

Water and Climate Scenarios for Alberta's South Saskatchewan River Basin

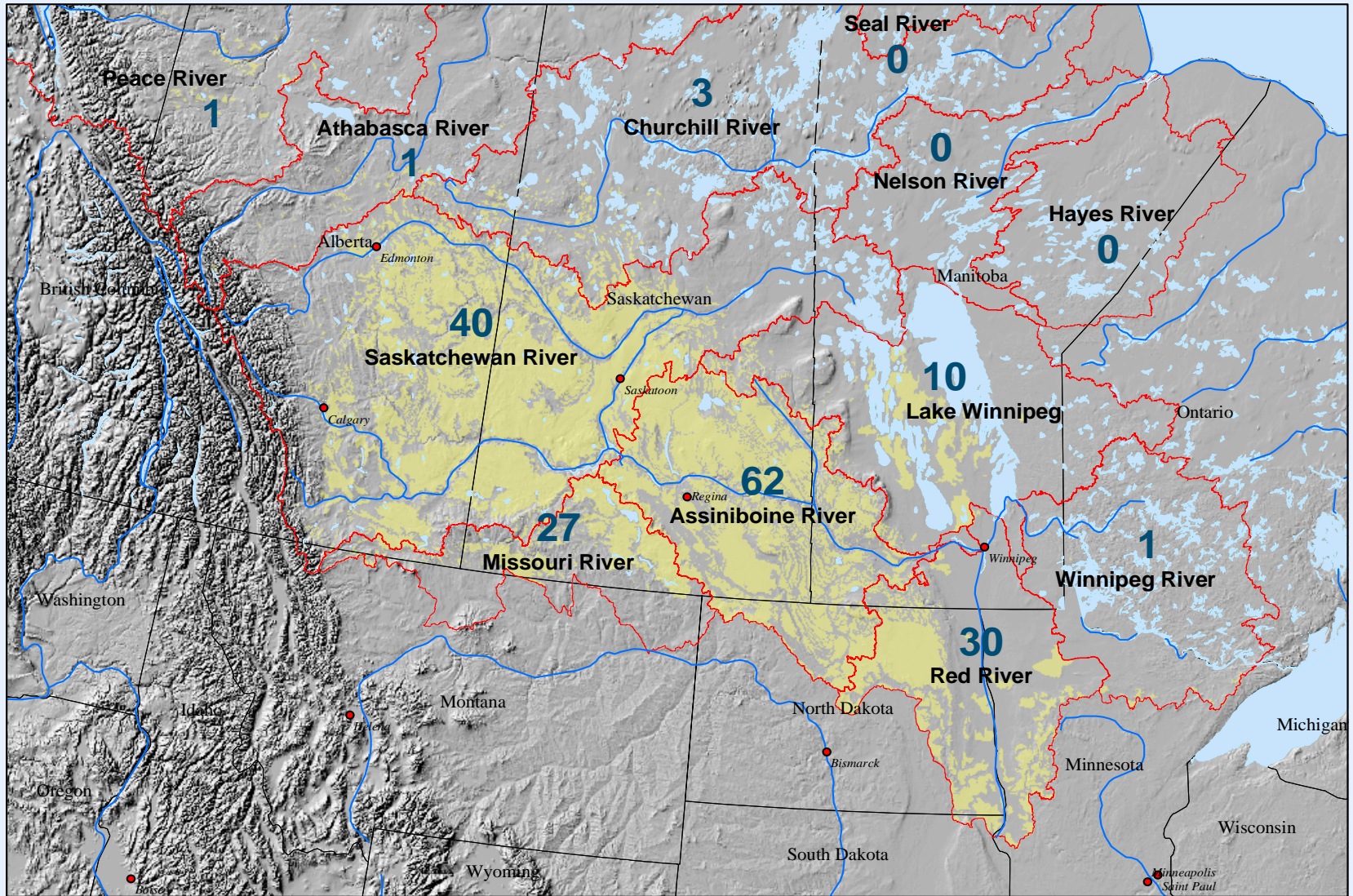
Dave Sauchyn and Suzan Lapp
Prairie Adaptation Research Collaborative
University of Regina



Stakeholder Workshop on Water and Climate, Dec 1/06, Lethbridge

Prairie Drainage Basins

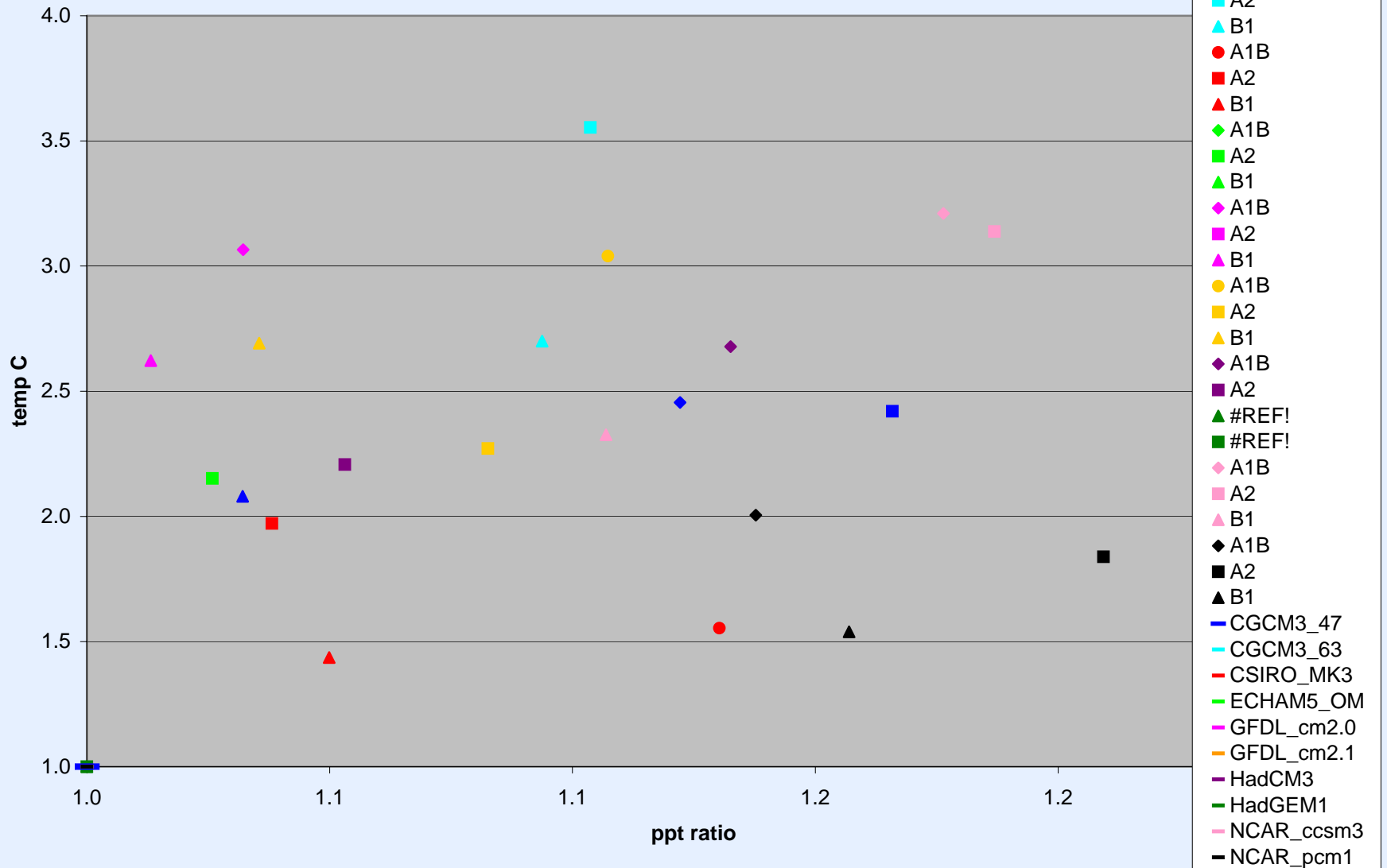
Non-contributing drainage area (percent of total basin area) for prairie drainage basins
-median annual runoff-



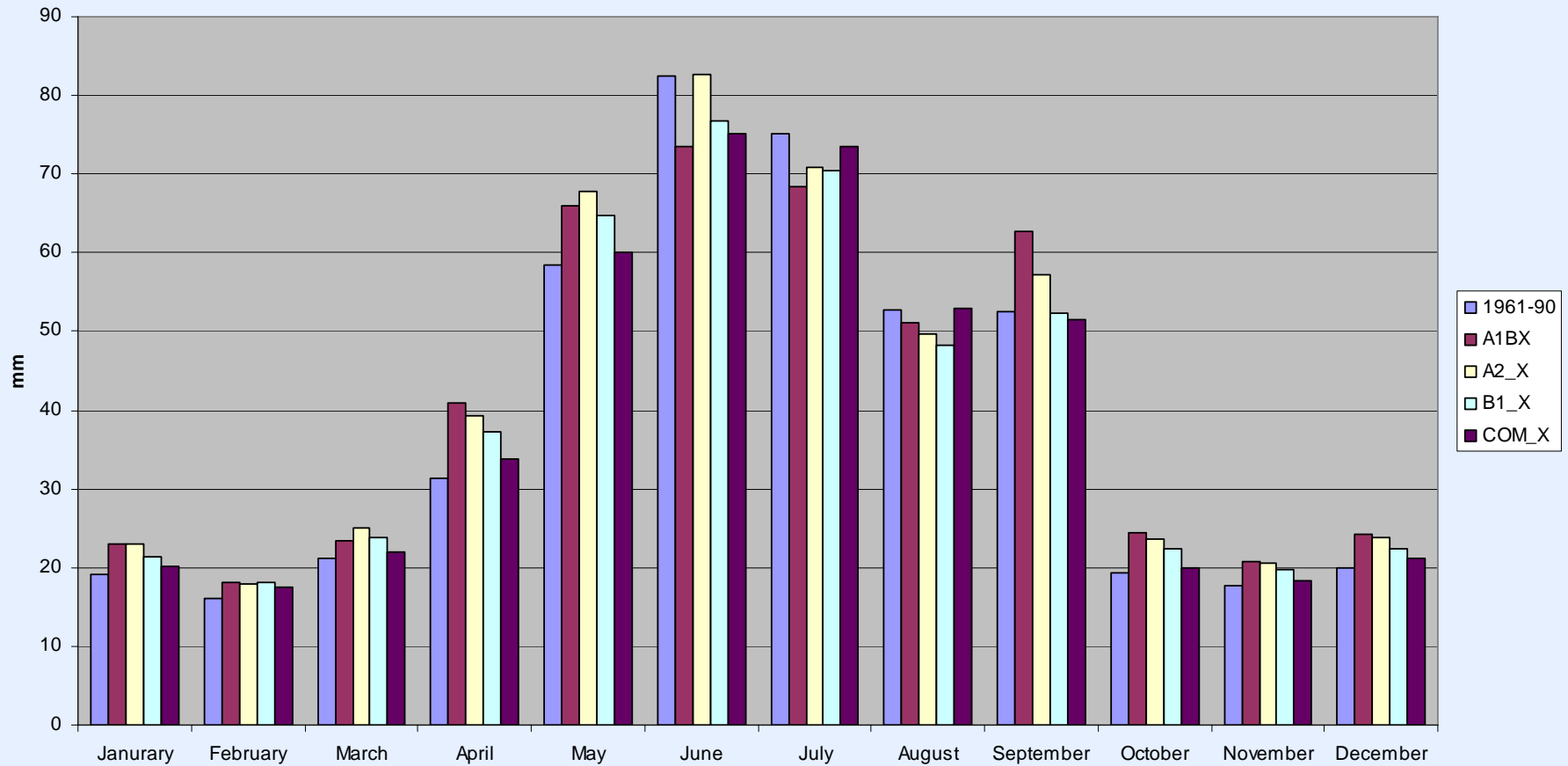
Source: Non-contributing area - Agriculture and Agri-Food Canada, P.F.R.A.
Elevation data - Environmental Systems Research Institute

0 50 100 200
Kilometers

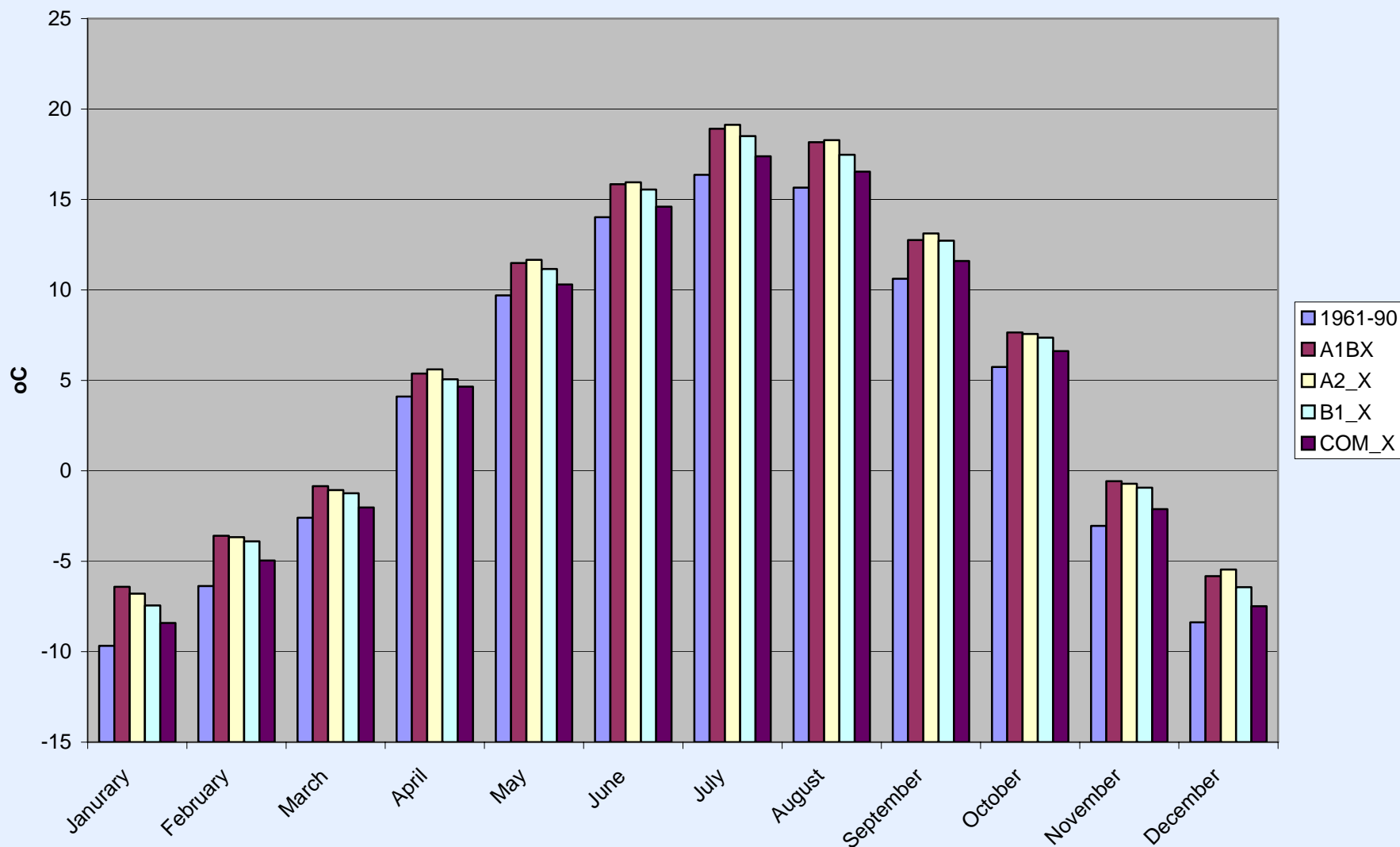
Lethbridge 2050



Mean Precipitation 2050, Calgary, CGCM3

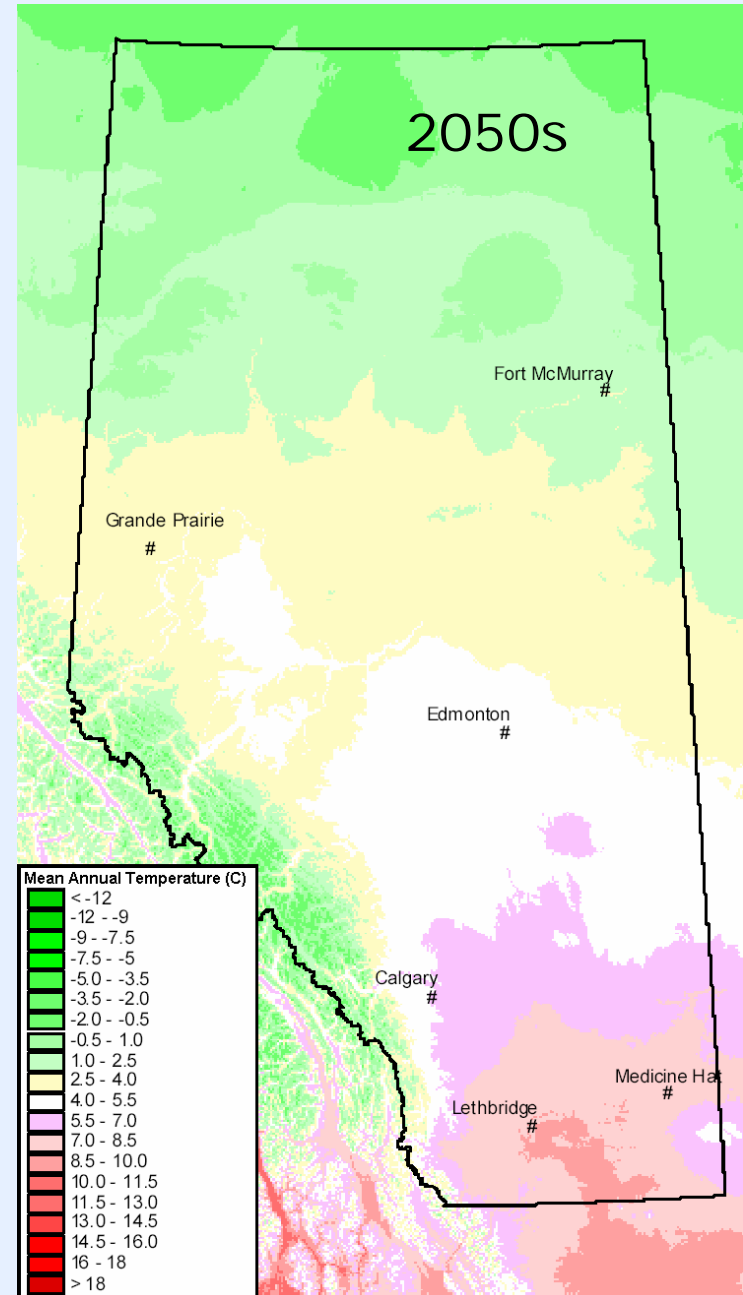
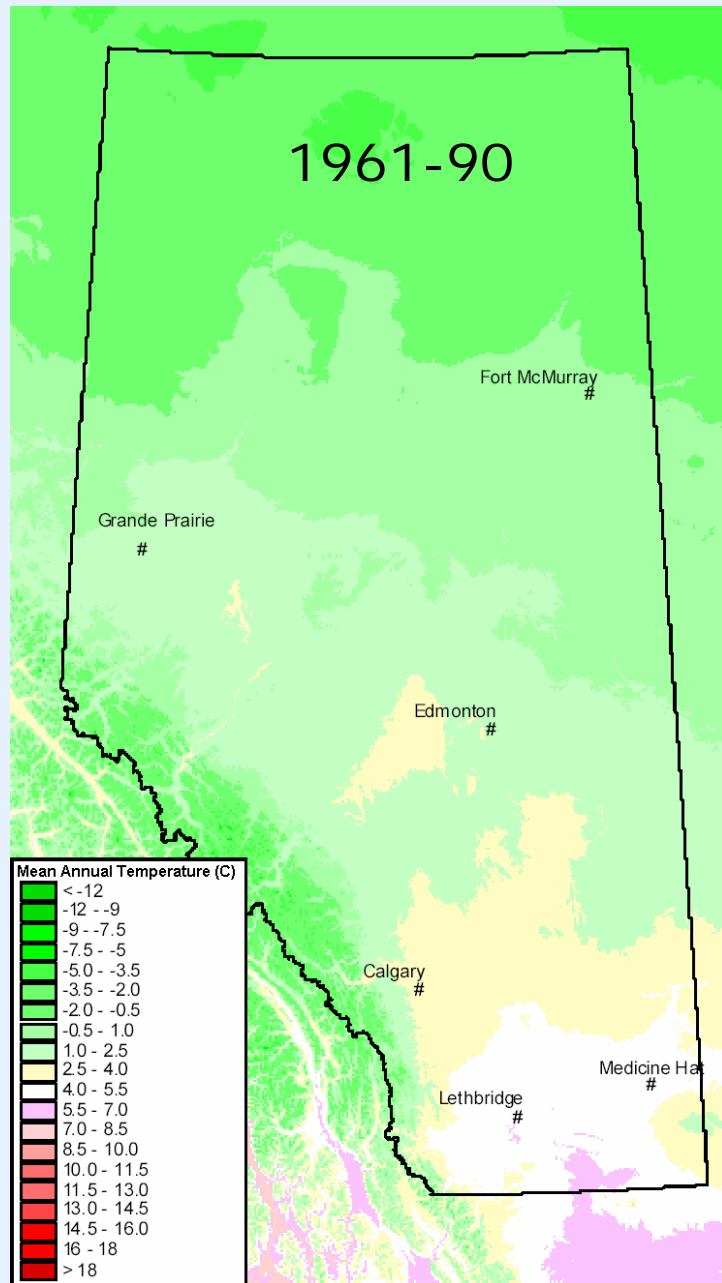


Mean Temperature 2050, Calgary, CGCM3



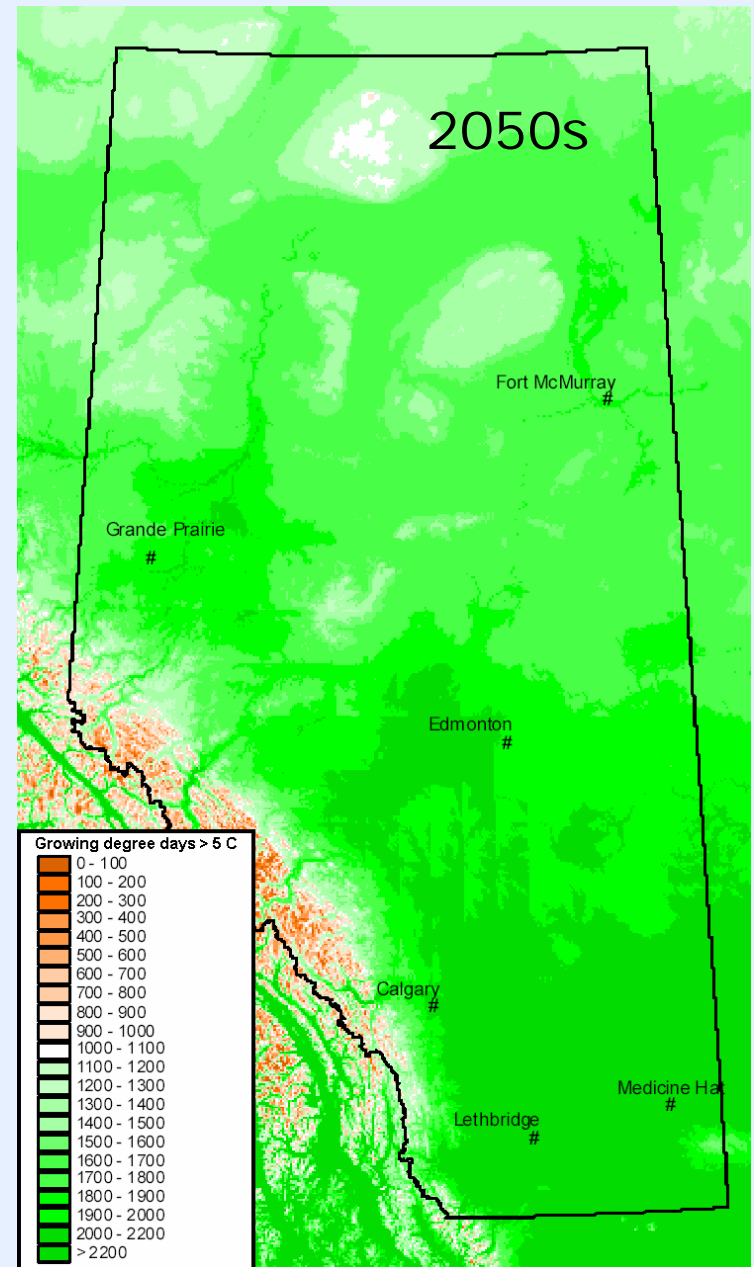
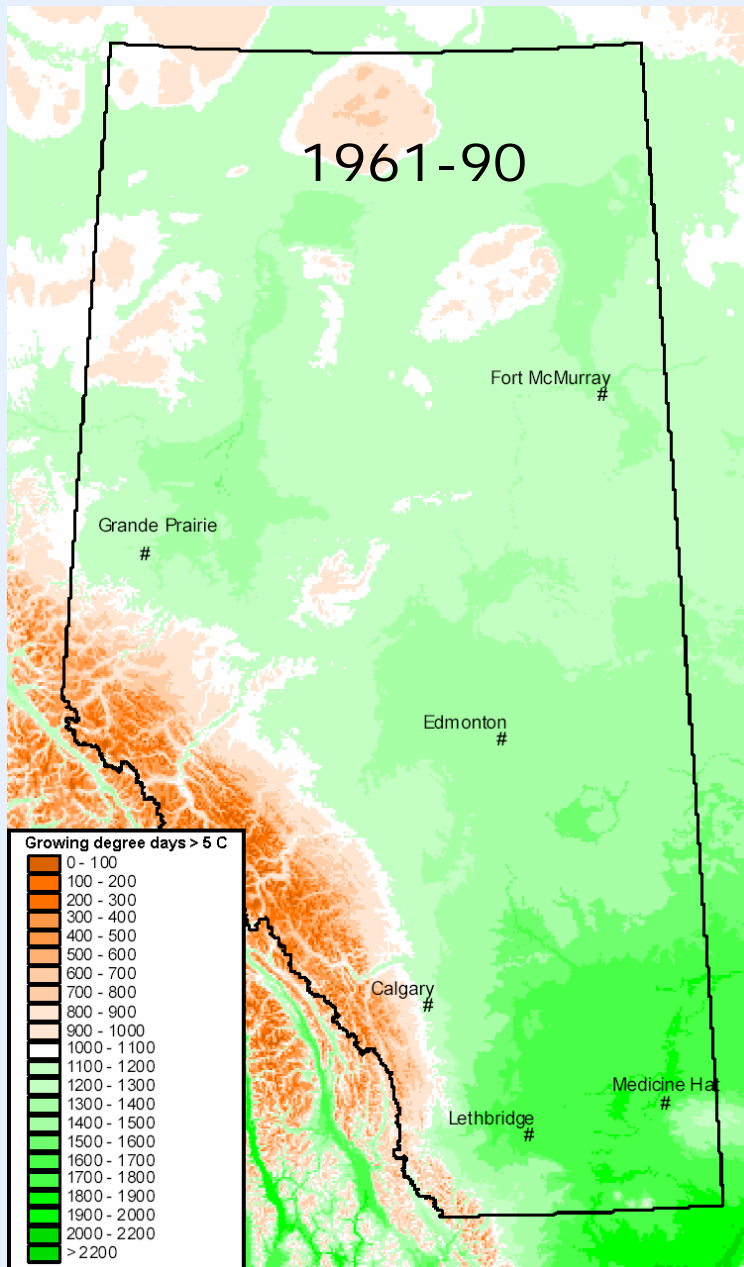
Mean Annual Temperature

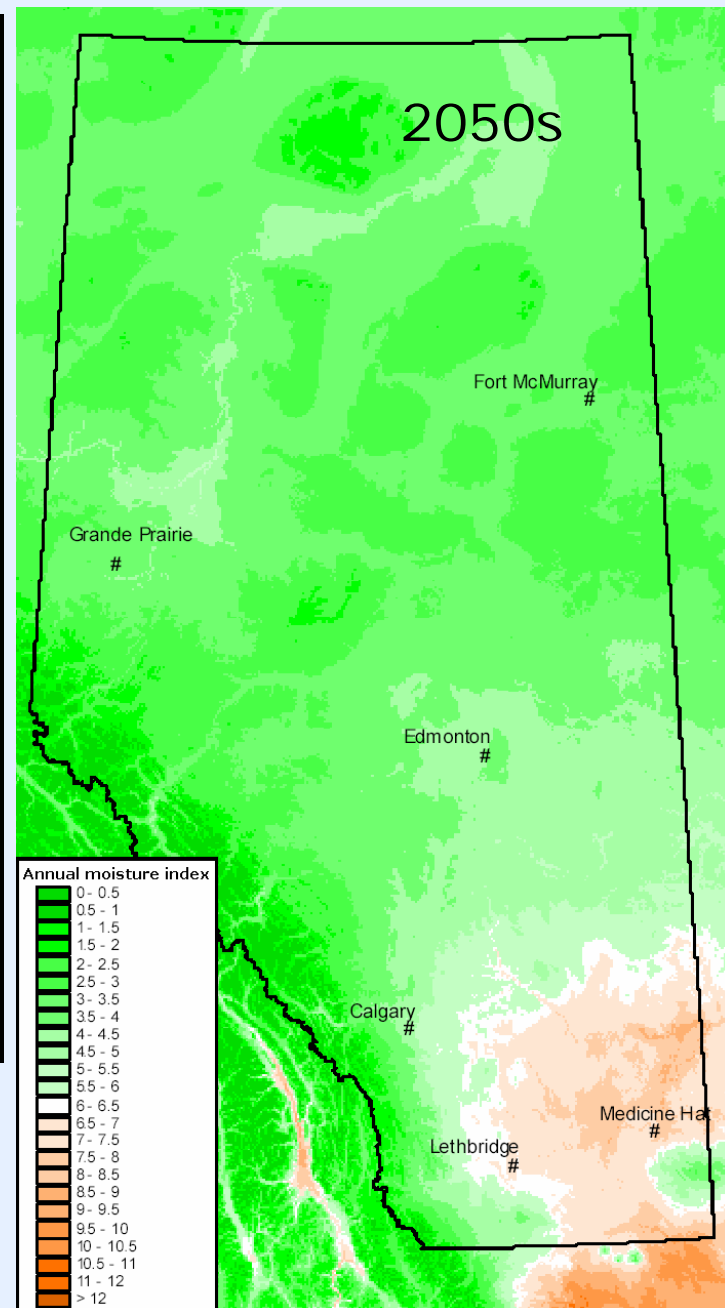
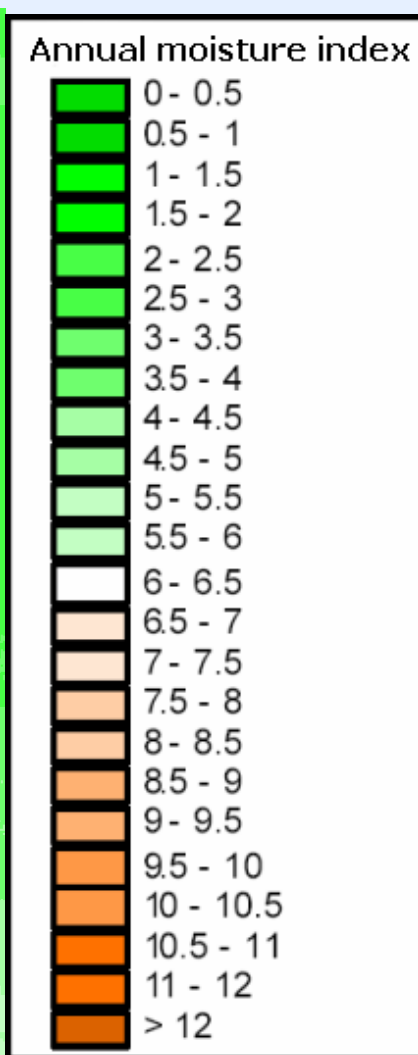
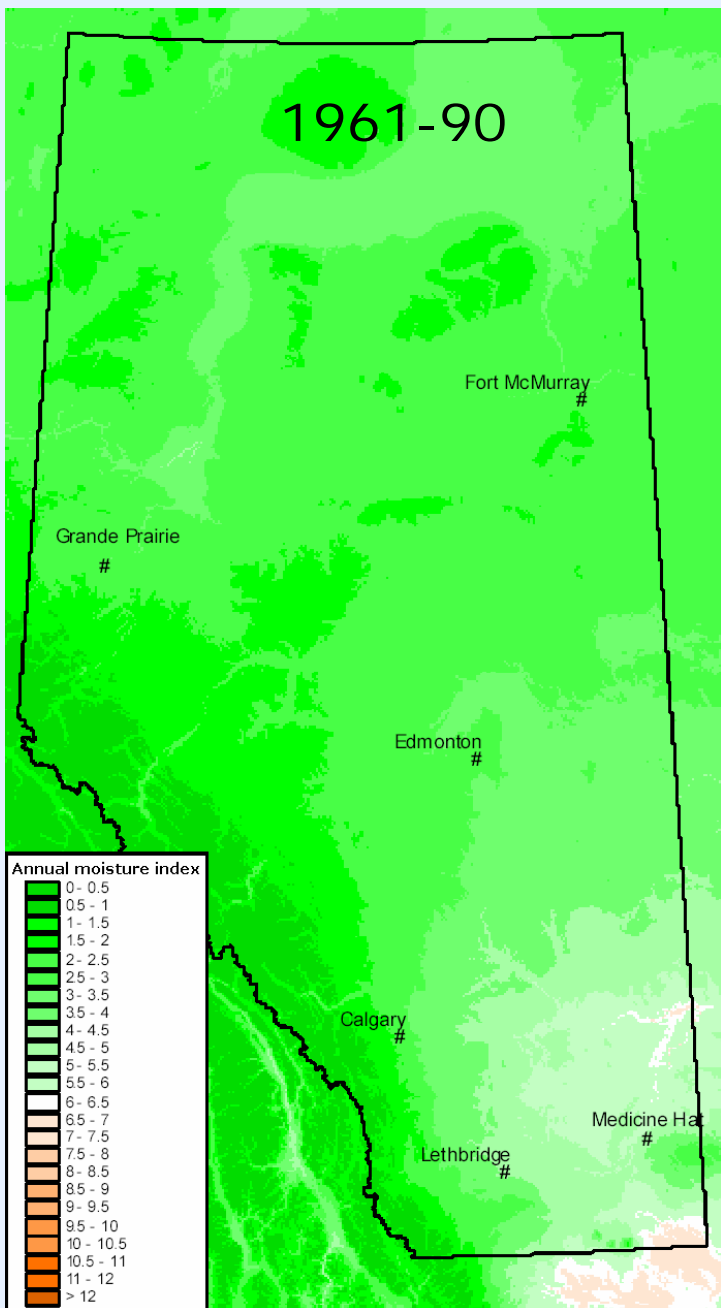
Barrow and Yu, 2005

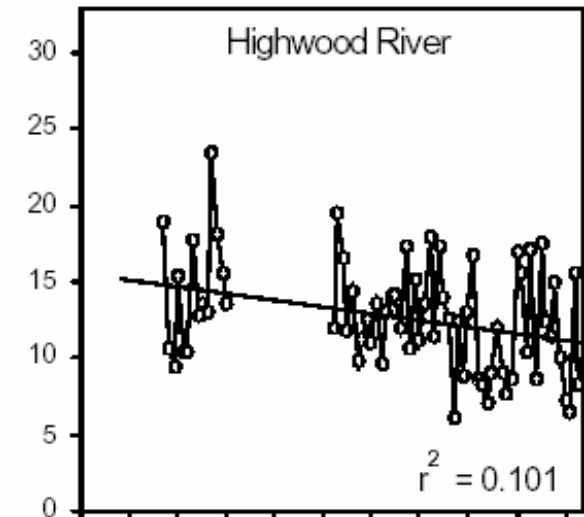
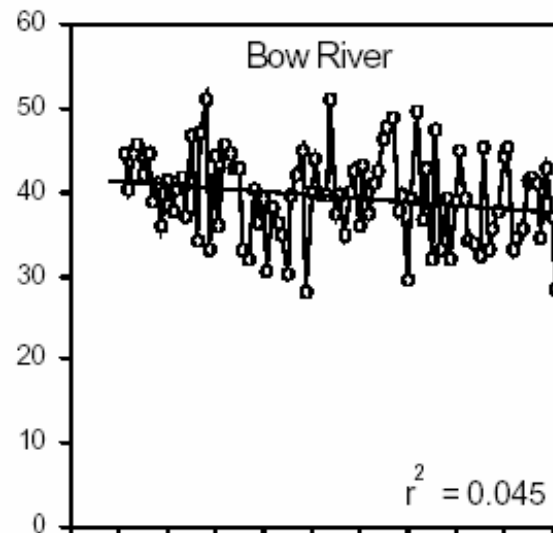
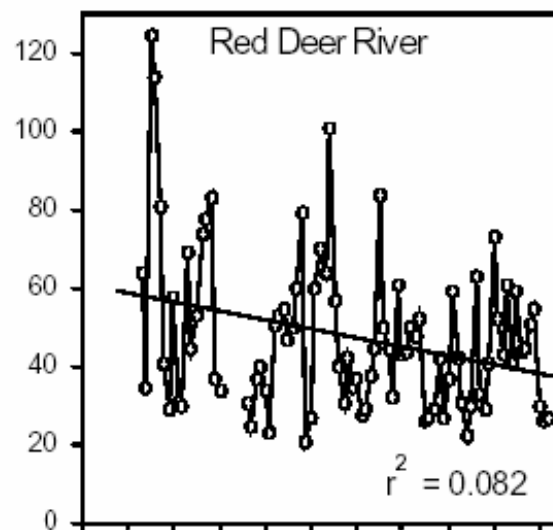
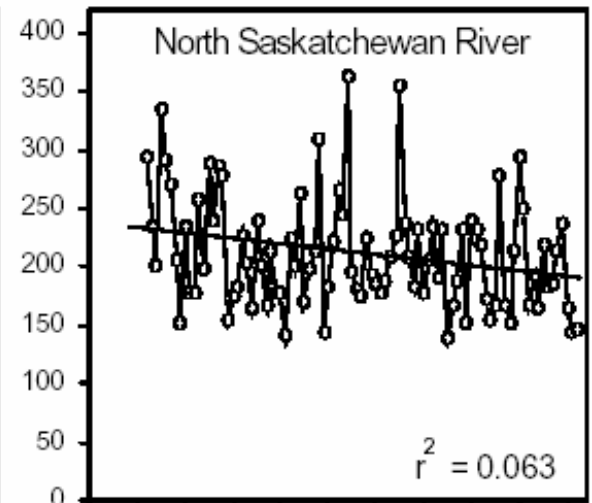
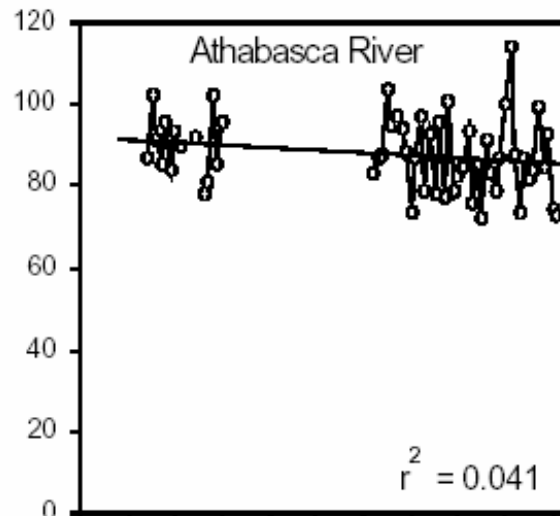
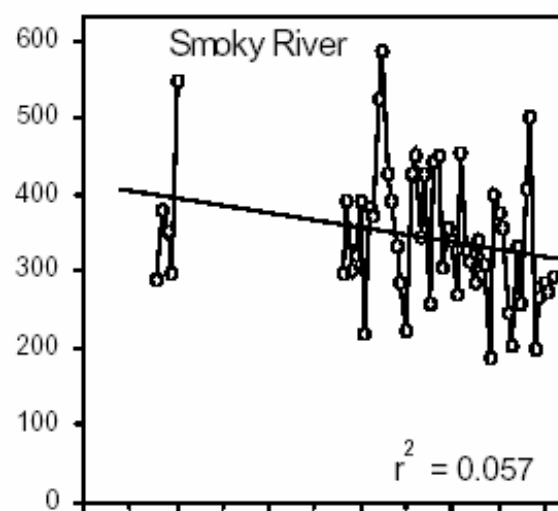


Growing Degree Days > 5° C

Barrow and Yu, 2005



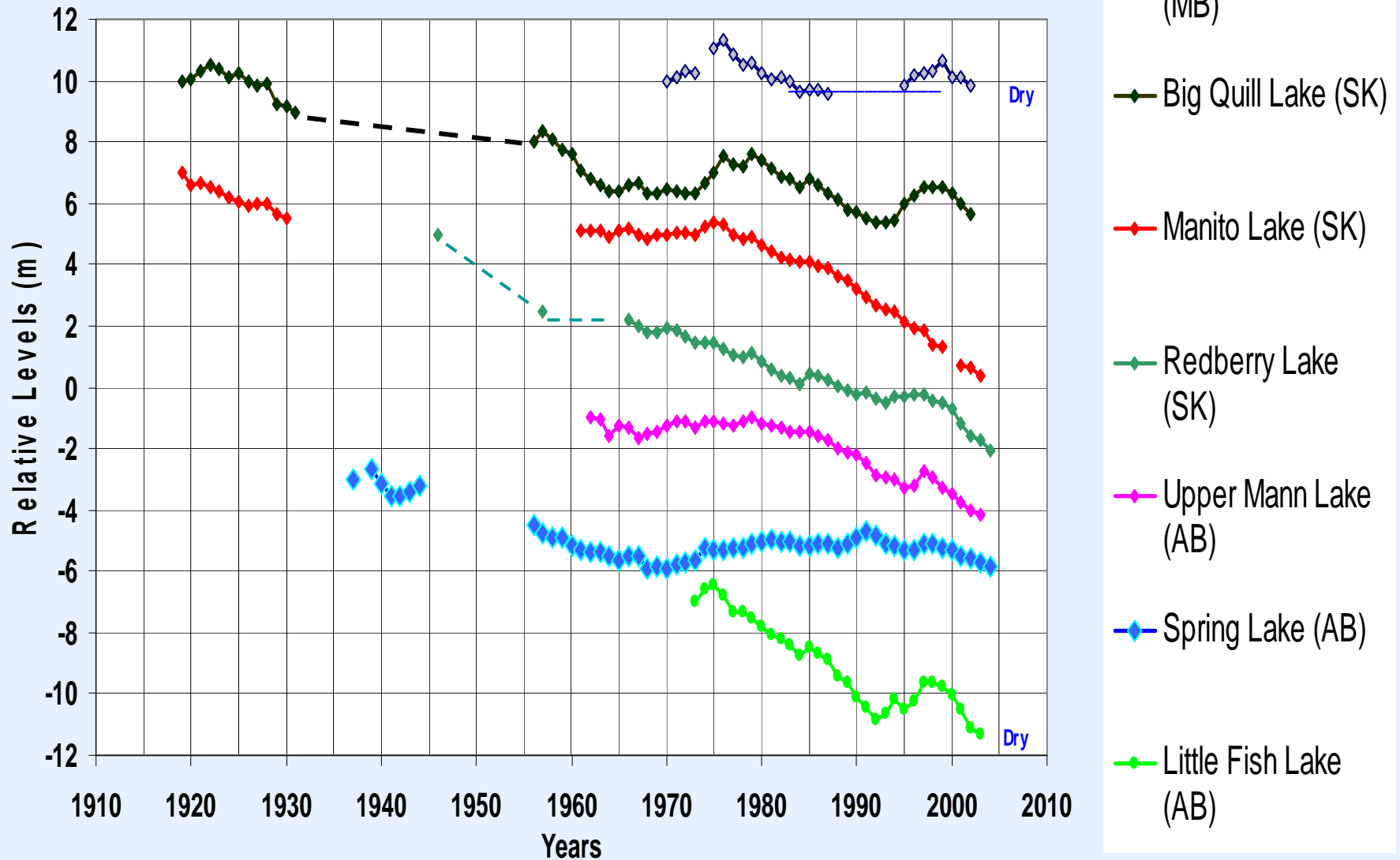




Rood and Samuelson, 2005

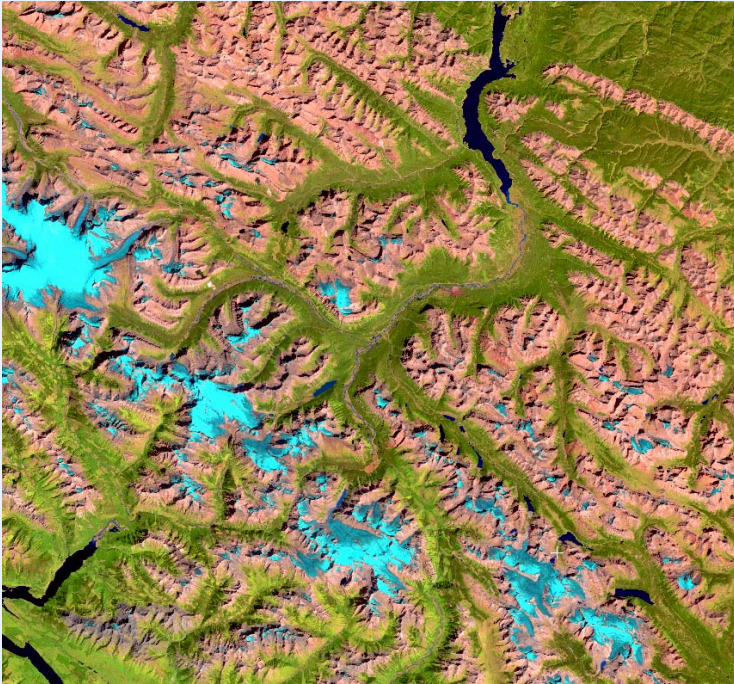
Closed-basin prairie lakes

Water level changes, 1918-2004 (van der Kamp *et al.*)



Climate Change Impacts on Rocky Mountain glaciers

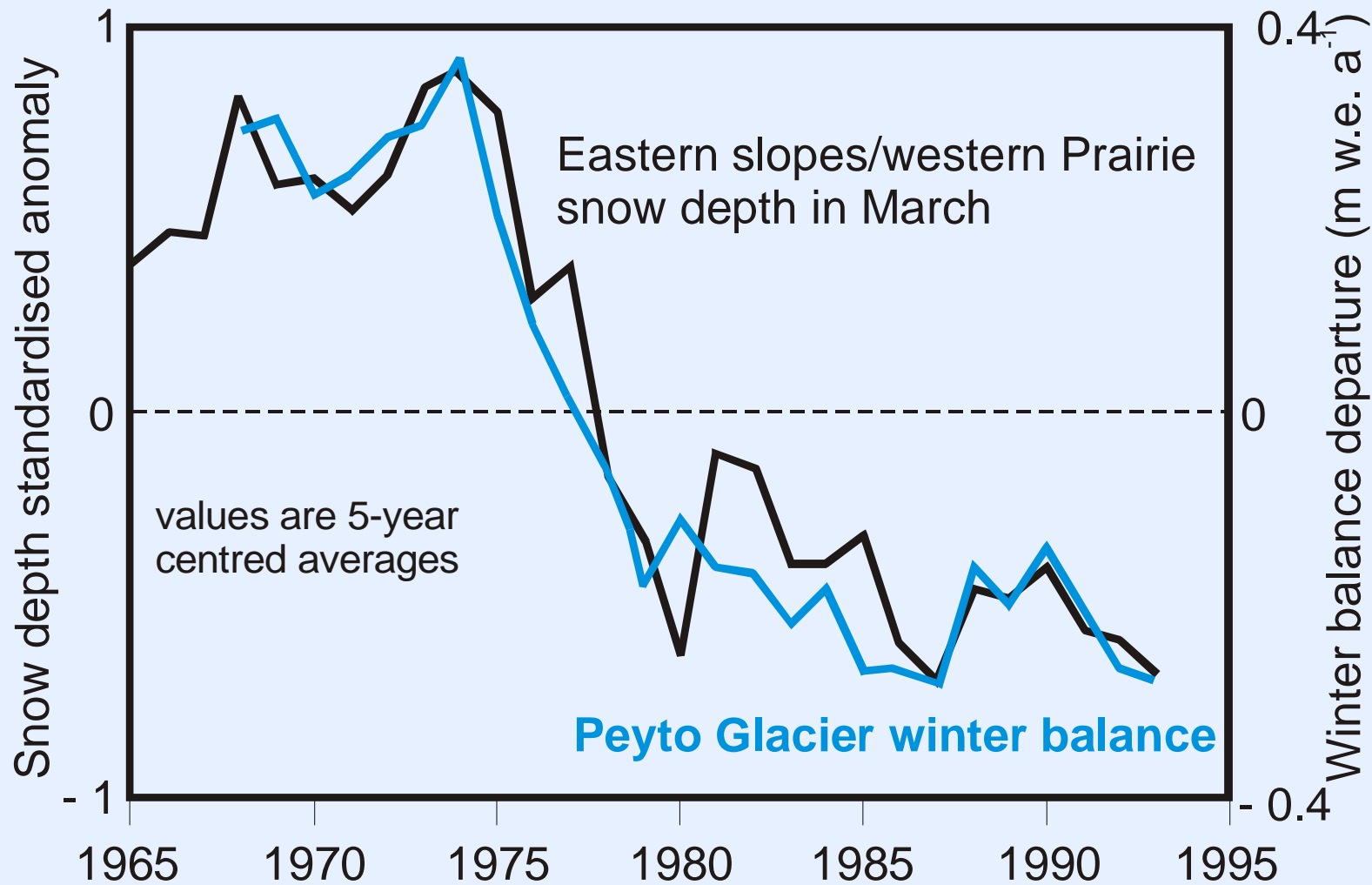
Demuth and Pietroniro, 2001



Glacier cover has decreased rapidly in recent years; it now approaches the least extent in the past 10,000 years

A phase of increased stream flow from global warming has past; basins have entered a potentially long-term trend of declining flows

Declining supplies of glacier runoff have serious implications for the adaptive capacity of downstream surface water systems and for trans-boundary water allocation



Demuth and Pietroniro, 2001

Peyto Glacier

2006

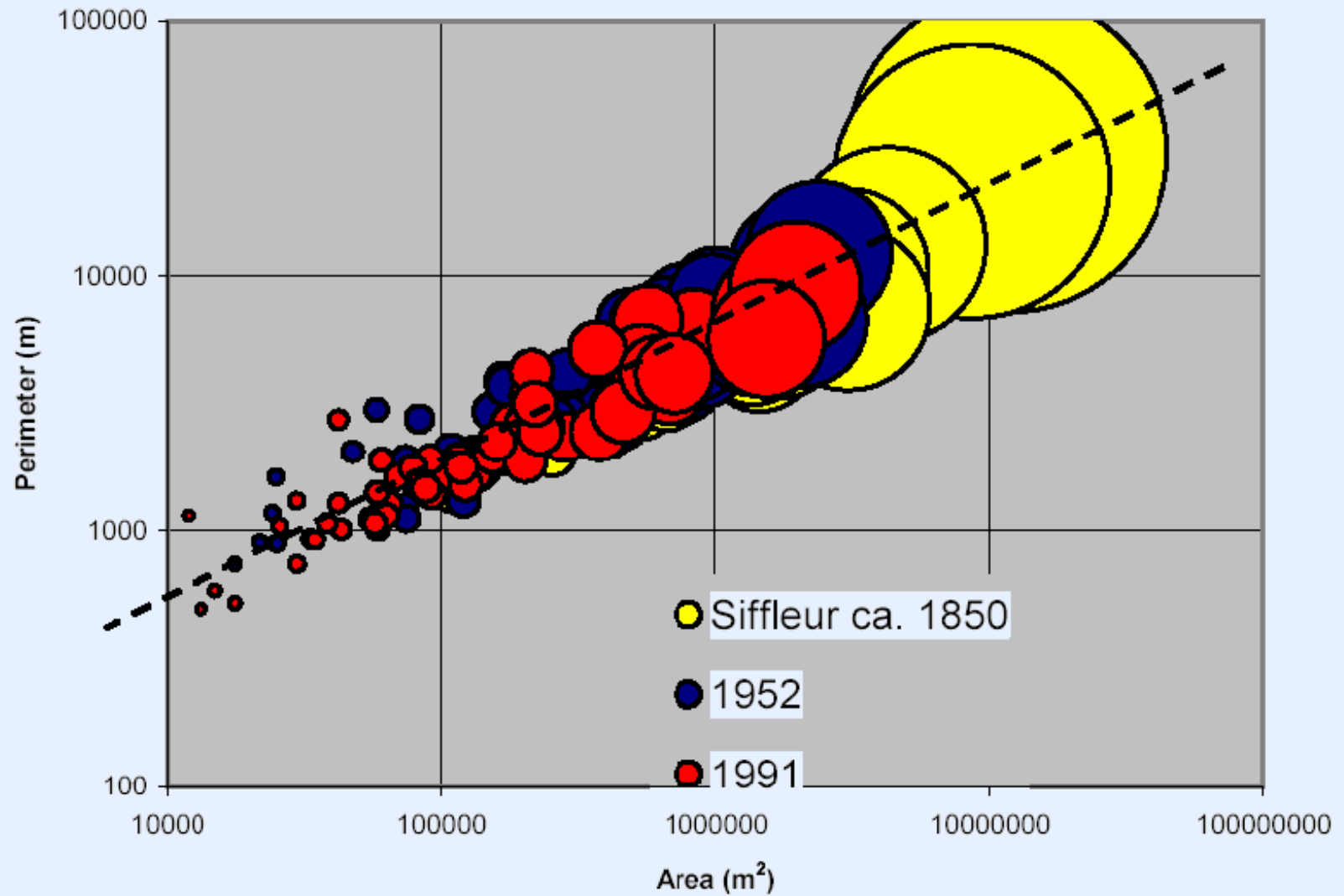
M.N. Demuth



Whyte Museum V263

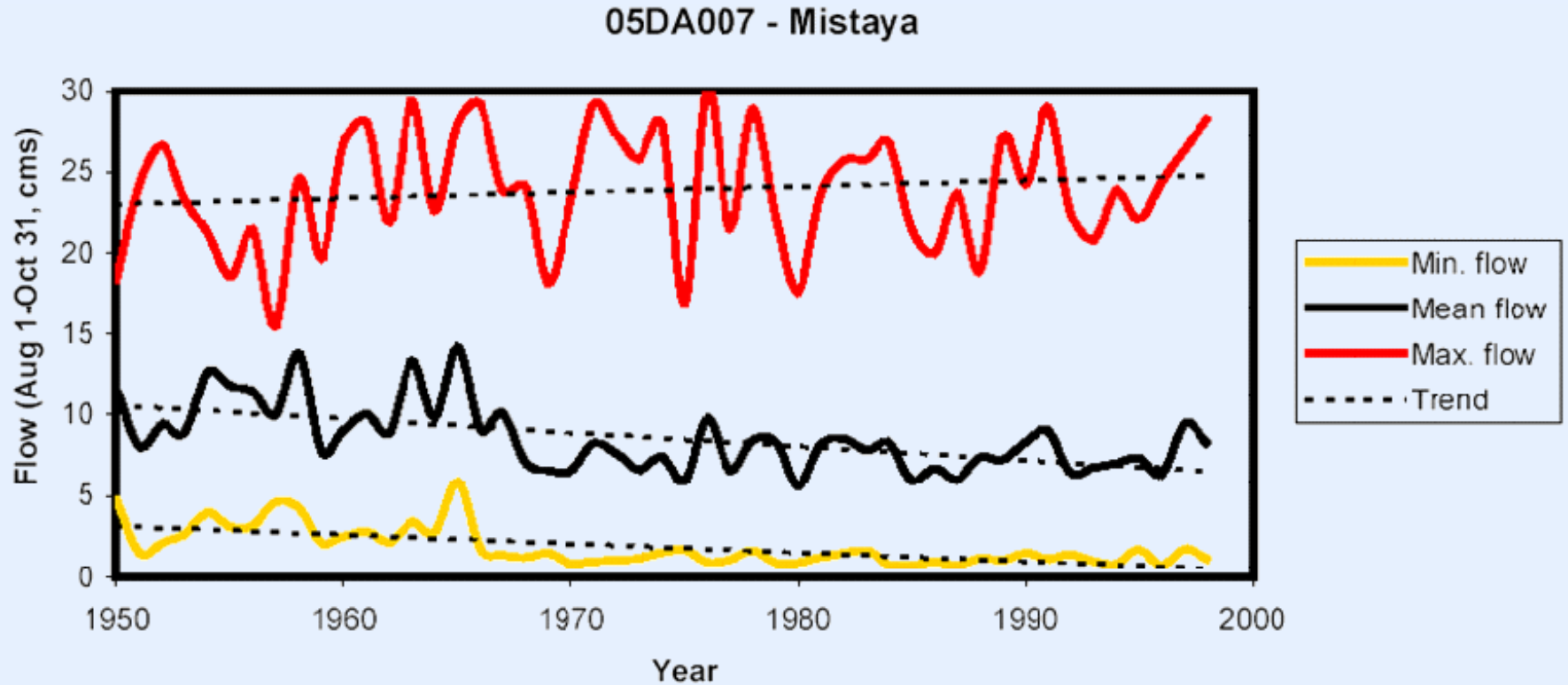
1917

Shrinking Glaciers



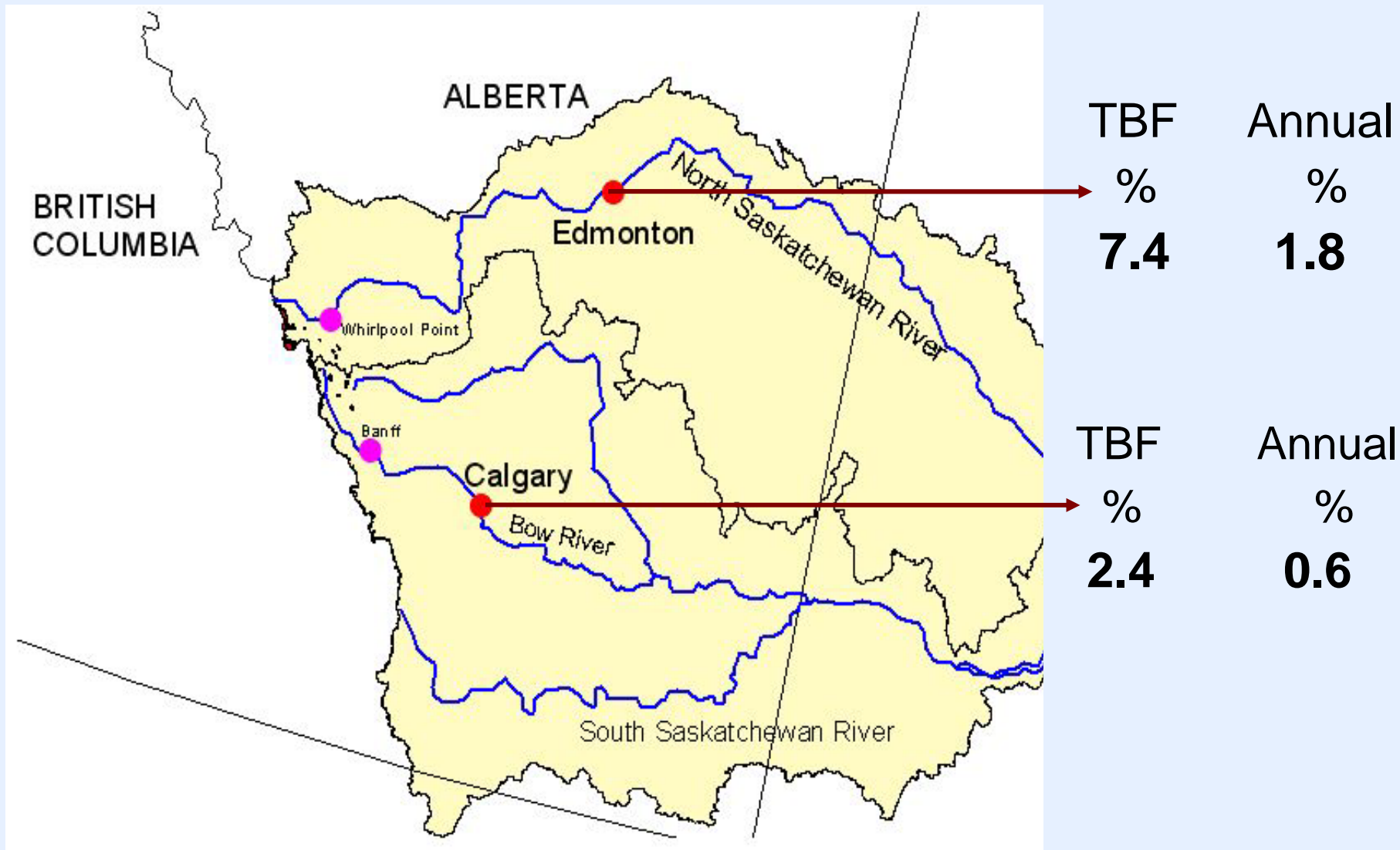
Demuth and Pietroniro, 2001

Declining Mean and Minimum Streamflow



Demuth and Pietroniro 2001

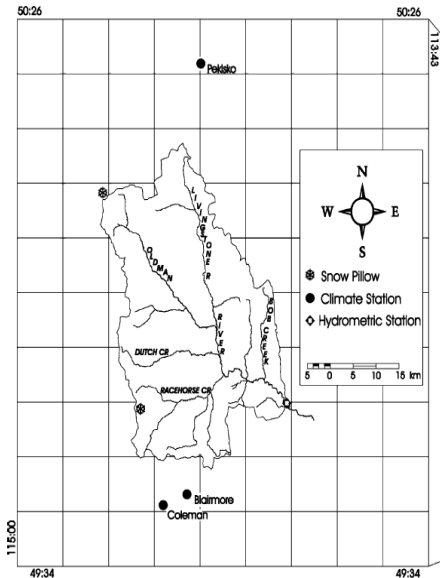
Estimated Glacier Melt Contribution



Climate Warming Impacts on Snowpack Accumulation in an Alpine Watershed

Suzan Lapp, M.Sc. thesis, U of L
Lapp *et al.* 2005, Int. J. Climatology

UPPER OLDMAN RIVER BASIN



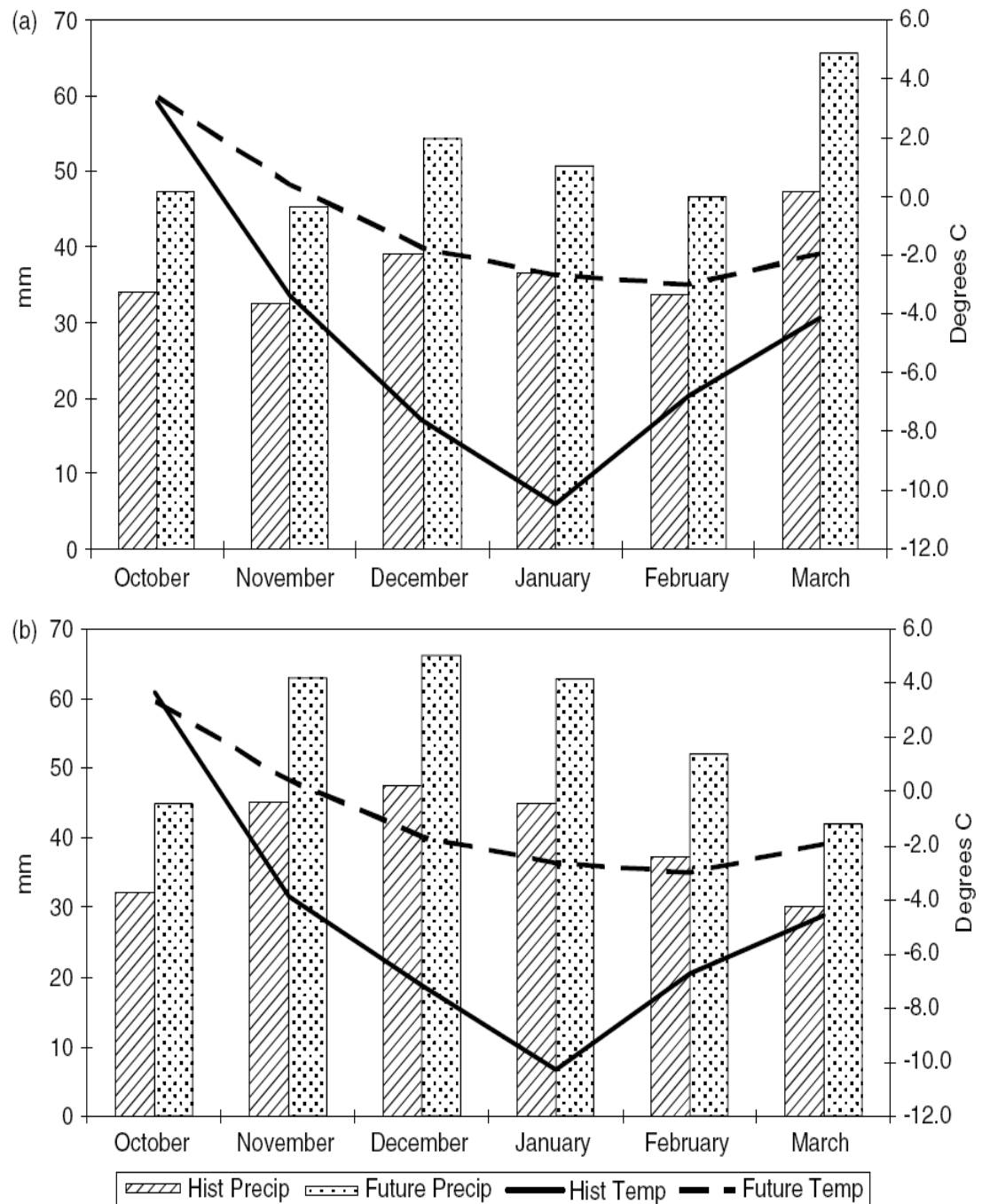
Historical and Future (CGCM1) Climate

October - March

(a) Pekisko

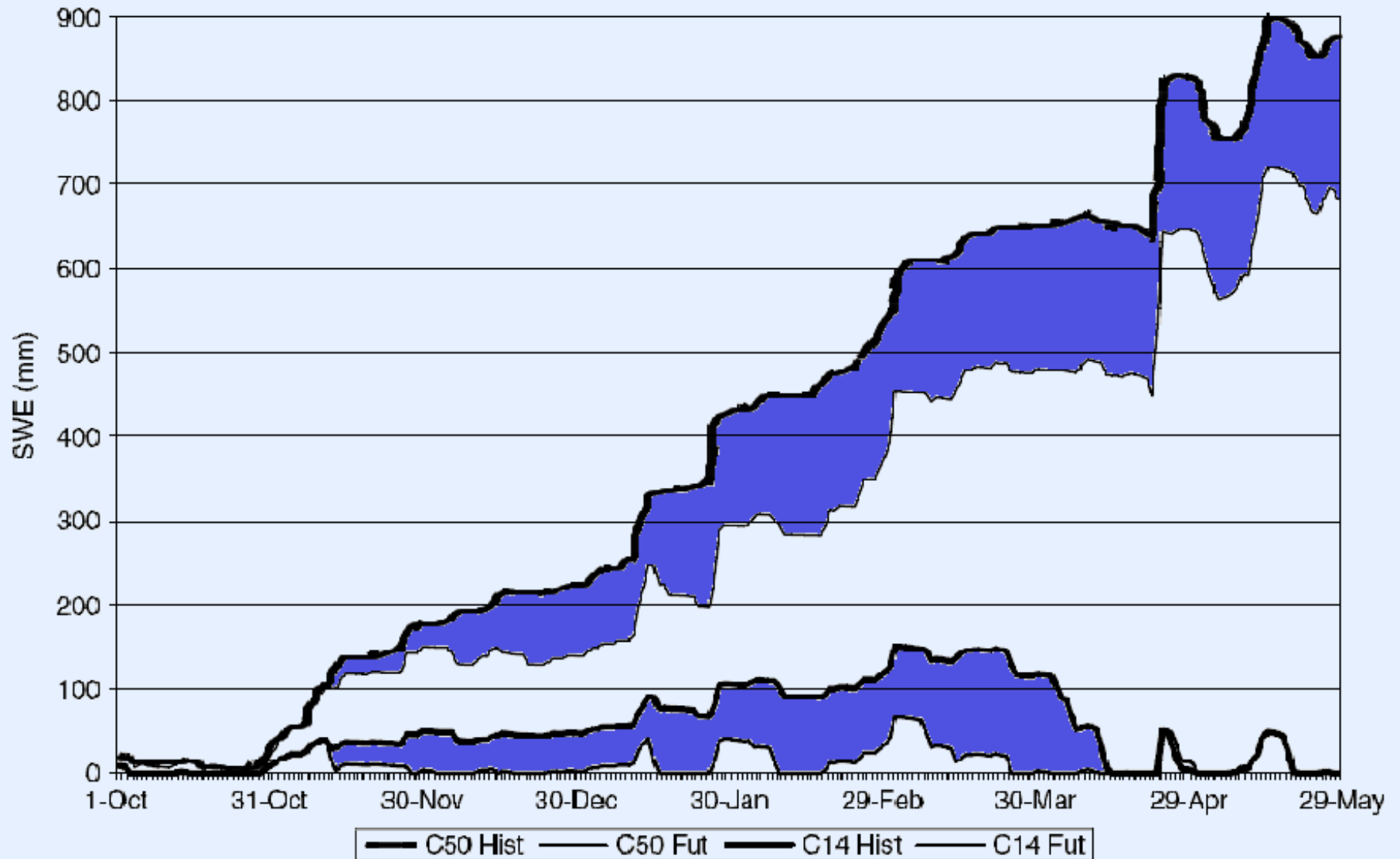
(b) Coleman

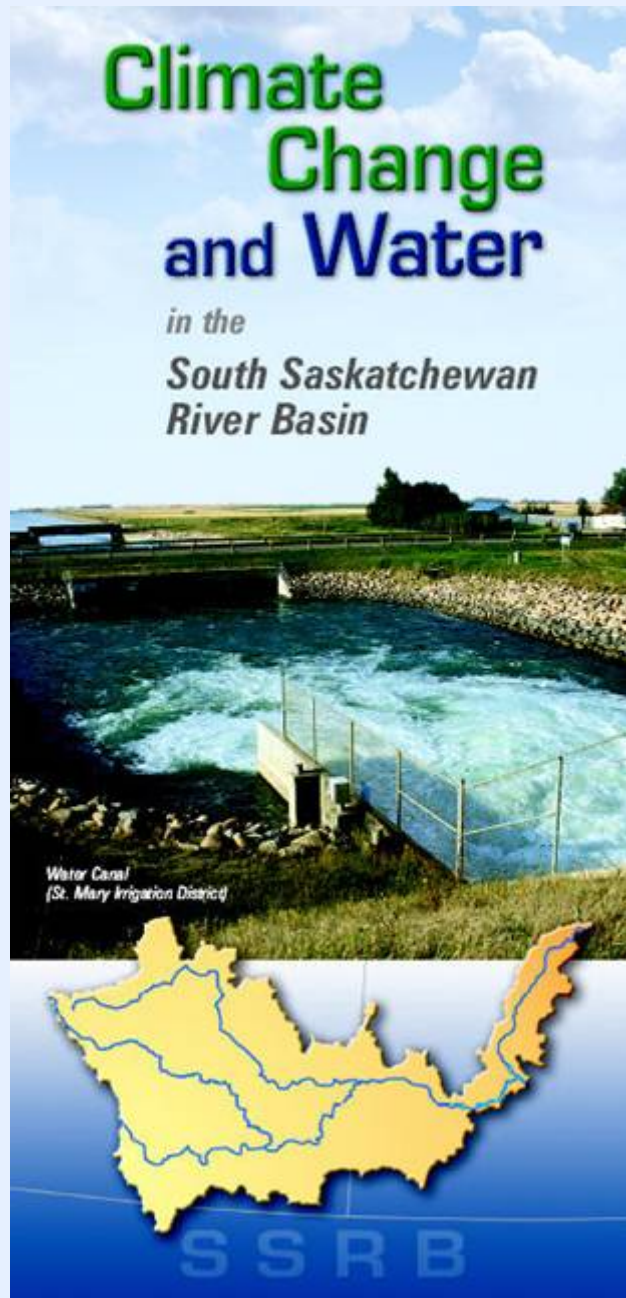
Lapp *et al.* 2005



Cumulative Snowpack

Lapp *et al.* 2005

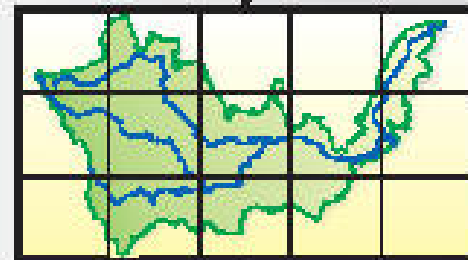




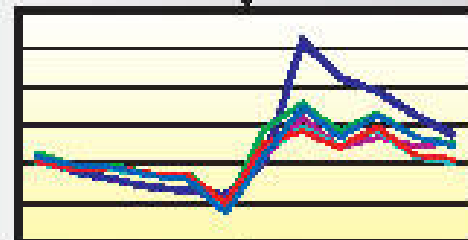
Future Global
Climate
Scenarios



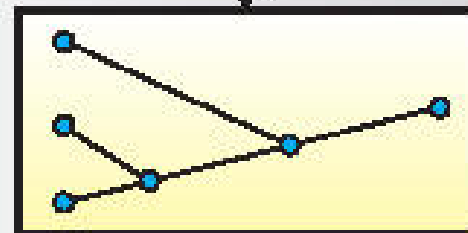
WATFLOOD and
SACRAMENTO
Hydrological
Models



Climate
Scenario
Monthly Flows

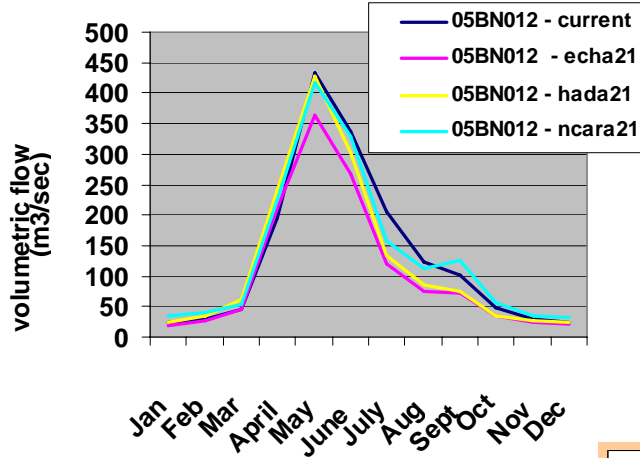


WUAM
Water Use
Model

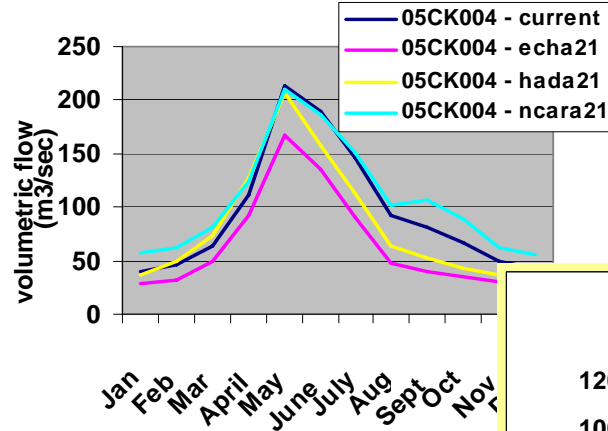


GCM scenario results, 2039 – 2070, cumulative flows

Bow River at the Mouth



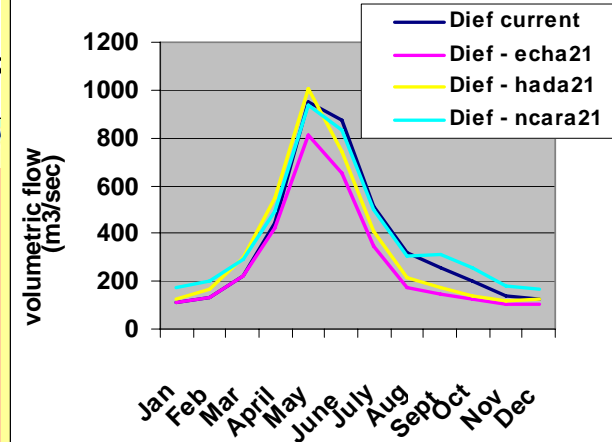
Red Deer River at Bindloss



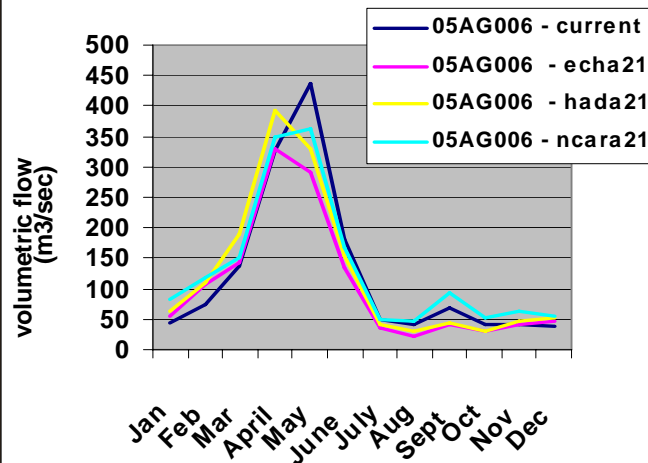
SOUTH SASK RIVER
AT ST. LOUIS



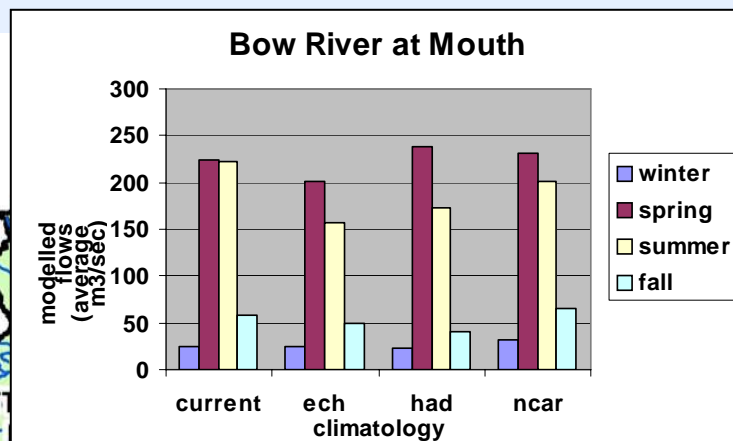
South Sask at Diefenbaker



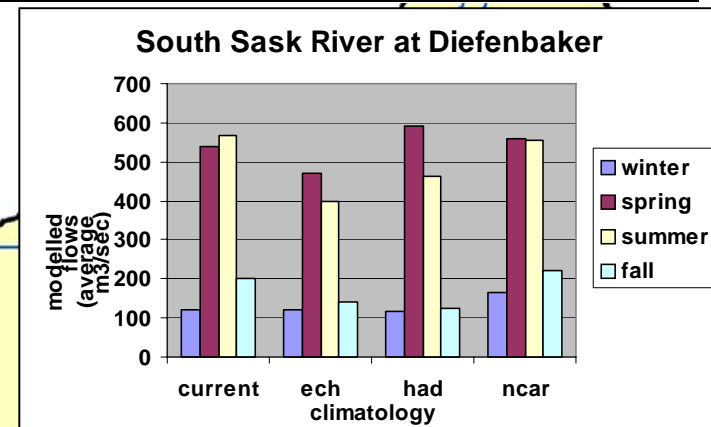
Oldman River at the Mouth



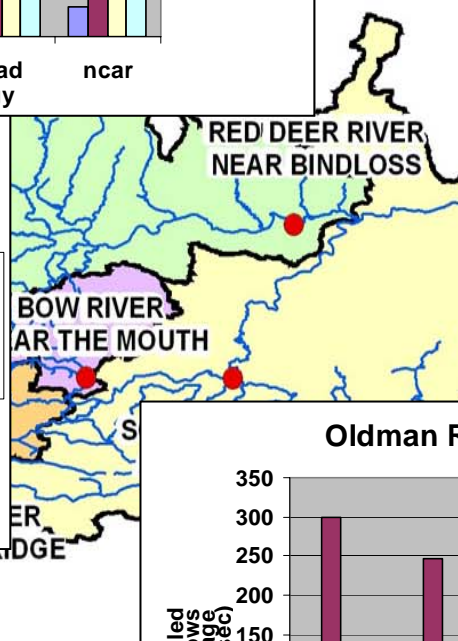
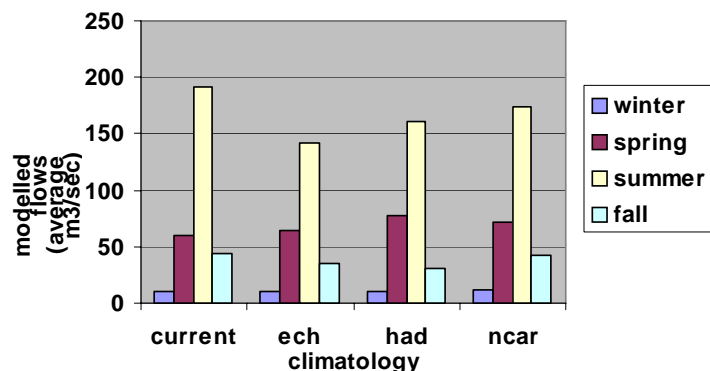
Spatial and seasonal response in flows, 2039-2070



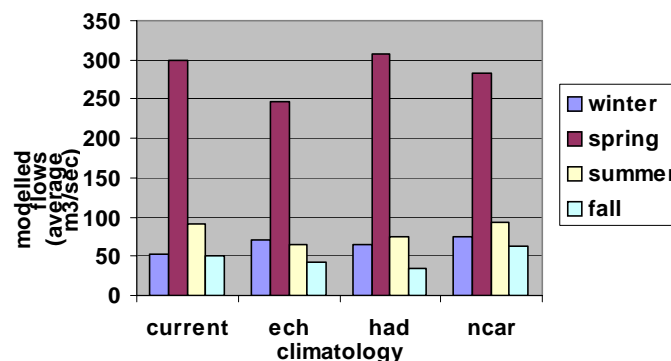
GCM	%Precip	+Temp	Description
echa21	-3.8	2.8	driest, warmest
echb21	-2.0	2.8	
hada21	6.4	2.3	moderately wet and warm
hadb21	0.2	2.1	
ncara21	11.5	1.7	wettest and least warm
ncarb21	9.1	1.5	



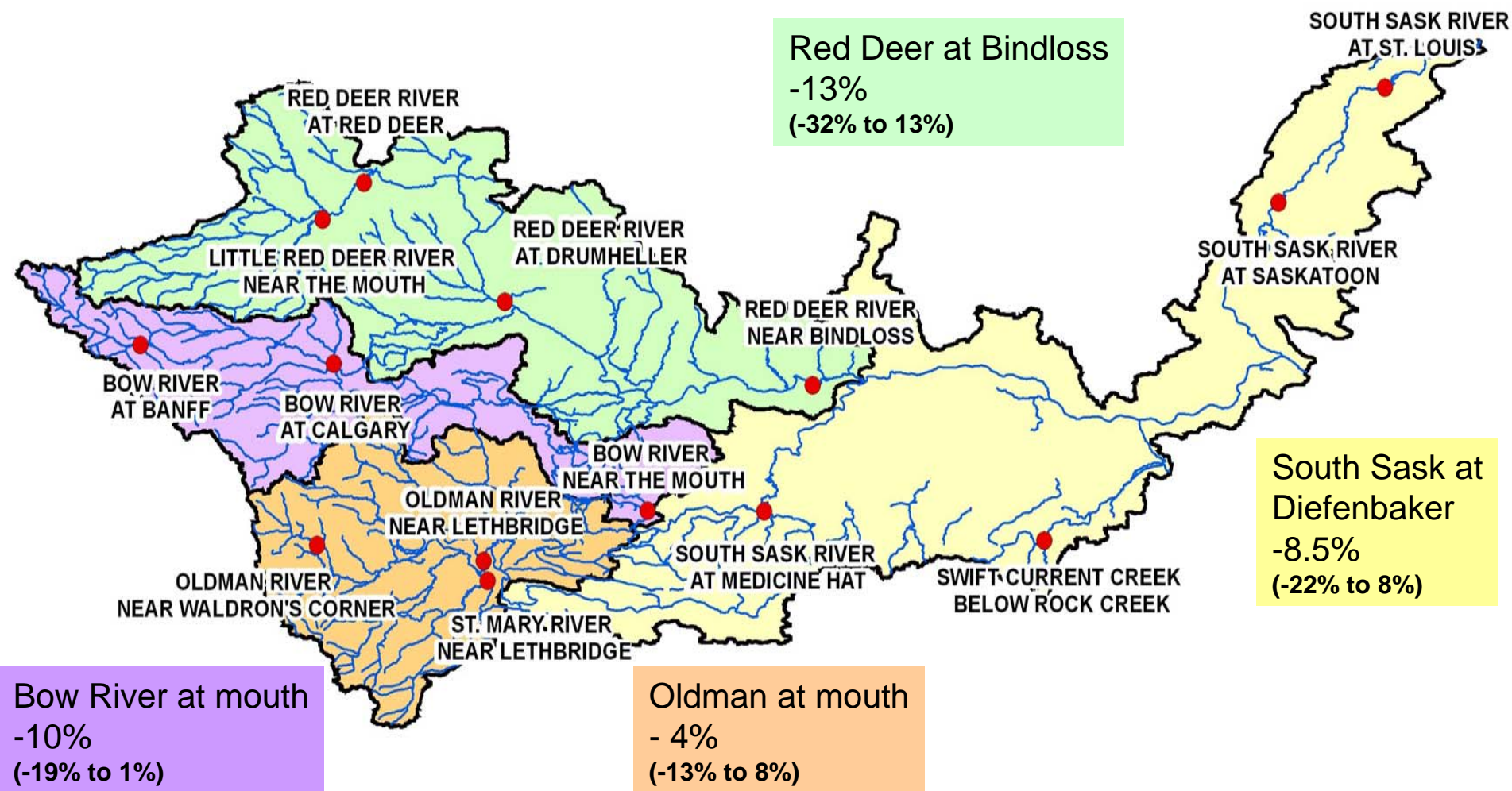
Bow River at Calgary



Oldman River at Mouth

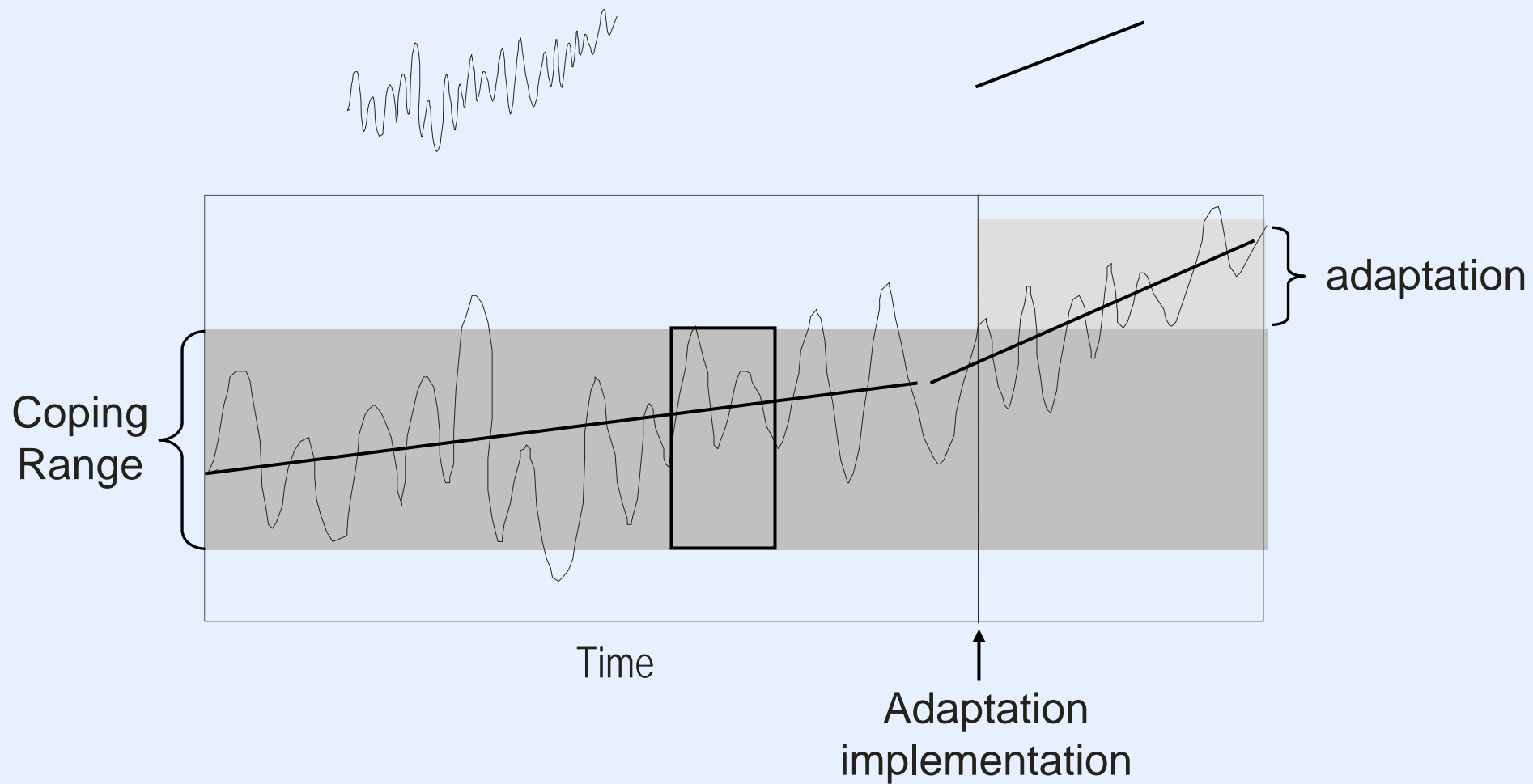


GCM scenario results, 2039 – 2070, cumulative flows



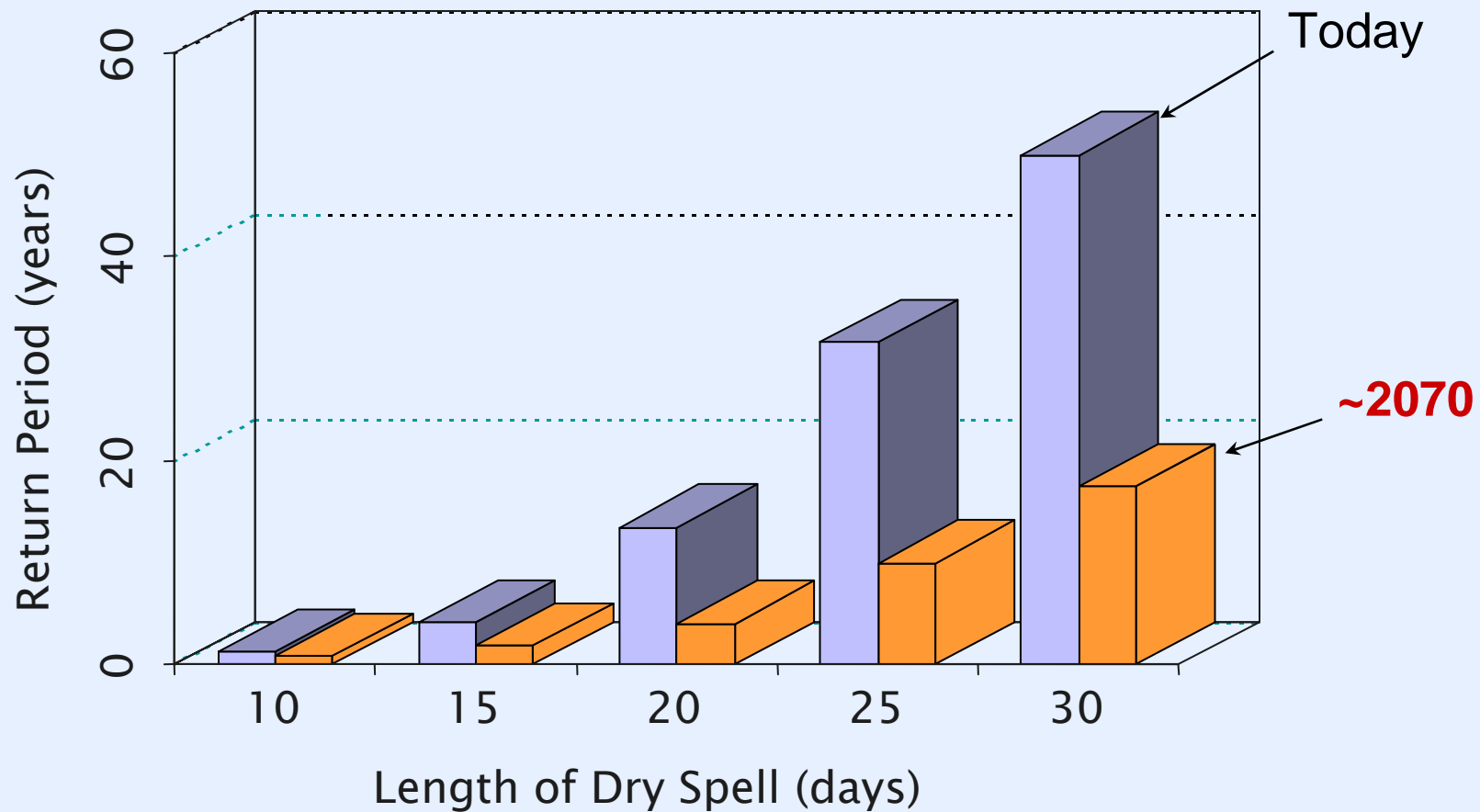
Climatic variability

Climatic change

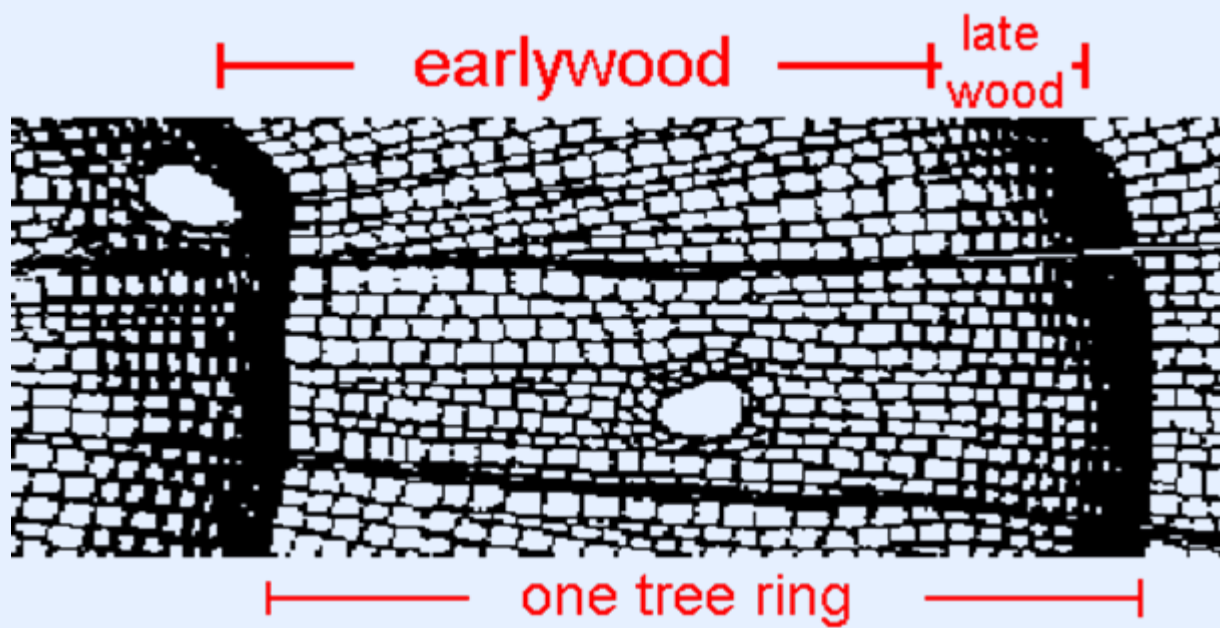


Increasing Drought Frequency

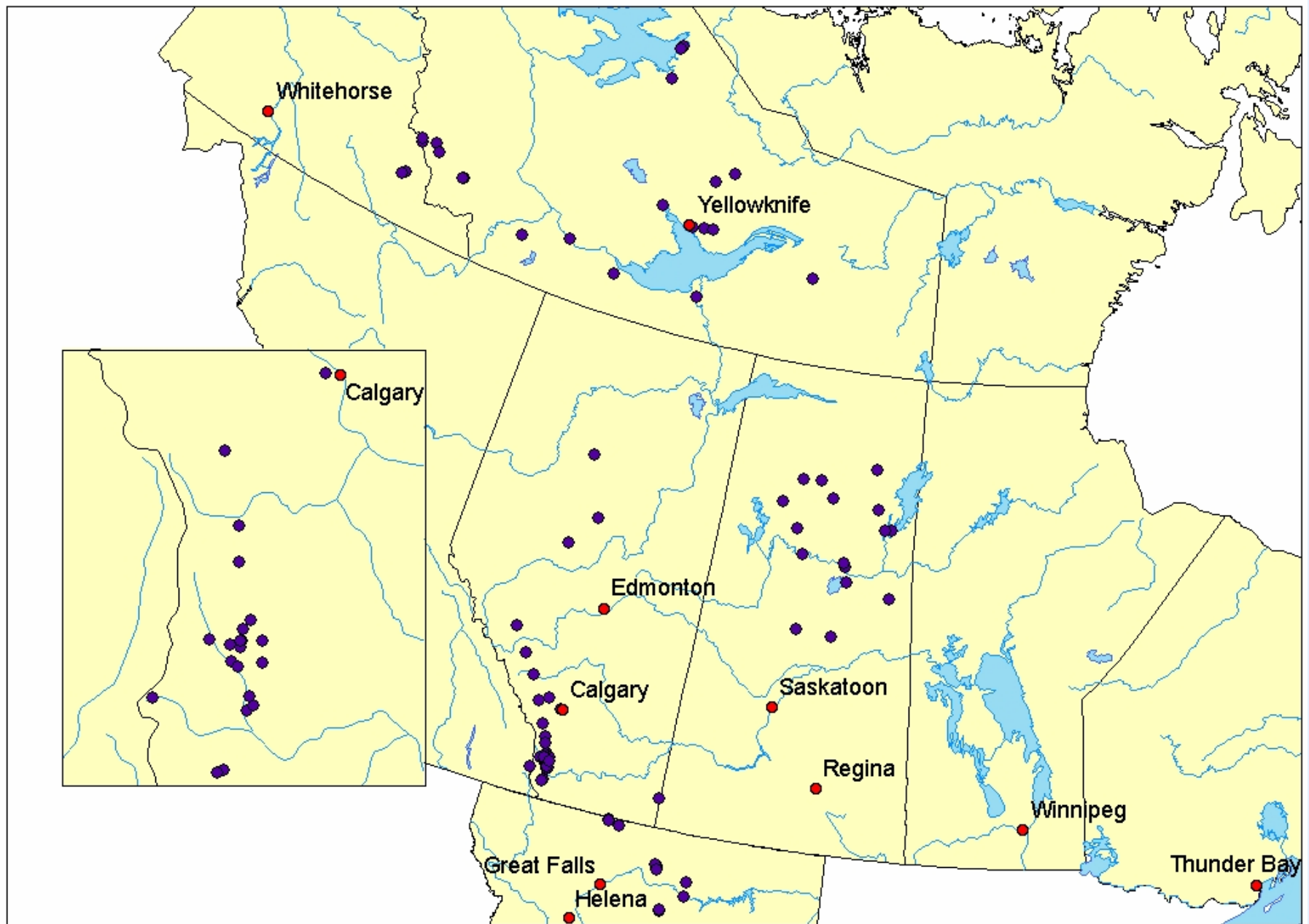
Central North America



Kharin and Zwiers 2000

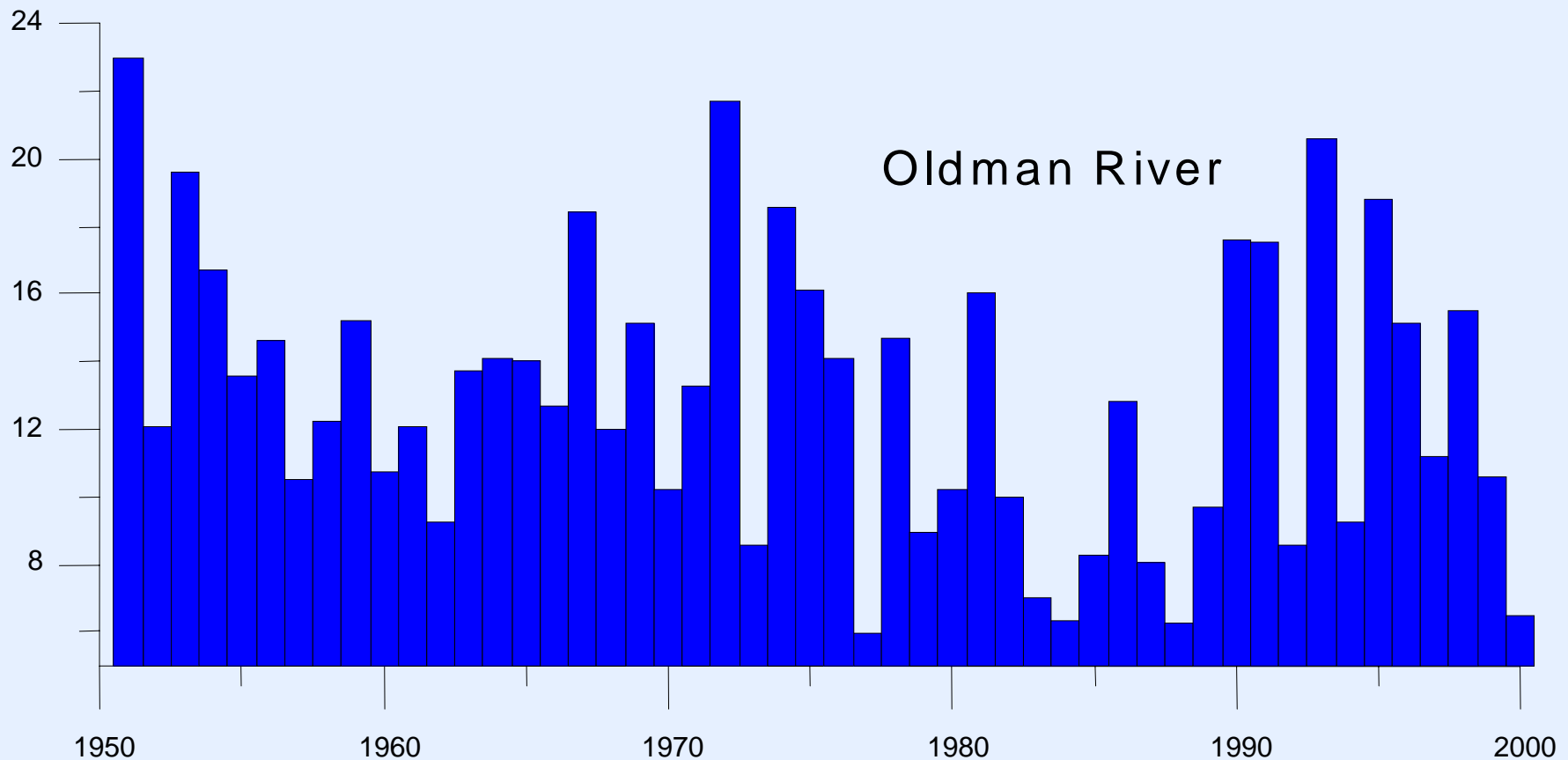


Tree-Ring Sampling Sites

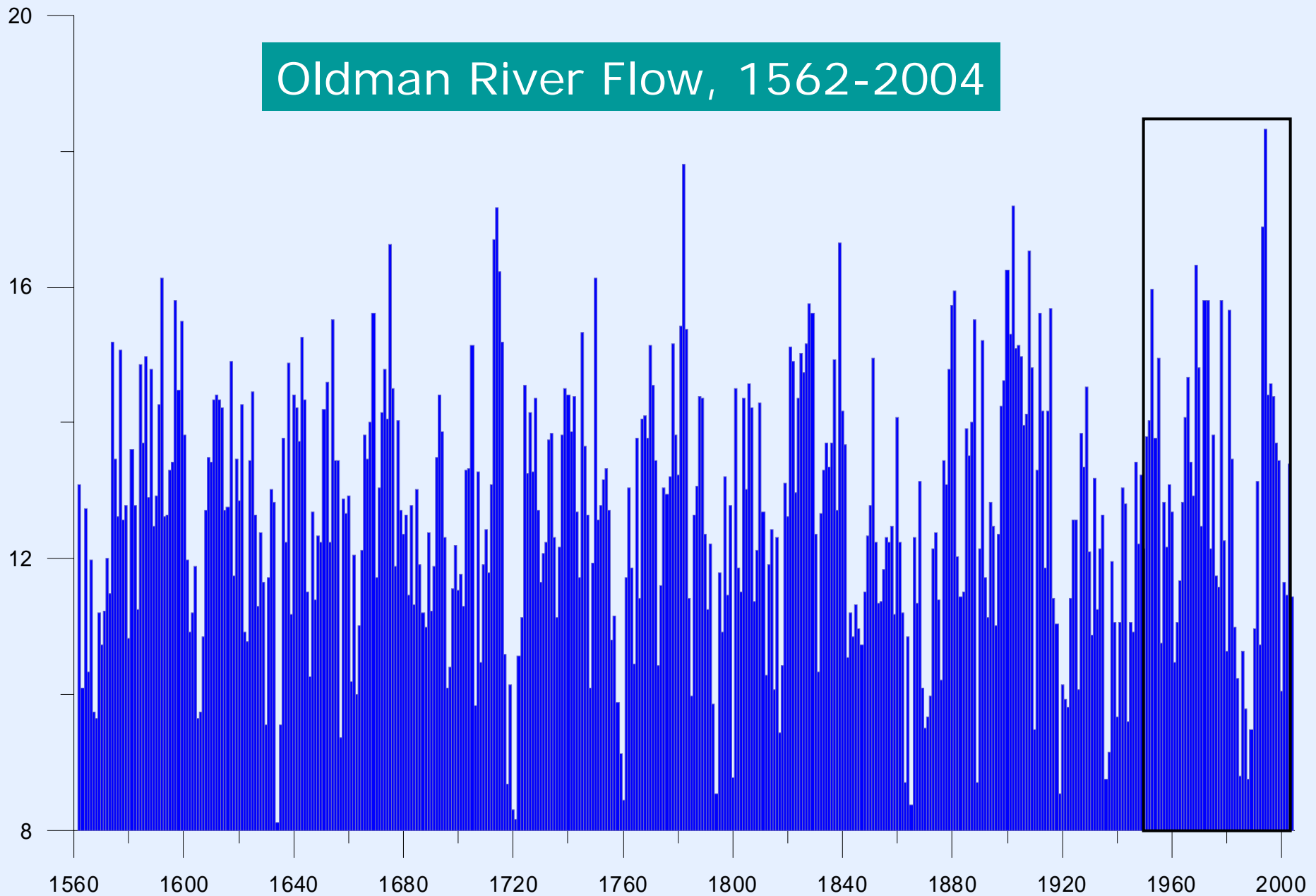




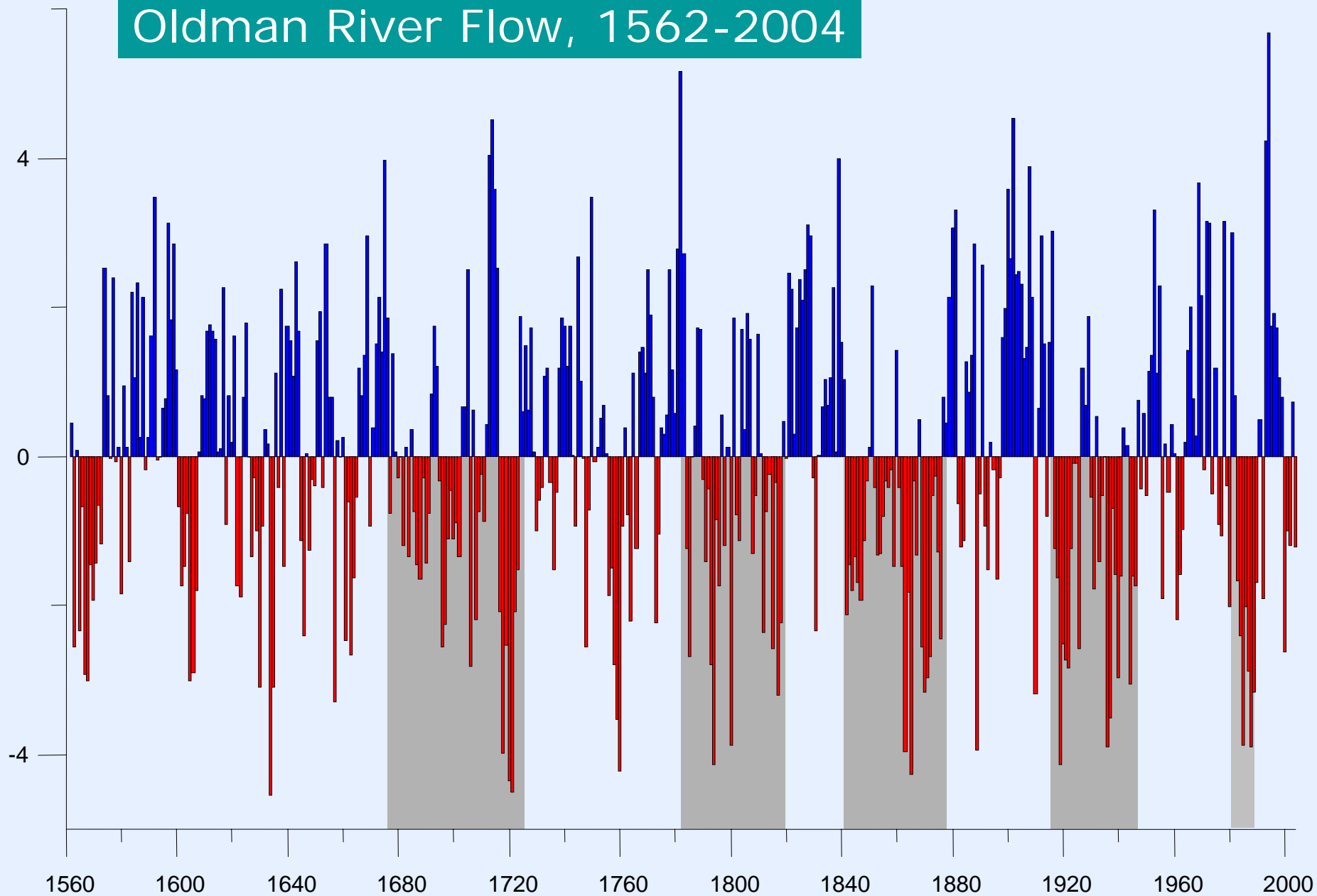
Mean Annual Flow (m^3/s), Oldman River above Oldman Reservoir 1951-2000



Oldman River Flow, 1562-2004



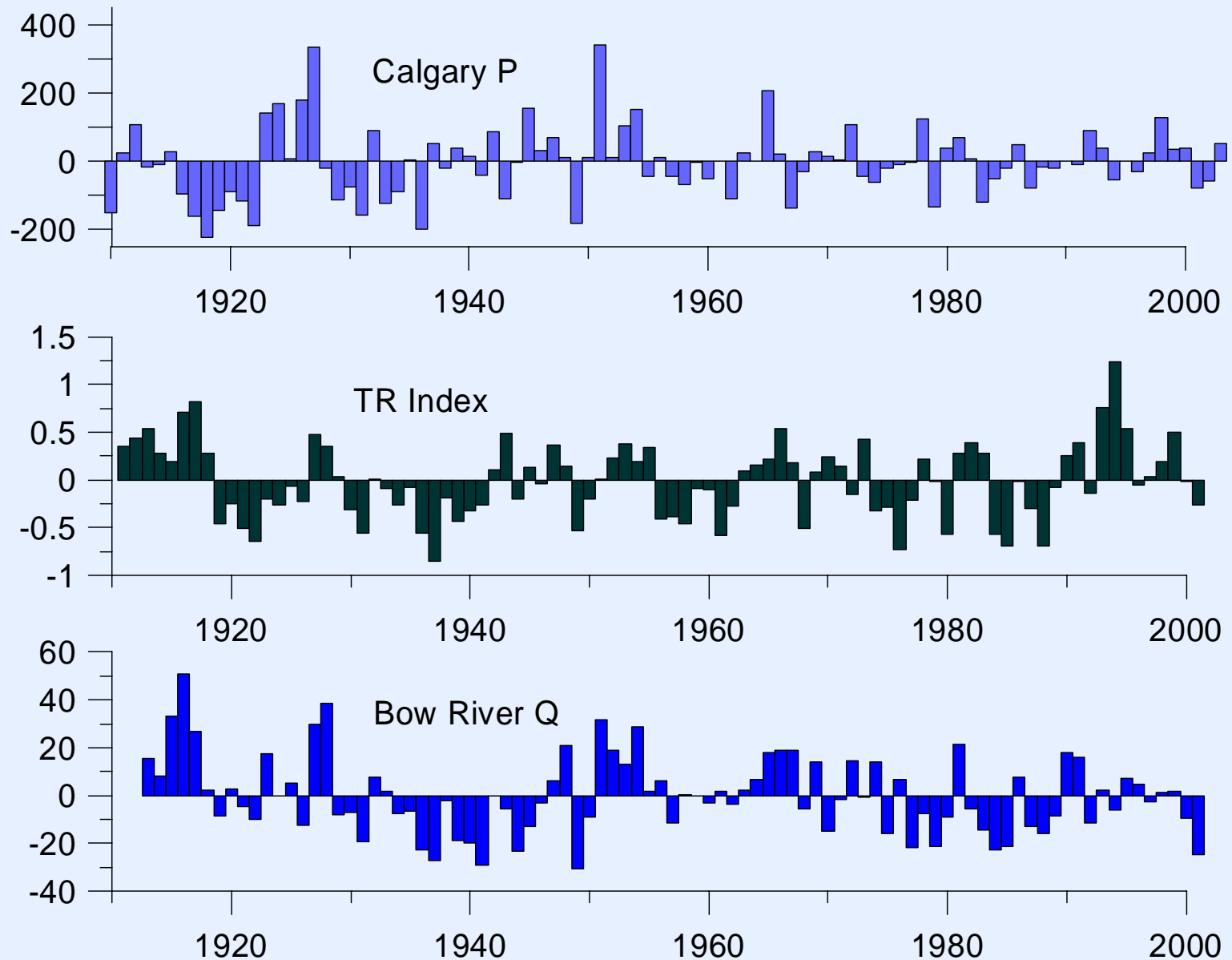
Oldman River Flow, 1562-2004



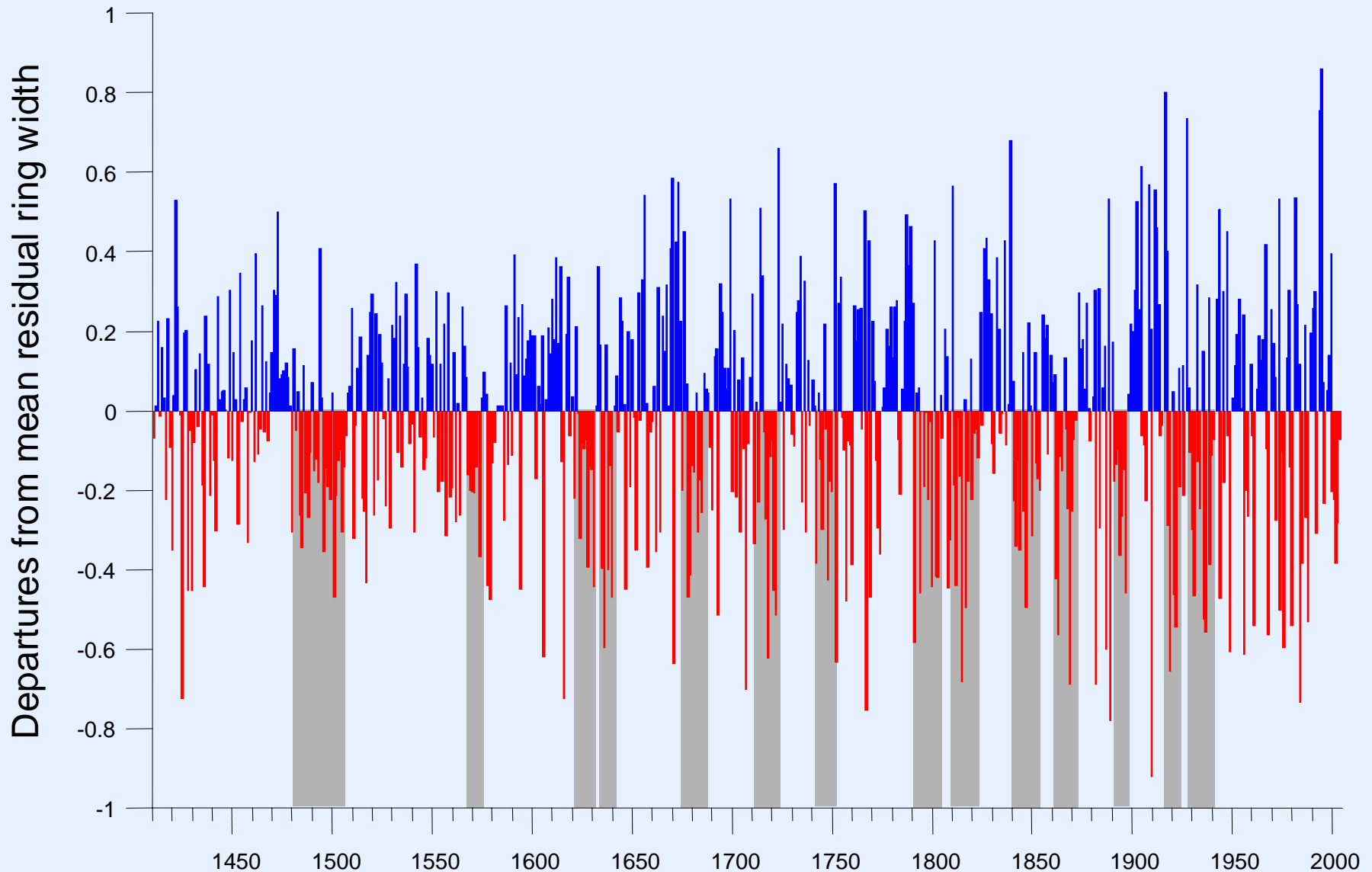


Wildcat Hills Tree-Ring Chronology

Annual Precipitation and Streamflow at Calgary



Wildcat Hills Tree-Ring Chronology, 1411-2004



Spring 1796, Edmonton House

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.

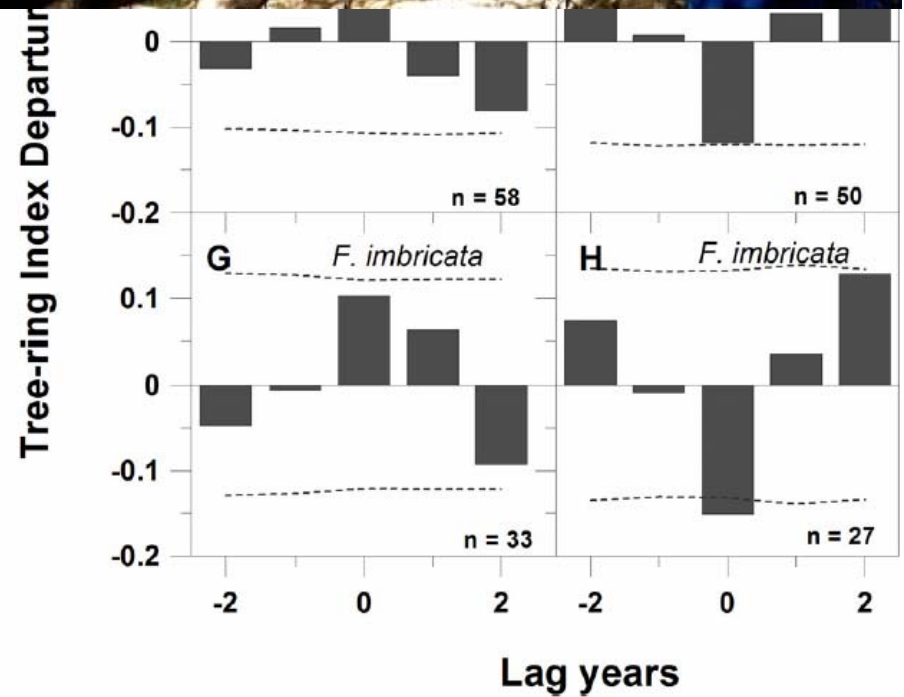
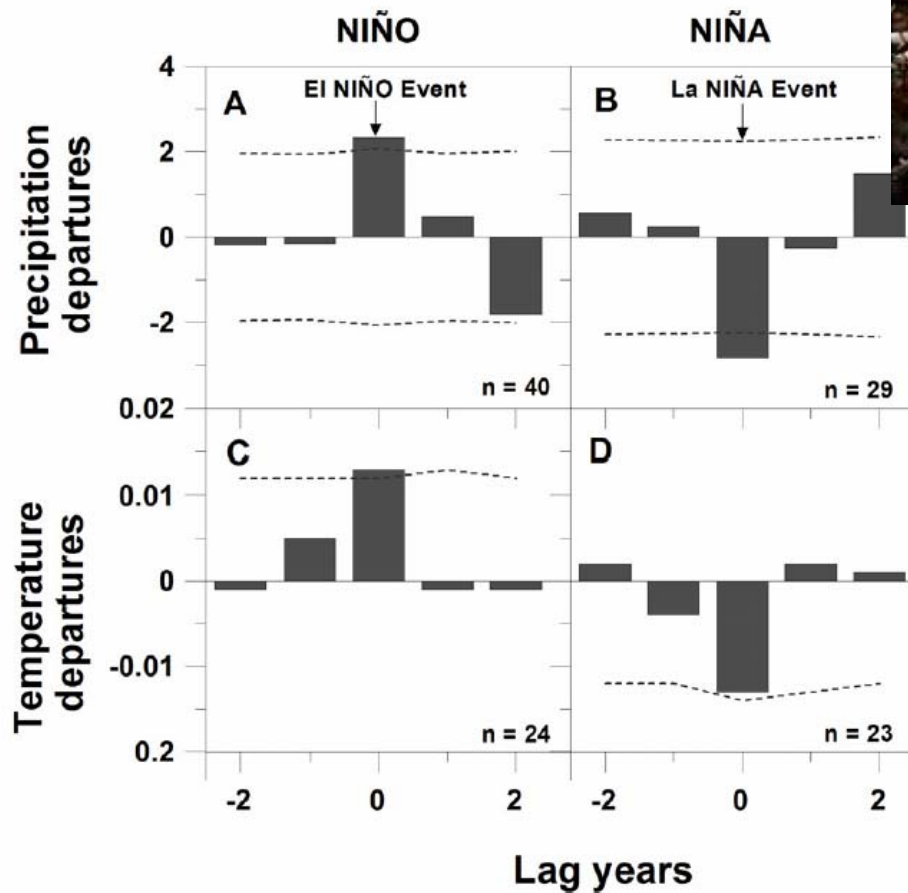
Timber intended to be used at Edmonton House could not be sent to the post “for want of water” in the North Saskatchewan River. On May 2nd, William Tomison wrote to James Swain that furs could not be moved as, “there being no water in the river.” (Johnson 1967: 33-39, 57)

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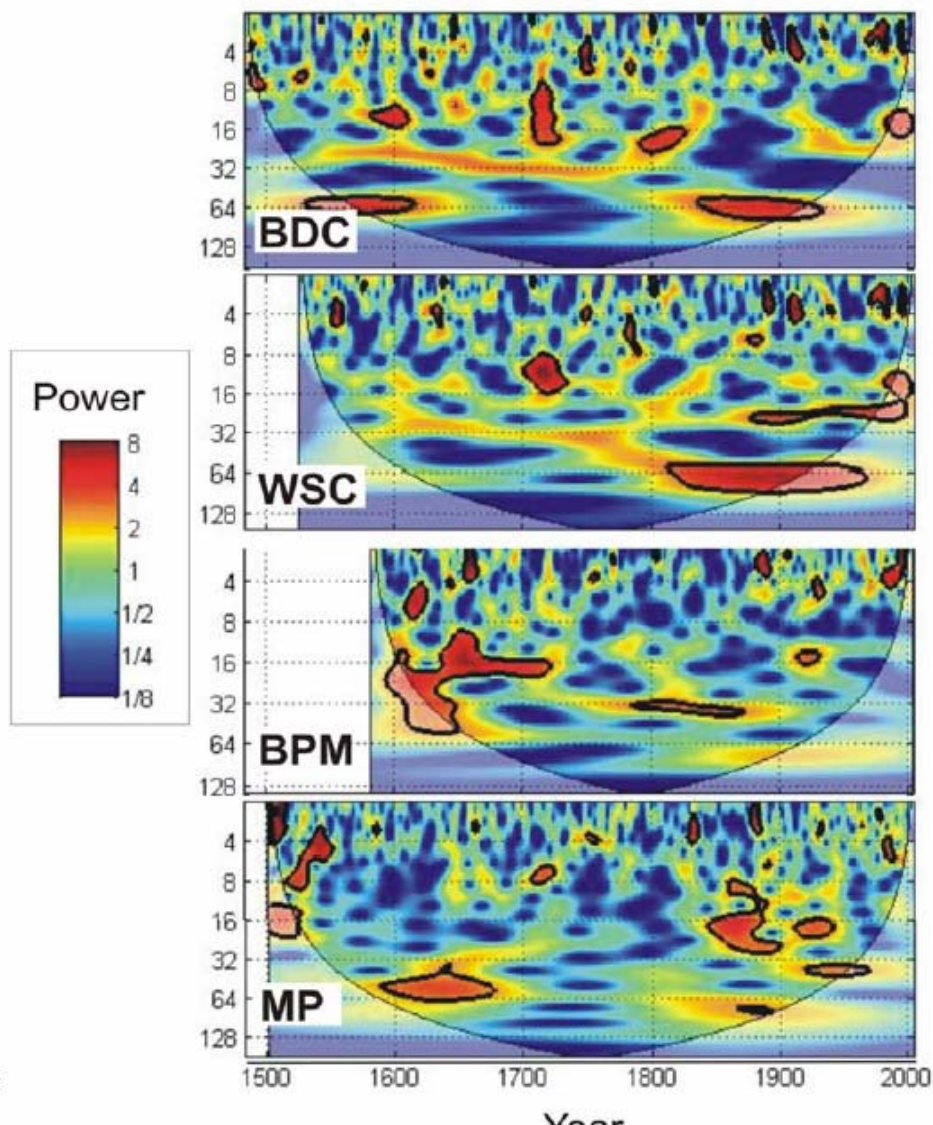
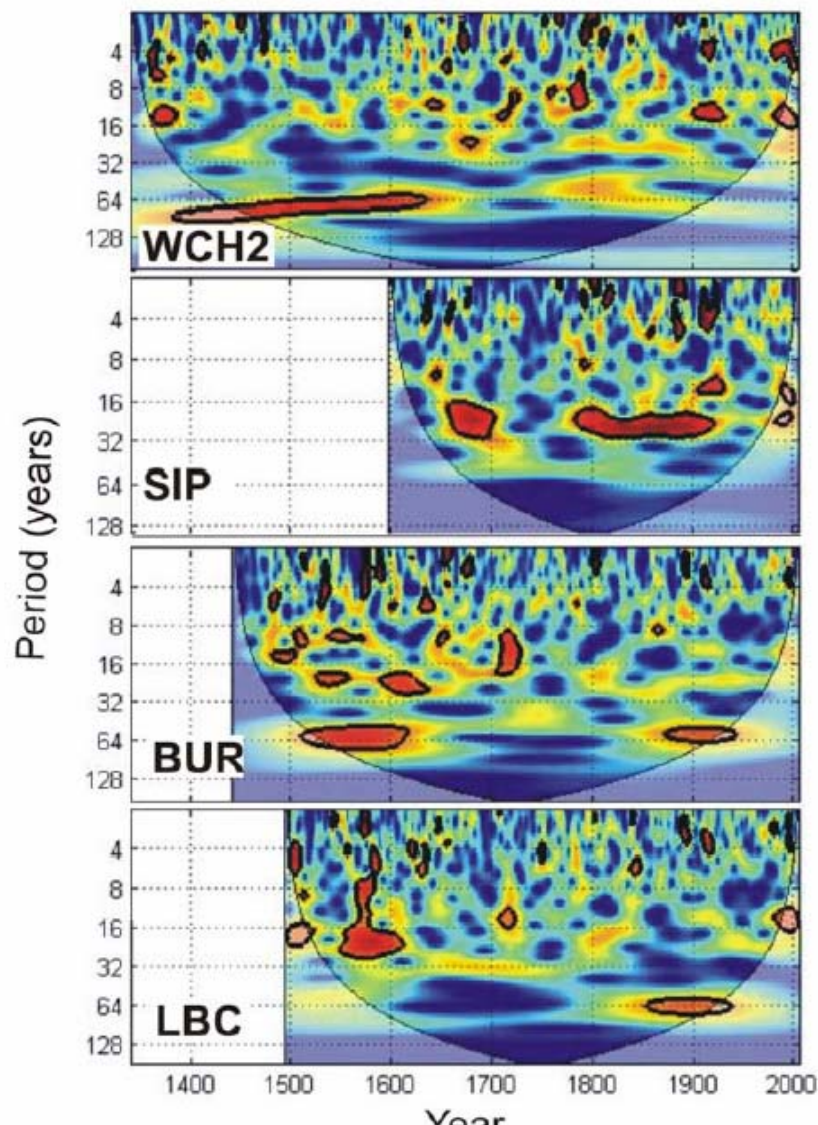
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Causes of climate variability



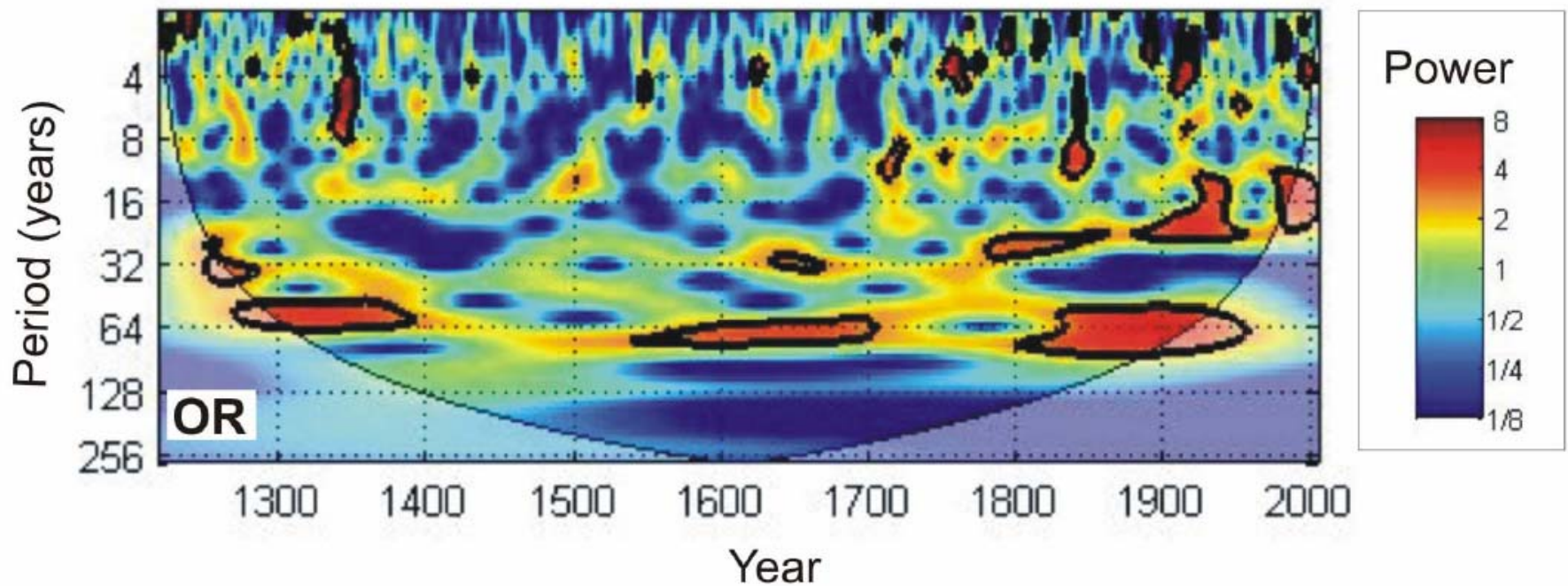
Wavelet power spectrum

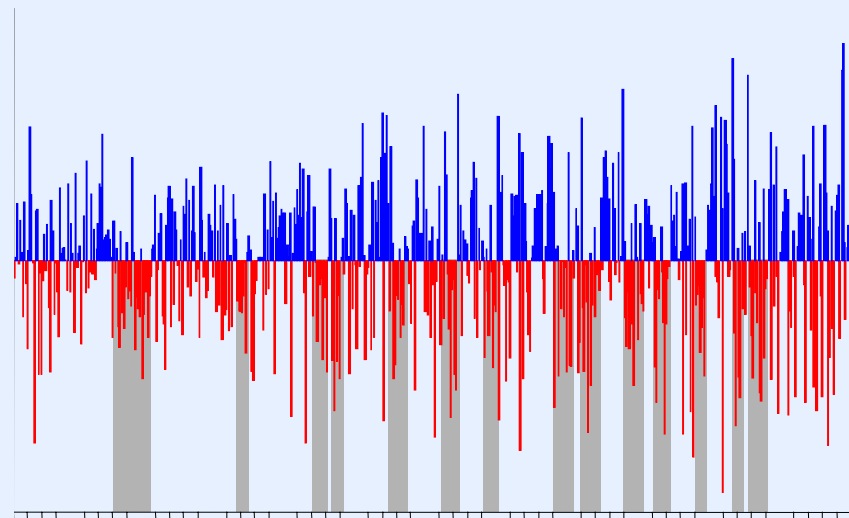
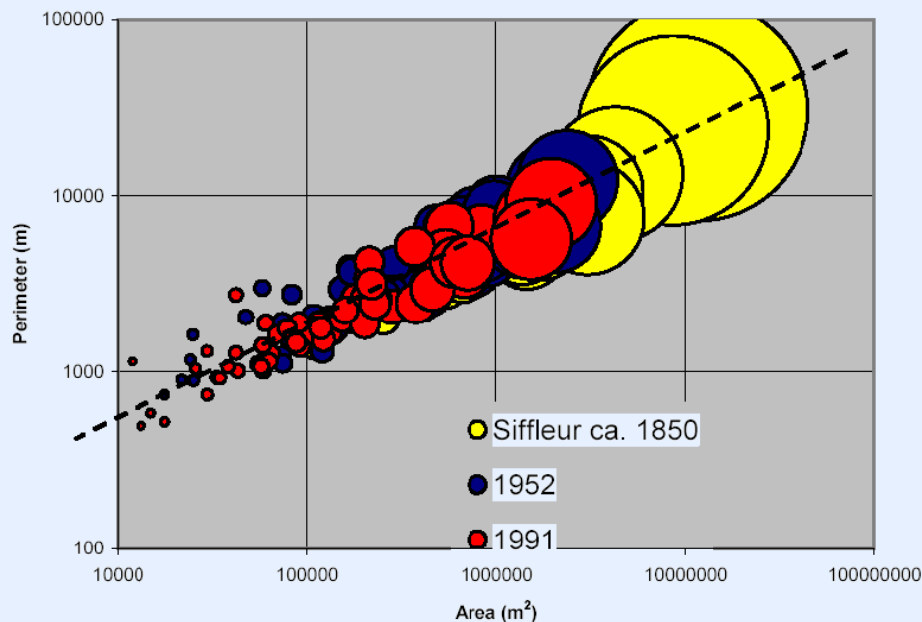
Pseudotsuga menziesii



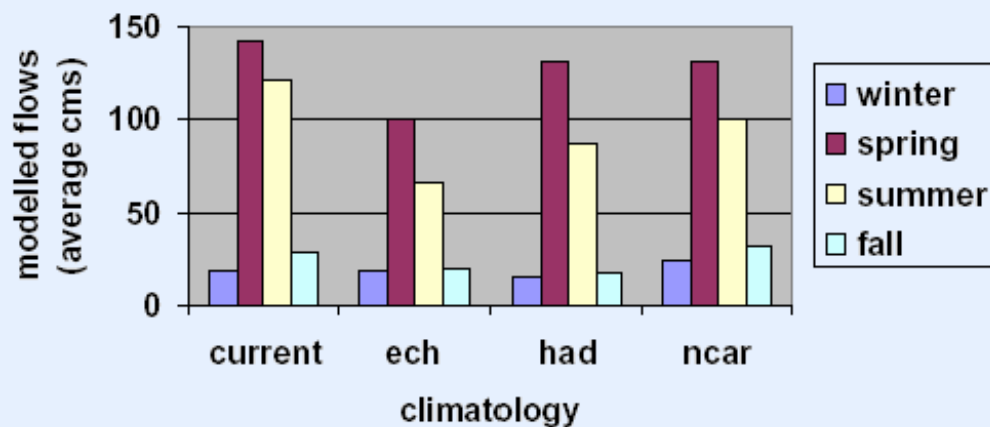
Wavelet power spectrum

Pinus flexilis





Old Man River at Lethbridge

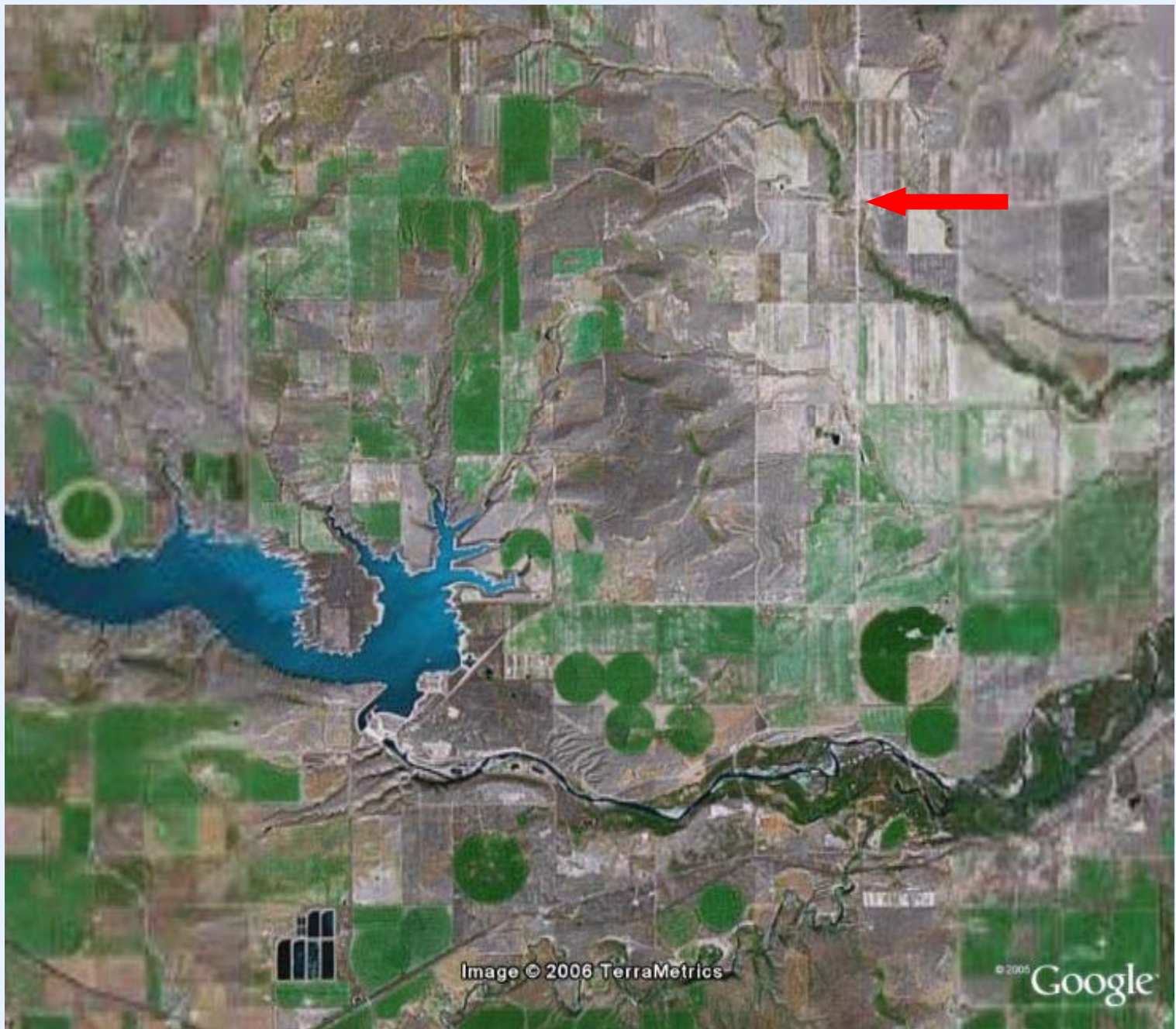


A “myth of abundance” and an explicit assumption that “the hydrological regime is stationary and will continue to be stationary in the future”.

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





Resolution - 2005 PC AGM

Progressive Conservative Party of Alberta 2005 AGM

Resolution submitted by the Cardston-Taber-Warner PC Association

Resolved: The Government of Alberta recognizes and acknowledges that water is a very important commodity and valuable resource. The Government also recognizes the need for more storage of this valuable resource.

We will look at alternatives to costly and environmentally sensitive dams, by encouraging a study to look at the possibility of on farm storage, particularly on the corners of pivot irrigation land. This storage would help producers have water for agriculture in the early and late season if required.