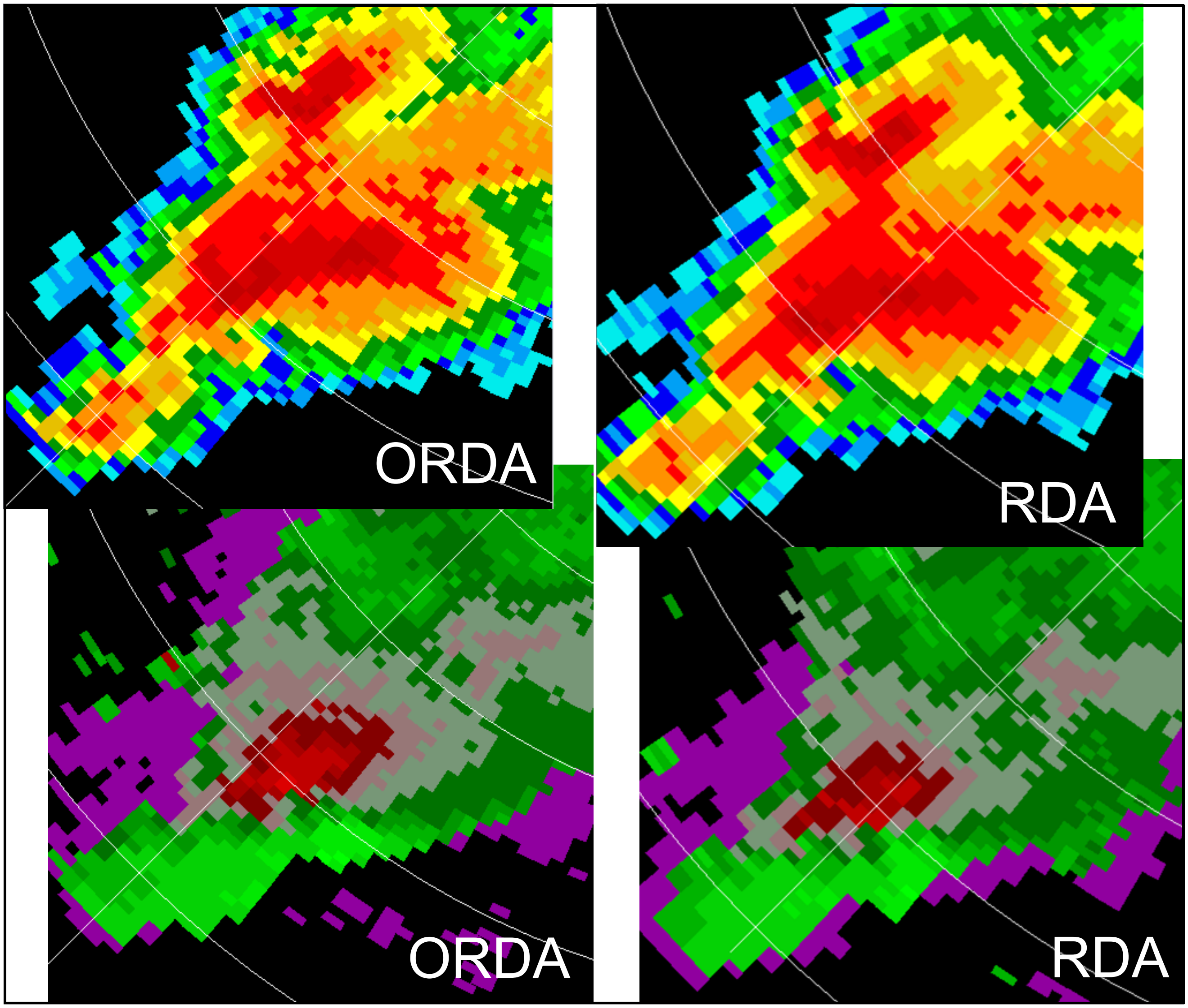
Open RDA Build 7.0 Training



Presented by the

Warning Decision Training Branch

Version: 0511

Overview

The Open RDA (ORDA) is a significant upgrade to the Radar Data Acquisition (RDA) functional area of the WSR-88D. The ORDA design allows for the removal or replacement of many of the legacy RDA hardware components, such as the signal processor. This training presents the purpose of the ORDA upgrade, an overview of the hardware and software, the ORDA-related windows at the Master System Control Function (MSCF), and the operational impacts.

Differences

The Base Data generated by the ORDA has some differences in appearance as compared to the legacy RDA. In some cases these differences have little operational impact. In other cases the operational impact is a significant improvement in the quality of the Base Data. By design the ORDA will produce Base Data quality that is as good as or better than the legacy RDA. The information in this document reflects the pre-deployment state of knowledge of the operational impacts of the ORDA Build 7.0.

Resources

Additional copies of this document, as well as all relevant training materials are available from the ORDA Build 7.0 Training web site:

http://wdtb.noaa.gov/buildTraining/ORDA/

Any new information that becomes available as the deployment progresses will also be posted on this site.

Deployment

The ORDA Deployment is scheduled for November 2005 through September 2006. The date for any particular office is available from the ORDA Web Site:

http://www.orda.roc.noaa.gov/deployment/schedule/schedule.asp

The ORDA and RPG Build version that will be used for the initial part of the ORDA deployment is Build 7.0. ORDA/RPG Build 8.0 is scheduled to be deployed in the Spring of 2006. At the time when ORDA/RPG Build 8.0 is released, those sites that already have ORDA installed will be upgraded to Build 8.0 on both the RPG and ORDA. For all remaining Single Channel sites, the initial ORDA installation will be ORDA Build 7.0, followed by an upgrade to ORDA/RPG Build 8.0. Only NWS Redundant and FAA sites will have an initial ORDA installation with Build 8.0. ***The material in this document is based on ORDA and RPG Build 7.0.***

Purpose

The requirements for converting the legacy RDA to an open systems design (ORDA) are the same requirements that led to the conversion of the legacy RPG to the ORPG. An Open System design is flexible with respect to hardware, software and communications. The conversion to the ORDA design significantly improves processing speeds in components such as the signal processor. It offers improvements, such as a better calibrated radar with simpler calibration procedures, that benefit ***both*** weather decision makers and system maintainers.

New Science and Applications

The flexible design will allow for planned upgrades and provide a necessary foundation for future enhancements. These include advanced techniques for mitigating velocity and range ambiguities, and Dual Polarization.

Hardware Overview

The ORDA system is essentially a new set of hardware components, along with the necessary software and communications equipment. The components that are of operational interest are presented here.

RVP8 - Radar Video Processor

The Radar Video Processor (RVP8) is the digital receiver/signal processor of the ORDA system (Figure 1). The RVP8 is a SIGMET Corporation, industrial grade PC with LINUX as the operating system. The processing speed and memory of the RVP8 is sufficient for current and future complex algorithms such as Dual Polarization.

The RVP8 replaces the legacy Hardwired Signal Processor (HSP) and the Programmable Signal Processor (PSP). Though it is a commercial product, it does contain some features that were customized by SIGMET for the WSR-88D. For example, the use of Batch mode (alternating low and high PRFs at middle elevation angles) is unique to the WSR-88D. SIGMET modified the code in the RVP8 to accommodate Batch mode.

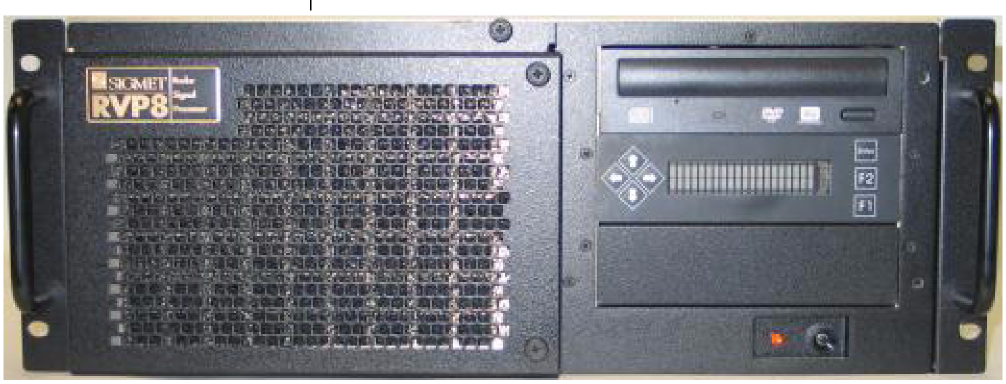


Figure 1. The RVP8, ORDA’s digital receiver and signal processor.

RCP8 - Radar Control Processor

The Radar Control Processor (RCP8) is a replacement for the Concurrent Micro 5 computer (Figure 2). As with the RVP8, the RCP8 is also a commercial product from the SIGMET Corporation, running with LINUX as the operating system.

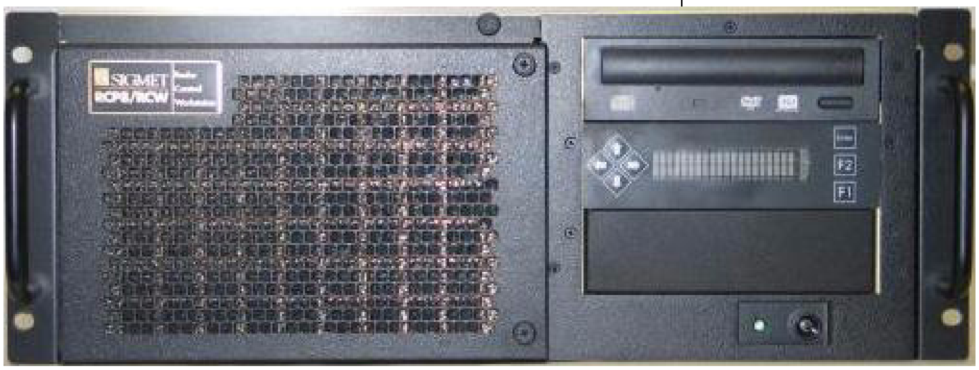


Figure 2. The RCP8, ORDA's radar control processor.

With the legacy system, when the RDA was controlled locally at the RDA shelter, the commands were going to the Micro 5. Similarly with the ORDA system, when the RDA is controlled locally at the RDA shelter, the commands are going to the RCP8. When the RDA is controlled remotely from the MSCF, the commands are also going to the RCP8.

The RCP8 is connected to the Digital Control Unit (DCU), which drives the pedestal and implements the current VCP. When a VCP has been changed or downloaded, the RCP8 sends the VCP information to the DCU. The DCU is essentially telling the pedestal and antenna "what to do" in order to execute that particular VCP.

RCP8 and VCP Usage

The local versions of the VCPs are stored at the RCP8. As with the legacy RDA, the local VCPs will be limited to 11, 21, 31, and 32. The Change command is used at the RPG in order to invoke one of the local VCPs, while the Download command is used to invoke the remote VCPs. The remote VCPs are stored at the RPG and are 11, 12, 21, 121, 31 and 32. With ORDA Build 7.0, there will be no need to adjust local procedures for changing or downloading VCPs. There is no change to the VCP Control window at the RPG (Figure 3).

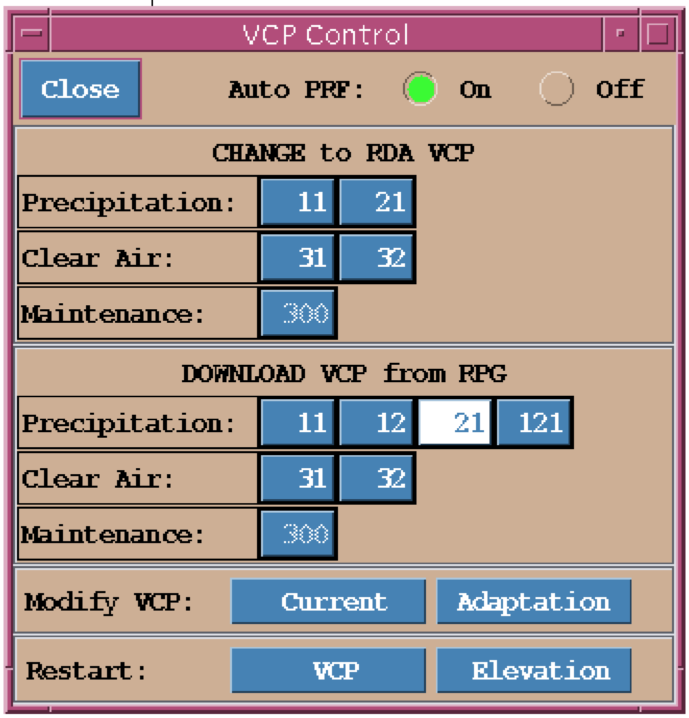


Figure 3. VCP Control window. Note VCPs stored at the RDA vs. RPG.

The RCP8 also relays information to the transmitter through the RVP8. For example, different PRFs are implemented throughout a VCP, and the transmitter needs to know how rapidly to transmit pulses. The RCP8 sends the PRF information to the RVP8. The RVP8 triggers the transmitter at the correct rate for the current PRF.

KVM

At the RDA shelter, the Keyboard Video Mouse (KVM) and Monitor provide access to both the RCP8 and the RVP8. The KVM is the interface for local user access only (Figure 4).

GPS

The ORDA has a GPS server that sets the clocks on the RVP8 and the RCP8 within very close tolerances (Figure 5). The GPS servers will increase the accuracy for ***every*** WSR-88D with respect to

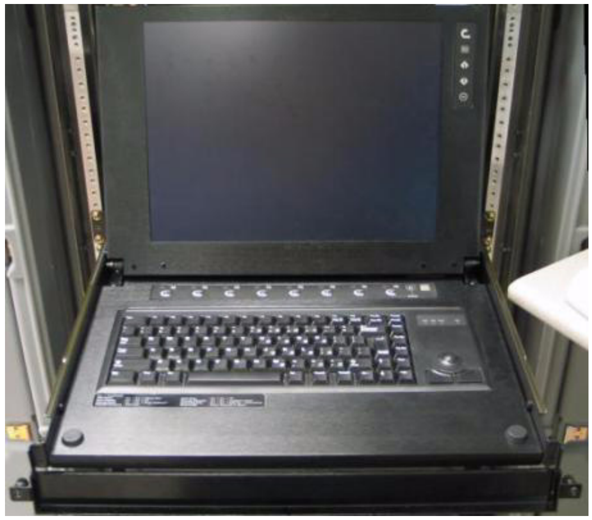


Figure 4. The KVM and monitor, for local user access.

time. Since it is GPS-based, the location of each radar will also be highly accurate.

Figure 5. The GPS server.

RDA HCI at the MSCF

The MSCF (Figure 6) is used to launch the RPG Human Computer Interface (HCI). The RPG HCI is the set of windows where weather decision makers perform radar control tasks such as downloading VCPs or changing the Doppler PRF. The windows within the RPG HCI that are impacted by the ORDA will be presented where appropriate in the Operational Impacts section (page 8).

With ORDA/RPG ***Build 8.0***, the RDA HCI will be accessible from the MSCF by clicking on the RDA HCI button. The RDA HCI main page is the same interface that is available to technicians locally at

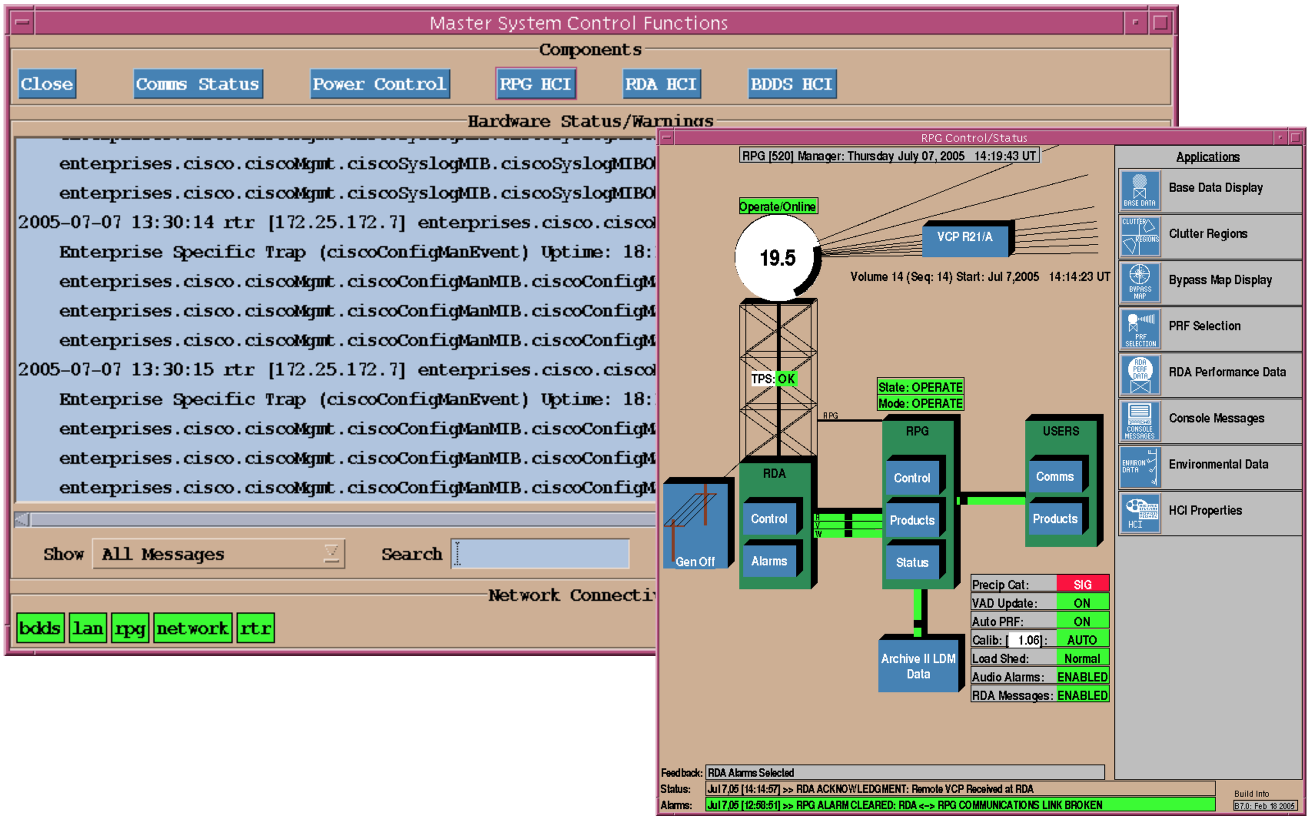


Figure 6. MSCF and the RPG HCI.

the RDA shelter. The design is similar to the RPG HCI, with dynamic status information such as

- the current VCP and elevation angle
- the state of the wideband connection
- RDA state (operate or standby)
- power source (utility or generator)

Operational Impacts

This section presents the operational impacts of the ORDA:

1. Improvements in calibration
2. Improved sensitivity in long pulse (VCP 31)
3. New clutter suppression technique: Gaussian Model Adaptive Processing (GMAP)
4. Differences in Batch elevation Reflectivity data

5. Improvements to the quality of Spectrum Width estimates
6. Differences in elevation angle settling
7. End of first trip Velocity less noisy with ORDA
8. Differences in types of RDA Alarms
9. Differences in RDA Performance Data Menus
10. False Alarm at AWIPS

1. Improvements in Calibration

The ORDA design offers a better calibration procedure which is both more accurate and simpler to implement. Compared to the legacy design, there are only about 1/3 the number of components that need to be calibrated. In addition to fewer components that require calibration, this shortens the "path" that the signal must follow.

Calibration is performed by injecting a test signal into the receiver and comparing the actual result to an expected result. With the legacy design, the test signals that were used were at two fixed power levels. With the ORDA, the test signal used for calibration varies over the entire dynamic range of the received signal, i.e. from the weakest to the strongest. Testing has shown that the dynamic range for ORDA is 96 dB, which is 3 dB better than the NEXRAD specifications.

Off-line Calibration

The off-line calibration process is better automated and can be viewed graphically. The technician is able to see the actual dynamic range that was generated, and can also see the linearity of the transition from lower to higher power (the more linear, the better).

On-line Calibration

As with the legacy RDA, an on-line calibration procedure is performed at the end of each volume scan as the antenna drops back down to 0.5°. A number (Delta Sys Cal at AWIPS or Calib at the RPG HCI), will continue to be generated each volume scan, with ±4 as a maintenance mandatory condition and ±2 as a maintenance required condition. With the calibration improvements that the ORDA brings, this number is expected to show less variation over time as compared to the legacy RDA.

With fewer components as compared to the legacy RDA, this on-line calibration procedure is completed much faster with the ORDA.

Calibration and Radar Products

A better calibrated radar produces better quality Base Data, which positively impacts ***all*** of the Base and Derived Products. Rainfall estimates are particularly sensitive to calibration errors. With the $Z=300R^{1.4}$ relationship, a calibration error of +4 dB ***doubles*** the rainfall rate, while an error of -4 dB ***halves*** the rainfall rate. Calibration errors that are not this extreme still result in significant rainfall estimation errors over time. The simpler and more accurate calibration procedures with ORDA are expected to reduce the impact of calibration errors on the accuracy of rainfall estimates.

2. Improved Sensitivity in Long Pulse (VCP 31)

One benefit of the ORDA hardware design is an improvement in the sensitivity, especially when using long pulse (VCP 31). Having some tasks performed digitally with ORDA eliminates losses due to hardware that were present with the legacy RDA. This results in an increase in long pulse sensitivity of about 3 dB, which will improve detection of weak returns such as boundaries and snow bands.

Figure 7 depicts VCP 31 on the left with VCP 32 (just 10 minutes later) on the right. Both images are from an ORDA system and there is no weather present. Note the improved areal extent of weak returns with VCP 31. This improvement in areal extent will be greater with an ORDA VCP 31 as compared to a legacy RDA VCP 31.

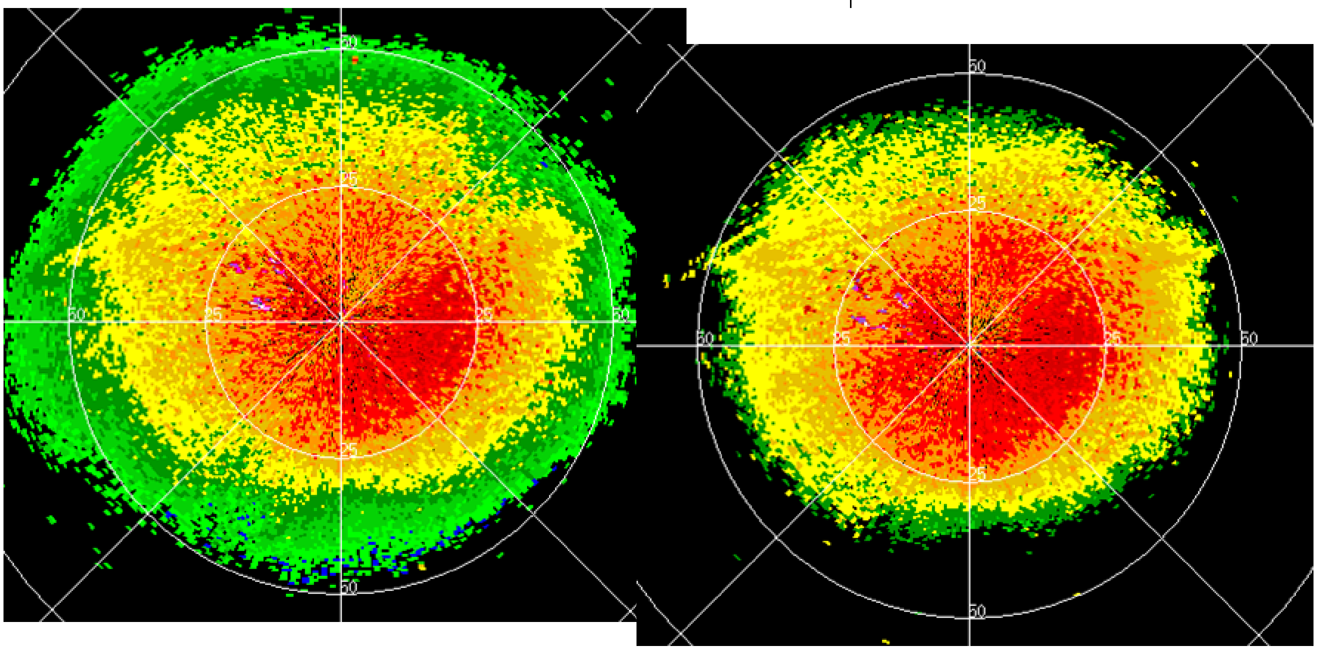


Figure 7. Comparison of VCP 31 (left) and VCP 32 (right) with ORDA.

Reference: *A First Look at the Operational (Data Quality) Improvements Provided by the Open Radar Data Acquisition (ORDA) System*, J. Chrisman, C. Ray, Radar Operations Center, Norman, OK

3. New Clutter Suppression Technique: GMAP

The new clutter suppression technique with ORDA is called Gaussian Model Adaptive Processing (GMAP). A Gaussian curve is a good approximation of the power spectrum for weather targets as well as clutter. Gaussian is part of this title because GMAP uses this approximation. Adaptive is part of this title because the routine adapts to the weather and clutter that is present in each range bin. Signal removal is based on the spectrum width of the clutter signal, which GMAP identifies in an iterative process.

There are similarities and differences between the legacy RDA clutter filtering technique and GMAP with respect to both design and implementation. The ***most significant difference*** between GMAP and the legacy RDA clutter filtering technique is that with GMAP ***most of the weather signal*** that is removed with the clutter ***will be restored***.

Legacy RDA filtering

With legacy RDA clutter suppression, a level of suppression (low, medium, or high) was selected for each clutter region defined. Each of these levels of suppression had an associated velocity notch width, though the actual notch width varied depending on the antenna rotation rate and the waveform. Clutter filtering was applied to the signal that fell within the particular notch width, centered on zero velocity. Velocity notch widths ranged from ±1.7 kts in the lower (Split Cut) elevations to ±10 kts or more in the middle (Batch) elevations.

This technique worked well provided that the entire clutter signal was within the notch width and the entire weather signal was outside of the notch width. ***Any*** signal that fell within the notch width was removed, whether it was composed of clutter or weather. Once the signal was removed by the legacy clutter filters, it was no longer recoverable. In Figure 8, both the clutter signal and the weather signal are centered at zero velocity and clutter filtering has not yet been performed. The black curve is the Gaussian estimate of the weather signal.

Figure 9 depicts the result after legacy RDA clutter filtering has been applied. The clutter signal falls within the notch width and has been removed, but the weather signal within the notch width is also

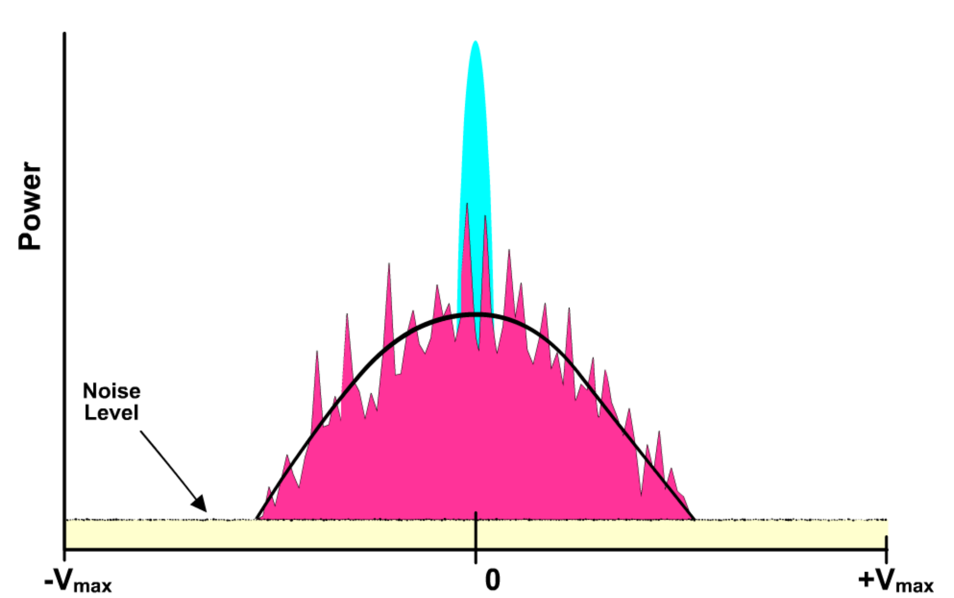


Figure 8. Before legacy RDA filtering is applied, a clutter signal (blue) and a weather signal (red) are both centered on zero velocity.

removed. Since the computed returned power is the area under the curve, legacy RDA clutter filtering in Figure 9 results in a loss of returned power for that range bin and an underestimate of reflectivity.

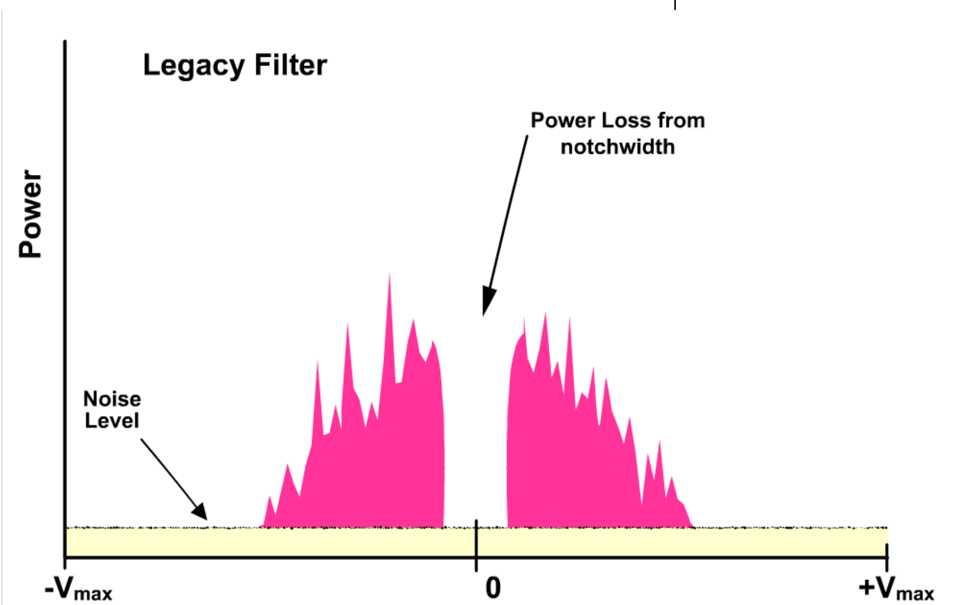


Figure 9. Legacy RDA clutter filtering has been applied. Though the clutter signal has been removed, the weather signal that fell within the notch width has also been removed.

GMAP clutter filtering

GMAP still removes a portion of the signal centered around zero velocity. However, the width of what is initially removed is not fixed, but adaptive. This width is also ***significantly*** narrower than the notch widths used by the legacy RDA filter. GMAP uses 1.33 kts (± .67 kts) as an initial width, then as needed it can iteratively narrow this width to better isolate the clutter signal. GMAP processing also has steps that rebuild the weather signal using the Gaussian estimate of that signal which existed prior to clutter removal.

The performance improvement with GMAP will be most noticeable where there is ***both*** clutter and weather signal in the same range bin with velocities close zero. See Figure 10 for the result of GMAP suppression in the case where the clutter and weather signal are both centered on zero (same initial condition as in Figure 8).

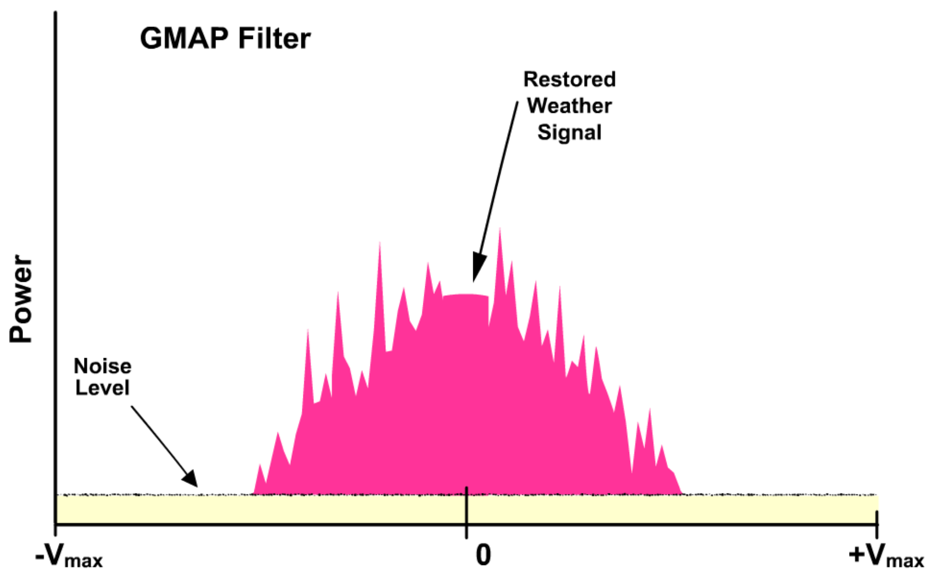


Figure 10. GMAP clutter filtering has been applied. Though the clutter signal has been removed, the weather signal has been mostly restored.

Weather signals are not usually centered at zero velocity. GMAP can rebuild any portion of the weather signal that falls within the clutter signal that was initially removed. In Figure 11, the weather signal is offset from zero and no clutter filtering has yet been applied.

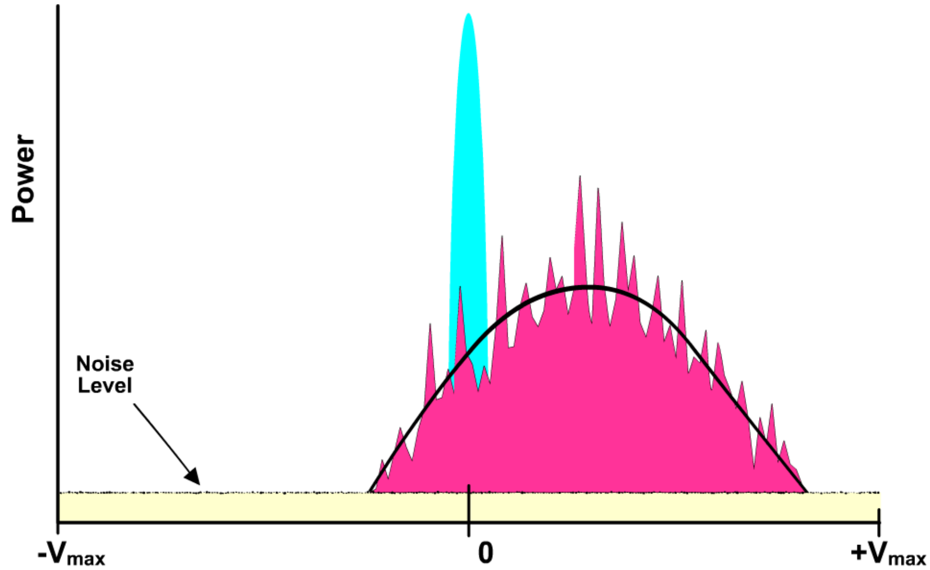


Figure 11. In this example, the weather signal is not centered at zero velocity.

In Figure 12, the legacy RDA filtering has been applied. A portion of the weather signal has been removed along with the clutter signal. This results in a bias of the base data induced by the clutter filtering process. There is a loss of power and thus an underestimate of reflectivity. Since velocity estimates are power weighted, the power loss would also bias the velocity estimate away from zero.

In Figure 13, GMAP filtering has been applied to the power spectrums (clutter and weather) in Figure 11. A small portion of the weather signal was initially removed along with the clutter signal. GMAP then rebuilt most of the weather signal across the gap. There is significantly less clutter filter induced bias with GMAP as compared to the legacy RDA filtering technique.

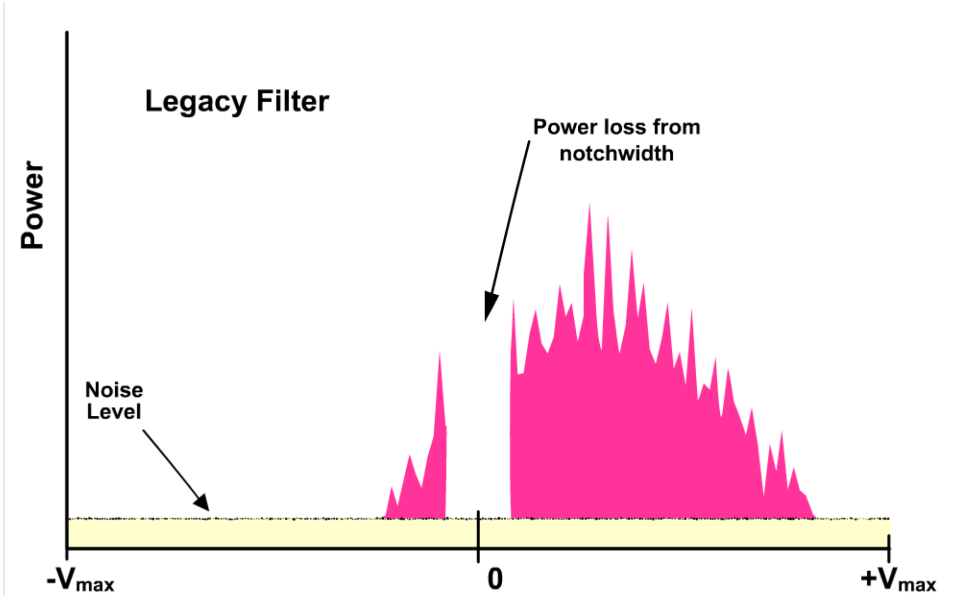


Figure 12. Legacy RDA clutter filtering has been applied. Though the clutter signal has been removed, the weather signal that fell within the notch width has also been removed.

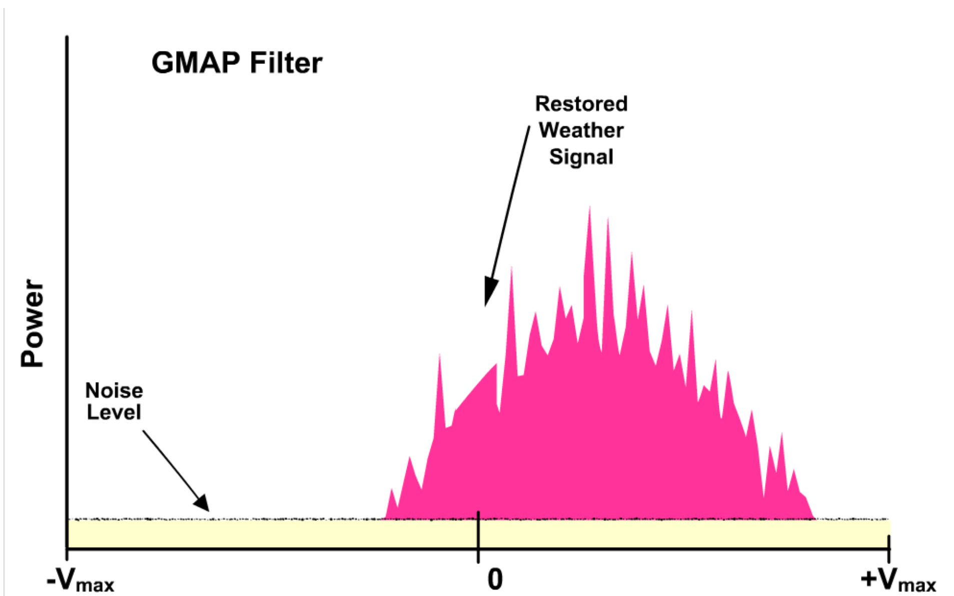


Figure 13. GMAP clutter filtering has been applied. Though the clutter signal has been removed, the weather signal has been mostly restored.

Radar example of GMAP performance

In Figure 14, the velocity image shows the clutter pattern near the RDA when there is no weather present. For range bins with ***only*** clutter present, a process called censoring assigns no data. Note the areas where clutter has been removed and there is no data, particularly a ridge at short range to the southwest.

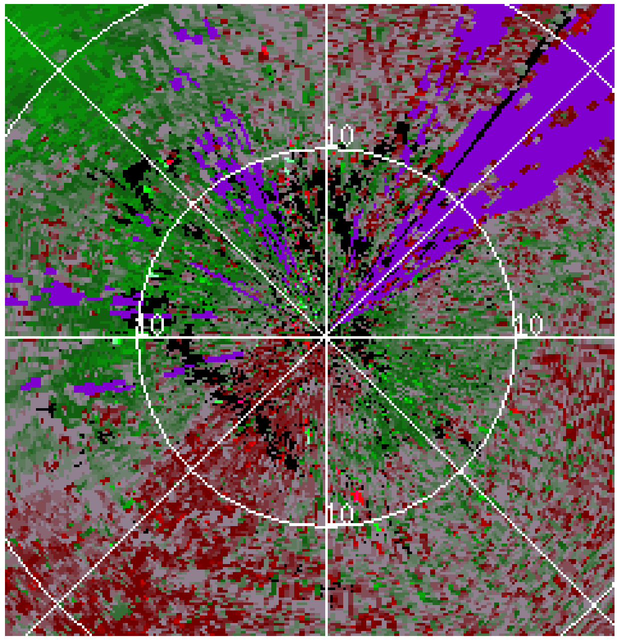


Figure 14. Example of GMAP clutter removal with no weather present. Note the ridge at close range to the southwest

In Figure 15, the reflectivity image on the left shows that a squall line has passed through and is just east of the RDA (note the scale of the range rings). On the associated velocity image which has been zoomed in over the RDA, note that there are weather returns available over most of the areas of clutter. Since GMAP can restore the weather signal in areas of clutter, the ridge to the southwest is no longer apparent.

Differences in Clutter Censoring

Clutter censoring is a technique used by both the legacy RDA and ORDA after clutter filtering has been performed. Censoring is necessary since there are limits to the amount of power that can be removed for both legacy and ORDA filtering. Some clutter targets (e.g. mountains at close range) return significantly greater power than the filters can remove. Censoring is a technique to remove residual clutter. If the residual clutter does not represent any weather signal, it is censored, which means it is not displayed.

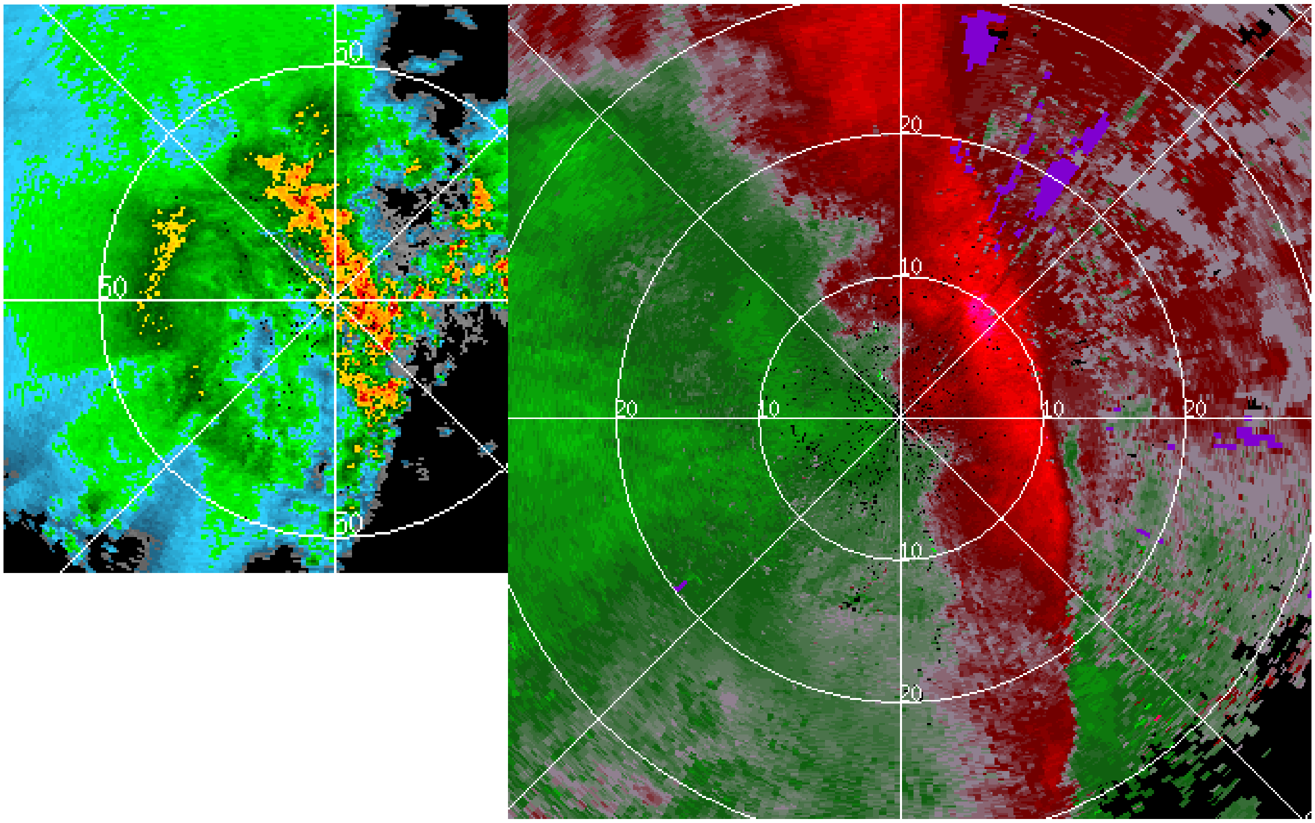


Figure 15. Example of GMAP clutter removal and weather recovery with a squall line passing through.

The censoring technique for ORDA has some differences that will improve the availability of data in clutter prone areas. The censoring process with the legacy RDA is performed on bins of .54 nm (1 km) range resolution. With ORDA, censoring is performed on bins of .13 nm (.25 km) range resolution. The ORDA censoring process is also dynamic, while the legacy process is hard coded and static. The result is less data loss and an overall smoother appearance with ORDA (Figure 16).

Types of Suppression Unchanged

Bypass Map

The Bypass Map is still a “yes/no” map for whether or not to apply filtering. The Bypass Map will continue to be used to address contamination from normal clutter targets (e.g. terrain and buildings).

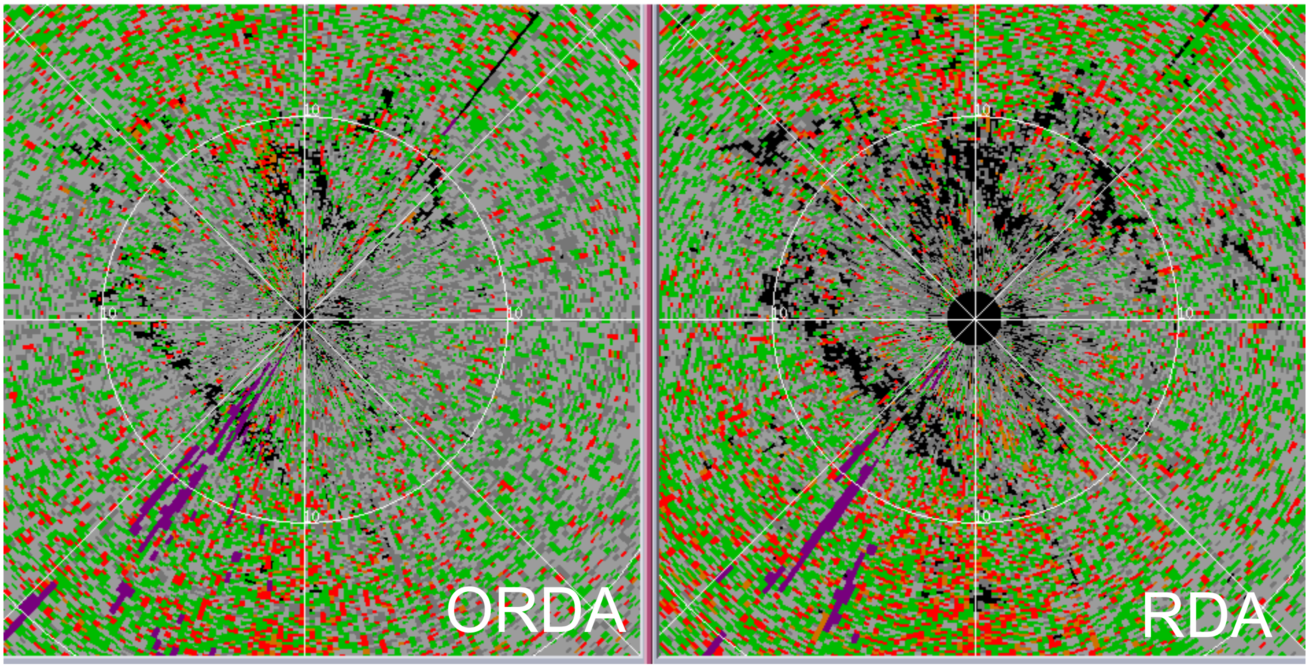


Figure 16. Example of differences in clutter censoring with ORDA (left) vs. legacy RDA (right).

Bypass Map generation with ORDA is a significantly faster process and the resulting maps are at a higher resolution.

The resolution of the ORDA Bypass Map is 1° x .54 nm as compared to 1.4° x .54 nm with the legacy RDA. A "yes" to performing suppression for any particular 1° x .54 nm bin is dependent on the characteristics of the returned signal. Clutter characteristics are high power, low velocity and low spectrum width.

Bypass Map Generation

The conditions under which a new Bypass Map should be generated have not changed with ORDA. The Bypass Map should be generated under conditions of ***no precipitation, no AP or other abnormal beam refraction***. When the Bypass Map is generated, two versions of the signal characteristics for each range bin are compared:

1. unprocessed data (power, velocity, and spectrum width)
2. data processed by GMAP (power, velocity, and spectrum width)

If there is a significant power difference between these two versions, then the bin is flagged as requiring clutter suppression. That's why it is ***so important*** to generate new Bypass Maps under conditions where ***only*** "typical" clutter exists. Generation of a new Bypass Map is still an off-line procedure with ORDA, but will take about 20 minutes.

For the Build 7.0 ORDA, there will continue to be two maps generated. The first map is for elevation angles below 1.65° and the second map is for elevation angles above 1.65°. These two maps correspond to each of the two segments, low and high. There may be additional segments (up to 5) available in future builds, resulting in additional Bypass Maps.

All Bins

It will still be necessary to use All Bins suppression for areas of AP. Since AP is transient in space and time, the Bypass Map cannot identify where the clutter targets are located. All Bins suppression applies suppression on ***every*** bin throughout the geographic region that has been defined.

Applying All Bins suppression to areas of AP by GMAP has been found to be just as effective at removing the AP as the legacy clutter suppression technique. However, since GMAP is able to restore most of any weather signal that is initially removed, there is less bias in the base data. With All Bins suppression in the legacy RDA applied to weather, reflectivities were often significantly reduced and velocities were biased away from zero. With GMAP, the base data will be less biased when All Bins is used, as compared to the legacy RDA.

AP Removal Example

In the following example, a large area of AP exists over most of the radar display with small areas of precipitation to the east and south (Figure 17).

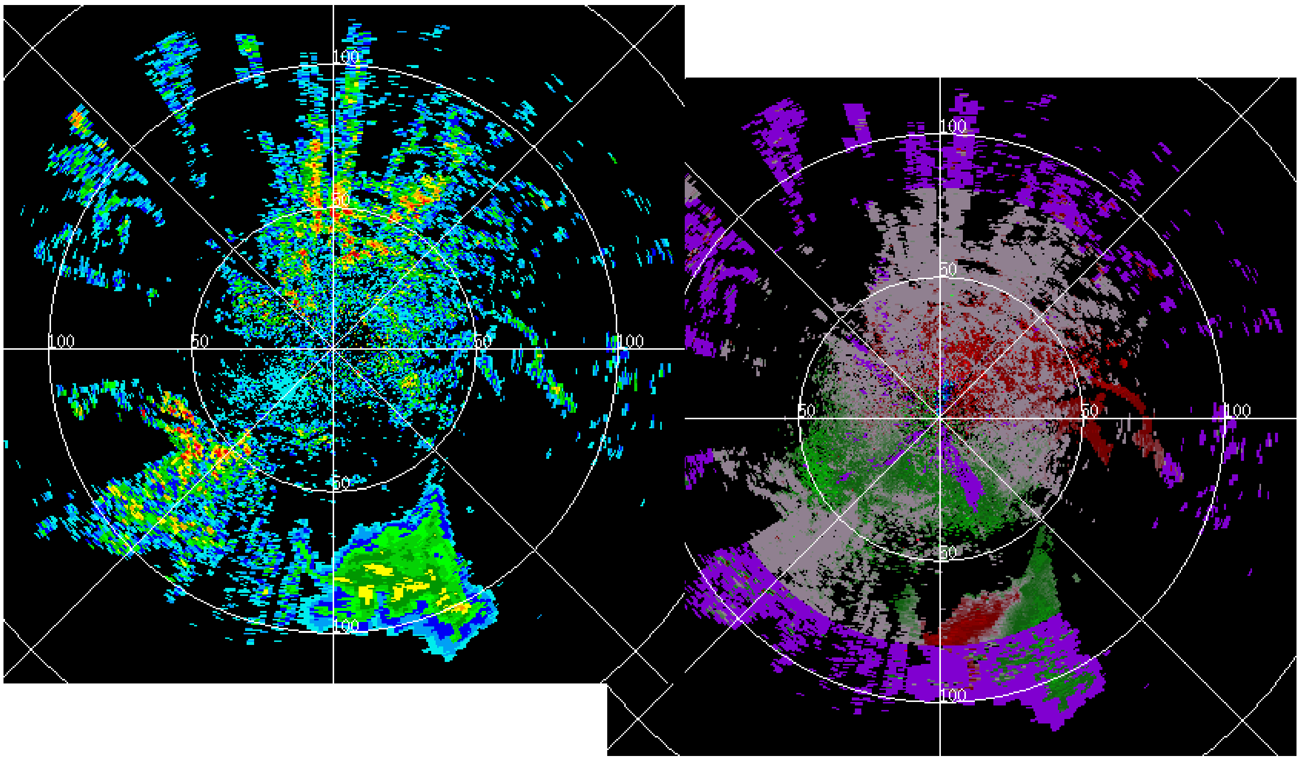


Figure 17. There is unfiltered AP over most of the display with areas of precipitation to the east and south.

This data example was captured for both ORDA and a legacy RDA which was nearby. For both radars, All Bins suppression was applied to address the AP contamination. In Figure 18, All Bins suppression is applied to the ORDA (left) and legacy RDA (right) Reflectivity data.

In Figure 19, All Bins suppression is applied to the ORDA (left) and legacy RDA (right) Velocity data. Note that the ORDA GMAP is just as effective at removing the AP as the legacy RDA technique.

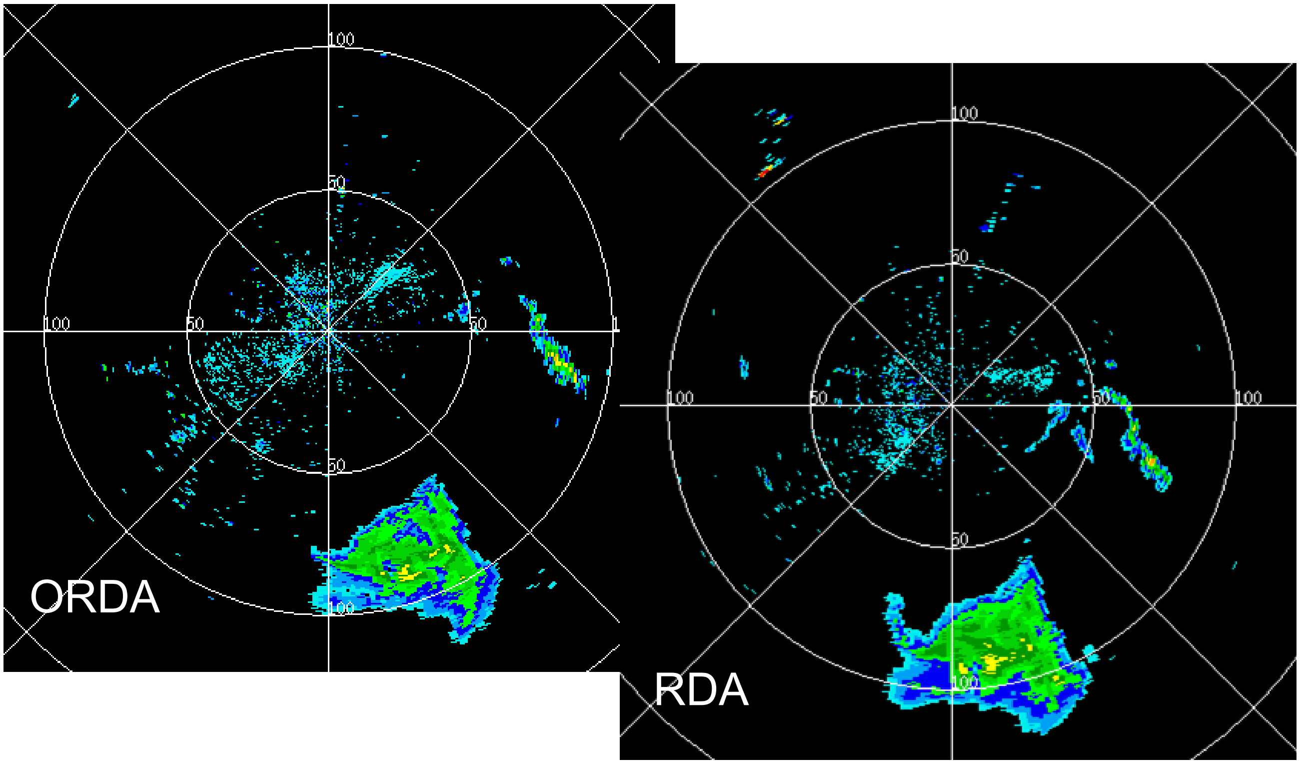


Figure 18. AP removal using All Bins for Reflectivity (ORDA left and legacy RDA right).

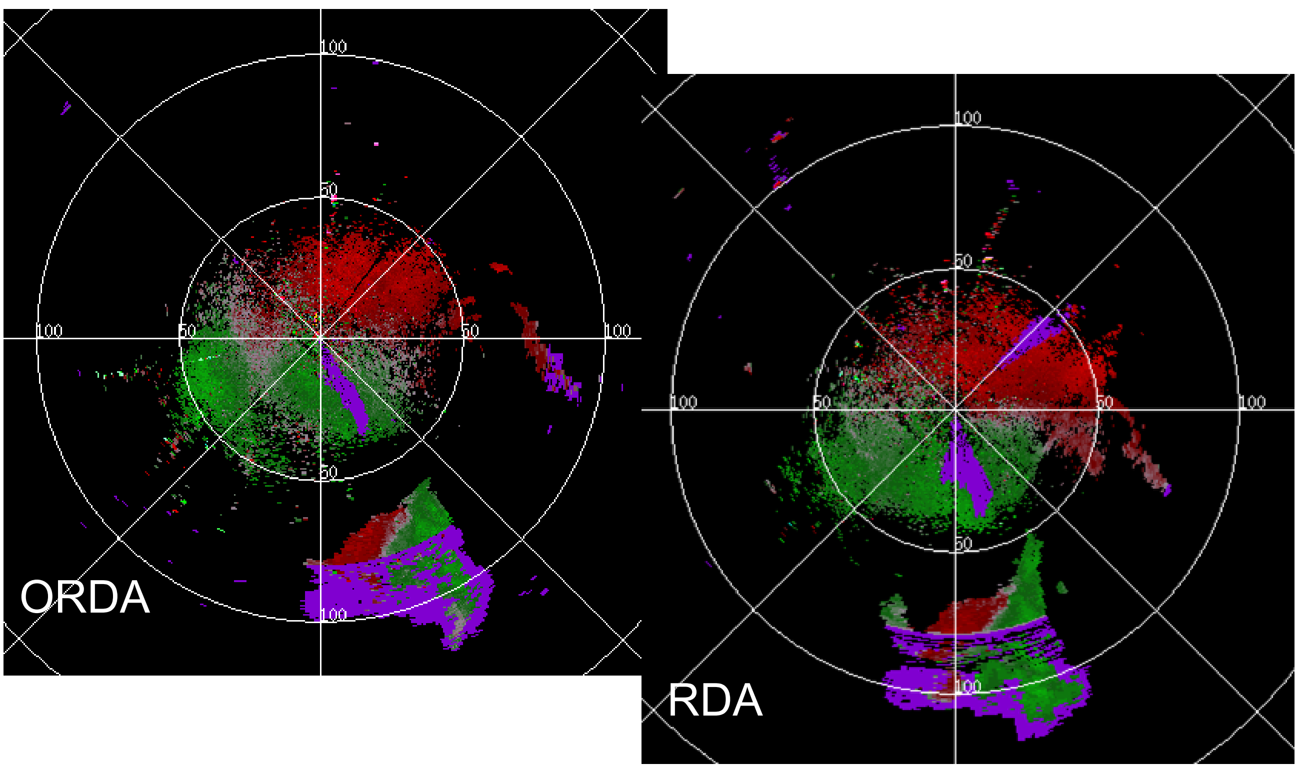


Figure 19. AP removal using All Bins for Velocity (ORDA left and legacy RDA right).

Differences in the Zero Isodop Area with All Bins

When All Bins suppression is applied to weather targets, there is a difference in the appearance of the zero isodop area with the legacy RDA vs. the ORDA. Note from Figure 20 that the zero isodop area with the legacy RDA (right) is very narrow compared to the ORDA (left). This example is from a Batch mode elevation, where the difference will be the greatest. Since the legacy RDA is unable to restore any weather signal that is removed, the velocity estimates are often biased away from zero. With GMAP, most of the weather signal is restored, significantly reducing this bias. The result is a wider, more realistic zero isodop area.

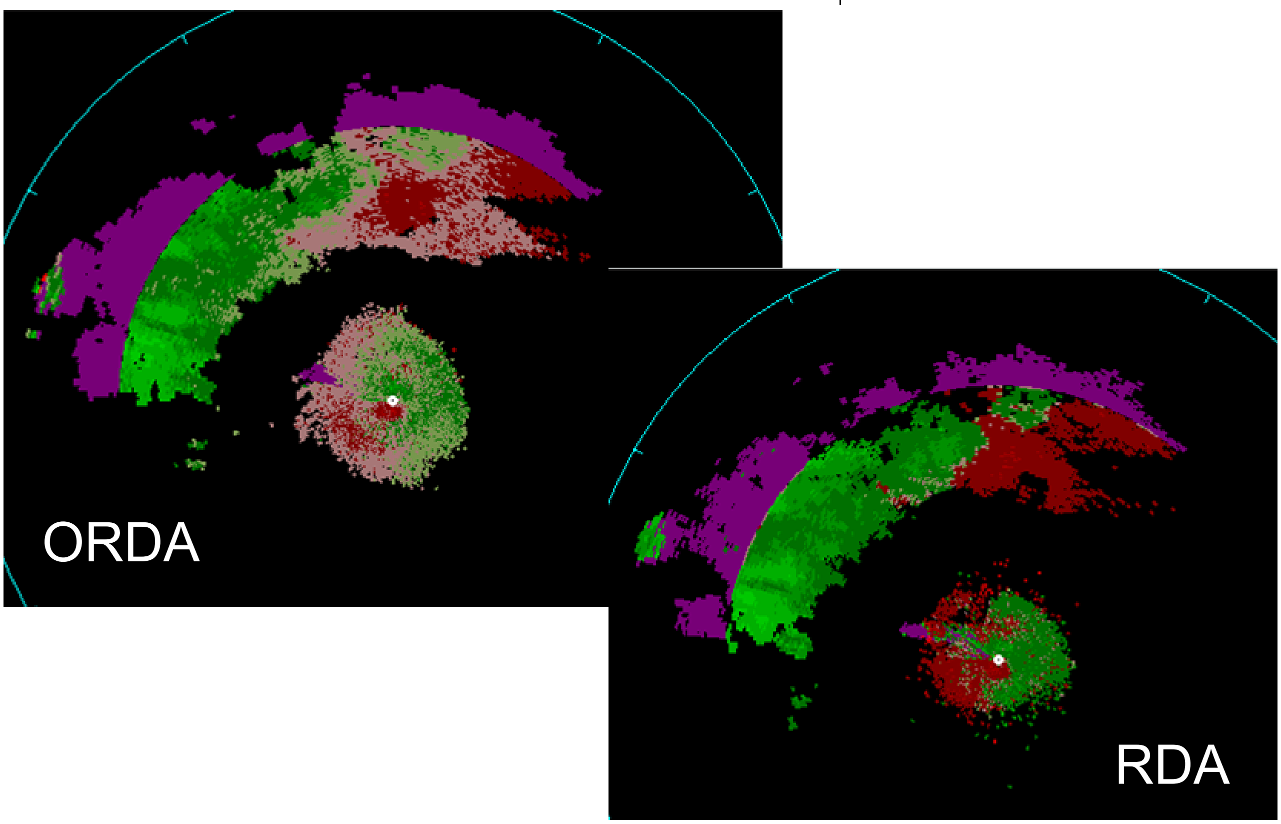


Figure 20. Difference in zero isodop area when All Bins is applied in the Batch elevations.

Implementing GMAP Clutter Suppression

Region and Select Code

There are fewer operator decisions required with GMAP. There are no longer any notch widths, so there are no longer any levels of suppression for the Doppler and Surveillance channels. The geographic area (range to range and azimuth to azimuth) for a clutter suppression region still needs to be determined, followed by the Select Code (Bypass Map, All Bins, or None), which defines the type of suppression.

Elevation Segment

Another difference with the Clutter Regions Editor window design (Figure 21) is the number of elevation segments. With the legacy RDA, there were two segments, low (<1.65°) and high (>1.65°) and two Bypass Maps were built, one for each segment.

Note that in Figure 21 there are the numbers 1 through 5 listed as segments, with only 1 and 2 enabled. GMAP allows for up to five different segments. However, ORDA Build 7.0 matches the legacy design. Segment 1 will be the low segment and Segment 2 will be the high segment. Additional segments are expected to become selectable in later builds and the Bypass Map generation process will build one map for each segment.

Recommendations for GMAP Implementation

1. Legacy Bypass Maps cannot be transferred to the ORDA. Bypass Maps will be generated by the ORDA installation team as soon as the installation is complete. This is done to verify that the map generation process is valid, and is unlikely to be conducted under ideal conditions.
2. After installation, sites can use GMAP All Bins everywhere ***until*** Bypass Maps can be generated under ideal conditions.
3. Bypass Maps should be generated ***as soon as*** ideal conditions permit.

At the time of this writing, additional instructions concerning the process of Bypass Map generation are being developed. Any documents produced by

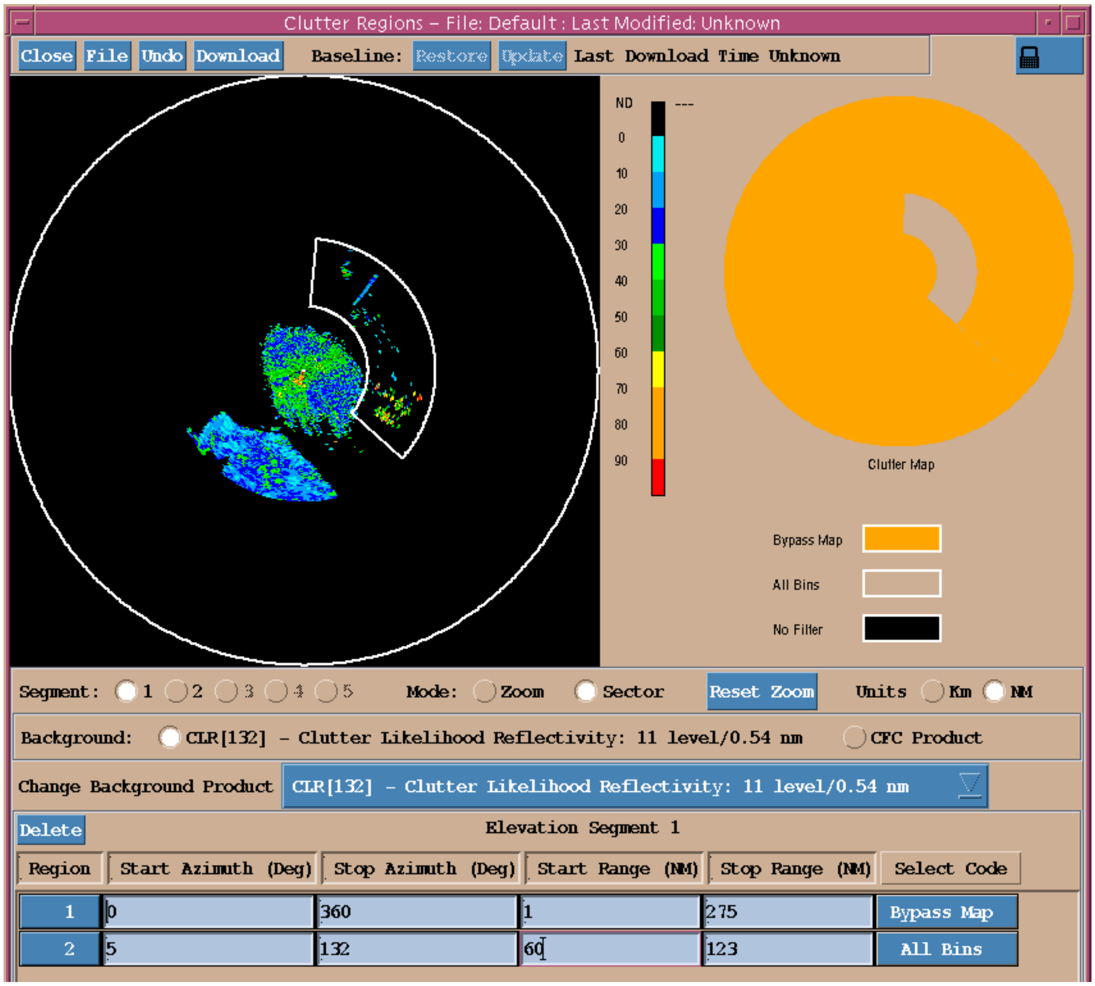


Figure 21. Clutter Regions window at RPG with ORDA installed.

the Radar Operations Center will also be available from the ORDA Build 7.0 Training web site:

http://wdtb.noaa.gov/buildTraining/ORDA/

4. Once Bypass Maps are generated, sites should then use GMAP Bypass Map or All Bins as they judge operationally appropriate. However, ***applying All Bins suppression everywhere for the high segment (Batch elevations) should be avoided.***

4. Differences in Batch Elevation Reflectivity Data

There have been problems with the legacy RDA when applying All Bins suppression in the Batch elevations, in some cases significantly biasing the base data. With the ORDA, some of these problems have been mitigated. However, ***there are still reasons to avoid applying All Bins suppression in the Batch elevations with ORDA***.

There are two differences with ORDA Reflectivity data in the Batch elevations as compared to the legacy RDA. The first difference is a ring of slightly reduced reflectivity which corresponds to the boundary of the first trip in the associated velocity. This is a consequence of data processing at the boundary of the first trip in the velocity. It is also accentuated by applying All Bins suppression everywhere in the high segment (Batch elevations). The data processing technique will be improved with ORDA Build 8.0. The second difference is slightly reduced reflectivity in areas that correspond to range folding in the velocity. This second difference is ***entirely*** a consequence of applying All Bins suppression everywhere in the high segment (Batch elevations).

1. Ring of Slightly Reduced Reflectivity

In Figure 22, the data examples come from the 3.4° elevation angle. In the reflectivity product, there is a ring of slightly reduced reflectivity. This ring corresponds to the boundary at the end of the first trip in the associated velocity product.

The first few range bins near the radar do not have data assigned to them. This small data gap near the radar also makes data assignment difficult at the boundary at the end of the first trip of the velocity data. This problem was also present with the legacy RDA, but was mitigated by a smoothing technique applied to the bins at the end the veloc-

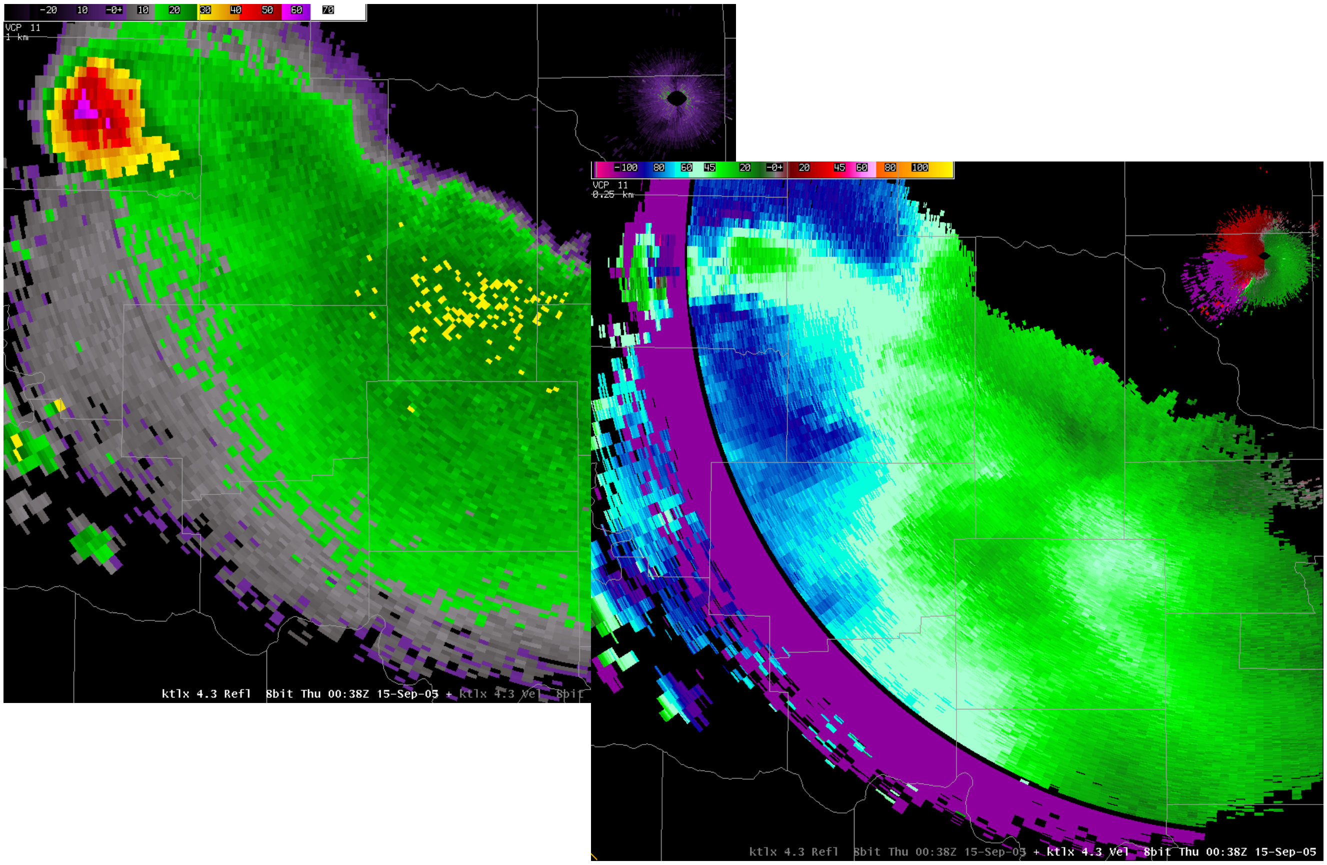


Figure 22. Batch elevation reflectivity with All Bin suppression applied to the high segment. Note the ring of reduced reflectivity which is associated with the end of the first trip in the velocity data.

ity first trip. ORDA Build 8.0 will apply a similar smoothing technique to mitigate this problem. The ring is accentuated when All Bins suppression is applied everywhere in the high segment (Batch elevations), but All Bins is not the primary cause.

2. Areas of Slightly Reduced Reflectivity

Batch processing alternates between low and high PRFs, such that each radial is sampled by a number of pulses from each of the low and high PRF modes. In the Batch elevations, one of these two modes is used for reflectivity processing, depending on whether the associated velocity data is range folded. In areas that are range folded, the reflectivity estimation comes from the low PRF data, which has a low number (3-10) of pulses. In areas that are not range folded, the reflectivity estimation comes from the high PRF data, which has a high number (25-278) of pulses.

With ORDA, GMAP is applied ***only*** to the high PRF data in the Batch elevations where the number of pulses is sufficiently high. For the low PRF data, a simple cancellation filter is applied since the number of pulses is very low. These two different clutter filtering techniques and the distribution of range folding in the associated velocity data may result in slight differences in the magnitude of reflectivity. This use of differing filtering techniques in the Batch elevations also existed with the legacy RDA, but differences in the data were less apparent.

In Figure 23, there is an example of reflectivity reduction beyond the first trip that is associated with range folded velocity data. All Bins suppression was in effect everywhere within the high segment (Batch elevations). To mitigate this problem, sites are encouraged to generate Bypass Maps at the ***earliest*** opportunity after initial ORDA installation and to ***avoid using All Bins suppression everywhere in the high segment***.

5. Improvements to the Quality of Spectrum Width Estimates

Though the same technique is used by ORDA for estimating spectrum width, ORDA design allows for a better implementation as compared to the legacy RDA. There were errors with both hardware and software in estimating spectrum width with the legacy RDA.

The legacy RDA hardware device that contributed to spectrum width errors no longer exists with ORDA. ORDA also provides the needed software upgrade. Spectrum Width estimates are particularly difficult in areas where the returned power is

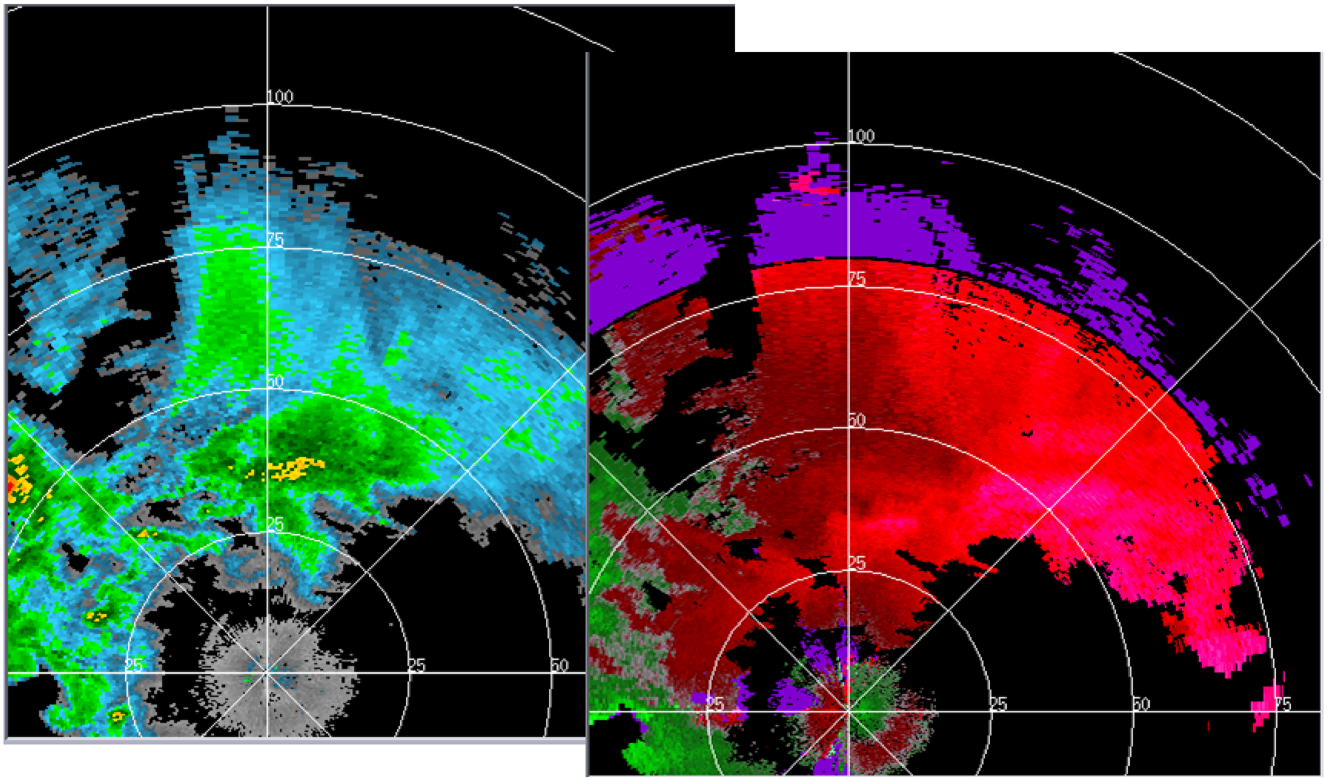


Figure 23. Batch elevation radar products with All Bins suppression applied everywhere in the high segment. Note the area of reduced reflectivity associated with range folding in the corresponding velocity data.

weak, and ORDA design improves that process. Where the returned power is weak, it will be close to the noise level, often resulting in erroneously high spectrum widths.

Spectrum width data generated by the legacy RDA had a bias toward higher values and a more noisy appearance. Though there will still be high spectrum widths with a weak power signal, the frequency of occurrence is lower with ORDA and the overall appearance is less noisy. In addition to product appearance, these improvements to the Spectrum Width estimation also produce better input to the Radar Echo Classifier (REC) algorithm. The REC uses all three base moments to determine areas of unaddressed clutter. The REC is used by the Precipitation Processing System

(PPS) to prevent clutter from contaminating precipitation products.

In Figure 24, the Spectrum Width on the right was generated by the legacy RDA, while the Spectrum Width on the left was generated at the same time by the ORDA on a radar very close by. Note that the legacy RDA image has regions of higher values and is noisier in overall appearance.

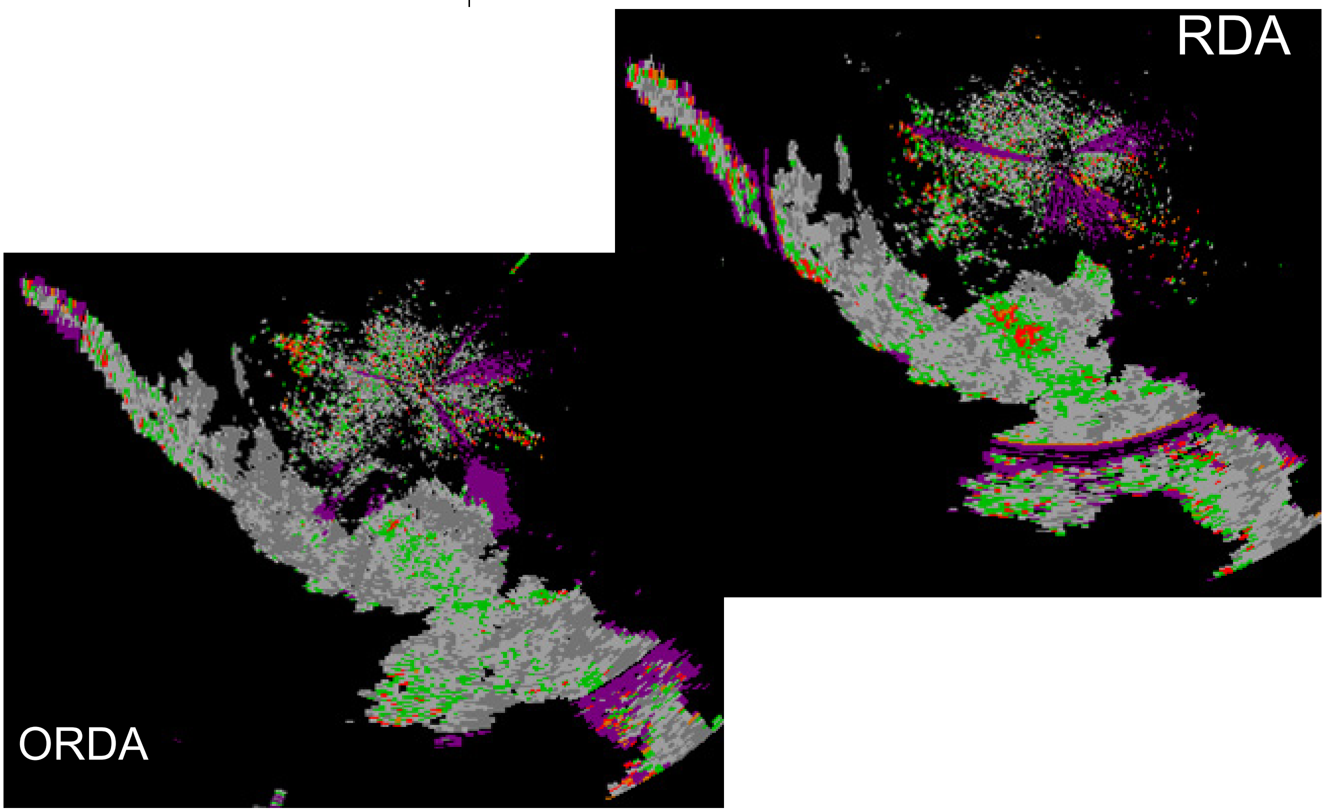


Figure 24. Spectrum width generated by the ORDA on the left and the legacy RDA on the right, with the two radars close together. Note that the legacy has more high values and the overall look is noisier.

6. Differences in Elevation Angle Settling

As the antenna transitions from one angle to the next, there is a short time required for the antenna to settle on the given angle and to then begin collecting data. The NEXRAD system requirement is that the antenna must be within 0.2° of the target elevation angle before data collection begins. The antenna settling process is the most challenging at 0.5°, since the antenna has transitioned down from the highest elevation of the particular VCP

(19.5° or 4.5°). Occasionally, this settling effect has been and will continue to be apparent in the data, causing a discontinuity from the azimuth where data collection began compared to where it ended.

Figure 25 is a 0.5° Base Reflectivity product from an ORDA field test conducted at Corpus Christi, TX. Note the discontinuity to the west-southwest. Data collection began at the 247° azimuth (antenna rotating clockwise) and the antenna angle was actually at 0.65°. By the end of data collection, the antenna angle was at 0.48°.

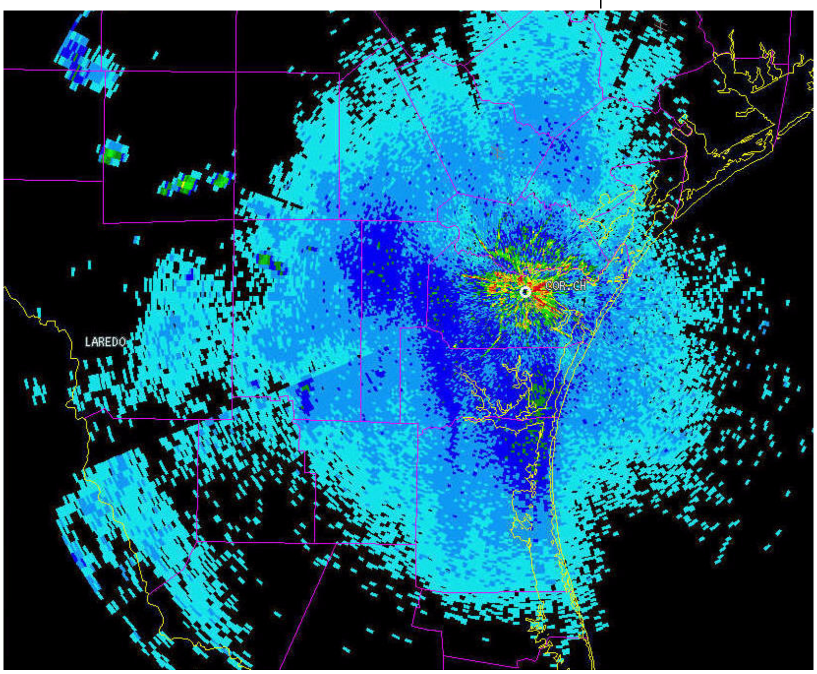


Figure 25. ORDA field test at CRP. Antenna settling results in a data discontinuity at 0.5°

Though this data discontinuity has occurred in the past with the legacy RDA (Figure 26), it may be more frequent with ORDA at 0.5°. Data collection begins at 0.5° once the antenna is within 0.2° of 0.5° ***and*** the on-line calibration check is complete. With the legacy RDA, the on-line calibration process takes longer and thus allows more time for antenna settling at 0.5°. There are plans to improve antenna settling performance in a future software build.

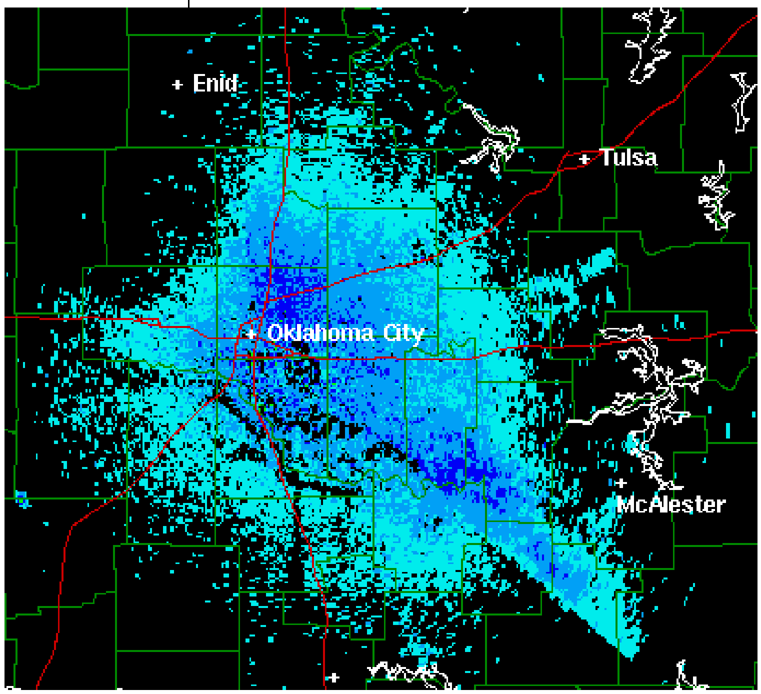


Figure 26. Data discontinuity at 0.5° due to antenna settling on a legacy RDA.

7. End of First Trip Velocity Less Noisy

With the legacy RDA, the transition from the first to the second trip of the velocity data has often had a narrow ring of false, sometimes noisy, velocity values. This is an artifact of the Range Unfolding Algorithm as it processes the first few bins of data in the first trip (close to the radar) vs. the first few bins of data in the second trip.

The ORDA processes data close to the radar in a way that has reduced the frequency of this problem. For both the Split Cut and the Batch elevations, the transition from the end of the first trip to the beginning of the second trip with ORDA will be be a ring of missing data (Figure 27). In future builds, the ring of missing data will be replaced by a smooth transition from the first to the second trip.

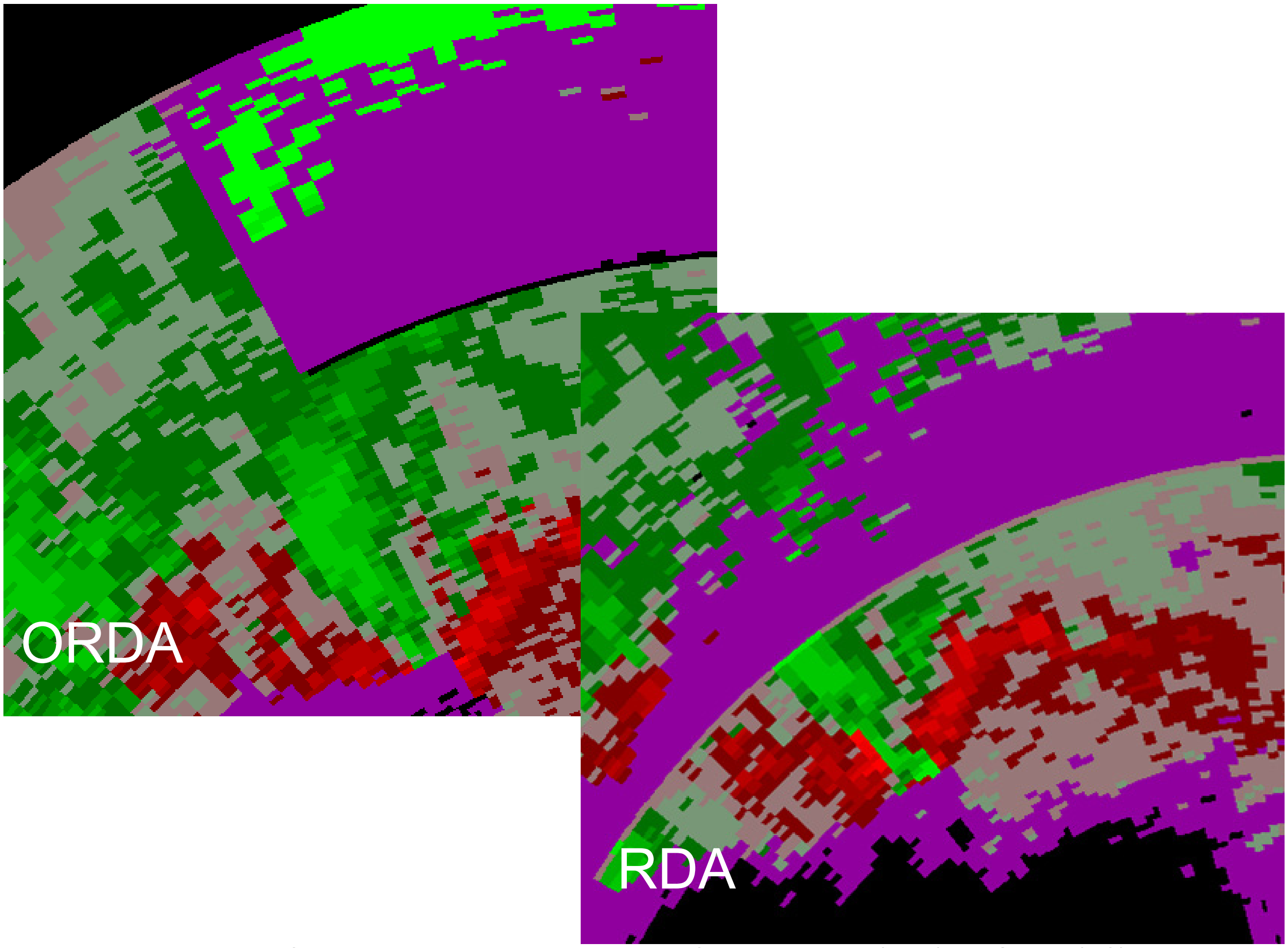


Figure 27. Transition from 1st to 2nd trip in velocity data for legacy RDA (right) vs. ORDA (left).

8. Differences in Types of RDA Alarms

There are differences in the types of RDA Alarms with the legacy RDA vs. the ORDA. With the legacy RDA, there were 8 types of alarms:

- ARC - Archive II (no longer done at RDA)
- UTL - tower utilities
- CTR - RDA controller (Micro 5 computer)
- WID - wideband
- PED - pedestal
- XMT - transmitter

- RSP - receiver/signal processor
- USR - a device that was not used

With the ORDA, there are 7 types of alarms:

- RCV - receiver (RVP8 and other components)
- UTL - tower utilities
- CTR - RDA controller (RCP8)
- XMT - transmitter
- PED - pedestal
- COM - wideband and RDA LAN communications
- SIG - signal processor (RVP8)

See Figure 28 for a comparison of the RDA Alarms windows for legacy RDA vs. ORDA.

9. Difference in RDA Performance Data Menus

There are differences in the RDA Performance Data menus between the legacy RDA and ORDA. From the RDA Performance Data application button on the RPG HCI Main Page, the RDA Performance Data window is opened. The selections on the RDA Performance Data window will vary from the legacy RDA to the ORDA (Figure 29).

One item that is often noted as part of a shift change checklist is the Generator Fuel Level. With the legacy RDA, the Generator Fuel Level was part of the Tower Utilities submenu. With ORDA, the Generator Fuel Level is part of the Equipment Shelter window (Figure 29).

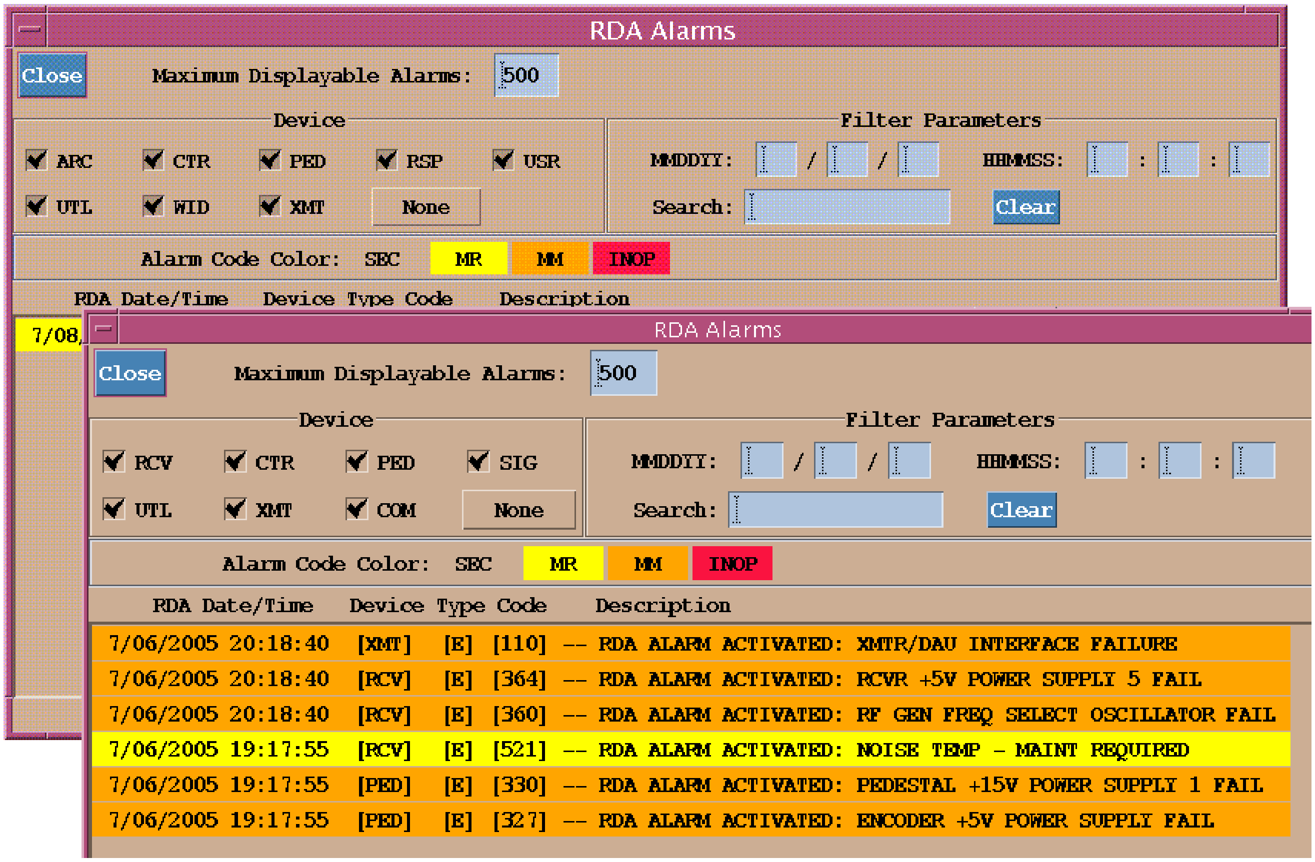


Figure 28. Types of RDA Alarms for legacy (top) vs. ORDA (bottom).

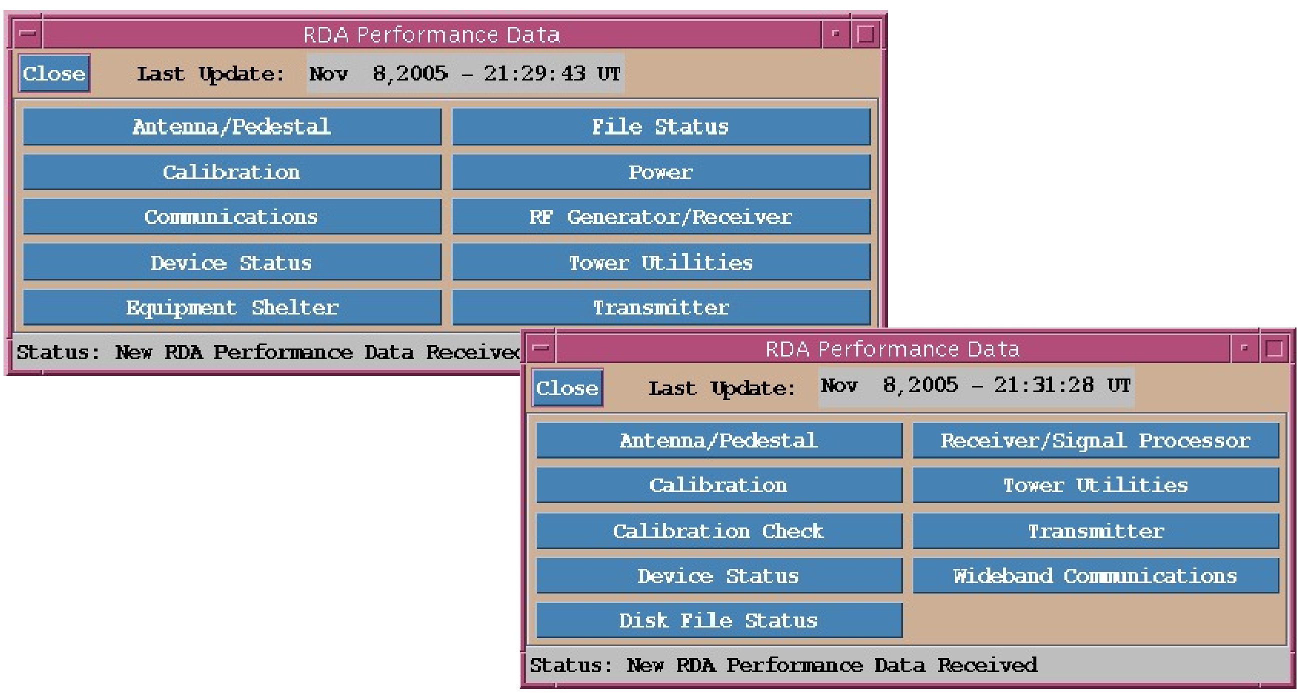


Figure 29. RDA Performance Data for legacy RDA (right) vs. ORDA (left).

10. False Alarm at AWIPS

After ORDA installation, there is the possibility of false alarms indicating an interruption in product flow. When the RDA is accessed through a dial up connection, this alarm is falsely generated. It is a red banner alarm at the bottom of the D2D, but there will be no interruption in radar products.

Summary and Resources

This document presents the operational impacts of ORDA Build 7.0. There are differences in the appearance of the Base Data with the legacy RDA vs. the ORDA. In some cases, the differences have minimal operational impact. In other cases, the differences are the result of improvements in the quality of the Base Data due to ORDA design.

All relevant training materials are available from the ORDA Build 7.0 Training web site:

http://wdtb.noaa.gov/buildTraining/ORDA/

For those NWS offices that wish to track training completion, the ORDA Build 7.0 Training streaming presentation can also be accessed from the LMS.