Alberta Vulnerability Assessment Project - Climate and Biophysical Scenario Overview

Dave Sauchyn
Prairie Adaptation Research Collaborative
University of Regina

Vulnerability Assessment - Social/Economic Workshop
U of A, May 26, 2005

Climate and Biophysical Scenarios - Workplan

Climate Scenario Modelling – Barrow and Yu

A range of potential future climates by downscaling Global Climate Model output to the provincial scale using the Alberta Climate Model.

Biophysical Scenario Development – Sauchyn *et al*.

An interpretation of potential impacts of climate change on the basic productivity and characteristics of ecosystems within the context of the economic sectors that these ecosystems support.

Stage 1: Reevaluation of existing biophysical impact scenarios using the climate change scenarios developed specifically for the vulnerability assessment

Stage 2*: Developing new biophysical scenarios by running impact models using climate inputs from the scenarios developed for the vulnerability assessment

* Conditional on funding of the CSESAW research network

CLIMATE SCENARIOS FOR ALBERTA

A Report Prepared for the Prairie Adaptation Research Collaborative (PARC) in co-operation with Alberta Environment

Elaine Barrow & Ge Yu

May 2005

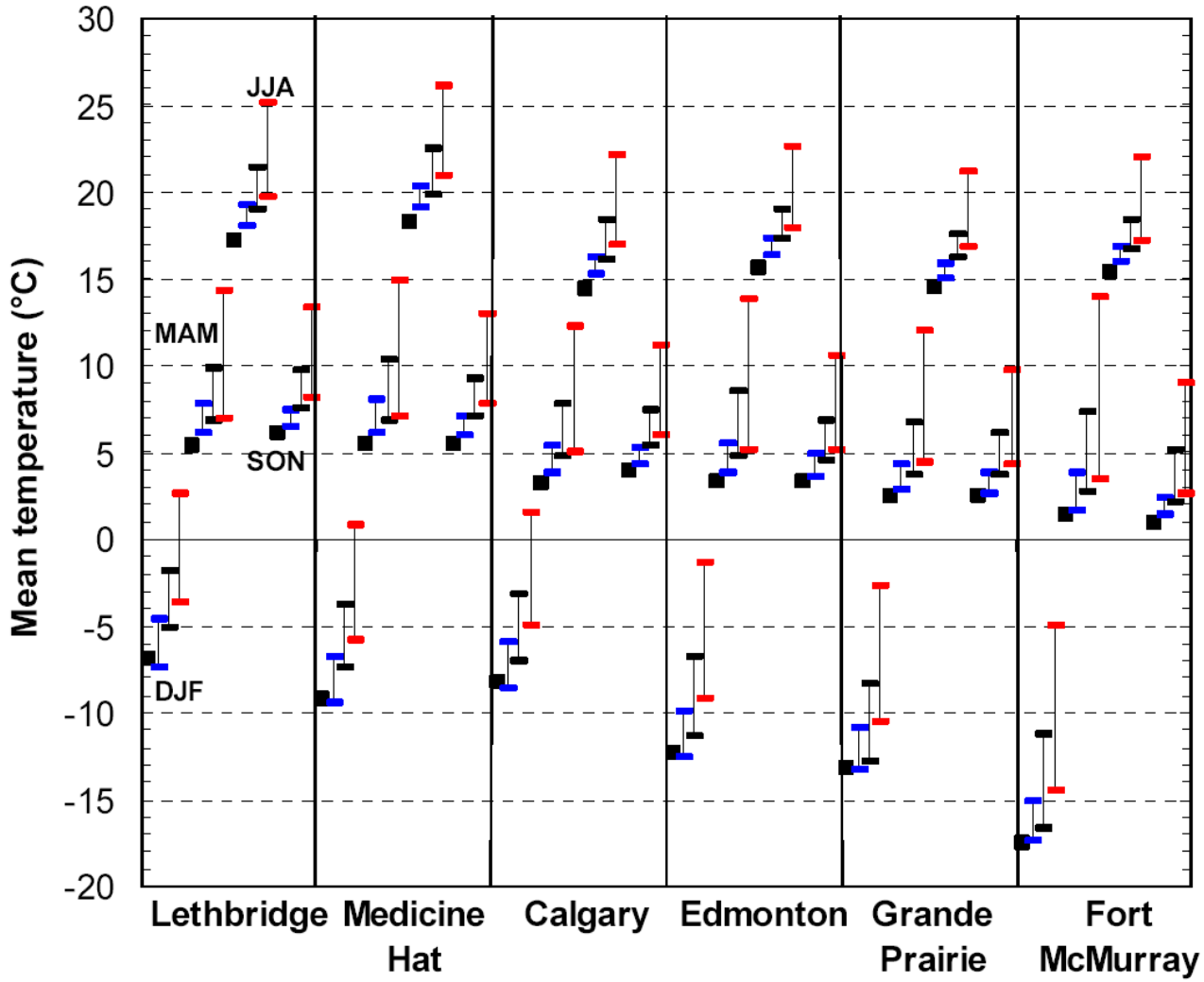
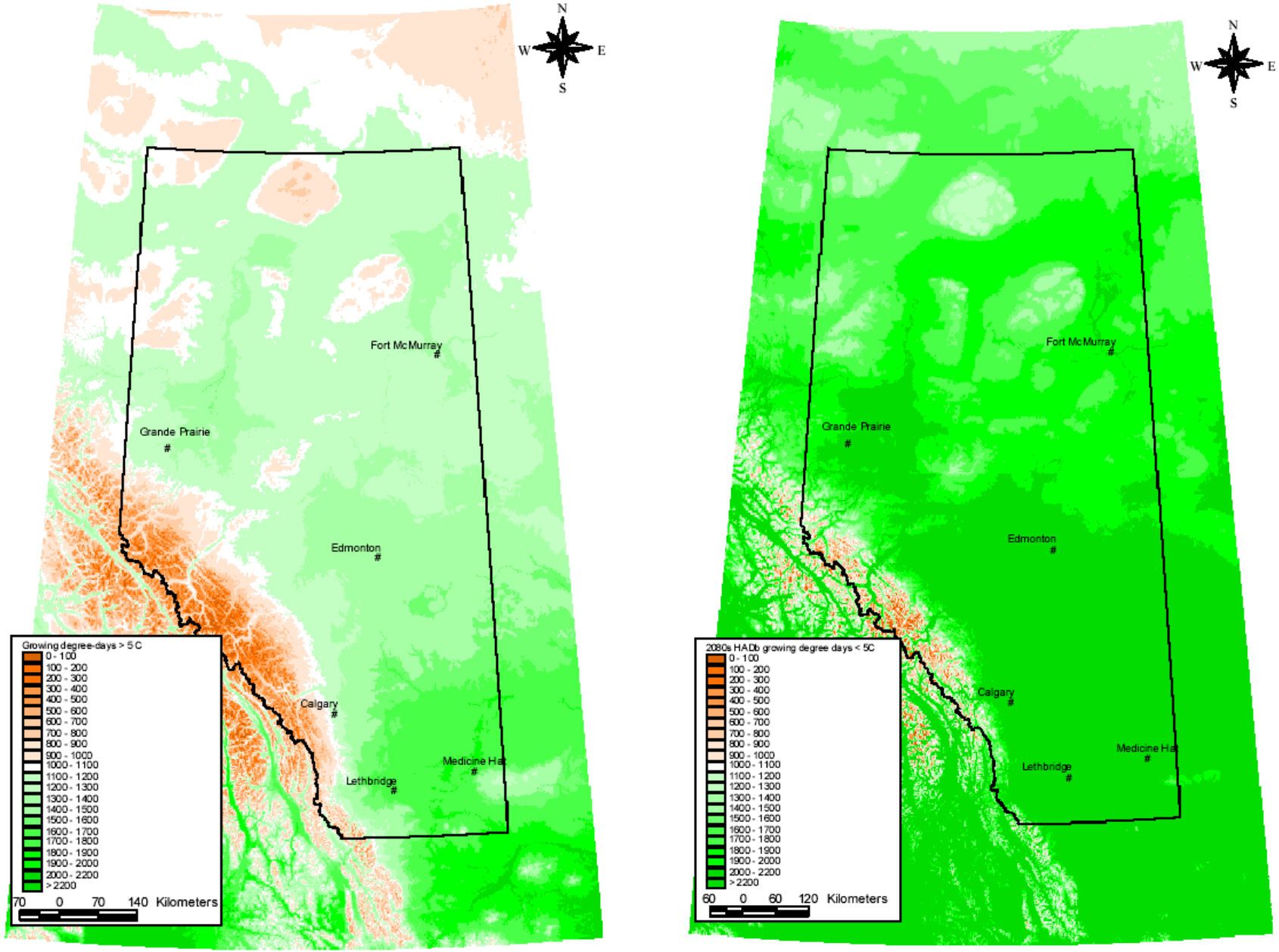
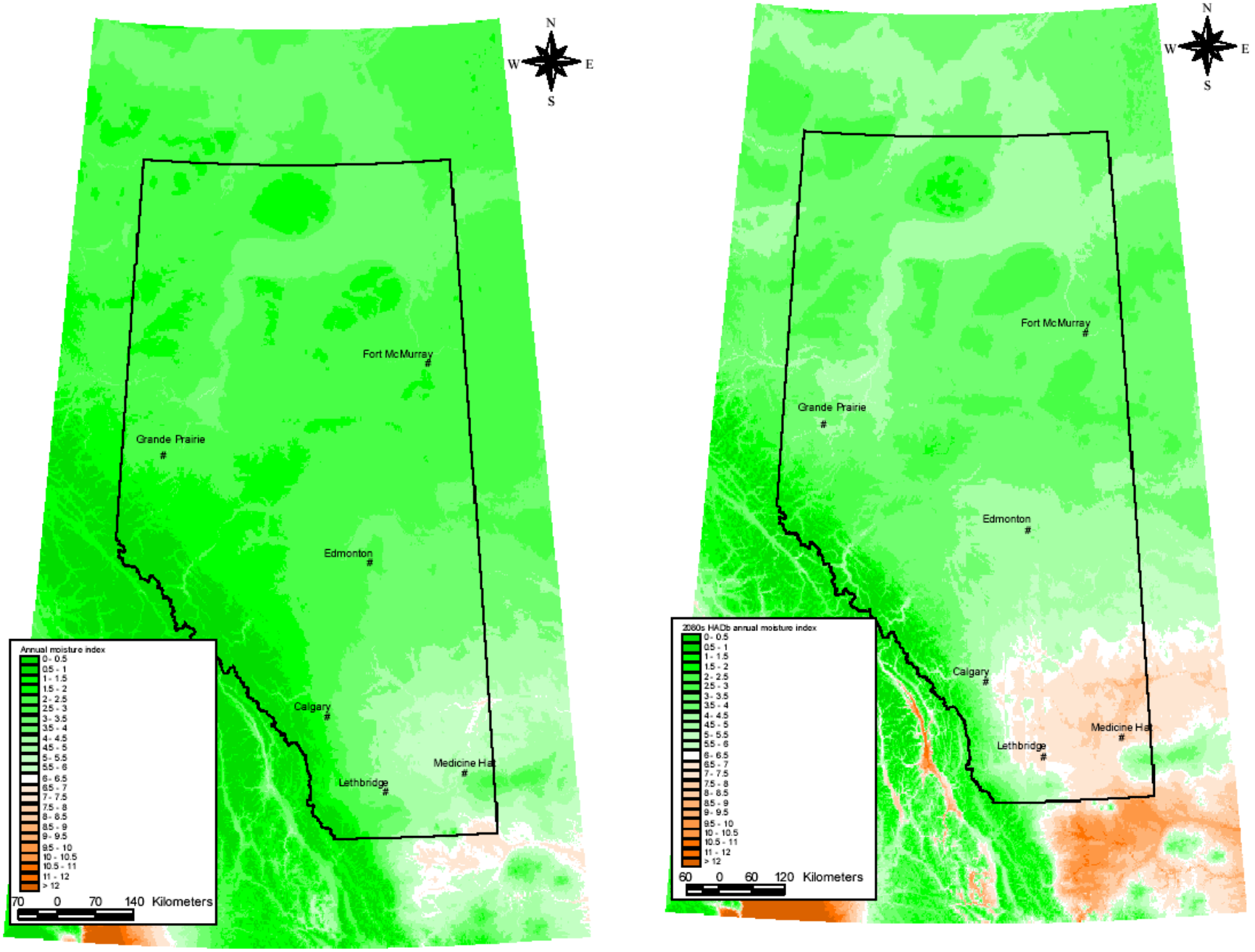


Figure 28: Seasonal mean temperature (°C) for six selected sites in Alberta. At each site there are four blocks of data [baseline (1961-1990) conditions (black square), and the scenario ranges for the 2020s (blue high-low lines), the 2050s (black high-low lines) and the 2080s (red high-low lines]. Each block of data represents a single season: from left to right – Winter (DJF), Spring (MAM), Summer (JJA) and Fall (SON). The scenario range has been calculated from the results for the five selected scenarios.



Degree days > 5°C for 1961-90 (left) and for the median scenario (HadCM3 B2(b)) for the 2080s (right).



Annual moisture index for 1961-90 (left) and for the median scenario (HadCM3 B2(b)) for the 2080s (right).

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PRAIRIE ADAPTATION RESEARCH COLLABORATIVE

Partners
Staff Profiles
Current Projects
Research Professors
Research Publications
Sectors of Research
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Agriculture
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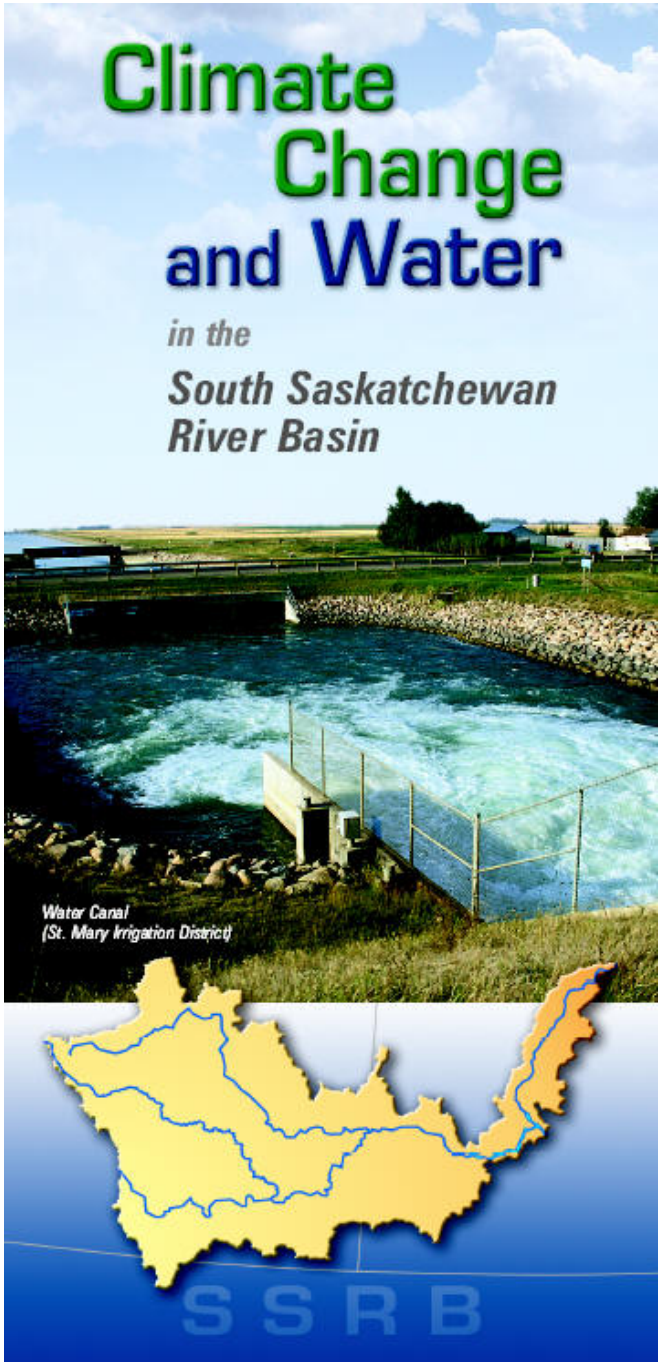
Earth Sciences
Energy
Forestry and Biodiversity
General Policy
Scenarios
Water Resources

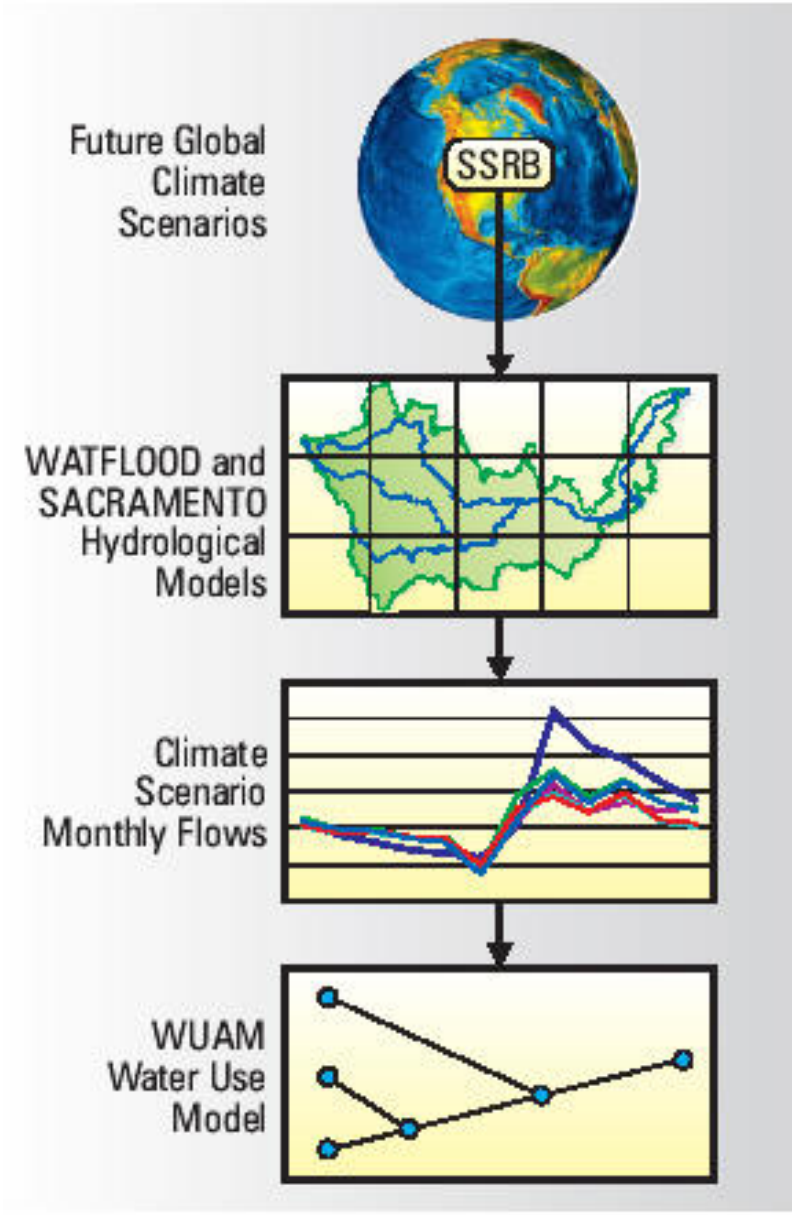
Prairie Adaptation Research Collaborative

aptation Research Collaborative is a partnership of the governments of Canada, Alberta, Saskatchewan and Manitoba mandated to pursue climate change ptation research in the Prairie Provinces. Our objective is to generate practical options to adapt to current and future climate change. We are also charged with velopment of new professionals in the emerging science of climate change impacts and adaptation.

PARC also hosts **C-CIARN Prairies**, part of the national Canadian Climate Impacts and Adaptation Network.

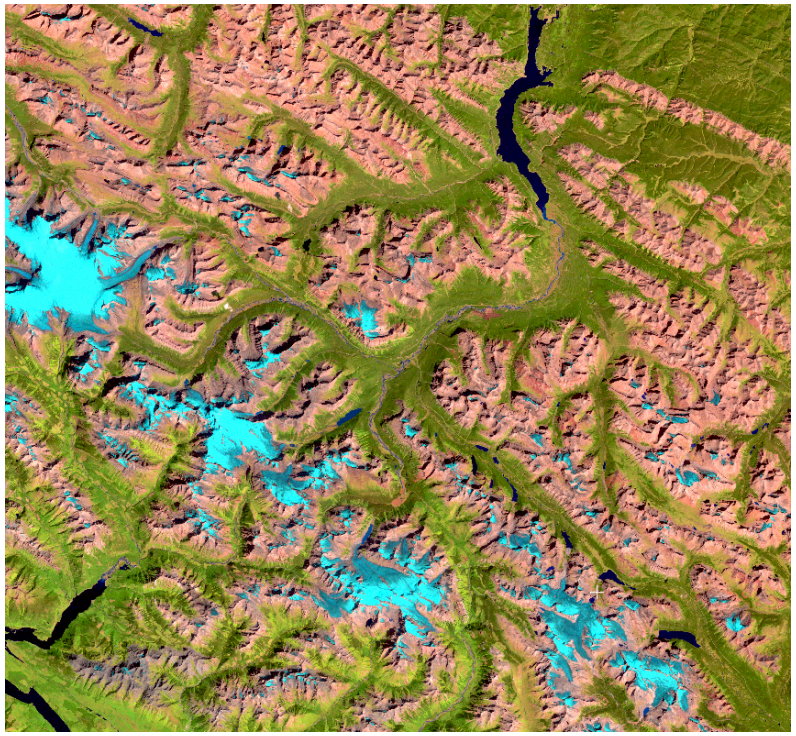
Climate models generally forecast drier and warmer conditions and increased climate variability for the Prairie Provinces. This implies stress on agriculture, reduced river and stream flows, increased fires and pathogen stress in our forests, and impacts on biodiversity, to highlight a few challenges. Since its inception in 2000, PARC has been involved in dozens of interdisciplinary projects to address climate change impacts and adaptation issues. Explore our site to view our research projects and reports and learn about our support for graduate researchers and interns. Climate change affects all of us in some way - how does it affect you?


Climate
Change
and Water
in the
South Saskatchewan
River Basin
Water Canal
(St. Mary Irrigation District)
SSRB


Future Global
Climate
Scenarios
SSRB
WATFLOOD and
SACRAMENTO
Hydrological
Models
Climate
Scenario
Monthly Flows
WUAM
Water Use
Model

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

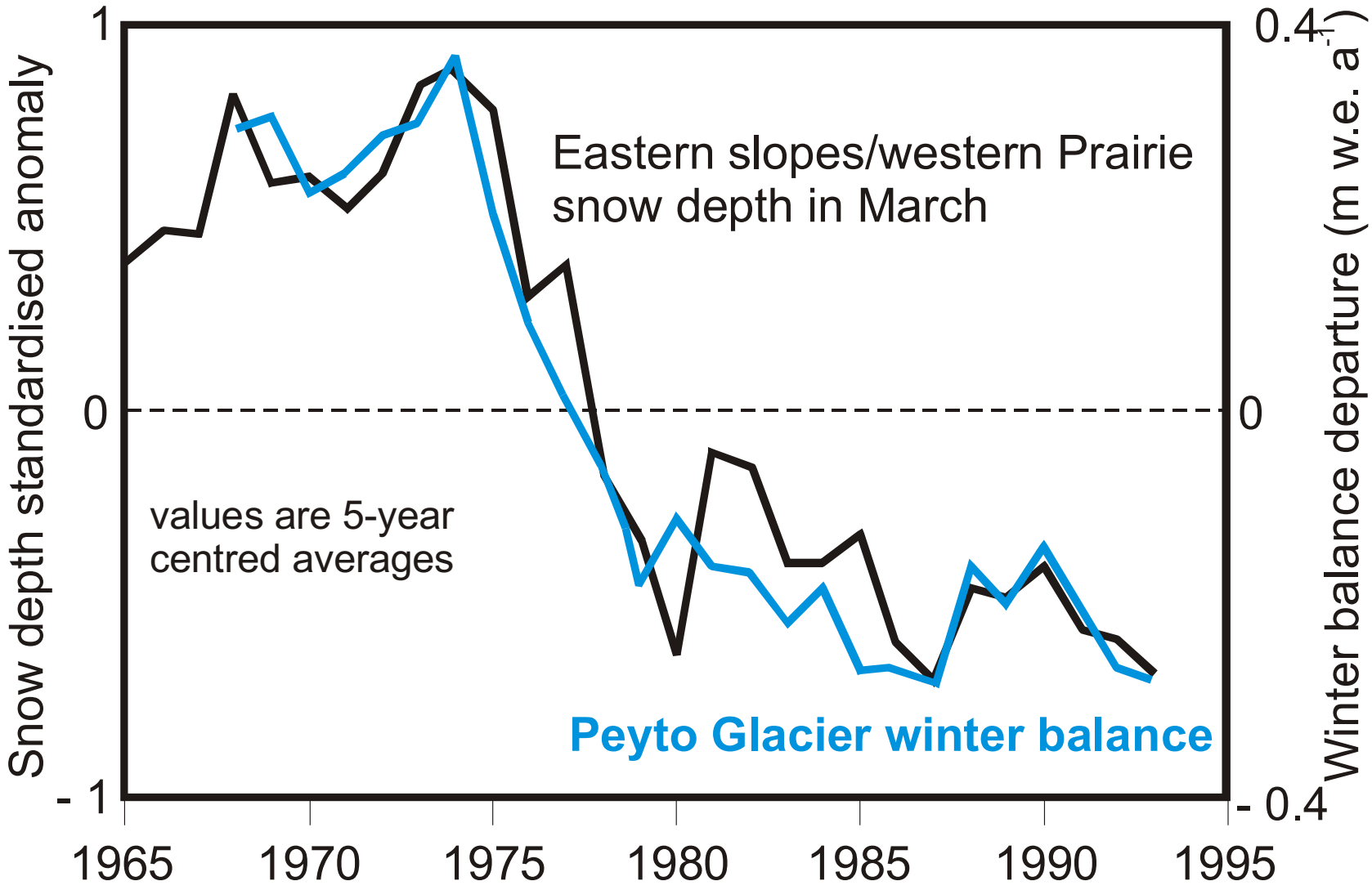
Declining supplies of glacier runoff have serious implications for the adaptive capacity of downstream surface water systems and for trans-boundary water allocation

1966

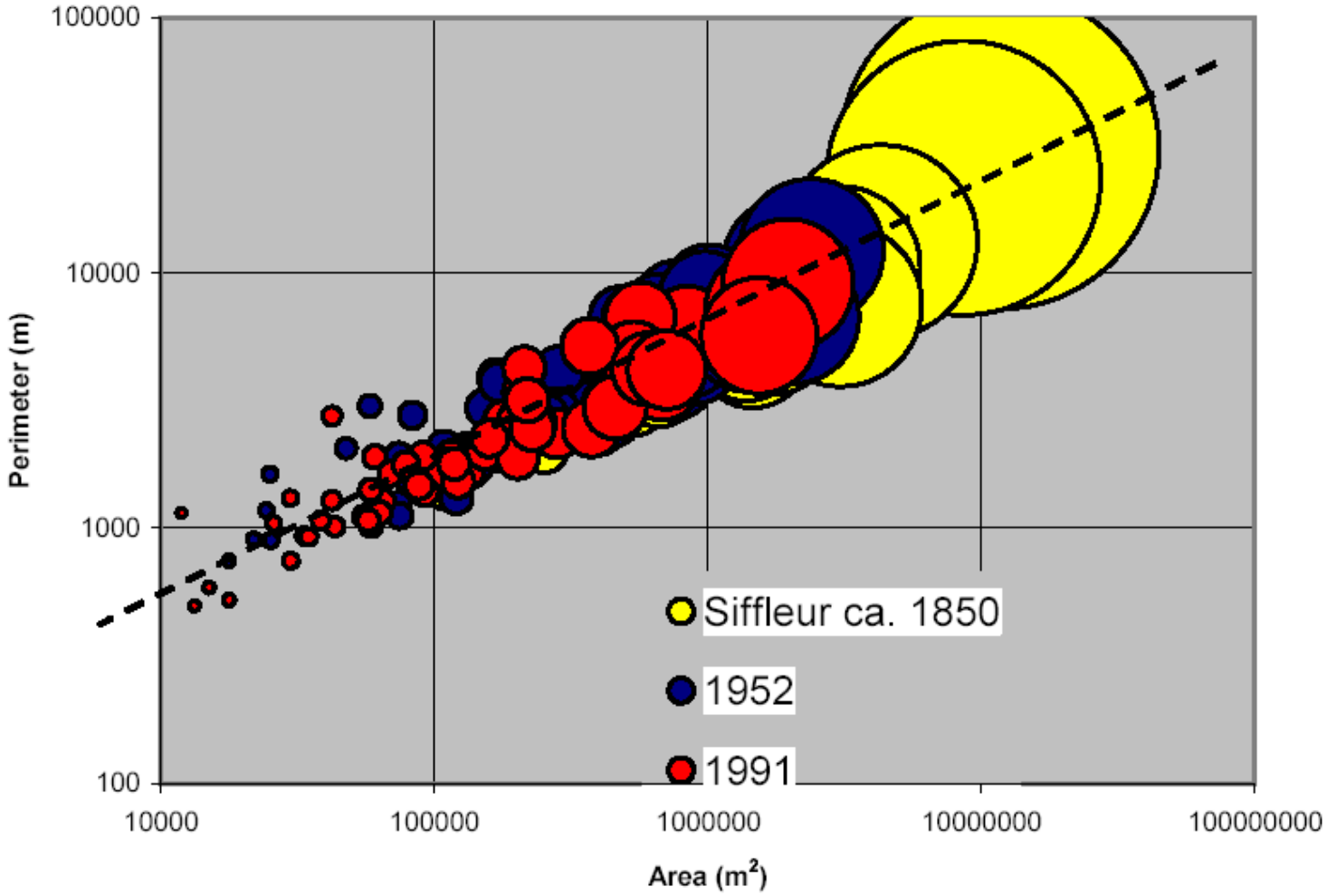
W.E.S Henoch

2001

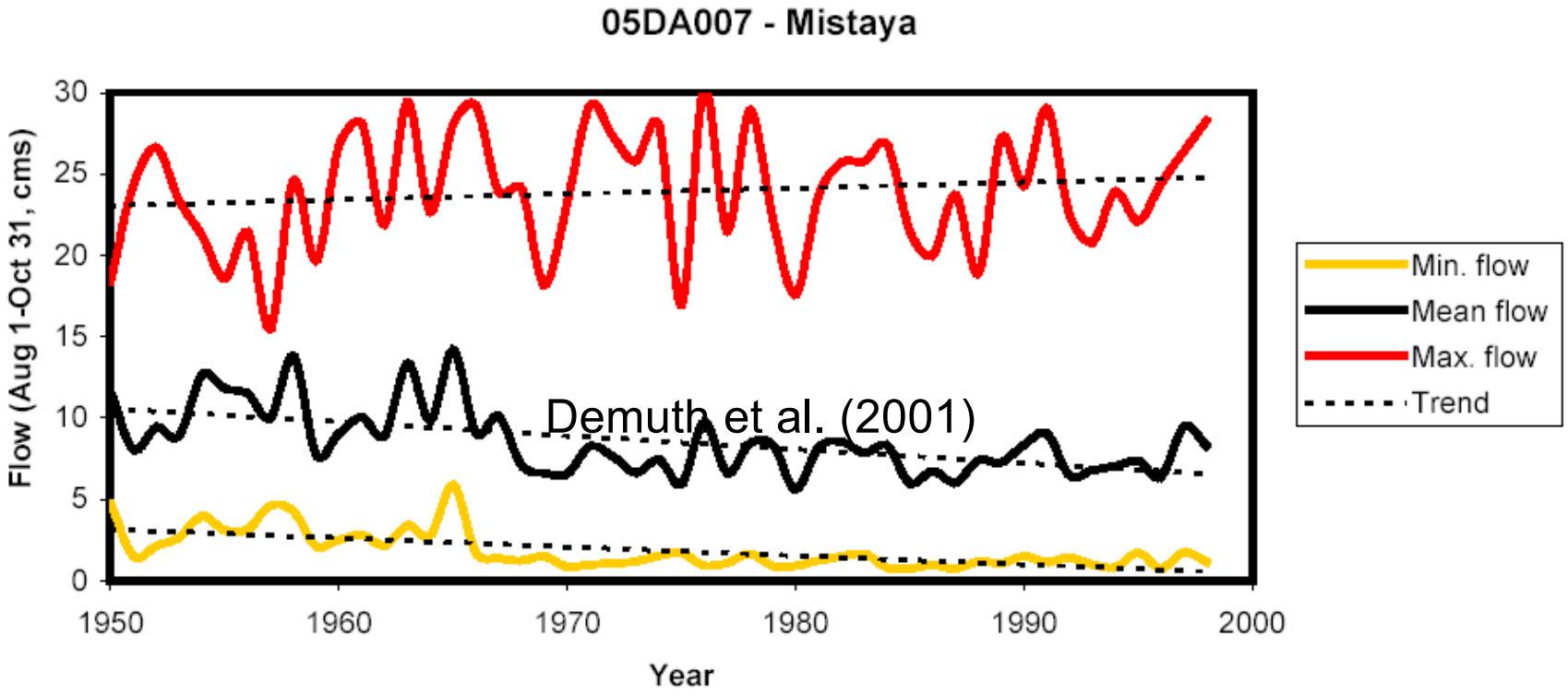
M.N. Demuth



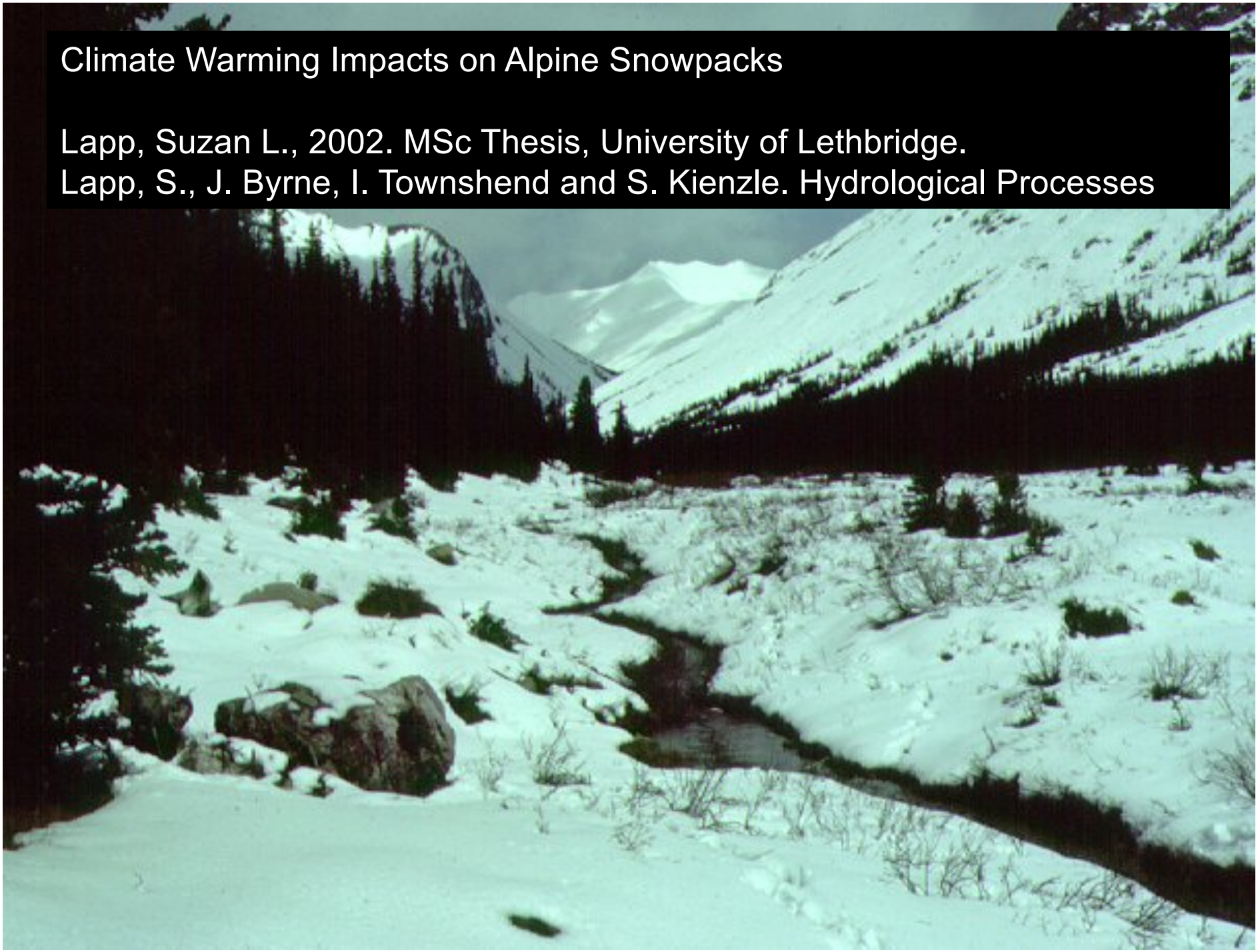
Demuth and Pietroniro, 2001



Demuth and Pietroniro, 2001

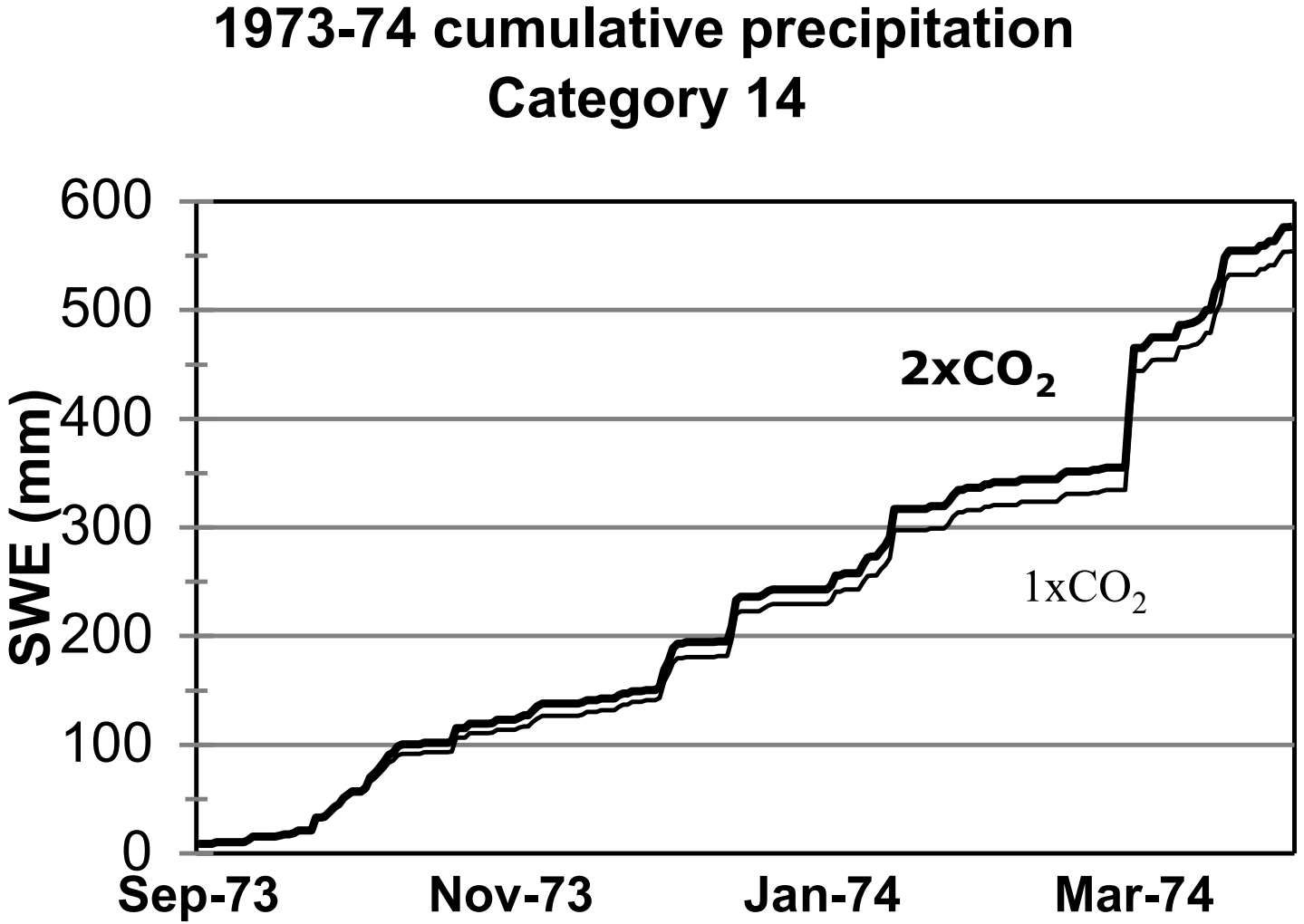


Demuth and Pietroniro, 2001

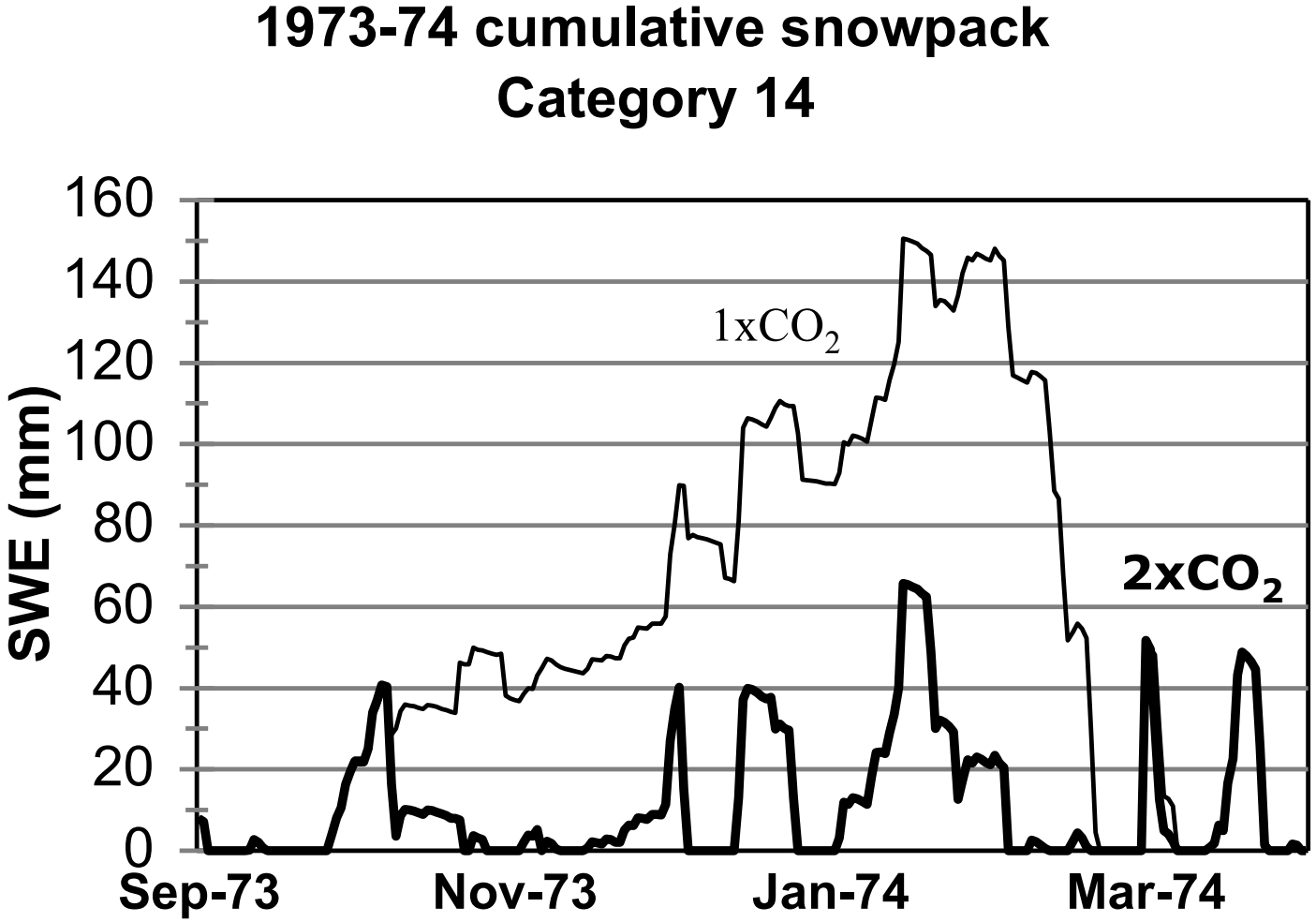


Climate Warming Impacts on Alpine Snowpacks

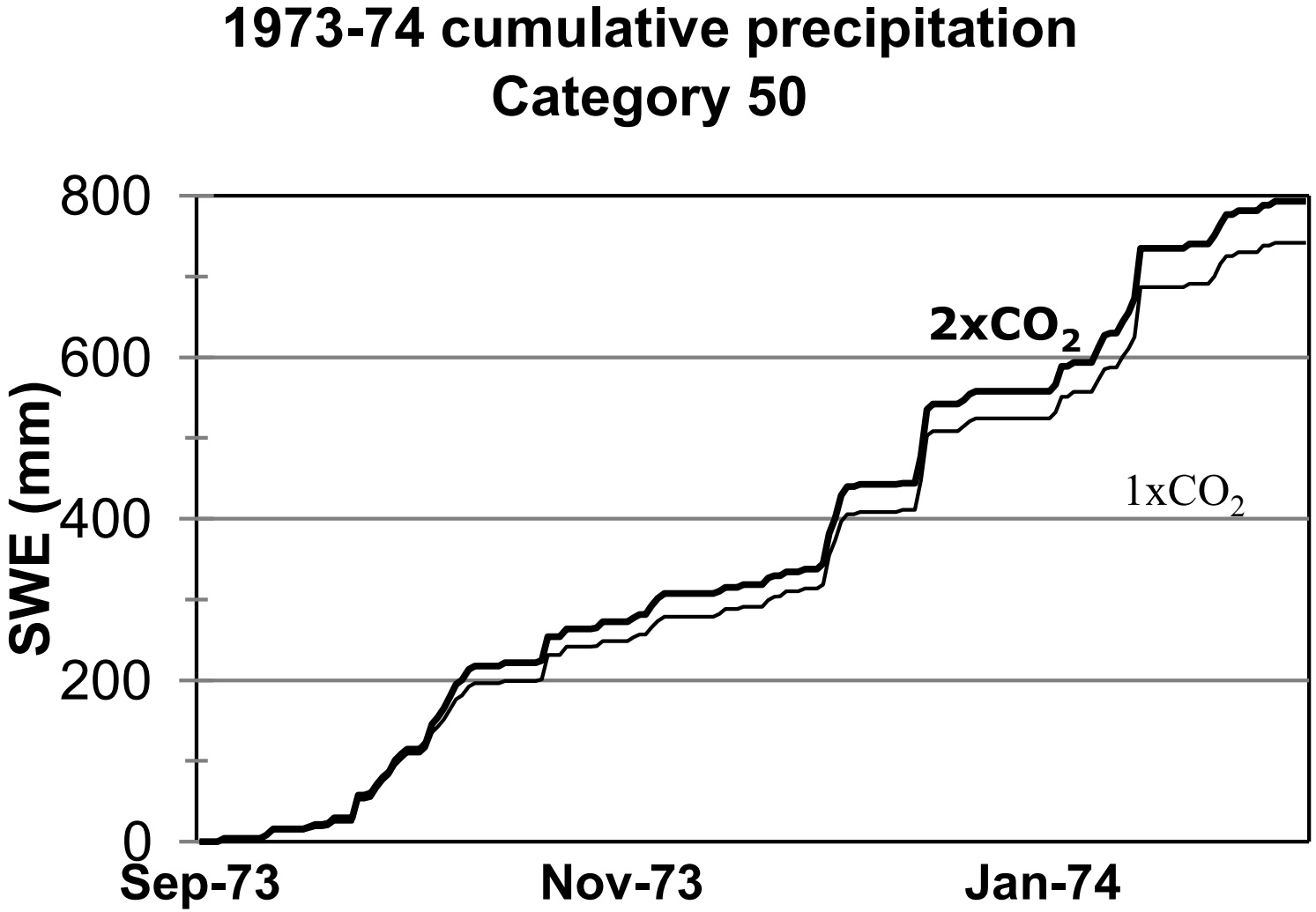
Lapp, Suzan L., 2002. MSc Thesis, University of Lethbridge.
Lapp, S., J. Byrne, I. Townshend and S. Kienzle. Hydrological Processes



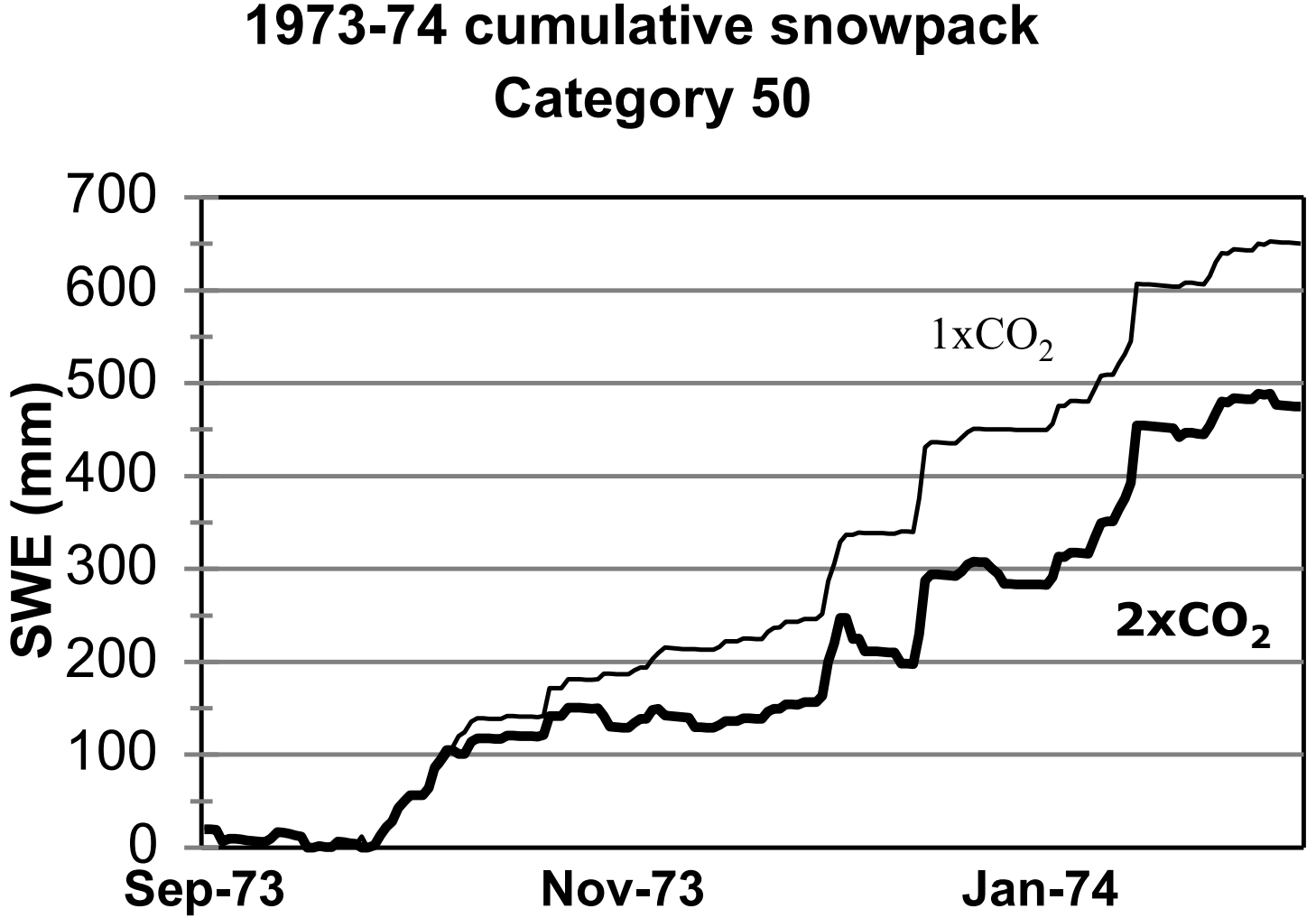
Cumulative precipitation for the winter period for category 14 (elevation 1401-1600m, slope 0-42%, aspect east) under 1xCO_2 and 2xCO_2 conditions.



Cumulative snowpack for the winter period for category 14 (elevation 1401-1600m, slope 0-42%, aspect east) under $1xCO_2$ and $2xCO_2$ conditions.

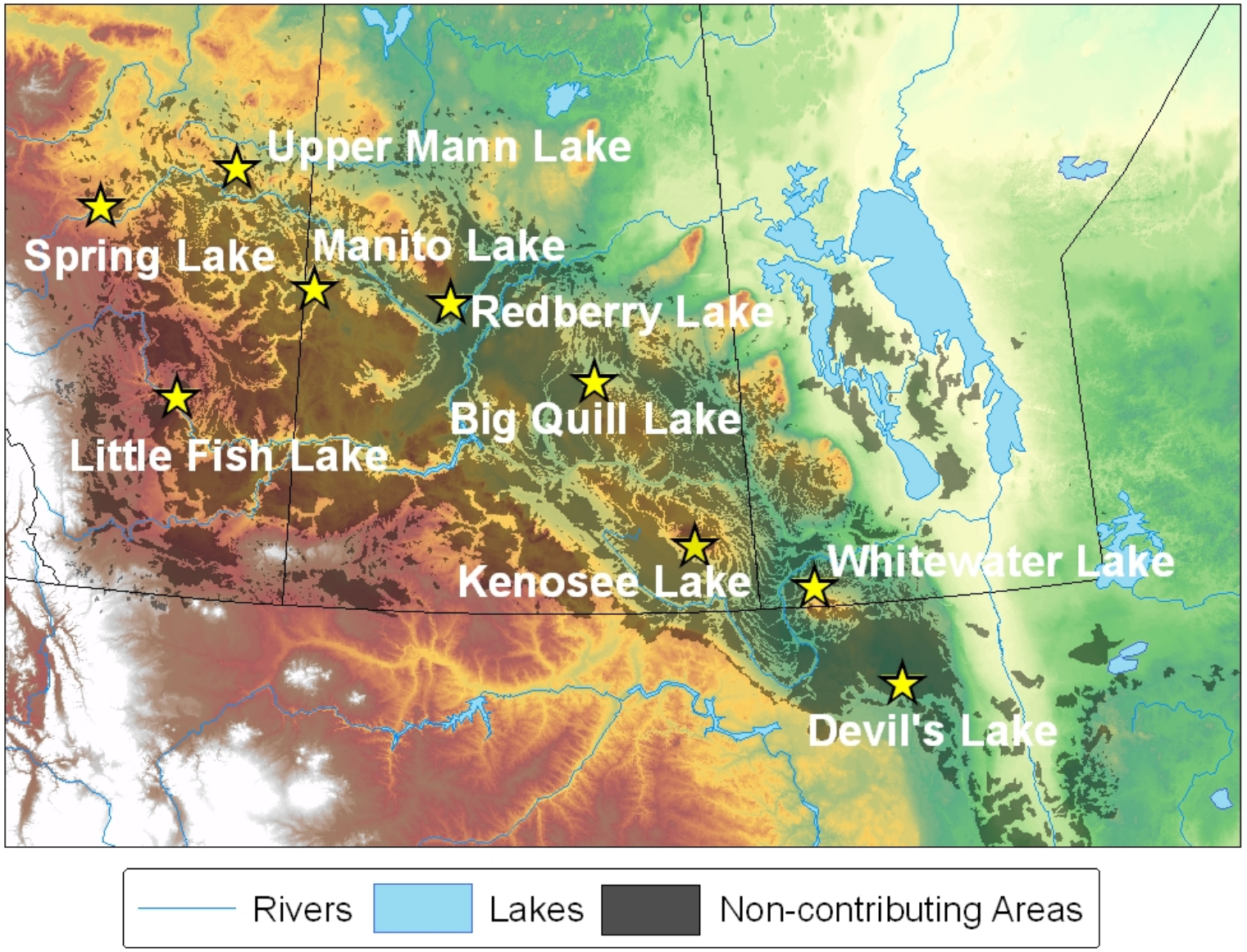


Cumulative precipitation for the winter period for category 50 (elevation 2001-2200m, slope 0-42%, aspect east) under 1xCO_2 and 2xCO_2 conditions.



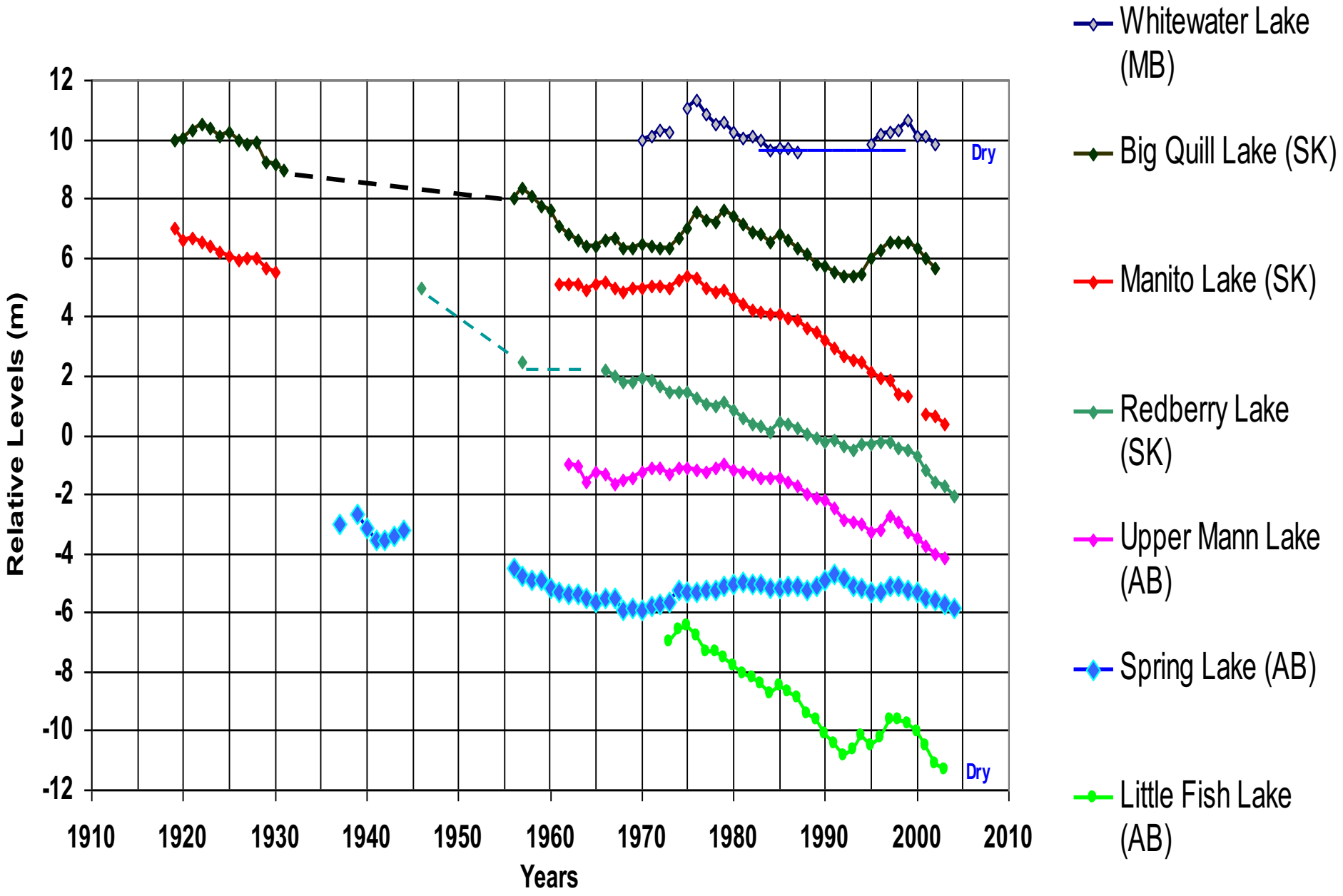
Cumulative snowpack for the winter period for category 50 (elevation 2001-2200m, slope 0-42%, aspect east) under 1xCO_2 and 2xCO_2 conditions.

Closed-basin prairie lakes

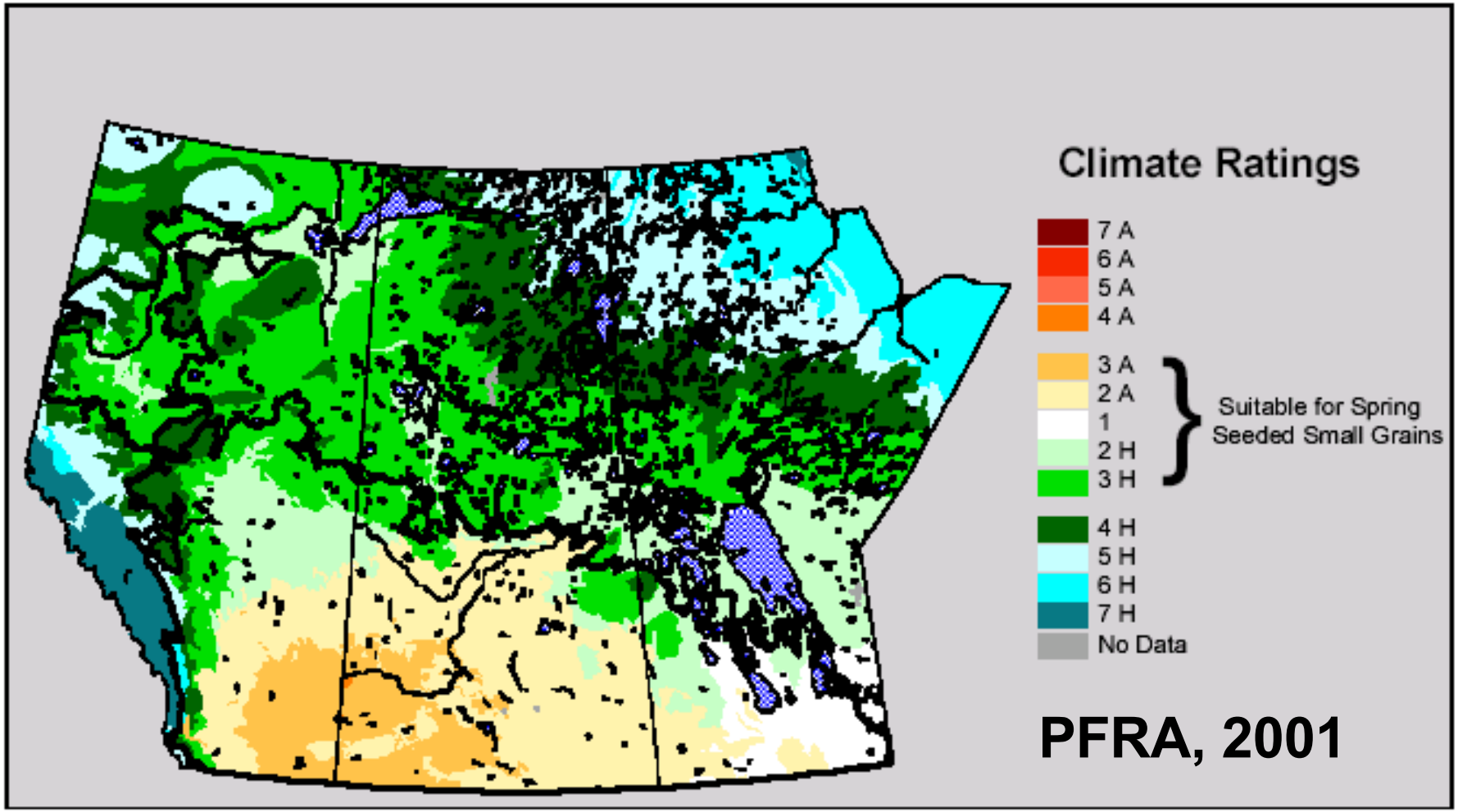


Source: Garth van der Kamp, NHRI

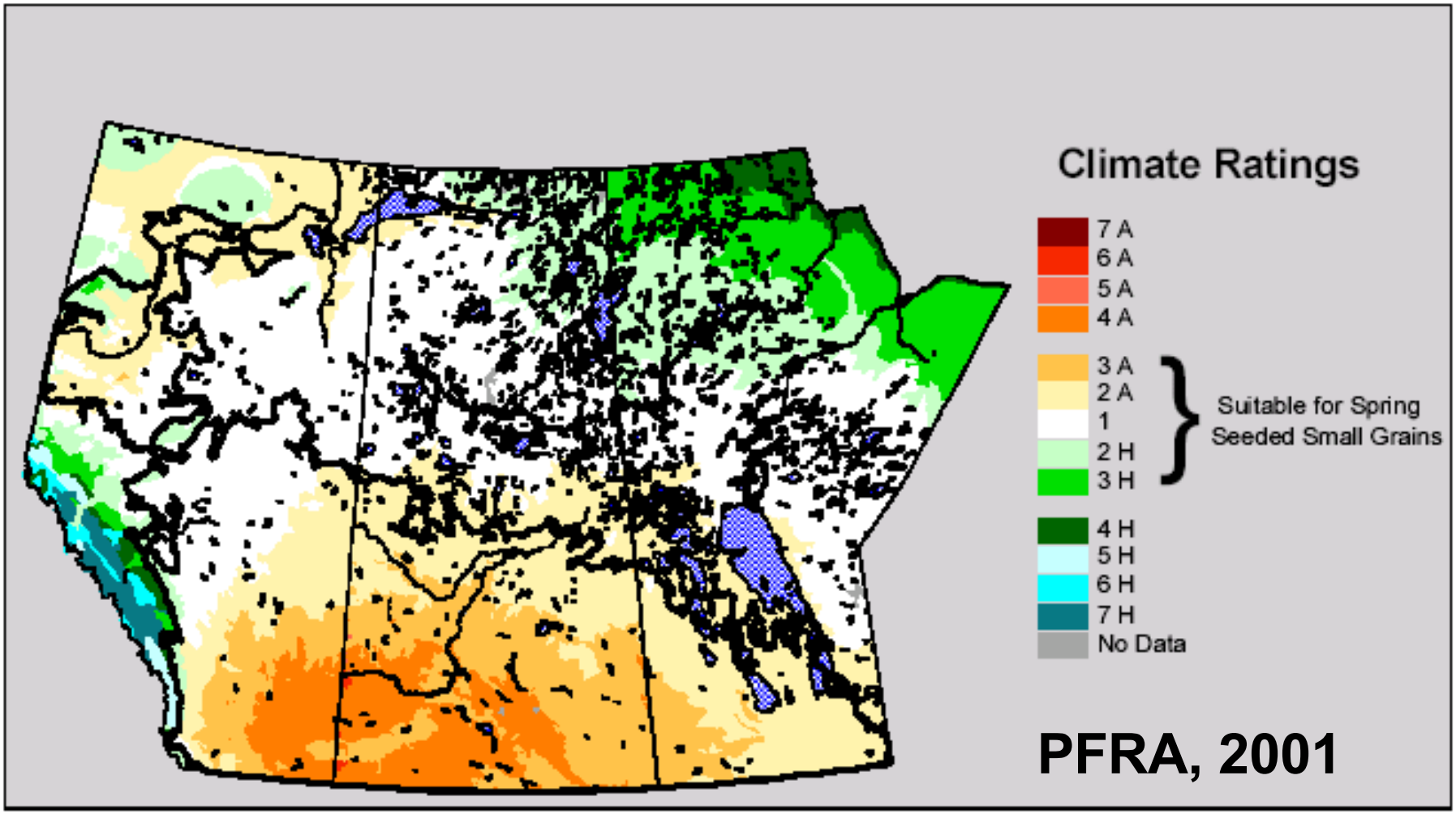
Water level changes in closed-basin prairie lakes 1918-2004

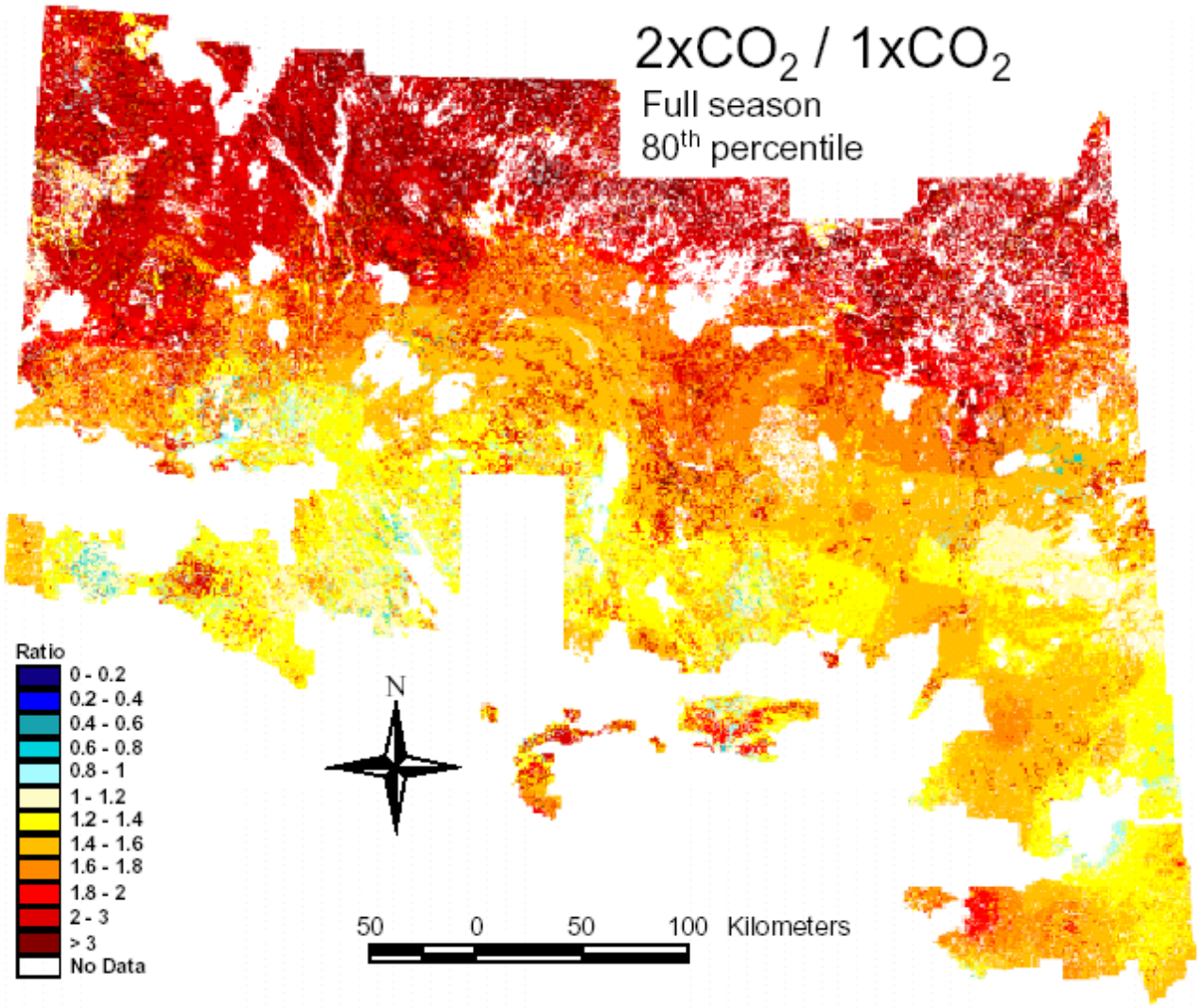


Land Suitability Rating System (LSRS)
Climate Classification (1961-90)

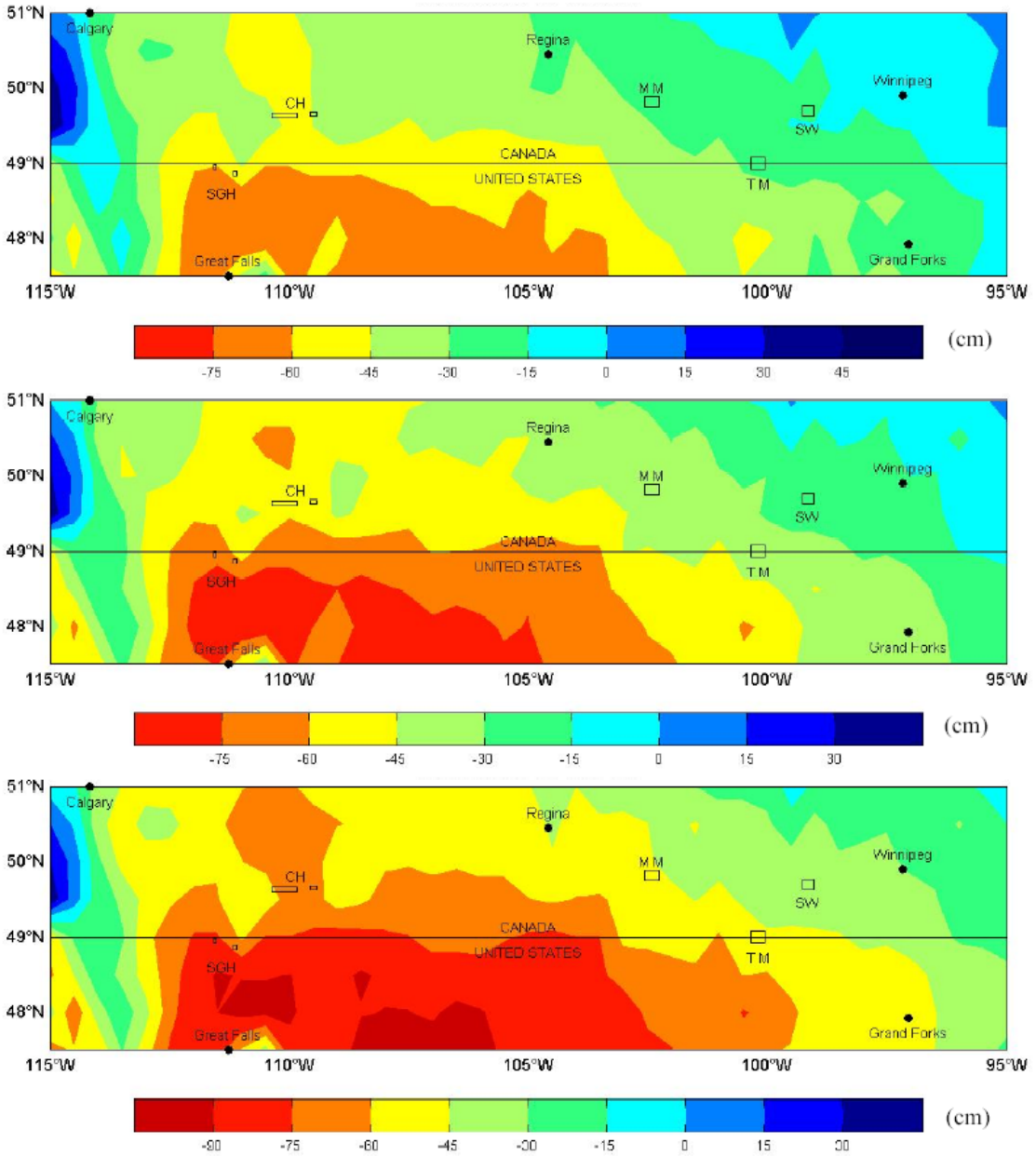


Land Suitability Rating System (LSRS)
Climate Classification (2040-69)

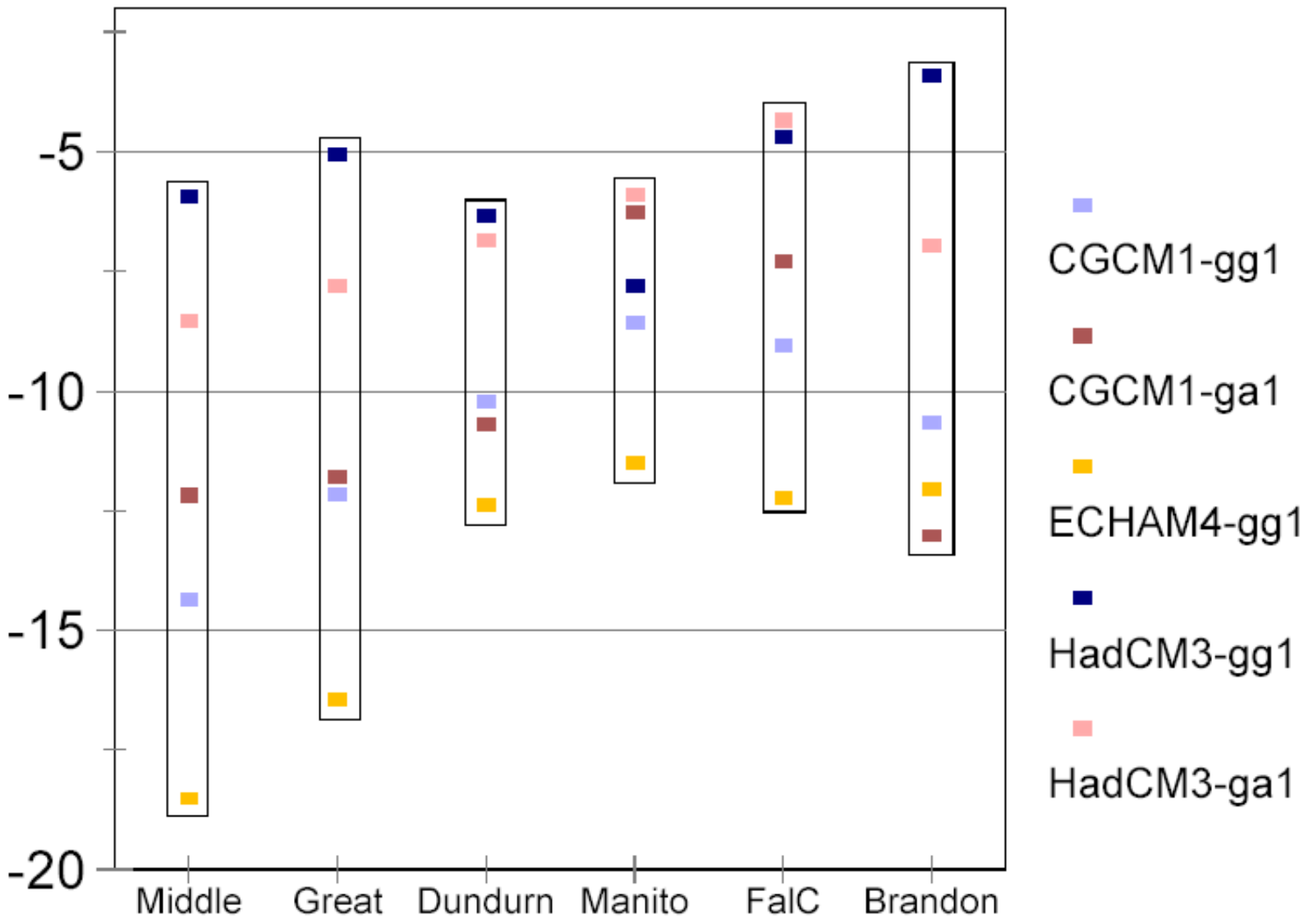




Forecasted proportional change in head fire intensity (Kafka *et al.* 2001)



Projected soil moisture levels for the 2020s (top), 2050s (middle) and 2080s (bottom). (Henderson *et al*. 2002)



Percent change in grass yield from current conditions (1961-90 normals) to the 2050s. (Thorpe *et al*., 2001)

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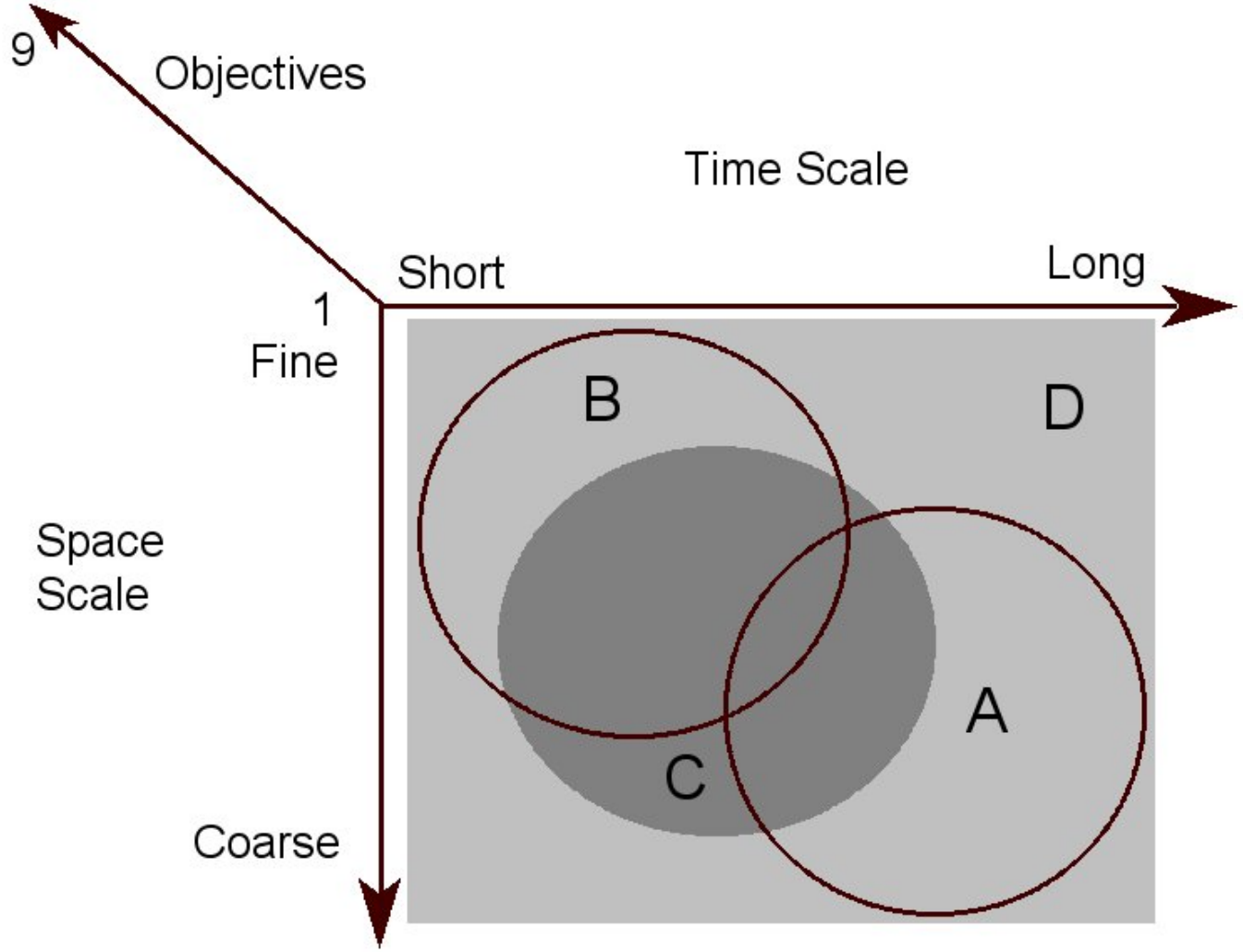
Climate Sensitivity of the Ecosystems of the Saskatchewan and Athabasca Watersheds – CSESAW

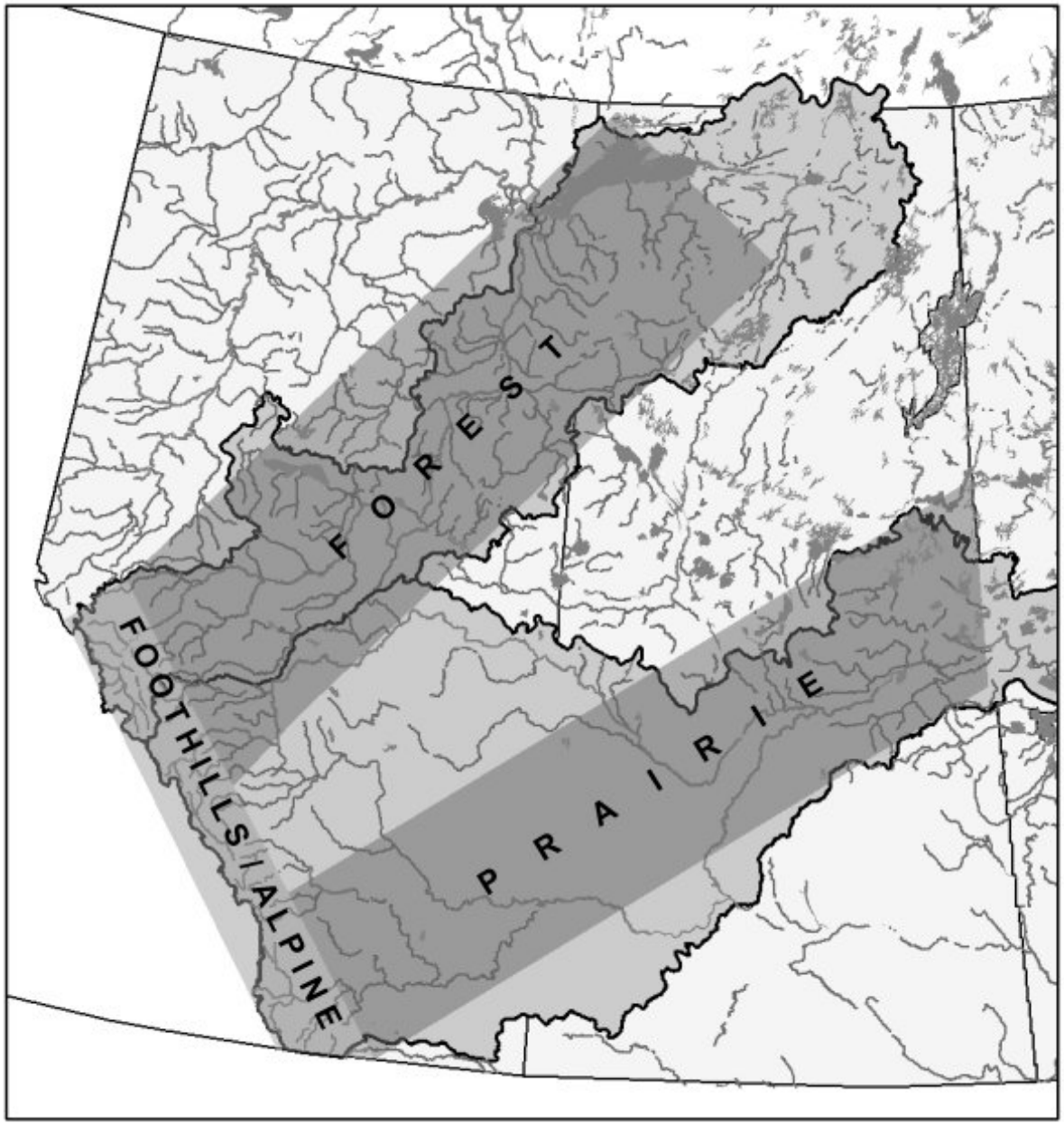
A Proposed CFCAS Research Network

The **goal** of the proposed CSESAW network is to develop and improve models of the climate sensitivity of the alpine, forest and grassland ecosystems in two large and contrasting watersheds in western Canada, and to construct quantitative scenarios of future climate impacts in support of planning and policy for the renewable resource sectors (forestry, agriculture, water resources, and environmental protection).

Investigator	Expertise
Theme Leaders	
Sauchyn, David	dendroclimatology, climate impacts
Byrne, James	climatology, scenarios, snow models
Schindler, David	paleoecology, limnology, paleolimnology
Wheaton, Elaine	impacts, climatology
Participants	
Bayley, Suzanne	wetlands, aquatic ecology
Berg, Aaron	regional climate modelling, soil moisture models hydrology
Barrie Bonsal	hydro-climatology, drought
Blair, Danny	long-term hydroclimatic forcing, climate downscaling,
Creed, Irena	remote sensing, aquatic ecology
Johnson, Daniel	landcover ecology, ecoregions, soil water
Johnston, Mark	forest ecology
Kienzle, Stefan	snow models, soil water, hydrology, spatial models
Letts, Matthew	bioclimate, ecoregions
Peddle, Derek	remote sensing, landscape models
Price, David	climate, scenarios, ecological impacts modelling
Piwowar, Joseph	remote sensing, landscape models
Vetter, Mary	high-resolution palynology, alpine and grassland ecology



A – long-term climate variation and climate sensitivity
B – climate scenarios and short-term climate sensitivity
C – ecological impact scenarios
D – collaboration/integration


FOREST
PRAIRIE
FOOTHILLS/ALPINE

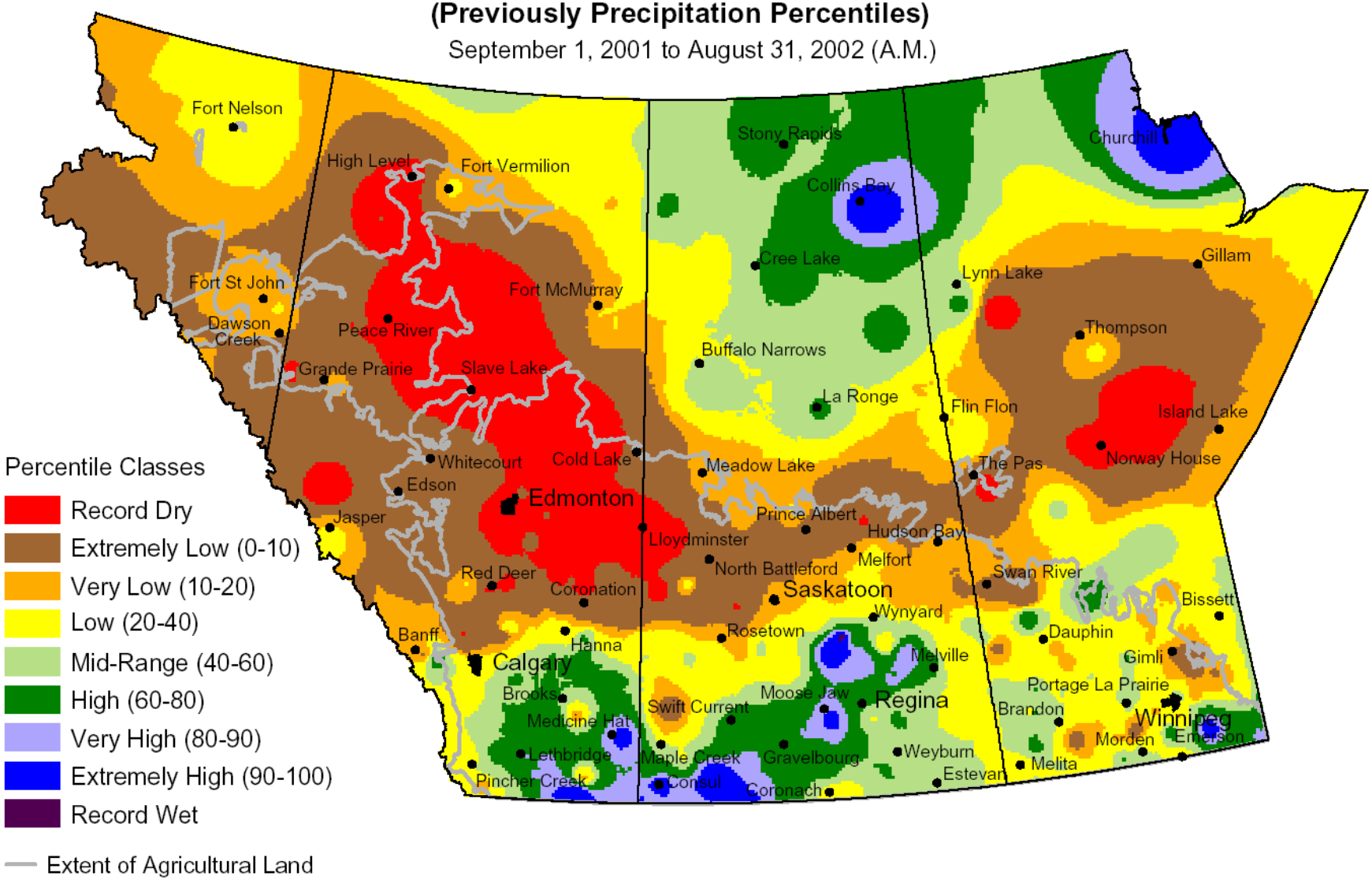
Soil drifting near Oyen, Alberta, May 5, 2002

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Current Precipitation Compared to Historical Distribution

(Previously Precipitation Percentiles)

September 1, 2001 to August 31, 2002 (A.M.)



Percentile Classes

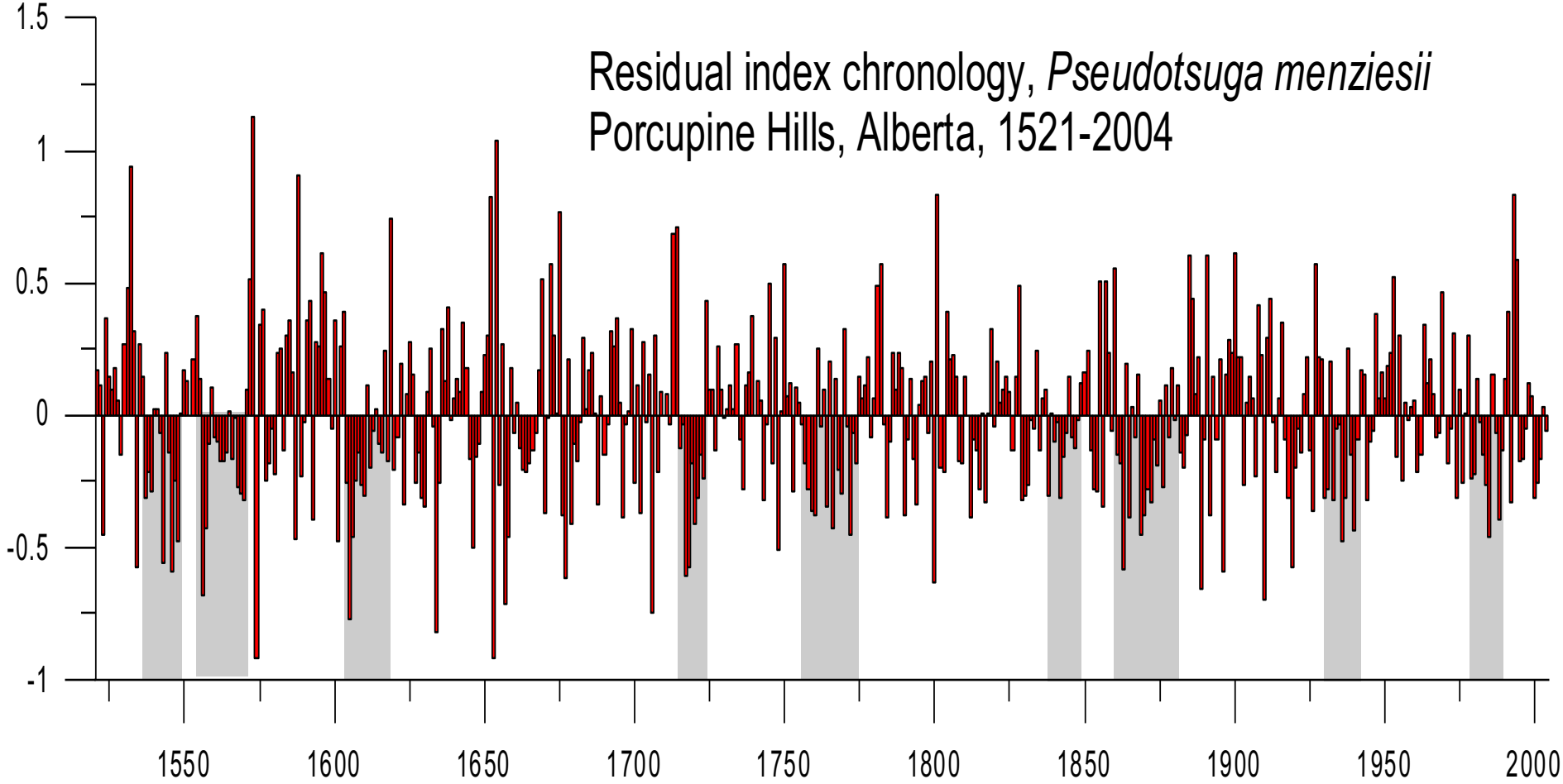
- Record Dry
- Extremely Low (0-10)
- Very Low (10-20)
- Low (20-40)
- Mid-Range (40-60)
- High (60-80)
- Very High (80-90)
- Extremely High (90-100)
- Record Wet

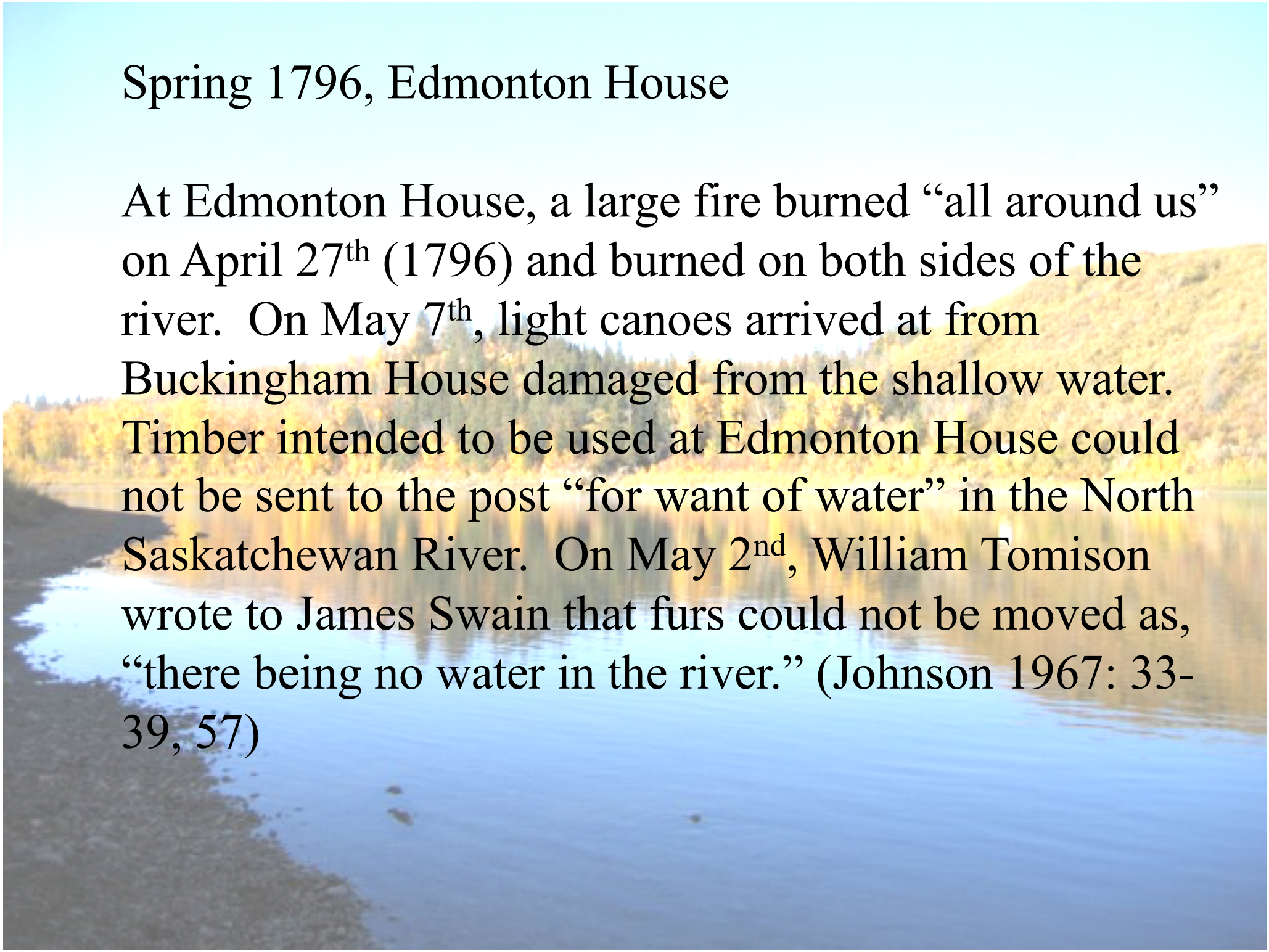
— Extent of Agricultural Land

Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from the Timely Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.

Canada

Porcupine Hills, Alberta

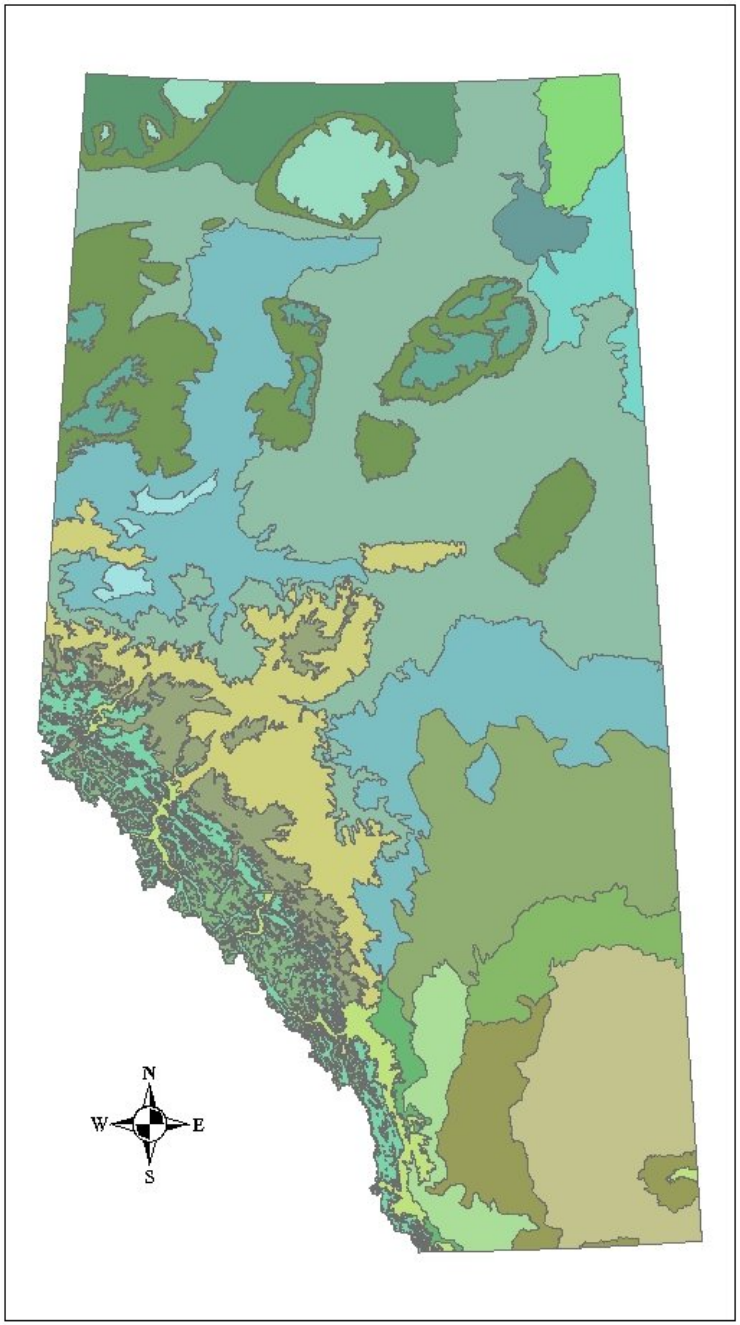

Residual index chronology, *Pseudotsuga menziesii*
Porcupine Hills, Alberta, 1521-2004
1.5
1
0.5
0
-0.5
-1
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000



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)

Alberta Natural Regions



Legend

NSRNAME

- Alpine
- Athabasca Plain
- Central Mixedwood
- Central Parkland
- Dry Mixedgrass
- Dry Mixedwood
- Foothills Fescue
- Foothills Parkland
- Kazan Uplands
- Lower Boreal Highlands
- Lower Foothills
- Mixedgrass
- Montane
- Northern Fescue
- Northern Mixedwood
- Peace River Parkland
- Peace-Athabasca Delta
- Sub-Alpine
- Sub-Arctic
- Upper Boreal Highlands
- Upper Foothills