JP3J.16 DRYLINE CONVERGENCE AND THE INITIATION OF DEEP MOIST CONVECTION

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1. INTRODUCTION

One of the biggest issues facing forecasters every spring in the southern Plains is whether or not a present dryline will initiate deep convection. Schaefer (1986) noted that in the months of April through June a dryline is present on roughly 45% of the days and that about 70% of the drylines are convectively active. Being able to accurately predict the initiation of deep moist convection is of utmost importance, as dryline convection is often associated with large hail and tornadoes, and the precipitation from the convection is of vast importance to the agricultural practices of the south Plains.

Drylines have long been known to be zones of enhanced surface convergence. The initiation of deep moist convection is associated with small amounts of convective inhibition (CIN), large values of convective available potential energy, and strong low-level convergence (Ziegler et al. 1997; Ziegler and Rasmussen 1998; Banacos and Schultz 2005). Strong boundary layer convergence creates sustained updrafts and a decrease in the amount of CIN present near the dryline (Ziegler et al. 1997).

This study seeks to quantify the relationship between CIN, surface convergence, and the initiation of deep moist convection. Horizontal convergence will be determined using the Texas Tech University West Texas Mesonet (WTM). The advantage of using the WTM is that the increased density of surface observations leads to more accurate placement of the dryline and a more precise calculation of the convergence (the decrease in the length scale used in computing the convergence with the WTM leads to the more precise calculation of horizontal convergence over synoptic observations). CIN for an environment was determined through the use of operational soundings.

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2. METHODOLOGY

Thirty dryline cases were selected by studying surface weather maps in the south Plains during the spring months of 2004 and 2005. For the chosen cases, fields of CIN and surface convergence were computed. To determine CIN, composite soundings were generated using the 1200 and 0000 UTC soundings from Amarillo and Midland, TX. These four soundings were interpolated linearly in both space and time in order to come up with vertical temperature and dewpoint profiles at desired times and locations. Once the composite sounding was created, the CIN for that sounding was calculated using WTM observations at the surface. Horizontal convergence along the dryline was calculated with observations from the WTM (Fig. 1).

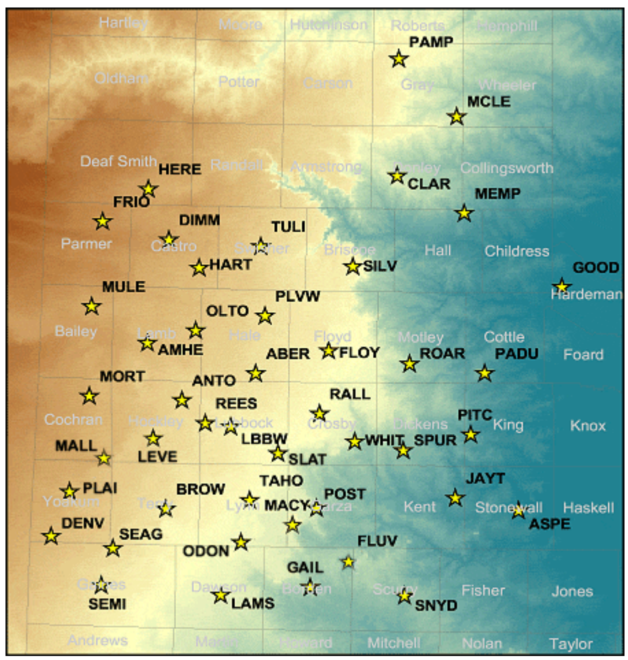

Figure 1. Map showing the locations of the 45 WTM Sites.

3. PRELIMINARY RESULTS (APRIL 20, 2005)

During the morning hours a rather diffuse moisture gradient advanced eastward from the eastern New Mexico plains towards the high plains of west Texas and the Caprock Escarpment (the sharp color gradient in Fig. 1).

By 2000 UTC the dryline had become stationary and the moisture gradient had sharpened. A narrow band of enhanced convergence was present along the dryline and a shallow field of cumulus clouds had developed from roughly Floydada, TX (FLOY) to Clarendon, TX (CLAR).

At 2100 UTC, visible satellite data (Fig. 2) reveal a large area of convection near Silverton, TX (SILV). Radar echoes are first noted at this time (Fig. 3). An analysis of the surface conditions 30 minutes prior to this time (2030 UTC) shows that the dryline was associated with a tight moisture gradient (Fig. 4) and enhanced convergence (Fig. 5) near the Caprock Escarpment. Closer examination of the convergence plot (Fig. 5) shows that the strongest horizontal convergence, and therefore the strongest ascending motion in the boundary layer, was near the location of deep convective initiation 30 minutes later. The storm produced two reported tornadoes in Hall County, Texas and numerous reports of large hail from Silverton, TX into southwest Oklahoma. No other deep convection developed in the WTM domain.

4. CONCLUSIONS AND FUTURE WORK

Observations from the WTM were used in this study to calculate the horizontal convergence along the dryline. On April 20, 2005 the maximum in calculated convergence matched up well with where deep moist convection initiated 30 minutes later. This case displays the usefulness of horizontal convergence calculated with WTM data to help predict where convective initiation may occur along the dryline in west Texas.

Future work to be done for this study includes compiling all of the soundings needed for the individual dryline cases. CIN will be calculated and related to the convergence along the dryline to find a relationship between these variables and the initiation of deep moist convection. Results from this ongoing research will be presented at the conference.

ACKNOWLEDGEMENTS

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5. REFERENCES

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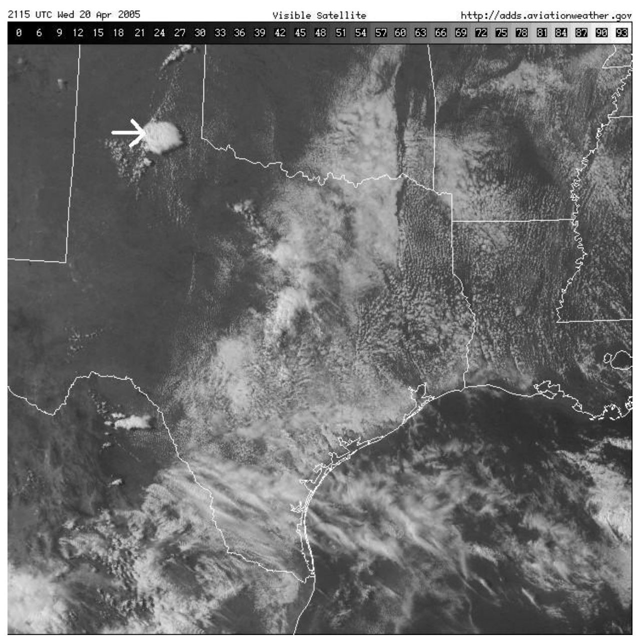

Figure 2. Visible satellite image valid at 2100 UTC. The white arrow points to where deep convection initiated along the dryline.

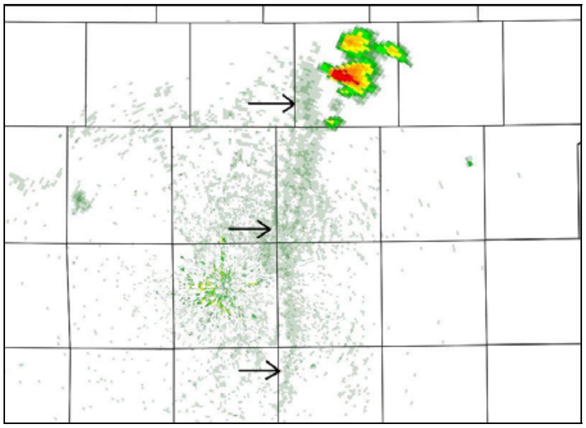

Figure 3. KLBB 0.5 degree base reflectivity valid at 2106 UTC. The black arrows point to the location of the dryline.

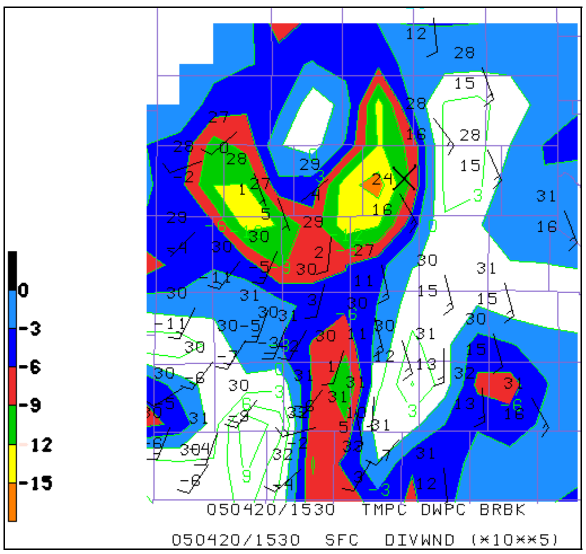

Figure 5. WTM surface observations and horizontal convergence (shaded, 10^{-5} s^{-1}) valid at 2030 UTC. Contours are at 3 x 10^{-5} intervals. The black "X" marks where convective initiation occurred.

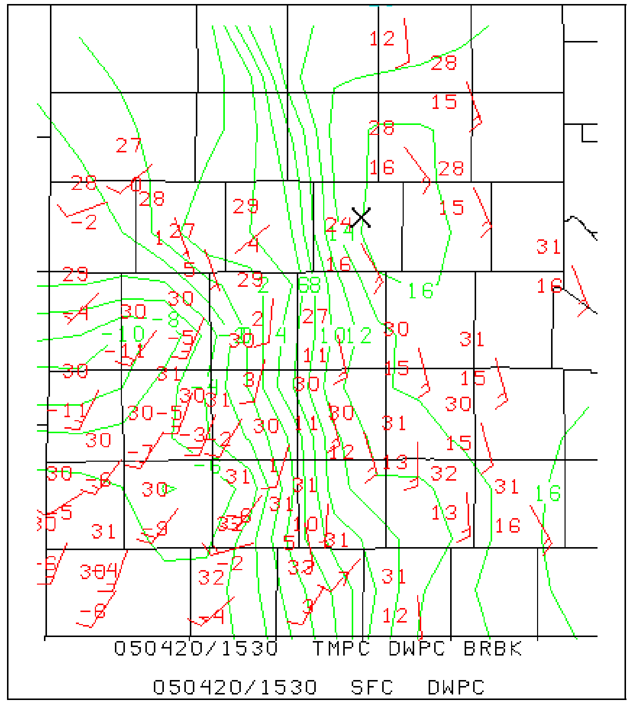

Figure 4. WTM surface observations and dewpoint analysis (green contours, 2^{o} C intervals) valid at 2030 UTC. The black "X" marks where convective initiation occurred.