Mar 2010

Additional Automated Volume Scan Evaluation and Termination (AVSET) FAQs

Question: It seems that AVSET deems 18dBZ return as unimportant. When AVSET is active, does the radar disregard weak (<18dBZ) return?
Response: The radar processing does not disregard weak (<18dBZ) return and we understand that usable data can be gleaned from weak return and therefore all sampled return greater that the SNR is processed. A quick review of the role that the 18dBZ threshold plays in AVSET processing will help to clarify the use of 18dBZ as a threshold. (A more detailed description of the AVSET algorithm logic is provided below).

> For each elevation above 5º, AVSET calculates the areal coverage of return 18dBZ and greater and 30dBZ and greater. If the areal coverage of ≥18dBZ is **less** that 80 km^2 (total over the entire radar coverage area) **AND** the areal coverage of ≥30dBZ is **less** that 30 km^2 (total over the entire radar coverage area) **AND** the areal coverage of 18dBZ and greater has not increased by 12 km^2 or more since the last volume scan ***THEN*** AVSET terminates the volume scan **AFTER** completion of the next higher elevation. For example, in VCP 12 if the thresholds are not met on the 6.4º elevation, then AVSET will terminate the volume scan after completion of the 8.0º elevation slice. In this example, the data from the 6.4º elevation and the 8.0º elevation slice will be collected by the RDA and processed by the RPG.

The threshold (80 km^2 of 18dBZ) is used to "forecast" the likelihood of meaningful meteorological return 2 elevation angles above the processed elevation (e.g., if the areal coverage is below the threshold on the 6.4º elevation slice then it is expected that there will not be notable return present on the 10º elevation slice and above). In the context of height ARL there are significant differences between the elevation slices (see Table 3). For example, at 40 nm the center of the beam for the 6.4º elevation is approximately 27,000ft ARL while the center of the beam for the 10º elevation is approx 42,000ft ARL; a difference of 15,000ft.

Table 3: Beam Height (ARL) For Elevation Angles at Selected Ranges

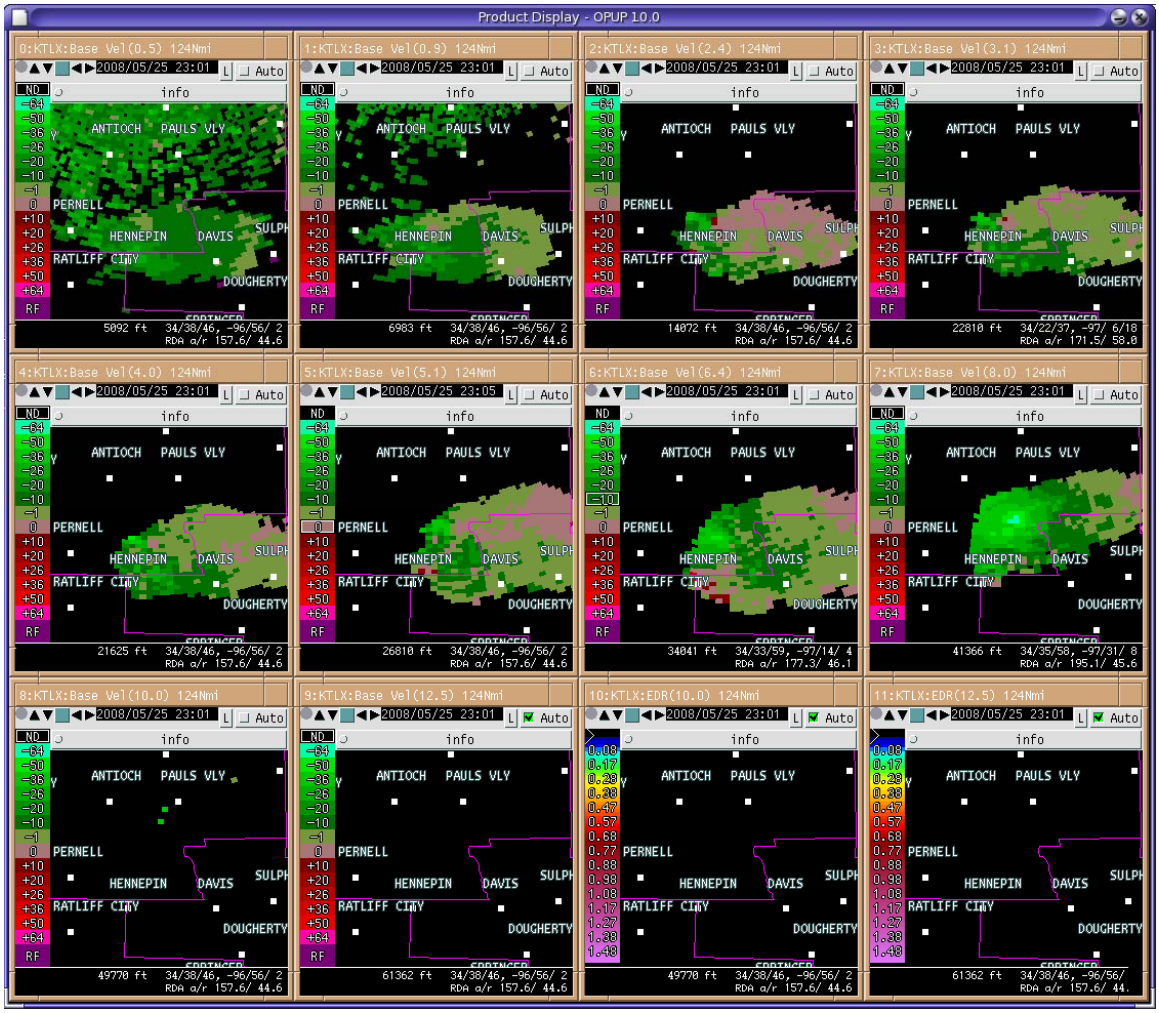
	VCP 12 Elevation Angles					
Range	5.1º	6.4º	8.0º	10.0º	12.5º	15.6 º
20nm	11 kft	14 kft	17 kft	21 kft	26 kft	32 kft
40nm	23 kft	27 kft	34 kft	42 kft	52 kft	65 kft
60nm	35 kft	43 kft	53 kft	65 kft	>70 kft	>70 kft

NOTE: The vertical beam width at the referenced ranges is approximately 2000ft, 4000ft and 6000ft respectively.

Question: What is the impact of AVSET on the detection of upper level storm top divergence?
Response: With AVSET active, the radar always collects at least one elevation above the elevation where the minimum threshold (80 km^2 of 18dBZ) is not met. This design was implemented due to the vertical structure of convective storms. It is not expected that there will be any detectable return several thousand feet (two elevation angles) above the storm top anvil. (Please refer to the information provided in section 2, above, for a review of AVSET processing and vertical radar coverage.)

The series of velocity images below illustrate this concept. The images, Windows 0-9, step vertically though a thunderstorm, elevations 0.5 º – 12.5 º, respectively. The storm anvil is last scanned with the 8.0º elevation slice (Window 7). The AVSET thresholds are not met on the 10º elevation slice (Window 8) and the volume scan is terminated after completion of the 12º elevation slice (Window 9).

NOTE: Windows 10 and 11 present the 10.0º and 12.5 º Turbulence products.



Question: What is the Cone-of-Silence when AVSET is active?
Response: With the current VCP definitions, AVSET will always scan at least through the 6.2º elevation slice. The radar "cone-of-silence" for AVSET is approximately 14 kft ARL at a range of 20 nm (~7 kft ARL at a range of 10 nm) **. To address rapidly developing convection, AVSET logic includes a function that looks for an increase in reflectivity areal coverage since the last volume scan. If the reflectivity coverage area is less than the coverage threshold but has increased by 12 km^2 or more from the previous volume scan, AVSET does not initiate the termination of the current volume scan but, instead, lowers the areal coverage thresholds (30 km^2 of $\geq$18dBZ or 10 km^2 of $\geq$30dBZ) for the subsequent elevations. In other words, even though the 18dBZ areal coverage threshold was not met for a particular elevation, if the areal coverage is increasing then AVSET does not terminate the volume scan, but instead, lowers the areal coverage thresholds and continues to process higher elevations.

In the event that a convective cell is experiencing rapid development, with AVSET active, the growth would be detected within a couple of minutes. (In the case where AVSET terminates the volume scan after the 6.4 degree elevation slice, the VCP update time is approximately 190 seconds.)

** NOTE: The radar "cone-of-silence" for VCPs 31 and 32 is approximately 10 kft ARL at a range of 20 nm (~5 kft ARL at a range of 10 nm).

Question: How is the RPG notified that AVSET is prematurely terminating a volume scan?
Response: When the AVSET minimum threshold values are not met, the RDA sends notification to the RPG that the next elevation is the "last elevation cut" for the current volume scan. This is done by the use of a special beginning of elevation status value in the RDA to RPG radial message. When RPG receives this status, all azimuths of the last scan in the VCP are flagged (i.e., the last elevation flag in the RPG internal radial message is set). The RDA then terminates the volume scan upon completion of the "last elevation cut". It does this by setting the radial status of the last radial to end-of-volume. This volume scan termination scheme causes the system to enter its normal transition (RDA antenna retrace, RPG concludes algorithm processing and product generation, etc.,) to prepare for the start of a new volume scan. This processing is the same as if we had defined a VCP with the exact number of elevation angles as the AVSET-terminated volume scan.

Question: What is the flow of the AVSET algorithm logic?
Response: The following description of the Automated Volume Scan Evaluation and Termination (AVSET) Algorithm Description was revised July 7, 2008

Algorithm Description:

Information Required:

- Previous Volume Scan Time
- Current Volume Scan Time
- Current Volume Scan Elevation Angles
- Previous Volume Scan Elevation Angles
- Initial Pass Significant Low Reflectivity Areal Coverage amount for each AVSET-processed elevation from the previous volume scan

Data Required:

Initial Pass Significant Low Reflectivity Threshold
Initial Pass Significant High Reflectivity Threshold
Initial Pass Significant Low Reflectivity Areal Coverage Threshold
Initial Pass Significant High Reflectivity Areal Coverage Threshold
Second Pass Significant Low Reflectivity Threshold
Second Pass Significant High Reflectivity Threshold
Second Pass Low Reflectivity Areal Coverage Threshold
Second Pass High Reflectivity Areal Coverage Threshold
Change in Areal Coverage Threshold

Processing:

Begin processing on the first elevation angle $\geq$ 5.0°

Initial Pass
Calculate *Initial Pass Significant Low Reflectivity* areal coverage present
Calculate *Initial Pass Significant High Reflectivity* areal coverage present

If

The areal coverage of *Initial Pass Significant High Reflectivity* is **GREATER THAN** the *Initial Pass Significant High Reflectivity Areal Coverage* Threshold **OR** the areal coverage of *Initial Pass Significant Low Reflectivity* is **GREATER THAN** the *Initial Pass Significant Low Reflectivity Areal Coverage* Threshold

Then

Proceed to next elevation angle

Execute **Initial Pass**

Else

Determine what to do next

If

The elapse time between the Previous Volume Scan Time and the Current Volume Scan Time is **LESS THAN** 15 minutes AND the current elevation angle has a matching elevation (within $\pm$ 0.3°) from the previous volume scan

Then

Execute **Determine if Second Pass is Required**

Else

Execute **Terminate Current Volume Scan**

Determine if Second Pass is Required

Compare the *Initial Pass Significant Low Reflectivity* areal coverage value from this elevation angle (current volume scan) to the *Initial Pass Significant Low Reflectivity* areal coverage value of the "matching elevation" from the previous volume scan

If

The difference between the "matching elevations" *Initial Pass Significant Low Reflectivity* areal coverage value from this volume scan and the *Initial Pass Significant Low Reflectivity* areal coverage value from the previous volume scan is GREATER THAN OR EQUAL TO the *Change in Areal Coverage* Threshold

Then

Implement Second Pass AVSET Thresholds (*Second Pass Significant Low Reflectivity* Threshold, *Second Pass Significant High Reflectivity* Threshold, *Second Pass Low Reflectivity Areal Coverage* Threshold and *Second Pass High Reflectivity Areal Coverage* Threshold)

Proceed to next elevation angle

Execute **Second Pass**

Else

Execute **Terminate Current Volume Scan**

Second Pass

Calculate *Second Pass Significant Low Reflectivity* areal coverage present
Calculate *Second Pass Significant High Reflectivity* areal coverage present

If

The areal coverage of *Second Pass Significant High Reflectivity* is **GREATER THAN** the *Second Pass Significant High Reflectivity Areal Coverage* Threshold **OR** the areal coverage of *Second Pass Significant Low Reflectivity* is **GREATER THAN** the *Second Pass Significant Low Reflectivity Areal Coverage* Threshold

Then

Proceed to next elevation angle

Execute **Second Pass**

Else

Execute **Terminate Current Volume Scan**

Terminate Current Volume Scan

Send notification to the RPG that the next elevation is to be the "last elevation cut" for the current volume scan.

Allow the RDA to process the next elevation angle (last elevation cut)

Notify the RDA to terminate the volume scan after completion of this "last elevation cut". This volume scan termination scheme should cause the system to enter its normal transition (RDA antenna retrace, RPG concludes algorithm processing and product generation, etc.,) to prepare for the start of a new volume scan.

Reset the AVSET parameters to the Initial Pass thresholds (*Initial Pass Significant Low Reflectivity* Threshold, *Initial Pass Significant Low Reflectivity* Threshold, *Initial Pass Low Reflectivity Areal Coverage* Threshold and *Initial Pass High Reflectivity Areal Coverage* Threshold)

Adaptable Parameters:

Initial Pass Significant Low Reflectivity Threshold
Initial Pass Significant High Reflectivity Threshold
Initial Pass Significant Low Reflectivity Areal Coverage Threshold
Initial Pass Significant High Reflectivity Areal Coverage Threshold
Second Pass Significant Low Reflectivity Threshold
Second Pass Significant High Reflectivity Threshold
Second Pass Low Reflectivity Areal Coverage Threshold
Second Pass High Reflectivity Areal Coverage Threshold
Change in Areal Coverage Threshold

Default Values for Adaptable Parameters:

Initial Pass Significant Low Reflectivity Threshold	*18dBZ*
Initial Pass Significant High Reflectivity Threshold	*30dBZ*
Initial Pass Significant Low Reflectivity Areal Coverage Threshold	*80 km^2*
Initial Pass Significant High Reflectivity Areal Coverage Threshold	*30 km^2*
Second Pass Significant Low Reflectivity Threshold	*18dBZ*
Second Pass Significant High Reflectivity Threshold	*25dBZ*
Second Pass Low Reflectivity Areal Coverage Threshold	*30 km^2*
Second Pass High Reflectivity Areal Coverage Threshold	*10 km^2*
Change in Areal Coverage Threshold	*12 km^2*