J3.16 PROSPECTS FOR FASTER AND DENSER WSR-88D SCANNING STRATEGIES

Randy M. Steadham *
Radar Operations Center, Norman, Oklahoma

Rodger A. Brown
National Severe Storms Laboratory, Norman, Oklahoma

Vincent T. Wood
National Severe Storms Laboratory, Norman, Oklahoma

1. INTRODUCTION

This paper describes new radar scanning strategies, or Volume Coverage Patterns (VCPs), and briefly mentions operational benefits and the need for system changes. Weather Surveillance Radar - 1988 Doppler (WSR-88D) users have been requesting additional VCPs. Formal change requests for faster VCPs and VCPs with denser far-range coverage at lower elevation angles have been submitted to the Radar Operations Center (ROC). In response, the ROC and the National Severe Storms Laboratory (NSSL) have been developing new VCPs for possible supplement to existing VCPs 11, 21, 31, and 32. The proposed new scanning strategies tentatively are called VCPs Alpha, Beta, Gamma, Delta, Epsilon, and Zeta.

After successful testing (Brown and Wood 2000), VCPs Alpha, Beta, and Gamma were recommended for further study by the WSR-88D Technical Advisory Committee (TAC) in August 2000 with the prospect of integrating these new VCPs into a future Open Radar Product Generator (ORPG) software build. VCPs Delta, Epsilon, and Zeta will be similarly tested. The TAC also recommended combining future work on new VCPs with an ongoing effort to deploy a Multiple Pulse Repetition Frequency (PRF) Dealiasing Algorithm (MPDA), a proposed interim software solution to correct improper velocity dealiasing and mitigate range folding (Conway et al. 1997). VCPs Epsilon and Zeta were created to fulfill the TAC recommended MPDA.

Important operational benefits are expected from new VCPs. In general, the new VCPs facilitate faster and increased lower-altitude sampling, thus increasing target resolution. Expected benefits from increased resolution are improved warnings and forecasts, more accurate hydrological measurements, and, increased algorithm performance. Elevation angles for new VCPs are chosen to make target height uncertainty constant with range (Wood and Brown 1999), assuring adequate sampling of distant storms.

2. VCPs ALPHA, BETA, AND GAMMA

VCP Alpha, shown in Fig. 1, provides nine unique elevation angles from 0.5° through 4.9° in 10 minutes. This long-pulse scan strategy combines dense vertical sampling with the sensitivity of clear-air mode for detailed recognition of clear air features such as fronts and outflow boundaries.

VCP Beta, shown in Fig. 2, completes 12 scans from 0.5° through 8.1° in five minutes. VCP Beta was designed to improve precipitation estimates in shallow

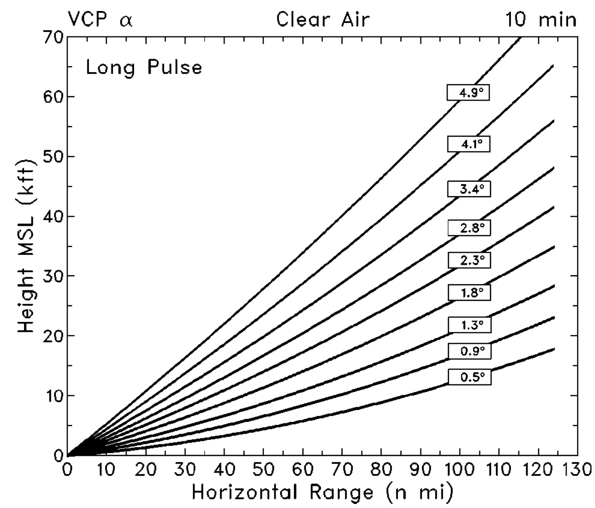

Figure 1 *- VCP Alpha provides 9 unique elevation angles in 10 minutes in clear air mode.*

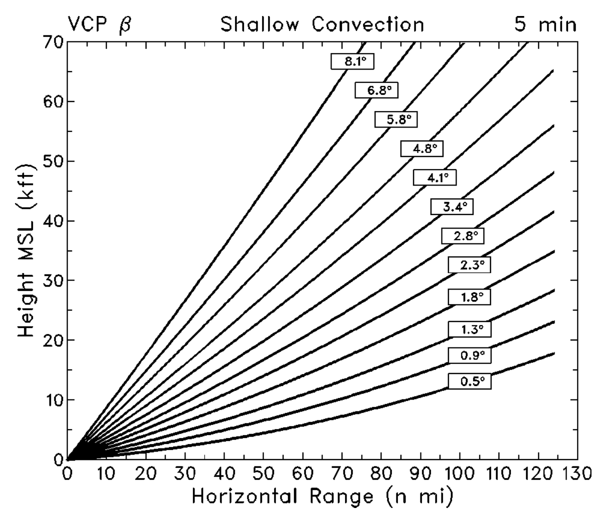

Figure 2 *- VCP Beta provides 12 unique elevation angles in 5 minutes using more pulses than other precipitation VCPs.*

* Corresponding author address: Randy M. Steadham, Radar Operations Center, 1200 Westheimer Dr., Norman, OK 73069; e-mail: randy.m.steadham@noaa.gov.

rainstorms and snowstorms and non-severe thunderstorms. With VCP Beta, forecasters can monitor lake effect storms, distant severe convection, and low-top thunderstorms.

VCP Gamma, shown in Fig. 3, provides 14 unique elevation angles from 0.5° through 19.5° in 4.1 minutes. VCP Gamma would be used during severe thunderstorm outbreaks. Forecasters can sample deep convection at a faster rotation rate than VCP 11. As with all new VCPs, VCP Gamma will provide better estimates of rainfall and snowfall, particularly in situations of beam blockage, since the next unblocked elevation angle is nearer the earth than elevation angles of current VCPs.

3. VCP DELTA

VCP Delta, Fig. 4, completes six unique elevation angles from 0.5° through 6.5° in 2.3 minutes. VCP Delta offers quicker updates of elevation and volume products used in severe weather warning situations. The increased temporal resolution of VCP Delta correlates radar data in time with rapidly evolving tornadoes (Trapp et al. 1999), microbursts (Roberts and Wilson 1989), and circulations found in tropical cyclones (Spratt et al. 1997).

4. VCPs EPSILON AND ZETA

VCPs Epsilon and Zeta are modified versions of VCPs Gamma and Delta to support MPDA and are designed to be used when Doppler velocity aliasing or range folding problems exist. VCP Epsilon, Fig. 5, completes 12 unique elevation angles from 0.5° through 19.5° in five minutes.

VCP Zeta, Fig. 6, completes five unique elevation angles from 0.5° through 6.5° in 3.3 minutes. VCPs Epsilon and Zeta require the use of MPDA to deduce the most likely Doppler velocity values and reduce range folding.

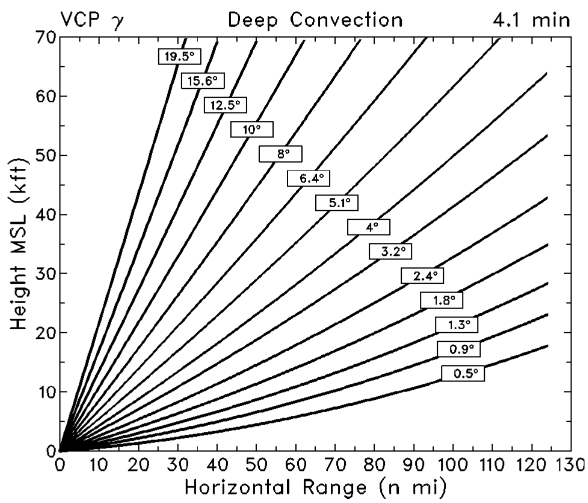

Figure 3 *- VCP Gamma provides 14 unique elevation angles in 4.1 minutes.*

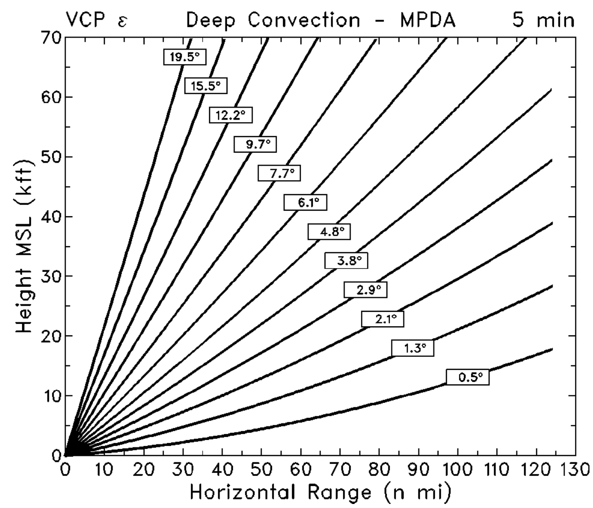

Figure 5 *- VCP Epsilon provides 12 unique elevation angles in 5 minutes using multiple pulse repetition frequencies to improve velocity fields.*

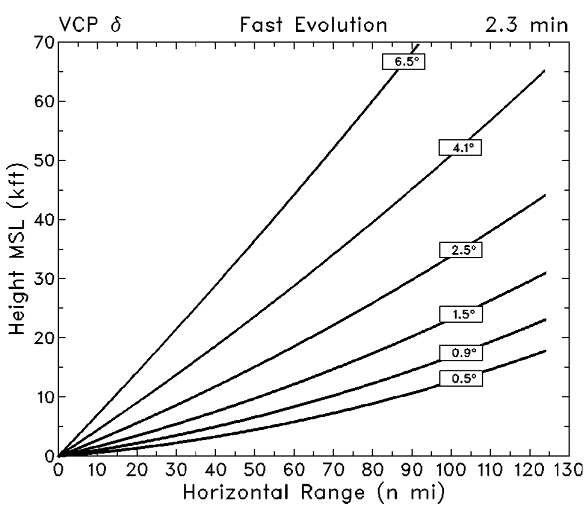

Figure 4 *- VCP Delta provides 6 unique elevation angles in 2.3 minutes.*

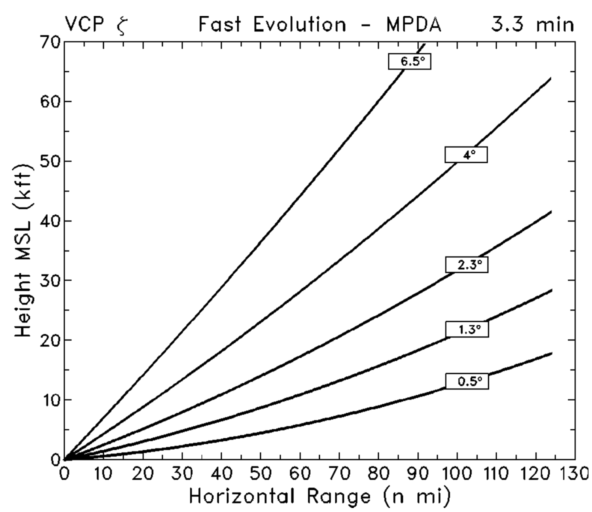

Figure 6 *- VCP Zeta provides 5 unique elevation angles in 3.3 minutes using multiple pulse repetition frequencies to improve velocity fields.*

The elevation increment among the three lowest elevation angles of these MPDA VCPs is about 0.8°. For each of the lowest three elevation angles, a reflectivity and three Doppler velocity scans are completed; each Doppler velocity scan has a different pulse repetition frequency (Conway et al. 1997).

5. SYSTEM CHANGES FOR NEW VCPS

Several meteorological systems make use of WSR-88D data and products. Products generated from new VCPs will not be received correctly by a system if the software has been hardcoded to receive elevation products built from current elevation angles. Consecutive products with faster refresh rates resulting from faster VCPs will not be received by systems that assume current VCP refreshes rates.

Automated Weather Interactive Processing System (AWIPS) presently will not process all products generated from new VCPs. AWIPS software will need to be modified to accommodate faster product updates and new elevation products resulting from new VCPs.

Further approvals must be obtained before new VCPs can be fielded. After formal system tests of new VCPs are performed, field tests may follow at selected forecast offices.

6. SUMMARY

New VCPs, compared to current VCPs, may provide greater temporal and vertical resolution, particularly at low altitudes. Increased resolution in time and space should result in improved algorithm performance capabilities leading to improved warnings and forecasts. Faster VCPs will provide forecasters a better chance to see first signs of potentially severe weather from quickly evolving phenomenon. More accurate radar-based precipitation estimates are anticipated. MPDA VCPs may improve Doppler velocity values and reduce range folding. Radar data processing systems will need to be ready for WSR-88D data changes resulting from new VCPs. New scanning strategies promise to become an effective operational tool for forecasters, however, further work and testing remains.

7. REFERENCES

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