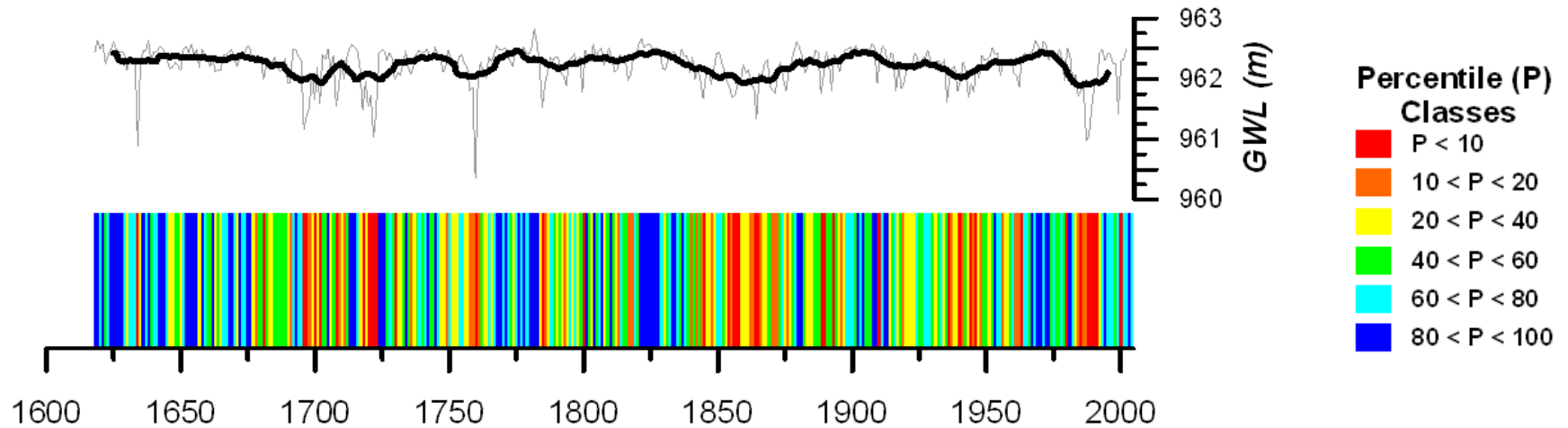


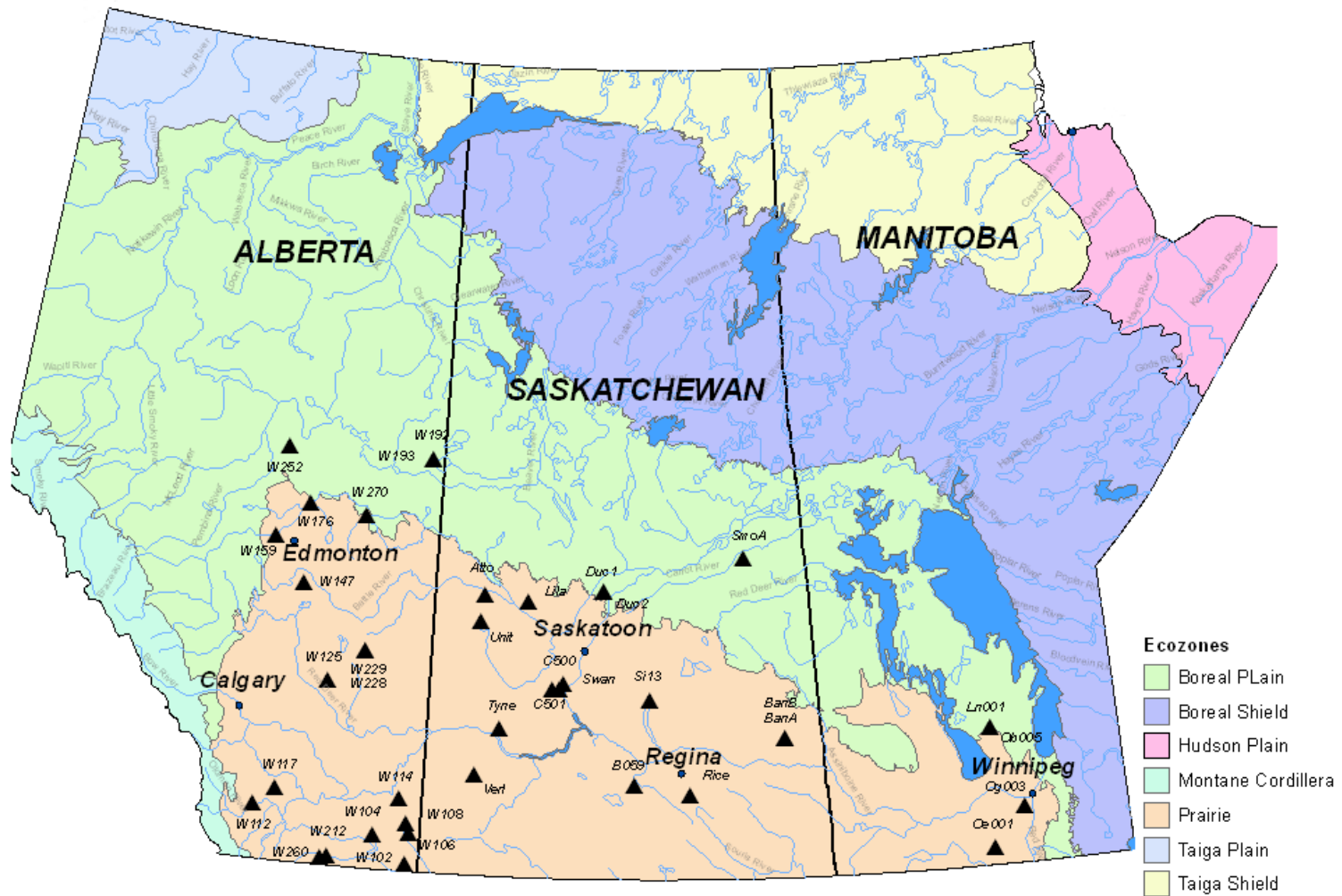
Groundwater Trends and Climate Change

Dave Sauchyn and Cesar Perez-Valdivia
Prairie Adaptation Research Collaborative, University of Regina

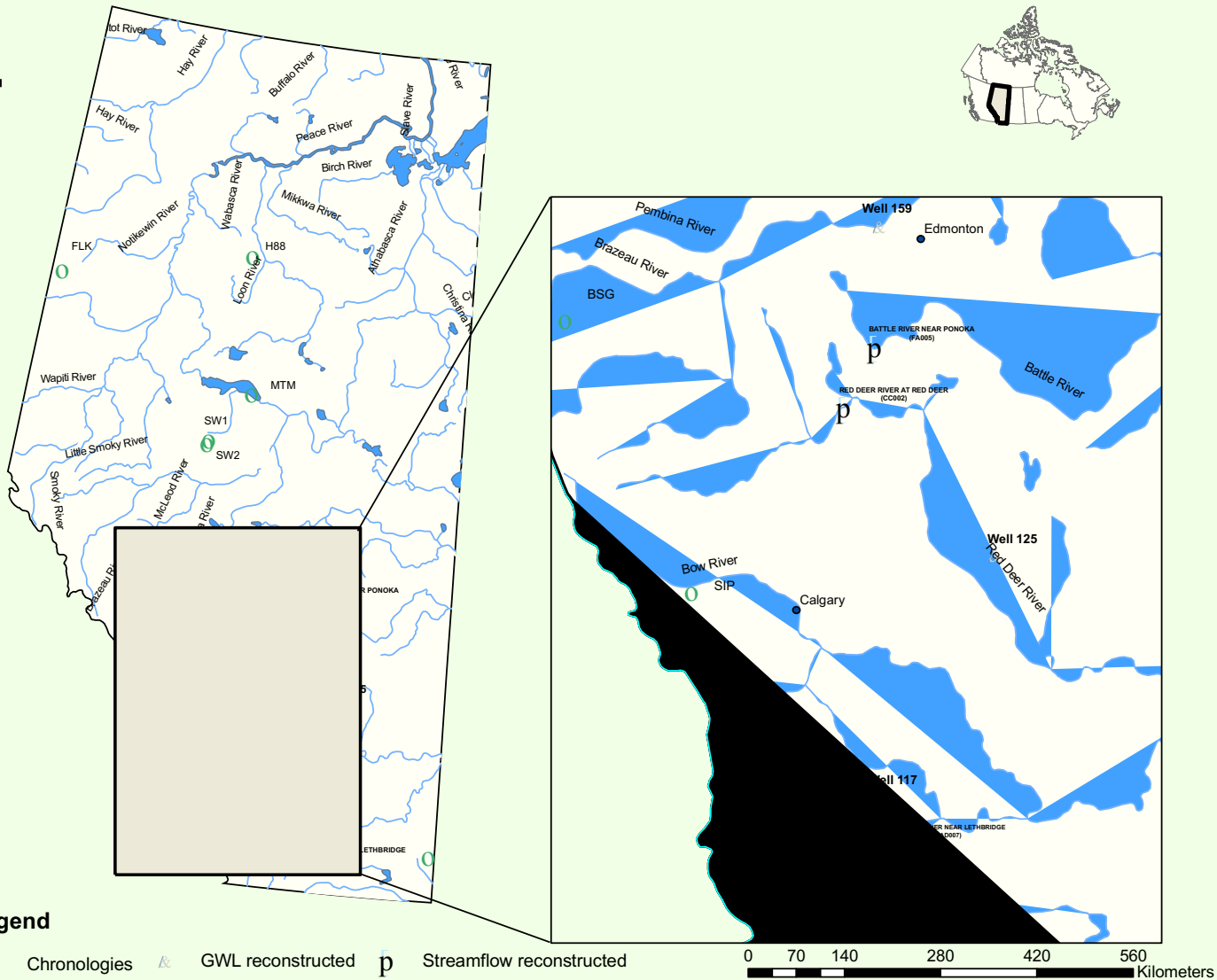


“Below Your Watershed” Groundwater Conference
March 11-12, 2010, Medicine Hat

39 “Long” Groundwater Observation Well Records



4



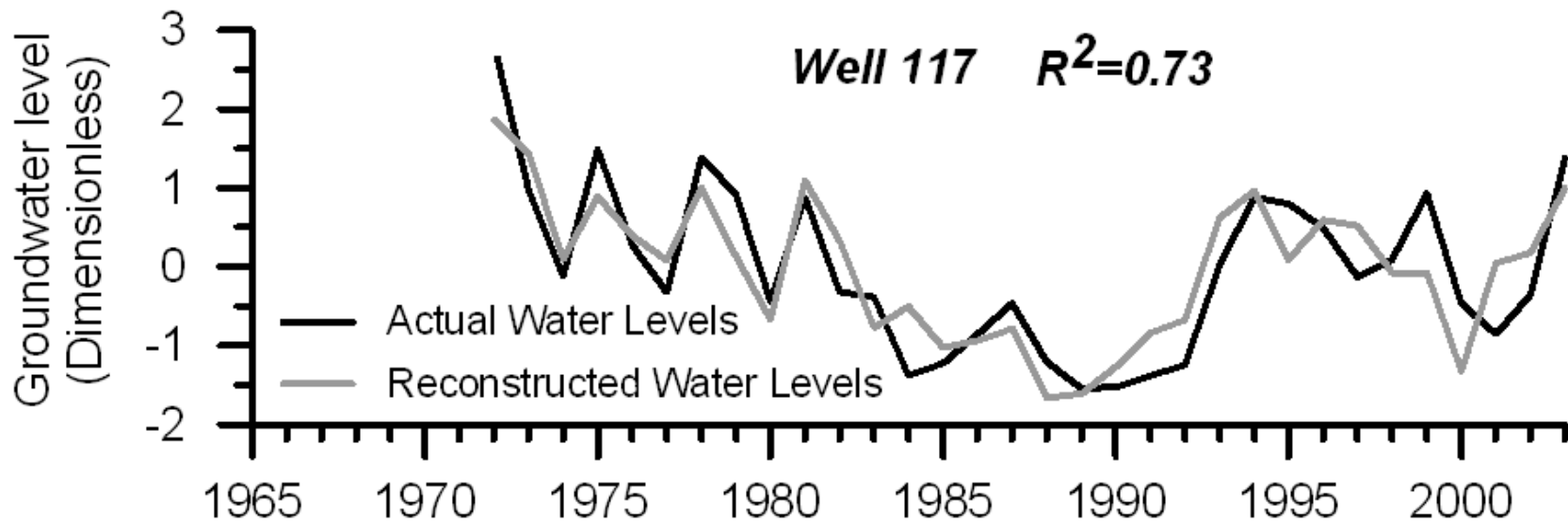
Alberta data

The Alberta tree-ring network is based on 19 chronologies. The longest one goes back to 1203 and the shortest to 1860.

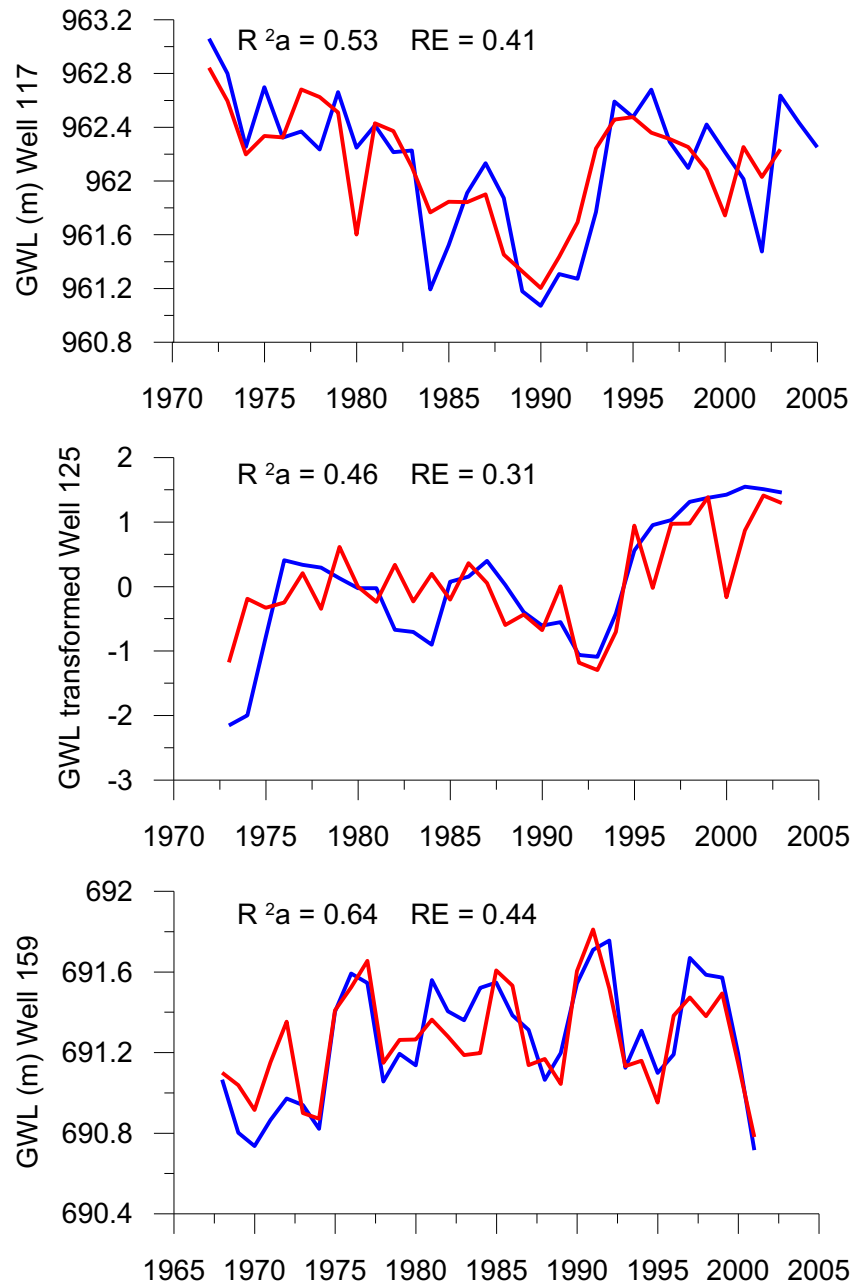
There are over 600 groundwater wells in Alberta, just over 100 with records for 20 or more years and only 39 that have not been affected by pumping.

Name	Gown ID#	Affected by man	Depth	Established	Starting recording	Ending recording	Years of record	Aquifer	Lithology
Barons 615E	well 117	NO	19.81	22-Jun-71	Jun-71	06-Sep	36	Horseshoe Canyon	Sandstone
Hand Hills #2 (South)	well 125	NO	40.54	20-Oct-65	Oct-65	05-Mar	41	Paskapoo	Sandstone
Devon #2 (North)	well 159	NO	7.62	13-May-65	May-65	06-Dec	42	Surficial	Sand

Observed and Reconstructed Levels – Well 117

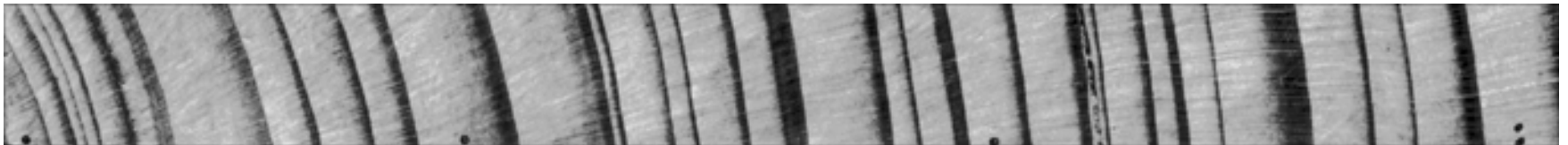
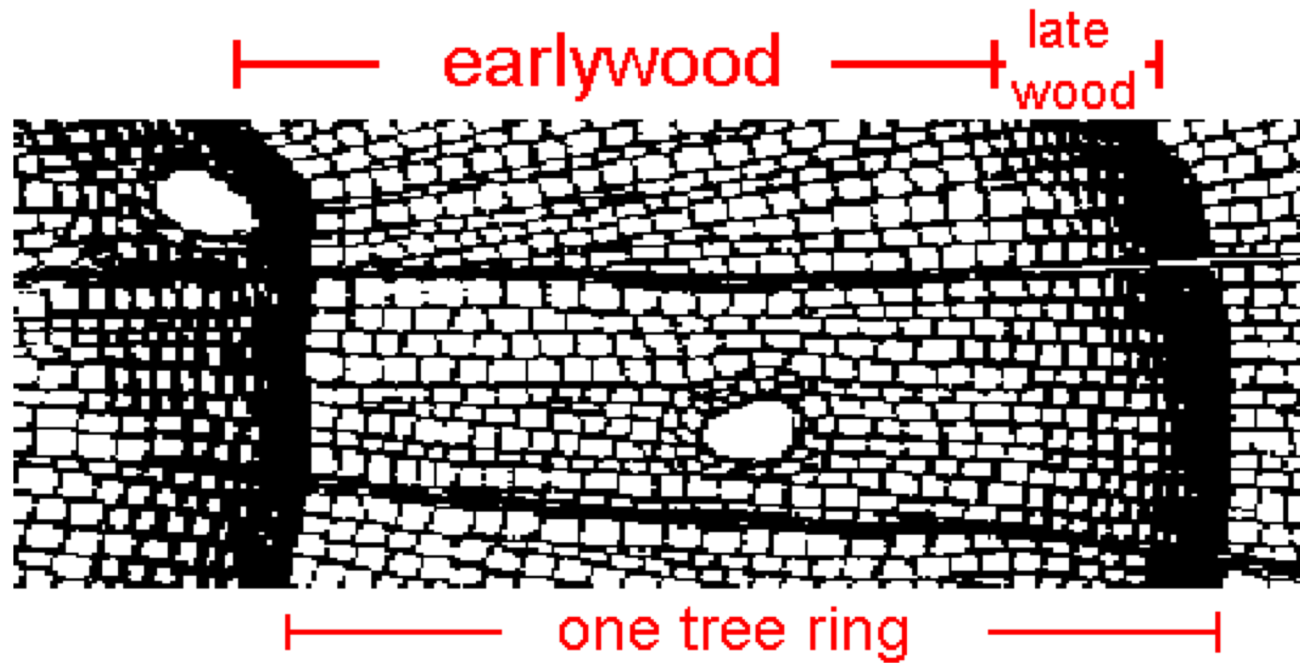


Recorded (blue) and reconstructed (red) groundwater levels





A Paleo-hydroclimate Record







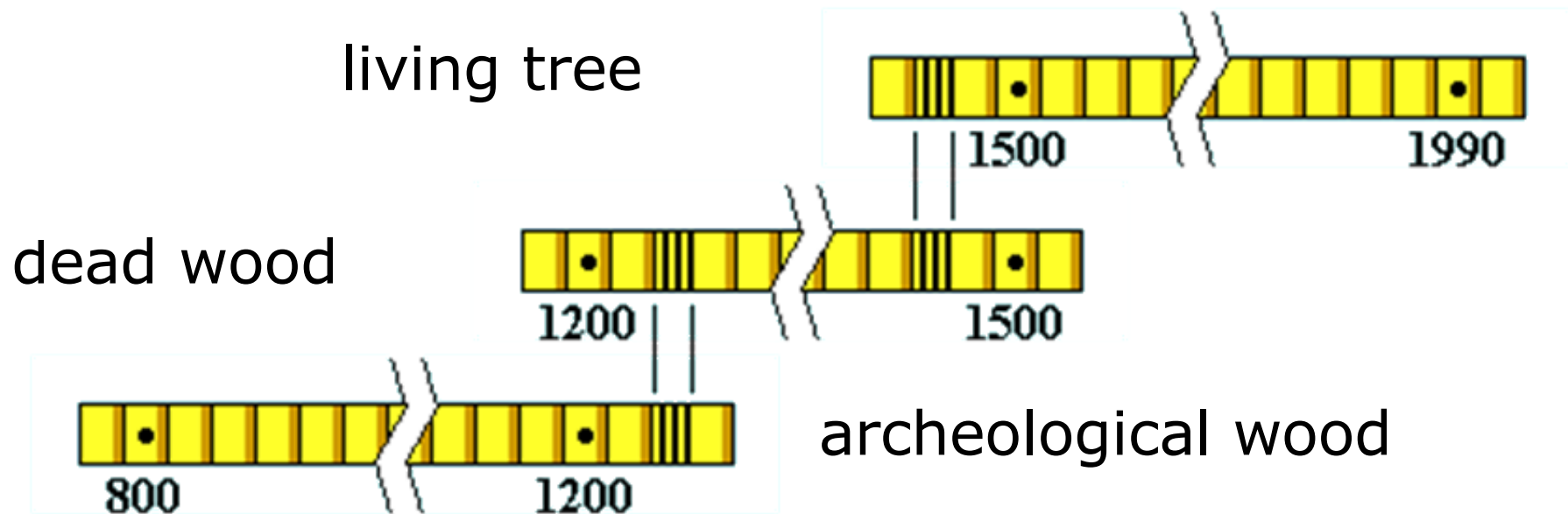






Crossdating – Pattern Matching

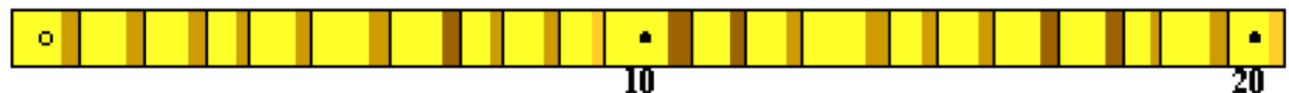
The outer growth of dead trees crossdates with inner portions of living trees



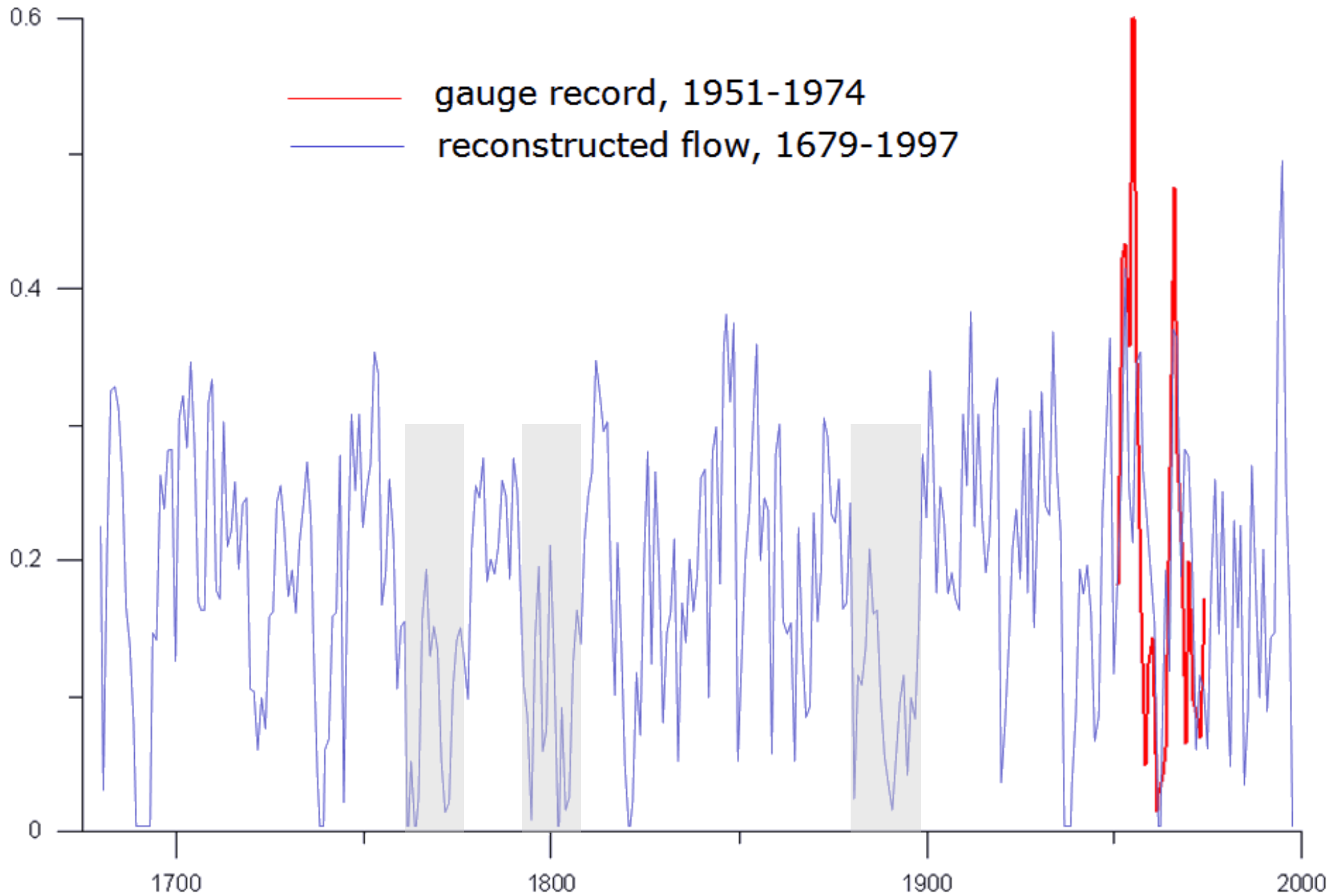
Sensitive

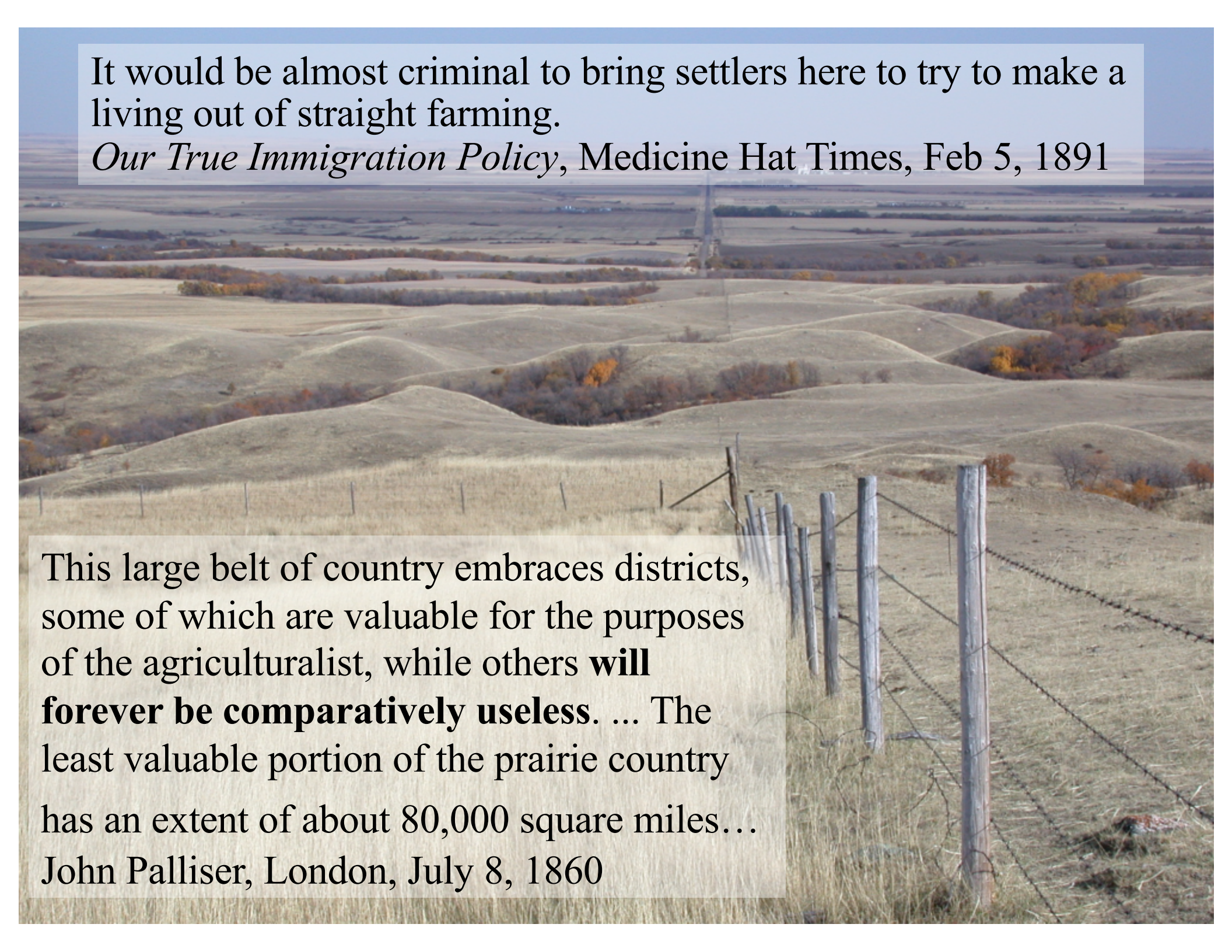


Complacent



Battle Creek at the Ranger Station, 1679-1997





It would be almost criminal to bring settlers here to try to make a living out of straight farming.

Our True Immigration Policy, Medicine Hat Times, Feb 5, 1891

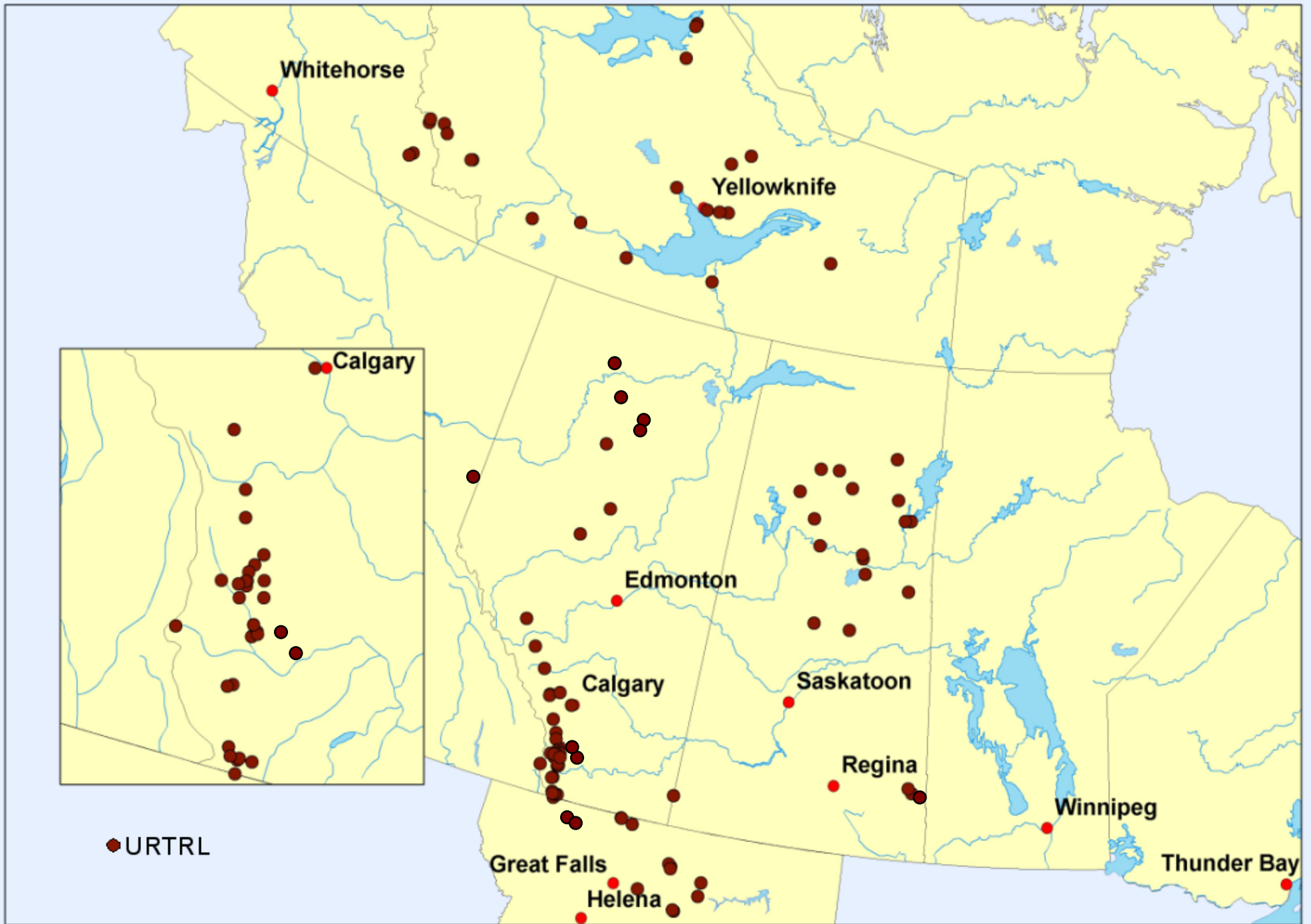
This large belt of country embraces districts, some of which are valuable for the purposes of the agriculturalist, while others **will forever be comparatively useless**. ... The least valuable portion of the prairie country has an extent of about 80,000 square miles...

John Palliser, London, July 8, 1860

Widespread late 18th century sand dune activity (Wolfe, *et al.* 2001)

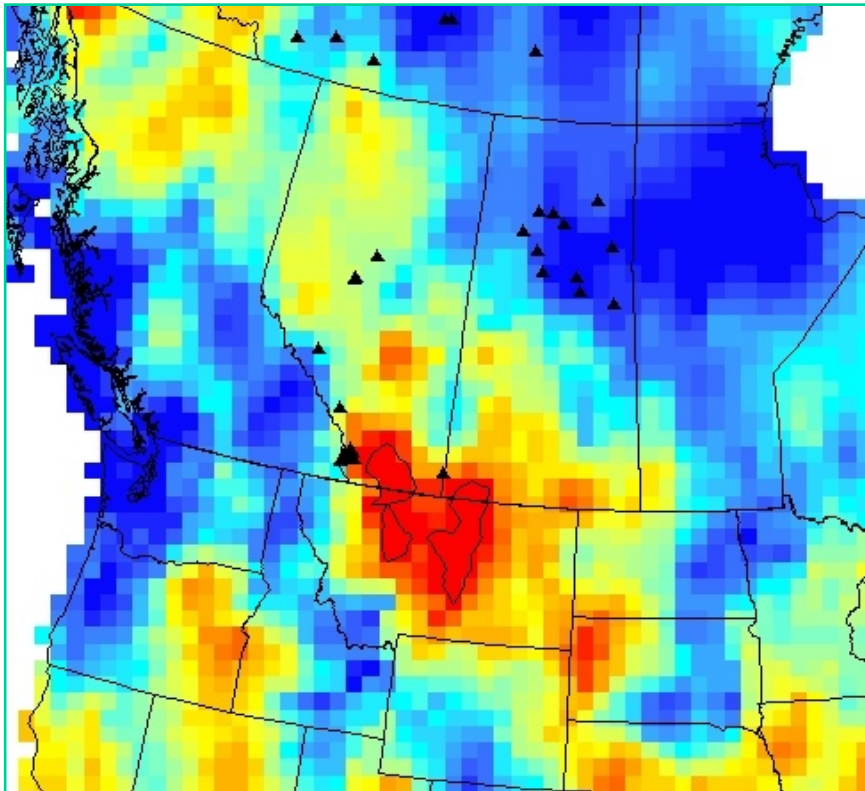


Tree-Ring Sampling Sites

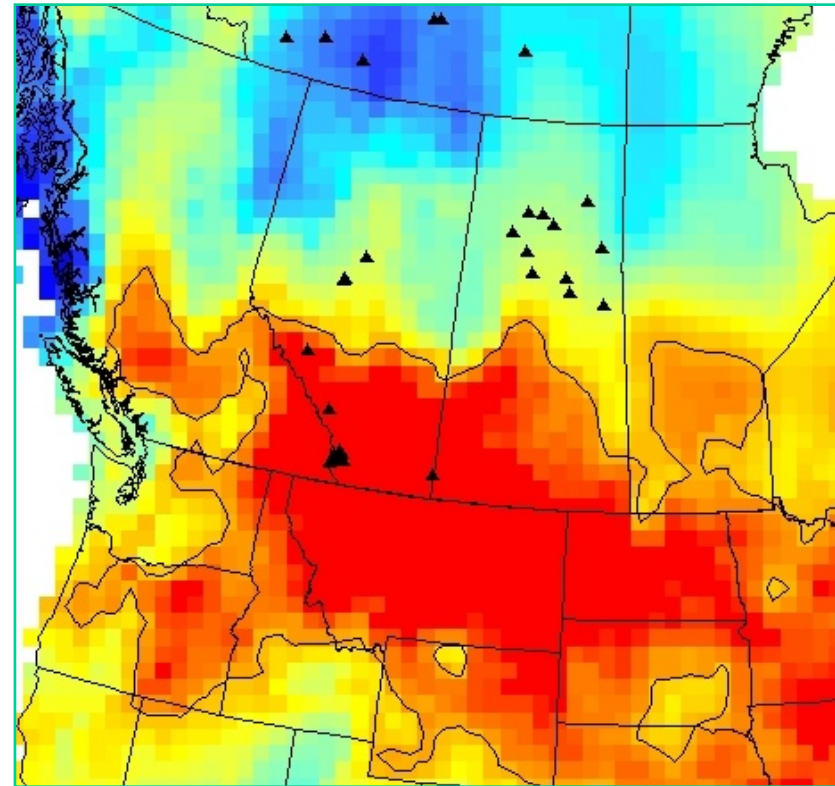




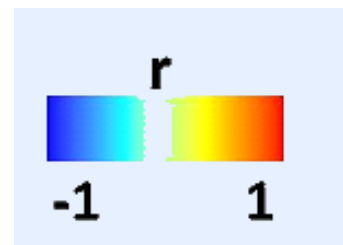
Correlation: precipitation versus tree-ring width, 1901-2000)



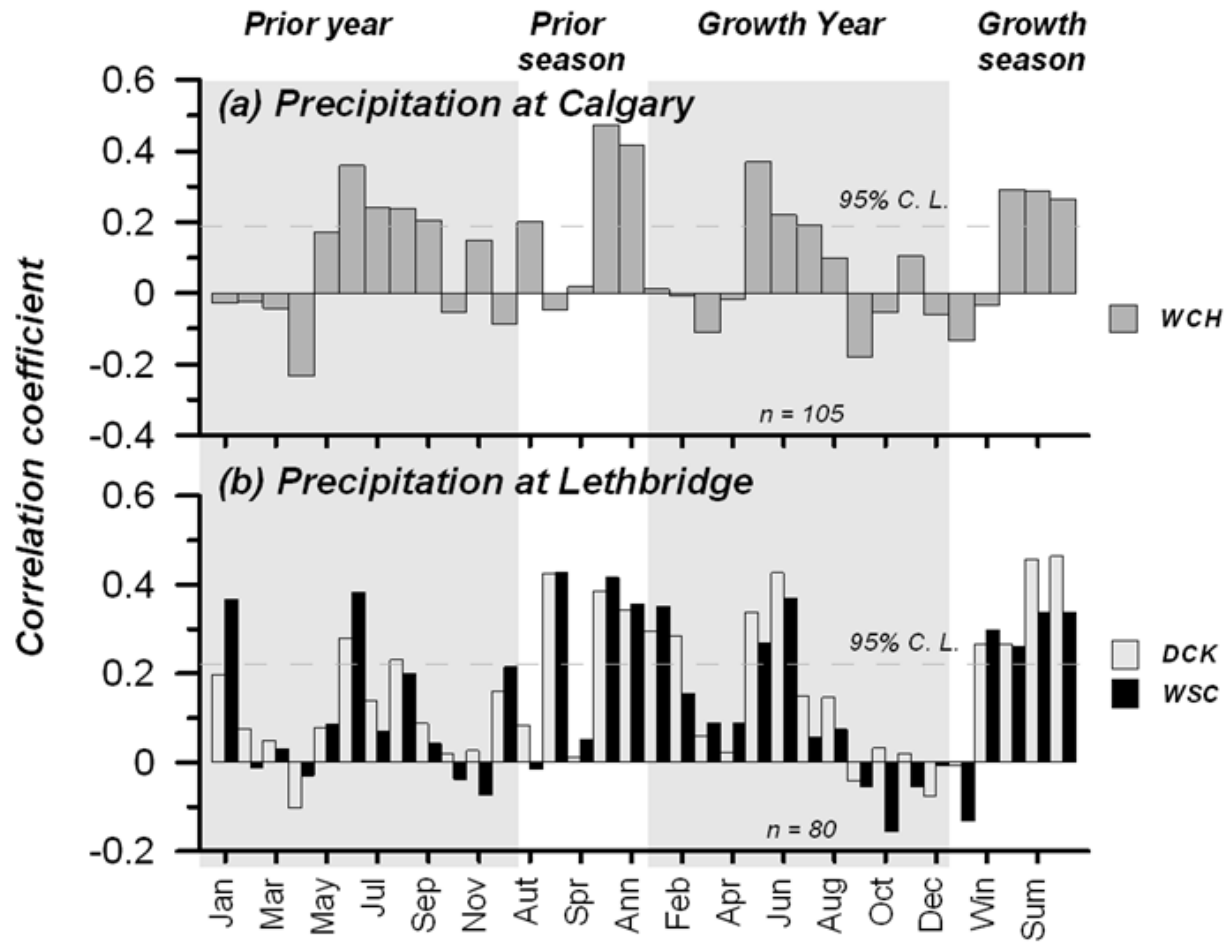
PC1 vs Jan-Feb ppt



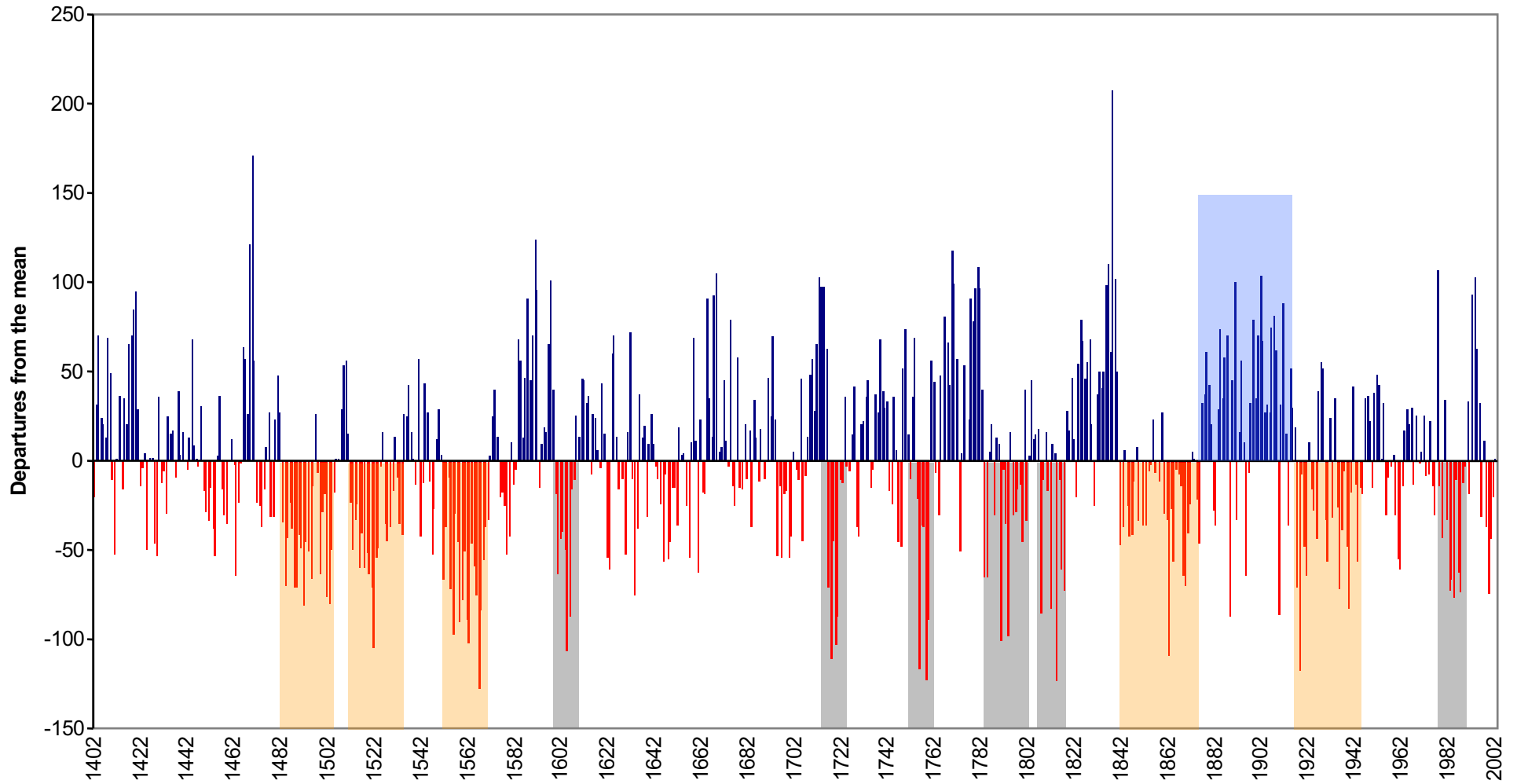
PC1 vs May-July ppt



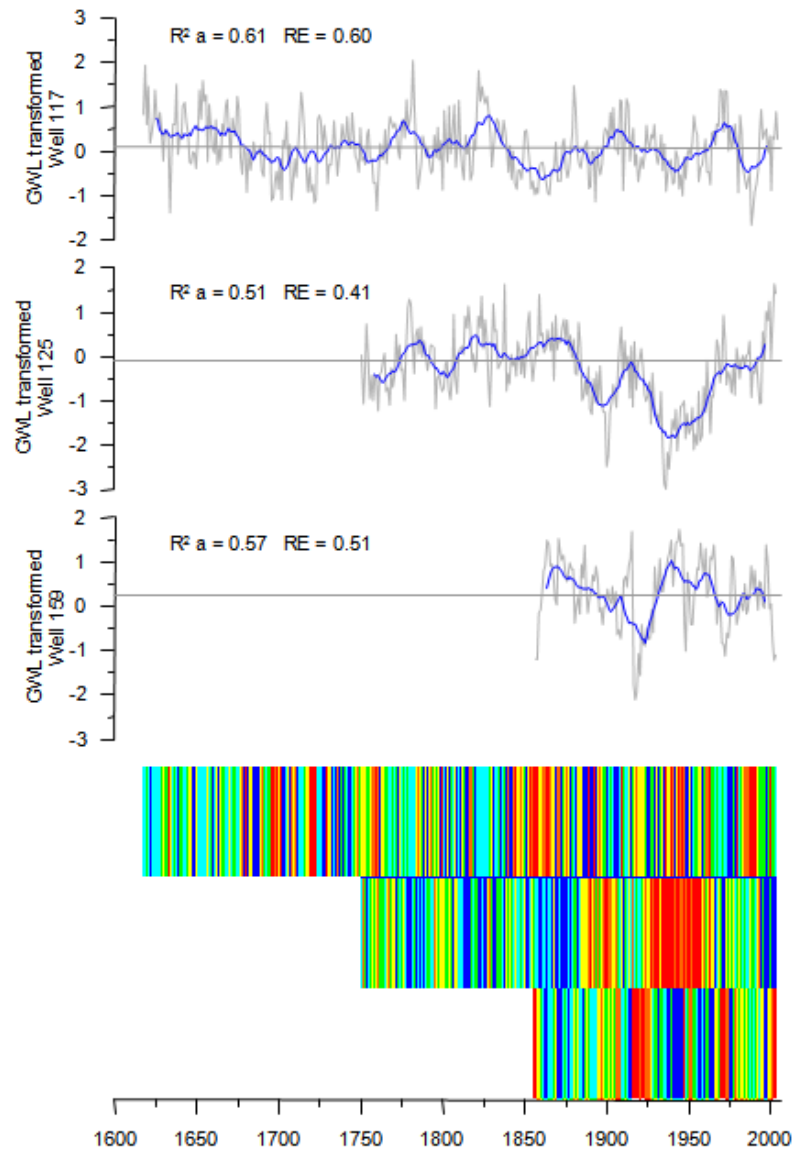
Correlation: precipitation versus tree-ring

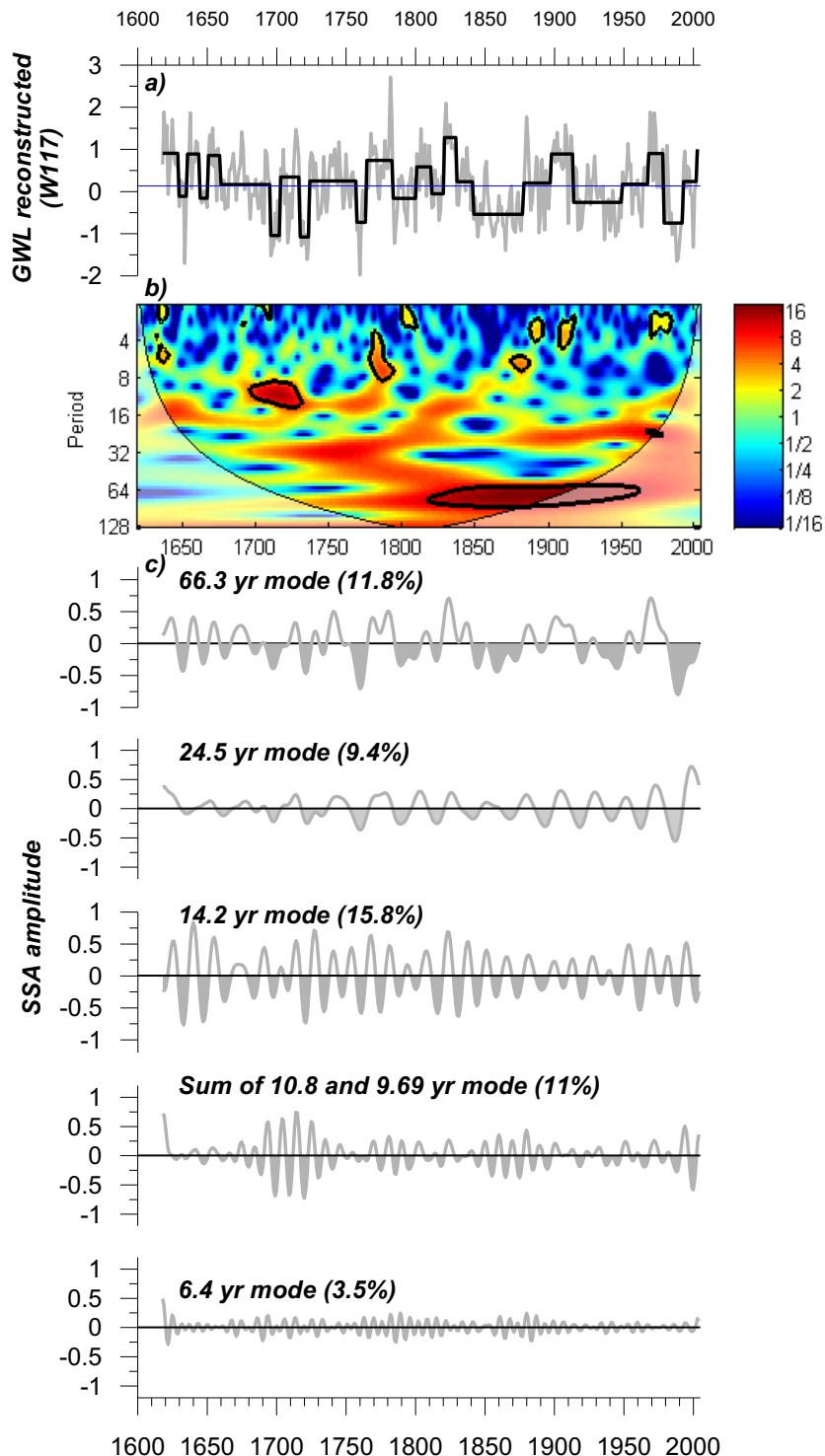


South Saskatchewan River at Medicine Hat, 1402-2004



Groundwater reconstructions



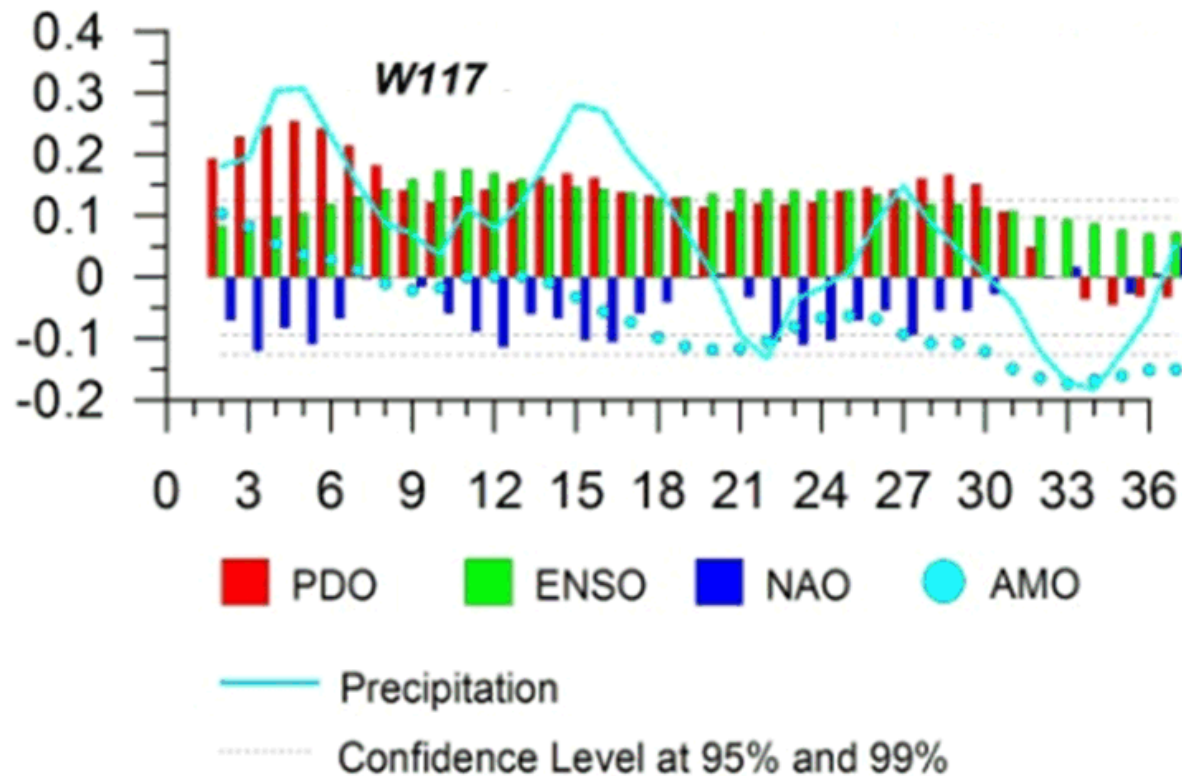


Well 117 (SW Alberta) groundwater levels reconstruction (grey line) and **regime shifts** (black line).

Wavelet **power spectrum**. Black contour line shows the 95% confidence.

Singular spectrum analysis shows different **oscillation modes**. Periods in years (and the percentage of variance associated with each).

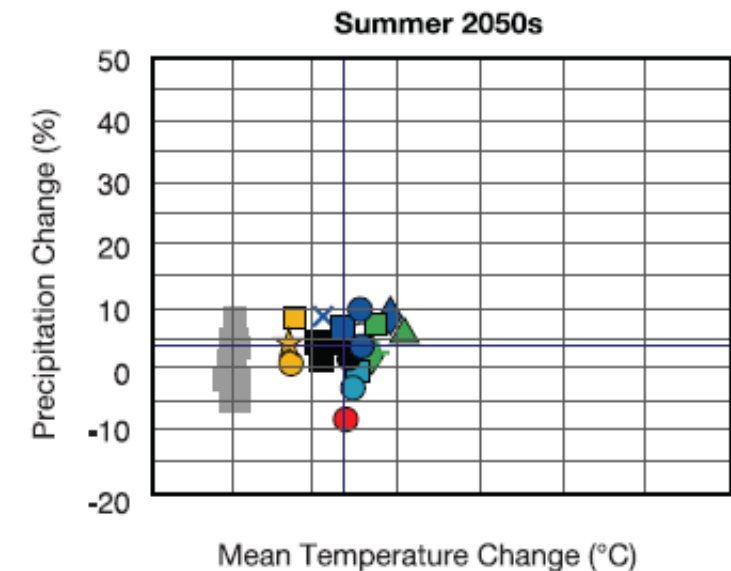
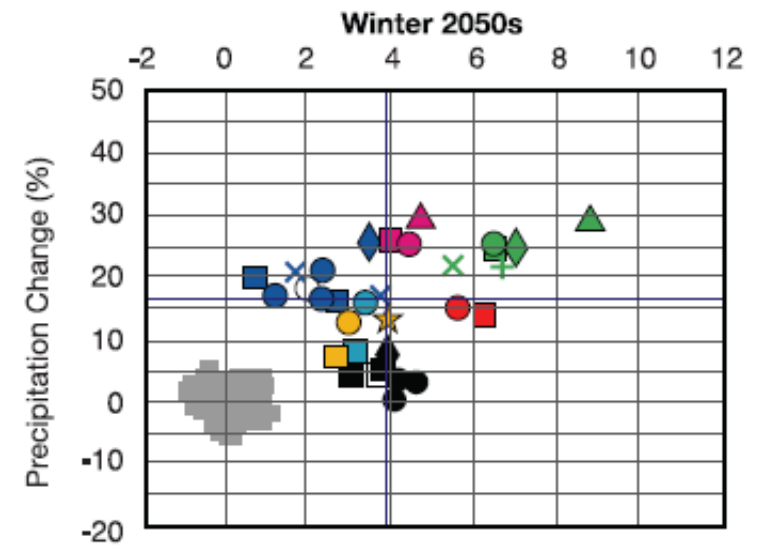
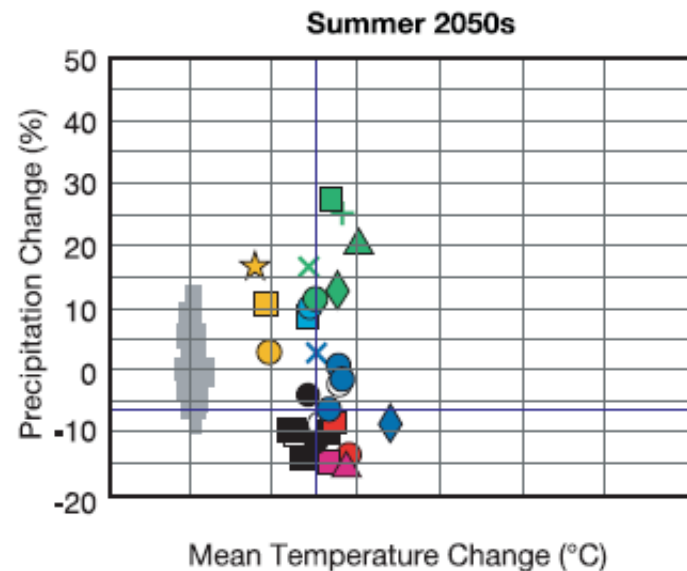
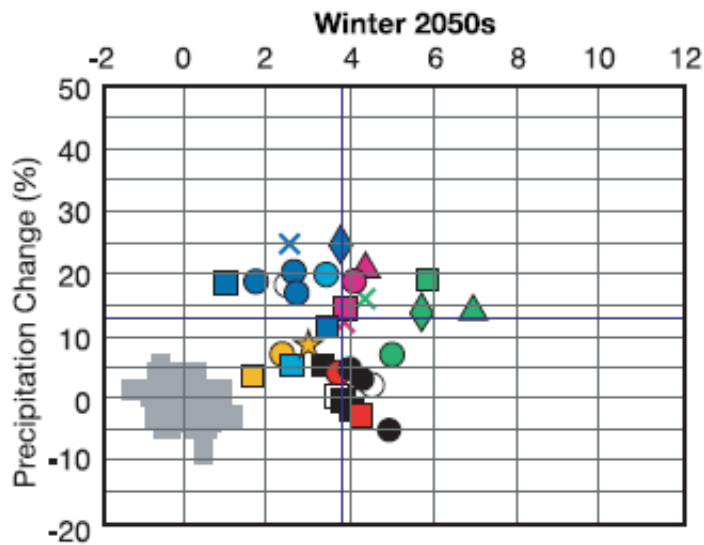
Correlation: Detrended groundwater levels and climate indices



Grassland

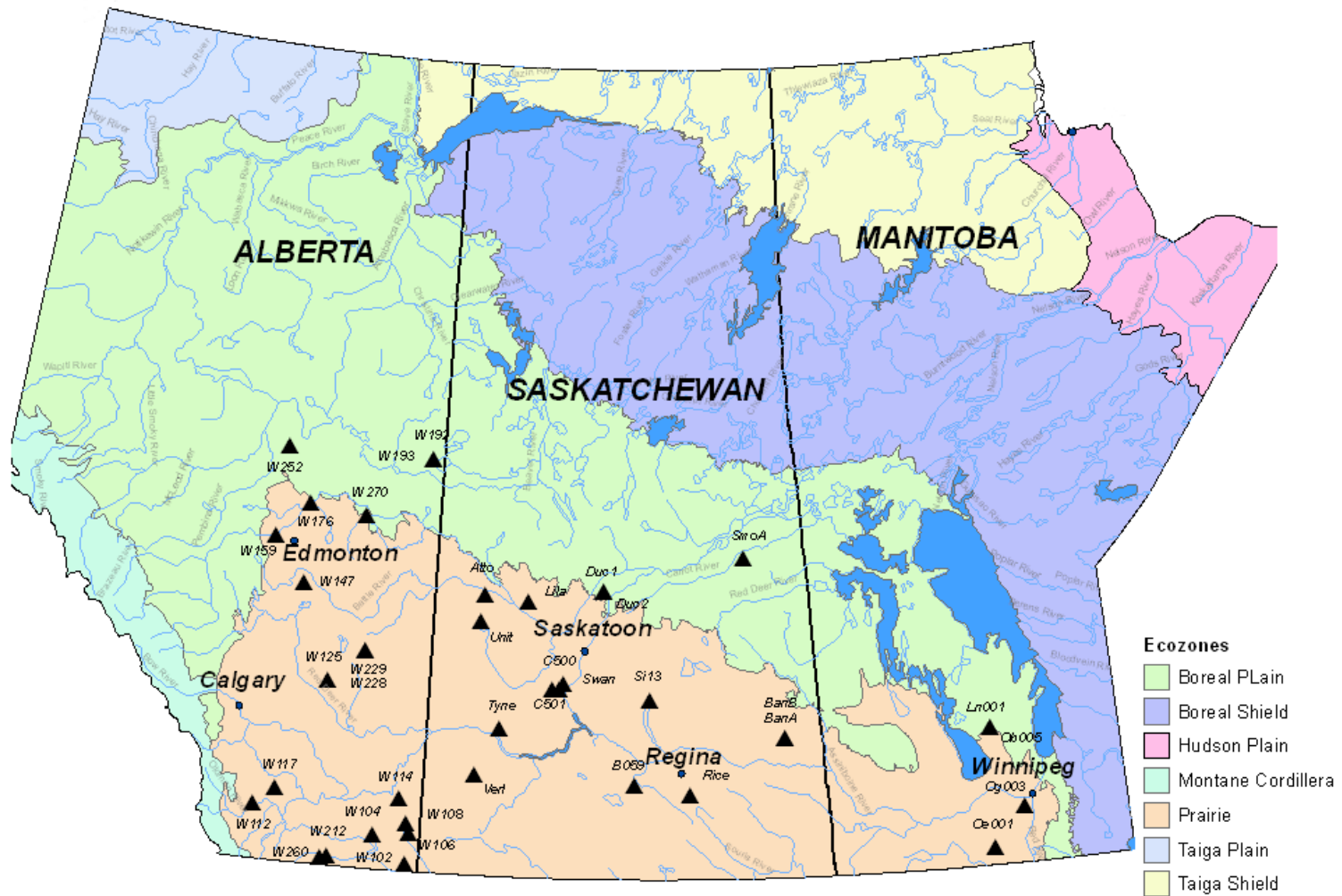
Climate Change Scenarios

Forest

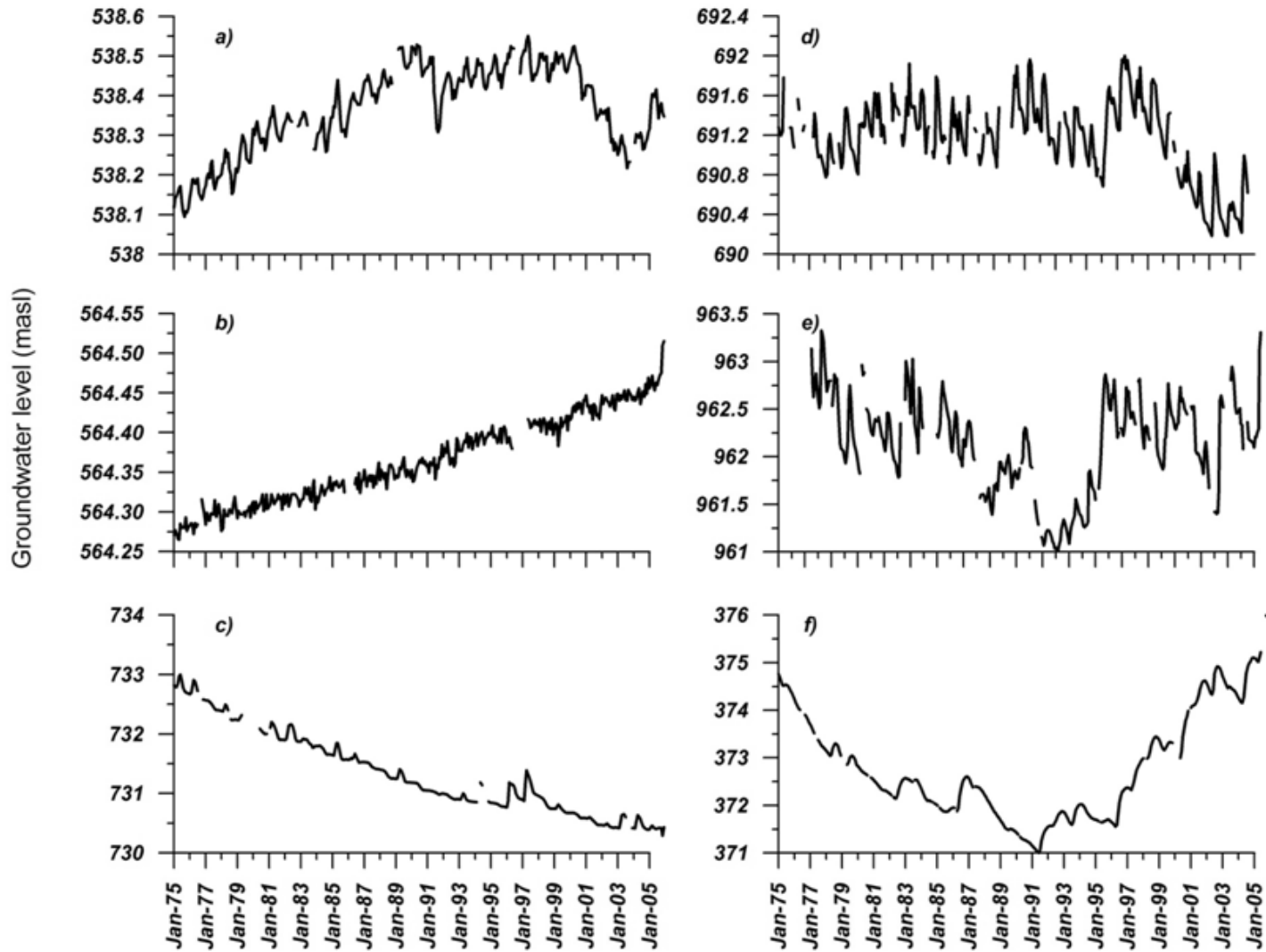


Projected changes in mean seasonal temperature and precipitation for the grassland forest regions. The grey squares indicate the ‘natural’ climate variability simulated by a long control run of the CGCM2.

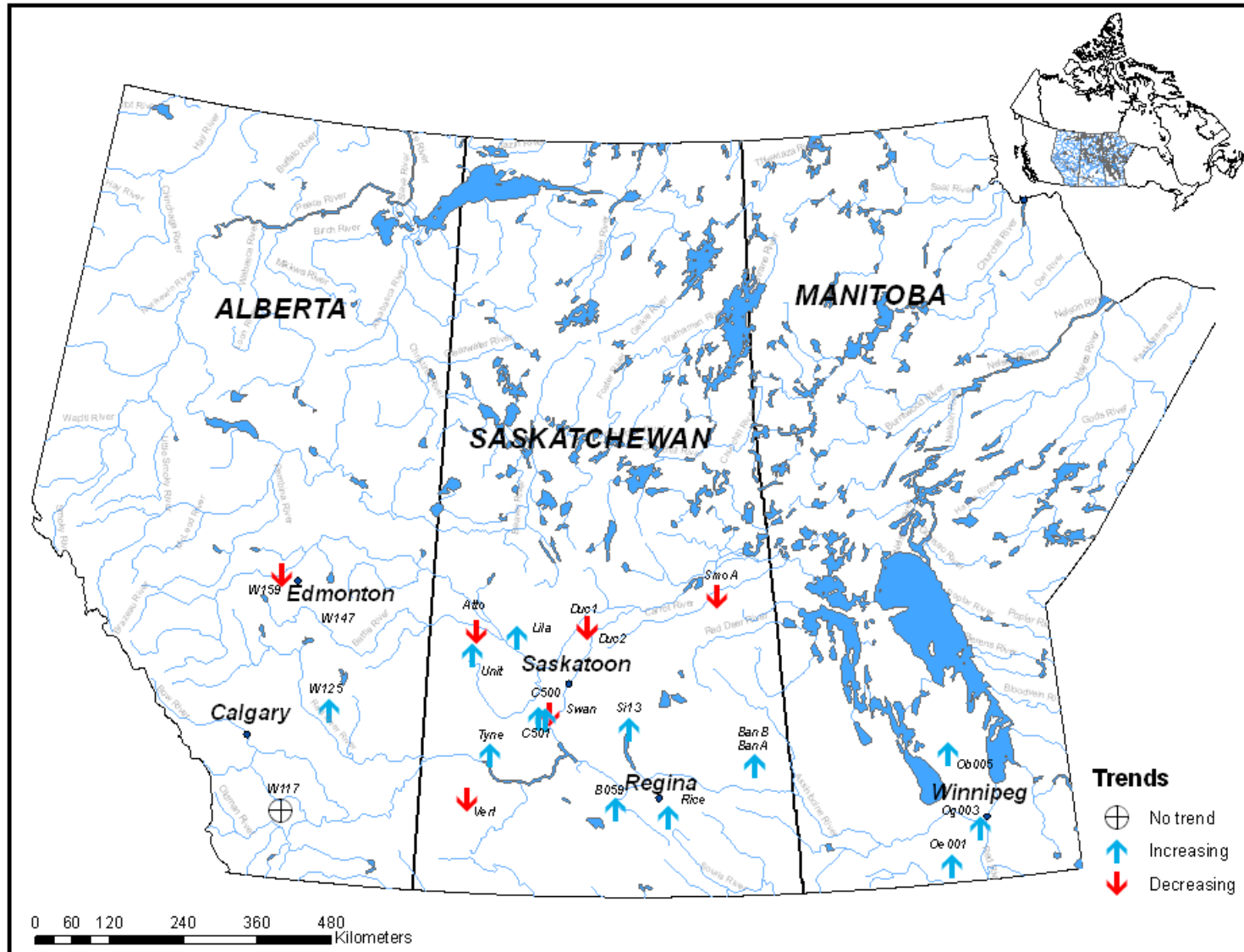
39 “Long” Groundwater Observation Well Records



Typical Groundwater Observation Well Records



Trends in mean annual groundwater levels (1975-2004)



Trends in annual groundwater levels (1990-2004)

