

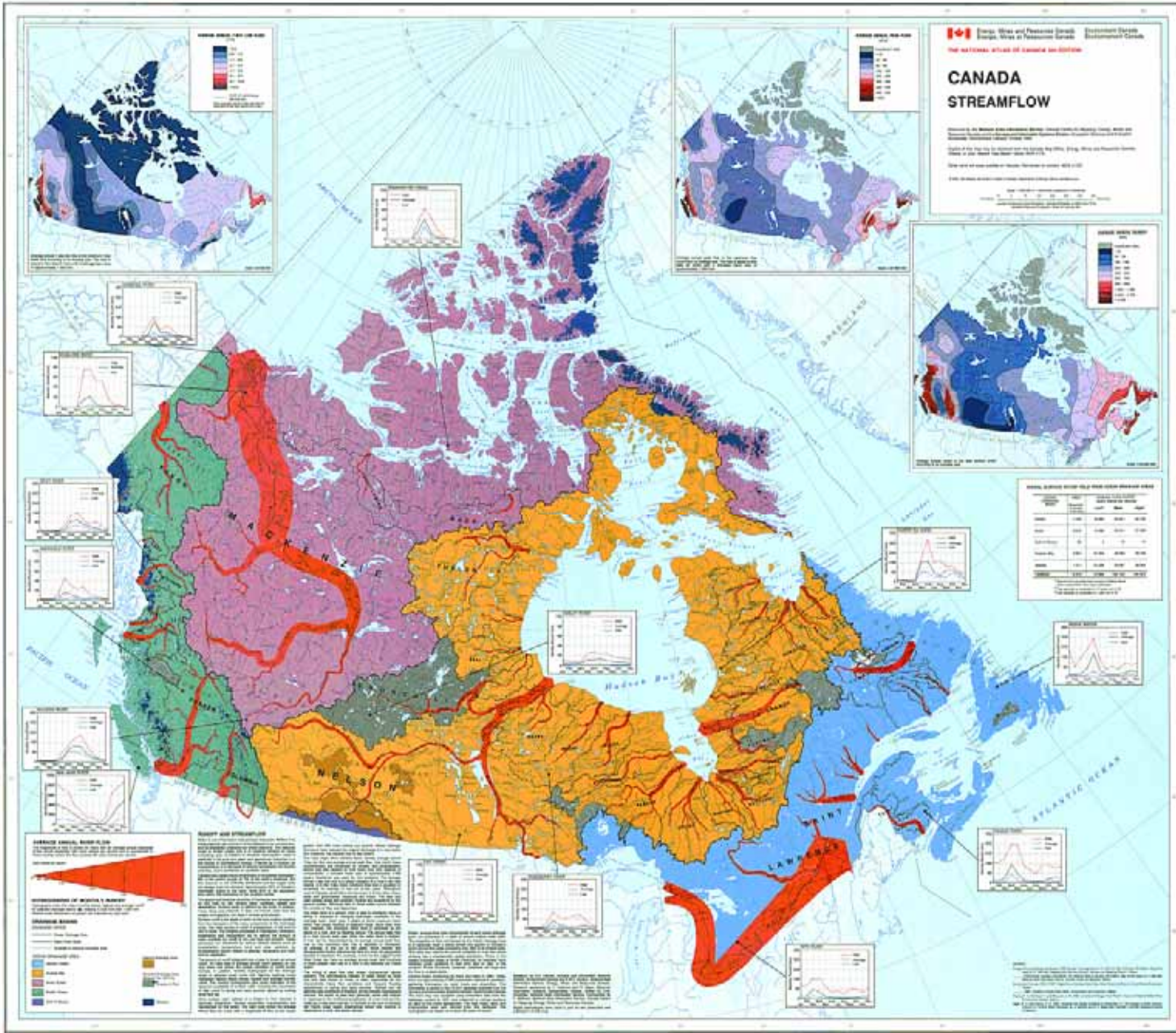
# Past, recent and future hydroclimatic variability, North Saskatchewan River Basin

Dave Sauchyn, Prairie Adaptation Research Collaborative, University of Regina

James Byrne and Stefan Kienzle, Department of Geography, University of Lethbridge



CWRA Alberta Branch, Edmonton, March 28-30, 2010



**Canada, Water and Fisheries Canada**  
**Environment Canada**  
**THE NATIONAL OFFICE OF CANADA GOVERNMENT**

## CANADA STREAMFLOW

Report of the National Office of Canada Government, Environment Canada, and the National Office of Fisheries and Aquaculture, Fisheries and Aquaculture Canada, on the Streamflow of the Major Rivers of Canada.

Published by the National Office of Canada Government, Environment Canada, and the National Office of Fisheries and Aquaculture, Fisheries and Aquaculture Canada, in 1982.

For more information, contact the National Office of Canada Government, Environment Canada, and the National Office of Fisheries and Aquaculture, Fisheries and Aquaculture Canada, at the following address:

National Office of Canada Government, Environment Canada, and the National Office of Fisheries and Aquaculture, Fisheries and Aquaculture Canada, 1100 Avenue de la Paix, Ottawa, Ontario, Canada K1P 6K6.

**REGIONAL STREAMFLOW VOLUMES (CUBIC KILOMETERS PER YEAR)**

Region	1970-79	1980-89	1990-99
Pacific	1,100	1,100	1,100
Yukon	1,100	1,100	1,100
Northwest Territories	1,100	1,100	1,100
Nunavut	1,100	1,100	1,100
Prairie Provinces	1,100	1,100	1,100
Ontario	1,100	1,100	1,100
Quebec	1,100	1,100	1,100
<b>Total</b>	<b>11,000</b>	<b>11,000</b>	<b>11,000</b>

**REPORT AND DISCUSSION**

**OBJECTIVE AND SCOPE**

The objective of this report is to provide a comprehensive overview of the streamflow of the major rivers of Canada. The scope of the report includes the following:

- Description of the major river systems of Canada.
- Assessment of the streamflow of these systems.
- Discussion of the factors that influence streamflow.
- Recommendations for the management of these systems.

**DEFINITIONS**

**Streamflow:** The volume of water that flows in a stream or river.

**Streamflow Volume:** The total volume of water that flows in a stream or river over a given period of time.

**Streamflow Rate:** The volume of water that flows in a stream or river per unit of time.

**Streamflow Frequency:** The frequency with which a given streamflow rate is exceeded.

**Streamflow Duration:** The duration of a given streamflow rate.

**Streamflow Intensity:** The intensity of a given streamflow rate.

**Streamflow Variability:** The variability of a given streamflow rate.

**Streamflow Reliability:** The reliability of a given streamflow rate.

**Streamflow Quality:** The quality of a given streamflow rate.

**Streamflow Quantity:** The quantity of a given streamflow rate.

**Streamflow Quality:** The quality of a given streamflow rate.

# 6-9 Heavy Oil Upgraders planned for the Edmonton Industrial Heartland

Each upgrader would require **20-30,000 cubic metres per day** for evaporative cooling

## Water Sources

- The **North Saskatchewan River** (new licences)
- Under-utilized existing licences
- Recycled Wastewater
- Produced water in the area

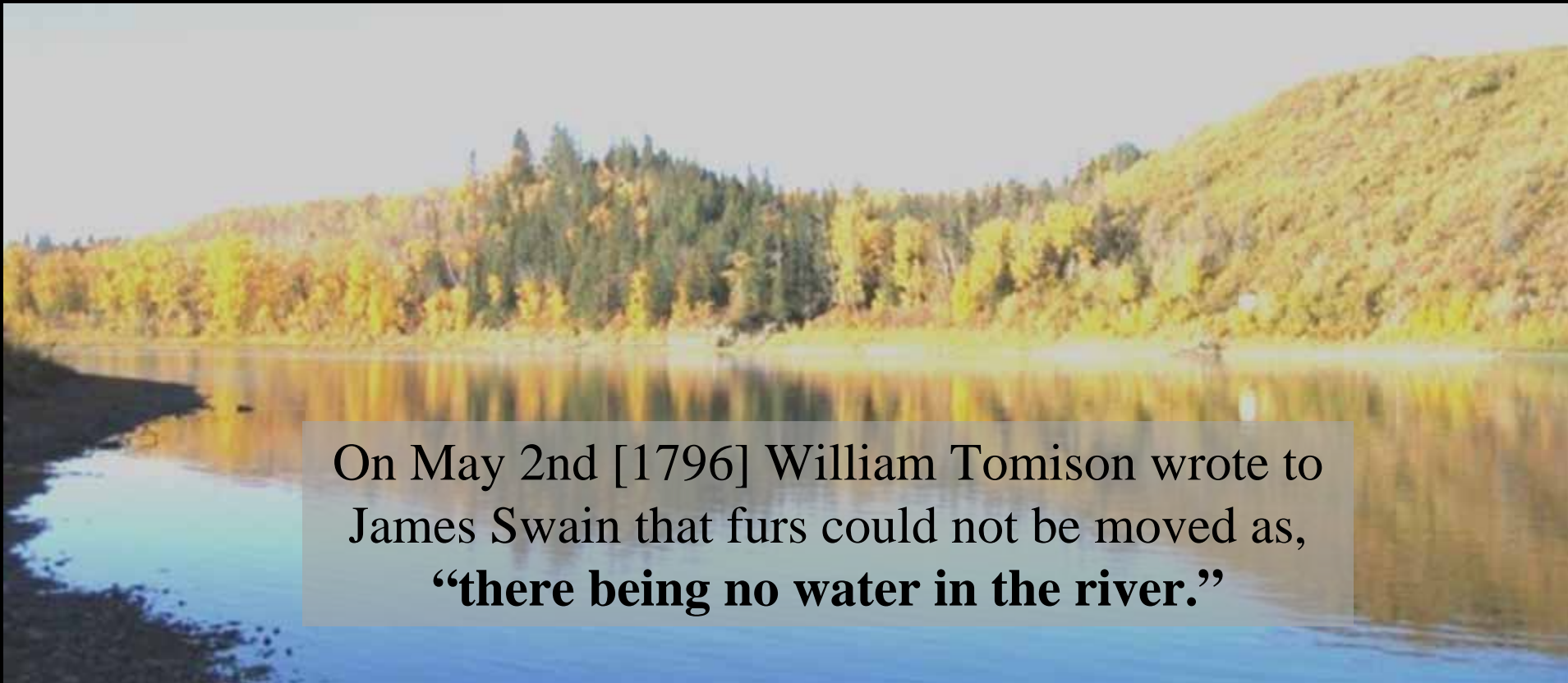
From - WATER: Alberta's Next Big Economic and Social Challenge (P. Kim Sturgess, P.Eng. FCAE - [www.apegga.org/Members/Events/.../APEGGAPDApr17-2008.ppt](http://www.apegga.org/Members/Events/.../APEGGAPDApr17-2008.ppt))

# **Bruce Power study eyes northwest Saskatchewan for new nuclear power plant**

“the area on the **North Saskatchewan River** meets a lot of the criteria to support a nuclear power plant.  
**“It's got a good water source”**

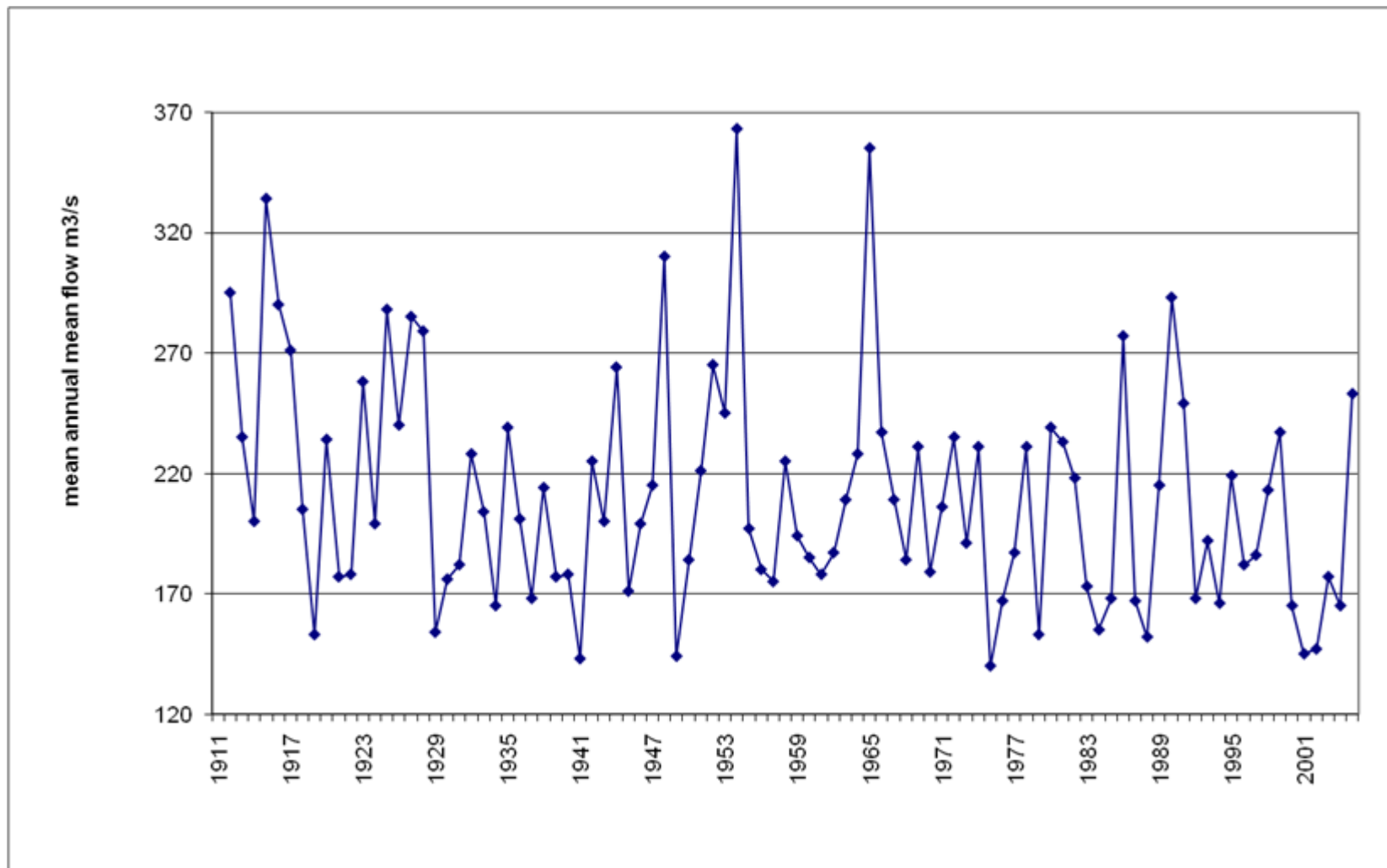
Duncan Hawthorne,  
President and CEO  
Bruce Power  
The Canadian Press *27/11/08*

# North Saskatchewan River at Edmonton



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

# North Saskatchewan River at Edmonton, 1912-2007





# North American Drought Monitor

February 28, 2010

Released: Monday March 22, 2010

<http://www.ncdc.noaa.gov/nadm.html>

**Analysts:**

- Canada - Trevor Hadwen  
Dwayne Chobanik  
Richard Rieger
- Mexico - Valentina Davydova  
Fernando Romero  
Reynaldo Pascual
- U.S.A. - Mark Svoboda\*  
Rich Tinker

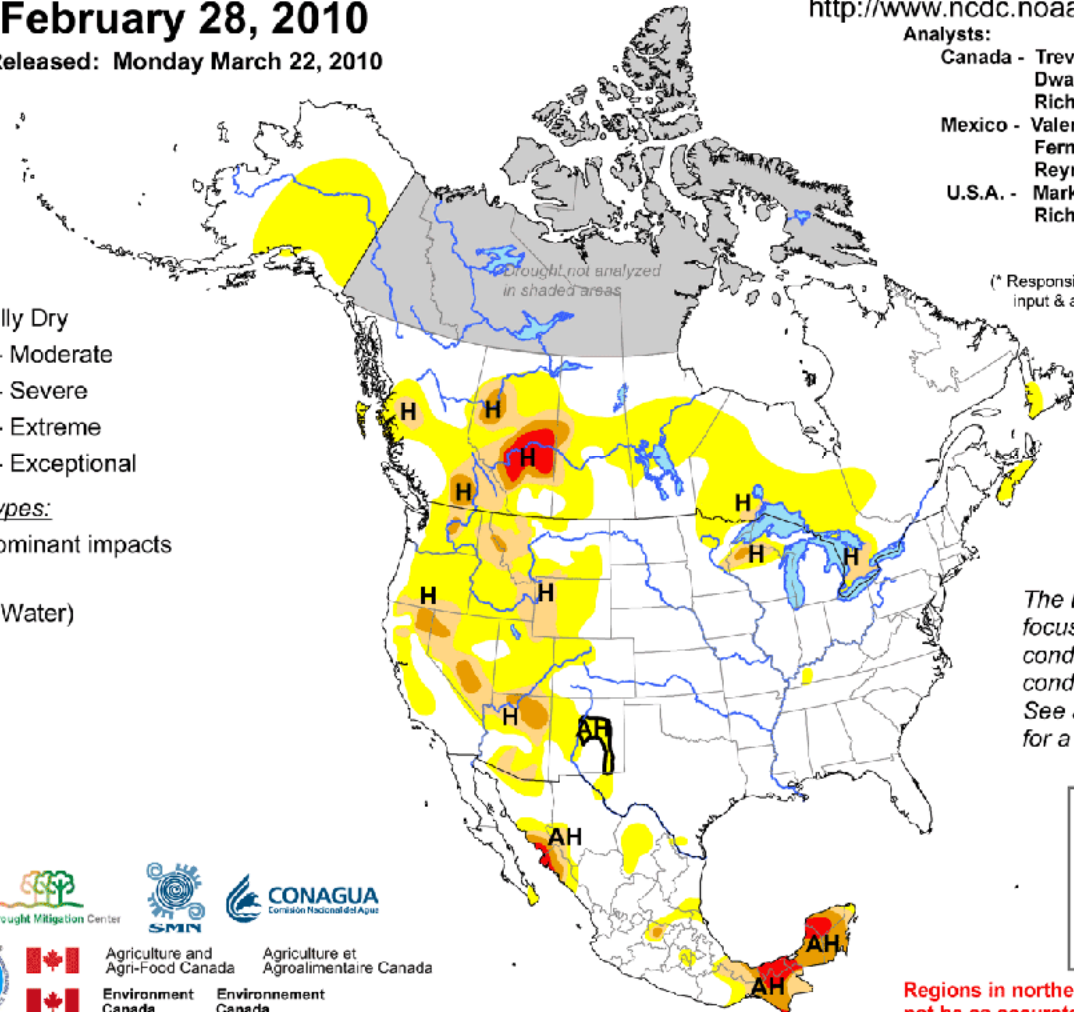
(\* Responsible for collecting analysts' input & assembling the NA-DM map)

Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

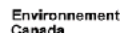
- Delineates dominant impacts
- A = Agriculture
- H = Hydrological (Water)



*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text for a general summary.*



**Regions in northern Canada may not be as accurate as other regions due to limited information.**





- EPCOR Water Services Inc. (EWSI) provides water, wastewater, and distribution services to over one million people in more than 50 communities across Western Canada.
- EWSI utilizes an Integrated Resource Planning (IRP) approach for the development of capital and operational plans for the Edmonton water system.
- Traditional planning would **consider flow characteristics of the raw water streams as “knowns”** in the system.

*Source: Climate Change – Potential IRP Impact areas*



**NSERC  
CRSNG**



## **Past, recent and future hydroclimatic variability, North Saskatchewan River**

NSERC Collaborative Research and Development (CRD) project,  
2008-10

Principal Investigator: Dr. Dave Sauchyn, University of Regina

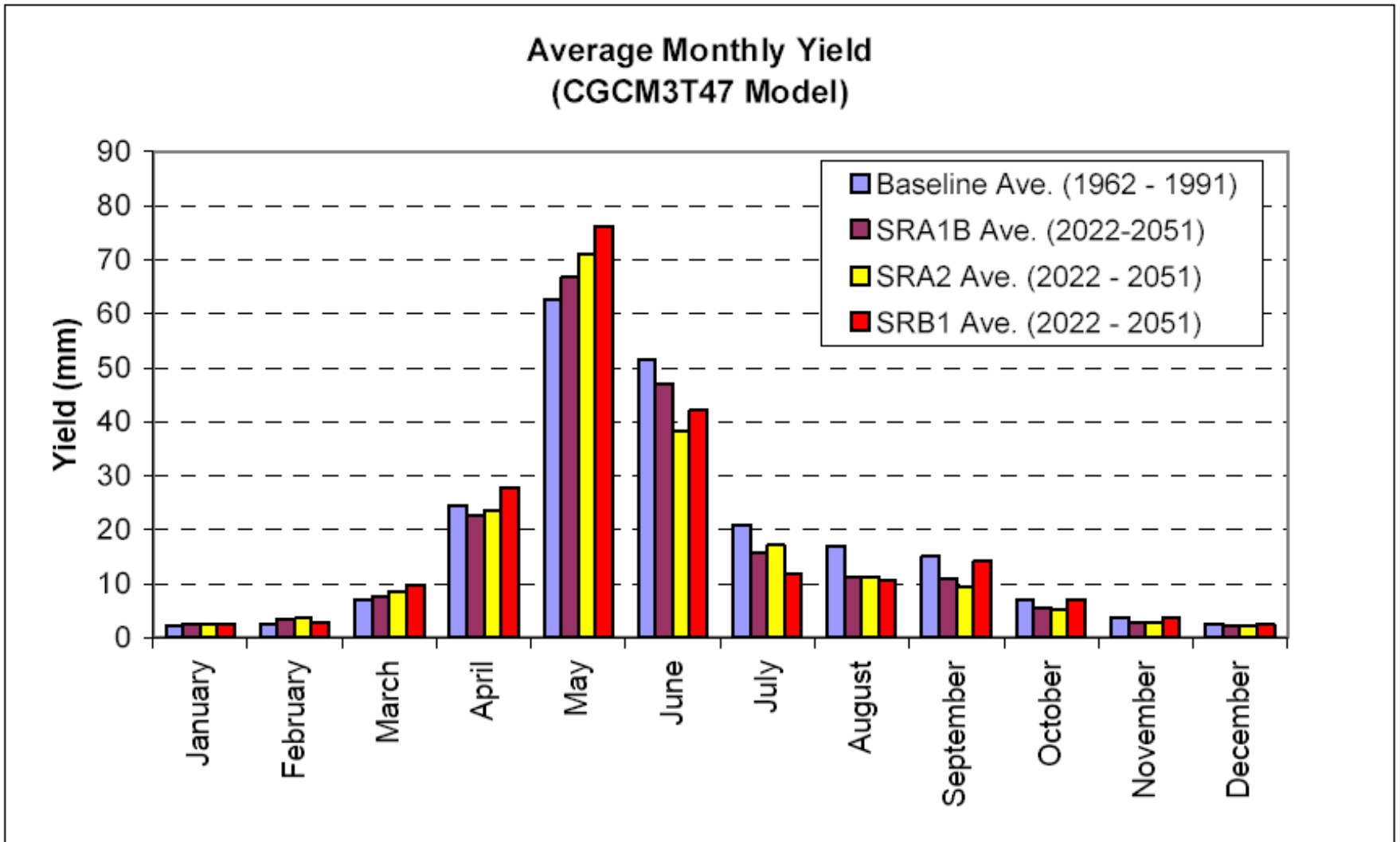
Co-Investigators: Dr. James Byrne and Dr. Stefan Kienzle  
University of Lethbridge

# Project Objectives

Develop a 600-year (1500 to 2100 A.D.) record of the hydroclimate of the North Saskatchewan River basin above Edmonton to assist EPCOR Water Services Inc., with preparation for the impacts of climate change on water supplies.

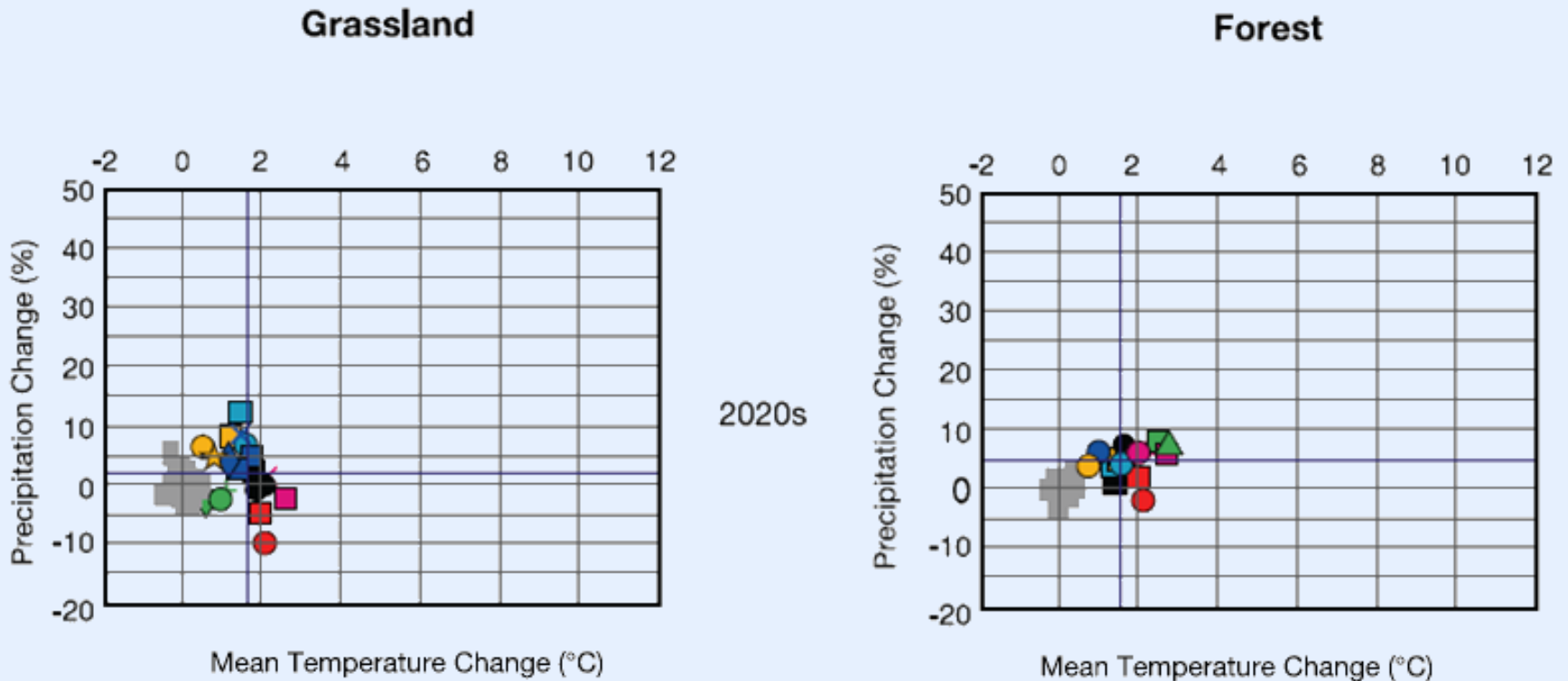
1. derive a **paleo-hydroclimate record** for the interpretation of the forcing of hydrological change over the past 500 years
2. develop historical and future **climate scenarios** at the temporal and spatial scale appropriate for watershed modelling
3. calibrate and validate a distributed physical-conceptual climatologic and **hydrological simulation model** to provide a realistic physical representation of hydrological variables
4. simulate **hydrologic response to future climate** scenarios
5. project flood and drought frequencies to assess risk and provide water managers with **future water supply scenarios**

# Climate Change Effects on Water Yield, NSRB



Golder Associates, 2008 for  
NSWA

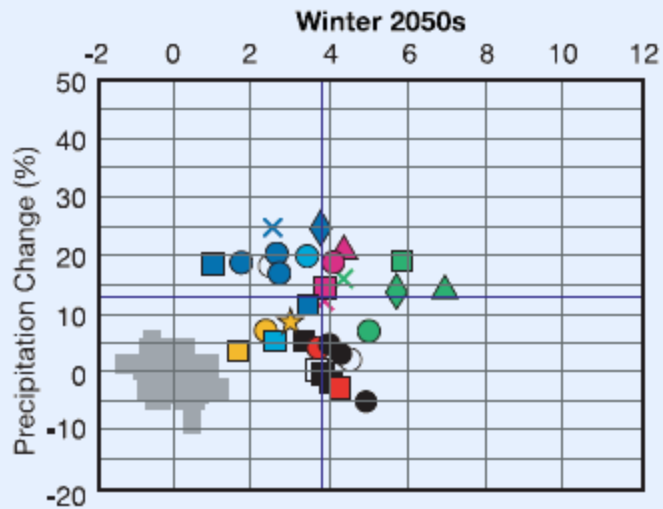
# Projected changes in mean annual temperature and precipitation



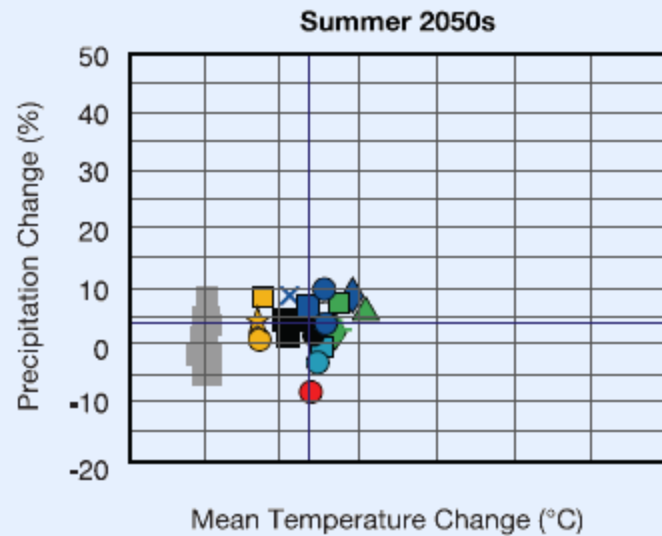
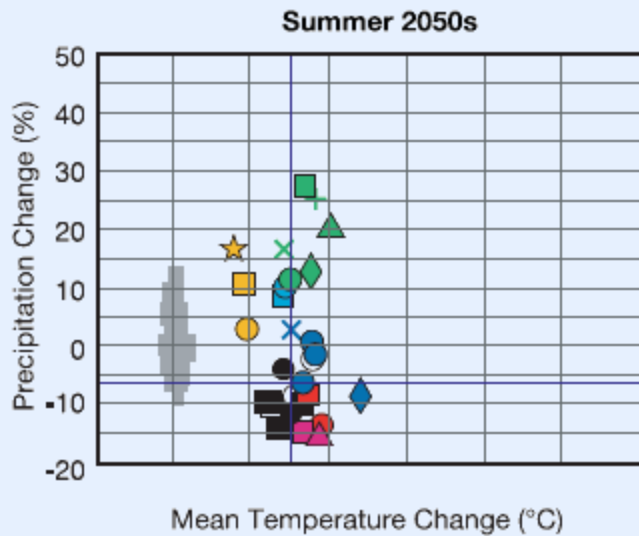
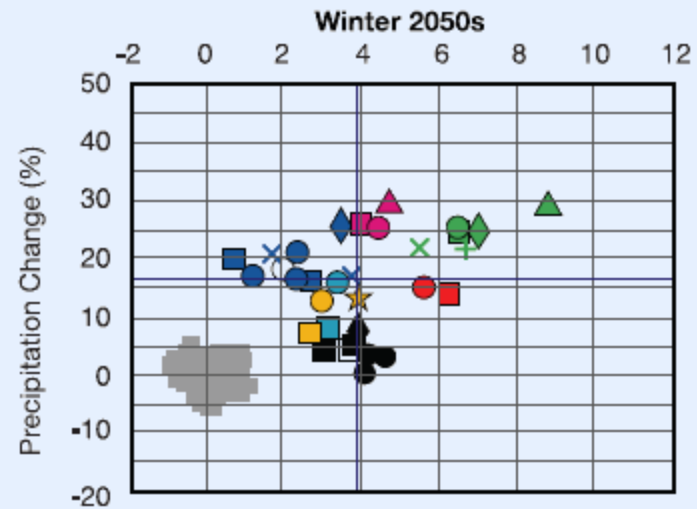
The grey squares indicate the ‘natural’ climate variability simulated by a long control run of the CGCM2.

# Seasonal Scenarios

## Grassland



## Forest



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 water and climate



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

## History and Future of Climate and Hydrology

8:30 - 8:50

**Ryan MacDonald**

*Climate Change and Mountain Hydrology NSASK Basin*

8:50 - 9:10

**James Byrne**

*Historical and future environmental change indices?*

9:10 - 9:30

**Stefan Kienzle**

*Verification of simulated hydrological processes*

9:30 - 9:50

**Suzan Lapp**

*Historical and future scenarios of moisture indices*

9:50 - 10:00

**Questions**

10:00 - 10:30

**Health Break**

10:30 - 10:50

**Jeannine-Marie St. Jacques**

*Streamflow trends: global warming, human impacts, or natural variability?*

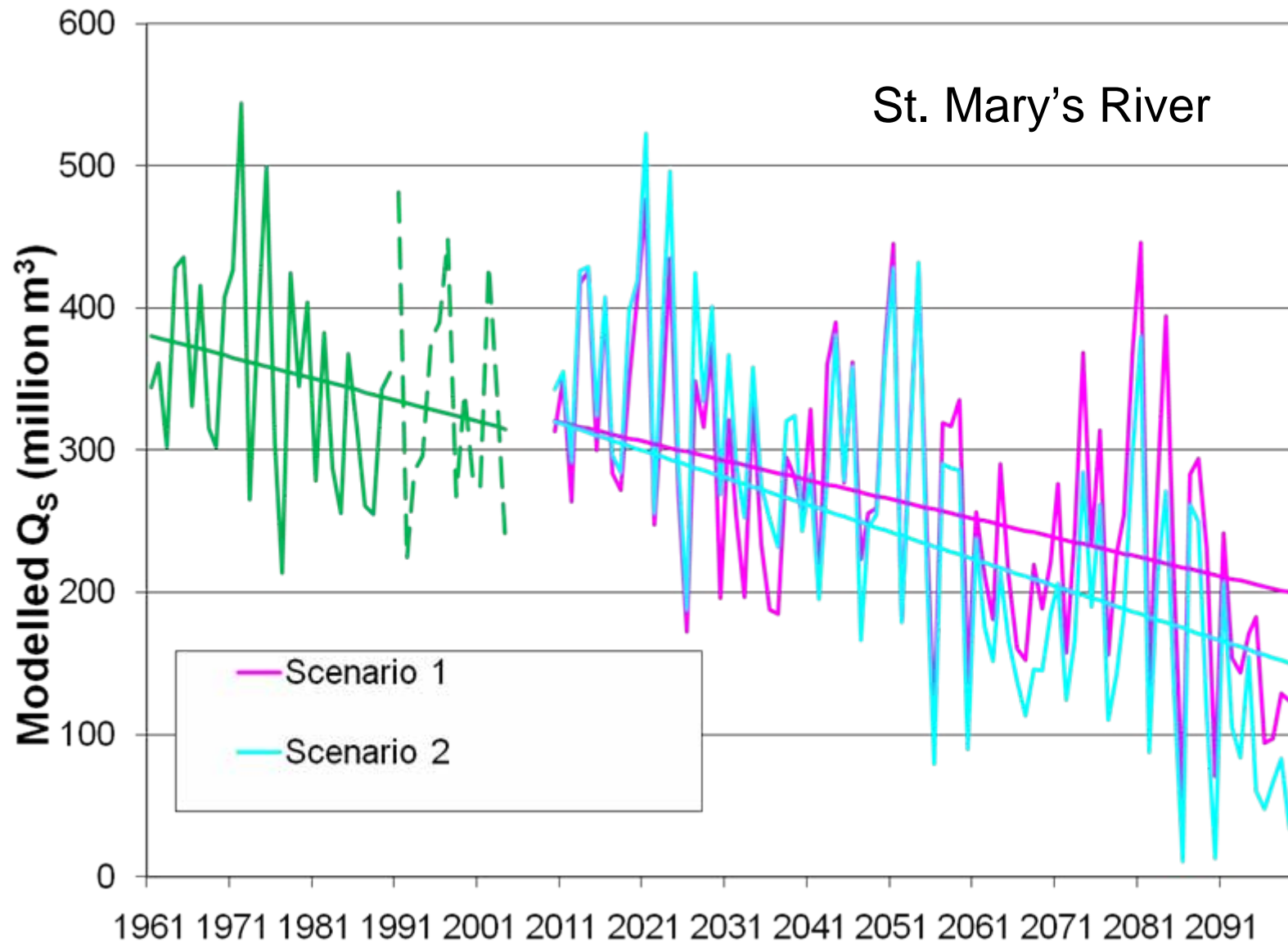
10:50 - 11:10

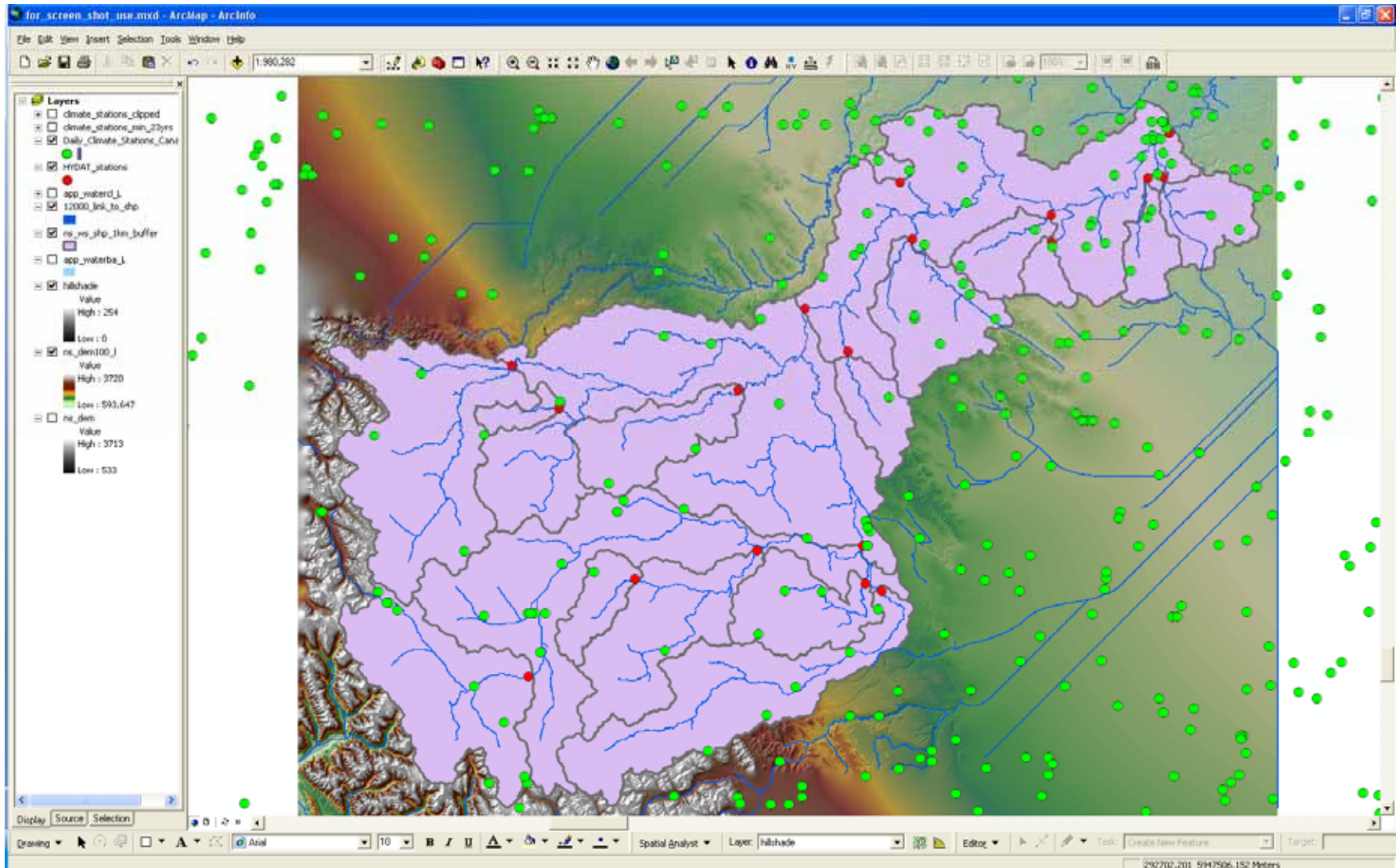
**Jessica Vanstone**

*Nine hundred year streamflow reconstruction of the North Saskatchewan River*

11:10 - 11:15

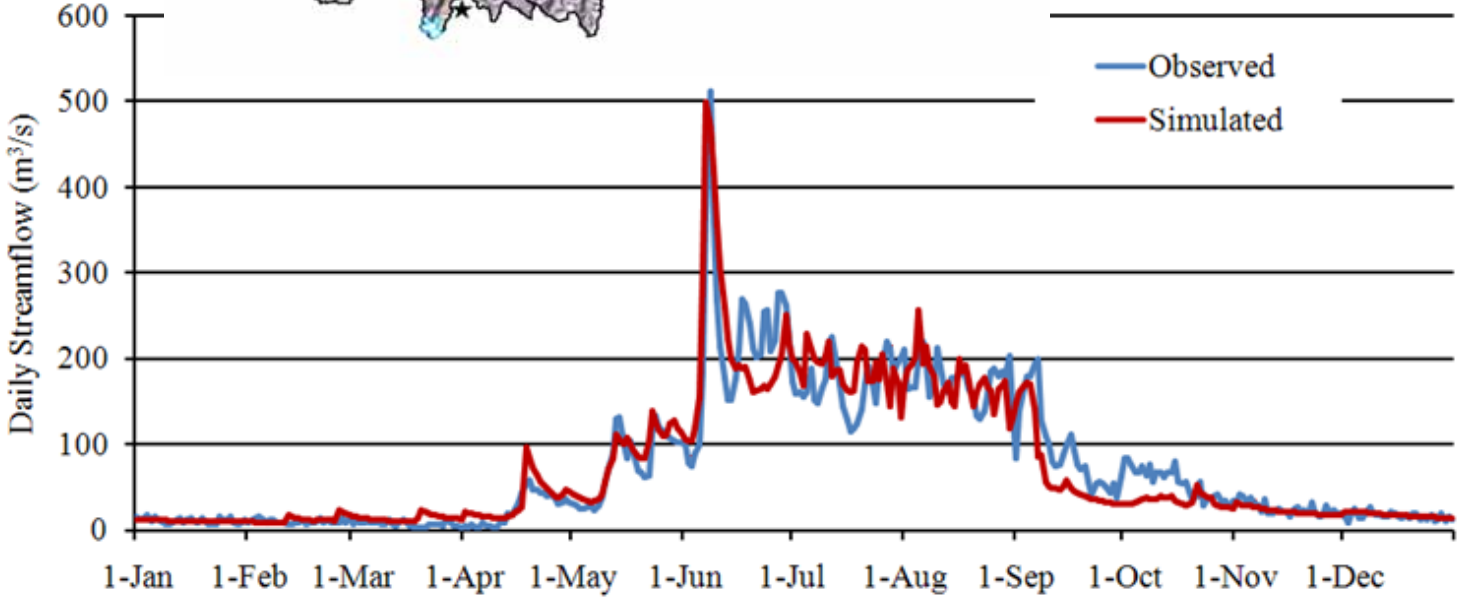
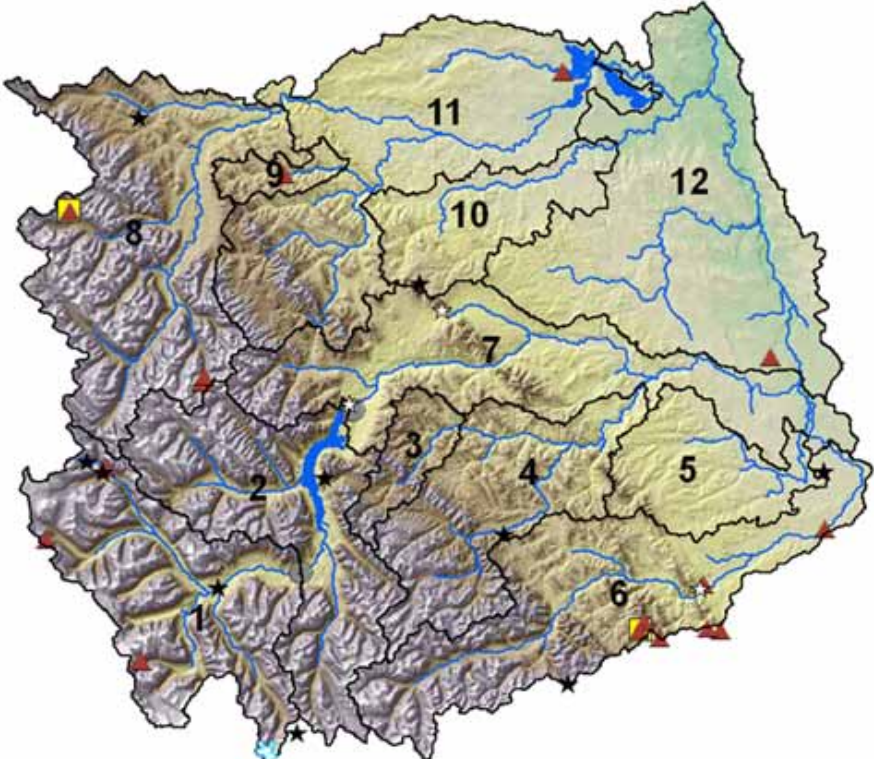
**Questions**



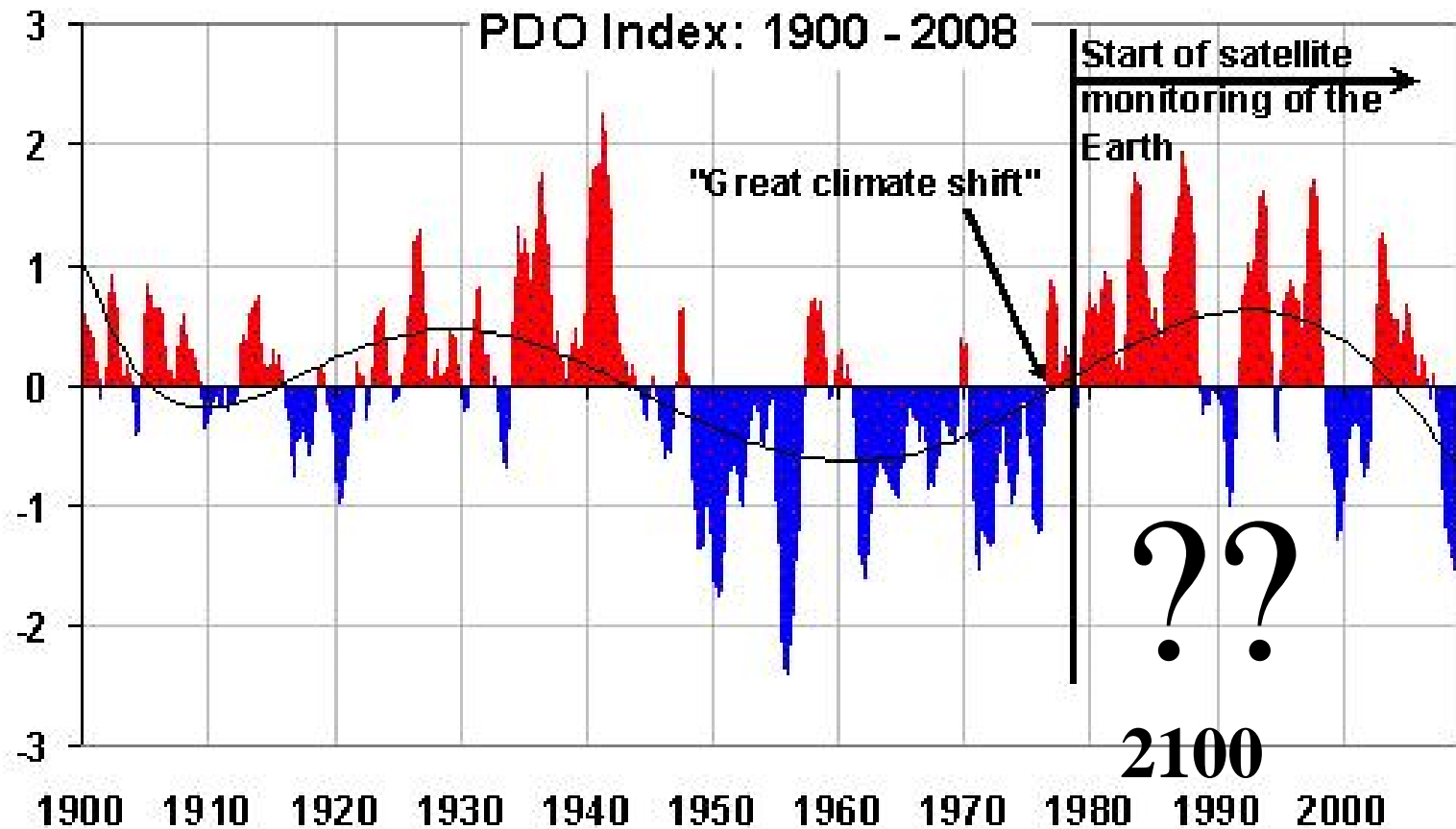


Kienzle et al.

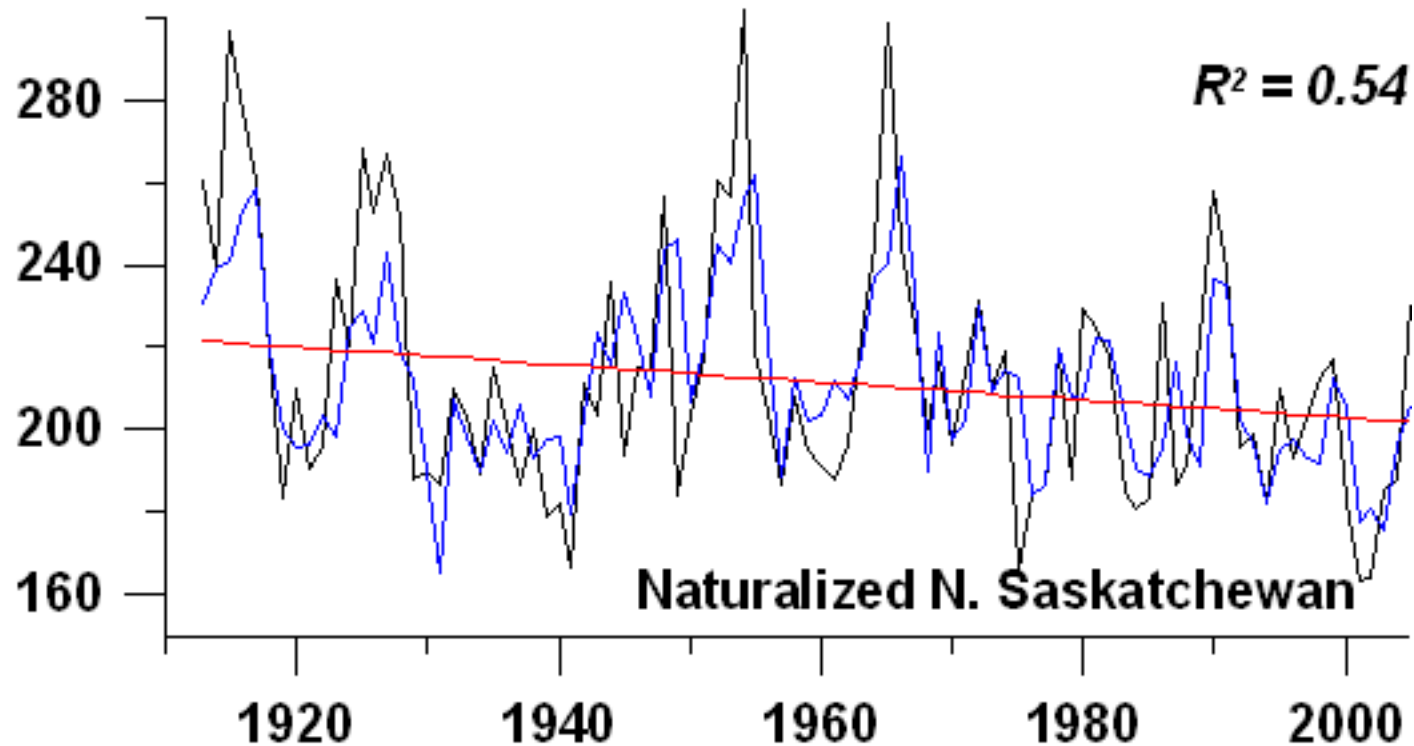
# Verification of Simulated Hydrological Processes



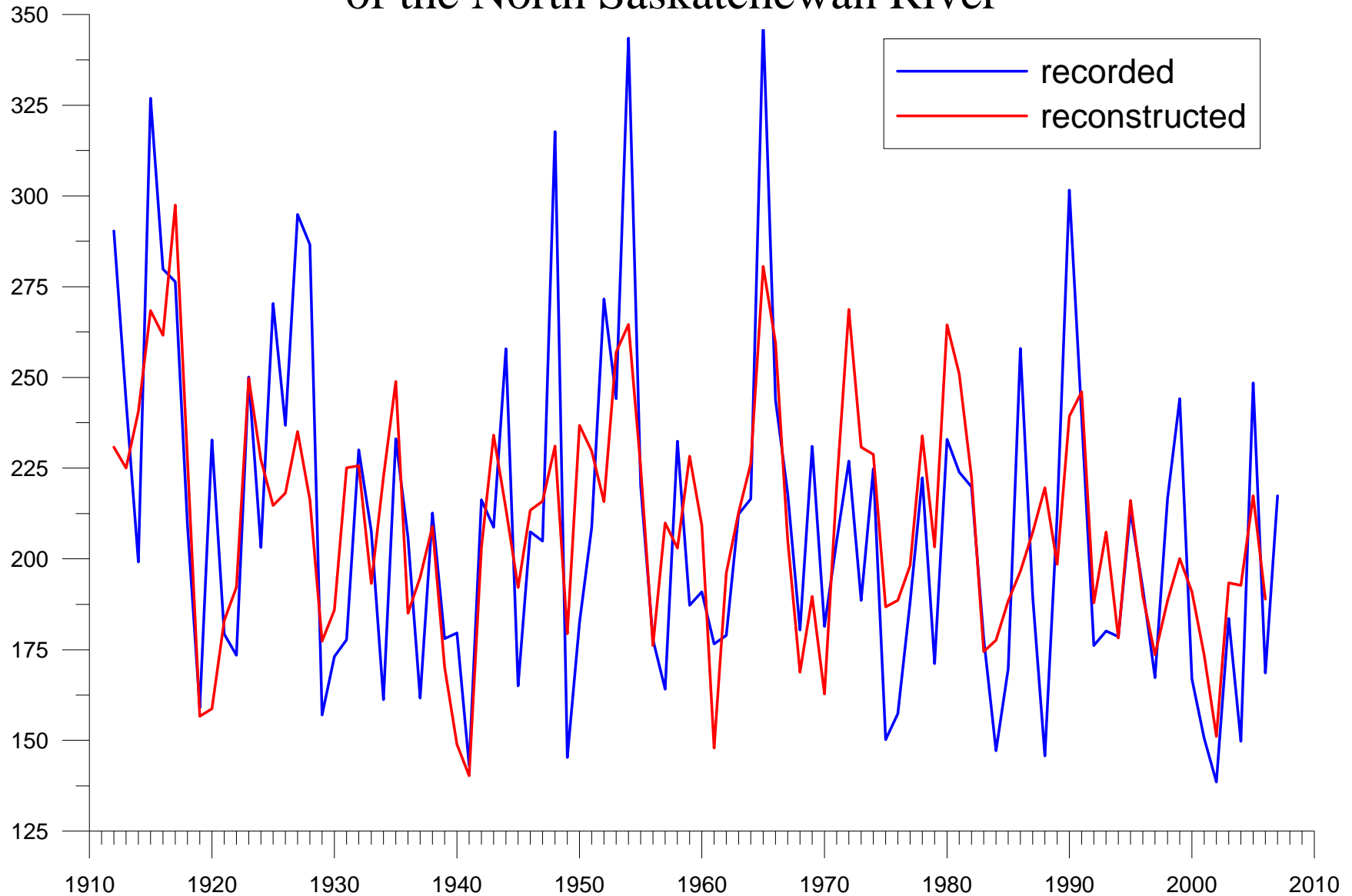
## Developing Early 21<sup>st</sup> Century Pacific Decadal Oscillation Projections

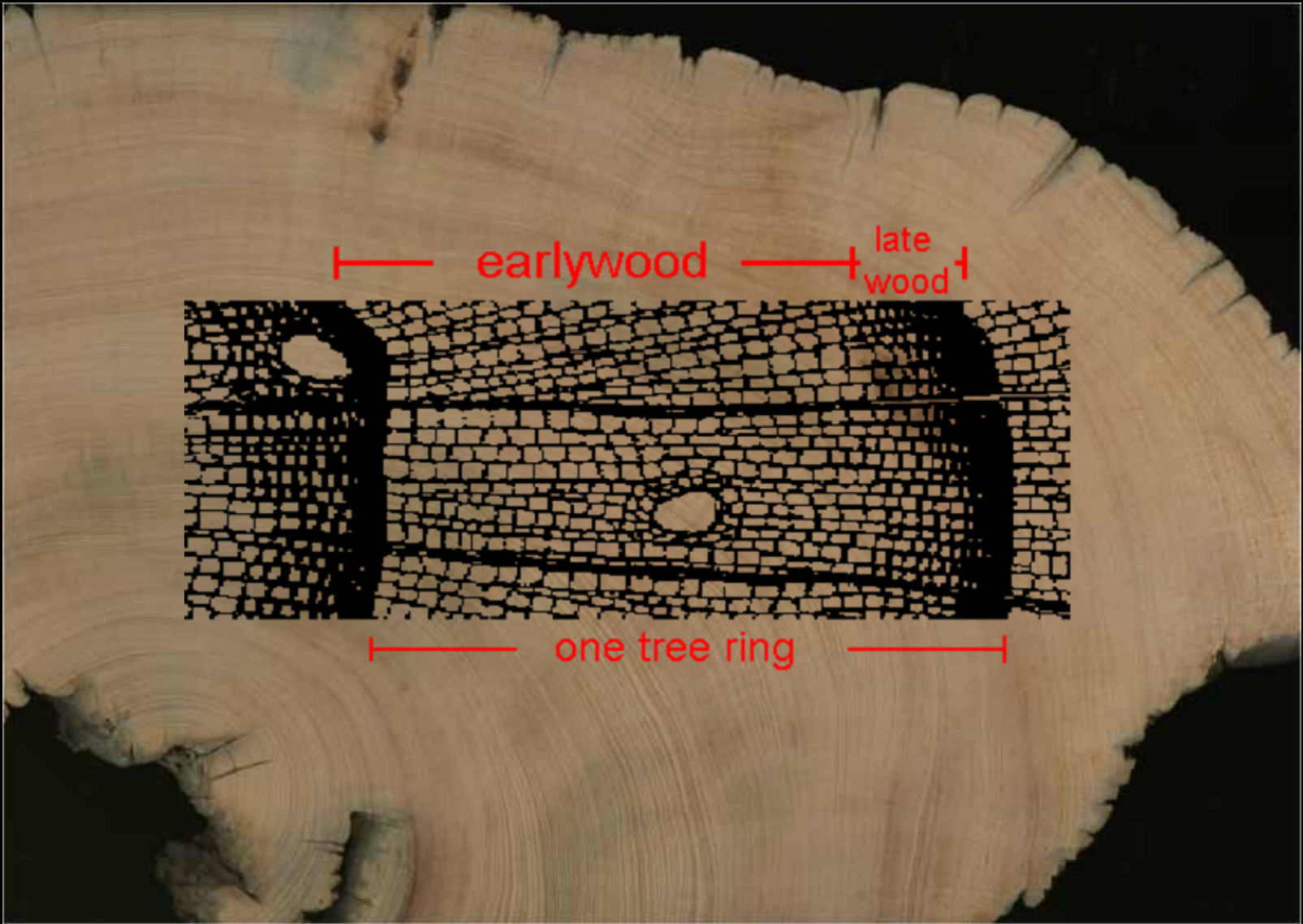


Northern Rocky Mountain streamflow records: Global warming trends, human impacts or natural variability?

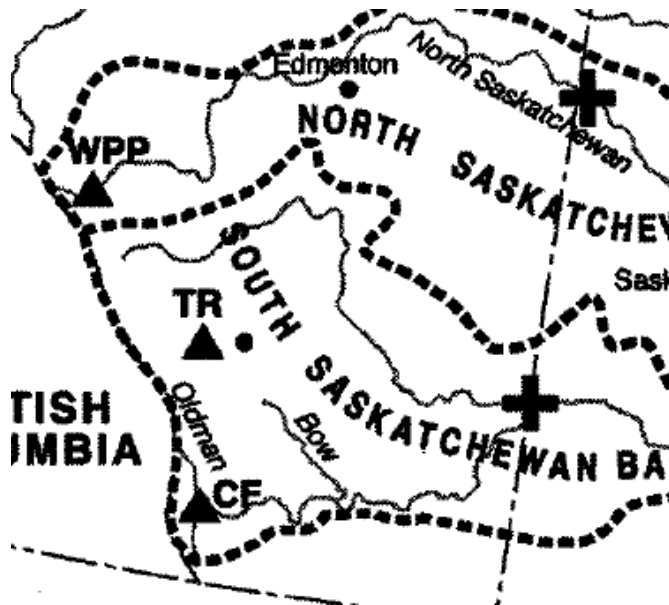
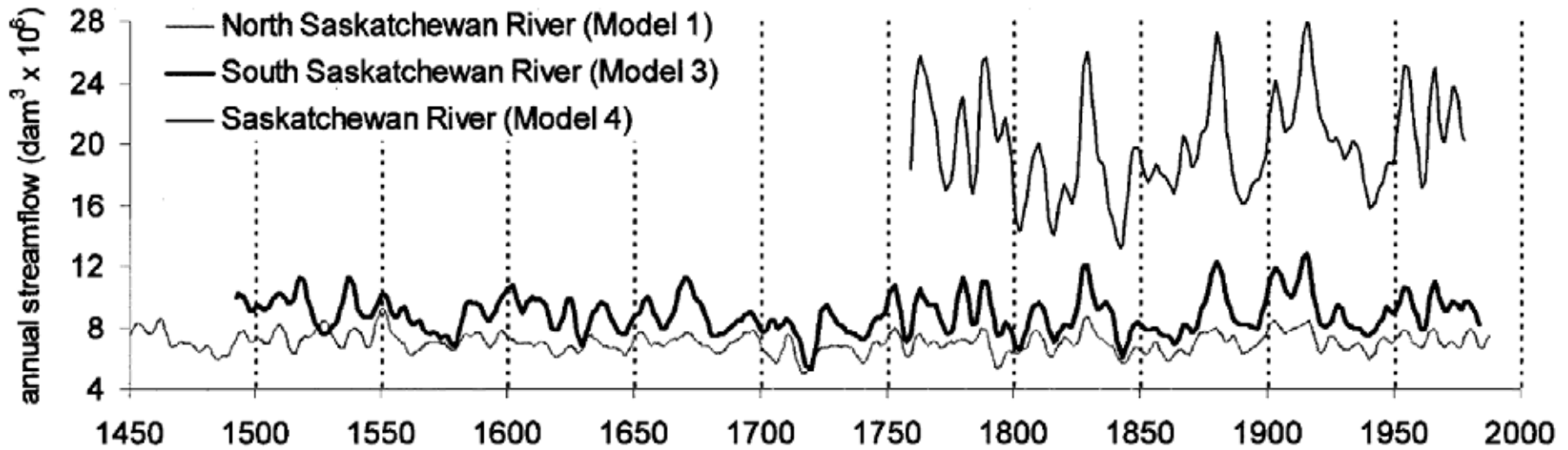


# Nine hundred year streamflow reconstruction of the North Saskatchewan River





# Previous Reconstruction



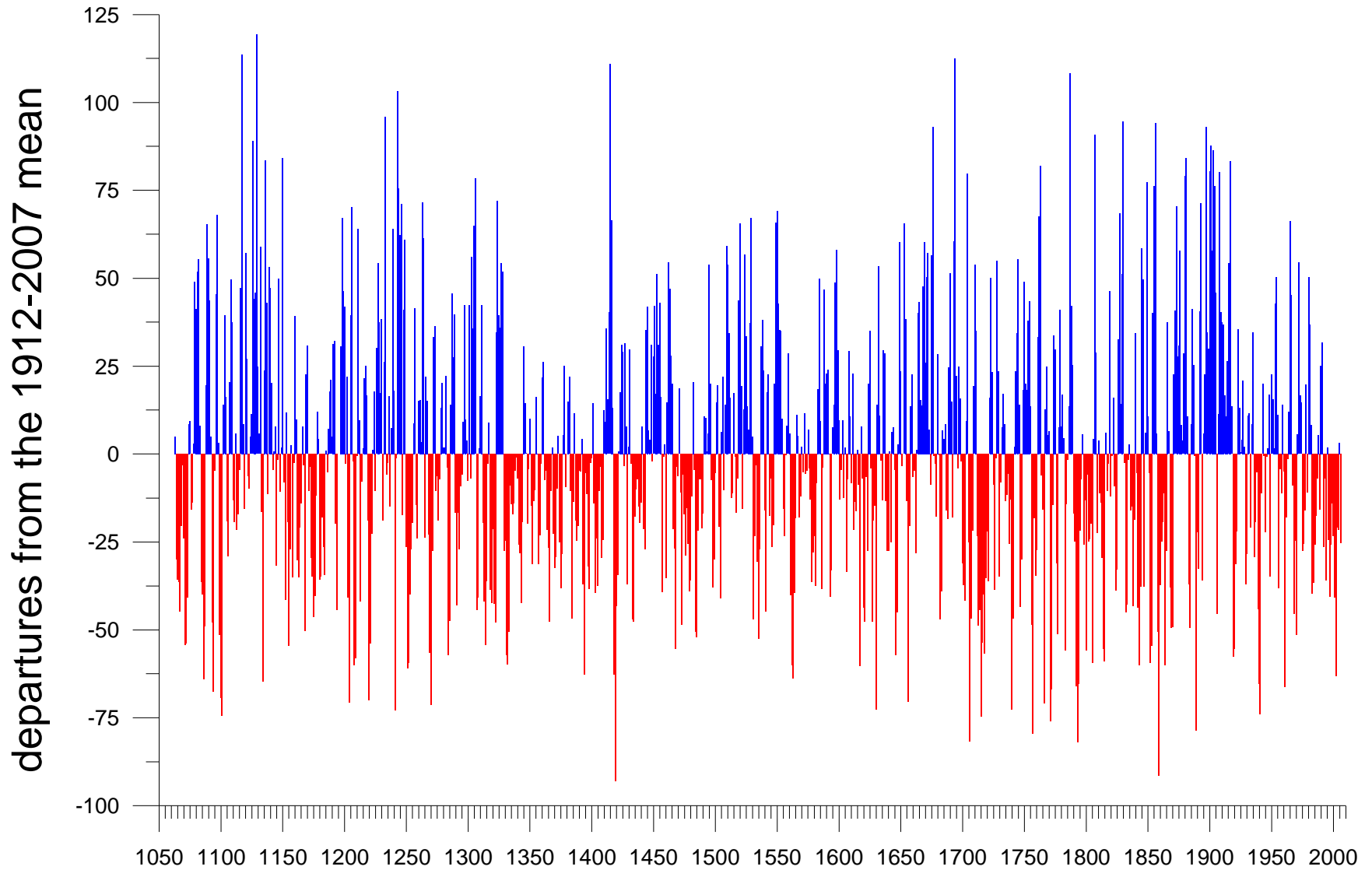
Case and Macdonald\*, 2003

\* UCLA

Old Wood  
Headwaters, NSRB



# North Saskatchewan River at Edmonton, 1063-2006



# Global Warming and Hydro-Climatic Variability

