# 13.4 THE USE OF POLARIMETRIC RADAR DATA IN THE WINTER WEATHER WARNING DECISION MAKING PROCESS: A CASE STUDY

Daniel J. Miller* – NOAA/NWS/Weather Forecast Office, Norman OK

and

Kevin Scharfenberg – Cooperative Institute for Mesoscale Meteorological Studies, University of Oklahoma, Norman OK

## 1. INTRODUCTION

A winter storm affected parts of southern Oklahoma during the afternoon and evening hours of 24 February 2003. Snow was the primary precipitation type produced by this winter storm in the affected areas of southern Oklahoma, with a 65 km (40 mi) wide area where storm total amounts were in excess of 10 cm (4 in), and maximum amounts exceeded 20 cm (8 in). In addition to traditional Doppler radar data from the WSR-88D network, forecasters at the Norman, OK NWS weather forecast office (WFO) had access to polarimetric radar data from the KOUN WSR-88D located in Norman, OK (Schuur et al, 2003). Although research is ongoing regarding the polarimetric radar signatures to be discussed herein (Straka et al, 2000), this paper will briefly document how forecasters at the Norman WFO greatly benefited from the availability of polarimetric radar data during the course of this winter weather event. Despite some sampling limitations due to range, real-time evaluation of polarimetric radar data from KOUN was quite helpful to forecasters in detecting mixed precipitation early in this event, and in detecting the change in precipitation type to heavy snow. Figure 1 at the top of the next page shows storm total snow accumulations during this event over south central and southeast Oklahoma.

## 2. METEOROLOGICAL OVERVIEW

Space limitations preclude a detailed meteorological discussion of this event here. However, it is necessary to note the large scale synoptic setting for this snowfall event. A west-southwest to east-northeast oriented baroclinic zone extended from northwest Texas into Arkansas. A mid-tropospheric disturbance moved eastward across southern Oklahoma along this baroclinic zone during the afternoon and evening of 24 February. Although only a weak surface reflection of this feature was noted, lower to mid level tropospheric deformation increased significantly in advance of the disturbance. Strong deformation within the baroclinic zone resulted in strong frontogenetic forcing for ascent, which was the primary contributor to heavy snowfall (Nicosia et al 1998). This is a common pattern for heavy snowfall in the southern plains during the cool season (Branick, 1985). However, just before onset of precipitation, forecast confidence in heavy snow accumulation over southern Oklahoma was low, due mostly to forecasted thermodynamic profiles that were unclear about dominant precipitation type. A winter weather advisory was issued at 2036 UTC for 1 to 2 inches of total accumulation in the affected areas, with the forecast reasoning that a significant amount of the precipitation would fall in the form of freezing rain and/or ice pellets, thus severely limiting accumulation amounts. Forecasters did acknowledge, however, that sufficient atmospheric cooling due to the strong deep-layer ascent could be sufficient to change the dominant precipitation type to snow.

## 3. RADAR OBSERVATIONS

Precipitation developed over southern Oklahoma during the mid to late afternoon hours on 24 February, and rapidly increased in areal coverage and intensity between 2030 and 2130 UTC. During this time, forecasters monitored both traditional Doppler radar observations from the Twin Lakes (KTLX) WSR-88D, and the polarimetric data from KOUN, and several calls to weather spotters were made to ascertain precipitation type. Although a few reports of light snow were received, a majority of spotters between 2130 and 2200 UTC in and east of Ardmore, OK (near the tip of the arrows in Figure 2) reported ice pellets, freezing rain or a wintry mixture of precipitation, occasionally accompanied by thunder. Over Carter county at 2141 UTC,

*Corresponding Author Address: Dan Miller, 1200 Westheimer, Room 101, Norman, OK 73069; email: dan.j.miller@noaa.gov

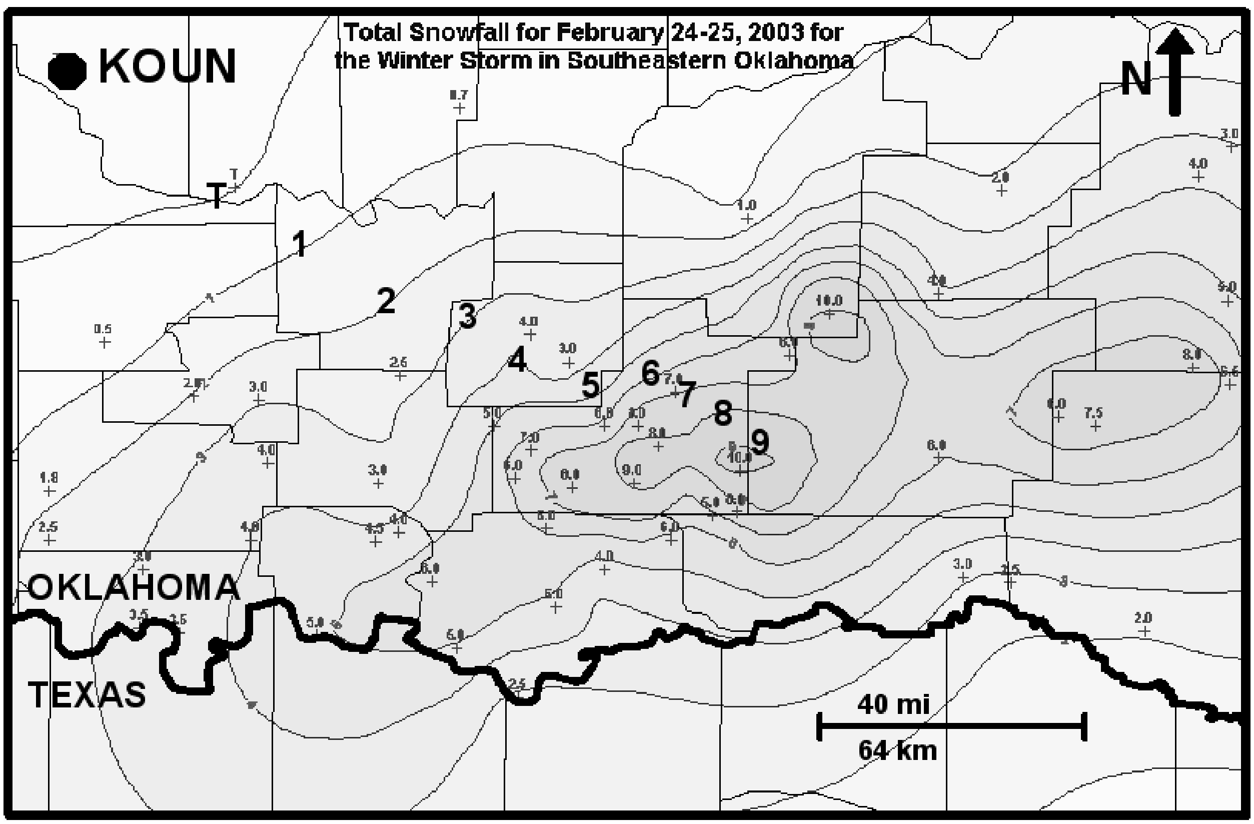


**Figure 1.** Map of storm total snow accumulation during the winter storm of 24-25 February 2003 across south central and southeast Oklahoma. Location of the KOUN WSR-88D in Norman in relation to the areas affected is noted at the upper left of the image. Snowfall contours are drawn every inch, with a maximum snowfall total of 10 inches (22 cm) observed in eastern Atoka County.

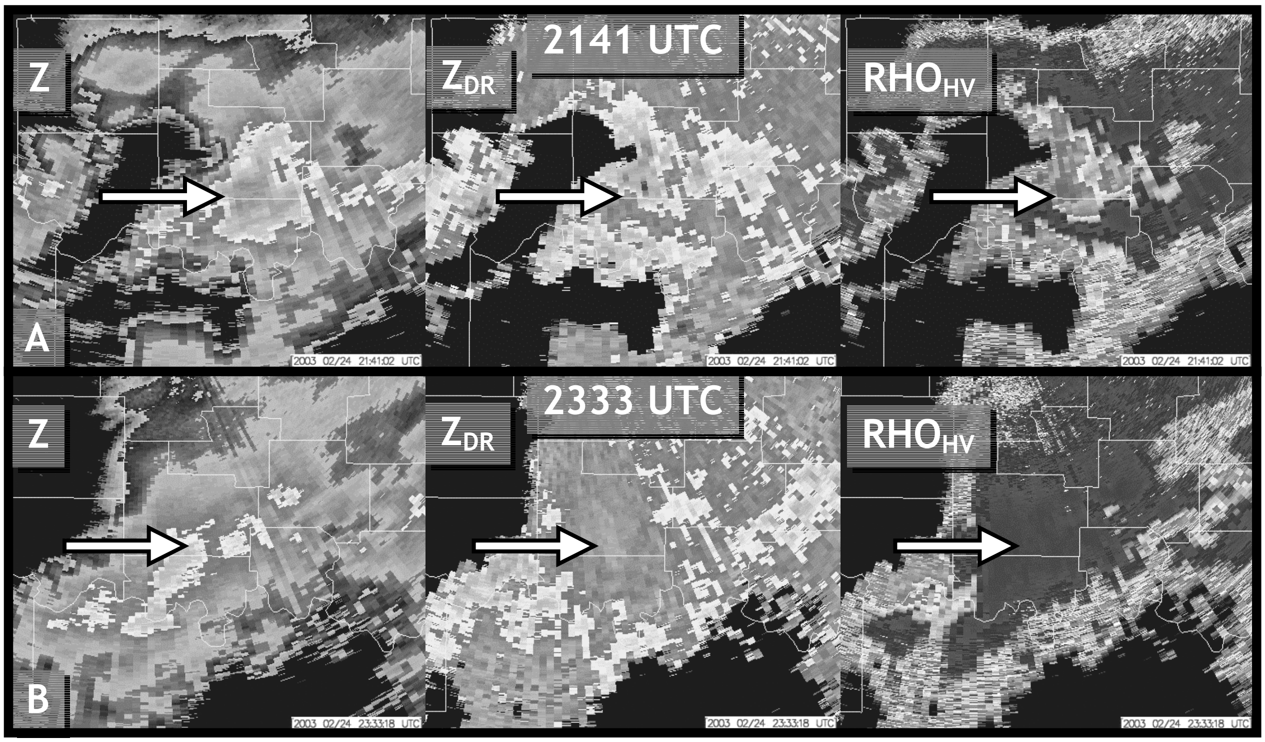


**Figure 2.** Reflectivity (left), differential reflectivity (center) and correlation coefficient (right) from the 0.5 degree elevation slice from KOUN at **A)** 2141 UTC, **B)** 2333 UTC. The arrow indicates the specific area of interest near Ardmore, OK in Carter County. Approximate beam height AGL at this location is 1070 m (3500 ft). Note the substantial change in polarimetric variables between the two times with co-location of high reflectivity (max value ~55 dBz), high differential reflectivity (max value 3-4 dB) and low correlation coefficient (min values ~0.80) at 2141 UTC; by 2333 UTC reflectivity had decreased to generally less than 50 dBz, differential reflectivity values had decreased to generally 1 dB or less, and correlation coefficient had increased to near 1.

KOUN data showed co-located high reflectivity (max value ~55 dBz), high differential reflectivity (values 3-4 dB), and low correlation coefficient (values ~0.80), strongly suggesting mixed precipitation (Illingworth and Caylor, 1991) at a range of 95 km (60 mi) and beam height of approximately 1070 m (3500 ft) AGL (Figure 2A). By 2333 UTC, KOUN data at the same location indicated that reflectivity values had decreased by 5 to 10 dBz (45-50 dBz), but more importantly, differential reflectivity had decreased to ~1 dB or less, and correlation coefficient had increased to near 1 (Figure 2B), strongly suggesting that snow was becoming the dominant precipitation type (Straka et al, 2000), given the cold thermodynamic profile in place.

## 4. DISCUSSION

Between 2230 and 2330 UTC, forecasters became increasingly confident that dominant precipitation type would rapidly change to snow based primarily on three observations, 1) the presence of convection within the precipitation band which would further enhance already strong synoptic and mesoscale ascent and act to enhance cooling of the atmospheric column through a deep layer, 2) the rapid change in character of reflectivity data from KTLX (reflectivity values decreased and the overall look of reflectivity became more “fibrous” which operational experience strongly suggests is representative of snow) and 3) the rapid change in character of the polarimetric variables from KOUN. Additional spotter calls were made to Carter County between 2315 and 2345 UTC, and indicated that precipitation had rapidly changed to heavy snow during the previous 30 minutes. Despite the limited availability of additional spotters in areas farther east, continued trends in polarimetric radar data between 2330 and 0000 UTC, contributed to significantly increased forecaster confidence that heavy snow would rapidly become the dominant precipitation type for the duration of the event within a couple hours after precipitation onset in those locations. Thus, the winter weather advisory was upgraded successfully to a heavy snow warning at 2355 UTC.

## 5. ACKNOWLEDGEMENTS

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