Automated Volume Scan Evaluation and Termination (AVSET)

Joe N Chrisman
Engineering Branch
Radar Operations Center (ROC)

AVSET Overview

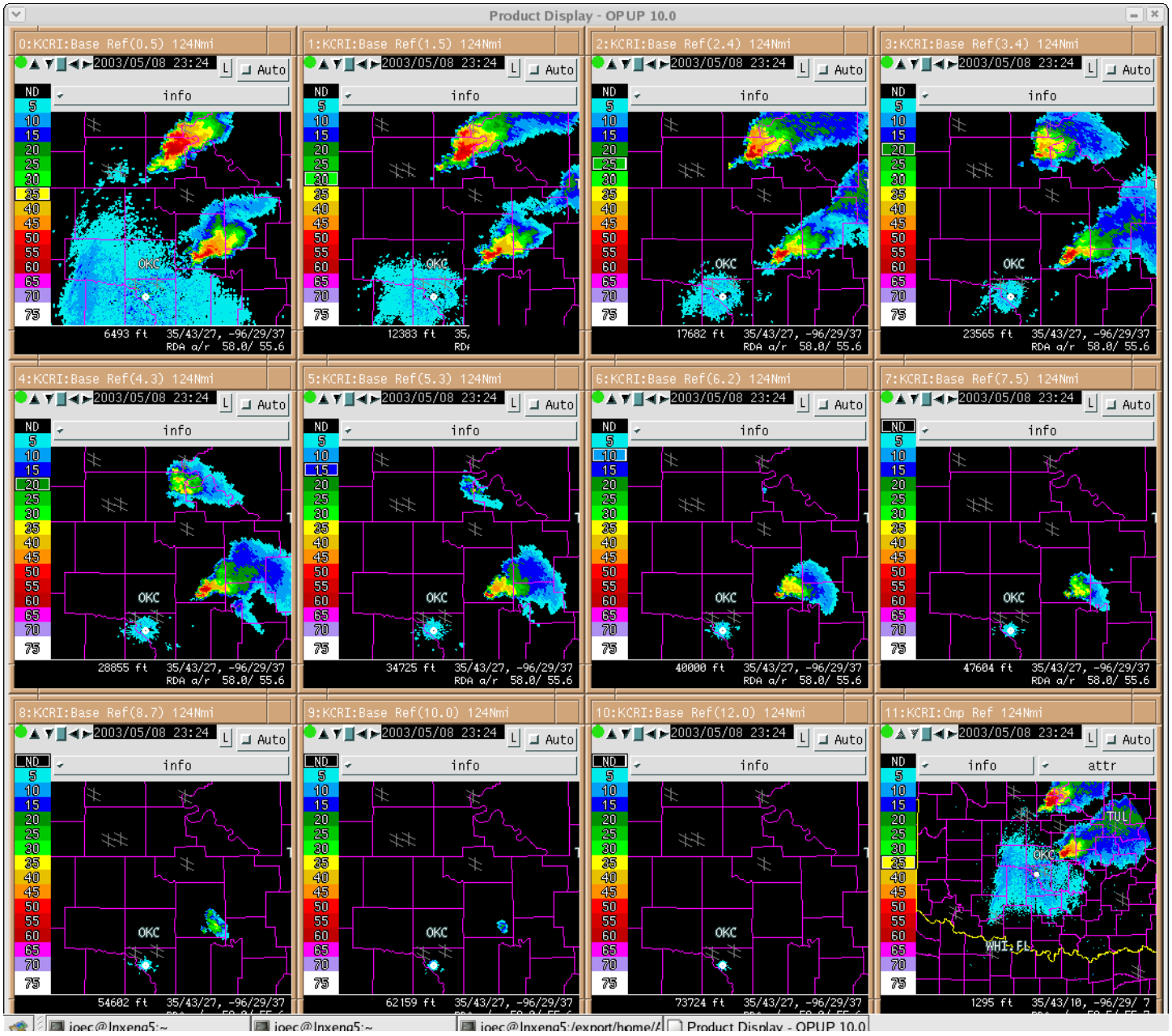
- The basic premise of the Automated Volume Scan Evaluation and Termination (AVSET) function is to terminate the current volume scan after the radar has scanned all the elevations with important return.
- Once the data collection elevation overshoots the available radar return the volume scan is terminated (because there is no benefit realized by continuing the execution of the current volume scan) and a new volume scan is begun.

AVSET Overview (cont)

- To ensure adequate vertical coverage to support precipitation accumulation processing, the AVSET process will only run on elevations higher than 5.0°.
- Two conditions must be met before the AVSET process will terminate a volume scan:
  - The areal coverage of reflectivity above *30 dBZ* must be less than *30 km2* and
  - The areal coverage of reflectivity above *18 dBZ* must be less than *80 km2*.

    NOTE: These parameters would be adaptable and would be modified if warranted by test results
- The AVSET-commanded volume scan termination would emulate the normal “end of volume scan” processing as opposed to the restart volume scan process.

AVSET VCP 11

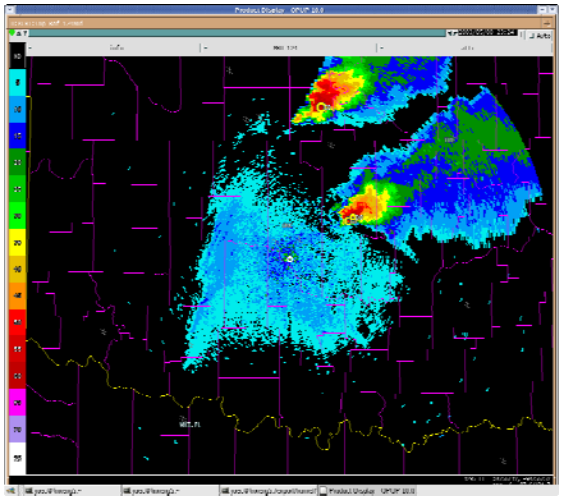

Product Display - OPUP 10.0
0:KCRI:Base Ref(0.5) 124Nmi
1:KCRI:Base Ref(1.5) 124Nmi
2:KCRI:Base Ref(2.4) 124Nmi
3:KCRI:Base Ref(3.4) 124Nmi
4:KCRI:Base Ref(4.3) 124Nmi
5:KCRI:Base Ref(5.3) 124Nmi
6:KCRI:Base Ref(6.2) 124Nmi
7:KCRI:Base Ref(7.5) 124Nmi
8:KCRI:Base Ref(8.7) 124Nmi
9:KCRI:Base Ref(10.0) 124Nmi
10:KCRI:Base Ref(12.0) 124Nmi
11:KCRI:Cmp Ref 124Nmi
2003/05/08 23:24
Auto
info
attr
OKC
TUL
6493 ft 35/43/27, -96/29/37
12383 ft 35/43/27, -96/29/37
17682 ft 35/43/27, -96/29/37
23565 ft 35/43/27, -96/29/37
28855 ft 35/43/27, -96/29/37
34725 ft 35/43/27, -96/29/37
40000 ft 35/43/27, -96/29/37
47604 ft 35/43/27, -96/29/37
54602 ft 35/43/27, -96/29/37
62159 ft 35/43/27, -96/29/37
73724 ft 35/43/27, -96/29/37
1295 ft 35/43/10, -96/29/ 7
RDA a/r 58.0/ 55.6

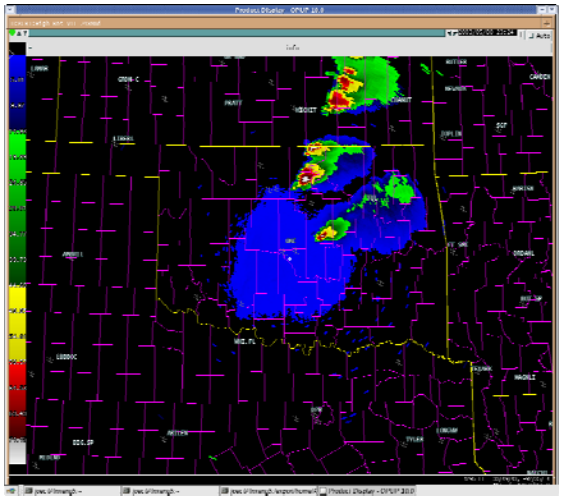
Example Volume Scan Times

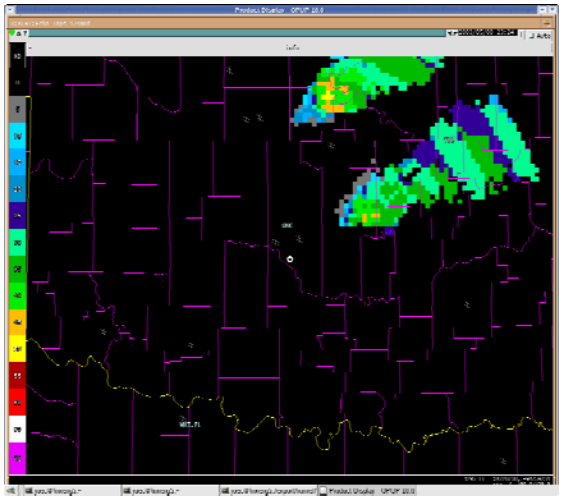
AVSET-Controlled Shortest VCP 11		AVSET-Controlled Shortest VCP 12		AVSET-Controlled Shortest VCP 212		AVSET-Controlled Shortest VCP 21	
Elevations	Time (sec)	Elevations	Time (sec)	Elevations	Time (sec)	Elevations	Time (sec)
0.5	19	0.5	17	0.5	17	0.5	32
0.5	19	0.5	14	0.5	21	0.5	32
1.5	18	0.9	17	0.9	17	1.5	32
1.5	19	0.9	14	0.9	21	1.5	32
2.4	22	1.3	17	1.3	17	2.4	32
3.4	20	1.3	14	1.3	21	3.4	32
4.3	20	1.8	15	1.8	15	4.3	32
5.3	21	2.4	14	2.4	14	6.0	32
6.2	21	3.1	14	3.1	14	9.9	25
		4.0	14	4.0	14		
		5.1	14	5.1	14		
		6.4	13	6.4	13		
Scan time	179		177		197		281
Ret/Trans	13		13		13		15
Total Time	**192**		**190**		**210**		**296**

Standard VCP 11 vs: AVSET

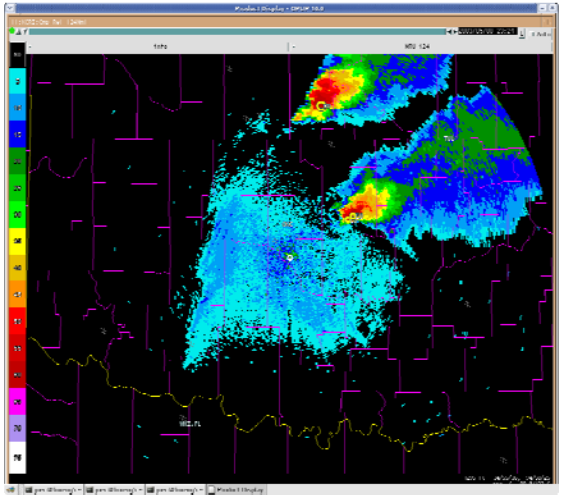
VCP 11

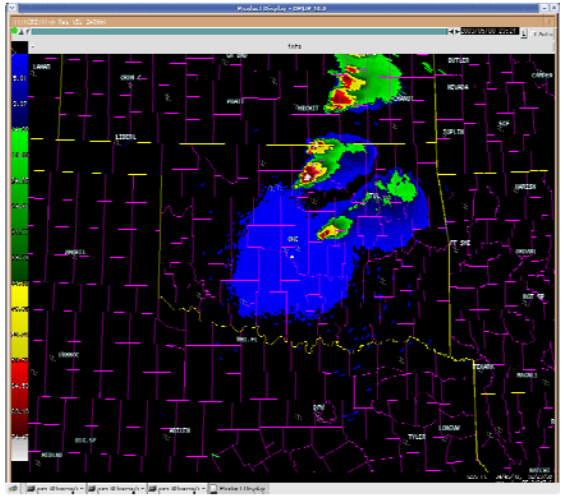


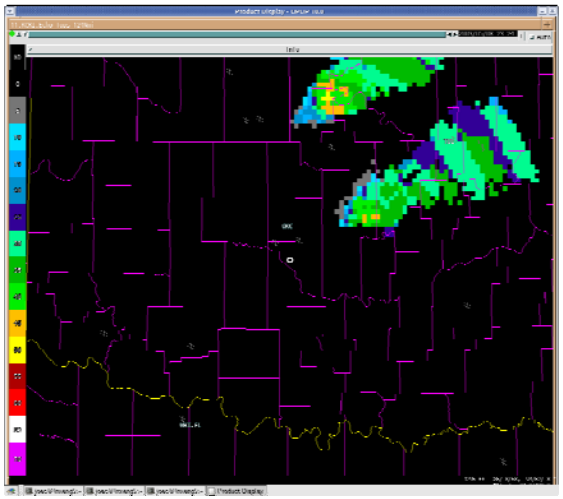




AVSET VCP 11



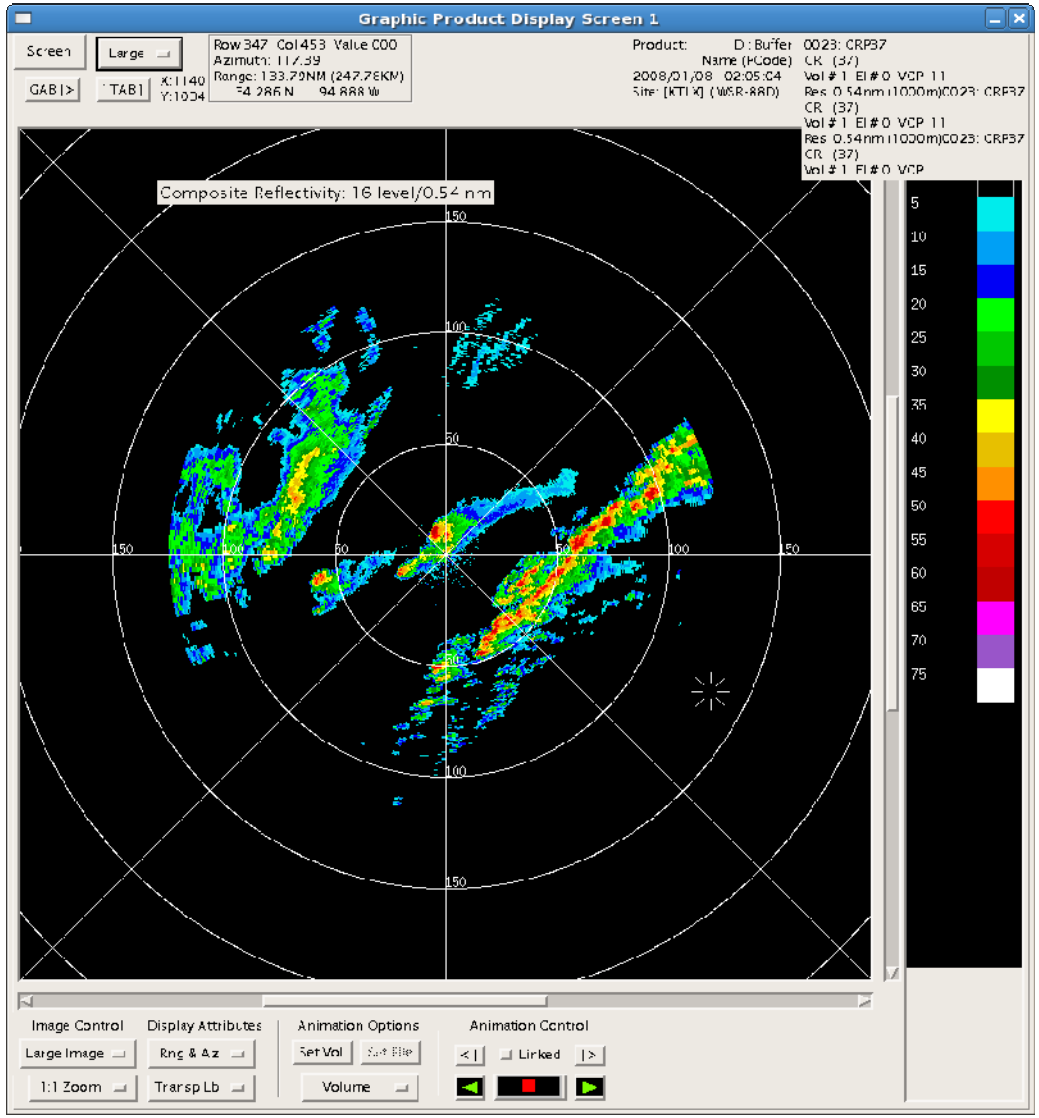


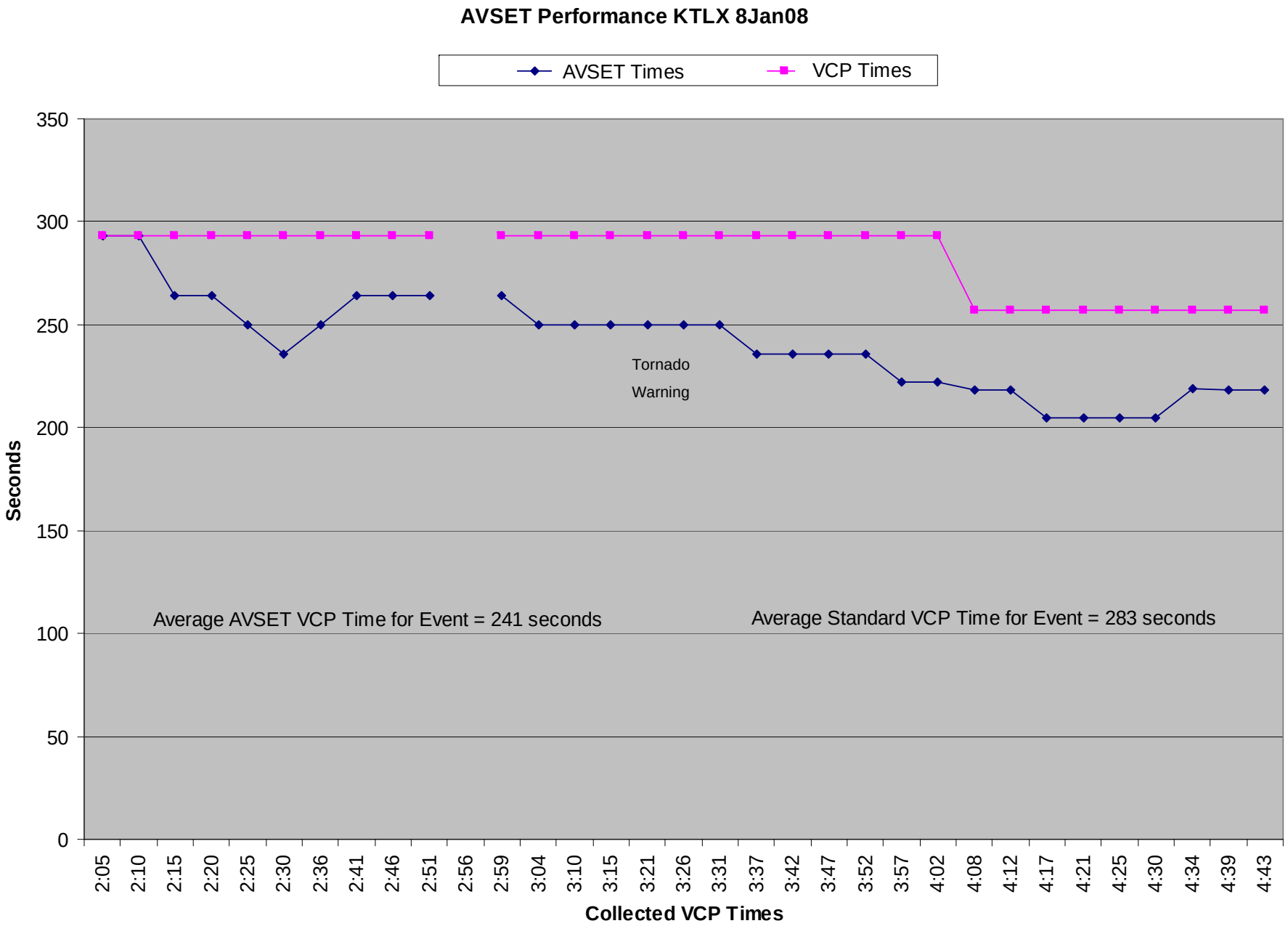


Desktop Testing

- Desktop testing of the AVSET function using RPG tool that emulates AVSET processing.
- Processes Level II data and “terminates” processing when data coverage falls below AVSET thresholds
- Emulates data collection/termination but cannot change VCP update times.

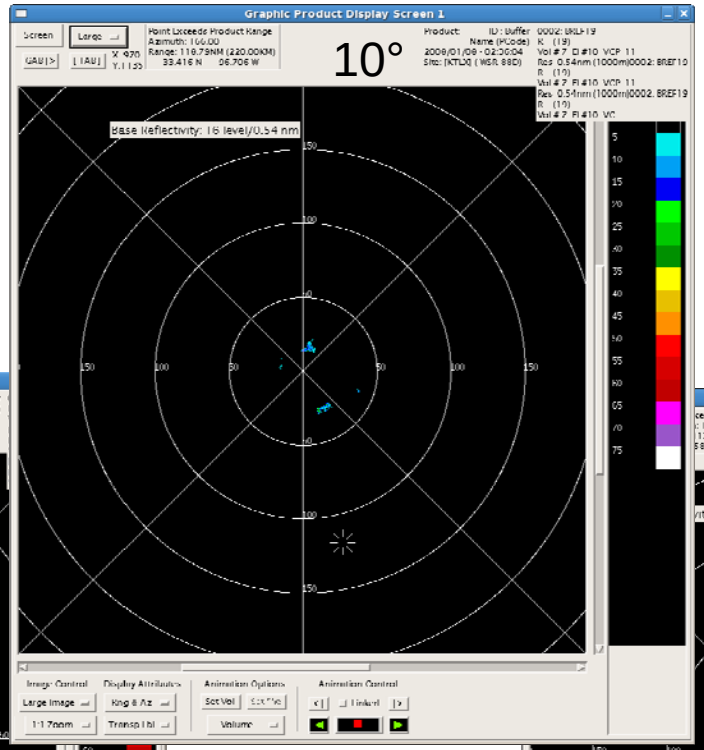
KTLX Jan 8, 2008



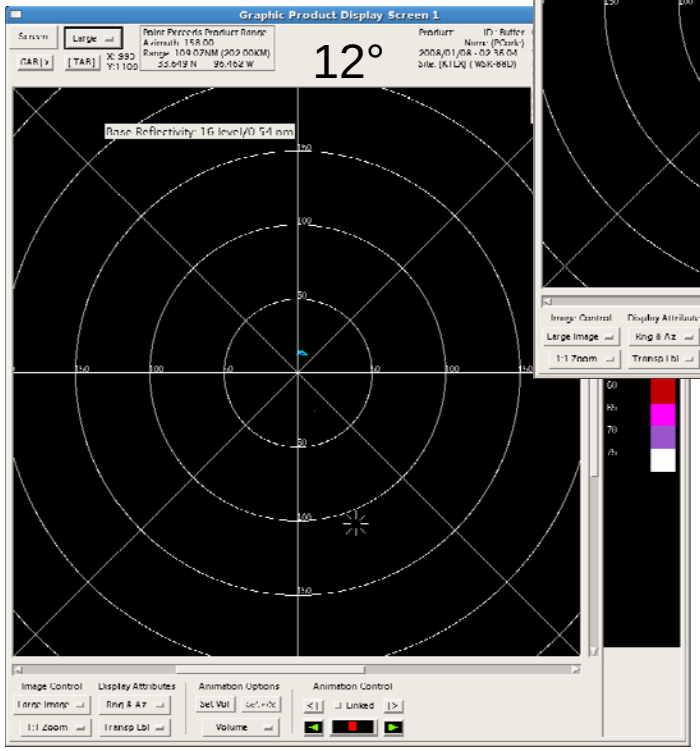

AVSET Performance KTLX 8Jan08
AVSET Times
VCP Times
350
300
250
200
150
100
50
0
Seconds
Tornado
Warning
Average AVSET VCP Time for Event = 241 seconds
Average Standard VCP Time for Event = 283 seconds
2:05
2:10
2:15
2:20
2:25
2:30
2:36
2:41
2:46
2:51
2:56
2:59
3:04
3:10
3:15
3:21
3:26
3:31
3:37
3:42
3:47
3:52
3:57
4:02
4:08
4:12
4:17
4:21
4:25
4:30
4:34
4:39
4:43
Collected VCP Times

AVSET Processing

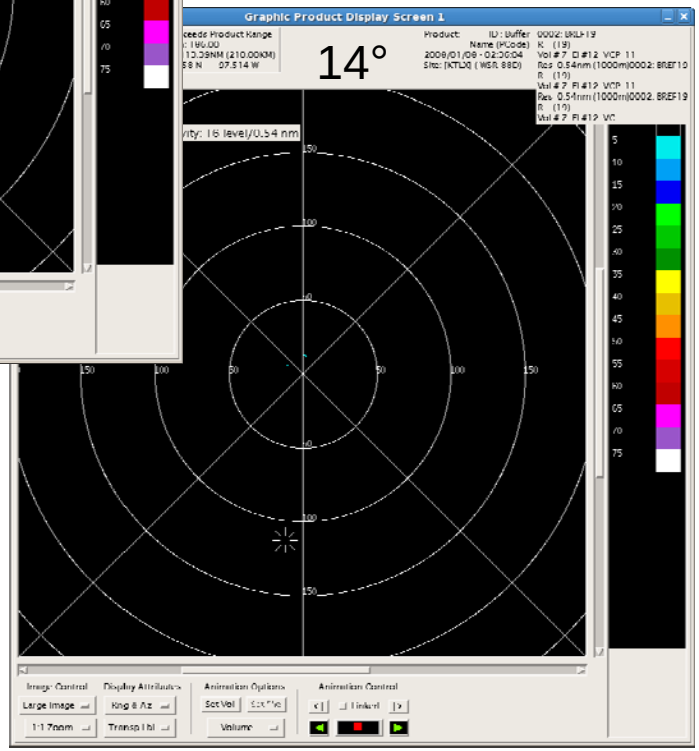
AVSET Minimum Thresholds NOT Met



Last Elevation Processed in Volume Scan

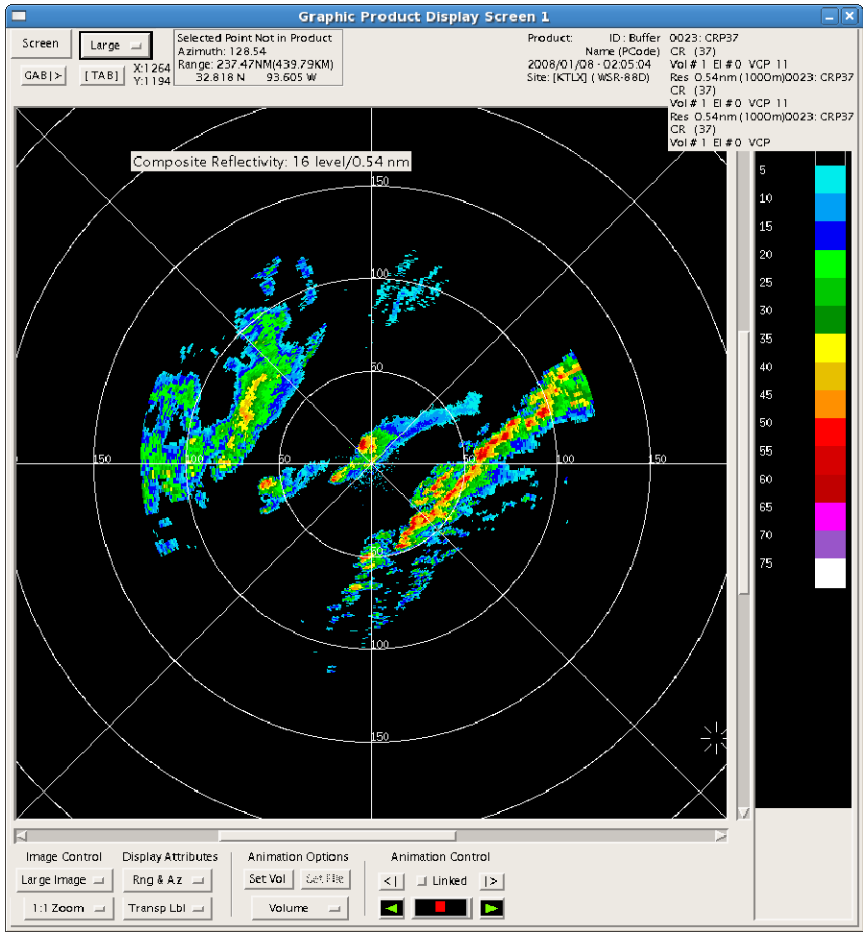


Elevation NOT Processed under AVSET Control

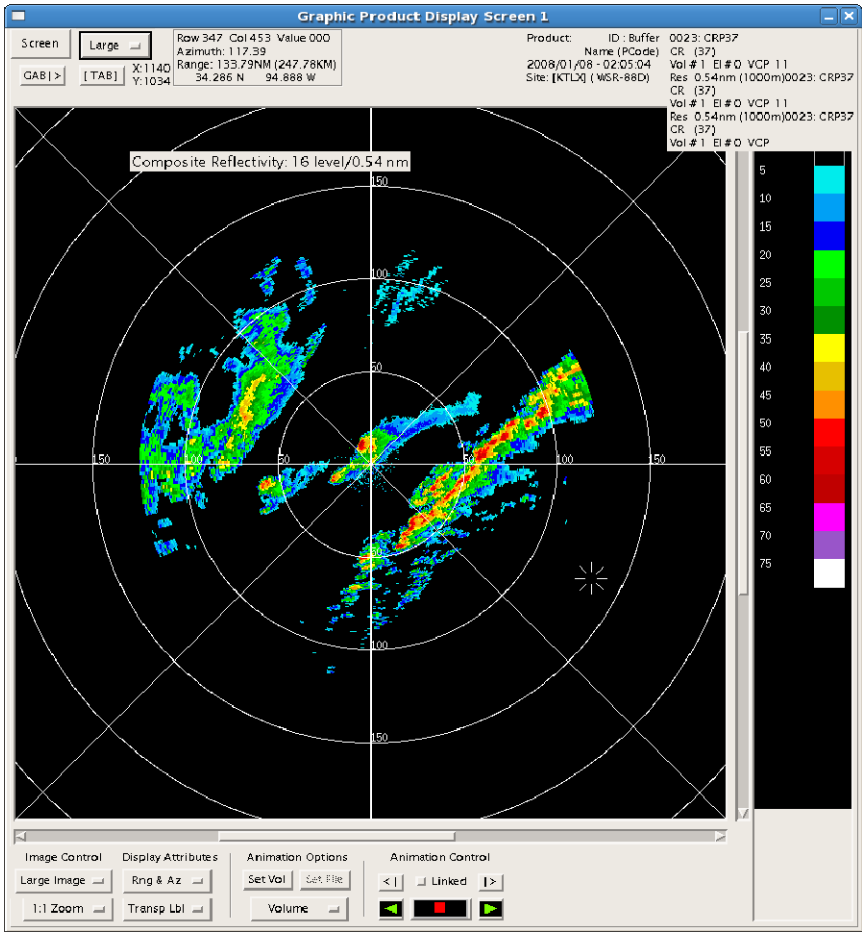


KTLX 8 Jan 2008 0205Z

- CR Baseline

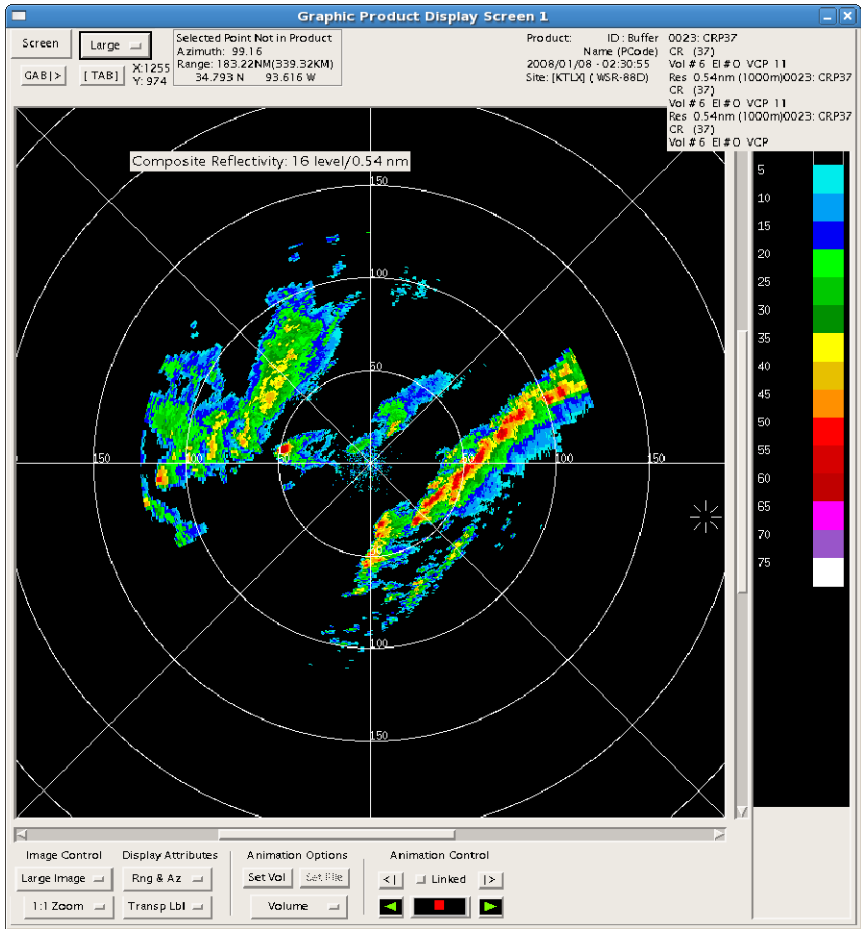


- CR AVSET

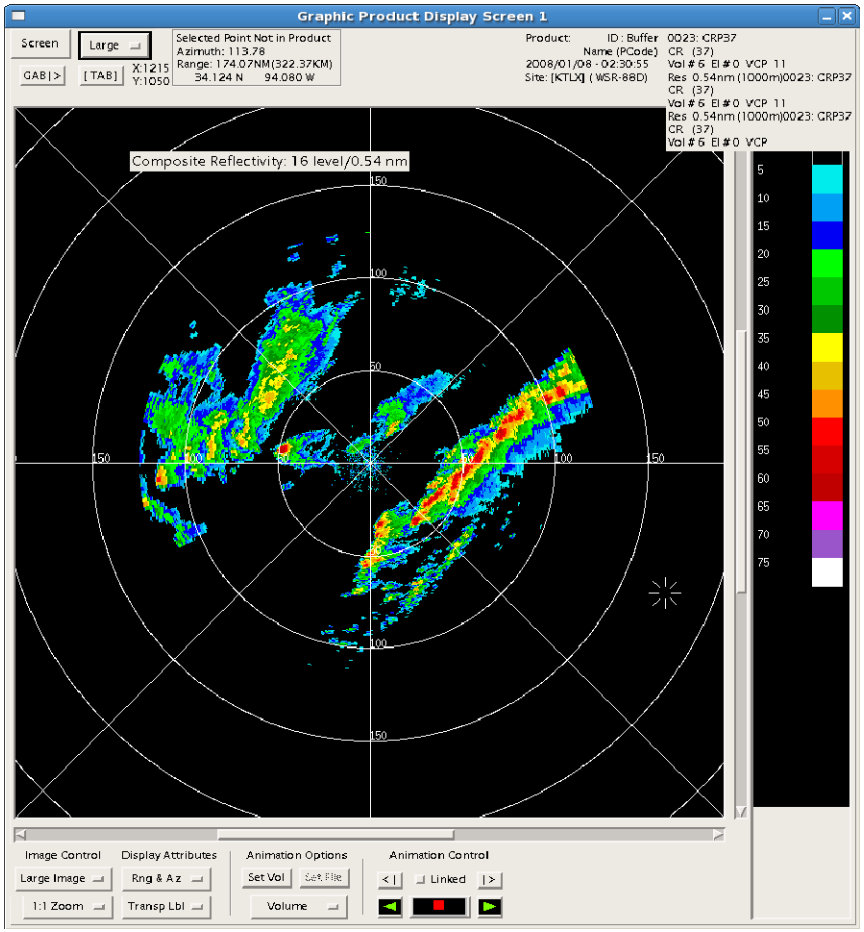


KTLX 8 Jan 2008 0230Z

- CR Baseline

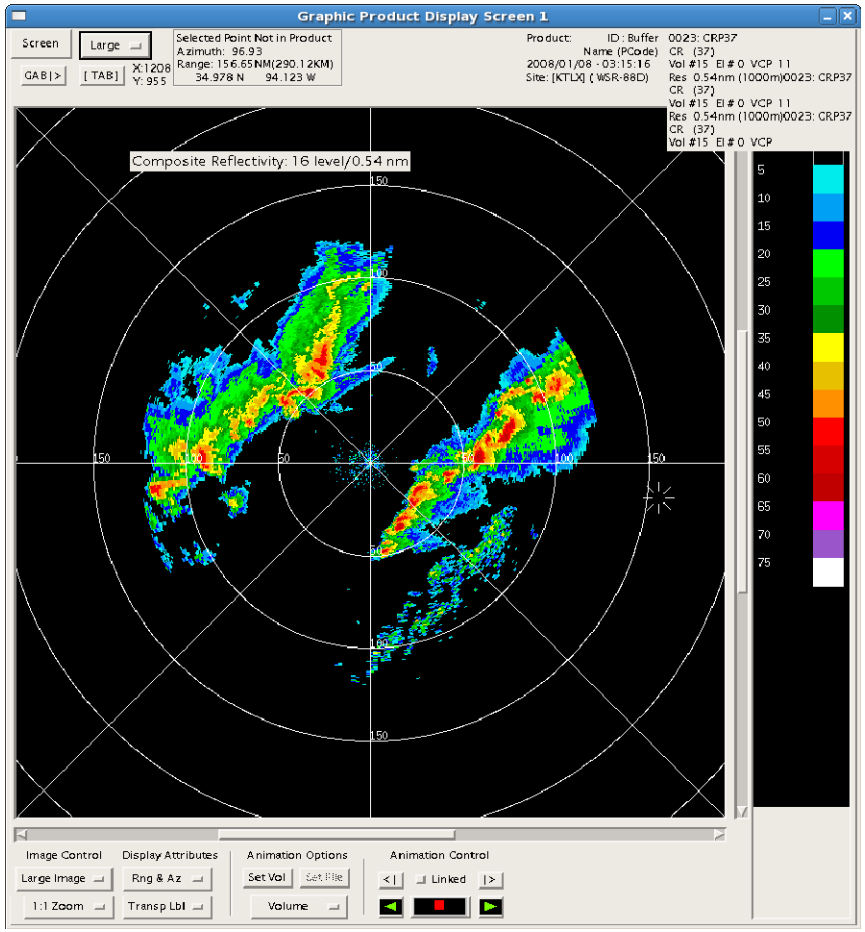


- CR AVSET

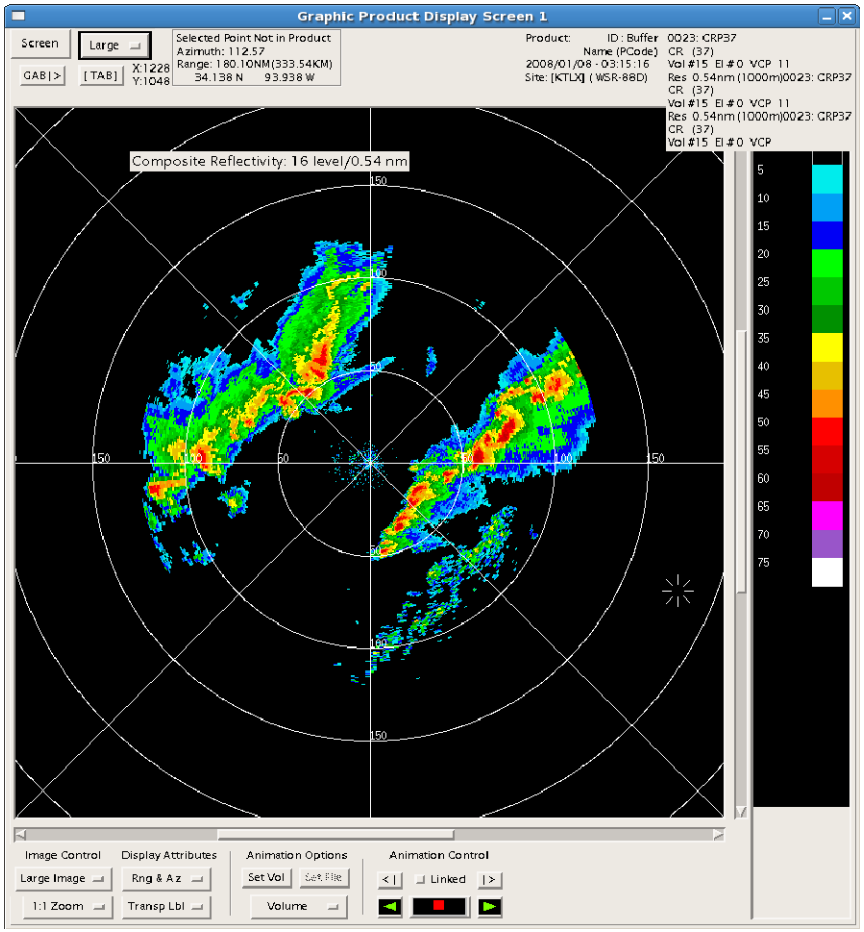


KTLX 8 Jan 2008 0315Z

- CR Baseline

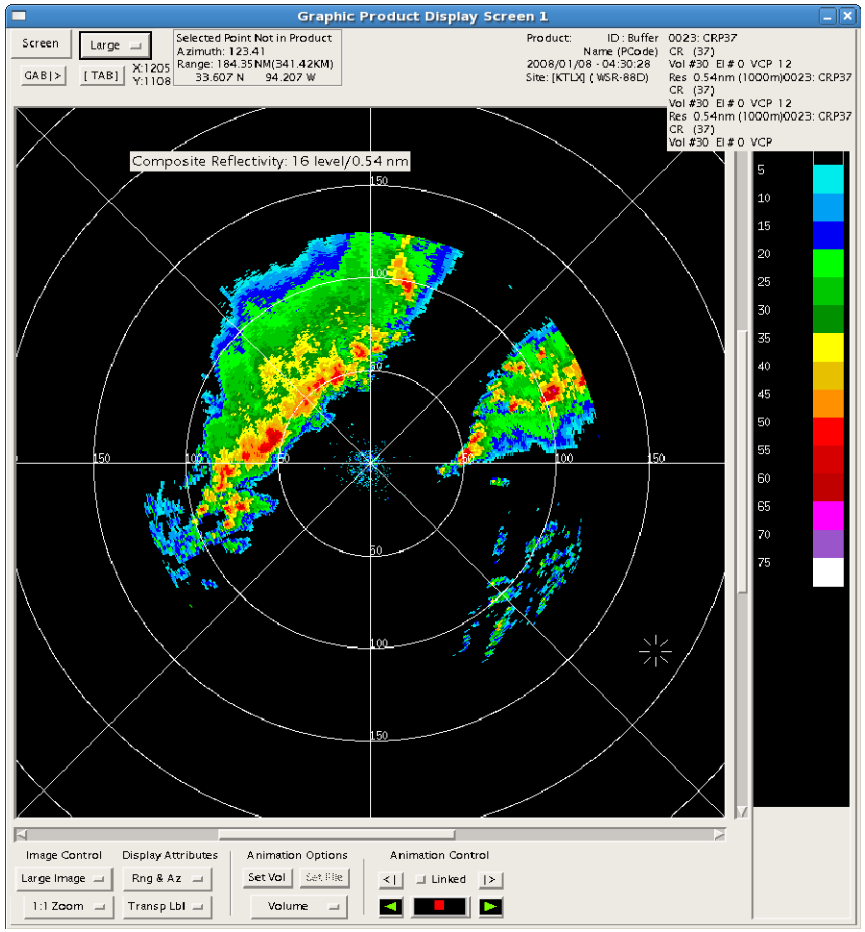


- CR AVSET

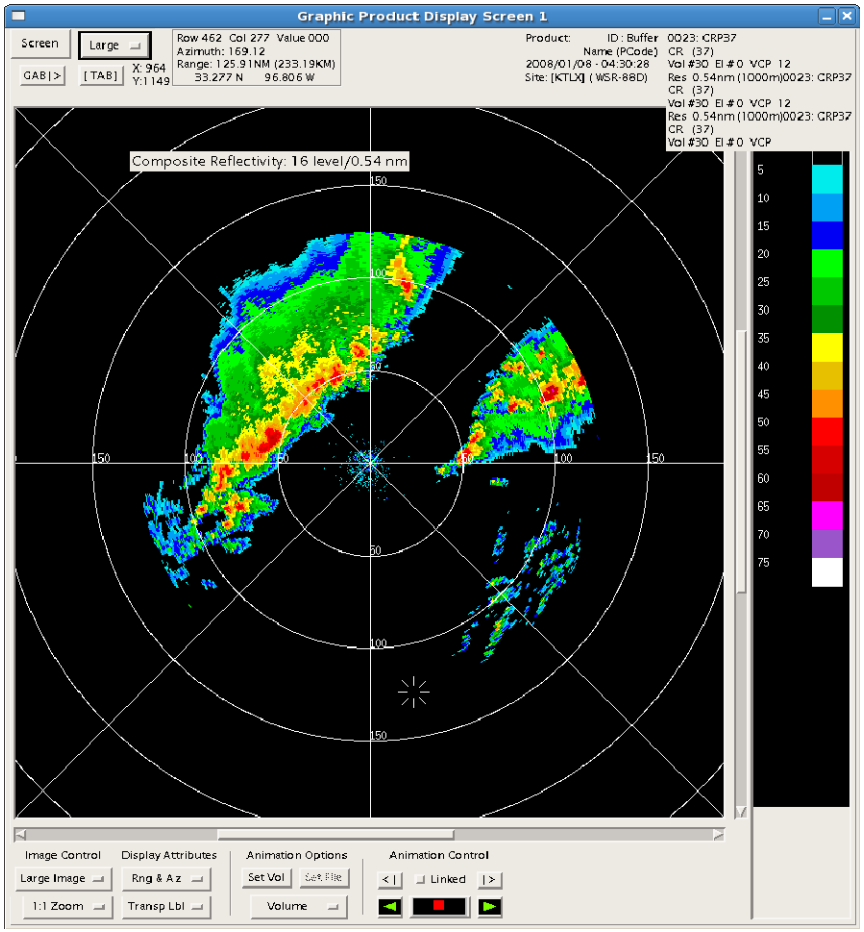


KTLX 8 Jan 2008 0430Z

- CR Baseline



- CR AVSET



KTLX 8 Jan 2008 0230Z

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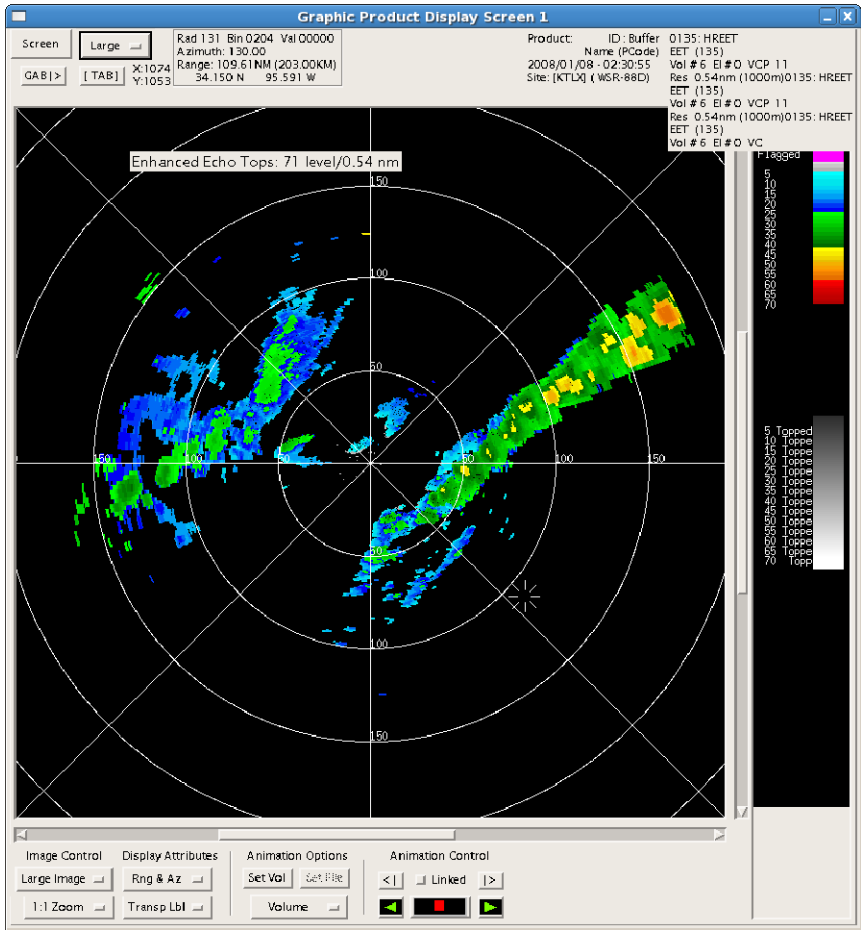
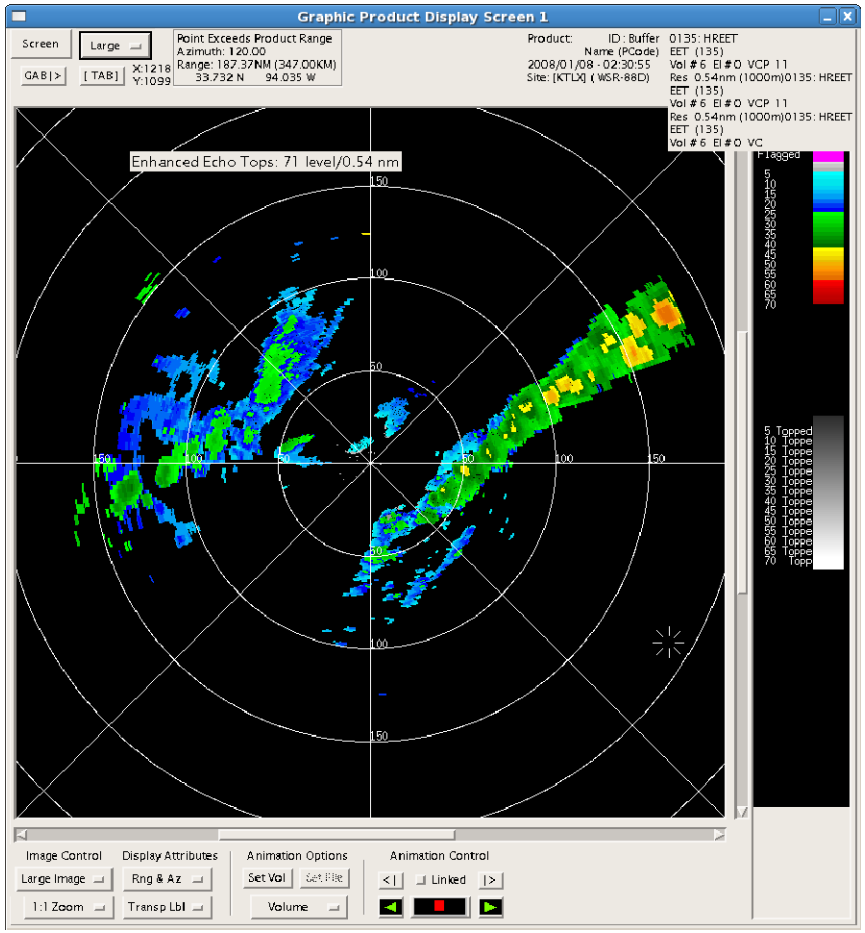
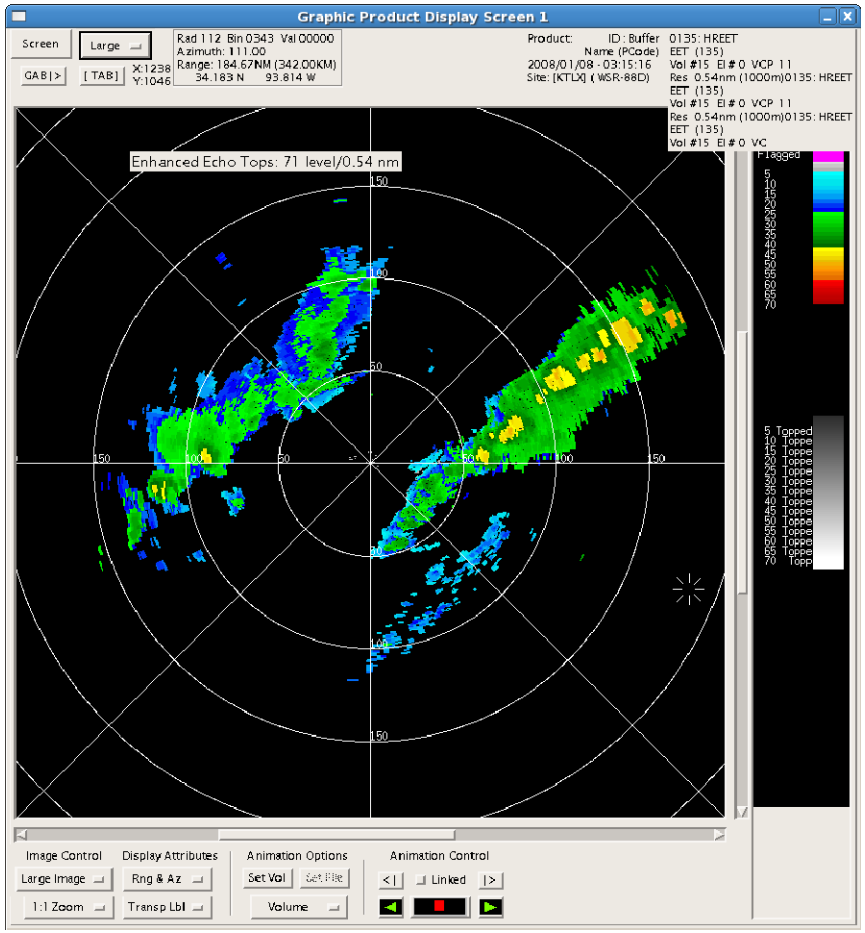


- EET AVSET

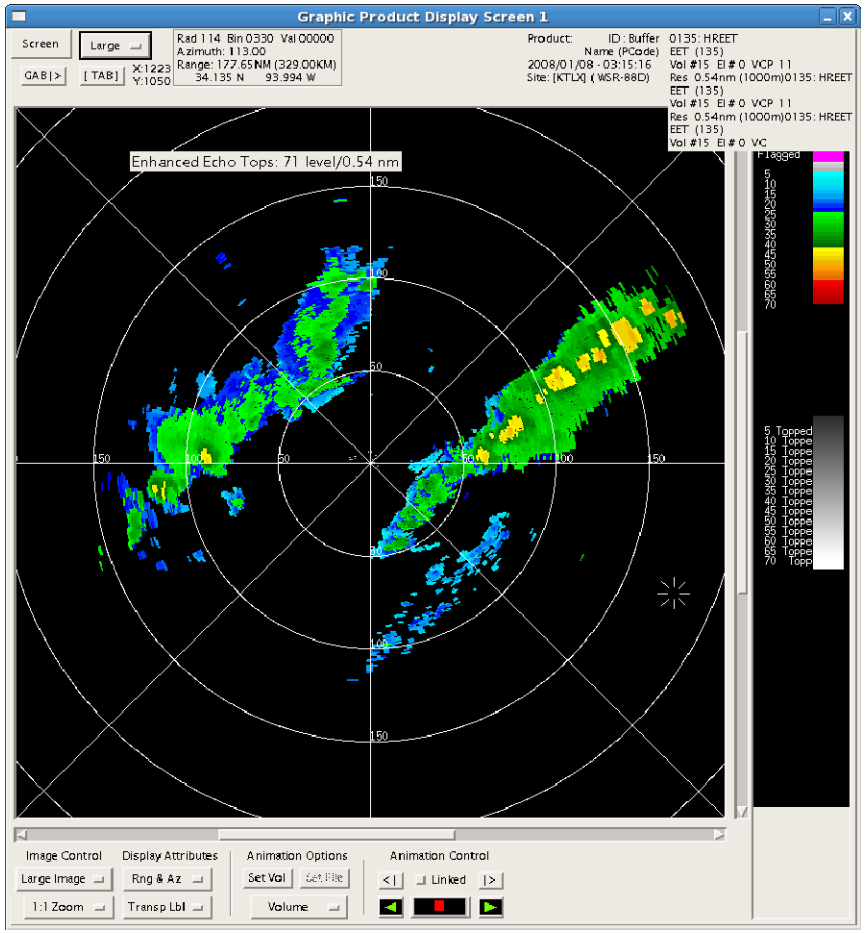


KTLX 8 Jan 2008 0315Z

- EET Baseline

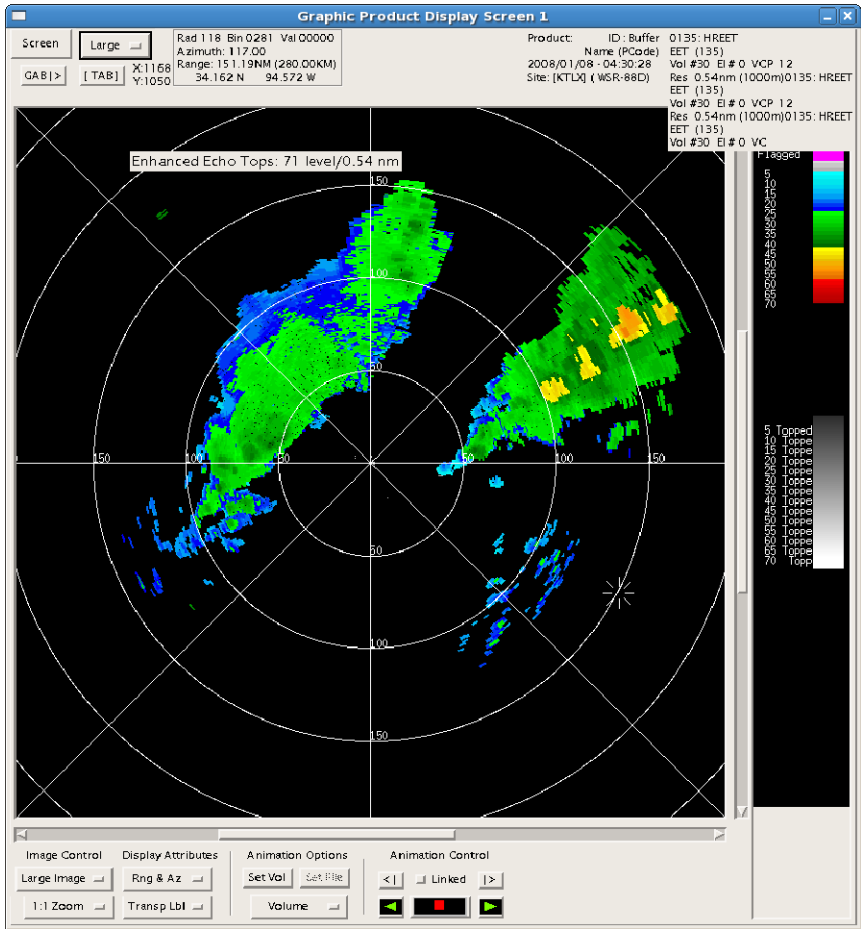


- EET AVSET

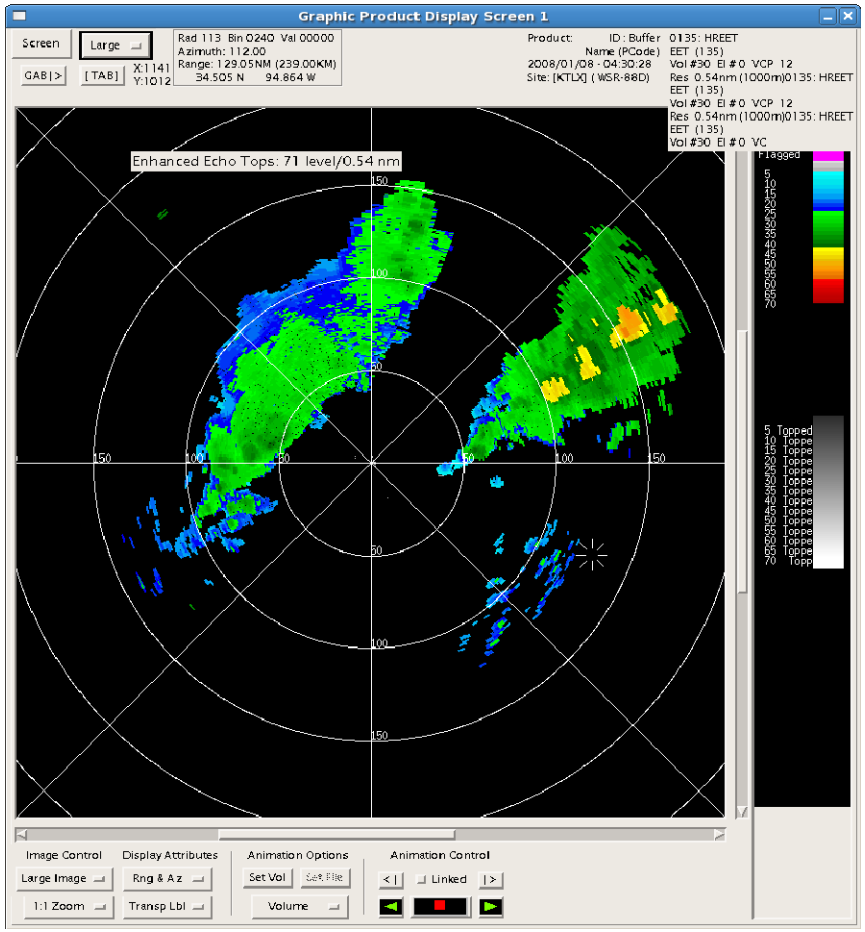


KTLX 8 Jan 2008 0430Z

- EET Baseline

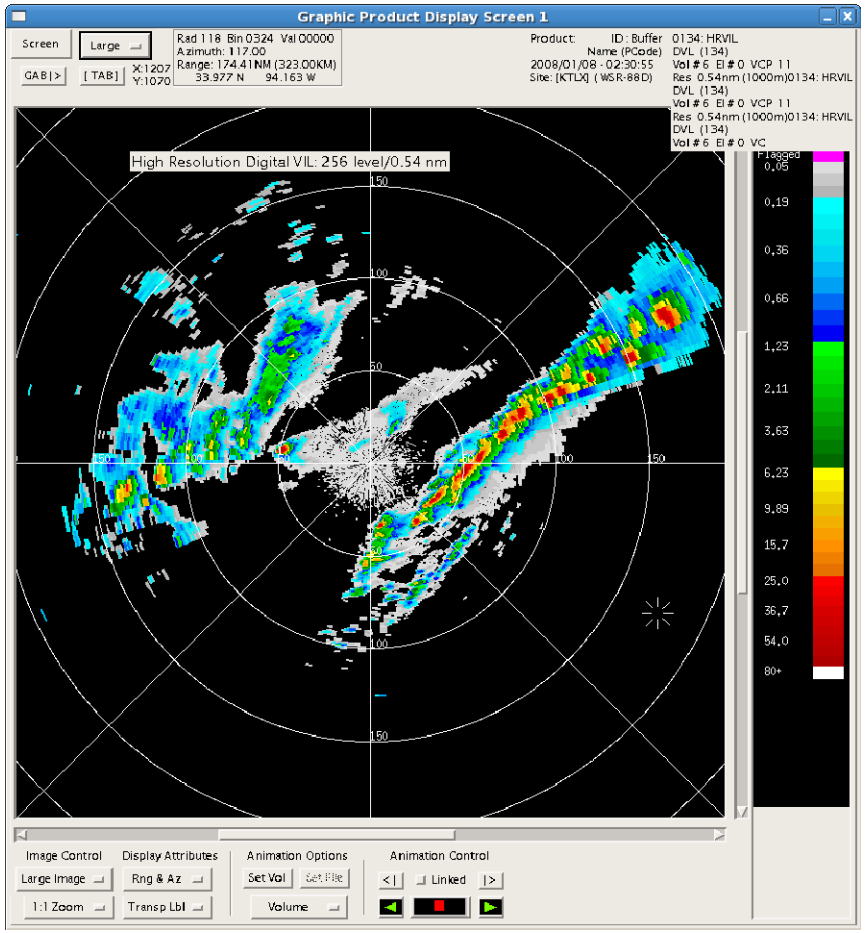


- EET AVSET

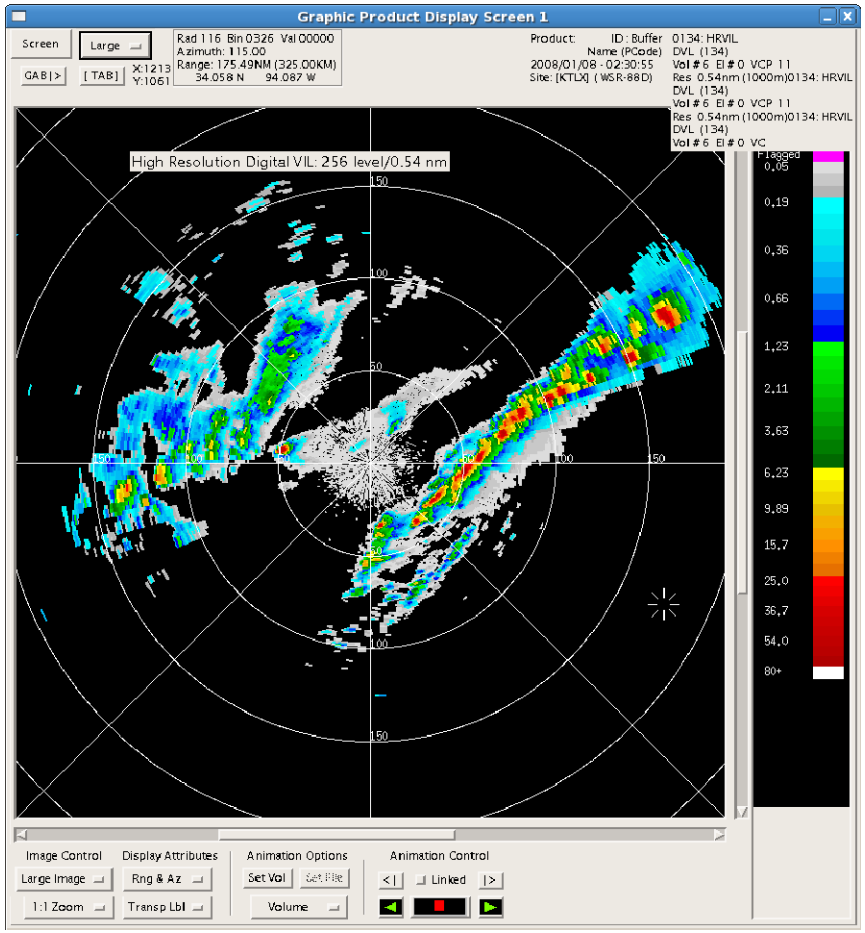


KTLX 8 Jan 2008 0230Z

- DVIL Baseline

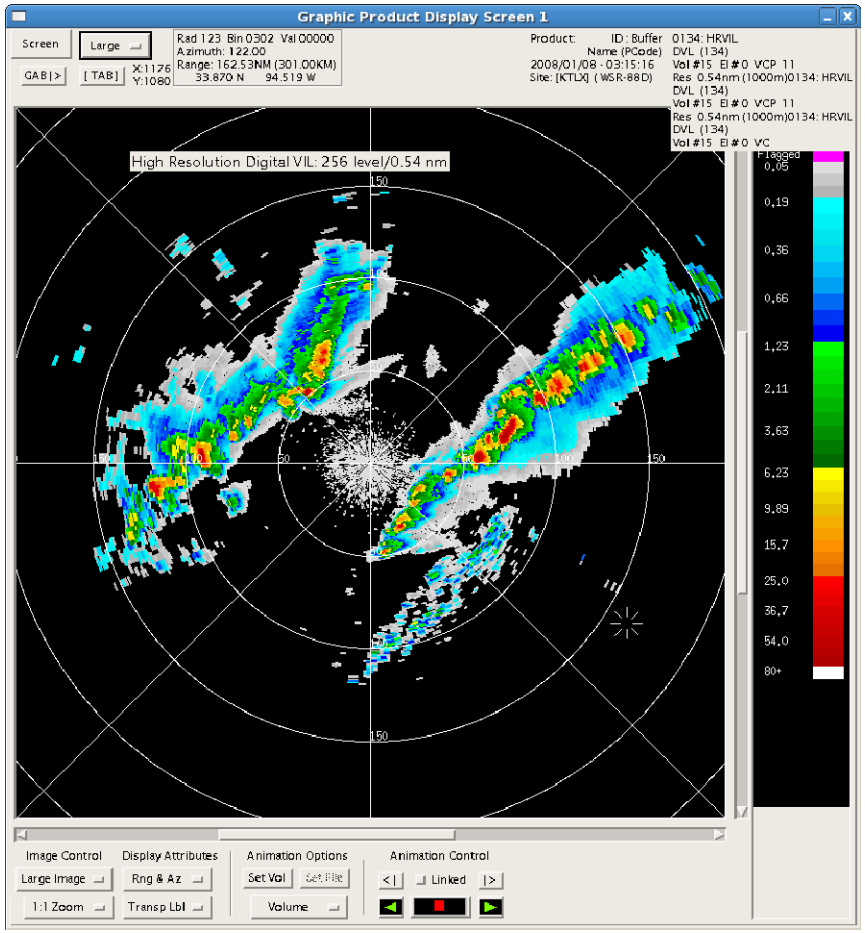


- DVIL AVSET

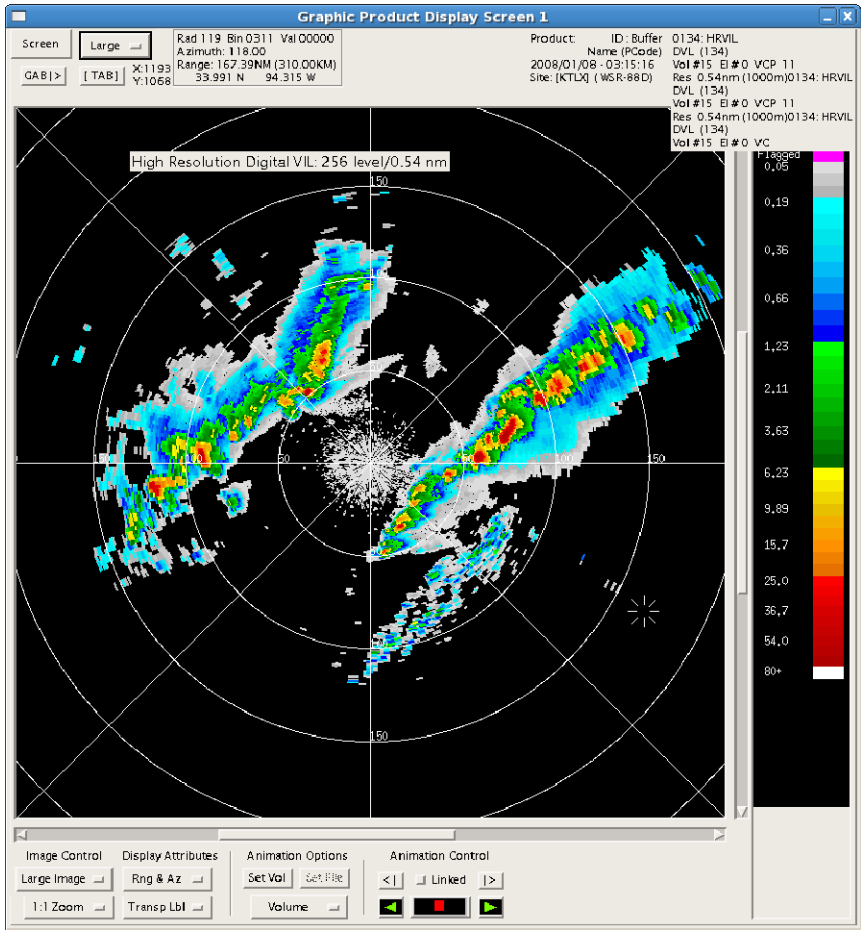


KTLX 8 Jan 2008 0315Z

- DVIL Baseline

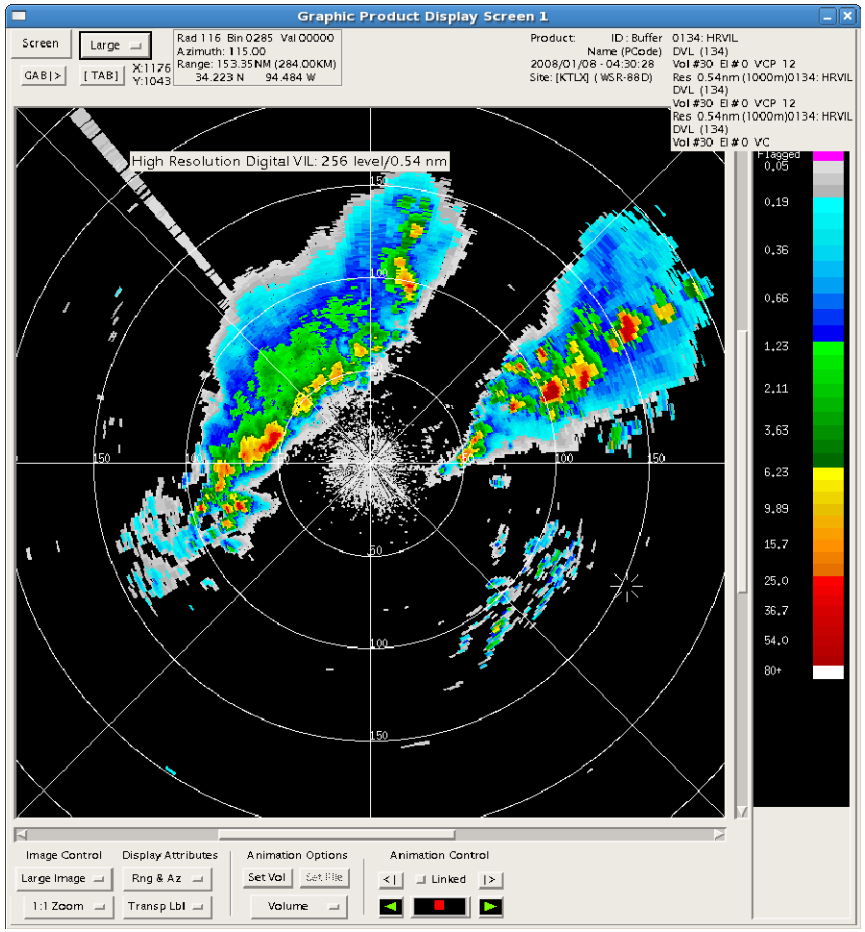


- DVIL AVSET

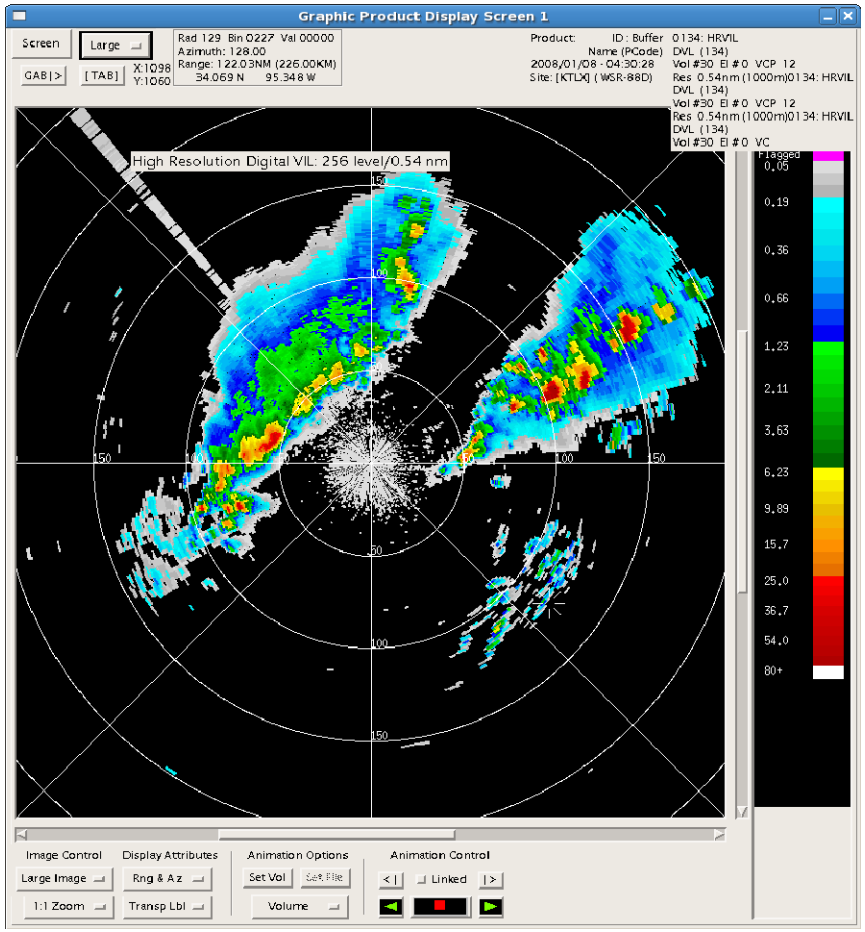


KTLX 8 Jan 2008 0430Z

- DVIL Baseline



- DVIL AVSET



Preliminary Summary

The AVSET-controlled VCP times averaged 241 seconds for the 2 ½ hour test case compared with the standard VCP average execution time of 283 seconds.

- Automated comparison of the 968 volume products resulted in a 92% exact (byte-byte) match.

Preliminary Summary

- Visual comparison of the “mis-matched” products revealed very small differences (a single to a few gates) between the “original” and “mis-matched” products
- The differences were confined to within 10nm from the radar.
- In the context of their contribution to the interpretation of the weather event, the “mis-matched” gates correspond to operationally insignificant differences in the products.

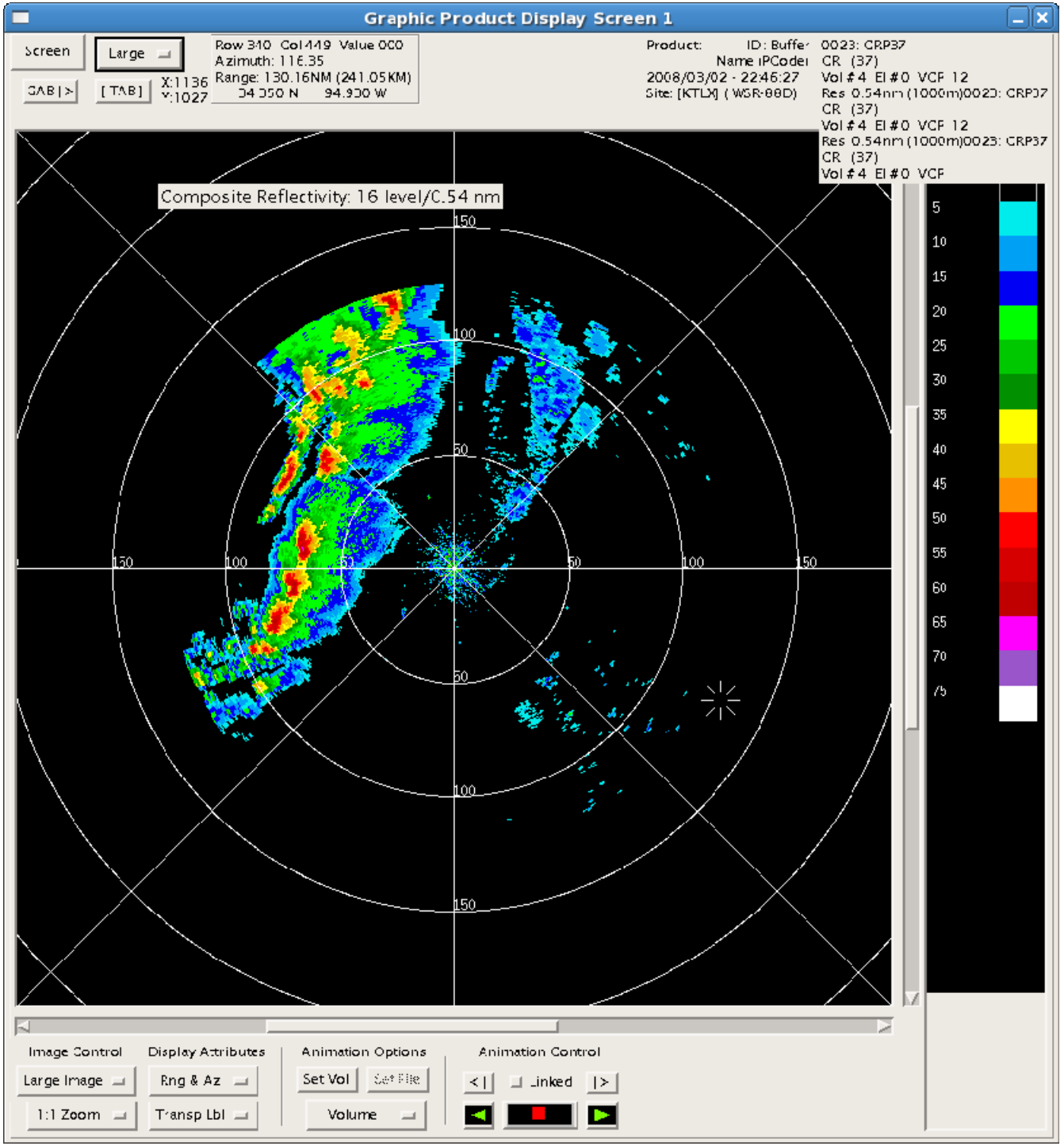
Real World Testing

- AVSET (“non-operational” Build 11) installed on ROC Testbed (KCRI).
- KTLX (Build 9) located approximately 10nm NE of KCRI.
- Level II data collected from both sites.

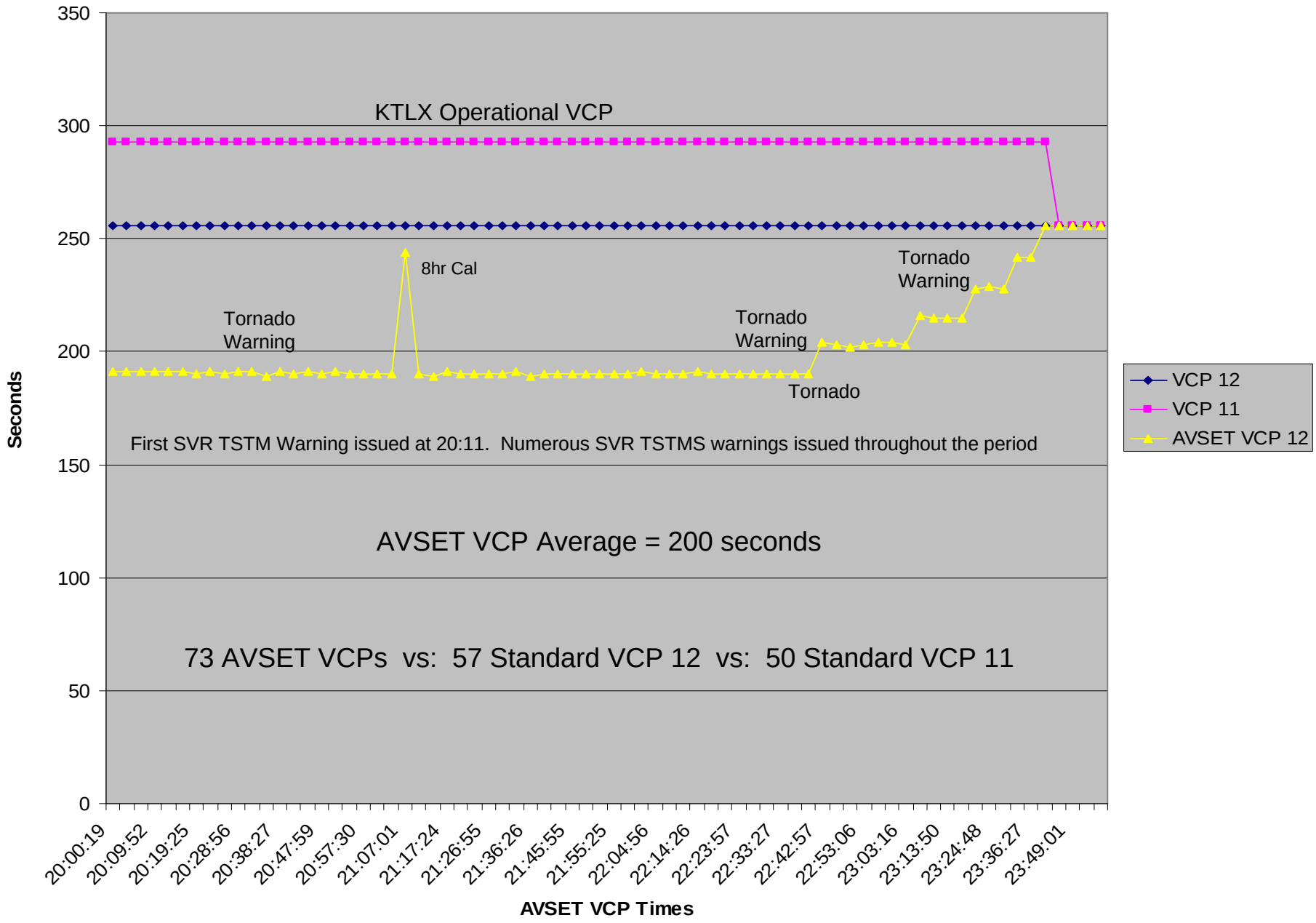
AVSET-Controlled

VCP 12

KCRI CR 22:46



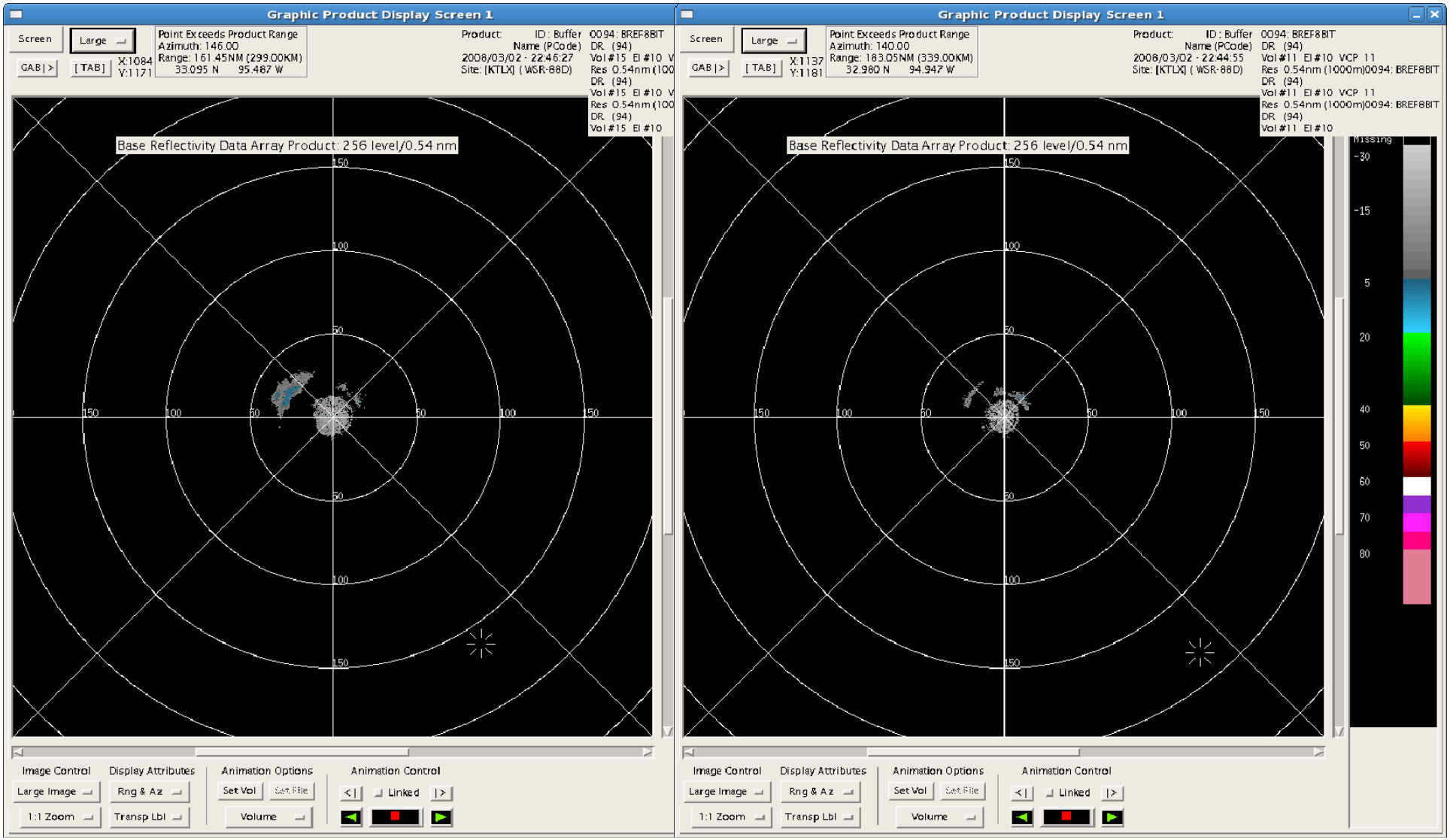
AVSET Controlled VCPs vs: VCPs 11 and 12 for Mar 2, 2008 Event



Base Reflectivity

KCRI 8.0° 22:46

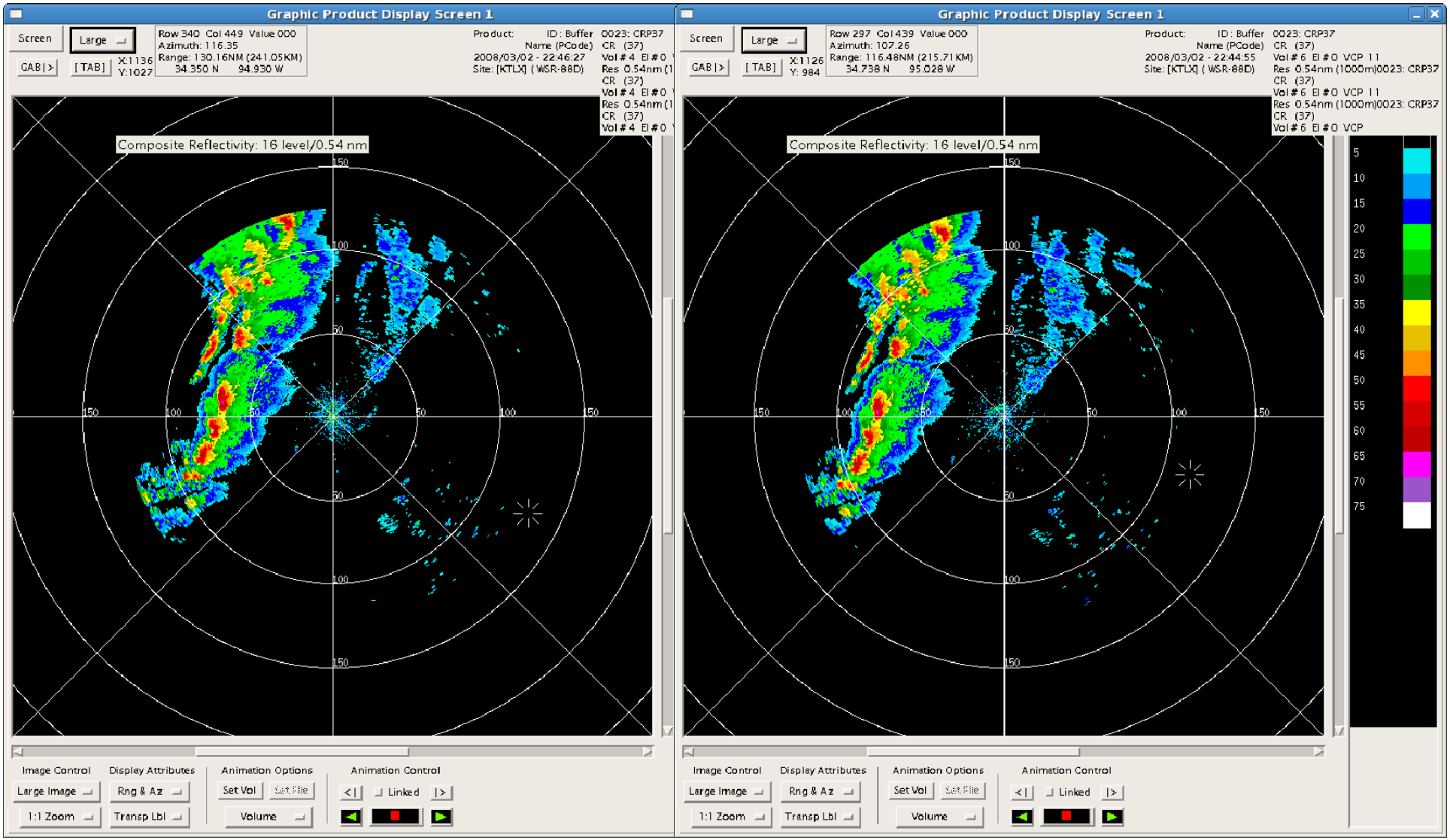
KTLX 10.0° 22:44



Composite Reflectivity

KCRI 22:46

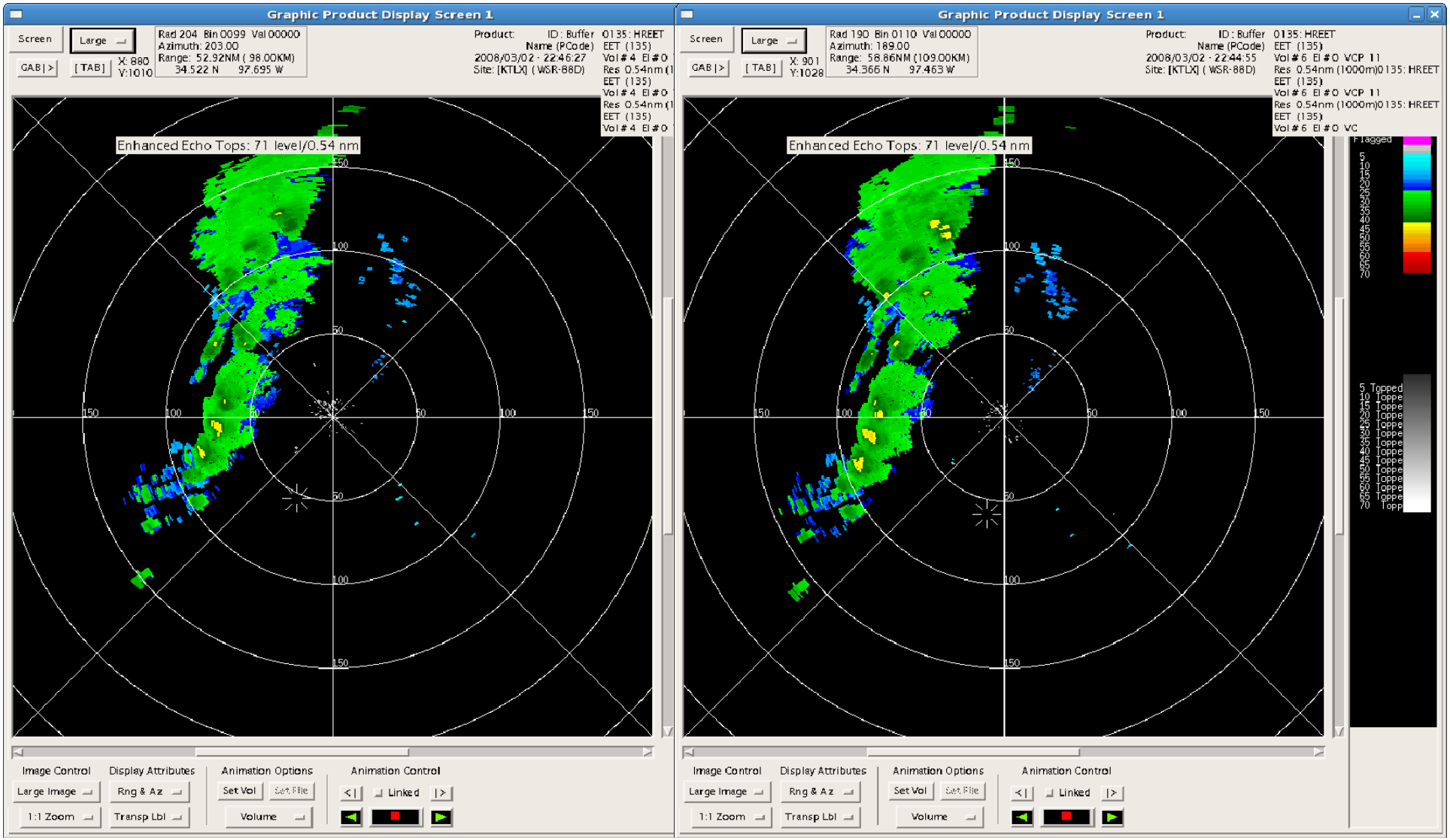
KTLX 22:44



Enhanced Echo Tops

KCRI 22:46

KTLX 22:44



Interim Summary

- For the entire 4-hour time period, the AVSET-controlled VCP times averaged 200 seconds.
- Focusing on the 3-hour period prior to, and including, the tornado, the AVSET-controlled VCP 12 times averaged 190 seconds.
- AVSET enabled KCRI to produce 73 volume scans during the 4-hour period; conversely, only 57 volumes scans executing VCP 12, or 50 volume scans executing VCP 11, would have been possible with AVSET inactive.

Interim Summary

- A visual inspection of the products from KTLX (standard VCP 11 and VCP 12) and KCRI (AVSET-controlled VCP 12) showed only operationally insignificant differences that did not impact the identification and interpretation of the unfolding weather events.

AVSET - Operational Concerns

- Missed return due to the Cone-of-Silence
- Communications Load with shorter volume scan durations

Cone-of-Silence

- In Clear-Air Mode, the field has always accepted the risk of the possibility that a “new” updraft (return) would develop above 4.5 degrees (close to the radar).
- AVSETs always samples about 2 degrees higher than the Clear-Air VCPs which results in a significantly smaller “cone-of-silence” than we currently accept.
- The “cone-of-silence” for AVSET is approximately 10kft ARL at a range of 20nm (5kft ARL at a range of 10nm).
- It unlikely that important return would be completely confined to this small “cone of silence”, where it would not be detected, for more than a few minutes.
- In the case where there AVSET terminates the volume scan at 6.4 degrees, the VCP update time is approx 190 seconds.

Communications Impact Questions

- What impact will AVSET have on the Narrowband Communications - Specifically Central Data Collection?
- Are there any Techniques available to mitigate the increased bandwidth requirements?

Multicast and FTP Servers (Radar Products Service) List

Reflectivity	19	16	0.5
Reflectivity	19	16	1.5
Reflectivity	19	16	2.5
Reflectivity	19	16	3.5
Reflectivity	20	16	0.5
Velocity	27	16	0.5
Velocity	27	16	1.5
Velocity	27	16	2.5
Velocity	27	16	3.5
Storm Rel Velocity	56	16	0.5
Storm Rel Velocity	56	16	1.5
Storm Rel Velocity	56	16	2.5
Storm Rel Velocity	56	16	3.5
Composite Ref	36	8	n/a
Composite Ref	37	16	n/a
Composite Ref	38	16	n/a
Lyr Comp Ref Max	65	8	n/a
Lyr Comp Ref Max	66	8	n/a
Lyr Comp Ref Max	90	8	n/a
Lyr Comp Ref Max	67	16	n/a

Echo Tops	41	16	n/a
Vert Integ Liq	57	16	n/a
One Hour Precip	78	16	n/a
Three Hour Precip	79	16	n/a
Storm Total Precip	80	16	n/a
VAD Wind Profile	48	0	n/a
Digital Precip Array	81	256	n/a
Velocity	25	16	n/a
Base Spectrum Width	28	8	n/a
Base Spectrum Width	30	8	n/a
STI	58	0	n/a
Hail Index	59	0	n/a
Mesocyclone	60	0	n/a
Mesocyclone	141	0	n/a
TVS	61	0	n/a
Storm Structure	62	0	n/a
SPD	82	0	n/a
Digital HR	32	256	n/a
Digital STP	138	256	n/a

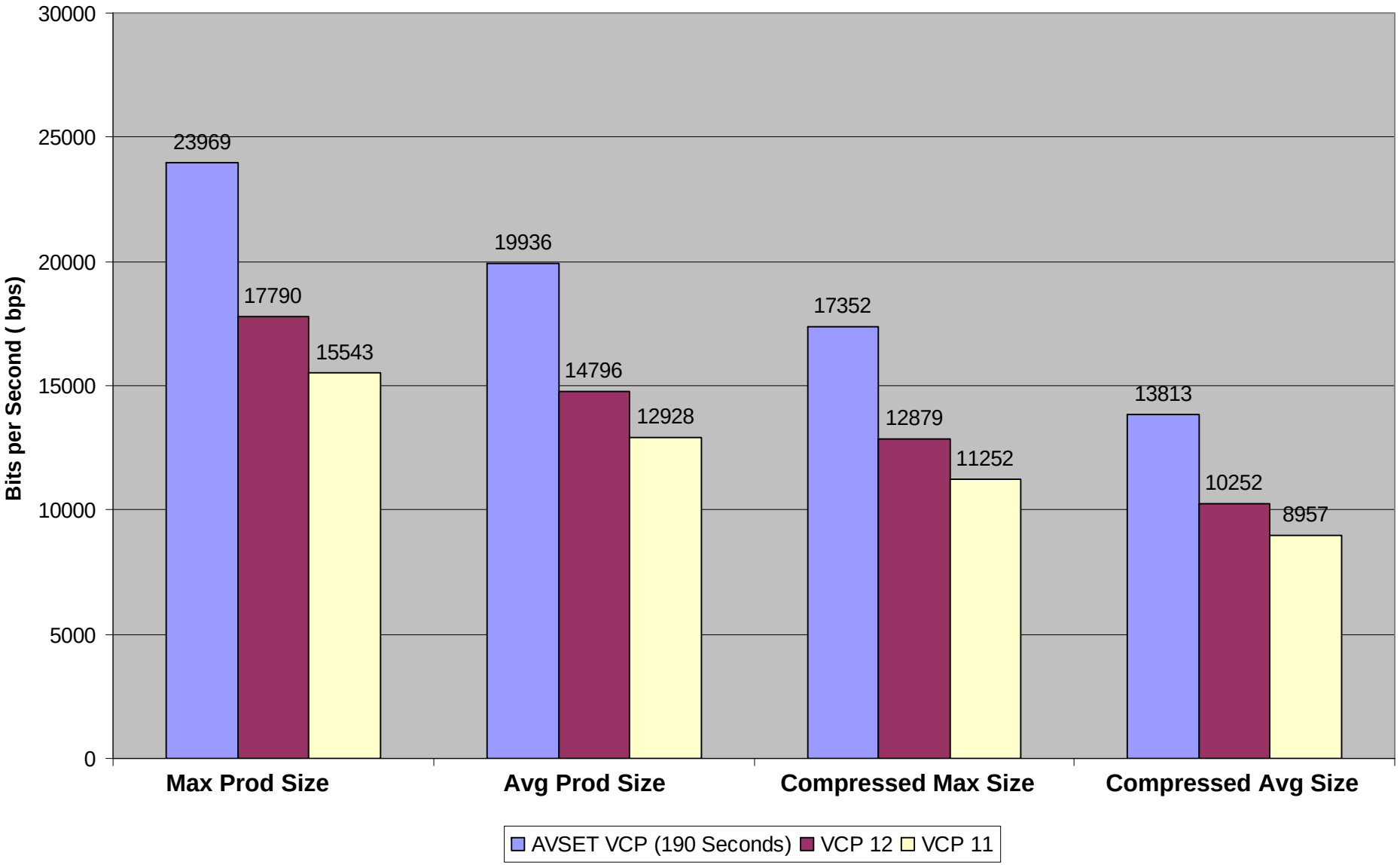
Comms Load Testing

- Performed AVSET communications load test using the 3/2/08 severe convective data set.
- A 1-hour period (22-23Z), which included the tornado touchdown time (22:46Z), was processed to generate the products included on Multicast Product List (acquired from AWIPS).
- The size of each product was recorded using an automated RPG tool. The maximum size and the 1-hour average product size for each individual product type were used in the analysis.

Comms Load with Product Compression

- The same test was performed with RPG product compression applied to the Base Reflectivity, Base Velocity, Base Spectrum Width and Storm Relative Mean Radial Velocity, Composite Reflectivity and Layered Composite Reflectivity products.
- This test was performed to estimate the potential bandwidth savings obtainable by applying product compression.

Standard Product vs. Compressed Product Comm Load Comparison



Comms Load Test Summary

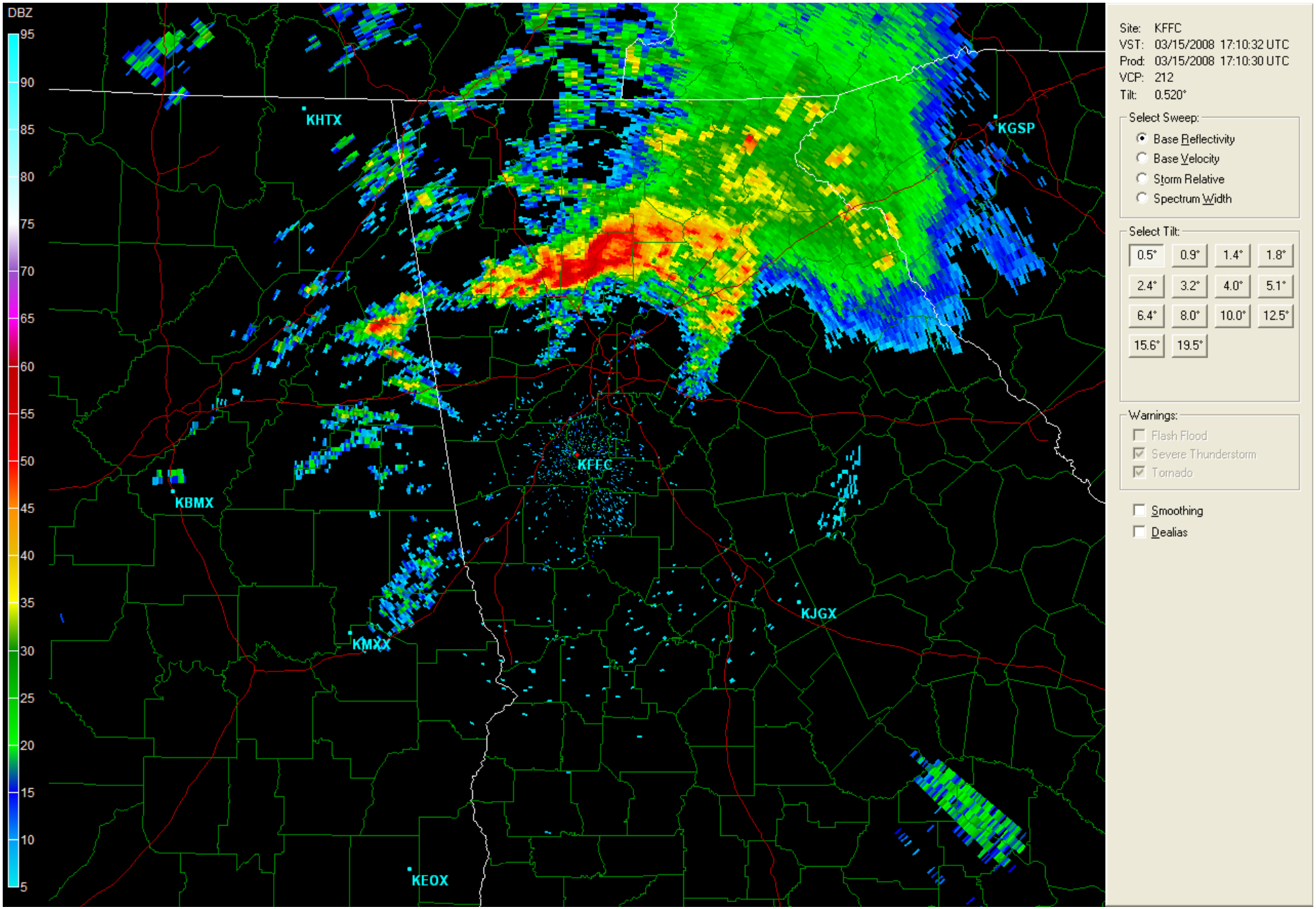
- For this test case, AVSET operation increased the Multicast List communications load by approximately 26% to 24kbps.
- However, when applying product compression to only the listed six product types, the bandwidth required to support the fastest AVSET update was reduced to levels below the current VCP 12 baseline.
- A CCR has been submitted to enable product compression.

AVSET Test Case

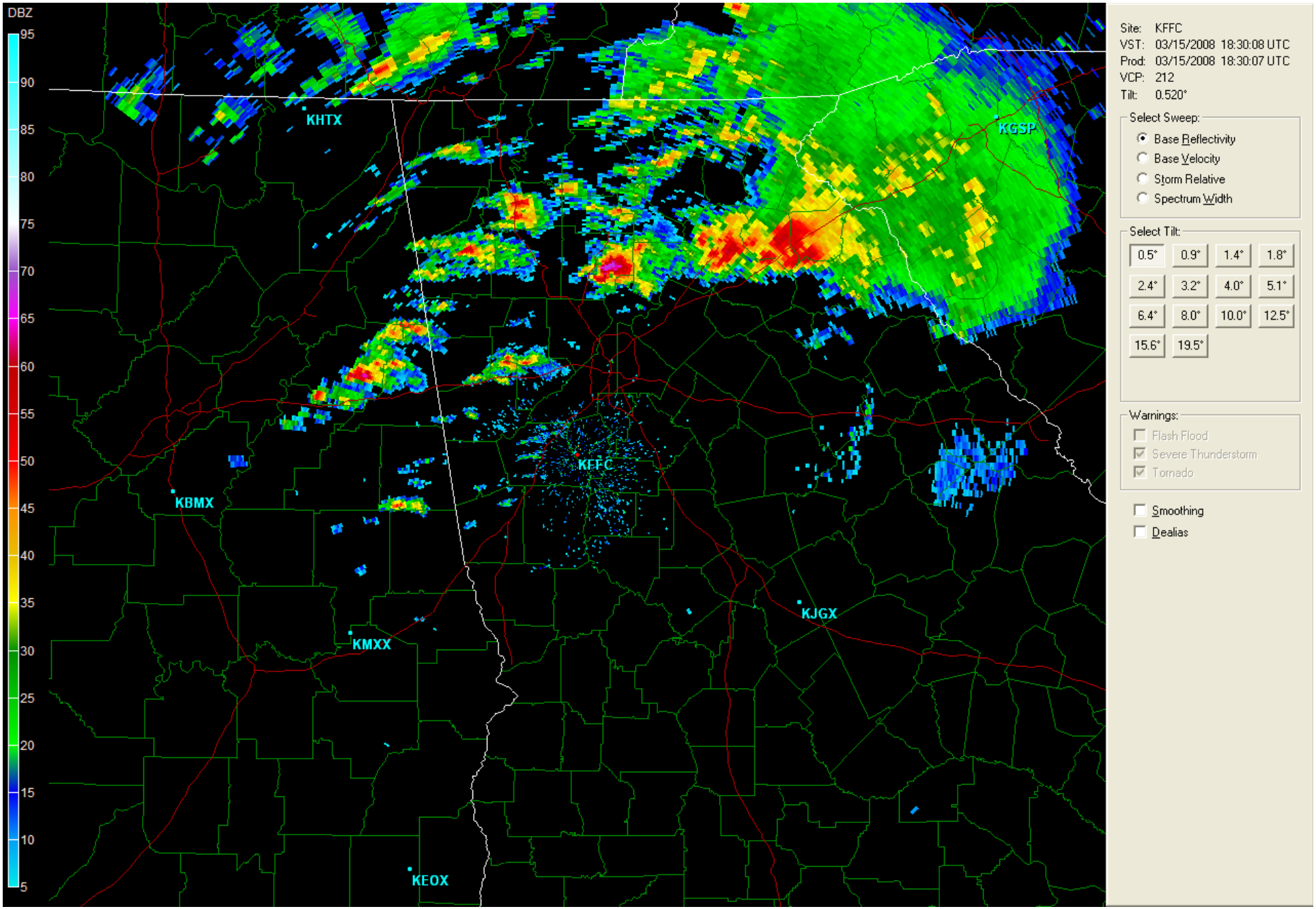
KFCC

Mar 15, 2008

KFCC Reflectivity 0.5 17:10



KFCC Reflectivity 0.5 18:30



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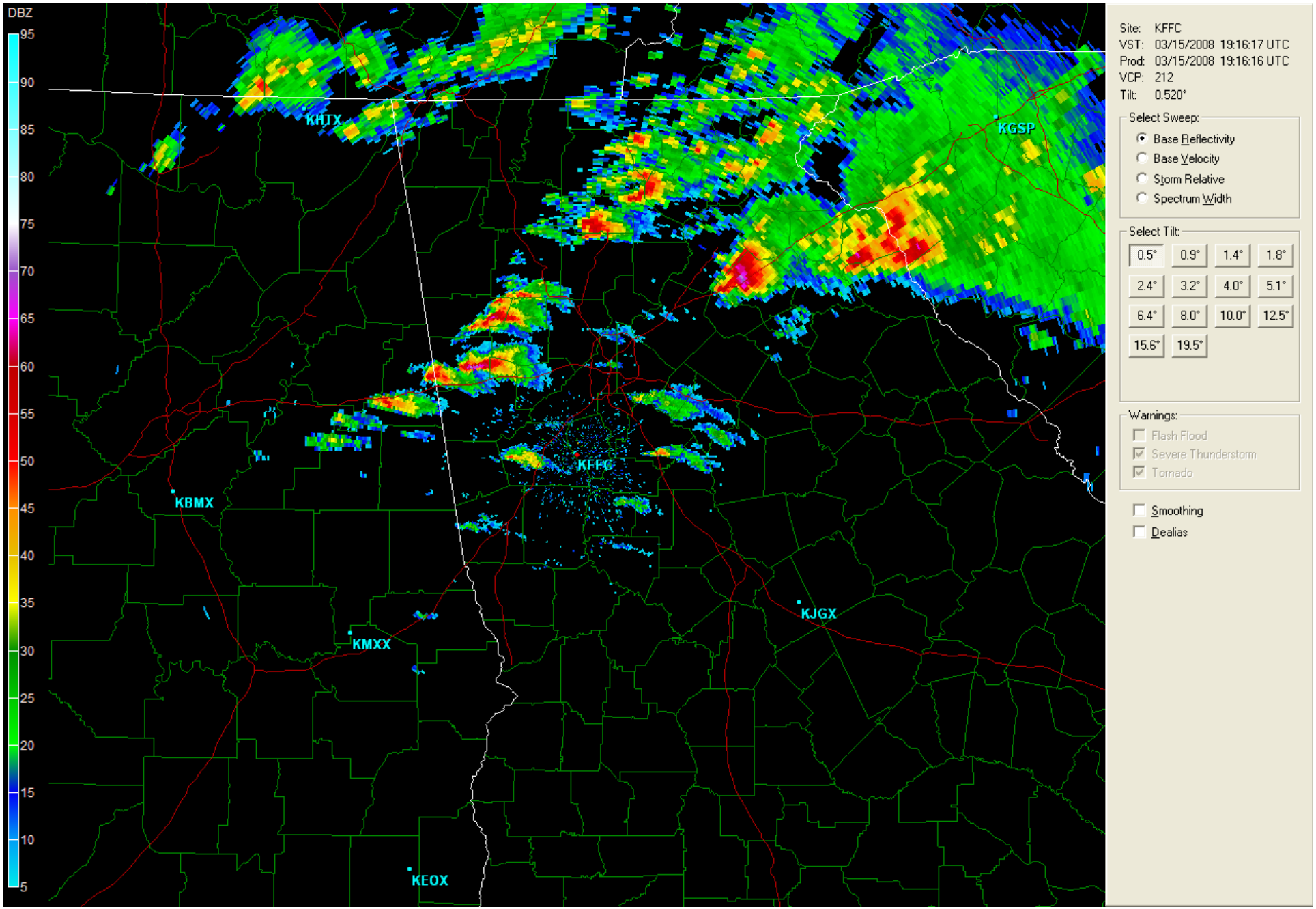

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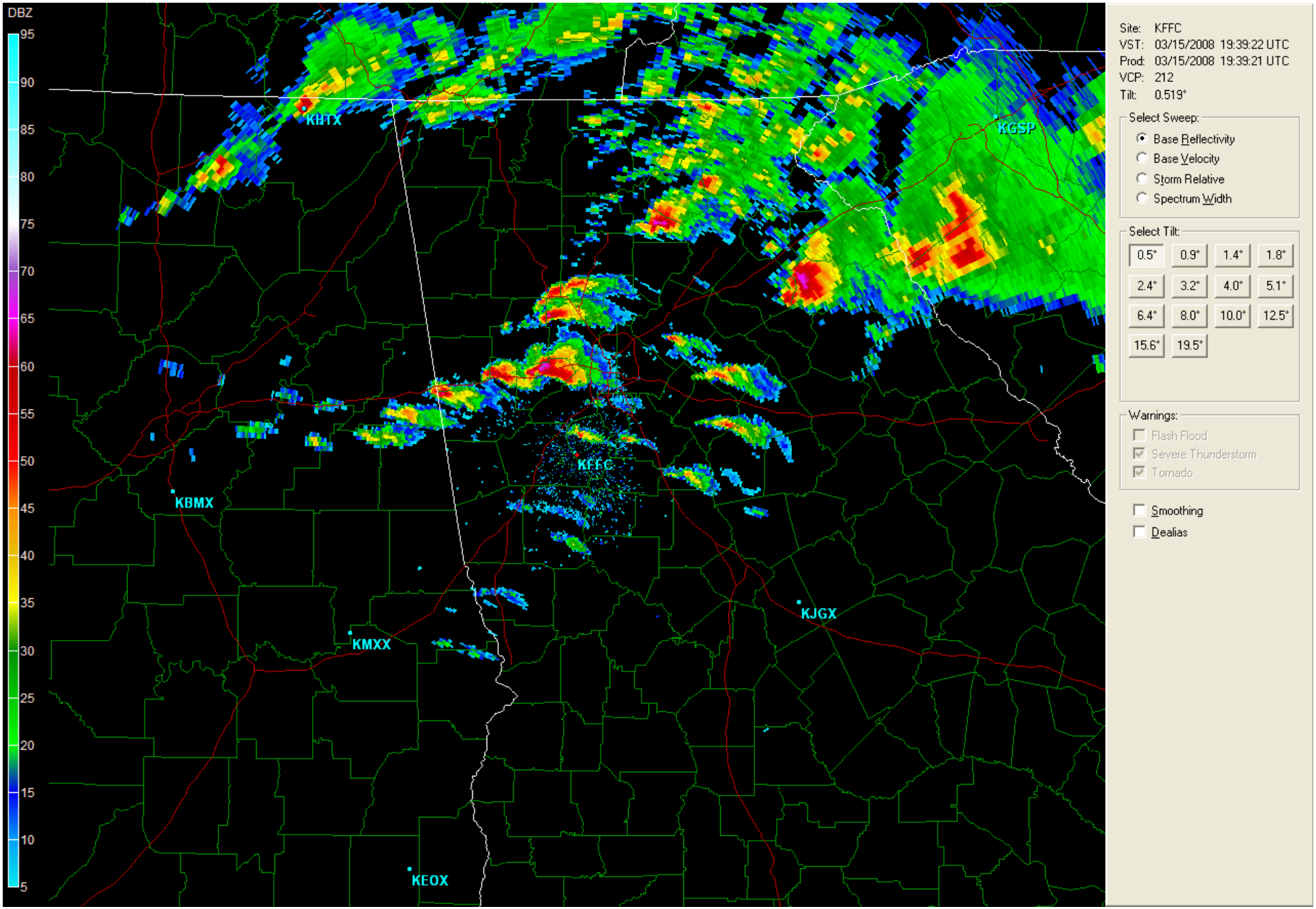
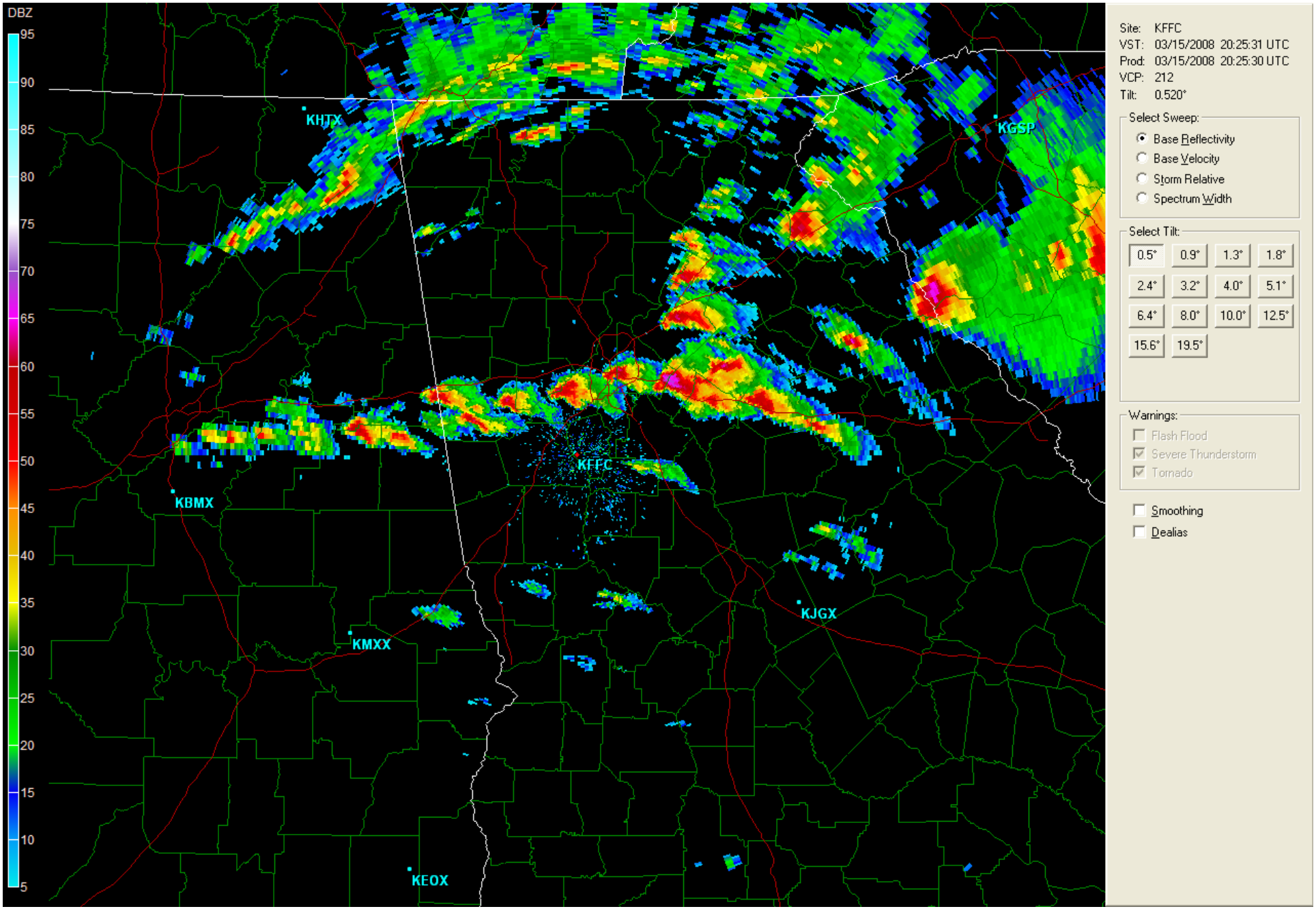
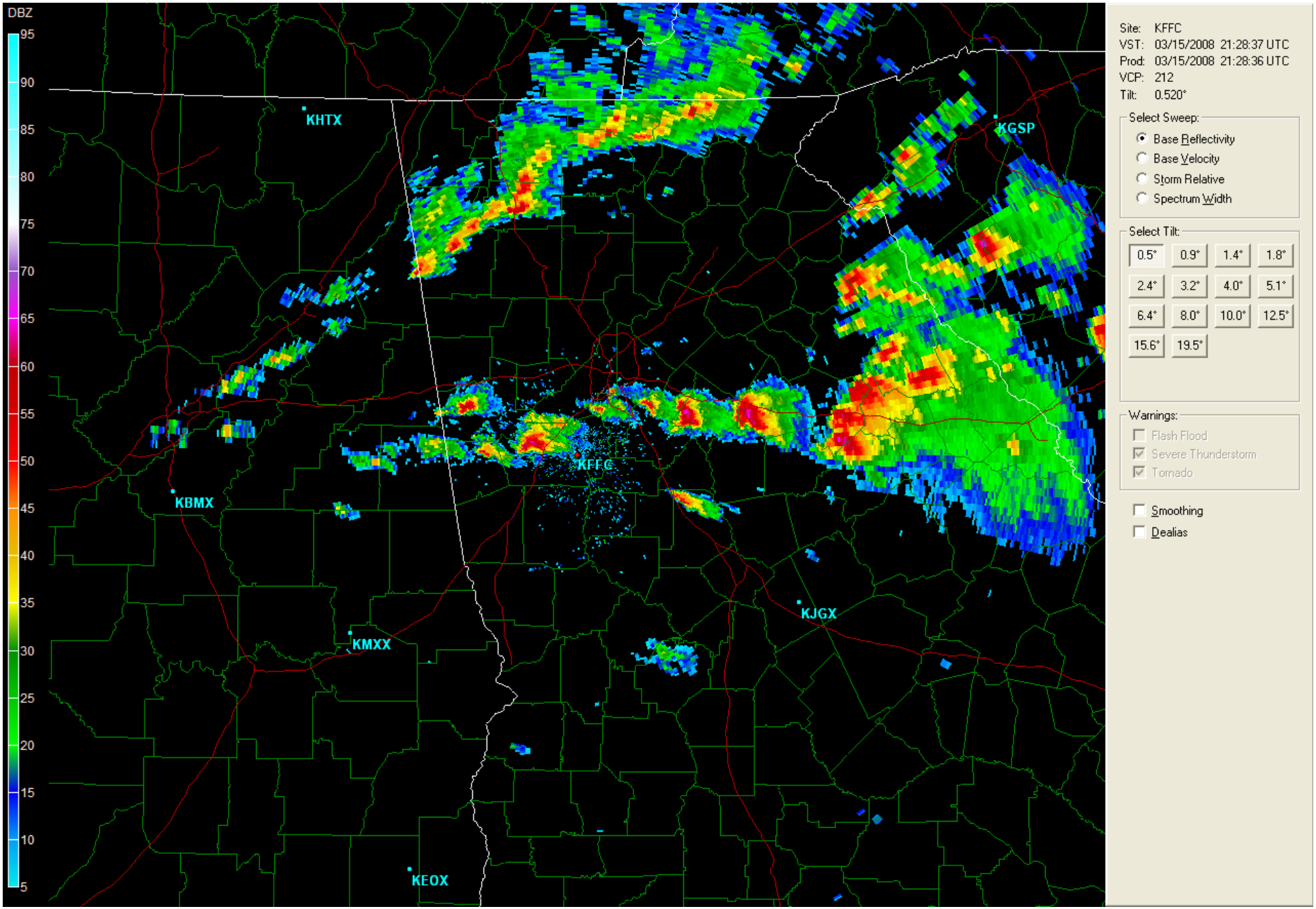


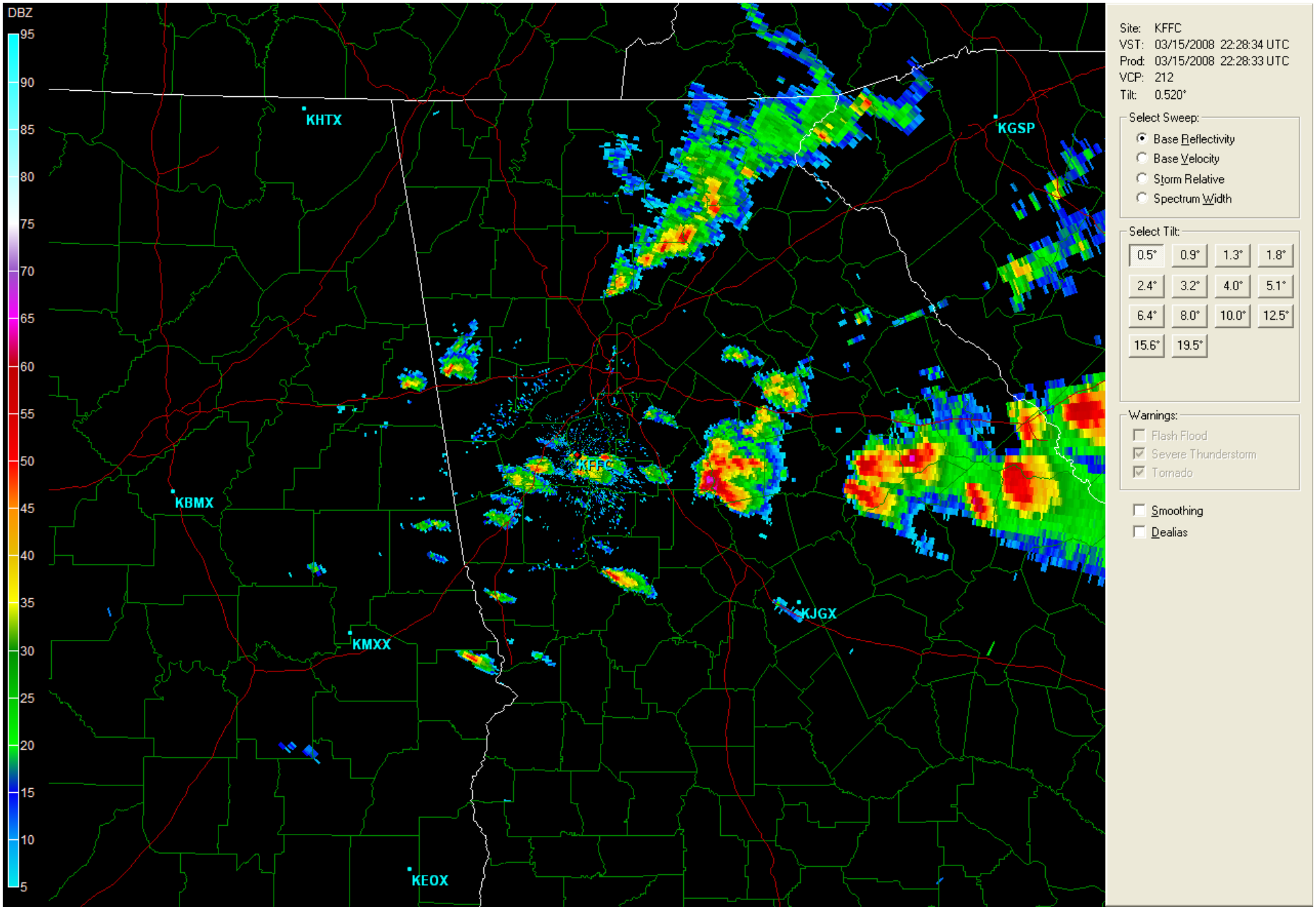
KFCC Reflectivity 0.5 20:25



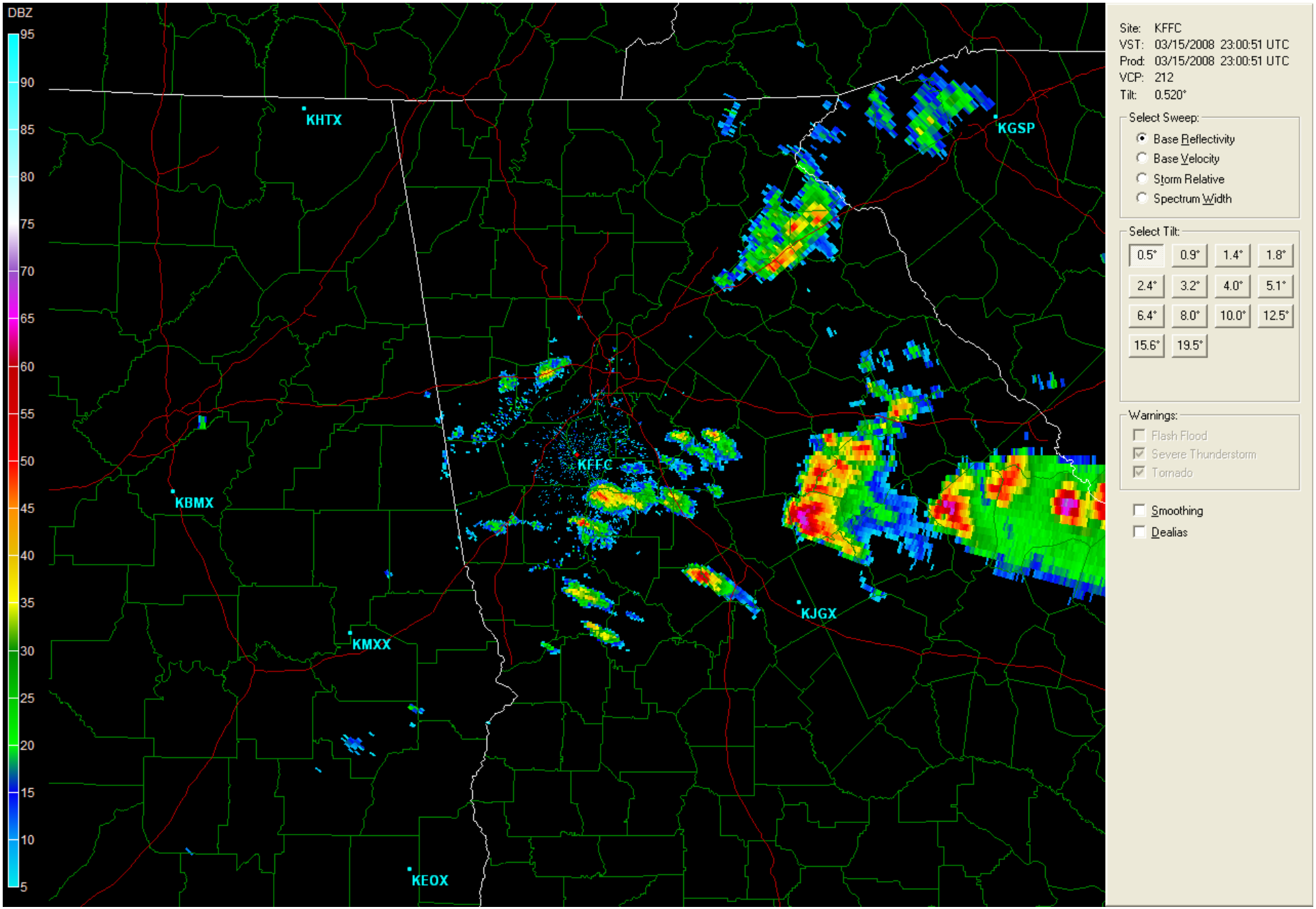
KFCC Reflectivity 0.5 21:28



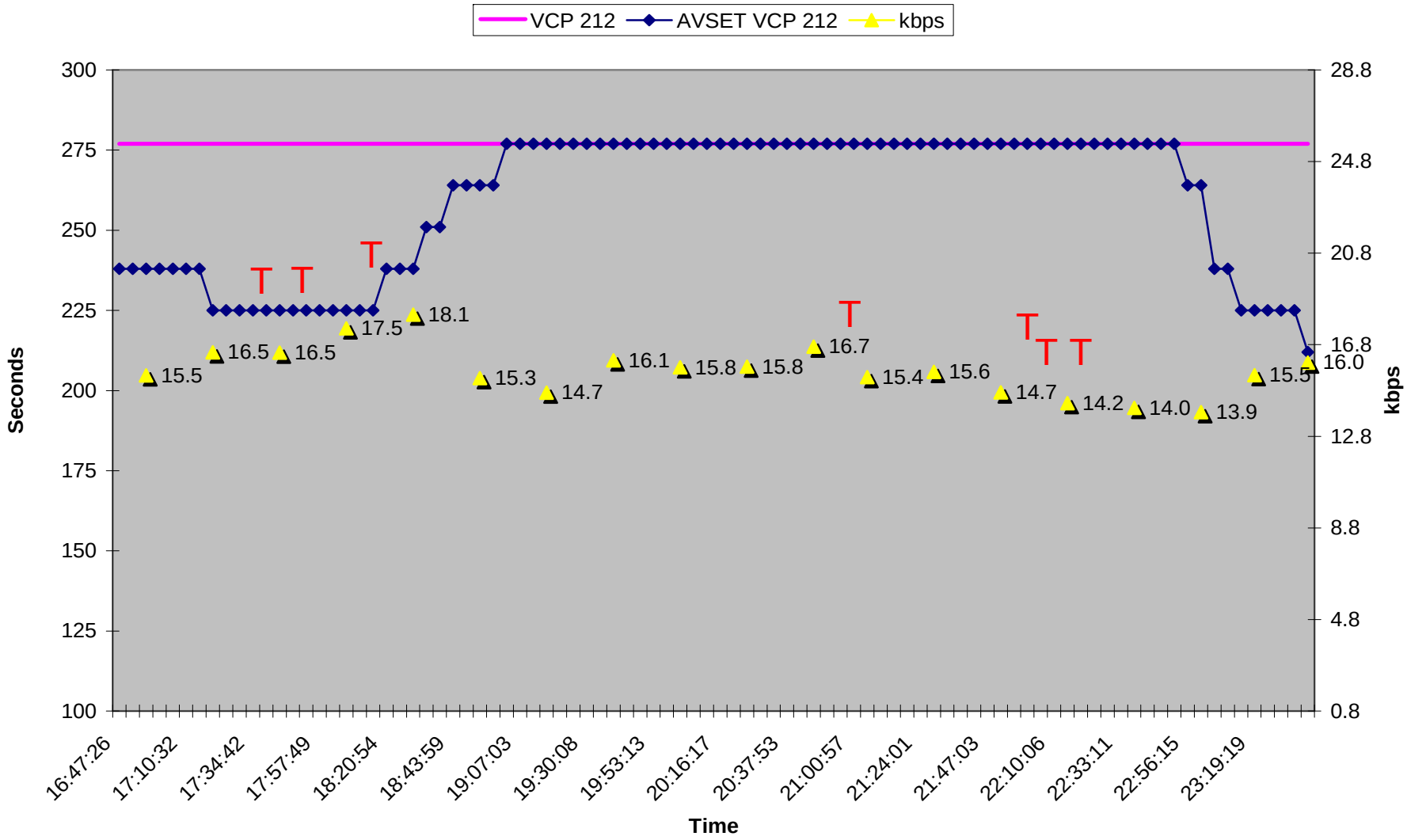
KFCC Reflectivity 0.5 22:28



KFCC Reflectivity 0.5 23:00

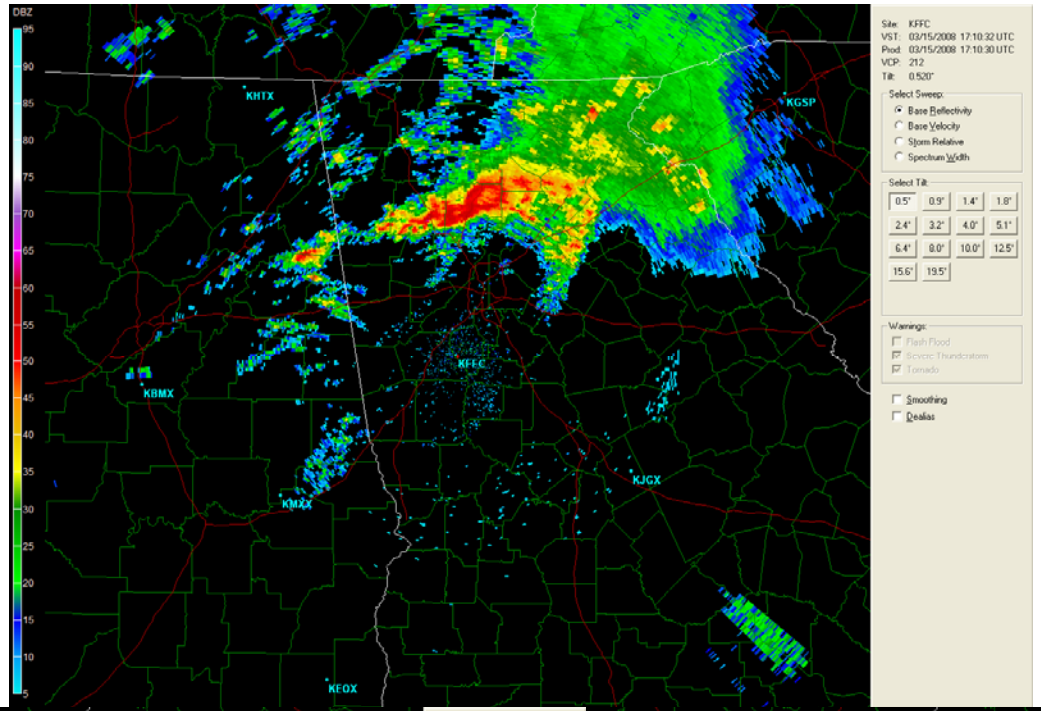


KFCC Mar 15, 2008 VCP Comparison and Multicast Bandwidth Usage



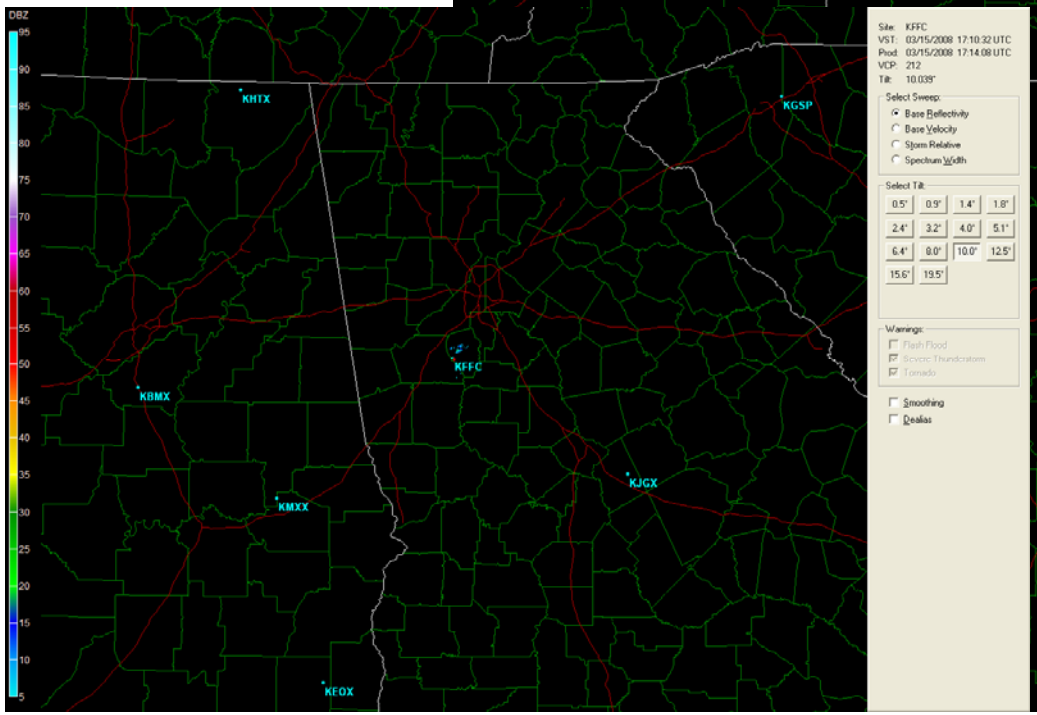
KFCC 17:10

0.5 Deg Ref



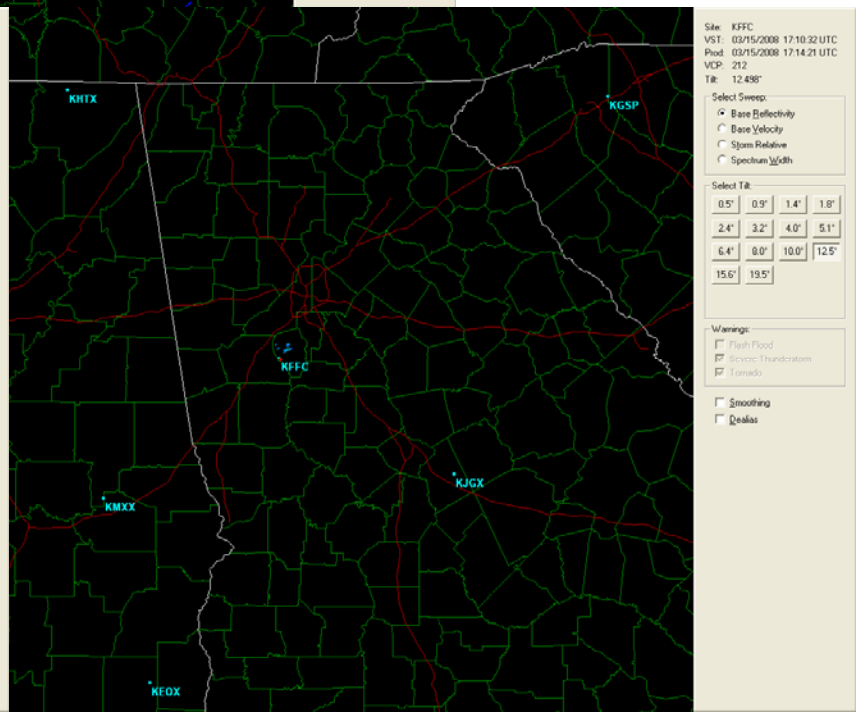
Last AVSET-Processed Elevation

10.0 Deg Ref



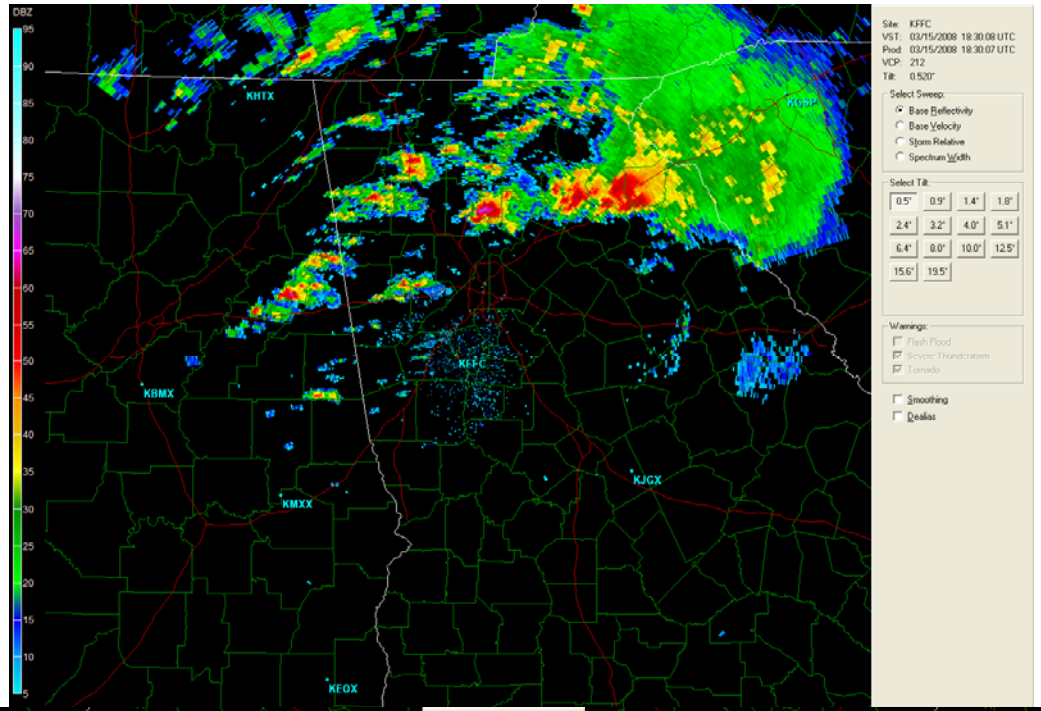
Next Higher Elevation

12.5 Deg Ref



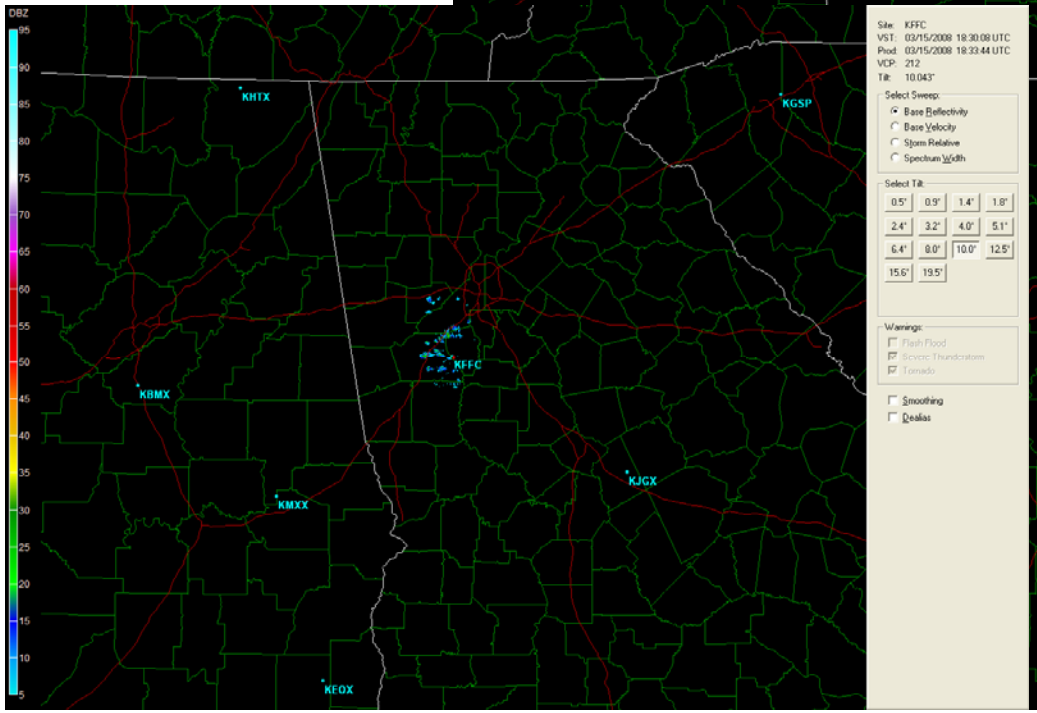
KFCC 18:30

0.5 Deg Ref



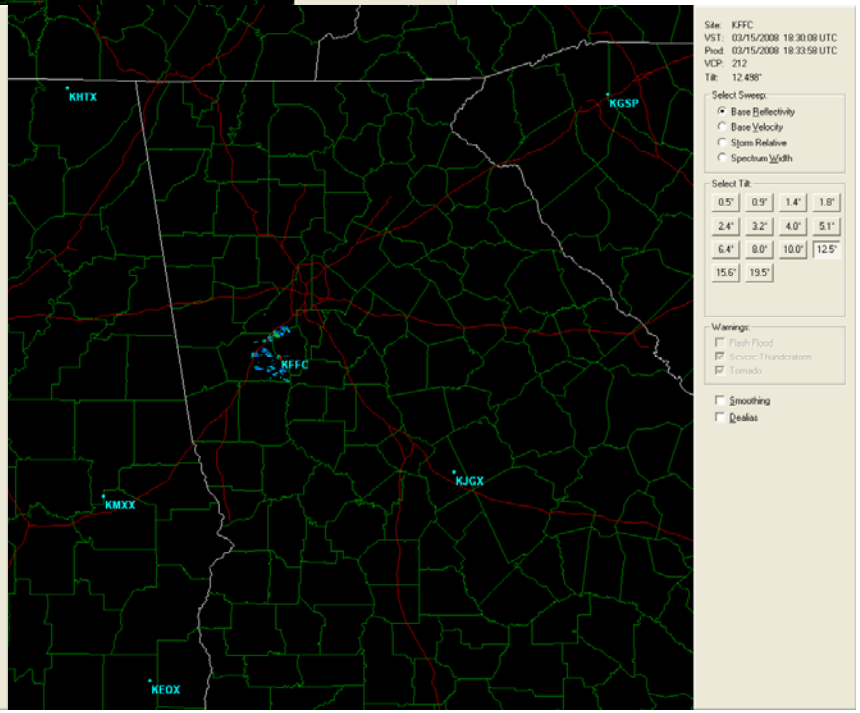
Last AVSET-Processed Elevation

10.0 Deg Ref



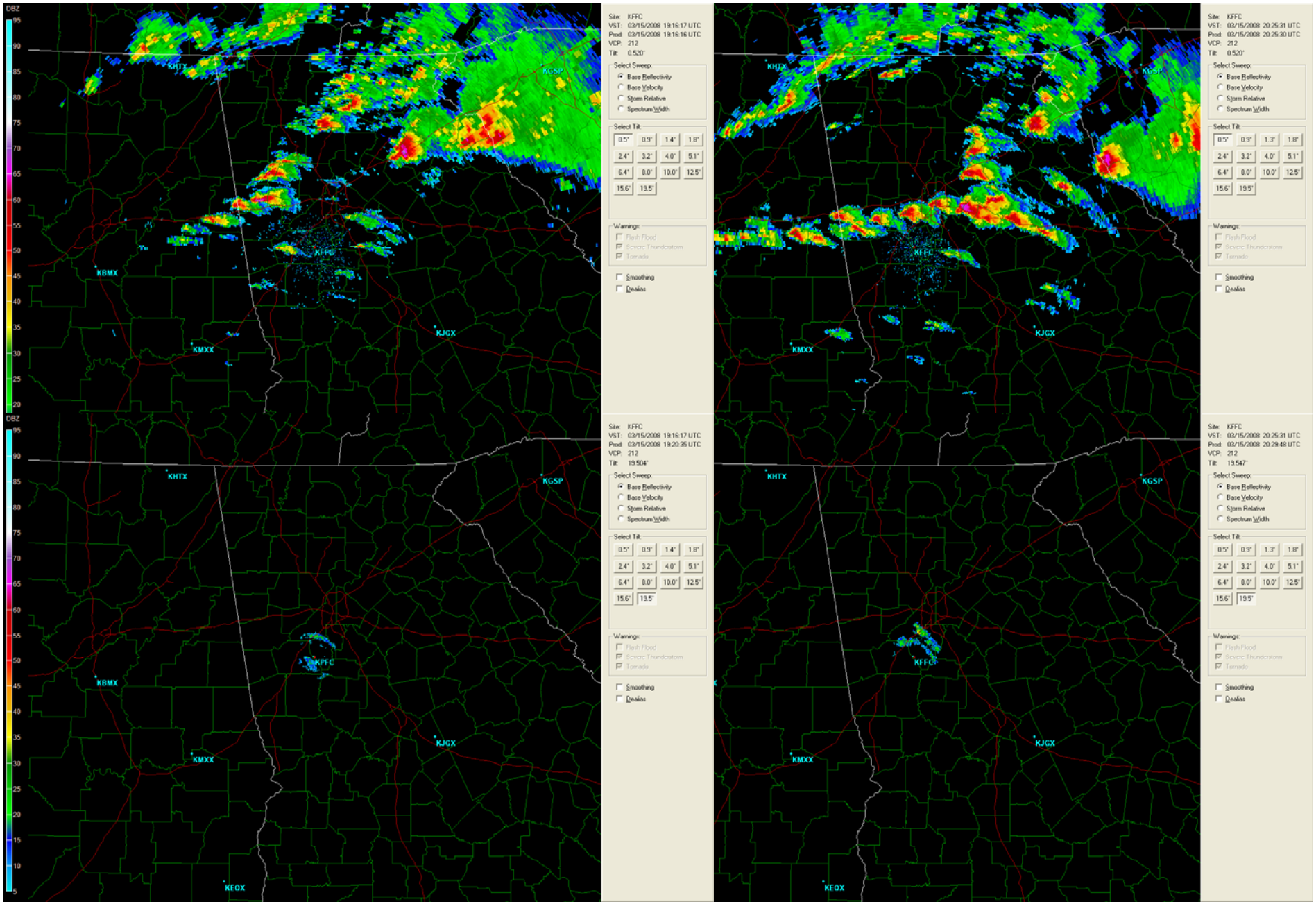
Next Higher Elevation

12.5 Deg Ref



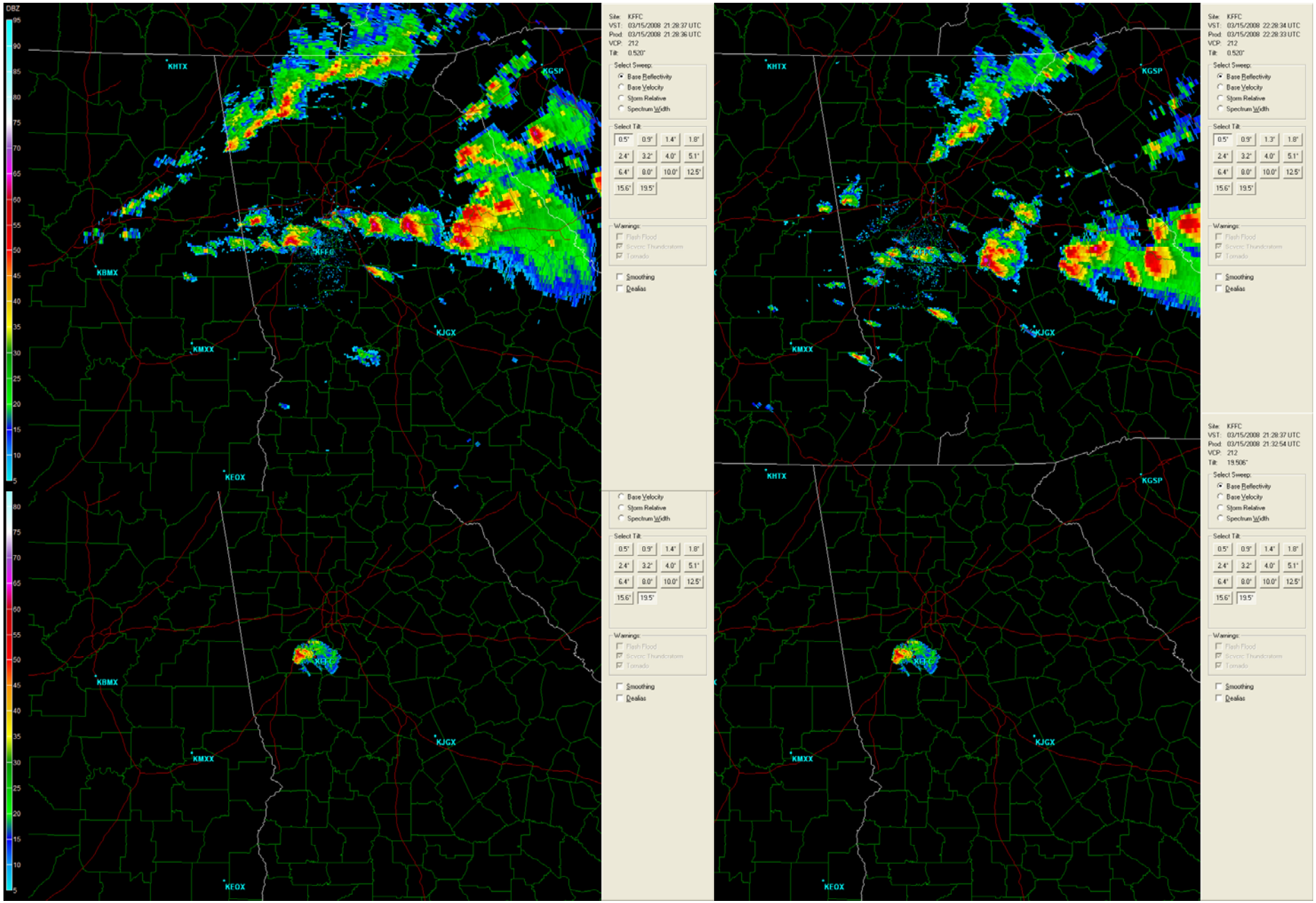
KFCC 19:16

KFCC 20:25



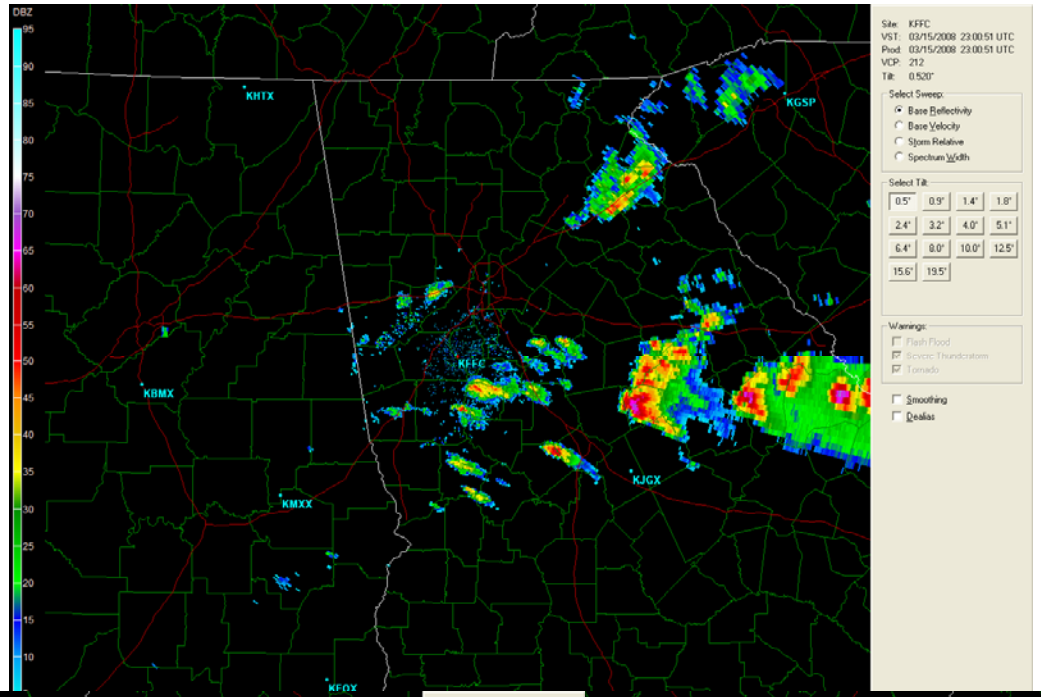
KFCC 21:28

KFCC 22:28



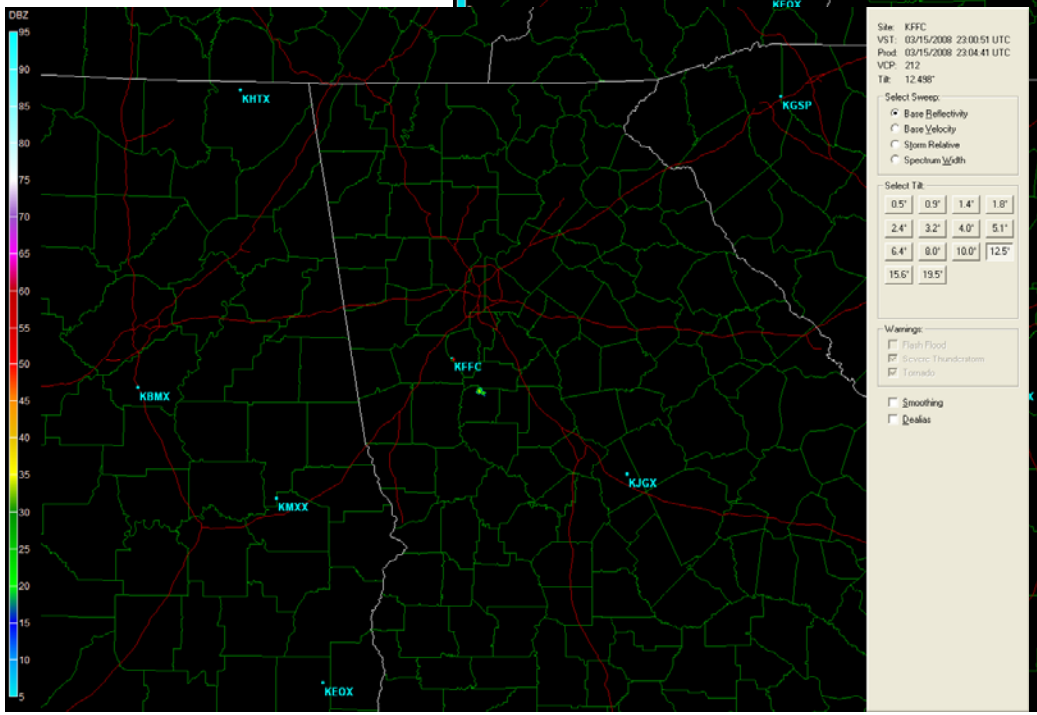
KFCC 23:00

0.5 Deg Ref



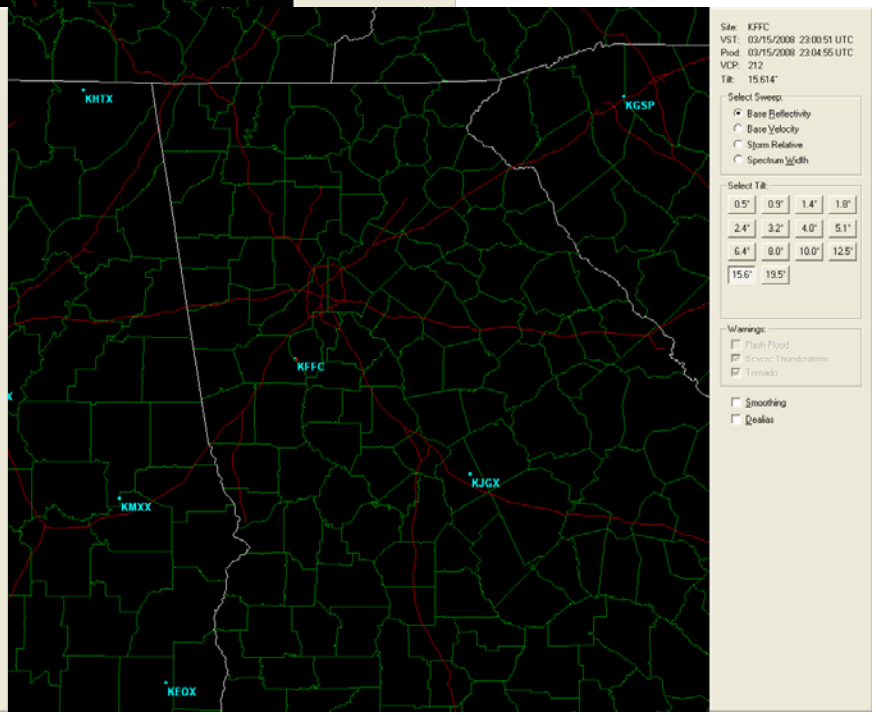
Last AVSET-Processed Elevation

10.0 Deg Ref



Next Higher Elevation

12.5 Deg Ref



Summary

- WSR-88D VCPs were designed to automatically and continuously scan predefined elevation angles.
- This scheme results in each VCP having a particular periodic update cycle that does not change, regardless of the current meteorological conditions.
- The only way to change the update period is to invoke another VCP and accept its elevation scans and periodic update rate.

Summary (cont)

- The AVSET function evaluates the return on each elevation above 5° and terminates the current volume scan after the radar has scanned all elevations with important return.
- AVSET shortens the elapse time between data collection on low elevation angles (and generating volume-based products) during periods when no significant data are available on the higher tilts.
- The AVSET function results in faster volume scan update times without impacting the quality and accuracy of the base data estimates.
- AVSET works with all Precipitation Mode VCPs

Future Plans

- Test and analysis are on-going at ROC
- AVSET is currently under OSIP (Stage 2)
- WSR-88D CCR in review (Disapproved by NWS due to communication impact concerns and desire for more testing)
- SREC briefing seeking CCR approval scheduled for Jun 08.