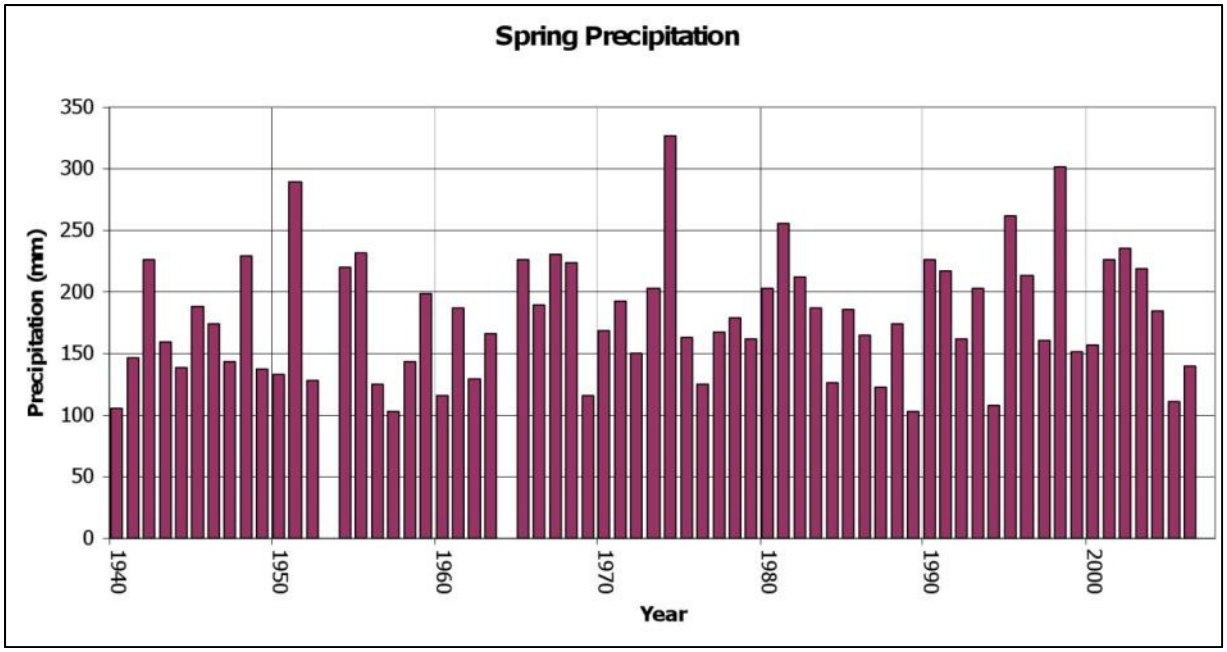
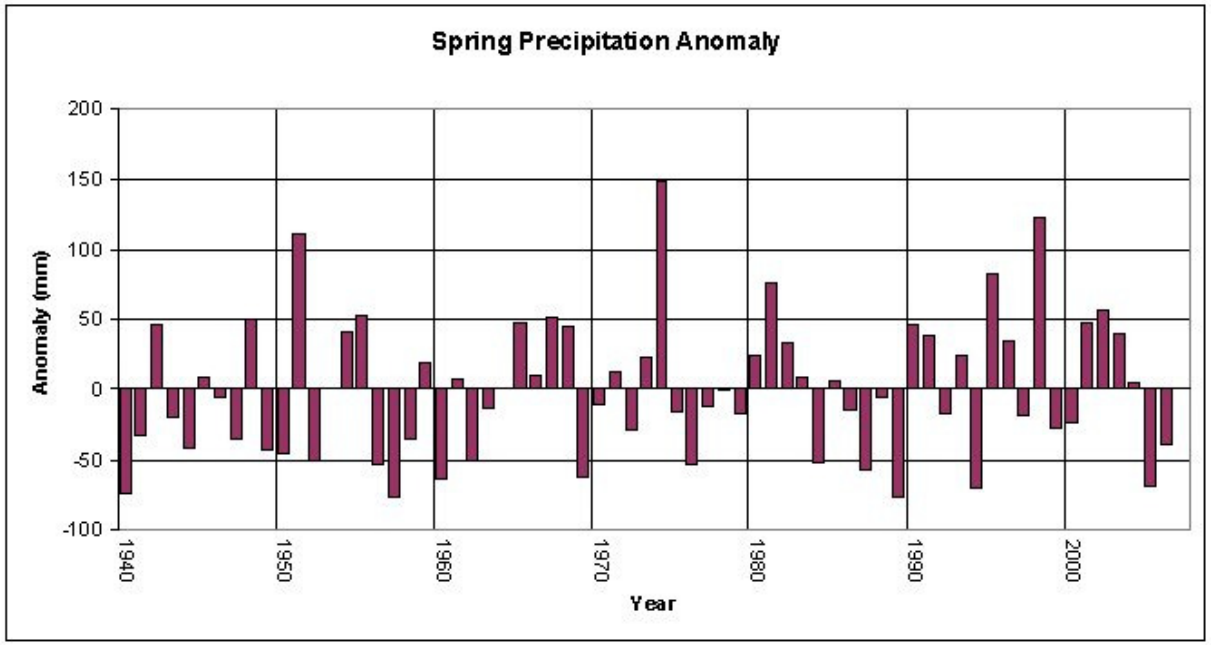
Lack of Spring Precipitation?

Use station data from the Kananaskis Field Station

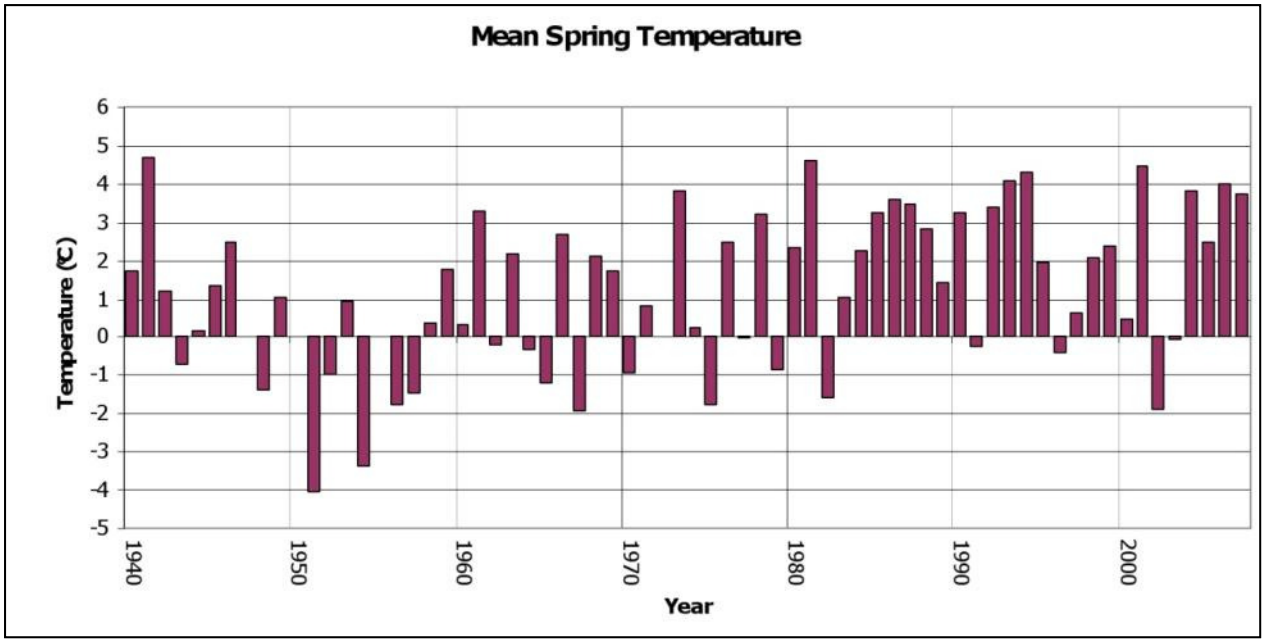
Alberta Foothills

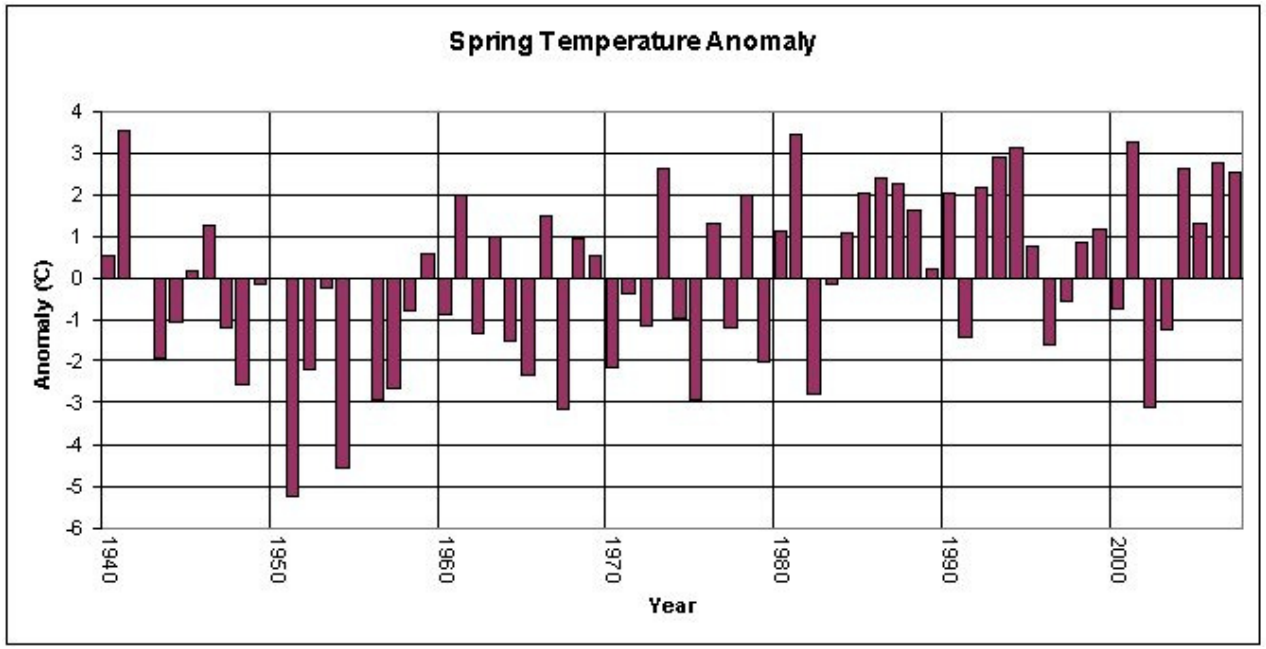




- 1999 and 2000 spring precip was slightly below normal

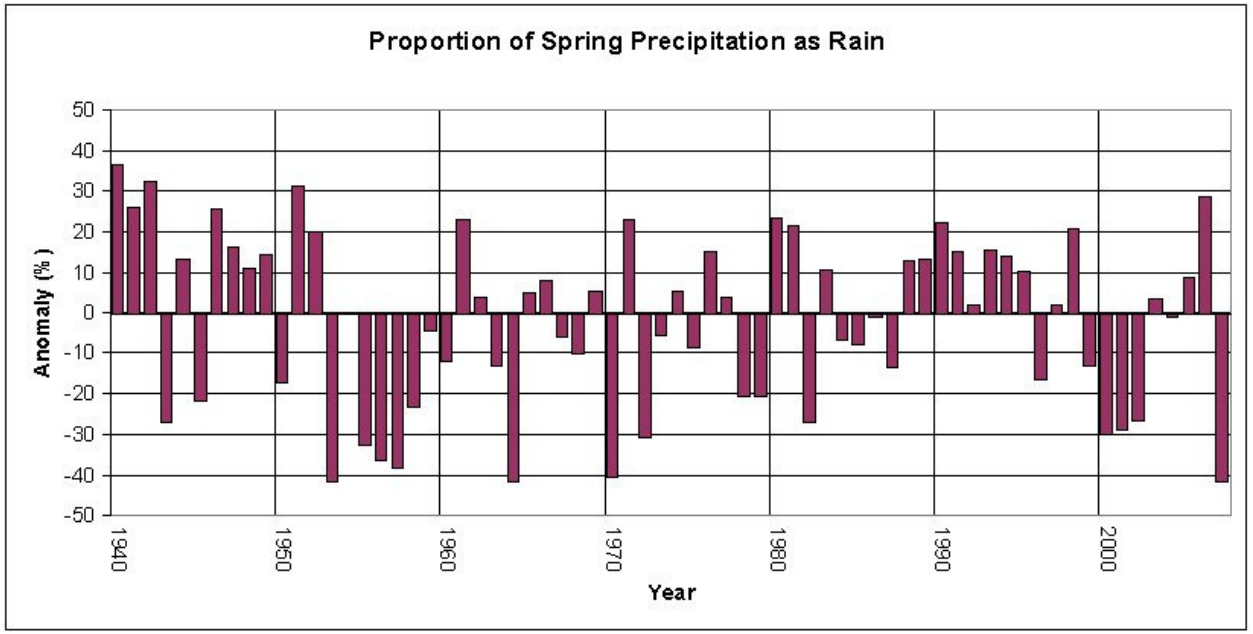
- 2001-2004 spring precip was above normal





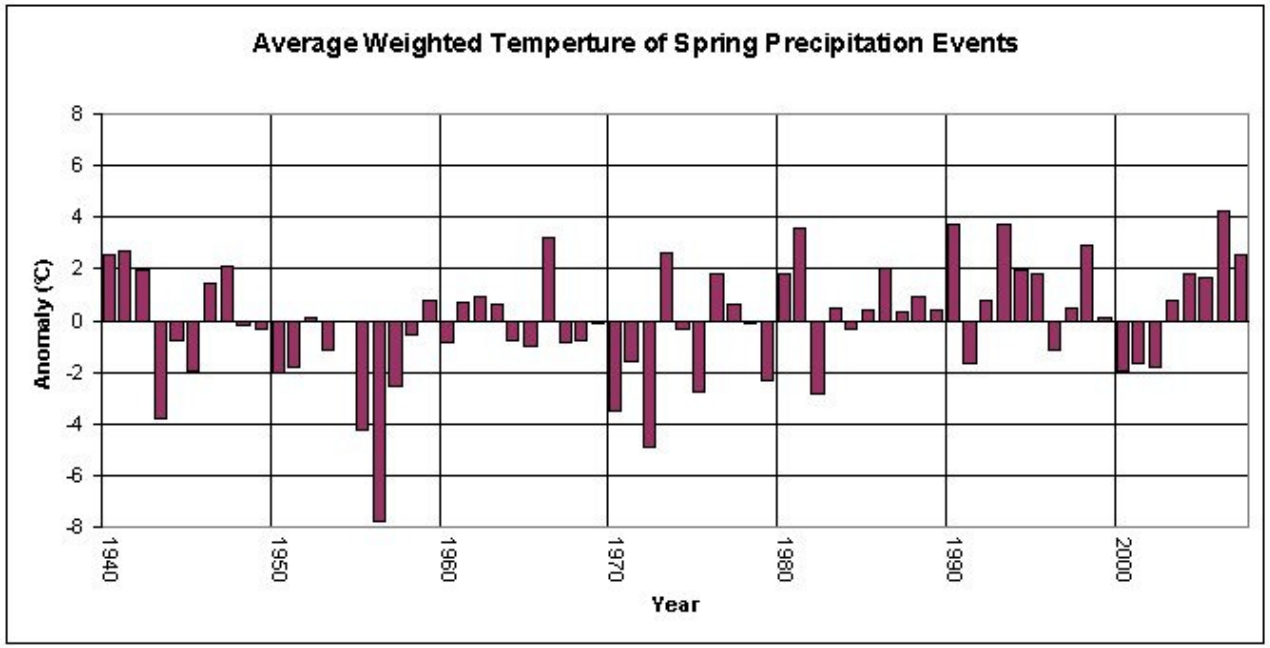
- 1999,2001 and 2004-5 spring temperatures were above normal

- 2000 and 2002-3 spring temperatures were below normal



•Proportion of spring precipitation as rain was significantly below normal for 1999-2003

•Near normal 2004-5



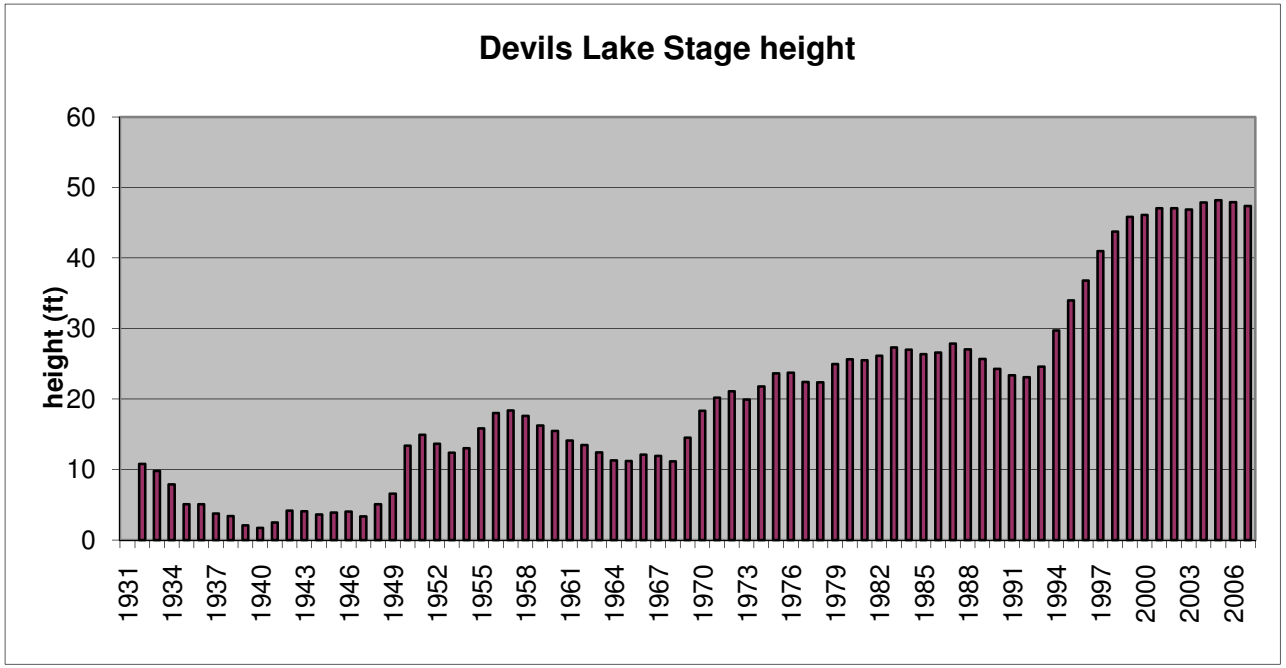
•Mean daily temperature of weighted spring precip events was below normal during 2000-2002

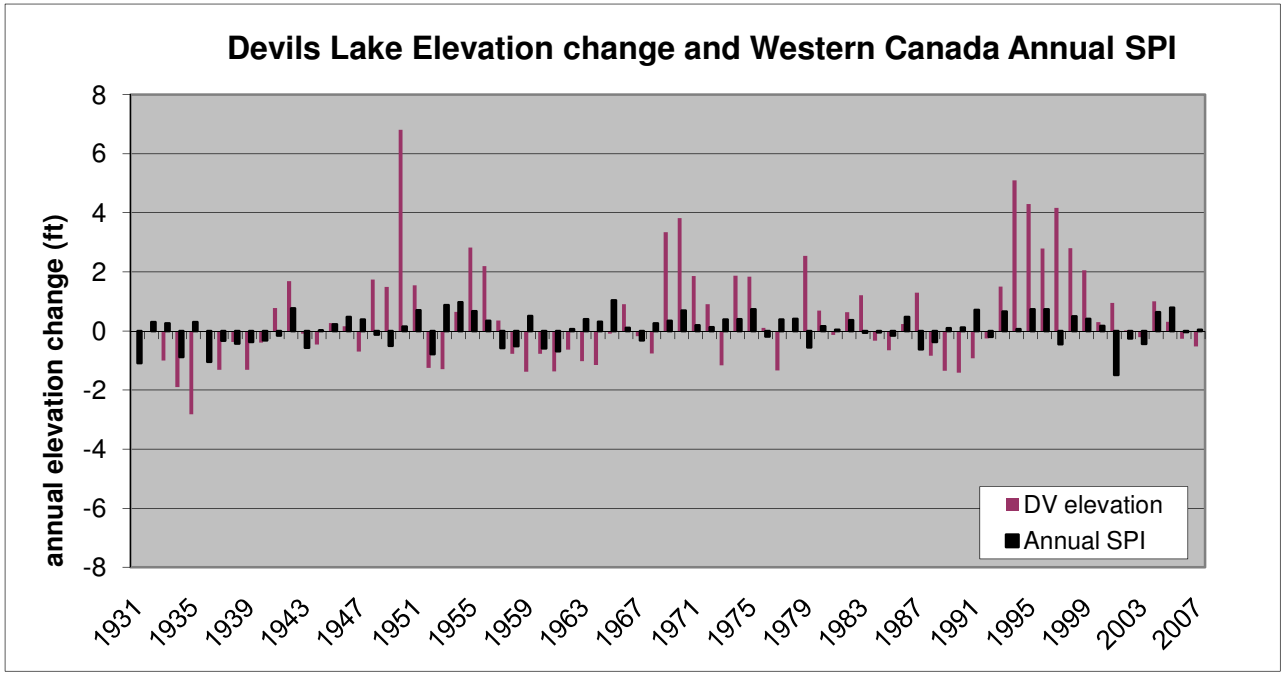
Preliminary conclusions

- Spring precip amounts did not have a discernable pattern
- Changes in patterns due to temperature differences
  - Mean temperatures and temperature of precip events were below normal
- Lack of precip as rain a result
- Implications for snowmelt and plant available water supplies during early growing season
- Need to broaden analysis to validate preliminary findings

Devils Lake

- A closed basin lake in North Dakota that is steadily rising and flooding valuable farmland and municipalities has transnational implication for the US and Canada
- Rising due to (Manitoba Wildlands, 2005) :
  - drains routing water to the lake,
  - the disappearance of wetlands which act as natural drains
  - unusually high levels of precipitation





•Preliminary analysis between Western Canadian annual SPI and Devils lake annual elevation changes show that they are correlated.

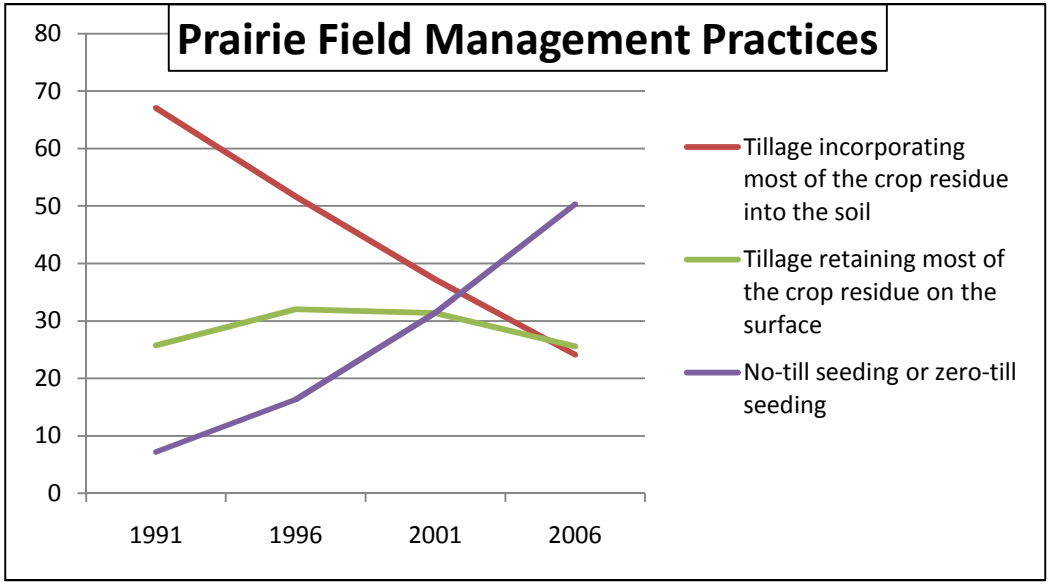
• A correlation coefficient of 0.204 was calculated with a statistical significance of p=0.0787.

Conclusions

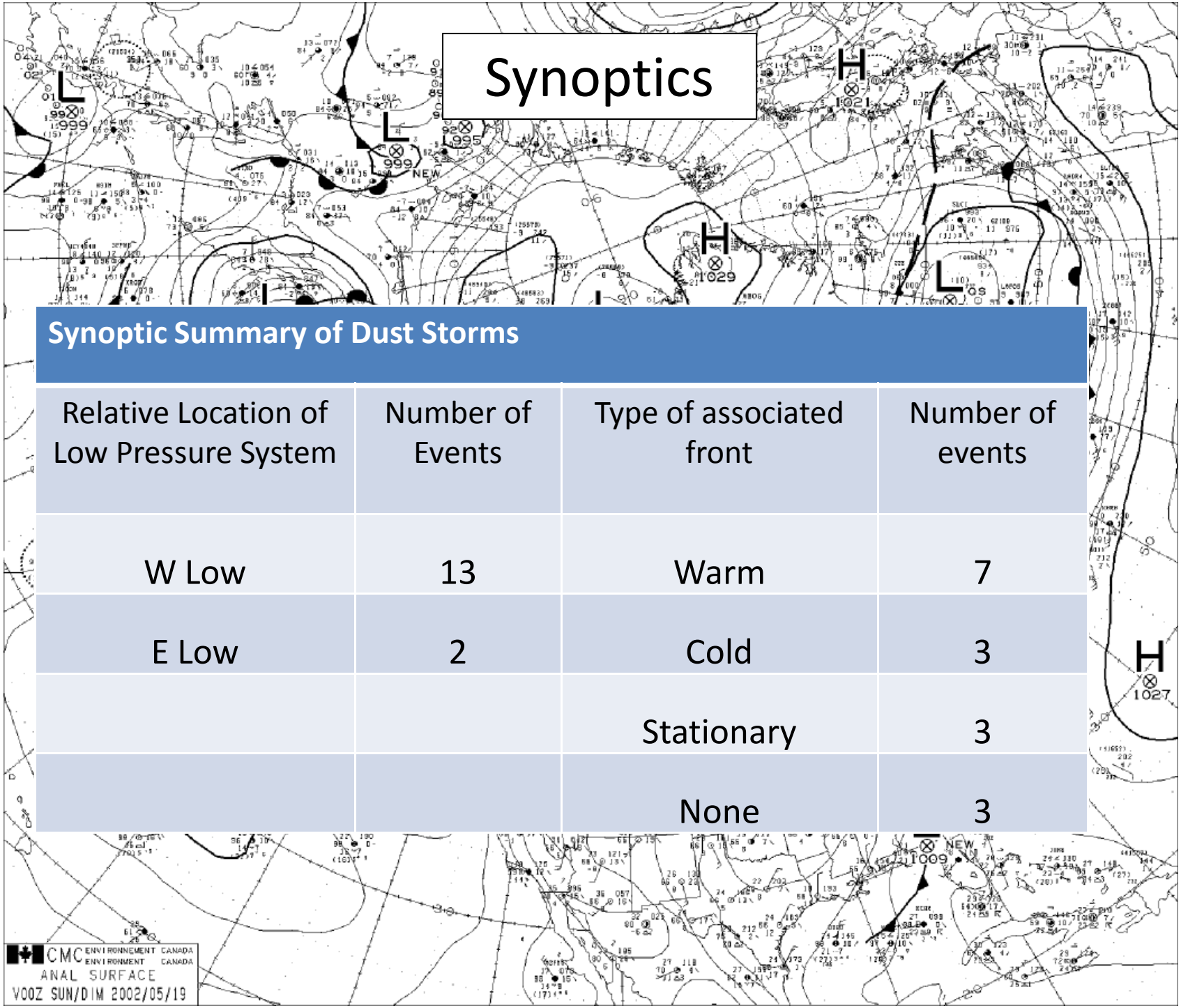
- During the 1999-2005 drought period the stage of the lake did not increase substantially and stayed relatively constant.
- As a correlation exists one could infer that future droughts affecting Devils Lake will correspond to stabilization and/or decrease in stage.
- Additionally a controversial artificial outlet began operation in 2005 to drain water into the red river system which will play an ongoing role in the regulation of Devils Lake water levels and impact future drought impacts.

Dust Storms

- Focusing on dust storms reported in:
  - Wheaton, Elaine. 2005. Canadian Droughts of 2001 and 2002: Wind Erosion in Western Canada: Impacts and Adaptations. Prepared for Agriculture and Agri-Food Canada. SRC Publication No. 11602-3E03
- Dust Storms and Dust are visible manifestations of drought, brings to mind the classic image of drought
- Farming Practices are changing as well



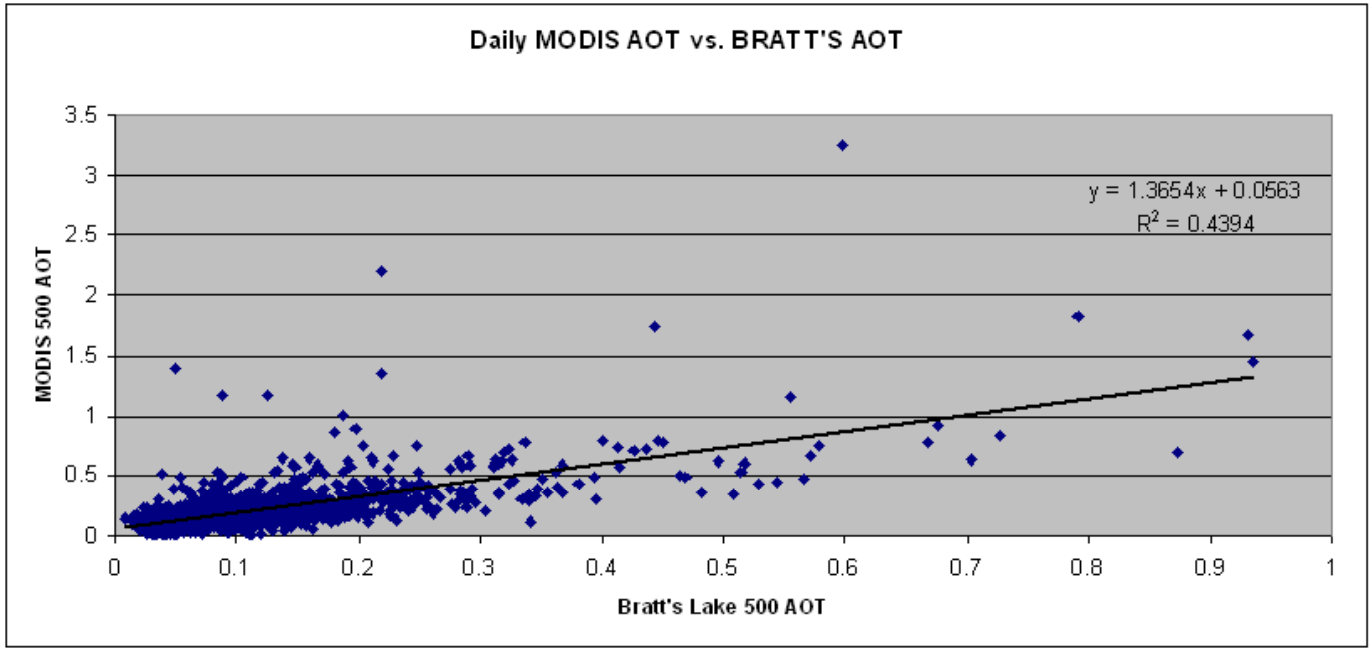
Synoptics



Synoptic Summary of Dust Storms

Relative Location of Low Pressure System	Number of Events	Type of associated front	Number of events
W Low	13	Warm	7
E Low	2	Cold	3
		Stationary	3
		None	3

MODIS



Summary of MODIS Daily Observations of Dust Storms			
Angstrom Exponent		Aerosol Optical Depth	
Average	0.993265	Average	31.1559
Average Percent Rank	0.431667	Average Percent Rank	57.8088

Preliminary Conclusions

- Dust Storms synoptics do not have a defined pattern
  - Associated more with W Lows and Warm fronts but that is pretty generalized
- MODIS AOT does have some correlation with surface observed AOT.
  - Does not do a good job of identifying dust storms
  - Lack of Dust Storm signature in datasets may be due to changing land use practices
- Need a better dataset of dust storm events and longer term particulate matter

Streamflow analysis

- Employed the threshold technique to characterise hydrologic drought
  - Based upon work by Yevjevich (1967)
- Threshold level employed was the 10th percentile of monthly stream flow

Variables:

- Q_z= threshold level
- t_i= start of drought
- d_i= drought duration
- v_i= deficit volume of drought (severity)
- v_i/d_i= average deficit flow (intensity)

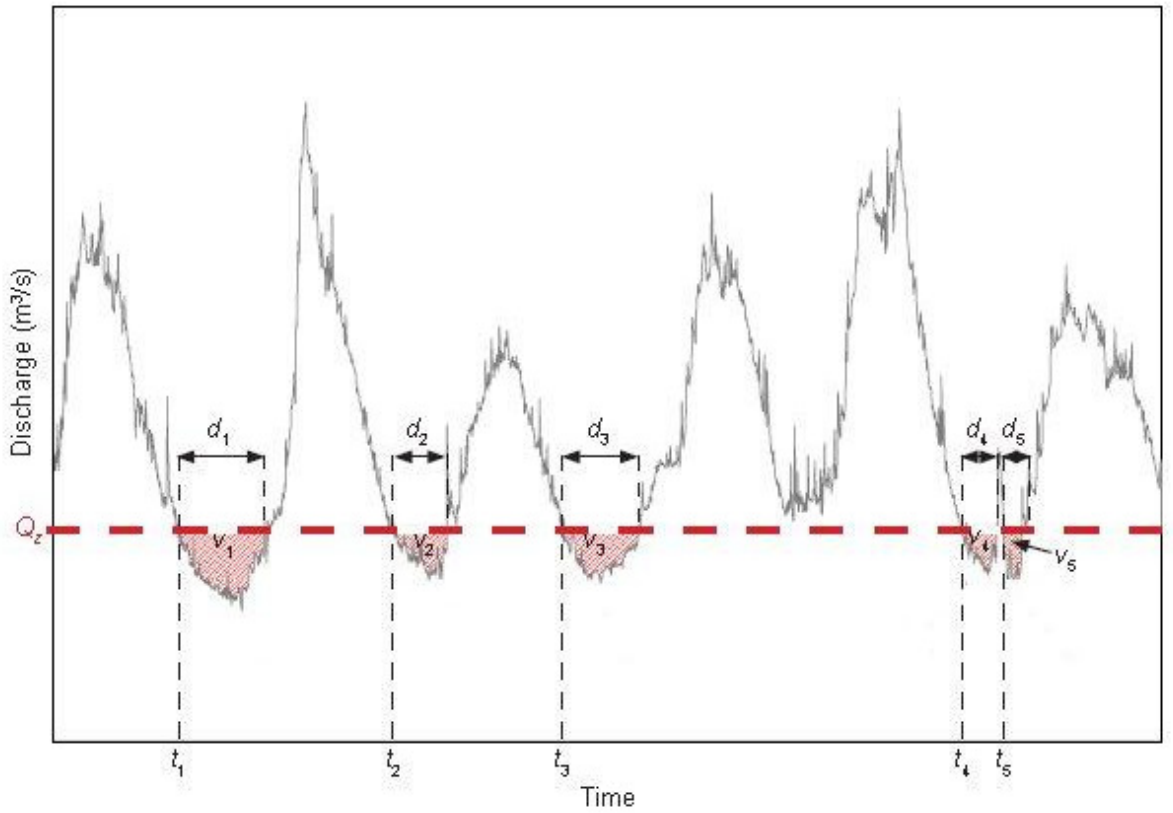
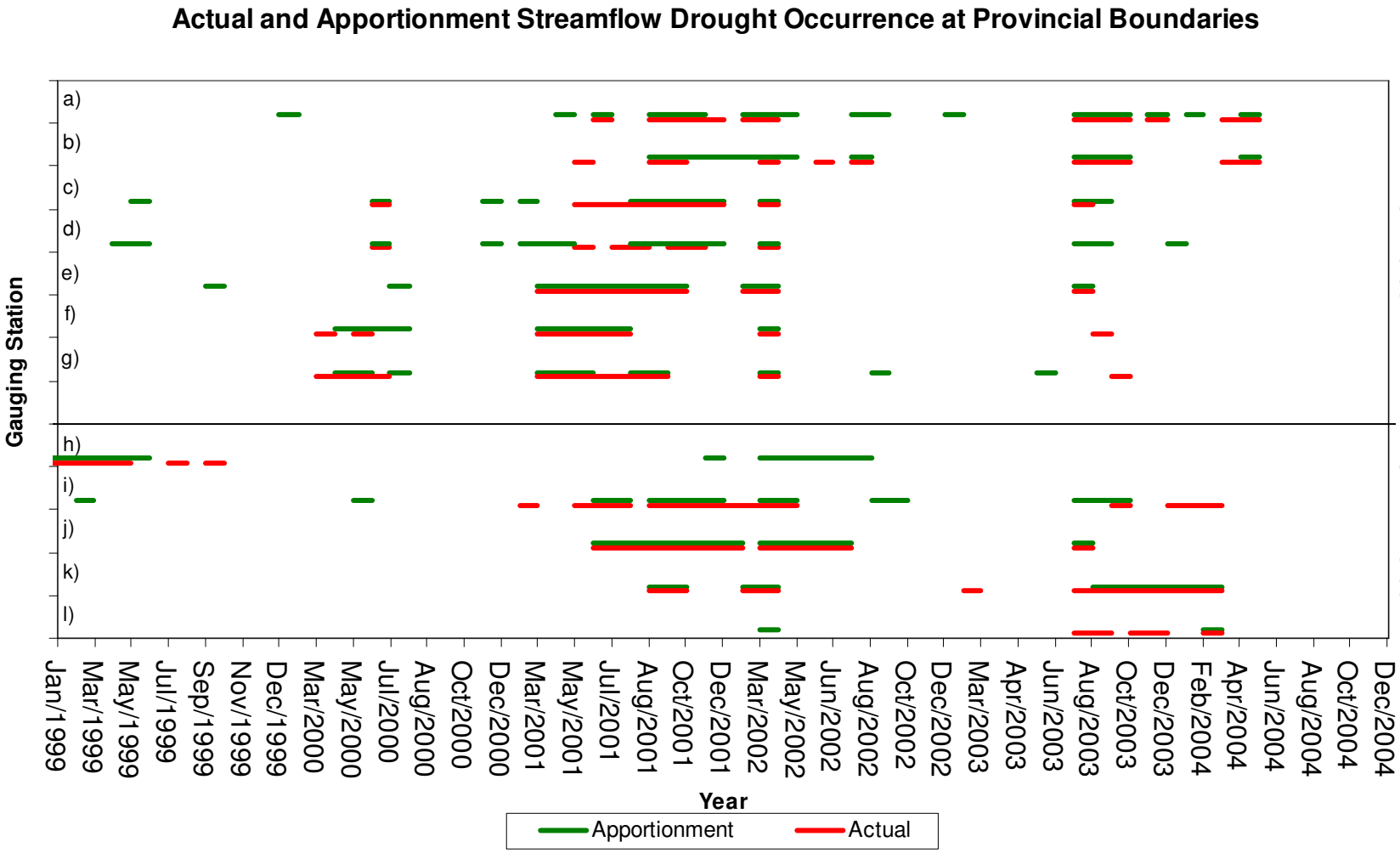


Figure modified from Flieg et al (2006)

Results

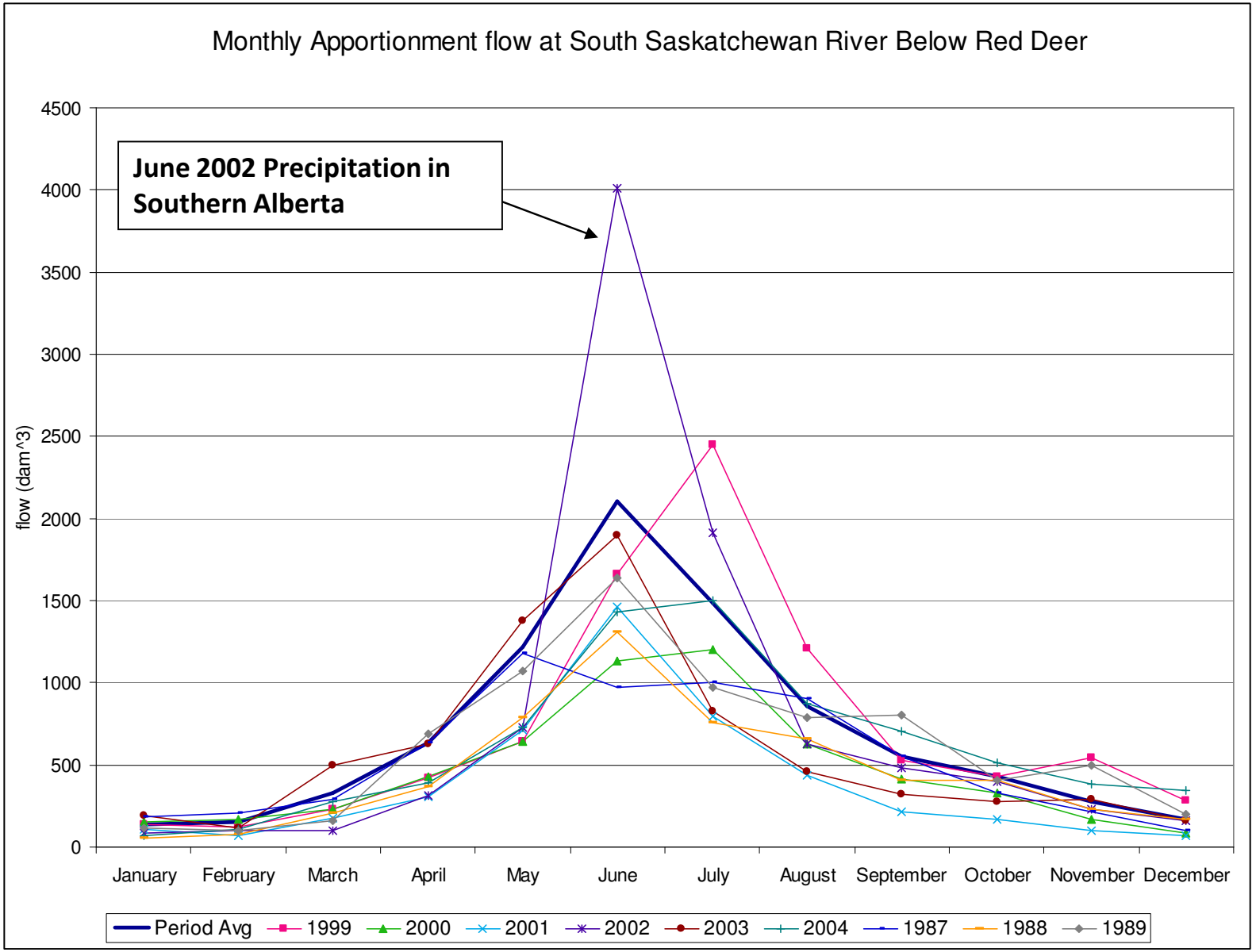


Gauging Stations: a) North Saskatchewan at Border, b) Red Deer at Bindloss, c) South Saskatchewan below Red Deer, d) South Saskatchewan at Medicine Hat, e) Battle Creek at Border, f) Lodge Creek at Border, g) Middle Creek at Border, h) Churchill River at the Border, i) Saskatchewan at The Pas, j) Red Deer near Erwood, k) Assiniboine at Kamsack and l) Pipestone Creek.

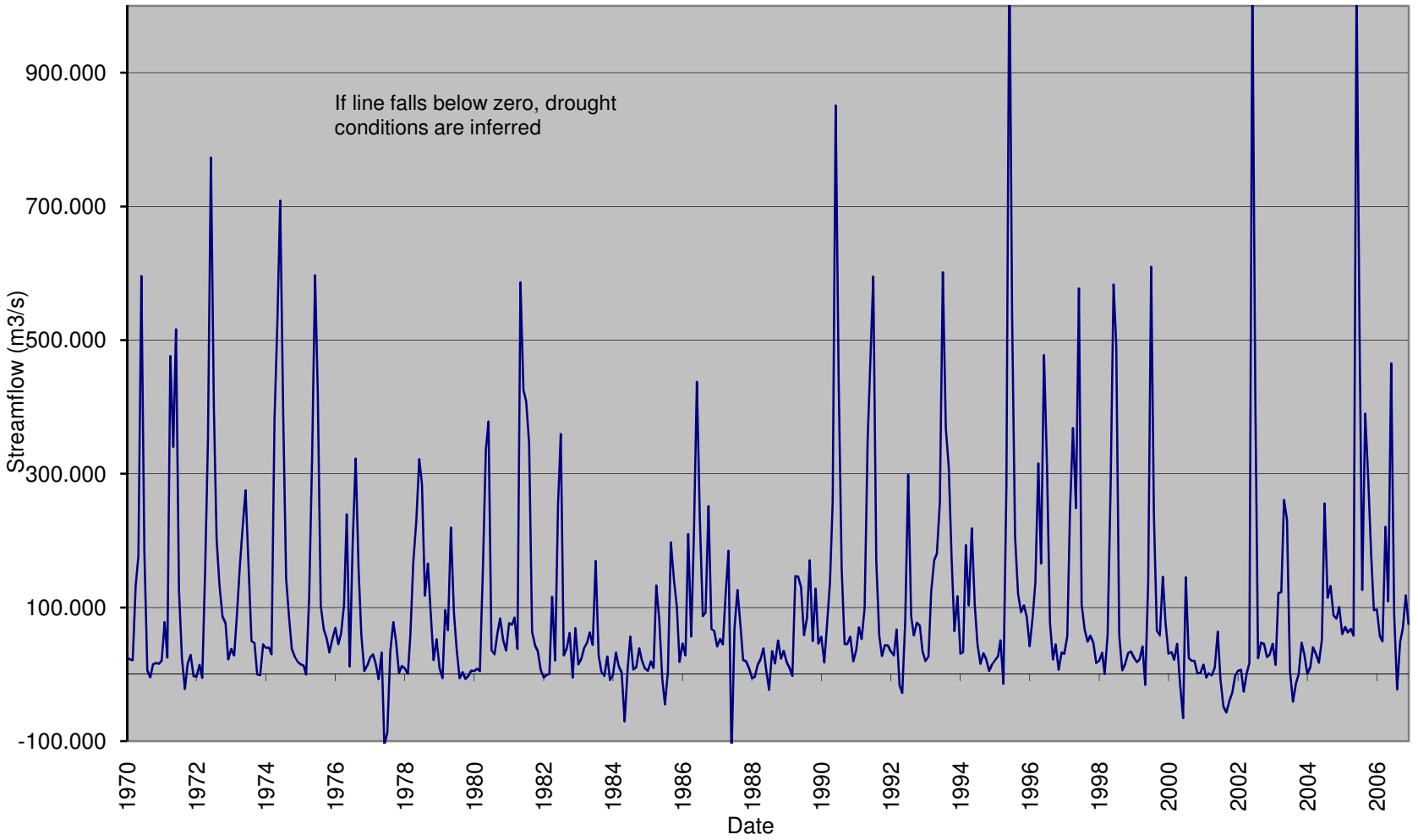
Most severe drought events

Station	Total Months below Q10*	Max. consecutive months below Q10*	Start date of max consecutive period below Q10*	Deficit Volume ($m^{3)*}$
North Sask. at A-S border	13/ 10	4/3	Sept 2001/ Sept 2001	4,819,392/6,432,903
Red Deer River at Bindloss	11/13	3/8	Aug 2003/ Sept 2001	2,931,552/3,400,940
South Sask. below Red Deer River	11/12	8/5	May 2001/ Aug 2001	8,825,376/15,332,151
South Sask at Medicine Hat	7/16	2/5	Oct 2001/Aug 2001	3,646,944 /14,016,767
Battle Creek	11/12	8/8	Mar 2001/Mar 2001	15,652/19,496
Middle Creek	13/11	7/3	Mar 2001/Mar 2001	2028/2,123
Lodge Creek	10/10	5/5	Mar 2001/Mar 2001	673/2,642
Churchill River	2/7	1/6	Sept 1999/Mar 2002	900,000/2,615,903
Saskatchewan River at The Pas	16/15	8/4	Sept 2001/Sept 2001	57,049,920/32,552,424
Red Deer River (near Erwood)	14/14	8/8	Jun 2001/Jun 2001	309,121/275,813
Assiniboine River at Kamsack	13/11	8 /7	Aug 2003/ Sept 2003	73,815/35, 606
Pipestone Creek	5/ 3	2/1	Aug 2003/Mar 2004	608/5,545
Median	11/11.5	6/5	Jun 2001/Aug 2001	
*Actual/Apportionment				

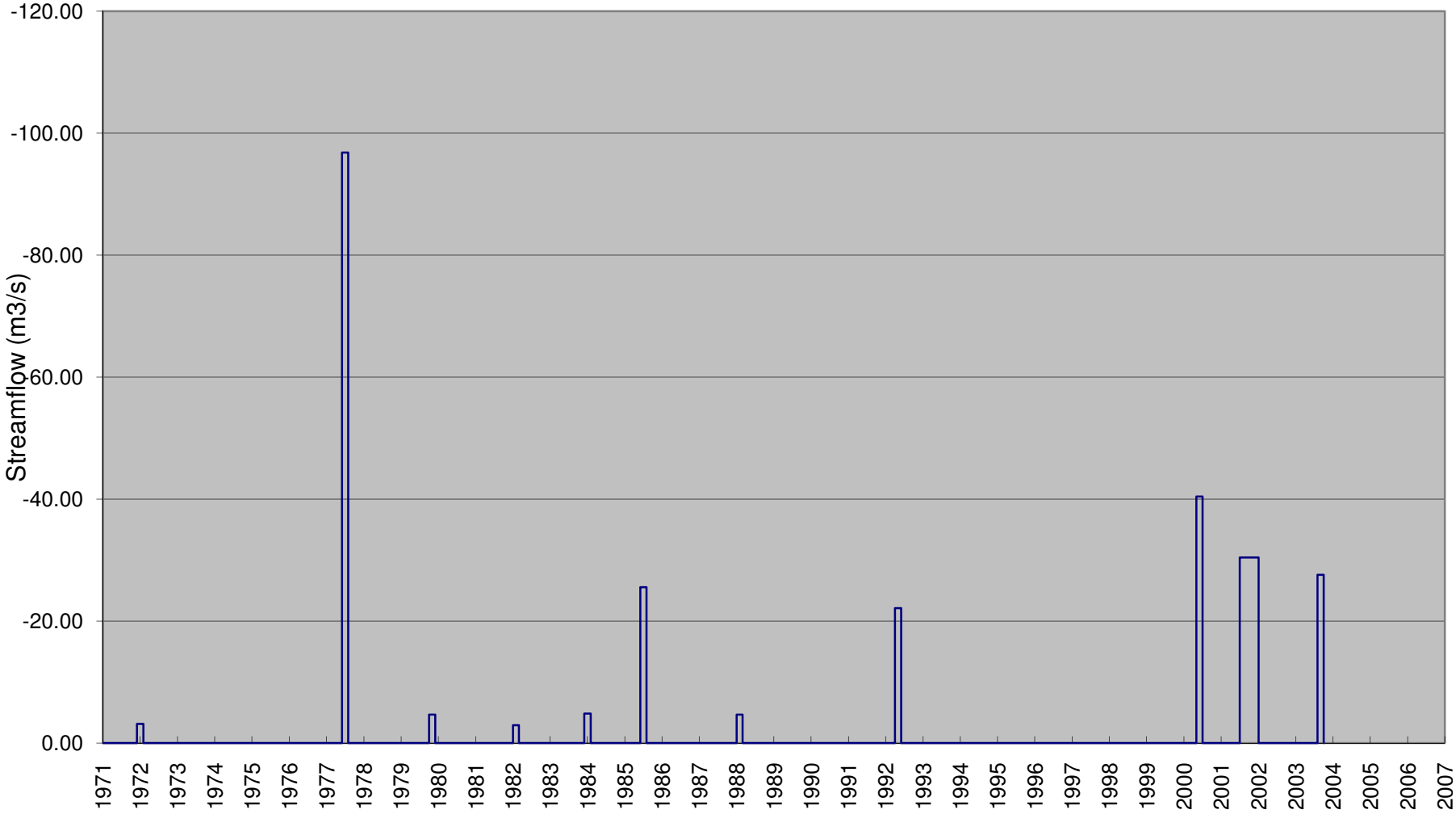
Effect of Severe Rainfall Event



Difference between the Naturalized and 10th Percentile Flow for the South Sask below the Red Deer



South Sask below the Red Deer Significant Drought Events summarized for duration and severity



Conclusions

- Apportionment and actual stream flows using the threshold method do provide a reasonable indicator of drought conditions.
- Small basins respond more quickly to drought than larger basins which suggests that streamflow in these basins is more susceptible to drought.
- Apportionment flows generally reflected the progress of the actual streamflow drought along the Alberta/ Saskatchewan and Saskatchewan/Manitoba borders during the 1999/2004 drought although some significant deviations occurred at specific stations.
- Severe apportionment drought periods generally lag behind severe actual drought periods
- While small rain events do not have a measurable impact on the flows, larger-scale, heavy rain events can result in significant increases in flows that can last for as long as a month.
- In context of the last 100 years the 2001-2002 streamflow drought on the South Sask below the Red Deer was the most severe on record (naturalized).