Water Budgets, Extremes and Cold Season

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3 micro-talks

- Water Budgets (Ron)
- Cold Season (Ron)
- Extreme Precipitation (William)

Objectives of Study

- To evaluate the surface and atmospheric water and energy budgets for the Canadian Prairie region, and examine their interannual variability with a focus on the anomaly budgets that characterize the extreme wet and dry years

- Focus on Saskatchewan River basin

Available Datasets

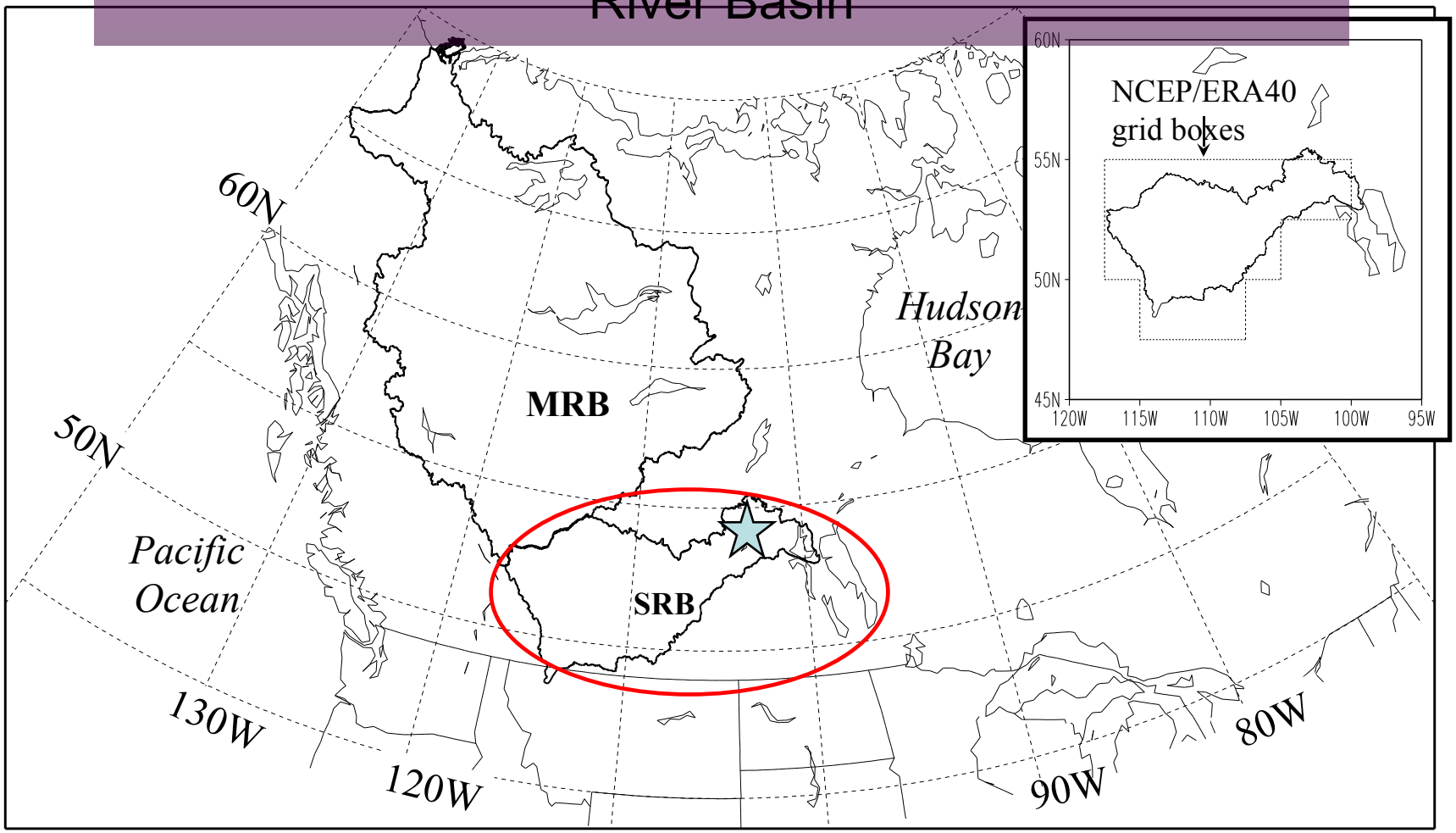
Local (L), regional (R) and global (G) observations

Parameter	Source	Resolution	Coverage Period
Precipitable Water	Rawinsondes (L)	Sites	Various - Current
	GVAP/NVAP (G)	1 deg	1988-1999
Snow	SSMI (R)	25 km	1978 Dec - 2003 Mar (Dec-Mar)
Surface Air Temperature	CANGRID (R)	50 km	1895 - 2003 Dec
Atmospheric Enthalpy	Rawinsondes (L)	Sites	Various - Current
Precipitation	CANGRID (R)	50 km	1895 - 2003 Dec
	CMAP (G)	2.5 deg	1979 - 2003 Sep
	GPCP (G)	2.5 deg	1979 – 2003 Dec
Discharge	WSC (L)	sites	1913 - Current (The Pas)
Radiative Fluxes	ISCCP FD (G) BERMS (L)	280 km Sites	1983 Jul - 2001 Jun 1994 - Current
Sensible/Latent Heat Flux	BERMS (L)	Sites	1994 - Current
Cloud Cover	Surface Obs (L/R)	Sites	Various - Current

Global (G) and regional (R) analysis and model datasets

Dataset	Resolution	Coverage period
CRCM (R)	51 km	1997 Apr - 2003 Dec
CMC (R)	35/24 km	1997 Mar - Current
NARR (R)	32 km	1979 Jan - Current
NCEP-R2 (G)	2.5 deg	1979 Jan - Current
ERA-40 (G)	2.5 deg	1957 Sep - 2002 Aug

The Canadian Prairies and the Saskatchewan River Basin



SRB - study domain for budget assessments

= BERMS CEOP reference sites

- Budget anomalies will be examined for extreme dry and wet Prairie growing seasons within 1960-2002 which include 2001 and 2002 when it was at the peak of the 1999-2004 drought

Driest

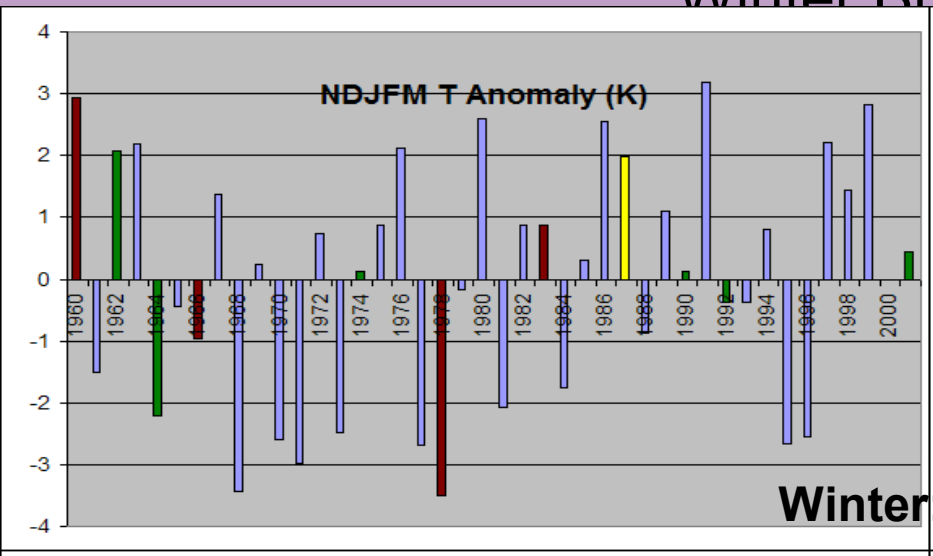
Wettest

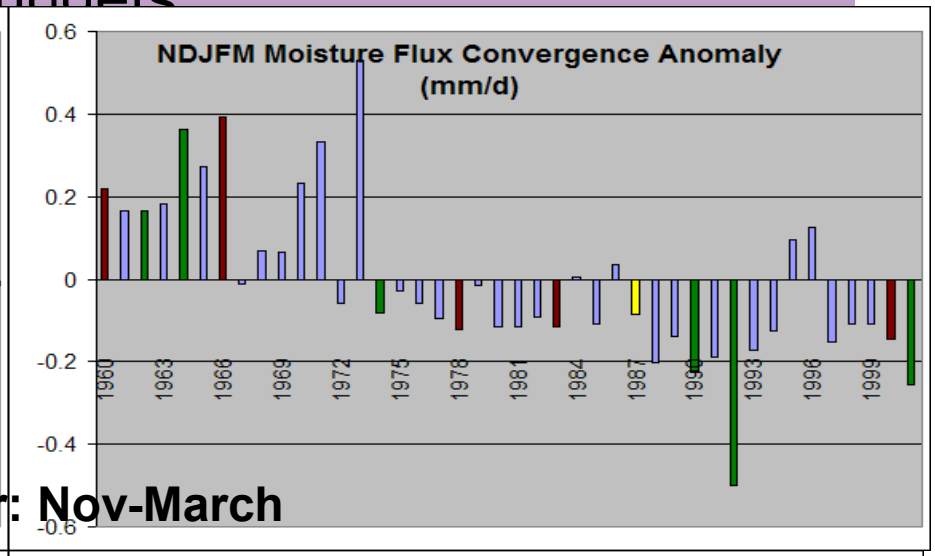
YEAR	DEP	YEAR	DEP	Year	DEP
1961	-49.2	1988	-1.3	1993	70.8
1967	-48.4			2002	31.4
1979	-34.1			1991	31.4
1984	-32.1			1963	30.8
1960	-24.9			1975	23.5
2001	-20.5			1965	21.1

DEP = Departure of total AMJJA Prairie precip from 1961-90 normal (%)
Source: Agriculture and Agri-Food Canada

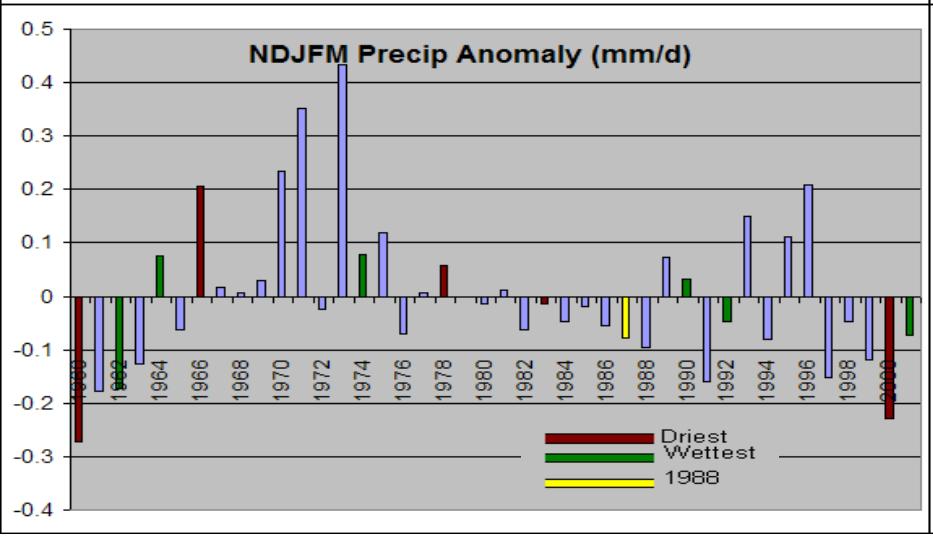
*Results for 1988, a well-known recent drought year, is also highlighted

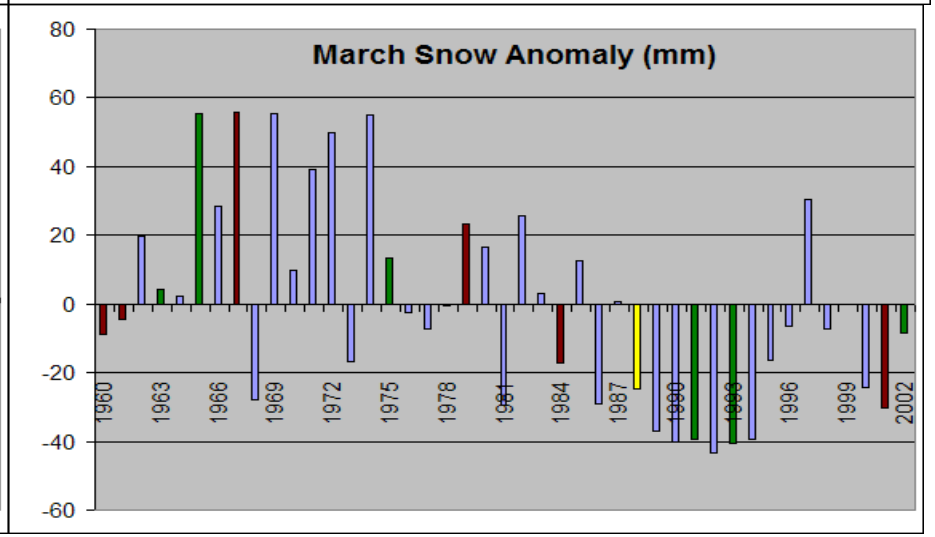
1960-2002 Annual Timeseries of Seasonal Budget Anomalies: Winter Budgets





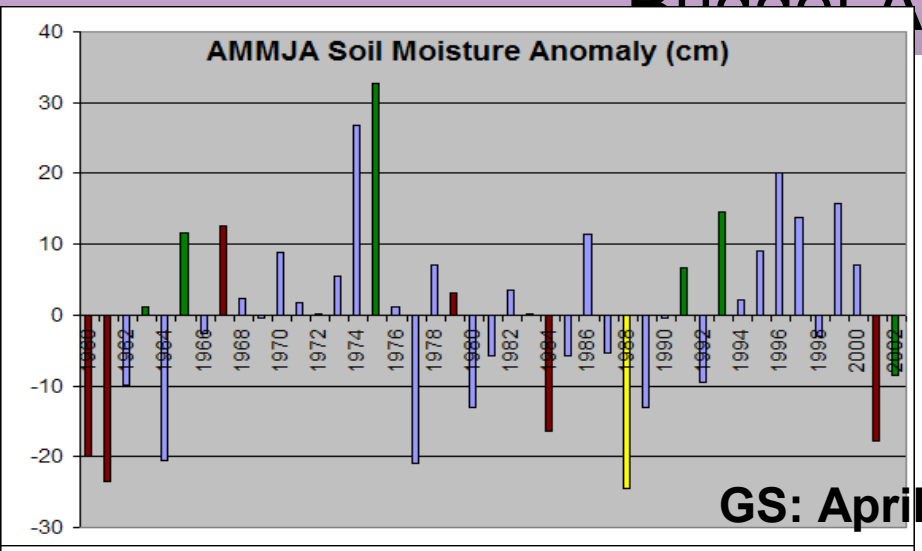
Winter: Nov-March

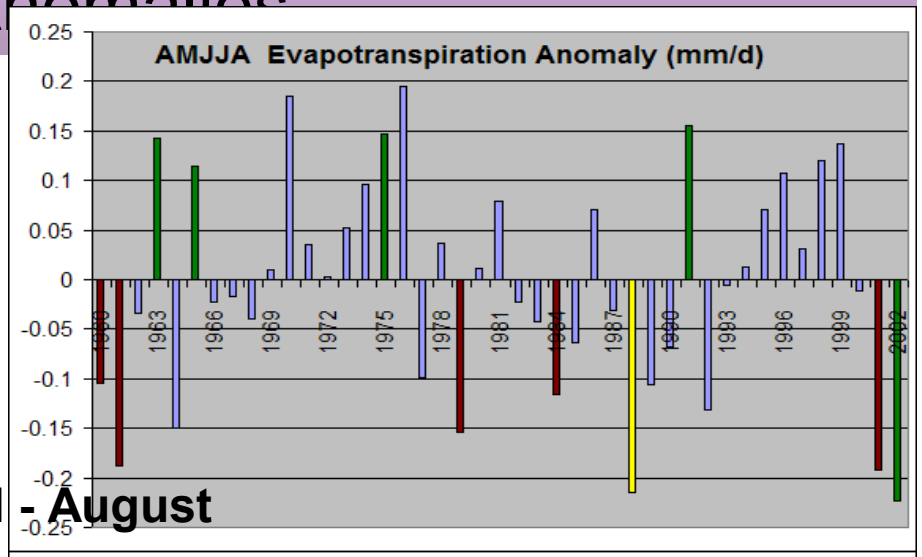




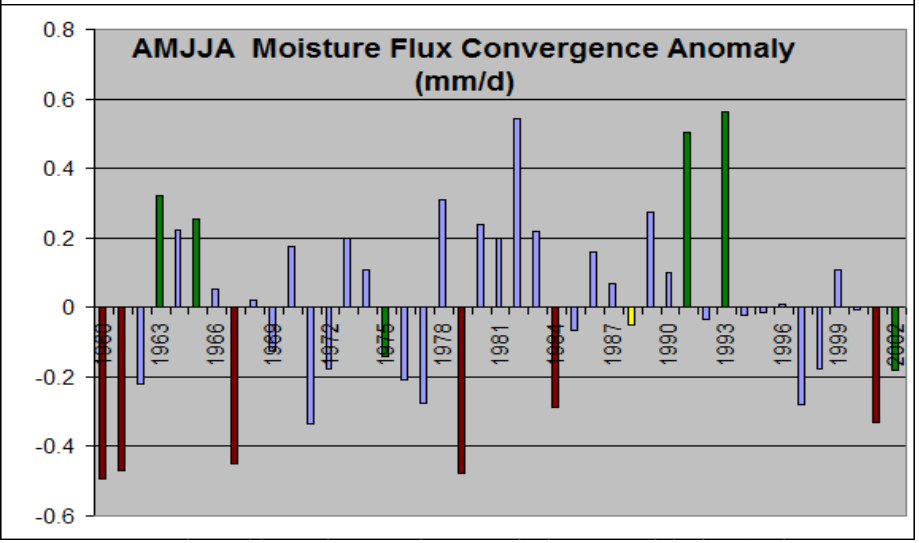
- In general, no consistent P or T anomalies for winters preceding either the extreme wet or extreme dry growing seasons
- 2001 and 2002 were characterized by relatively low winter MC, P and spring snowcover

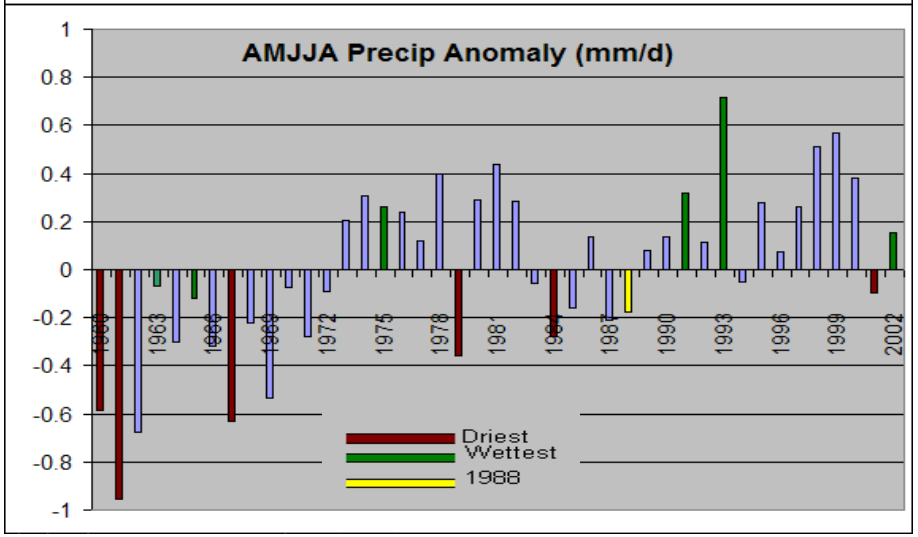
1960-2002 Annual Timeseries of Growing Season (GS) Budget Anomalies





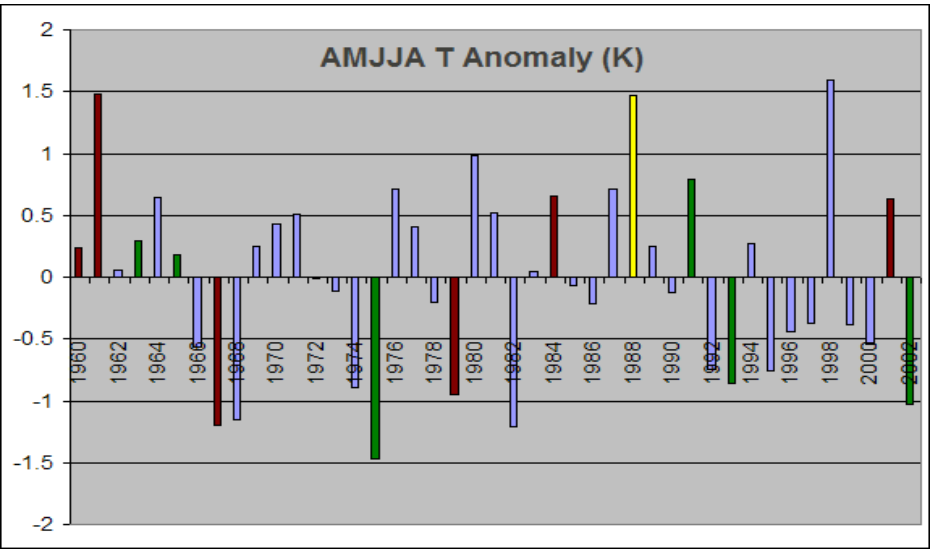
GS: April - August





- Exceptions: MC was high but ET was slightly lower than normal for 1993 and 1995
- Although ET was extremely low and MC was also lower than normal, GS P for 2002 was higher than normal due to an extreme rain event

1960-2002 Annual Timeseries of Growing Season (GS) Budget Anomalies



- No consistent Ts anomalies were found for either extreme dry or wet GSs
- 2001 was affected by moderate above-normal Ts while 2002 was found to be characterized by much below normal Ts

Summary

- The 2001 and 2002 growing seasons were preceded by relatively low winter moisture flux convergence, precipitation and spring snowcover

- While both 2001 and 2002 were characterized by strong lower than normal soil moisture conditions, moisture flux convergence and evapotranspiration, the 2001 GS was one of the driest whereas the 2002 GS was one of the wettest on record

- 2001 was affected by moderate above normal surface temperatures, while the 2002 GS was found to be much cooler than normal

Cold Season and Drought

- Investigating the summer months during a drought is a logical step in understanding the factors that led to drought conditions.
- The effects of the winter months must also be considered when examining the drought
- The objective of this study is:

to characterize some aspects of the winter months of 1999-2005.

Data

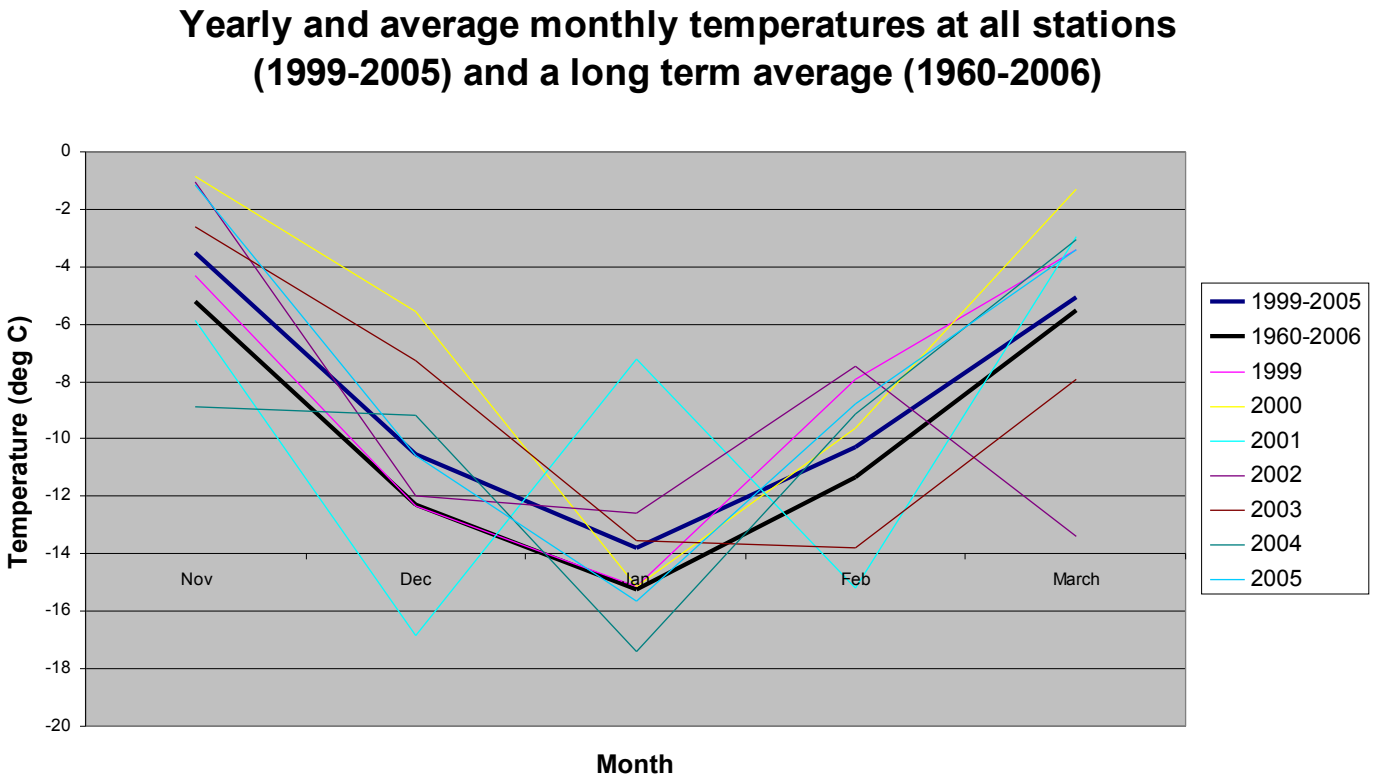
- Station data from 15 prairie observation sites was used to examine characteristics during the cold seasons of the 1999-2005 drought

Brandon, MB	Estevan, SK	Peace River, AB	Saskatoon, SK
Calgary, AB	Grand Prairie, AB	Prince Albert, SK	The Pas, MB
Cold Lake, AB	Lethbridge, AB	Red Deer, AB	Winnipeg, MB
Edmonton, AB	Medicine Hat, AB	Regina, SK	

- The cold season is defined as November to March inclusive

Overall Temperature Trend

- The average monthly temperature for the 1999-2005 cold seasons for all stations plotted in comparison with the monthly average for all stations in the climatology.
- Warmer winter temperatures generally occurred during the winters of 1999-2005 compared to those of 1962-2006.



Changes in Cold-Season Parameter Values

Over the Prairies during the winters of 1999 to 2005 (in comparison with the winters of 1960-2006), there was, on average:

i) 11% more hours with T >0°C
ii) 7% fewer hours of snow
iii) 51% fewer hours of blowing snow
iv) 11% more freeze-thaw days
v) 5% more freeze-thaw days with snow on the ground

Conclusions

- For the cold season, the recent drought was in general associated with warmer temperatures and associated variables in general reflected this difference.

Extremes