



RDA Build 13.0 Training

*Presented by the
Warning Decision Training Branch*



Welcome to the RDA Build 13.0 operator training.

RDA Build 13.0



- Clutter Mitigation Decision (CMD) & Automated Volume Scan Evaluation and Termination (AVSET) are back!!
 - Not your pre-Dual-Pol CMD...
- Hybrid Spectrum Width (HSW) Estimator
- Clutter residue & SZ-2

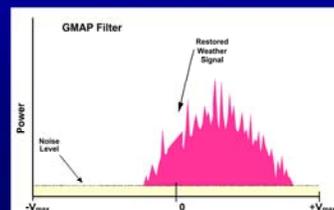
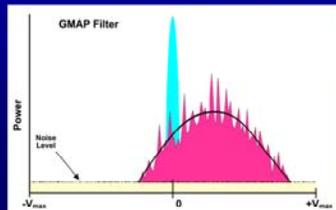
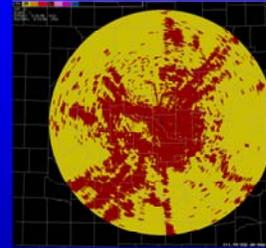
The most important feature of RDA Build 13.0 is that two significant algorithms that became unavailable with the initial Dual-Pol upgrade at the RDA make a comeback. The two algorithms are Clutter Mitigation Decision (CMD) and Automated Volume Scan Evaluation and Termination (AVSET). AVSET allows for an automated termination of a volume scan when there are no significant data at higher elevations. AVSET must be enabled manually. With the exception of one new parameter, the RDA Build 13.0 implementation of AVSET is the same as before.

On the other hand, the RDA Build 13.0 version of CMD is very different, and the bulk of this presentation will be about the new CMD.

There is a new method for estimating Spectrum Width. Lower values of spectrum width will be better represented, though differences on the products will be subtle. During the RDA Build 13.0 Beta Test, a difference in the areal coverage of residual clutter with velocity vs. spectrum width was noticed. This difference is limited to clear air returns when an SZ-2 VCP is active. More about this later.

What Does CMD Do?

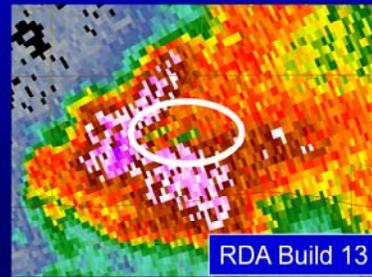
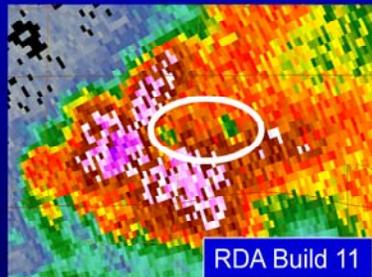
- Reminder
 - CMD identifies clutter for the bin
 - GMAP removes the power near zero velocity and (usually) rebuilds lost signal for the bin



First, a reminder of CMD's place in the task of identifying and removing clutter. CMD is the identification algorithm, finding bins with clutter every volume scan. CMD does not remove the clutter. That is the job of the Gaussian Model Adaptive Processing (GMAP) algorithm. GMAP first finds an interval of low spectrum width very close to zero velocity. GMAP then removes power only from this interval near zero velocity. If there is sufficient returned signal remaining outside of this interval, GMAP is then able to rebuild the lost signal across that interval.

Build 13.0 (New) CMD

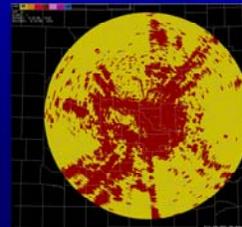
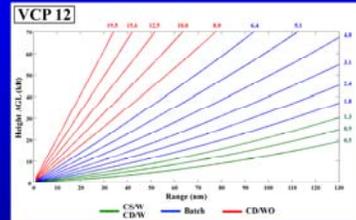
- Same goal: bin by bin clutter identification every volume scan
- Testing with variety of cases
 - Build 13 (New) CMD meets or exceeds performance of Build 11 (Old) CMD



The new CMD has the same goal as before. It identifies clutter on a bin by bin basis, every volume scan. The version of CMD that you've used in the past was based on RDA Build 11.0. Here's a comparison of the Build 11.0 CMD to the Build 13.0 CMD from the development and testing. With this intense convective storm, there are two rather distinct areas of CMD false detections on the Build 11.0 CMD on the left. For the Build 13.0 CMD applied to the same data (right side image), there are fewer pixels with false detections.

What's New About New CMD?

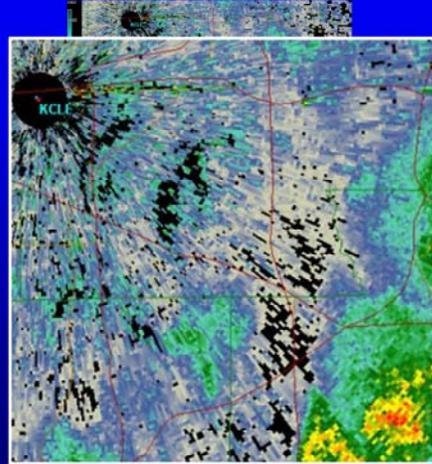
- Incorporates Dual-Pol data to identify clutter
- Implementation changes
 - CMD on *all* elevations
 - builds clutter map for each rotation/elevation
 - CFC product shows *one* map for each segment



The new CMD is different in design in that the Dual Pol data are part of the decision making to identify clutter. There are also significant implementation changes. The old CMD was only applied to the Split Cut elevations. The new CMD is applied to all elevations, which means that a “clutter map” is built by CMD for every rotation, every elevation, of the volume scan. However, you cannot see all of these maps. The Clutter Filter Control (CFC) product only shows you one map from each of the five clutter filter elevation segments.

What's New About New CMD?

- “Old CMD” fuzzy logic
 - Z texture
 - Smooth (low) = weather
 - Rough (high) = clutter
 - Z spin
 - Z gradient sign changes
 - CPA (phase consistency)
 - High CPA = clutter
 - Low CPA = weather



CMD is a fuzzy logic algorithm. For now, here are the inputs for the old CMD:

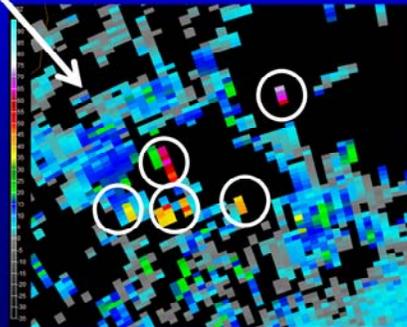
1. Z texture, which is smooth (a low value) for a meteorological target and rough (a high value) for a clutter target
2. Z spin, which looks at the number of times that the Z gradient changes sign along a portion of the radial. The higher the number of sign changes, the higher the likelihood of clutter.

In the associated Z image, the weak signal areas close to the radar have a visually rougher texture and one would find more frequent changes in sign of the Z gradient.

3. Clutter Phase Alignment (CPA) captures the consistency of pulse to pulse phase changes. Since we are looking for clutter targets that don't move, there is low variation in returned pulse phase change with clutter. A high CPA means good alignment of phasors, a low variation of returned phase, and a higher likelihood of clutter.

What's New About New CMD?

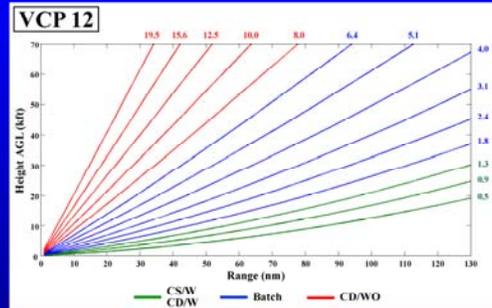
- “New CMD” fuzzy logic
 - Same Z texture & spin
 - CPA modified to minimize sporadic missed detections in terrain
 - STDZDR
 - High STDZDR = clutter
 - STDPHI
 - High STDPHI = clutter



The Build 13.0 version of CMD uses the same input for Z texture and Z spin. The CPA has been modified to provide better performance in mountainous terrain. With the old CMD in mountainous terrain, sporadic missed detections resulted in patchy “hot spots” on the radar products. The Build 13 CMD is expected to better mitigate these missed detections.

There are two new inputs, both based on Dual-Pol base data. They are standard deviations of ZDR and PHI. ZDR may be familiar, but PHI is Φ_{DP} , the data that are used to build the KDP product. Φ_{DP} is generated at the RDA and sent to RPG, but not available as a product for viewing in AWIPS. For both STDZDR and STDPHI, the higher the value, the higher the likelihood that the range bin contains clutter.

Build 13.0 CMD Implementation

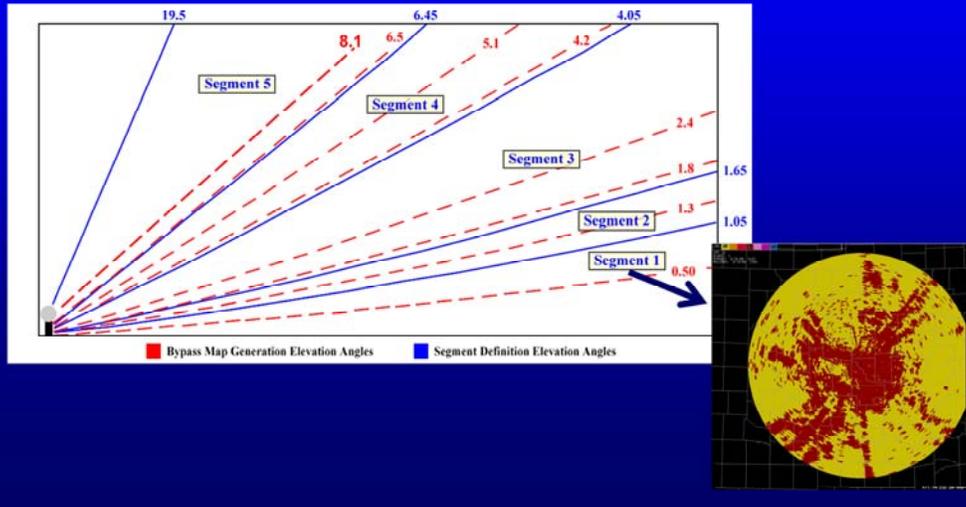


- CMD builds a map for every rotation & every elevation
 - Split Cuts: one for CS, another for CD
 - Batch and higher: one for each elevation

In addition to changes in design with the Build 13.0 CMD, there are significant changes with its implementation. CMD is active for every rotation and every elevation, building a “clutter map” each time. For the Split Cuts, there are two rotations at the same elevation, Contiguous Surveillance (CS), then Contiguous Doppler (CD). CMD builds a different map for each of these two rotations. For the remaining elevations in the volume scan, a different map is built each time. The down side is that you cannot see all of these maps, which may be challenging for troubleshooting efforts.

Build 13.0 CMD Implementation

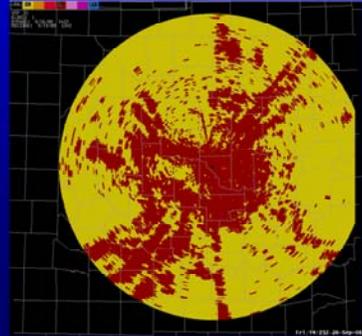
- CFC product and elevation segments



In the past, the Clutter Filter Control (CFC) product has been helpful for visualizing where clutter filtering is applied. The CFC product depicts which bins have clutter filtering applied. The CFC is generated each volume scan, with one product for each clutter elevation segment. There are five elevation segments, bounded by the angles in blue on the graphic.

Build 13.0 CMD Implementation

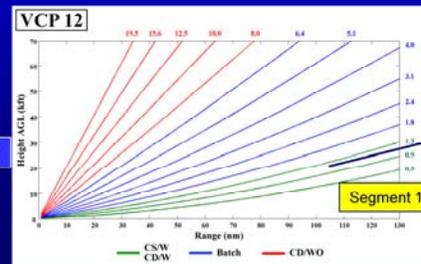
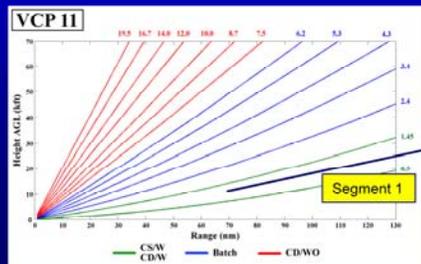
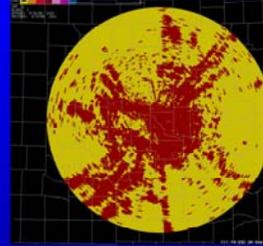
- One CFC per elevation segment
- CMD builds a map for every rotation & every elevation
 - CFC products only a subset



There are five CFC products generated each volume scan, one for each elevation segment. With the Build 13.0 CMD implementation, a clutter map is built for every rotation and every elevation of every volume scan. This means that the CFC product is only showing you a subset of the maps built by CMD. The next few slides provide a bit more detail for the lower angles.

Build 13.0 CMD Implementation

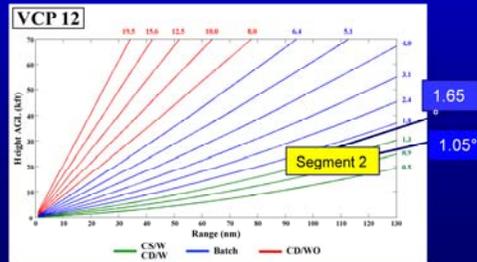
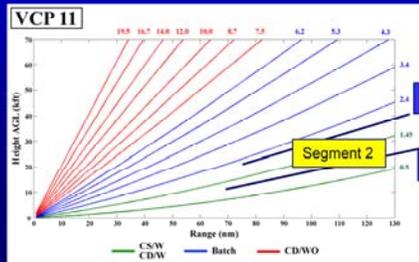
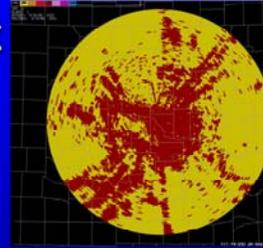
- CFC for elevation segment 1 built from 0.5° CS rotation
 - CMD builds maps for all remaining cuts in segment



Elevation segment 1 includes all angles below 1.05° . For VCPs 12 and 212, this means 0.5° and 0.9° , while 0.5° is the only angle in segment 1 for the remaining VCPs. Since all of these angles are Split Cut, CMD will build a clutter map for each CS and CD rotation. However, the CFC product for elevation segment 1 will only depict the first map built, which is from the 0.5° CS rotation.

Build 13.0 CMD Implementation

- CFC for elevation segment 2 built from 1.3° or 1.45° CS rotation
 - CMD builds maps for all remaining cuts in segment



Elevation segment 2 includes all angles between 1.05° and 1.65° . For VCPs 12 and 212, 1.3° is the only angle in segment 2, while 1.45° is the only angle for the remaining VCPs. Since both 1.3° and 1.45° are Split Cut, CMD will build a clutter map for both the CS and CD rotations. However, the CFC product for elevation segment 2 will only depict the first map built, which is from the 1.3° or 1.45° CS rotation.

Build 13.0 CMD Implementation

- Bottom line: CFC for any elevation segment only shows you 1 CMD clutter map
 - Could complicate troubleshooting
 - Work with ROC Hotline



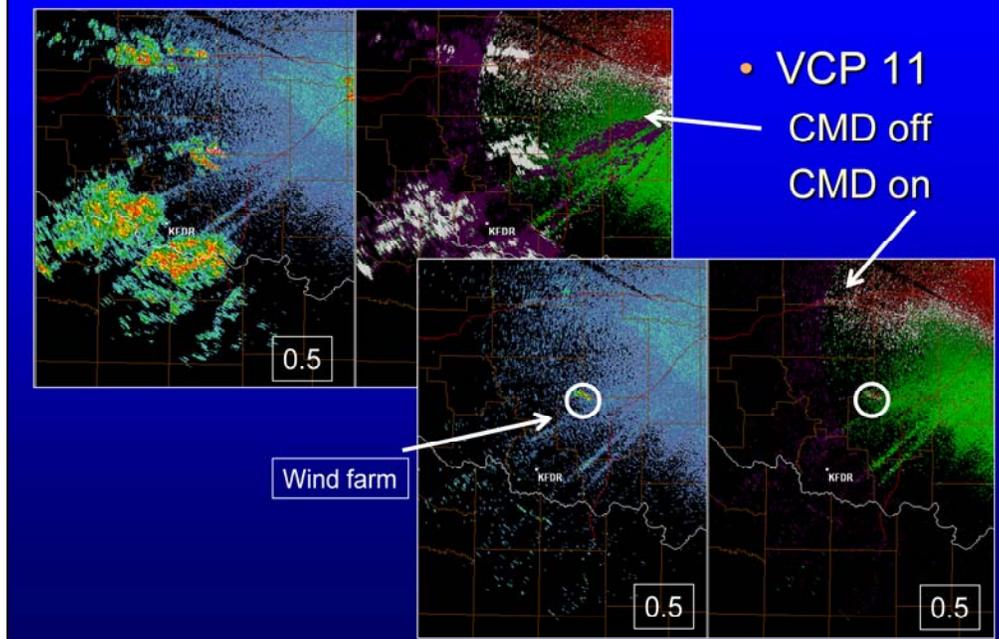
I could continue for each of the remaining elevation segments, but I'm guessing you've had enough! The bottom line here is that the CFC product for each elevation segment is going to depict one clutter map for that segment, the first one generated at the lowest elevation in the segment. There will be other maps built by CMD for that segment that are not depicted by the CFC product, which may complicate troubleshooting the performance of CMD. The ROC Hotline is available for support if you need it!

Build 13.0 CMD Performance Test Cases

Case	Date	Radar	VCP	# Vols
Stratiform Precip	17 April 2010	KOUN	21	19
Phi Wrap w/ Tornadoic Storms	10 May 2010	KOUN	12	2
NBF/Bow Echo	19 May 2010	KOUN	212	2
AP Case	08 April 2011	KOUN	11	68
Tornadoic Storms & AP	14-15 April 2011	KOUN	12	80
Tornado Outbreak (Piedmont)	24 May 2011	KOUN	12	81
Mountain Clutter	31 May 2011	KIWA	32	22
Storms & AP	15 June 2011	KOUN	11	18
AP, Sea Spray & Precip	26-27 June 2011	KMHX	21, 212	31
AP/Strong Storms Mix	28 June 2011	KOUN	12	11
Tornadoic Storms	07 Nov 2011	KOUN	12	209
SZ-2 Precipitation	19 Dec 2011	KOUN	212	42
Sidelobes	5 Jan 2012	KOUN	32	3

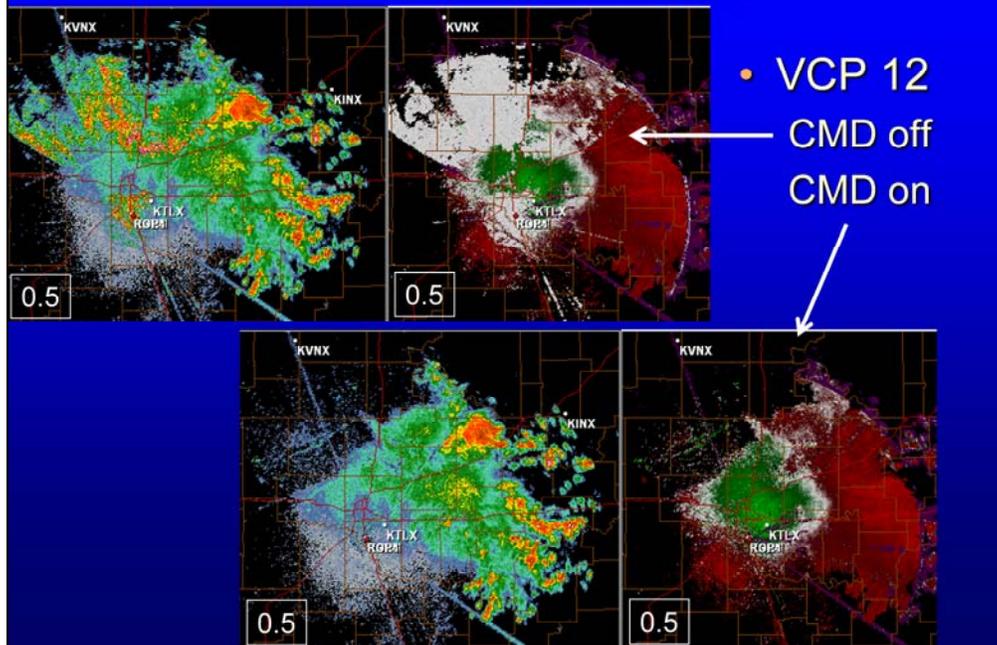
Though I will only show a few of these, here is a summary of the variety of cases that were used to test the performance of the Build 13.0 CMD. Notice that there is wide variety in the types of cases that were processed to test the Build 13.0 version of CMD.

Build 13.0 CMD: AP



Here is an example of how CMD performs with widespread AP. All images are from the 0.5° elevation. CMD has been turned off for the Z and V images at the top left and turned on for the Z and V images on the bottom right. The only return that CMD could not identify for removal is a wind farm (circled).

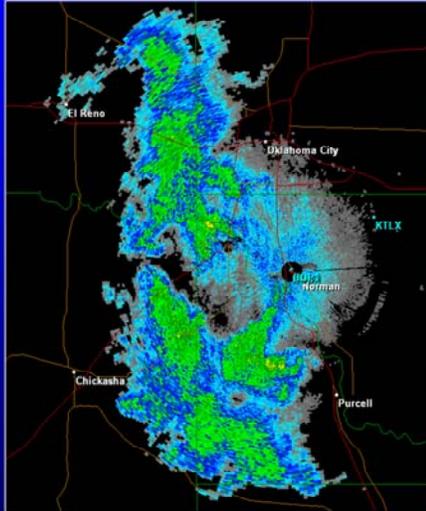
Build 13.0 CMD: Precip & AP



In this example, CMD is dealing with precipitation and AP together. These images are from the 0.5° elevation. CMD has been turned off for the Z and V images at the top left and turned on for the Z and V images on the bottom right. The precipitation areas are preserved, while the AP to the north and northwest is identified by CMD, then the clutter signal is removed by the Gaussian Model Adaptive Processing (GMAP) algorithm.

Build 13.0 CMD: Higher Tilts

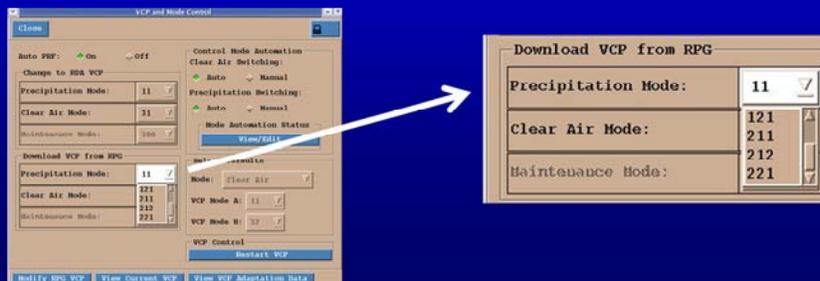
- VCP 212 @ 8.0°



Here's an example from a higher elevation product, 8.0°. This is high enough where clutter is unlikely unless there is nearby terrain. These two images come from the Build 13.0 testing and imply that CMD "does no harm" for the higher elevations.

CMD & VCPs 211, 212, & 221

- All Bins degrades SZ-2 velocity
 - CMD enabled: Default clutter file downloaded with SZ-2 VCP
 - CMD disabled: CMD enabled & Default clutter file downloaded with SZ-2 VCP



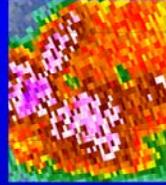
There is one implementation step with the new CMD that is the same as with the old CMD...the relationship to the SZ-2 VCPs, 211, 212, & 221. Use of All Bins with the return of CMD is discouraged in general, but in particular when a SZ-2 VCP is used. All Bins and SZ-2 do not play well together, and there is RPG software in place to prevent All Bins and an SZ-2 VCP from being active together.

When CMD is enabled and an SZ-2 VCP is downloaded, the Default clutter regions file is also downloaded. This just ensures that the Bypass Map is in control everywhere, and CMD does the clutter identification.

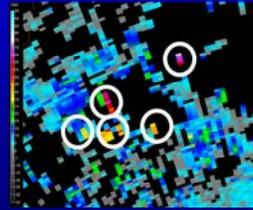
If CMD has been disabled and an SZ-2 VCP is downloaded, CMD will be enabled, and the Default clutter regions file is downloaded along with the SZ-2 VCP.

Build 13.0 CMD Expectations

- Based on testing thus far...
 - Decrease in false detections



- Decrease in missed detections in mountainous terrain

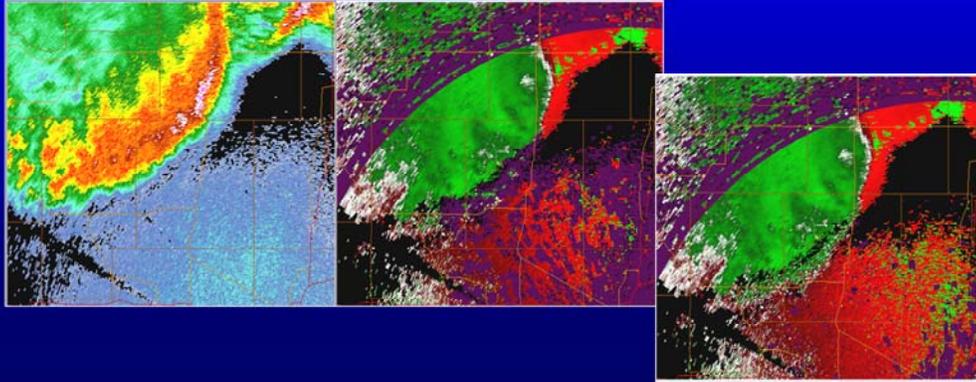


- Acceptable to apply to every elevation/rotation

Here are some Build 13.0 CMD expectations based on the testing conducted thus far. CMD false detections have resulted in sporadic blocks of reduced signal, even near convective storms. Fewer false detections are expected with the Build 13.0 CMD. Where the radar beam encounters mountainous terrain, there have been sporadic bins of high signal, which are missed detections. Fewer missed detections in mountainous terrain are also expected with the Build 13.0 CMD. Finally, testing thus far has shown no degradation with applying CMD to every elevation angle, even above the Split Cuts.

New CMD & SZ-2

- DP inputs lower for SZ-2 VCPs
- Trade off:
 - More undetected clutter vs. increase in RF



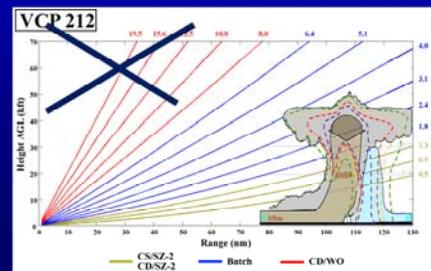
The development and testing of the new CMD did reveal an extra challenge when using the SZ-2 VCPs. It turns out that allowing the Dual-Pol inputs in the same way as other VCPs resulted in an unacceptable increase in RF in the velocity data (see velocity product on left). Reducing the weighting of the Dual-Pol inputs mitigated this RF problem, but also increases the amount of undetected clutter.

SZ-2 processing, like CMD and GMAP, is a base data quality algorithm. All of these algorithms are challenged as the number of pulses per radial decrease. Among the SZ-2 VCPs, 212 has the faster antenna rotation rates and the lowest number of pulses per radial. VCP 212 was designed for the threat of severe convection, and should be used when appropriate. Data quality problems with VCP 212 are most likely to be noticed when VCP 212 is used for non-severe weather, or clear air.

AVSET is Back!

- What is AVSET?
- AVSET makes each volume scan “dynamic”
- Sampling above the weather?
 - Stop current volume scan & start a new one!

Precip Status:	ACCUM
VAD Update:	ON
Model Update:	ON
Auto PRF:	ON
Super Res:	ENABLED
CMD:	ENABLED
AVSET:	ENABLED
Calib: [-0.10]:	AUTO
Load Shed:	NORMAL
RDA Messages:	ENABLED
Adapt Times:	MATCH



In addition to CMD making a comeback with RDA Build 13.0, Automated Volume Scan Evaluation and Termination (AVSET) returns. AVSET, when enabled, looks at the areal coverage of return for the higher elevations. If the current volume scan begins to sample above the weather, AVSET will stop the current volume scan and start a new one. This is a brief “thumbnail” version of what AVSET does and how it does it.

Build 13.0 AVSET

- Build 13.0: one new parameter to better catch developing elevated convection
- Want reminder of how AVSET works?
 - See RPG Build 12.3 Training

National Weather Service
Warning Decision Training Branch

RPG Build 12.3 Training

The Warning Decision Training Branch (WDTB) has provided training to support the RPG Build 12.3 deployment. There are two features of RPG Build 12.3 addressed in the training:

- New RPG status messages
- Automated Volume Scan Evaluation and Termination (AVSET)

The new RPG status messages will not be apparent unless your RDA has been upgraded to Dual Polarization. They are presented in this training only if they are noticed and operators are curious.

AVSET is the star of RPG Build 12.3! AVSET meets a long desired need for faster product updates. When the weather return is limited to the lower elevation angles, AVSET automatically terminates the volume scan early. This is dependent on both the depth of any weather (the range from the radar). When AVSET is active, each volume scan is "dynamic".

Presentation

The training presentation in streaming format is available from this page for DoD, FAA, and NWS partners who wish to learn about RPG Build 12.3. The presentation takes about 15 minutes to complete.

NWS Staff

To receive credit on your transcript, you must complete the course in the NWS Learning Center. Use the button below to access the course in the CLC.



NWS Partners

NWS Partners can access this training from WDTB directly. You have the option of launching the presentation directly from our web site or downloading a copy for local viewing.

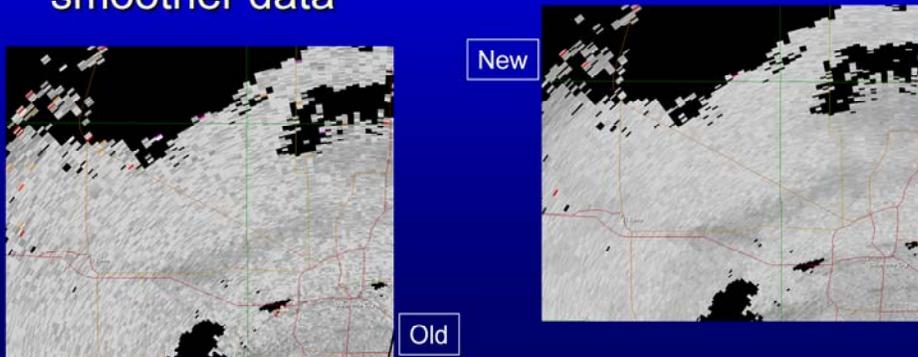


<http://www.wdtb.noaa.gov/buildTraining/Build12-3/index.html>

There is one slight difference in the RDA Build 13.0 version of AVSET. It is a new parameter setting that improves the ability to sample elevated convection that may be developing near the radar. Other than that, if you want a reminder of how AVSET works, it is the primary feature in the RPG 12.3 training, which is available from the WDTB web site.

Hybrid Spectrum Width Estimator

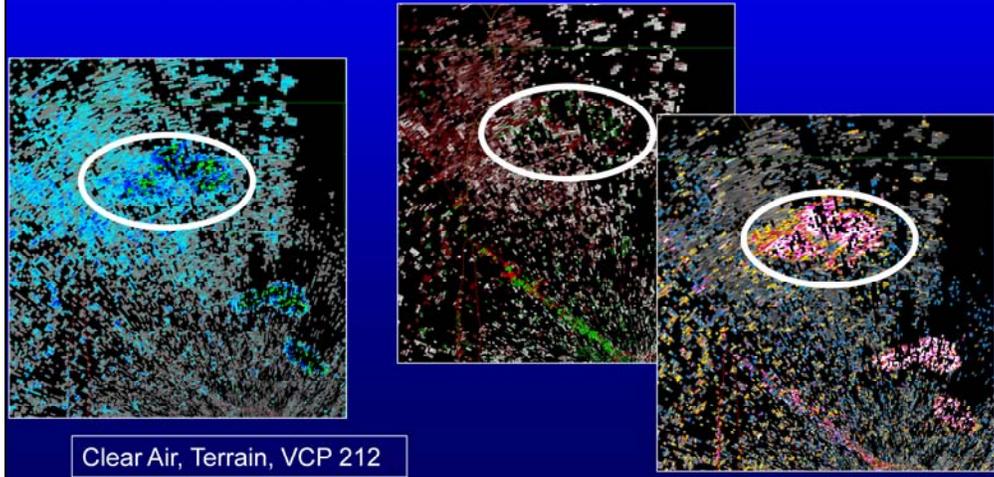
- Motivation: FAA Turbulence Detection Algorithm
- May see more very low values, and smoother data



RDA Build 13.0 has a new technique for calculating spectrum width. This change was motivated by the FAA, specifically to provide better resolution of low spectrum width values to support the FAA's Turbulence Detection Algorithm. NWS decision makers may notice very little difference, with the exception of a slight increase in bins with very low spectrum width values. The data fields of low spectrum width will often appear slightly smoother (right side image).

Clutter Residue & SZ-2

- Difference in areal coverage of V & SW
 - limited to SZ-2 VCPs

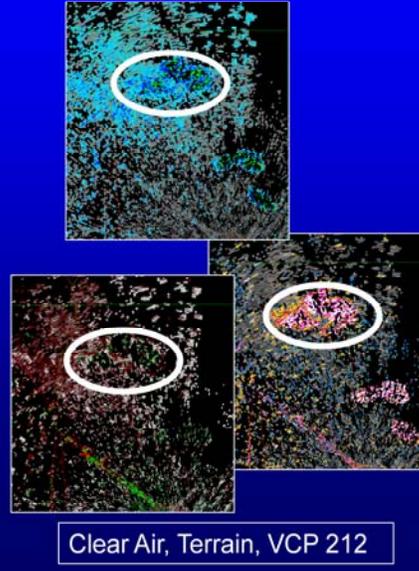


During the RDA Build 13.0 Beta Test, a difference in the areal coverage of residual clutter with velocity vs. spectrum width was noticed. This difference is related to SZ-2 processing with the new Hybrid Spectrum Width estimator. In this example, there is no precipitation present. The large oval area is mountainous terrain, where CMD has identified clutter and GMAP has removed it. Notice a significant difference in the number of gates where there is ND on the velocity product, though there is a spectrum width value at the same gate.

It is expected that an adjustment (change in thresholding) will be applied in a future WSR-88D build.

VCP Selection: The Trade Offs

- Worst case: VCP 212 in clear air & mountains
 - Do not try this at home
- Faster VCPs (12, 212, 121)
 - Fewer pulses/radial
- Fewer pulses/radial limit CMD, GMAP, SZ-2 etc. performance

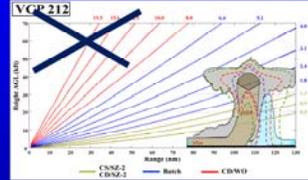
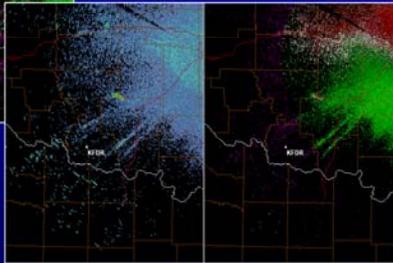
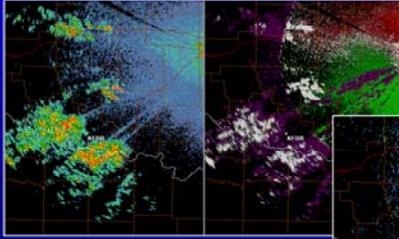


The use of VCP 212 in clear air with mountainous terrain was helpful in this case, only because it revealed a difference in thresholding that will be fixed in a future build. However, running VCP 212 in clear air with mountainous terrain is not recommended, and here's why.

VCP 212 is among the fastest VCPs, along with 12 and 121. These VCPs have the fastest antenna rotations, which also means the fewest pulses per radial. The lower the number of pulses per radial, the more difficult it is for the base data quality algorithms to perform well. It's harder for CMD to accurately identify clutter. It's harder for GMAP to rebuild any residual clear air signal after the clutter has been removed. It's harder for SZ-2 to recover velocity data from more than one trip.

Thank You For Your Time

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Thank you for your time and please let me know if you have any questions.