Atmospheric Moisture and Thunderstorm Drought

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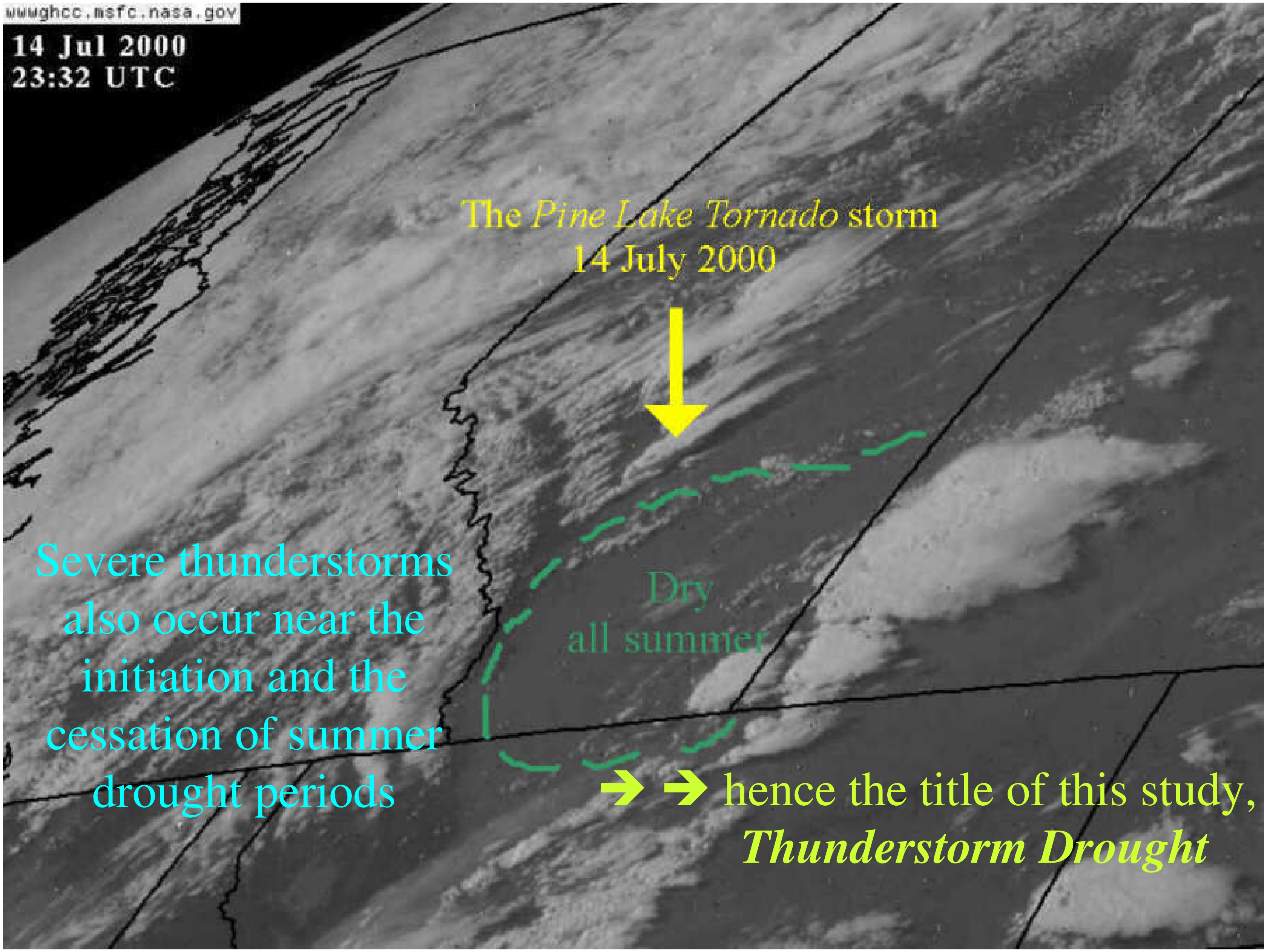
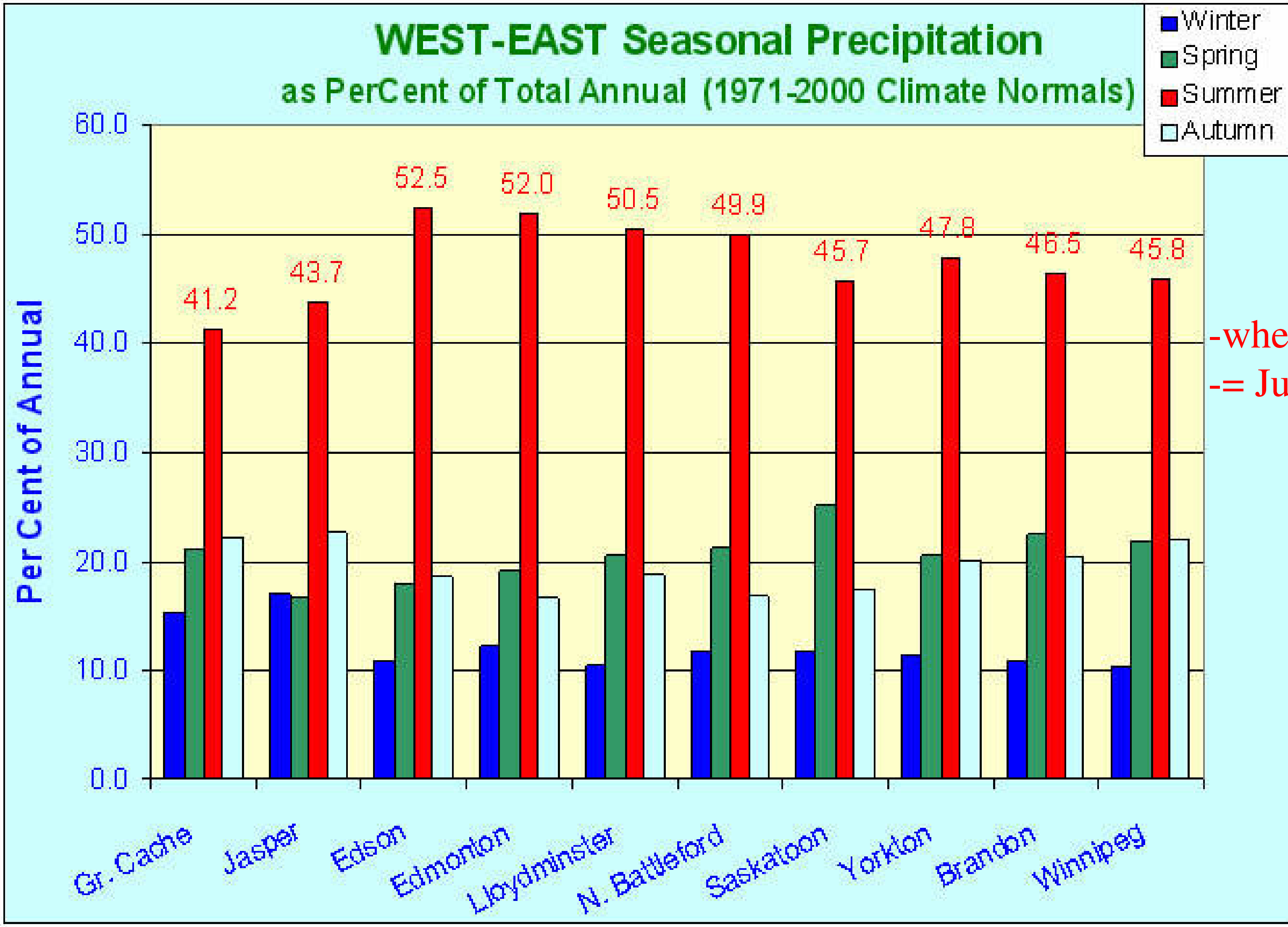
Severe thunderstorm northwest of Swift Current, SK, July 1994

Severe thunderstorms *<u>do</u>* still occur during droughts!

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


wwwghcc.msfc.nasa.gov
14 Jul 2000
23:32 UTC
The *Pine Lake Tornado* storm
14 July 2000
Dry
all summer
Severe thunderstorms also occur near the initiation and the cessation of summer drought periods
➔ ➔ hence the title of this study,
Thunderstorm Drought

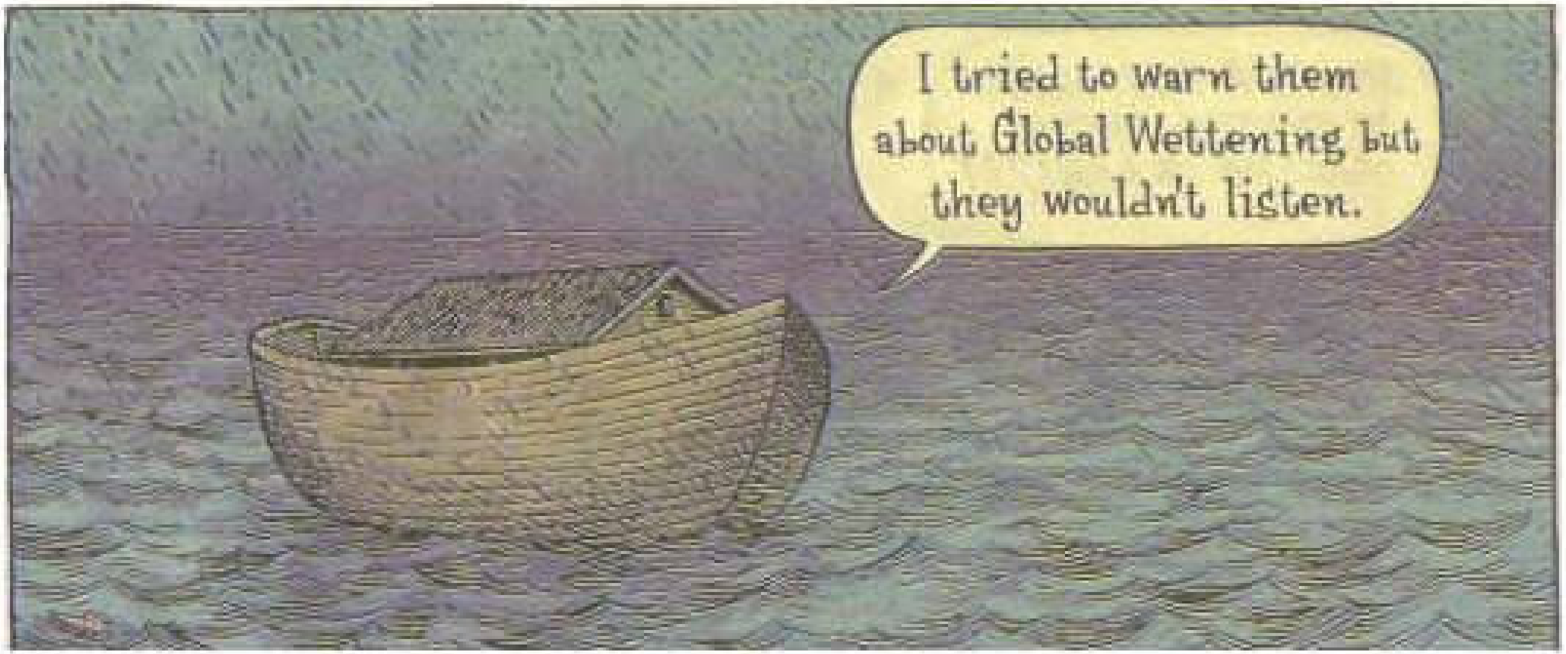
The Prairies are *extremely dependent* on **summer precipitation**!



-where 'summer'
-= June/July/August

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



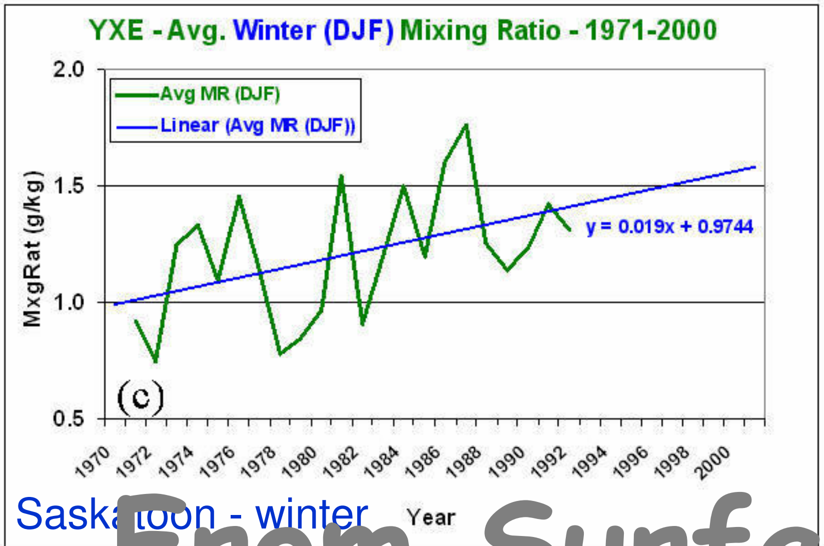
➔ Short-term cycles & climate trends in *temperature* **and** *moisture*

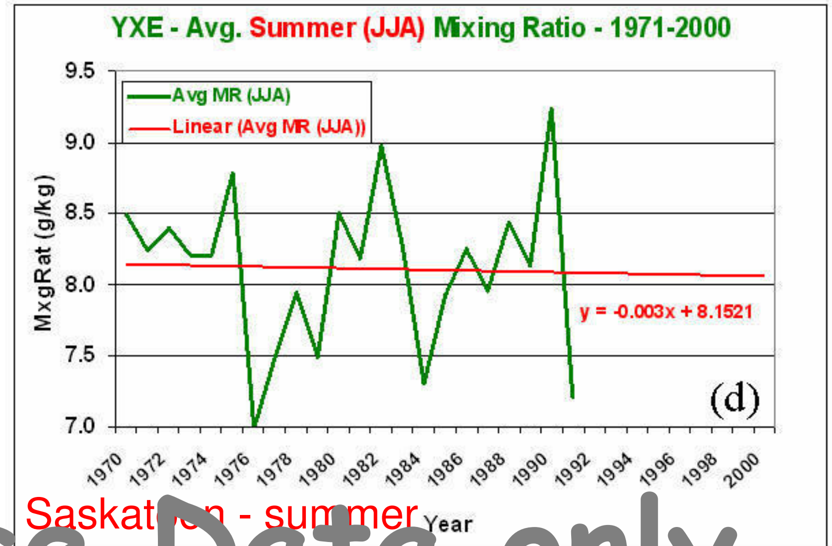
↕ ↕

Thunderstorm Energy source ➔ from diurnal increases in sensible and latent heat

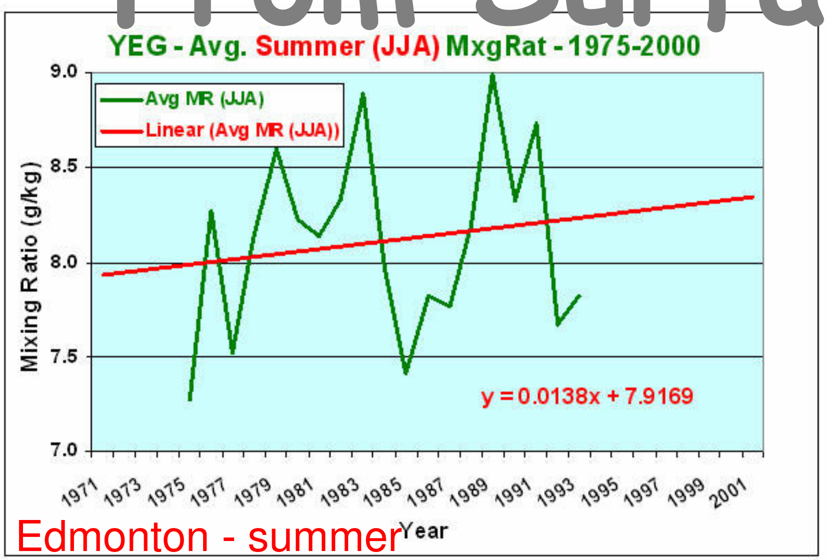
Drought ➔ results from normal (or above) sensible heating (surface temperatures) but a definite lack of latent heating (moisture)

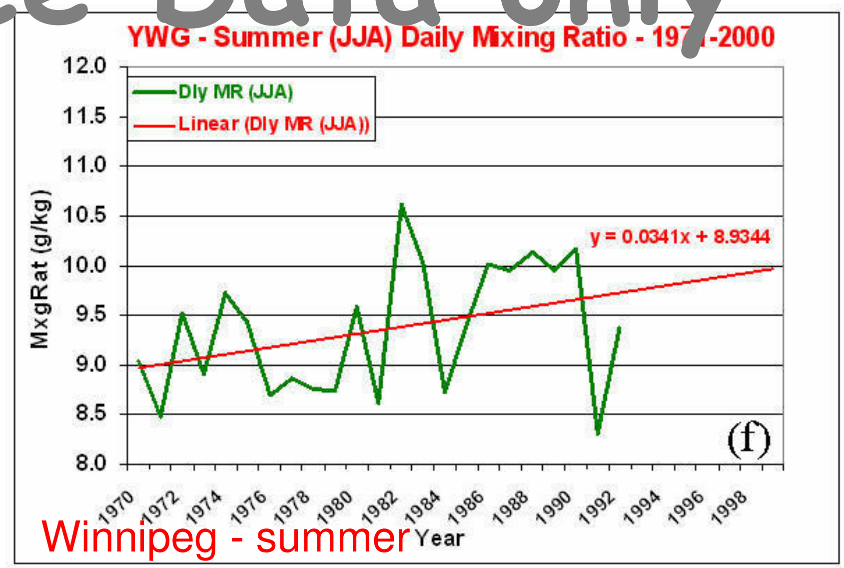
Climate Trends in Atmospheric Moisture*





From Surface Data only



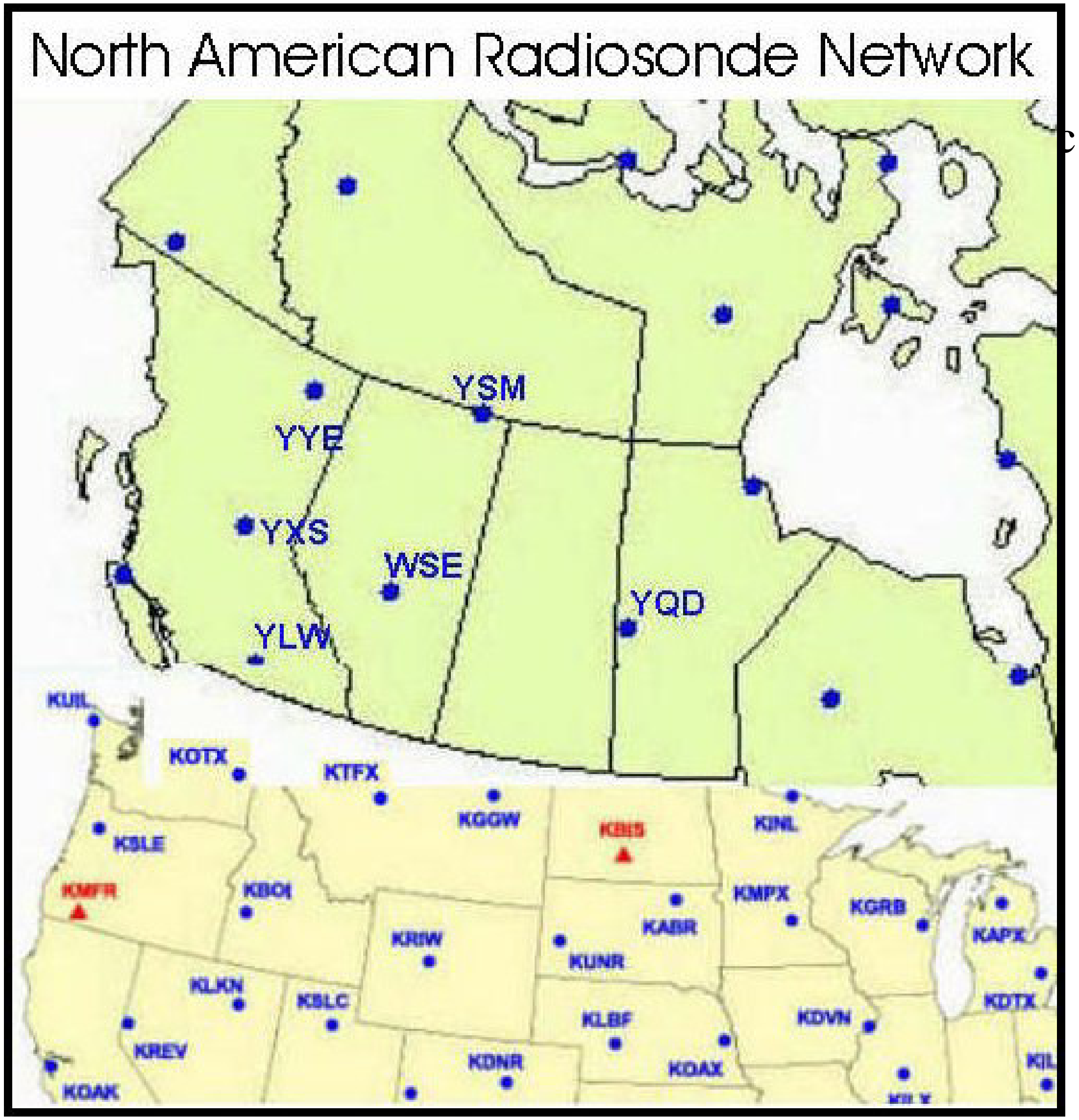


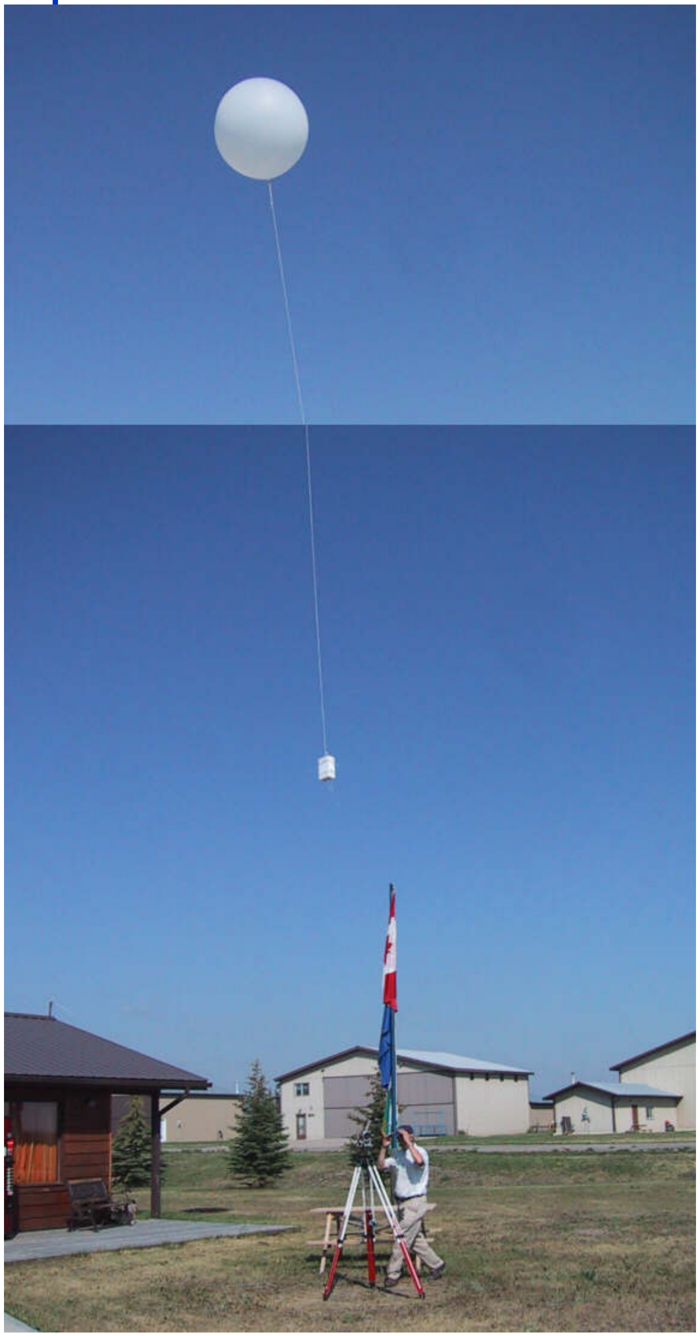
* Mixing Ratio = mass (g) of water vapour per kg of dry air

- from Strong (2005)

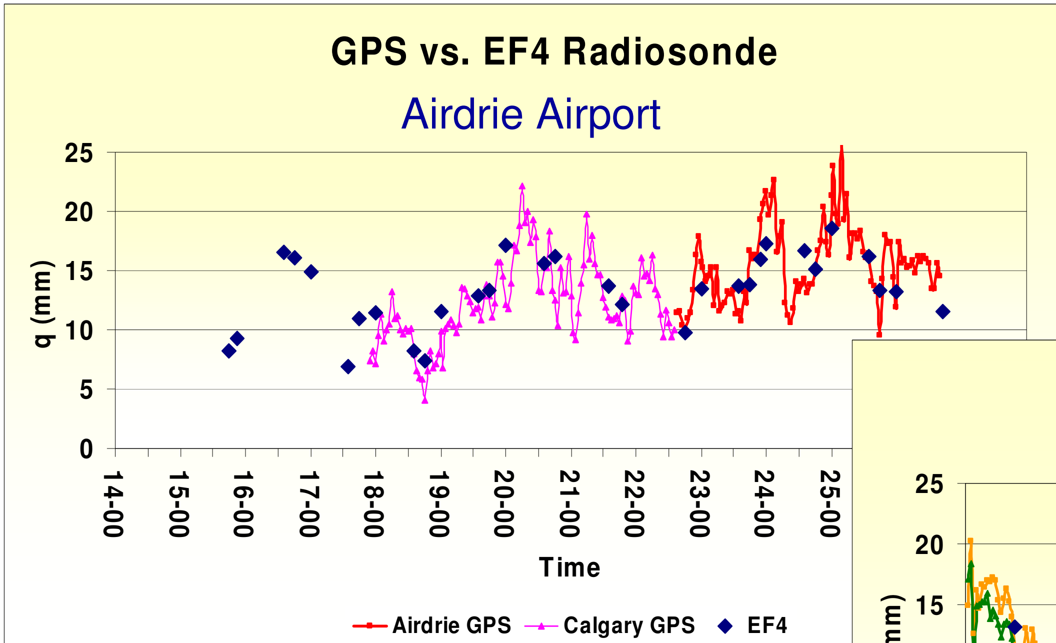
More important to look at the ‘total’ Atmospheric Moisture

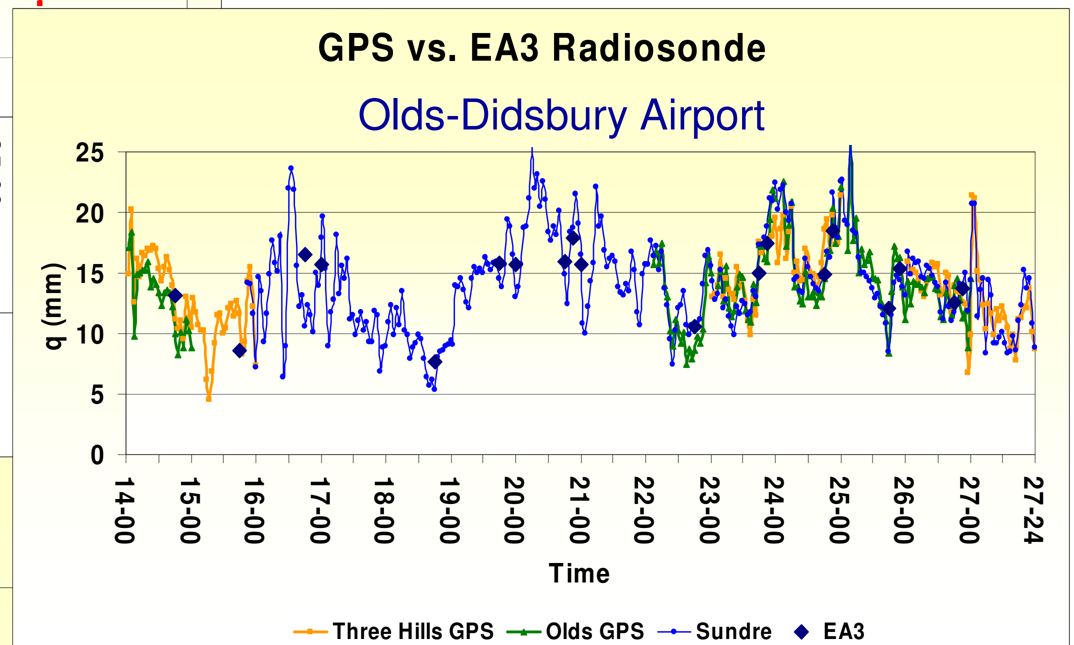
From radiosondes we can derive
the ***precipitable water****

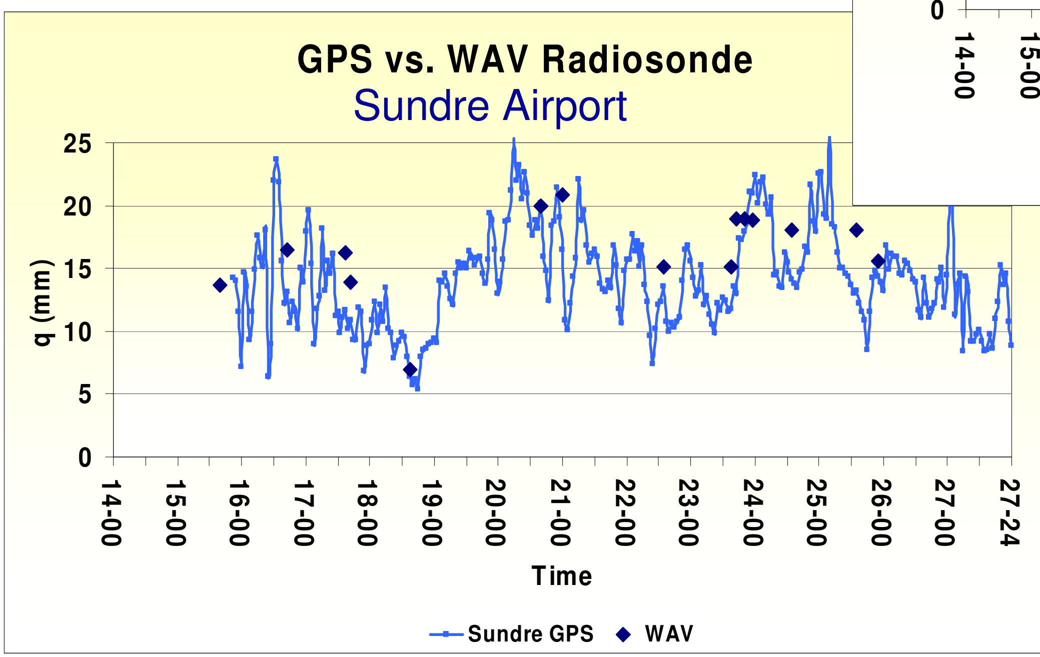




GPS vs. Radiosonde Precipitable Water (mm) (A-GAME - July/2003)







- 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