January 2010
Issue 19

It's All in How You Look at It

Late evening and early morning severe thunderstorms in eastern Minnesota demonstrated the importance of viewing angle in Doppler measurement. The location and the motion of these storms relative to the WSR-88D made them a challenge for radar interrogation by warning forecasters at WFO Twin Cities/ Chanhassen (KMPX).

In the two events of interest, there was a pair of Doppler radars at nearly identical distances from the storms. One was the WSR-88D at WFO KMPX while the other was TMSP, an FAA Terminal Doppler Weather Radar (TDWR) that assists operations at the Minneapolis/St. Paul International Airport. These radars are located 30 miles apart from one another.

While the radars were at a similar proximity from the storms and the heights of the lowest beam centers were quite comparable, the output velocity data was markedly different. This was a direct result of the nearly 90° angle that the KMPX pulses intersected the storm paths. The Doppler radar receiver can detect phase shifts in the pulses that strike targets, and from that returned data derive target velocities. The more orthogonal to the beam radial that the target motion is, the less of a target velocity component the radar receiver can measure. This was the case for the KMPX WSR-88D

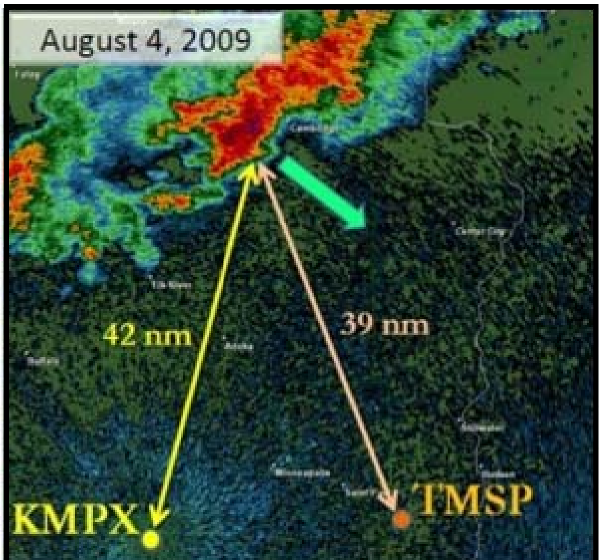

Figure 1: 10:28pm CDT August 4, 2009 KMPX reflectivity with radar distances and storm motion vector.

Lowest Beam Center Heights of Velocity Data of Interest on August 4	
KMPX	**2,300 ft**
TMSP	**3,300 ft**

Table 1

Continued on Page 2

What's Inside?

Look at It

Continued from Page 1

during these two events.

Near 10:30pm CDT on August 4, 2009 an organized thunderstorm north of the Twin Cities was evolving east southeast. This had no history of being severe, but the reflectivity revealed morphology into a potential wind threat. There was little in the way of automated observations in the area of the storm, so accurate Doppler data was essential. Seen in Figure 1, the WSR-88D radar was at a disadvantage in measuring velocity due to the storm motion vector. The angle between the measuring radials and the storm motion was a nearly orthogonal 84° at warning decision time. On the other hand, TMSP's radials crossed the storm motion vector at a considerably less angle of 37°, which actually improved to 27° later in the storm's life cycle. Thus a much larger component of storm motion was measurable by TMSP, and accordingly more realistic Doppler data was output.

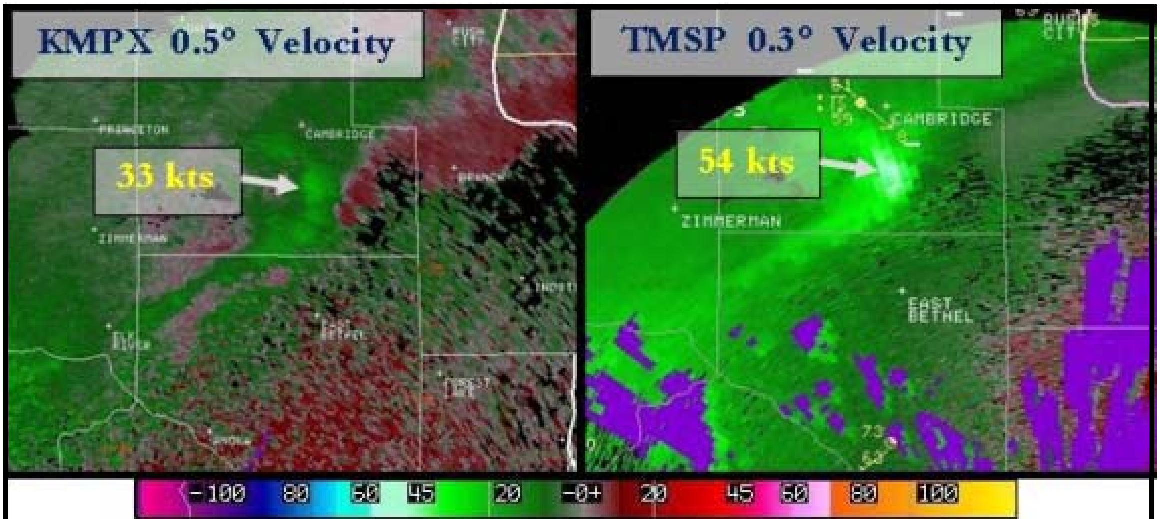

Figure 2: August 4, 2009 Doppler radar data comparison of the lowest angles from KMPX and TMSP.

From Table 1, one can see that the lowest beam height from each radar was within only a few thousand feet of the ground, potentially offering a more accurate indication of the winds realized at the surface. The lowest level base velocity data from near the time of this event's Severe Thunderstorm Warning issuance can be seen in Figure 2. Just over a 20 kt difference existed in the maximum velocity bin data within the storm as a direct result of the radial angles versus the storm motion. Warning forecasters that evening recognized this discrepancy given this storm this

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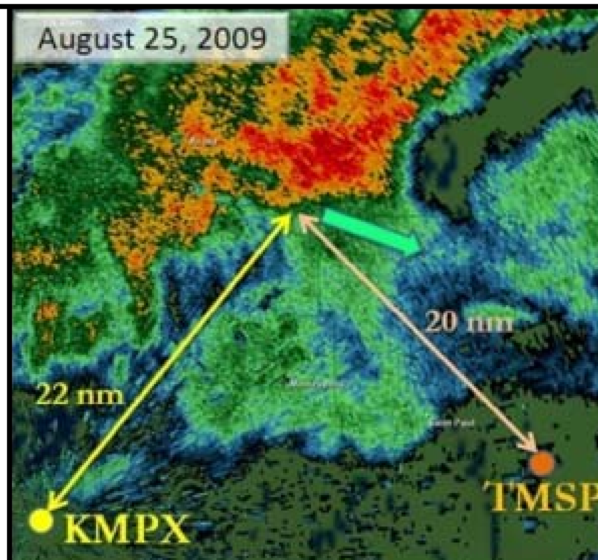

Figure 3: 6:28am CDT August 5, 2009 KMPX reflectivity with radar distances and storm motion vector.

Lowest Beam Center Heights of Velocity Data of Interest on August 25	
KMPX	**1,200 ft**
TMSP	**1,550 ft**

Table 2

Look at It

Continued from Page 2

discrepancy given this storm location and its motion. As a result, TMSP was the radar favored for more representative velocity data. The warning was issued ahead of destructive winds that brought down dozens of large trees near the community of Wyoming.

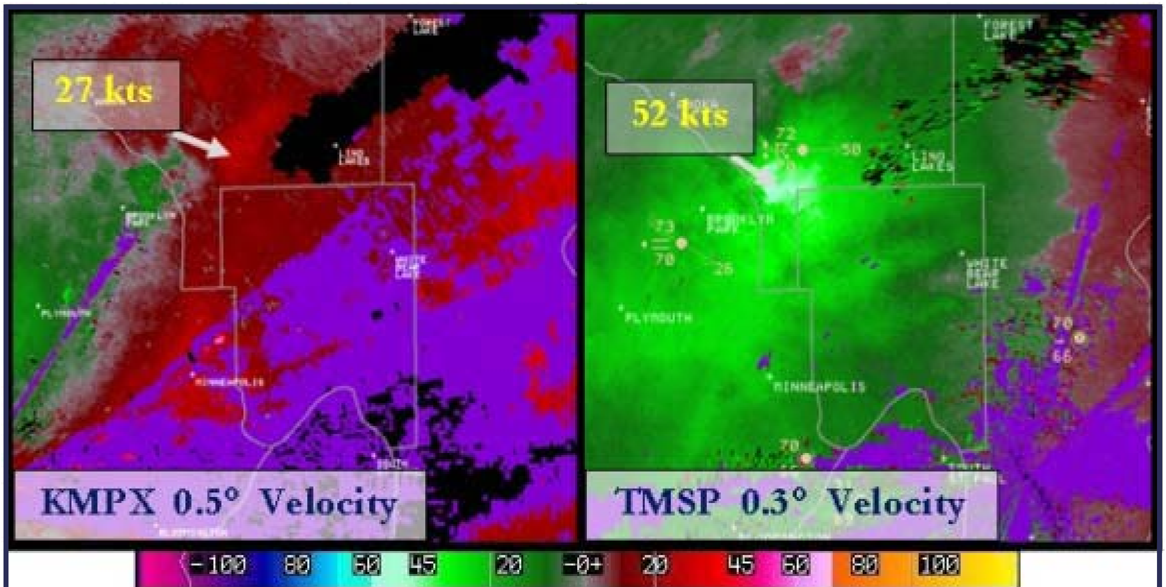

Figure 4: August 25, 2009 Doppler radar data comparison of the lowest angle from KMPX and TMSP.

Three weeks later, another thunderstorm at an almost identical line of longitude led to a very similar observation. On August 25th, an early morning area of storms was moving across the north metro of the Twin Cities. Figure 3 depicts how this storm was closer to the radar than the first case, but the geometry of it was just as challenging for the KMPX radar because of the east southeast storm motion.

As seen in Figure 4, the velocity magnitudes on TMSP were once again higher, but even more appreciable in this case. The interpreted near zero velocities are in the gray colors on the KMPX image. Because the echoes were in reality moving, this area basically highlights where the radial orthogonally met the target motion vectors. Some of the radials with the greatest amount of gray shade are those cutting through the high velocity area of the storm, highlighting the problem. This storm would soon produce a measured 58 mph gust, as well as, take down several large trees.

These two August events from eastern Minnesota reflect how critical it is for operational WFO staff to keep in mind their radar viewing angles relative to the storm during an event and utilize available resources. The zero or near-zero isodop in velocity data can highlight radials where perpendicular storm motion may cause challenges. Within the WFO Advanced Weather Interactive Processing System (AWIPS) there is an Estimated Actual Velocity (EAV) tool that can calculate the target motion component of measured base velocity. The user-provided variable is sim-

Figure 5: TMSP lowest level base velocity data with AWIPS EAV tool output from the Aug. 5th severe thunderstorm warning (outlined in yellow) event.

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Solar Flux Resources

Each morning, WSR-88D maintainers around the country call the Space Weather Prediction Center (SWPC) requesting the 10.7cm solar flux values (observed and forecast).

As a former WSR-88D operator and instructor at Keesler AFB, I wanted to inform the radar maintainers they can also obtain the flux measurements from the SWPC web site and via email.

Section IV of the Joint USAF/NOAA Report of Solar and Geophysical Activity, available at http://www.swpc.noaa.gov/forecast.html, provides the observed 10.7cm flux, as well as, a 3-day forecast.

These forecasts, along with space weather alerts of potential interest to radar maintainers, can be received via email by subscription at https://pss.swpc.noaa.gov/LoginWebForm.aspx?ReturnUrl=%2fproductsubscriptionservice%2fMainMenuWebForm.aspx.

Finally, SWPC plans to introduce a menu-driven phone answering system within the year. One option will be dedicated to providing current and forecast 10.7cm flux values.

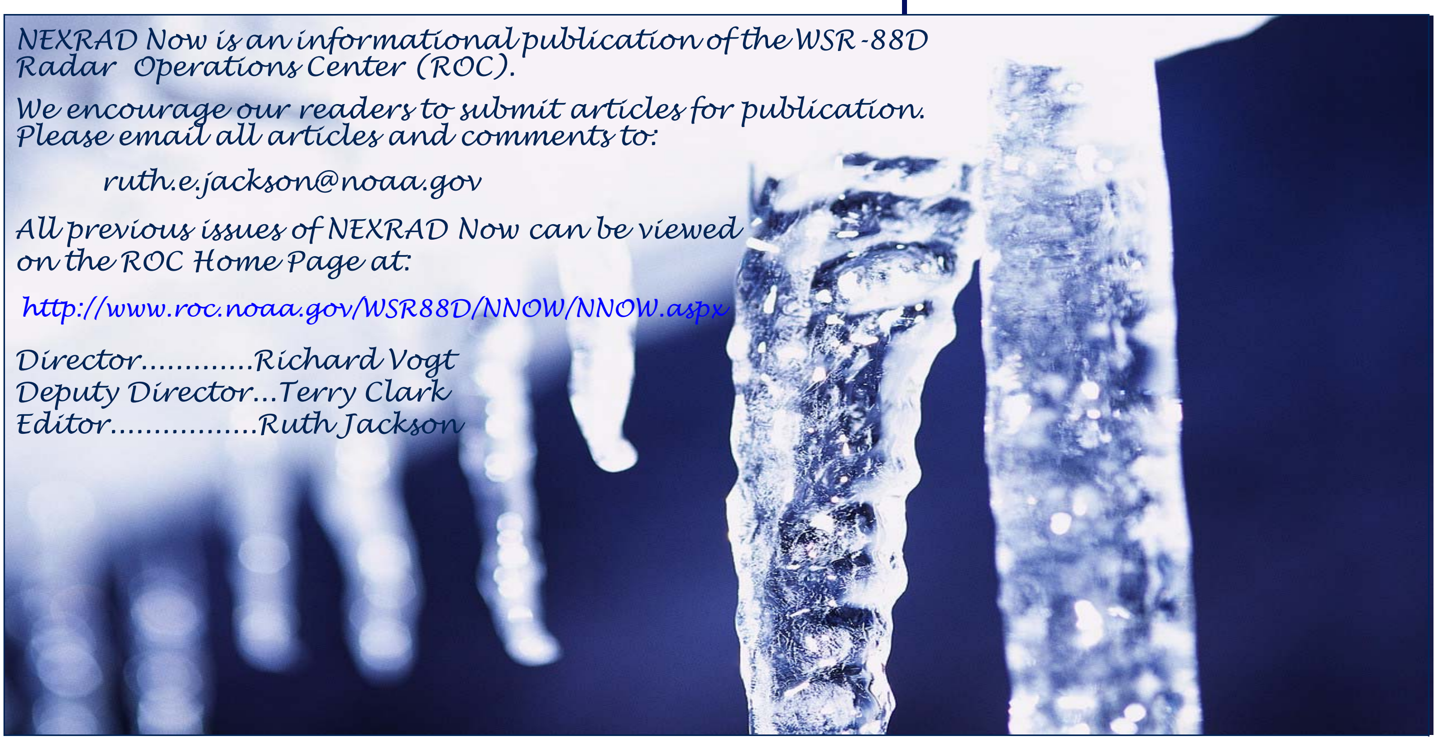
Rob Steenburgh, SMSgt, USAF
AF Liaison to SWPC

Look at It

Continued from Page 3

ply the motion of the storm of interest. This tool will only provide output however if the angle of intersection between the radial and storm motion is less than 75°. In the two scenarios above, the EAV tool provided no output for the KMPX radar for that very reason. It did though further help estimate the TMSP measured winds. In Figures 2 and 4, the TMSP maximum velocity estimated by the EAV tool was 68 kts for the August 4th event (Figure 5) and 63 kts for the August 25th event. This tool may allow for more direct correlation of measured data and observed speeds or wind damage for warning forecasters and damage survey teams.

Matthew Friedlein
Twin Cities/Chanhassen WFO



NEXRAD Now is an informational publication of the WSR-88D Radar Operations Center (ROC).

We encourage our readers to submit articles for publication. Please email all articles and comments to:

ruth.e.jackson@noaa.gov

All previous issues of NEXRAD Now can be viewed on the ROC Home Page at:

http://www.roc.noaa.gov/WSR88D/NNOW/NNOW.aspx

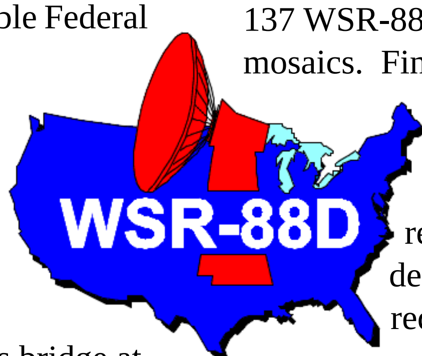
Director.............Richard Vogt
Deputy Director...Terry Clark
Editor.................Ruth Jackson

Operational “Tid Bits”

Terminal Doppler Weather Radar (TDWR) Data Flow

Several Weather Forecast Offices (WFOs) have experienced frustration with extended TDWR outages and having the outages addressed in a timely manner. The Radar Operations Center (ROC) recommends that the availability of TDWR data be checked during shift changes. If there is an outage, the first call should be to the applicable Federal Aviation Administration (FAA) Maintenance Operations Control Center (MOCC). If the MOCC cannot find or correct the issue, call the WSR-88D Hotline for assistance. The ROC will begin deployment in late January 2010 of a replacement for the communications bridge at the TDWR shelter, which should improve communications reliability. The ROC recommends the WFO Meteorologist in Charge (MIC) or Electronic Systems Administrator (ESA) contact the MOCC supervisor for TDWR maintenance and arrange periodic meetings at the MOCC and at the WFO.

The ROC also encourages WFOs to exchange in-person visits with Department of Defense (DOD) WSR-88D maintenance staff. These visits can develop a better working relationship and help DOD WSR-88D and FAA TDWR maintainers better understand how the WFO uses the FAA TDWR and DOD WSR-88D data in forecast and warning operations.



WSR-88D Redundant Channels

Consider periodically changing channels on redundant WSR-88Ds, whether National Weather Service (NWS) or FAA, to help ensure the operational status of the other channel. The status of the FAA channels can be reviewed at: http://ssm.roc.noaa.gov/faa_channel.asp.

NCDC WSR-88D Archives and Display Tools

The National Oceanic and Atmospheric Administration’s (NOAA) National Climatic Data Center (NCDC) is an on-line and no-charge source for all the centrally collected TDWR (all 45 operational sites) and WSR-88D (155 sites) products (http://www.nws.noaa.govtgrpccds_radar_products.pdf). In addition, NCDC archives the Level II data from 137 WSR-88Ds and has hourly NEXRAD national mosaics. Find inventories of archived radar data at: http://www.ncdc.noaa.gov/nexradinv/choosesite.jsp. Data ordered is sent to an FTP site for retrieval in usually less than an hour – depending on the amount of data requested.

The NCDC has some excellent visualization tools. NOAA's Weather and Climate Toolkit is an application that provides simple visualization and data export of weather and climatological data archived at NCDC.

The Multi-Function Phased Array Radar (MPAR) Update

NOAA, the Office of Atmospheric Research and NWS are collaborating with the FAA, Air Force, Department of Homeland Security (DHS) and other federal agencies to study the feasibility, viability, and cost-effectiveness of replacing today’s air surveillance and weather radars with a common system using phased array radar (PAR) technology. No decision has been made as to whether a PAR-based system will be deployed, and multi-mission PAR technology is likely at least a decade away from being ready for possible operational use. Also, no decision has been made as to where the possible radars will be sited.

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Tid Bits

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The second MPAR Symposium was held November 17 - 19, 2009 in Norman, OK. The theme of the symposium was based on the three risk-reduction objectives of demonstrating service improvements, multi-functionality, and cost reduction. The overall schedule called for an optional workshop or "short course" on the first morning of the symposium to provide general technical information on phased array radar, an afternoon introductory session followed by a session on multi-functionality. The second day's sessions focused on service improvements, with sessions on the final morning dealing with cost reduction followed by wrap-up activities. Tours of the various facilities at Norman were offered in the afternoon. Additional information on the Symposium and the MPAR Project is located at: http://www.ofcm.noaa.gov/homepage/text/spc_proj.htm.

What the ROC Really Said about "Faster" Volume Coverage Patterns (VCPs)

During the summer there were many discussions and emails about whether the use of "faster" VCPs would cause more repairs and maintenance. There was also a discussion point that the ROC had suggested limiting the use of VCP12 on an as "really needed" basis. To be clear, the ROC's bottom line position has been that antenna movement rates in all VCPs are within the design limits of the radar and forecasters should use the VCP that maximizes their use of the WSR-88D for forecast and warning support.

Western Washington

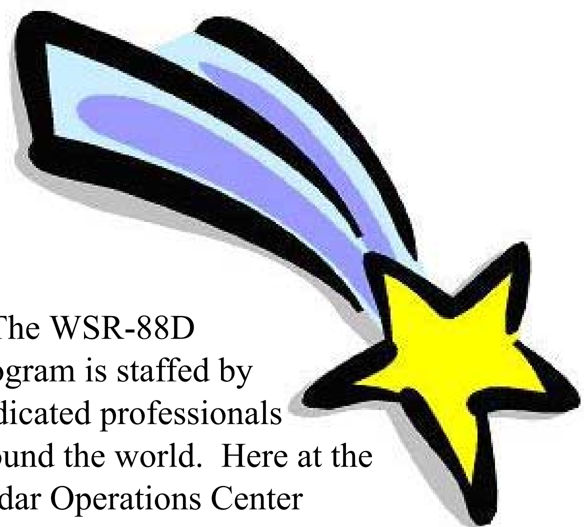
On May 28, 2009 US Senator Maria Cantwell announced that Congress had appropriated $2 Million to start a project for a new weather radar along the Washington State coast. Subsequently, the FY10 Omnibus Appropriation Bill included $7 Million needed to buy the radar, prepare the land, and install the radar. The radar will be a high-power, high-resolution long-range S-band Doppler radar with Dual Polarization capability that integrates seamlessly with the NEXRAD network. The ROC is working with NWS Office of Science and Technology (OS&T), NWS Western Region Headquarters, and others in the NWS and NOAA, to plan and execute this project with a scheduled operational date of September 2012.

Level II Data Collection, Distribution, and Archive Update

The NWS will add the 4 FAA WSR-88D sites in Hawaii to the Level II network in February 2010. Then beginning with the deployment of software Build 12.0 in July 2010, the NWS will begin to add the remaining 8 CONUS DOD WSR-88D sites to the Level II network. The NWS will add the three dual polarization moments to the Level II data stream from NWS sites, as the dual polarization modification is installed beginning in 2010. Last, but not least, the NWS will implement a new architecture for the Level II network in 2010. The new architecture will use NOAANet communications to send the data to two aggregation points – the NWS Telecommunications Operations Center as the primary and the Radar Operations Center as a backup. The new architecture will be more reliable, remove the NWS regional headquarters as aggregation points, replace hardware that is reaching end of service life, and provide data to the same four "top tier" distribution centers located at Purdue University, the University of Maryland, Oklahoma University, and the Educational Research Consortium of the Western Carolinas.

Tim Crum
ROC Director's Office

ROC Stars



The WSR-88D program is staffed by dedicated professionals around the world. Here at the Radar Operations Center (ROC) we are proud of our employees, many of whom have been recognized for their outstanding work and commitment to excellence. The following employees have received awards in the past several months:

- 2009 Isaac M. Cline Award for Support Services was presented to Donna Kitchell for outstanding support and service accomplishments that demonstrated teamwork while vastly enhancing productivity within the Next Generation Radar mission.
- ROC Employee of the Quarter
  1st Quarter 2009 – Sallie Ahlert
  2nd Quarter 2009 – Mike Weeks
  3rd Quarter 2009 – Christina Horvat
  4th Quarter 2009 – Doug Botner
- ROC Team Member of the Quarter
  1st Quarter 2009 – Carolyn Wittenbach
  2nd Quarter 2009 – Amy Maddox
  3rd Quarter 2009 – Ruth Jackson
  4th Quarter 2009 – Don McCuddy
- 2009 Oklahoma Federal Executive Board Employee of the Year nominees:
  - Maj. John Sandifer - Tech, Professional, Admin. DOD GS-9 and above
  - Christina Horvat - Technical, Professional, Admin. Civilian GS-9 or above
  - Steve Smith - Supervisory-Civilian
  - Lt. Col. Scott Saul - Supervisory-DOD
  - Terrell Ballard, Dan Beurer, Nigel Ellis, Dan Garcia, Bobby Harp, Frank Hewins, Monte Keel, Ray Lena, Matt Lynch, Ron Pattison, Jimmy Roper, Mike Shattuck, Chad Smith, Felicia Woolard, James Bollinger, Scott Kelly, Jason Howard - team category.
- Overall winners for the 2009 Oklahoma FEB Employee of the Year:
  - Eric Ice - Technical, Professional & Administrative, GS-8 and below
  - Janalee Pacheco - Clerical/Administrative
- NOAA Team Member of the Month, July 2009 - Bill Deringer
- 2008 Bronze Medal Award for leadership and technical excellence in implementing a major, life-saving enhancement to the Nation's Doppler weather radar network: Tim Crum, Steven Smith, Zhongqi Jing, Olen Boydstun, Robert Lee, Walter Zittel, Cheryl Stephenson, and Joe Chrisman
- 2008 Bronze Medal Award for professional excellence in restoring weather radars in Mt. Holly, NJ and Dover, DE to full mission capability to support weather warning operations:
  Terrell Ballard, Jimmy Roper, Matthew Lynch, Michael Shattuck, Bobby Harp, Frank Hewins, Felicia Woolard, MSgt James Bollinger (USAF), TSgt Chad Smith (USAF), and SSgt Jason Howard (USAF)

Nancy Beck
ROC Director's Office

The Importance of Proper Clutter Filtering

For the past few months, CMD (Clutter Mitigation Decision) has been available to field sites with the recent software upgrade of Builds 11.0 and 11.1. We at the ROC have seen vast improvement across the field of day-to-day clutter filtering, especially during Anomalous Propagation (AP) events.

A rather impressive event occurred over most of the central US, including Oklahoma, in late June 2009 with an unusually steep inversion. Figure 1 shows a Clutter Filter Control (CFC) product while CMD was enabled (the dynamic Bypass Map) with the corresponding reflectivity and velocity images shown to its right. The CMD algorithm detected a large amount of clutter – almost the entire radar coverage area was flagged as having clutter. Now that's a lot of AP!

After CMD flagged these bins, GMAP (Gaussian Model Adaptive Processing) removed the clutter and rebuilt the weather signal, which is seen in the base moments below. The resulting reflectivity and velocity products show clear air return from moving scatterers.

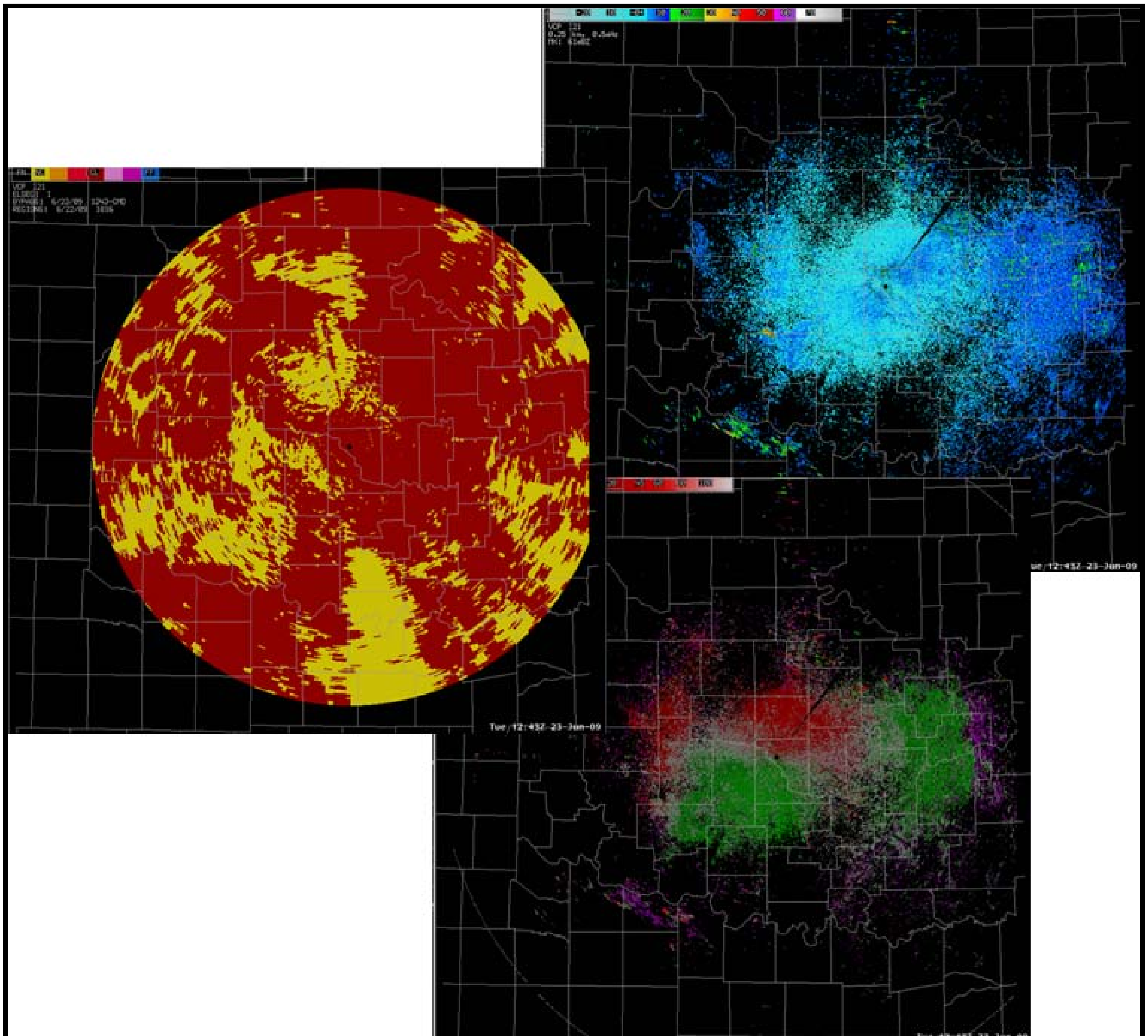


Figure 1: A Clutter Filter Control product while CMD was enabled at 1243Z with the corresponding reflectivity and velocity images shown at right.

Don't believe it? We turned off CMD and ran the legacy static Bypass Map. The results of which are shown in Figure 2.

Operators should request a

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Proper Clutter Filtering

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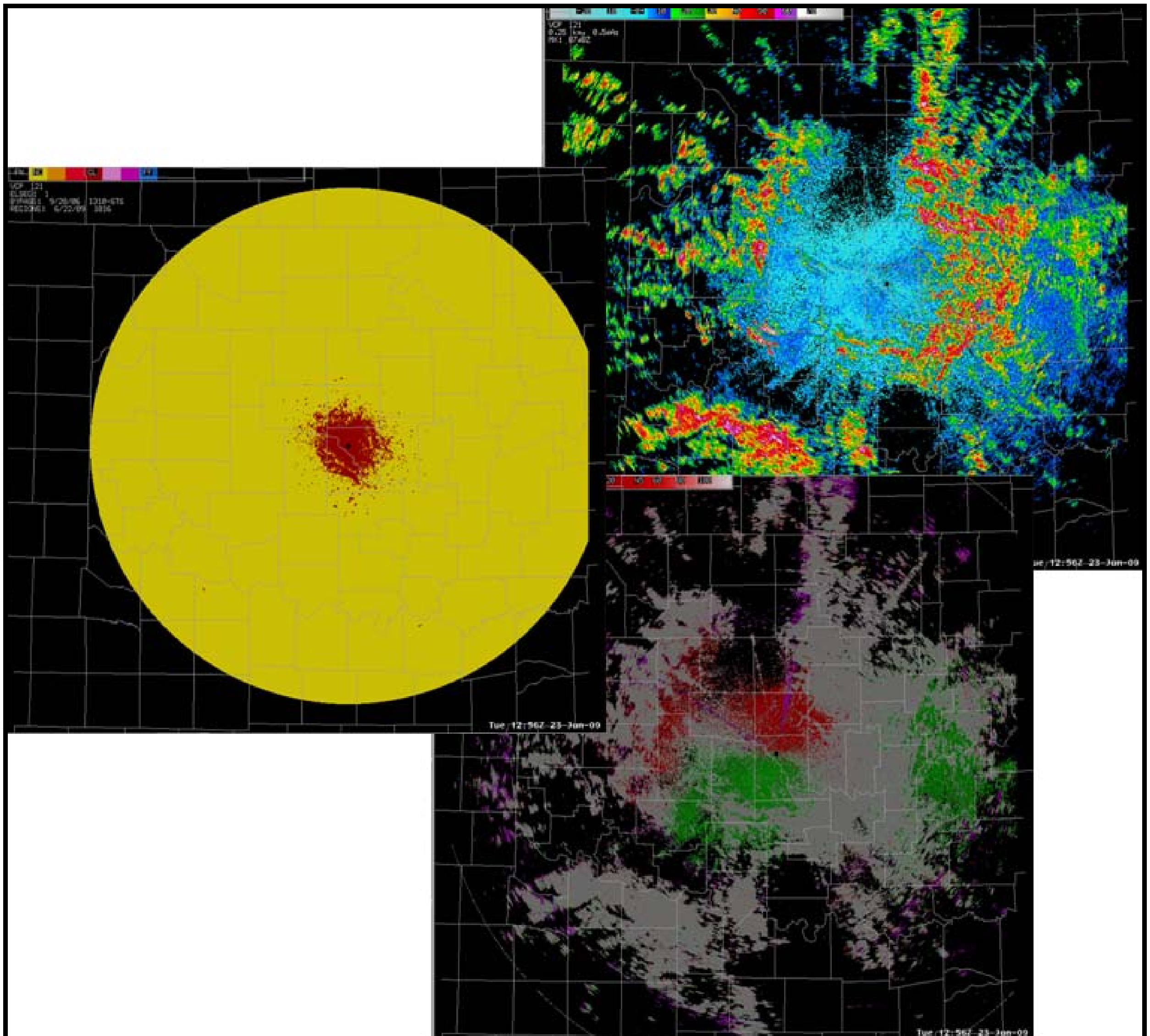

Figure 2: As in Figure, 1 but for 1256Z when CMD was disabled.

CFC product via an Advanced Weather Interactive Processing System (AWIPS) Radar Multiple Request (RMR) and watch the loop of the product during an AP event. It's amazing how fast the atmospheric properties change from volume scan to volume scan!

There was an unexpected issue in the Build 11.0 version of CMD. Beta sites with rugged mountainous terrain saw small isolated areas of missed detections by CMD. ROC engineers quickly found the source for the error and applied a "fix" to CMD which was included in the Build 11.1 version of CMD. The first ten sites experiencing missed clutter detections were sent the new version of CMD in Build 11.1, which received numerous favorable comments.

With the Build 11.1 version, unusual box-shaped areas became noticeable along the zero isodop during not only slow-moving stratiform events, but also faster-moving convective events. The data in these boxes have weaker reflectivity values than surrounding bins, and velocities biased away from zero. This is the result of the bias when clutter filtering is applied. In Figure 3 below, the three base moments are shown, each illustrating these biased areas.

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Proper Clutter Filtering

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What causes the box-shaped biased areas? CMD now operates with a processing resolution of 1 degree by 1 km, meaning there are 8 Super Resolution (SR) bins in each of the bins CMD identifies for filtering. The boxes in the data are a result of this map-building process. There may be 1 or 2 SR bins which are flagged, but the entire 1 degree by 1 km bin is flagged for filtering, even if the rest of the SR bins do not have clutter. And, if the data falls beneath the thresholds used by GMAP, then the bins are filtered, which may result in biased data: weaker reflectivity values and velocities biased away from zero. If one is looking at the SR data, one can see that these patches are in multiples of 4 SR bins down radial and 2 SR bins in azimuth. In addition, the weaker areas of reflectivity that result seem to be more evident in the faster VCPs because of the fewer pulses used to sample the data, leaving the possibility for noisy calculations. Folks at the ROC continue to analyze data to refine the CMD algorithm; though, there is always a trade off. The Build 11.0 version of CMD used SR bins for the processing, and there were missed detections of clutter by CMD in rugged mountain terrain. The Build 11.1 version is performing better than the Build 11.0 version for many sites, but the filtering is more aggressive than the former version.

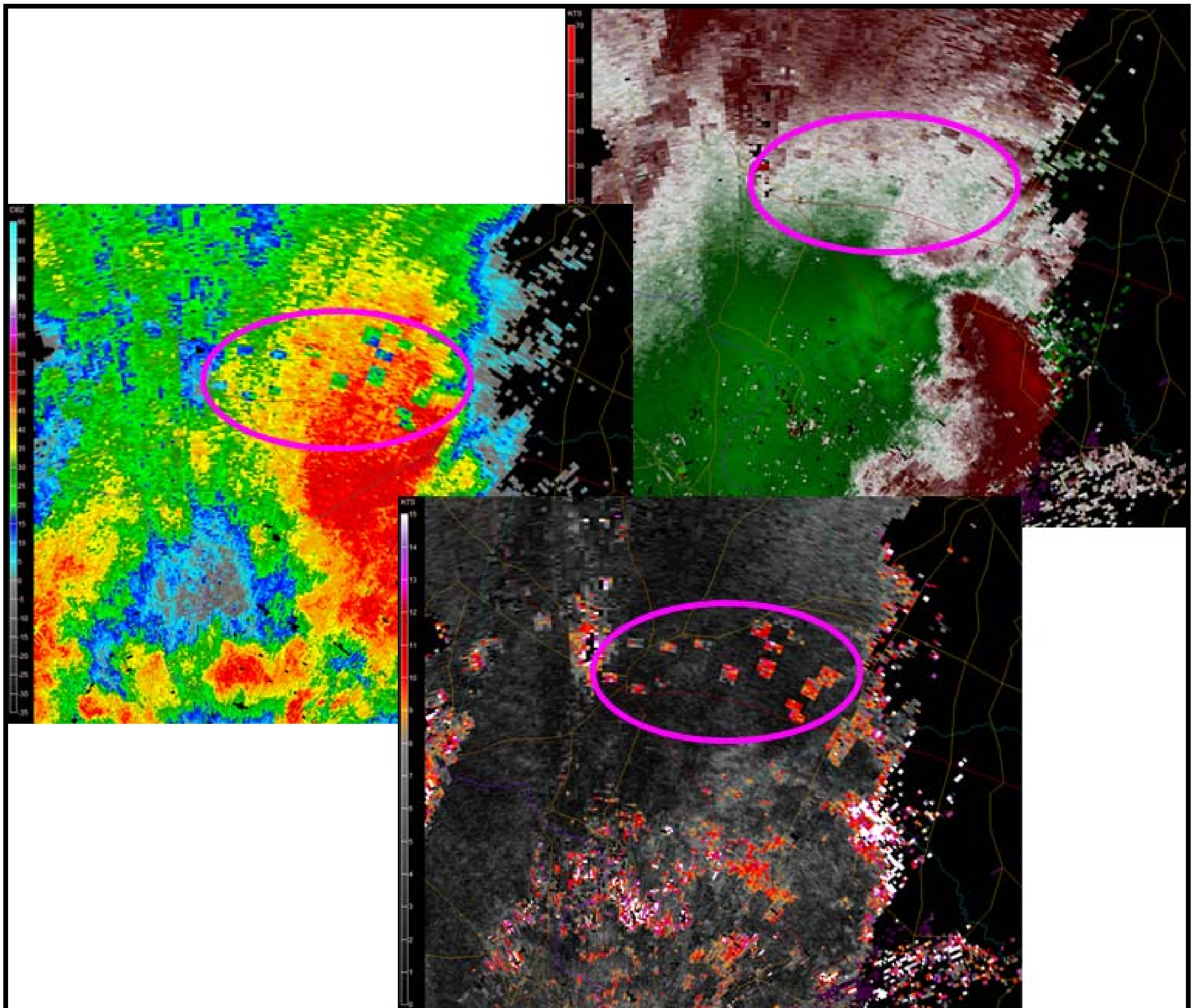

Figure 3: The three base moments illustrating the biased areas along the zero isodop.

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Proper Clutter Filtering

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While these biased areas seem new, the data loss due to too much clutter filtering has always been a possibility. In fact, the downstream effect due to over-suppression degrades the data far more if applying forced filtering everywhere, aka All Bins. The box-shaped areas that are occasionally possible along the zero isodop with CMD tend to move around from one volume scan to the next so the 'loss' in terms of precipitation accumulation is negligible. So far, we have not yet seen a case where the 'losses' due to CMD negatively impact precipitation products. We have often, however, seen negative impacts on precipitation accumulation when All Bins is left as the clutter filter for a period of time. Figure 4 shows a vertical cross-section of reflectivity on the left with the usual Plan Position Indicator (PPI) view of base reflectivity from tilt 2 on the right. The dashed line on the plan-view image indicates the cross-section location. It can be easily seen that the second tilt shows reduced power, even holes, in reflectivity, which correspond to holes, or losses, of data seen in the cross-section. This can result in significant underestimations of precipitation.

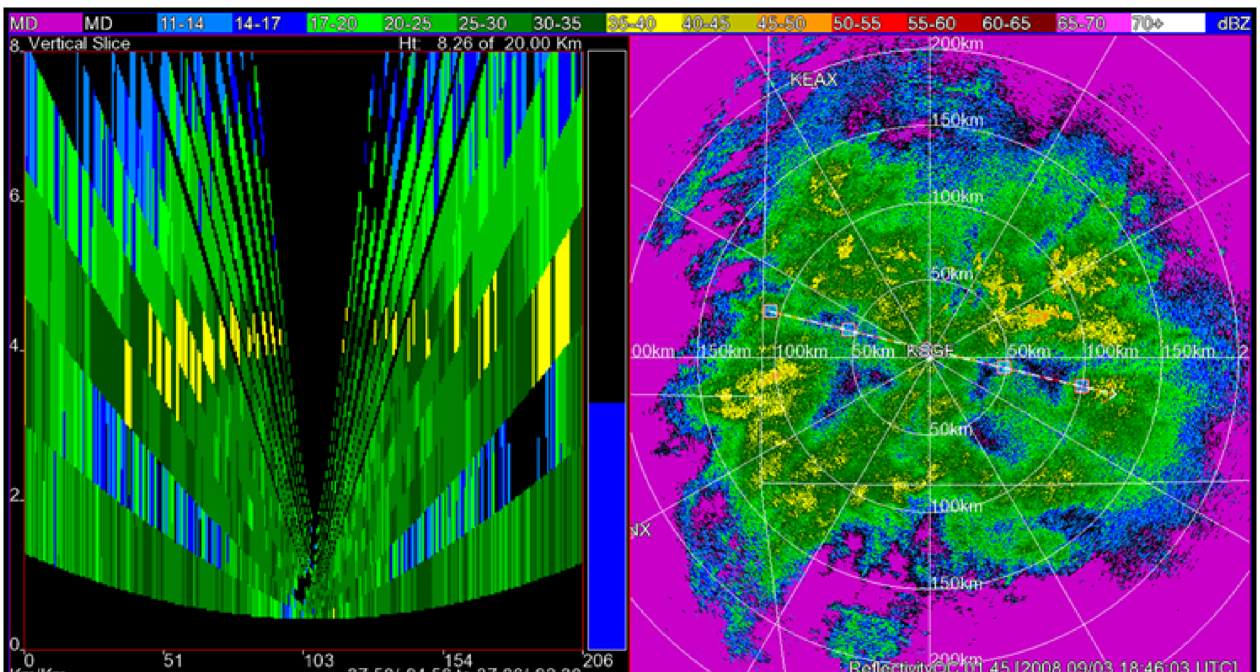

Figure 4: Vertical cross-section of reflectivity (left) and base reflectivity of the second tilt (right) at 1846Z. The dashed line shows the location of the cross-section.

But, what was the cause for the holes seen in Figure 4? That's right - filtering. Forced filtering was used on Segment 2 as opposed to the Bypass Map (pre-Build 11.1). In this case, only one elevation was affected. But, if forced filtering had been invoked on Segment 1, and say, VCP 12 was running, then the lowest *two* elevations (0.5 and 0.9 degrees) would have seen data losses. Over-suppression results in a reduction of power. How? GMAP. Remember that if a bin is flagged to be filtered (and every bin is flagged when using All Bins), then GMAP removes power from signals with zero to near zero velocities then rebuilds some of the weather signal ... But, not the entire signal. In the event shown in the figures, slow-moving stratiform rain remained over the radar site for more than 40 hours! Weather events with these

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Proper Clutter Filtering

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characteristics commonly result in lost power return, and lower precipitation estimates, when clutter filtering is overdone, aka All Bins.

Prior to the image in Figure 4, the site had been running with the Bypass Map defined on all five segments. In Figure 5, we see that the reflectivity is filled-in on both images. This would have been the likely case as well if the data had been processed with the CMD algorithm.

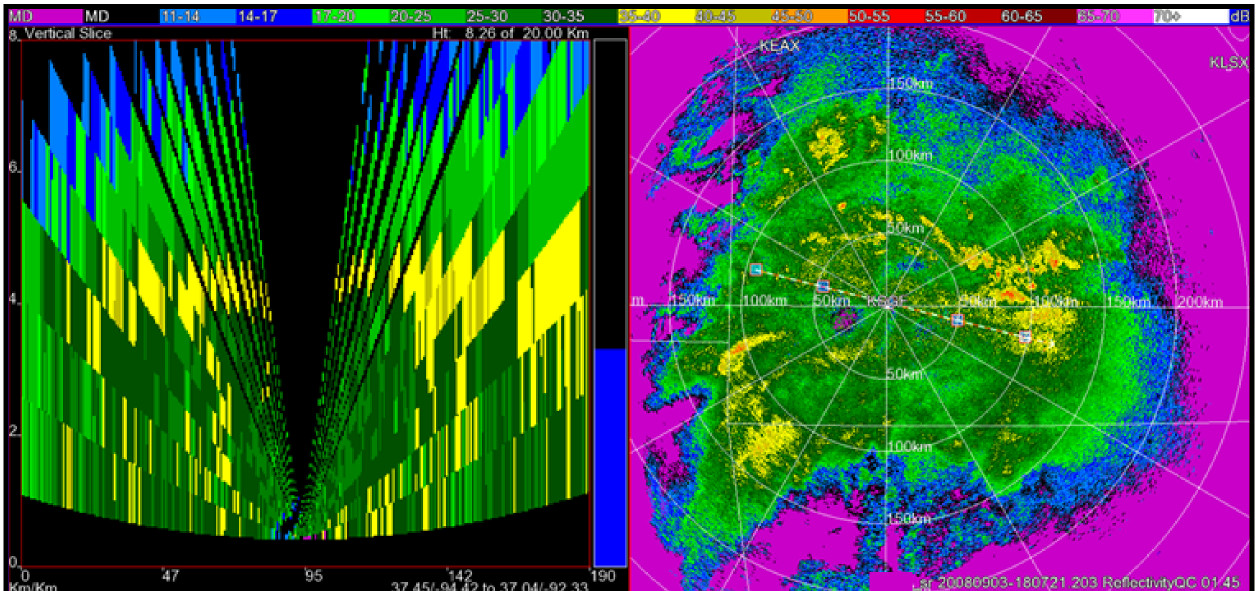

Figure 5: Same as in Figure 4, but with the Bypass Map applied to all five segments at 1807Z.

As the Dual-Polarization (DP) installation draws nearer, we want to remind sites of the importance of proper clutter filtering. The first fielded build version of DP will not include CMD; although, CMD will be included in the first build upgrade after DP installation (Build 13). Some sites will have a short interruption to the use of CMD, whereas other sites will experience longer interruptions depending on the deployment schedule for DP. During this time without CMD, sites will need to resume using the legacy static Bypass Map.

When DP is installed, it is essential that operators revert to tried-and-true filtering: generating a new Bypass Map, as well as, seasonal Bypass Maps with an electronics technician and employing the map on all five segments. At most field sites, it is unnecessary to use All Bins filtering higher than Segment 2, and is typically only necessary during AP events. If time permits, it is more beneficial to use clutter regions on the Bypass Map during AP events than to employ All Bins filtering over the entire range of the radar. There are mountainous sites, however, which may have to create small clutter regions over peaks and ridges, somewhat like the sites did when Build 11.0 was first deployed. For further review of generating Bypass Maps and optimizing clutter filtering, the Build 9 training (when Bypass Maps were first introduced with five segments) is still available at (http://www.wdtb.noaa.gov/buildTraining/Build9/index.html).

Amy Maddox
Wyle Information Systems/ROC Operations Branch

NWS VCP Usage Survey

Forecasters have experienced an increase in the number and type of volume coverage patterns (VCPs) used operationally with the WSR-88D; future enhancements are likely to be associated with additional VCPs. By understanding the methodology and diversity of VCP usage, the ROC is in a better position to manage the inclusion or exclusion of old and new VCPs in future software releases. This prompted a field survey of National Weather Service (NWS) Weather Forecast Office (WFO) Science and Operations Officers (SOOs) and/or WSR-88D Radar Focal Points. The survey contained questions about local Mode Selection Function (MSF) settings, VCP usage, and technical staff opinions.

The ROC received 80 individual survey responses from 70 WFOs, or 57% of the possible number of offices. Five offices provided more than one response.

Questions about the MSF were included because the local settings have an impact on VCP usage. Office settings for the MSF can be in one of four possible configurations (listed below). It was discovered that 60% of offices had set the MSF to perform with complete automation while only using manual control as needed. Eighty percent of respondents said the MSF was ‘somewhat helpful’ or ‘very helpful.’ Only 10% of offices maintain a configuration similar to legacy.

The survey revealed that most forecasters select VCPs based upon personal choice. Station guidelines for VCP selection, however, are commonly established as policy during severe weather events. At least 75% of respondents believe there would be no adverse impacts if VCP 21 were removed. Many forecasters commented that VCP 21 was used meteorologically for stratiform rain or snow, scattered insignificant rain, by habit or by virtue of default settings.

A large number of respondents, 44%, believe there are too many VCP choices.

When asked about types of scanning strategy improvements, 62% said either more frequent low elevation scans or faster VCPs were most important.

Mode Section Function

A few survey questions were about the MSF and user satisfaction. Since each office has the capability to set the MSF in four different ways, the ROC wanted to examine ‘how’ each office tailored settings.

The MSF was added to replace the obsolete Precipitation Detection Function (PDF). The MSF provides operator control over automated or manual VCP switching. Specifically, from a Radar Product Generator (RPG) graphical user interface, office staff can select either automated or manual control for both Clear Air mode control and Precipitation mode. When the radar automatically switches mode, a locally chosen default VCP for that mode is used. When a manual setting is chosen, the operator has control of operating the radar in that mode.

Actions of the four possible MSF settings are:

Manual-Manual. If Clear Air switching is set to Manual and Precipitation switching is set to Manual, regardless of radar detection, the current VCP will remain in manual control until a long timeout period (8 to 48 hours) if a conflict is detected. For ANY change of VCP to occur, operators must download or change VCPs.

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VCP Usage

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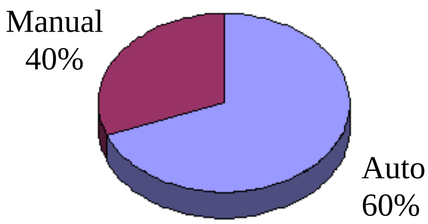
Auto-Manual. If Clear Air switching is set to Auto and Precipitation switching is set to Manual, the radar cannot automatically switch to the default precipitation VCP, but the radar will automatically switch to the default Clear Air VCP after clear air is detected and after a time delay specified as an adaptable parameter with a value from 20 to 60 minutes (default is 60). Operators can manually download or change to a precipitation VCP at any time.

What is the current setting on your Mode Selection Function for Clear Air?



Manual-Auto. If Clear Air switching is set to Manual and Precipitation switching is set to Auto, the radar cannot automatically switch to the default Clear Air VCP. This combination of radio button settings is similar to legacy RPG software; the difference is that no wait time is required to manually switch to a Clear Air VCP. The radar will automatically switch to the default precipitation VCP on the next volume when precipitation is detected. Operators can manually download or change to a clear air VCP at any time.

Auto-Auto. If Clear Air switching is set to Auto and Precipitation switching is set to Auto, the radar will switch to either default VCP after a change in mode is detected. The switch to Clear Air VCP after clear air is detected requires a time delay specified by the operator (20 to 60 minutes).

In the survey, the ROC wished to examine proportions of various MSF settings. The survey revealed that 60% of respondents said the MSF for Clear Air mode was configured to ‘automatic.’ Additionally, 69% of offices indicated the MSF for Precipitation mode was set to ‘automatic.’ The combination of MSF settings, as shown in the action of MSF settings above, was 29% in Manual-Manual, 1% in Auto-Manual, 10% in Manual-Auto and 60% in Auto-Auto. Notably, before the MSF had been deployed, the radar behaved identically to the Manual-Auto setting. In other words, forecasters appear to have collectively and purposely migrated away from this configuration.

What is the current setting on your Mode Selection Function for Precipitation Mode?

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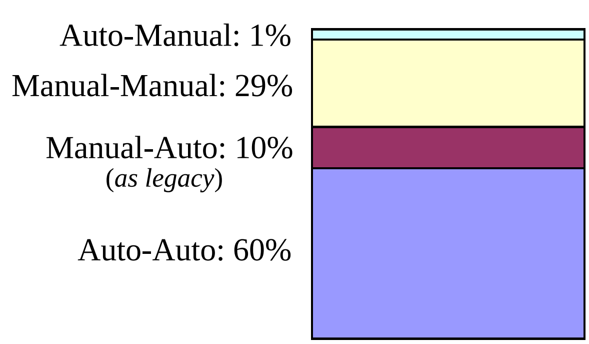
Both MSF Settings
[Clear Air-Precipitation]



VCP Usage

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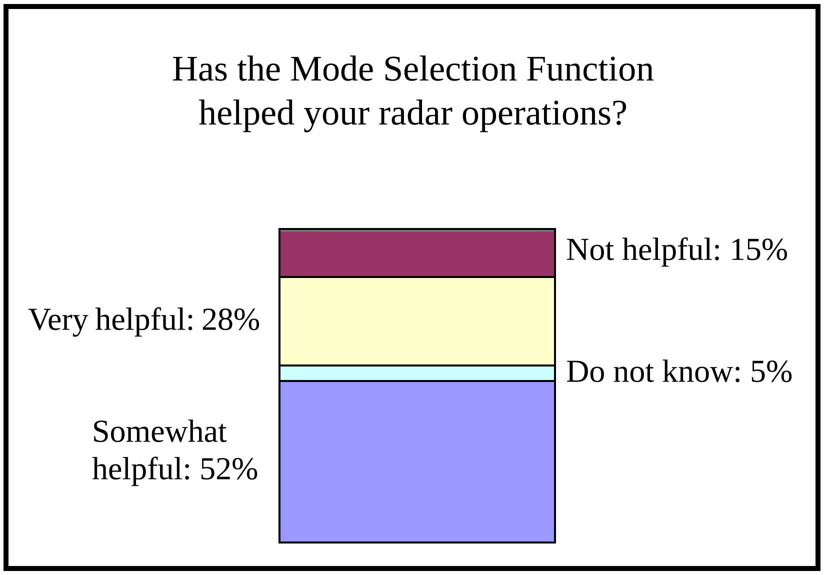
Volume Coverage Pattern Usage

The options of how forecasters selected VCPs were 'Other', 'Station Guidelines' and 'Personal Choice.' If 'Other' was selected, explanatory comments were requested. Several choosing 'Other' stated that VCP selection during severe weather was guided by station policy; otherwise, VCP selection was a personal choice.

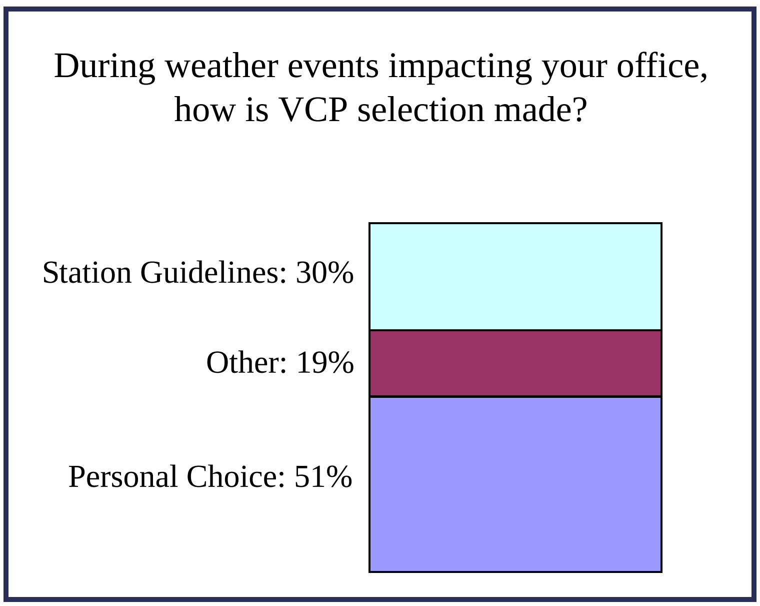


Other comments regarding VCP selection included using the Quick Reference VCP Comparison Table, using Warning Decision Training Branch (WDTB) Software Build training materials, using FMH-11, and relying on senior forecaster guidance.

VCP selection in the NWS appears to be chiefly determined by duty forecaster decisions. Over half of the responses indicated VCP selection is made by personal choice.

When asked 'Would there be adverse impact(s) at your office if VCP 21 were removed from your radar?' 75% responded 'No;' 10% had no opinion. A small percentage of forecasters, 15%, said there would be an adverse impact at their office if VCP 21 were removed. Among those voicing concern about removal of VCP 21, most forecasters were concerned about increased wear and tear on the antenna pedestal components.

Questions were included in the survey specifically to satisfy an Software Recommendation and Evaluation Committee (SREC) action item. A Federal Aviation Administration (FAA) briefing requested justification for keeping VCP 21, and possibly VCP 11, since new and improved VCPs have been provided. We wanted to investigate meteorological purposes for retaining VCP 21. One survey question asked, 'What prompts your office to switch to VCP 21?' Many forecasters replied that stratiform rain or snow, scattered insignificant rain, or habits were the primary reasons for using VCP 21.



The suite of operational VCPs has grown from four to nine possible selections. The

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VCP Usage

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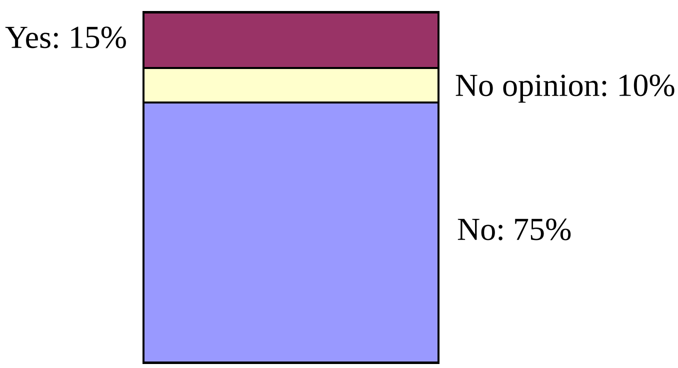
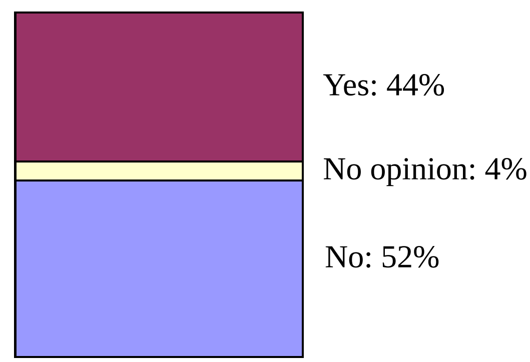
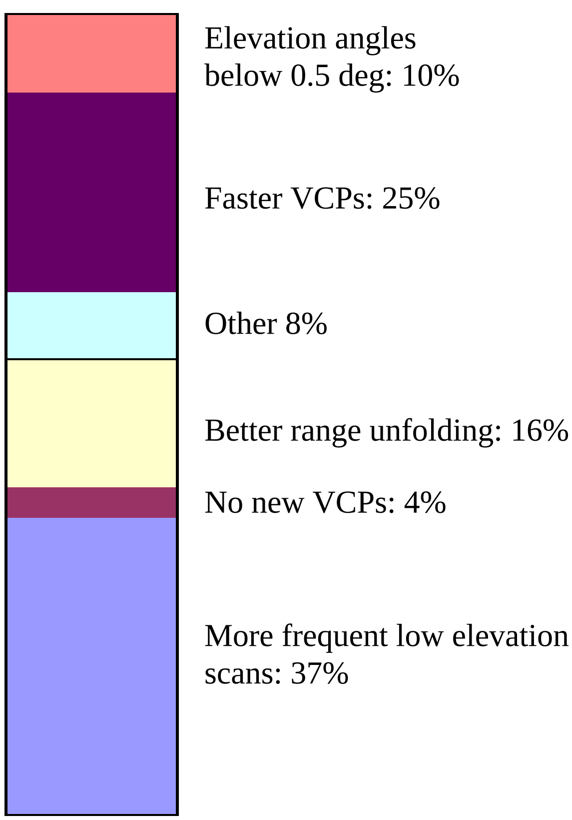
Would there be adverse impact(s) at your office if VCP 21 were removed from your radar?



In your opinion, are there too many VCP choices?



Which type of scanning strategy improvement do you consider most important?



survey showed that 44% of respondents believe there are too many VCP choices. The ROC surmised that this large number may be due to the difficulty of VCP selection as applied to a specific meteorological situation.

Thirty-seven percent of respondents believe the most important scanning strategy improvement would be more frequent low elevation scans. If this response were combined with the similar response of Faster VCPs, 62% of respondents appear to want faster low-level product updates. Some WFOs are faced with radar beam overshoot problems as reflected by 10% of respondents wanting or needing elevation angles below 0.5 degree. A small percentage (4%) of forecasters does not want new VCPs. Among those choosing ‘Other,’ most mentioned combinations of improvements such as more frequent low elevation scans with better range unfolding.

Randy Steadham
ROC Applications Branch

Wind Farms and the WSR-88D: An Update

INTRODUCTION

This article is an update to "Wind Farms: Coming Soon to a WSR-88D Near You" published in the last edition of *NEXRAD Now*. Many changes have occurred in the Radar Operations Center's (ROC) efforts to work with field sites and wind farm developers since the last article, which will be discussed. In addition, we will provide an update on ROC plans for the future and actions WSR-88D operators can take to help the ROC. Those unfamiliar with the potential for WSR-88D and wind farm/wind turbine interaction, please visit last year's *NEXRAD Now* article and/or the Wind Farm Interaction section on the ROC web site (http://www.roc.noaa.gov/WSR88D/) for more background information.

Wind power is one of the primary renewable energy sources being aggressively pursued by government and industry, as one solution to our fossil fuel dependence. In July 2008, the Department of Energy released a feasibility study on wind energy (20 % Wind Power by 2030, Increasing Wind Energy's Contribution to U.S. Electricity Supply), which provides a roadmap for reaching the report title's goal. This report can be found at http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf. Currently, only ~2% of the Nation's total electric supply comes from wind power, thus most of the wind farm construction is yet to occur. Figure 1 depicts another record year for wind turbine installations.

Due to several reasons (e.g., adequate low-level wind resources, power transmission infrastructure) the distribution of wind farms is not and will not be uniform across the country. Figure 2 shows the installed wind energy capacity by state. The growth in the number of wind farms and the fact that opti-

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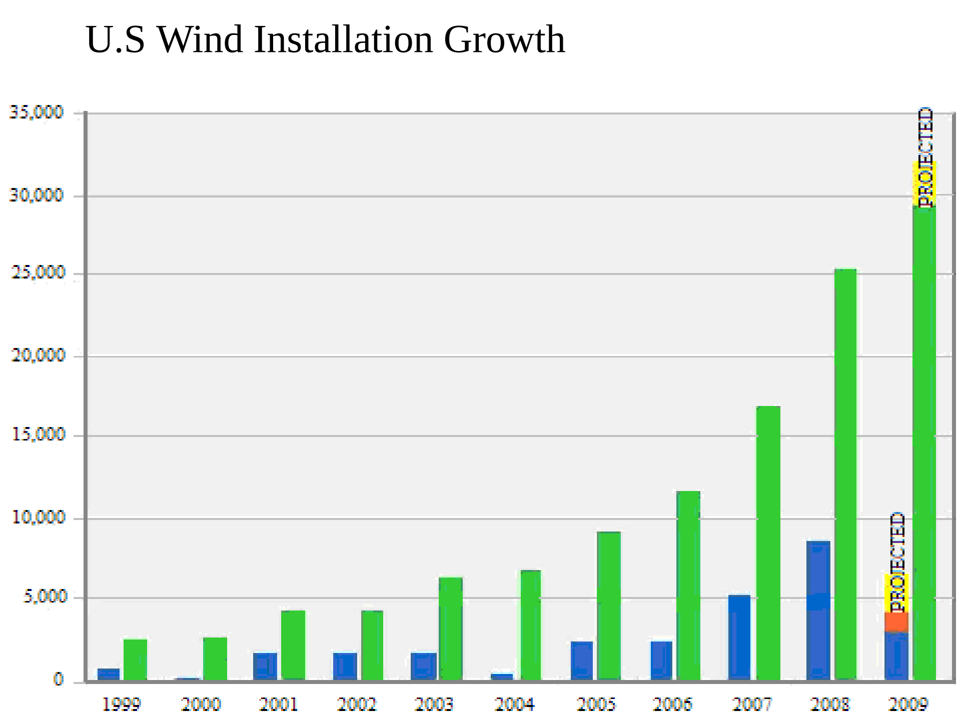

Project Numbers Brightening

The wind energy industry completed a total of 1,210 MW in the second quarter of 2009. The industry had previously commissioned 2,860 MW in the first quarter of 2009. That brings the U.S. cumulative installed wind power capacity to 29,440 MW.

The new projects added in 2Q09 will be able to generate enough new electricity to power the equivalent of 350,000 average American homes.

Over 5,000 MW of new projects are under construction for completion either in the second half of 2009 or in 2010.

Figure 1: Another record year for wind turbine installations (Source: American Wind Energy Association (AWEA) 2nd Quarter 2009 Market Report).

Wind Farms

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mum wind farm locations are similar to WSR-88D siting preferences – relatively high, unobstructed terrain - suggests the number of wind farms developed near WSR-88Ds is likely to increase.

One may ask, "Why should I care about all these new wind farms?" Well, it turns out that rotating wind turbines in the line of sight of the radar can show up very strongly on all three base products (R,V,SW) and some derived products (e.g., precipitation accumulation estimates) of the WSR-88D, even with appropriate clutter filtering applied. The impacted radar data is often referred to as "wind turbine clutter (WTC)."

ROC CHANGING HOW IT EVALUATES WIND TURBINE IMPACTS

During the year, the ROC and affected WSR-88D operators have gained more experience in observing and "working around" WTC. The ROC

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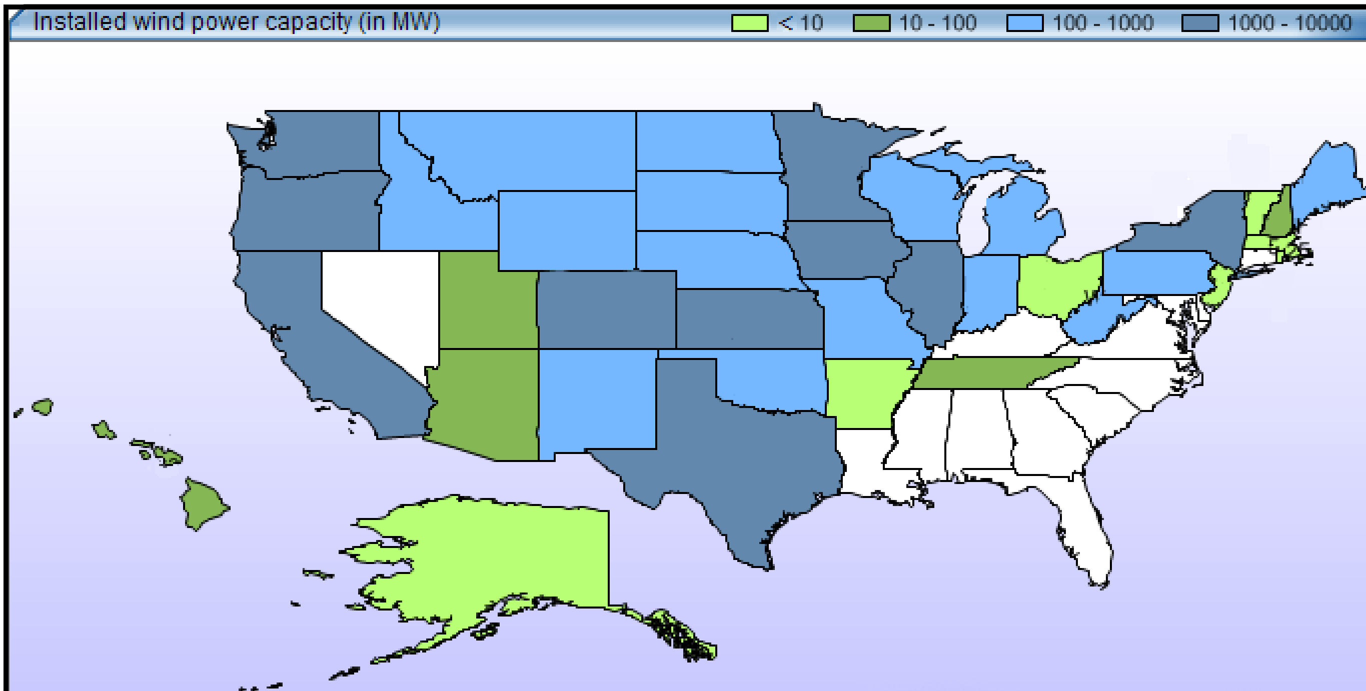

State Facts

Texas again gains the largest amount of new capacity bringing the state past the 8-GW mark.

Iowa passed the 3-GW mark with 160 MW of new capacity in the second quarter. It now has a total of 3,043 MW installed, consolidating its position as #2, behind Texas and ahead of California.

The state posting the fastest growth in the 2nd quarter was Missouri, where wind power installations expanded by 90%.

Kansas moved into the "Gigawatt Club" in the 1st quarter of 2009. Nine states now have more than 1,000 MW of wind power capacity installed.

There are now utility-scale wind power installations in 35 states.

Figure 2: Installed wind power capacity (MW) for each state as of July 2009. (Source: American Wind Energy Association (AWEA) 2nd Quarter Market Report.)

Wind Farms

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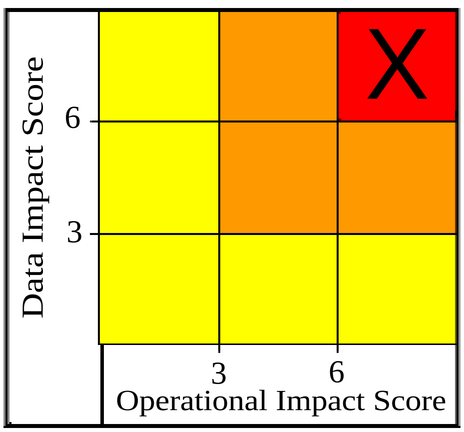
analysis process now considers the potential impact on radar data and potential impact on weather warning operations separately.

There can be situations of a "high or moderate" impact on radar data, products, or imagery, but forecasters can "work around" the impacts without degrading weather warning performance. We do not know precisely what distances or situations will cause weather warning operations impacts, but we know they are more likely to occur due to close proximity, intrusion of turbine blades into multiple radar angles, the number of turbines, the width of the wind farm with respect to the WSR-88D, and other considerations.

We have used distance between a WSR-88D and a wind farm as a primary, but not only, criteria for focusing our efforts on working with developers to mitigate potential impacts. Based on experience, the ROC has created the simplistic drawing of the estimated relationship between wind turbines in the radar line of sight and their distance from a WSR-88D versus impacts on operations (Figure 4). While these distances are not absolute values and are situational dependent, the figure has helped us convey to developers the relationship between location and radar impacts.

In general, the public does not have as much radar interpretation experience as National Weather Service (NWS) or Department of Defense (DoD) forecasters. Thus, these users are more likely to incorrectly interpret radar data/products/imagery if the data contain wind turbine clutter, even when weather warning operations are not impacted. Some WFOs have undertaken educating their users by showing examples of wind turbine clutter imagery from their WSR-88D on their web sites. This is to help the public learn how, just as trained forecasters do, all data/product/imagery users should take the wind turbine signatures into account – just as they need to consider anomalous propagation, terrain blockage, migratory birds, etc., in radar

Impact Risk Matrix



Legend	
Red	**High impact risk** - ROC will follow-up with developer to discuss impacts and mitigation options. We will work closely with the developer to find an acceptable solution.
Orange	**Moderate impact risk** - Follow-up requested to discuss impacts and mitigations for developer's consideration.
Yellow	**No or low impact risk** - No further analysis or follow-up requested. For this and future projects, developers should consider mitigation options listed in this report.

Figure 3: The newly-created Impact Risk Matrix tool the ROC uses as a method to provide a more consistent estimate of impacts on radar data and weather warning operations. The scaling factors are a "work in progress" and based on experience from existing sites. The matrix is a tool used along with interviews with affected field sites to complete our case-by-case analysis of wind turbine-WSR-88D interaction.

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Wind Farms

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data. The ROC plans to add an external user section to the ROC web page to help users who do not use radar data frequently to be able to identify wind turbine clutter signatures on radar data.

product users to lessen any current or future potential wind turbine – radar impacts.

- Continue outreach and education efforts to the wind energy industry. In three years we have progressed from the wind energy industry not knowing the possible impacts on weather radars to many developers unilaterally contacting WFOs

Estimated Potential Wind Turbine Impact on Warning Operations

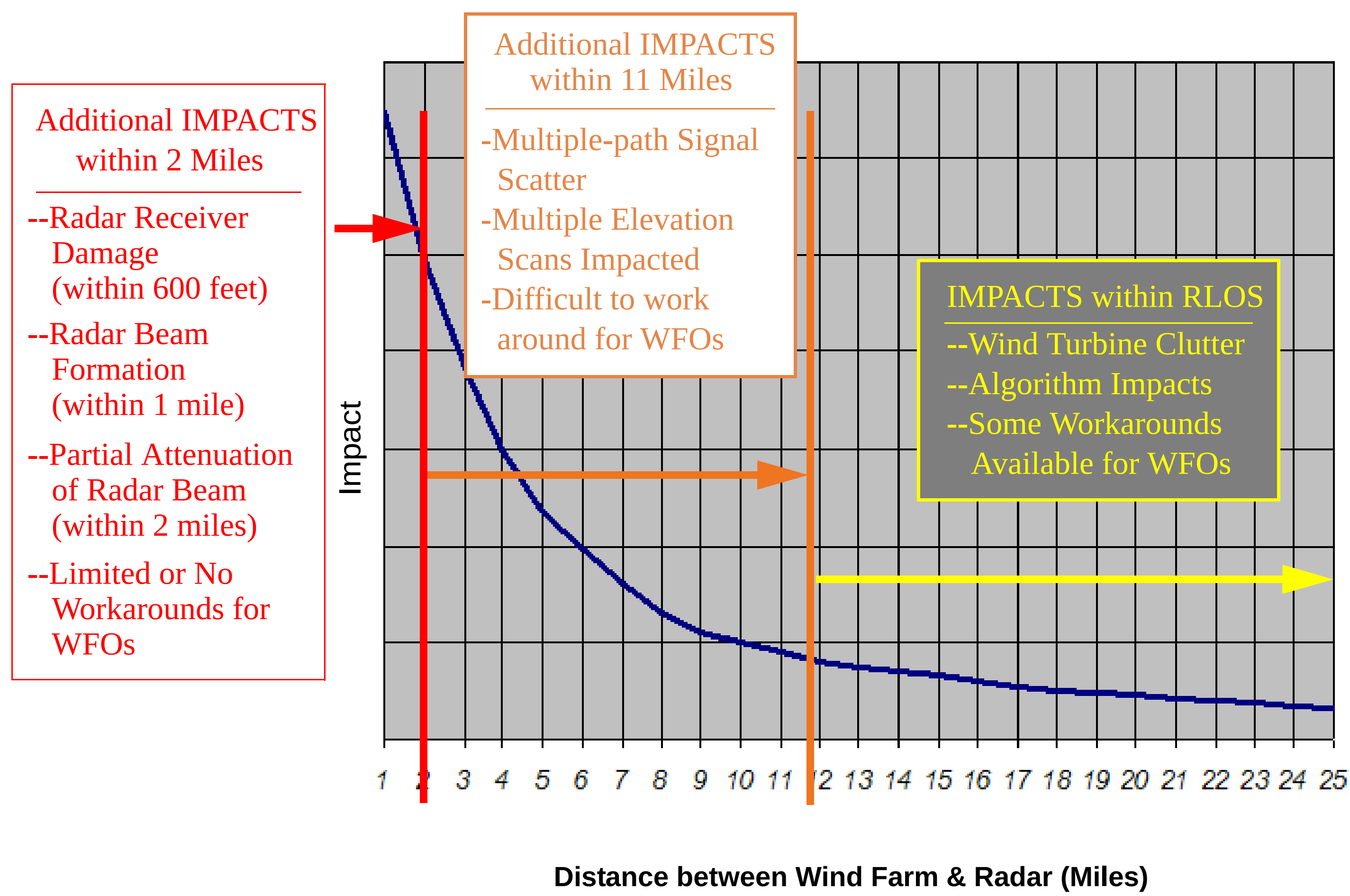

Figure 4: Wind turbine impacts vary with distance from the radar. The impacts (blue line) increase as turbines are sited closer to the radar, increasing quickly very close to the radar. Two key distances are 11 miles and 2 miles, which delineate where additional impacts generally begin (assuming a level terrain). The actual distances where these impacts can occur vary by many miles depending on terrain and weather conditions.

ROC PLANS

The ROC has several on-going and planned initiatives to work with the wind energy industry, help WSR-88D operators, and other WSR-88D data and

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and the ROC for guidance on how to lessen any potential impacts on the WSR-88D.

- Continue to support Oklahoma University (OU) studies in regard to possible changes to the WSR-88D signal processor to mitigate wind turbine clutter.
- Continue to work with some WFOs and wind farm developers to explore the possibility of "operational curtailment" of wind turbines at select sites with "near" wind farms and under certain severe weather potential situations.
- Continue to work with some wind farm developers to explore the possibility of sharing real-time wind farm meteorological data, primarily wind, with WFOs.
- Provide WSR-88D operators a 2-page fact sheet they can use to help answer potential media and public questions in regard to potential wind farm impacts on the WSR-88D, and forecast and warning operations.

- Provide suggested talking points for staff use during media interviews concerning potential wind farm – WSR-88D impacts.
- Publish a 2-page fact sheet that is oriented to distribution to the public to inform them of the WSR-88D capabilities, uses in forecast and warning operations, and state generic facts about wind farm – radar interactions.
- Provide WSR-88D operators information of the location of known/constructed wind farms.
- Work with the American Wind Energy Association (AWEA) and developers to increase common understanding with respect to WSR-88D – wind farm interaction.
- Develop case studies of wind farm impacts on weather warning operations to provide better "work around" information for sites.
- Collaborate with the National Severe Storms Laboratory (NSSL) to provide .shp files of locations of existing wind farms.

WHAT FIELD SITES CAN DO TO HELP THE ROC

First, visit the ROC web site (http://www.roc.noaa.gov/windfarm/windfarm_index.asp) to learn more about the WTC issue.

Second, if site personnel learn about a wind farm development planned for their area, send the information via email to the ROC at: wind.energy.matters@noaa.gov. Wind farm developers are not required to notify us of planned wind farm developments. Sometimes our first knowledge of proposed wind farms comes from forecast offices that notice an announcement in a local newspaper or other source.

Third, if a site is already dealing with WTC and encounter cases that impact forecast and/or warning operations, the ROC needs to hear about them. WFOs may want to document wind turbine clutter impacts for their particular radar with the goal of

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developing a "climatology" of the clutter (how often, under what conditions, products affected, etc.) We are interested in collecting significant impact cases (missed or delayed weather warnings) from around the country to better understand the interaction between wind turbines and the WSR-88D, and if warranted, make a case for action by policymakers. A clearer picture of the impacts may also help the development of a formal policy for working with the wind energy industry and avoid over-reacting or under-reacting to this issue.

THE FUTURE

Wind power will continue to rapidly expand in the U.S. due to its appeal as a clean, alternative energy source. As a result, the number of wind farms installed in the line of sight of WSR-88Ds and in "close" proximity will also increase. Presently, there is not much we can do about developments close to radars because the federal government has no regulatory authority over wind farm developments on private land. Some WFOs (and military bases) will be affected more than others and perhaps feel like they are being surrounded by wind farms. However, it is imperative that we keep this issue in perspective — it's a clutter issue and largely confined to the lowest radar elevation tilt(s). Yes, the wind farms may impact the radar data and products, but the key is whether or not they affect weather warning operations. WFOs must be ready to document these operational impacts, if we are to successfully make a case for action. In the mean time, WFOs will need to include wind farm signatures and possible impacts on data and products in their forecast and warning process and work around the issue as best they can. However, we must ensure the WSR-88D's capability to support weather warning operations that are critical for life saving and property protection decisions.

The WSR-88D ROC contact for wind farm issues is: wind.energy.matters@noaa.gov.

Tim Crum
ROC Director's Office

WSR-88D Electronic Technical Manual Distribution

For the past several years the ROC has distributed WSR-88D technical manuals (TM) on compact discs (CDs) in Adobe PDF format. The CDs are developed and distributed during major software builds (i.e. Build 10.0, 11.0, etc.), and this practice will continue.

In recent years, the ROC has also issued software updates (i.e. 10.1, 11.1, etc.) and minor hardware modifications (i.e. Modification Notes, Electronic Equipment Modifications (EEMs), and Time Compliance Technical Orders (TCTOs)); however, the ROC does not distribute new TM CDs for software updates or minor hardware modifications.

Each time a TM revision or change is required for software updates or minor hardware modifications, the ROC places the updated TM PDFs on the ROC website, which may be downloaded by authorized users.

To find the TM PDFs, log onto the ROC webpage (http://www.roc.noaa.gov/WSR88D/) and select System Documentation/Tech Manuals from the menu on the left-hand side of the page. If you have questions/comments please contact Danny Green at danny.g.green@noaa.gov.

Danny Green
ROC Program Branch

Scenic RDA Photo Contest Winners

In the last edition of *NEXRAD Now* readers were asked to submit scenic photos of RDA's, which incorporated unique factors such as weather, lighting, sky cover, setting, etc. Photos were received from Amarillo, TX WFO; Des Moines, IA WFO; Quad Cities, IA WFO; Lubbock, TX WFO; Riverton/Lander, WY WFO; Lincoln, IL WFO; San Francisco, CA WFO; and Cincinnati, OH WFO.

The photographs were presented to a panel of judges, comprised of members of all three agencies of the WSR-88D program, and judged in six categories: Night-time photo, Weather Effects, Timing, Seasonal, Color Effects, and Creativity. A winner for each category, as well as, Overall Winner and Special Mention were selected.

The Radar Operations Center (ROC) would like congratulate the winning photographers and thank everyone for their participation in the contest. It was very apparent from the photo submissions that the WSR-88D program has some very talented personnel with great pride in their work and their radars. Enjoy the photos!

Daryl Covey
ROC Operations Branch

Ruth Jackson
ASRC/ROC Program Branch

Photographs continued on Pages 24 - 29

Winner of the night-time photo category: Andrew Hatzos, Cincinnati, OH WFO

Contest Winners

Winner of the Weather Effects category: David Wilburn, Amarillo, TX WFO

Contest Winners

Winner of the Timing category: Andrew Hatzos, Cincinnati, OH WFO

Contest Winners

Winner of the Seasonal category: David Wilburn, Amarillo, TX WFO

Contest Winners

Winner of the Color Effects category: David Wilburn, Amarillo, TX WFO

Contest Winners

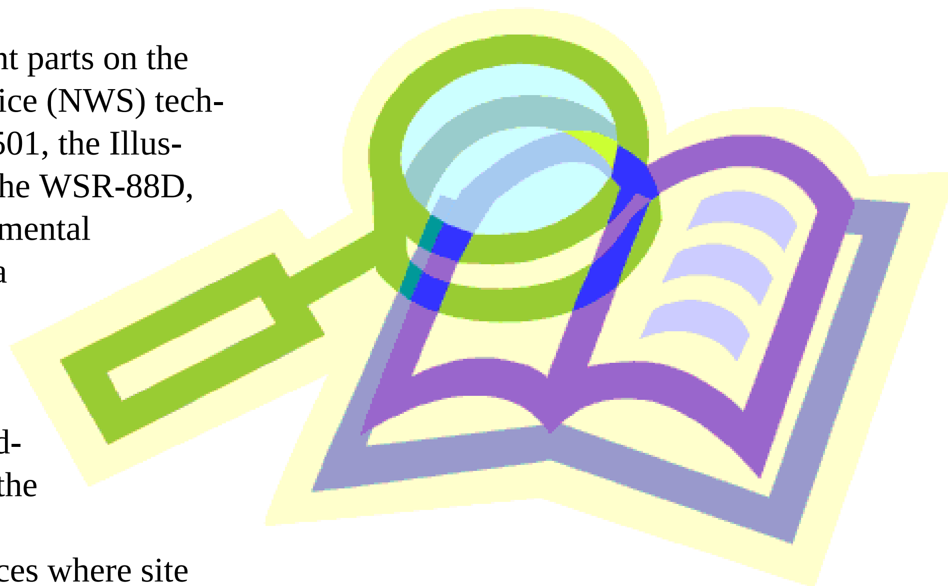
Winner of the Creativity category: Steve Anderson and Curt Lutz, San Francisco, CA WFO

Special Mention: Brenda Brock,
Des Moines, IA WFO

Contest Winners

Overall Winner: Todd Lindley, Lubbock, TX WFO

Researching WSR-88D Parts



When searching for replacement parts on the WSR-88D, National Weather Service (NWS) technicians are advised to use EHB 6-501, the Illustrated Parts Breakdown (IPB) for the WSR-88D, as opposed to using EHB-1, Instrumental Equipment Catalog. Maintaining a current list of parts in the IPB is the responsibility of the Radar Operations Center (ROC) and it gets updated every time a new hardware or software modification for the WSR-88D is implemented.

There have been several instances where site technicians ordered parts using Agency Stock Numbers (ASNs) listed in EHB-1 that had been replaced due to a modification. EHB-1 is not maintained by the ROC and changes will not be published as quickly as EHB 6-501. Needless to say, the technicians could not use the parts they received.

After finding the reference designator in EHB 6-501, one can perform a "sanity check" by visiting the National Logistics Support Center (NLSC) website at http://140.90.44.160/web_asn.htm. Simply enter the R400- prefix to most reference designators (and some part numbers) to see critical data for a part. It even has a hyperlink to see a picture of the part. NLSC, not the ROC, is responsible for the content of this website.

The WSR-88D Illustrated Parts Breakdown (EHB 6-501) and all other WSR-88D technical and operational manuals can be viewed electronically via the ROC website at http://www.roc.noaa.gov/WSR88D/; follow the appropriate links under System Documentation, located on the left-hand side of the webpage. NWS personnel will need a valid NOAA.GOV e-mail address to login and view the pdf files. Federal Aviation Administration (FAA) personnel should obtain a login via an e-mail request to the WSR-88D Program FAA Liaison, Dennis Roofe, at dennis.r.roofe@noaa.gov.

Department of Defense (DoD) personnel should obtain a login via a request to the DoD liaison, Ricky Keil, at (402) 294-3023 [DSN 271-3023] or by e-mail at Ricky.Keil.ctr@offutt.af.mil.

Monte Keel
ROC Operations Branch