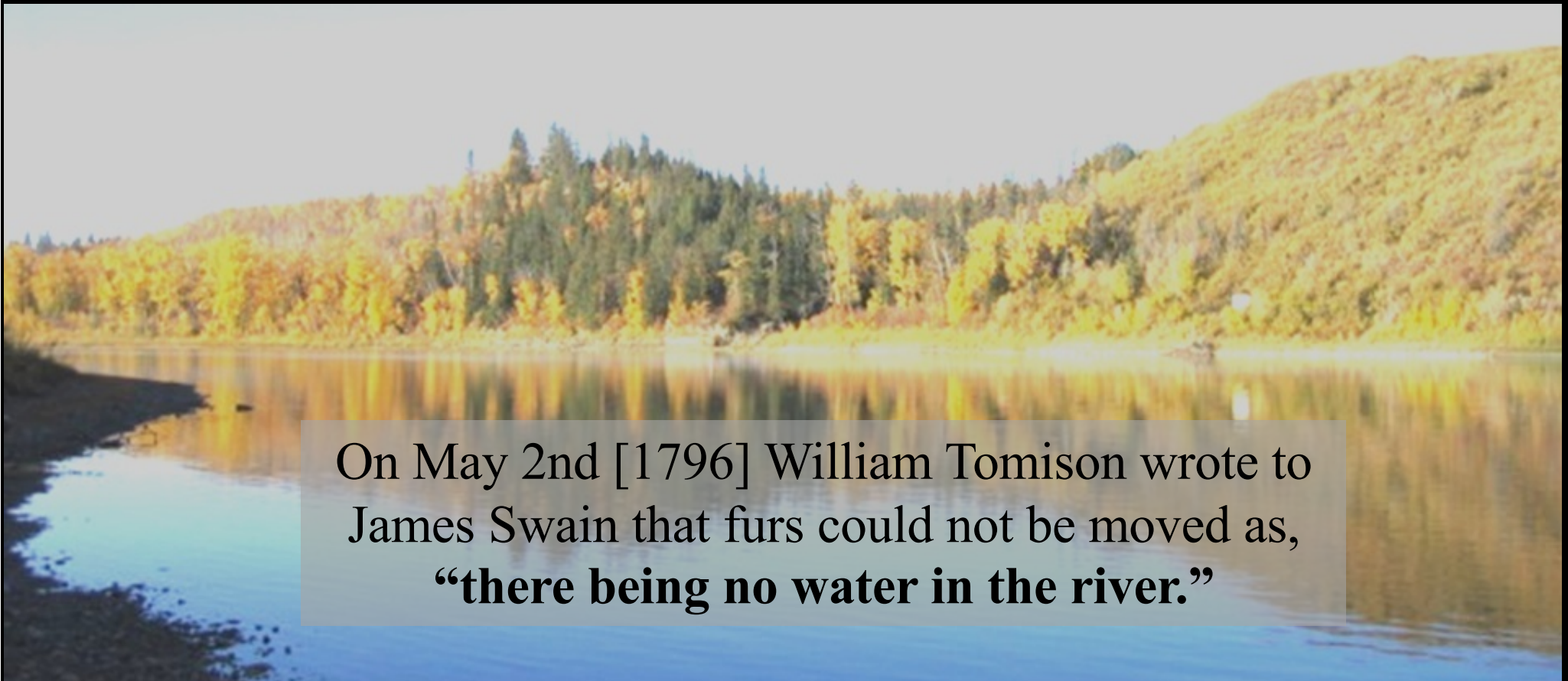


Water Scarcity, Climate and Environmental Concerns

Dave Sauchyn, Prairie Adaptation Research Collaborative, U of R



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

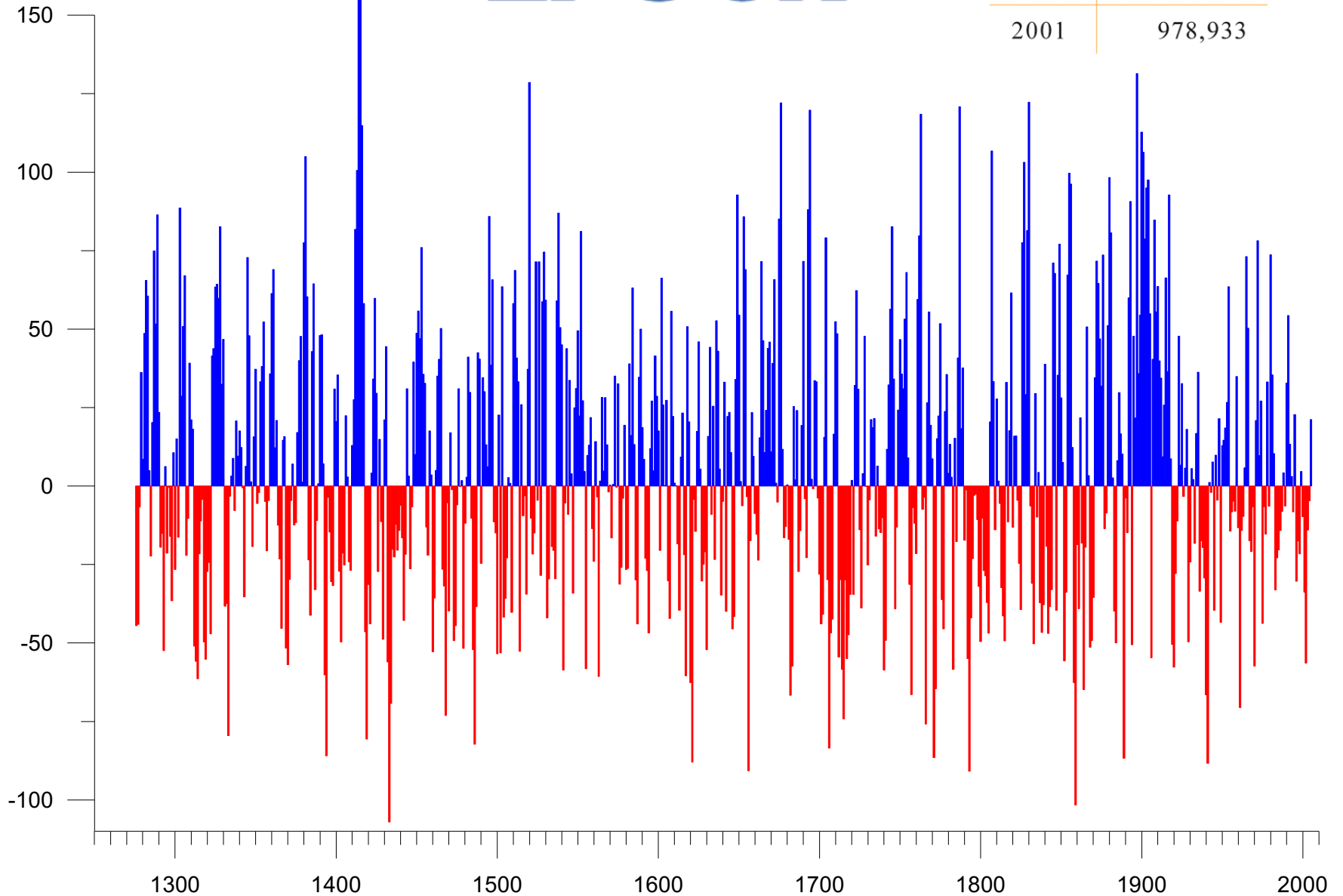
Saskatchewan Institute of Agrology AGM
March 17-18, 2010

North Saskatchewan River at Edmonton, 1276-2006

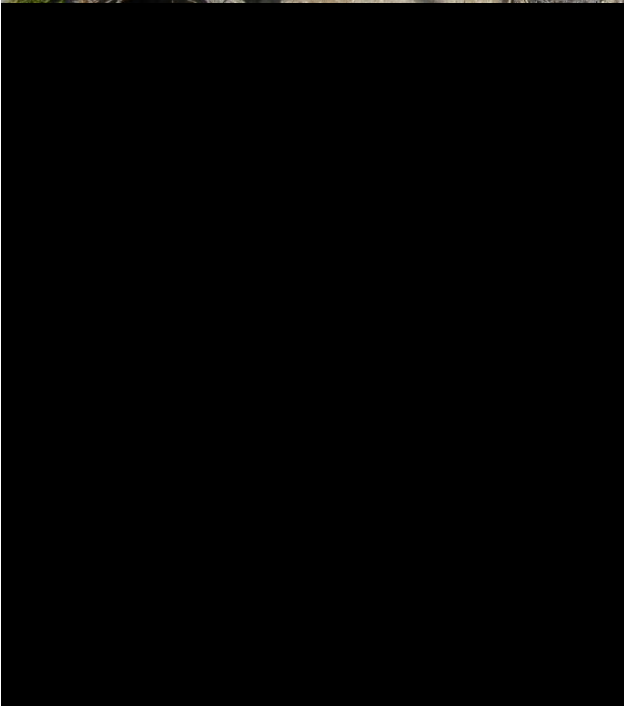


1901	91,279
1931	921,785
2001	978,933

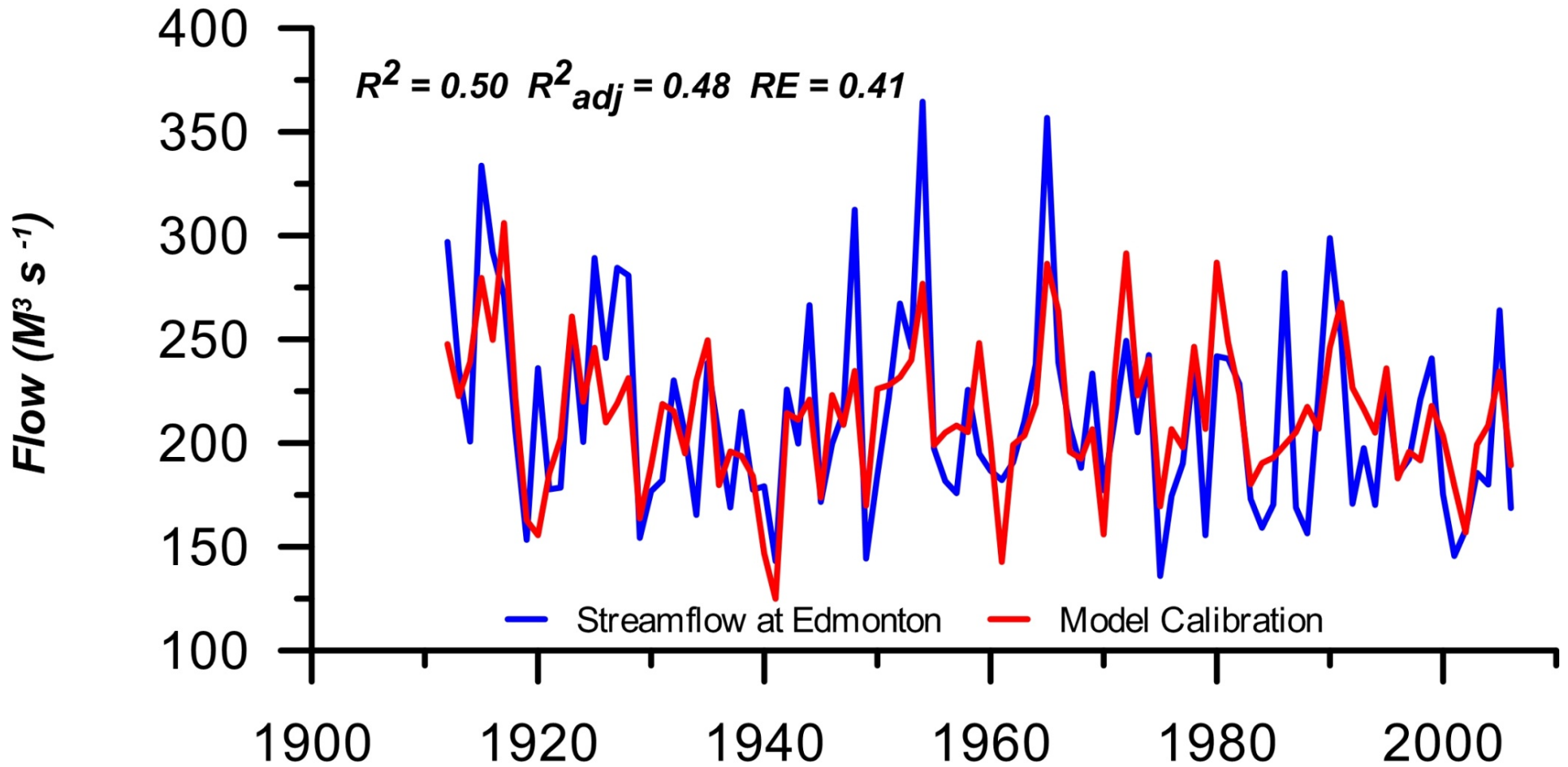
Departures from Mean Annual Flow (m^3/sec)



Old Wood Headwaters, NSRB



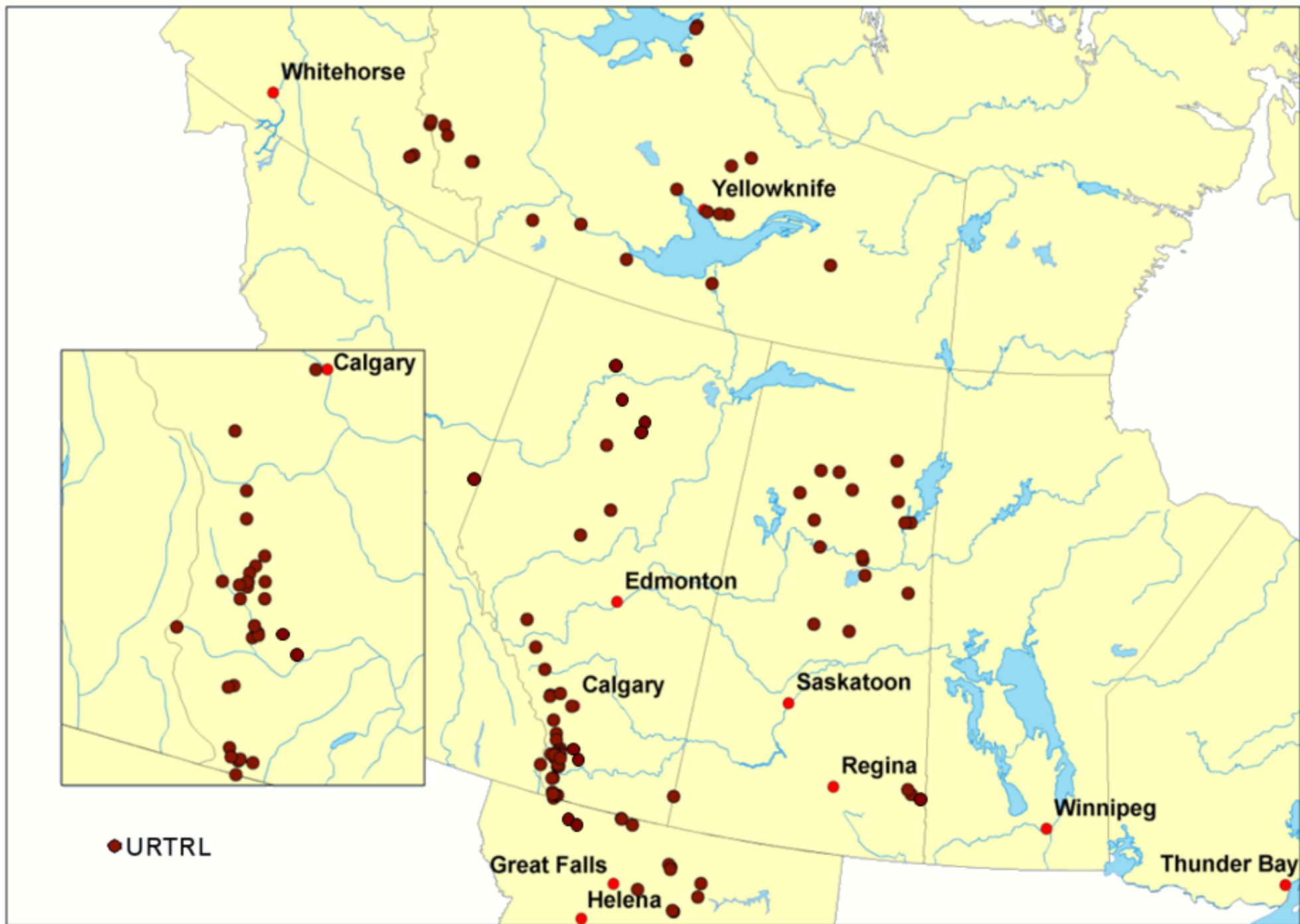
North Saskatchewan River at Edmonton Annual Flow (m³/sec), 1912-2006





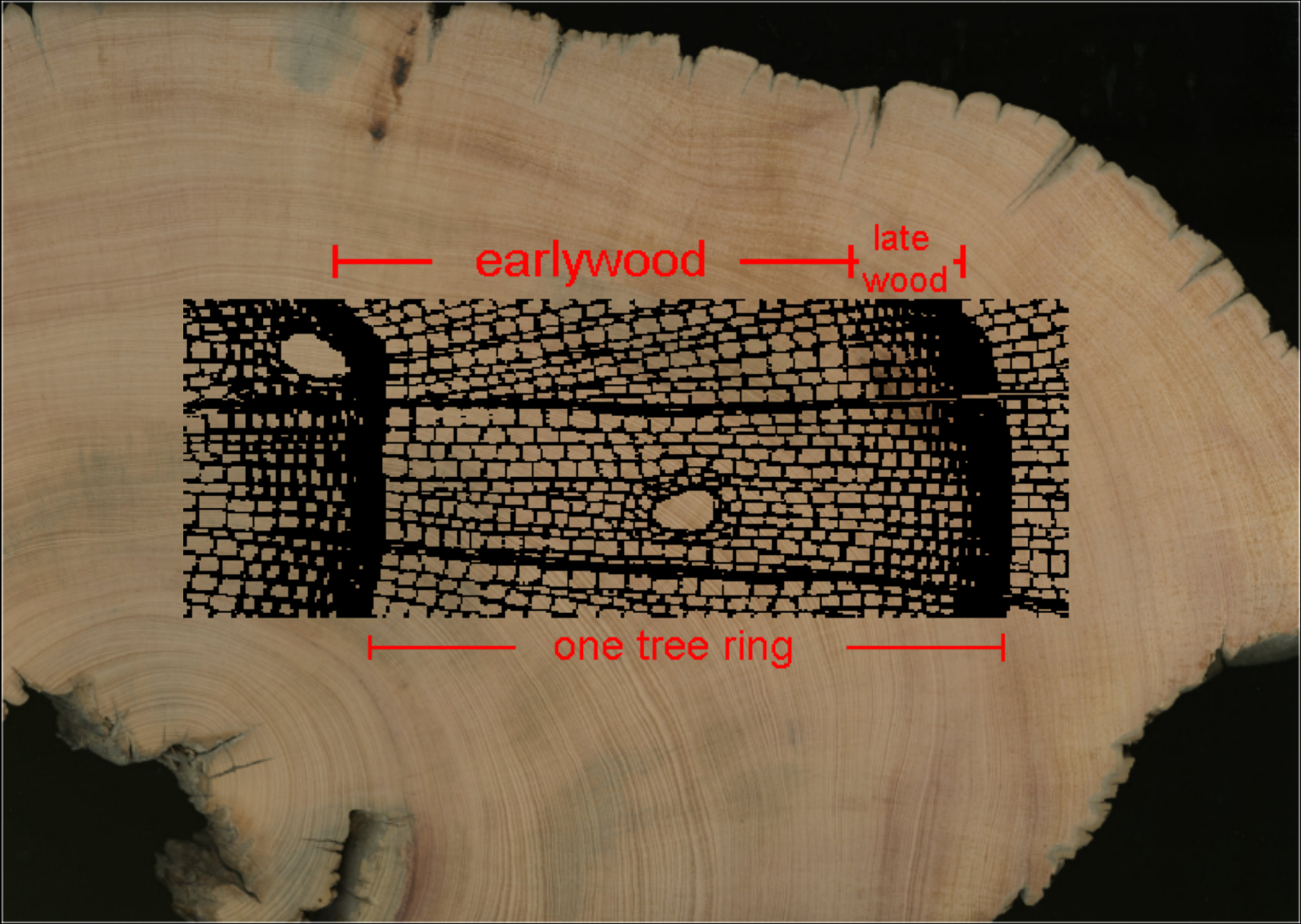


Tree-Ring Sampling Sites







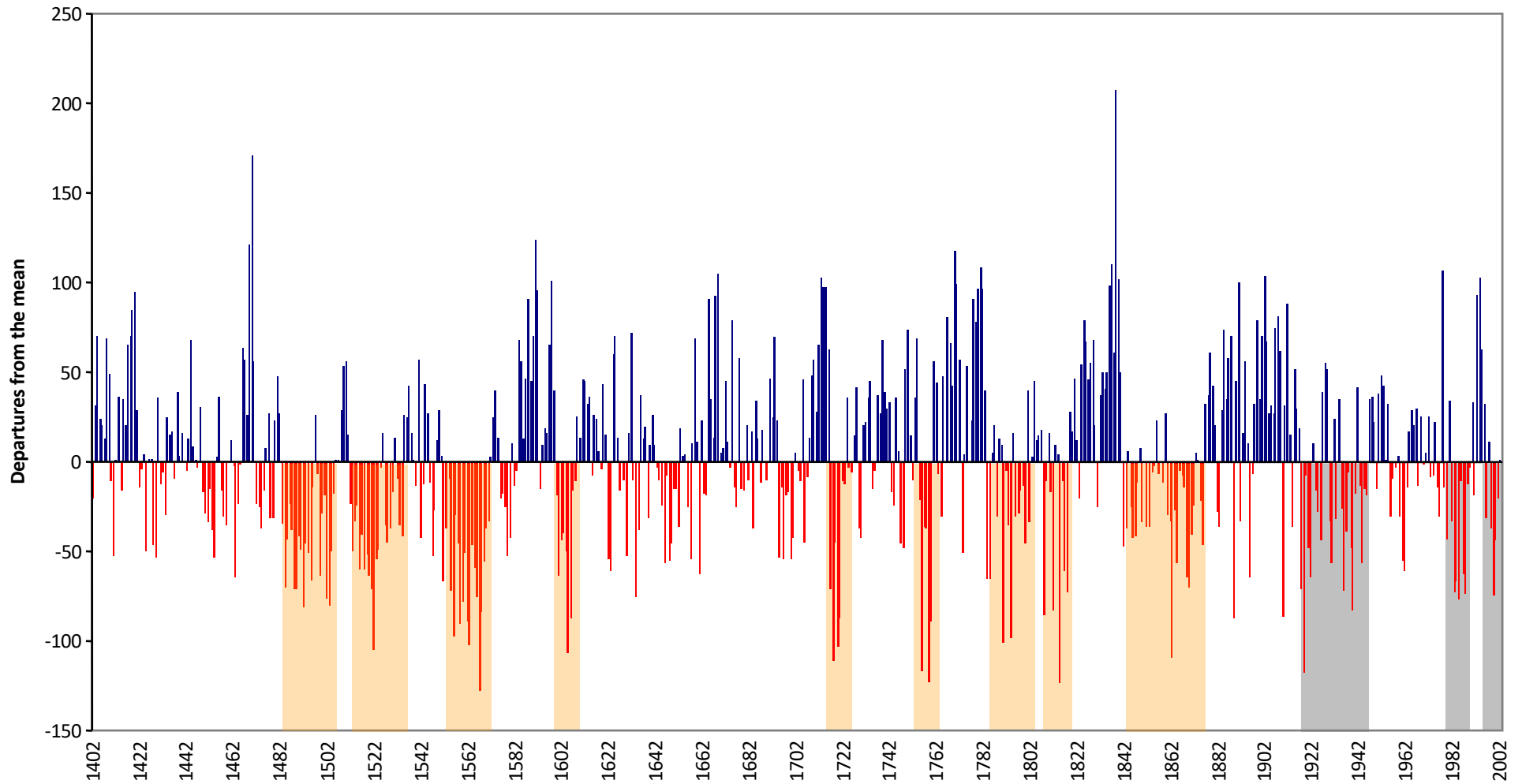


earlywood

late wood

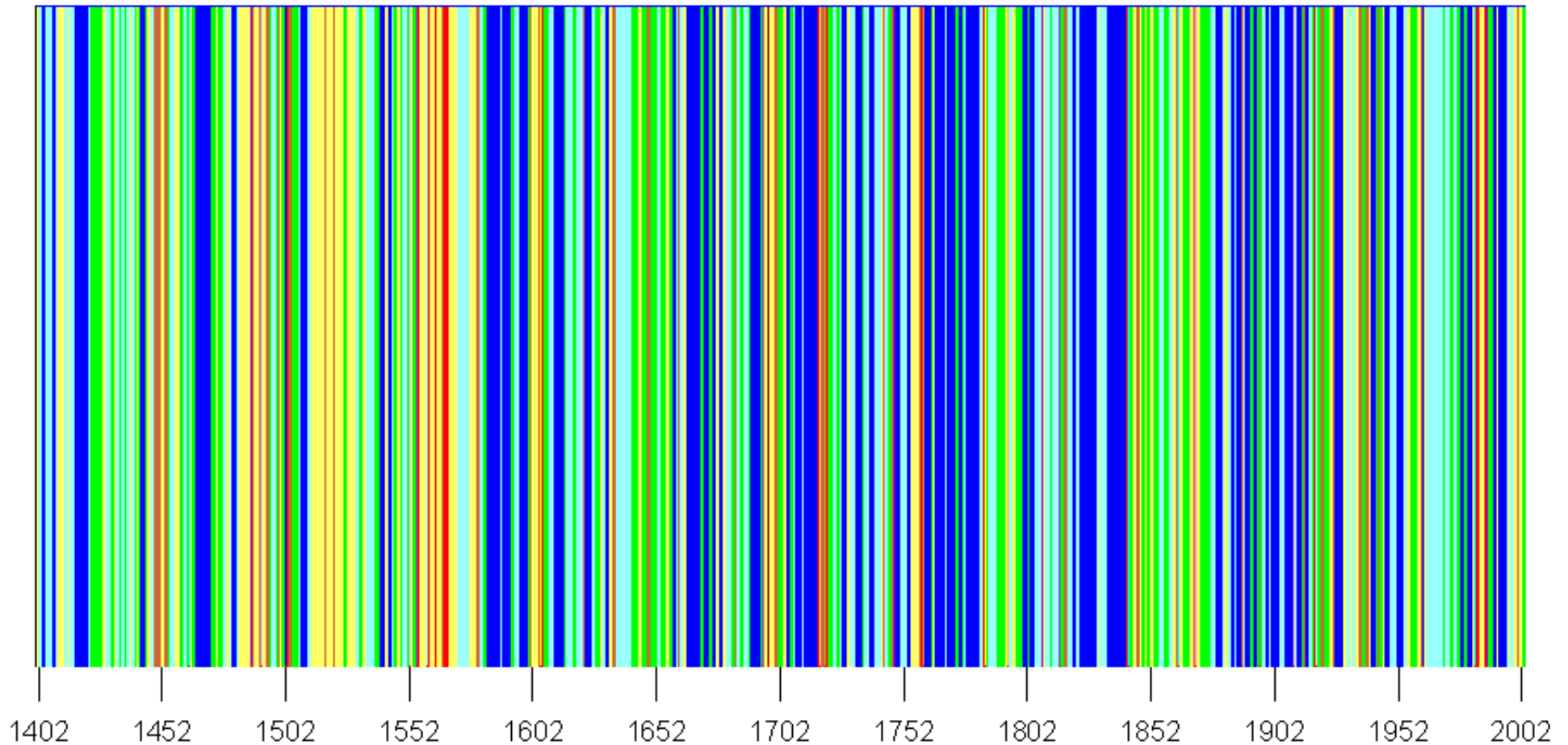
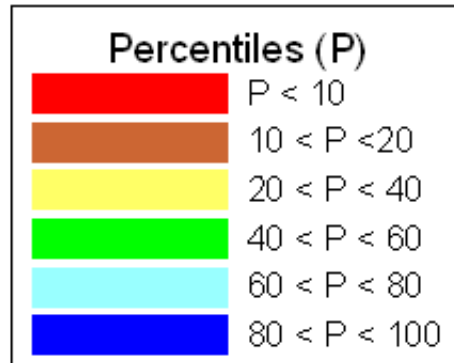
one tree ring

South Saskatchewan River at Medicine Hat, 1402-2004



Axelson ,Sauchyn, and Barichivich, 2009

South Saskatchewan River at Medicine Hat, 1402-2004



Seasonal precipitation, ENSO and tree growth response

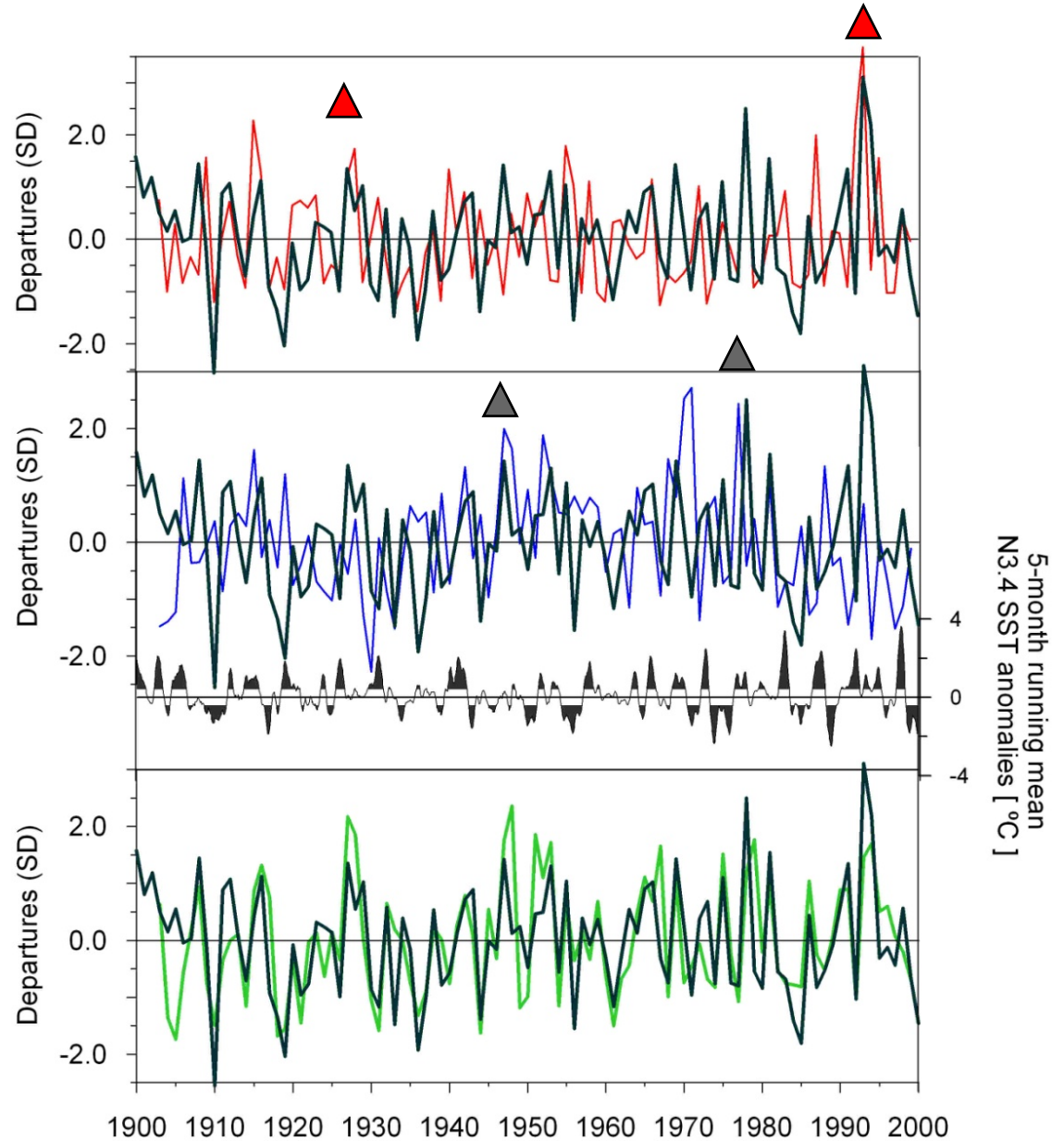
▲
Response to
summer

▲
Response to
winter

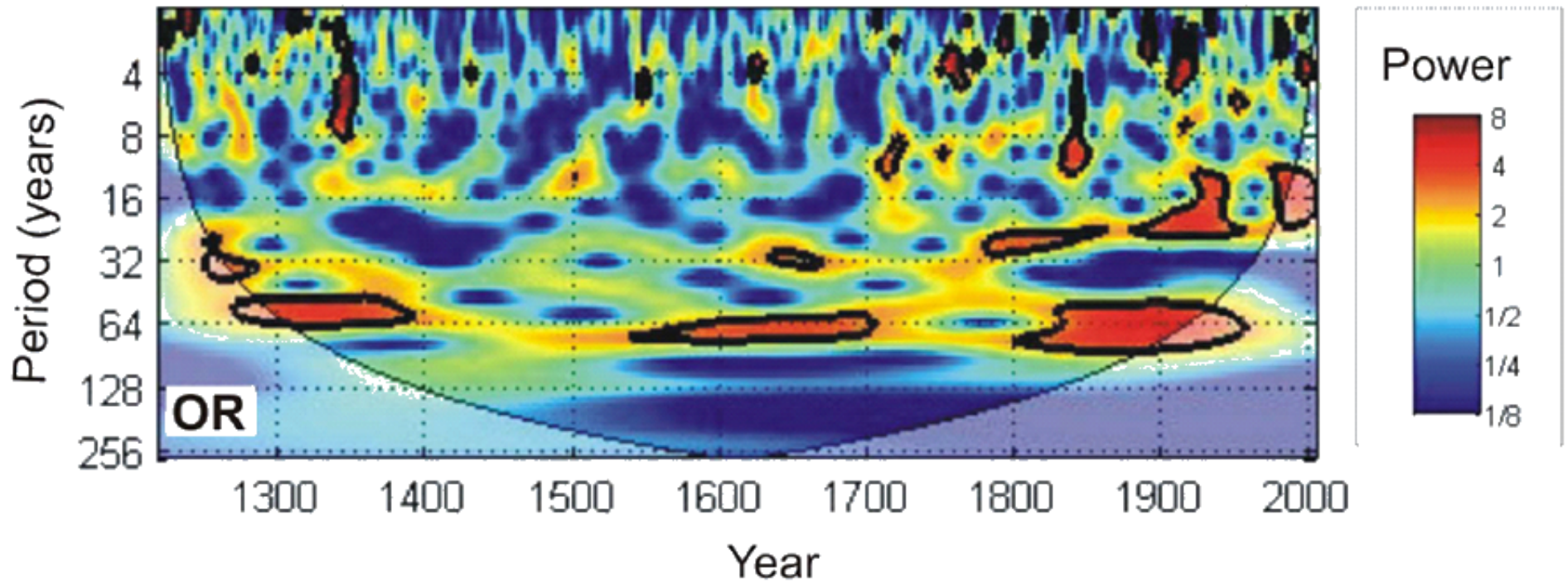


$r = .67$

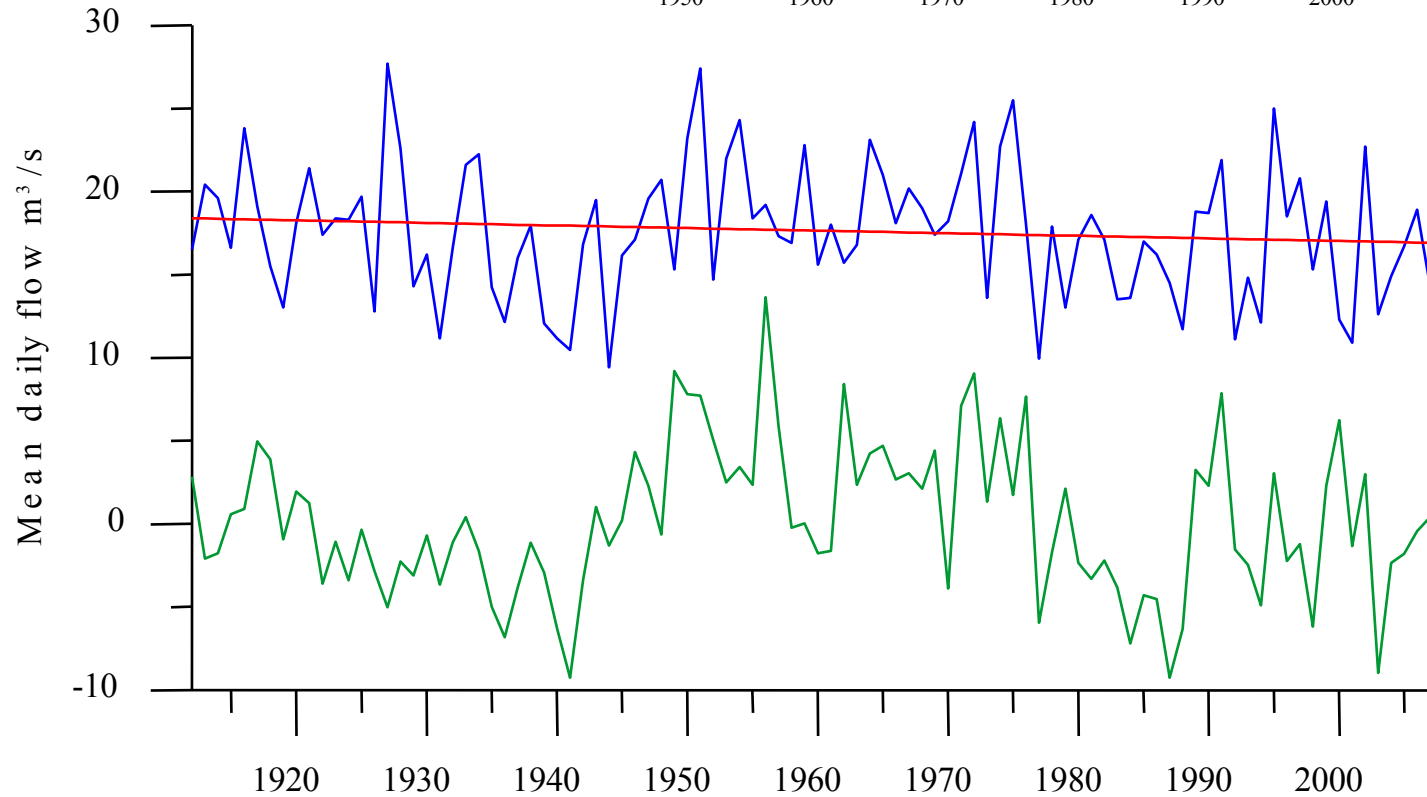
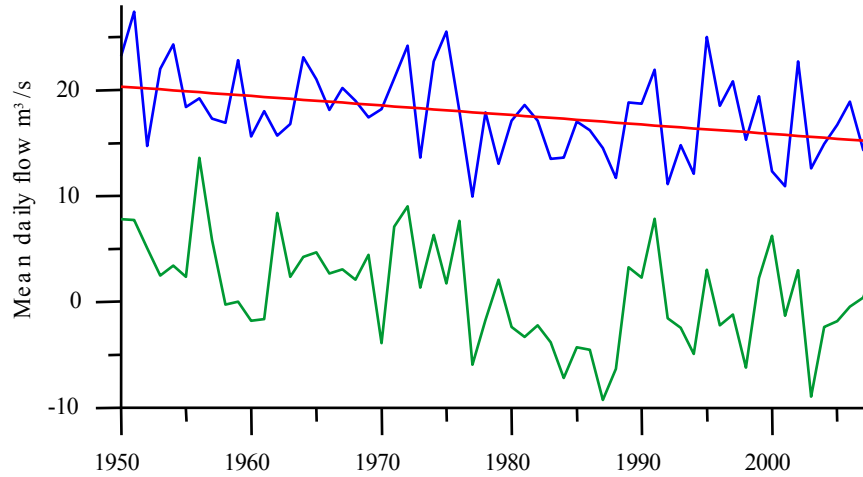
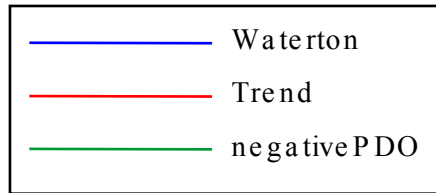
El Niño → winter (-); summer (+)
La Niña → winter (+); summer (-)



Cycles in the tree rings



Waterton River at Waterton, AB



Actual and Natural Flow, South Saskatchewan River

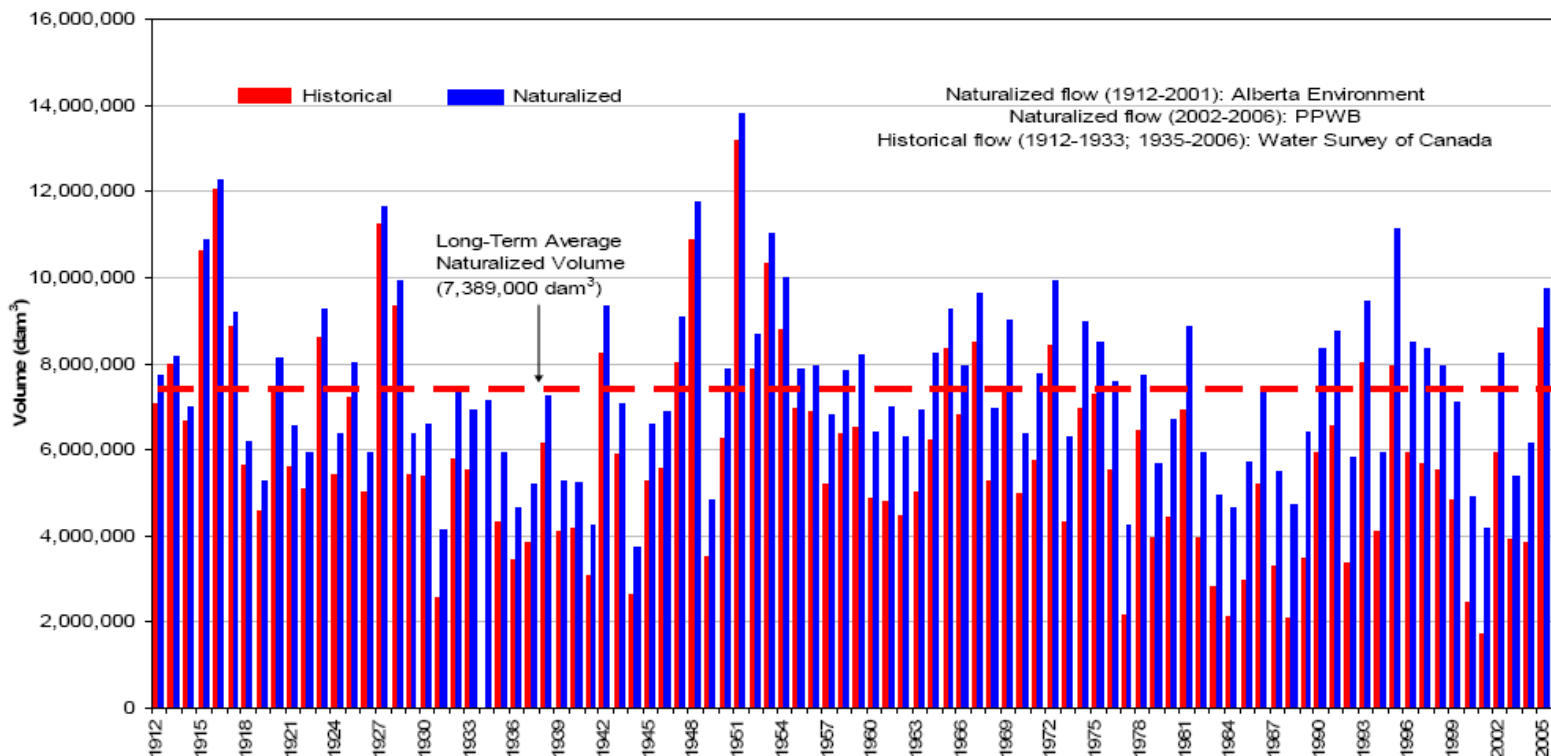
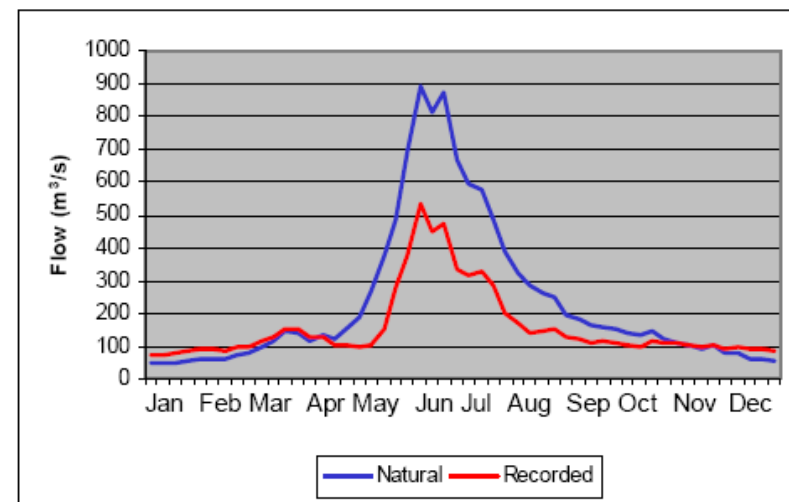


Figure 3.5 South Saskatchewan River at Medicine Hat Annual Historical and Naturalized Flow Volumes

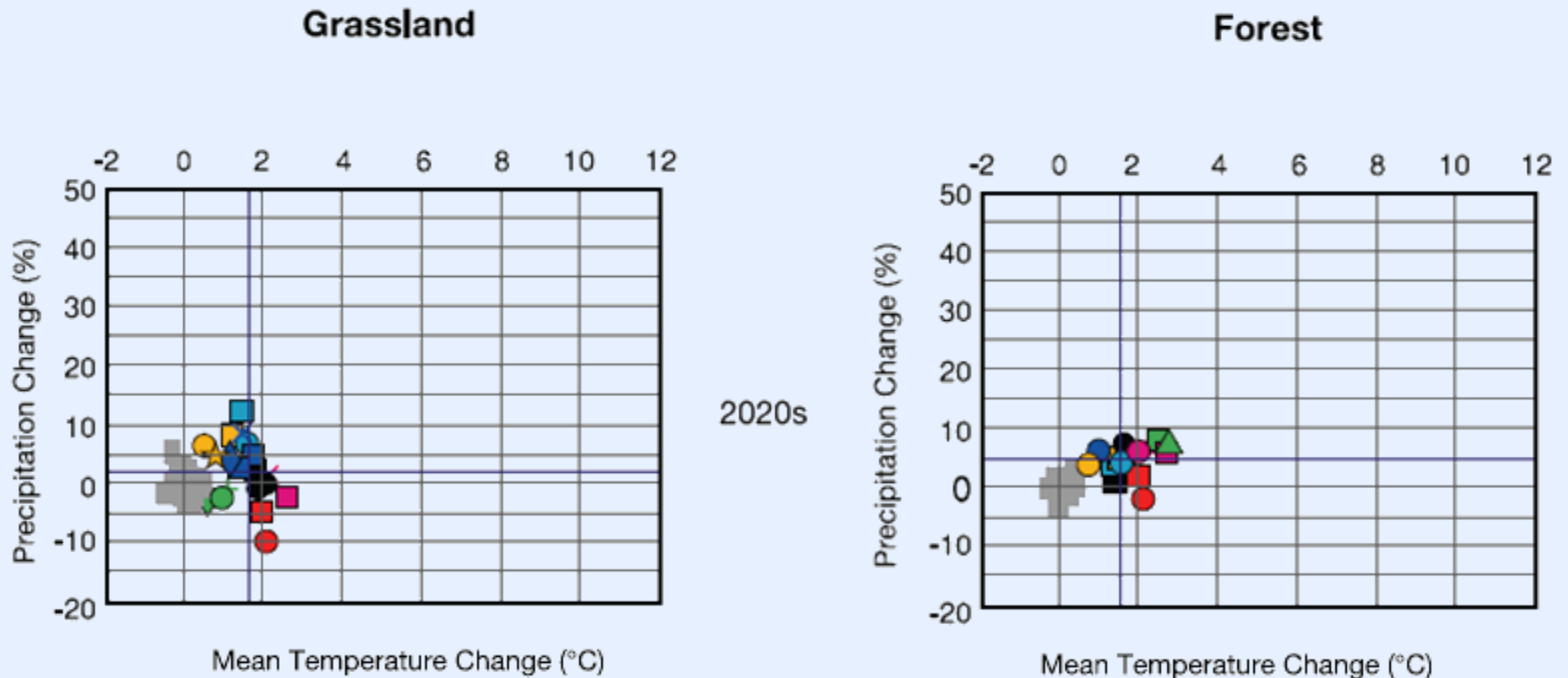
AMEC. 2009. South Saskatchewan River Basin in Alberta: Water Supply Study. Alberta Agriculture and Rural Development.



Net Streamflow Trends

Flow Record	Actual flow record			Naturalized flow record			Human Impact /yr
	Record period	Significant linear trend?	Change% /yr	Record period	Significant linear trend?	Change% /yr	
<i>1. Marias R. near Shelby, MT</i>	1912-2007	decreasing	-0.26	n.a.			
<i>2. Waterton R. near Waterton Park</i>	1912-2007	none	-0.05	n.a.			
<i>3. Castle R. near Beaver Mines</i>	1945-2007	none	-0.04	n.a.			
<i>4. Oldman R. near Waldron's Corner</i>	1950-2007	increasing	0.43	n.a.			
<i>5. Highwood R. at Diebel's Ranch</i>	1952-2007	none	0.11	n.a.			
<i>6. Bow R. at Banff</i>	1911-2007	decreasing	-0.12	n.a.			
<i>7. Columbia R. at Nicholson, BC</i>	1917-2007	none	-0.001	n.a.			
<i>8. Red Deer R. at Red Deer</i>	1912-2007	decreasing	-0.22	n.a.			
<i>9. St. Mary R. at International Boundary</i>	1903-2007	decreasing	-0.46	1912-2001	none	0.006	-0.47
<i>10. Belly R. near Mountain View</i>	1912-2007	none	0.02	1912-2001	none	0.02	-0.002
<i>11. Oldman R. near Lethbridge</i>	1912-2007	decreasing	-0.76	1912-2001	decreasing	-0.18	-0.58
<i>12. S. Saskatchewan R. at Medicine Hat</i>	1912-2007	decreasing	-0.36	1912-2001	increasing	0.05	-0.41
<i>13. Elbow R. below Glenmore Dam</i>	1911-2007	decreasing	-0.70	1912-2001	decreasing	-0.34	-0.36
<i>14. Bow R. at Calgary</i>	1912-2007	decreasing	-0.16	1912-2001	decreasing	-0.16	-0.01
<i>15. Spray R. at Banff</i>	1911-2007	decreasing	-2.20	1912-2001	decreasing	-0.11	-2.09
<i>16. N. Saskatchewan R. at Edmonton</i>	1912-2007	decreasing	-0.14	1911-2007	decreasing	-0.10	-0.04

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.

Global warming -- it's not all bad

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

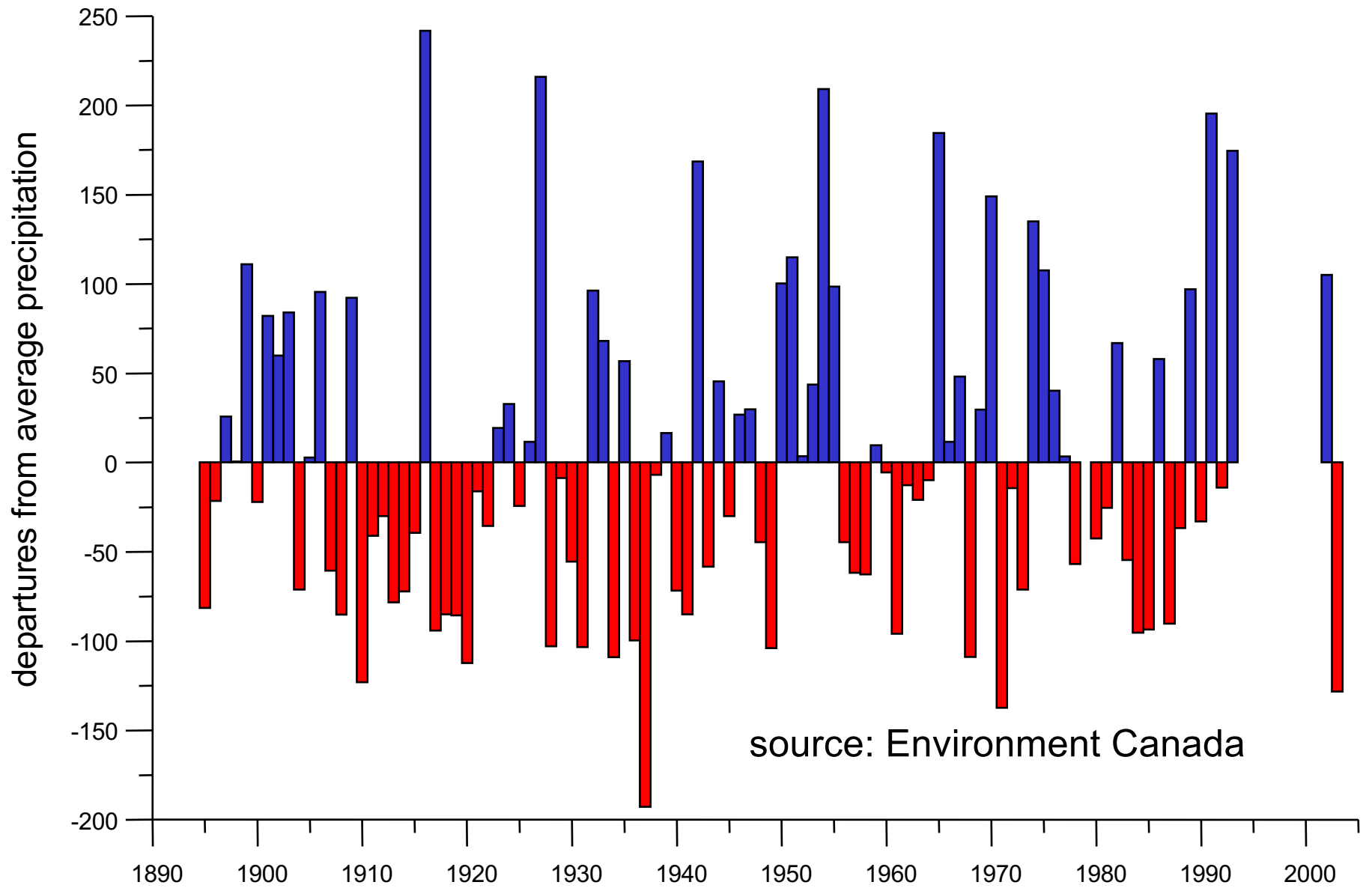
David Staples, The Edmonton Journal

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."**

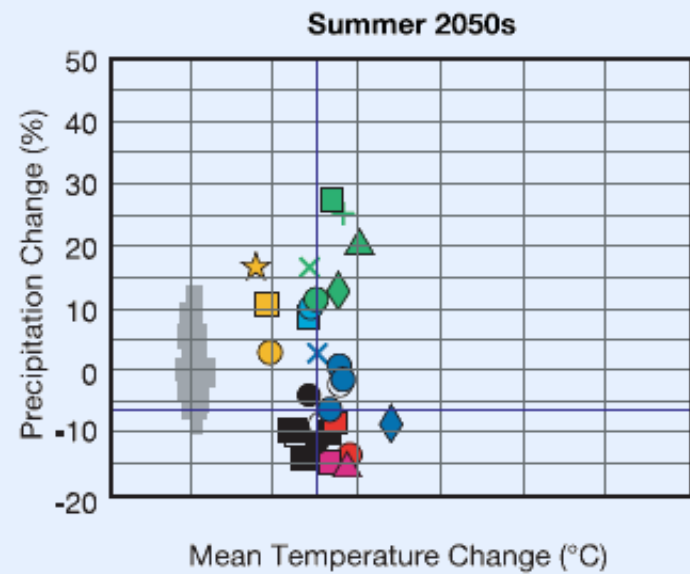
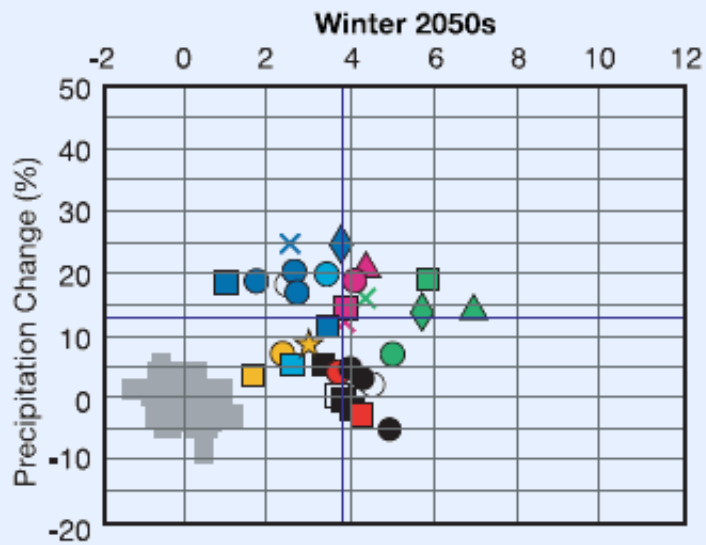
There will be opportunities for Canadian farmers going forward, **Sauchyn says ...** "The most challenging impact of climate change is not going to be a shift in average conditions ..."

Annual Precipitation, Swift Current, 1895-2003

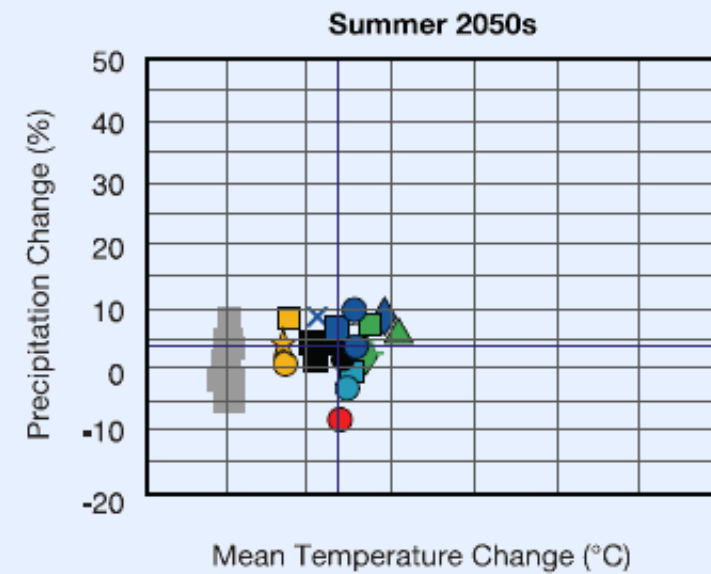
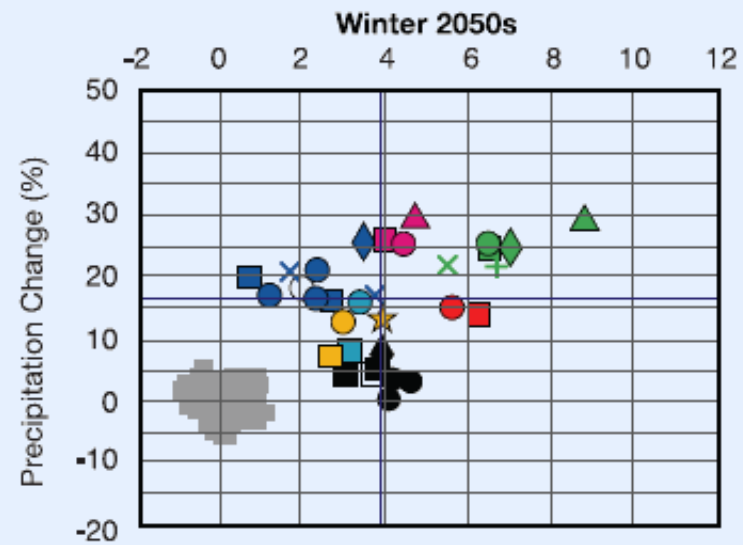


Seasonal Scenarios

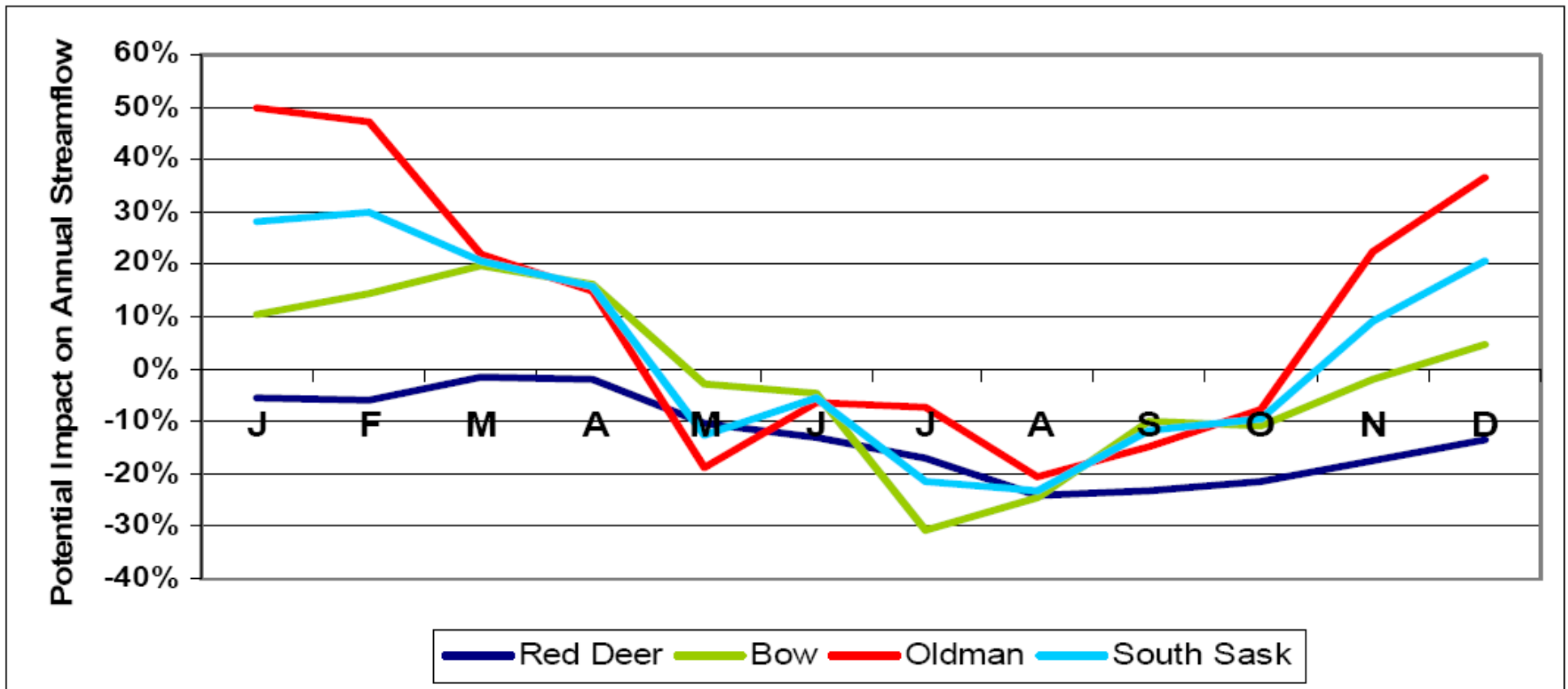
Grassland



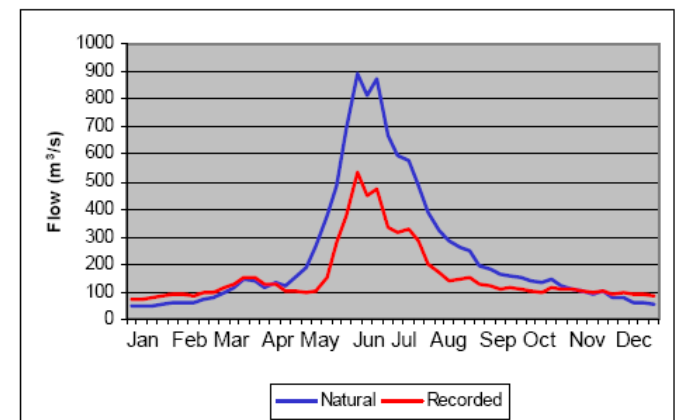
Forest



Potential Climate Change (%) Impacts on Natural Flows in the SSRB



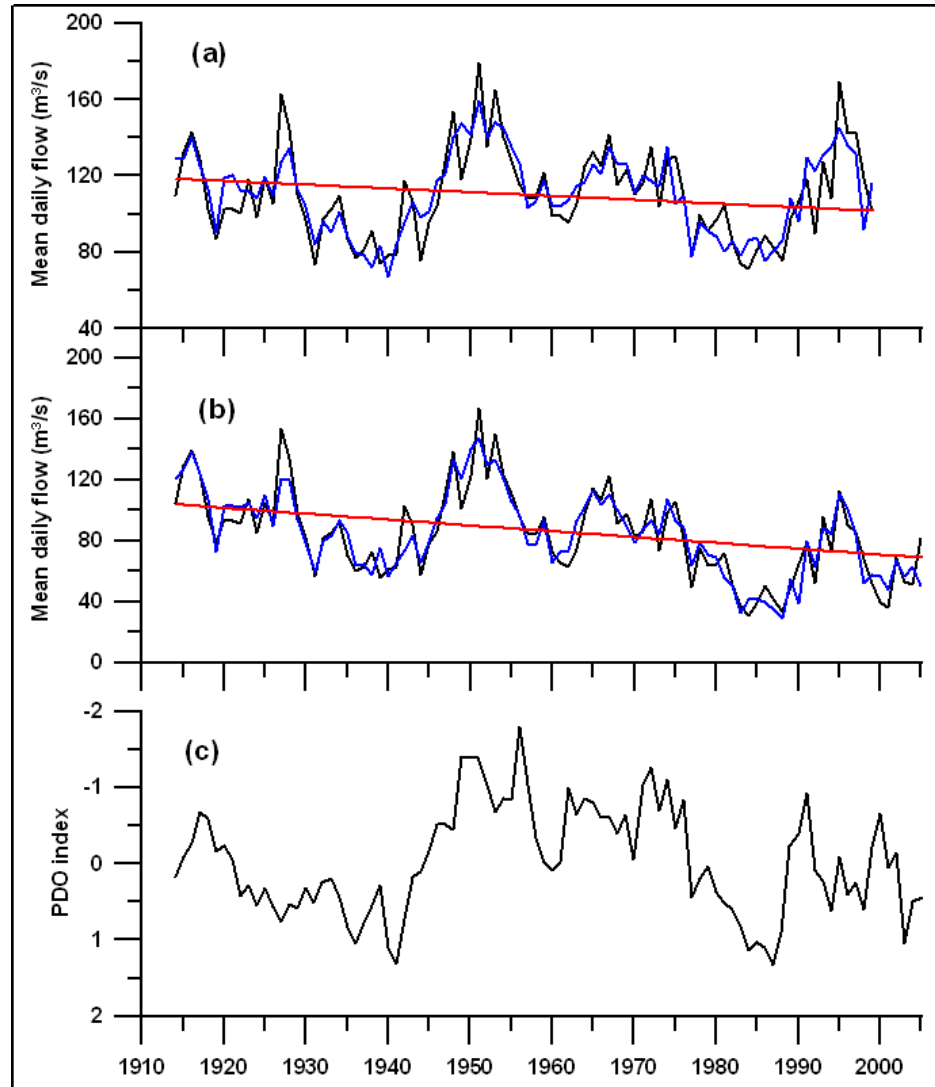
AMEC. 2009. South Saskatchewan River Basin in Alberta: Water Supply Study. Alberta Agriculture and Rural Development.
Martz et al. (2007)



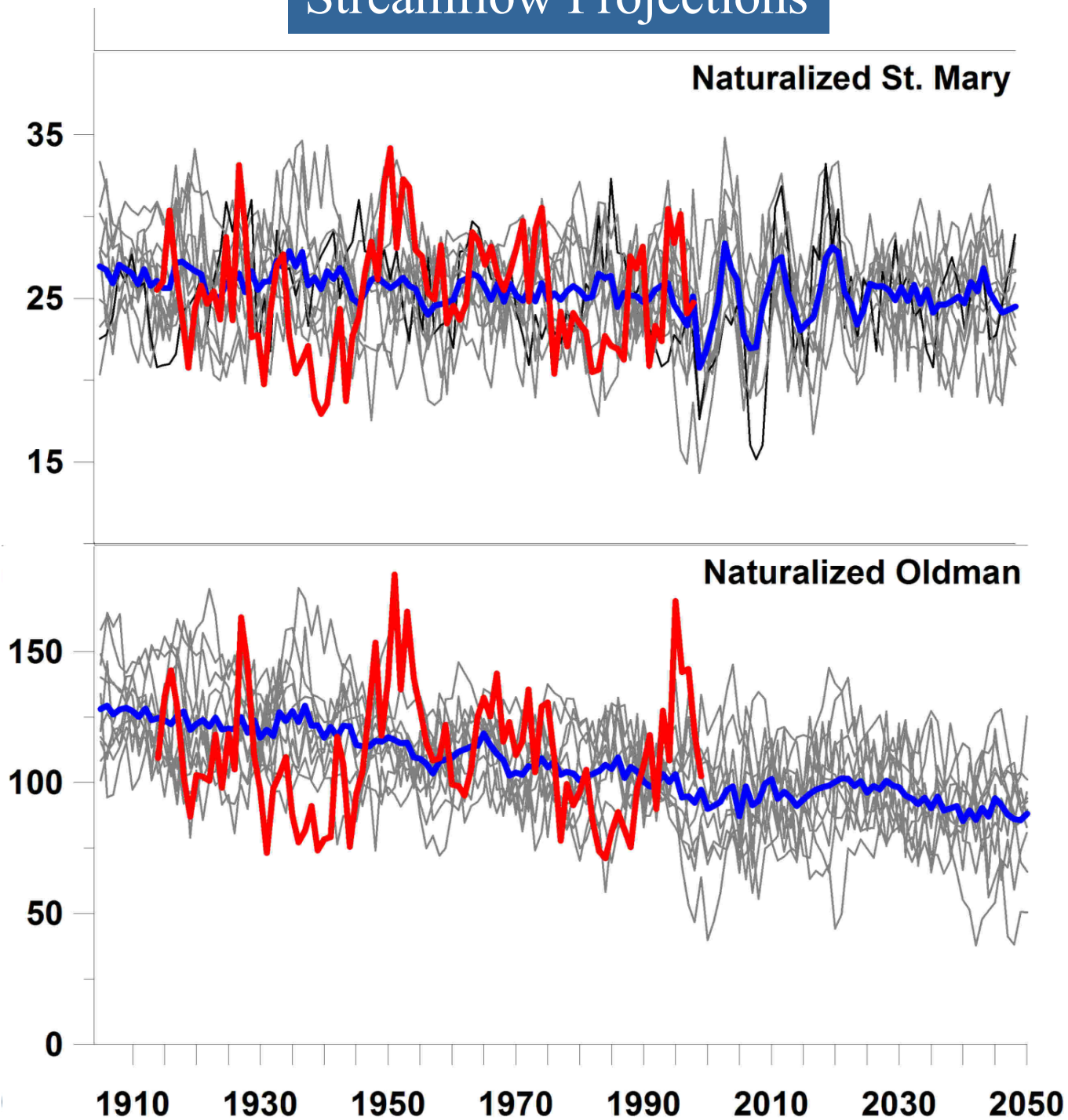
Global Warming Amplifies Hydro-Climatic Variability



Oldman River – Modeled Variability (blue)



Streamflow Projections



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



There will be greater variation in hydroclimate



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

A warmer climate will provide new opportunities, but most impacts are adverse because we are not presently adapted to the larger range of climate conditions projected



Economies and communities are sensitive to climate variability

South Saskatchewan River Watershed

Source Water Protection Plan

September 2007

