Western Region Technical Attachment
No. 90-14
April 17, 1990

OPERATIONAL PROBLEMS ASSOCIATED WITH WEST TEXAS DRY MICROBURSTS

Tim Garner, WSO Amarillo, Texas

[Editor's Note: The following is a reproduction of a Southern Region Technical Attachment on some guidelines to forecasting dry microbursts. The focus is on west Texas, but the discussion really applies to all areas where dry microburst activity is possible. Since the convective season is almost upon us, we all need to start thinking about how we can improve our forecasts of these types of events.]

Technical Attachment

OPERATIONAL PROBLEMS ASSOCIATED WITH WEST TEXAS DRY MICROBURSTS

Tim Garner
WSO Amarillo, Texas

INTRODUCTION

The dry microburst is not an uncommon occurrence in the High Plains of West Texas. Documentation of the dry microburst occurring outside of Colorado is, however, an uncommon occurrence. Sohl (1987) is the only previous study of a dry microburst occurrence in West Texas known to this author. The microburst was defined by Fujita and Wakimoto (1983) as,

> Microburst: a strong downdraft which induces an outburst of damaging winds on or near the ground. The outflow is less than 4 km in size, with peak winds lasting only 2 to 5 min.

Furthermore, Wakimoto (1984) states that microbursts, "...may result in tornado-like damage up to F3 intensity at the surface." Wakimoto further defines the dry microburst as,

> Dry microburst: a microburst that is accompanied by less than 0.01" of rain between the onset and the end of the high winds, including calm periods, if any. This type of microburst is usually associated with virga.

The meteorological environment associated with the dry microburst is better understood than that which occurs with wet microbursts (Caracena et al.,1989). When the wind speeds associated with dry microbursts reach speeds associated with severe thunderstorms, the operational meteorologist is left somewhat in a quandary. This paper will use a case study of a West Texas dry microburst to highlight some forecast and warning techniques for public service. Sohl previously discussed the problems concerning issuance of terminal forecasts (FT's) when dry microbursts are forecast. The case of April 22, 1989 in the Texas Panhandle and South Plains of Texas will be used. Dry microbursts on this day had largely formed in association with shallow high-based cumulonimbi.

THE DRY MICROBURSTS OF APRIL 22, 1989

The April 22, 12Z and April 23, 00Z soundings from Amarillo are presented as Figures 1 and 2. Both soundings appear very similar to the Amarillo and Midland soundings taken before and after the dry microbursts of May 21, 1986 (see Sohl, Figures 1a, 1b, 4a, and 4b). Most forecasters would easily recognize Figures 1 and 2 as environments often associated with dry microbursts. The "classic" dry microburst soundings for the Denver, Colorado area look similar to these two Amarillo soundings.

The Amarillo soundings for this case show strong mid-level instability. One possible aid for forecasting mid-level instability is to use the 70s and 7qs charts from the Turbo UA upper air diagnostics program (Foster, 1988) in use at many NWS stations. 70s is a chart depicting the 700mb-500mb lapse rate. This chart can be used to find areas where a deep dry adiabatic lapse rate exists. 7qs depicts layer stability which Foster defined as "...the difference in the mean potential temperature between the 850-500 mb layer and the 700-300 mb layer." Foster goes on to say that values of layer stability near zero imply dry adiabatic atmospheres. Overlaying these two charts gives the forecaster an analysis of the synoptic scale areas in the middle troposphere favorable for dry microbursts.

One quick forecasting method was developed by Caracena, McCarthy, and Flueck (1983) for use in the eastern plains of Colorado. This "eight and eight" rule is quite simple. When the 500 mb dew point depression is less than 8°C and the 700 mb dew point depression is greater than 8°C, dry microbursts were observed 87% of the time during the Joint Airport Weather Studies Project (JAWS). Without an extensive observing network like JAWS, a verification rate of 87% in the field is unlikely.

Lastly, Wakimoto presents a method of obtaining an estimate of the peak wind of dry microbursts using the observed surface temperature and mixing ratio with the nearest sounding. His method is reproduced here as Figure 3. Wakimoto noted that peak horizontal winds observed with dry microbursts were usually near that of the downdraft speed computed from the nearest sounding (see Table 1 below).

This technique was applied to an estimated 21Z sounding for Amarillo and is illustrated here as Figure 4. The entire process is relatively easy to do in five to ten minutes and could be automated by computer. Plot the nearest sounding (preferably on a DOD WPC 9-16 skew-T log P chart). The dry microburst is assumed to travel moist adiabatically from cloud base until it intersects the mixing ratio isohume associated with the surface dew point. The microburst then travels along that dry adiabat to the surface. Next, find the negatively buoyant area created in the sounding (refer to Figure 4). Numerically, 1cm² on a DOD WPC 9-16 skew-T log P chart is equal to 28.0 Joules/kg). Downdraft speed in m/s can be computed by:

$$\sqrt{(2*\text{Negative Bouyant area})}$$

The next step is to convert to units of choice. From the estimated 21Z Amarillo sounding the computed downdraft was about 65 knots ($T = 97°F$, $T_d = 36°F$). Observed weather from WSO Amarillo and a few wind speed reports in the vicinity and from WSFO Lubbock appears as Table 2. As one would expect the airways observations from Amarillo and Lubbock contain remarks indicative of dry microbursts: WSHFT, BD, VIRGA, variable wind directions, PCPN VRY LGT, and PKWND.

THE WARNING DILEMMA

Perhaps of more importance than recognizing the possibility of dry microbursts on the forecast shift is the decision of how to warn the public of the threat. Ideally, the forecaster would note the microburst threat shortly after analyzing the morning sounding and other upper air data, then issue a special weather statement concerning the dry microburst threat when high-based cumulus is observed. If confidence in the microburst threat is high enough, the forecaster could use the sounding estimates as a peak gust in a statement or zone forecast. The dilemma is how to warn the public. Warning and forecasting dry microbursts for the aviation community has already been addressed by Sohl.

The Weather Service Operations Manual (WSOM) briefly offers a suggestion of what to do when dry microbursts are occurring and severe thunderstorm criteria are met:

> Under some circumstances, such as with "dry thunderstorms," it may be more appropriate to issue a "high wind warning" or "dust storm warning" for strong thunderstorm winds. (WSOM C-40 5.3)

This passage later refers the reader to WSOM C-42 and the issuance of high wind warnings for non-gradient wind conditions over short periods. This is at regional option.

The crux of the warning problem is this: high wind warnings would most likely be issued in a severe weather statement which will not get the dissemination of a severe thunderstorm warning. On the other hand, a severe thunderstorm with very little or no rain and no thunder is difficult to explain to the public. For dry microbursts from shallow high-based cumulonimbi, a compromise seems in order. This author suggests issuing a severe thunderstorm warning, but writing your own call-to-action statement describing the threats of high winds and blowing dust and definition of a dry microburst.

SUMMARY

Some aids to forecasting dry microbursts have been presented with the hope of improving their predictability in West Texas. The WSOM presents a few ideas on how to handle the operational aspects of dry microbursts when winds reach severe limits, and ways to improve the warning process have been suggested. Little of this material should have been new to a forecaster, but hopefully this paper has combined some of the theoretical and operational aspects of dry microbursts.

Thanks to Steven Cooper and the staff of WSO Amarillo for their comments and criticisms. Also to Ron McQueen and Larry Toombs of WSFO Lubbock for additional suggestions and data.

REFERENCES

Caracena F., Holle R. L., and Doswell C. A., 1989: Microbursts a Handbook for Visual Identification. U.S. Dept. of Commerce NOAA/ERL-NSSL.

Caracena F., McCarthy J., and Flueck J. A., 1983: Forecasting the Likelihood of Microbursts Along the Front Range of Colorado. Preprints 13th Conference on Severe Local Storms. Amer. Meteor. Soc.

Foster M. P., 1988: Upper-Air Analyses and Quasi-Geostrophic Diagnostics for Personal Computers. NOAA/NWS/SRH/SSD.

Fujita T. and Wakimoto R. M., 1983: Microbursts in JAWS Depicted by Doppler Radars, PAM, and Aerial Photographs. Preprints 21st Conference on Radar Meteorology. Amer. Meteor. Soc.

Sohl C. J., 1987: West Texas Microbursts of 21 May, 1986. Observed Microbursts in the NWS Southern Region During 1986. NOAA Technical Memorandum NWS SR-121.

Wakimoto R. M., 1984: Forecasting Dry Microburst Activity Over the High Plains. Preprints 10th Conference on Weather Analysis and Forecasting. Amer. Meteor. Soc.

Weather Service Operations Manual. DOC/NOAA/NWS.

TABLE 1

Comparison of calculated vertical wind speed and observed horizontal speeds within a dry microburst. Vertical speeds are based solely on negative bouyancy from evaporative cooling of precipitation particles. (From Wakimoto, 1984; speeds converted to knots from original)

Day	Calculated vertical speeds (knots)	Observed horizontal speeds (knots)
May 19	51.9	47.8
July 4	72.9	47.4
July 14	69.9	55.0
July 15	62.9	57.3
July 18	73.4	57.5

TABLE 2. OBSERVATIONS OF APRIL 22, 1989 DRY MICROBURSTS

```
AMA SA 2048 80 SCT E250 BKN 20 017/97/36/2211/976/CB RWU
    SW-S MOVG NE/ 724 1908
AMA SP 2127 E80 OVC 10RW- 0510G34/977/WSHFT 26
AMA SP 2133 E80 OVC 10RW- 1113G20/976/WSHFT 32 VIRGA
    ALQDS PCPN VRY LGT
AMA SA 2159 E80 OVC 15 020/90/31/2407G18/976/WSHFT 26
    WSHFT 32 RB23E41

1600 CST TRADEWINDS AIRPORT, SOUTH AMARILLO.  67KT WIND
    WITH BLOWING DUST.
1655 CST PANTEX, NE OF AMARILLO.  PEAK WIND OF 68 KTS.

LBB SA 2050 50 SCT 100 SCT 250 SCT 15 021/100/41/2404/
    978/CB SW-W-NW MOVG NE VIRGA SW-W/ 825 1953
LBB SP 2112 50 SCT 100 SCT 250 SCT 10 2530G43/976/CB SW-
    W-NW MOVG NE BD S-W-N WND 17V27
LBB SA 2152 E50 BKN 250 OVC 15 017/93/32/0707/975/CB
    ALQDS MOVG NE WND SHFTD GRDLY PKWND 2148/17
LBB SP 2216 E50 BKN 250 OVC 15 2318G26/975/CB NE-SE-SW
    MOVG NE WSHFT 13 WND 20V27
```

FIGURE 1.

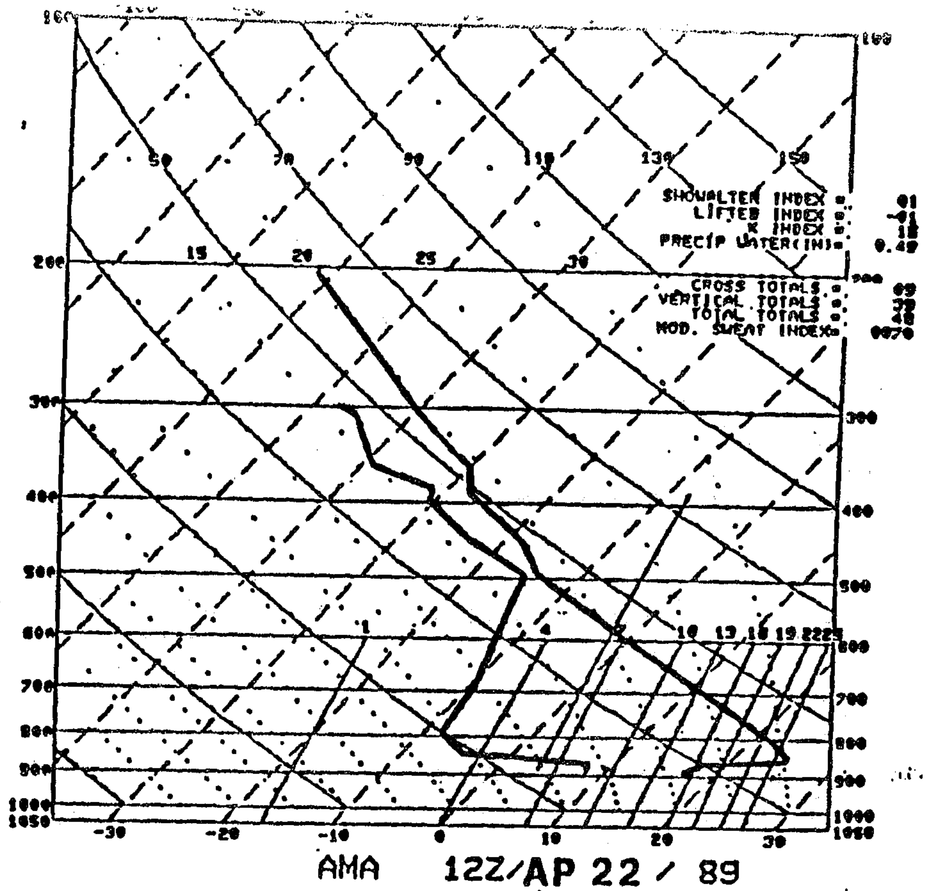


FIGURE 2.

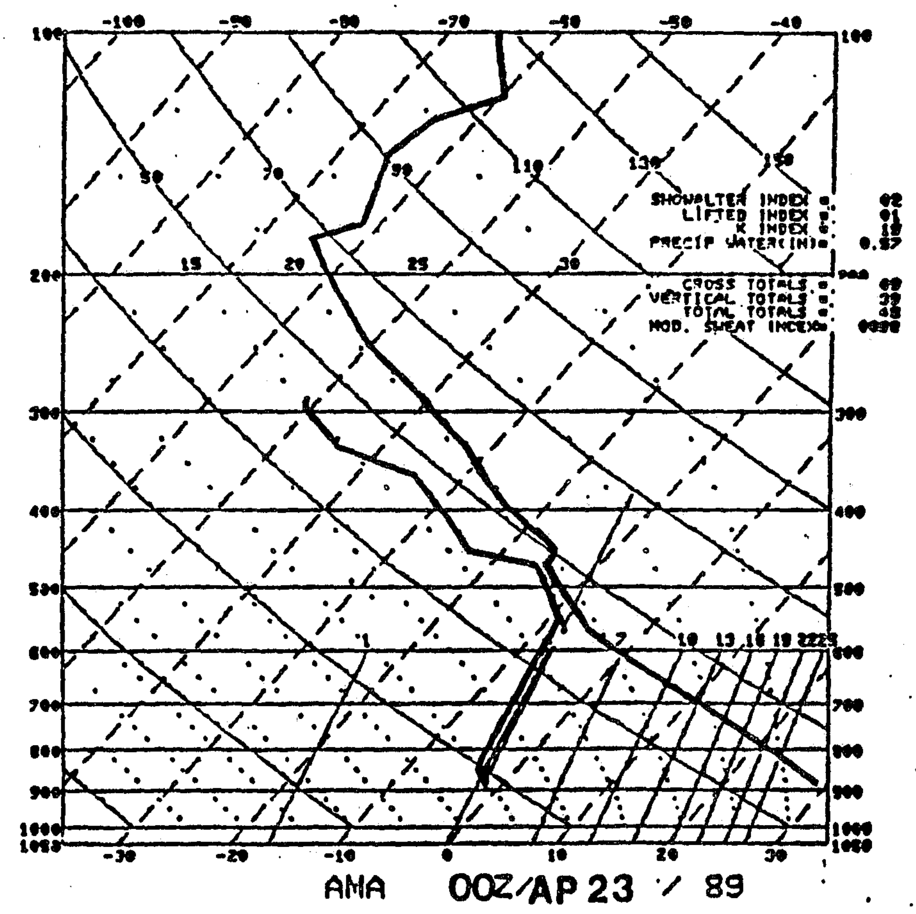
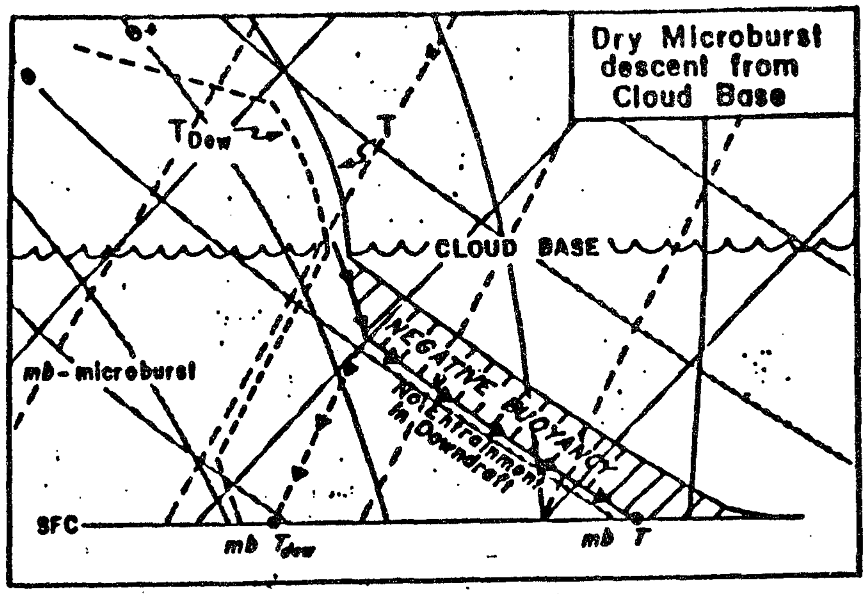


FIGURE 3.



Model of the thermodynamic descent of a dry microburst from cloud base. Surface temperature and dew-point temperature within the microburst are determined from PAM data. It is assumed that there is no entrainment into the downdraft. (Reprinted from Wakimoto, 1984)

FIGURE 4.

Downdraft = sqrt(2*NB) where NB is negative area of sounding