

Atmospheric Moisture and Thunderstorm Drought

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'drought summer'



Severe thunderstorms do still occur during droughts!



Pine Lake Tornado storm – 14 July 2000
* most severe storm of 2000 in all of North America.

14 Jul 2000
23:32 UTC

The Pine Lake Tornado storm
14 July 2000



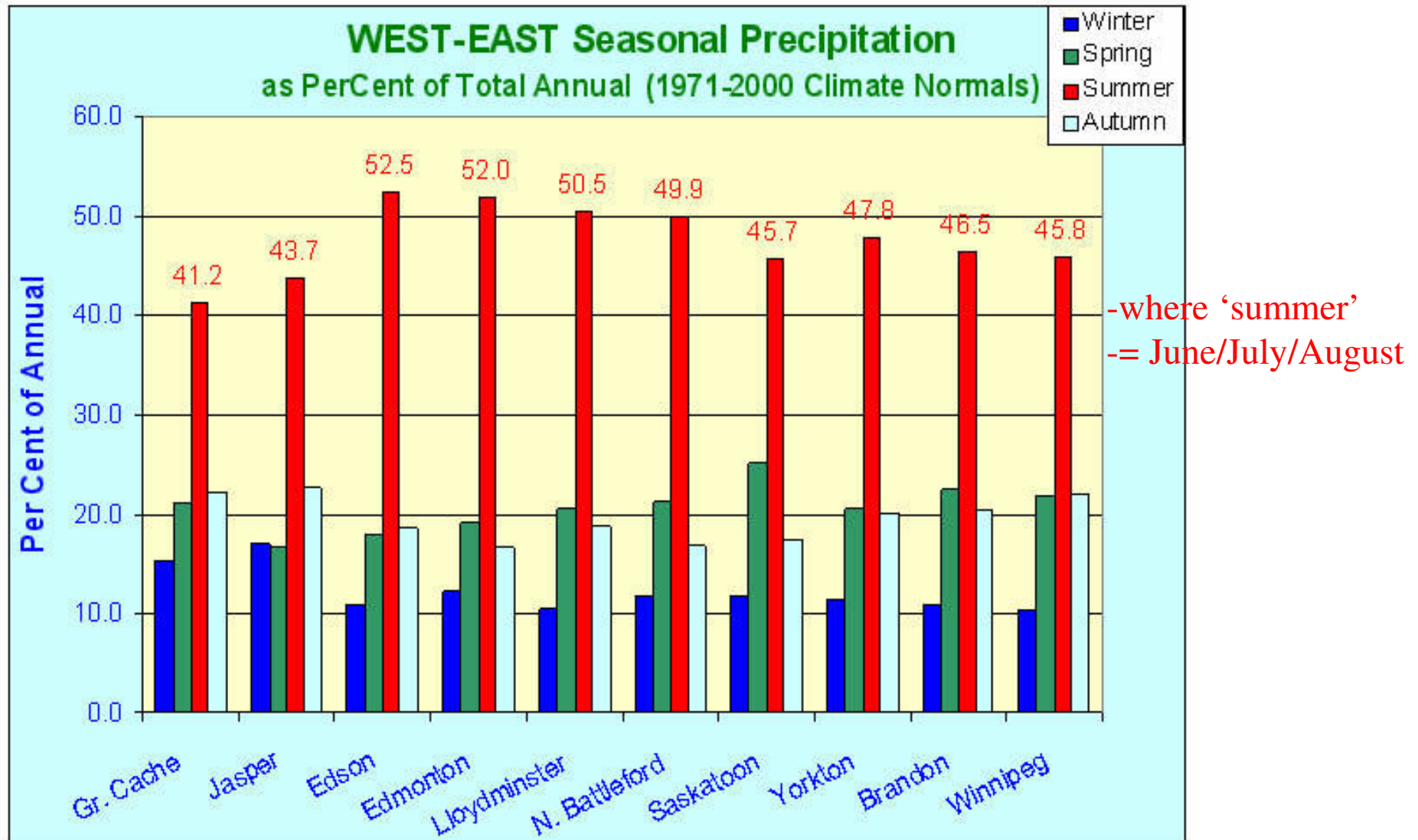
Severe thunderstorms
also occur near the
initiation and the
cessation of summer
drought periods

Dry
all summer



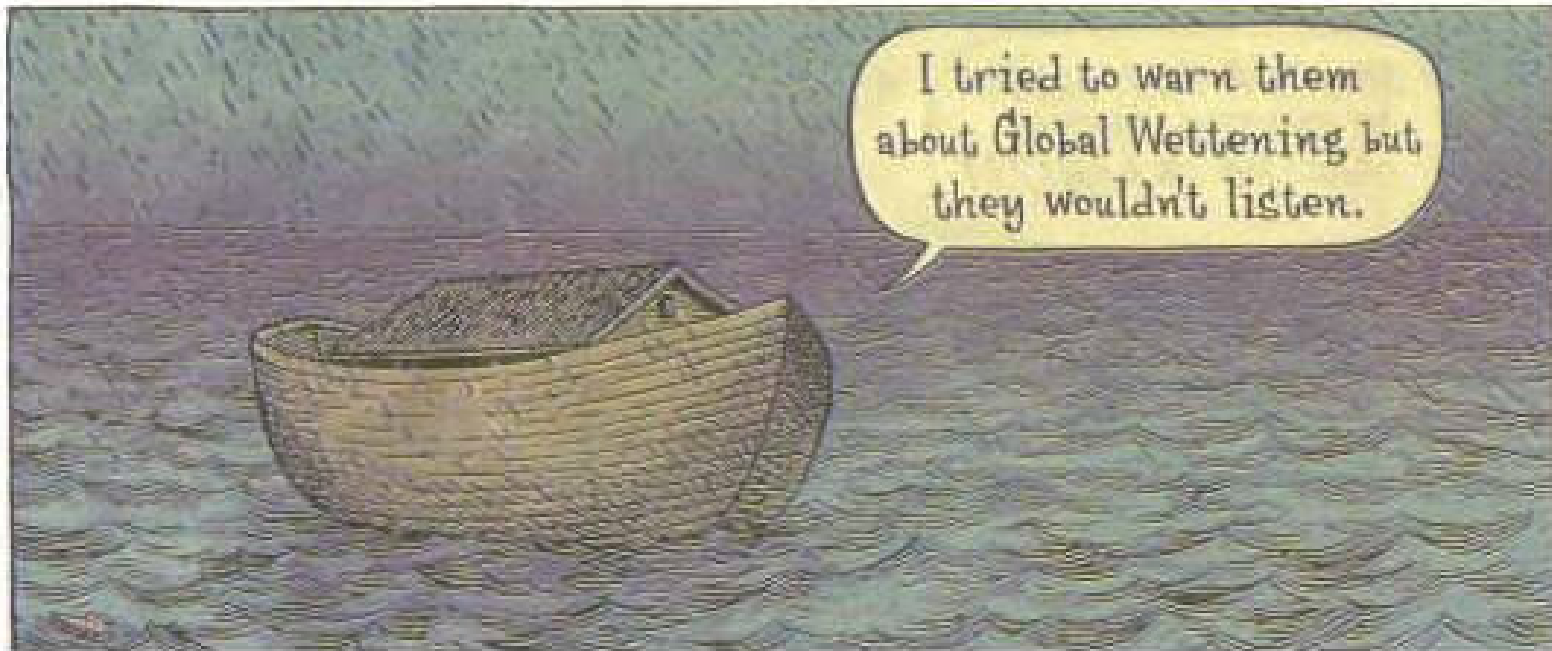
hence the title of this study,
Thunderstorm Drought

The Prairies are *extremely dependent* on **summer precipitation!**



One factor contributing to summer drought is when this summer precipitation ratio is disrupted significantly.

Climate Change Studies – much emphasis on temperature trends
– atmospheric moisture is relatively ignored



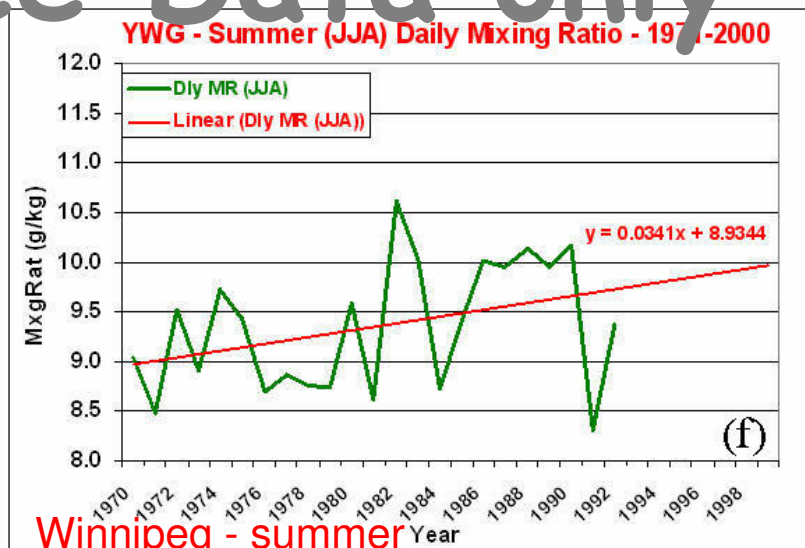
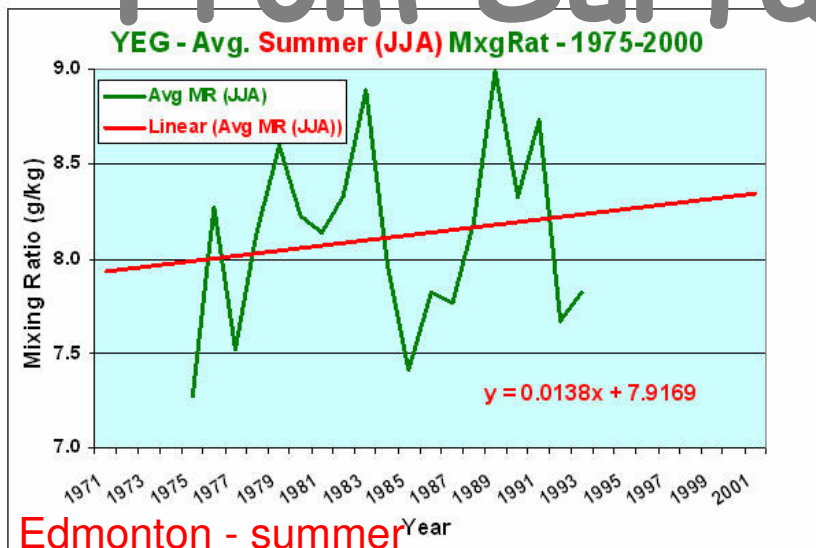
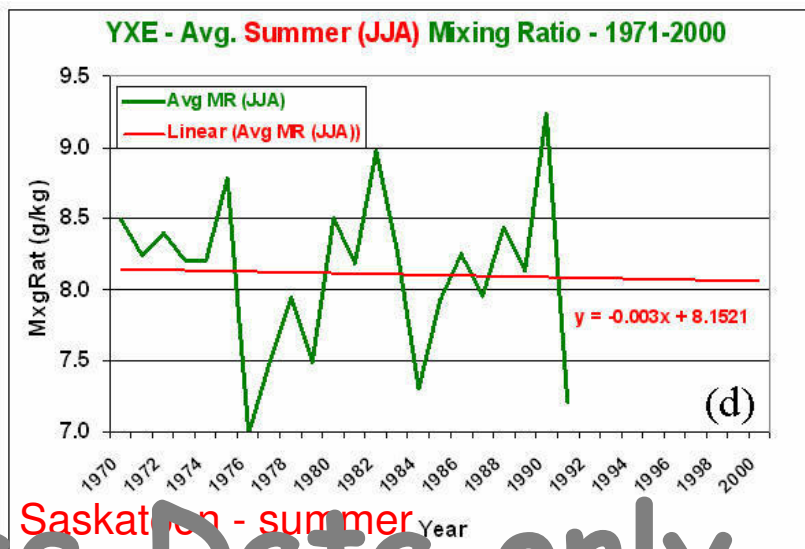
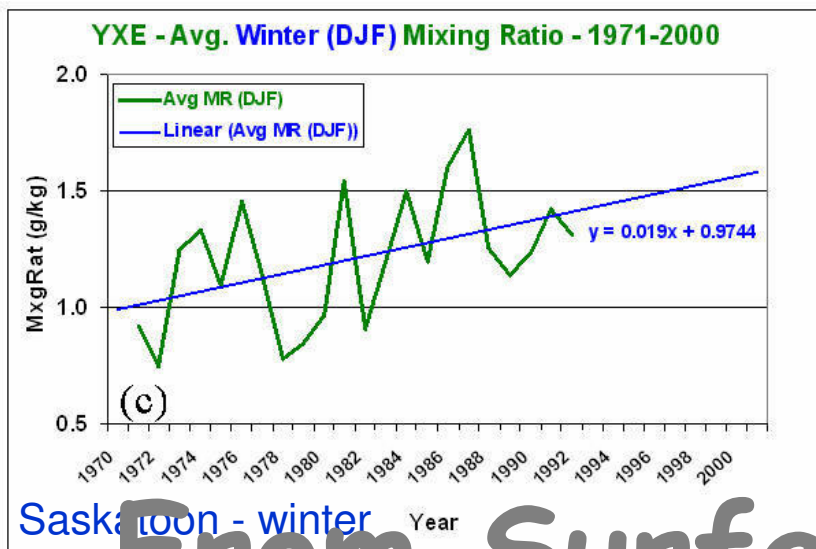
→ Short-term cycles & climate trends in *temperature* and *moisture*



Thunderstorm Energy source → from diurnal increases in *sensible* and *latent* heat

Drought → results from normal (or above) sensible heating (surface temperatures)
but a definite lack of latent heating (moisture)

Climate Trends in Atmospheric Moisture*



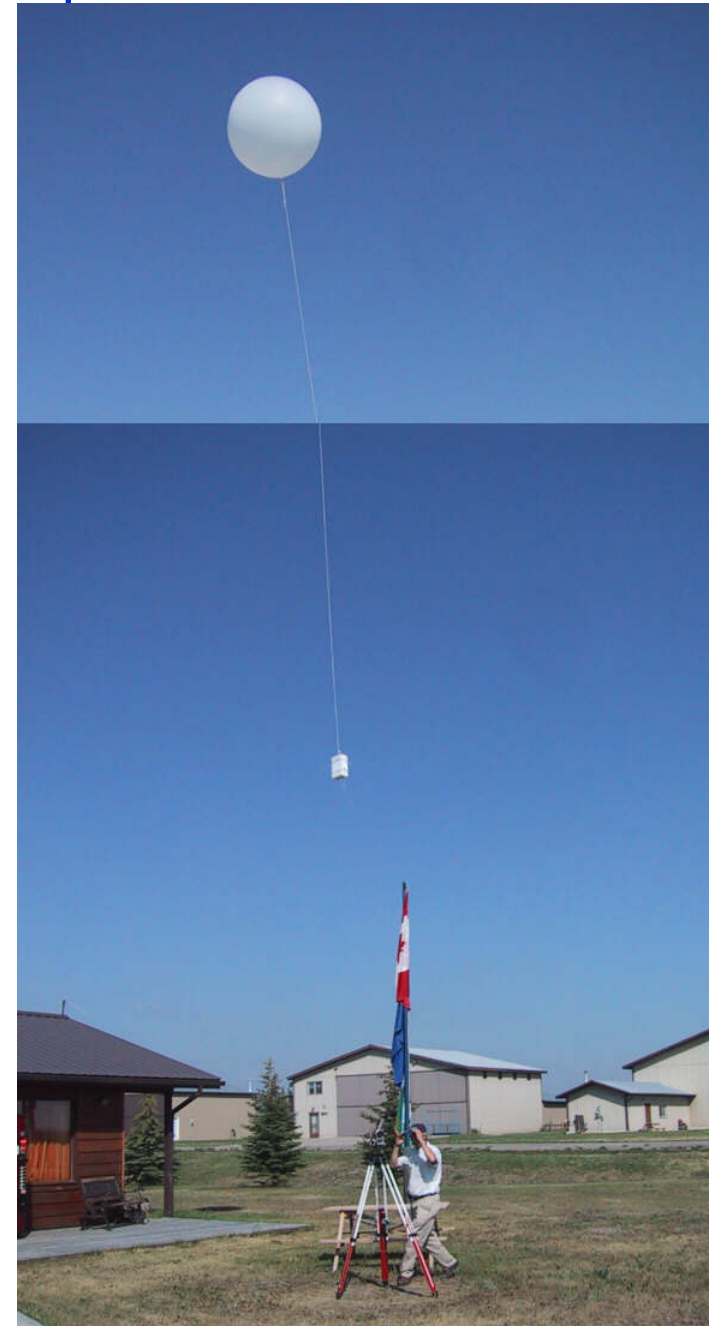
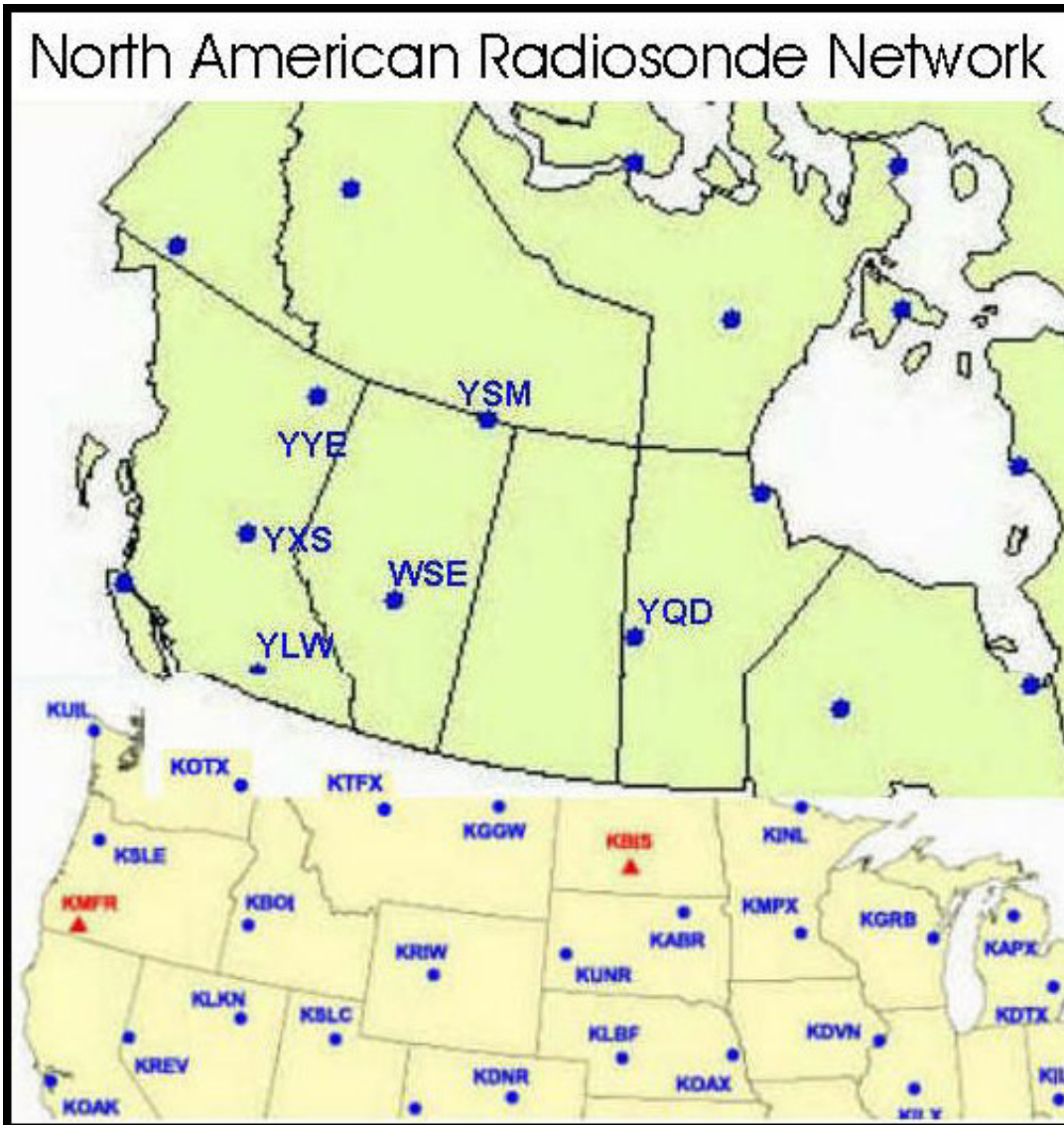
From Surface Data only

* Mixing Ratio = mass (g) of water vapour per kg of dry air

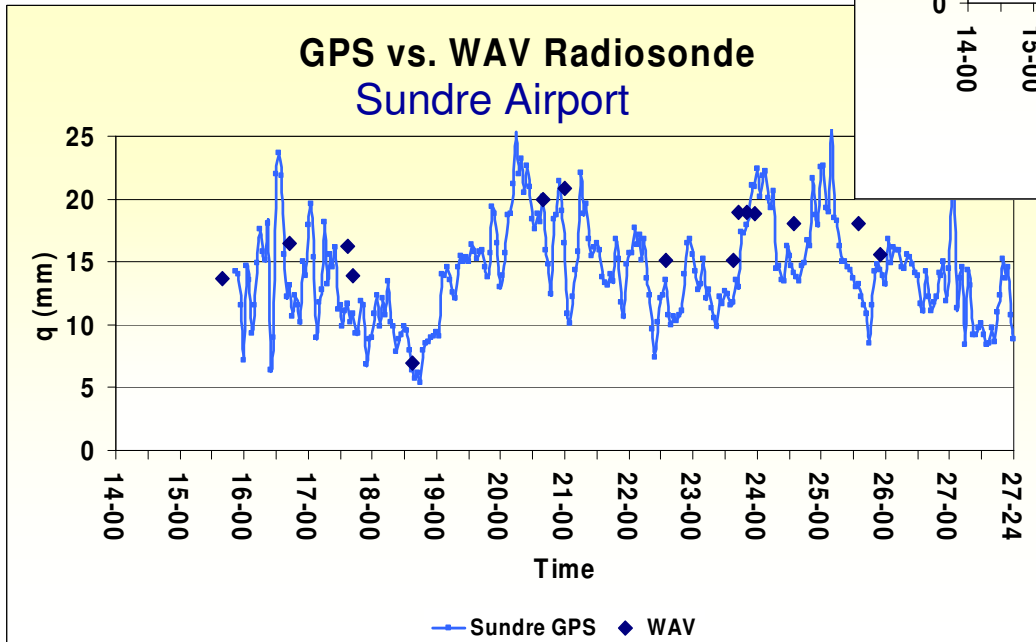
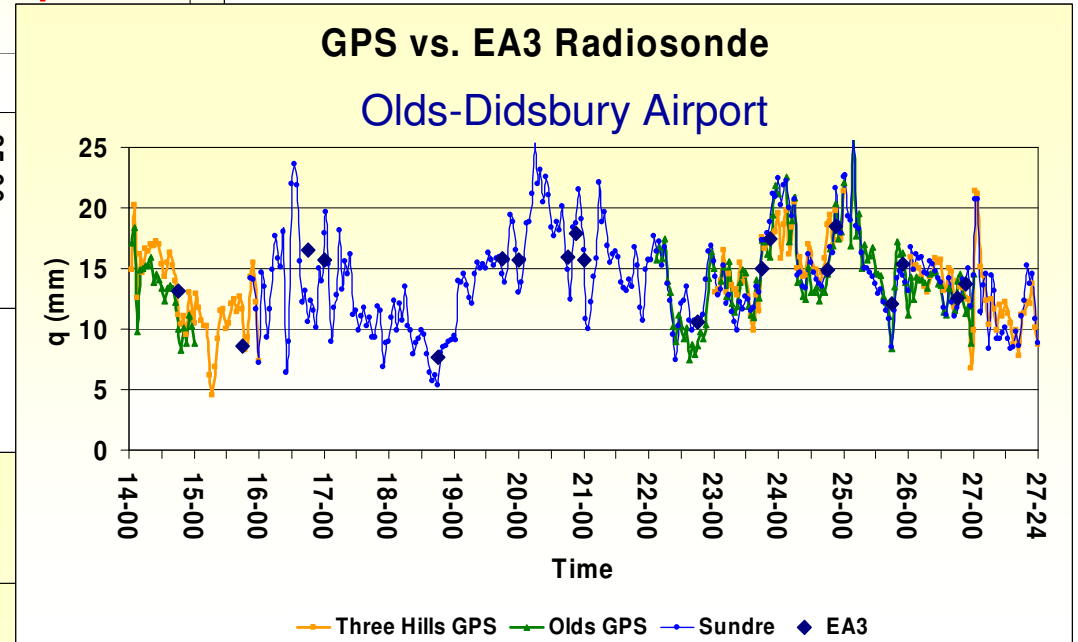
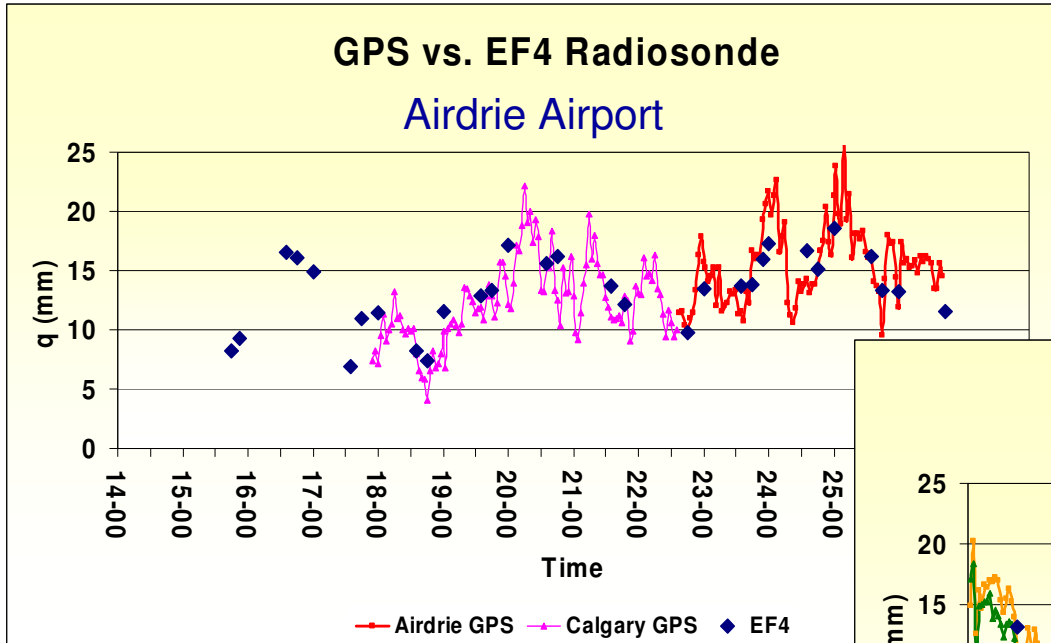
- from Strong (2005)

More important to look at the 'total' Atmospheric Moisture

From radiosondes we can derive
the *precipitable water**



GPS vs. Radiosonde Precipitable Water (mm) (A-GAME - July/2003)



- from Smith, Skone, & Strong (2003)



Environment Canada
Meteorological Service of Canada
Climate Research Branch

Environnement Canada
Service météorologique du Canada
Direction de la recherche climatologique

INITIAL QUESTIONS TO ADDRESS:

- 1) Given climate warming at the surface (since early 70s),
 - what evidence for *warming in the troposphere* (surface-10 km)?
 - tropospheric moisture changes?
 - effects on surface precipitation patterns?
- 4) What tropospheric changes are observable for the *drought period*, 1999-2004?
- 5) Quantify causative trends in convective weather activity, particularly with respect to initiation and cessation of drought?
- 6) Effects on the prairie water budget (atmospheric moisture/surface water)?

DATA REQUIREMENTS:

- 1) Surface temperature, humidity, and precipitation for 1971-2005 (or later)
- 2) Radiosonde data (P/T/RH) for Edmonton, The Pas (& adjacent sites) for at least 1980-2005.
- 3) Available GPS PW data from UofC Geomatics Engineering Department (2003-??)
- 4) Archived CMC Run-0 model-assimilated data (prairies) for 1998-2005.
- 5) Convective weather information (radar, satellite, lightning, ground observations)

Applications to DRI Goals:

- 1) Quantify changes in *tropospheric temperatures & moisture* over last 35 years, and during the *focus drought period*, 1999-2004,
- 2) How do these changes affect *precipitation patterns*?
- 3) Can we detect causative trends in convective weather activity from this, particularly with respect to the initiation and cessation of drought?
- 4) Continued collaboration with Skone/Smith on GPS 'PW':
 - to quantify diurnal changes in evapotranspiration
 - as a means to detect early onset and cessation of seasonal drought.
- 5) Collaboration with Hanesiak/Szeto/Stewart/Snelgrove on *closing* the prairie water budget.

END ... of the beginning