WESTERN REGION TECHNICAL ATTACHMENT
NO. 97-11
MARCH 25, 1997

A DECEMBER SEVERE THUNDERSTORM IN SOUTHWEST IDAHO

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Introduction

During the afternoon of December 10, 1996, a number of strong to severe thunderstorms developed over southwest Idaho. One of the cells produced severe hail and exhibited supercell characteristics including a long-lived rotating updraft and storm splitting. This convective outbreak provided forecasters at NWSFO Boise an early opportunity to examine and utilize new features of the WSR-88D Build 9.0 software load. The intent of this Technical Attachment (TA) is to both document unusually strong wintertime convection in southwest Idaho and to provide a glimpse of the potential benefits of new displays produced by the Build 9.0 software.

Synoptic Setting

The synoptic pattern of the afternoon considered here, can best be described using the "kata" type cold front conceptual model of Browning and Monk (1982). The kata, or "split" front configuration has been shown to produce significant, and sometimes severe weather east of the Rocky Mountains (Hobbs et al., 1990). In southwest Idaho, this pattern has been associated with a number of severe convective weather episodes, although these outbreaks usually occur during the spring and summer.

On December 10, 1996, a kata-type cold front moved across Idaho. The upper-level front traversed the region during the morning hours, providing partial clearing over southwest Idaho as cooler and drier air moved in aloft. The surface cold front lagged behind the upper-level feature and was still west of the region by mid-afternoon. In advance of the surface front, unusually mild air was advected into the area by low-level southerly flow.

The configuration of (relatively) warm and moist air at low levels with dry and cool air aloft can result in an environment with significant convective instability. Modification of the 0000 UTC 11 December Boise sounding yielded a lifted index of -5° and a CAPE of 500-

600 J/KG. Thus, the environment was characterized by conditionally unstable air and any lifting by the terrain, or the approaching surface front would likely result in convection.

With the jetstream positioned over the region, vertical wind shear was significant. The Boise hodograph (Fig. 1) was relatively unidirectional. The magnitude of the shear, as measured by the length of the hodograph from the surface to 6 km was greater than 60 knots. A value around 50 knots is generally used at Boise as a threshold for development of organized convection (supercellular traits).

The Storm

Isolated, intense thunderstorms developed across the region after 2000 UTC. One in particular was long-lived, producing severe hail and strong straight line winds. The cell developed in extreme eastern Oregon and moved northeast across southwest Idaho at about 45 mph. As the storm moved across the populated region near Boise, storm relative velocity data indicated a weak, broad but persistent cyclonic circulation at low to mid levels within the storm. At 2215 UTC, the AWOS at the Caldwell, ID (25 miles west of Boise) reported a wind gust to 54 mph. During the next 10 minutes hail up to .5 inches in diameter was reported by weather spotters. By 2224 UTC, the cell had moved into northern Ada County and was over the communities of Star and Eagle (Fig. 2). Maximum hail size within the storm was estimated at 1.25 inches by the hail algorithms.

The Cell Trends display (new for software Build 9.0), provided interesting details about the storm severity and evolution (Fig. 3). Note that the radar derived storm top is only about 20,000 feet and the height of the maximum reflectivity (DBZM HT) was increasing and decreasing in a "pulsing" manner. The hail detection algorithms indicated a rapid rise in the probability of hail and severe hail contained within the storm after 2149 UTC. Values of VIL and maximum reflectivity increased through the period, with the VIL rising dramatically after the 2149 UTC volume scan. A severe thunderstorm warning was issued at 2227 UTC for northern Ada County. At 2245 UTC a weather spotter reported .75 inch hail in extreme northern Ada County. A severe thunderstorm warning was issued for Boise County at 2250 UTC.

As the cell reached its maximum intensity over northern Ada County, it appears to have split. Storm relative velocity data at 2214 UTC (Fig. 4, quadrant 1) shows the weak low-level cyclonic meso-cyclone just southwest of Star. By 2229 UTC (quadrant 2), the cyclonic rotation center had moved into a region of ground clutter suppression and cannot be seen. However, a center of anti-cyclonic rotation is evident on the west flank of the storm. This is believed to be the center of a newly formed left moving cell which weakened rapidly (quadrant 3). One kilometer resolution satellite data (not shown) also indicates the formation of a new cell on the north flank of the original storm. The observed splitting behavior of this storm agrees well with the results of numerical simulations of storm development and evolution in moderate to strong unidirectional shear (Weisman and Klemp 1986).

As the storm moved northeast into Boise County the circulation re-emerged from the area of clutter suppression (quadrant 4). At 2310 UTC, a spotter reported 1 inch diameter hail at the location indicated on the figure. The cell dissipated over northern Boise County over two hours after it had formed in extreme eastern Oregon.

Summary

Although December thunderstorms are rare in Boise, averaging one December thunderstorm day every 10 years, unusually vigorous convection developed near the city on December 10, 1996. One cell produced severe weather and contained features normally associated with supercells. The new software load for the WSR-88D, including the Cell Trends display and Hail Detection Algorithms, proved very useful for monitoring these storms. It is apparent that this technology will play a significant role in our abilities to detect and provide warnings for severe thunderstorms during the upcoming convective season.

Acknowledgment

I'd like to thank Dr. David Billingsley and the other reviewers for their excellent suggestions regarding this TA.

References

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Hobbs, P. V., J. D. Locatelli and J. E. Martin, 1990: Cold Fronts Aloft and the Forecasting of Precipitation and Severe Weather East of the Rocky Mountains. Wea. and Forecasting, **5,** 613-626.

Weisman, M. L. and J. B. Klemp, 1986: Characteristics of Isolated Convective Storms. Mesoscale Meteorology and Forecasting (P. S. Ray, ed.), Amer. Meteor. Soc., Boston, 341-358.

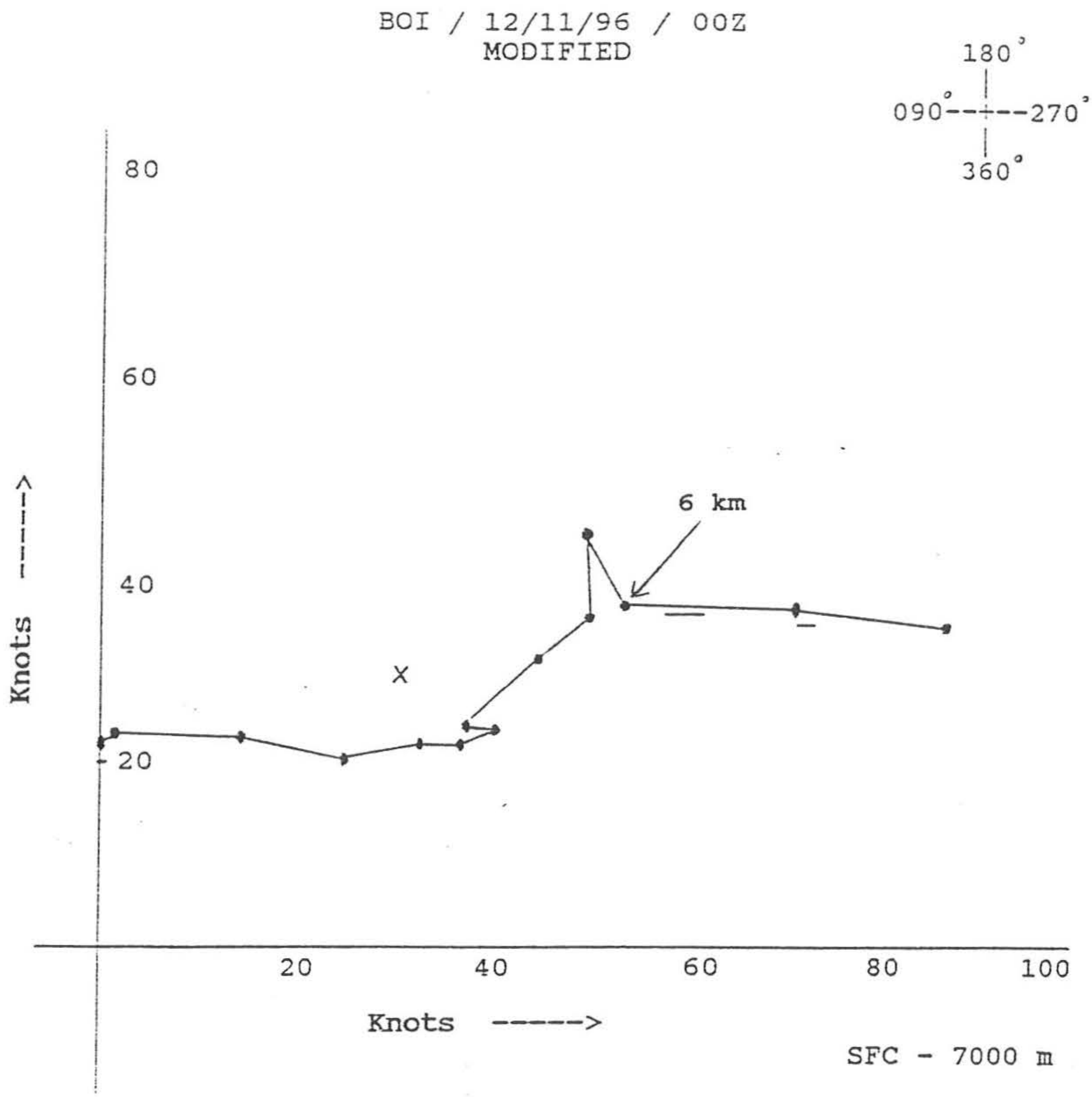

Figure 1. Hodograph for Boise 0000 UTC 10 December, 1996. Wind speed is in Knots. x indicates the approximate observed storm motion.

STM ID	AZ/RAN	TVS	MESO	POSH/POH/MX SIZE	VIL	DBZM HT	TOP	FCST MVMT
N0	335/ 16	NO	NO	100/100/ 1.25	32	63 9.4	18.8	240/ 40
U0	359/ 65	NO	NO	70/100/ 0.75	18	52 13.4	19.7	240/ 33
X1	0/ 51	NO	NO	20/ 70/<0.50	7	47 10.1	20.6	211/ 35
C2	355/ 47	NO	NO	10/ 70/<0.50	6	47 9.0	18.8	221/ 32

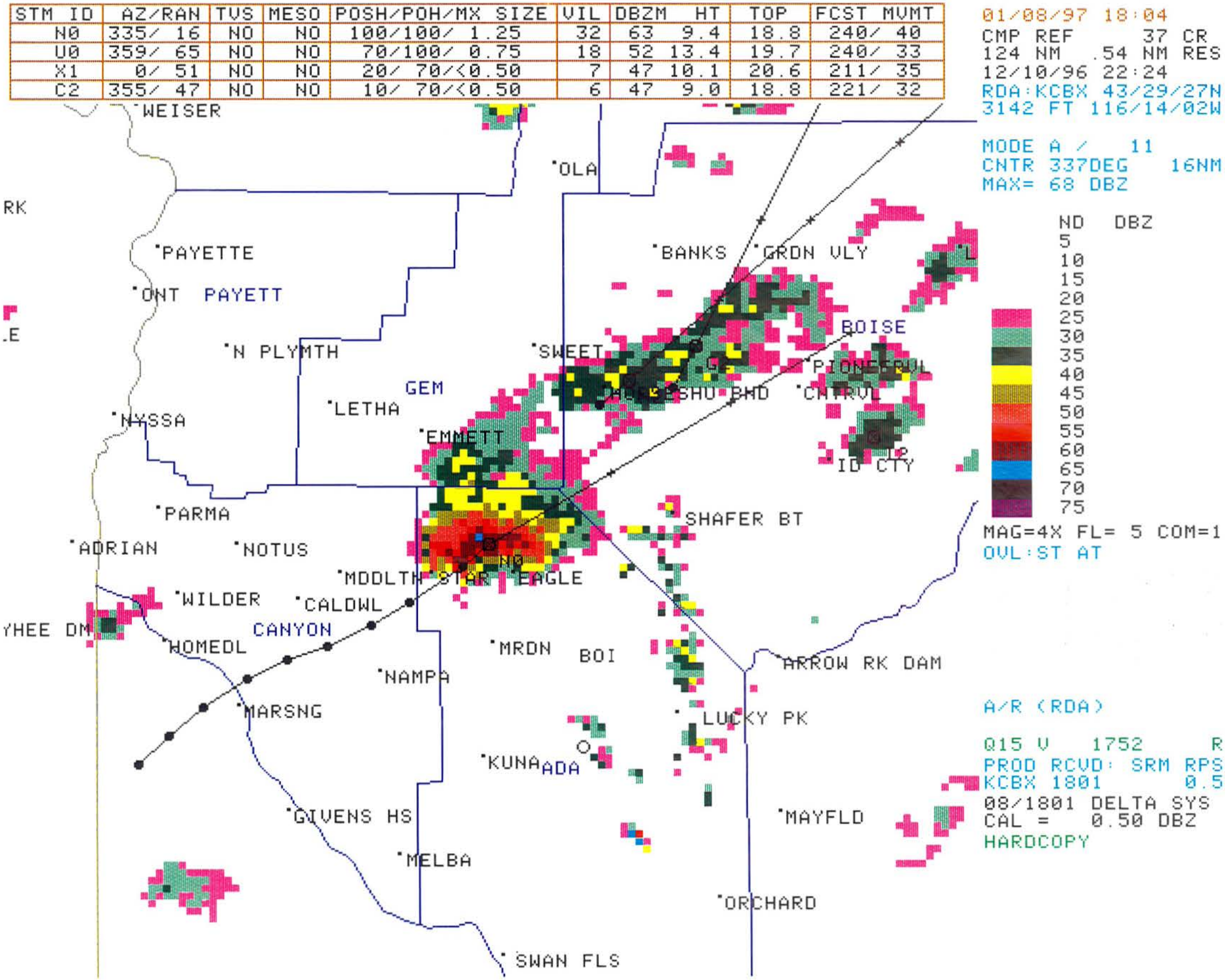

Figure 2. Composite reflectivity from the KCBX radar for the 2224 UTC 10 December 1996 volume scan.

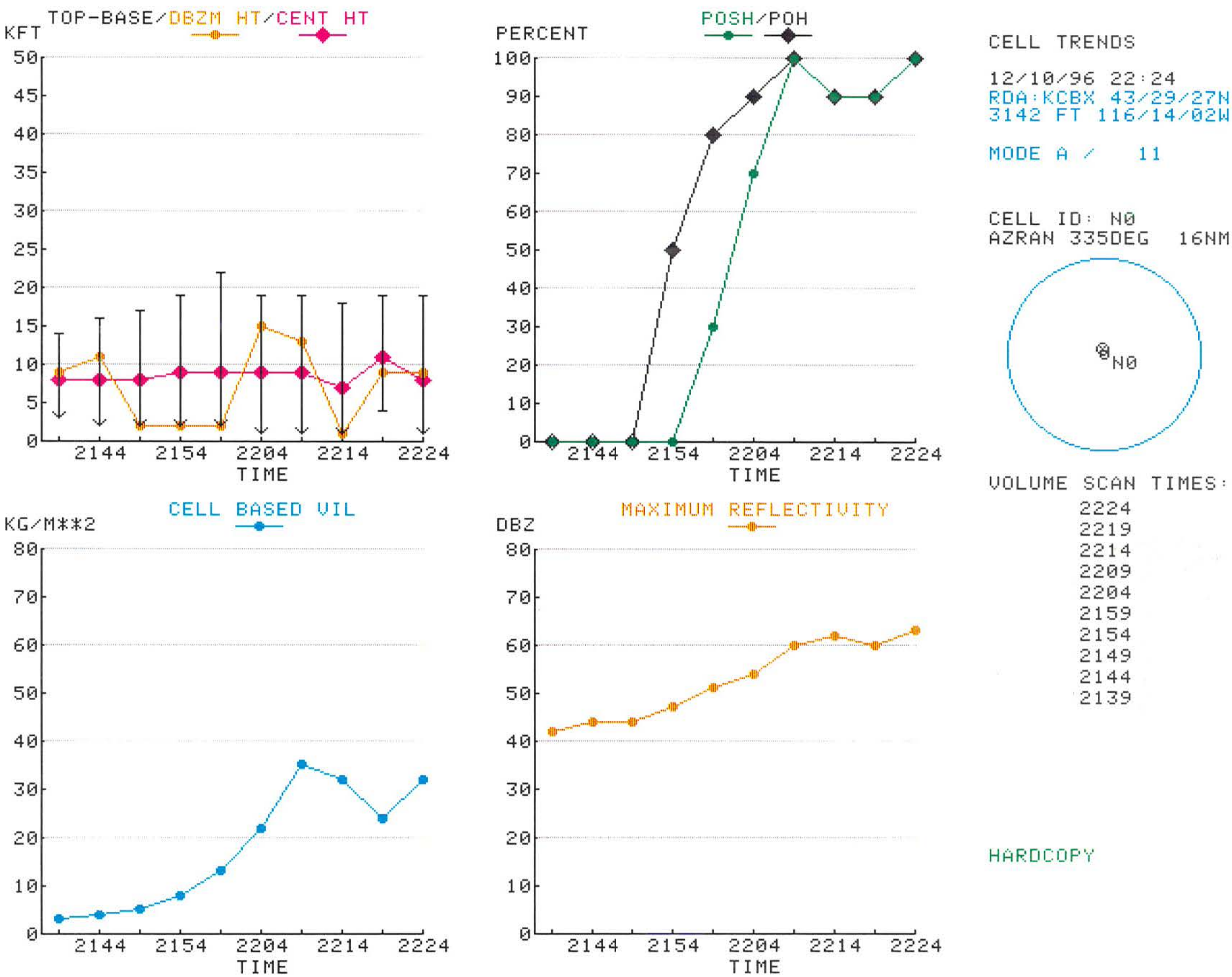

Figure 3. Cell Trends display for cell **NO** from the 2224 UTC 10 December 1996 volume scan.

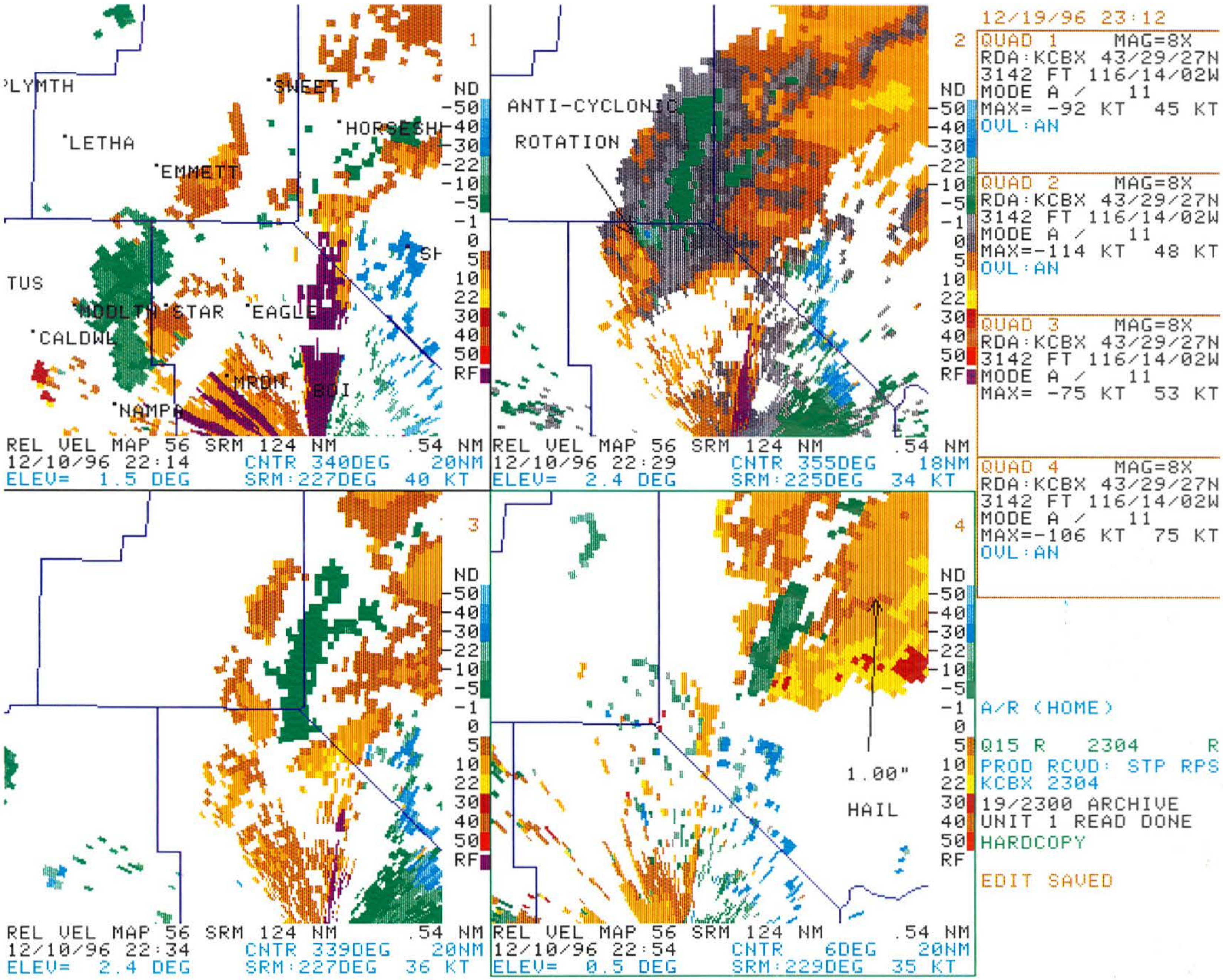

Figure 4. Storm relative velocity display from the KCBX radar on 10 December 1996 for (quad 1) 1.5 degree elevation angle at 2214 UTC, (quad 2) 2.4 degree elevation angle at 2229 UTC, (qual 3) 2.4 degree elevation angle at 2234 UTC and (quad 4) 0.5 degree elevation angle at 2254 UTC.