

Meteorological diagnosis of the 1999-2005 Canadian Prairie drought

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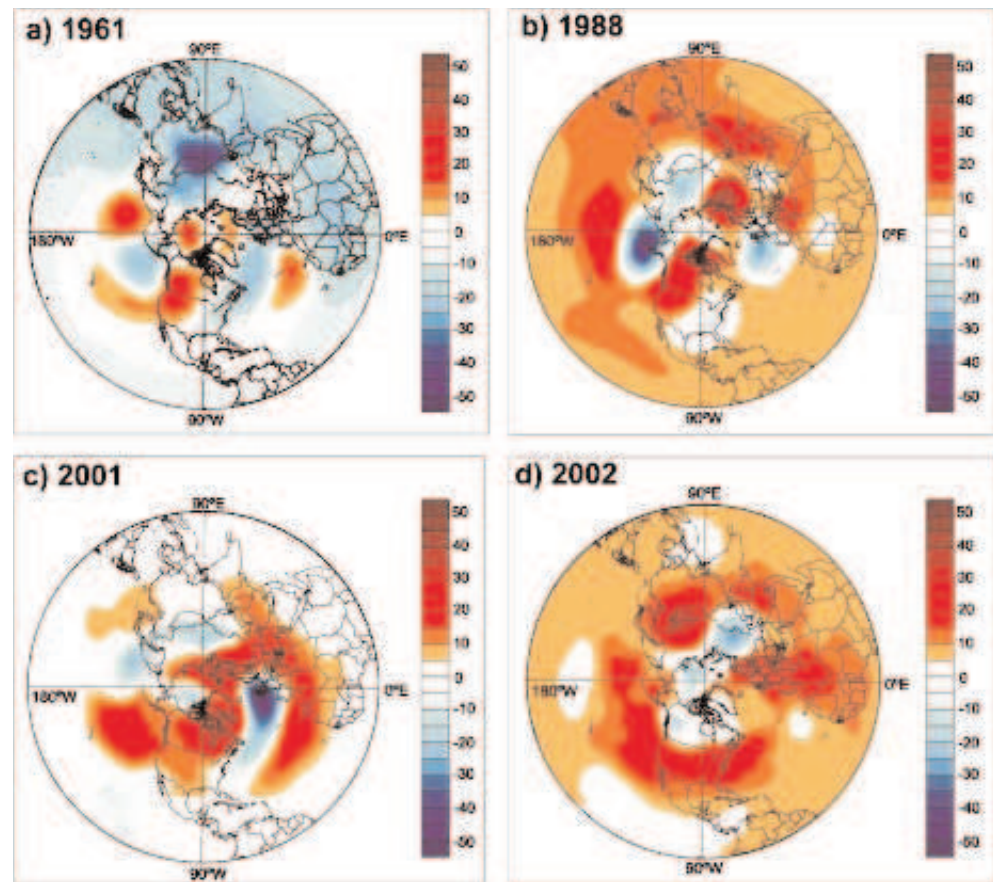
McGill



Photo from the Prairie Farm Rehabilitation Administration

Synoptic Motivation: This Drought is Different!

- Drought in the Canadian Prairies is usually associated with persistent ridging or teleconnections - not the case here!
- Bonsal and Wheaton (2005) noted the distinct lack of meridional flow in 2001-2002 that was present in other Canadian Prairie droughts (1961, 1988)

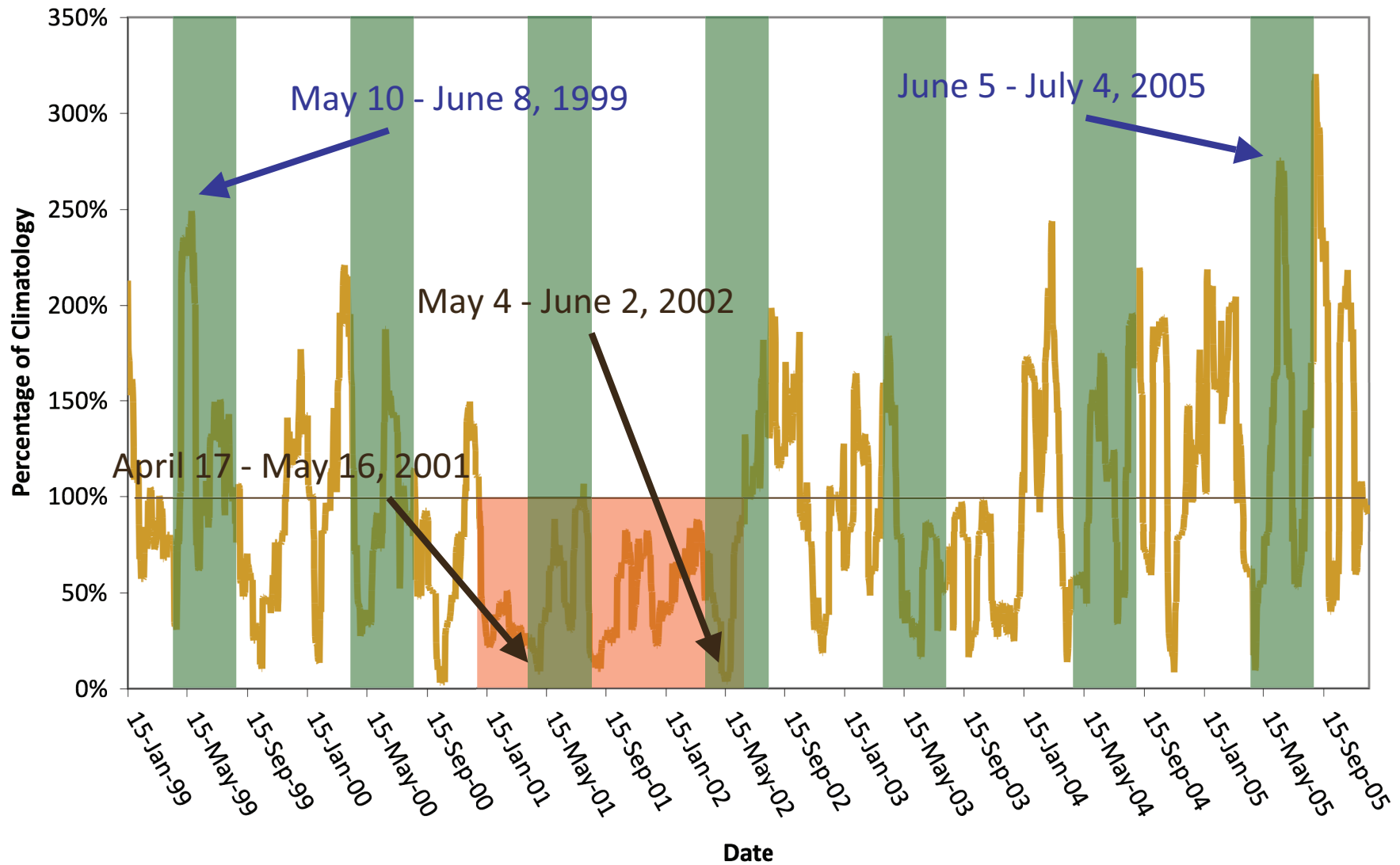


Average 500hPa height anomalies for the autumn to summer period [Fig. 2 from Bonsal and Wheaton (2005)]

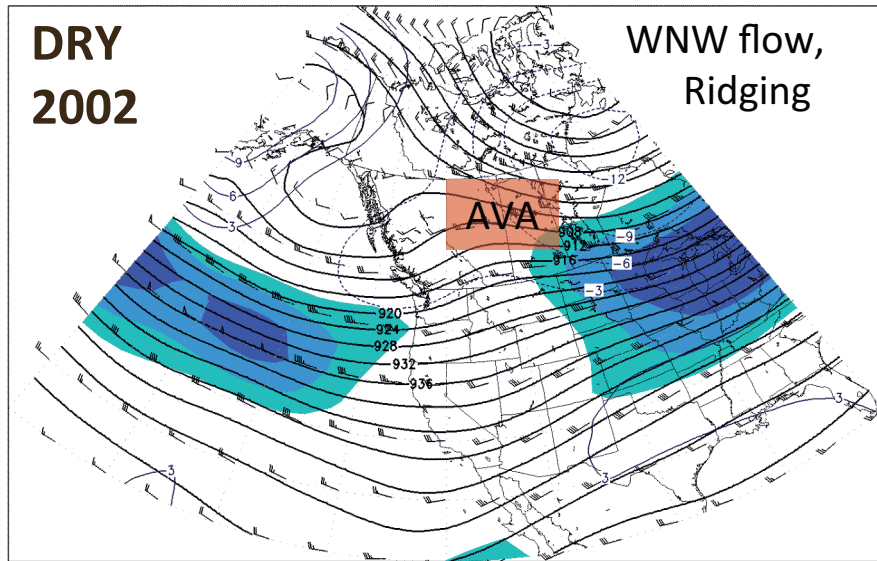
Methodology/Data

1. Identify key severe periods throughout the 1999-2005 drought using the daily and monthly corrected precipitation station data (Environment Canada, Mekis and Hogg, 1999)
2. Diagnose synoptic mechanisms for subsidence during the identified periods (NCEP/NCAR Global Reanalysis R1, 1948-present: 6h, 28 vertical levels, 2.5° resolution)

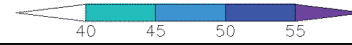
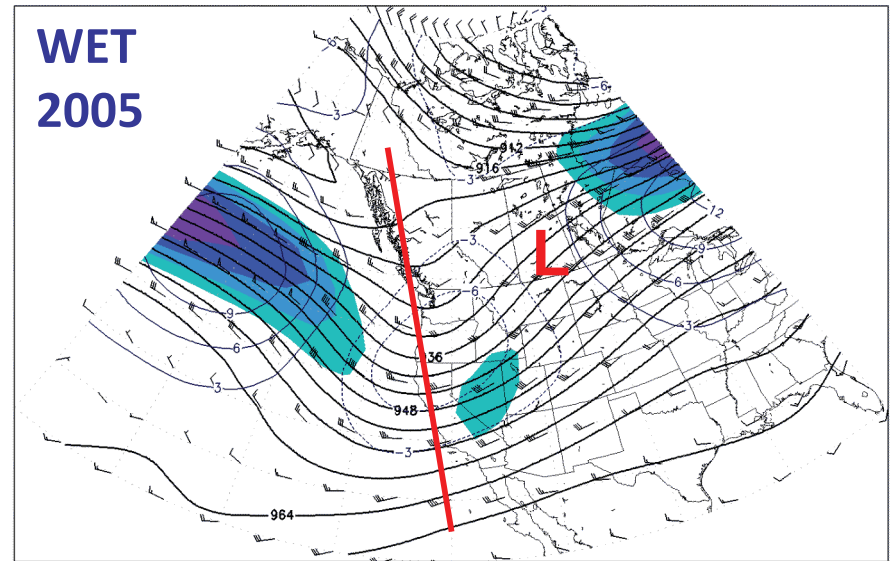
30 day running means for Saskatoon, SK



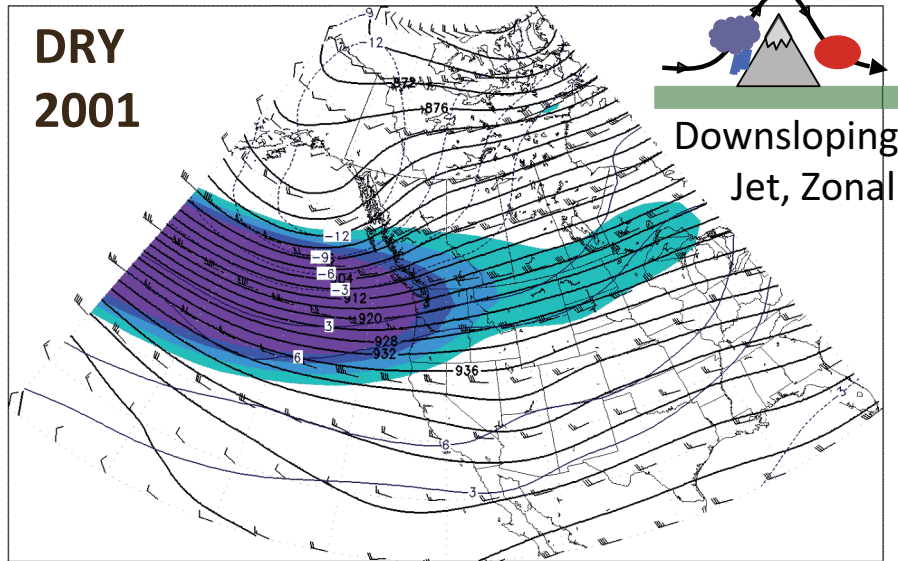
Average 300hPa Heights and anomalies (dam, contoured),
isotachs (kts, shaded) and winds (kts)
DRY 00Z04MAY2002 to 18Z02JUN2002



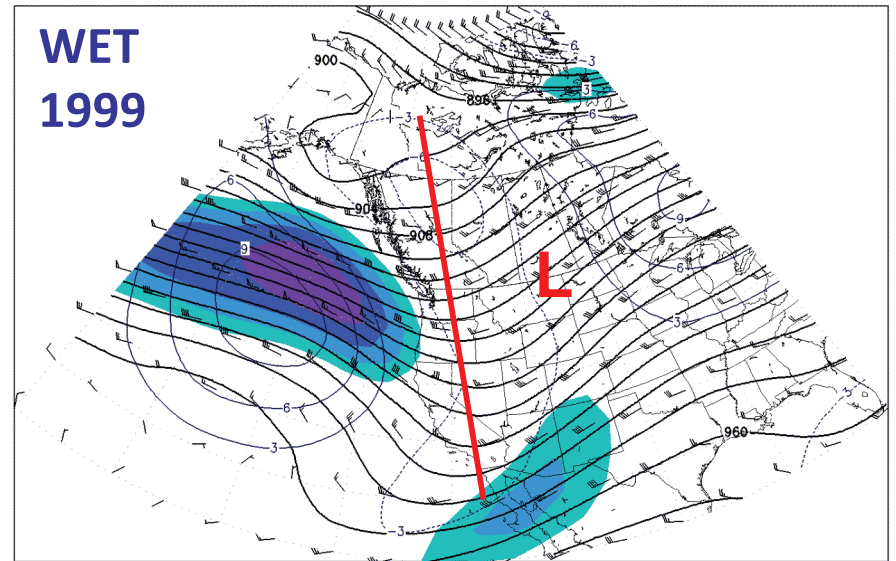
Average 300hPa Heights and anomalies (dam, contoured),
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WET 00Z05JUN2005 to 18Z04JUL2005



Average 300hPa Heights and anomalies (dam, contoured),
isotachs (kts, shaded) and winds (kts)
DRY 00Z17APR2001 to 18Z16MAY2001



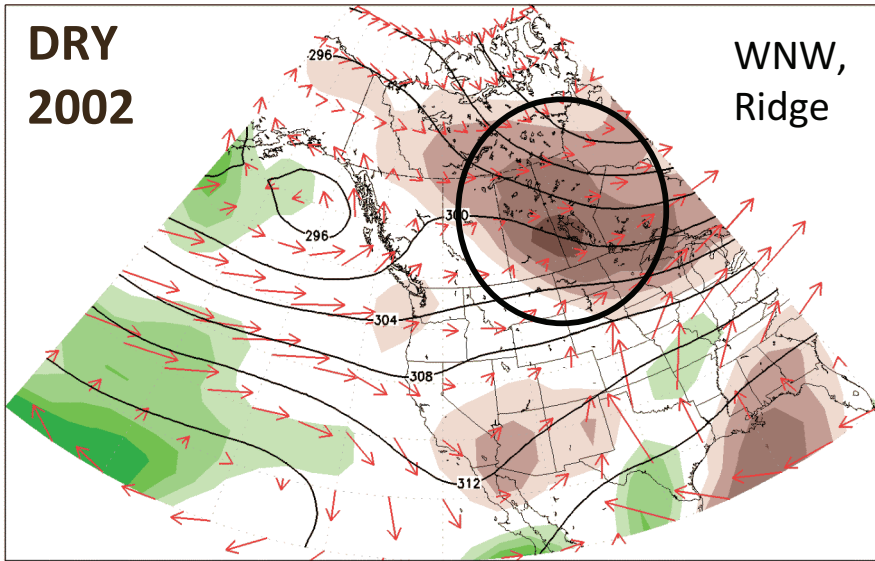
Average 300hPa Heights and anomalies (dam, contoured),
isotachs (kts, shaded) and winds (kts)
WET 00Z10MAY1999 to 18Z08JUN1999



Average 700hPa Heights (dam), precipitable water anomalies (mm, shaded), and moisture transport ($\text{kg m}^{-1} \text{s}^{-1}$, arrows)
DRY 00Z04MAY2002 to 18Z02JUN2002

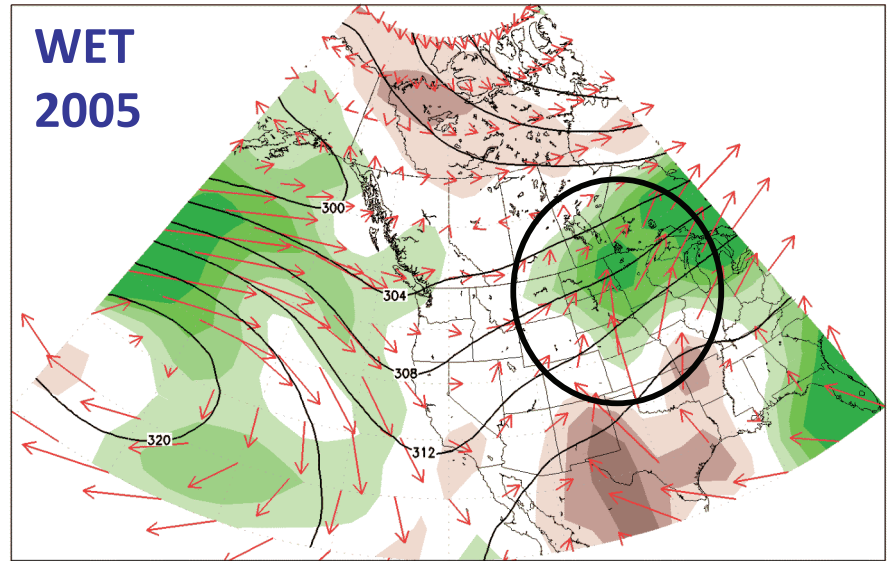
**DRY
2002**

**WNW,
Ridge**



Average 700hPa Heights (dam), precipitable water anomalies (mm, shaded), and moisture transport ($\text{kg m}^{-1} \text{s}^{-1}$, arrows)
WET 00Z05JUN2005 to 18Z04JUL2005

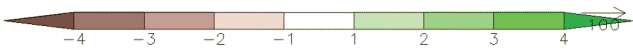
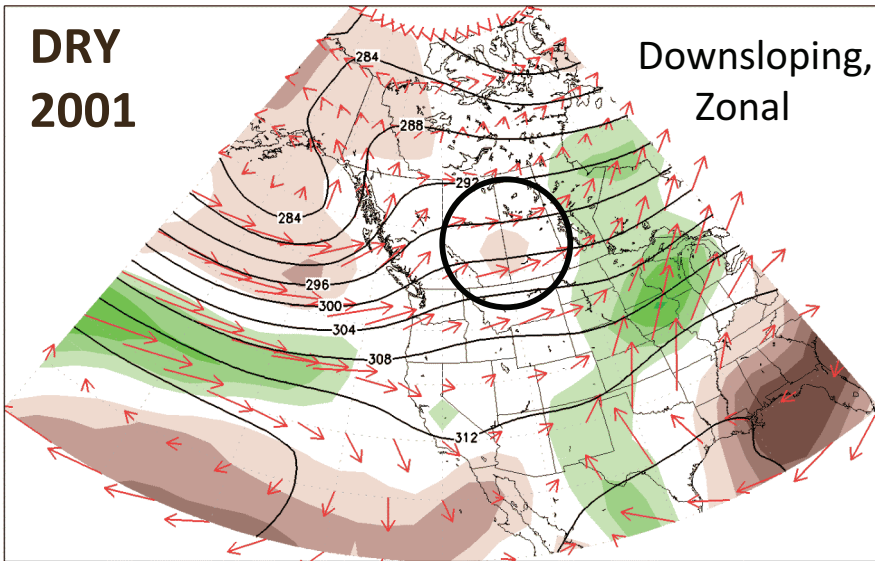
**WET
2005**



Average 700hPa Heights (dam), precipitable water anomalies (mm, shaded), and moisture transport ($\text{kg m}^{-1} \text{s}^{-1}$, arrows)
DRY 00Z17APR2001 to 18Z16MAY2001

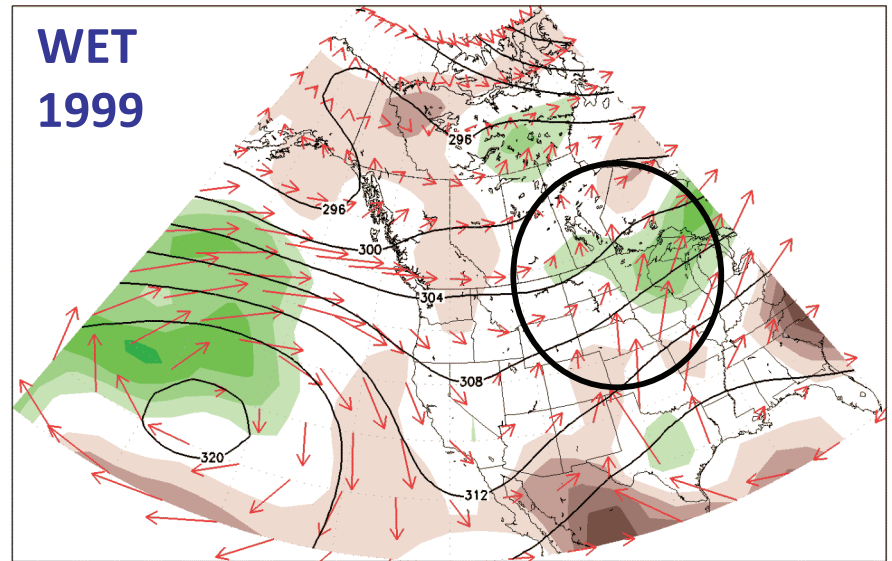
**DRY
2001**

**Downsloping,
Zonal**



Average 700hPa Heights (dam), precipitable water anomalies (mm, shaded), and moisture transport ($\text{kg m}^{-1} \text{s}^{-1}$, arrows)
WET 00Z10MAY1999 to 18Z08JUN1999

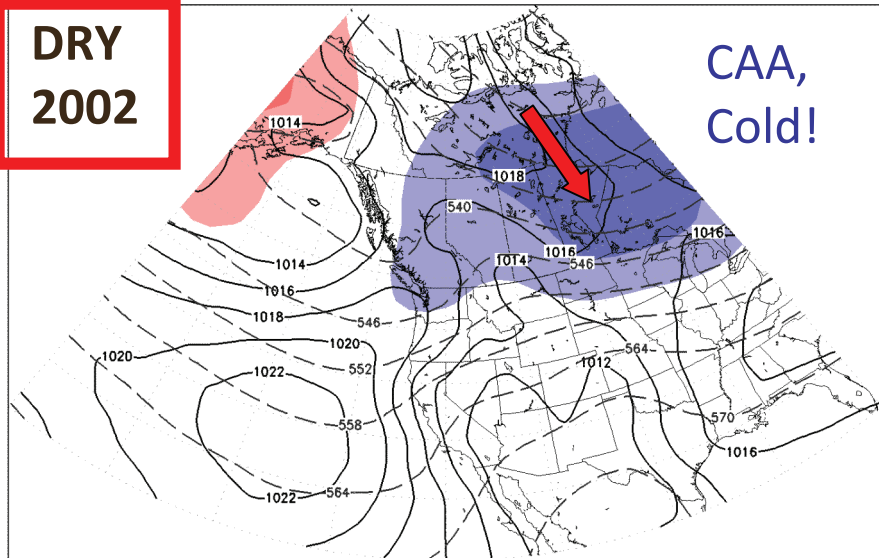
**WET
1999**



Average MSLP (mb), 500–1000hPa thickness (dam, dashed),
and thickness anomalies (dam, shaded)
DRY 00Z04MAY2002 to 18Z02JUN2002

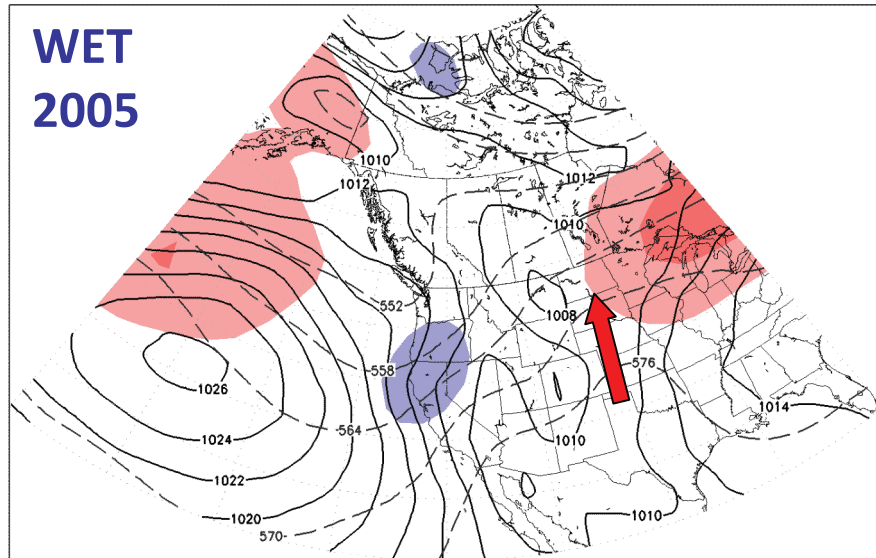
**DRY
2002**

CAA,
Cold!



Average MSLP (mb), 500–1000hPa thickness (dam, dashed),
and thickness anomalies (dam, shaded)
WET 00Z05JUN2005 to 18Z04JUL2005

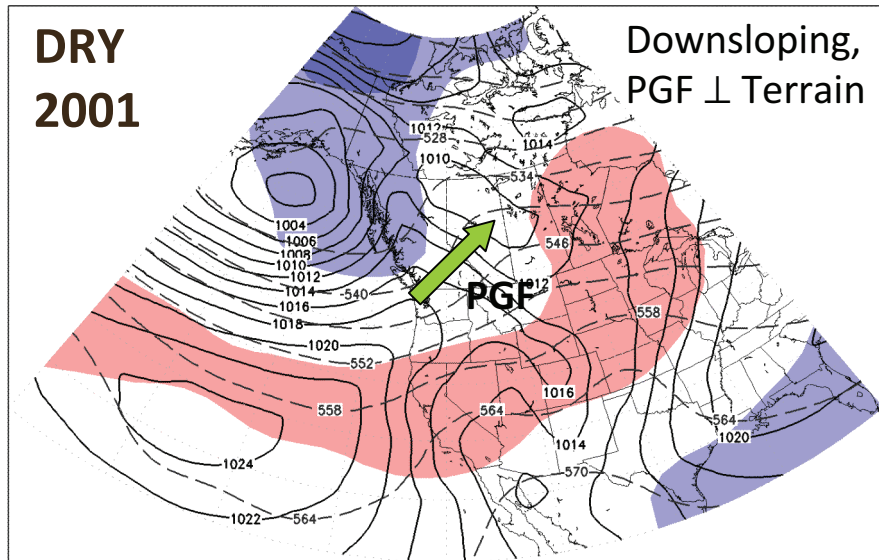
**WET
2005**



Average MSLP (mb), 500–1000hPa thickness (dam, dashed),
and thickness anomalies (dam, shaded)
DRY 00Z17APR2001 to 18Z16MAY2001

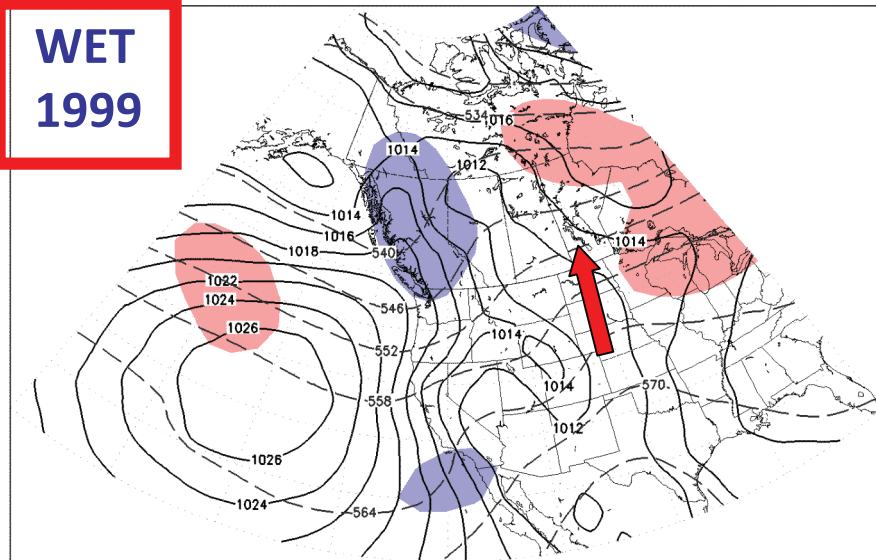
**DRY
2001**

Downsloping,
PGF \perp Terrain



Average MSLP (mb), 500–1000hPa thickness (dam, dashed),
and thickness anomalies (dam, shaded)
WET 00Z10MAY1999 to 18Z08JUN1999

**WET
1999**



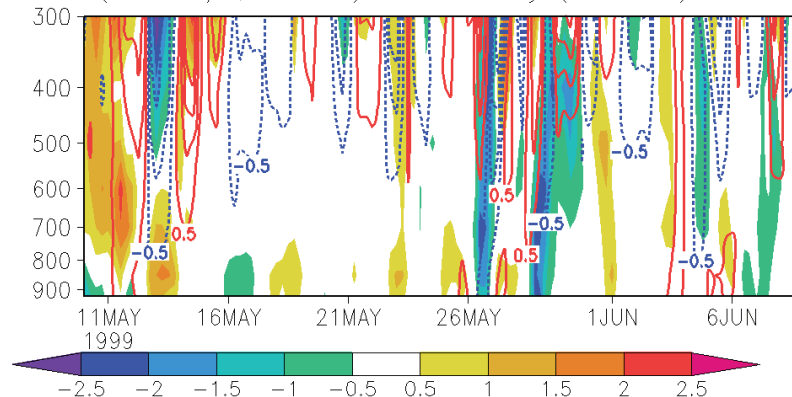
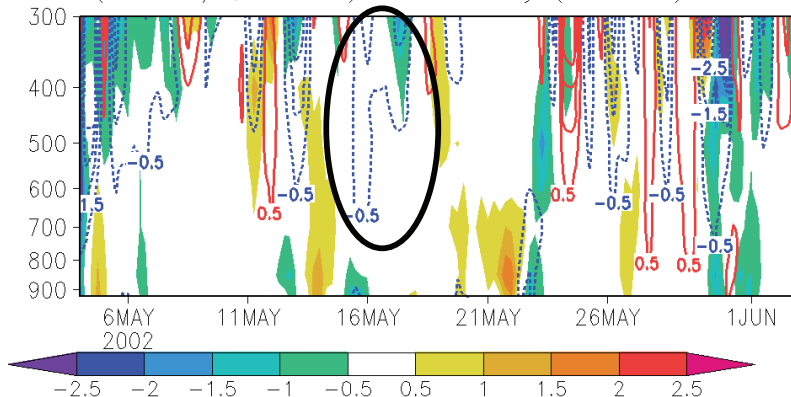
DRY 2002

SASKATOON

WET 1999

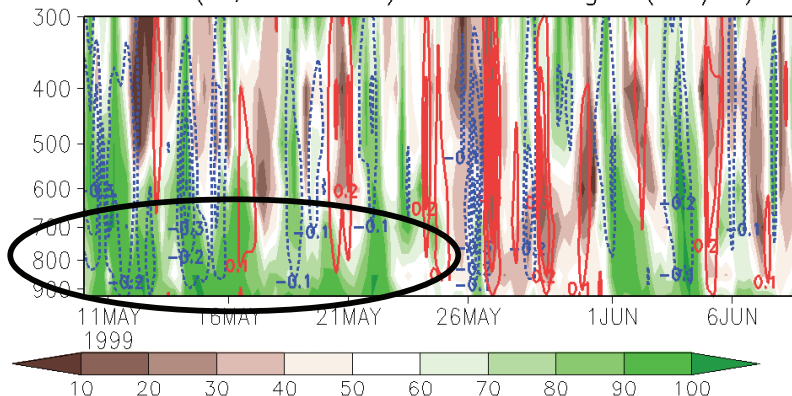
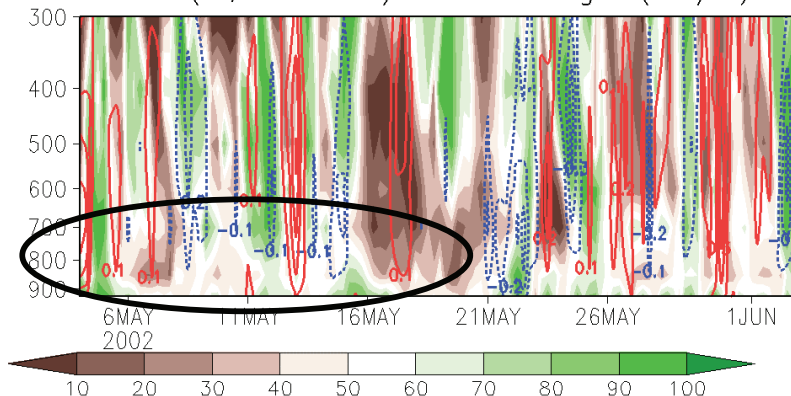
Temperature ($\times 10^{-4}$ K/s, shaded) and Vorticity ($\times 10^{-9}$ s $^{-2}$) Advections

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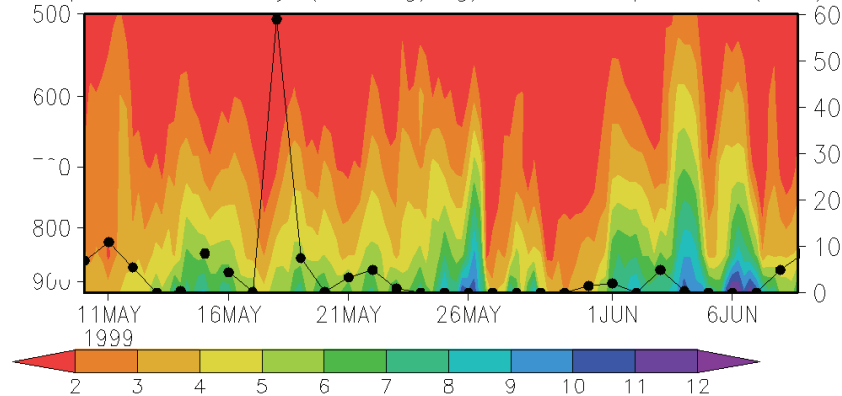
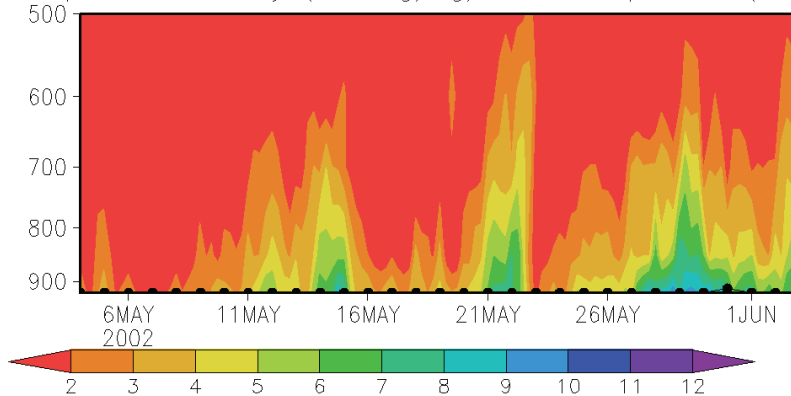
RH (% , shaded) and Omega (Pa/s)

RH (% , shaded) and Omega (Pa/s)



Specific Humidity ($\times 10^{-3}$ kg/kg) and Precipitation (mm)

Specific Humidity ($\times 10^{-3}$ kg/kg) and Precipitation (mm)



Conclusions



- No one underlying cause, series of “Unfortunate Events”
- Spring 2002 characterized by subsidence from AVA and CAA (Cold and Dry)
- Spring 2001 characterized by subsidence from downsloping, strong pacific jet
- Importance of low level RH for precipitation in the prairies (ascent is not enough)

A photograph of a sand dune landscape. The foreground shows a sand dune with some green and brown grasses. In the middle ground, there are more sand dunes with sparse, dry-looking vegetation. A wire fence with wooden posts runs across the dunes. The sky is overcast with grey clouds, and there's a hint of blue light near the horizon.

Questions?

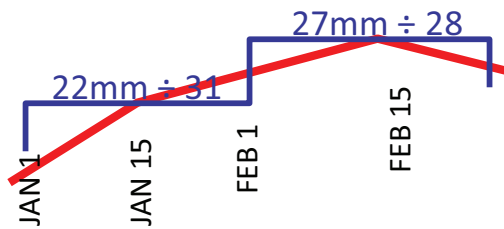
Thank you!

Photo from the Prairie Farm Rehabilitation Administration

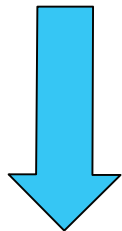
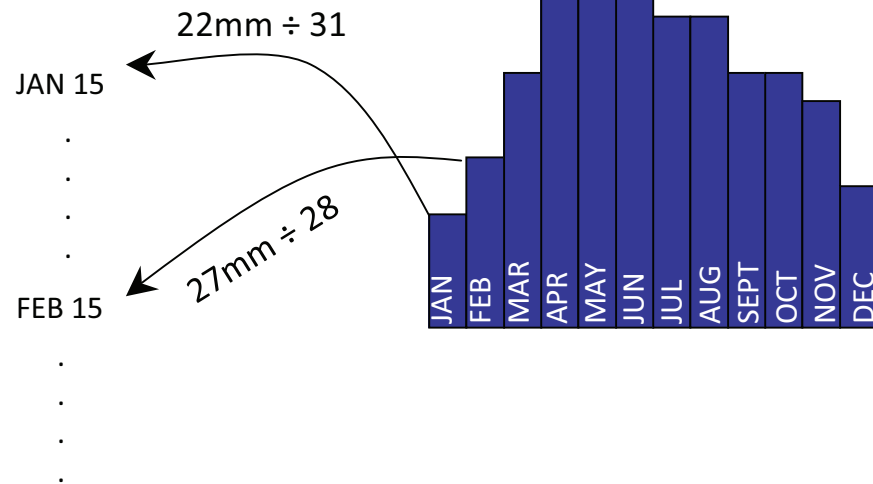
Climatology Interpolation and 30-day Moving Windows

30y Monthly Climatology for Precipitation

“Daily” Climatology for Precipitation



Linear Interpolation!



Percentage of “daily” climatology = $\frac{\text{Actual (mm)}}{\text{Expected (mm)}}$



Smoothing! Running Means

