Long-term moisture variability in the western boreal forest

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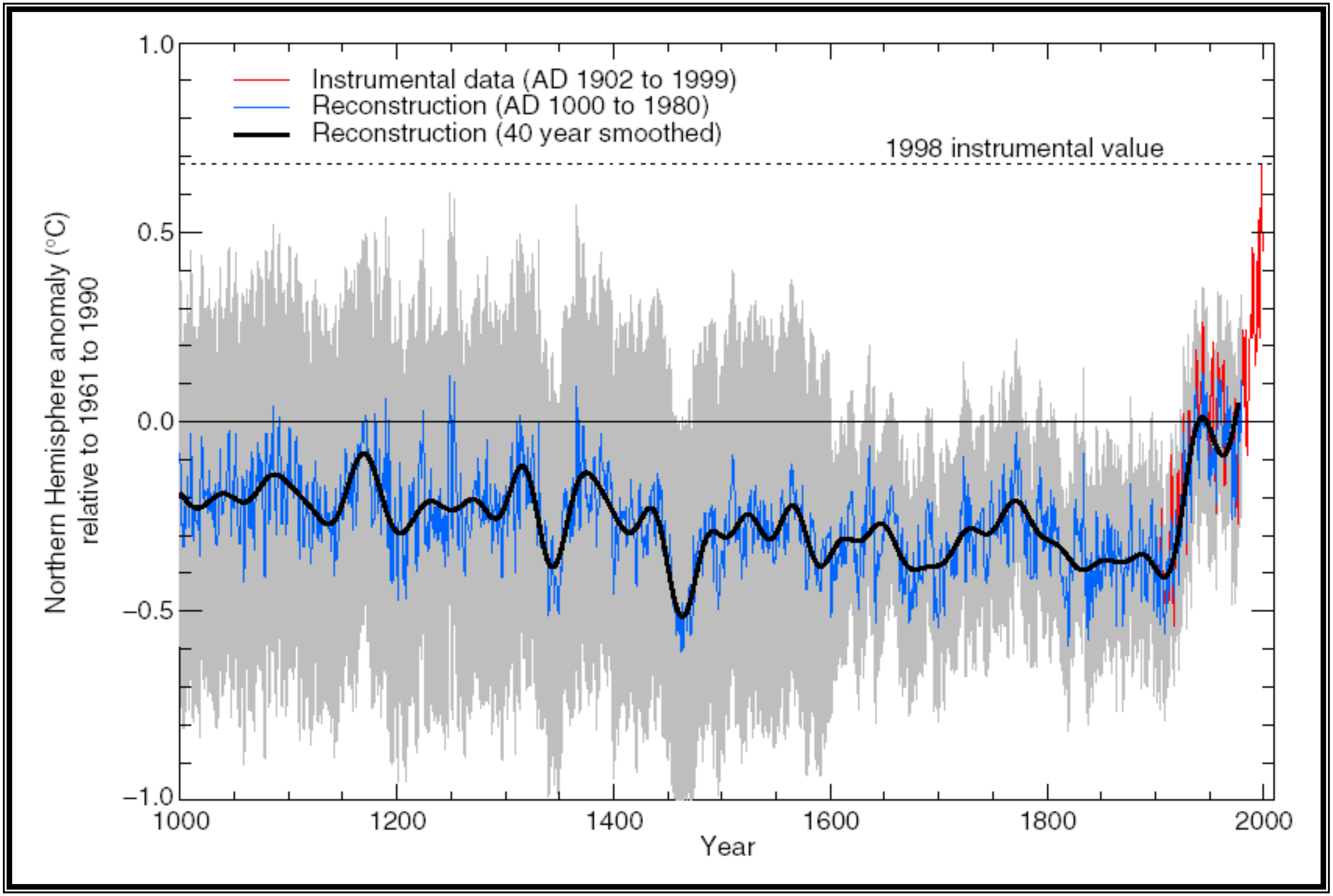
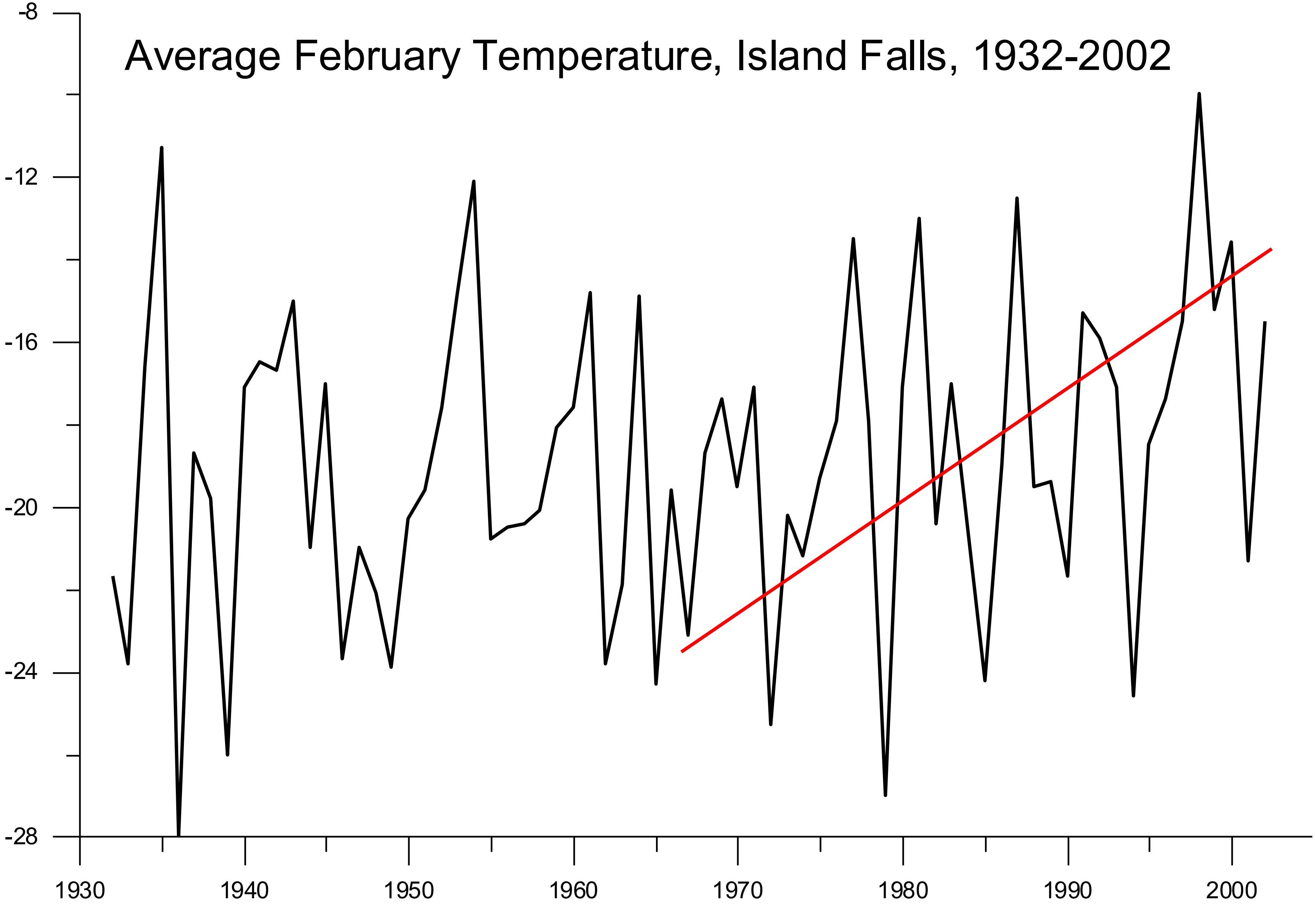
Prairie Adaptation Research Collaborative, U of R

Northern Forestry Centre
Edmonton, 26 March, 2004

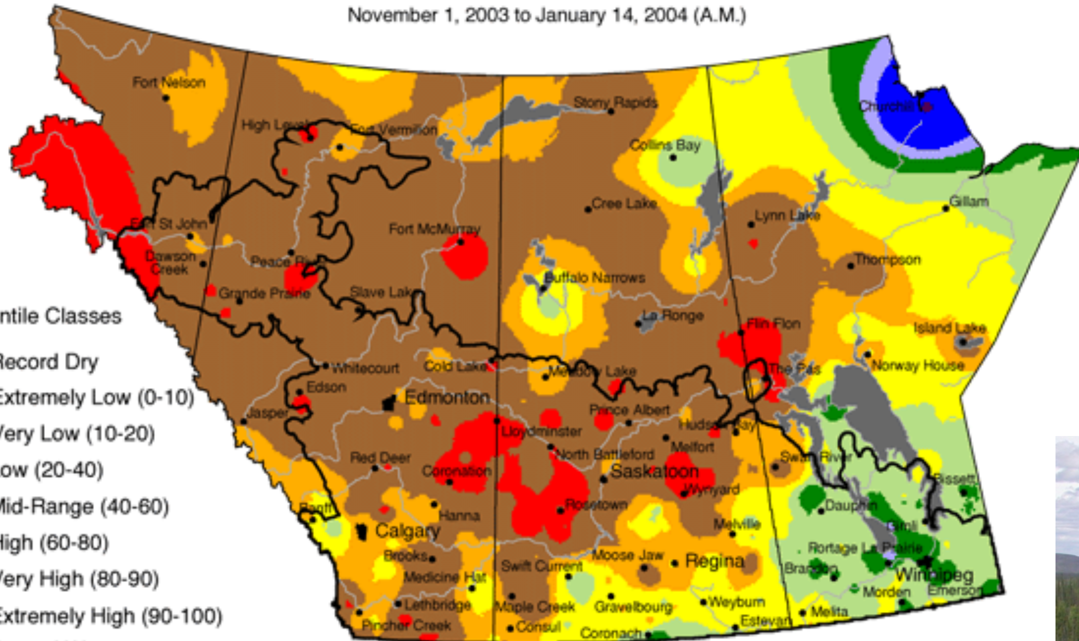


Mann, *et al*., 1999


Average February Temperature, Island Falls, 1932-2002
-8
-12
-16
-20
-24
-28
1930
1940
1950
1960
1970
1980
1990
2000

Current Precipitation Compared to Historical Distribution

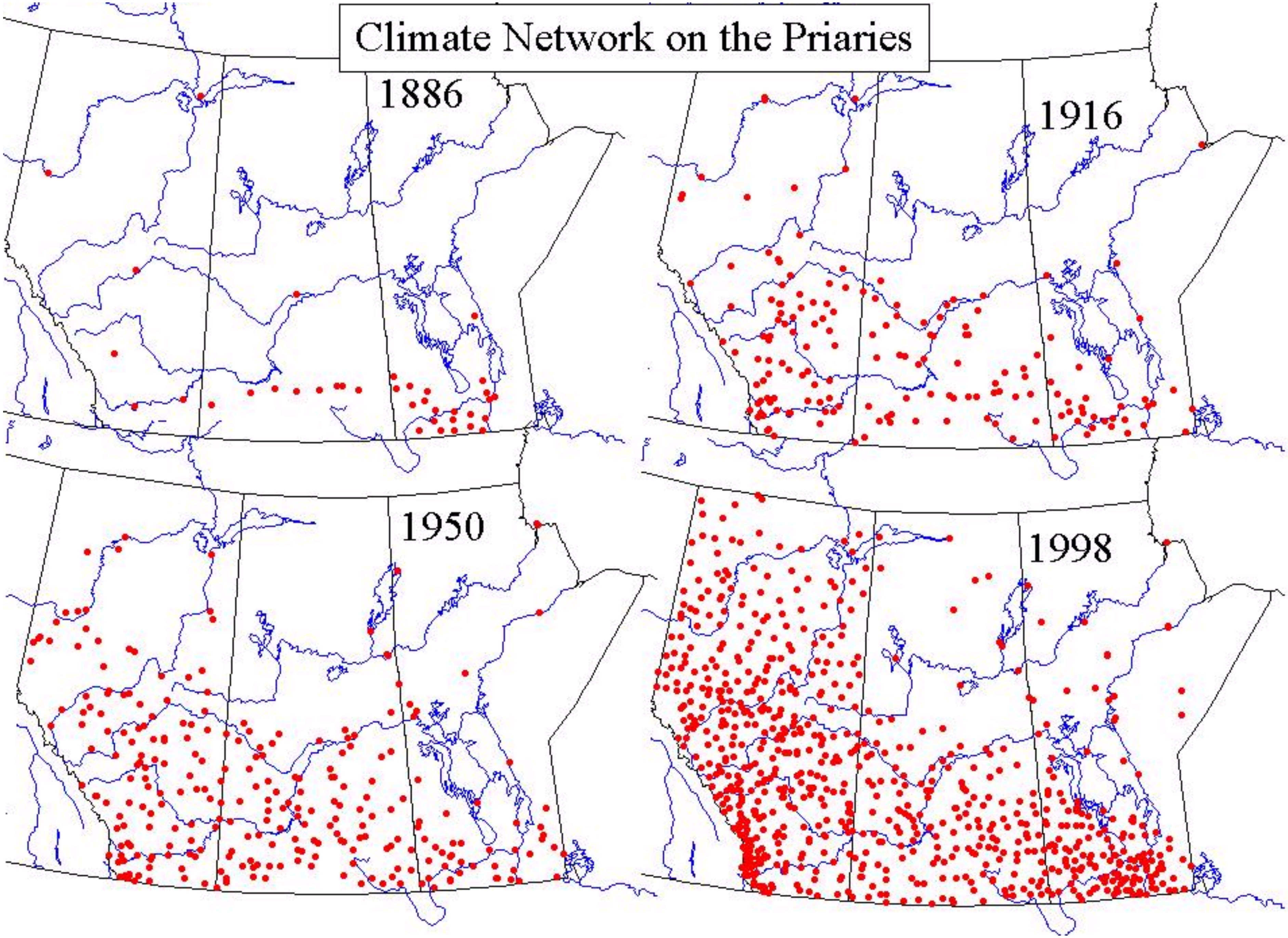
November 1, 2003 to January 14, 2004 (A.M.)



Percentile Classes

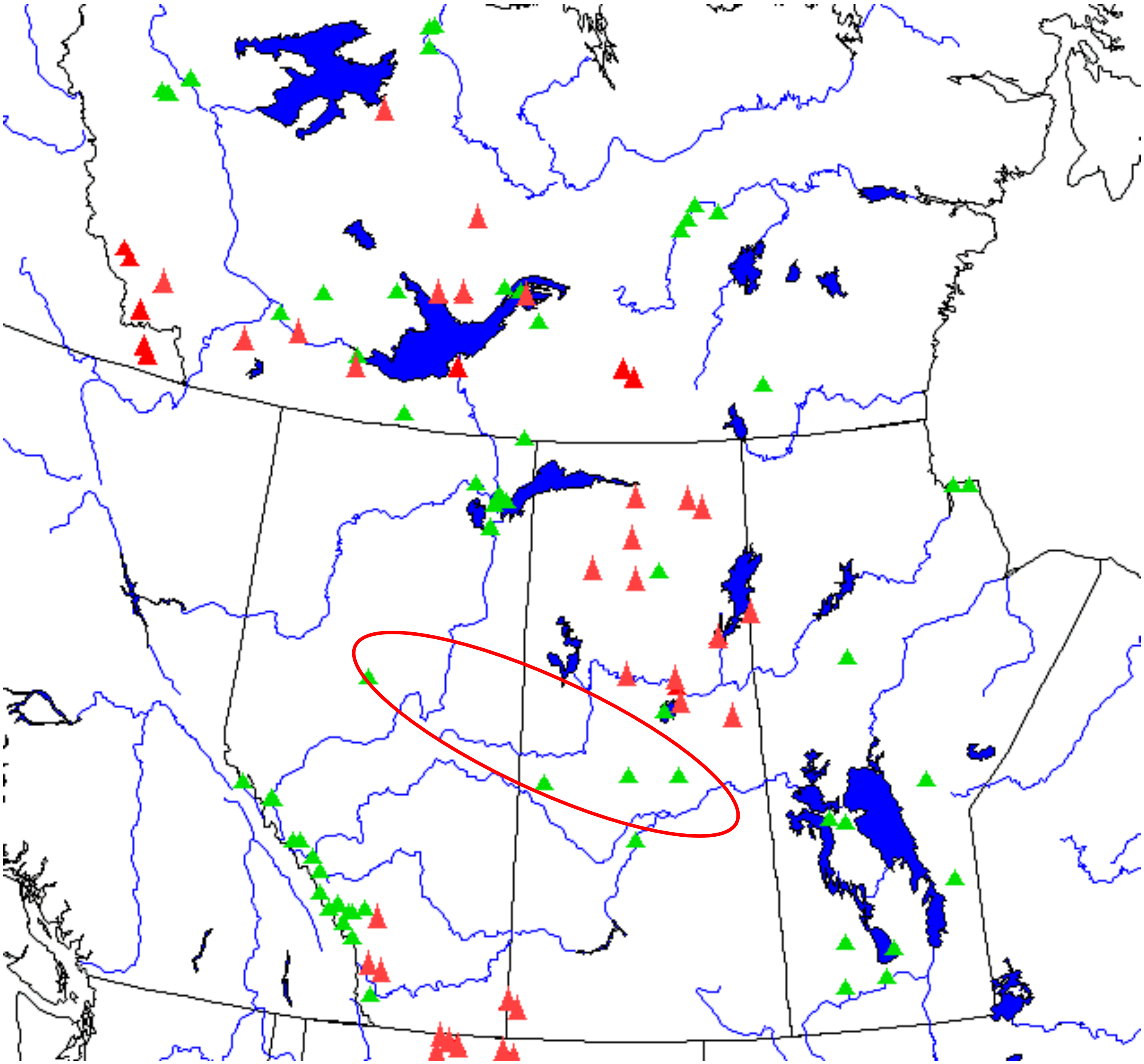
- Record Dry
- Extremely Low (0-10)
- Very Low (10-20)
- Low (20-40)
- Mid-Range (40-60)
- High (60-80)
- Very High (80-90)
- Extremely High (90-100)
- Record Wet
- Lakes and Rivers
- Extent of Agricultural Land

Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from the Timely Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.



Ron Hopkinson, MSC

Tree-Ring Chronologies



Sustainable Forest Management NCE

CANADIAN WATER NETWORK
RÉSEAU CANADIEN DE L'EAU

Manitoba Hydro

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Environment Canada

Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)

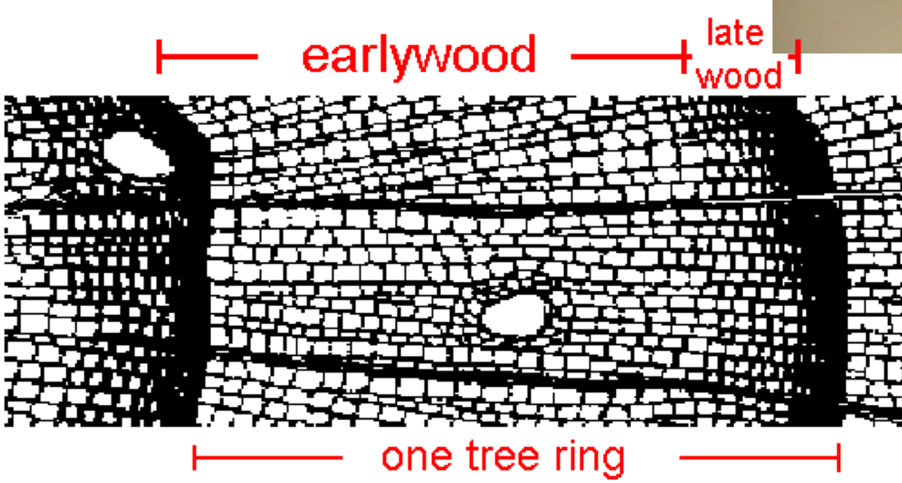
NSERC
CRSNG

Canada

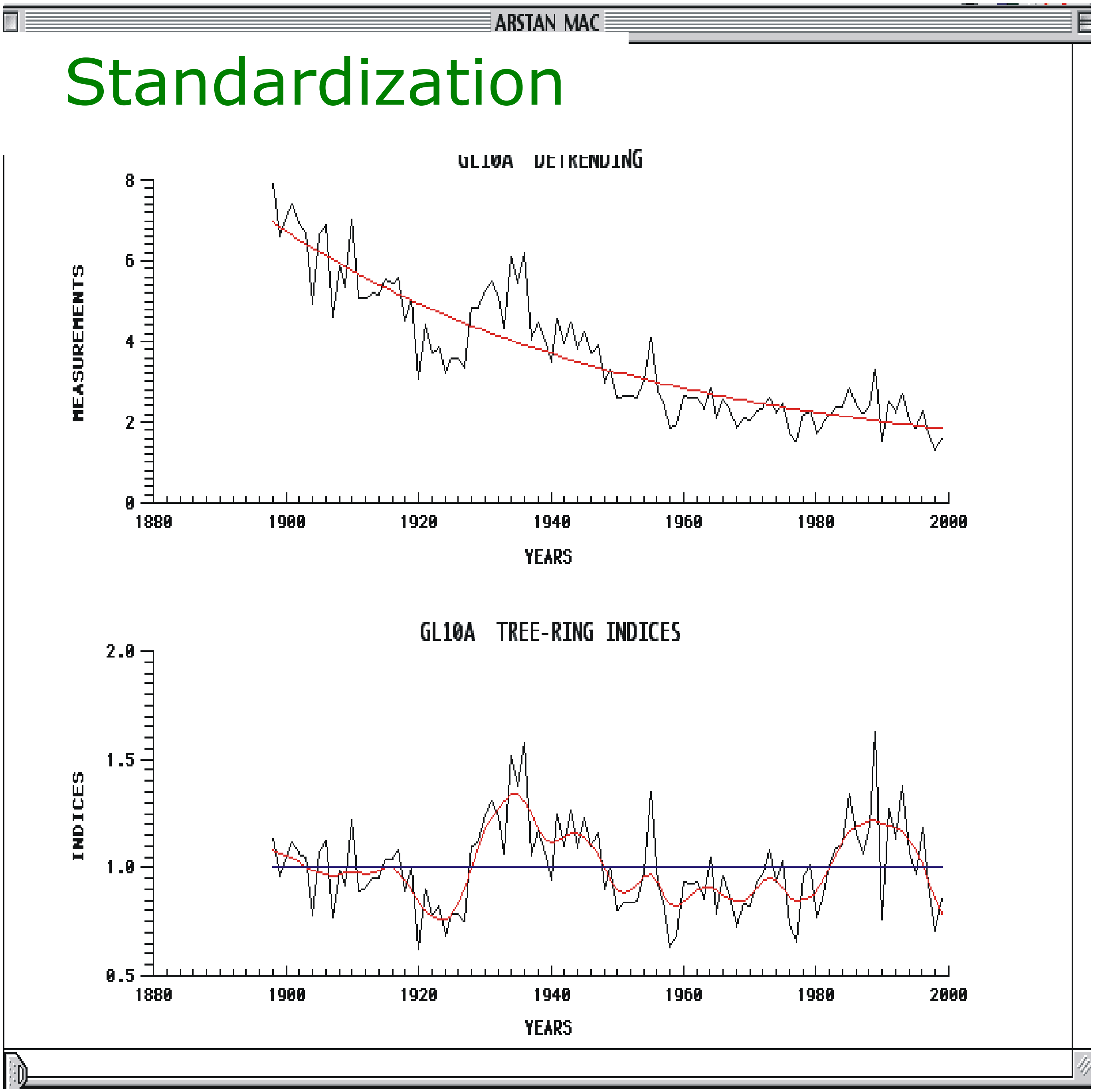
Canadian Climate Impacts and Adaptation Program (formerly the Climate Change Action Fund)

Ring-width Measurement

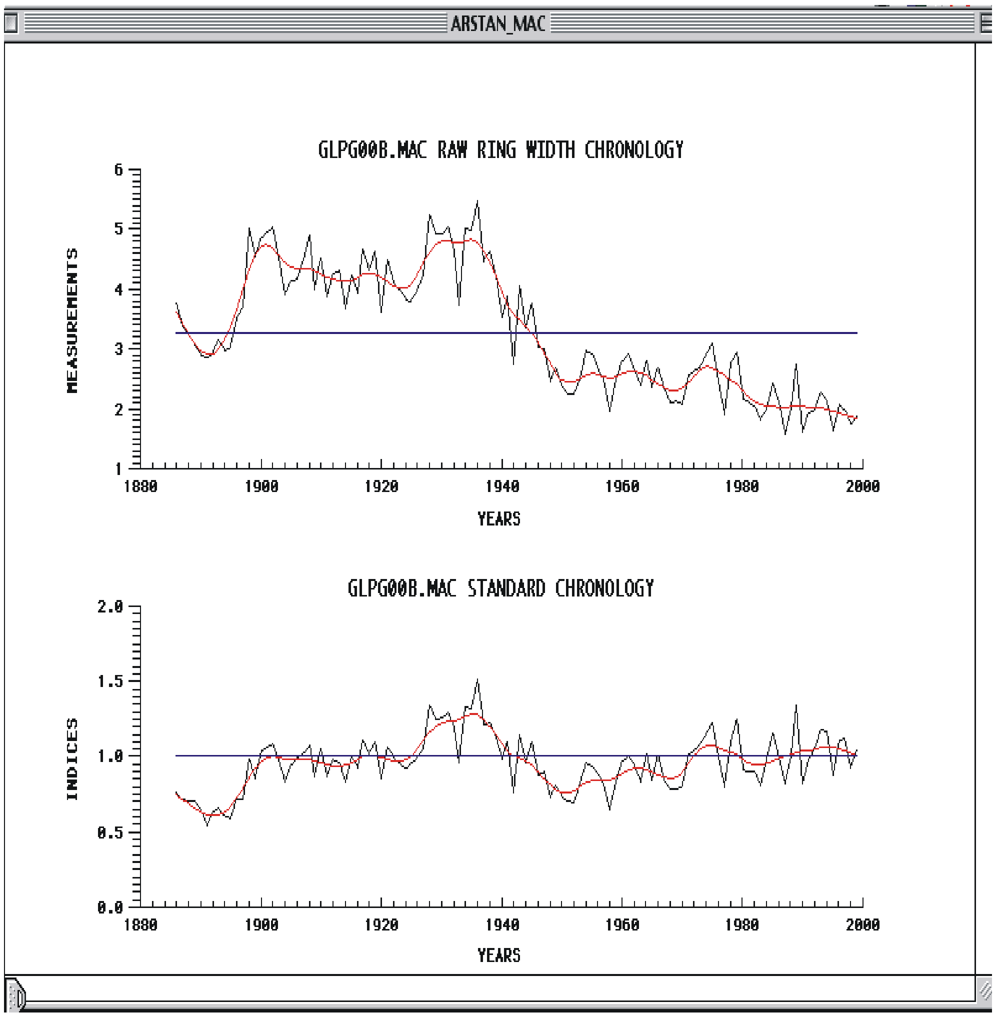
- Nikon SMZ800
  10x-63x Microscope
- Velmex Accurite measuring system
- Accuracy of 1×10^{-6}m

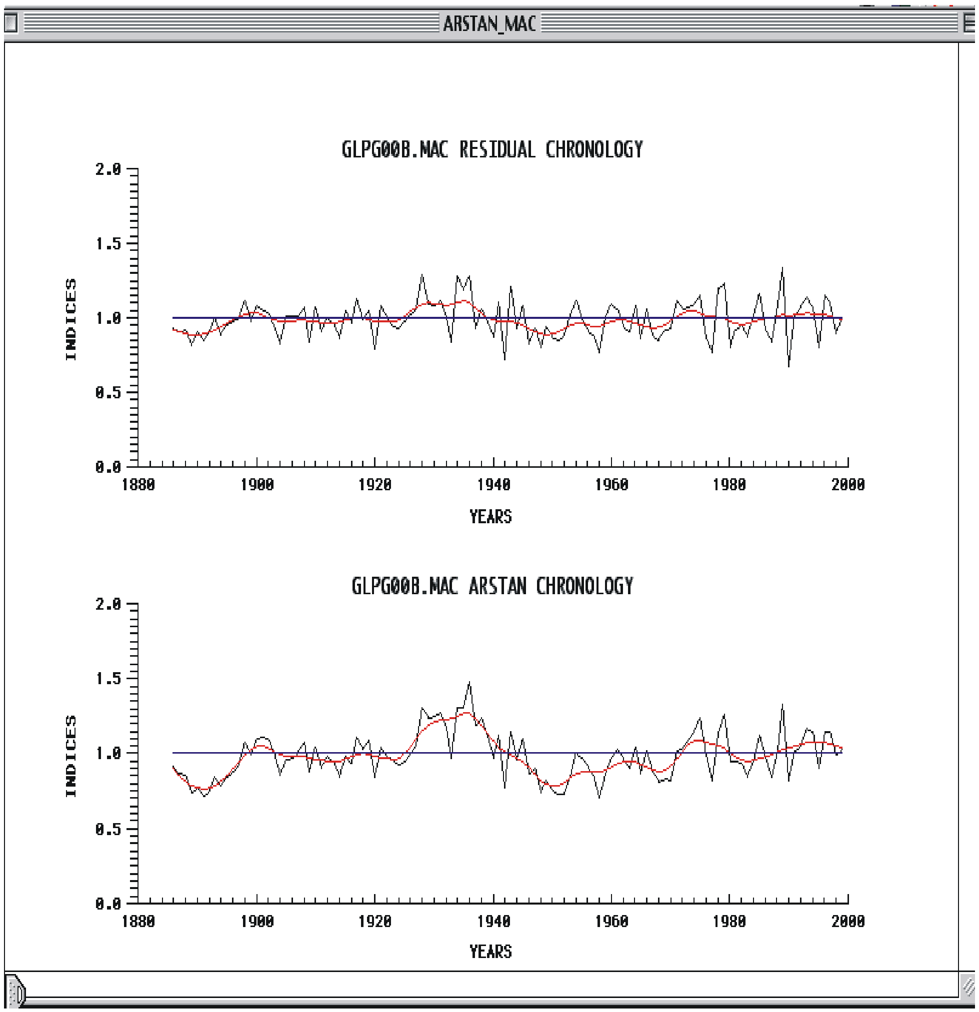


Standardization

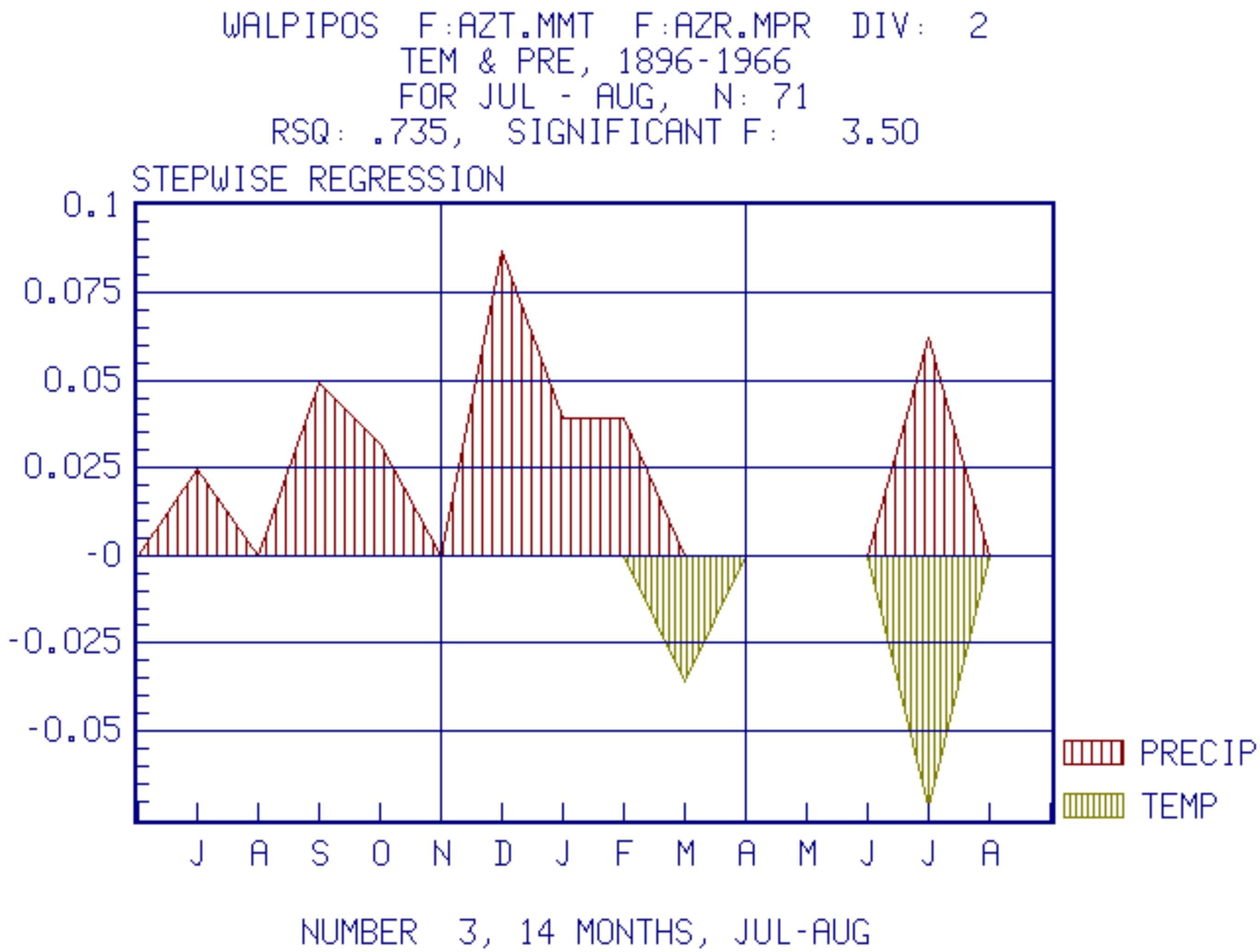


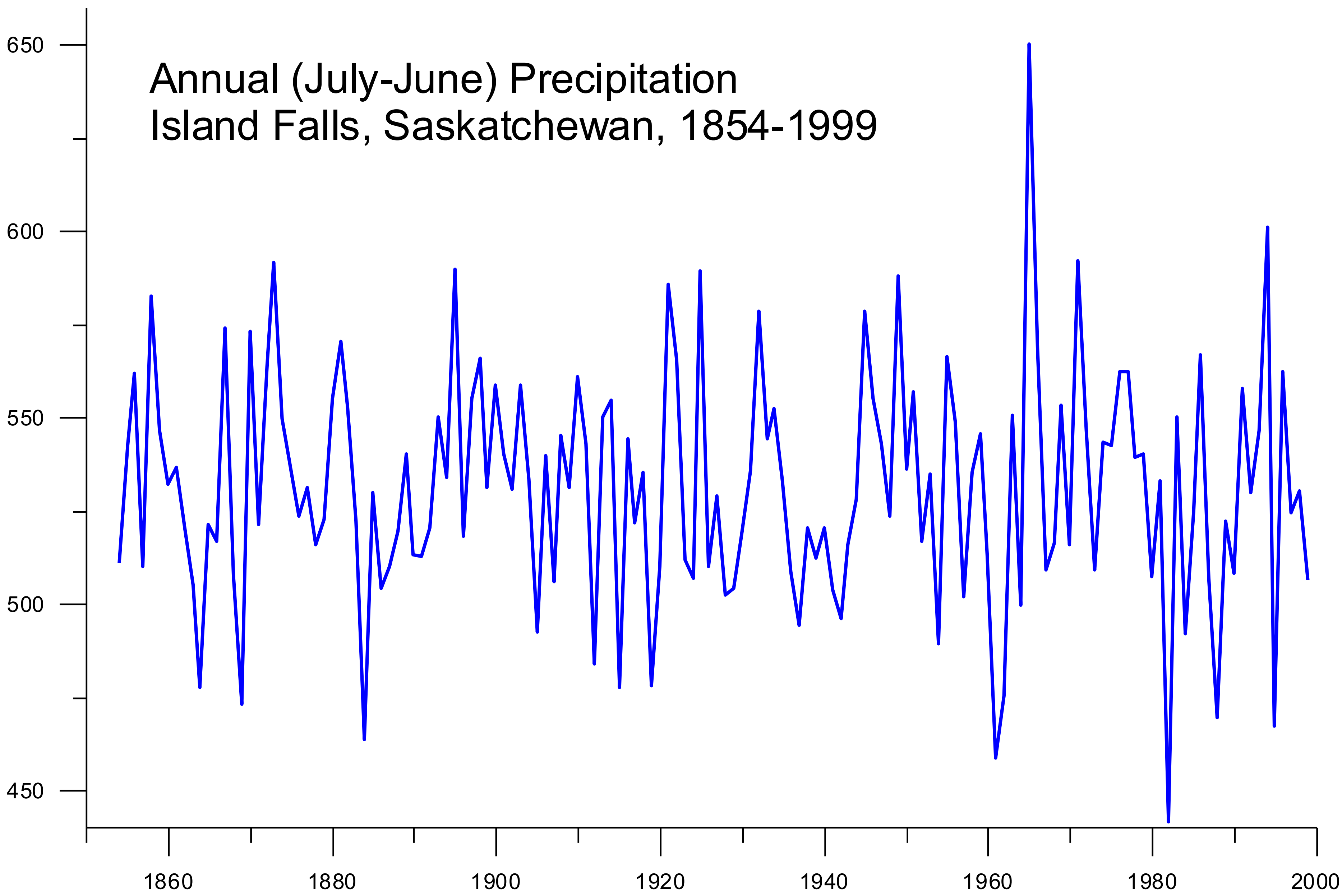
Chronology Plots



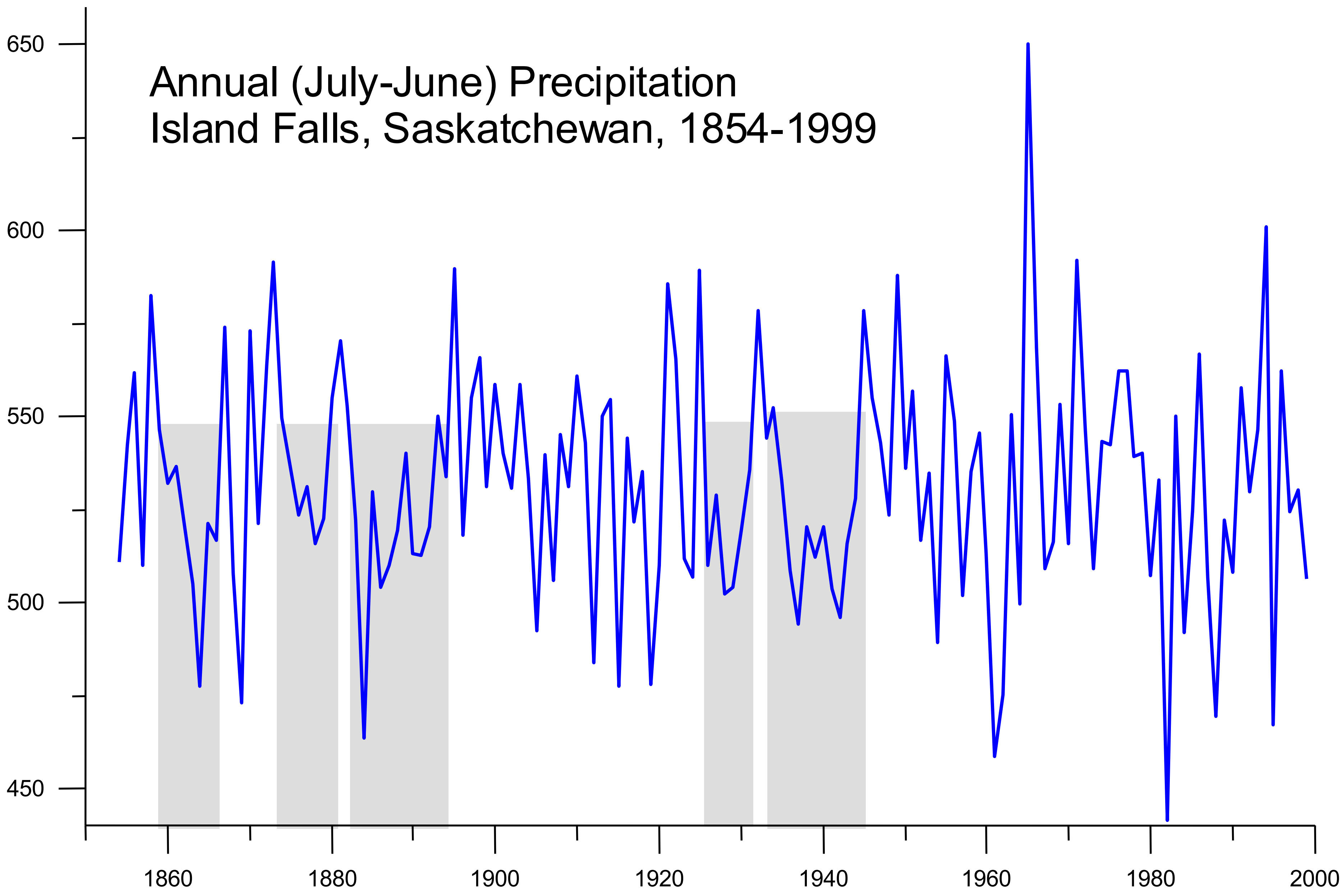


PRECON Multiple Regression Output





Annual (July-June) Precipitation
Island Falls, Saskatchewan, 1854-1999
650
600
550
500
450
1860
1880
1900
1920
1940
1960
1980
2000


Annual (July-June) Precipitation
Island Falls, Saskatchewan, 1854-1999
650
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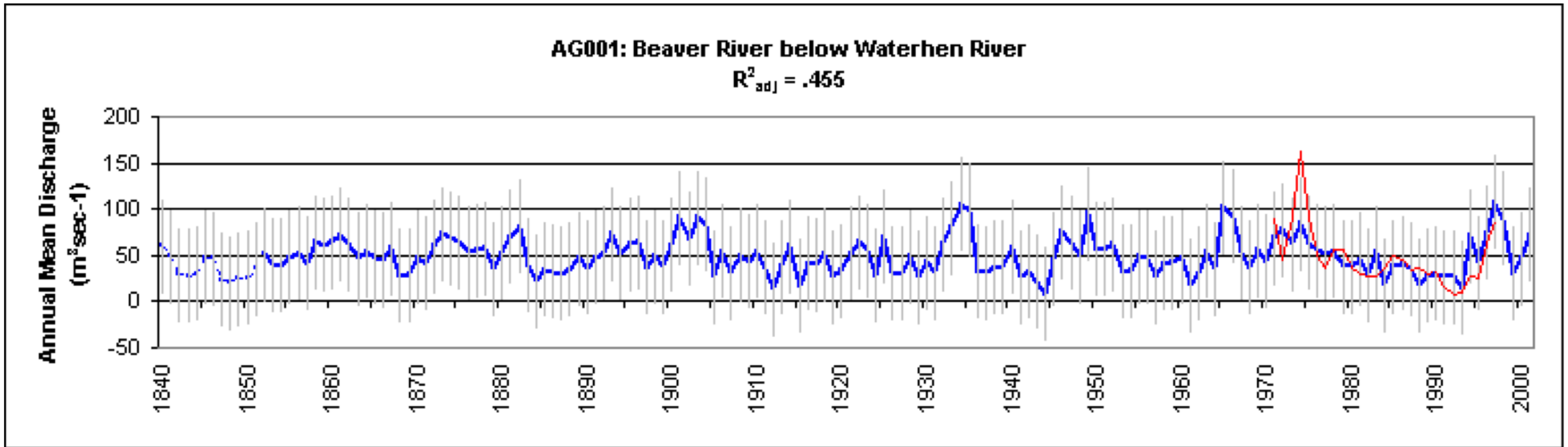
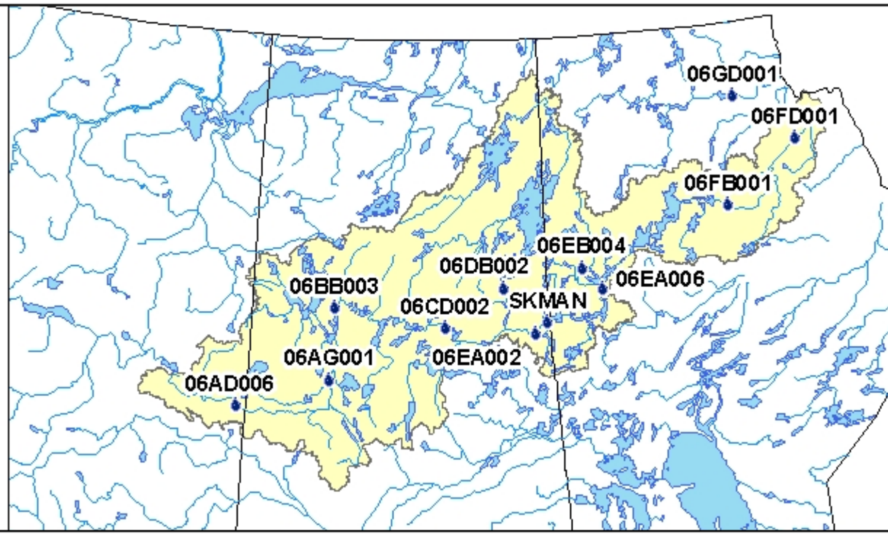
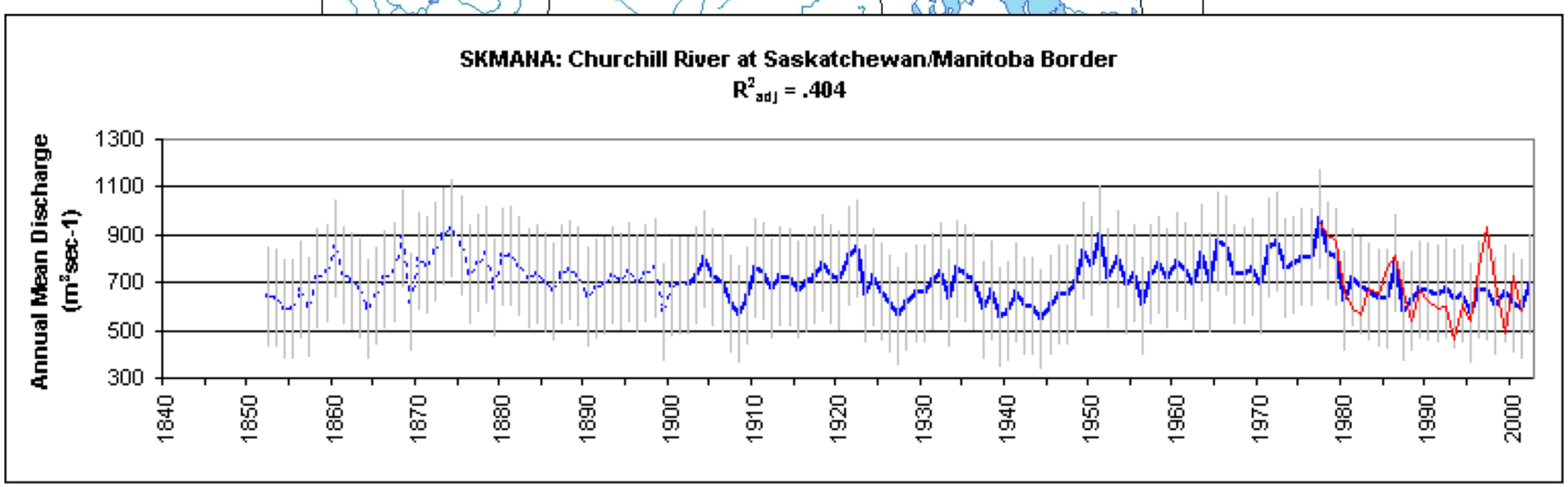
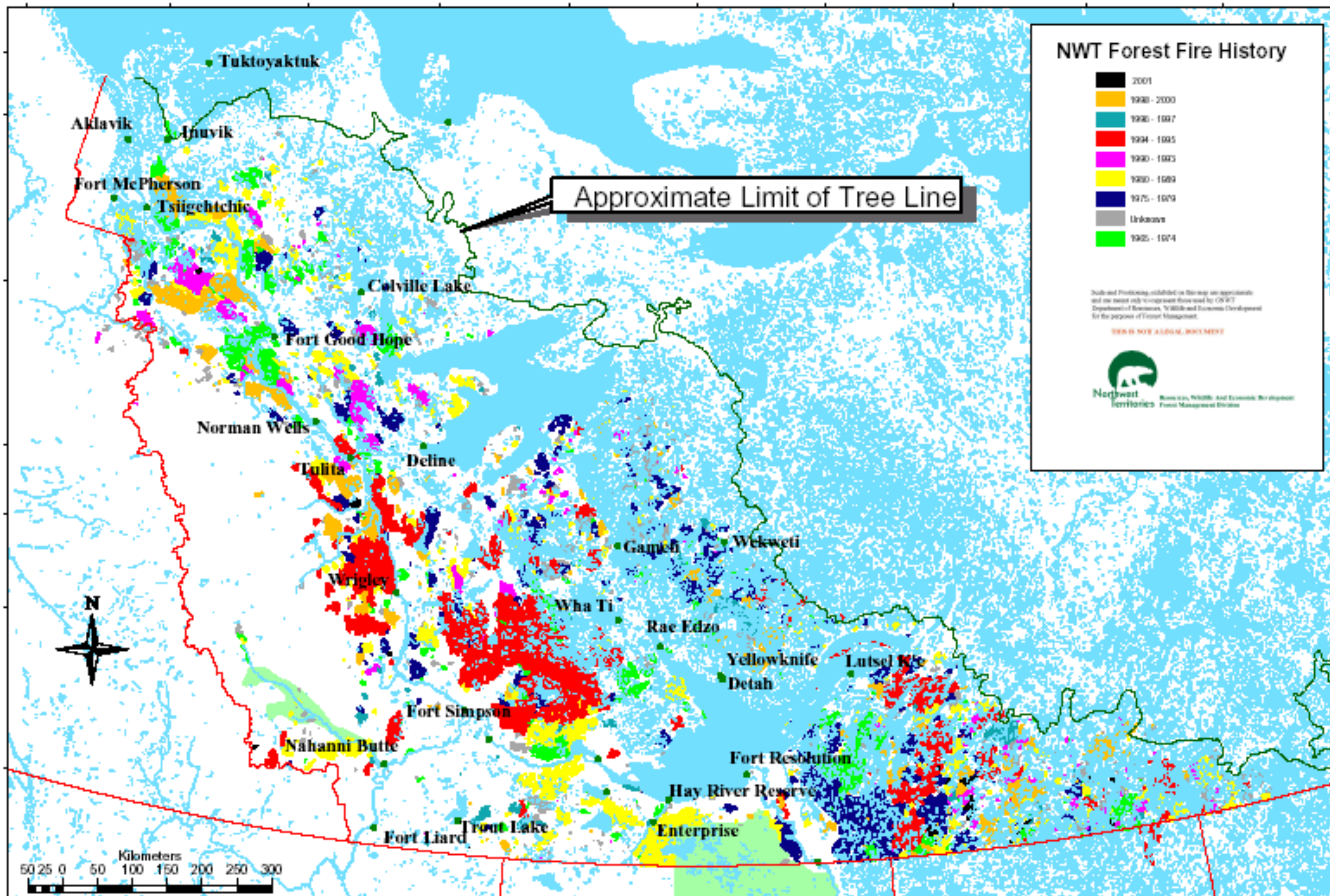
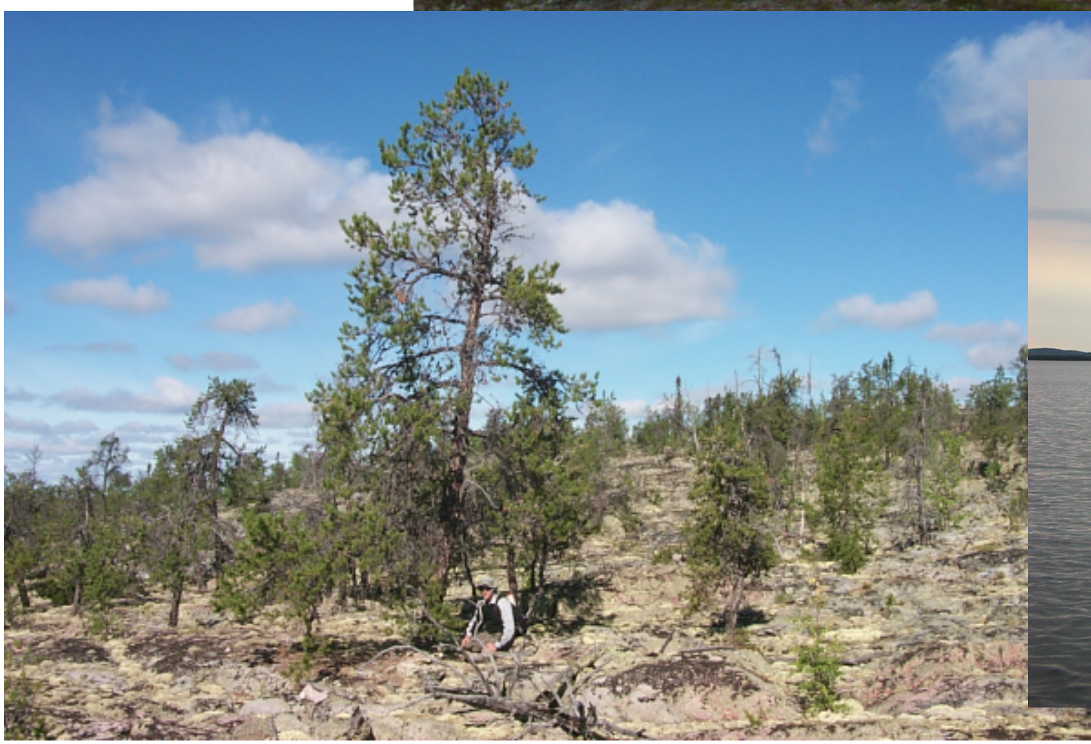

AG001: Beaver River below Waterhen River
R²adj = .455
Annual Mean Discharge (m³sec-1)
200
150
100
50
0
-50
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

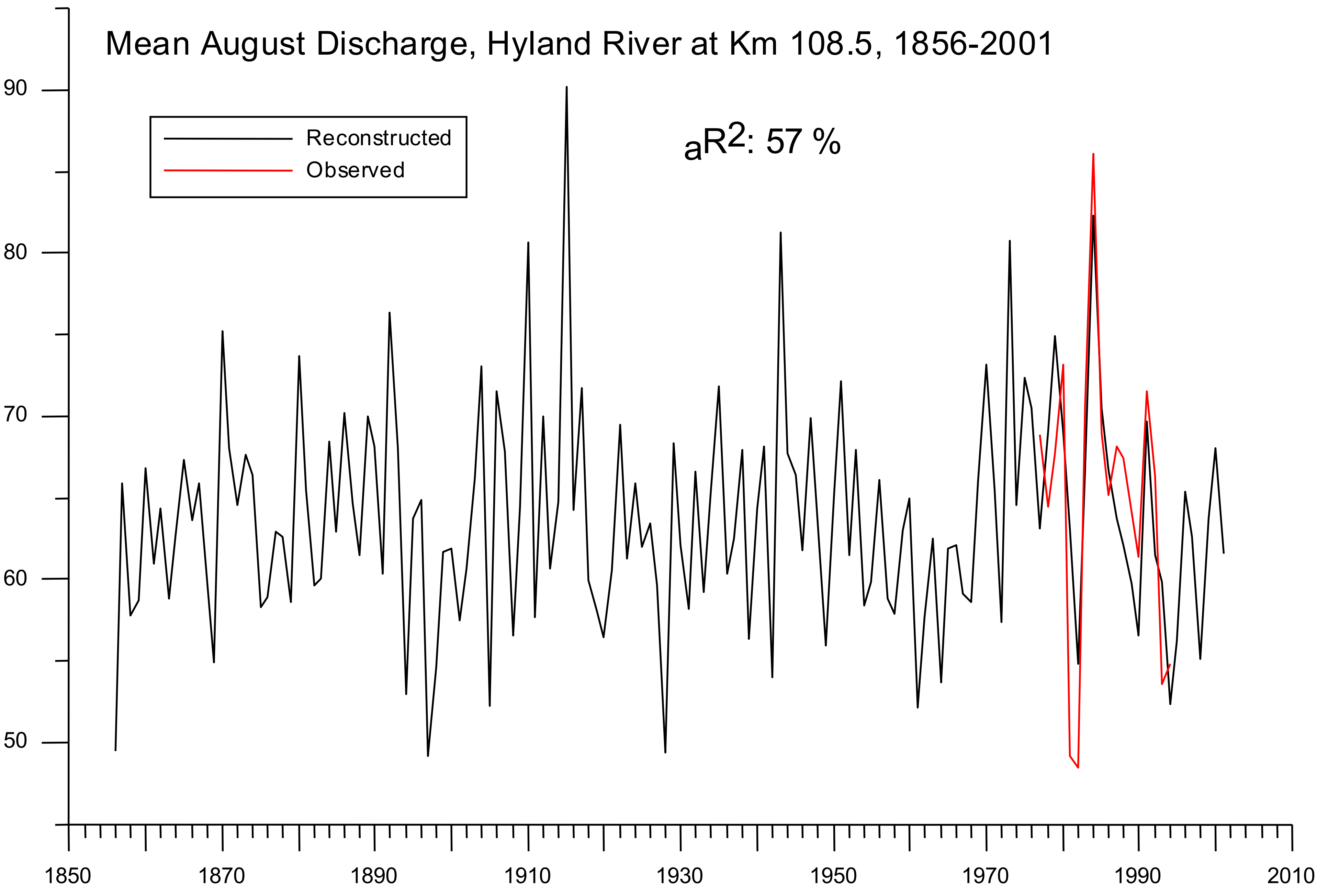

06GD001
06FD001
06FB001
06EB004
06DB002
06EA006
06BB003
SKMAN
06CD002
06AG001
06EA002
06AD006


SKMANA: Churchill River at Saskatchewan/Manitoba Border
R²adj = .404
Annual Mean Discharge (m³sec-1)
1300
1100
900
700
500
300
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

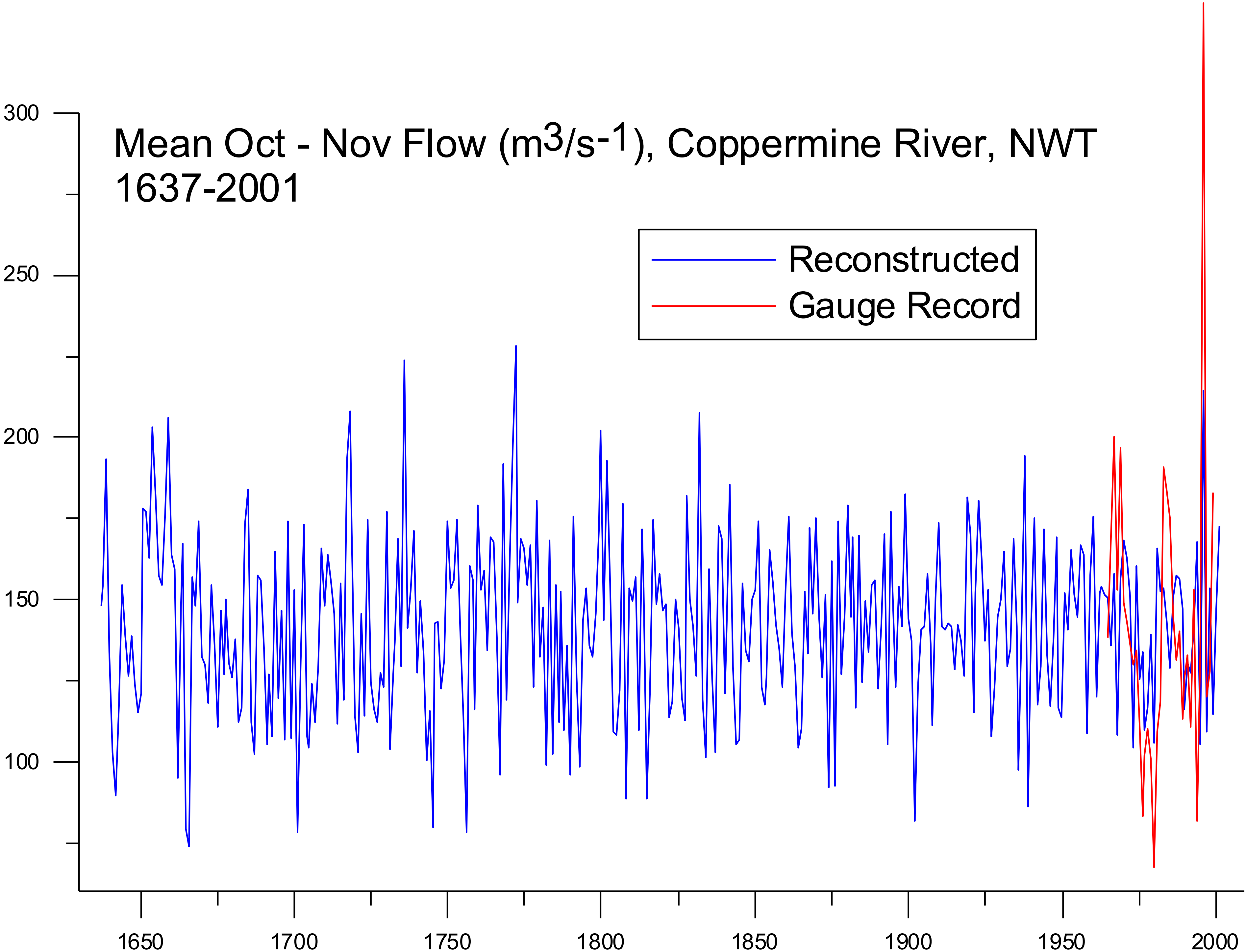


NWT Forest Fire History
2001
1998 - 2000
1996 - 1997
1994 - 1995
1990 - 1993
1980 - 1989
1975 - 1979
Unknown
1965 - 1974
Northwest Territories
Approximate Limit of Tree Line
Tuktoyaktuk
Aklavik
Inuvik
Fort McPherson
Tsiigehtchic
Colville Lake
Fort Good Hope
Norman Wells
Deline
Tulita
Wrigley
Gameti
Wekweti
Wha Ti
Rae Edzo
Yellowknife
Detah
Lutsel K'e
Fort Simpson
Nahanni Butte
Fort Resolution
Hay River Reserve
Enterprise
Trout Lake
Fort Liard
N
Kilometers
50 25 0 50 100 150 200 250 300





Mean August Discharge, Hyland River at Km 108.5, 1856-2001
Reconstructed
Observed
aR2: 57 %
90
80
70
60
50
1850
1870
1890
1910
1930
1950
1970
1990
2010


Mean Oct - Nov Flow (m3/s-1), Coppermine River, NWT
1637-2001
Reconstructed
Gauge Record
300
250
200
150
100
1650
1700
1750
1800
1850
1900
1950
2000

Mirror Lake
Selwyn Mountains
NWT

Paleo Data (Products)

raw proxy data

filtered data (signal)

paleoclimatic and paleo-environmental records

trends, variability, frequencies, probabilities

temporal analogues

climate change and impact scenarios

CGCM2 climate simulation for 1000-yr control run versus proxy precipitation

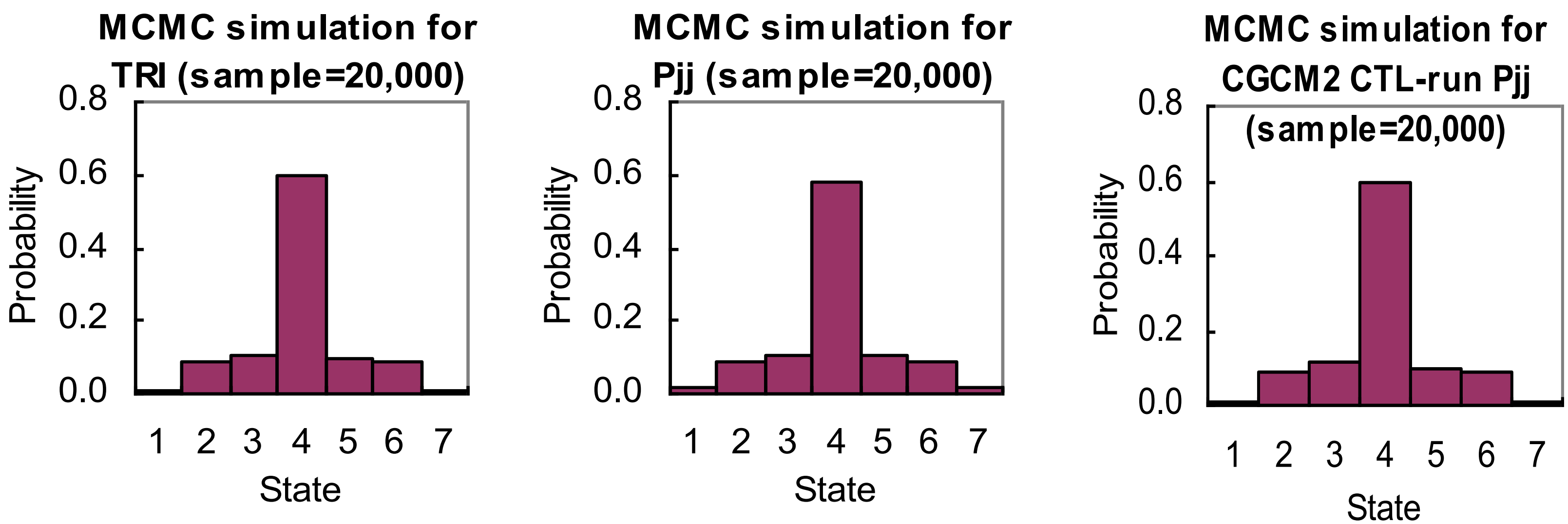
The CGCM2 1000-year simulation with late 20th century greenhouse gase forcing (Flato *et al.*, 2000)

	State	Code	Observation (sample=1000)	Simulation (sample=20,000)		T-test for Mean	F-test for SD
Sample/df			1000	20000	df1	20998	999
Frequency	Dry (<1th %)	1	0.011	0.012	df2		19999
	Dry (<10th %)	2	0.089	0.090			
	Dry (<20th %)	3	0.110	0.109			
	Normal	4	0.591	0.585			
	Wet (>80th %)	5	0.100	0.104			
	Wet (>99th %)	6	0.089	0.090			
	Wet (>90th %)	7	0.010	0.010	alpha	0.05	0.05
Mean			3.987	3.990	Lower limit	0.0627	0.92595
Median			4	4	Upper limit	1.9601	1.07675
Stdev			1.054	1.065	Statistics	0.59636	0.97981
Skew			0.005	-0.021	Conclusion	H0: M1=M2	H0: SD1=SD2
Kurt			0.866	0.825		Accepted	Accepted

There is no significant difference ($p < 0.05$) between the means and standard deviations from a 20,000 iteration MCMC simulation by T-test and F-test.

Markov Chain Monte Carlo probabilities for seven classes of precipitation in three climate series

Mode: 20~80th percentiles



The similarity among the probabilities suggests that the GCM modeling has simulated a similar distribution to the real climate; probabilities of extreme dry (States 1) and extreme wet (State 7) are slight smaller in GCM than the gauge precipitation or tree-ring reconstructions, suggesting the GCM CTRL_run insufficiently simulates the two tails of the distribution of events.