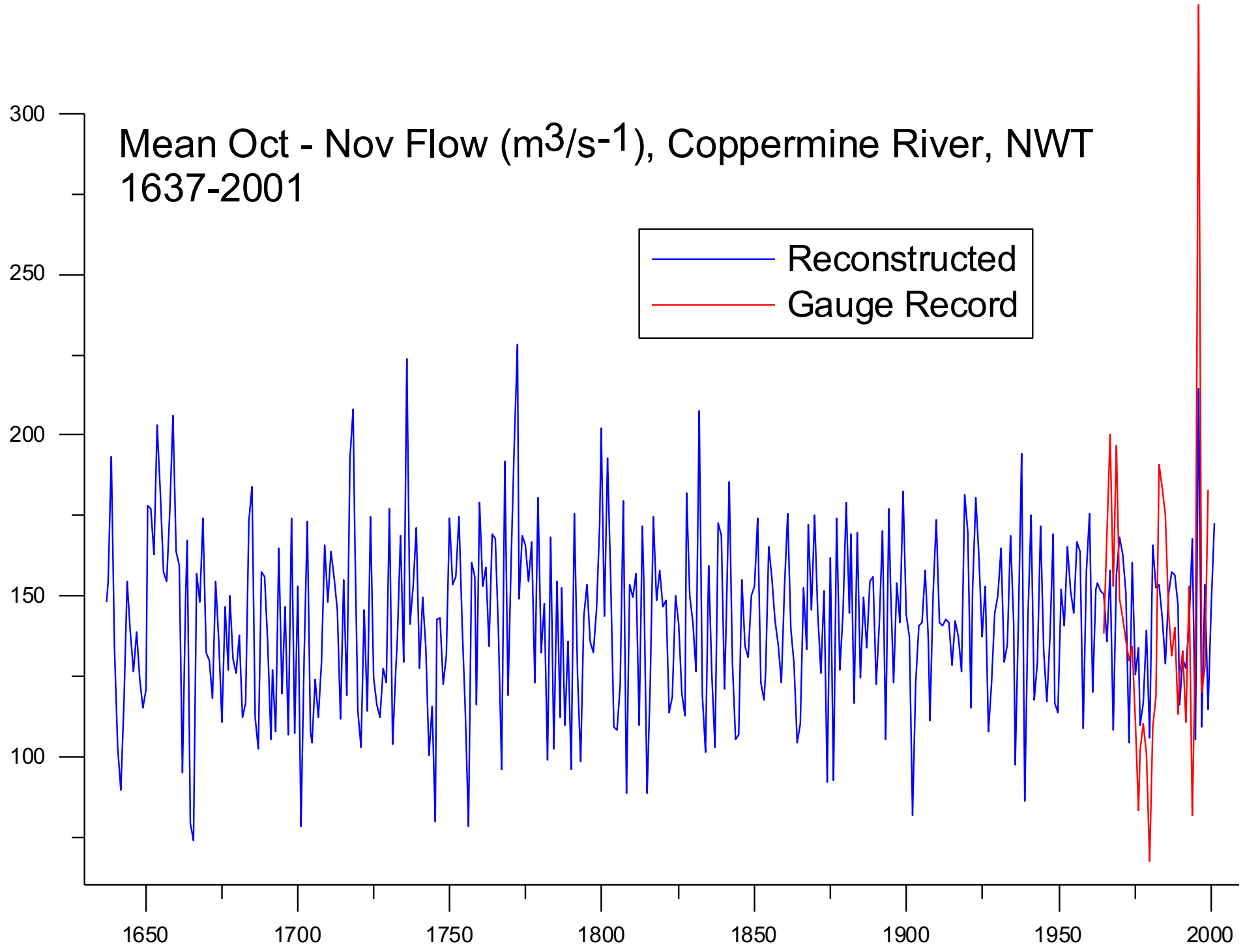


Beriault, 2004



Beriault, 2004

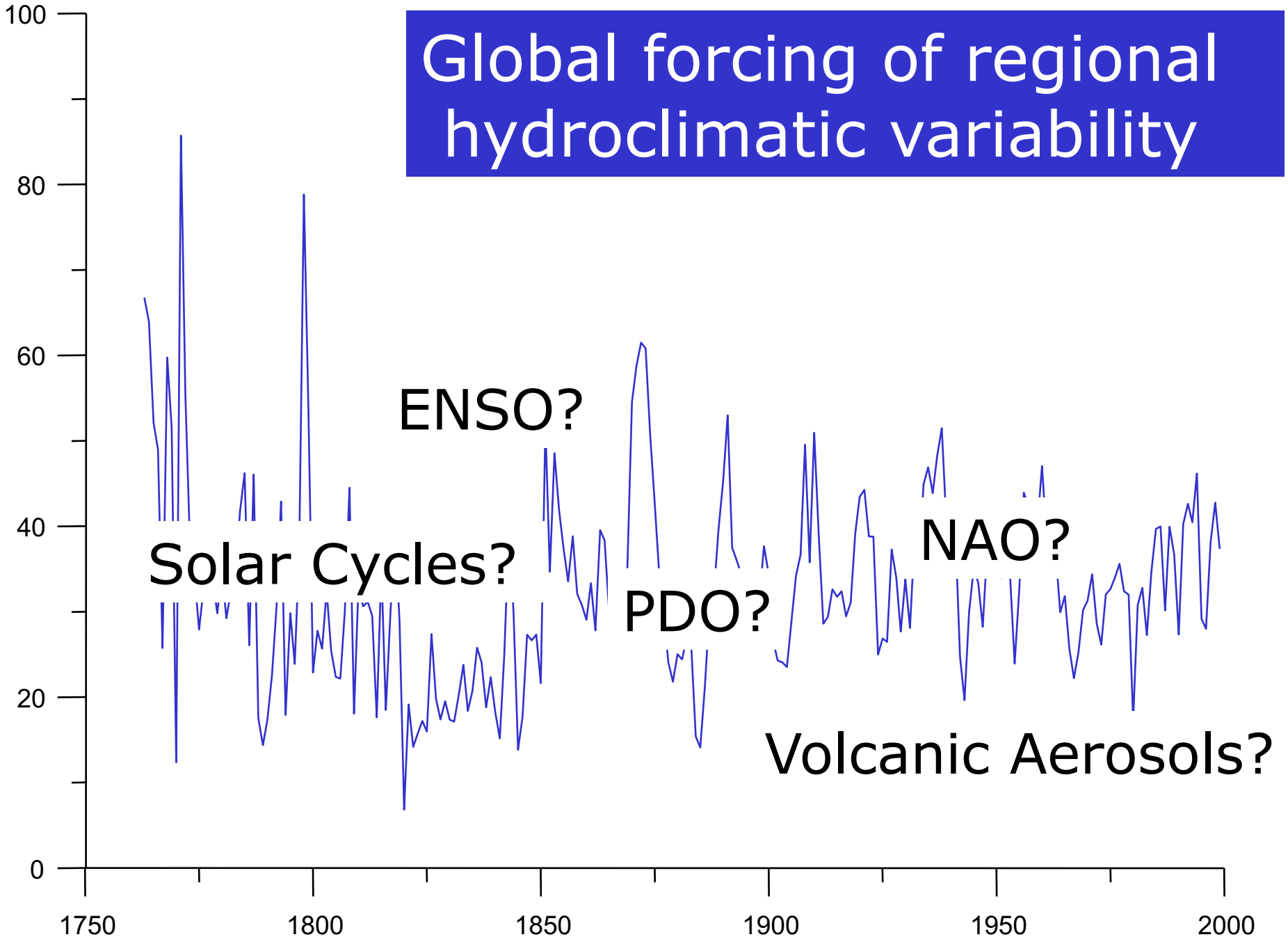

Mean Oct - Nov Flow (m^3/s^{-1}), Coppermine River, NWT
1637-2001
Reconstructed
Gauge Record
300
250
200
150
100
1650
1700
1750
1800
1850
1900
1950
2000

Fort Edmonton – HBC Archives

At Edmonton House, a large fire burned "all around us" on April 27th (1796) and burned on both sides of the river. On May 7th, light canoes arrived at from Buckingham House damaged from the shallow water. Timber intended to be used at Edmonton House could not be sent to the post "for want of water" in the North Saskatchewan River. On May 2nd, William Tomison wrote to James Swain that furs could not be moved as, "there being no water in the river." (Johnson 1967: 33-39, 57)

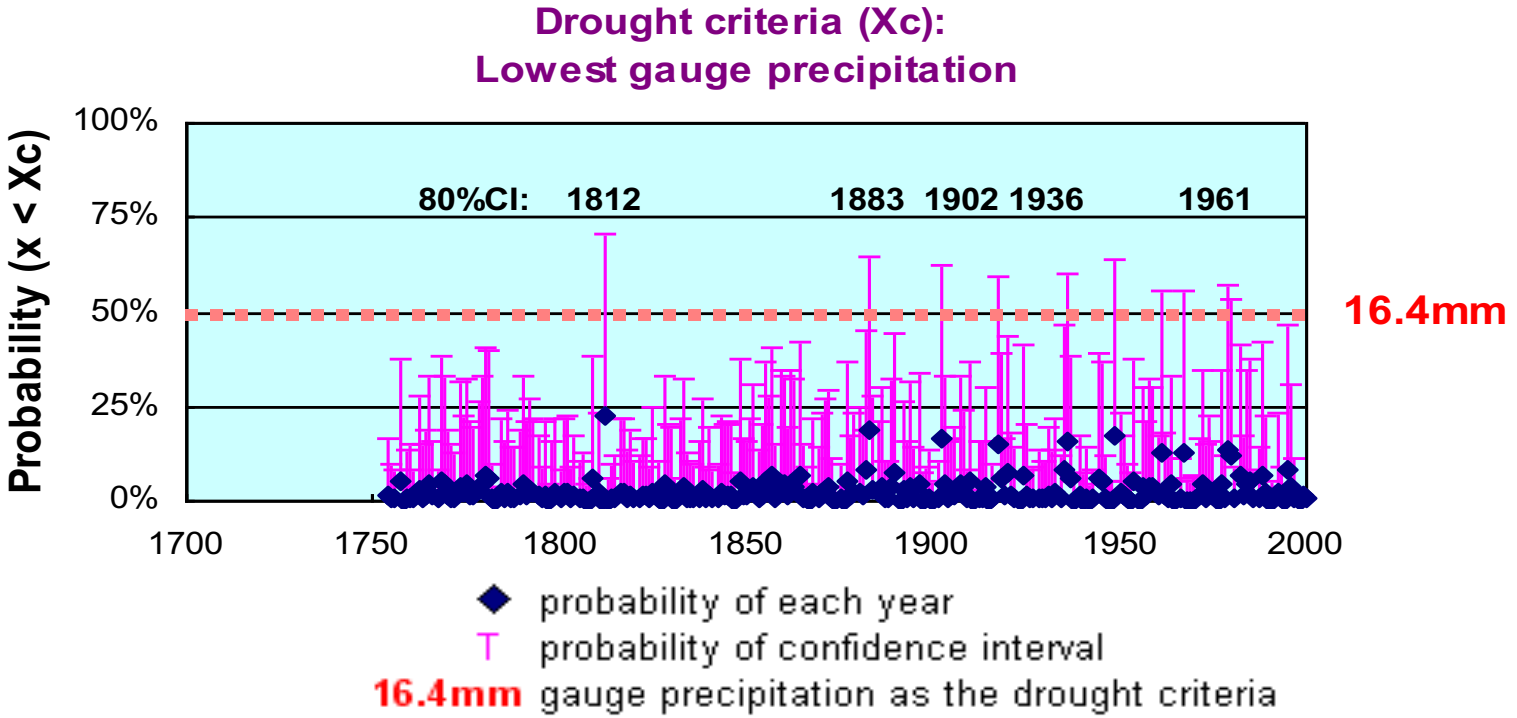
In 1800 "Fine weather" continued into April at Edmonton House. On April 18th, James Bird repeated his observation that the poor trade with both the Slave and Southern Indians was the result of "the amazing warmness of the winter" diminishing both the bison hunt and creating a "want of beaver." Bird reported "clear weather except for the smoke which almost obscures the sun. The country all round is on fire." On June 15th, he noted that the "amazing shallowness of the water" prevented the shipment of considerable goods from York Factory (Johnson 1967: 240-248)


GLAD


Global forcing of regional hydroclimatic variability
100
80
60
40
20
0
1750
1800
1850
1900
1950
2000
ENSO?
Solar Cycles?
PDO?
NAO?
Volcanic Aerosols?

Monte-Carlo Analysis

- Using Monte Carlo methods, we generated error-added reconstructions to establish the probability that proxy precipitation in any year or group of years was below a threshold.
- Normally-distributed random samples of 10,000 errors were generated for each year, thereby producing 10,000 error-added reconstructions (Touchan et al., 1999; Meko et 2001).



How can Manitoba Hydro use Paleo Research?

- Enhance statistical predictions of frequency & severity of drought:
  - Currently 100-yr record for drought probability analysis
  - Identification of more severe droughts before historical record
- Reconstruct past streamflow records

(Bill Girling, March 21, 2003)

Research Topics

- hydroclimatic variability at annual to decadal scales
- the synoptic weather characteristics of extreme hydroclimate events
- linkages between climate change, climate variability and extreme hydroclimatic events
- the hydroclimate signals in various proxies of climate variability
- the forcing of interannual to decadal climate variation by global-circulation anomalies (teleconnections)
- using paleo hydroclimatic data to validate hydrological models and GCMs
- using proxy data to evaluate instrumental records
- establishing the frequency of hydroclimatic events and periods of anomalous climate of specific magnitudes

Research Topics

- scenarios of future of hydroclimate in support of adaptation planning and development of public policy
- the sensitivity of natural and social systems to climate variability
- adaptation options for managed and unmanaged ecosystems and watersheds
- historical and geographical analogues: climatic variability and human responses in the past and in other mid-latitude continental regions
- implications of future variations in water quantity and quality for energy production
- hydroclimatic variability in a risk management context
- competing demands for future water supplies; energy sector requirements versus agriculture, fisheries, forestry, recreation, communities

Manitoba Hydro

CANADIAN WATER NETWORK
RÉSEAU CANADIEN DE L'EAU

Sustainable Forest Management NCE

Environment Canada

Social Sciences and Humanities Research Council of Canada

NSERC
CRSNG

PARC

The Climate Change Action Fund (CCAF)

Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)

Indian and Northern Affairs Canada