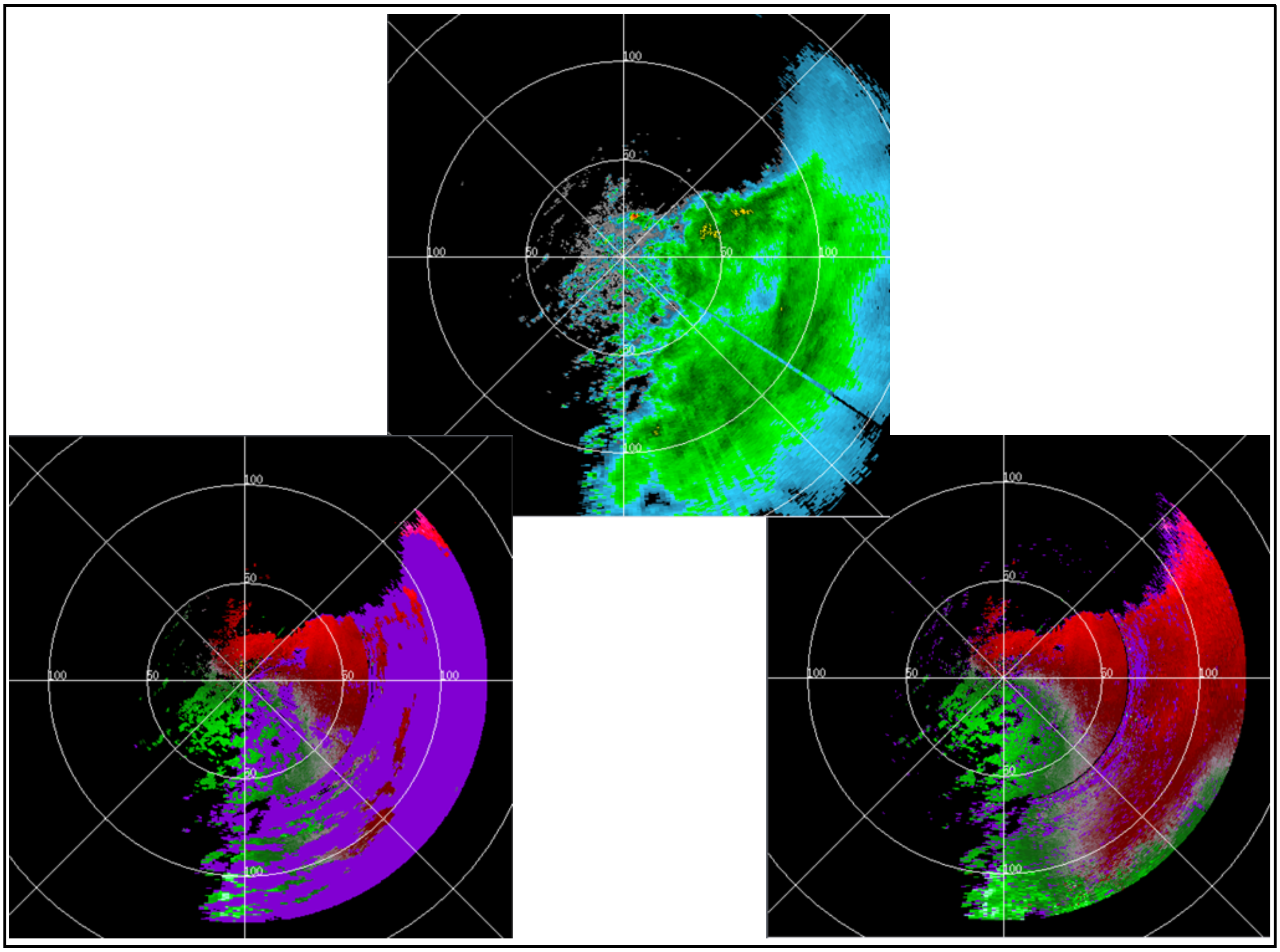
RDA/RPG Build 9.0

Training



Presented by the

Warning Decision Training Branch

Version: 0706

Overview

RDA/RPG Build 9.0 is a software upgrade at the RDA, while at the RPG both the hardware and software are upgraded. This document will present a summary of the operational impacts of RDA/RPG Build 9.0 with separate sections on the RDA and the RPG. The RDA impacts will be presented first, with the RPG impacts following.

The Build 9.0 changes at both the RPG and the RDA may impact Unit Radar Committee (URC) decision making. Coordination among URC members with respect to Build 9.0 URC impacts may be necessary.

RDA Build 9.0 Operational Impacts

The information in the RDA section reflects the pre-deployment state of knowledge of the operational impacts of RDA Build 9.0. Each of the following impacts are presented:

RPG Build 9.0 Operational Impacts

The information in the RPG section reflects the pre-deployment state of knowledge of the operational impacts of RPG Build 9.0. Each of the following impacts are presented:

Objectives

The overall goal of the RDA/RPG Build 9.0 training is to familiarize NWS forecasters with the operational impacts of this upgrade. The objectives are:

1. Identify the operational impacts of RDA Build 9.0 and integrate these impacts into operational procedures.

   a. Identify the benefit of narrowing the GMAP Seed Width Value.

   b. Identify the benefit of increasing the number of Clutter Filtering Elevation Segments.

   c. Identify differences between SZ-2 and the legacy Range Unfolding Algorithm.

2. Identify the operational impacts of RPG Build 9.0 and integrate these impacts into operational procedures.

a. Identify the overall goal of the RPG Refresh and the resultant changes to the RPG HCI windows.

b. Identify the impact of increasing the number of Clutter Filter Elevation Segments on the use of clutter regions files.

c. Identify the strengths, limitations and implementation procedures for the SZ-2 VCPs.

d. Identify the impacts of RUC data ingest on procedures for updating the Environmental Winds Table and hail temperature heights.

e. Identify changes to the MDA.

f. Identify corrections that affect cross sections in VCP 121, VCP changes or downloads, and the rain and snow products.

Electronic Performance Support System (EPSS)

The Electronic Performance Support System (EPSS) has been updated to support the Build 9.0 changes that are apparent at the RPG Human Computer Interface (HCI).

Things You Forgot You Knew?

Understanding the impacts of RDA/RPG Build 9.0 requires familiarity with a number of WSR-88D functions and concepts, some of which you may not have thought about in a long time! The following will be referenced in this document:

1. Bypass Map Clutter Filtering - A Bypass Map should be generated at the RDA for each elevation segment. The map identifies the ***location*** (azimuth and range) of clutter targets (targets with near zero velocity and narrow spectrum width). When clutter filtering within a defined region is controlled by the Bypass Map, filtering is applied ***only*** to the discrete bins identified by the map.

2. All Bins Clutter Filtering - All Bins is appropriate to address Anomalous Propagation (AP) clutter, which is transient in space and time. When clutter filtering within a defined region is controlled by All Bins, filtering is applied to ***every*** bin in that region.
3. Split Cut processing - employed for lower elevation angles for all VCPs except for VCP 121. For each Split Cut elevation, there is first a rotation using Contiguous Surveillance (CS) mode, which has a low PRF and a long maximum unambiguous range (R_{max}). At the same elevation, there is a second rotation using Contiguous Doppler (CD) mode, which has a high PRF and a short R_{max}.
4. Batch processing - employed for middle elevation angles for all VCPs except for VCP 31. The transmitted signal alternates between low PRF and high PRF mode such that ***each radial*** is sampled by a certain number of low PRF pulses, then a certain number of high PRF pulses.
5. Doppler Dilemma - there is no single PRF that maximizes R_{max} and Maximum Unambiguous Velocity (V_{max}). For example, the high PRFs necessary for good quality velocity estimates (high V_{max}) also result in a short R_{max}.
6. Range Unfolding Algorithm - The high PRFs necessary for velocity and spectrum width estimates result in range folding (multiple trip echoes) and overlaid echoes. When echoes are overlaid, the Range Unfolding Algorithm assigns the appropriate range to a velocity or

spectrum width estimate only if its returned power is significantly higher than the other(s).

7. Velocity Dealiasing Algorithm - Once velocity estimates are assigned to the appropriate range, the Velocity Dealiasing Algorithm attempts to unfold any first guess velocities that are incorrect or aliased.
8. Multiple PRF Dealiasing Algorithm (MPDA) - MPDA is used only with VCP 121. There are extra Doppler rotations at the lower elevations and the legacy Range Unfolding Algorithm unfolds velocity estimates for each Doppler rotation. Then MPDA processing performs velocity dealiasing while providing better availability of velocity estimates (less range folded data) due to the extra Doppler rotations.

RDA Build 9.0 Operational Impacts

This section covers the Build 9.0 changes at the RDA. The four changes below may or may not impact operations at the RPG. For example, the change to the GMAP seed width is not apparent at the RPG HCI, while the increase in the number of elevation segments has a big impact on tasks performed at the RPG HCI.

1. Change to GMAP Seed Width Value
2. Increase in Clutter Filtering Elevation Segments
3. SZ-2 Algorithm
4. Change To First Displayable Range Bin

1. Change to GMAP Seed Width Value

Reference

GMAP is the clutter suppression technique employed with the digital Signal Processor recently installed with the Open RDA (ORDA) upgrade. For a comprehensive overview of GMAP design and performance and Build 9.0 improvements to the clutter filtering process, see "***Optimizing Clutter Filtering in the WSR-88D***"***; R. Ice, R. Rhoton, D. Saxion, C. Ray, N. Patel, RS Information Systems; D. Warde, A. Free, SI International; O. Boydstun, D. Berkowitz, J. Chrisman, Radar Operations Center; J. Hubbert, C. Kessinger, M. Dixon, National Center for Atmospheric Research; S. Torres, National Severe Storms Laboratory.***

This document is available for download from the Build 9.0 Training web site and the URL will be presented in the Summary section on page 53.

What is Seed Width?

The seed width is the initial spectrum width that is used to determine the interval around zero velocity for clutter signal removal. The seed width is the standard deviation of the Gaussian curve that is fit to the clutter signal, which is centered at zero velocity (σ_C on Figure 1). For the initial deployment of the ORDA, the seed width was 0.7 m/s or 1.33 kts. This width means that the clutter signal removal would be over a Gaussian curve with a standard deviation (spectrum width) of 1.33 kts. This width defines an interval of ± 0.67 kts around zero velocity.

The Build 9.0 GMAP seed width is 0.4 m/s or 0.76 kts. This narrower width reduces the standard deviation (spectrum width) for clutter signal removal to 0.76 kts. This width defines an interval of ± 0.38 kts around zero velocity. This narrower width was chosen to help mitigate cases of data loss.

Why Use a Narrower Seed Width?

There have been cases of clutter filtering removing meteorological base data along and near the zero isodop for the life of the WSR-88D. The notch widths employed with the legacy RDA clutter filter-

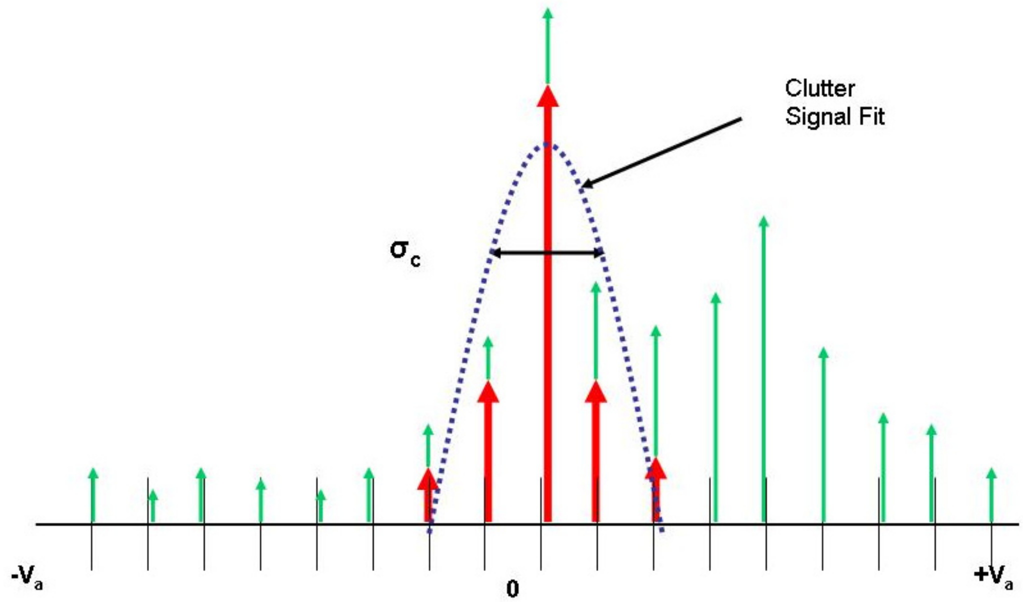


Figure 1. Interval around zero velocity for signal removal, defined by the standard deviation

ing technique varied, but ***all*** were wider than the width used by the ORDA GMAP. In the Batch elevations, there are fewer pulses per radial. With legacy clutter filtering, this resulted in very wide notch widths in the Batch elevations and the most frequent cases of data loss near the zero isodop. GMAP employs a much narrower width, but is capable of removing more power than the legacy filter. Thus, GMAP ***also*** has the potential for data loss along and near the zero isodop. Any loss of meteorological base data impacts both Base and Derived products. Rainfall estimates are particularly sensitive to data loss.

Cases of meteorological data loss due to clutter filtering are most likely to occur when All Bins clutter filtering is employed, since filtering is being applied to ***every*** range bin within the defined region. However, even with the Bypass Map in control, there can still be areas of data loss near the zero isodop if those bins are identified for clutter filtering by the

Bypass Map. In Figure 2, there is data loss on both Reflectivity and Velocity, south of the radar, along the zero isodop. ***All Bins*** suppression is being used at this time.

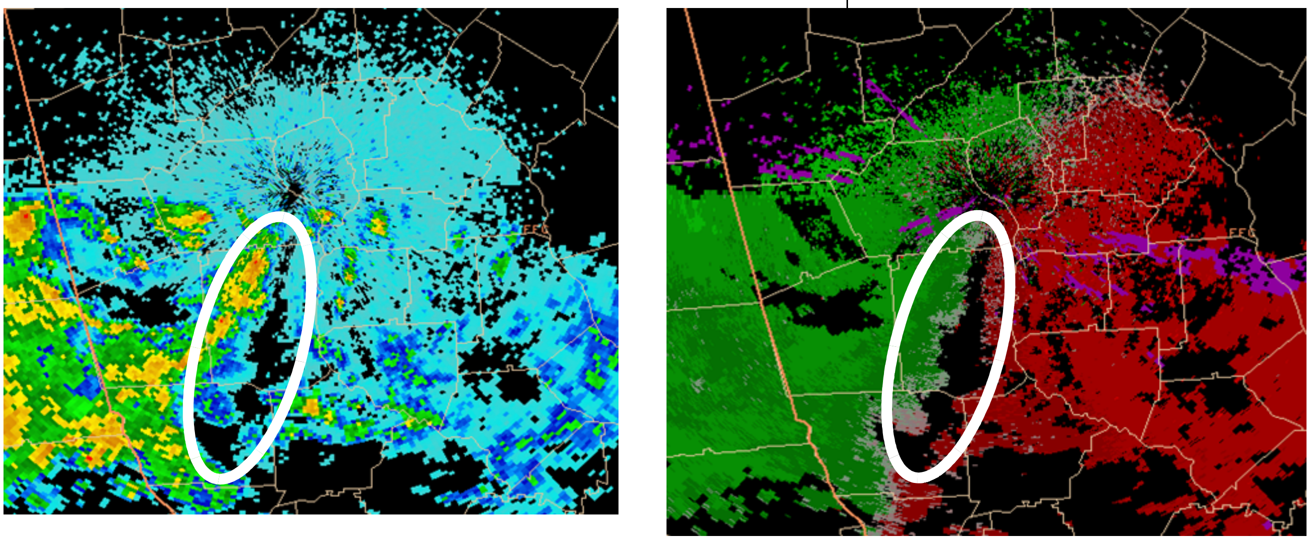


Figure 2. Data loss along the zero isodop (south of radar) with All Bins suppression applied.

Figure 3 shows the impact of applying ***Bypass Map*** suppression a short time later. Note that more data is available along the zero isodop on both Reflectivity and Velocity.

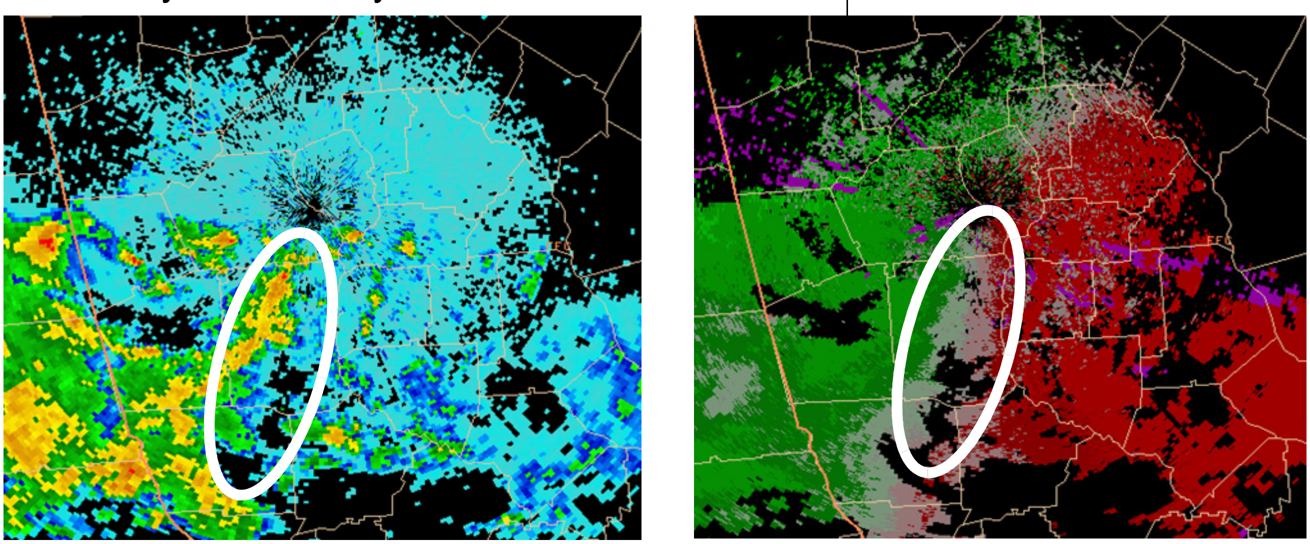


Figure 3. Data loss along the zero isodop (south of radar) mitigated by applying Bypass Map suppression.

The examples for Figure 2 and Figure 3 were collected using the original GMAP seed width of 0.7 m/s, used before Build 9.0. Figure 4 and Figure 5 illustrate the impact of narrowing the GMAP seed width to the Build 9.0 value of 0.4 m/s. In Figure 4, there is data loss along the zero isodop on both the Reflectivity and Velocity products, using the original seed width of 0.7 m/s.

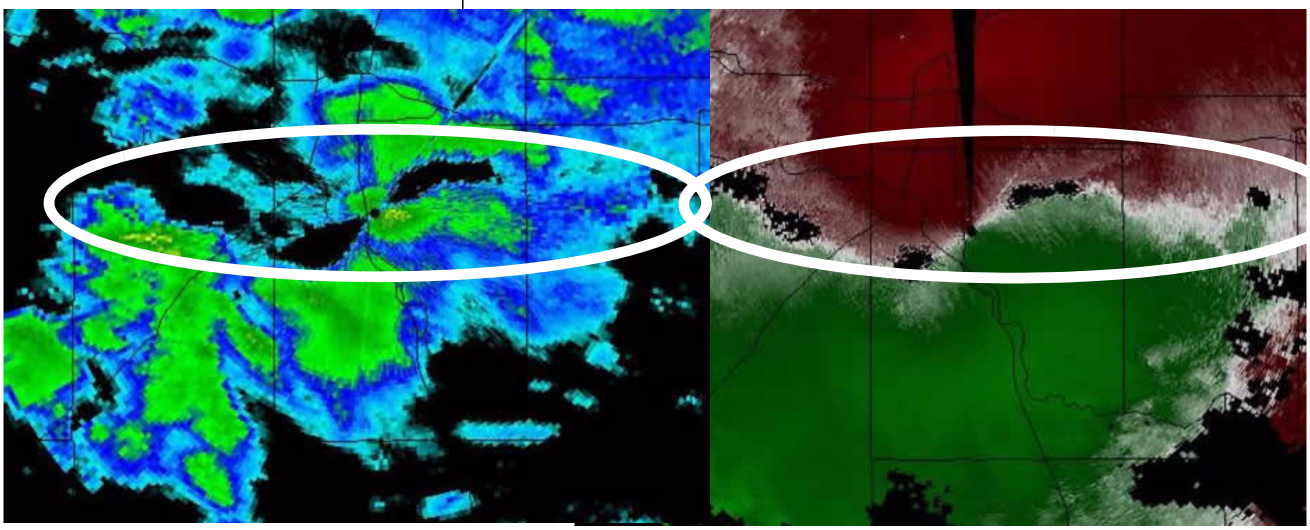


Figure 4. Data loss along the zero isodop for the GMAP seed width of 0.7 m/s.

Figure 5 depicts the same data with the Build 9.0 GMAP seed width of 0.4 m/s. There is still some data loss along the zero isodop on both the Reflectivity and Velocity products, but it is significantly less than the loss associated with the original seed width of 0.7 m/s (Figure 4).

The data case for Figure 4 and Figure 5 was collected with All Bins clutter filtering over a large area, which maximizes the data loss. Though narrowing the seed width mitigates data loss along the zero isodop, it is ***still*** important to ***avoid*** All Bins unless required by the presence of AP clutter.

Enhanced Clear Air Return

The narrowing of the GMAP seed width better isolates the clutter signal for removal. It also pre-

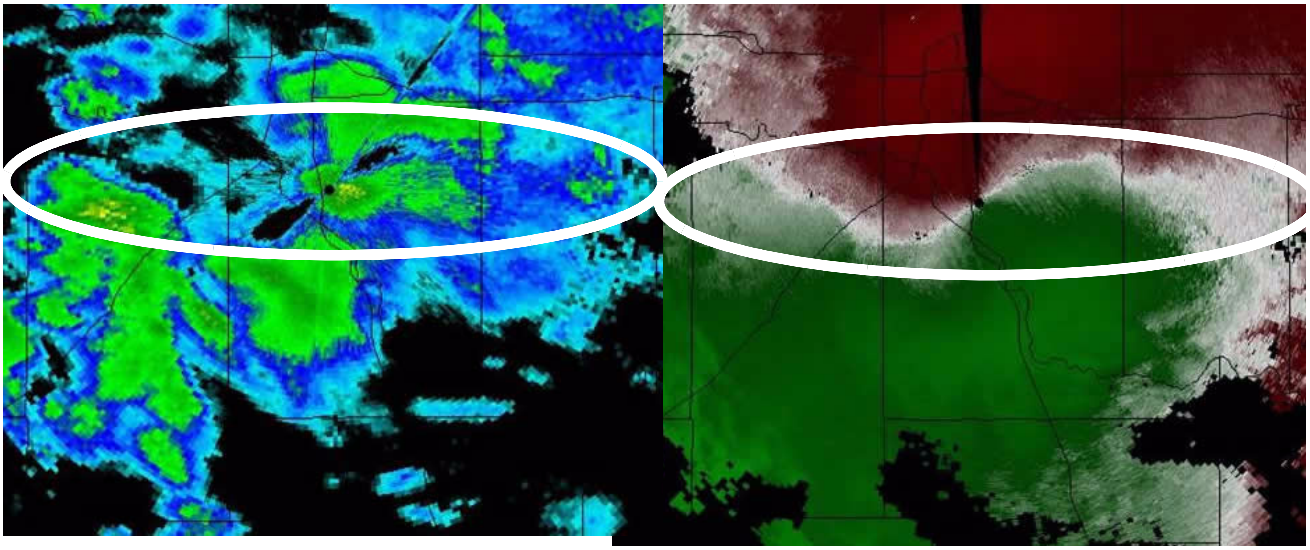


Figure 5. Data loss along the zero isodop for the Build 9.0 GMAP seed width of 0.4 m/s. Note the area of data loss is smaller with 0.4 m/s.

serves more meteorological data just outside the clutter to be available for GMAP to rebuild any lost weather signal. This will increase the availability of returns from moving non-hydrometeors such as particulates and biological targets. Though these scatterers are non-precipitable, the enhanced clear air return often reveals meteorological features of interest such as boundaries.

In Figure 6, a data case was processed with no clutter filtering (top), All Bins filtering and the pre-Build 9.0 seed width of 0.7 m/s (bottom left) and All Bins filtering and the Build 9.0 seed width of 0.4 m/s (bottom right). Note that the areal coverage of clear air return is slightly increased with the narrower Build 9.0 seed width (bottom right), compared to the pre-Build 9.0 seed width of 0.7 m/s (bottom left).

The area of precipitation is associated with low velocities and spectrum width. Note that there is some reduction in the areal coverage and intensity of precipitation with All Bins and the 0.7 m/s seed width (bottom left), compared to All Bins and the 0.4 m/s seed width (bottom right). This again demonstrates that the narrower seed width results in less data loss, even when All Bins is inappropriately used.

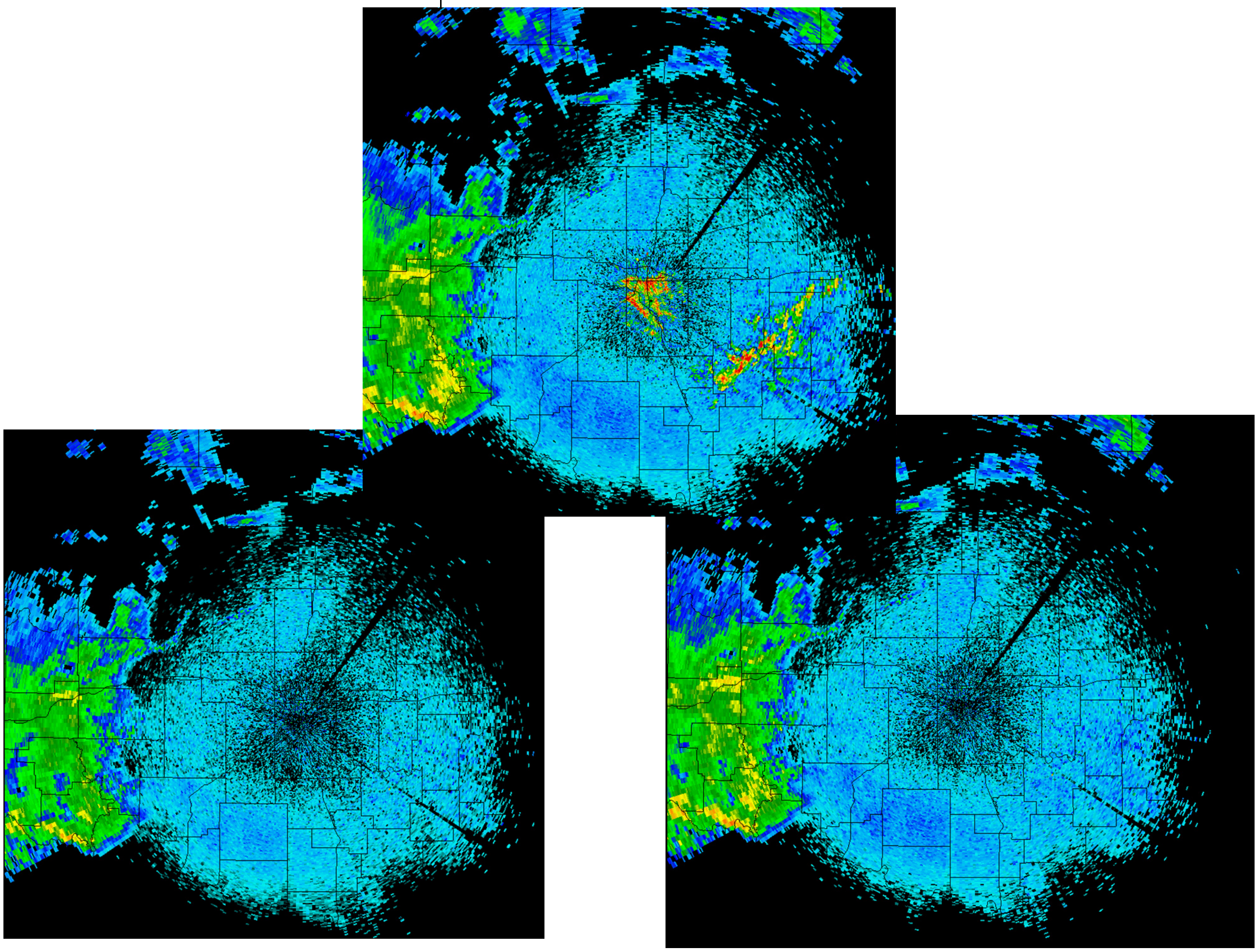


Figure 6. For the top image, there is no filtering applied, while All Bins is applied with a seed width of 0.7 m/s (bottom left) and 0.4 m/s (bottom right).

2. Increase in Clutter Filtering Elevation Segments

Reference

For a comprehensive overview of clutter filter implementation and the increase in the number of clutter filter elevation segments, see ***"A Method to Reduce the Clutter Filter Induced Bias by Improving the Vertical Application of WSR-88D***

***Bypass Maps*"; J. Chrisman, Radar Operations Center; C. Ray, RS Information Systems.**

This document is available for download from the Build 9.0 Training web site and the URL will be presented in the Summary section on page 53.

Since the original deployment of the WSR-88D, clutter filtering was available over two segments. Segment #1 (defined as the Low segment before ORDA) included the elevation angles below 1.65°. Segment #2 (defined as the High segment before ORDA) included the elevation angles above 1.65°. These two segments are depicted in Figure 7, as well as the VCP 12 angles.

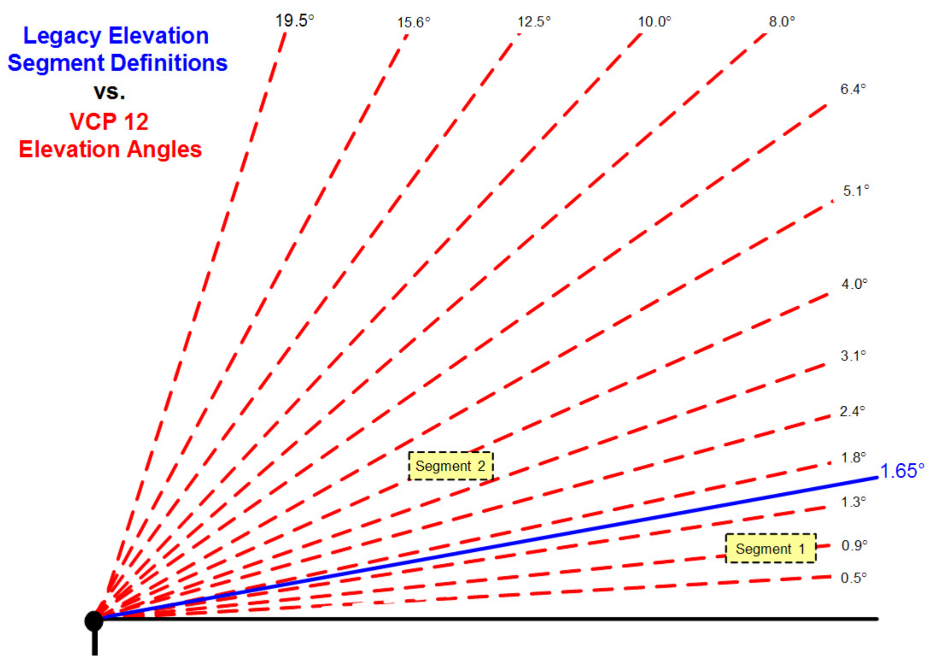


Figure 7. Pre-Build 9.0 Segments #1 and #2 and VCP 12 elevation angles.

Two Elevation Segments and Bypass Map Generation Before Build 9.0

When Clutter Filter Bypass Maps were generated before Build 9.0, one Bypass Map was created for Segment #1, while a second map was created for Segment #2. The location of clutter is identified during the map generation process and filtering is performed on those identified bins when the Bypass Map is in control.

Since the clutter pattern decreases with elevation, clutter at the lower angles within a segment dominates the Bypass Map for that segment. Filtering based on this pattern is then applied to ***all*** the elevation angles within that segment. Using Figure 7, assume that clutter is encountered up to 2.4°, but no higher. The Segment #2 Bypass Map identifies clutter targets encountered at 1.8° and 2.4°, and based on this pattern, filtering is applied to ***every*** elevation within Segment #2.

In some cases, this design has caused data loss, particularly on the products from the Batch elevations. Figure 8 shows an example of data loss over a number of range gates near a thunderstorm on both Reflectivity and Velocity just south of Stoddard. These two products are at an elevation of 6.4°. This area of data loss corresponds to the area identified by dark red on the Segment #2 Bypass Map shown on the Clutter Filter Control (CFC) product (Figure 8). In this case, the Segment #2 Bypass Map was built based on clutter identified on elevations above 1.65°. For this radar site, the clutter horizon extends up to 2.4°. There is no clutter at 6.4° and no need to filter there. However, since there were only two segments, the necessary filtering for 2.4° was applied to ***every*** elevation above 2.4°, including 6.4°.

Five Elevation Segments and Bypass Map Generation with Build 9.0

Increasing the number of elevation segments is designed to mitigate this problem. With Build 9.0, the number of elevation segments increases to five. The default elevation segment boundary angles are 1.05°, 1.65°, 4.05°, and 6.45°. Figure 9 depicts the default elevation segment boundary

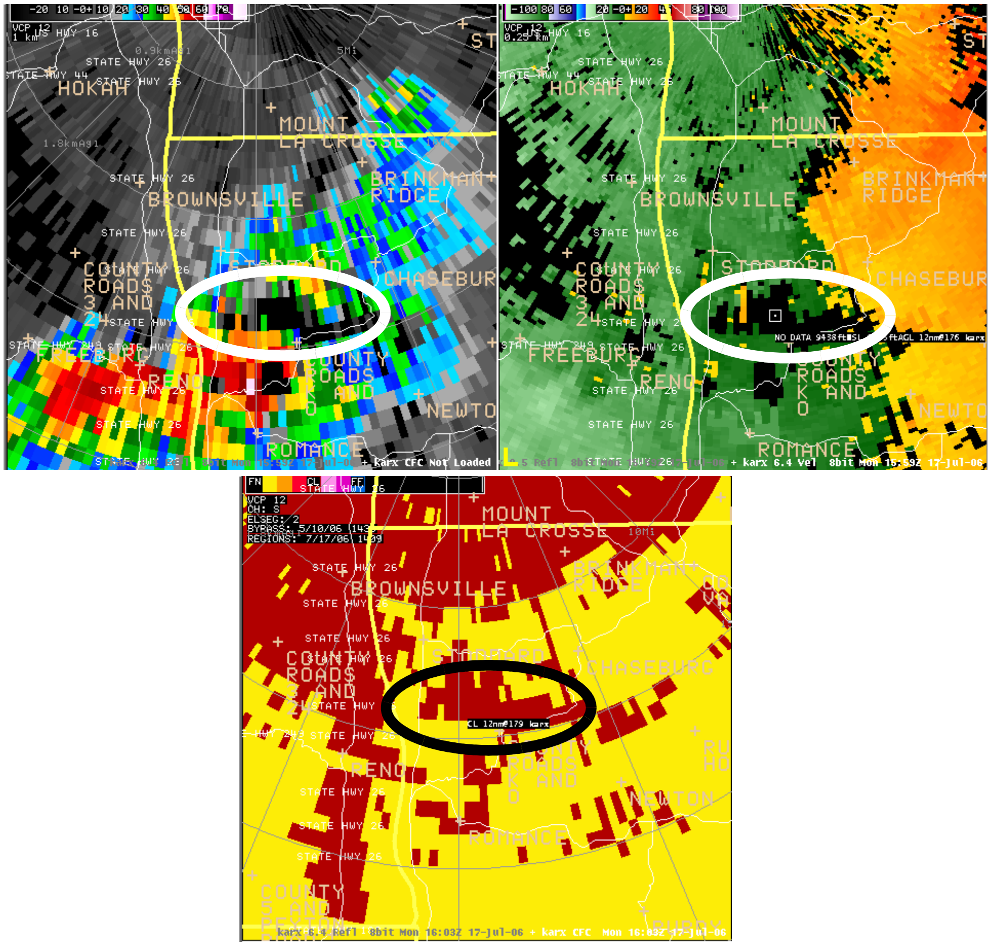


Figure 8. Data loss in Reflectivity (top left) and Velocity (top right) at 6.4° elevation for bins identified for clutter suppression by the Bypass Map (bottom).

angles along with the VCP 12 angles. ***Each*** of these elevation segments will have a ***separate*** Bypass Map. This design will help solve the problem discussed above, of filtering being applied to a particular bin based on clutter identified on the Bypass Map at a much lower elevation angle.

Build 9.0 Default Angles Used for Bypass Map Generation

Build 9.0 also has changes to the default angles used for the generation of Bypass Maps. These are the ***specific*** angles which are searched for clutter while the Bypass Maps are generated (note that this process is independent of any VCP). Except for FAA Redundant WSR-88D sites, these angles are viewed at the Generate Clutter Map window at the RDA HCI (Figure 10). Access to this

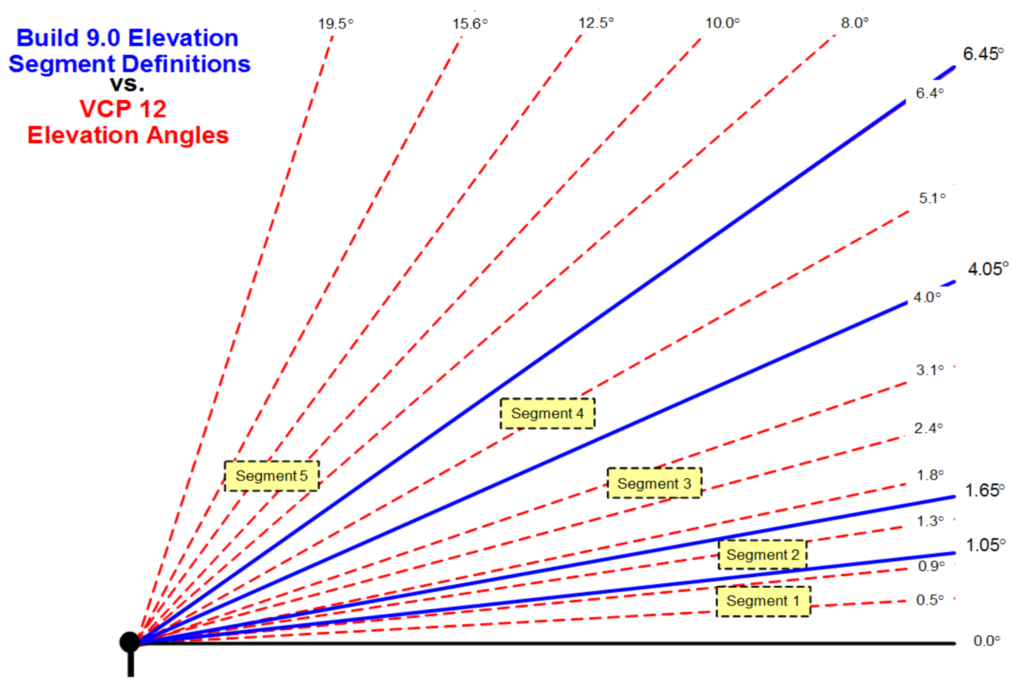


Figure 9. Build 9.0 default Elevation Segment Angles and VCP 12 angles.

window requires that a meteorologist and a technician work together to generate new Bypass Maps.

Note: The Build 9.0 ***default*** values for the SNR Threshold and the Clutter Threshold are 9.00 dB for both. It is ***recommended*** that these values be edited to 24.0 dB for SNR Threshold and 3.00 dB for Clutter Threshold, as shown in Figure 10.

The new default angles for Bypass Map generation provide better vertical resolution and are designed to correspond to the five new elevation segments. This configuration results in one or two angles per segment which are searched for clutter when the Bypass Maps are generated.

Figure 11 depicts the relationship between the Build 9.0 default Bypass Map generation angles and the angles which define the five elevation segments. With this configuration, the data loss exam-

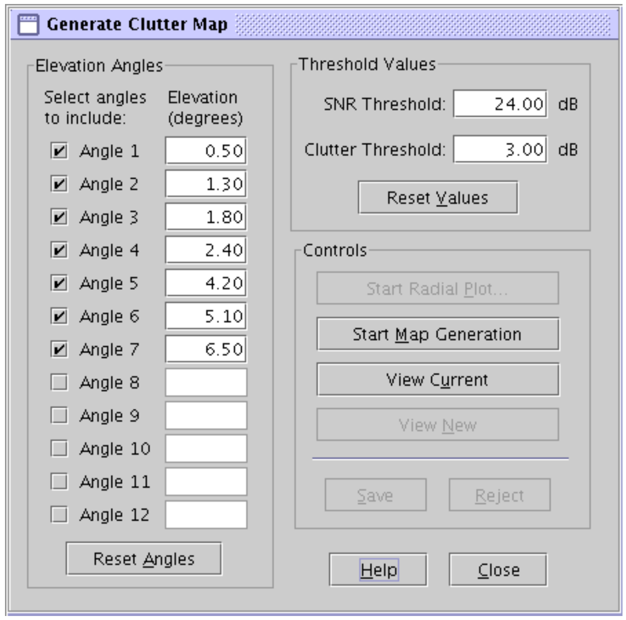


Figure 10. Build 9.0 Generate Clutter Map window at the RDA HCI.

ple that was presented in Figure 8 would not have occurred. With five elevation segments, clutter identified by the Bypass Map would have been limited to segments 1 through 3. The data at 6.4° would have been filtered based on the Bypass Map for segment #4, which was above the clutter horizon for the Figure 8 example.

The default segment definitions and Bypass Map generation angles were chosen to mitigate unnecessary clutter filtering based on sidelobe contamination. For example, clutter that is detected by the main beam at 1.8° could also be detected by sidelobes when the beam is at 2.4°. In this case, the Bypass Map for Segment 3 would apply suppression based on these detections, but this suppression would be limited to angles between 1.65° and 4.05°.

Angles are Editable

The default Bypass Map Generation angles and the elevation segment boundary angles can be edited. Though the default design is expected to

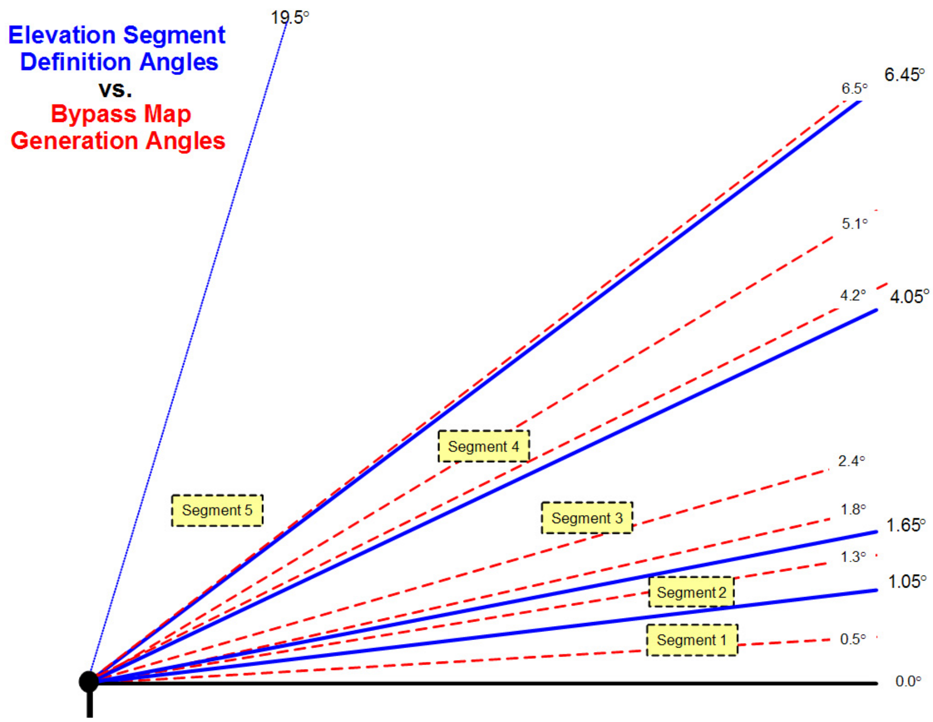


Figure 11. Build 9.0 default Bypass Map generation angles and elevation segments.

address most clutter regimes, individuals at offices considering editing the segments or the generation angles are encouraged to contact the ROC Hotline for guidance. The process of assessing the performance of the default settings as well as making any changes will require careful evaluation and testing. For example, there must be at least one default Bypass Map generation angle within each elevation segment. Editing these angles will require coordination between a technician and meteorologist (most likely the Radar Focal Point) and may also require URC coordination.

Generate New Bypass Maps ASAP

As soon as practical after the Build 9.0 installation, it ***will*** be necessary to generate Bypass Maps for ***all 5 segments***. After the Build 9.0 installation is complete, the Bypass Maps that previously existed for Build 8.0 Segments 1 and 2 are preserved and the Segment 2 Bypass Map will be copied to Segment 3. There will be ***no suppression*** defined for Segments 4 and 5.

Even for flatland sites with little terrain, sidelobes can encounter man made clutter targets. Though confined to a very close range to the radar, clutter detected by sidelobes has been observed up to 6.5° at some flatland sites. That is why it is ***so*** important to generate new Bypass Maps for all five segments ***as soon as possible*** after the Build 9.0 installation. Meteorologists are encouraged to coordinate with technicians to achieve this goal (instructions for technicians are available at NWS EHB 6-515 Revision 1, dated 15 May 2007, paragraph 6.6.3.4.8).

NWS Redundant site will need to build Bypass Maps for one side and copy the maps to the other side. Details are available as part of the Build 9.0 Release Notes.

Note: The Build 9.0 ***default*** values for the SNR Threshold and the Clutter Threshold are 9.00 dB for both. It is ***recommended*** that these values be edited to 24.0 dB for SNR Threshold and 3.00 dB for Clutter Threshold, as shown in Figure 10. See "Bypass Map Generation Guidance" available for download from the Build 9.0 Training web site (URL in the Summary section on page 53).

3. SZ-2 Algorithm

References

For a comprehensive overview of the problem of range folding, the legacy Range Unfolding Algorithm, and the new SZ-2 Algorithm, see ***"New Science for the WSR-88D: Implementing a Major Mode on the SIGMET RVP8" D. Saxion, R. Rhoton, R. Ice, G. McGehee, RS Information Systems; D. Warde, SI International; O. Boydstun,***

D. Zittel, Radar Operations Center; S. Torres, National Severe Storms Laboratory; G. Meymaris, National Center for Atmospheric Research.

Also see ***"Concept of Operations for the SZ-2 Range-Folding Mitigation Technique" D. Zittel, Radar Operations Center.***

These documents are available for download from the Build 9.0 Training web site and the URL will be presented in the Summary section on page 53.

Some History

The problem of range folding with the high PRFs needed for velocity and spectrum width estimates has been a fundamental limitation of Doppler data collection. The Range Unfolding Algorithm has been in use since the original deployment of the WSR-88D. When echoes are overlaid, the Range Unfolding Algorithm can recover ***one*** of the velocity estimates, provided the associated returned power is significantly greater than the other echo(es). The next step in mitigating range folding was the fielding of VCP 121, which uses the Multiple PRF Dealiasing Algorithm (MPDA). On the lower elevations, multiple Doppler rotations (2 or 3) with different PRFs are each range unfolded using the legacy Range Unfolding Algorithm. This improves the availability of a velocity or spectrum width estimate for any particular range bin. VCP 121 results in a significant improvement in recovering velocity data, as compared to legacy Range Unfolding with a single Doppler rotation.

The SZ-2 Algorithm is the next step in this evolution. It is executed at the signal processor at the RDA. SZ-2 can significantly reduce range folding compared to the legacy Range Unfolding Algorithm or MPDA. As with the legacy Range Unfolding Algorithm, base data that are range unfolded by SZ-2 are then passed to the legacy Velocity Dealiasing Algorithm for velocity unfolding.

SZ-2 Overview

The SZ-2 Algorithm offers an alternative method for mitigating range folding on velocity and spectrum width products. In this document, the term “velocity data” is meant to include both velocity and spectrum width. SZ-2 is named for the research scientists that developed the algorithm, Mangalore Sachidananda and Dusan Zrnic. SZ-2 is applied only to the Split Cut elevations and is available by selecting specific VCPs: 211, 221, and 212.

How Does SZ-2 Differ from Legacy Range Unfolding?

Multiple trip echoes are common with the velocity data because high PRFs are necessary for good quality velocity estimates. Thus some type of “unfolding” technique is necessary. The legacy Range Unfolding Algorithm is used for the Batch elevations in all of the VCPs. The SZ-2 VCPs use SZ-2 ***only*** for the Split Cut elevations. The non-SZ-2 VCPs use legacy Range Unfolding for the Split Cut elevations.

The legacy Range Unfolding Algorithm can, at best, recover ***one*** velocity estimate from the higher power echo, assigning Range Folded (RF) to the other(s). In most cases of echo overlay, the SZ-2 algorithm has the ability to recover velocity for ***two*** overlaid echoes.

In some cases, the difference between the legacy Range Unfolding Algorithm and SZ-2 can be dramatic. In Figure 12, there is widespread precipitation southeast of the radar. The velocity data has been processed by the legacy Range Unfolding Algorithm on the left and by SZ-2 on the right.

There is significantly greater velocity data recovery with SZ-2 for this example.

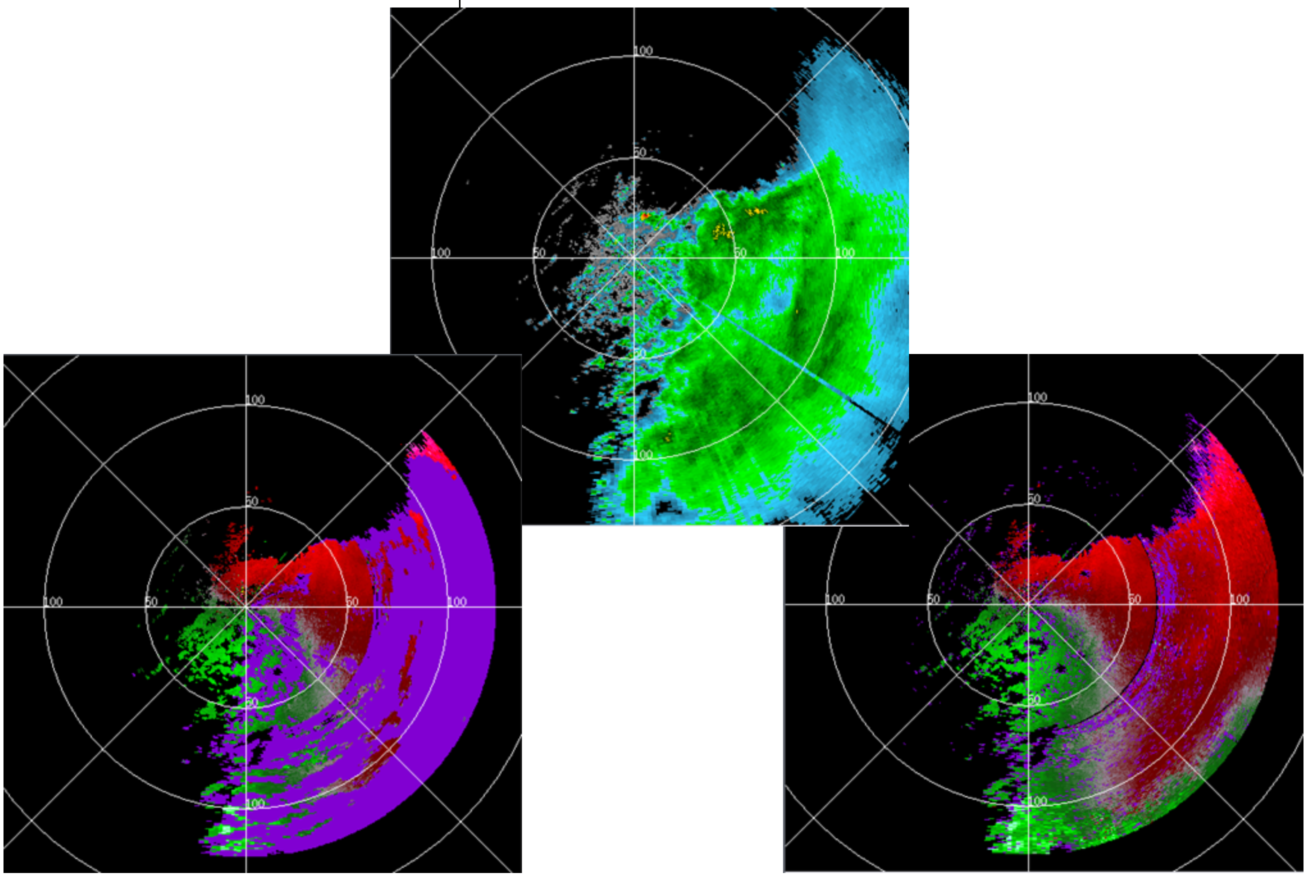


Figure 12. A widespread precipitation event with velocity processed with legacy Range Unfolding on the left and SZ-2 on the right.

The processing required to separate two echoes with similar returned power sometimes results in velocity data that are slightly noisier than data processed by the legacy Range Unfolding Algorithm.

The legacy Range Unfolding Algorithm uses Contiguous Surveillance (CS) data for power comparisons of overlaid echoes. SZ-2 also uses the CS data to compare power, but it has some additional techniques to separate overlaid echoes. During Contiguous Doppler (CD) Mode, the phase of each transmitted pulse is changed (or coded) in a systematic sequence. This sequence is known as the switching code. It is a series of 8 sequential transmitted phase values with the series repeated 8 times, resulting in a total of 64 pulses. An important requirement for SZ-2 is that there must be ***exactly*** 64 Doppler pulses per radial.

Implementing SZ-2

The requirement for 64 pulses per radial means that operators are not allowed to change the Doppler PRF for Split Cut elevations where SZ-2 is applied. Operational impacts when using the SZ-2 VCPs will be presented in more detail in “Using the SZ-2 VCPs”, (RPG Build 9.0 Impacts) beginning on page 33.

SZ-2 and the Radio Frequency (RF) Generator

A malfunctioning RF Generator may impact the SZ-2 data, which resides on the Split Cut elevations of VCPs 211, 221, and 212. The result of an RF generator problem would be SZ-2 velocity and spectrum width products with excessive noise, RF (purple) and/or excessive velocity dealiasing failures. If this is suspected, download and compare the data to a non-SZ-2 VCP. Next determine if there is a Velocity/Spectrum Width RDA Alarm. If the alarm is present, notify the maintenance technician to have the RF Generator checked.

A test was conducted at the Radar Operations Center (ROC) to determine the potential impacts of a malfunctioning RF Generator. In this particular test (Figure 13), velocity estimates were noisy and the number of velocity dealiasing failures increased. There may be cases where this type of failure also results in excessive RF (purple) on the velocity and spectrum width products.

4. Change to First Displayable Range Bin

When ORDA was initially deployed (Builds 7.0 and 8.0), the product display began at a range of 1 km, which was closer than the legacy RDA range of 2.5 km. Though initially desirable, this closer range has resulted in an increase in problems with veloc-

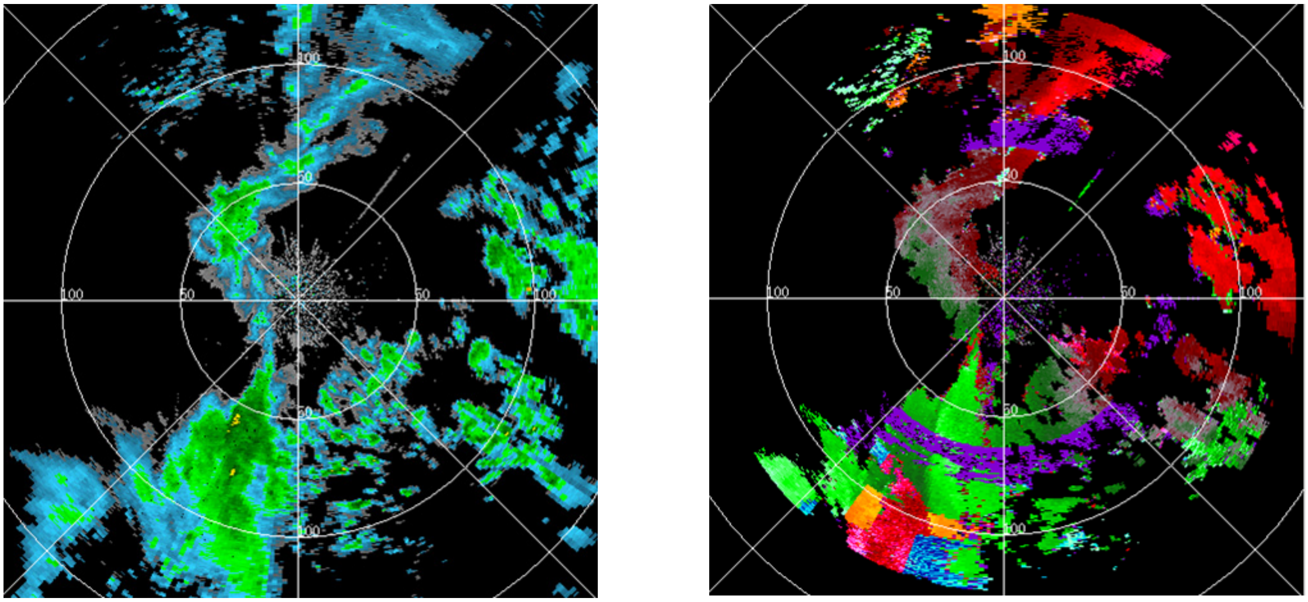


Figure 13. Results from a malfunctioning RF Generator test. Velocity estimates are noisy and velocity dealiasing failures are excessive.

ity and spectrum width estimates causing RDA alarms. With Build 9.0, the product display begins at a range of 2 km. Thus the “hole” at the center of the products will be slightly bigger. This change to the “blind spot” at the center of products is a good reminder of the need to use an adjacent radar to overcome the blind spot and the cone of silence.

RPG Build 9.0 Operational Impacts

The remainder of this document covers the eleven Build 9.0 impacts at the RPG. Some of the impacts at the RPG are unrelated to RDA changes (other than the two systems have to stay connected!). The best example of RPG changes unrelated to the RDA is the RPG Refresh, which is a redesign of the RPG that includes new hardware and software. On the other hand, some RDA changes, such as the SZ-2 Algorithm, also have a big impact at the RPG, since implementing SZ-2 requires downloading specific VCPs.

1. RPG Refresh

RPG Refresh is a replacement and redesign of both hardware and software. The long term goal is to have multiple processors running the algorithms and generating products, while the RPG software balances the workload among the processors. RPG Refresh is the first step in this redesign process. It addresses obsolescence of components as well as needed infrastructure redesign.

The MSCF/RPG operating system changes from Solaris 8 to Red Hat Enterprise Linux 4. There are two processors running with Build 9.0 and tasks are distributed between these two processors. The RPG Refresh infrastructure allows for up to eight processors. The MSCF hardware is also upgraded from the SUN Ultra 5 to a PC. The RPG components are Commercial Off the Shelf (COTS) and are easy to replace.

2. RPG HCI Window Changes

The conversion to a Linux operating system slightly changes the look of all the RPG HCI windows. One functional change for the windows is the minimize and close buttons on the upper right of each window.

RPG HCI Main Page

There are a number of changes to the RPG HCI Main Page (Figure 14). The colors have been adjusted to provide as much consistency as possible for feedback on the RDA vs. the RPG. Perhaps the most noticeable change is with the RPG box. A Maintenance Mandatory condition gives the RPG box an orange background, while a Maintenance Required condition gives the RPG box a yellow background. These same colors are used when the conditions are listed on the RPG Alarms window.

There are two new Application buttons along the right side (Figure 14). The first is “Blockage”, described as the Blockage Data Display. Clicking on the Blockage button brings up a window dis-

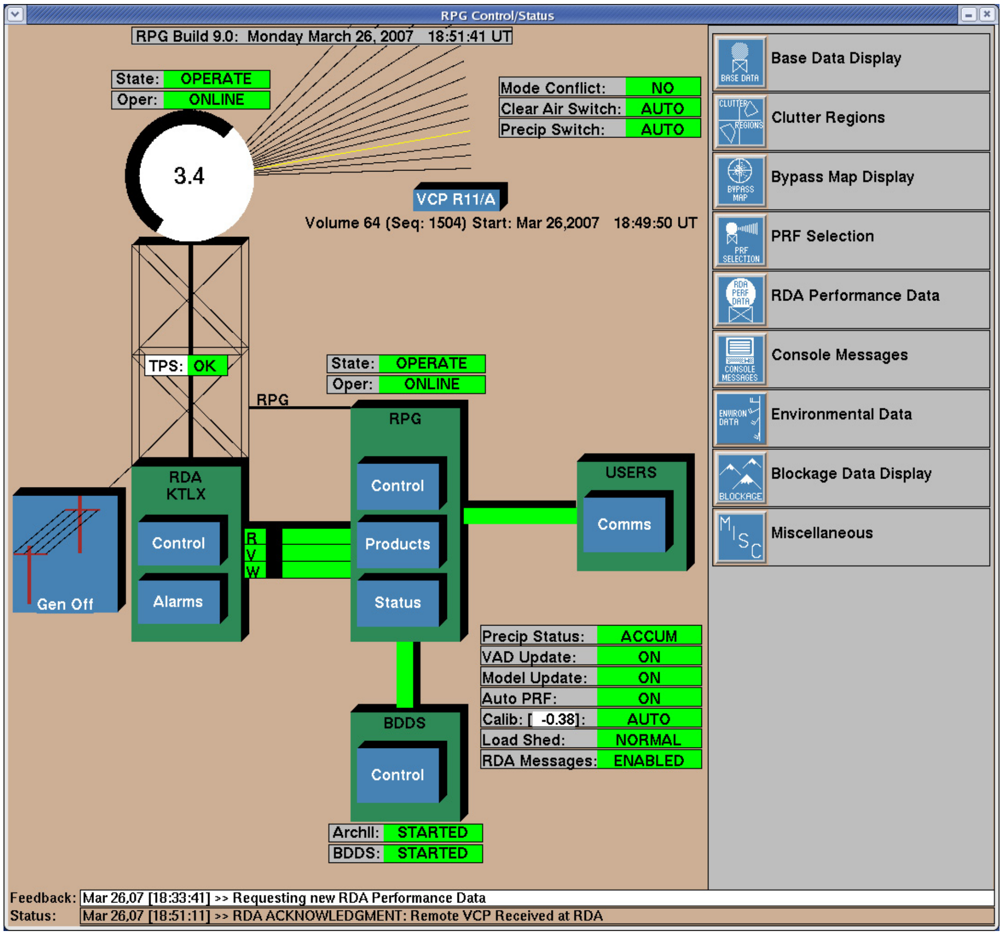


Figure 14. Build 9.0 RPG HCI Main Page.

playing the beam blockage data used by the rain and snow algorithms (Figure 15). This window can be used to verify if poor quality blockage data is suspected.

The second Application button is "MISC" described as Miscellaneous. Clicking on the MISC button brings up a window of tasks that are infrequently performed, but are now much more accessible (Figure 16). The tasks on this window would most likely be performed under the direction of a technician or the Hotline.

Communications Indicators on RPG HCI Main Page

On the RPG HCI Main Page (Figure 14), there are some changes to the indicators for the narrowband and wideband lines. If the wideband is white,

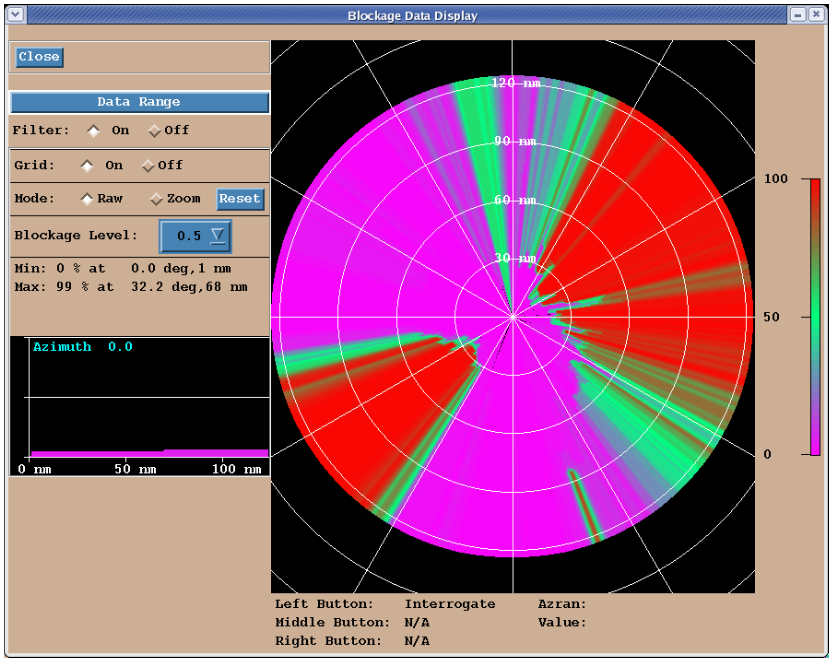


Figure 15. Build 9.0 Blockage Data Display window.

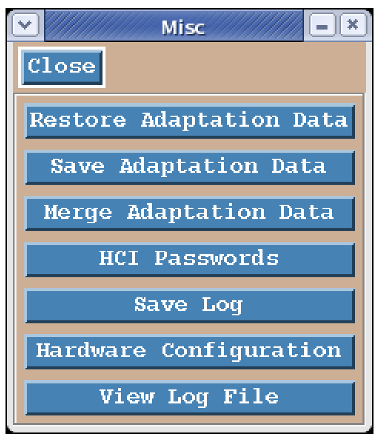


Figure 16. Build 9.0 Miscellaneous window.

it is connected, but the data moments (specifically R) are not enabled. If the wideband is yellow, it has been disconnected by an operator or a connect is pending. If the wideband is green without the R, V, and W markers, it is connected, but the base data are not flowing. If the wideband is green and the R, V, and W markers are moving, it is connected and the base data are flowing.

If any single narrowband line is connected, the narrowband line is green. There is no longer an animation when the data are flowing. If any single narrowband line has failed, the line is red. If all of the narrowband lines are disconnected (an unlikely event), the line disappears.

RPG Status Window

The choices regarding the filtering of all the status information on the RPG Status window have been combined. By clicking on the Message Filter button on the RPG Status window, a new window opens where filtering options for RDA Alarms, RPG Alarms and RPG Status messages can be selected (Figure 17).

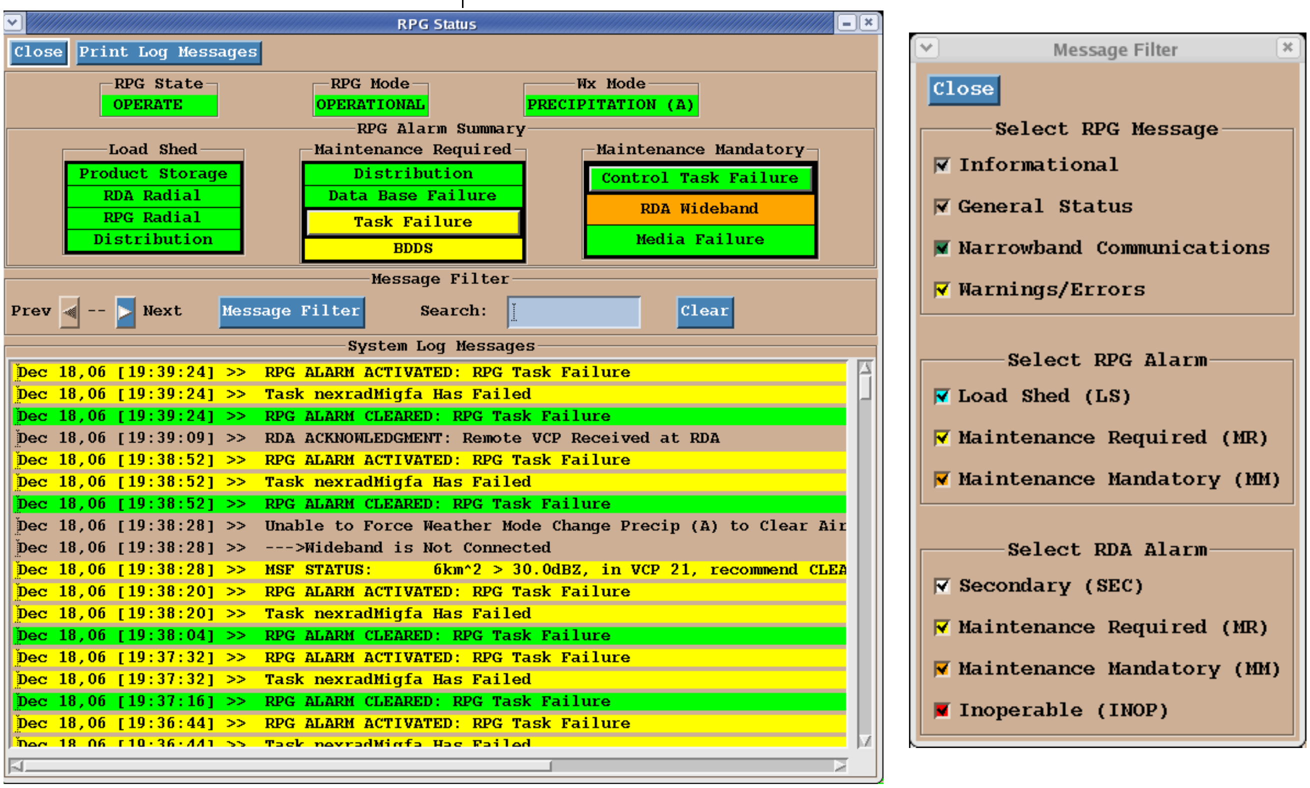


Figure 17. Build 9.0 RPG Status window and Message Filter window.

RPG Control Window

Two important tasks are now directly available at the RPG Control window once it is unlocked (Figure 18):

1. Reset Snow Accumulation

2. Hydromet (resets liquid accumulations on the STP product)

With Build 9.0, performing Standby followed by Startup is similar to the pre-Build 9.0 process of performing Standby then Restart All Tasks. The choice of performing Clean Startup vs. Startup would most likely be done under the direction of a technician or the Hotline (Figure 18).

Note: If an RPG Task Failure occurs, please notify the Radar Operations Center (ROC) Hotline. The ROC would like to identify causes for task failures in order to prevent them in the future and would like all RPG Task Failures to be reported.

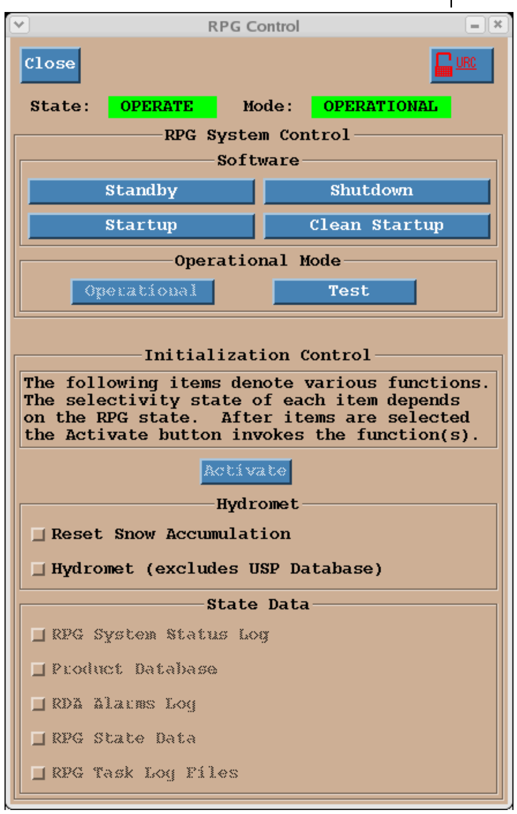


Figure 18. Build 9.0 RPG Control window.

3. RPG Impacts of Increase in Clutter Filtering Elevation Segments at RDA

Though the increase in clutter filter elevation segments resides at the RDA, there are implementation impacts at the RPG. The Clutter Regions editor window reflects the increase from two to five elevation segments, which are included in a single Clutter Regions file. The biggest impact is the existing limit of 15 regions per Clutter Regions file. Prior to Build 9.0, this has meant a total of 15 regions over two segments and thus the impact was minimal.

What is a Clutter Regions File?

A Clutter Regions file allows for customizing of clutter filtering. Suppression controlled by the Bypass Map is appropriate for most conditions except Anomalous Propagation (AP) clutter. The appropriate combination of Bypass Map and All Bins suppression is the most effective way to manage areas of AP clutter. When editing any Clutter Regions file, it is still recommended that line 1 have the Bypass Map in control everywhere (Figure 20), with additional areas drawn to address AP clutter as needed. Line 1 is one of the 15 regions allowed per file.

In Figure 19, the pre-Build 9.0 configuration is represented with two elevation segments. All of the clutter filter regions from each of these two segments are stored in a single clutter regions file. Each region within a file is a 3D volume defined by azimuth, range and elevation segment. Assume that the Segment 1 region in green has All Bins in control. Also assume that everywhere outside of this region, the Bypass Map is in control for ***both*** segments. In Segment 1, the Bypass Map is in control everywhere, forming region #1 and the green region (All Bins) is region #2. In Segment 2, the Bypass Map is in control everywhere, which would be the region #3 for this file. There are a total of 3 regions for the associated Clutter Regions file.

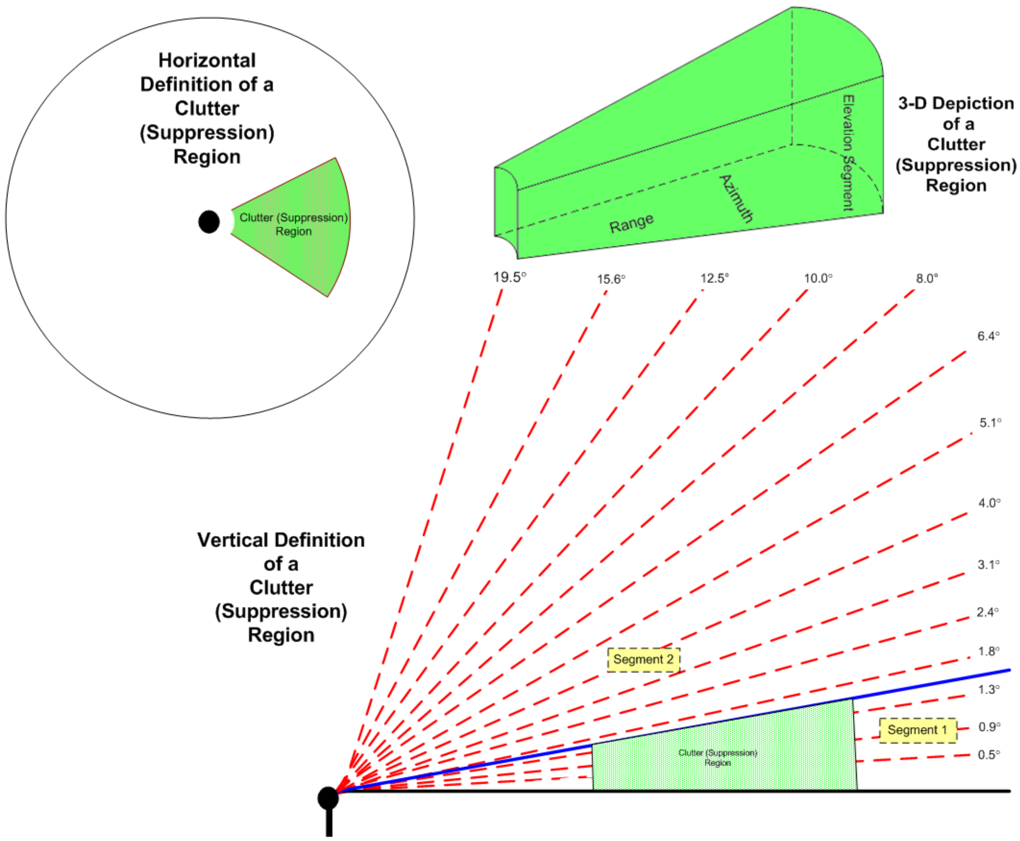


Figure 19. Pre-build 9.0 clutter filtering elevation segments and a sample clutter suppression region There are a total of 3 regions for this clutter regions file.

All Segments within One File

At the Clutter Regions editor window (Figure 20), the five segments are identified between the graphical area above and the tabular area below. A ***single*** file contains the clutter suppression regions information for ***all five*** segments. Selecting each segment button reveals the clutter suppression regions information for that segment.

For each segment, the first line in the table (region 1) indicates that the Bypass Map is in control everywhere (Figure 20). Though it is appropriate to have the Bypass Map in control as region 1 for each of the five segments, it also means that 5 of the total 15 regions have been used. There are then 10 remaining regions that can be defined among the five segments to address AP clutter. For locations with complex terrain, this limit may require some careful planning.

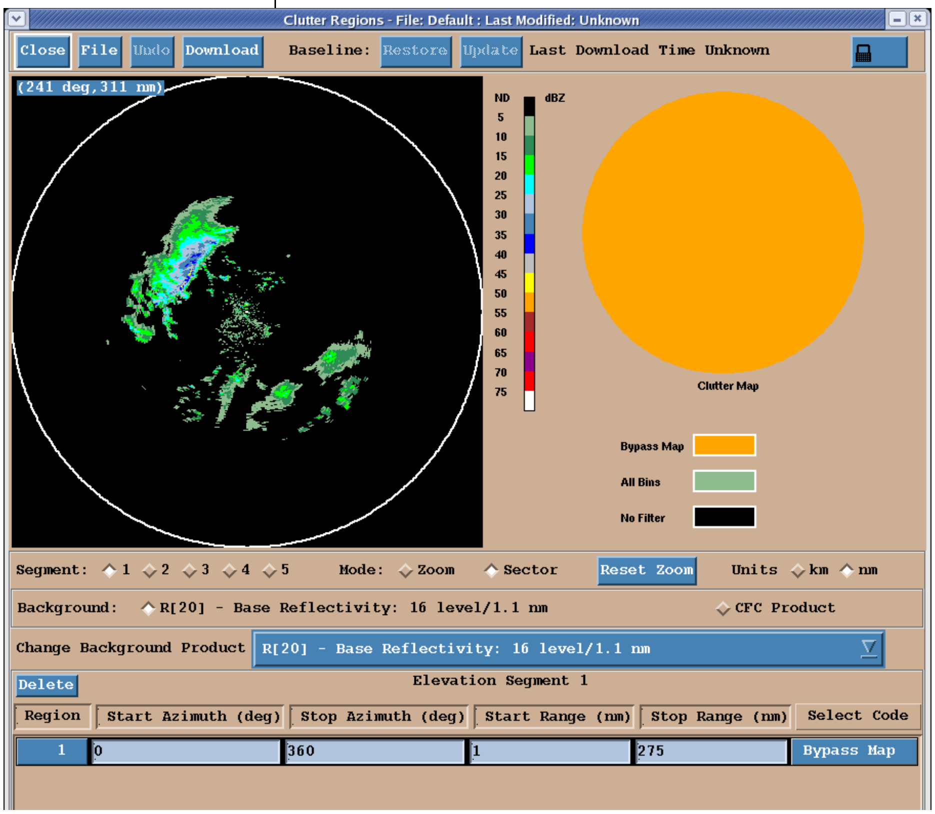


Figure 20. Build 9.0 Clutter Regions editor window at the RPG HCI.

Note: After Build 9.0 is installed, new Bypass Maps need to be generated for ***all*** 5 segments. For additional information, see “Generate New Bypass Maps ASAP” on page 18. New Bypass Maps for all 5 segments will create a new Default Clutter Regions file with the Bypass Map in control everywhere. For offices with predictable areas of AP clutter due to terrain, additional files will need to be defined to apply All Bins suppression to these areas.

Clutter Region Files Window

The Clutter Region Files window (Figure 21) has a new button labeled Open. Prior to Build 9.0, it was necessary to double click on a file in order to open it. There were occasional problems with this process. With Build 9.0, when a desired file that is currently ***not*** displayed on the Clutter Regions editor window is selected, the Open button becomes active. Clicking on Open will then open and display the selected file.

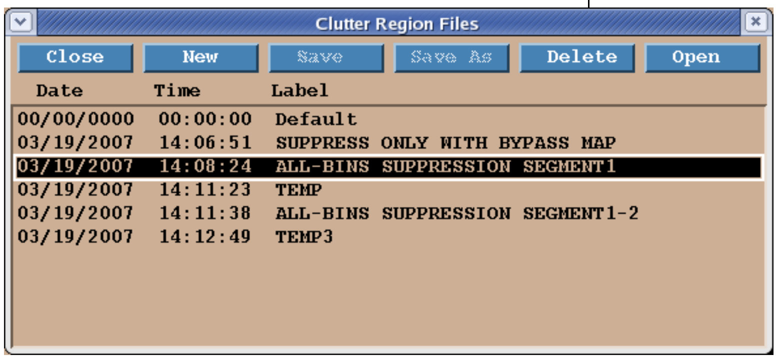


Figure 21. Build 9.0 Clutter Region Files window.

4. Using the SZ-2 VCPs

At the RPG, there are SZ-2 "versions" of VCPs 11, 21, and 12 available for downloading to the RDA. In each case, SZ-2 is used for the Split Cut elevatons. The elevation angles and volume scan update rates are similar for the legacy vs. SZ-2 VCPs. The naming convention is to precede the familiar VCP number with a "2" to indicate SZ-2:

- VCP 211 is the SZ-2 version of VCP 11 with SZ-2 applied to 0.5° and 1.5° (Figure 22).

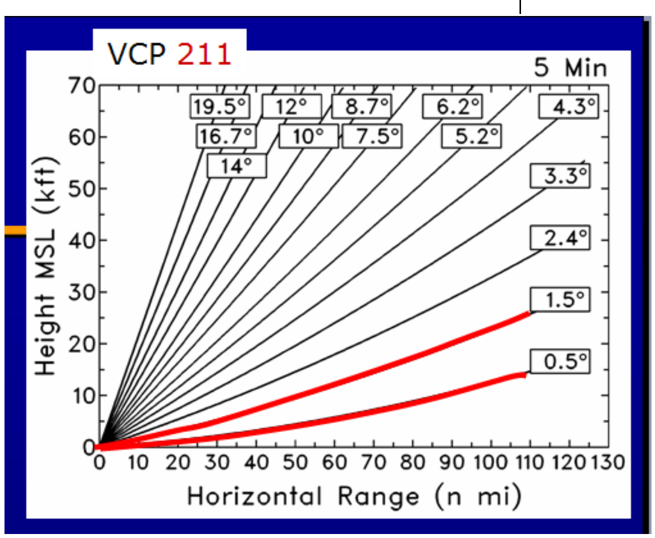


Figure 22. VCP 211.

- VCP 221 is the SZ-2 version of VCP 21 with SZ-2 applied to 0.5° and 1.5° (Figure 23).

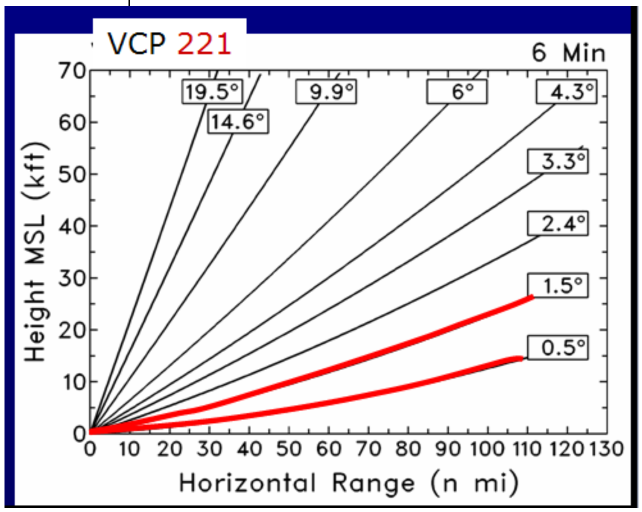


Figure 23. VCP 221.

- VCP 212 is the SZ-2 version of VCP 12 with SZ-2 applied to 0.5°, 0.9° and 1.3° (Figure 24).

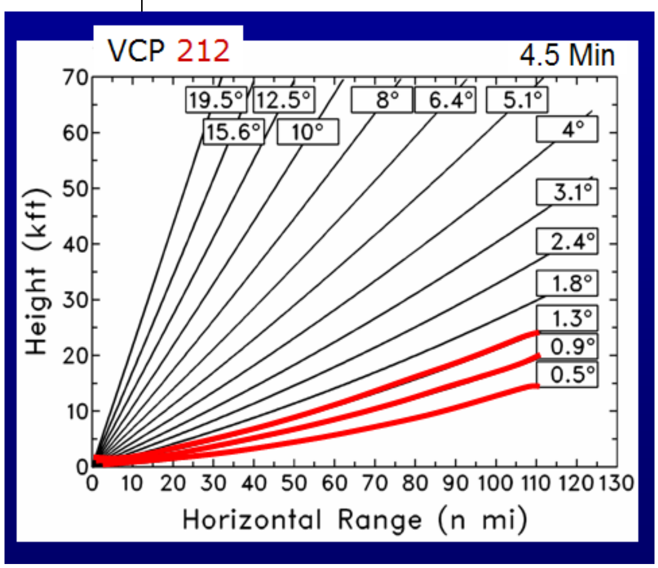


Figure 24. VCP 212.

For each of the new VCPs, the SZ-2 Algorithm is applied to the Split Cut elevations while the legacy Range Unfolding Algorithm is applied to the Batch elevations. For the Doppler rotation, the SZ-2 design requires exactly 64 Doppler pulses per radial, thus the Doppler PRF is ***not*** editable for ***any*** of the SZ-2 elevations.

Figure 25 depicts the VCP 211 specifications. To achieve the required 64 pulses per radial, PRF 8 is used for the CD rotations in SZ-2. This results in an R_{max} of 63 nm.

VOLUME COVERAGE PATTERN 211
SCAN STRATEGY SZ-2 SHORT PULSE

Scan				Surveillance		Doppler PRF No.				
Elevation (deg)	AZ Rate (deg/sec)	Period (sec)	WF Type	PRF No.	No Pulses	4 No. Pulses	5 No. Pulses	6 No. Pulses	7 No. Pulses	8 No. Pulses
0.5	18.68	19.28	SZCS	1	17	-	-	-	-	-
0.5	19.75	18.22	SZCD	-	-	-	-	-	-	64
1.45	19.84	18.14	SZCS	1	16	-	-	-	-	-
1.45	19.75	18.22	SZCD	-	-	-	-	-	-	64
2.4	16.12	22.34	B	1	6	35	41	43	46	50
3.35	17.90	20.12	B	2	6	35	41	43	46	50
4.3	17.90	20.12	B	2	6	35	41	43	46	50
5.25	17.46	20.62	B	3	10	35	41	43	46	50
6.2	17.47	20.61	B	3	10	35	41	43	46	50
7.5	25.17	14.30	CD	-	-	33	40	43	46	50
8.7	25.40	14.17	CD	-	-	33	41	43	46	50
10.0	25.42	14.16	CD	-	-	33	41	43	46	50
12.0	25.47	14.14	CD	-	-	33	41	43	46	50
14.0	25.51	14.11	CD	-	-	33	41	43	46	50
16.7	25.60	14.06	CD	-	-	33	41	43	46	50
19.5	25.70	14.01	CD	-	-	33	41	43	46	50

Figure 40-x. Volume Coverage Pattern 211

Default Doppler PRF numbers are underscored

Figure 25. VCP 211 specifications.

Figure 26 depicts the VCP 221 specifications. To achieve the required 64 pulses per radial, PRF 5 is used for the CD rotations in SZ-2. This results in an R_{max} of 80 nm.

Figure 27 depicts the VCP 212 specifications. To achieve the required 64 pulses per radial, PRF 6 is used for the CD rotations in SZ-2. This results in an R_{max} of 74 nm.

VOLUME COVERAGE PATTERN 221
SCAN STRATEGY: SZ-2 SHORT PULSE

Scan				Surveillance		Doppler PRF No.				
Elevation (deg)	AZ Rate (deg/sec)	Period (sec)	WF Type	PRF No.	No Pulses	4 No. Pulses	5 No. Pulses	6 No. Pulses	7 No. Pulses	8 No. Pulses
0.5	11.34	31.75	SZCS	1	28	-	-	-	-	-
0.5	15.61	23.06	SZCD	-	-	-	64	-	-	-
1.45	11.34	31.75	SZCS	1	28	-	-	-	-	-
1.45	15.61	23.06	SZCD	-	-	-	64	-	-	-
2.4	11.19	32.19	B	2	8	59	70	76	82	88
3.35	11.19	32.19	B	2	8	59	70	76	82	88
4.3	11.19	32.19	B	2	8	59	70	76	82	88
6.0	11.19	32.19	B	3	12	59	70	76	82	88
9.9	12.13	29.68	CD	-	-	70	83	89	96	104
14.6	12.13	29.68	CD	-	-	70	83	89	96	104
19.5	12.13	29.68	CD	-	-	70	83	89	96	104

Figure 40-x. Volume Coverage Pattern 221

Default Doppler PRF numbers are underscored

Figure 26. VCP 221 specifications.

VOLUME COVERAGE PATTERN 212
SCAN STRATEGY: SZ2 SHORT PULSE

Scan				Surveillance		Doppler PRF No.				
Elevation (deg)	AZ Rate (deg/sec)	Period (sec)	WF Type	PRF No.	No Pulses	4 No. Pulses	5 No. Pulses	6 No. Pulses	7 No. Pulses	8 No. Pulses
0.5	21.15	17.02	SZCS	1	15	-	-	-	-	-
0.5	16.90	21.30	SZCD	-	-	-	-	64	-	-
0.9	21.15	17.02	SZCS	1	15	-	-	-	-	-
0.9	16.90	21.30	SZCD	-	-	-	-	64	-	-
1.3	21.15	17.02	SZCS	1	15	-	-	-	-	-
1.3	16.90	21.30	SZCD	-	-	-	-	64	-	-
1.8	24.64	14.61	B	1	3	25	29	32	34	37
2.4	26.40	13.64	B	2	3	25	30	32	35	38
3.1	26.40	13.64	B	2	3	25	30	32	35	38
4.0	26.40	13.64	B	2	3	25	30	32	35	38
5.1	28.01	12.86	B	3	3	25	30	32	35	38
6.4	28.01	12.86	B	3	3	25	30	32	35	38
8.0	28.40	12.68	CD	-	-	30	35	38	41	44
10.0	28.88	12.46	CD	-	-	29	34	37	40	44
12.5	28.74	12.53	CD	-	-	29	34	37	40	44
15.6	28.74	12.53	CD	-	-	29	34	37	40	44
19.5	28.74	12.53	CD	-	-	29	34	37	40	44

Figure 40-x. Volume Coverage Pattern 212 PRF 6 (updated 22 Dec 2006)

Default Doppler PRF numbers are underscored

Figure 27. VCP 212 specifications.

For VCPs 211, 221, and 212, two new waveforms are defined for the Split Cut elevations. SZCS is similar to CS, using a low PRF for range and power. SZCD uses a high PRF just as the CD waveform does, with the Doppler PRF held constant at 64 pulses per radial. VCPs 211 and 221 have the same volume scan completion times as VCPs 11 and 21, five and six minutes, respectively. VCP 212 takes about 20 seconds longer than VCP 12, with a completion time of about 4.5 minutes.

Downloading an SZ-2 VCP

The SZ-2 VCPs are selectable at the RPG and must be downloaded to the RDA. The Build 9.0 VCP and Mode Control window (Figure 28) has been redesigned to accommodate the three new VCPs. As a result, there are now dropdown menus for selecting VCPs.

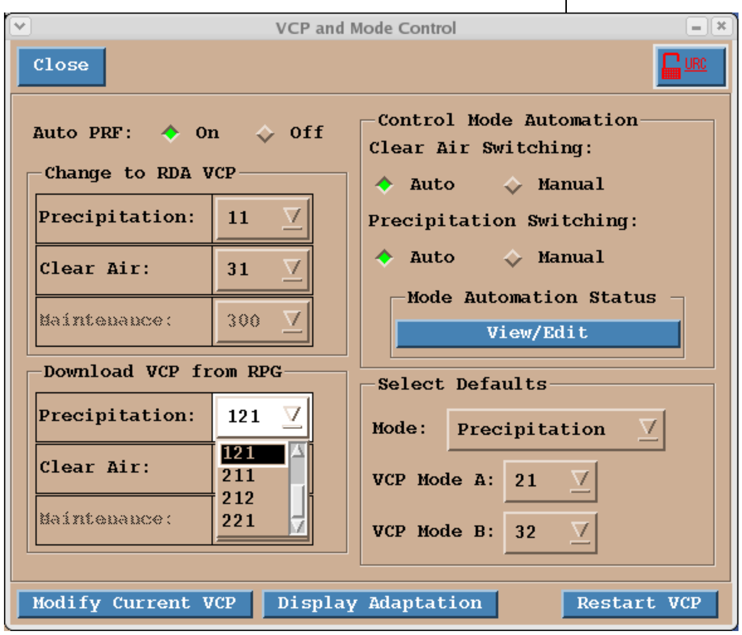


Figure 28. Build 9.0 VCP and Mode Control window. Note that VCPs are now selectable from dropdown menus.

AWIPS OB 7.1 provides default RPS lists for VCPs 211, 221, and 212. Feedback from the Build 9.0 Beta Test is that the default lists require minimal editing to begin using the SZ-2 VCPs.

Reduction of RF with SZ-2

In most cases, SZ-2 offers a significant reduction in range folded (RF) velocity data. In studies, the reduction ranges from 35% to 95%. SZ-2 will provide the best results for widespread precipitation events. SZ-2 can also sometimes recover velocity data for storms in the second trip of the velocity data that would not be recovered with the legacy Range Unfolding Algorithm. The choice of which SZ-2 VCP to use will likely be driven by the distribution and vertical extent of convection. Just as VCP 12 is preferred over VCP 21 for deep convection, the SZ-2 version, VCP 212, would also be preferred over VCP 221.

Figure 29 is an example of a widespread event comparing the extent of RF for legacy Range Unfolding (left) and SZ-2 (right) at the lowest elevation. These data were collected using the same antenna, switching from a conventional VCP to an SZ-2 VCP.

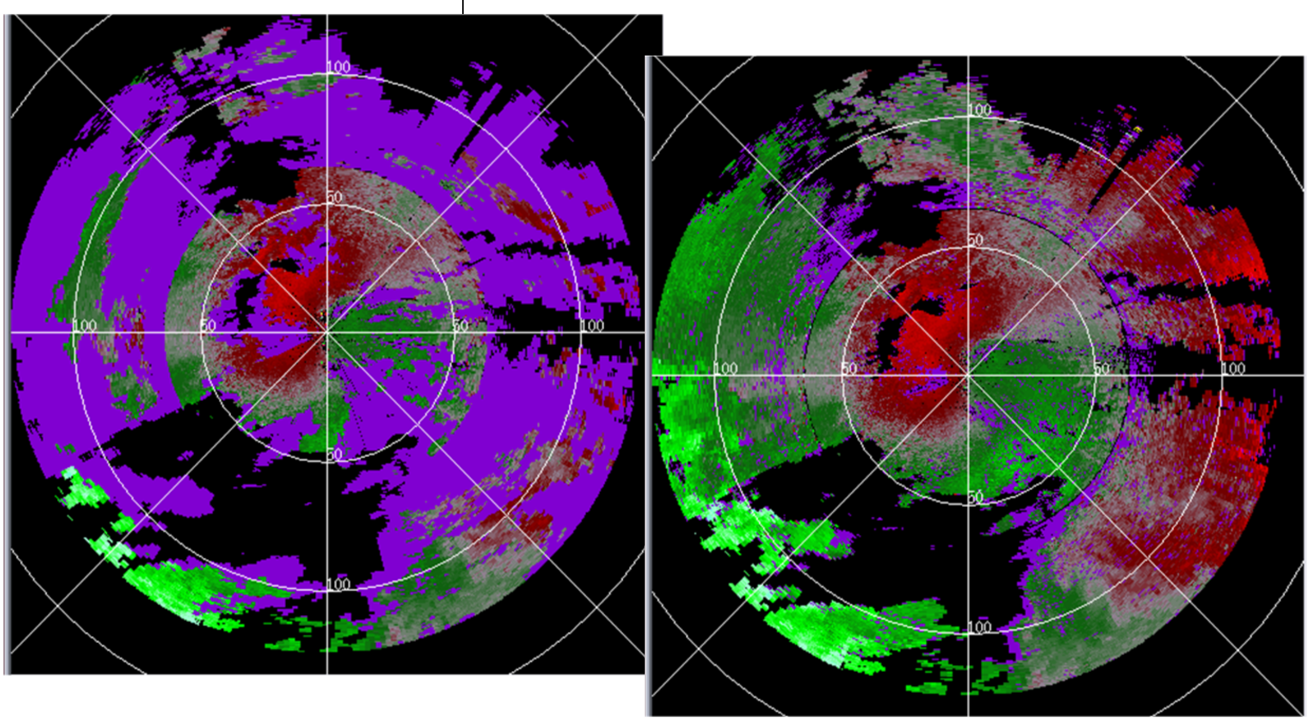


Figure 29. Example of legacy Range Unfolding (left) vs. SZ-2 (right) for a widespread event using the same antenna.

Figure 30 is an example of an event where a storm is located in the second trip of the velocity data. SZ-2 (right) does a much better job of recovering the velocity data for this particular storm than legacy Range Unfolding (left). These data were collected using two different but nearby antennas.

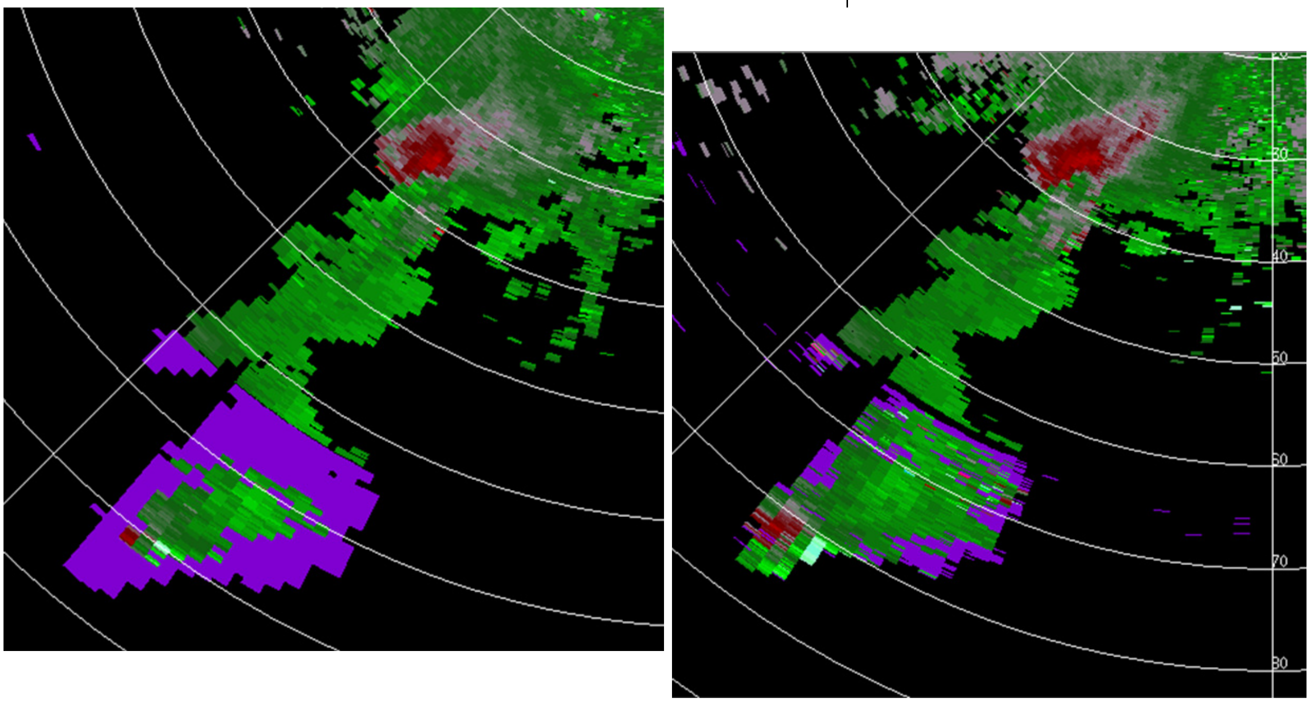


Figure 30. Example of legacy Range Unfolding (left) vs. SZ-2 (right) where a storm in the second trip is better recovered with SZ-2. This example was collected using two different, but nearby antennas.

Cautions When Using SZ-2

Though SZ-2 provides significant improvement in the availability of velocity data, there are two issues to consider when using the SZ-2 VCPs.

SZ-2 and All Bins

The use of All Bins clutter filtering over large areas for SZ-2 elevations will significantly degrade data quality. The result is velocities that are noisy in appearance and difficult to interpret. This is in addition to the risk of data loss in both Reflectivity and Velocity that can occur with the use of All Bins over large areas.

In Figure 31, All Bins has been applied over the entire display to the same data processed by the legacy Range Unfolding Algorithm (left) and by the SZ-2 Algorithm (right). Note that the SZ-2 velocity data are noisier in appearance and that there are a larger number of zero velocities. This impact of All Bins is a result of the design of the SZ-2 Algorithm. In cases where clutter regions have been defined with All Bins over more than one trip in the velocity, SZ-2 may not be able to remove the clutter and the velocity data may be biased toward zero. The use of All Bins over areas encompassing both trips is likely to create this condition.

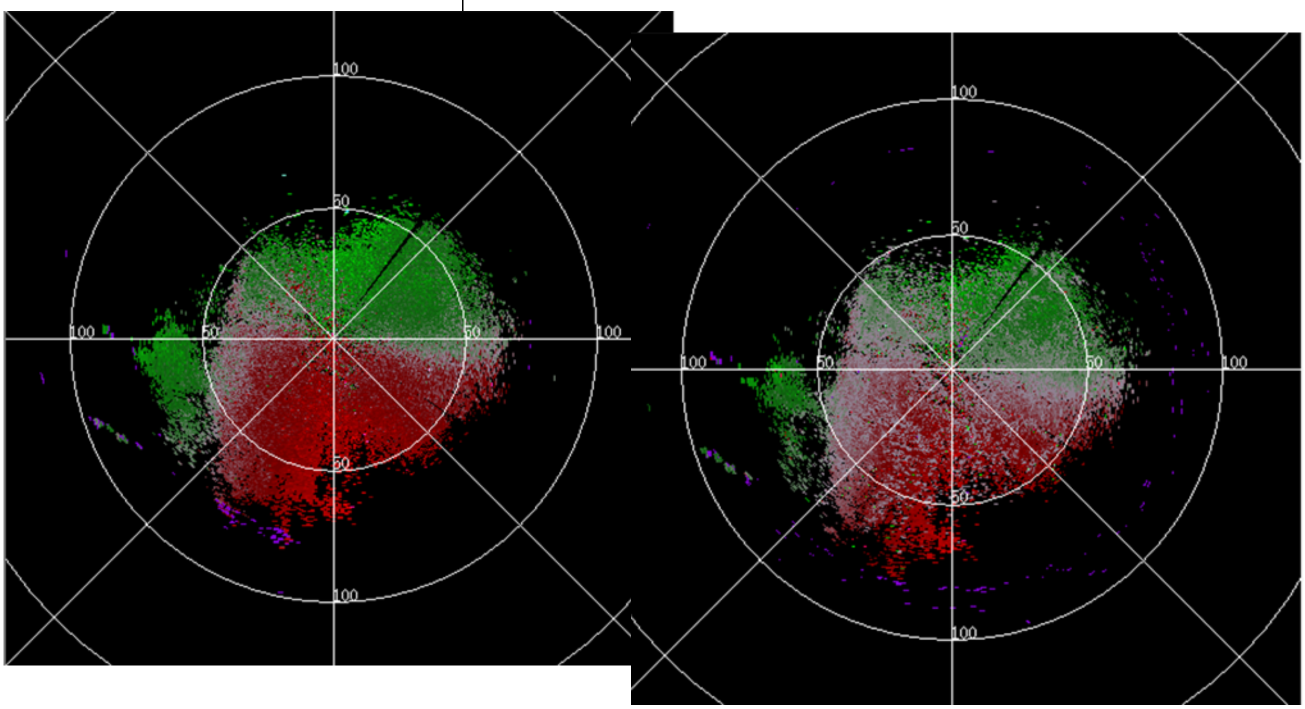


Figure 31. All Bins over the entire display is applied to the same data processed by the legacy Range Unfolding Algorithm (left) and by the SZ-2 Algorithm (right).

Cannot Edit Doppler PRFs with SZ-2

The Doppler PRF is not editable for any SZ-2 elevation. For the Batch elevations of the SZ-2 VCPs, Auto PRF can be used or the Doppler PRF can be edited. The R_{max} on the Velocity and Spectrum Width products for the Split Cut elevations for each of the SZ-2 VCPs ***will not*** change. The R_{max} values are:

- VCP 211: R_{max} = 63 nm

- VCP 221: R_{max} = 80 nm
- VCP 212: R_{max} = 74 nm

For events where the echoes extend into the second trip of the velocity data, there is often a band of RF just beyond the first trip. If there is a storm in this area, it will likely be obscured by RF. It will then be necessary to switch to an alternate SZ-2 VCP (different R_{max}) or a non-SZ-2 VCP to edit the Doppler PRF to unmask the storm. For example, if a storm is masked while using VCP 211, downloading VCP 11 will result in an initial R_{max} of 94 nm. Figure 32 has a typical example of this band of RF.

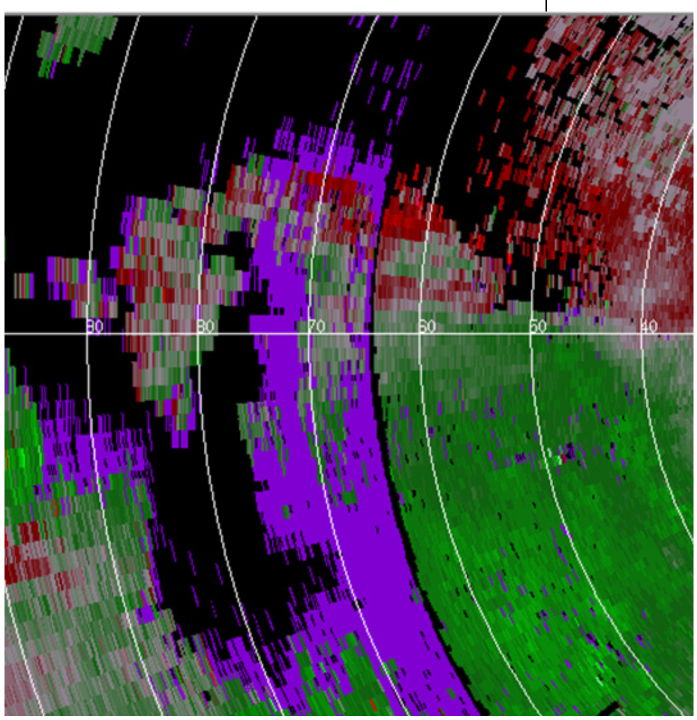


Figure 32. The Doppler PRF for SZ-2 elevations is constant and there is often a band of RF just beyond the first trip. Storms in this area may be obscured by RF.

Strengths of SZ-2 VCPs

1. Significant increase in the availability of velocity data with 35% to 95% less RF as compared to the legacy Range Unfolding Algorithm.

2. Best results from events with radar returns over widespread areas, which maximizes echo overlay.

Limitations of SZ-2 VCPs

1. Use of All Bins over large areas will degrade the quality of the velocity estimates. Use of the SZ-2 VCPs is discouraged when AP clutter is present, requiring All Bins to address the AP clutter.
2. For the SZ-2 VCPs, the Doppler PRF for the Split Cut (SZ-2) elevations is constant and not editable. It is typical for a small band of RF data to exist just beyond the first trip with SZ-2. If a significant storm is in this area of RF, a different VCP will be needed. A different SZ-2 VCP (with a different R_{max}) may be sufficient, or a legacy VCP with the capability to edit the Doppler PRF may be needed.

VCP Comparison Chart and VCP Naming Strategy

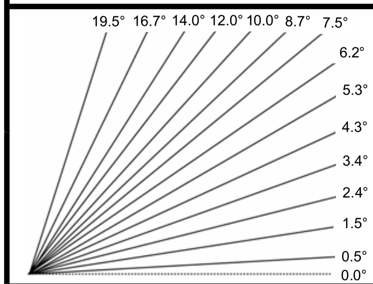
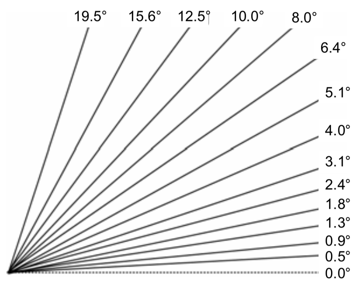
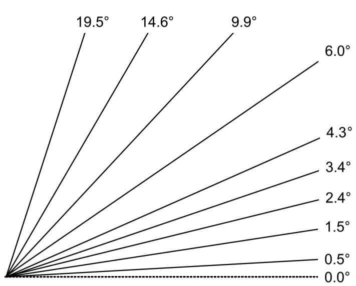
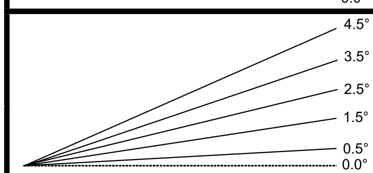
The new VCPs introduced with Build 9.0 increases the challenge of determining the best VCP for a given situation. The VCP Comparison Chart (Figure 33) is a summary of the uses and limitations for the available VCPs.

VCPs 11, 12, 21, 31, and 32 are most familiar to users and all use two digit names. Among the VCPs with three digits are 121, 211, 221, and 212. VCP 121 is the only MPDA VCP, and the preceding 1 signals that this is an MPDA VCP. The 1 is followed by 21, which tells you that this VCP uses the same angles as VCP 21.

The SZ-2 VCPs are all preceded by a 2. The remaining digits tell you which angles are used. For example, VCP 212 uses the same angles as VCP 12. The difference is that SZ-2 is used instead of legacy Range Unfolding on the Split Cut elevations.

Quick Reference VCP Comparison Table for RPG Operators

February 2007

Slices	Tilts	VCP	Time*	Usage	Limitations
	14	11	5 mins	Severe and non-severe convective events. Local 11 has Rmax=80nm. Remote 11 has Rmax=94nm.	Fewer low elevation angles make this VCP less effective for long-range detection of storm features when compared to VCPs 12 and 212.
		211	5 mins	Widespread precipitation events with embedded, severe convective activity (e.g. MCS, hurricane). Significantly reduces range-obscured V/SW data when compared to VCP 11.	All Bins clutter suppression is NOT recommended. PRFs are not editable for SZ-2 (Split Cut) tilts.
	14	12	4 ½ mins	Rapidly evolving, severe convective events. Extra low elevation angles increase low-level vertical resolution when compared to VCP 11.	High antenna rotation rates decrease the effectiveness of clutter filtering, increase the likelihood of bias, and slightly decrease accuracy of the base data estimates.
		212	4½ mins	Rapidly evolving, widespread severe convective events (e.g. squall line, MCS). Increased low-level vertical resolution compared to VCP 11. Significantly reduces range-obscured V/SW data when compared to VCP 12.	All Bins clutter suppression is NOT recommended. PRFs are not editable for SZ-2 (Split Cut) tilts. High antenna rotation rates decrease the effectiveness of clutter filtering, increase the likelihood of bias, and slightly decrease accuracy of the base data estimates.
	9	21	6 mins	Non-severe convective precipitation events. Local 21 has Rmax=80nm. Remote 21 has Rmax=94nm.	Gaps in coverage above 5°.
		121	6 mins	VCP of choice for hurricanes. Widespread stratiform precipitation events. Significantly reduces range-obscured V/SW data when compared to VCP 21.	PRFs are not editable for any tilt. Gaps in coverage above 5°.
		221	6 mins	Widespread precipitation events with embedded, possibly severe convective activity (e.g. MCS, hurricane). Further reduces range-obscured V/SW data when compared to VCP 121.	All Bins clutter suppression is NOT recommended. PRFs are not editable for SZ-2 (Split Cut) tilts. Gaps in coverage above 5°.
	5	31	10 mins	Clear-air, snow, and light stratiform precipitation. Best sensitivity. Detailed boundary layer structure often evident.	Susceptible to velocity dealiasing failures. No coverage above 5°. Rapidly developing convective echoes aloft might be missed.
		32	10 mins	Clear-air, snow, and light stratiform precipitation.	No coverage above 5°. Rapidly developing convective echoes aloft might be missed.

*VCP update times are approximate.

Figure 33. VCP Comparison Chart

5. RPG Ingest of Environmental Data from AWIPS

The RPG uses environmental data to support two algorithms:

1. Wind profile data from the Environmental Winds Table (EWT) supports the Velocity Dealiasing Algorithm
2. Temperature profile data supports the Hail Detection Algorithm with heights of the 0° and -20° C temperatures

In the past, both sets of data have had to be manually entered at the RPG. For the CONUS WSR-88D sites, RPG Build 9.0 and AWIPS OB 7.2 provide an automated environmental data transfer from AWIPS to the RPG. Transferring data automatically ensures that all environmental data in the RPG is updated regularly. In addition, future WSR-88D enhancements could use high resolution environmental data for applications such as assessing near storm environment or identifying precipitation type.

AWIPS to Send RUC Grid Hourly

Using the Rapid Update Cycle (RUC) model through AWIPS, 3-D grids of temperature, height, RH and U/V wind components are ingested into the RPG. The one hour forecast grids are provided hourly at the top of the hour. There are 3 possible RUC resolutions ingested by the RPG: 13 km, 40 km and 80 km. The 40 km grid is expected to be the default resolution, but the RPG software is designed to process a different resolution if 40 km is unavailable. The RPG will select the RUC grid point closest to the RDA, based on latitude and longitude.

Changes to Environmental Data Editor Window

The automated ingest of RUC data results in a number of changes to the Environmental Data Editor window (Figure 34). “Model Update” must be set to On to allow the hourly RUC data to populate

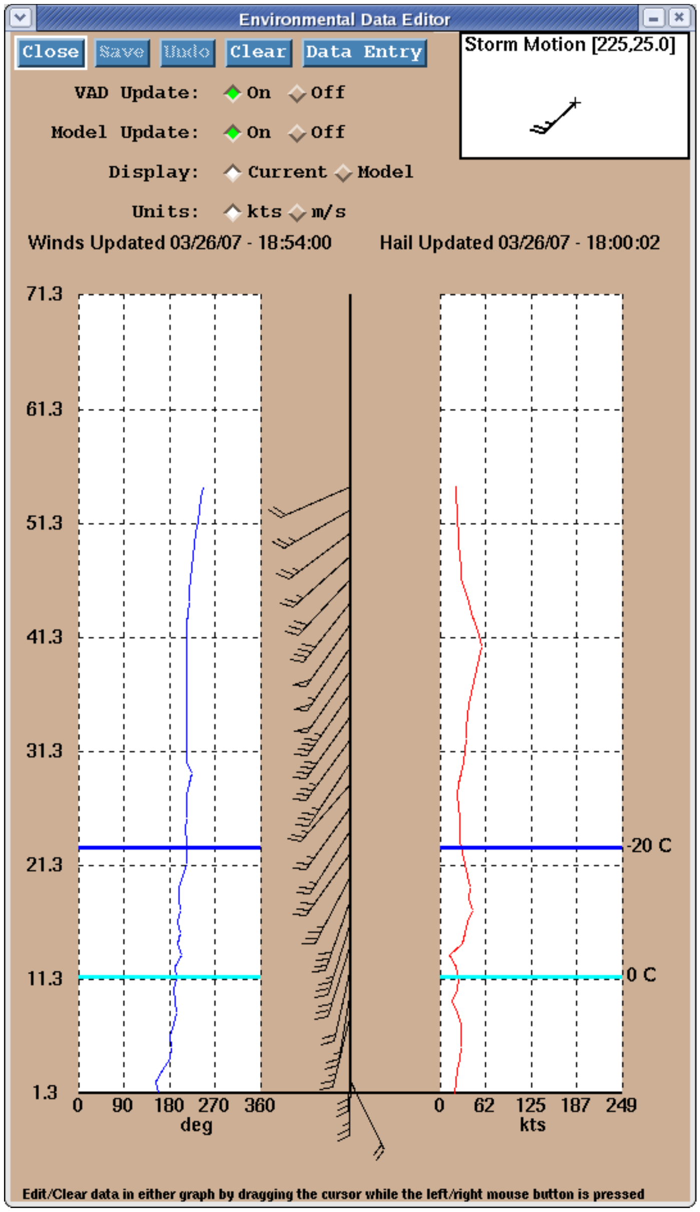


Figure 34. Build 9.0 version of the Environmental Data Entry window.

the EWT and to set the Hail temperature heights. As in the past, "VAD Update" must be set to On to populate the EWT every volume scan. It is recommended that both VAD Update and Model Update be set to On. Under most conditions, the RUC will provide adjustments to the EWT up to much higher heights than the VAD. The VAD is more likely to incorporate small scale low level features such as gust fronts. The difference in height domain for the

RUC vs. the VAD will usually provide complementary wind profiles for updating the EWT.

The “Display” button allows the operator to view the RUC data by selecting “Model”. By selecting “Current”, you can see the current state of the EWT. The Display feature can be used as a quality control check for the reliability of the RUC data. If the RUC data are not updating or the quality is poor, ”Model Update” can be set to Off and wind or temperature data can be edited manually. Though the automatic ingest of model data is very convenient, it is important to remember that the Velocity Dealiasing Algorithm relies on a representative EWT. Errors in the RUC data may result in an increase in dealiasing failures, and will require monitoring, and occasional adjustments.

6. Changes to MDA

RPG Build 9.0 includes a number of changes which move closer to the exclusive use of the Mesocyclone Detection Algorithm (MDA) and its products. In the future, the legacy Mesocyclone Algorithm will be removed and the associated products dropped from the suite of available products. The document ***“Mesocyclone Detection Algorithm (MDA) Operational Update”*** provides information regarding the implementation of MDA, its relationship to the legacy Mesocyclone algorithm and the Build 9.0 changes to MDA. This MDA document is available for download from the Build 9.0 Training web site and the URL will be presented in the Summary section on page 53.

MDA Background

MDA was designed to detect a broad spectrum of storm scale circulations. Compared to the legacy Mesocyclone Algorithm, MDA detects many more circulations, including weak, small scale shear regions, as well as larger mesocyclones. It also assigns a strength rank to each 3D feature, which is a measure of the overall rotation. Dependent on attributes such as base height and depth of the feature, it is considered either a circulation or a low core circulation. If a circulation (low core or not) has a strength rank of 5 or greater, it is considered a mesocyclone. MDA also provides past tracks and forecast positions of circulations and mesocyclones.

A minimum of two elevation angles is needed for the 3D correlation of 2D features to identify a circulation or a mesocyclone. Low core circulations or mesocyclones require that the base of the feature be less than 3 km above radar level (ARL). This height requirement will make low core circulations or low core mesocyclones less likely at long ranges.

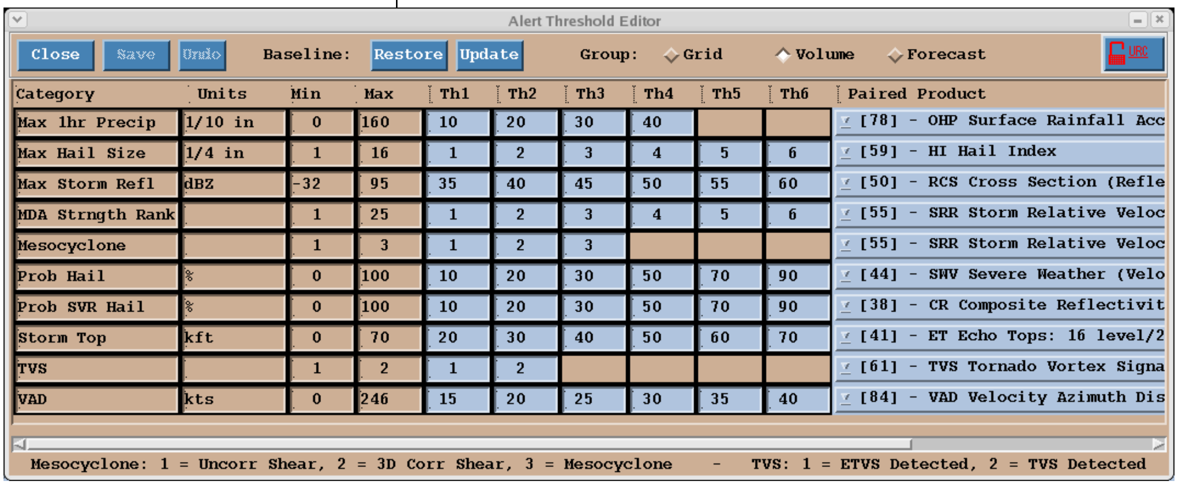
MD Product

An MDA adaptable parameter based on strength rank, Minimum Display Filter Rank, determines which MDA features are displayed on the MD product. The default setting for this parameter is 5, meaning that only mesocyclones (low core or not) are displayed. Build 9.0 includes a change that affects low core mesocyclones (see page 49). Assuming the default parameter setting, a low core mesocyclone must have a strength rank of 5 or greater ***and*** must be within 20 km of a SCIT cell to be displayed on the MD product. MDA features are indicated by circles on the MD product. If the circle has four spikes, the MDA feature includes the lowest elevation angle.

MDA-based Alerting

With Build 9.0, MDA-based Alert Codes and Thresholds are available for the Volume and Forecast alert groups. The Alert Category is titled MDA Strength Rank and there are six threshold categories. In Figure 35, threshold 1 is set to strength rank 1, threshold 2 is set to strength rank 2, etc.

The strength ranks for each of these thresholds can be edited. The default Alert Paired Product is the Storm Relative Region (SRR). The legacy Mesocyclone Alert Codes and Thresholds will be retained until the removal of the algorithm.


Alert Threshold Editor

Close Save Undo Baseline: Restore Update Group: Grid Volume Forecast

Category	Units	Min	Max	Th1	Th2	Th3	Th4	Th5	Th6	Paired Product
Max 1hr Precip	1/10 in	0	160	10	20	30	40			[78] - OHP Surface Rainfall Acc
Max Hail Size	1/4 in	1	16	1	2	3	4	5	6	[59] - HI Hail Index
Max Storm Refl	dBZ	-32	95	35	40	45	50	55	60	[50] - RCS Cross Section (Refle
MDA Strngth Rank		1	25	1	2	3	4	5	6	[55] - SRR Storm Relative Veloc
Mesocyclone		1	3	1	2	3				[55] - SRR Storm Relative Veloc
Prob Hail	%	0	100	10	20	30	50	70	90	[44] - SWV Severe Weather (Velo
Prob SVR Hail	%	0	100	10	20	30	50	70	90	[38] - CR Composite Reflectivit
Storm Top	kft	0	70	20	30	40	50	60	70	[41] - ET Echo Tops: 16 level/2
TVS		1	2	1	2					[61] - TVS Tornado Vortex Signa
VAD	kts	0	246	15	20	25	30	35	40	[84] - VAD Velocity Azimuth Dis

Mesocyclone: 1 = Uncorr Shear, 2 = 3D Corr Shear, 3 = Mesocyclone - TVS: 1 = ETVS Detected, 2 = TVS Detected

Figure 35. MDA Alert Codes and Thresholds.

CAT Populated by MDA

The Build 9.0 Combined Attribute Table (CAT) in the Composite Reflectivity products reports MDA information in place of the legacy Mesocyclone information (Figure 36). If an MDA circulation (low core or not) is within 20 km of a SCIT defined cell, the strength rank of the circulation will be reported in the MDA column of the CAT. There will be at most one MDA circulation per SCIT cell in the CAT. Each volume scan, the strongest MDA circulation is first associated with the closest SCIT cell within 20 km. Once this association is made, the strongest MDA circulation and the associated SCIT cell are no longer available for associations. The next strongest MDA circulation is then associated, and so on.

As with other columns in the CAT, external users will see the MDA information. Some external users may not be familiar with the meaning of the MDA strength rank, prompting inquiries.

STM ID	AZ RAN	TVS	MDA	POS/POH/MX SIZE	VIL	DBZM HGT	TOP	FCST MVMT
A0	240/30	NO	3	30/60/2.0	56	59 18	25.4	270/15
B3	180/15	NO	NONE	20/30/1.0	48	54 15	24.0	264/13

Figure 36. Build 9.0 version of the Combined Attribute Table.

Build 9.0 Change to Reduce Operationally Insignificant MDA Detections

MDA has sometimes detected circulations in areas that are operationally insignificant, such as light precipitation or even clear air. These detections are most likely to occur in areas of weak reflectivity and noisy velocity data. Operationally insignificant MDA detections have been increasing with a number of improvements to the WSR-88D in the past few years (e.g. ORDA, GMAP, SZ-2 and faster VCPs). Though experienced radar operators interrogate storms using the base data and can recognize these detections as insignificant, the increase has sometimes produced rather noisy displays on the MDA graphical products.

The majority of operationally insignificant MDA detections are low core features located away from cells identified by the SCIT algorithm. This fact was used to significantly reduce the number of these detections. Low core features that are ***not*** within 20 km of a SCIT cell are ***not*** displayed on any MDA product. Testing has shown that this change substantially reduces operationally insignificant MDA detections, yet retains relevant features detected in areas of convection.

Figure 37 is an example of pre-Build 9.0 MDA detections. These data were collected with VCP 212 which uses SZ-2 for range unfolding on the Split Cut elevations. Though there is a line of storms and scattered showers, the event was non-severe. Note that there are a number of MDA detections to the north, northeast and southwest that are in areas of either light non-convective precipitation or no precipitation. SZ-2 processing can be a contributor to these detections, producing velocities sufficiently noisy for operationally insignificant MDA detections.

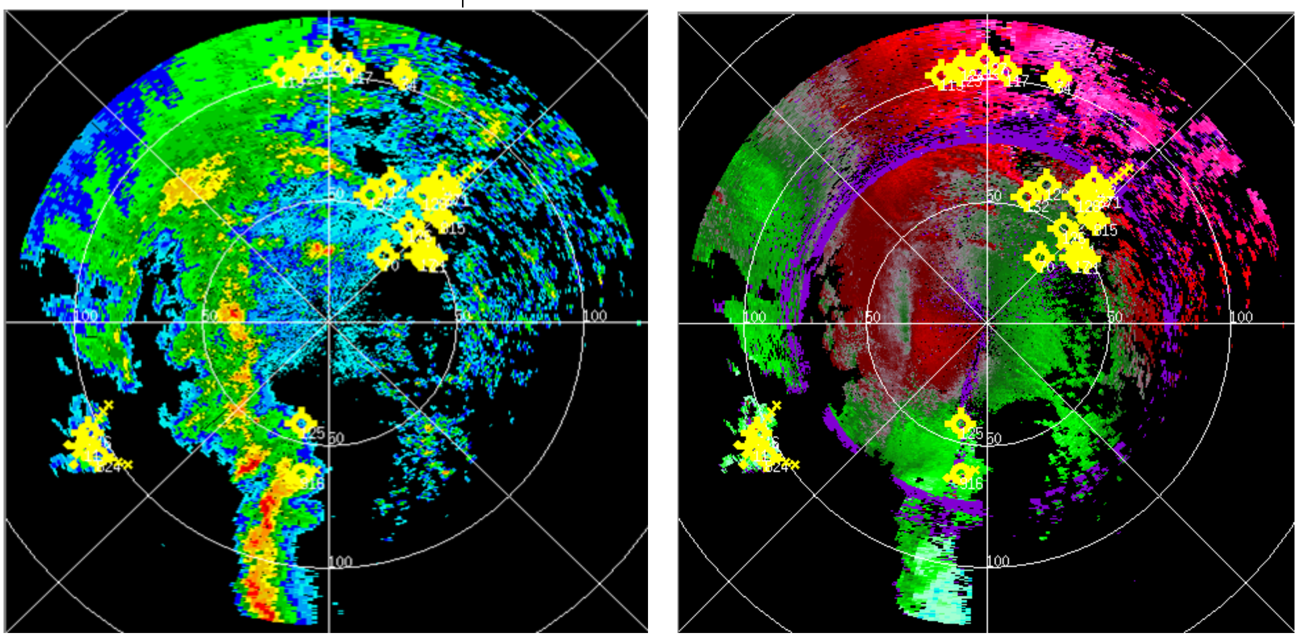


Figure 37. Example of MDA detections before the Build 9.0 change to MDA. Note the MDA features to the northeast and north, which are in areas of either light or no precipitation.

Figure 38 is the same data as Figure 37, but processed with the Build 9.0 change requiring low core features to be within 20 km of a SCIT cell. Note that most of the MDA detections in Figure 38 to the northeast are gone, while the ones to the north and southwest are still present. None of the remaining MDA features are low core and the 20 km distance requirement ***only*** applies to those that are low core. MDA features at long range are less likely to be low core and will not be impacted by the Build 9.0 change.

7. SAA Adaptable Parameter Changes

The start and stop hours for the User Selectable Snow Water Equivalent (USW) and User Selectable Snow Depth (USD) were inconsistent with the User Selectable Precipitation (USP) product. The USD and USW reported a start date/time at the

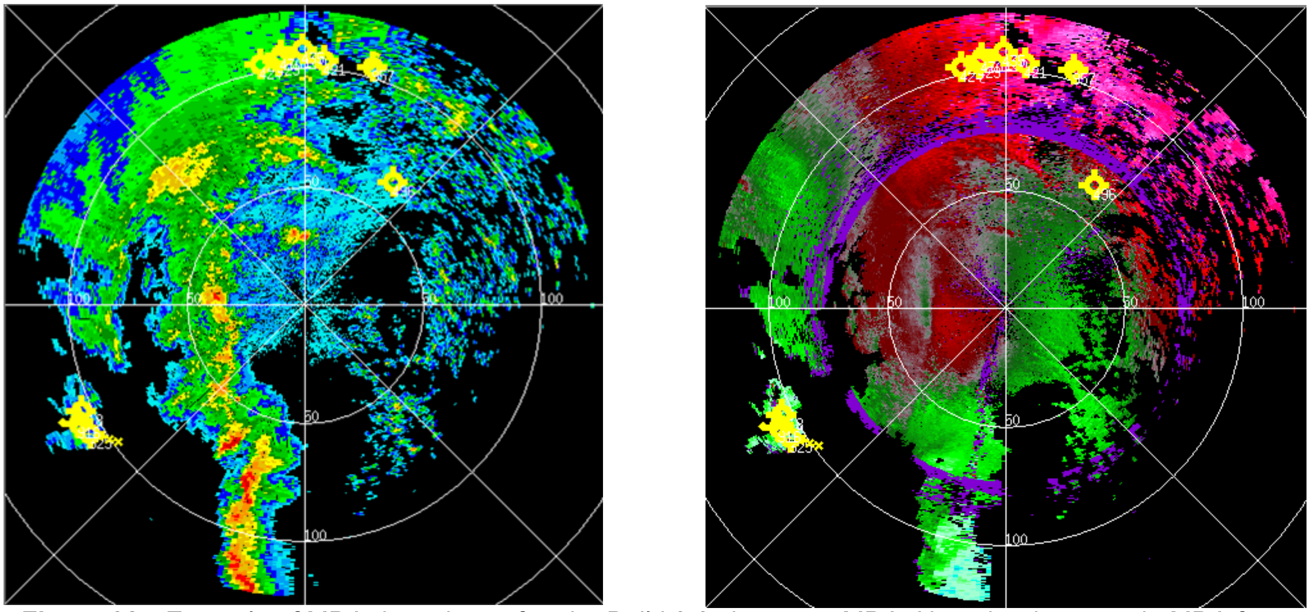


Figure 38. Example of MDA detections after the Build 9.0 change to MDA. Note the decrease in MDA features to the northeast, yet some are still retained to the north.

end of the first whole hour in the accumulation. For example, a one hour accumulation had a start/stop time of 17Z to 17Z. With Build 9.0, the start and stop times will be consistent with the USP. For the one hour accumulation example, a start/stop time would be 16Z to 17Z.

The SAA has sets of adaptable parameters with default values defined for six regions:

1. Northeast (Albany, NY)
2. Great Lakes (Cleveland, OH)
3. Northern Plains/Upper Midwest (Minneapolis, MN)
4. High Plains (Denver, CO)
5. Inter-mountain West (Grand Junction, CO)
6. Sierra Nevada (Reno, NV)

For two of the six SAA regions, the High Plains and the Northern Plains/Upper Midwest, the default value for the “Minimum Height Correction” adaptable parameter has changed from 0.40 km to the minimum allowable value, 0.01 km. This is the minimum height for applying the range/height correction to S, the rate of snow water equivalent. With the previous setting of 0.40 km, cases have been noticed where a discontinuity occurs in the SAA products at the range associated with this height.

8. MIGFA

MIGFA is an FAA sponsored algorithm designed to detect gust fronts and to provide short term forecast positions. The MIGFA products are currently not scheduled for any upcoming AWIPS builds, so it is unknown when NWS users would have the opportunity to see them. One place within the RPG HCI windows where MIGFA could be noticed by NWS users is one of the products, “Gust Front MIGFA”, listed on the Product Generation lists. Also, MIGFA runs on the same processor as the BDDS. If the BDDS is rebooted, there is a Nexrad MIGFA task failure that will clear itself.

9. Generation of Cross Sections in VCP 121

Prior to Build 9.0, Reflectivity Cross Sections (RCS) and Velocity Cross Sections (VCS) could not be successfully generated while using VCP 121. This problem was related to the additional CD rotations employed at the lower elevations with VCP 121. A Build 9.0 fix allows for the successful generation of both RCS and VCS products in VCP 121.

10. VCP Change or Download Anytime During a Volume Scan

RPG Build 8.0 introduced the Mode Selection Function (MSF), which had a big impact on operations when a VCP Change or Download was desired. The MSF still determines the appropriate mode each volume scan, but Build 9.0 removes a restriction with the timing of VCP Changes or Downloads. By looking at the areal coverage of returns at 0.5° each volume scan, the MSF determines if a Precipitation or Clear Air Mode VCP is needed. Depending on local settings, the MSF downloads either the current or a different VCP each volume scan.

Prior to Build 9.0, it was necessary to be aware of the timing of the MSF execution within each volume scan. In order to perform a VCP Change or Download, the command had to be entered after the MSF had run for any given volume scan. Otherwise the MSF could have overwritten the VCP command.

Build 9.0 removes this restriction. A VCP Change or Download command can be issued anytime during a volume scan. The only exception is if the MSF should command a mode change. For example, if Precipitation switching is set to Automatic and conditions exceed the thresholds, the MSF will download the Precipitation Mode Default VCP and it will be in effect next volume scan.

11. Fix to 1° Radial on Rain and Snow Products

The rainfall and snowfall products are based on the Enhanced Precipitation Preprocessing (EPRE) Algorithm. Due to a difference between techniques for processing radials between EPRE and ORDA, there have been instances of spikes or shadows along the 1° radial in the rain or snow products. The top images in Figure 39 show the spike (left) and the shadow (right). The bottom images show the same data processed with the Build 9.0 fix.

Summary

This document presents the Pre-deployment state of knowledge of the operational impacts of RDA/RPG Build 9.0. This build provides software changes at the RDA and both hardware and software changes at the RPG.

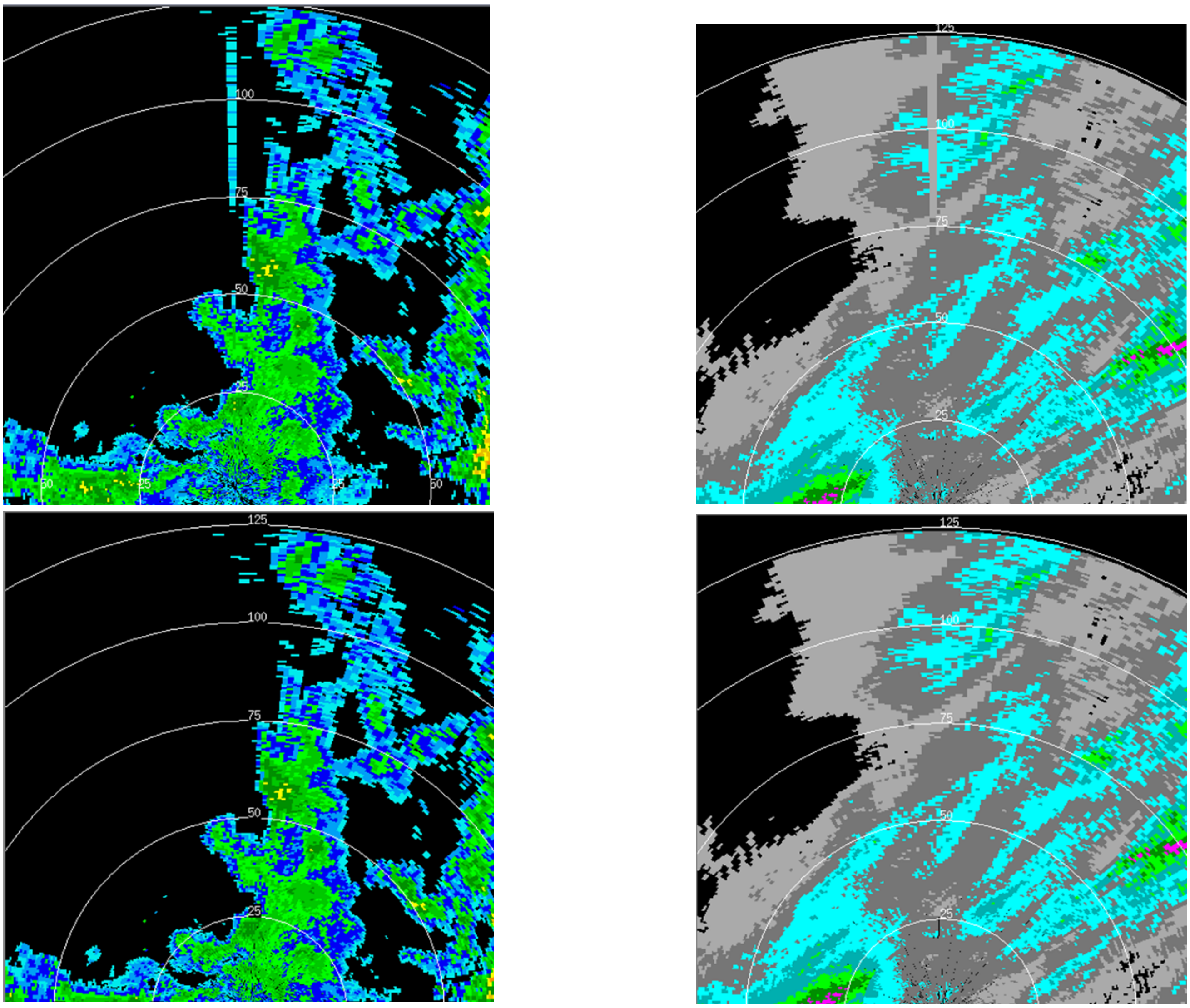


Figure 39. Build 9.0 fix for spikes and shadows along 1° radial on rain and snow products.

For NWS employees who wish to have completion of this training on their permanent training record, the training presentations (Parts 1 and 2) as well as the test and survey are available through the NWS Learning Center at

http://doc.learn.com/noaa/nws

The WDTB Build 9.0 Training web site is available at:

http://www.wdtb.noaa.gov/buildTraining/Build9/index.html

Additional copies of this document can be downloaded from the Build 9.0 Training page. Also, copies of the reference papers listed in this document are available for download from the Build 9.0 page. Finally, there is an opportunity to provide feedback on the effectiveness of this training. We welcome your comments!