

# Overview of the Drought Research Initiative

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April 8, 2010

Saskatchewan DRI Users Workshop  
Regina, Saskatchewan

**The Drought Research Initiative (DRI) is a 5-year research project funded by the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) to examine the 1999 – 2004 multiyear drought on the Canadian prairies.**

***The objectives of DRI are:***

- To better understand the physical characteristics of and processes influencing Canadian Prairie droughts, and***
- To contribute to their better prediction.***



# TIMELINE OF DRI

<b>2002</b>	<b>Dec</b>	<b>Call for new Network LOIs by CFCAS</b>
<b>2003</b>	<b>Nov</b>	<b>Acceptance of LOI (3 y Network)</b>
<b>2004</b>	<b>March</b>	<b>Drought workshop (5 y Network possible)</b>
	<b>Dec</b>	<b>Proposal submission</b>
<b>2005</b>	<b>August</b>	<b>Proposal formally accepted</b>
<b>2006</b>	<b>Jan</b>	<b>First workshop (Saskatoon)</b>
<b>2007</b>	<b>Jan</b>	<b>Second workshop (Winnipeg)</b>
<b>2007</b>	<b>June</b>	<b>Partners Advisory Committee formed</b>
<b>2008</b>	<b>Jan</b>	<b>Third workshop (Calgary)</b>
<b>2009</b>	<b>Jan</b>	<b>Fourth workshop (Regina)</b>
<b>Future:</b>		
<b>2010</b>	<b>May</b>	<b>Fifth and final workshop (Winnipeg)</b>
<b>2011</b>	<b>March</b>	<b>Completion of all network activities</b>

# Final Statements we hope to be able to make at the end of DRI:

- **“We have greatly increased our understanding of drought through a focus on the recent 1999-2004/05 one over the Prairies and we have applied this to improved prediction.”**
- **“We have left a legacy of comprehensive datasets, improved observational and modelling techniques, a new generation of drought scientists, and a public better educated about drought.”**
- **“We have, in partnership with others in Canada and internationally, developed a plan to improve drought and water cycle prediction at multiple scales.”**

# Why we need to understand drought: Some Economic Impacts of the 2001-2002 Period

- ◆ Total Canadian agricultural production loss was ~\$3.6 billion
- ◆ Gross Domestic Product fell ~\$5.8 billion
- ◆ Employment losses > 41,000
- ◆ Worst year was 2002
- ◆ Alberta and Saskatchewan were hit hardest



**(Wheaton et al. 2005, 2008)**

# DRI THEMES

Quantify the physical features,

- flows of water and energy into and out of the region, and
- storage and redistribution within the region

Improve the understanding of processes and feedbacks governing the

- formation,
- evolution,
- cessation and
- structure of the drought

Assess and contribute to reducing uncertainties in the prediction of drought

Compare the similarities and differences of current drought to previous droughts and those in other regions

Apply our progress to address critical issues of importance to society

# Theme #1: Drought Characterization – an important component of drought monitoring

## North American Drought Monitor

April 30, 2007

Released: Wednesday, May 15, 2007

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

Analysts:

Canada- Trevor Hadwen  
Dwayne Chobanik  
Mexico- Davydova Valentina  
Elvia Delgado Diaz  
U.S.A.- Chester Schmitt\*  
Douglas Le Comte  
Brian Fuchs

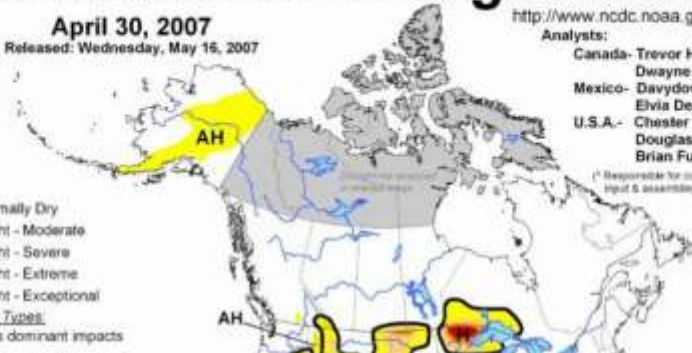
(\* Responsible for collecting analysts input & assembling the NA-DM map)

Intensity:

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

Drought Impact Types:

- Delineates dominant impacts

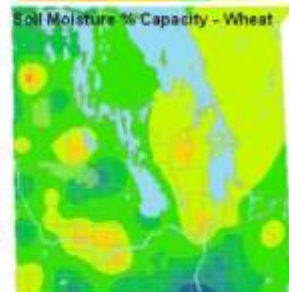
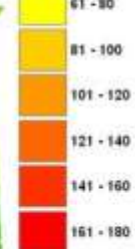
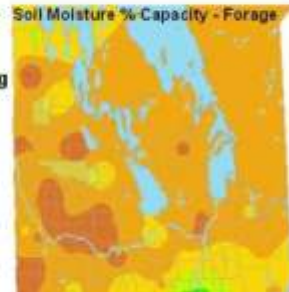
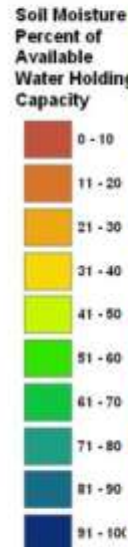
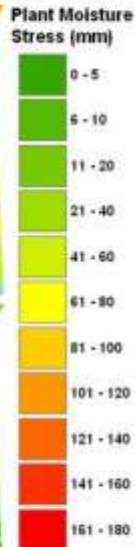
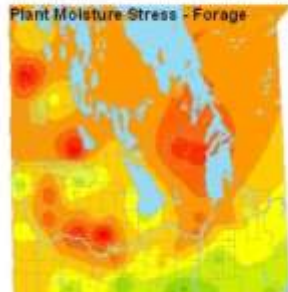


DRI Theme 1 directly addresses the concerns of the agriculture community regarding ways to characterize the extent and severity of drought.

## Moisture Status for Forage and Wheat in Manitoba from Season to July 6, 2003

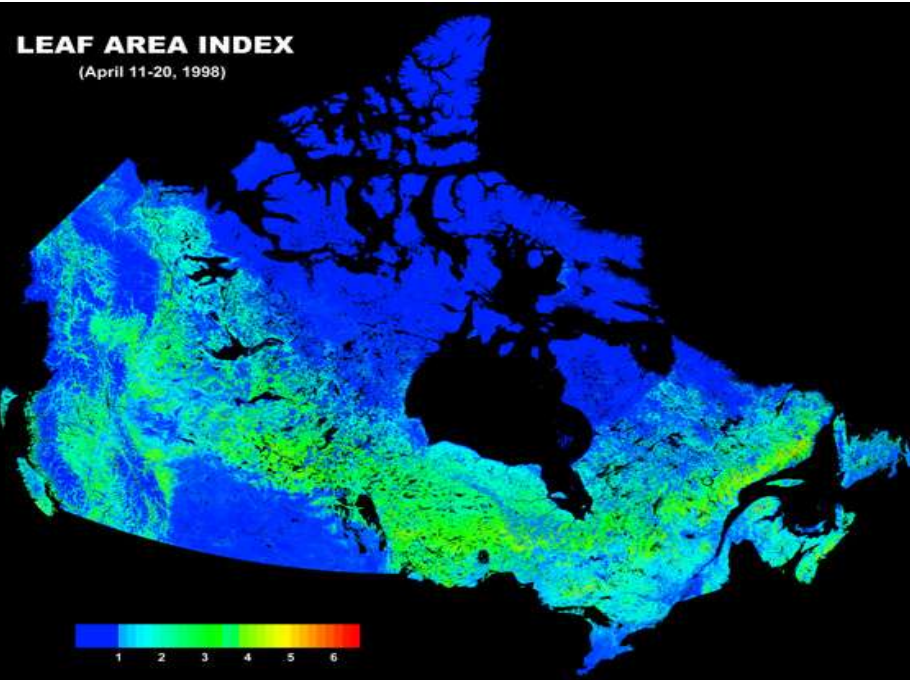
Plant moisture stress is the difference between the amount of water a crop can potentially use and the amount that it actually receives from precipitation and soil moisture throughout the growing season. Both the magnitude and timing of moisture stress are important in crop development.

Available root zone soil moisture represents the amount of water present in the soil that is potentially available for plant uptake. It is dependent on soil texture, rainfall amounts, distribution, and crop type and stage of development.



Environment Canada

Environment Canada



# Research provides the basis for development of drought monitoring services

## **Contribution of Research and Development**

Data assimilation products/ techniques for developing integrated data products

New experimental products and testing of NADM inputs through product comparisons and evaluations.

New insights about drought processes that facilitates the understanding of trends and variability of drought.

Interactions with partners/users to assess how the information can best be used in decision making

## **Operational services**

Data interpolated and mapped

Data products produced on a Routine basis.

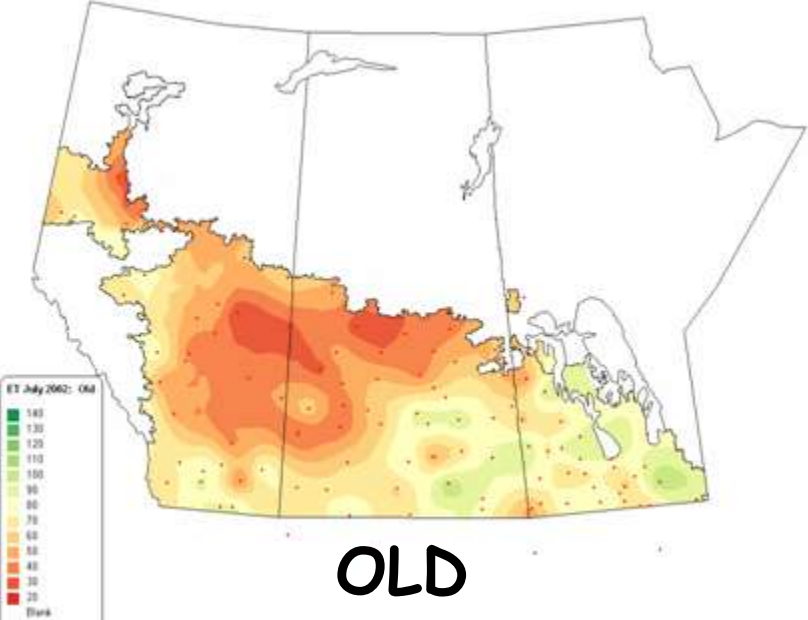
Interpretation of the maps and their impacts

Advisory Services

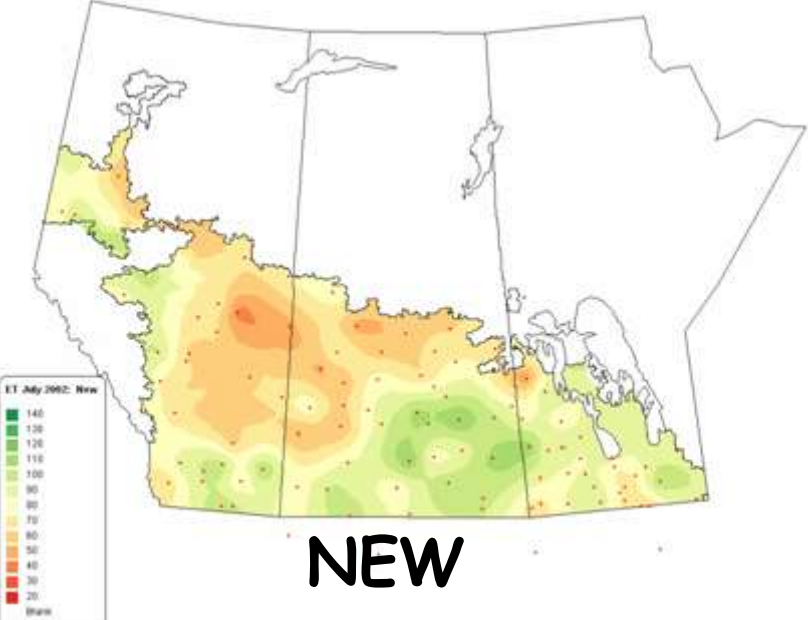


# Some DRI Contributions to Drought Monitoring

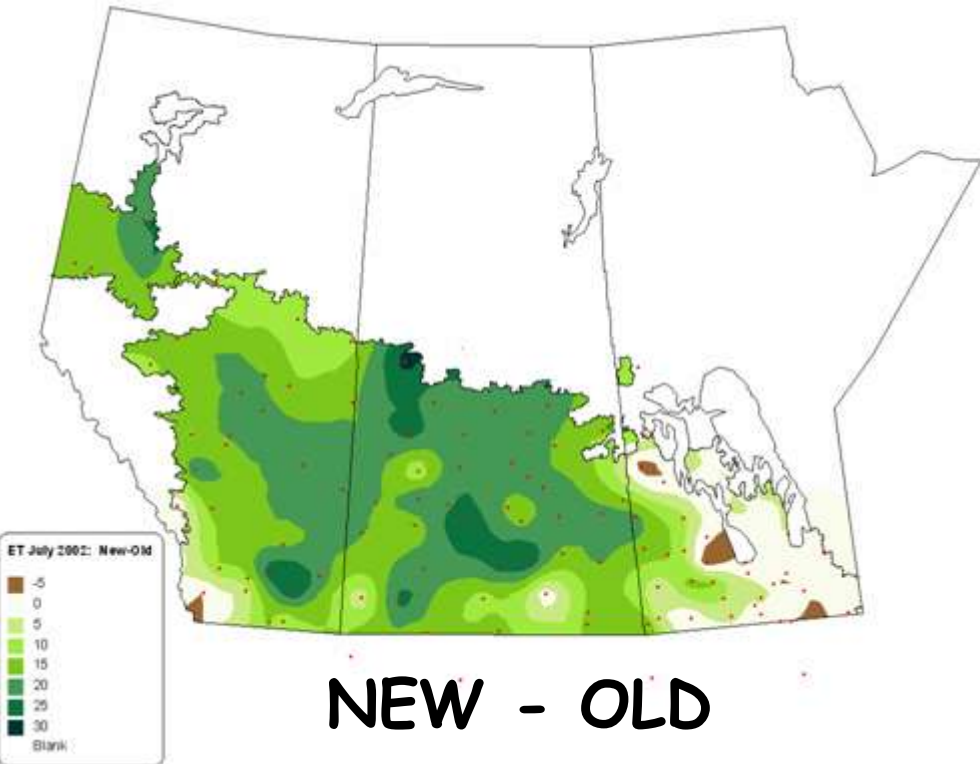
DRI supports the development of better techniques for estimating specific water cycle variables. PAM-modelled accumulation for ET in July 2002.



**OLD**



**NEW**

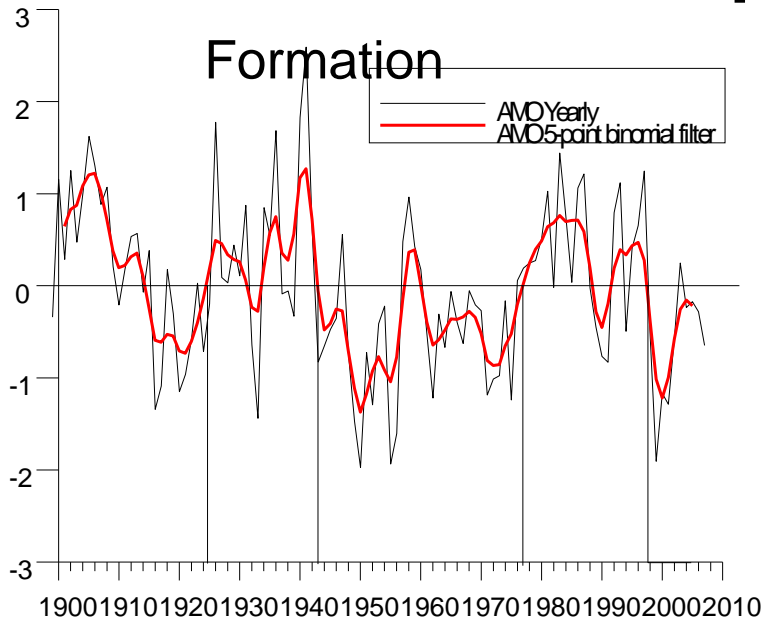


**NEW - OLD**

(Hanesiak, Brimelow)

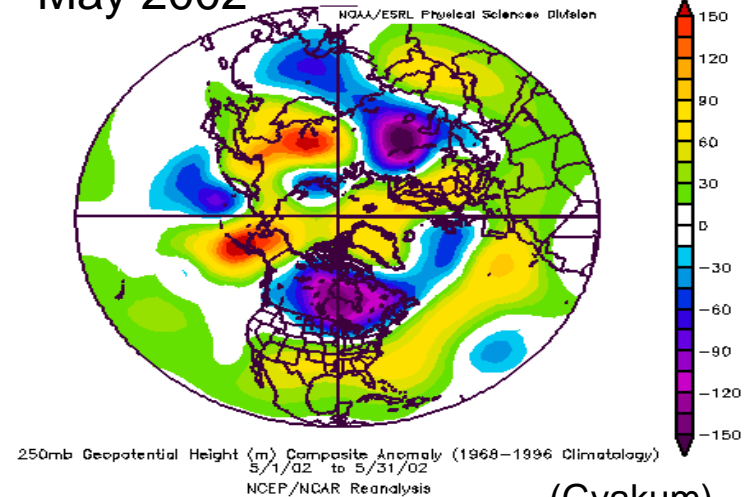
# Theme #2: Improved Understanding

## Formation



(Shabbar)

## May 2002

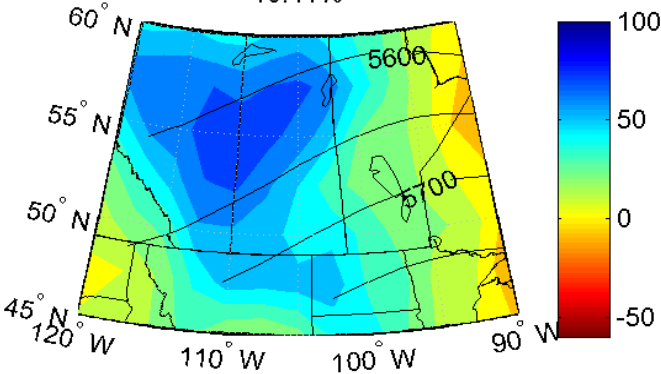


(Gyakum)

## Structure of the drought

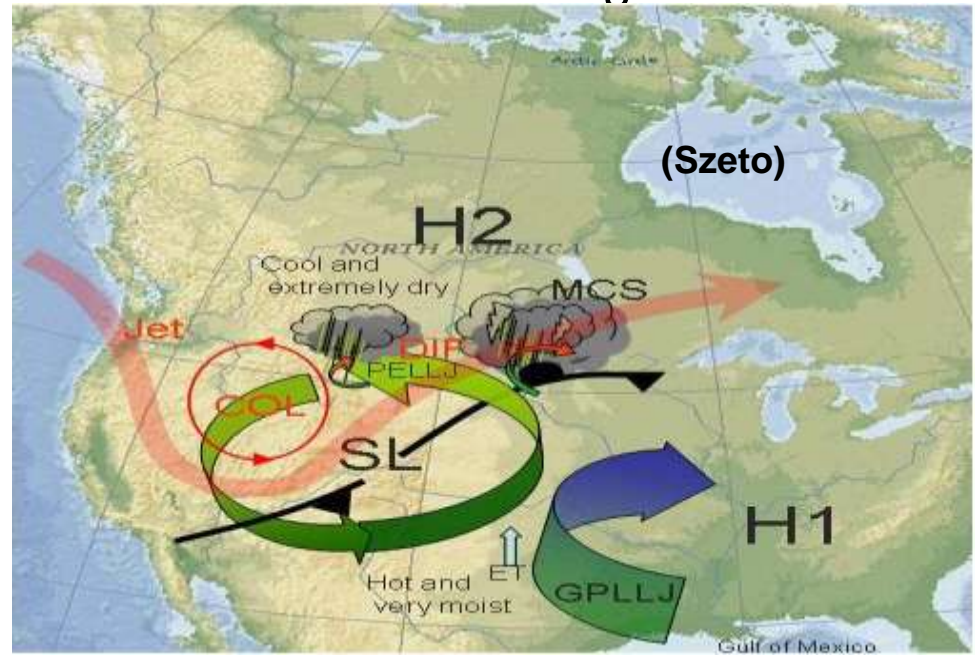
### Cessation

Type 1  
 10.41%



(Bonsal)

Flow pattern with SW flow  
 Common in wet summer of 2005



(Szeto)

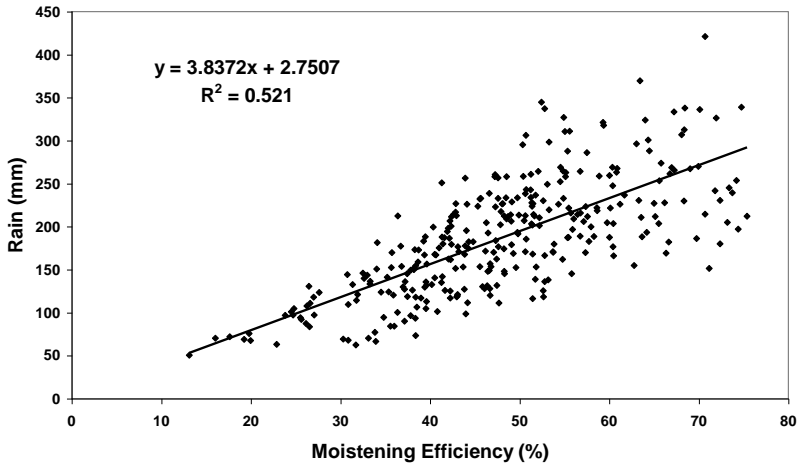
# Theme #3: Improved prediction by integrating process understanding into models.

Canadian  
Regional  
Climate  
Model

Clouds (Leighton)

Virga (Stewart)

Evapotranspiration  
(Raddatz, Hanesiak, Strong)

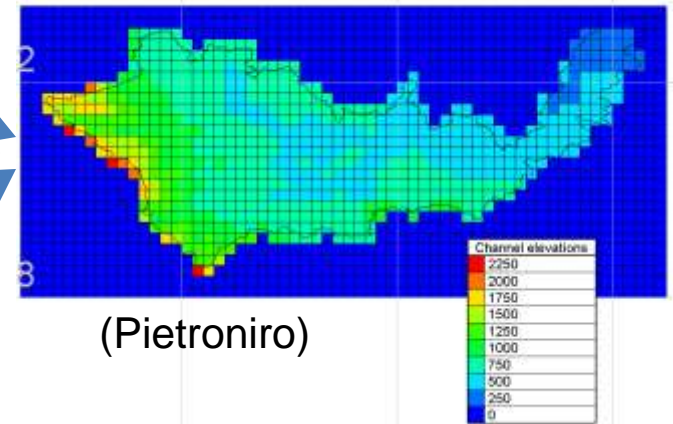


Soil  
Moisture (Berg)

Ponding  
(Pomeroy)

Ground  
Water (Woodbury, Snelgrove, Hayashi, van der Kamp)

MESH  
(TO BE MIGRATED TO CLASS)



(Pietroniro)

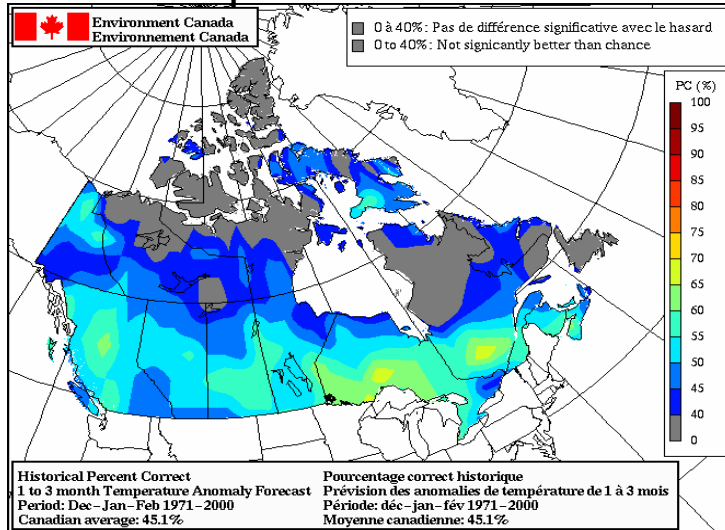
VIC model estimates are used to characterize soil moisture patterns



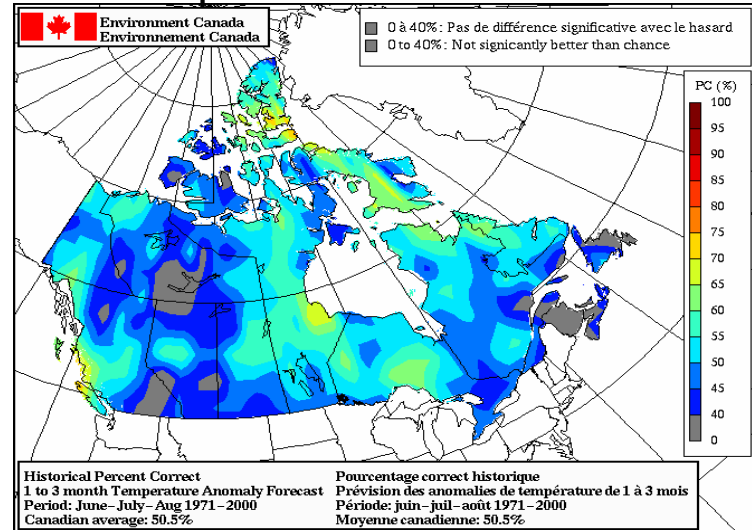
(Lei Wen)

# Skill (% correct)

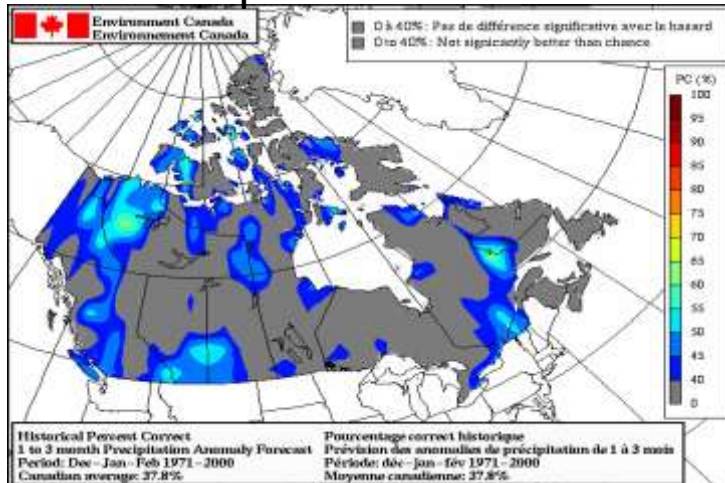
## DJF Temperature



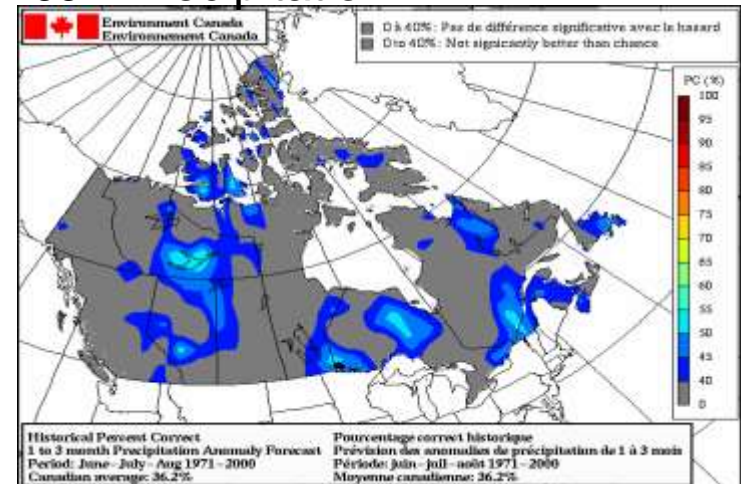
## JJA Temperature



## DJF Precipitation



## JJA Precipitation



(from G. Boer, 2008)

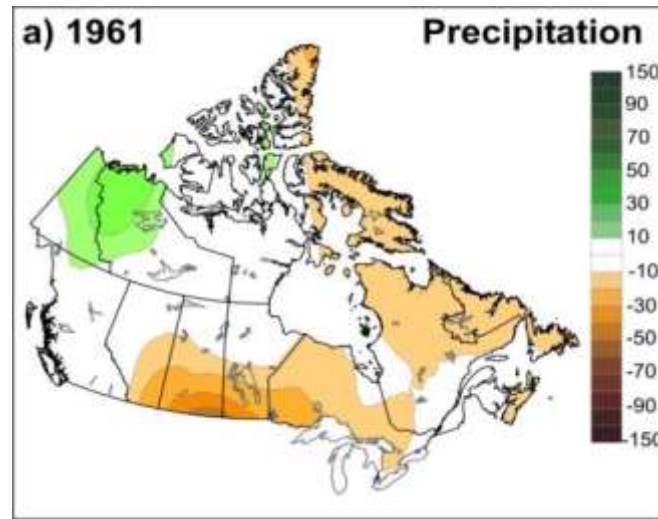
# Prediction (for drought)

- Skill is average skill – not “special skill” for El Nino/La Nina cases (often given)
- Precipitation skill low
- Temperature skill more reasonable
  - some utility for predicting thermal aspect of drought
- *Probability forecasts* offer information for the sophisticated (long-timescale) user

(from G. Boer, 2008)

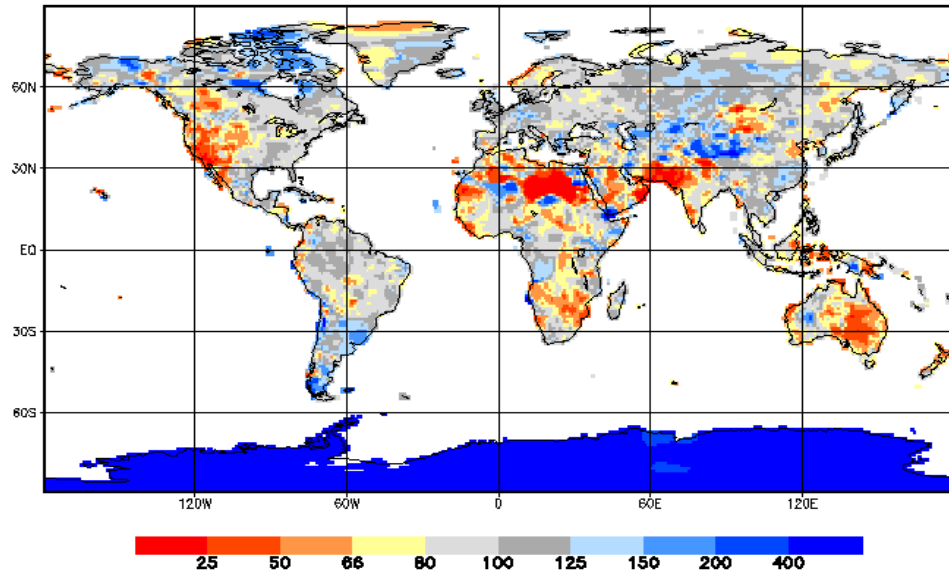
# Theme #4. Comparisons between droughts – putting drought impacts into context (after Barrie Bonsal)

- Comparisons are being carried out with:
  - Previous Canadian Prairie Droughts
  - Others in North America
  - Around the world



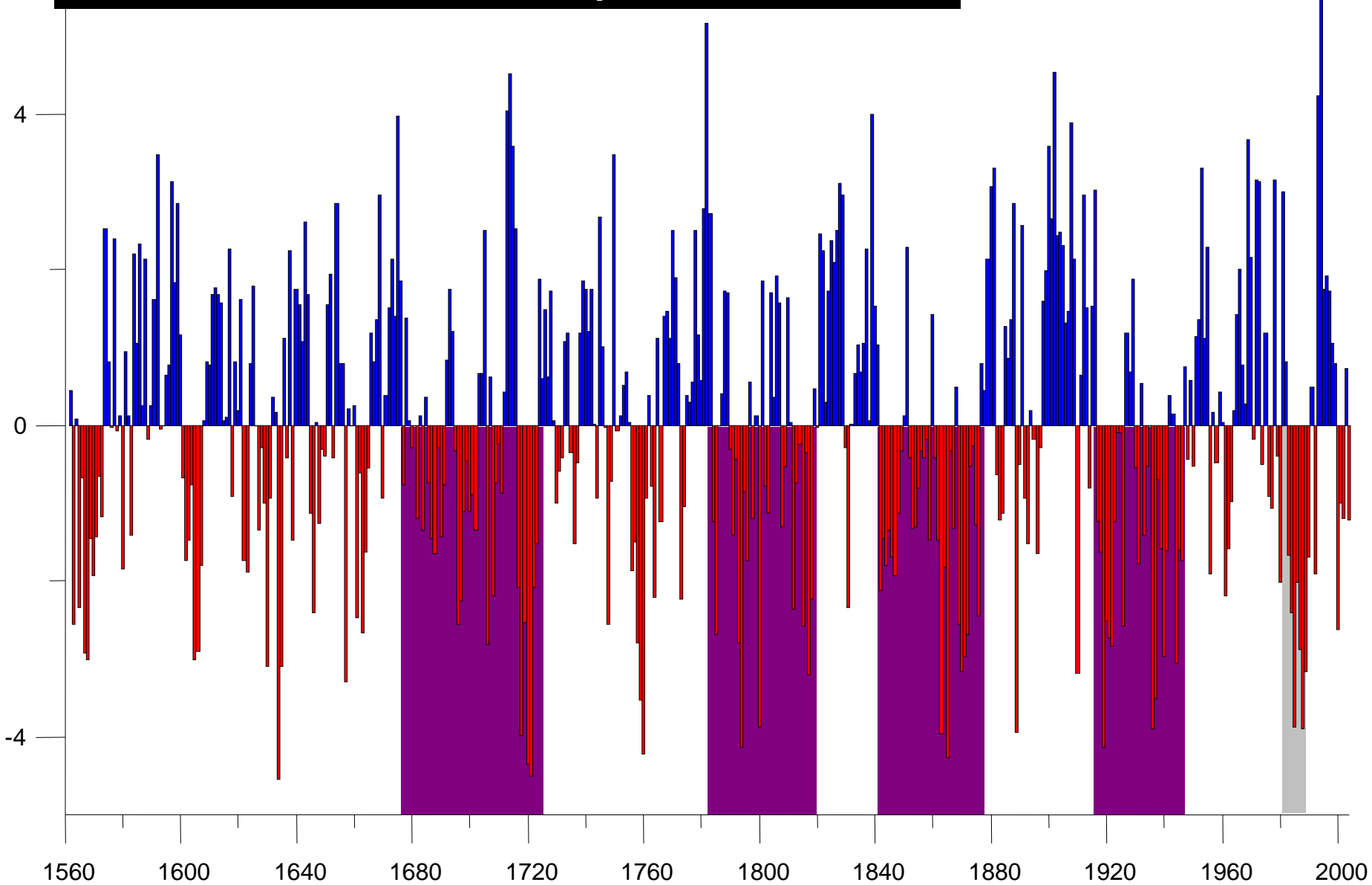
GPCC Monitoring Product Gauge-Based Analysis 1.0 degree precipitation percentage of normals 61/90 for year (Jan - Dec) 2002

2002 Global  
Precipitation  
Anomaly



(After David Sauchyn)

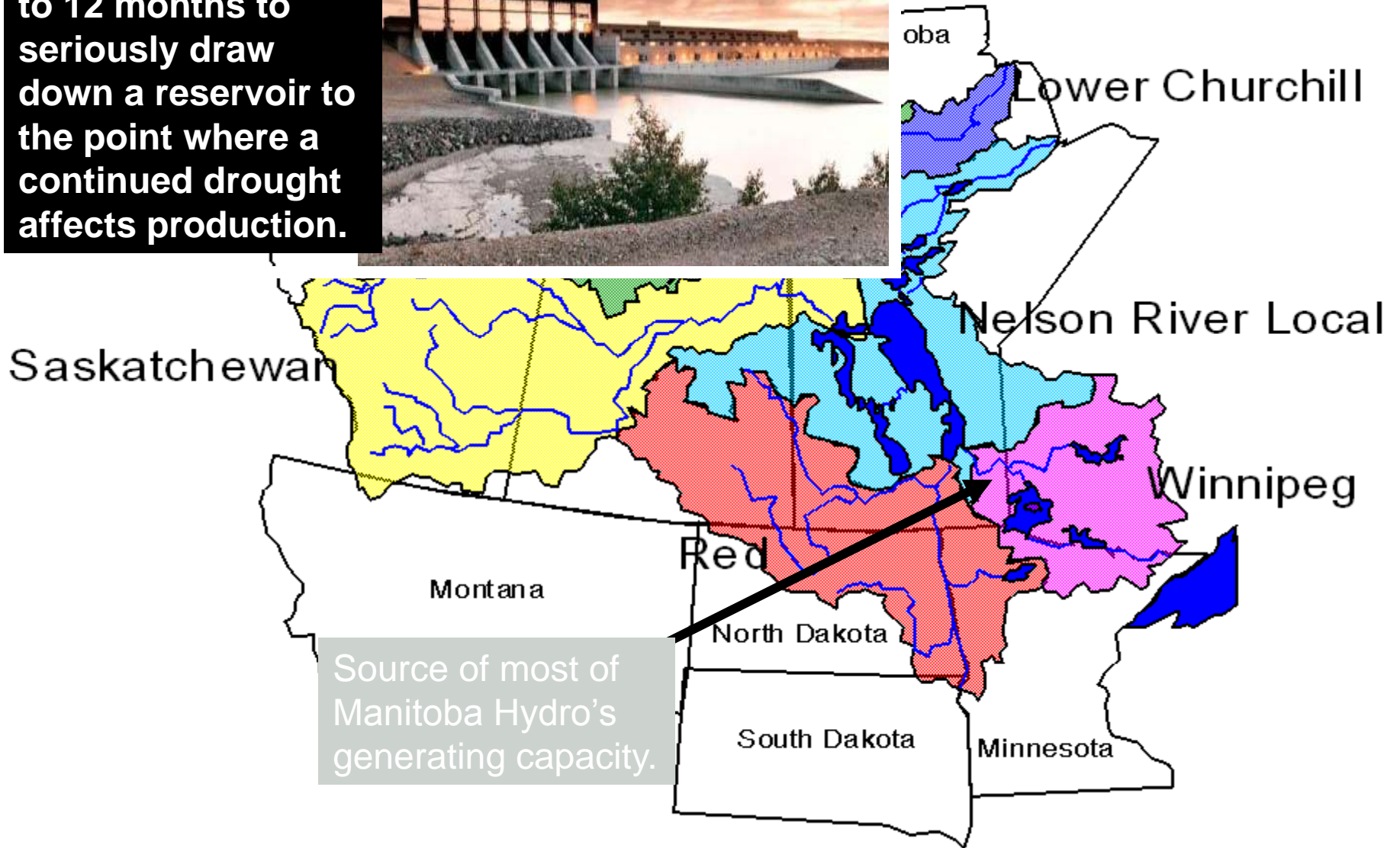
# Oldman River Flow, 1562-2004





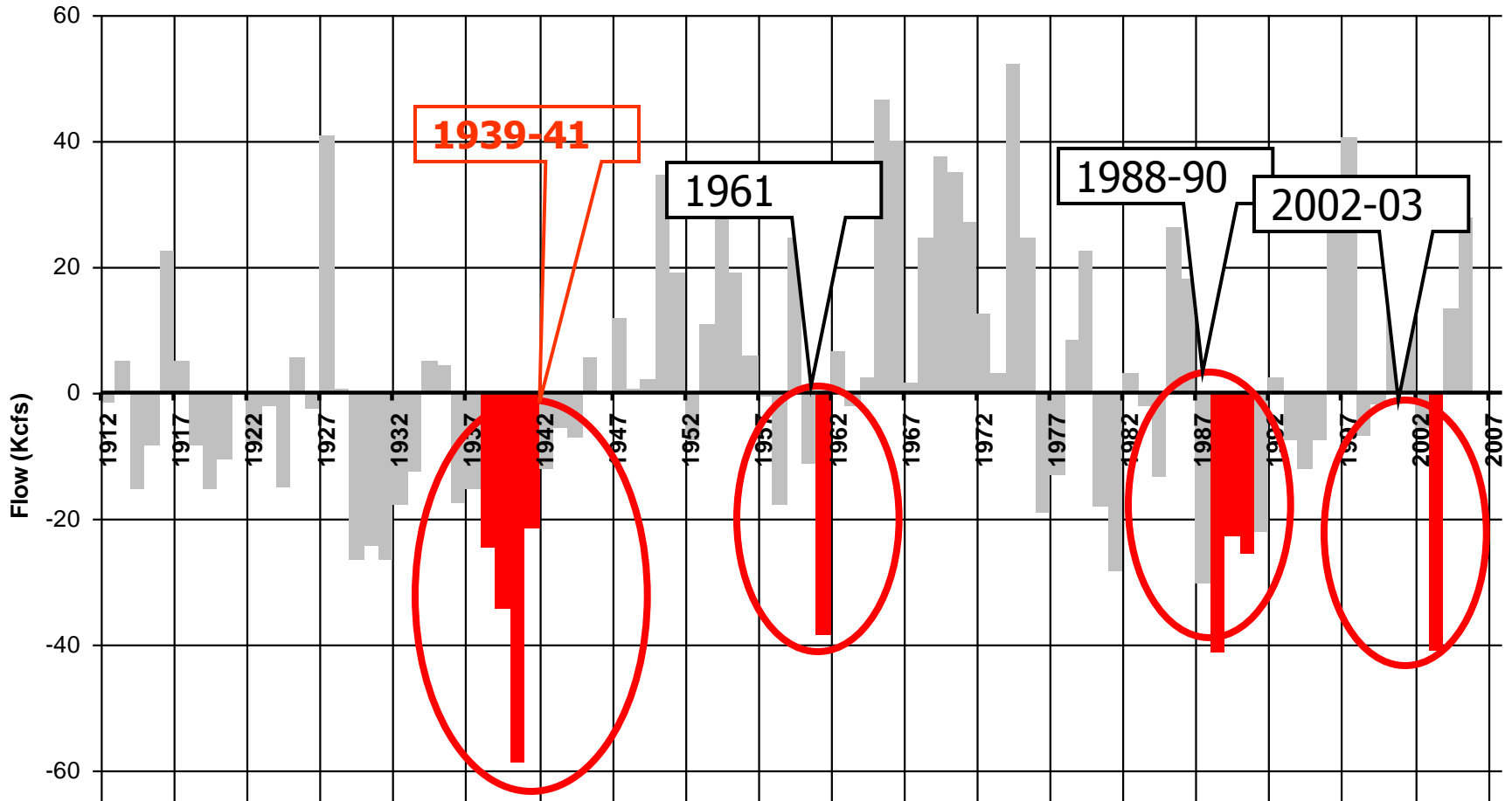
# Manitoba Hydro must plan for the Impact of drought in many basins

It frequently takes 9 to 12 months to seriously draw down a reservoir to the point where a continued drought affects production.



# Historical Drought of Record

Nelson-Churchill System Inflow



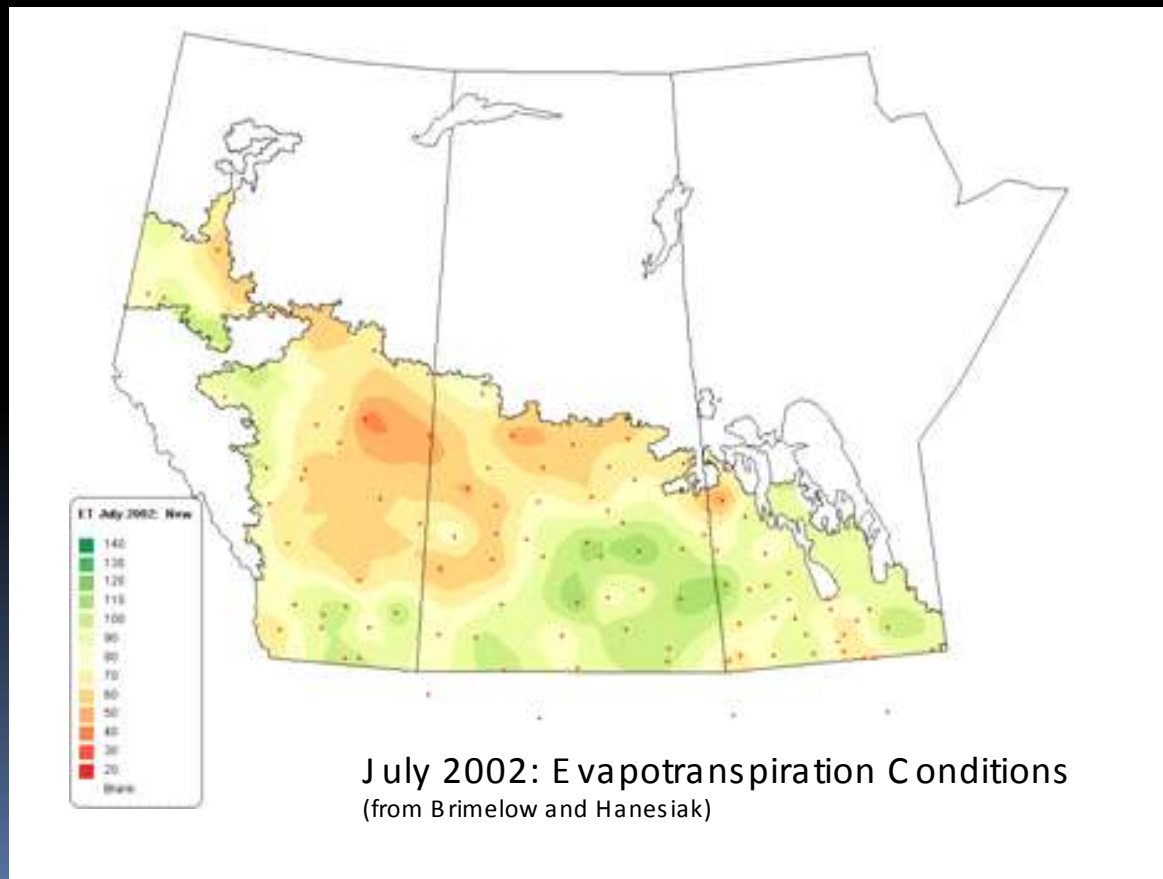
**The Manitoba Hydro challenge is to define the drought of record so they can plan sufficient capacity to ensure they will be able to supply the firm demand even under the worst conditions.**

# Theme #5: Assessing the needs and benefits for DRI Research results and products.

## DEWS: Partner Assessments of DRI Research Products

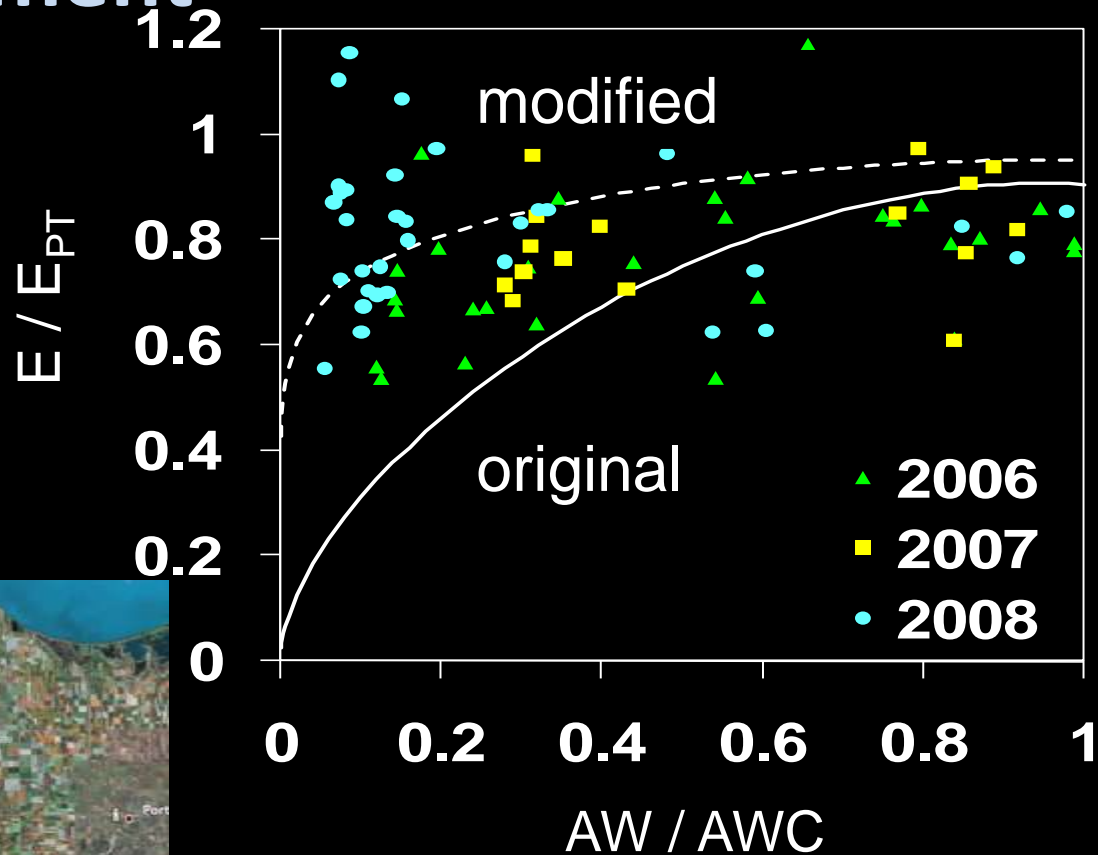
In DEWS workshops users were asked

What could you do with more or different information than what is currently available?



# DRI Contributions to Regional Water Resource Management

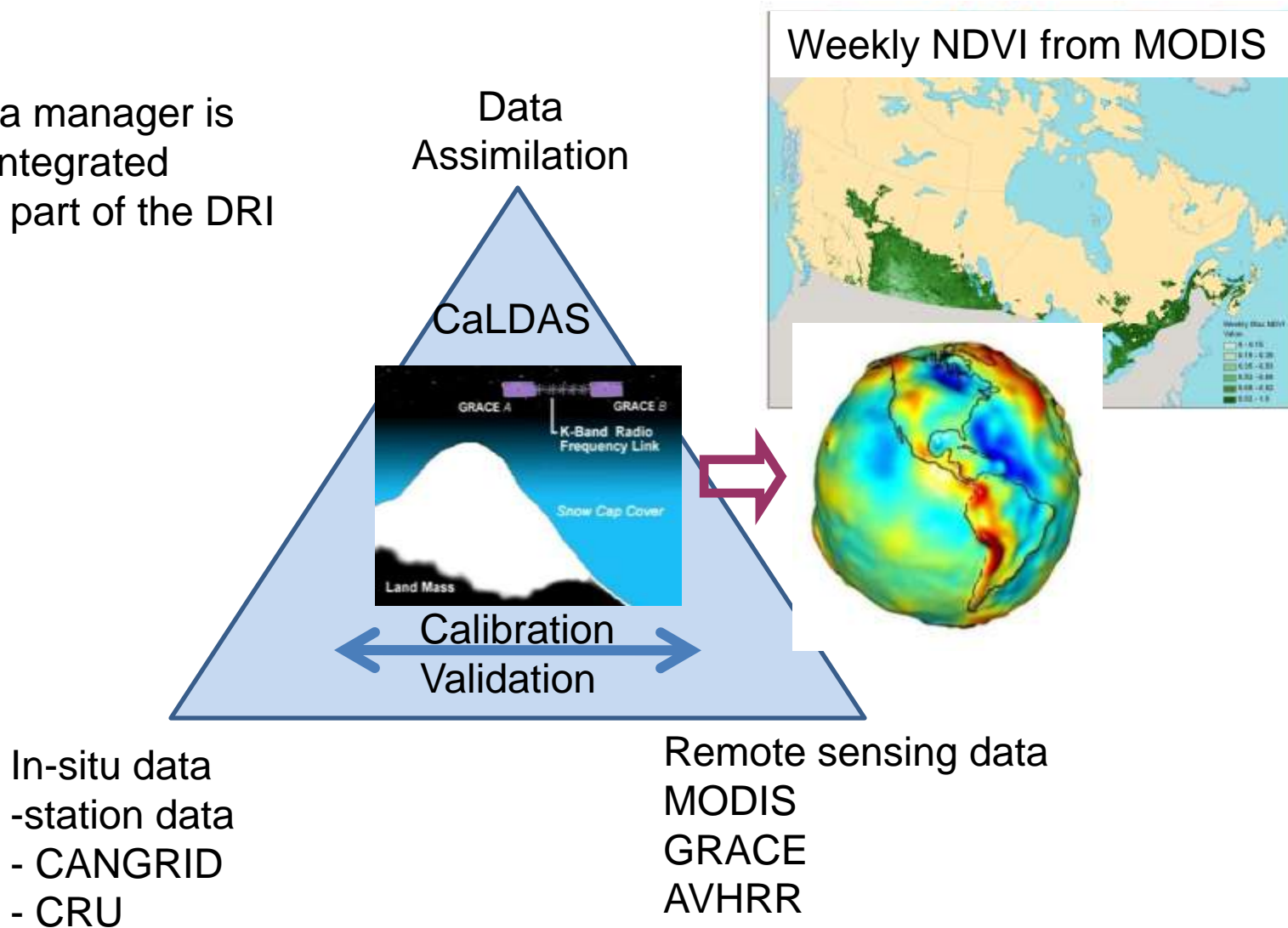
Masaki Hayashi's studies of the effect of prairie vegetation and solar vegetation on ET have led to modifications in the Versatile model used by Alberta Agriculture for planning purposes.



New groundwater model strengthens the guidance provided to the managers of the Assiniboine Delta Aquifer so its waters can be managed in a more sustainable way. (Woodbury)

# ISSUES FOR DATA INTEGRATION

The DRI data manager is developing integrated data sets as part of the DRI legacy.



# BIG SYNTHESIS ISSUES

Given the drought, some key issues include:

1. What maintained it over multiple years?
2. What governed its actual structure?
3. Why did it end?

*And, what was the role of the cold season ... a natural Canadian focus*

4. What did prediction systems 'miss' and why?
5. Given this progress, how can we better cope with drought?

# SUMMARY

DRI is making substantial progress in addressing its fundamental issues Although it will not fully address the prediction issue at its conclusion.

The benefits of drought research are becoming evident. It is important to continue this work to ensure that its full benefits are realized and that the findings already made will be incorporated into operational programs and decisions at the policy level.

**ENJOY THE WORKSHOP!**



**DROUGHT RESEARCH INITIATIVE**  
**RÉSEAU DE RECHERCHE SUR LA SÉCHERESSE**