Climate Change and Rocky Mountain Watersheds

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Crown Managers Forum, Fernie, BC, April 14, 2010
St Mary’s Basin Max SWE Date

(Larson 2008)
Standard Climate Change Scenarios from GCM output
2051 Active sites in 2006

MacCulloch 2008
41 Continuous Natural Flow Sites in 2006 with 50 years contiguous

MacCulloch 2008
earlywood → late wood

one tree ring
Spatial correlation: tree ring (PC1) and precipitation data, 1901-2000

PC1 vs Jan-Feb ppt

PC1 vs May-July ppt
CMI 1961-90: recorded versus inferred

Climate Moisture Index (CMI) = P-PET

PET: simplified Penman-Monteith (Hogg, 1994, 1997)
JJA PDSI < 0, Calgary, 1895-2002

TRI (-ve departures), WCH, 1895-2004

$r = 0.628$
Crossdating – Pattern Matching

The outer growth of dead trees crossdates with inner portions of living trees.
Oldman River at Waldron’s Corner, calibration period (1951-2004)

\[ R^2_a = 0.511 \]
\[ RE = 0.45 \]
\[ SE = 2.9 \]
South Saskatchewan River at Medicine Hat, 1402-2004

Axelson, Sauchyn and Barichivich, 2009
At Edmonton House, a large fire burned “all around us” on April 27th (1796) and burned on both sides of the river. On May 2nd [1796] William Tomison wrote to James Swain that furs could not be moved as, “there being no water in the river.”
Old Wood
Headwaters, NSRB
North Saskatchewan River at Edmonton, 1063-2006
North Saskatchewan River at Edmonton, 1063-2006
Seasonal precipitation, ENSO and tree growth

El Niño $\rightarrow$ winter (-); summer (+)
La Niña $\rightarrow$ winter (+); summer (-)

$r = .67$
Cycles in the tree rings
Waterton River near Waterton 1950-2007

Significant trend
p-value = 0.004

Daily mean flow m³/s

Waterton
negative PDO
Trend
Daily mean flow $m^3/s$

Whole Waterton record 1912-2007

Trend not significant

$p$-value = 0.290
Observed (red) and modeled variability, Waterton River, AB

Jacques et al., 2010; Lapp et al., in review
INTRODUCTION

The University of Regina Tree-Ring Lab was established in 1998. Since then, we have built a network of 60 tree-ring chronologies encompassing the aspen forests of eastern Montana, and the foothills and boreal forests of Alberta, Saskatchewan, and the NWT. Our tree-ring processing and announcing facility is located in the Department of Geography. The researchers and our data processing lab are based at the Prairie Adaptation Research Collaborative (PARC), a climate-change research center. At PARC, our tree-ring records are applied to providing a better understanding of the climate of the western interior, a context for forecasts of future climate change, high-resolution climate records for investigating the climate forcing of biophysical systems, and providing resource managers and planners with a longer view of precipitation and streamflow in this region.