

Update on
Combined SZ-2/MPDA Volume
Coverage Pattern to Mitigate
Range Folding

Technical Advisory Committee
28 March 2007

Presented by
Dave Zittel, ROC Applications Branch

Topics

- Review combined SZ-2/MPDA technique (VCP 122)
- Review results presented at November 2006 TAC meeting
- Review work to be accomplished by 30 March 2007 (briefed at November TAC meeting)
- Update data cases/analyses
 - Base data examples from three cases
 - KCRI with VCP 122 vs. KTLX operational radar
 - KCRI with VCP 122 vs. KCRI with just SZ-2 data
 - Statistical analyses
 - Mesocyclone Detection Algorithm performance for one case
- Describe field test scheduled for second half of 2007
- Summary/Conclusions

Review of Combined SZ-2/MPDA Technique (Test VCP 122)

- Uses same 9 elevation angles as VCPs 21 and 121
- Uses Multiple PRF Dealiasing Algorithm (MPDA) scan strategy
 - Combines up to three Doppler scans at the same elevation angle using different PRFs (unambiguous ranges 117, 137, & 175 km) to reduce range folding and improve velocity dealiasing
 - 20 cuts total
- Uses SZ-2 processing for the split cuts at 0.5 and 1.45 degrees
- Takes about 16 more seconds to complete than VCP 121 (~345 seconds)

Preliminary Conclusions

(November 2006 TAC Briefing)

- VCP 122 outperforms either MPDA VCP 121 or SZ-2 VCPs 211, 212, and 221 in reducing range folding
 - Less than half residual range folding left in by SZ-2 VCPs
 - Back-to-back single volume scan comparisons 9 October 2006
 - A 12-volume average from 15 October 2006
- May be able to omit one Doppler scan from MPDA VCP 121 at 0.5 and 1.45 degrees
 - Would cut 26+ seconds from volume scan time
- ORDA data quality team recommends modifying VCP 121 to meet Build 10 Design & Development deadline

Work to be Accomplished by 30 March 2007

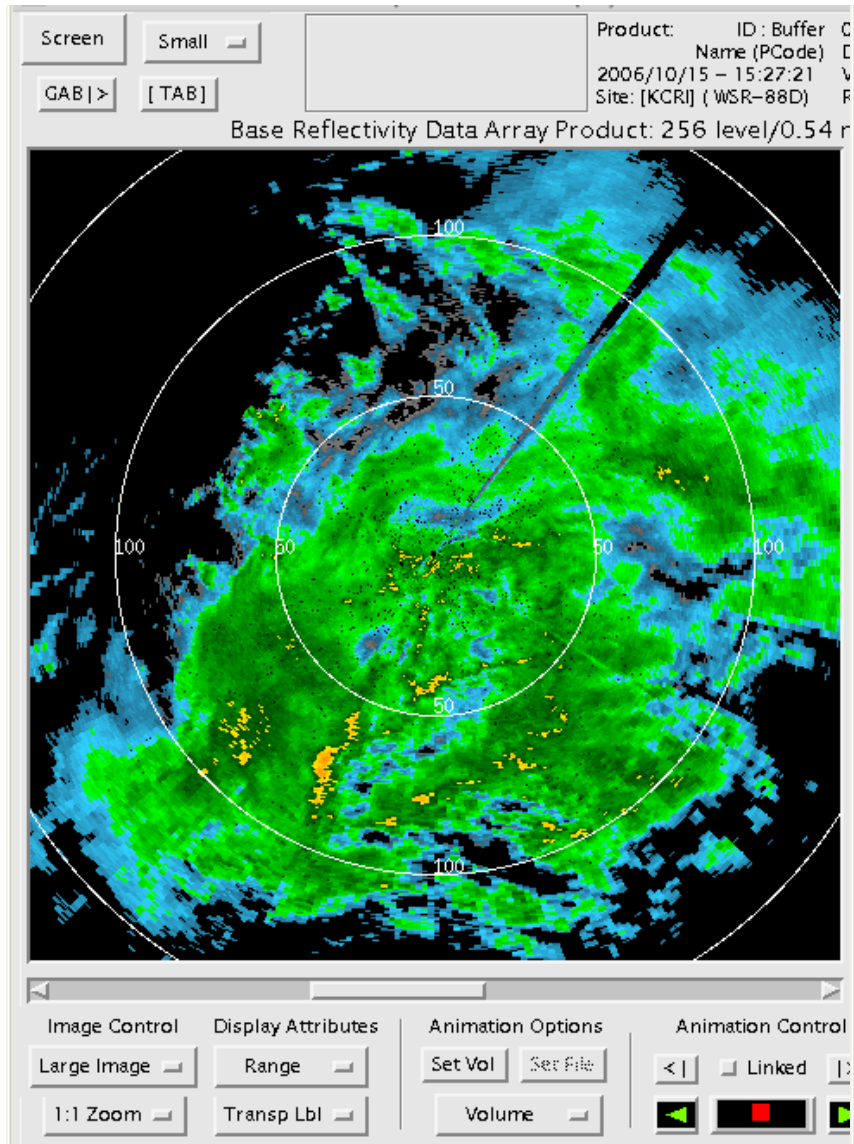
- Submit configuration change request - **Done**
- Collect more data sets ~10-12 cases, 3-4 hours per case
 - **2 new cases collected**
 - **Conduct field test to acquire more data sets**
- Evaluate two vs. three Doppler scans
 - If two is selected, coordinate with other users if needed
 - **Postpone decision until tropical cyclone data acquired**
 - **Make change in Build 11?**
- Complete statistical analyses on the cases
 - **Completed analyses on three cases (~21 hours)**
- Update TAC if requested to
 - **Done**
 - **Evaluate Mesocyclone Detection Algorithm**

Update on Data Cases/Analyses

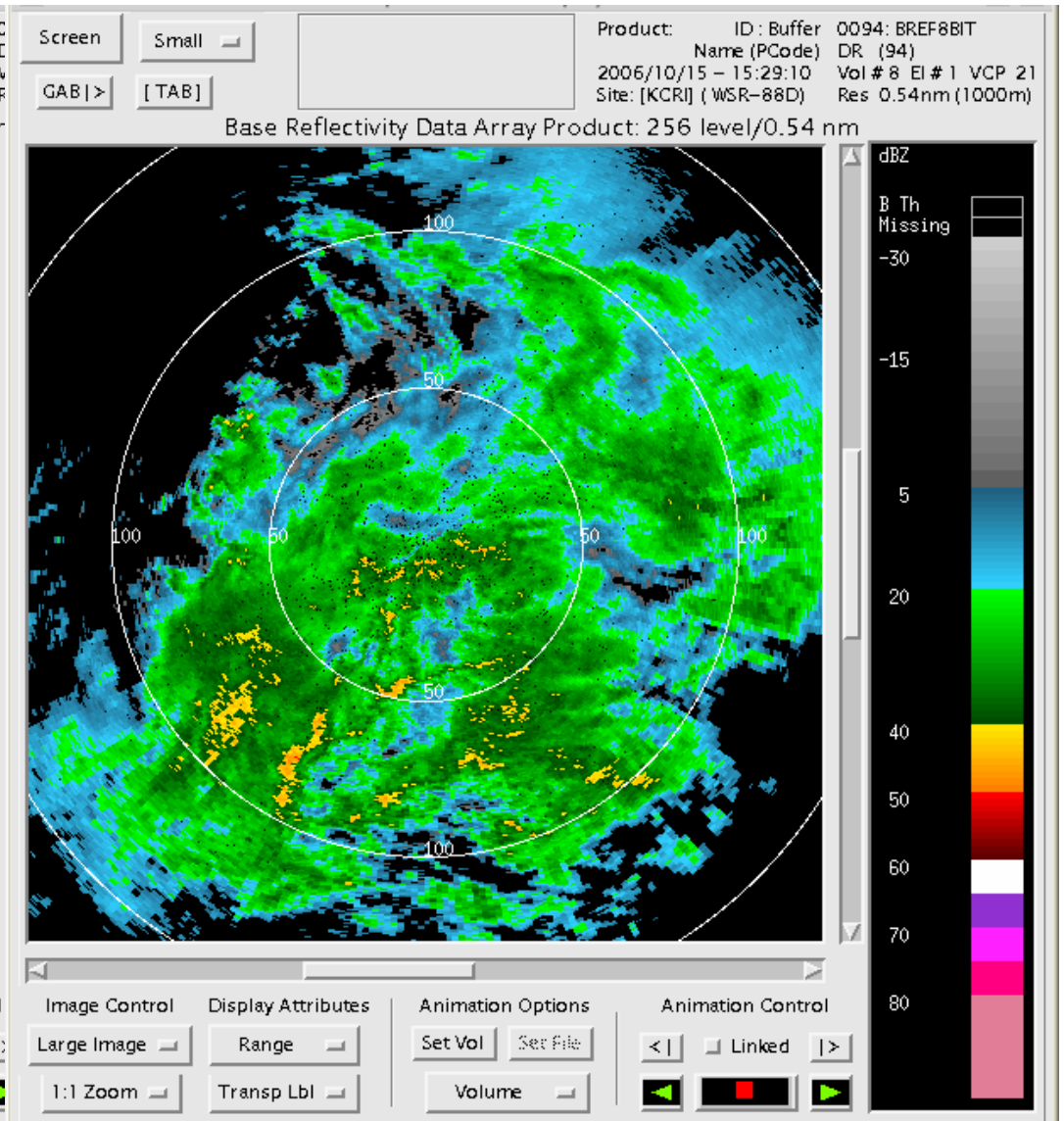
- 9-10 October 2006 (Not analyzed – weak case)
 - ~24 hours
 - Widespread rain across central Oklahoma
- 15-16 October 2006
 - ~28 hours (5 hours analyzed)
 - Widespread heavy rain south and central Oklahoma 15-16 October 2006
- 5-6 November 2006
 - ~24 hours (8 hours analyzed)
 - Hail storms west central and southern Oklahoma
 - Numerous mesocyclones detected by MDA
- 29-30 December 2006
 - ~48 hours (8 hours analyzed)
 - Widespread heavy rain/winter mix

Reflectivity, 15 October 2006, ~15:30Z, 0.5 Deg. Elev.

KCRI VCP122



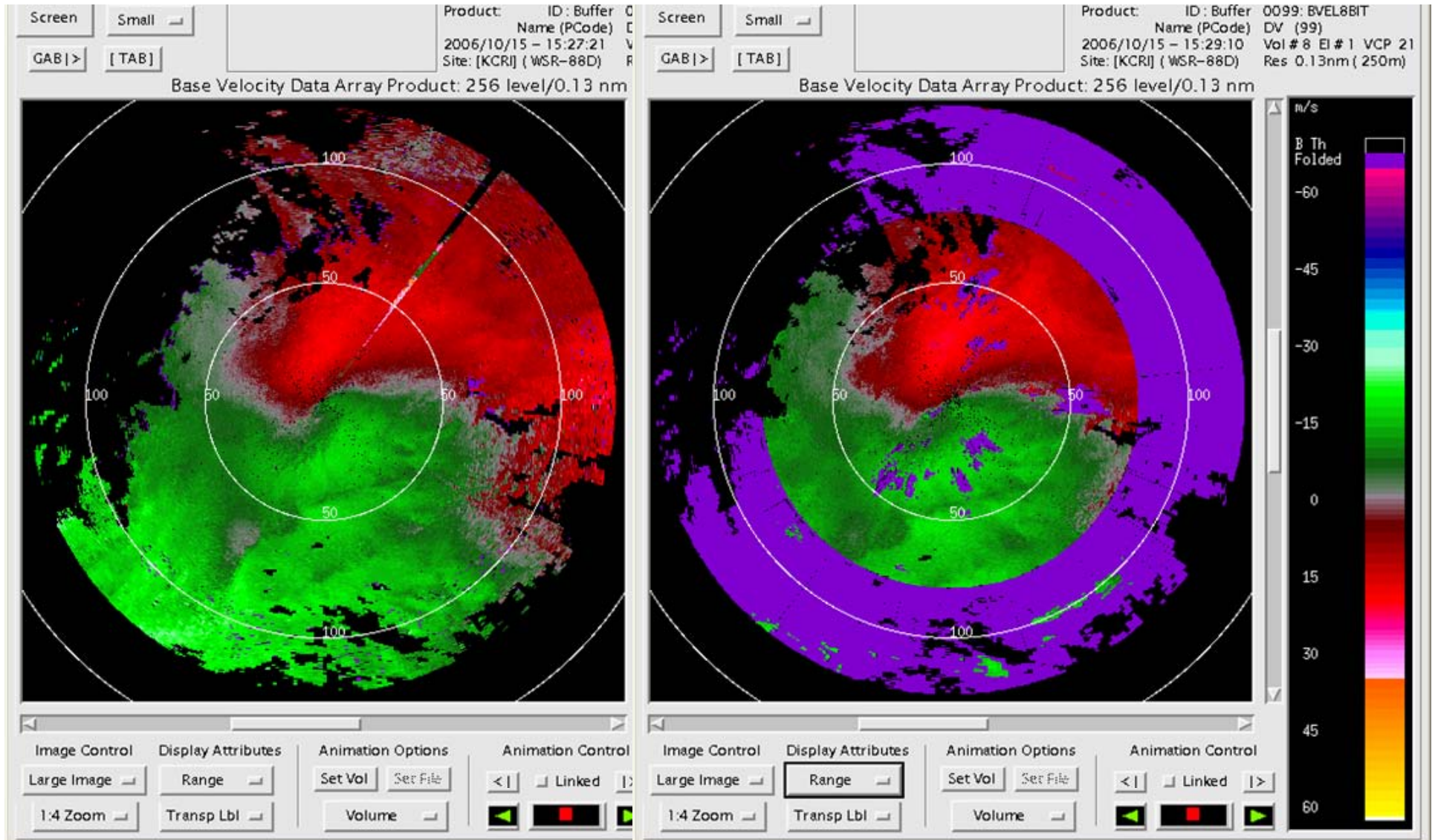
KTLX VCP21



Velocity, 15 October 2006, ~15:30Z, 0.5 Deg. Elev.

KCRI VCP122

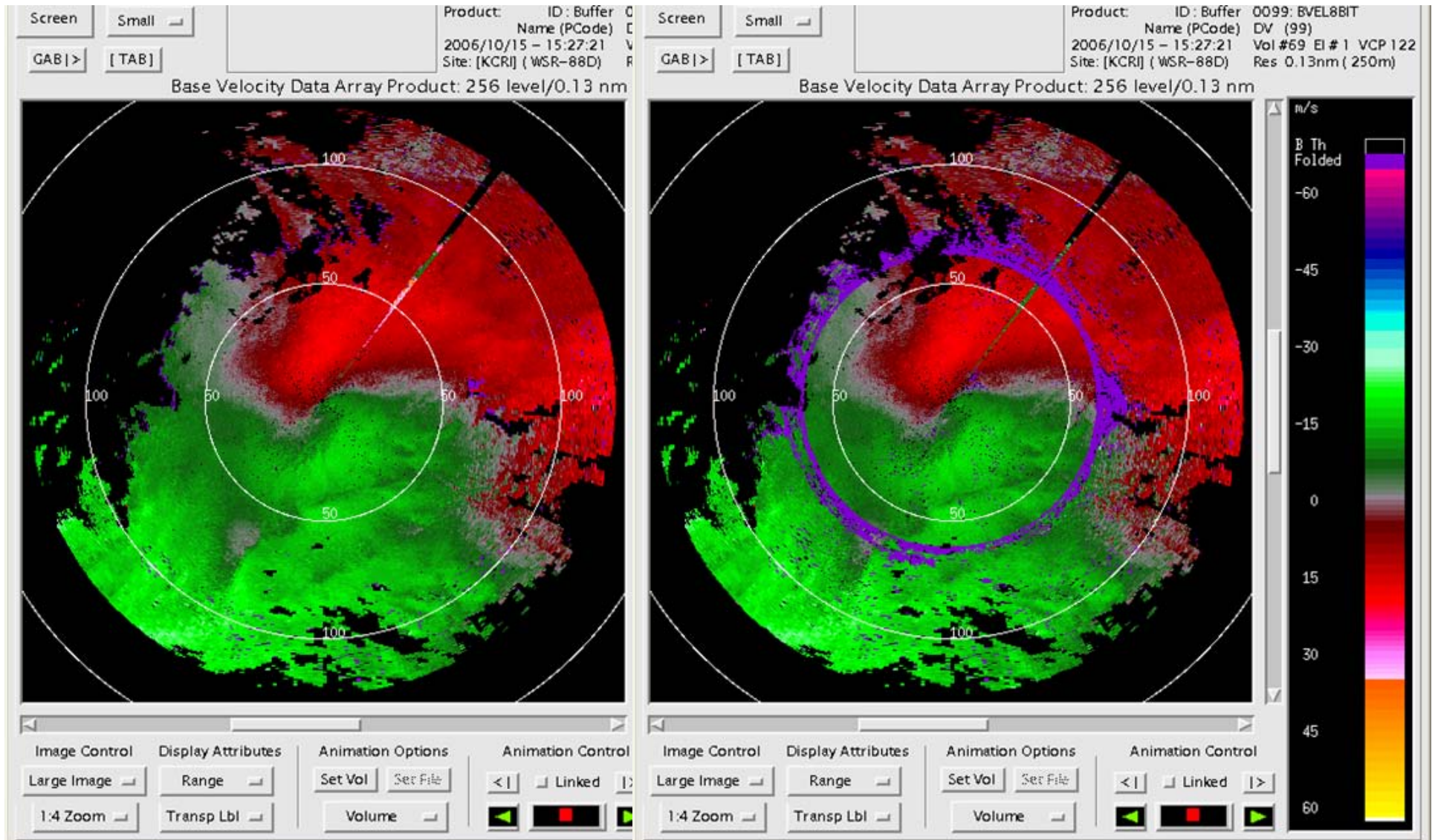
KTLX VCP21



Velocity, 15 October 2006, 15:27Z, 0.5 Deg. Elev.

KCRI VCP122

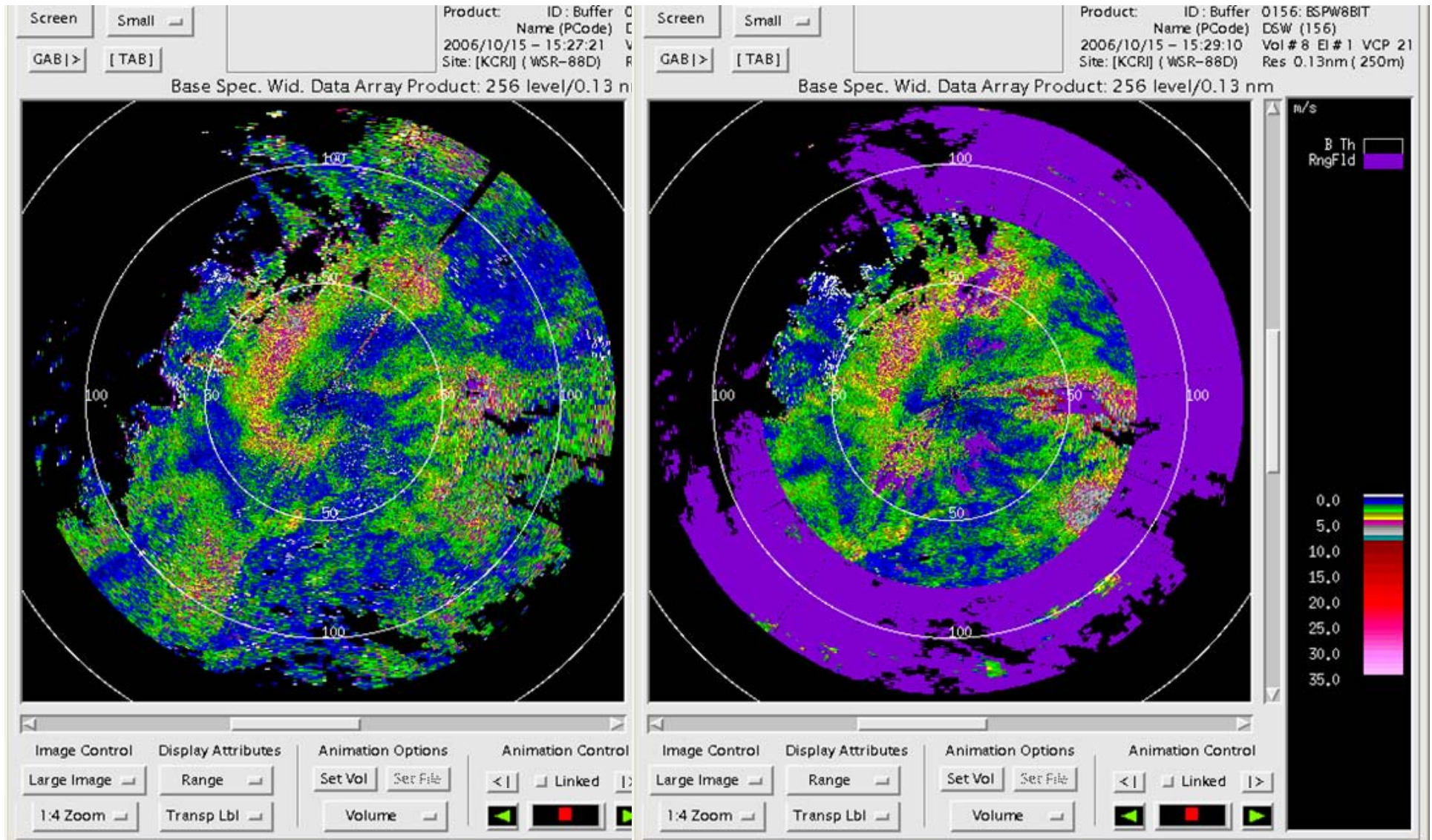
KCRI SZ-2



Spectrum Width, 15 October 2006, ~15:30Z, 0.5 Deg. Elev.

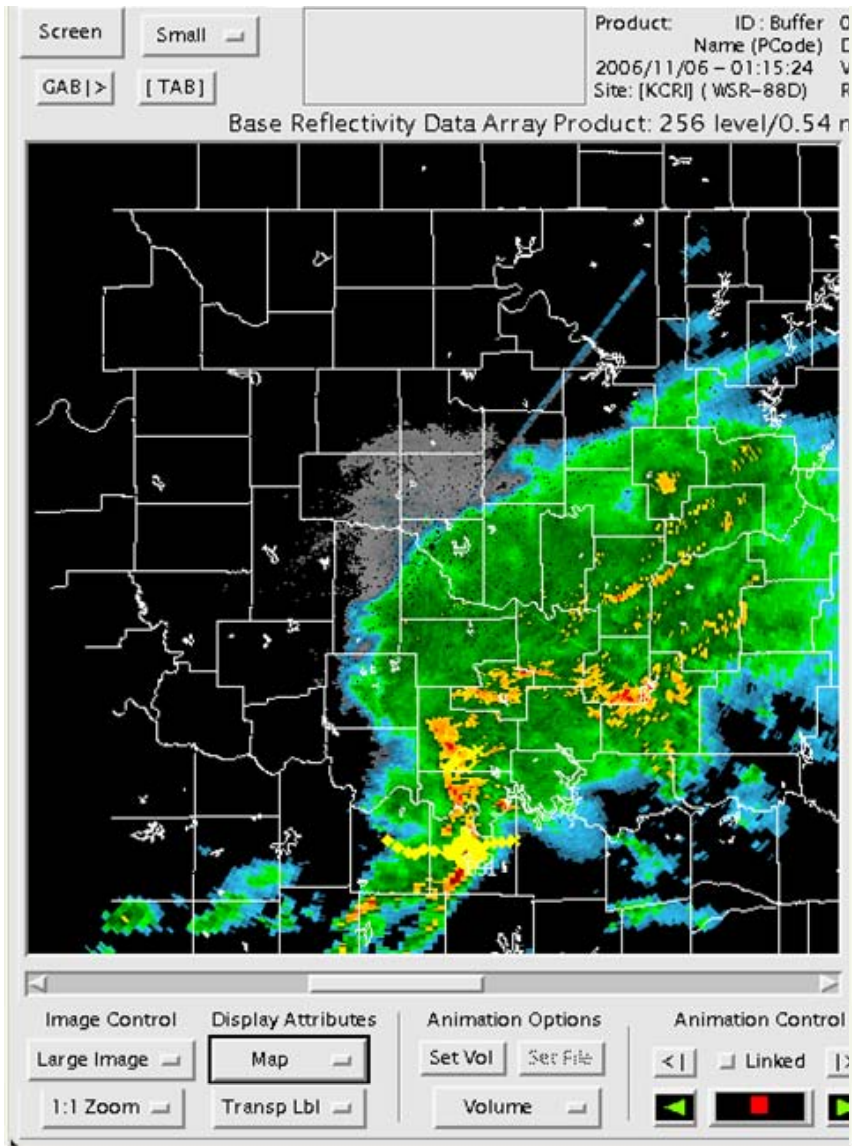
KCRI VCP122

KTLX VCP21



Reflectivity, 6 November 2006, 01:16Z, 0.5 Deg. Elev.

KCRI VCP122

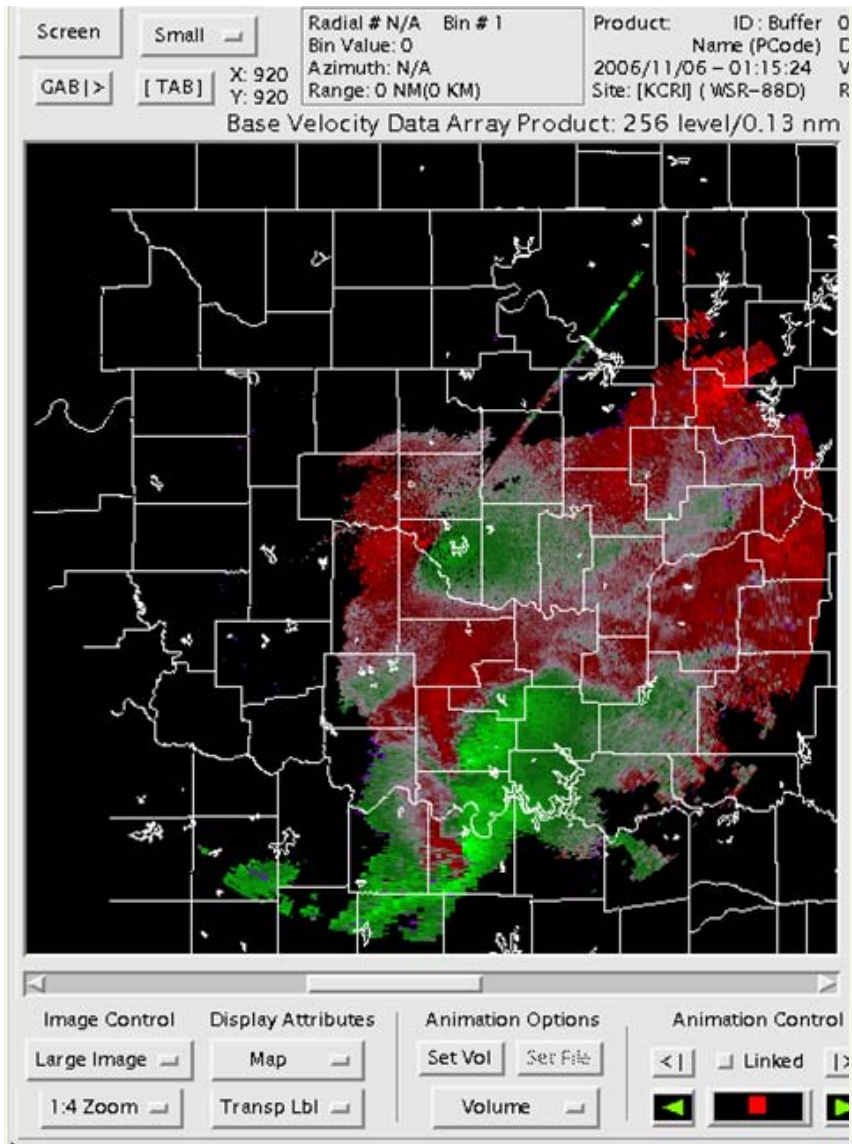


KTLX VCP 12

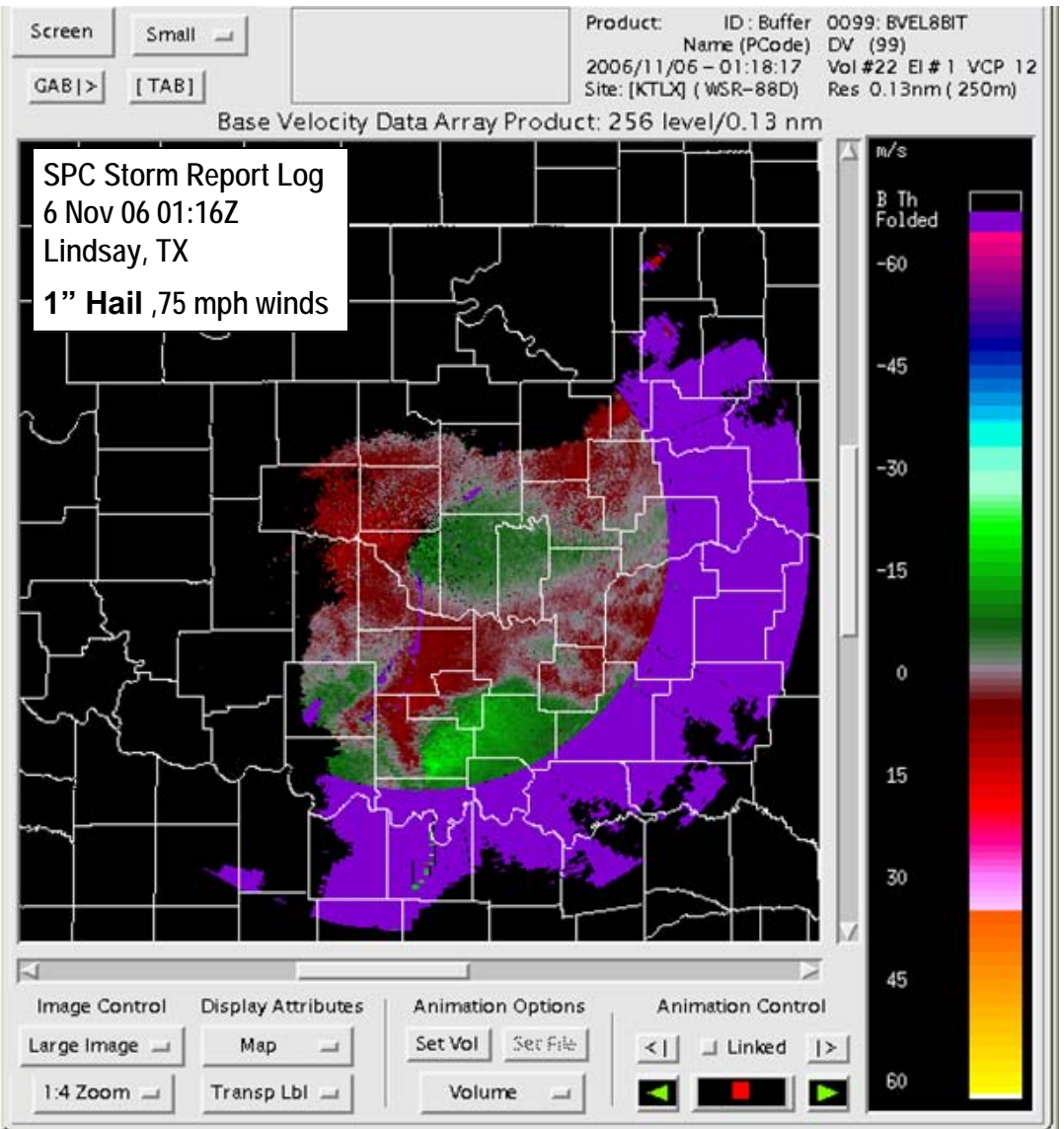


Velocity, 6 November 2006, 01:16Z, 0.5 Deg. Elev.

KCRI VCP122

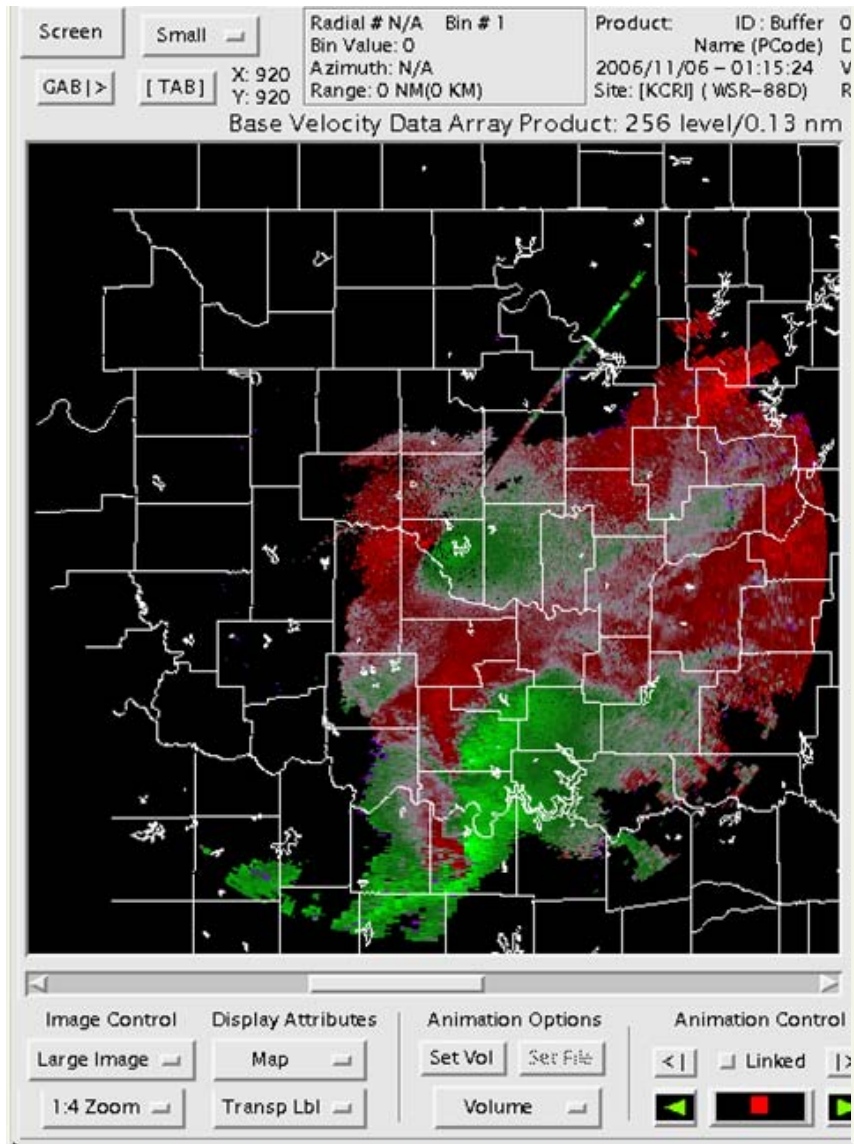


KTLX VCP 12

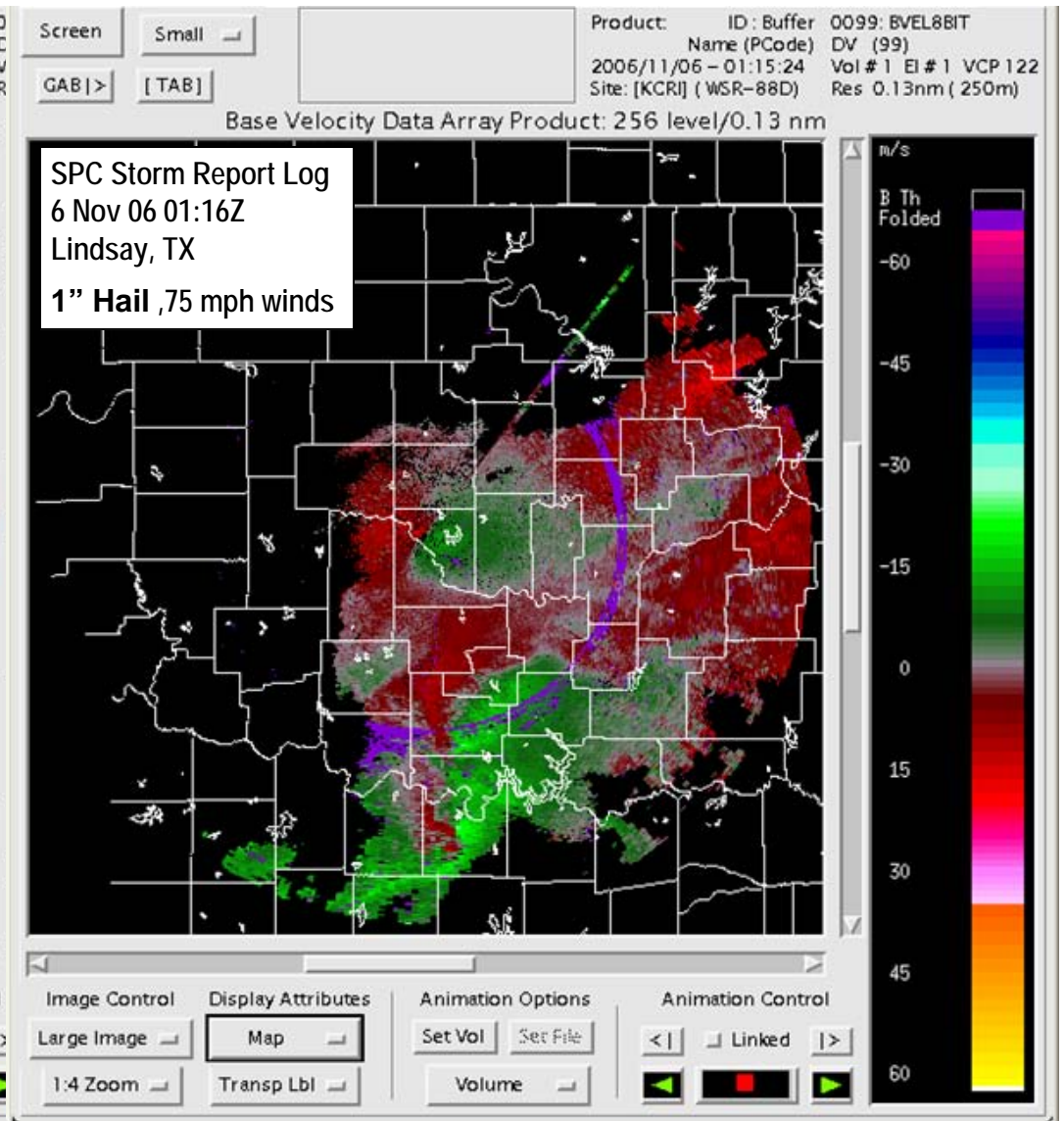


Velocity, 6 November 2006, 01:16Z, 0.5 Deg. Elev.

KCRI VCP122

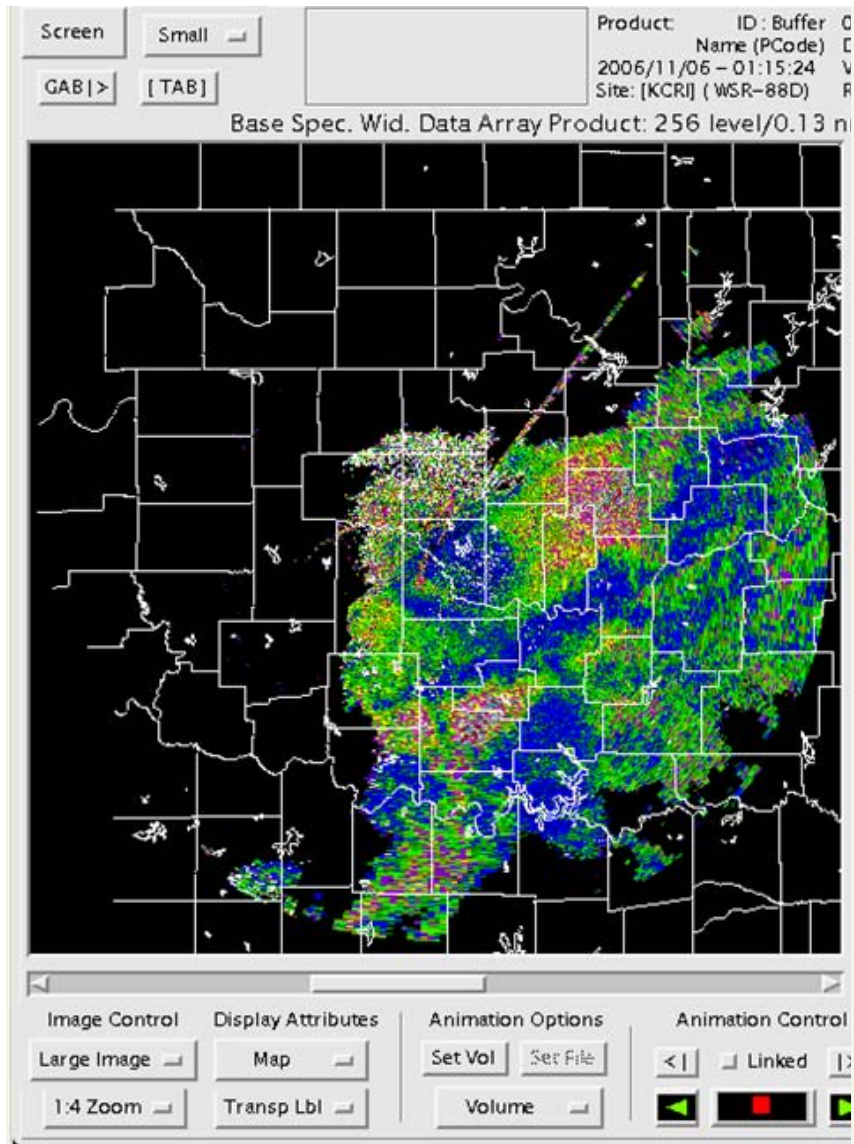


KCRI SZ-2

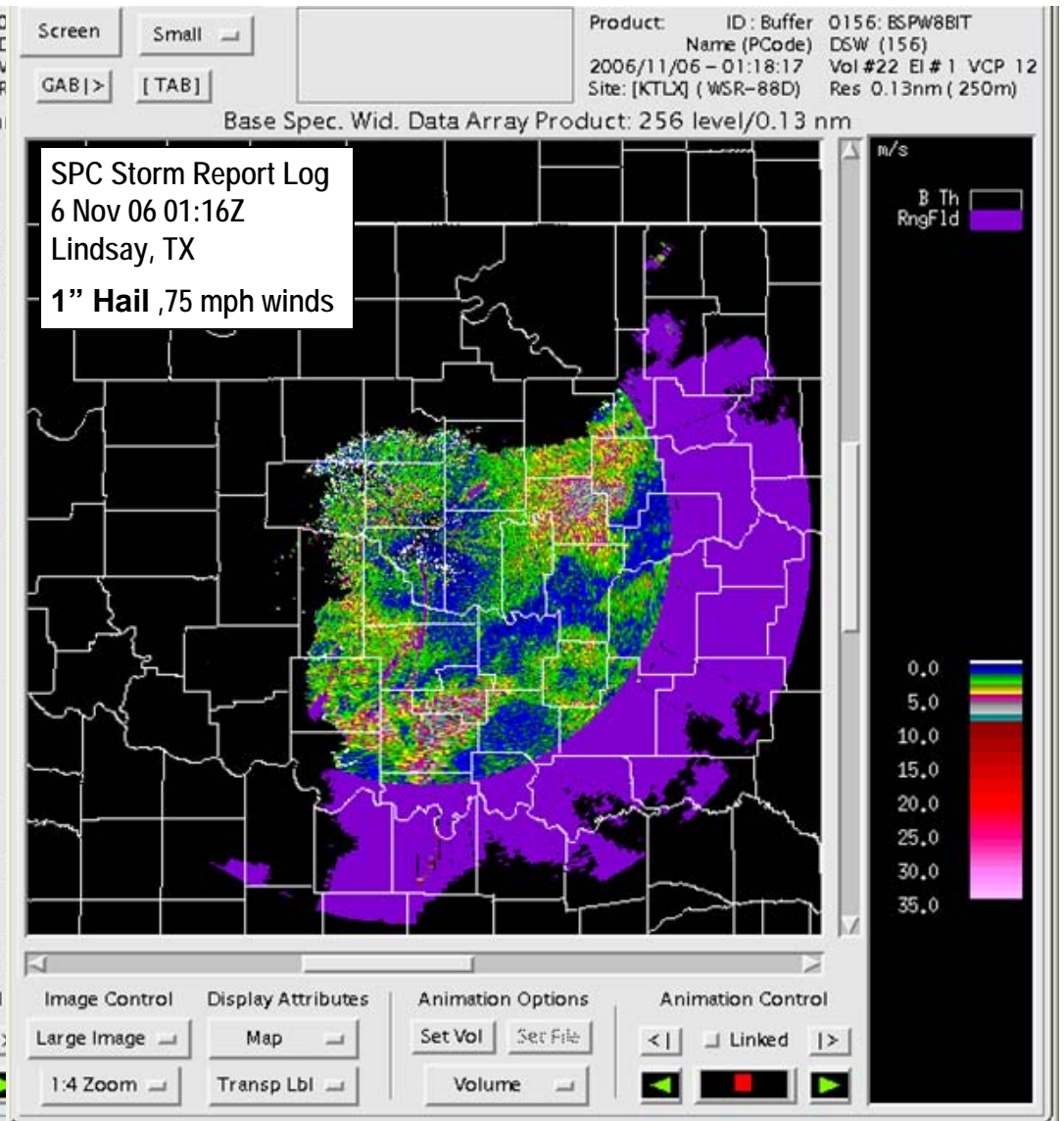


Spectrum Width, 6 November 2006, 01:16Z, 0.5 Deg. Elev.

KCRI VCP122

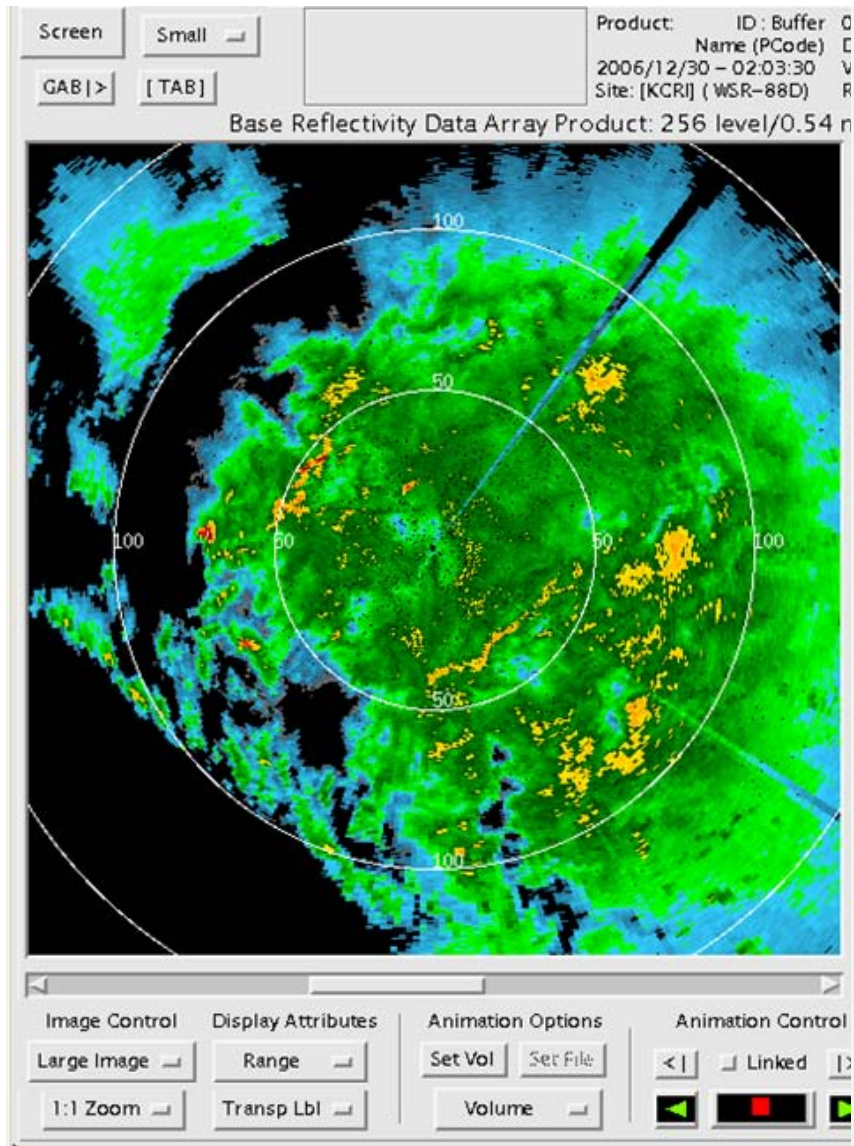


KTLX VCP 12

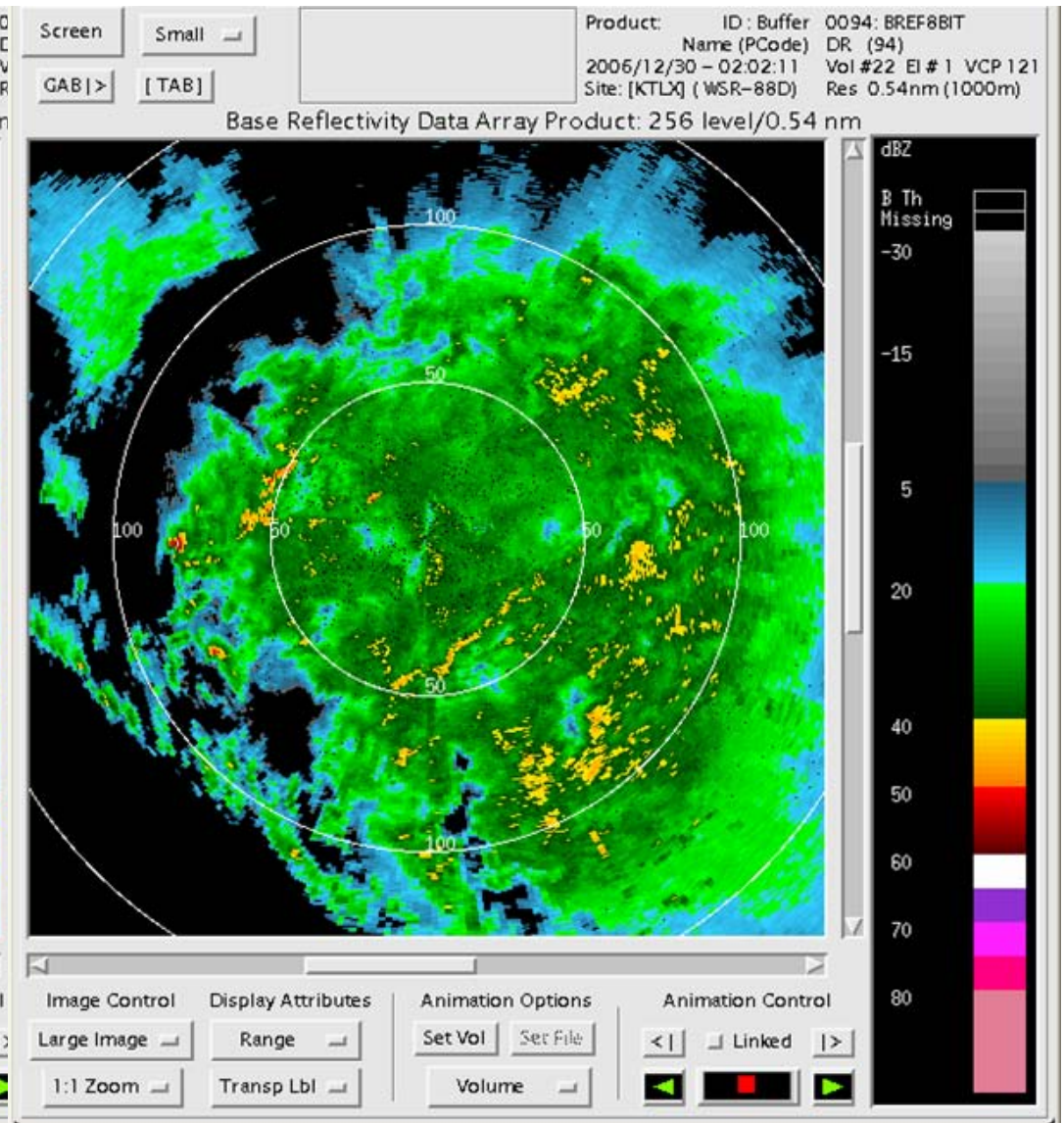


Reflectivity, 30 December 2006, 02:02Z, 0.5 Deg. Elev.

KCRI VCP122

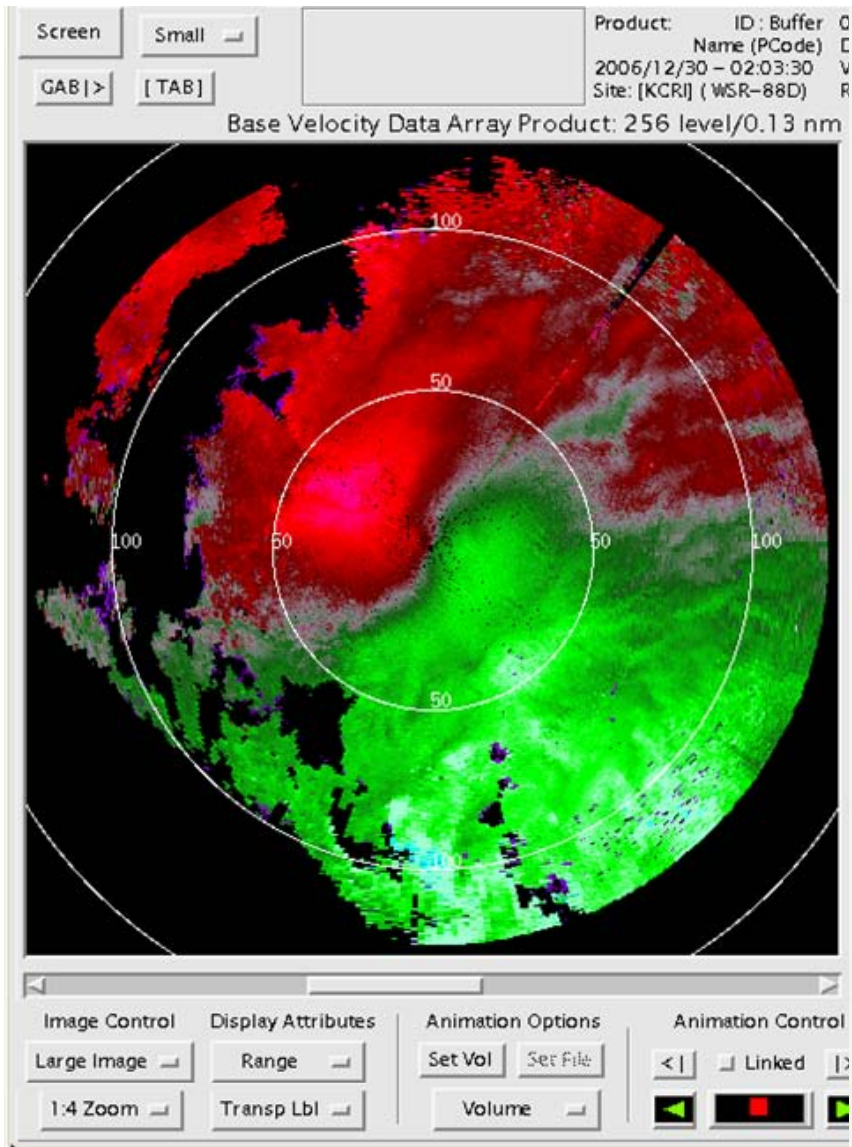


KTLX VCP121

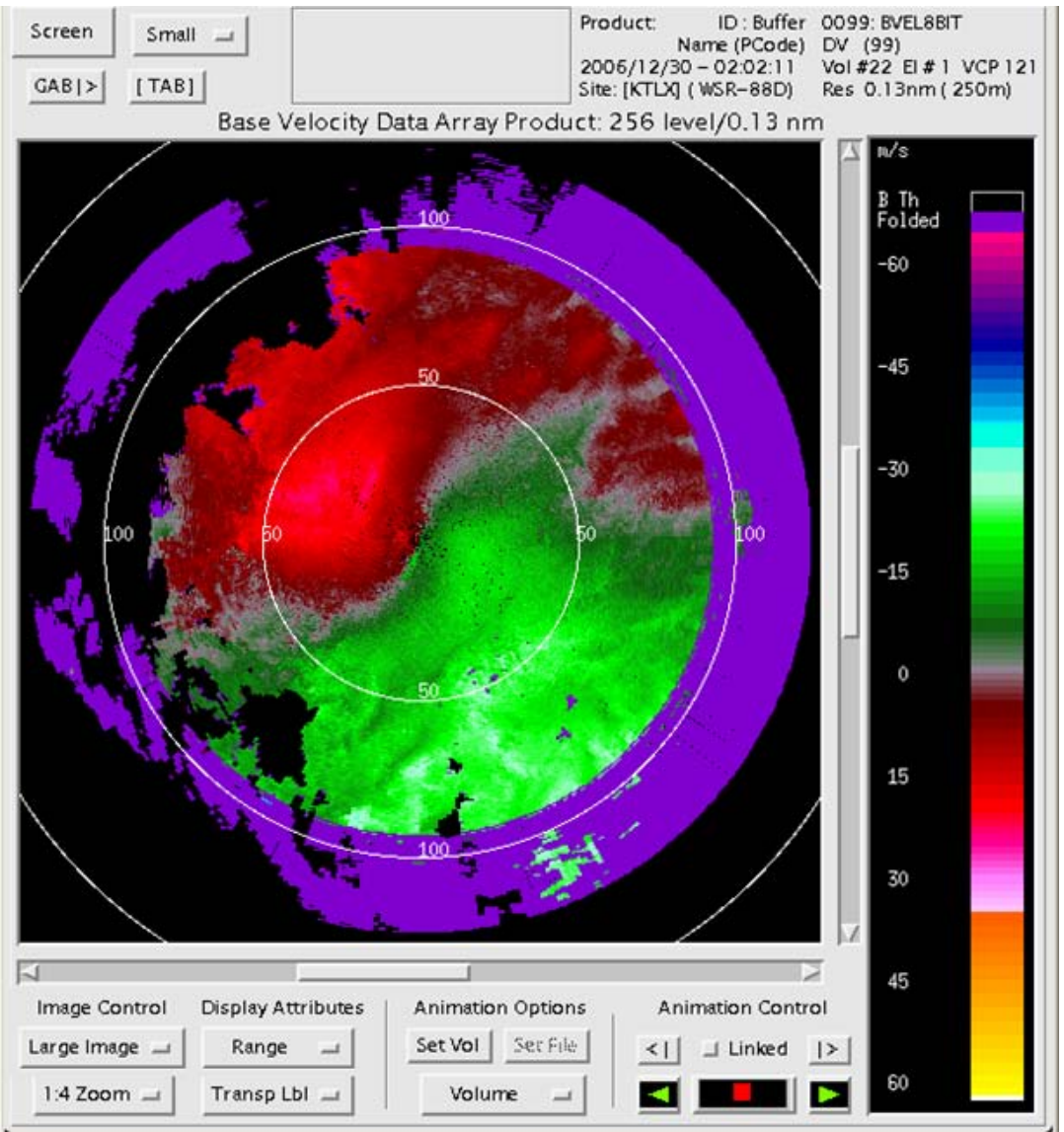


Velocity, 5 November 2006, 02:00Z, 0.5 Deg. Elev.

KCRI VCP122



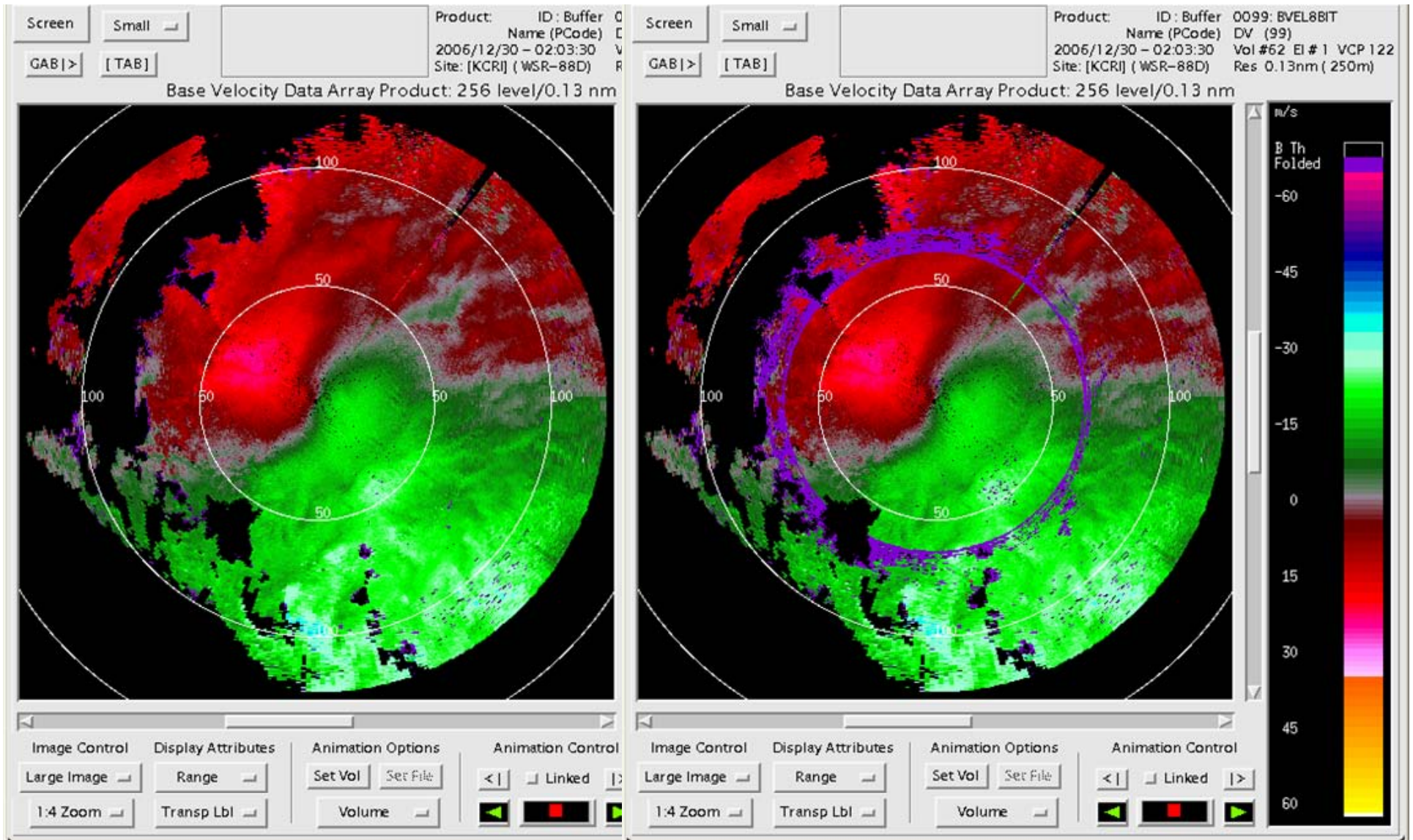
KTLX VCP121



Velocity, 30 December 2006, 02:00Z, 0.5 Deg. Elev.

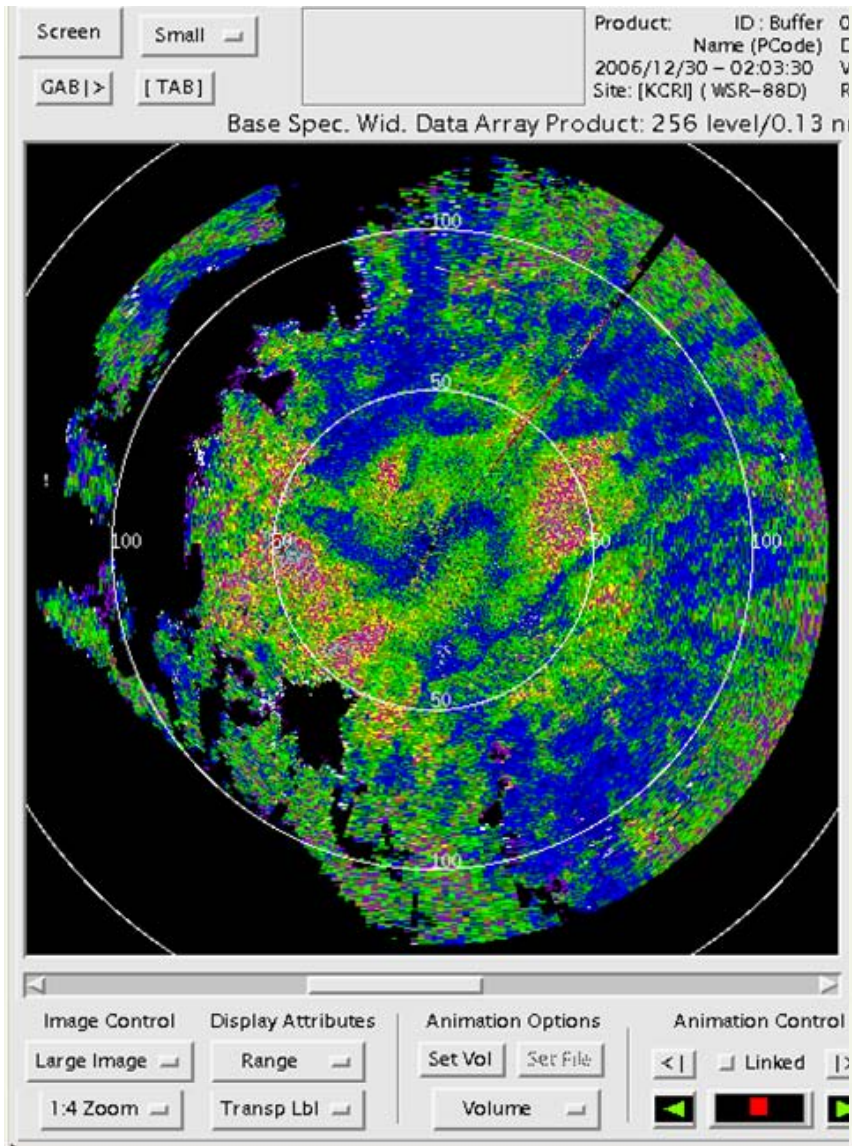
KCRI VCP122

KCRI SZ-2

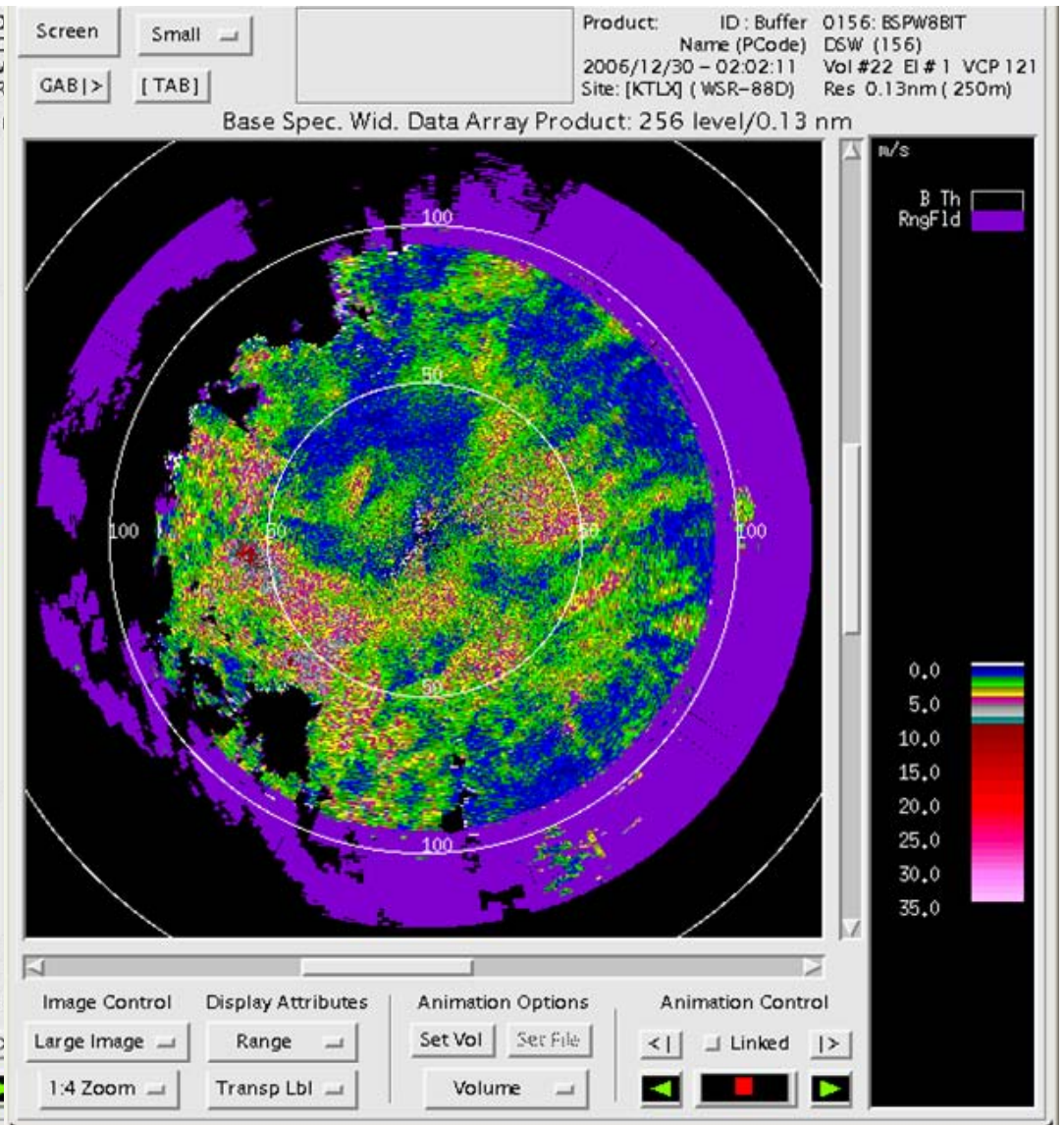


Spectrum Width, 30 December 2006, 02:02Z, 0.5 Deg. Elev.

KCRI VCP122

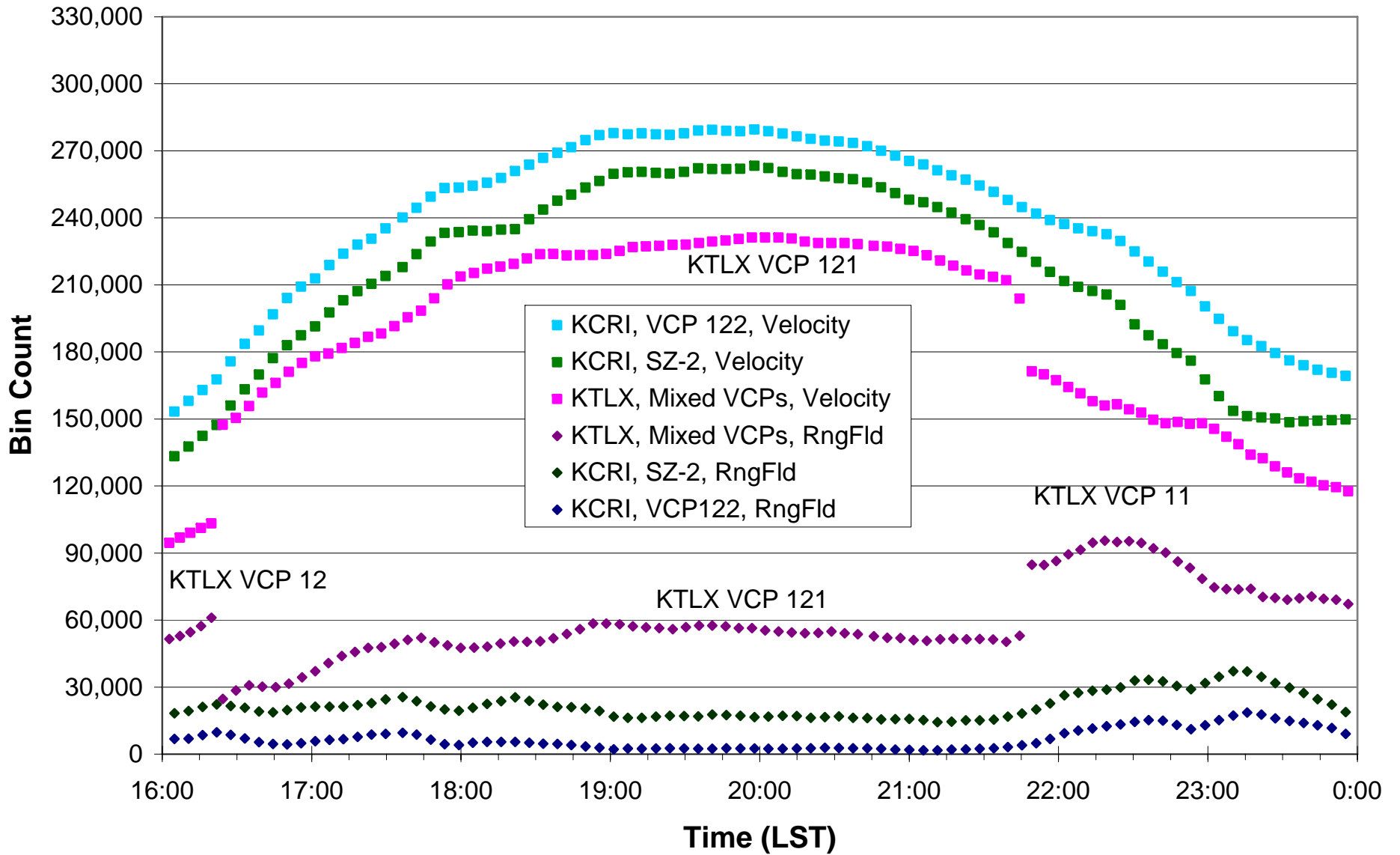


KTLX VCP121



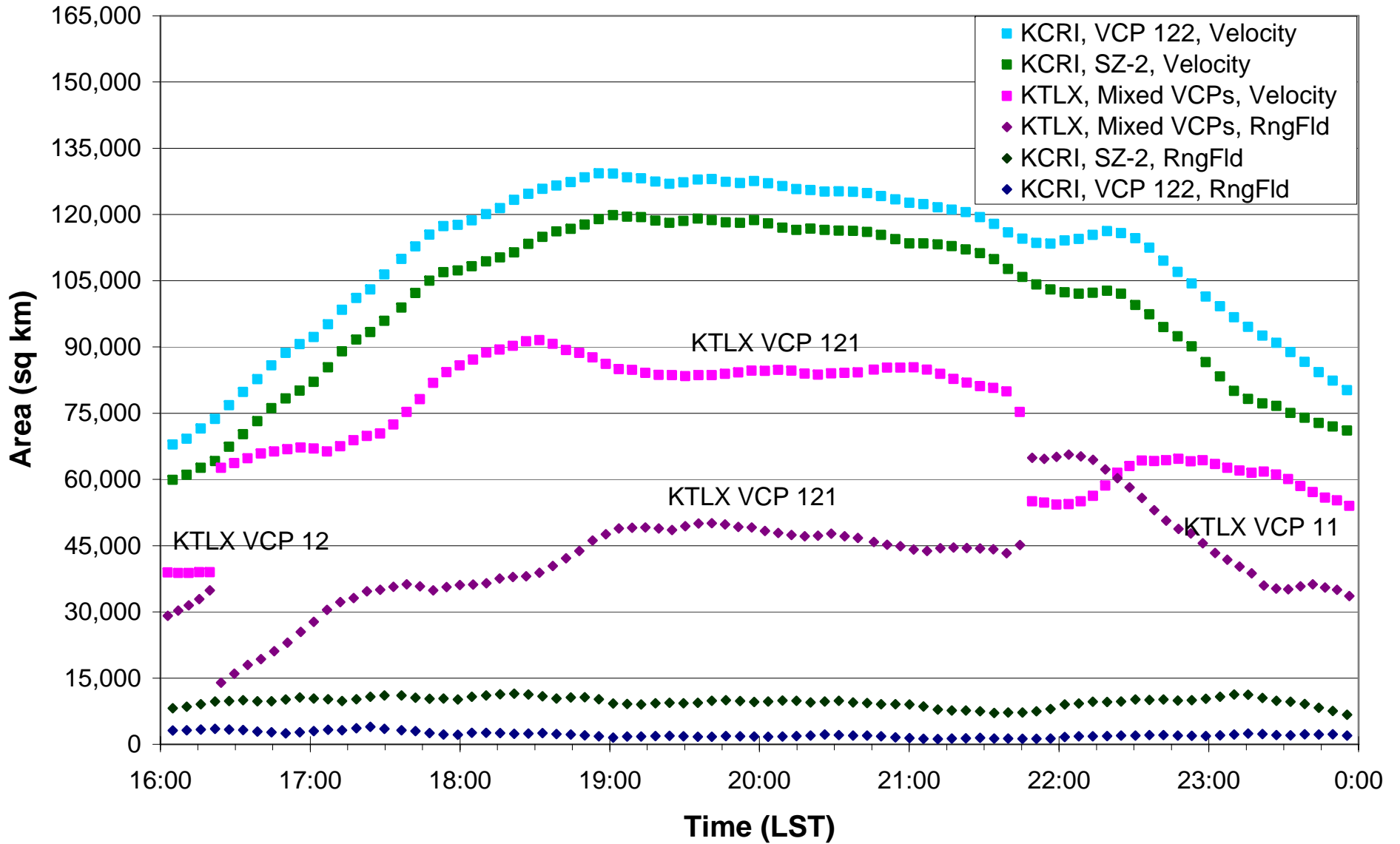
KTLX & KCRI Range Folding & Velocity Bin Count Comparison

29 December 2006, 16:00-00:00 LST, Elev. 0.5 Deg.



KTLX & KCRI Range Folding & Velocity Area Comparison

29 December 2006, 16:00-00:00 LST, Elev. 0.5 Deg.



Statistical Evaluation

- Three cases
 - 15 October 2006 (5 hours)
 - 5-6 November 2006 (8 hours)
 - 29-30 December 2006 (8 hours)
- KCRI w/VCP 122 compared to:
 - KTLX running legacy VCPs
 - KCRI with SZ-2 data only
- Statistical Analyses
 - Average volume of range folding
 - Histograms of velocity and spectrum width
 - Outlier frequencies

Velocity Bin Count and Area Statistics

0.5 degrees elevation

Average Percent Velocity Data

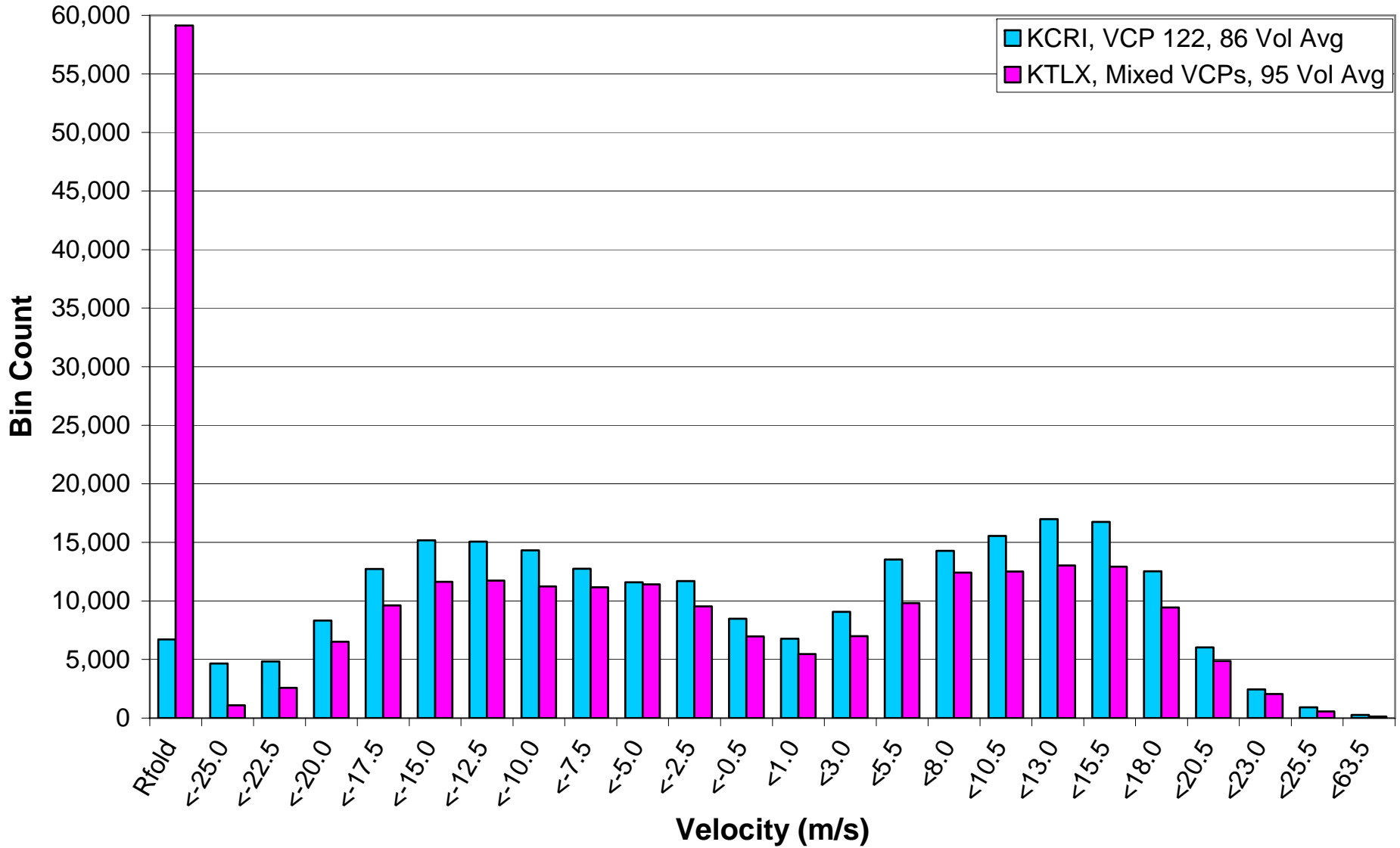
Case	% Bin Count			% Area		
	KCRI VCP 122	KCRI SZ-2	KTLX	KCRI VCP 122	KCRI SZ-2	KTLX
15-Oct-06	99.00	93.25	66.30	98.75	92.28	45.84
5-6 Nov 06	97.24	90.85	76.03	98.29	91.37	61.68
29-30 Dec 06	97.22	90.78	75.65	98.04	91.22	63.10
Average	97.82	91.63	72.66	98.36	91.62	56.87

Average Percent Range Folded Data

Case	% Bin Count			% Area		
	KCRI VCP 122	KCRI SZ-2	KTLX	KCRI VCP 122	KCRI SZ-2	KTLX
15-Oct-06	1.00	6.75	33.70	1.25	7.72	54.16
5-6 Nov 06	2.76	9.15	23.97	1.71	8.63	38.32
29-30 Dec 06	2.78	9.22	24.35	1.96	8.78	36.90
Average	2.18	8.37	27.34	1.64	8.38	43.13

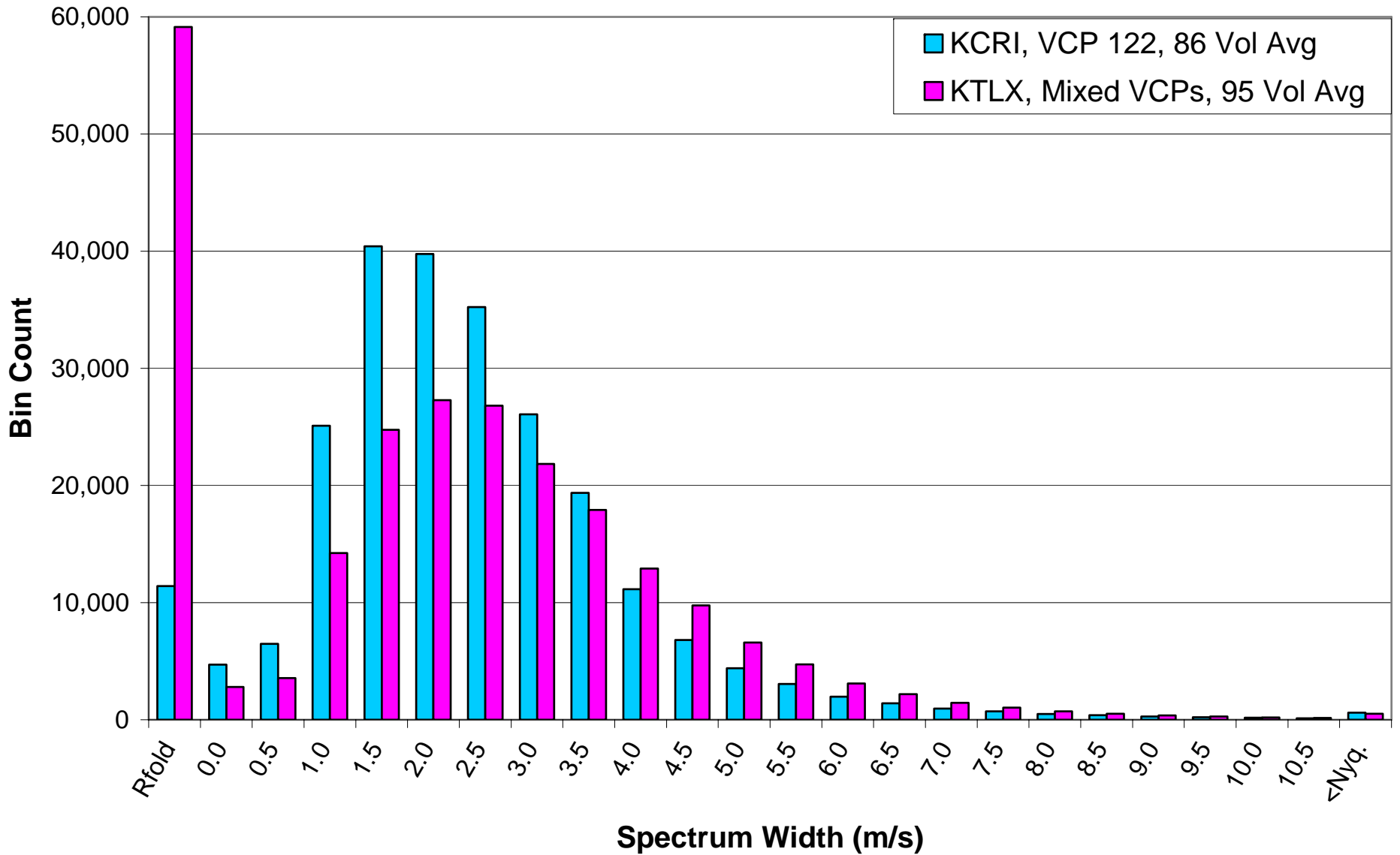
Velocity Histogram Comparison KTLX and KCRI

29 December 2006, 16:00-00:00 LST, 0.5 deg. elev.



Spectrum Width Histogram Comparison KTLX vs. KCRI

29 December 2006, 16:00-00:00 LST, 0.5 deg. elev.



Average Percent of Velocity Data That Meets Outlier Criteria for 0.5 deg. elev.

Case	KCRI VCP 122 Outlier Category *			KCRI SZ-2 Outlier Category			KTLX Legacy VCPs Outlier Category		
	5	10	20	5	10	20	5	10	20
15-Oct-06	2.07	0.34	0.03	2.78	0.48	0.06	0.60	0.06	0.00
5-Nov-06	3.95	0.74	0.06	3.86	0.68	0.09	2.88	0.44	0.03
29-Dec-06	2.11	0.40	0.04	2.44	0.44	0.07	1.36	0.23	0.02
Average	2.71	0.49	0.04	3.03	0.53	0.07	1.61	0.25	0.02

*Outlier category units are m/s

Average Percent of Spectrum Width Data That Meets Outlier Criteria for 0.5 deg. elev.

Case	KCRI VCP 122 Outlier Category *			KCRI SZ-2 Outlier Category			KTLX Legacy VCPs Outlier Category		
	1	2	4	1	2	4	1	2	4
15-Oct-06	19.68	4.32	0.75	17.46	3.14	0.58	14.35	2.40	0.23
5-Nov-06	30.73	11.73	2.73	27.69	9.84	2.32	25.90	7.10	0.89
29-Dec-06	21.06	5.31	1.03	18.97	4.22	0.81	23.52	5.39	0.70
Average	23.82	7.12	1.50	21.37	5.73	1.24	21.26	4.96	0.60

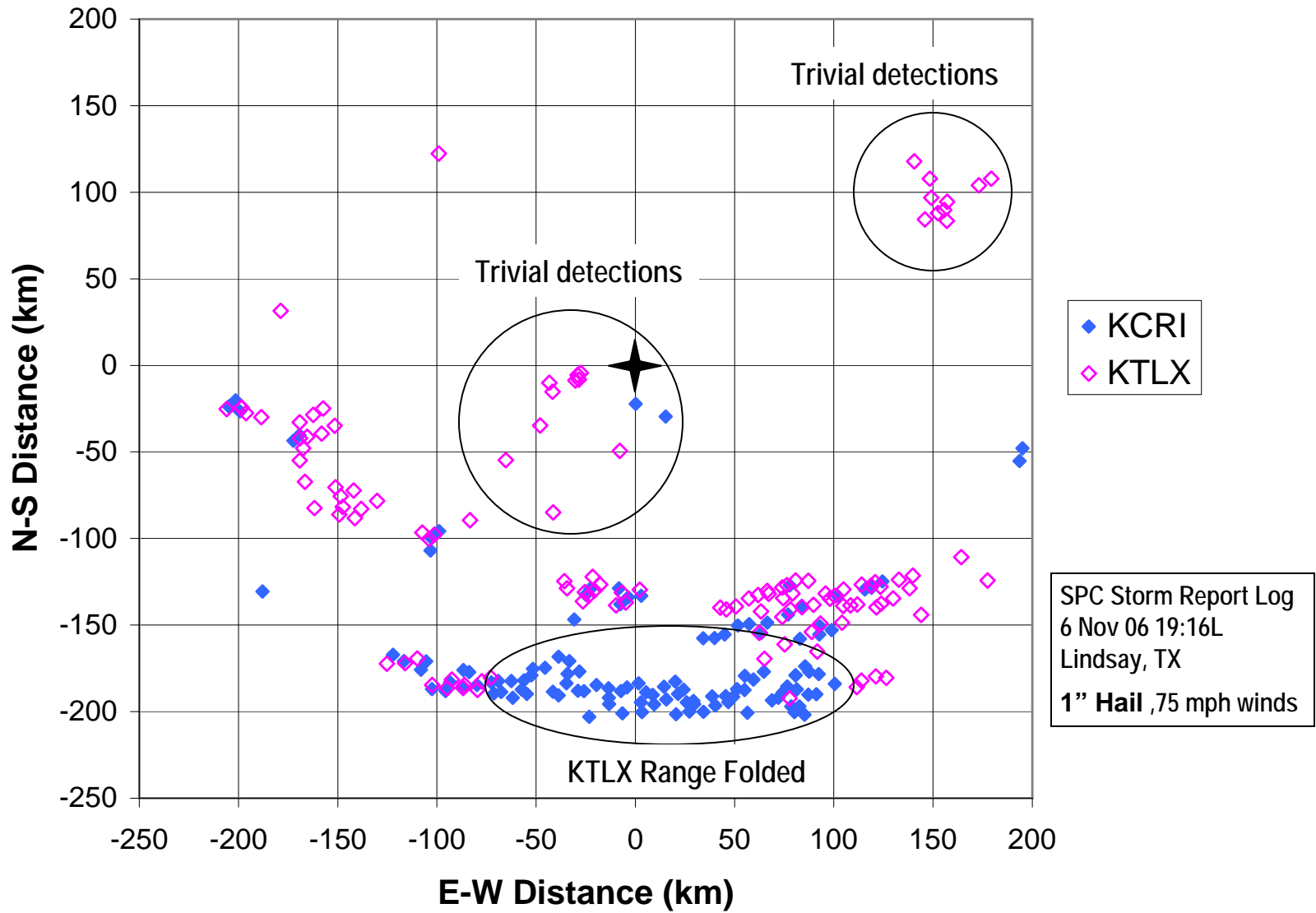
*Outlier category units are m/s

Mesocyclone Detection Algorithm for 5-6 November 2006

- Eight hour period examined from 14:00 to 22:00 LST
- Direct comparison between radars difficult
 - Radars not collocated
 - Different update rates between VCP 12 and 122
 - VCP 12 has denser vertical sampling at low elevations than VCP 122
 - Not evaluated statistically

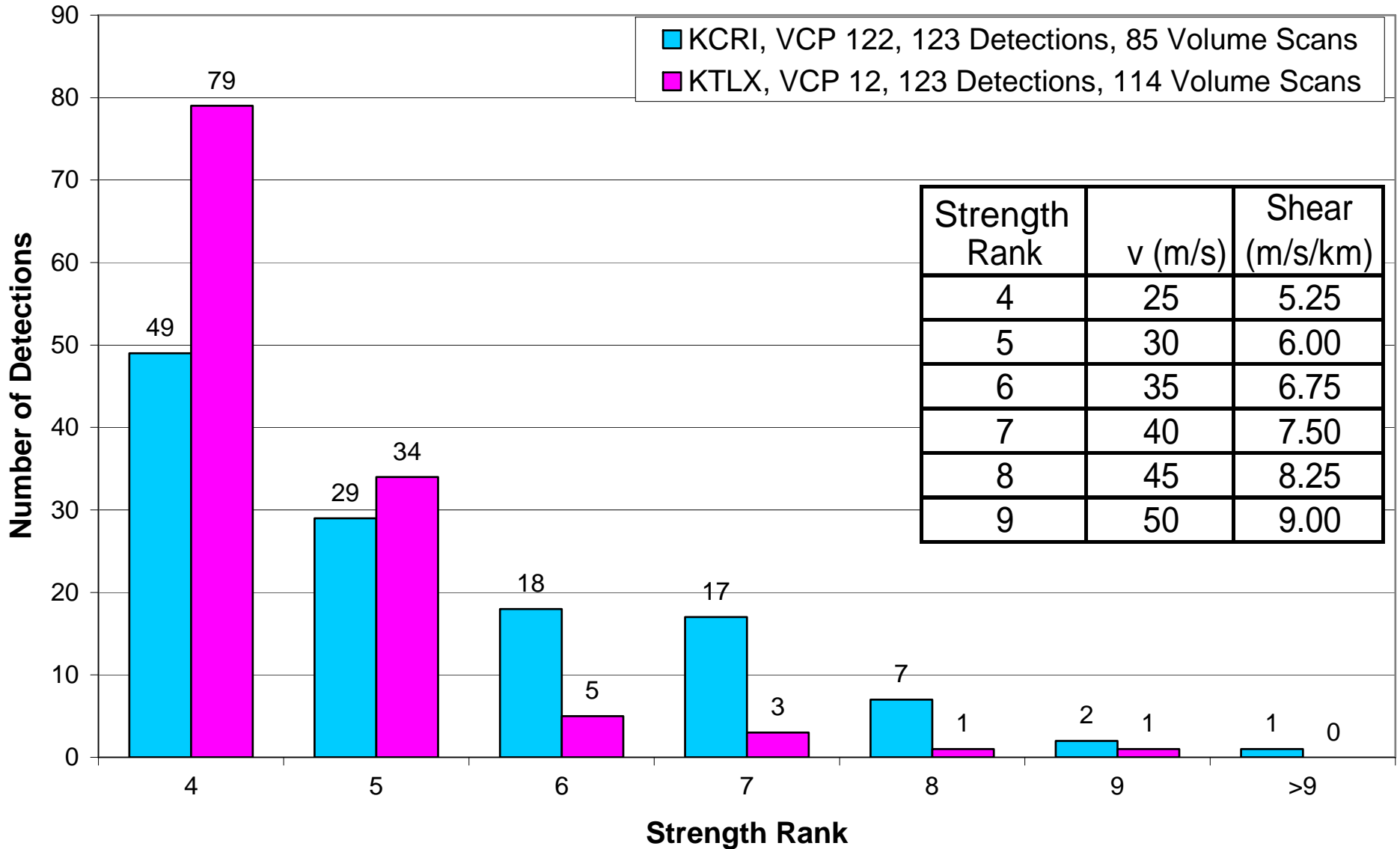
KCRI MDA Superimposed on KTLX MDA for Strength Rank 4 and Higher

5 November 2006, 14:00-22:00 LST



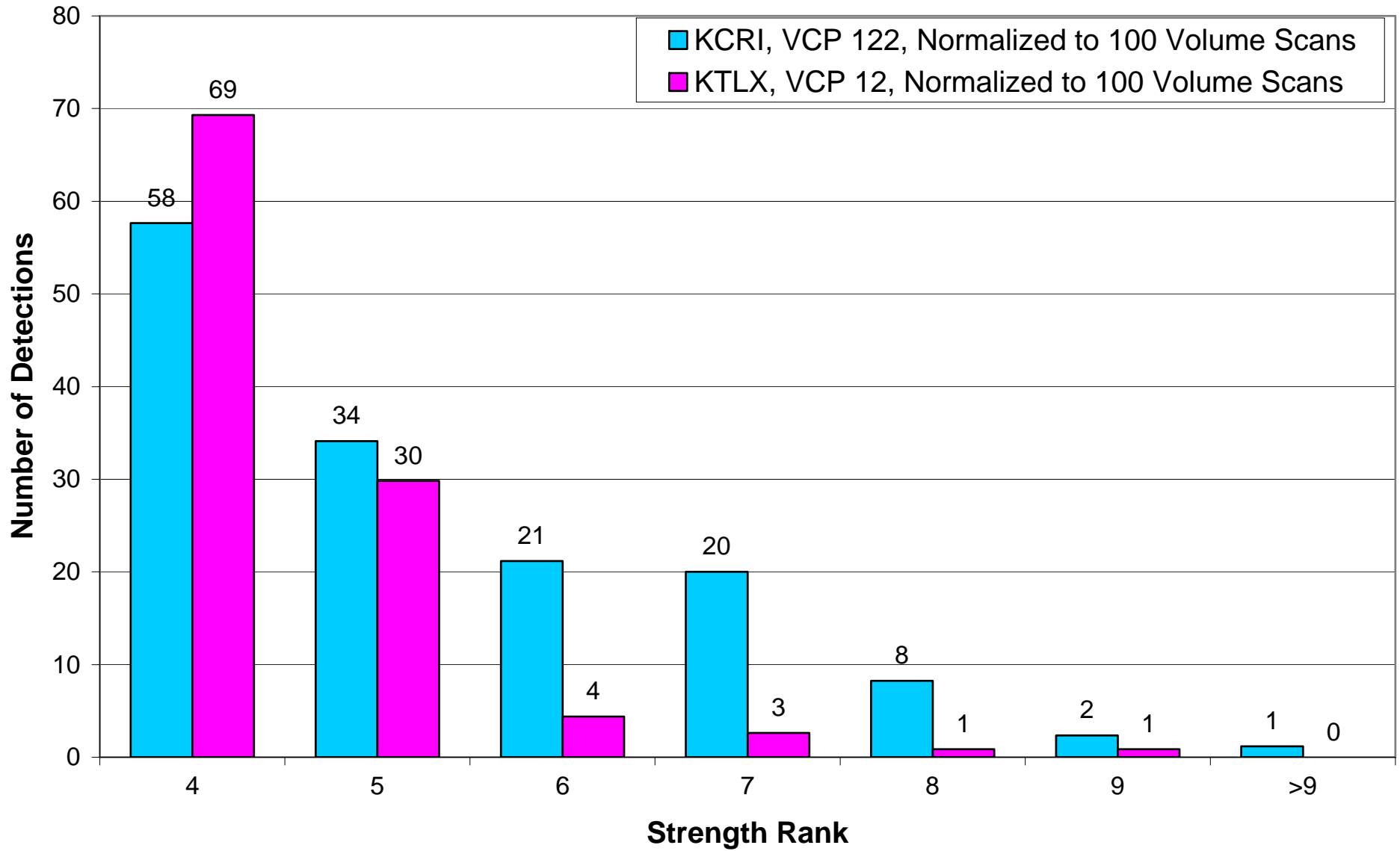
KTLX vs. KCRI Mesocyclone Detection Algorithm Comparison

5 November 2006, 14:00-22:00 LST



KTLX vs. KCRI Mesocyclone Detection Algorithm Comparison

5 November 2006, 14:00-22:00 LST



Field Test of Combined SZ-2/MPDA

- Goals
 - Increase number of cases
 - Test in geographically diverse areas
 - Test in strong winds (e.g., tropical cyclone)
 - Test with substantial 3rd and 4th trip echo present

Field Test of Combined SZ-2/MPDA (cont'd)

- VCP 121 will be modified to match test VCP 122
 - Transparent to external users
 - Eng. Change Prop. (software mod kit)
- 11 sites selected; most use VCP 121 routinely
 - 5 Gulf Coast/Atlantic
 - San Juan, PR; Jacksonville, FL, Melbourne, FL, Tallahassee, FL, Lake Charles, LA
 - 3 Mid-western
 - Cincinnati, OH; Lincoln, IL; Goodland, KS
 - 3 Western
 - Billings, MT; Boise, ID; Sacramento, CA
- Test dates
 - Tied to installation of Build 9 at each site with 3 week's burn-in time
 - Earliest start is San Juan, PR; Beta Test completed in late May
 - Latest start is Lincoln, IL in early August

Field Test of Combined SZ-2/MPDA (cont'd)

- Test data
 - Record Level 2 Archive data at ROC or retrieve from NCDC
 - Obtain at least two non-trivial cases from each participating site
 - Compare test VCP 121 data to simulated SZ-2 and MPDA data
- Evaluation criteria
 - Range folding reduction - 50% or better over any other VCP
 - Velocity dealiasing error rate – not statistically different than simulated data (hopefully better)
 - Kinematic algorithm performance
 - No operationally significant degradation in performance over other VCPs
 - Mesocyclone Detection Algorithm
 - Tornado Detection Algorithm
 - User survey
 - Favorable response
 - Recommendation to field the test version of VCP 121

Summary/Conclusions

- Combining the SZ-2 range mitigation algorithm with the MPDA removes nearly all range folded signal
- The combined SZ-2/MPDA range unfolding algorithm may slightly increase the frequency of velocity and spectrum width outliers
- With velocity data provided by the SZ-2/MPDA algorithm, mesocyclones were detected on the KCRI test bed radar in a region obscured by range folding on the operational KTLX radar for the 5-6 November 2006 case
- The combined SZ-2/MPDA may decrease the frequency of detection of weak shears
- A field test is planned for second half of 2007 at 11 operational sites

Questions?