

Land Surface (*Moisture Flux*) Feedbacks on Drought and on Thunderstorms

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Tornadic storm WSW from H16 N Ardrossan at 18:11 MDT, 21 Aug. 2009 (Photo:GStrong)

Remains of storm W from Wye Rd S Ardrossan @ 19:13 MDT, 21 Aug. 2009 (Photo: GStrong)



Canadian Foundation for Climate
and Atmospheric Sciences (CFCAS)
Fondation canadienne pour les sciences
du climat et de l'atmosphère (FCSCA)



12:00, 21 June, 2008

Seasonal stream 8 km ENE Ardrossan



15:25, 31 July 2008

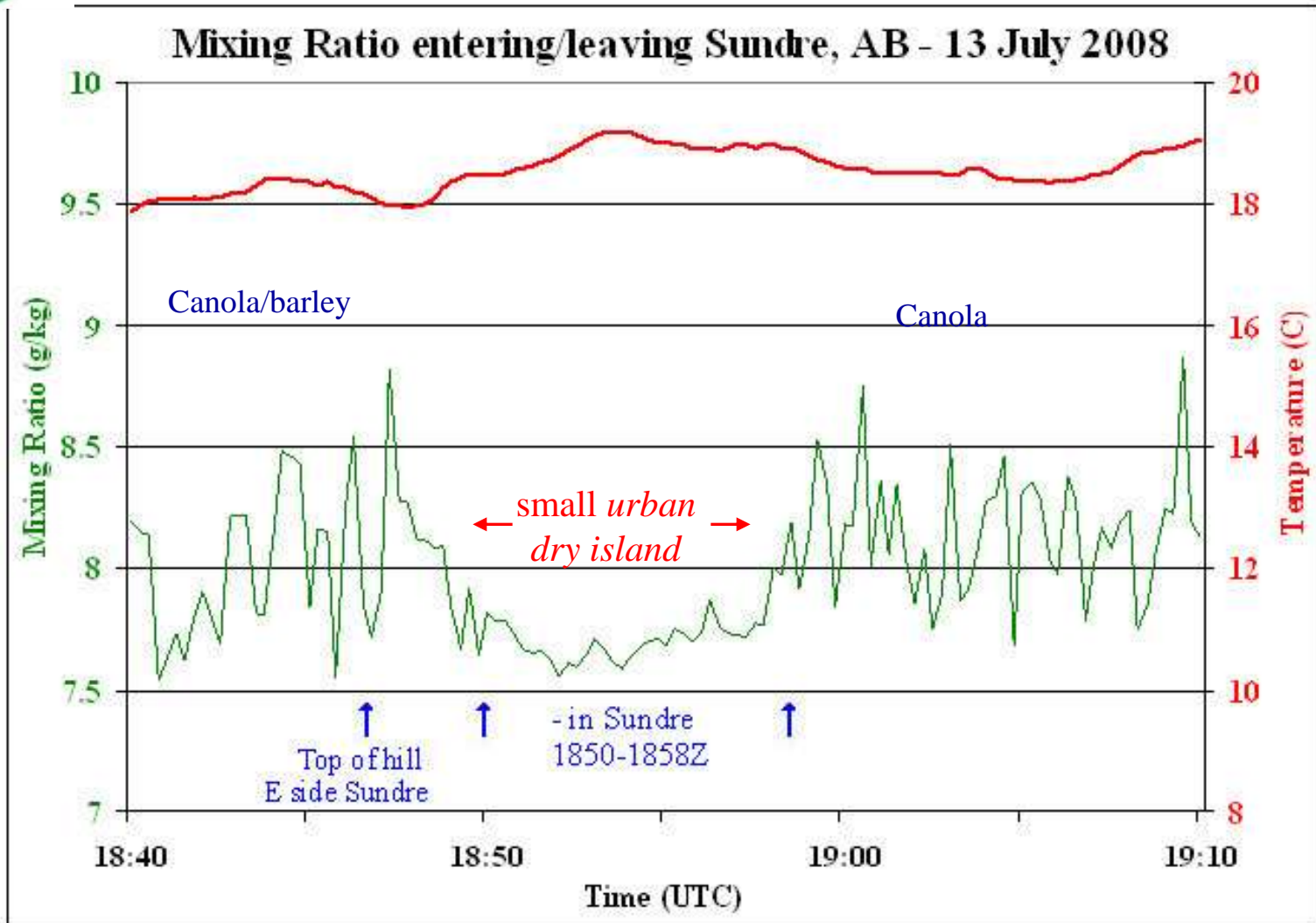
Humidity Variable:

Definition: Mixing Ratio is the ratio of the mass of water vapour (g) to the mass of dry air (kg) at a given pressure
– an expression of the *absolute humidity*.

Advantage of using *mixing ratio* over other moisture variables:
=> *conservative w.r.t. elevation changes.*



Transect E-W through Sundre (pop. 2,500) 13 July 2008



2009 Edmonton Mobile Transects

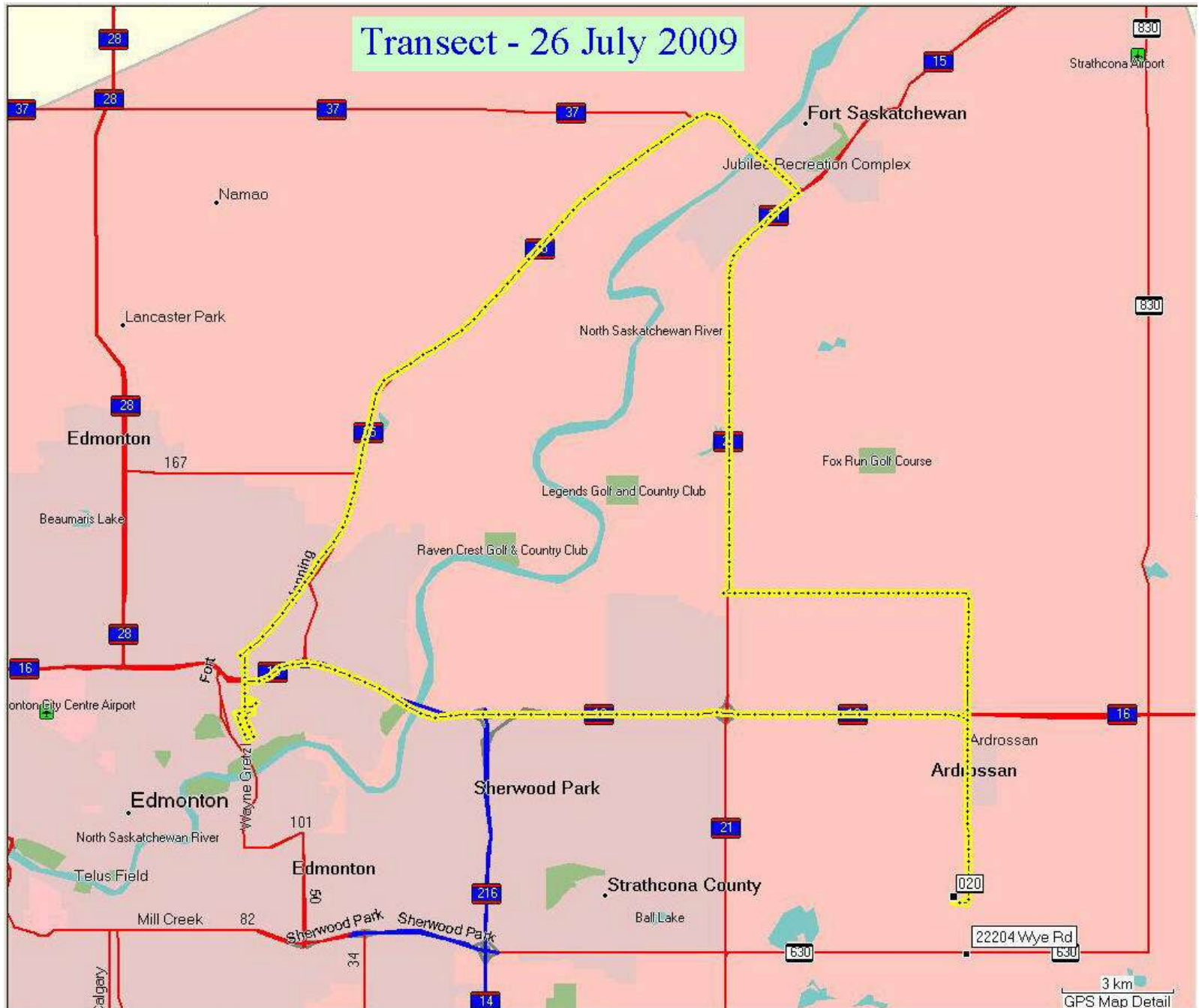
Objectives:

1. Quantify urban dry (heat) island across Edmonton (pop. 780,000) using mobile transects
 - carried out 22 transect days (more than double that no. of transects)
2. Quantify a) horiz. moisture gradient from crop - road during transects and possibly collect some b) vertical moisture profiles over a crop.
 - quantified horizontal gradient at least a dozen times
 - obtained 4 sample vertical moisture profiles (to 3 m) over canola crops

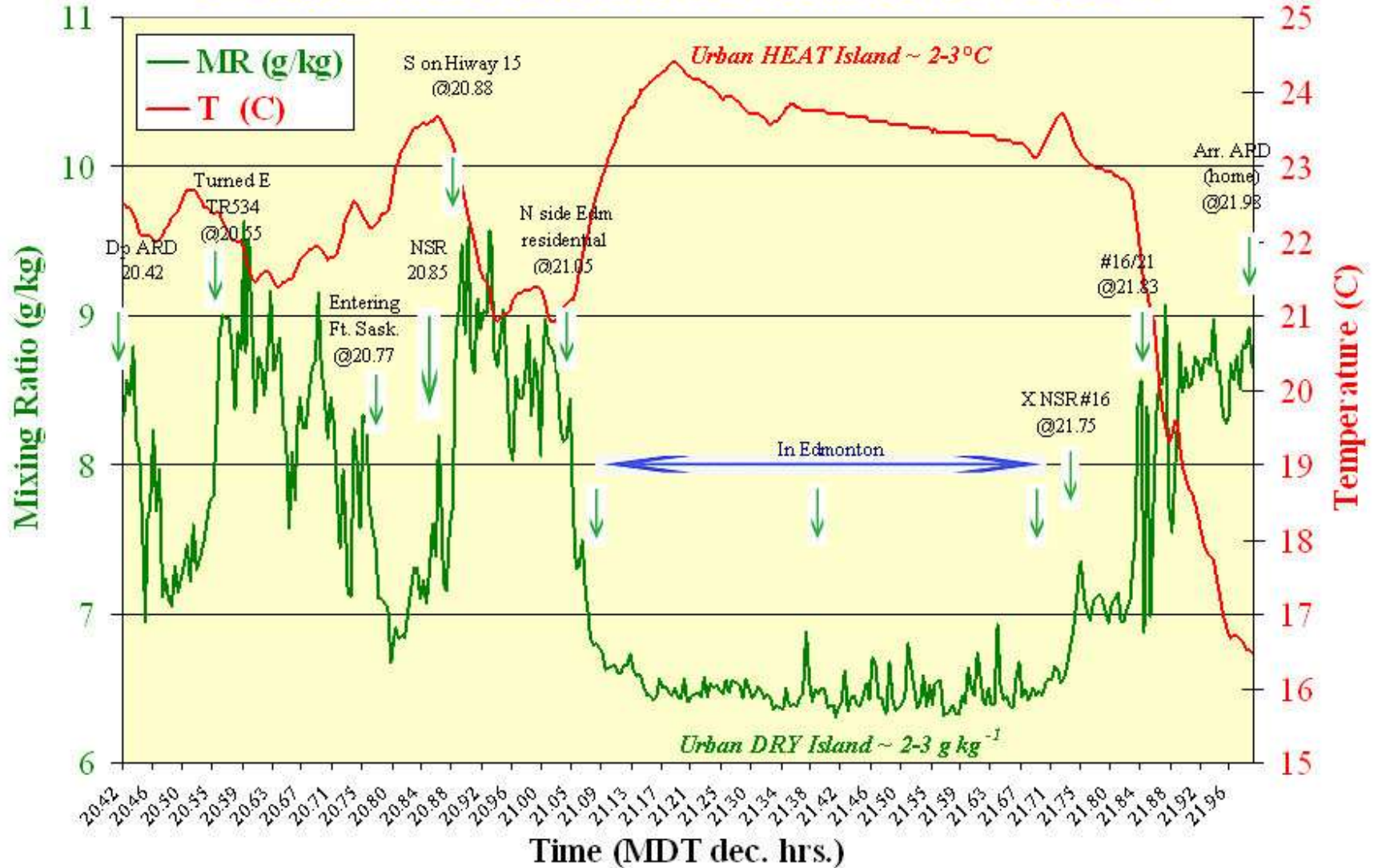
In parallel:

3. Fixed horizontal Transects and vertical Profiles (to 6 m) across pasture/barley at Kenaston SK
4. Monitor local drought conditions (photos) in Strathcona County
5. Carried out photo/data drought survey, Edmonton to Saskatoon
 - http://www.drinetwork.ca/current_drought.php

Transect - 26 July 2009



T/MxgRat Ard-FtSk-Edm-Ard Transect, 26 July 2009



Q1: What effect might this dry island have on thunderstorms approaching from west?

Q2: What longer-term impact might this play in terms of drought initiation and maintenance?

North American Drought Monitor

June 30, 2009

Released: Monday July 20, 2009



<http://www.ncdc.noaa.gov/nadm.html>

Analysts:


Canada - Trevor Hadwen
Dwayne Chobanik
Richard Rieger
Mexico - Valentina Davydova
Adelina Encarnación
Elvia Delgado
Reynaldo Pascual
Fernando Romero
U.S.A. - Brian Fuchs*
Rich Tinker

(* Responsible for collecting analysts' input & assembling the NA-DM map)

Intensity:

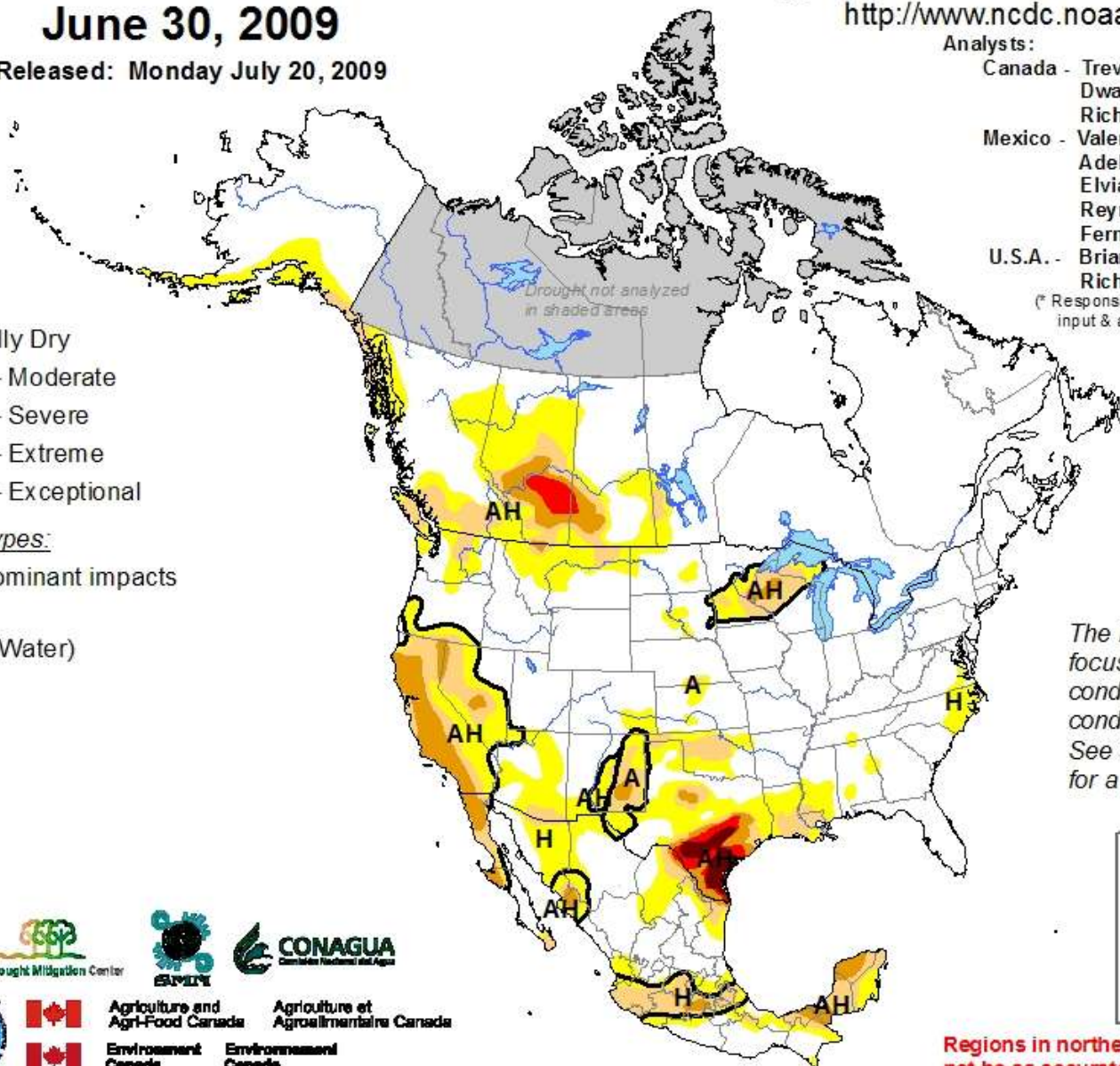
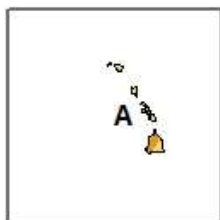
-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

Drought Impact Types:

 Delineates dominant impacts

A = Agriculture

H = Hydrological (Water)

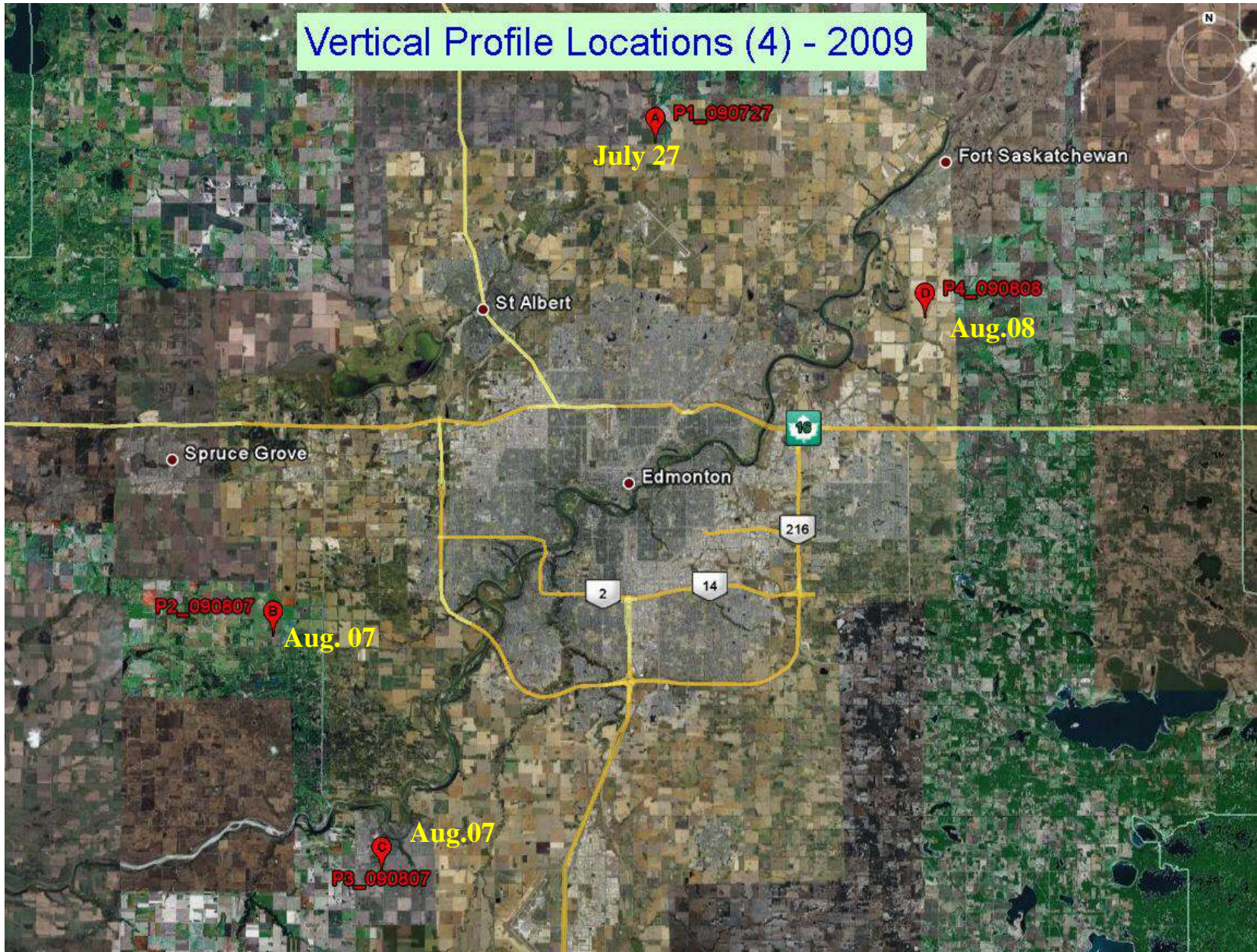


The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text for a general summary.



Regions in northern Canada may not be as accurate as other regions due to limited information.

2009 Edmonton Vertical Profiles



Spot Profile 'P4' (S of Ft. Sask.)

12:05 MDT, 08 Aug. 2009

Wind Sock



12:19 MDT, 08 Aug. 2009

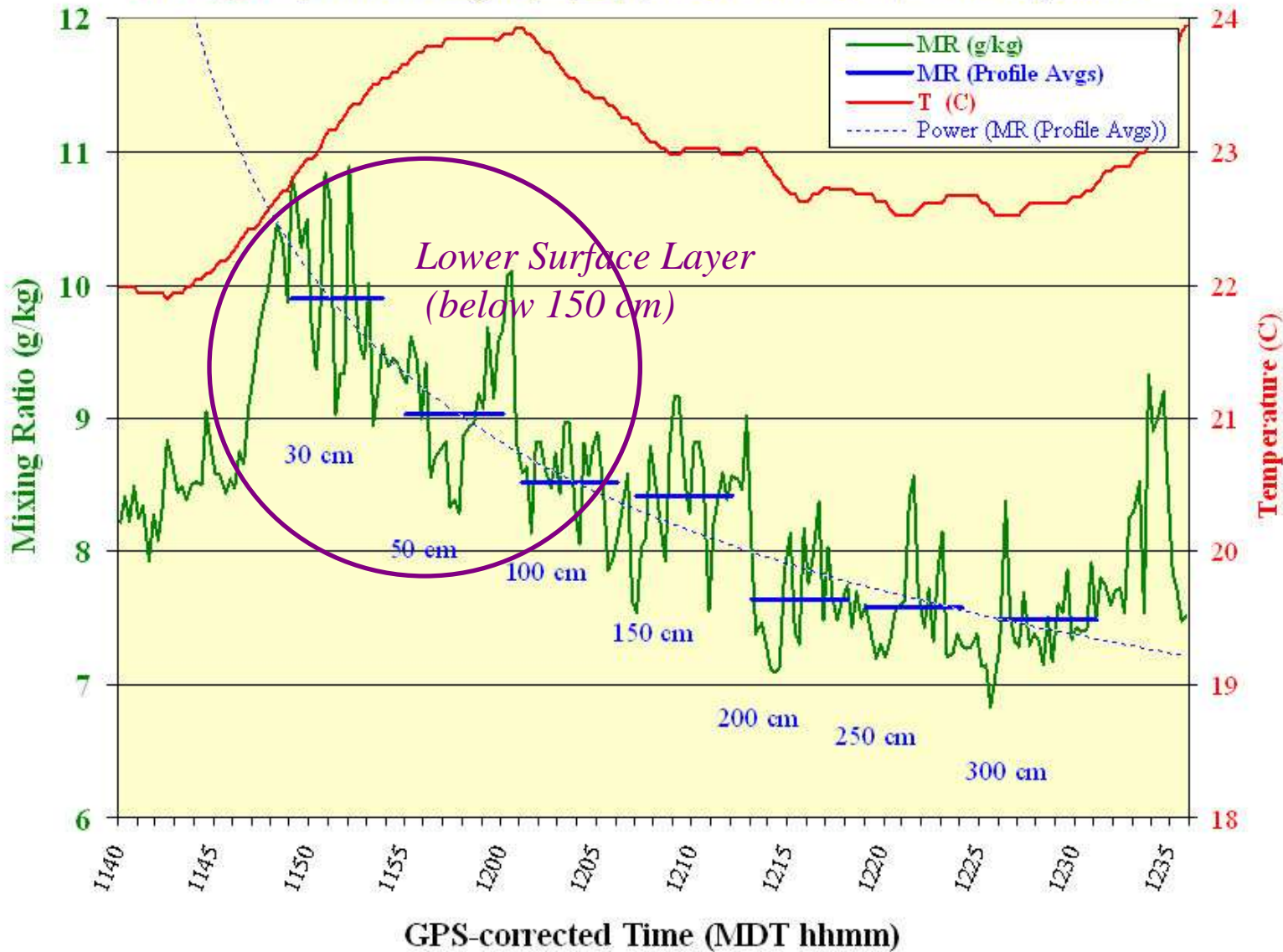


12:06 MDT, 08 Aug. 2009



Note: Due to low precipitation and lack of soil moisture, crops were 2-3 weeks behind.

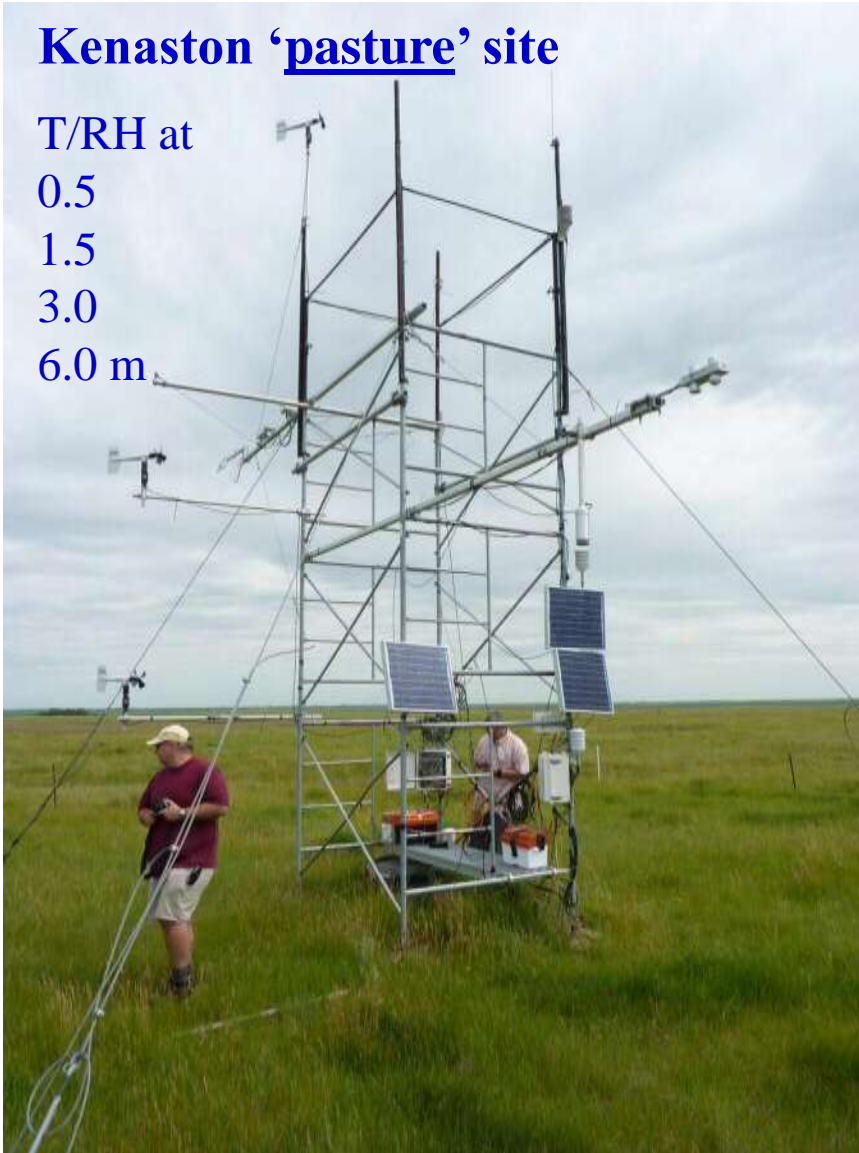
T/MxgRat *Canola Profile* - **P4** (53.628N 113.232W) - **08 Aug. 2009**



2009 Kenaston SK fixed Profiles (~ 1 km baseline)

Kenaston 'pasture' site

T/RH at
0.5
1.5
3.0
6.0 m



Kenaston 'barley' site

P/T/RH at
0.5
1.5
3.0 m



Kenaston 'transition' site

T/RH at
1.5 m



In addition: Pressure, Wind (3 levels), radiation, eddy correlation, precipitation, and soil moisture

CONCLUSIONS

Horizontal Profiles (Transects – applies to agricultural districts):

1. Small Towns (<5,000 pop.) – urban *heat island* ~ +0.1 C, *dry island* is -0.4 g kg⁻¹
2. Small Cities (5-15,000) – *heat island* ~ +0.2 C, *dry island*, -0.6 g kg⁻¹
3. Larger Cities (>500,000) – *heat island* +1-3 C, *dry island*, -2 to -3 g kg⁻¹
4. These results are valid for afternoon situations following mixing, which suggests that the results (dry island) may apply for the well-mixed ABL.
If so, these factors might:
 - => a) dramatically affect thunderstorms approaching the city from west (Example 21 Aug.)
 - b) contribute to initiation/maintenance of drought region downstream (curr. drought?)Requires low-level soundings (16Z/20Z over/downstream of Edmonton (+ WSE)).

Vertical Profiles:

5. Inner *surface layer* over crops (lowest 1-2 m) caused by crop ET that enhances convective cloud potential significantly, providing an additional 2-4 g kg⁻¹ mixing ratio (through daily ET) above the background ABL moisture.
6. Most of the diurnal increase (ET) occurs during late-morning (14-1600 UTC), which coincides with severe storm ABL changes observed during LIMEX-85.

DROUGHT Impacts (east/south of Edmonton)



Google-Earth view of *Twin Island Lake*
~ 5 km due south from where I live



Photo of Twin Island Lake, 22 Aug. 2009

The End - Thank you!

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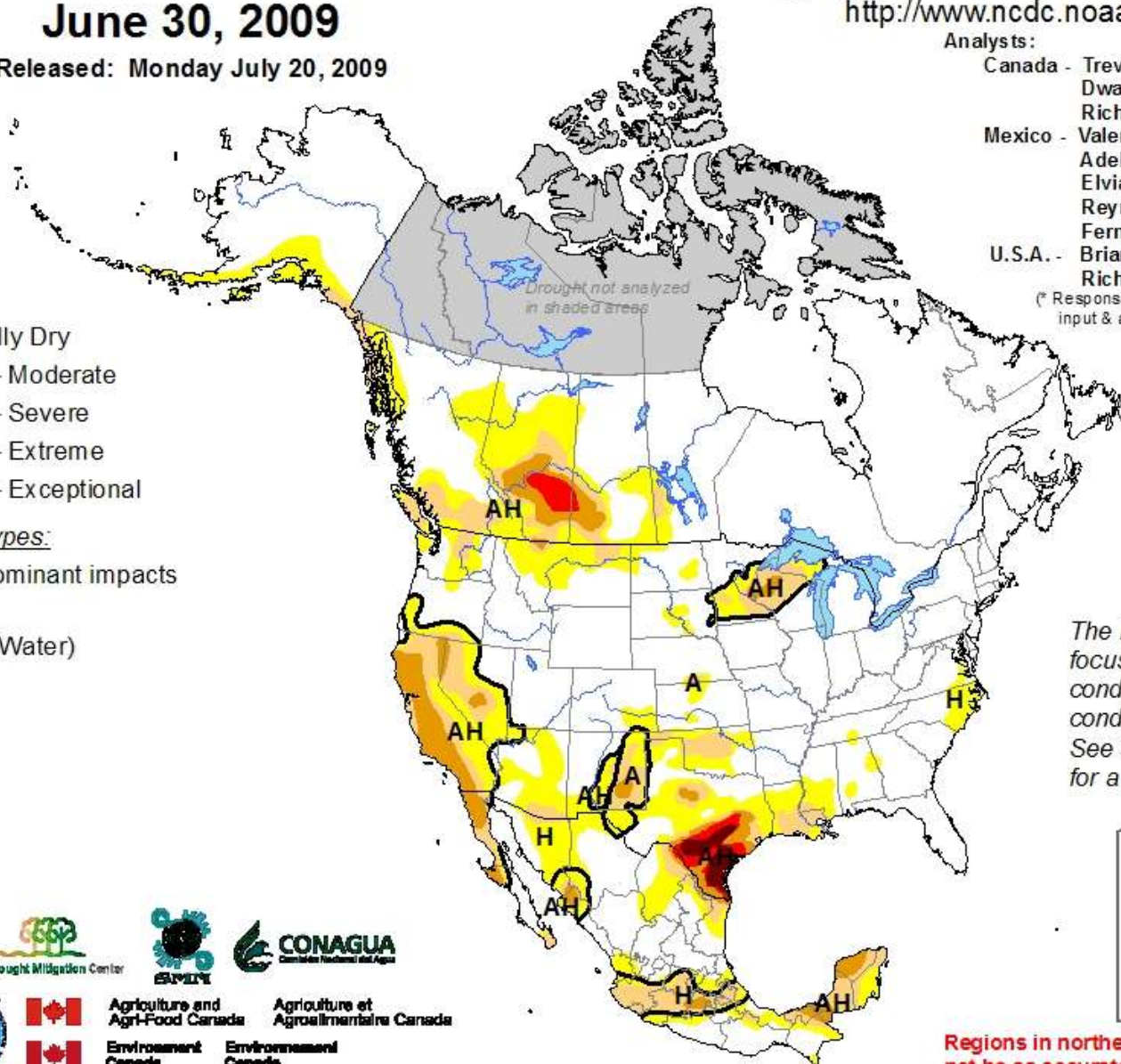
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