DETECTION AND ADAPTIVE SCHEDULING ON THE NWRT PHASED-ARRAY RADAR

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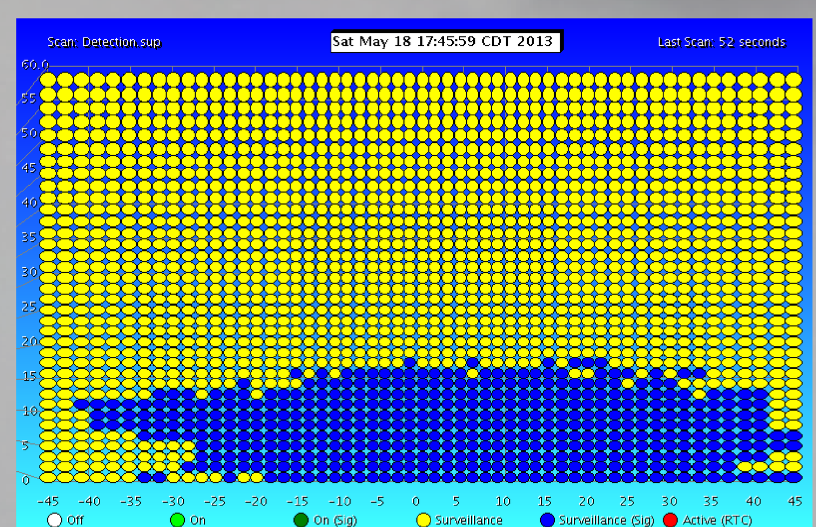
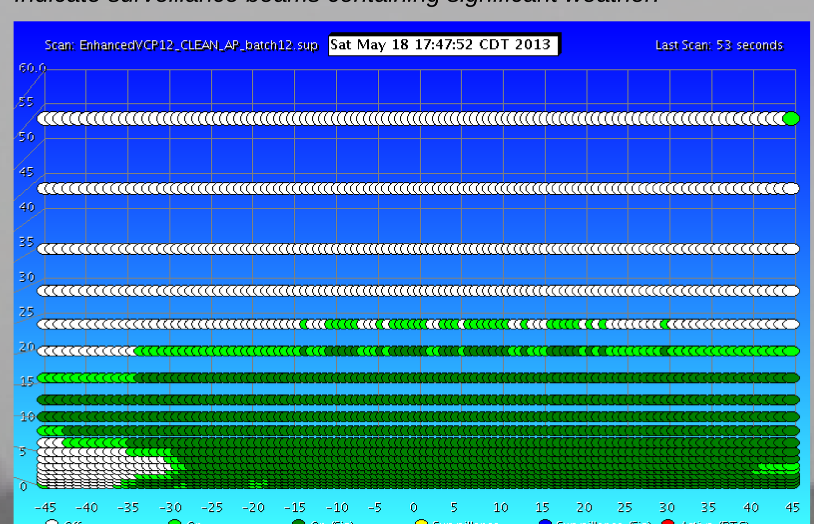
In prior studies the electronic scanning capabilities of the National Weather Radar Testbed (NWRT) Phased-Array Radar (PAR) have shown the benefits of faster scan updates in the detection of various types of severe weather. Scan update times benefited from sector scanning, and additional time savings were achieved by limiting scanning within the sector to regions of active weather. However, scanning did not focus on individual storms. As forecasters tend to focus their attention on the most intense storms during operations, it may be beneficial to provide focused scanning with higher update frequency on those storms. However, to detect both new storms and provide information for other applications, such as rainfall estimation, less frequent scanning of less active regions would still be required.

New scanning techniques have been developed for the NWRT PAR to support three main objectives: detection, identification, and tracking. The detection of new echoes is performed using a special ~7.5 second surveillance scan, scheduled to run once every ~2 minutes. In between surveillance scans, regions of active weather are scanned using a typical VCP. A cluster identification algorithm, that used a watershed technique to define objects in the reflectivity field, is used to identify storms in the active regions. More focused scanning of the sector encompassing a selected storm can be scheduled. The amount of time devoted to focused scanning is controlled be the operator. This determines the frequency of scanning in the regions outside the storm sector. This spring, data collected from several severe weather events in central Oklahoma are presented to illustrate these new capabilities along with the storm evolution information provided by them.

Detection



ADAPTS display showing beam map for the detection VCP. Yellow circles Indicate surveillance beams not containing significant weather. Blue circles Indicate surveillance beams containing significant weather.

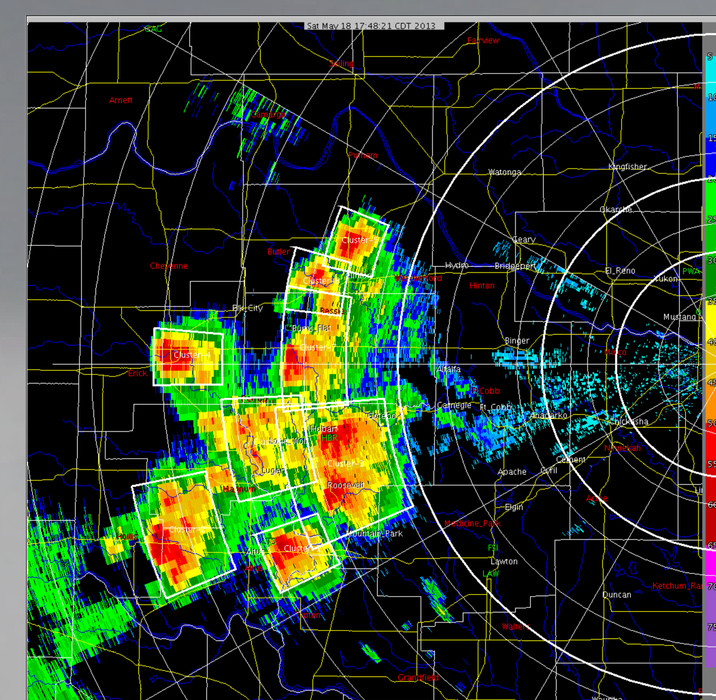


ADAPTS display showing beam map for the weather VCP scan. Dark green circles Indicate beams containing significant weather. Light green circles Indicate beams not containing significant weather but made active due to proximity to significant beam. White circles Indicate beams not containing significant weather and left inactive.

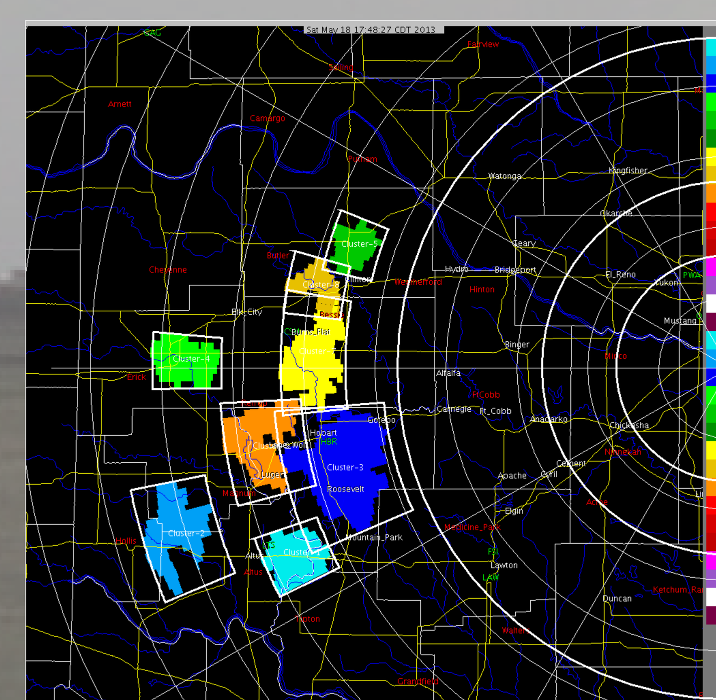
The Adaptive Digital Signal Processing Algorithm for PAR Timely Scans (ADAPTS) uses a periodic (~2minute frequency) detection scan to identify locations of significant weather. The detection scan provides full coverage inside a 90° azimuth and 60° elevation sector. The pulse repetition time (PRT) chosen for each elevation corresponds to the unambiguous range intersecting a height of 18km AGL. Using 4 pulses per beam, the detection scan completes in ~7.5 seconds.

The regular weather VCP uses this information to determine which beams to use by mapping the closest detection beam. Scan update times are fastest when storms are isolated and distant from the radar.

Identification



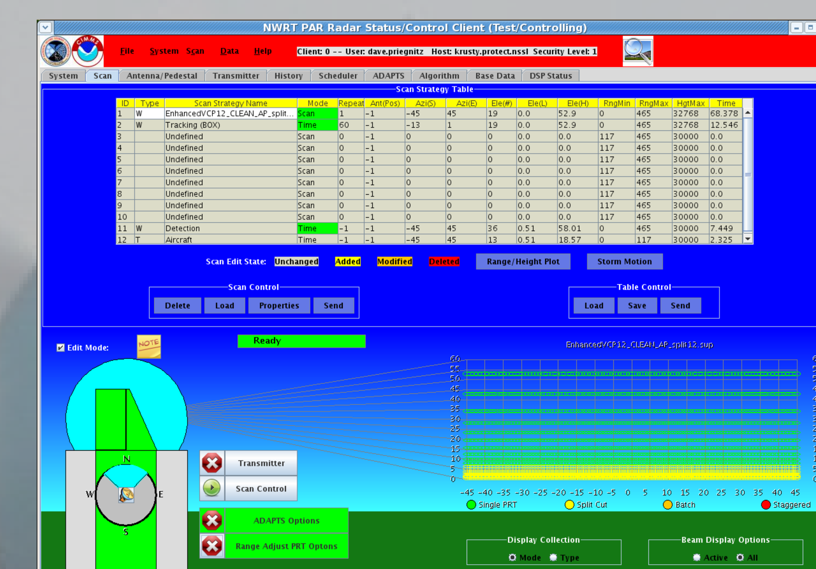
Low elevation reflectivity PPI showing storms with the boundaries of the clusters identified by the Cluster Identification Algorithm overlaid.



PPI display of the clusters identified by the Cluster Identification Algorithm using a median filter of 4km and a reflectivity threshold of 35 dBZ.

The Cluster Identification Algorithm (CIA) organizes the low elevation reflectivity field into a set of objects, or clusters. The clusters are ranked my maximum reflectivity.

Scheduling



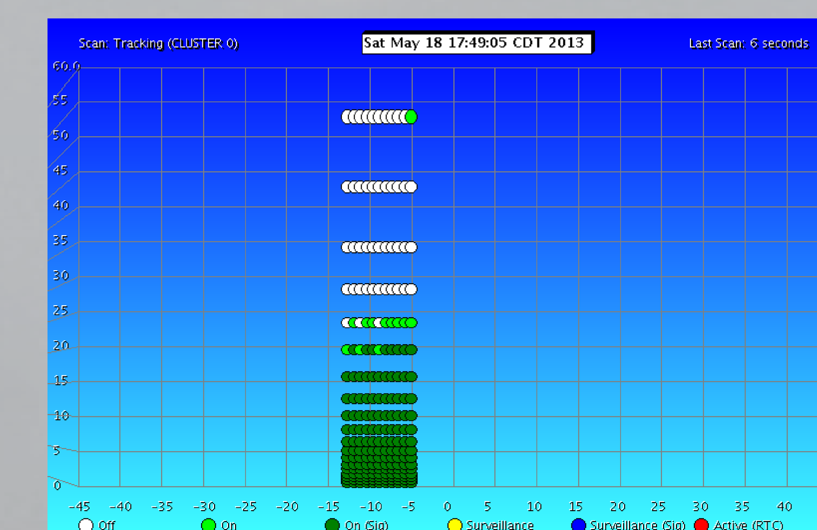
A sample Radar Control Interface (RCI) client display of the scan table and the beams defined in the primary VCP loaded in slot 1.

Cut	Elev	Waveform	Type	Mode	Azimuth(M)	Azimuth(I)	Nyquist	Range(E)	PRT(1)	Pulses(1)	PRT(2)	Pulses(2)
1	0.51	Short	Weather	Split Cut	Beam	0.5	29.296...	447.645	3000	12	800	25
2	0.9	Short	Weather	Split Cut	Beam	0.5	29.296...	434.46	2912	12	800	25
3	1.3	Short	Weather	Split Cut	Beam	0.5	29.296...	391.29	2624	12	800	25
4	1.8	Short	Weather	Split Cut	Beam	0.5	29.296...	345.735	2320	12	800	25
5	2.4	Short	Weather	Split Cut	Beam	0.5	29.296...	300.18	2016	11	800	25
6	3.1	Short	Weather	Split Cut	Beam	0.5	29.296...	258.21	1736	13	800	25
7	4.0	Short	Weather	Split Cut	Beam	0.5	29.296...	216.255	1456	15	800	25
8	5.1	Short	Weather	Split Cut	Beam	0.5	29.296...	179.085	1208	18	800	25
9	6.4	Short	Weather	Split Cut	Beam	0.5	29.296...	150.315	1016	20	800	25
10	8.0	Short	Weather	Single	Beam	0.5	28.443...	121.53	824	25	0	0
11	10.0	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
12	12.5	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
13	15.6	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
14	19.5	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
15	23.37	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
16	28.2	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
17	34.25	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
18	42.8	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0
19	52.9	Short	Weather	Single	Beam	0.5	29.296...	117.945	800	25	0	0

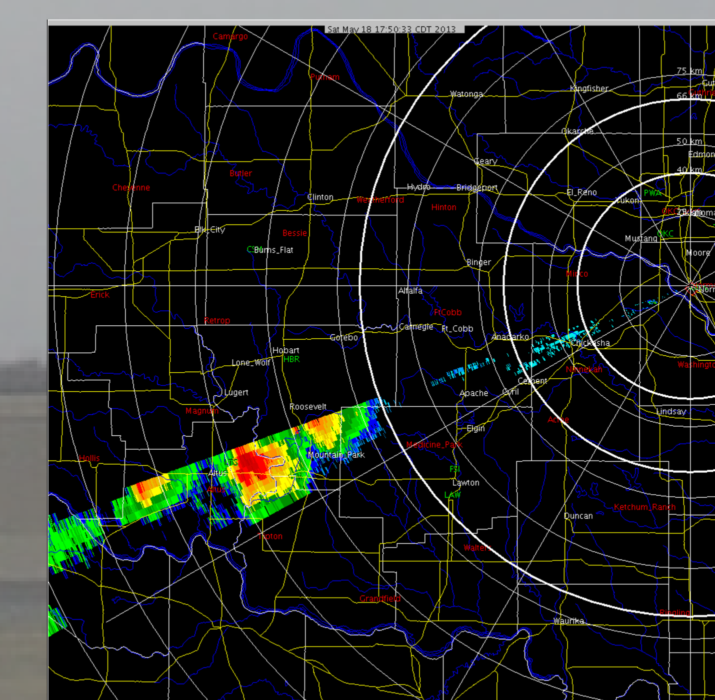
A high level display of the primary VCP definition.

Using the RCI client, an operator selects a storm of interest from a base reflectivity product. Output from CIA is then searched for a cluster that contains the selected location. If a match is found, the operator activates tracking and scheduling for the selected storm. At the RCI server, a copy of the primary VCP is retrieved and edited. The sector properties are modified to focus on the region containing the cluster. The new "cluster" VCP is sent to the RTC where it is inserted into the scan table into the first open position.

Focused Scans



ADAPTS display showing beam map for the cluster VCP scan. Dark green circles Indicate beams containing significant weather. Light green circles Indicate beams not containing significant weather but made active due to proximity to significant beam. White circles Indicate beams not containing significant weather and left inactive.



Low elevation reflectivity PPI showing the focused scan on the storm located on the south end of the cluster group.

The continued evolution of ADAPTS has resulted in better detection and faster scan updates for isolated and distant storms. However, the need for faster updates is the same regardless of coverage and proximity of storms to the radar. The scheme presented here, when used with ADAPTS, can be used to improve scan update times when and where it matters most.