Overview of the Drought Research Initiative

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Manitoba DRI Users Workshop
Winnipeg, Manitoba

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

2002	Dec	Call for new Network LOIs by CFCAS
2003	Nov	Acceptance of LOI (3 y Network)
2004	March	Drought workshop (5 y Network possible)
	Dec	Proposal submission
2005	August	Proposal formally accepted
2006	Jan	First workshop (Saskatoon)
2007	Jan	Second workshop (Winnipeg)
2007	June	Partners Advisory Committee formed
2008	Jan	Third workshop (Calgary)
2009	Jan	Fourth workshop (Regina)

Future:

2010	May	Fifth and final workshop (Winnipeg)
	December	Completion of all network activities

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

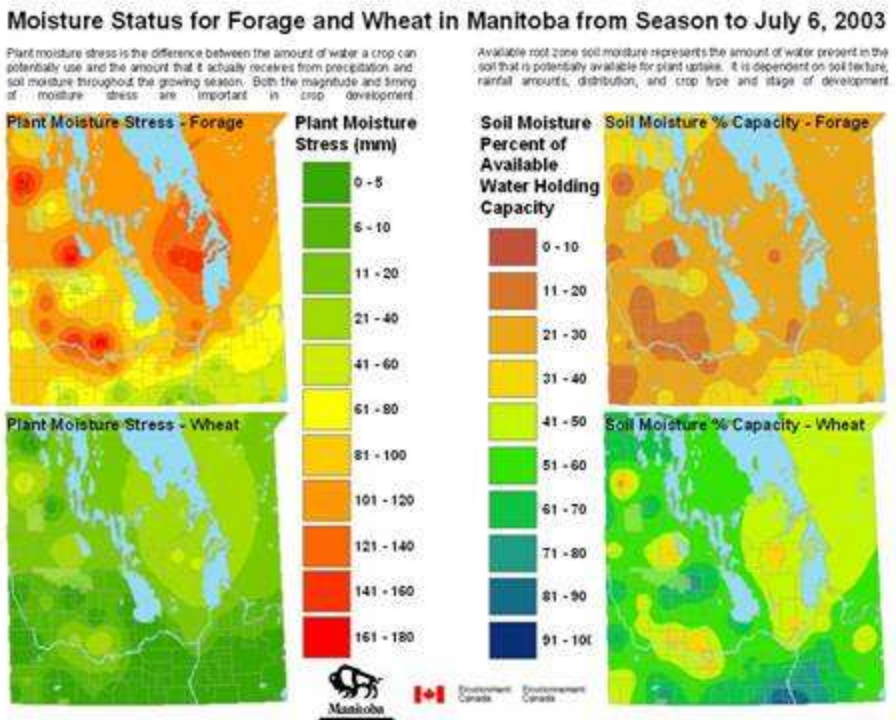
Assess and contribute to reducing uncertainties in the prediction of drought

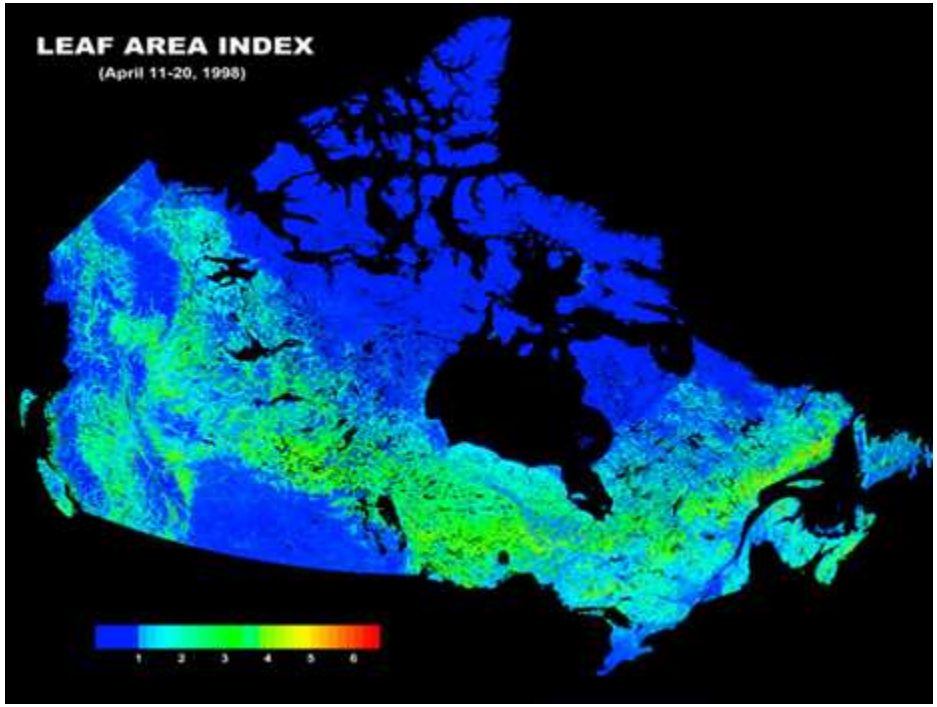
Compare the similarities and differences of current drought to previous droughts and those in other regions

Apply our progress to address critical issues of importance to society

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

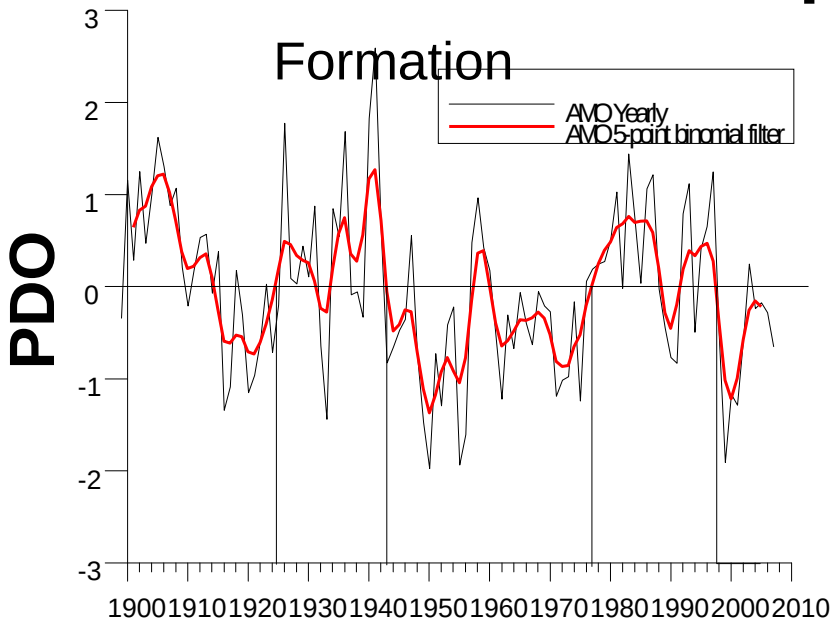
DRI Theme 1 directly addresses the concerns of the agriculture community regarding ways to characterize the extent and severity of drought.





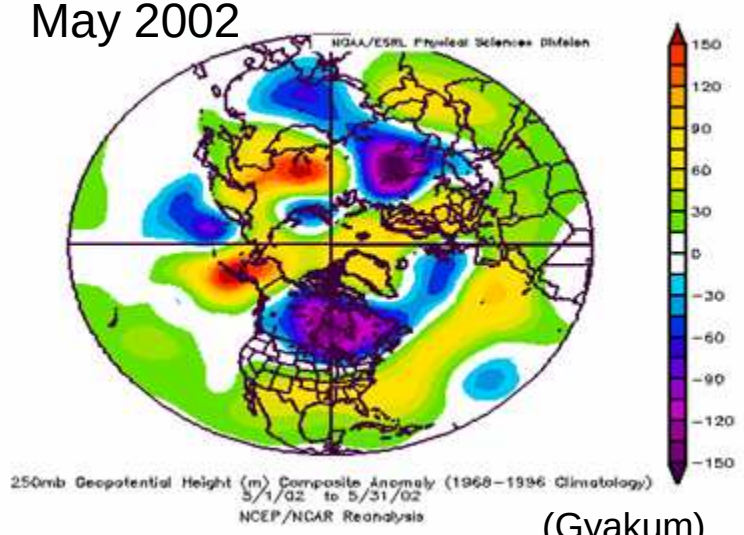
Theme #2: Improved Understanding

Formation



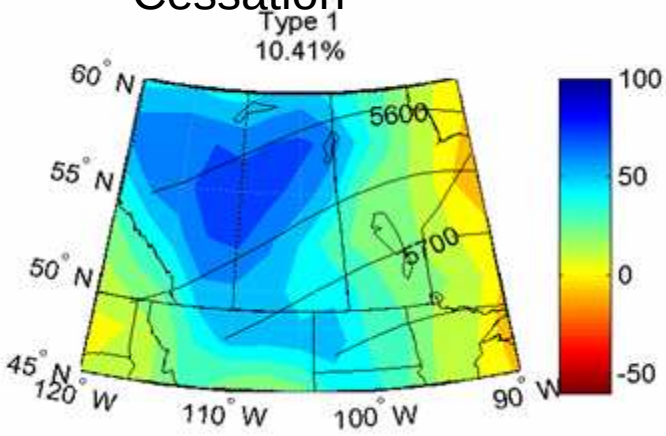
(Shabbar)

May 2002



(Gyakum)

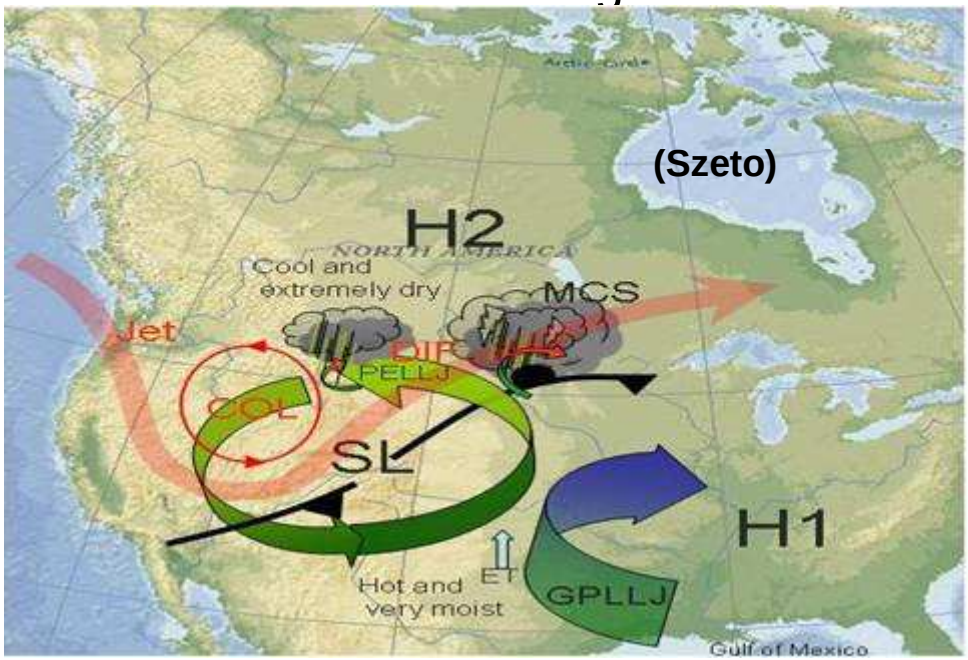
Cessation



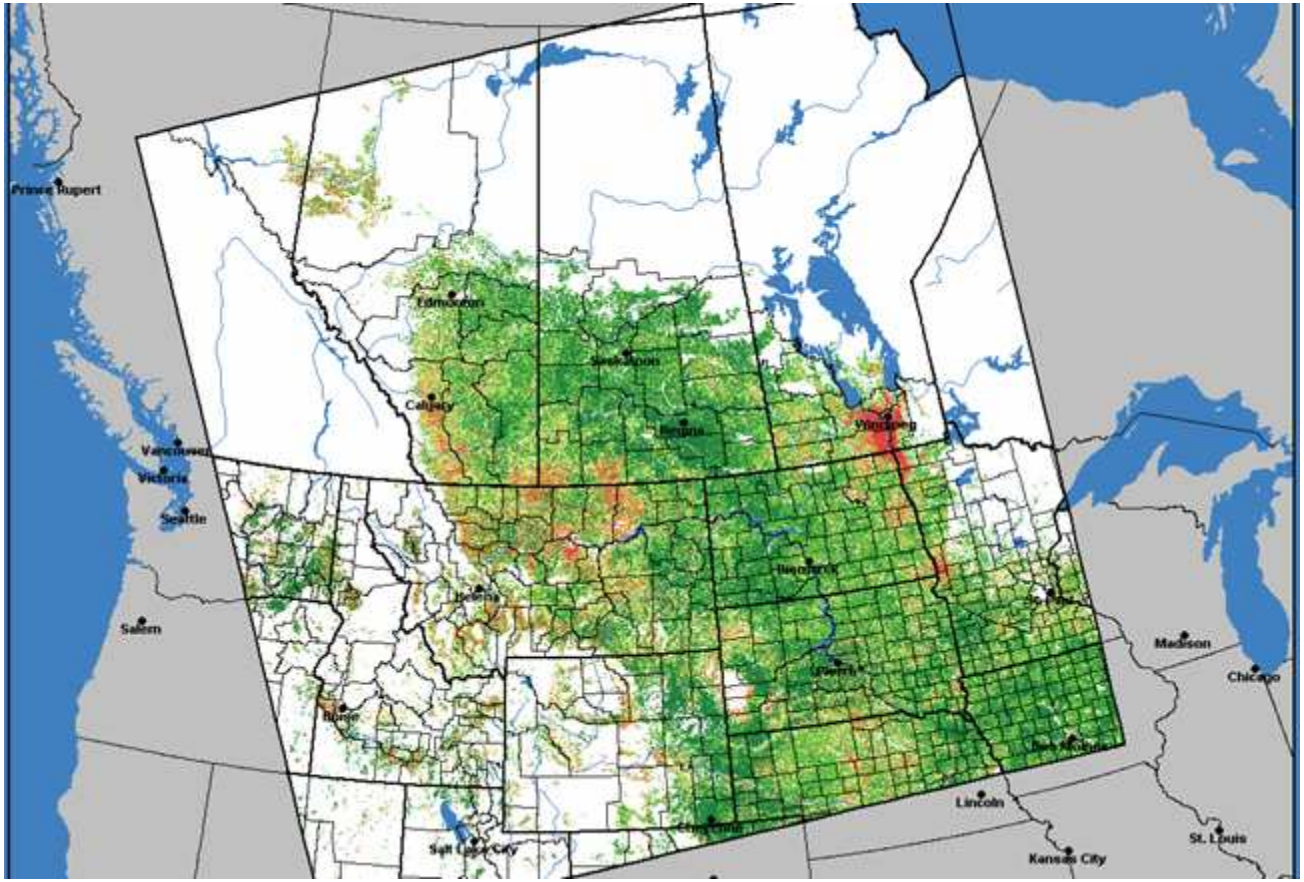
(Bonsal)

Flow pattern with SW flow
Common in wet summer of 2005

Structure of the drought

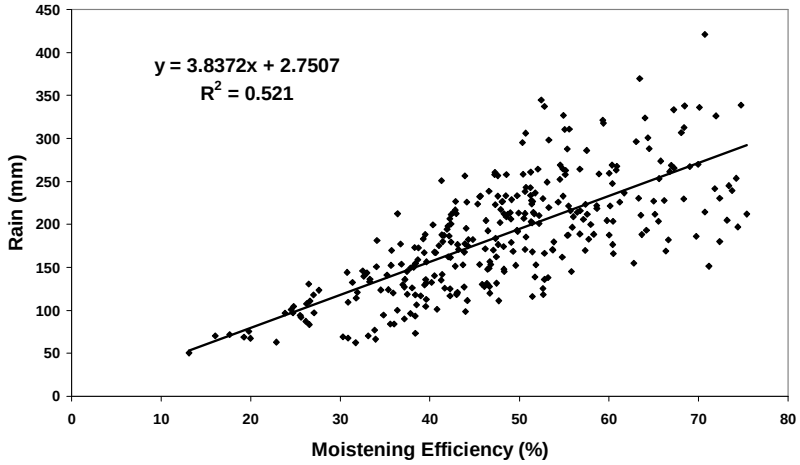


Agricultural production is aided by non-contributing areas



July 10 - 17, 2005

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

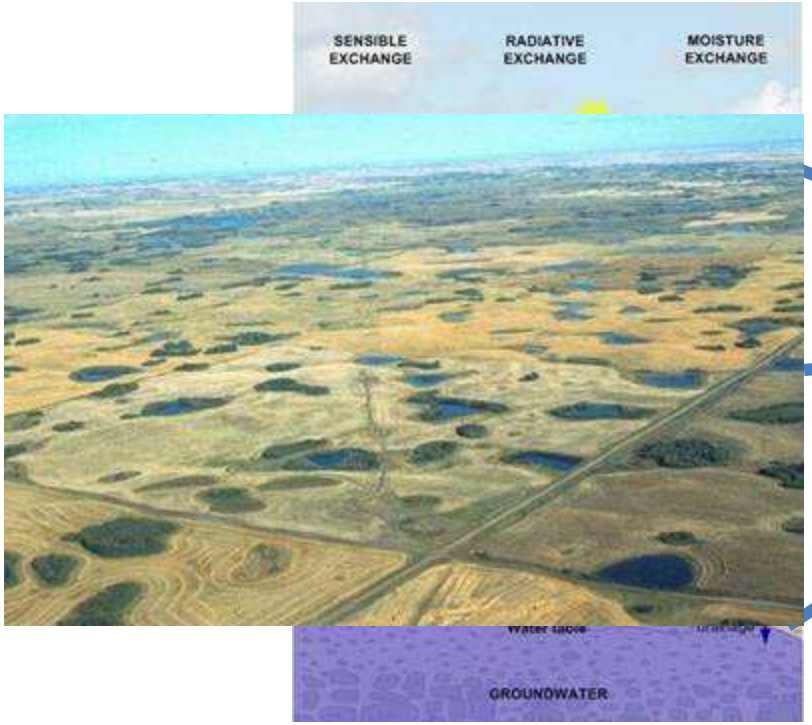


Clouds (Leighton)

Virga (Stewart)

Evapotranspiration
(Raddatz, Hanesiak, Strong)

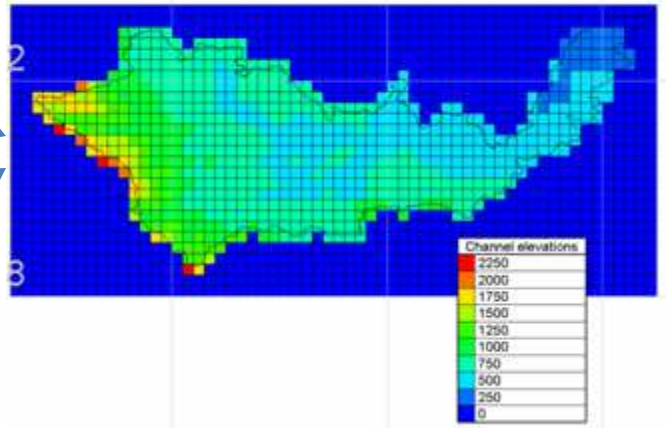
Canadian Regional Climate Model



Soil Moisture (Berg)

Ponding (Pomeroy)

MESH
(TO BE MIGRATED TO CLASS)



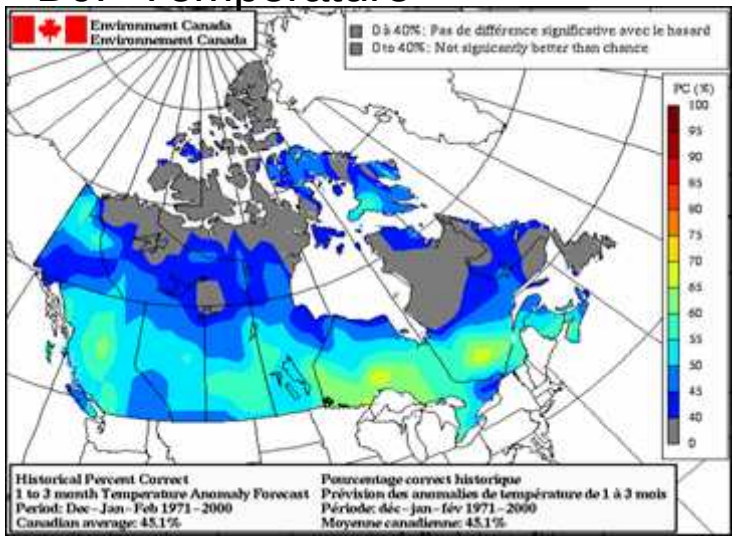
Ground Water (Woodbury, Snelgrove, Hayashi,van der Kamp)

VIC model estimates are used to characterize soil moisture patterns

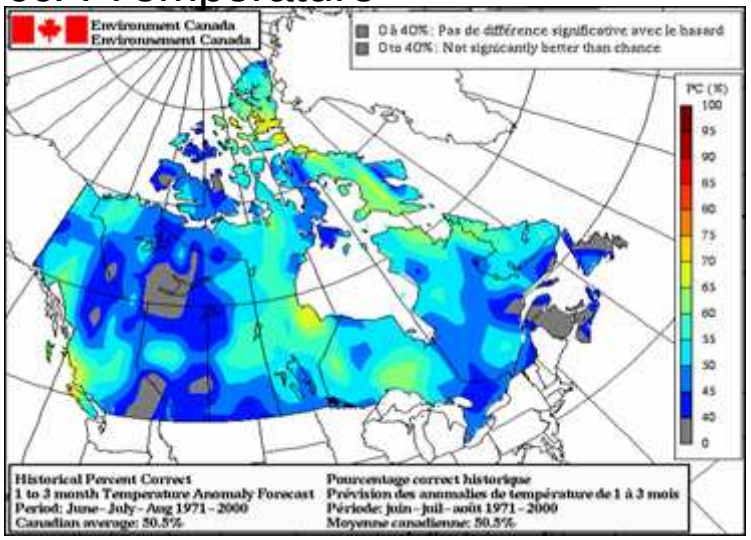
(Lei Wen)

Skill (% correct)

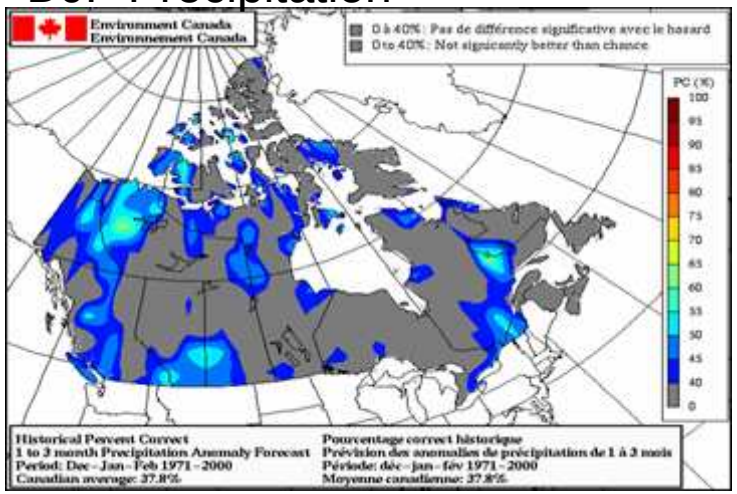
DJF Temperature



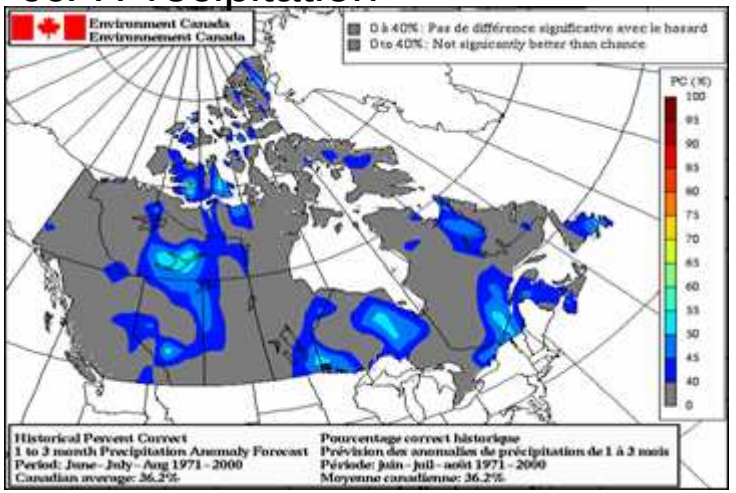
JJA Temperature



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)

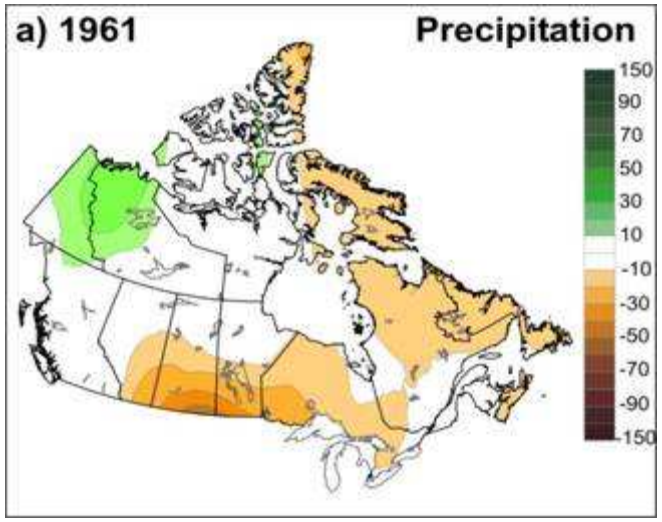
Theme #4. Comparisons between droughts – putting drought impacts into context (after Barrie Bonsal)

- Comparisons are being carried out with:

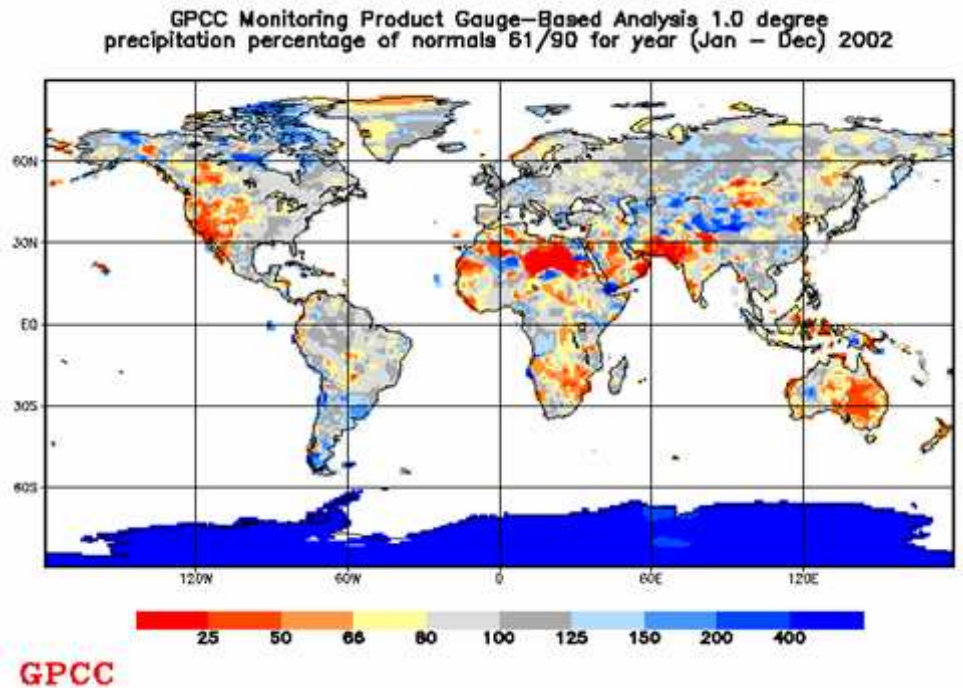
-Previous Canadian Prairie Droughts

- Others in North America

- Around the world

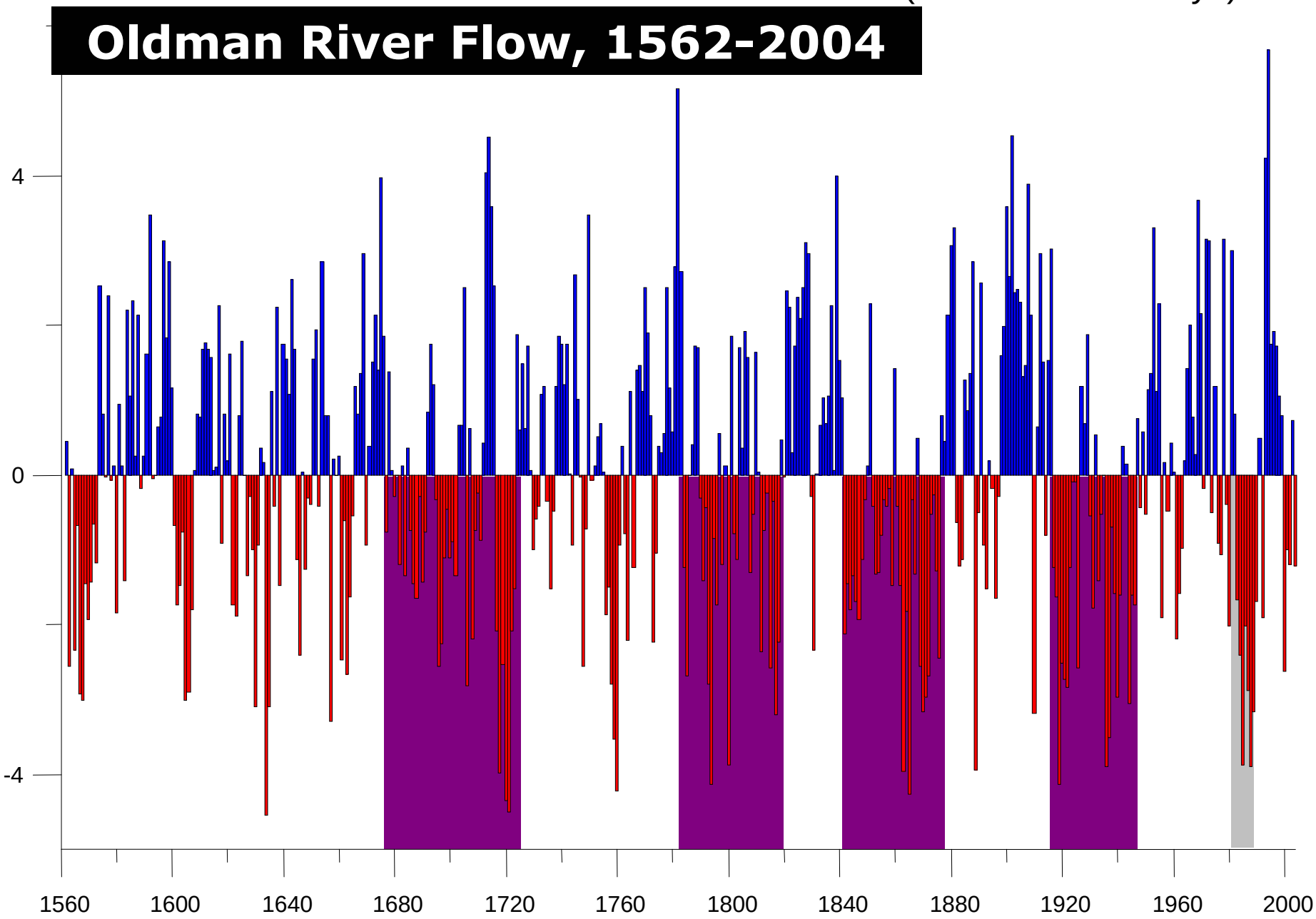


1961 Precipitation Anomaly



2002 Global Precipitation Anomaly

(After David Sauchyn)

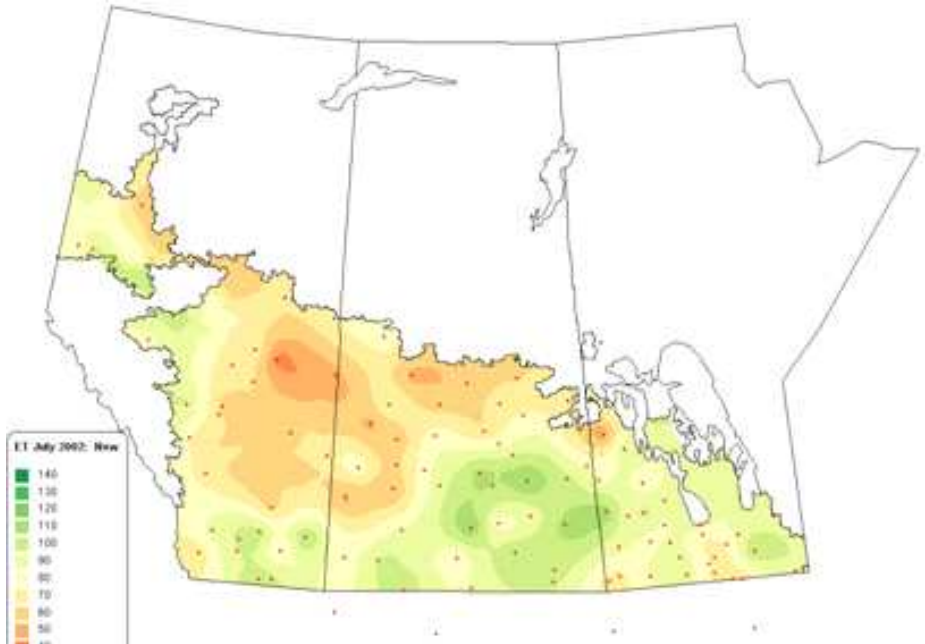


Theme #5: DEWS:
Partner Assessments of DRI Research Products

In user workshops they were asked

1. What could you do with more or different information that what is currently available?

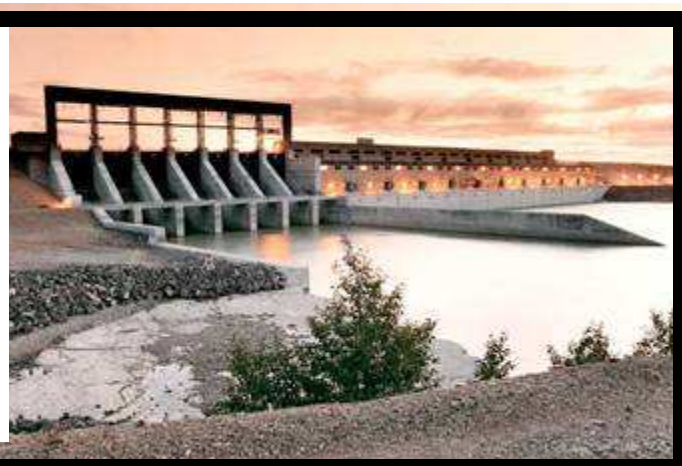
2. How would your decisions potentially change if you had access to information on Evapotranspiration?



July 2002: Evapotranspiration Conditions
(from Brimelow and Hanesiak)

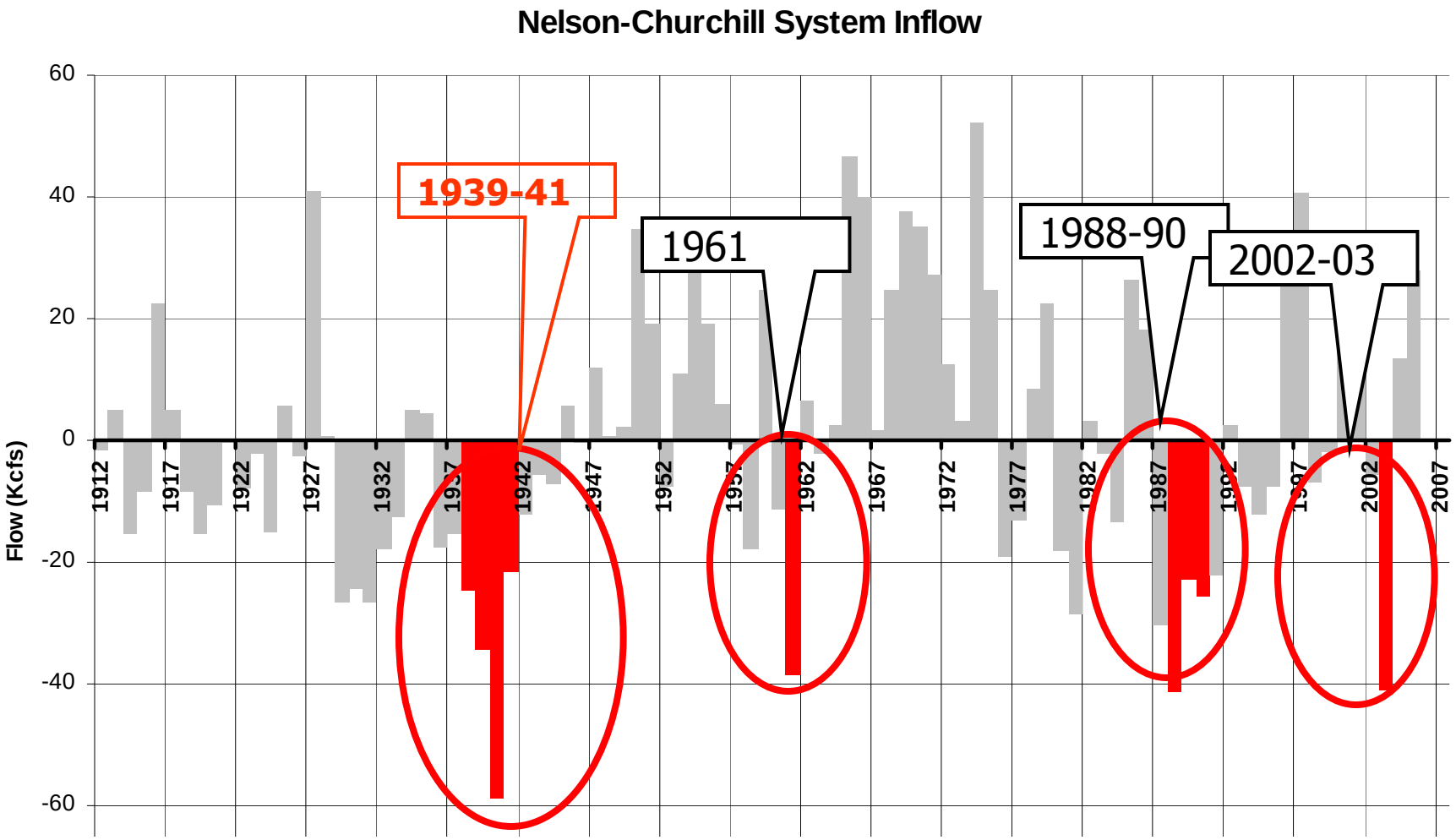
Manitoba Hydro must plan for the Impact of drought in many basins

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



Source of most of Manitoba Hydro's generating capacity.

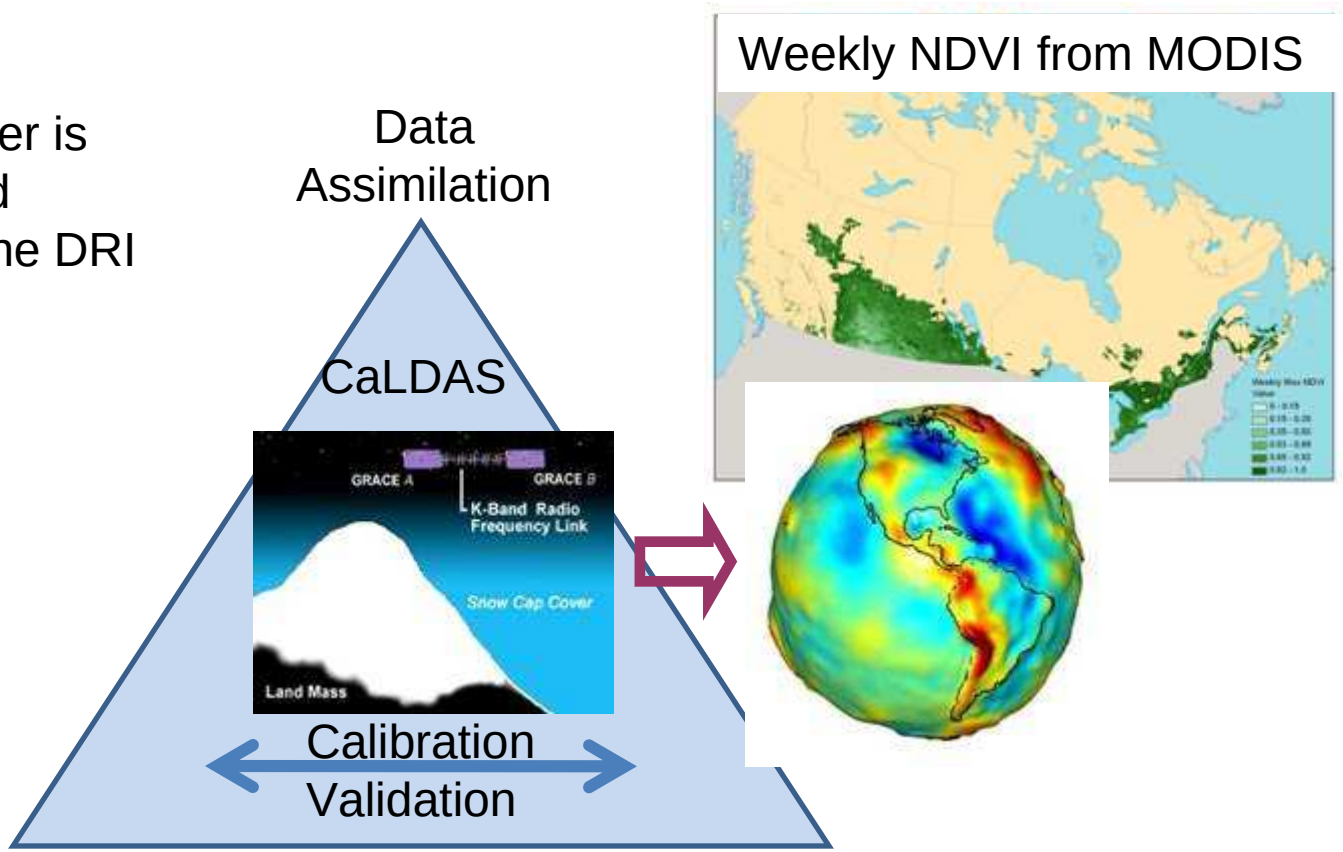
Historical Drought of Record



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.

ISSUES FOR DATA INTEGRATION

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



In-situ data
-station data
- CANGRID
- CRU

Remote sensing data
MODIS
GRACE
AVHRR

SUSTAINABLE DEVELOPMENT IN WESTERN CANADA

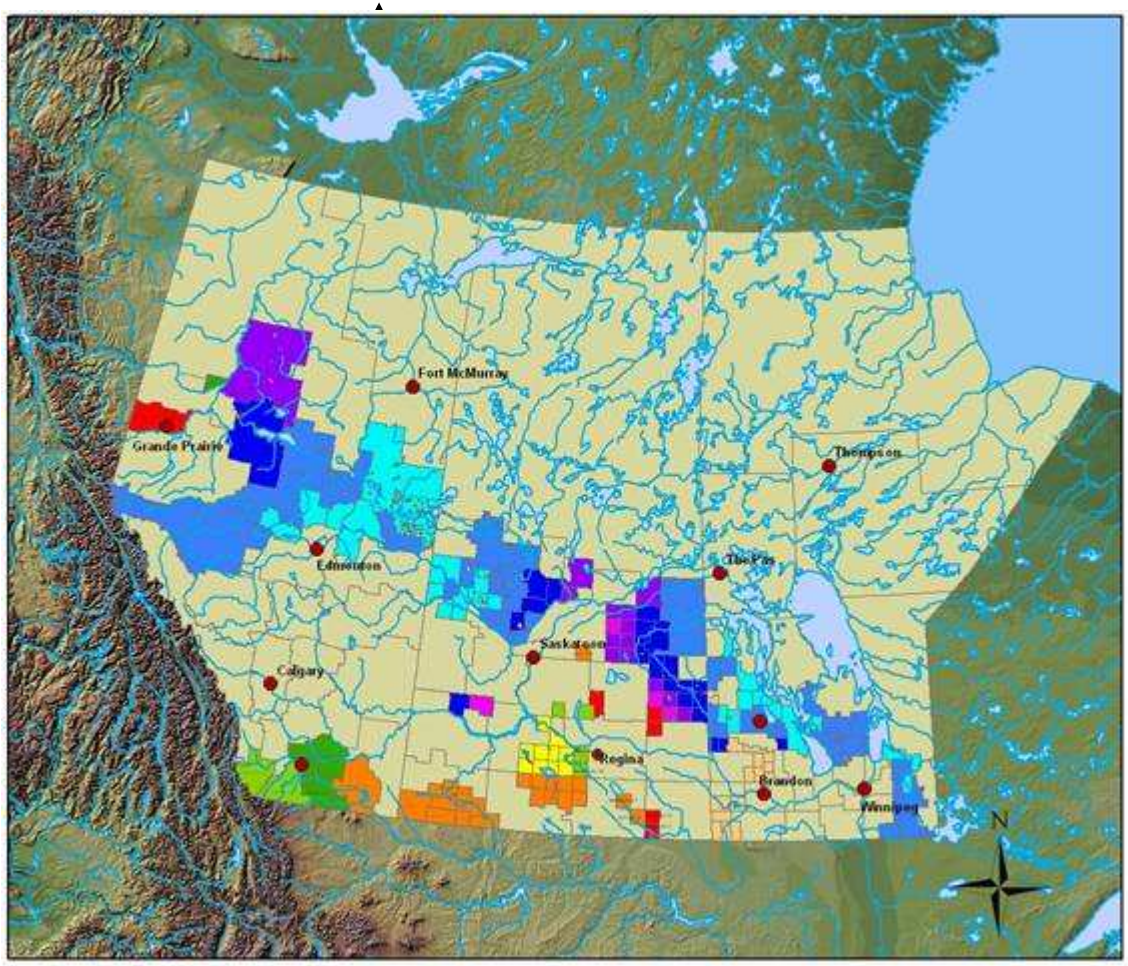
After Bruntland: *"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

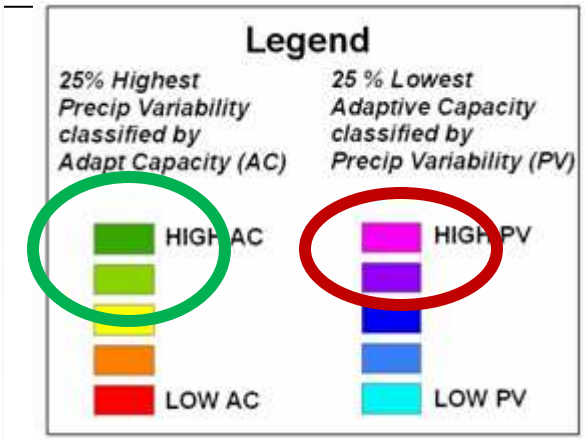
Drought impacts the water resources available for agriculture, forestry, urban water supplies, etc.

1930's – Impacts were not reversible for families who abandoned their farms.

1999 – 2004 – Impacts were more reversible due to land management practices.

Assessing Adaptive Capacity for dealing with Precipitation Variability



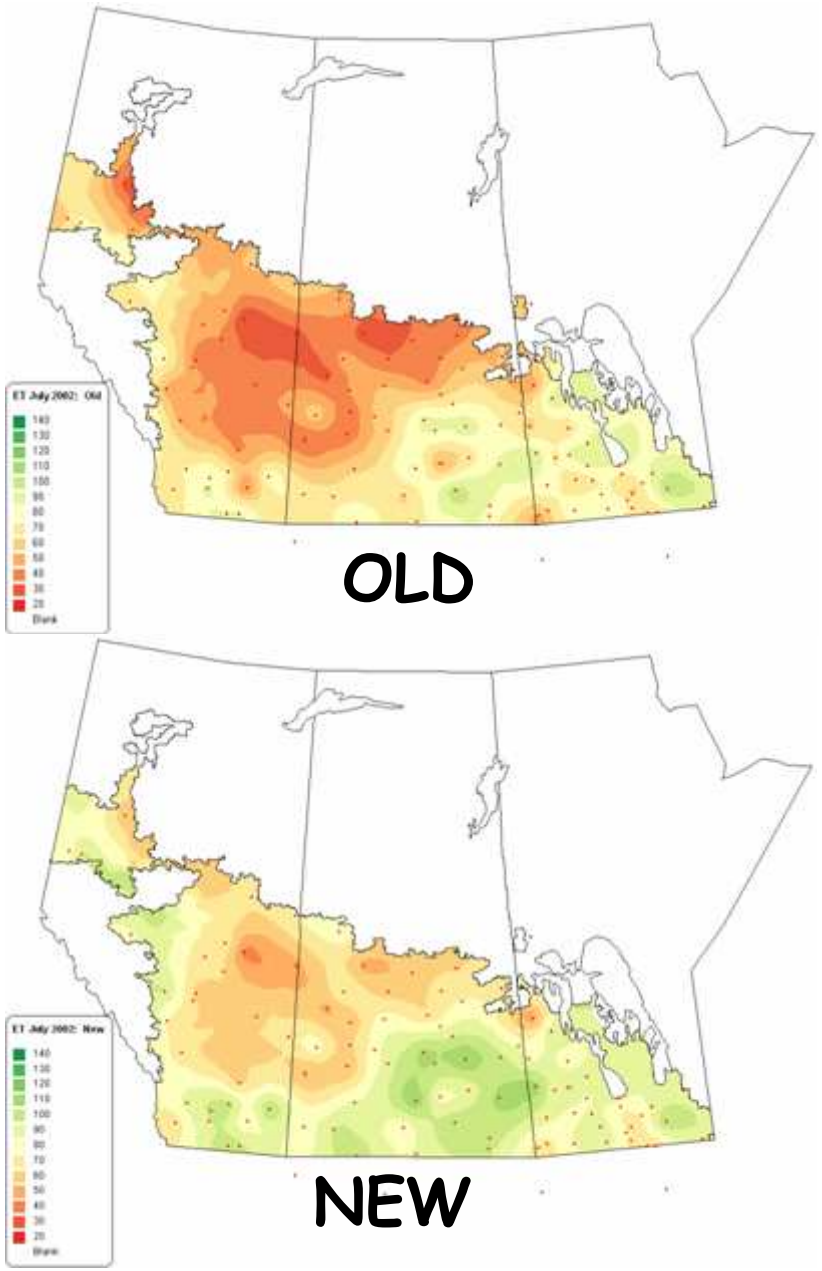


(after Venema)

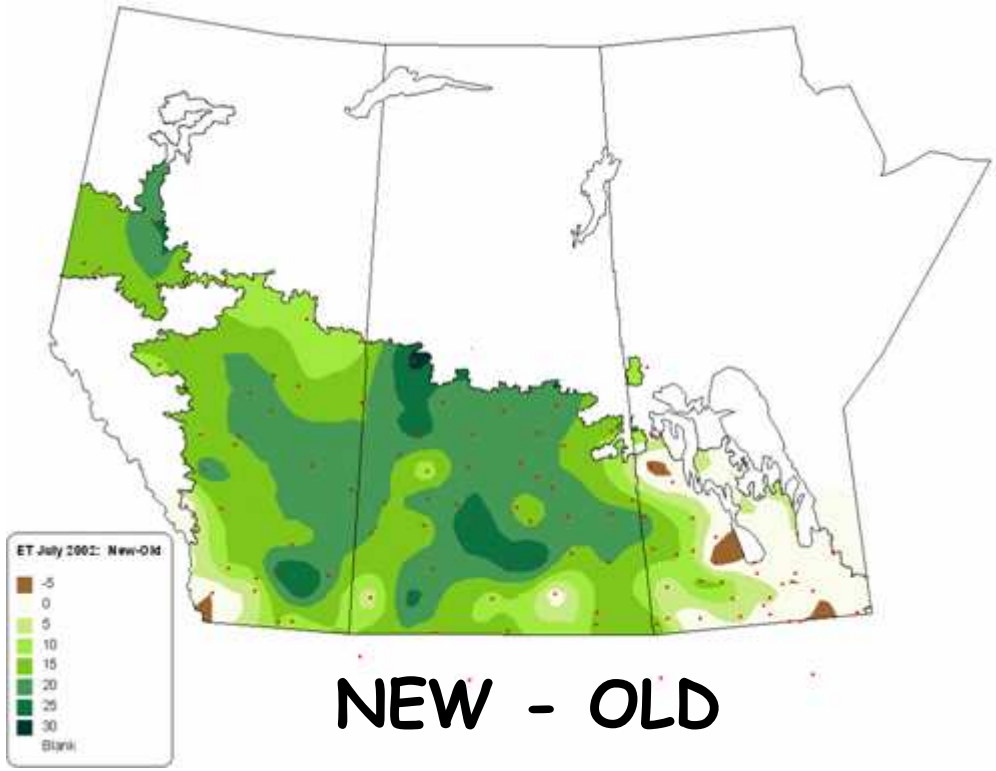
Research provides the basis for development of drought monitoring services

Contribution of Research and Development	**Operational services**
Data assimilation products/ techniques for developing integrated data products	Data interpolated and mapped
New experimental products and testing of NADM inputs through product comparisons and evaluations.	Data products produced on a Routine basis.
New insights about drought processes that facilitates the understanding of trends and variability of drought.	Interpretation of the maps and their impacts
Interactions with partners/users to assess how the information can best be used in decision making	Advisory Services

Some DRI Contributions to Drought Monitoring



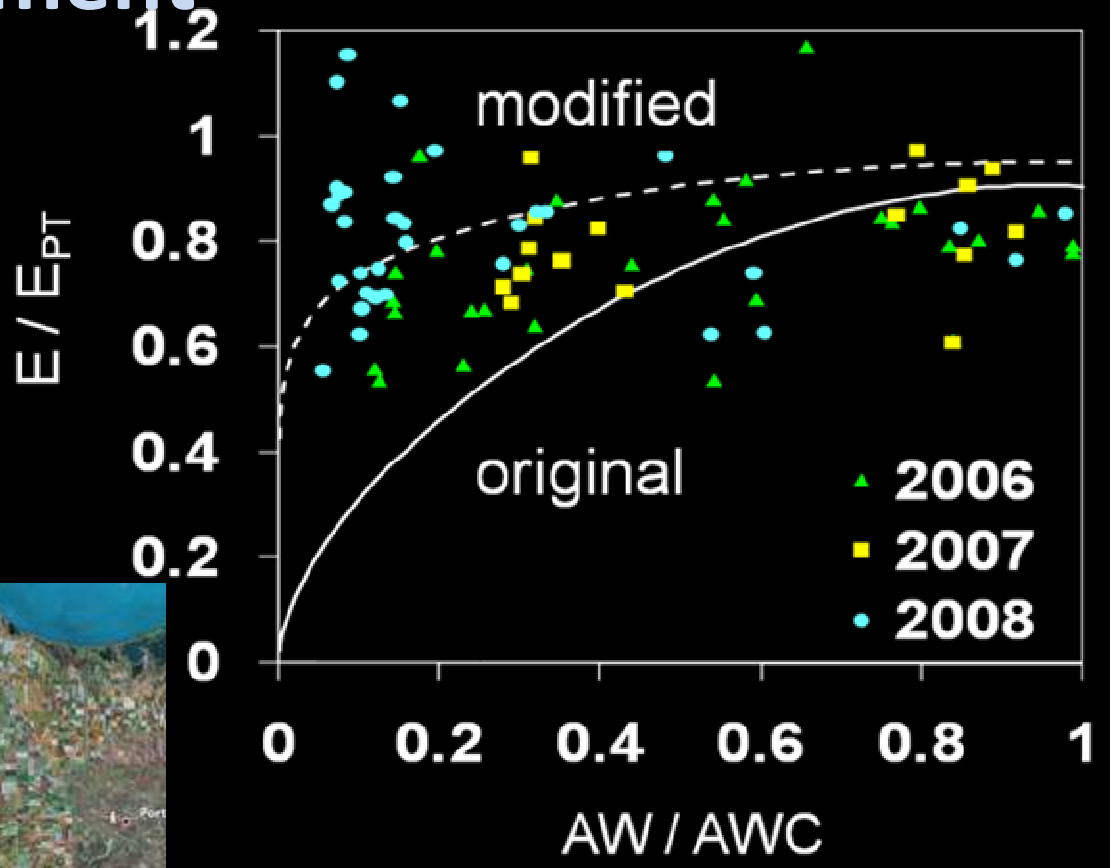
DRI supports the development of better techniques for estimating specific water cycle variables. PAM-modelled accumulation for ET in July 2002.



(Hanesiak, Brimelow)

DRI Contributions to Regional Water Resource Management

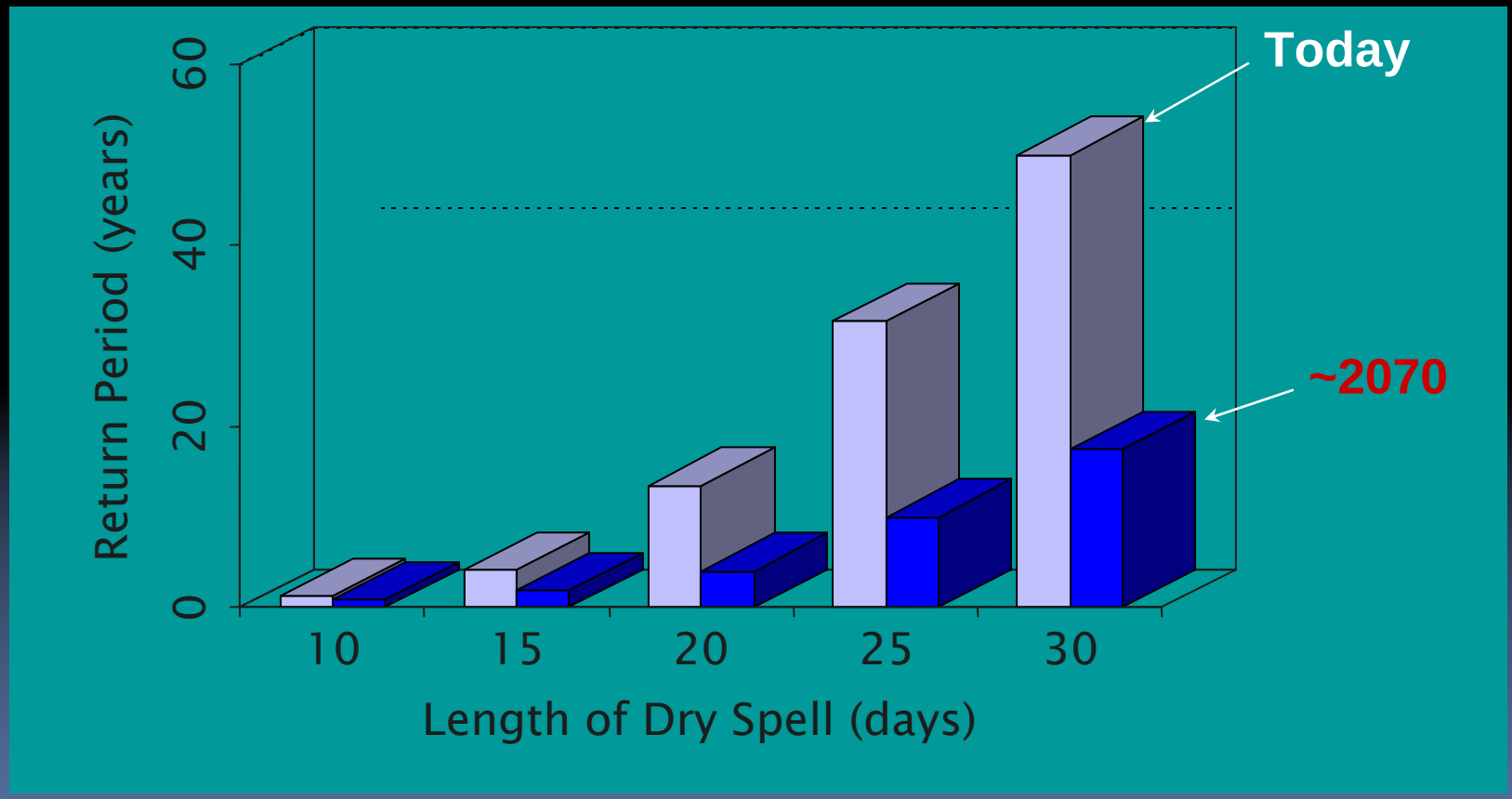
Masaki Hayashi's studies of the effect of prairie vegetation and solar vegetation on ET have led to modifications in the Versatile model used by Alberta Agriculture for planning purposes.



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)

DRI will enable departments to respond to climate change. The frequency and severity of droughts are likely to increase in southern Canada

Central North America



Gregory et al., 1997

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!