CENTRAL REGION TECHNICAL ATTACHMENT 95-17

EXAMPLE OF MANUAL PRF SELECTION TO UNMASK RANGE FOLDED VELOCITIES

George D. Phillips
National Weather Service Forecast Office
Topeka, Kansas

1. Introduction

Velocity data from the WSR-88D is often crucial to the process of making severe storm warning decisions. This is especially true when a severe storm contains a mesocyclone. Fortunately, algorithms employed by the WSR-88D help to minimize ambiguities in the velocity data by: 1) dealiasing velocities that exceed the Maximum Unambiguous Velocity (MUV), and 2) by attempting to determine the location of scatterers producing velocity return in an area of second trip echoes (Range Folding (RF)). Just beyond the Maximum Unambiguous Range (MUR) the Range Folding (obscured) data is dependent on the Pulse Repetition Frequency (PRF).

The WSR-88D algorithms reduce the area of RF data within 124 nm of the RDA when the AUTO PRF function at the UCP is set to ON. This setting usually works well. Although the area of RF velocities is decreased, important velocities within a significant storm are still obscured. In this instance, it is best to turn AUTO PRF to OFF and manually select a MUR. The case presented in this paper is an example where the manual selection of a MUR resulted in "unmasking" the velocities within a significant storm.

2. Environment

During the afternoon of 25 April 1995, a Mean Sea Level low pressure center was moving east across southern Nebraska (not shown). Surface temperatures south of the low across north central and northeast Kansas were generally around 70°F while dew point temperatures were in the middle to upper 40s. This combined with the relatively cold 500-mb temperatures (-20 to -25°C) resulted in the surface based lifted indices less than -4°C across central Kansas and extreme southeast Nebraska.

While the surface dew point temperatures were fairly low and the instability modest at best, vertical wind shear was depicted increasing by profiler hodographs (not shown). This resulted in 0-3 km storm-relative (SR) helicities at over 200 m^2s^{-2} for an eastward storm movement of 20 kt by 2200 UTC. The six-hour RUC forecast of SR helicity (from the 2100 UTC 25 April run (not shown) valid 0300 UTC 26 April) indicated values exceeding 400 m^2s^{-2} from central Oklahoma through central and eastern Kansas to southeast Nebraska. Thus, while not a classic supercell day, shear-related parameters suggested the potential for updraft rotation for persistent storms.

3. Radar Features and Radar Optimization

Shortly after 0000 UTC 26 April, a thunderstorm developed over north central Kansas and moved northeast toward Nebraska. As it entered Nebraska, it began intensifying and turned to the right, moving slightly south of east (from 275°) from 0100 to 0230 UTC. By 0113 UTC the storm had developed a tight, low-level reflectivity gradient and concavity, as well as a mid-level overhang on the south-southwest side of the storm (Figure 1). In fact, the 1.5 degree slice (approximately 15 kft AGL) depicted a notch in the overhang area. This is often a precursor signature of a Bounded Weak Echo Region (BWER). The corresponding SR mean Radial velocity Map (SRM) data showed rotation at both 0.5° and 1.5° (weak mesocyclone according to OUN/OSF criteria). At this time, the radar was operating with AUTO PRF ON and the MUR was 80 nm.

Twelve minutes later at 0125 UTC, the low level echo continued to show the concavity. The 1.5° slice continued to show the notch (Figure 2) and a BWER was evident at 2.4° (not shown). One would expect fairly strong rotation with this reflectivity signature. Also, corresponding SRM products did indeed show some rotation. However, part of the couplet was obscured by RF as AUTO PRF had moved the MUR to 63 nm! This change in the MUR was because the AUTO PRF had reduced the RF area. Also, numerous storms that developed in Nebraska were returning approximately the same power as the relatively strong return from the clear air boundary layer surrounding the radar.

This BWER continued over the next two volume scans as the obscuration of the velocity data worsened (Figure 3). Little confidence could be placed in the recognition and intensity of the rotational signature at the lowest elevation angles because of the RF.

Recognizing this, AUTO PRF was turned OFF and a new MUR was selected manually from the VCP menu at the UCP. Since Build 8 had just been installed, it was decided to choose the new 95 nm MUR. A better choice would probably have been the 80 nm MUR since it would have unmasked the storm while still having a high PRF (and MUV).

The results of this selection can be seen in the next volume scan. While the BWER lowered to 0.5° (Figure 4), the velocities within the storm were now depicted

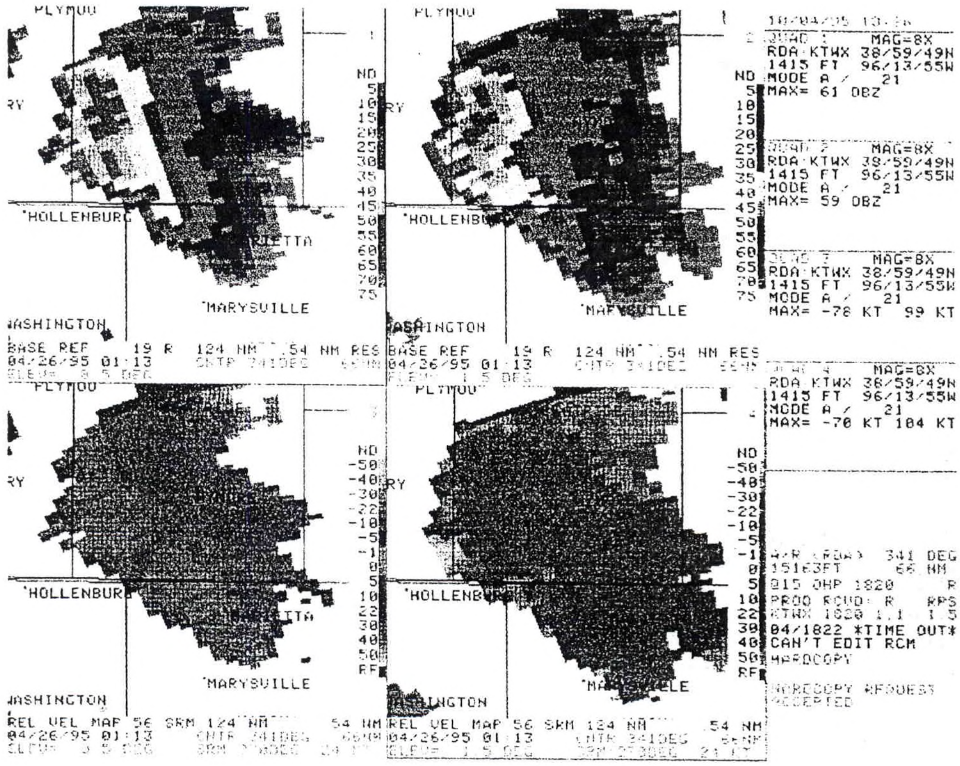

Figure 1. Low-level (0.5° and 1.5°) base reflectivity and SRM products valid 0113 UTC 26 April 1995.

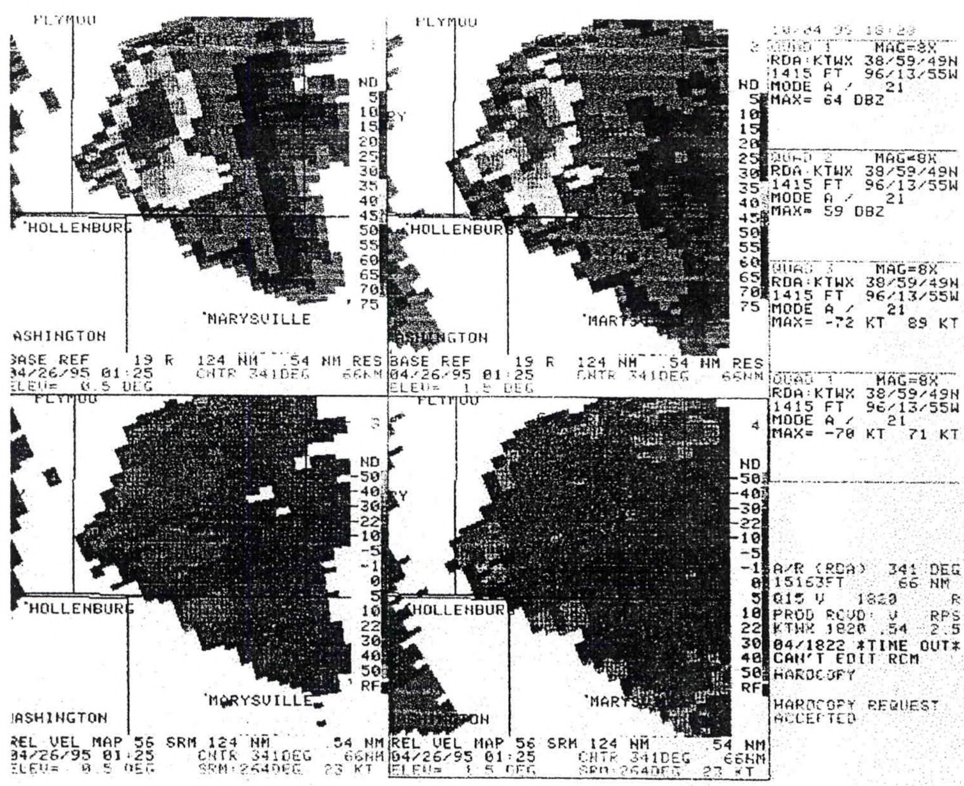

Figure 2. Same as in Figure 1 except valid 0125 UTC.

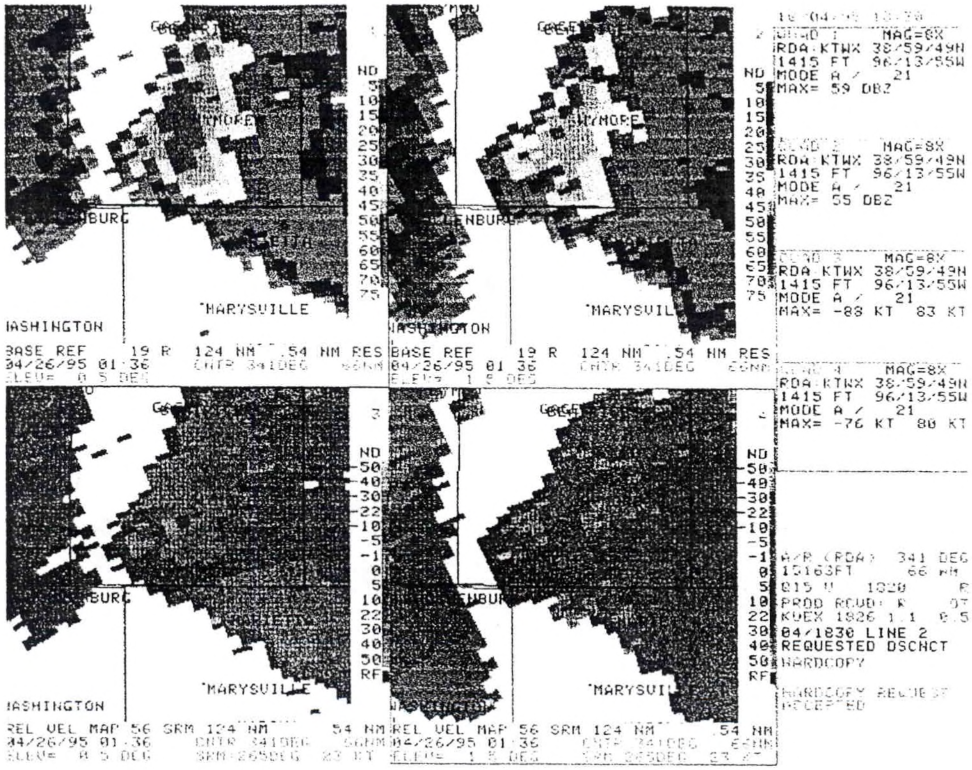

Figure 3. Same as in Figure 1 except valid 0136 UTC.

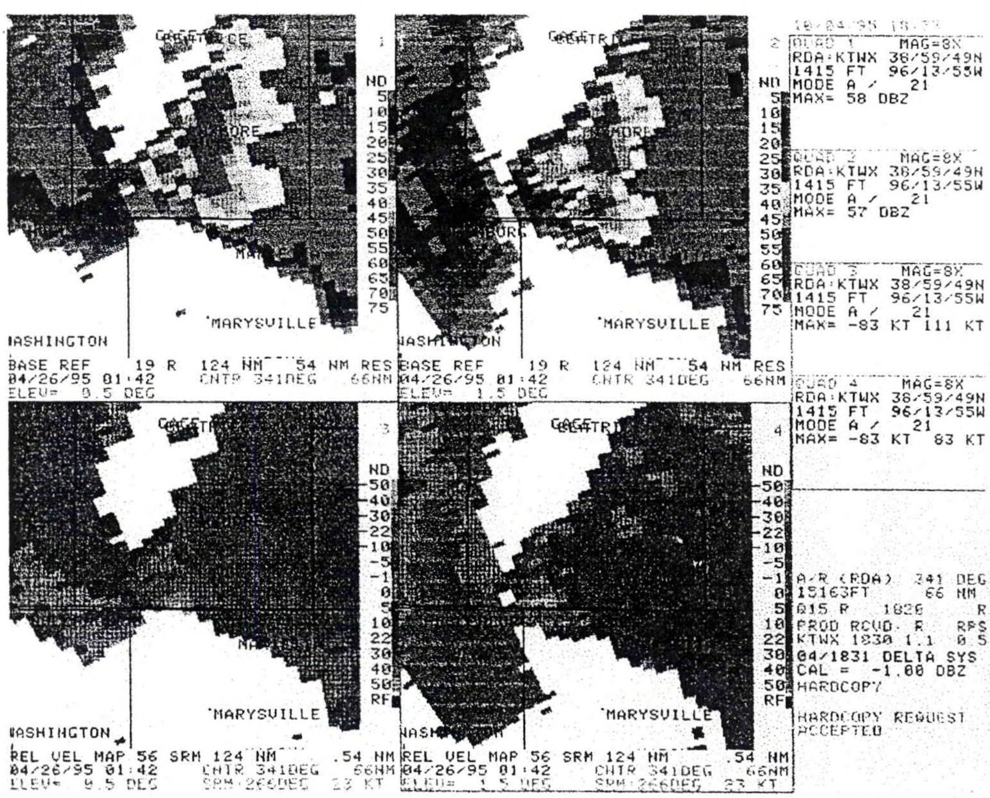

Figure 4. Same as in Figure 1 except valid 0142 UTC.

well. The strong convergence showed up at 0.5° and 40 kt rotational velocities were calculated with this couplet at 1.5°. At 65 to 70 nm from the RDA, this was indicative of a strong mesocyclone. While no confirmed tornadoes were observed with this storm, large hail was observed in Gage county Nebraska.

4. Summary and Implications for Radar Optimization

While normally, AUTO PRF is our friend in that it reduces RF area, in this case it was our worst enemy as by far the strongest storm became obscured. This case points out the importance of being prepared to change the MUR manually at the UCP. Care must be taken when changing the MUR as the RF area may be moved such that it obscures velocity data from other significant storms that your office, or another associated user, needs to investigate. Given this caution, the probability of changing the MUR is likely inversely proportional to the number of storms in a given County Warning Area.