

DROUGHT, HEAVY PRECIPITATION AND CLIMATE

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University of Manitoba***



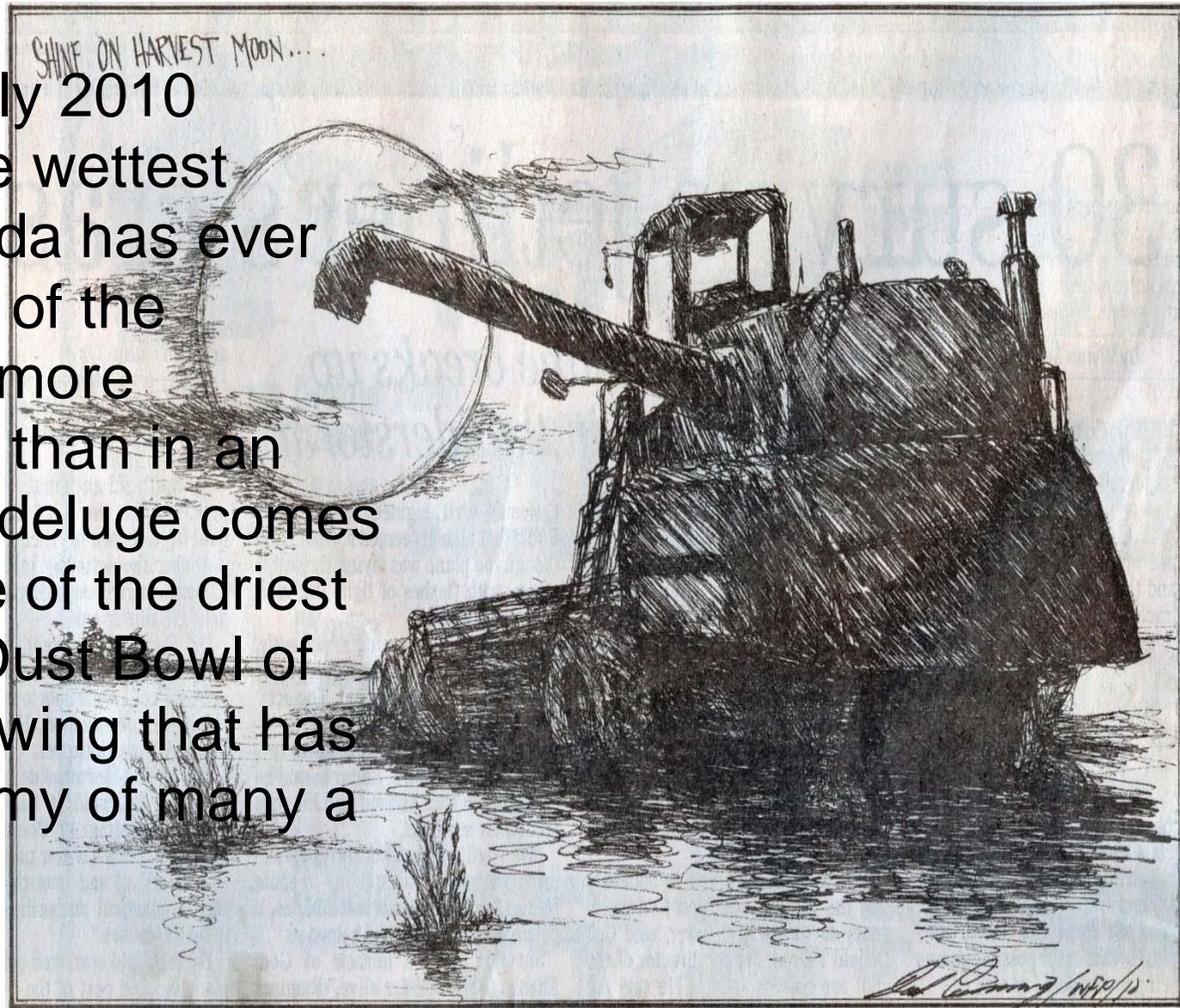
Canadian Foundation for Climate
and Atmospheric Sciences (CFCAS)

Fondation canadienne pour les sciences
du climat et de l'atmosphère (FCSCA)

2000-2009 TOP WEATHER STORIES

1. Vanishing Arctic ice in 2007.
2. B.C.'s year of disastrous weather -- fires, floods and freezes in 2003.
3. Prairies plagued with one of its worst growing seasons ever in 2002.
4. B.C.'s weather woes in 2006.
5. Alberta's floods in 2005.
6. The summer that wasn't for most of Canada in 2009.
7. The East's big summer soak in 2008.
8. Storm drowns and pounds Edmonton in 2004.
9. Canada dry from coast to coast in 2001.
10. 2000 tornado in Red Deer, Alta., that killed 12 and injured 140.

Globe and Mail: July 2010
This spring was the wettest Environment Canada has ever observed for much of the Prairies, with 70% more precipitation falling than in an average year. The deluge comes on the heels of one of the driest periods since the Dust Bowl of the 1930s, a wild swing that has made a public enemy of many a weatherman.



GLOBAL CONCERN

The World Meteorological Organization Secretary General has said that the media most often asks him questions about climate extremes.

OBJECTIVES

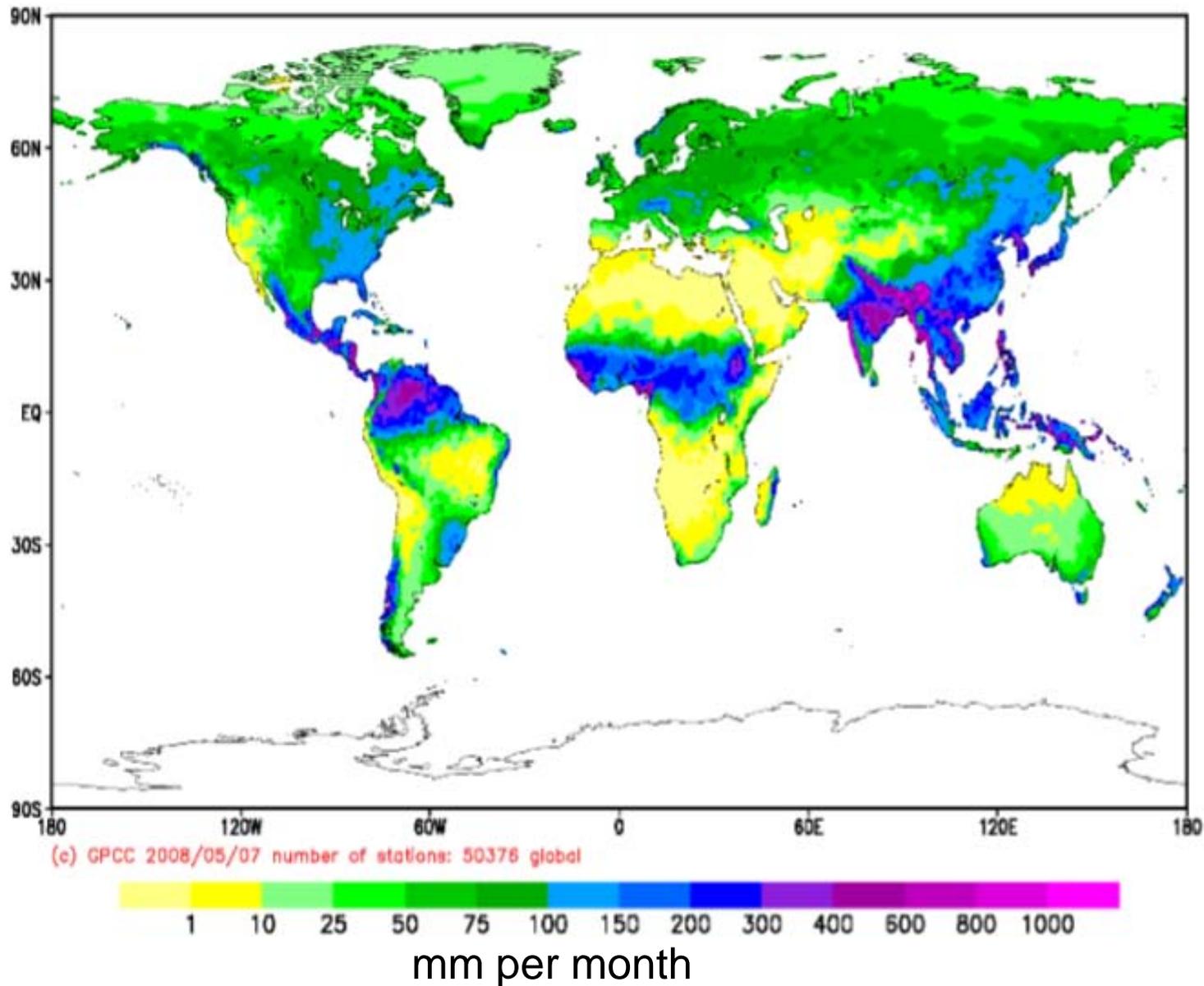
Overall: To summarize some of the connections between drought, heavy precipitation and climate

Specifics:

- **Precipitation extremes as inherent to climate**
- **Features of drought**
- **Connections with heavy precipitation**
- **Future conditions and issues**

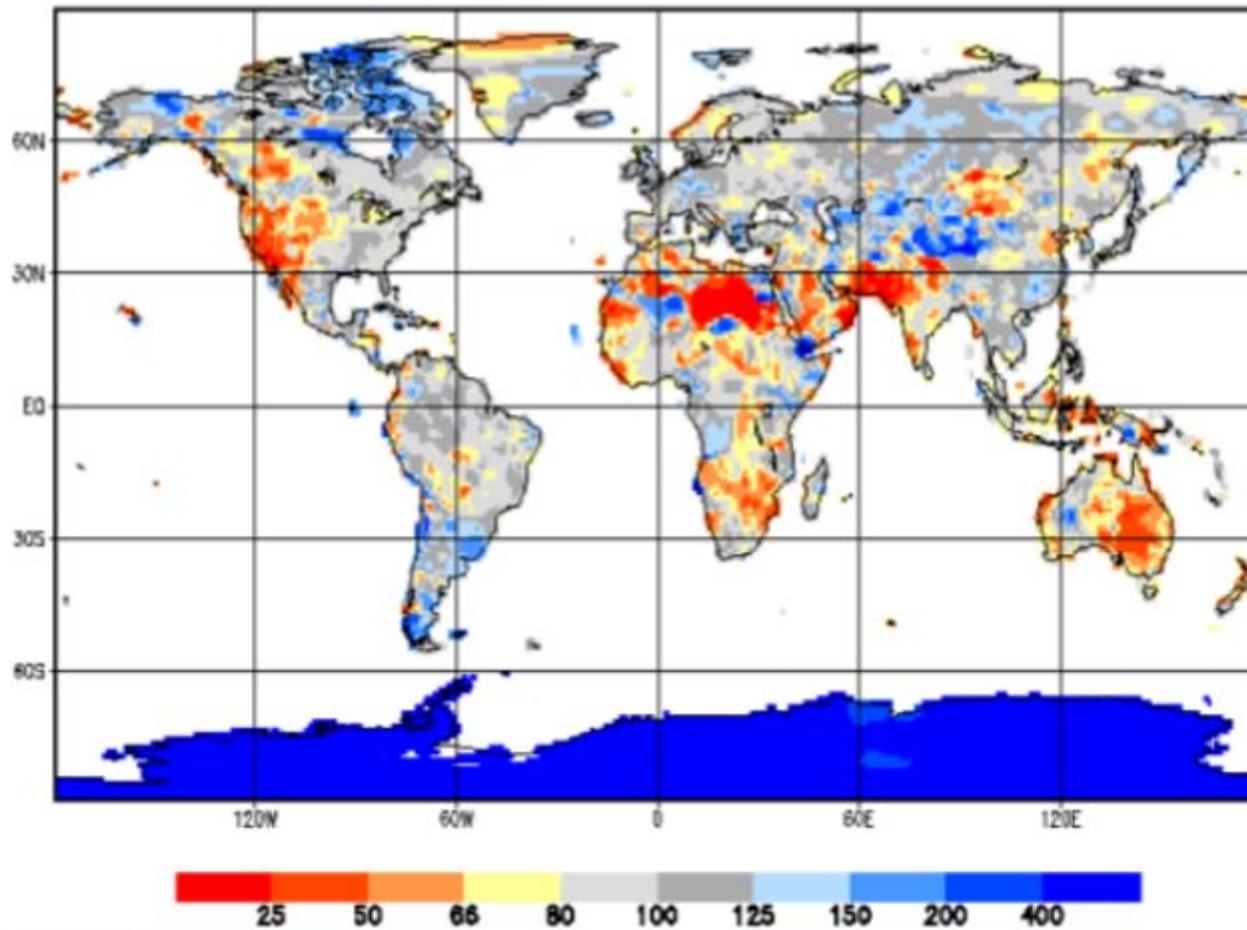
Special reference to 1999-2005 drought

JULY 10-YEAR PRECIPITATION



2002

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

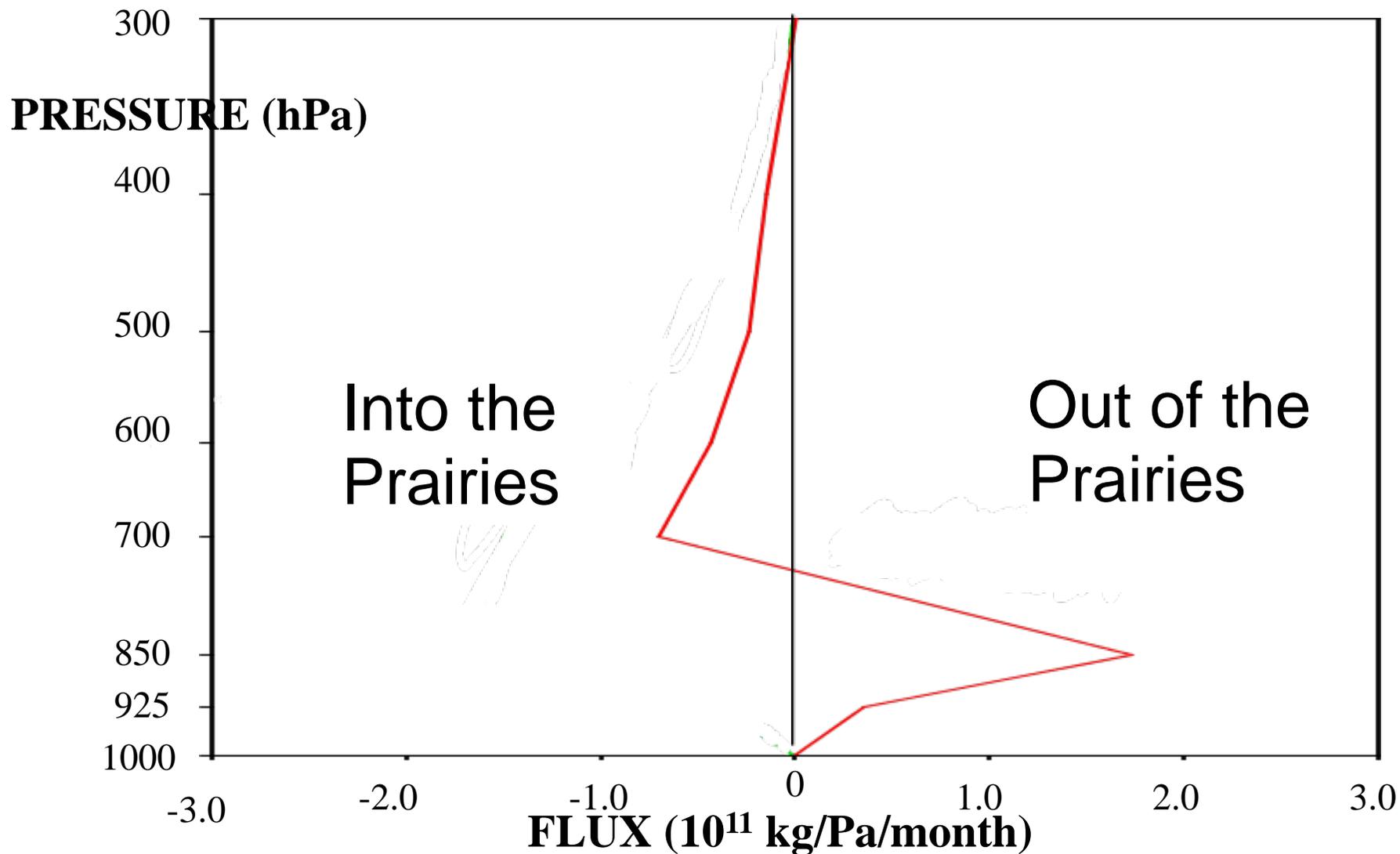


GPCC

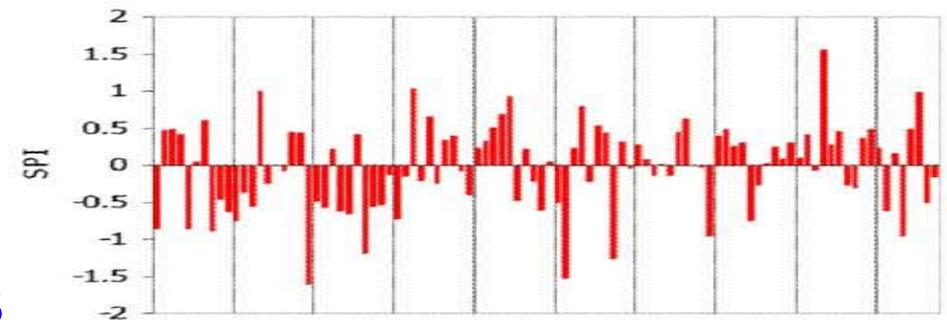
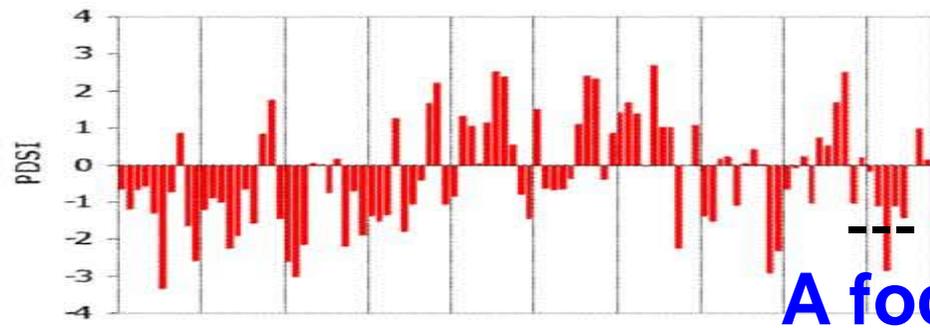


The Canadian
Prairies

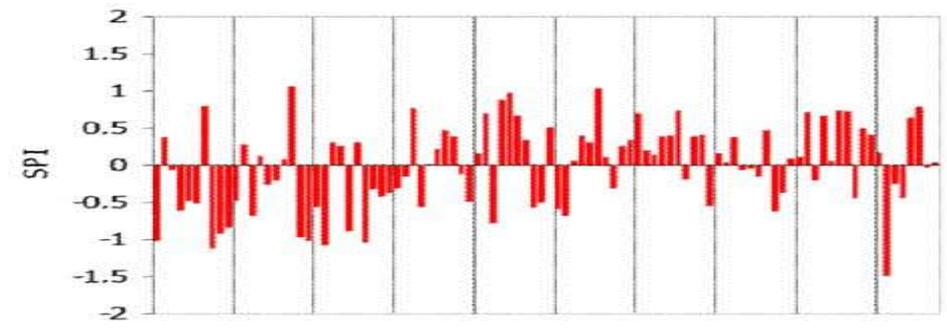
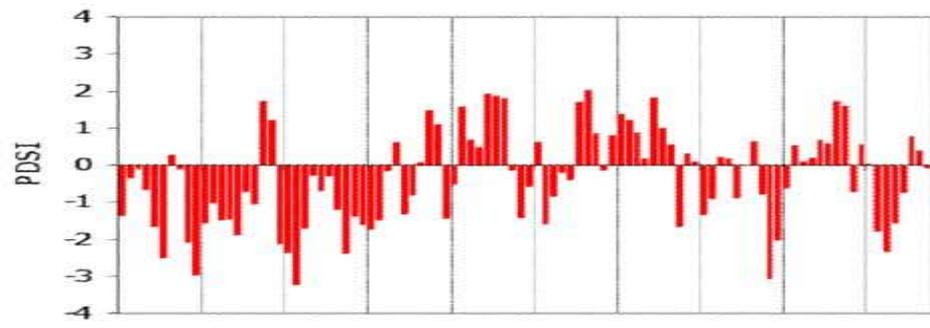
VERTICAL MOISTURE FLUX PROFILE



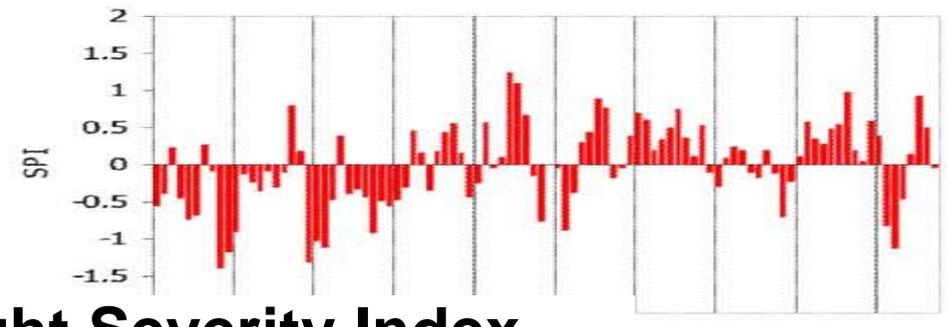
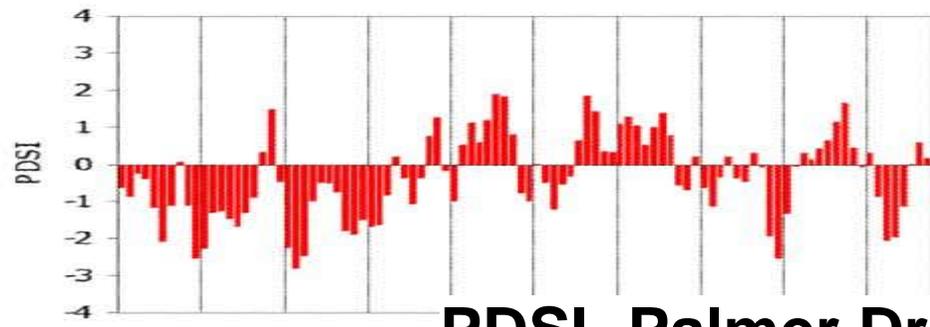
a) Summer Average (June July August)



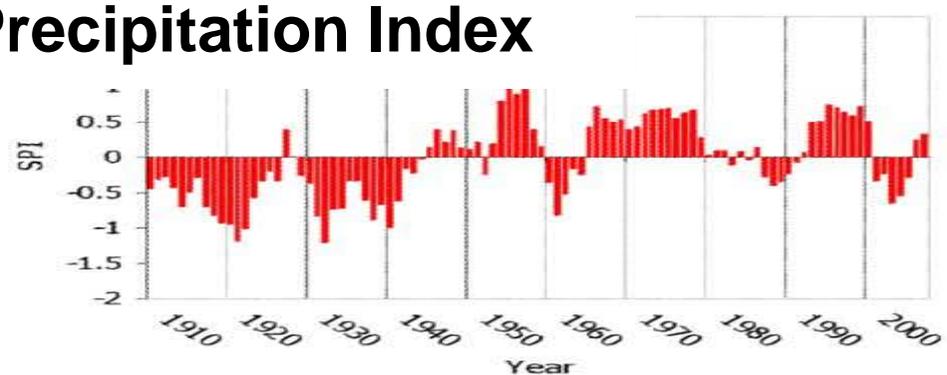
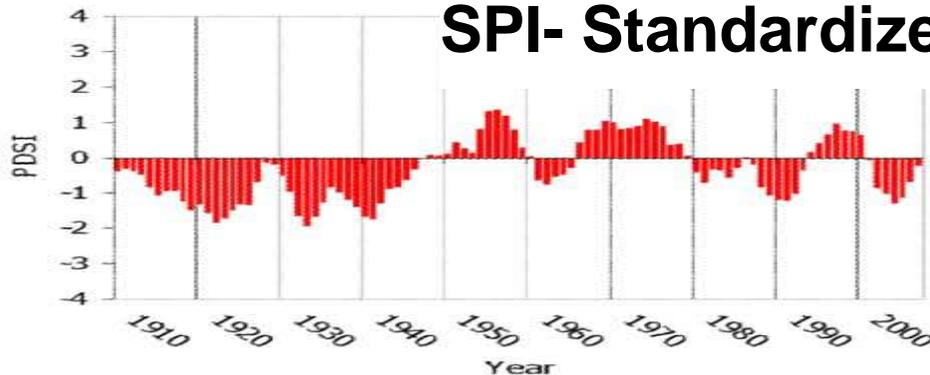
b) Annual Average



c) 2 year Average

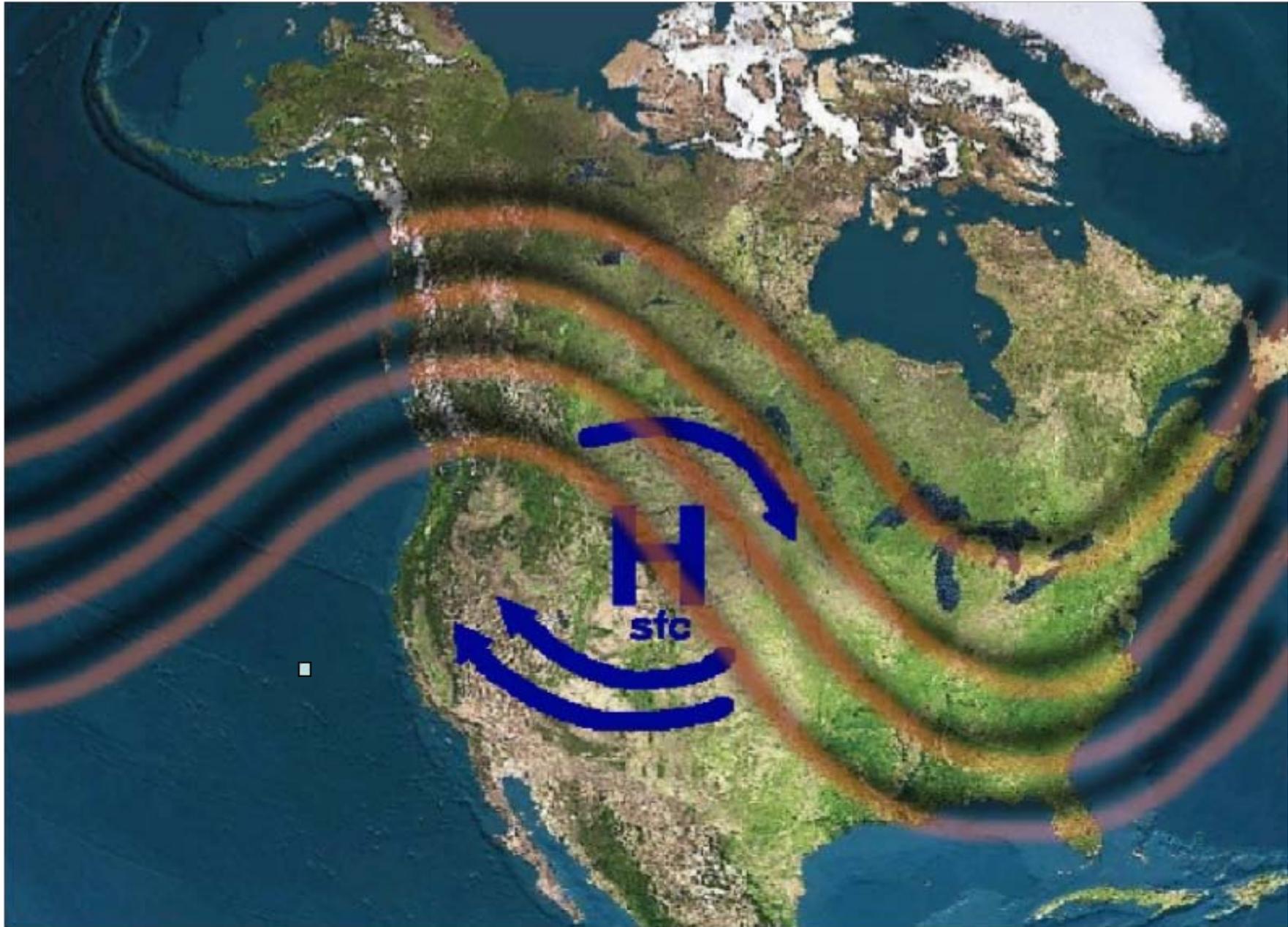


d) 5 year Average

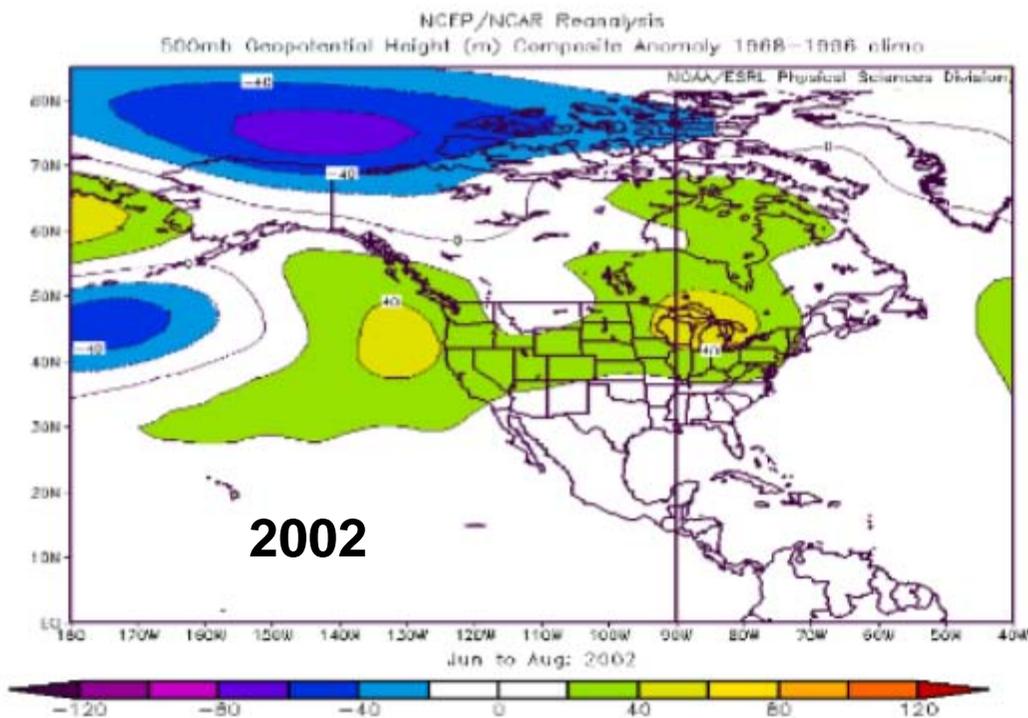
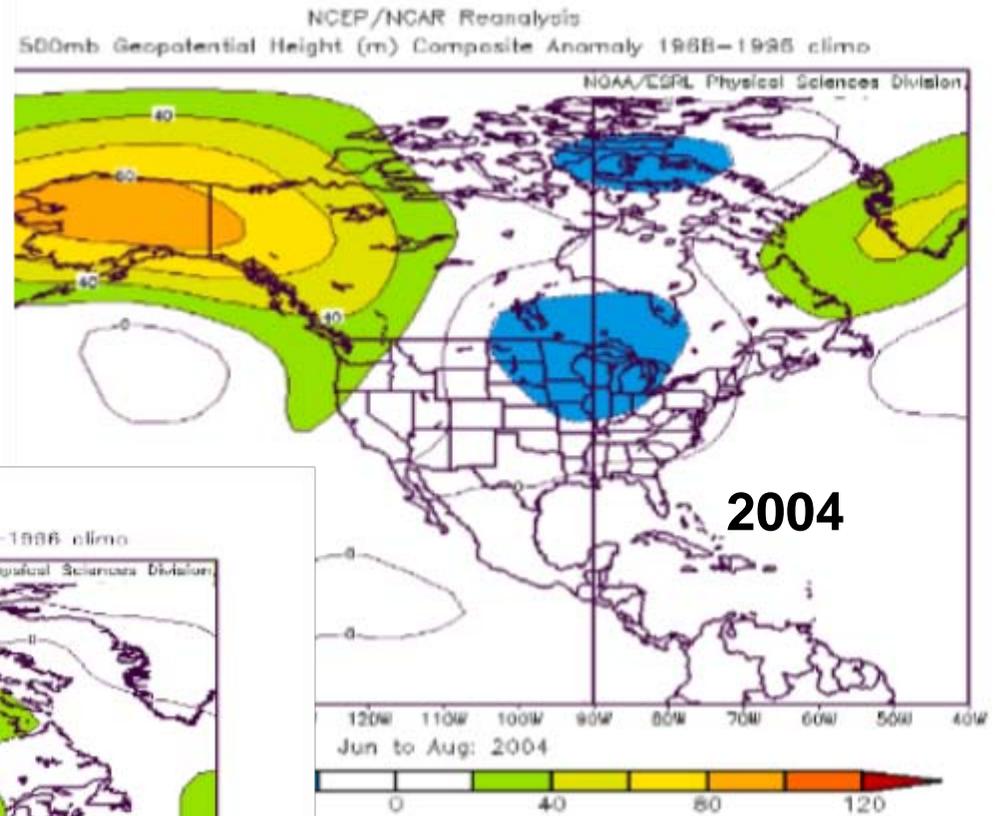
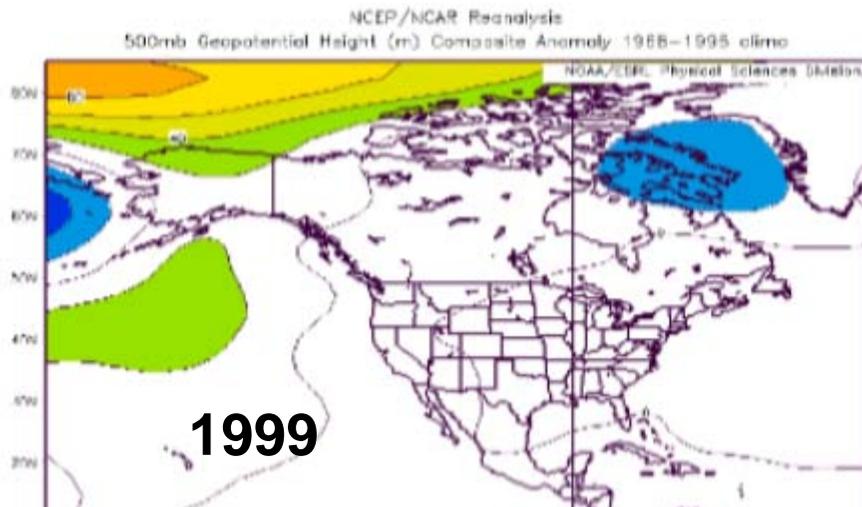


PDSI- Palmer Drought Severity Index
SPI- Standardized Precipitation Index

COMMON VIEW ...



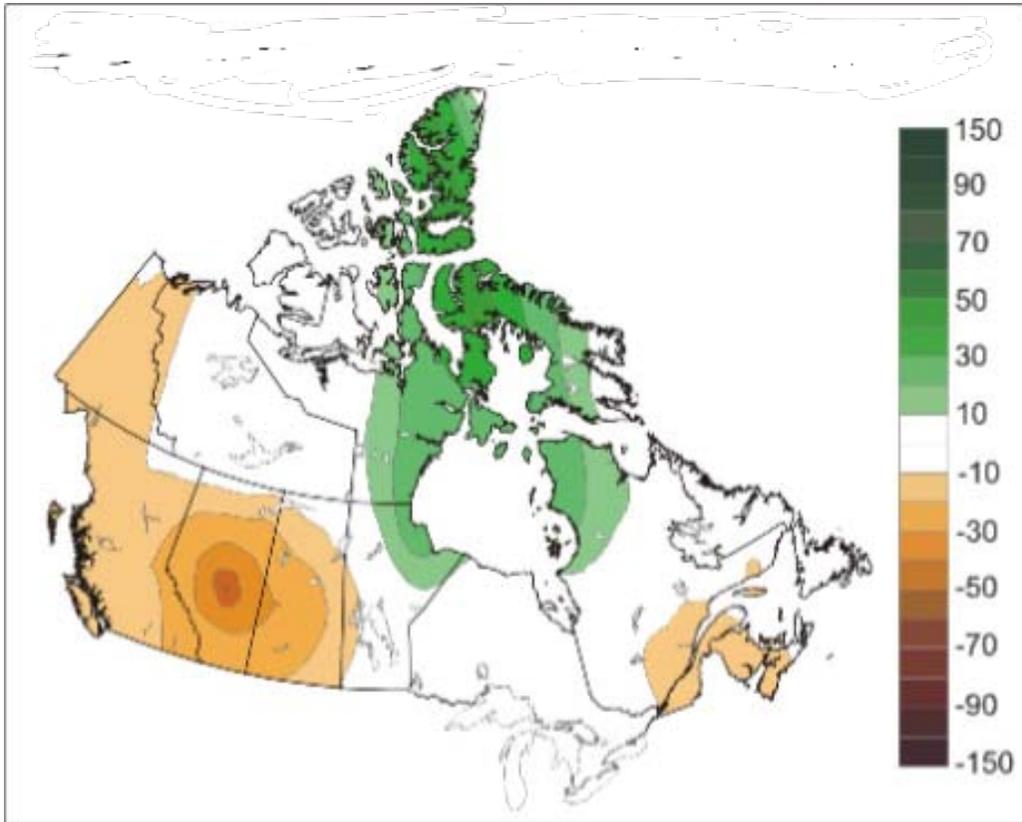
CONTINENTAL SCALE PATTERNS



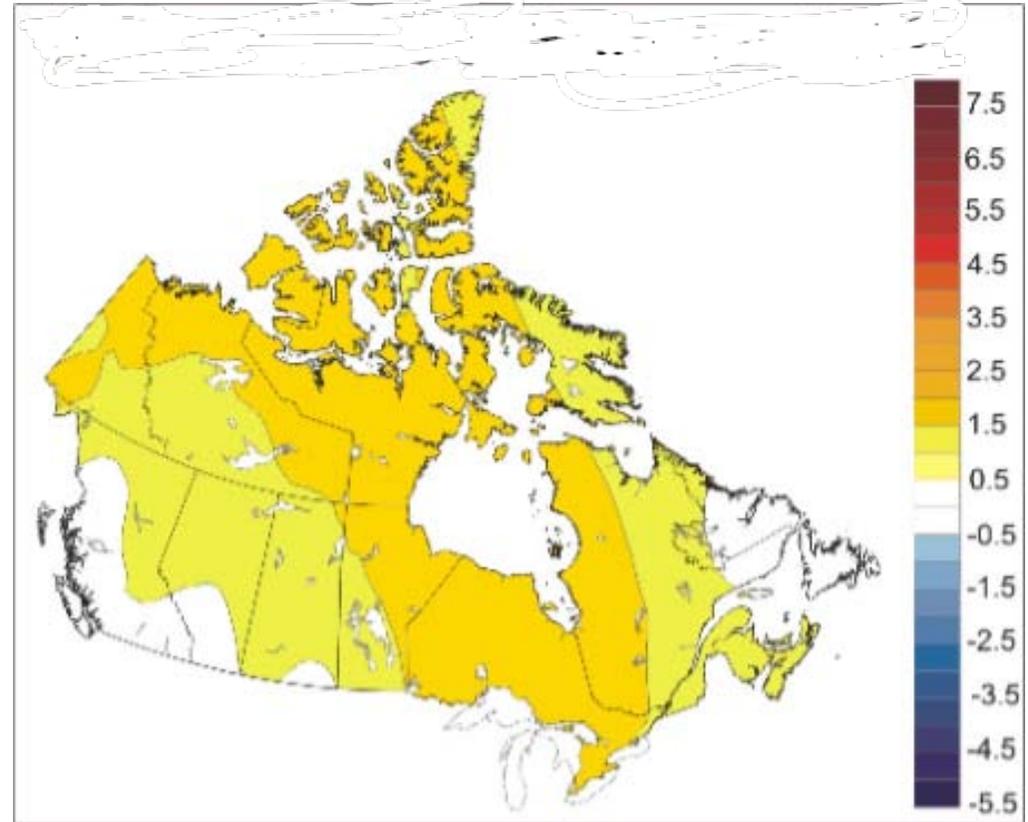
Summer 500 mb

Drought ... Not Too Hot

Precipitation



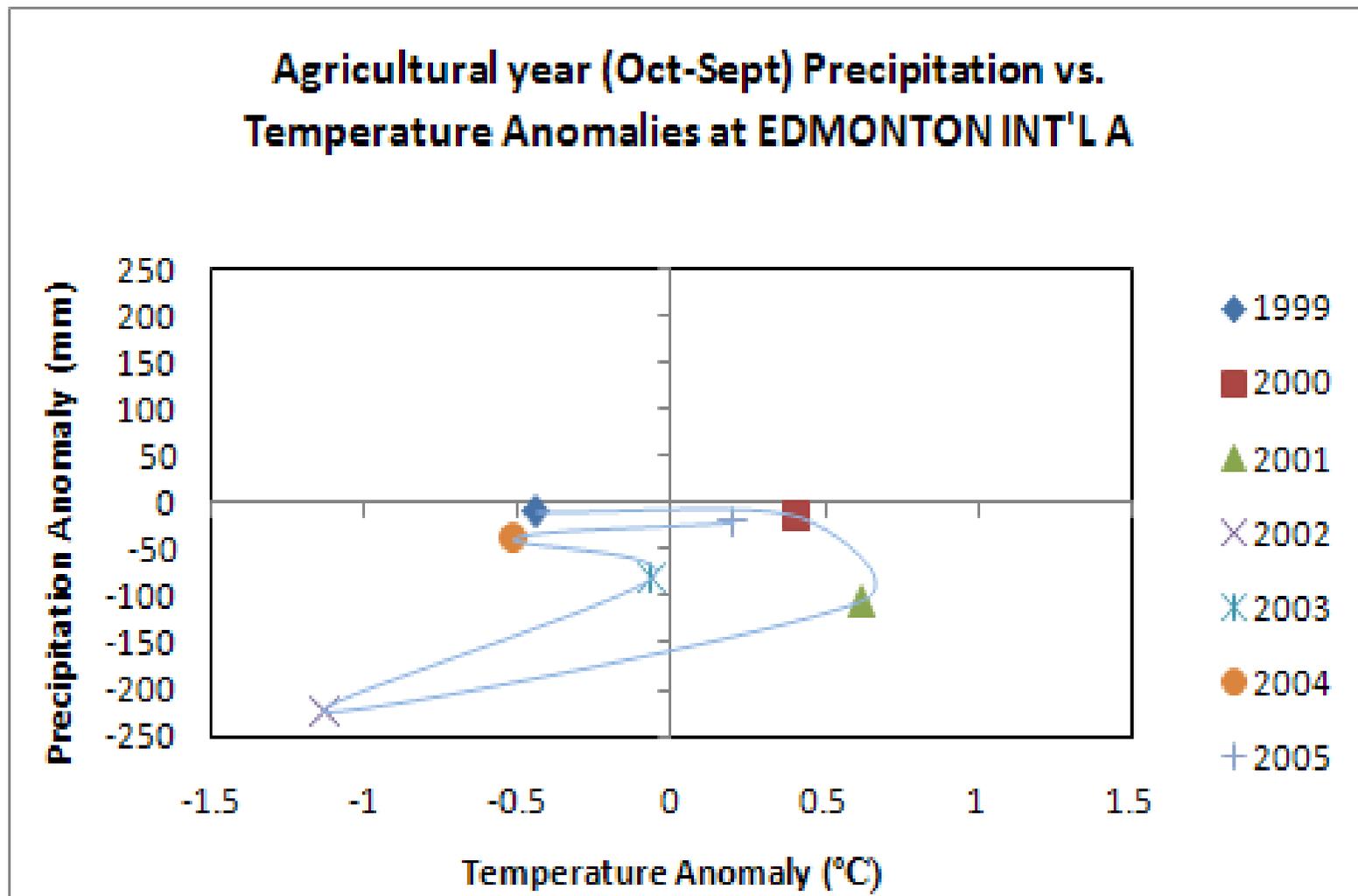
Temperature



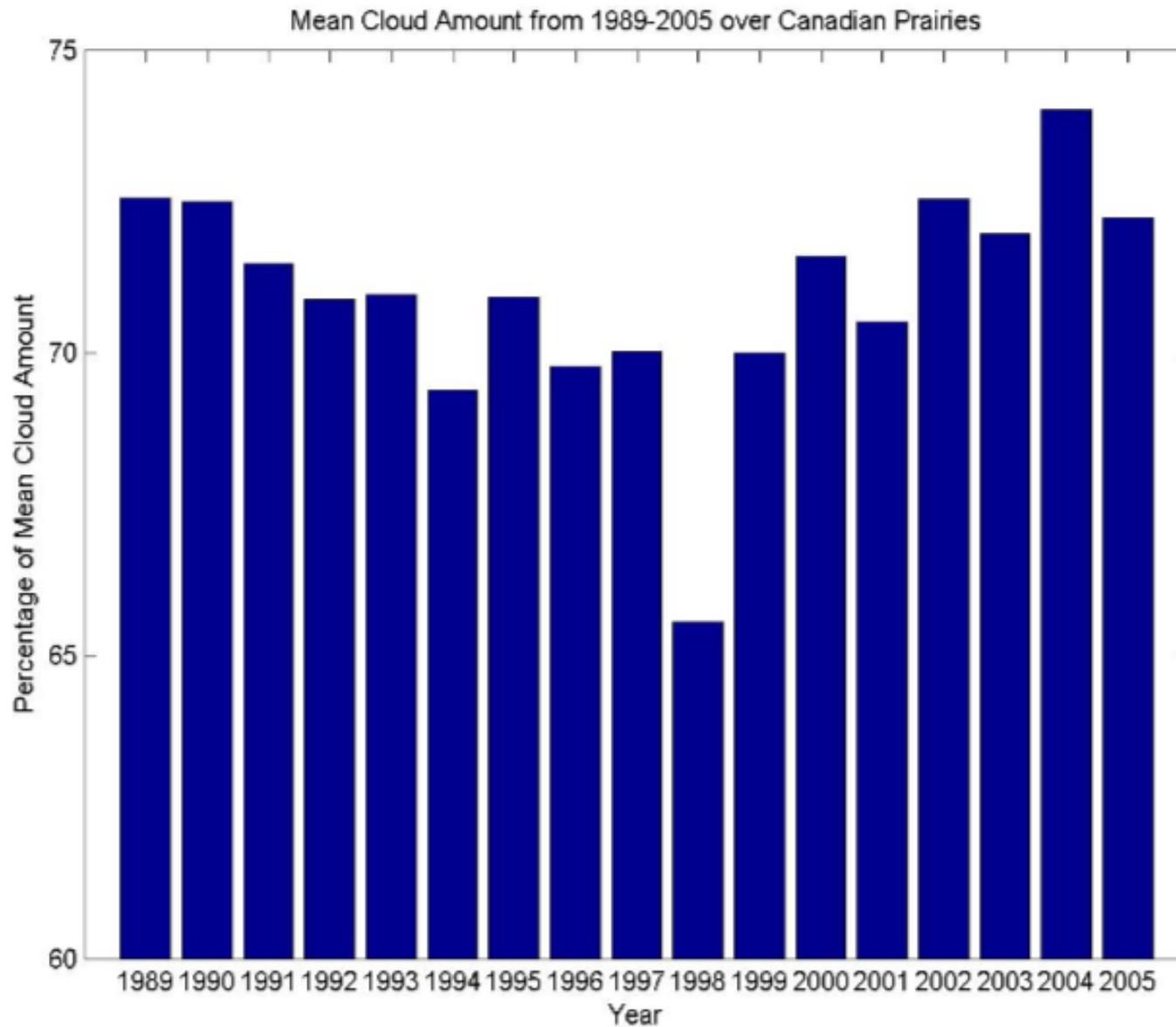
Summers of 2000, 2001 and 2002

PRECIPITATION-TEMPERATURE ANOMALY

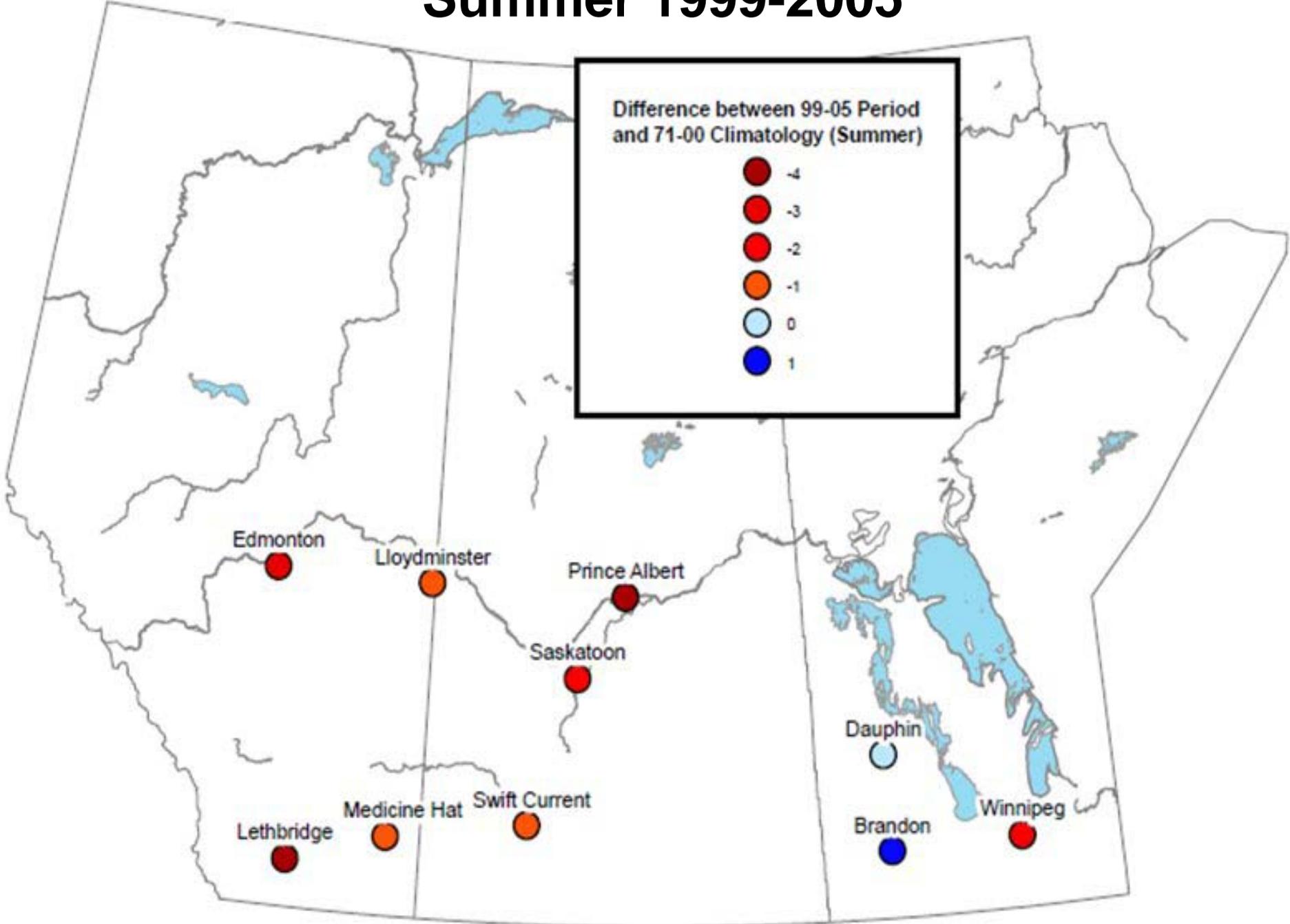
Agricultural Years (Sept-Aug) Edmonton



CLOUD AMOUNT



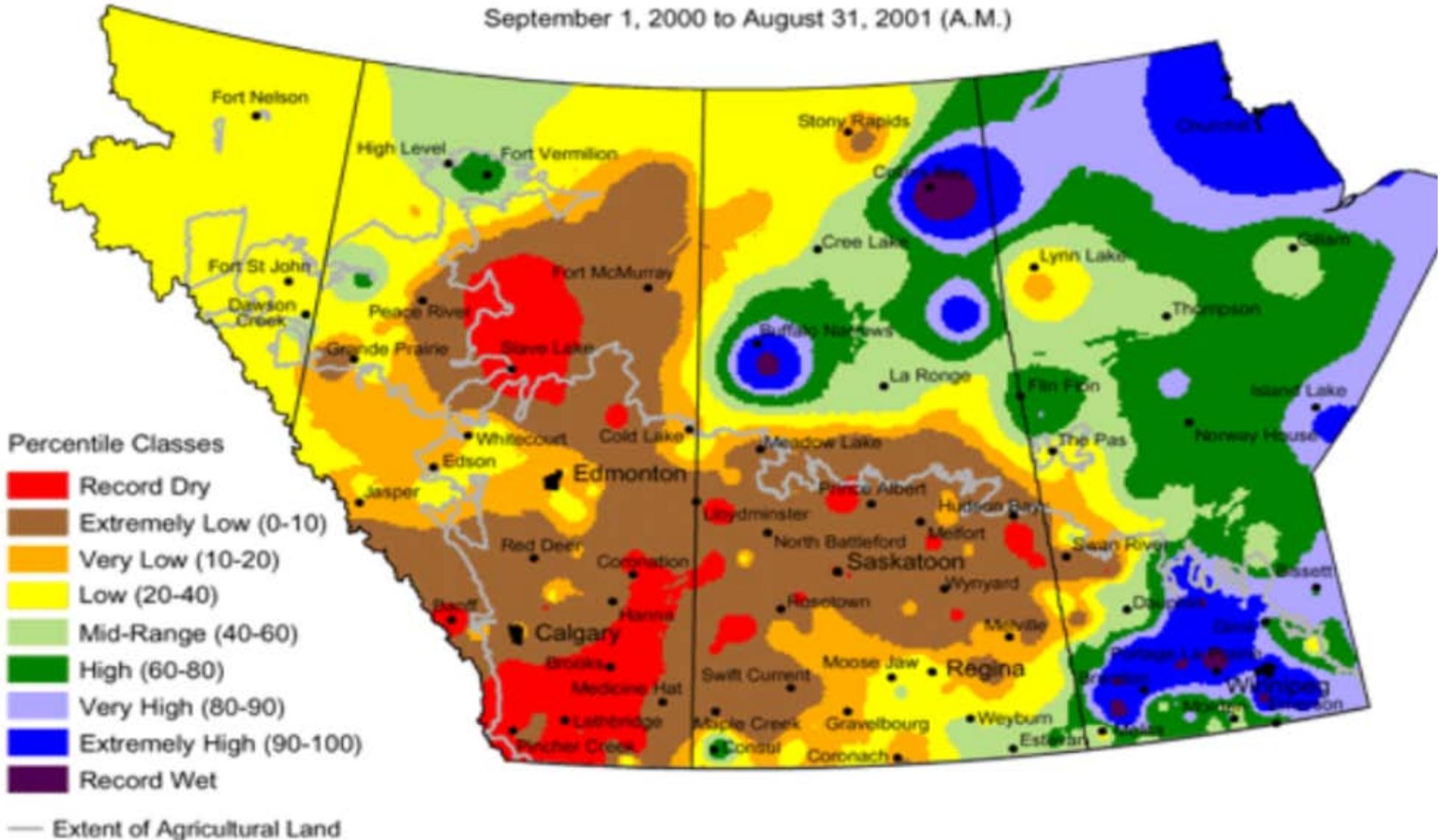
Wind-Calm Events: Summer 1999-2005



2001

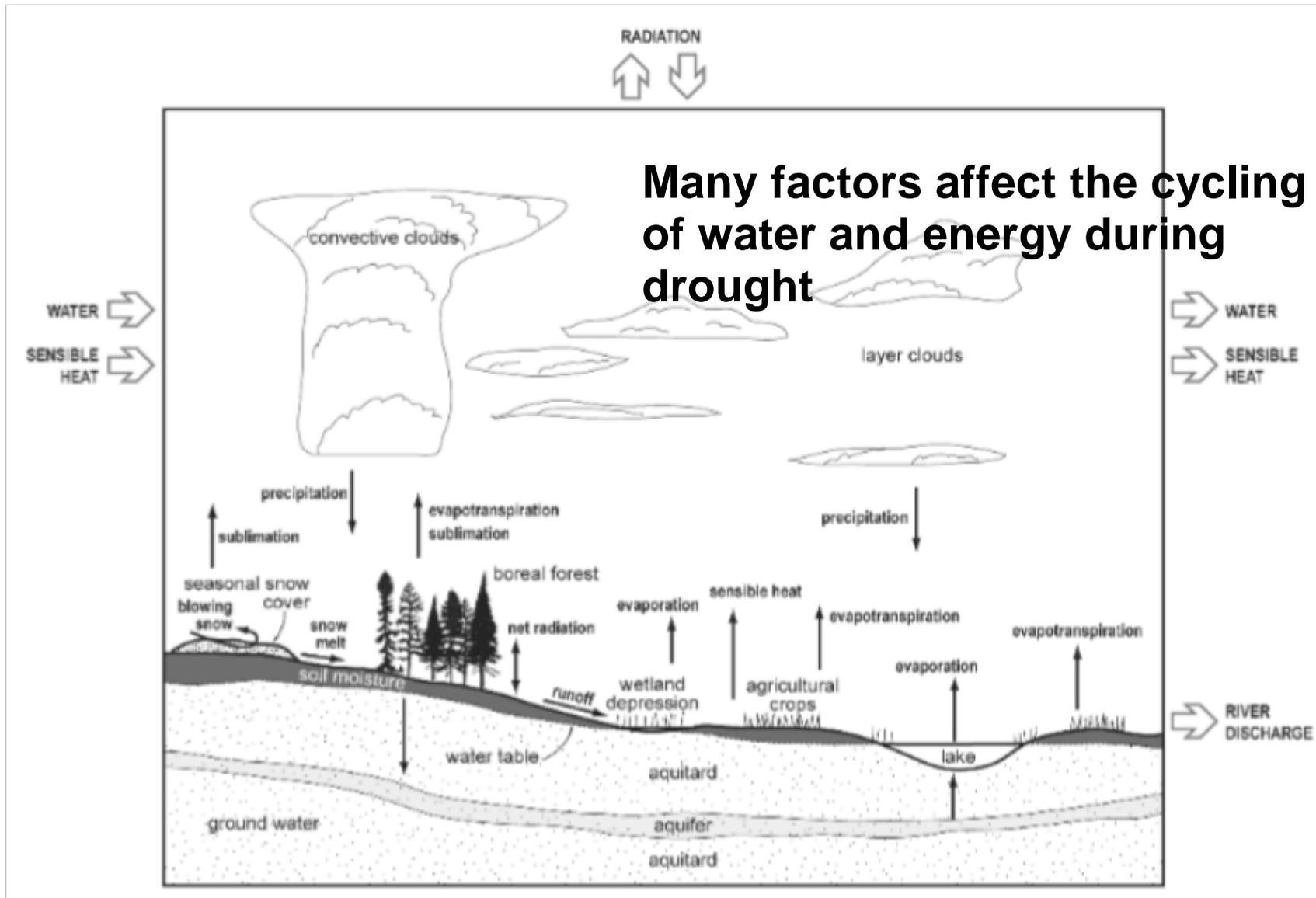
Current Precipitation Compared to Historical Distribution

September 1, 2000 to August 31, 2001 (A.M.)



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.

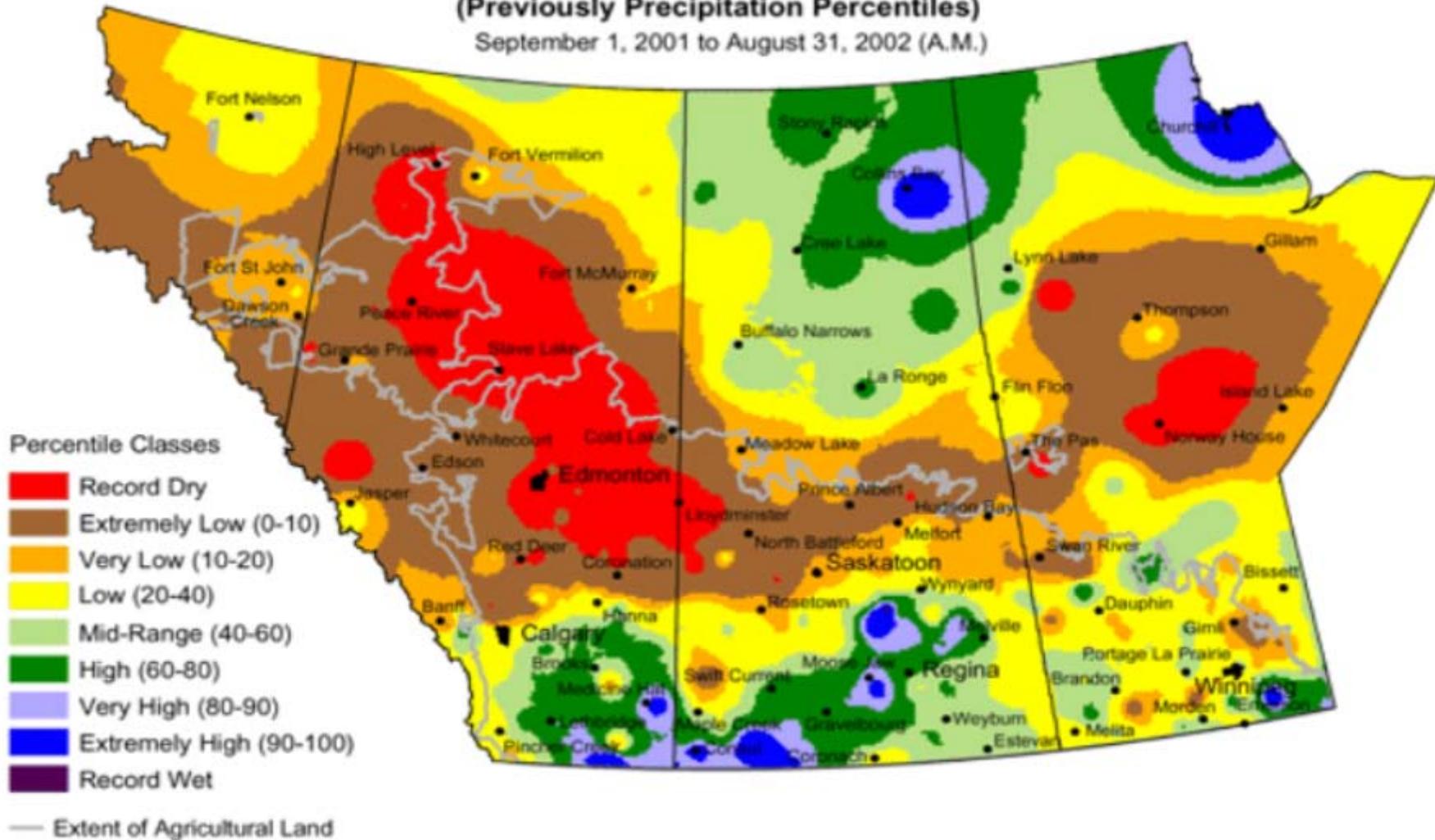
WATER AND ENERGY CYCLING



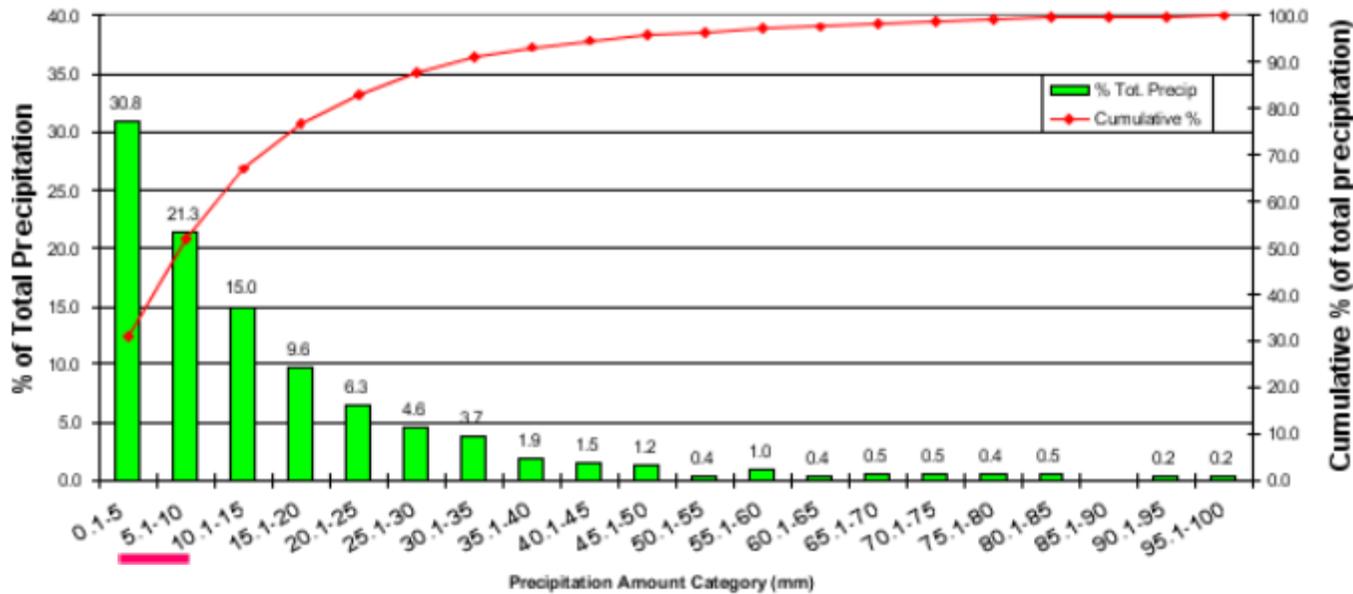
CANADIAN PRAIRIES

2002

Current Precipitation Compared to Historical Distribution
 (Previously Precipitation Percentiles)
 September 1, 2001 to August 31, 2002 (A.M.)

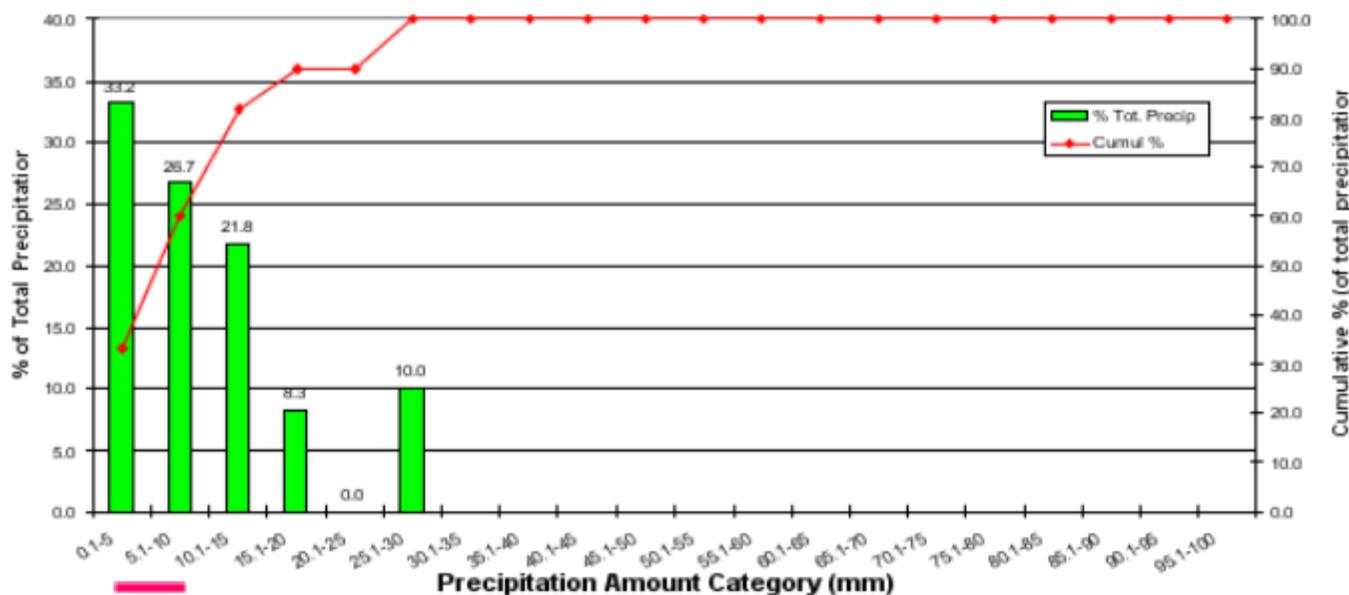


Daily Precipitation Amounts



Low precipitation event:
< 10 mm

Climatology
Low precipitation events: 52% of total



Sub-drought 2002
Low precipitation events: 60% of total

VIRGA

Summer 2002 - Edmonton

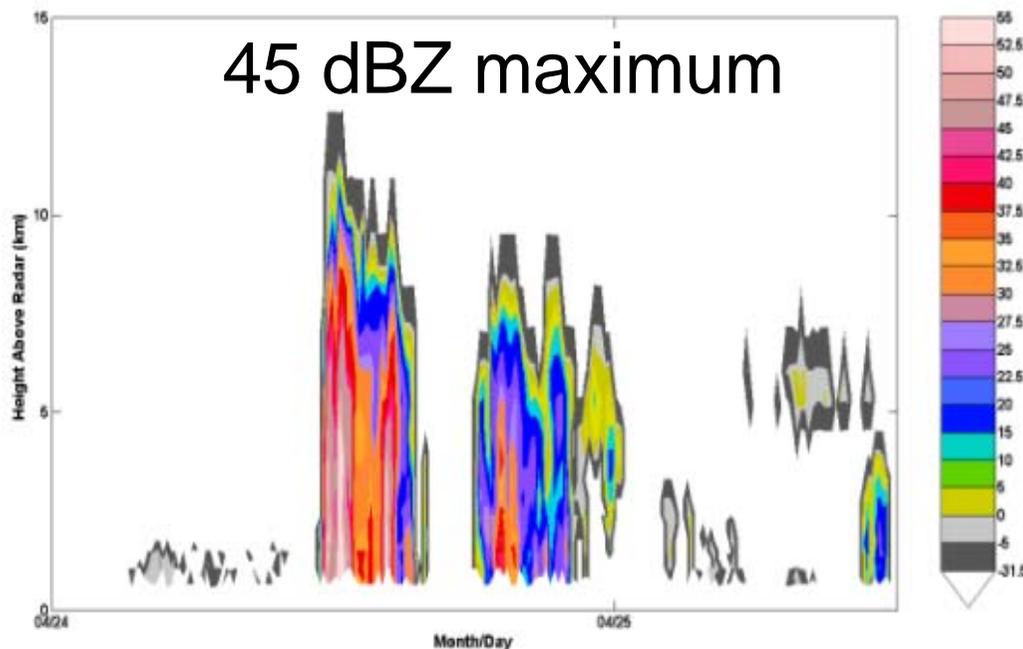
Precipitation Amount Reduction (%) -49

Precipitation (h) 123

Virga (h) 130



PRECIPITATION RATE

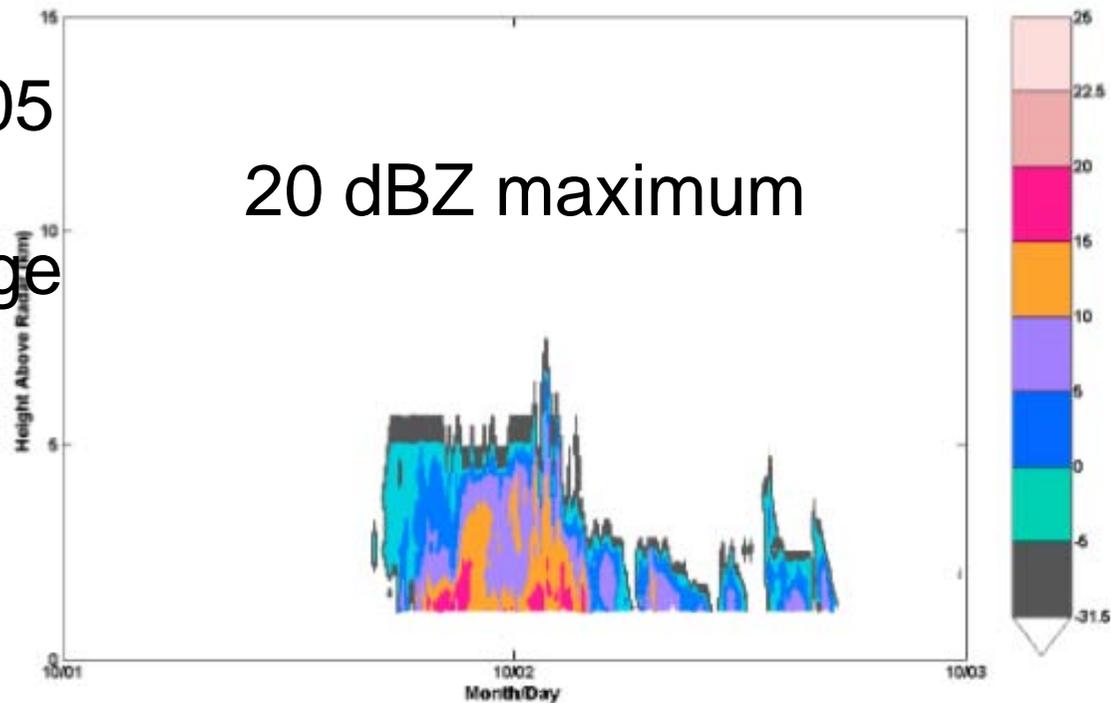


Cold Lake 24 April 2003

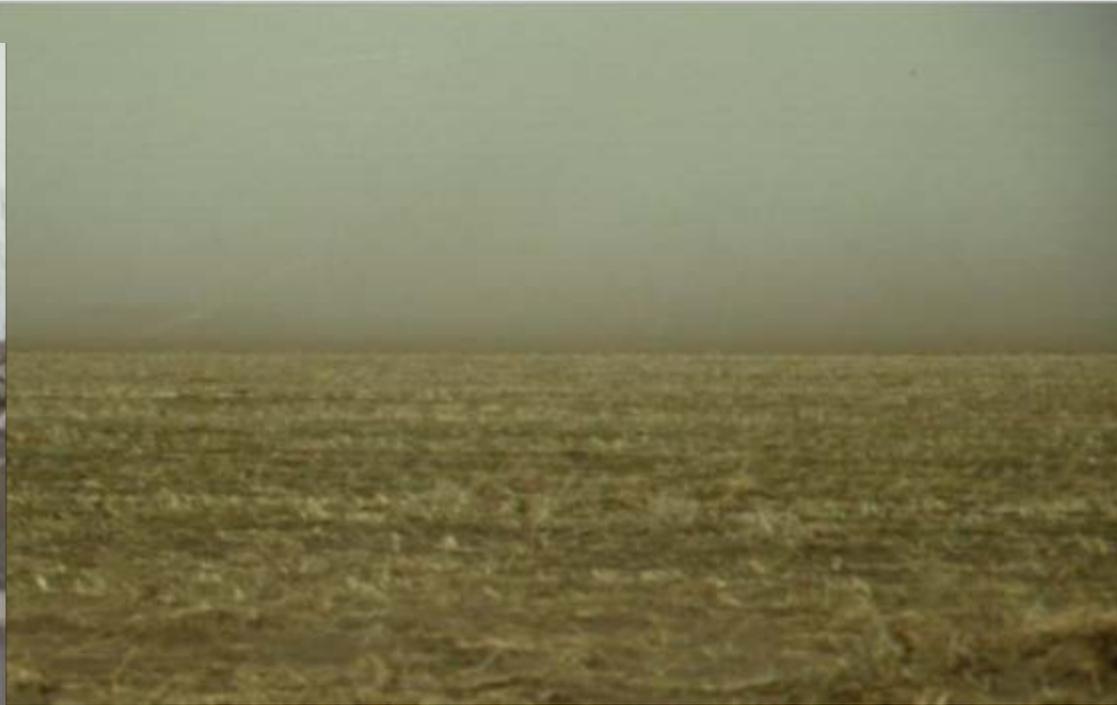
- Hail and rain
- 243% of monthly average accumulation

Cold Lake 1-3 October 2005

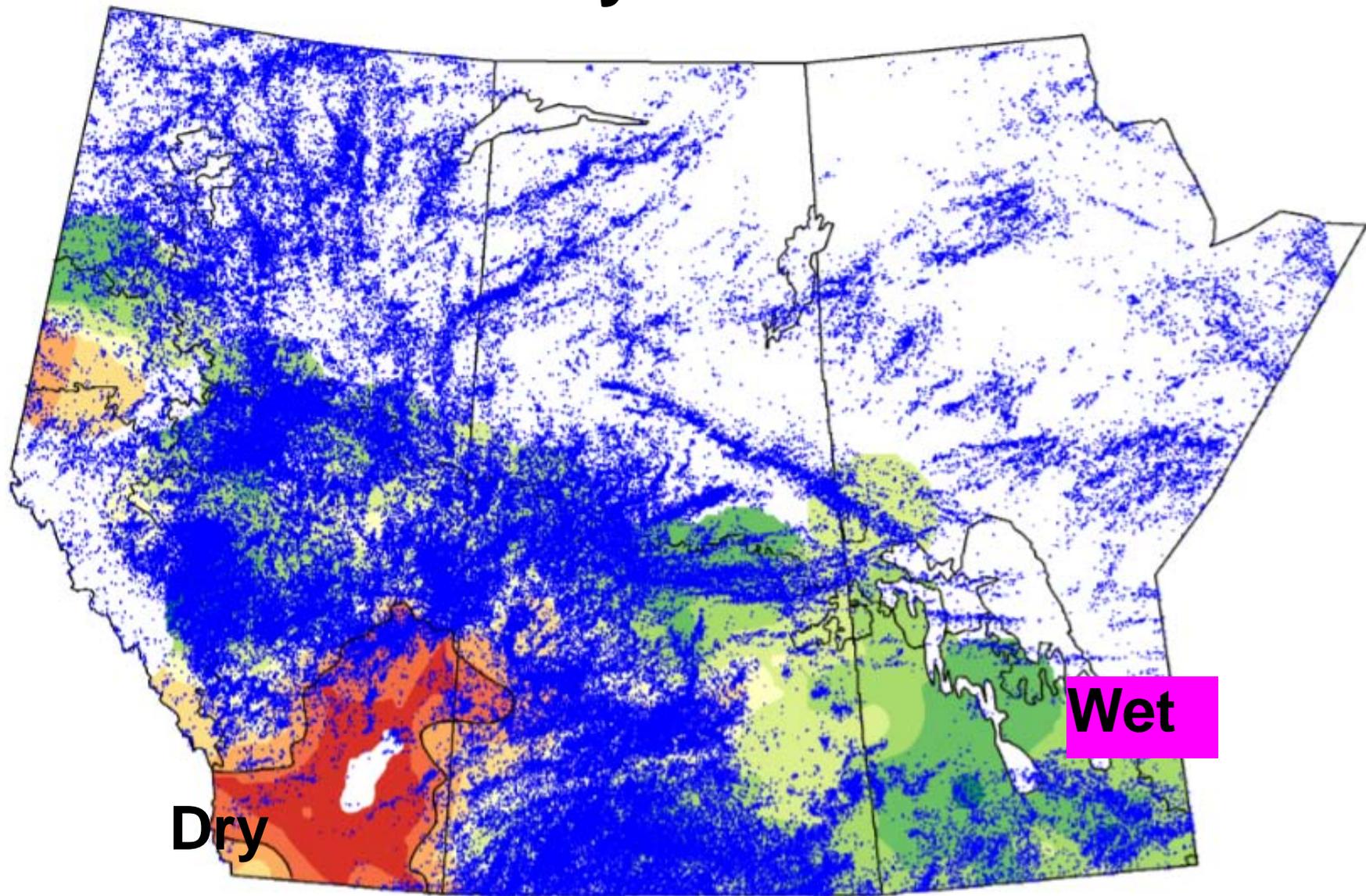
- Rain and snow
- 143% of monthly average accumulation



DUSTSTORMS



Soil Moisture and Lightning July 2000



IMPORTANCE OF SURFACE FEATURES

perturbations to extremes



**Less precipitation
Less evapotranspiration
Less precipitation**

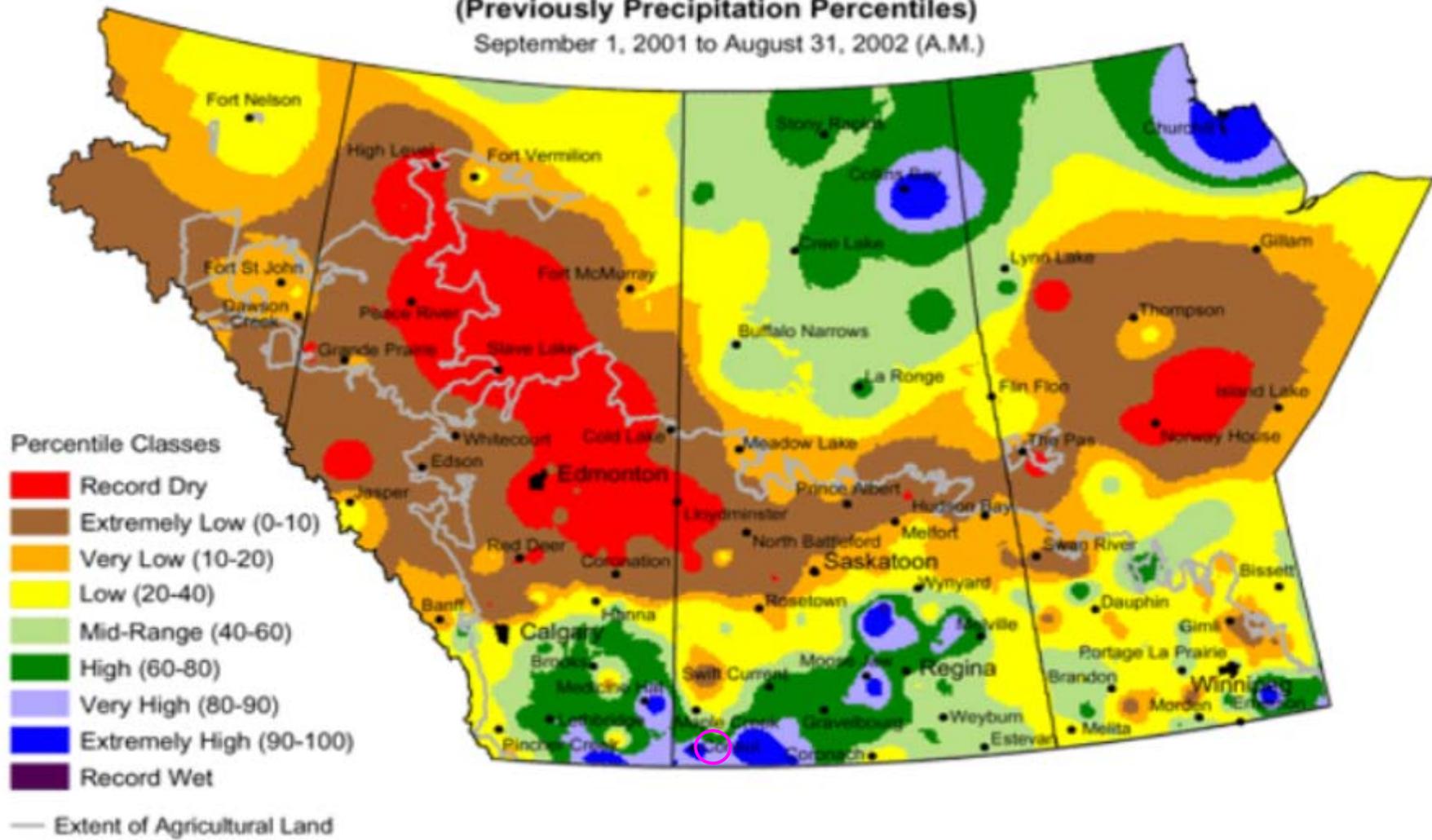


**More precipitation
Greater evapotranspiration
More precipitation**

CANADIAN PRAIRIES

2002

Current Precipitation Compared to Historical Distribution
 (Previously Precipitation Percentiles)
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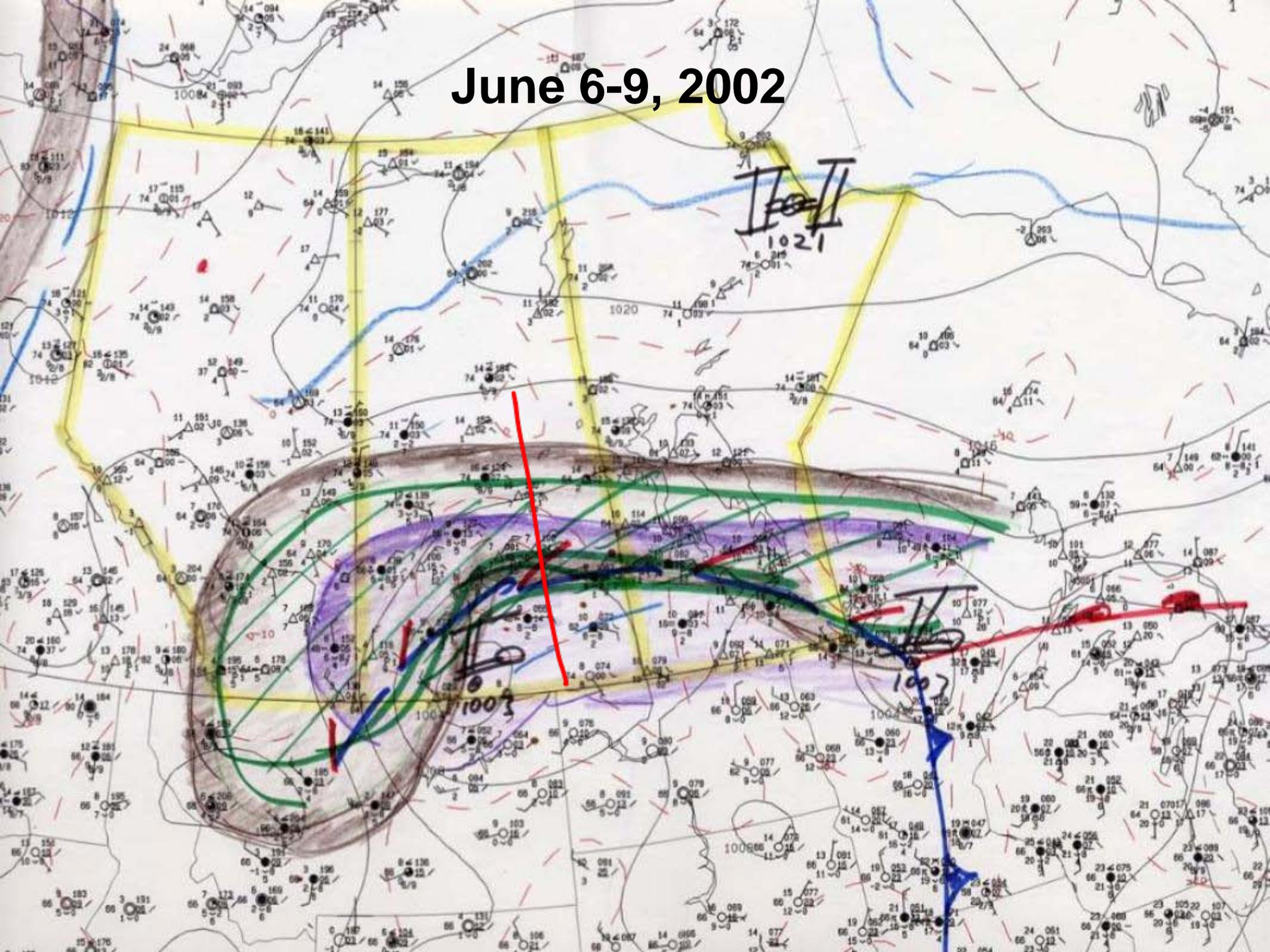


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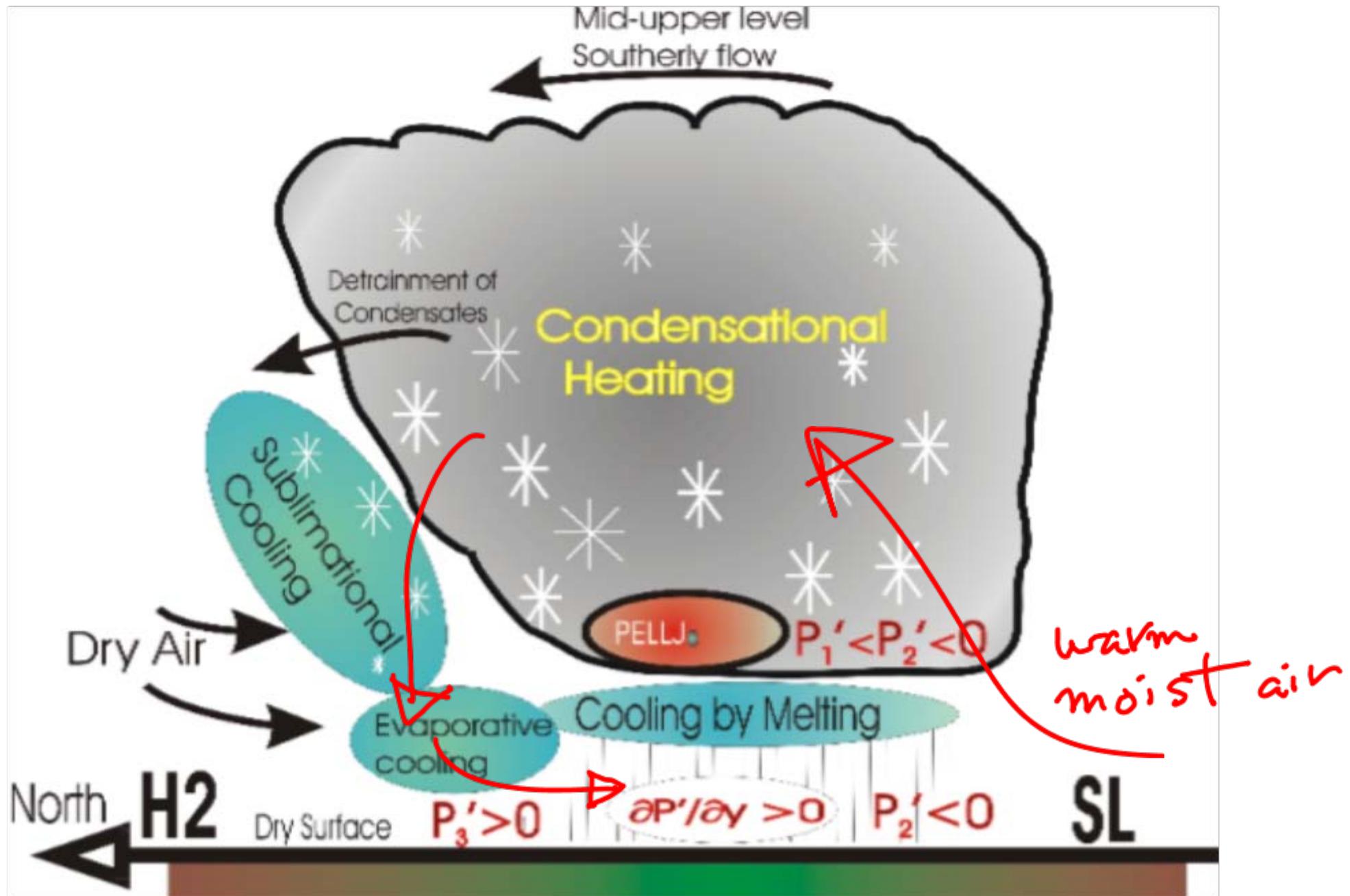
Dry in April 2002 ...

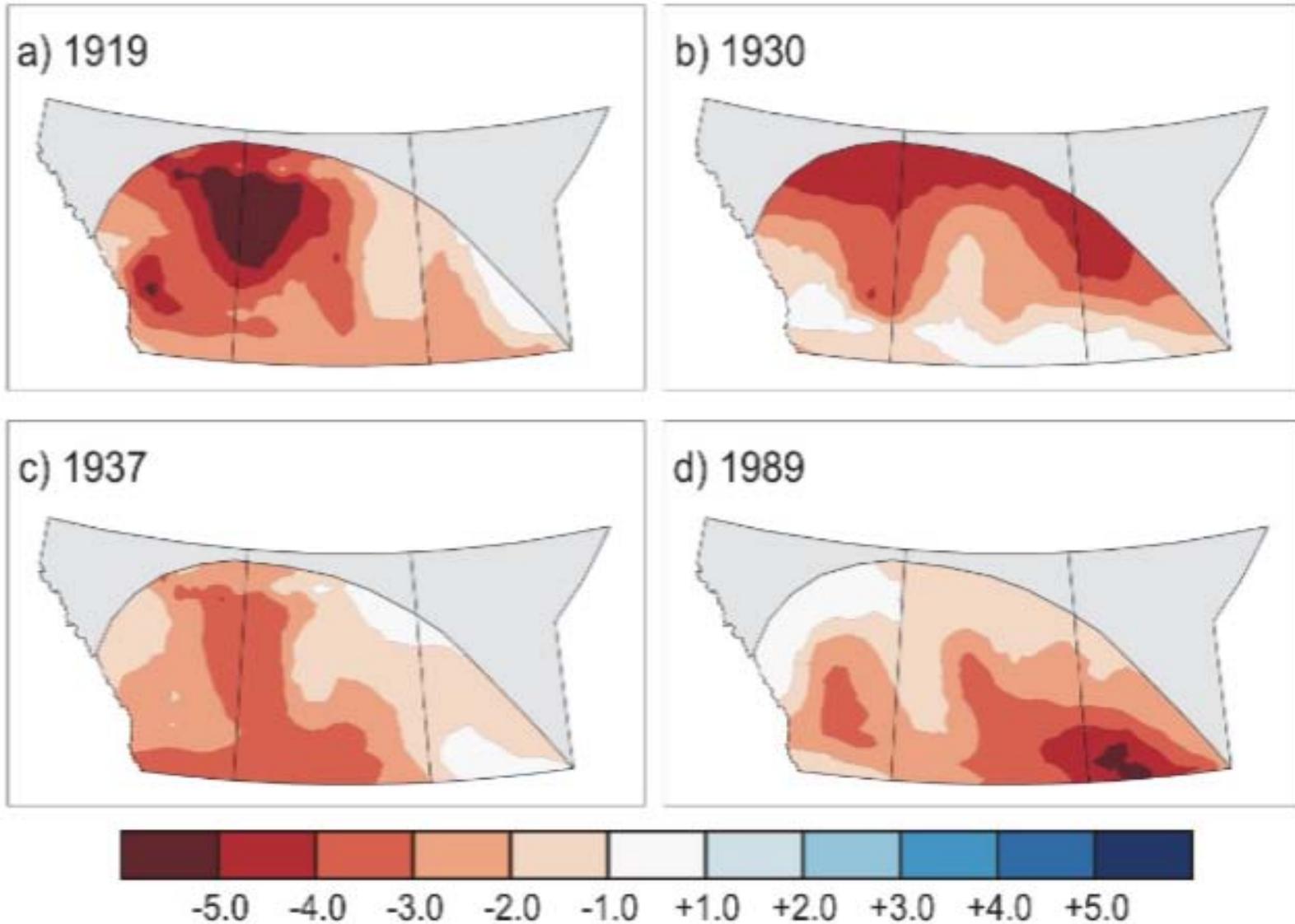


June 6-9, 2002



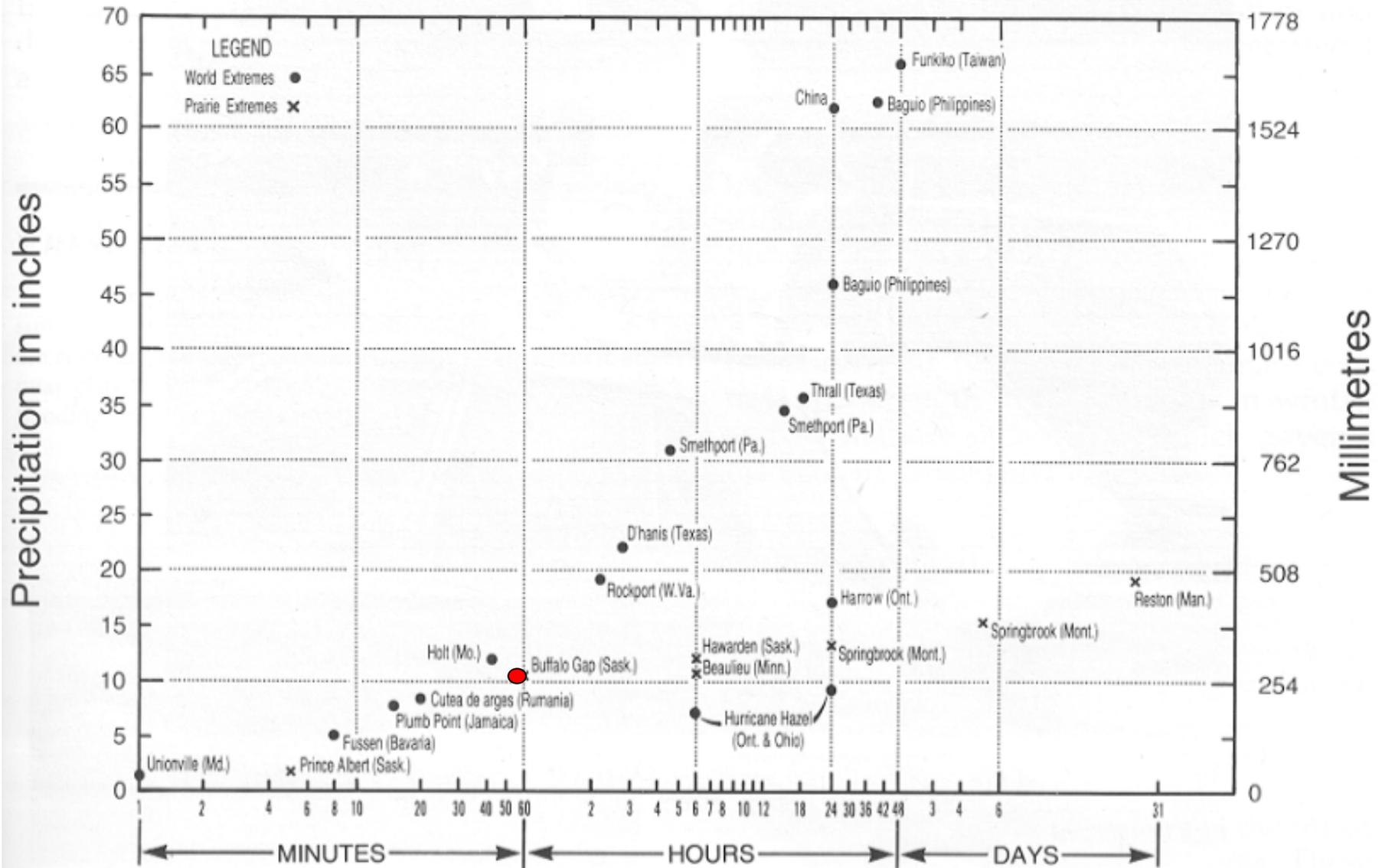
Storm- and cloud-scale feedbacks





Palmer Drought Severity Index (PDSI) for agricultural years with severe drought

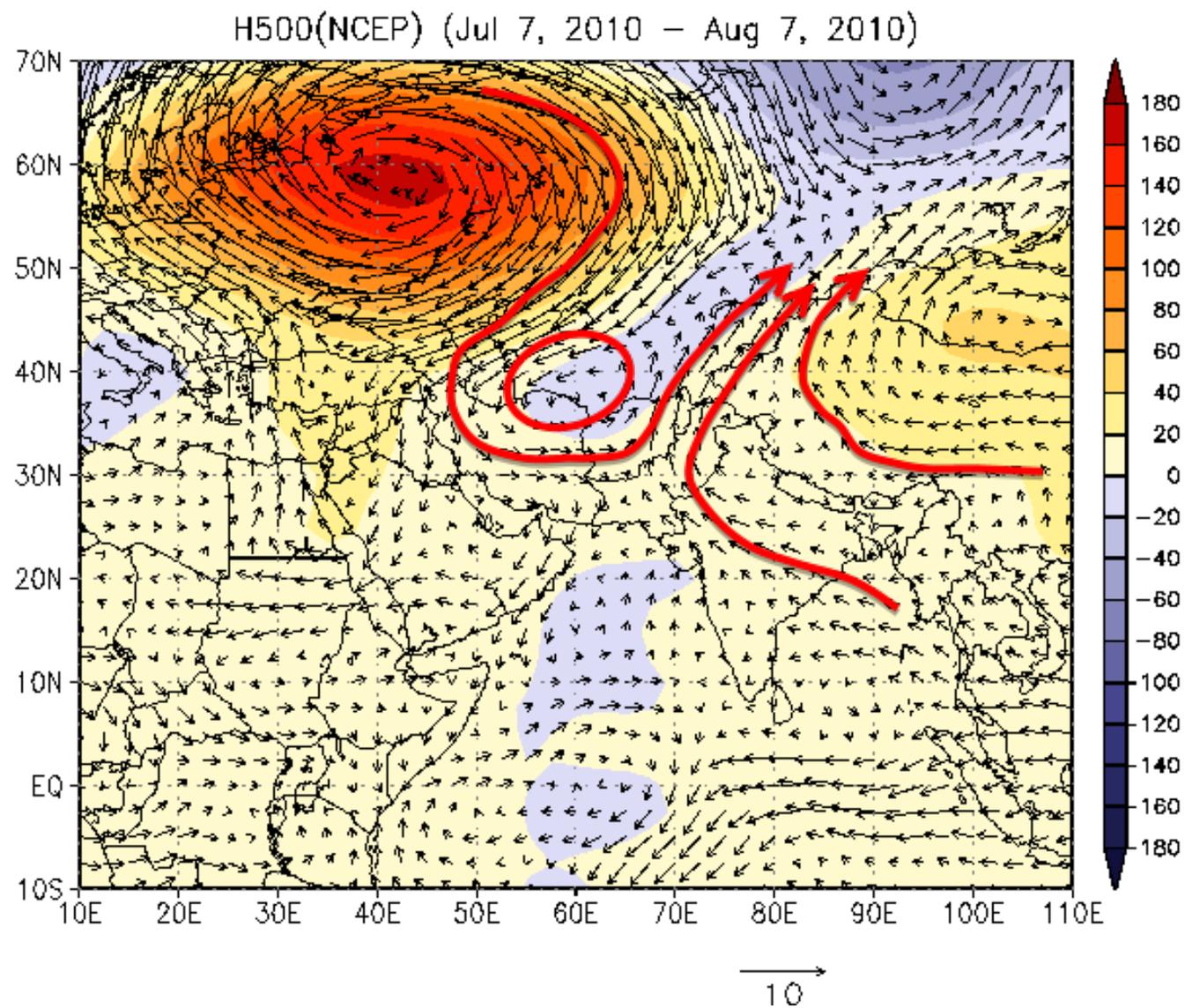
EXTREME RAINFALLS



Thanks to Danny Blair, Bill Rannie and Irene Hanuta

Adapted from Handbook on the Principles of Hydrology, D.M. Gray, ed.

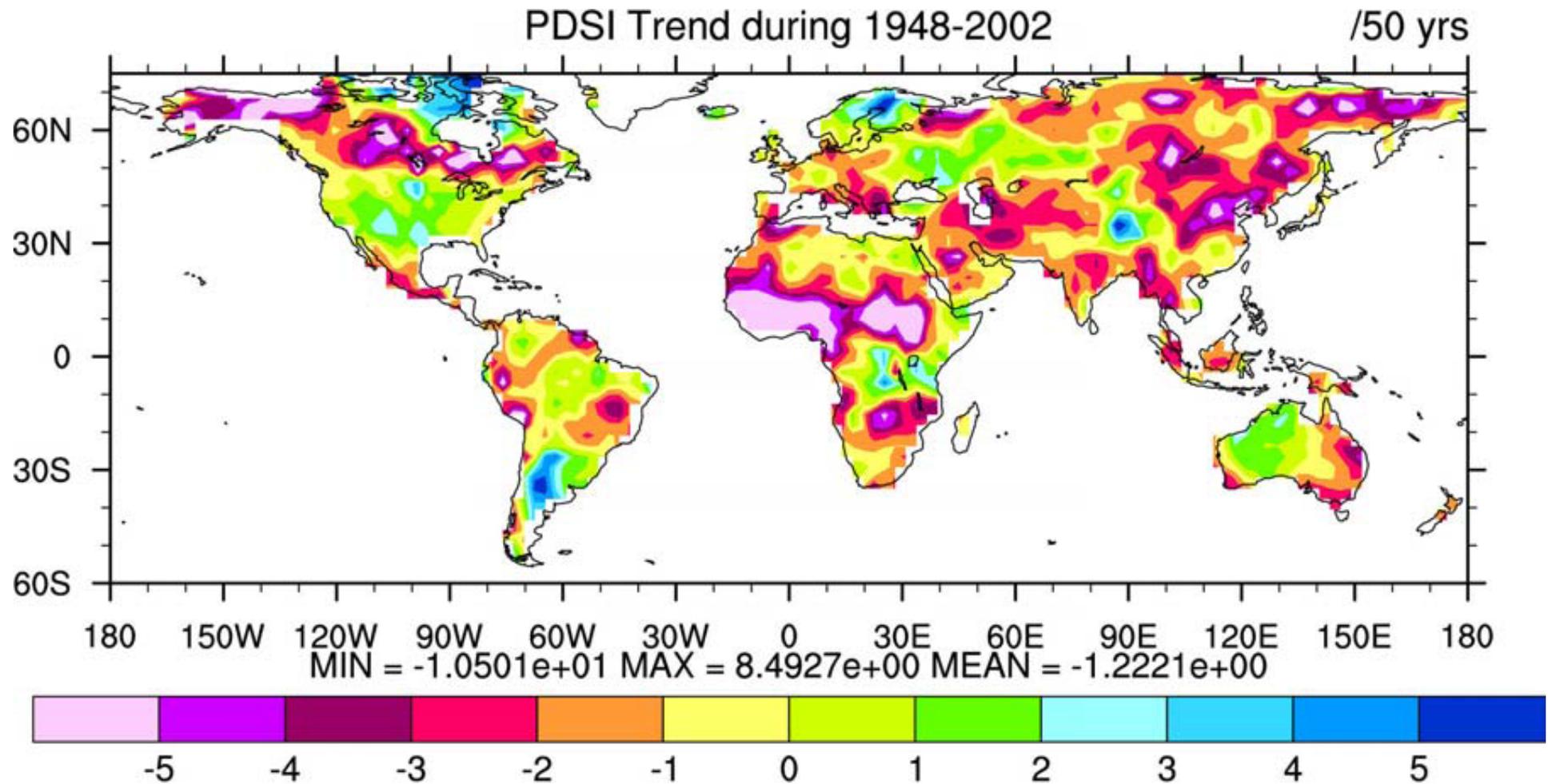
JULY-AUGUST 2010

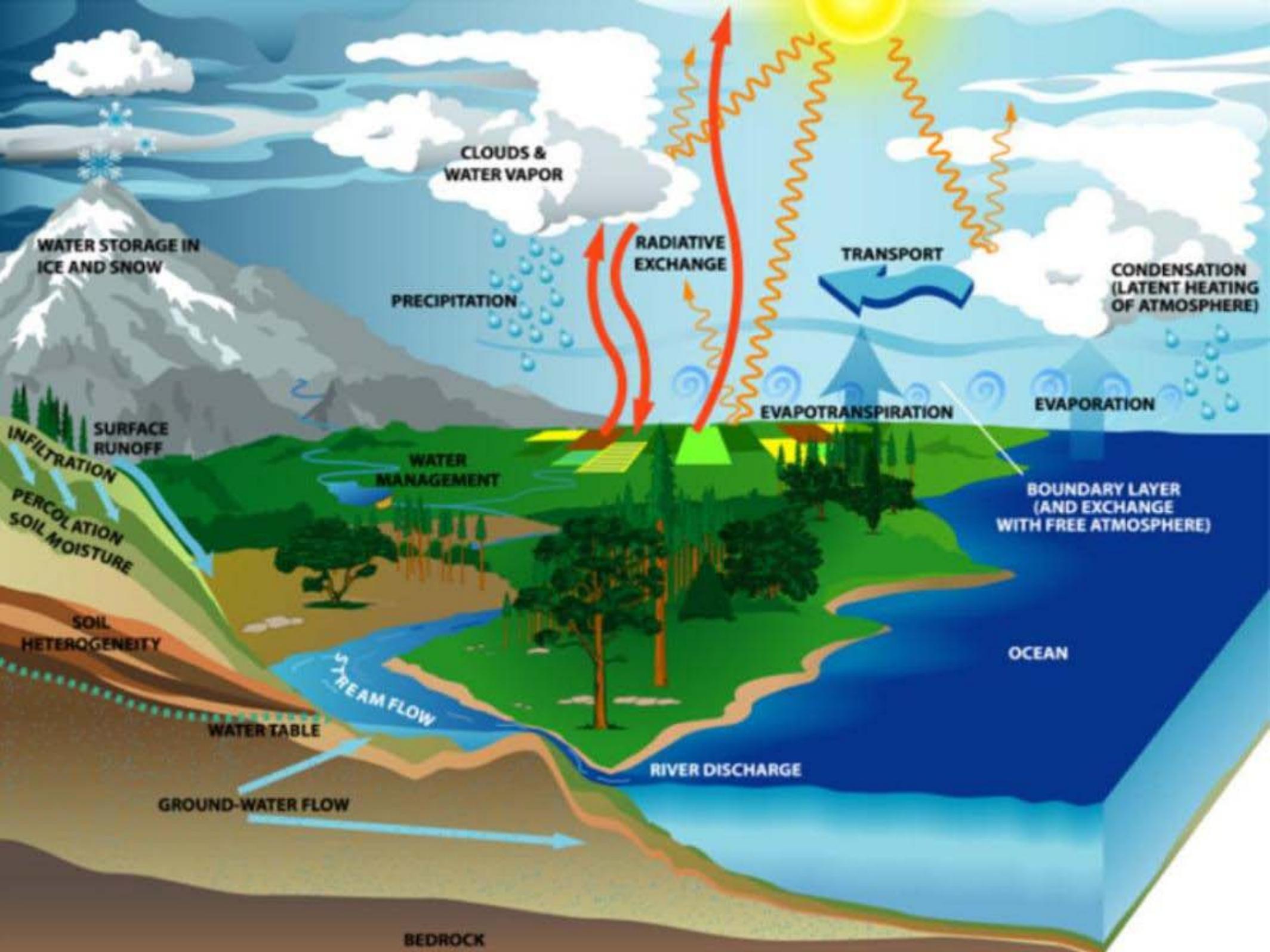


ATMOSPHERIC DROUGHT TYPES

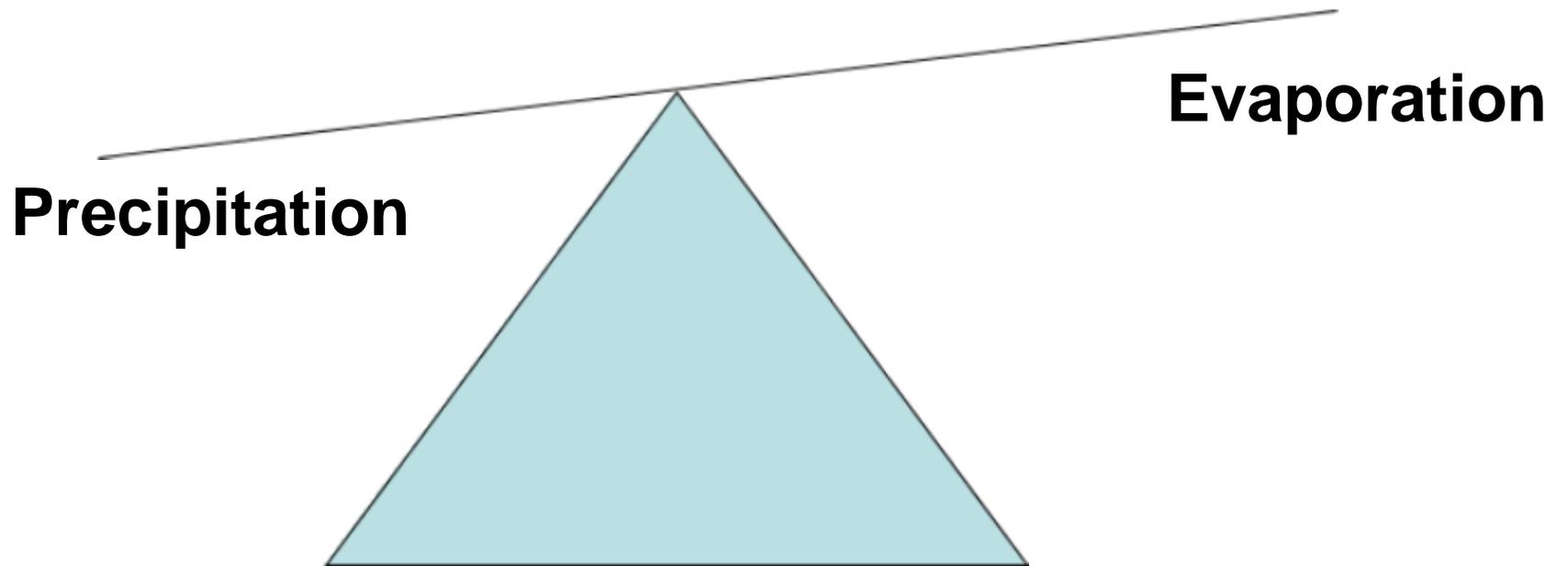
No precipitation	... or ...	Sprinkles
Virga		Chance of catastrophic rain
Steady rain		Torrential rate
Hot		Cold
Windy		Calm
Dusty		Clear
Cloud-free		Cloudy

DRYING TREND: 1948-2002



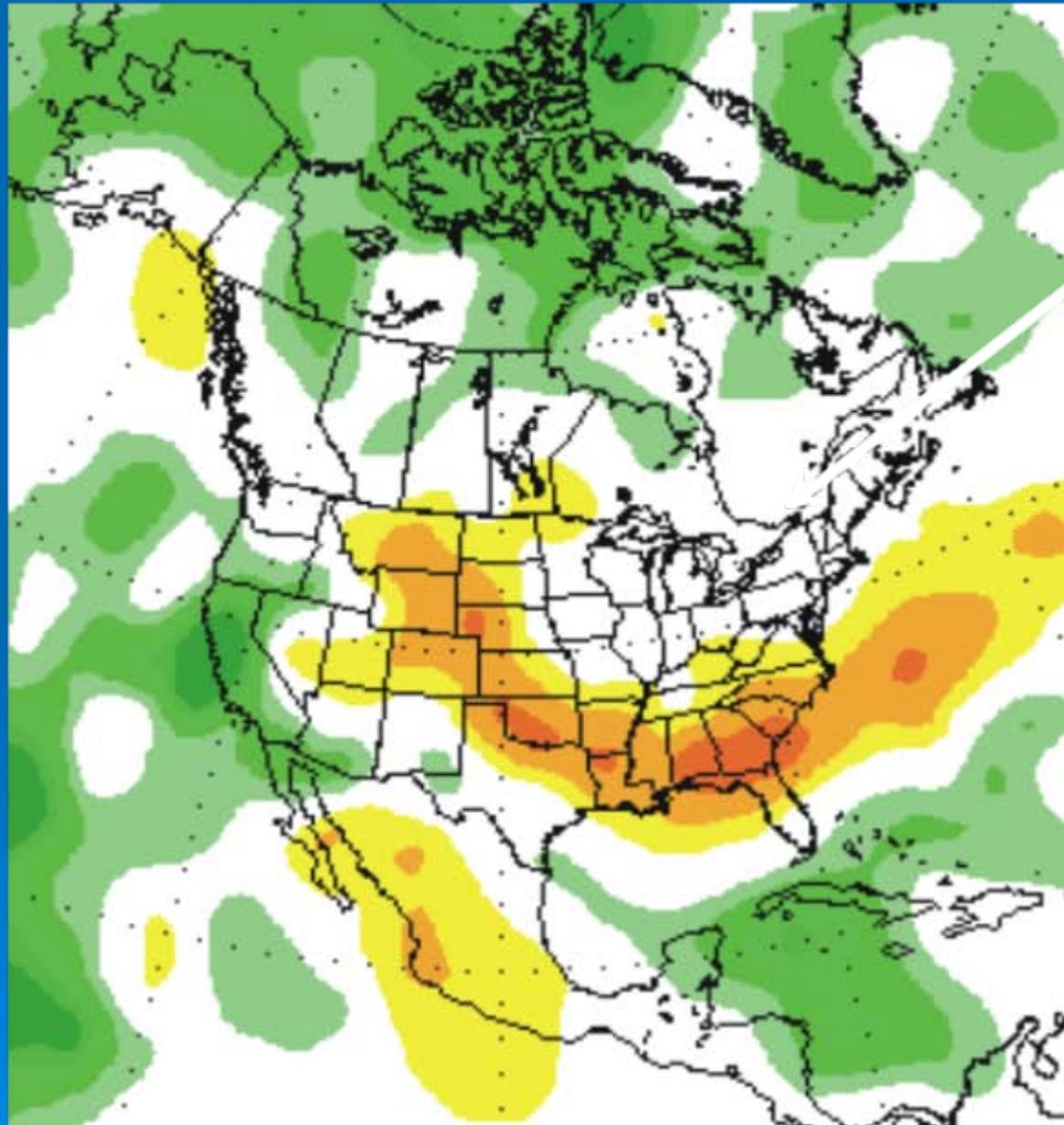


BALANCING OR NOT

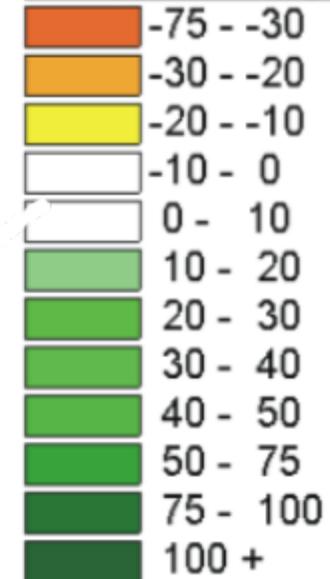


dry continental interior?

FUTURE PRECIPITATION?



Precip. % Change



METEOROLOGICAL DATA ANALYSIS INSTITUTE OF WESTERN CANADA

LONG-TERM PROJECTIONS :
LOOMING WATER-
SHORTAGE CRISIS



AND NOW...
OVER TO YOU.

SHORT-TERM PROJECTIONS :



GABE @WESTERNMAIL

SOME SCIENTIFIC ISSUES

There are a number of critical scientific and technical issues limiting quantitative assessment of future conditions including:

scientific:

- access to moisture sources
- surface vegetation feedbacks
- cloud fields and precipitating systems
- role of dust
- ...

technical:

- spatial resolution of climate models is insufficient
- ...

PRAIRIES' 'CLIMATE' FORECAST

What is it?

'probably' more drought and heavy precipitation

'probably' more variability

and, not clear what 'type' of drought will occur

Why?

feedbacks acting to maintain extremes

warmer climate accelerate these feedbacks

hotter ... more rapid water cycling ... wet and dry

But?

lots of uncertainty

SUMMARY

Extremes are an inherent aspect of climate

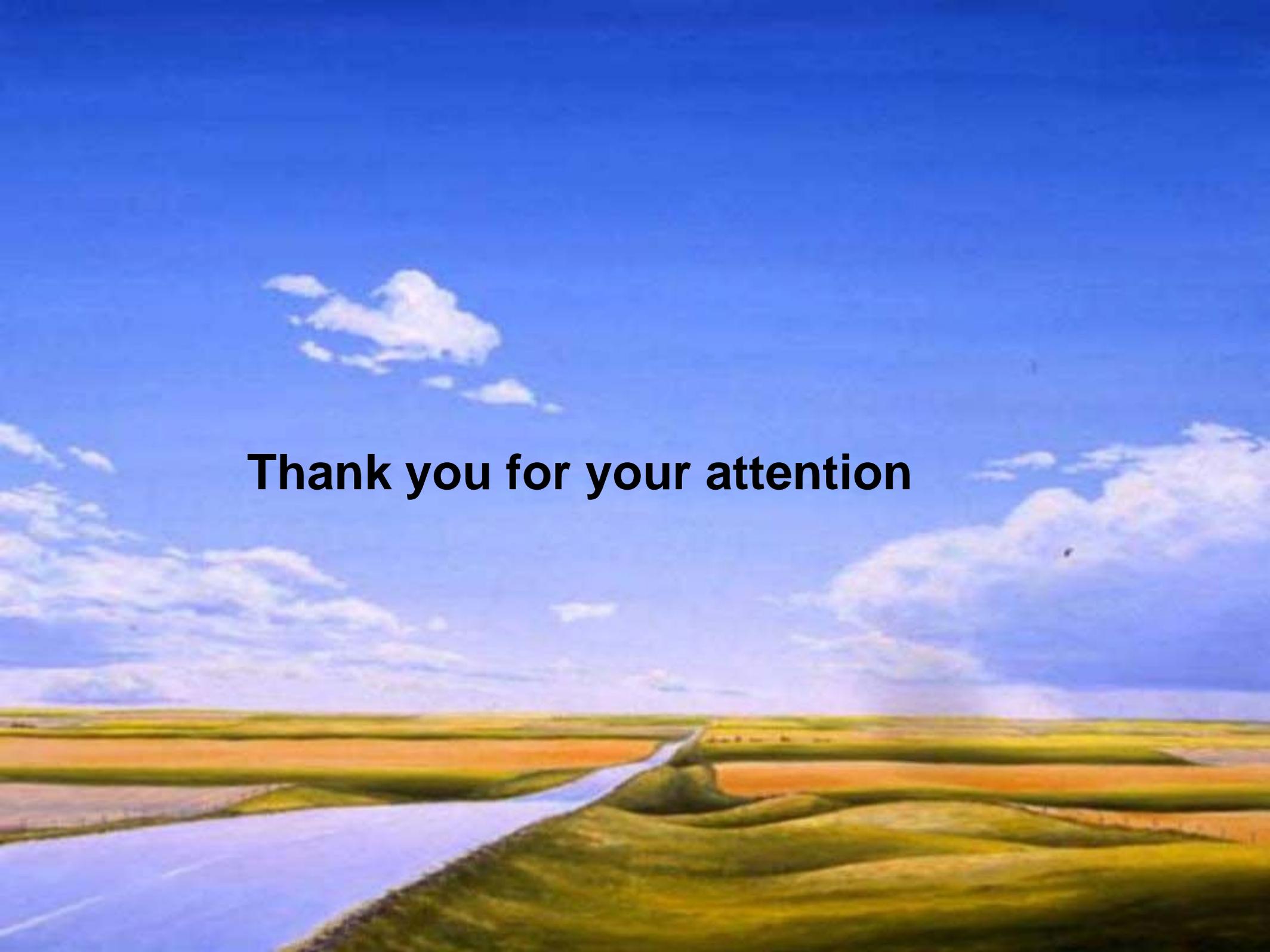
Drought is a multi-faceted phenomenon

Heavy precipitation is sometimes occurring simultaneously

Heavy precipitation/drought couplings occur

The future for the Prairie climate is unclear but extreme with many consequences.

southern Manitoba June 2005

A scenic landscape painting featuring rolling green hills in the foreground, a winding river or path that curves through the middle ground, and a vast blue sky with scattered white clouds. The overall mood is peaceful and expansive.

Thank you for your attention