

SZ-2 Validation & Operational Testing Information Brief : Preliminary Results

21 March 2006

ROC/Applications Branch

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Overview

- Past SZ Briefings to TAC
- SZ-2 VCPs
- Data Cases
- Early Examples
- Later Examples
- Data Evaluation Example
- Status of SZ-2 Engineering Integration
- Summary and Conclusions

Previous TAC Briefings on SZ/SZ-1/SZ-2

➤ April 2005

- NCAR Activity Update – John Hubbert (SZ-2 and super resolution)

➤ March 2004

- ROC RV Ambiguity Mitigation, Status and Decision Briefing – Lynn Allmon
- NSSL Mitigation of RV Ambiguities: Analysis and Evaluation – Sebastian Torres & Dusan Zrnic (excellent examples of SZ-2)
- NEXRAD RV Ambiguity Mitigation Progress at NCAR – John Hubbert et al.

➤ December 2001

- Report on RV/DQ Workshop – Jim Evans (SZ deemed most promising)
- AP Mitigation Schemes and RV Mitigation Schemes, Part I – Jeff Keeler
- RV Work at NSSL – Dusan Zrnic (contract w/SIGMET)

➤ March 1999

- Range Folding Mitigation – Chuck Frush (SZ deemed compatible with ORDA)

Data Collected Using ORDA Modified VCP 11

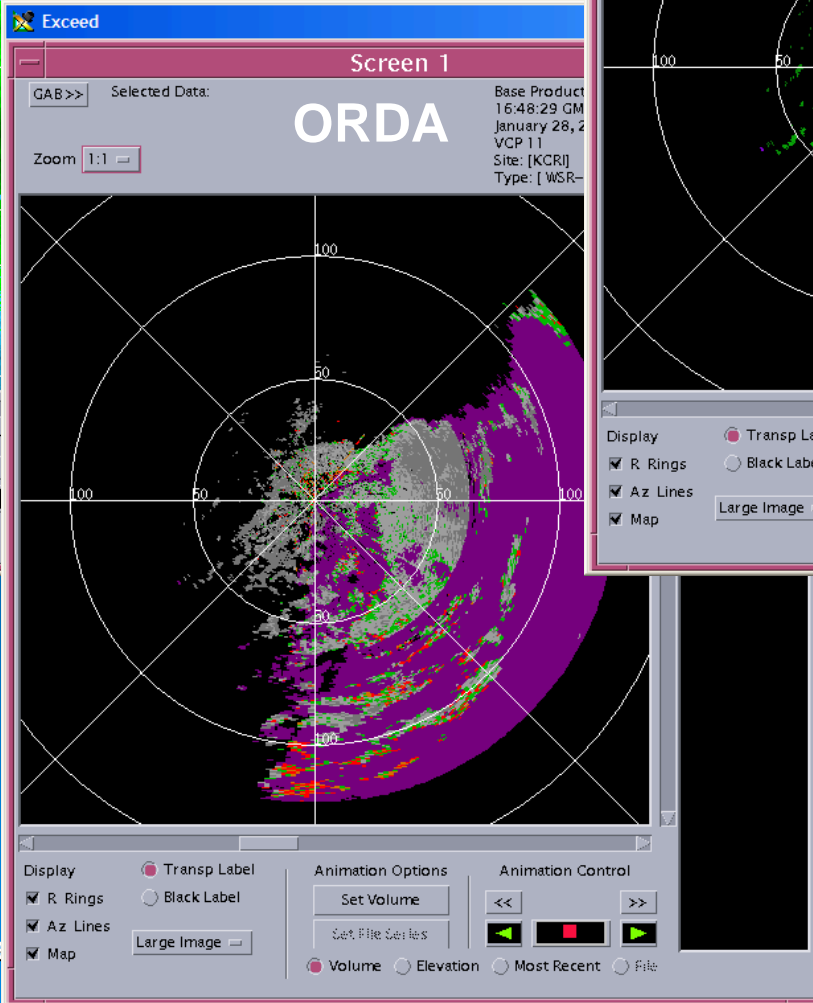
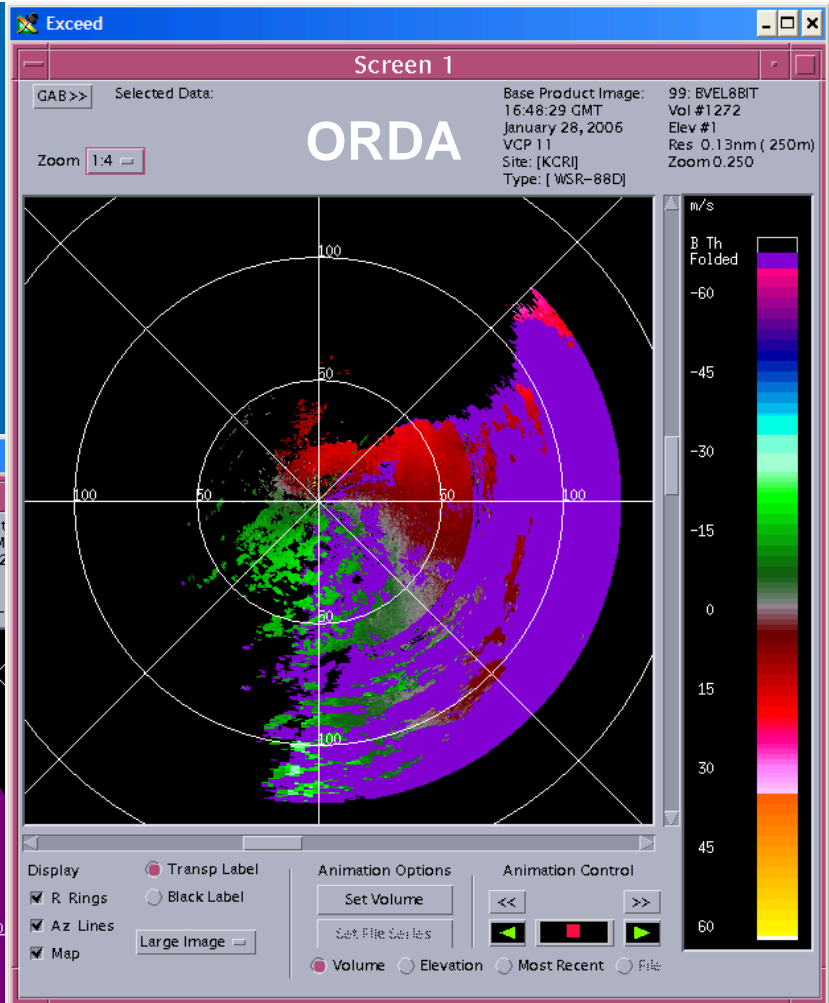
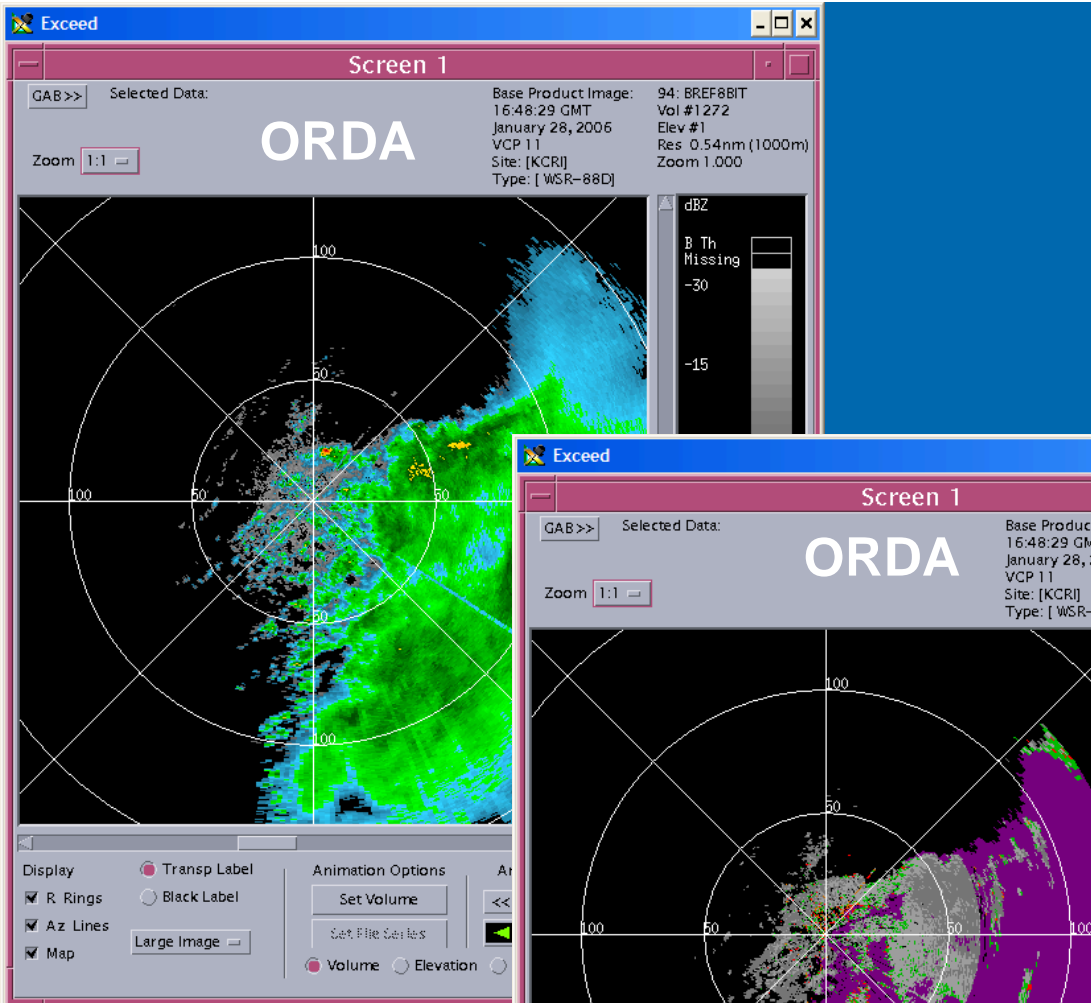
- Two consecutive split cuts at 0.5 degrees elevation (four sweeps total)
 - A split cut has one surveillance sweep (low PRF) and one Doppler sweep (high PRF)
 - 1st Doppler cut uses normal ORDA velocity and spectrum width data processing
 - 2nd Doppler cut uses SZ-2 processing for velocity and spectrum width data processing
 - Both Doppler scans use PRF 8

VCPs Planned for Build 9

| Existing VCP | SZ-2 VCP | PRF | Unambiguous Range (km)/ Nyquist Velocity (m/s) | No. SZ-2 Elev. Cuts |
|--------------|----------|--------|---|---------------------|
| 11 | 211 | 8 | 116/35 | 2 |
| 12 | 212 | 8 or 6 | 116/35 or 136/27 | 3 |
| 21 | 221 | 5 | 146/25 | 2 |

Summary of KCRI SZ-2 Data Cases

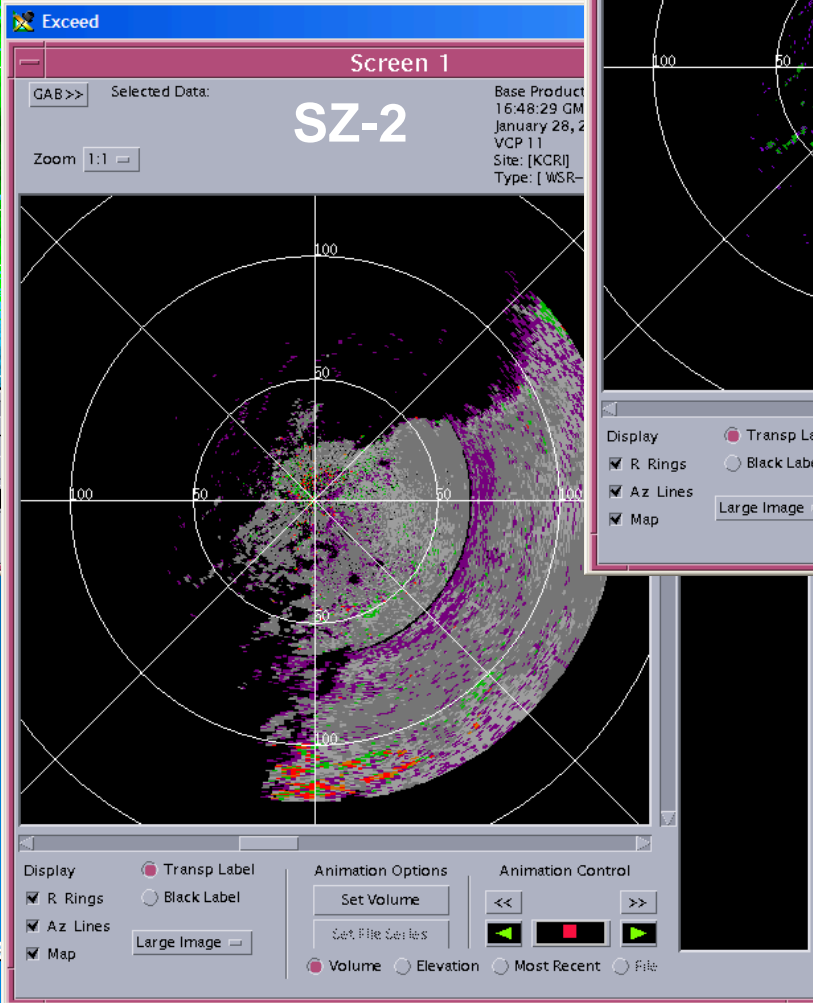
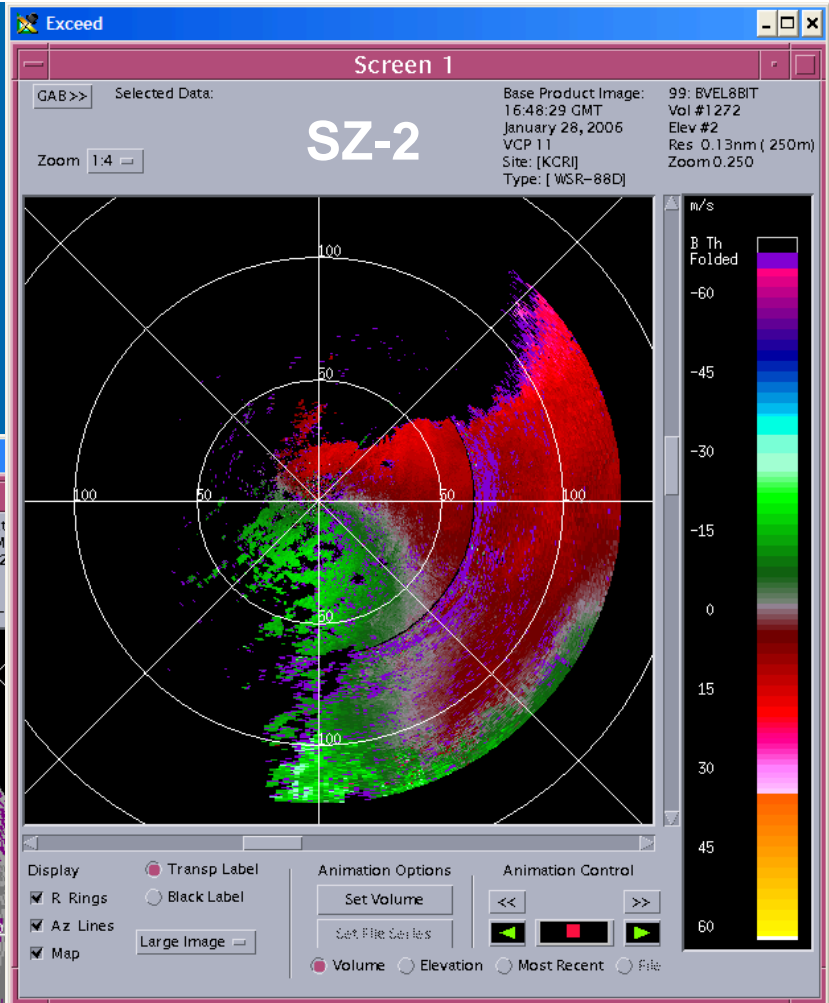
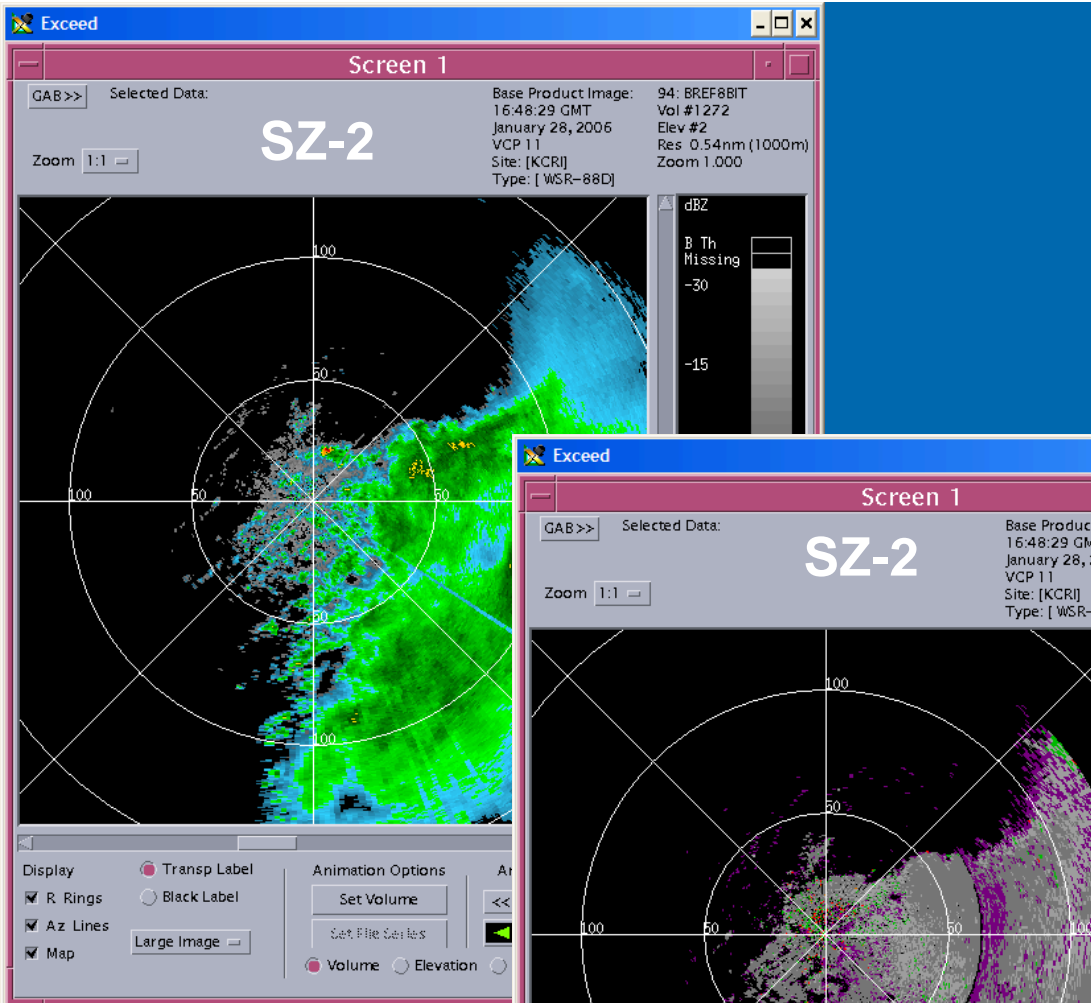
- Clear – 12
- Showers – 6
- Snow – 3
- Freezing rain – 2
- Small storms – 2
- Stratiform – 2
- Severe storm – 1
- October '05 – 3
- November '05 – 1
- December '05 – 3
- January '06 – 3
- February '06 – 14
- March '06 – 4



KCRI
 1/28/06

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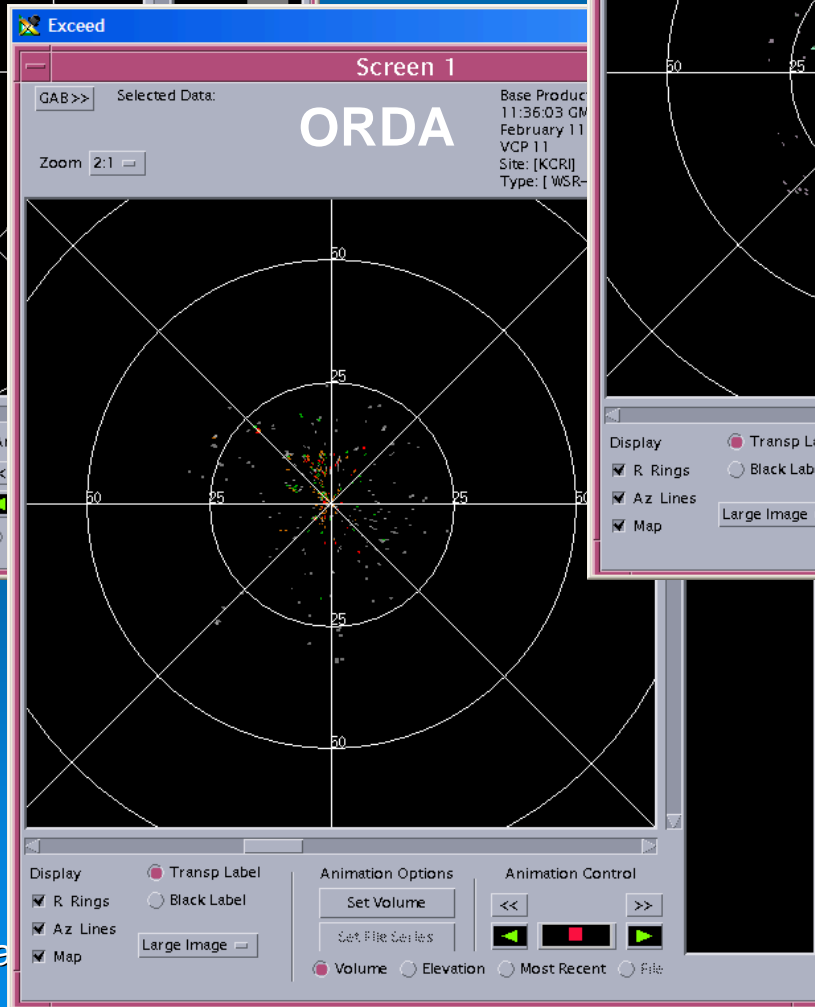
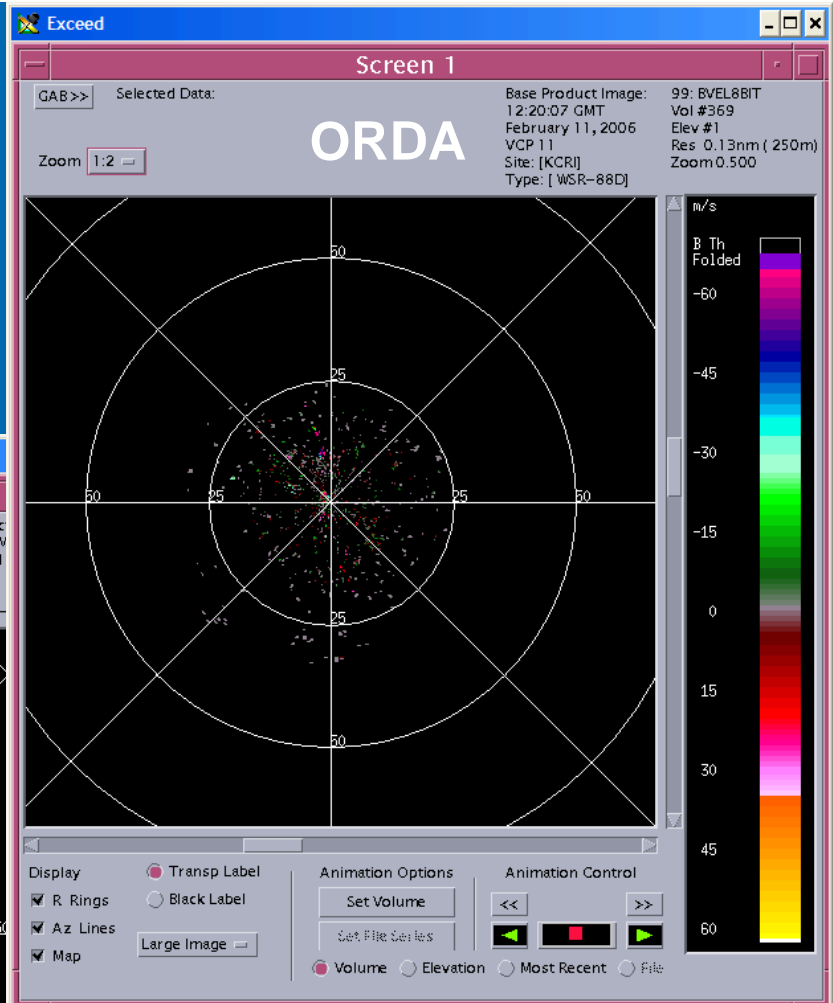
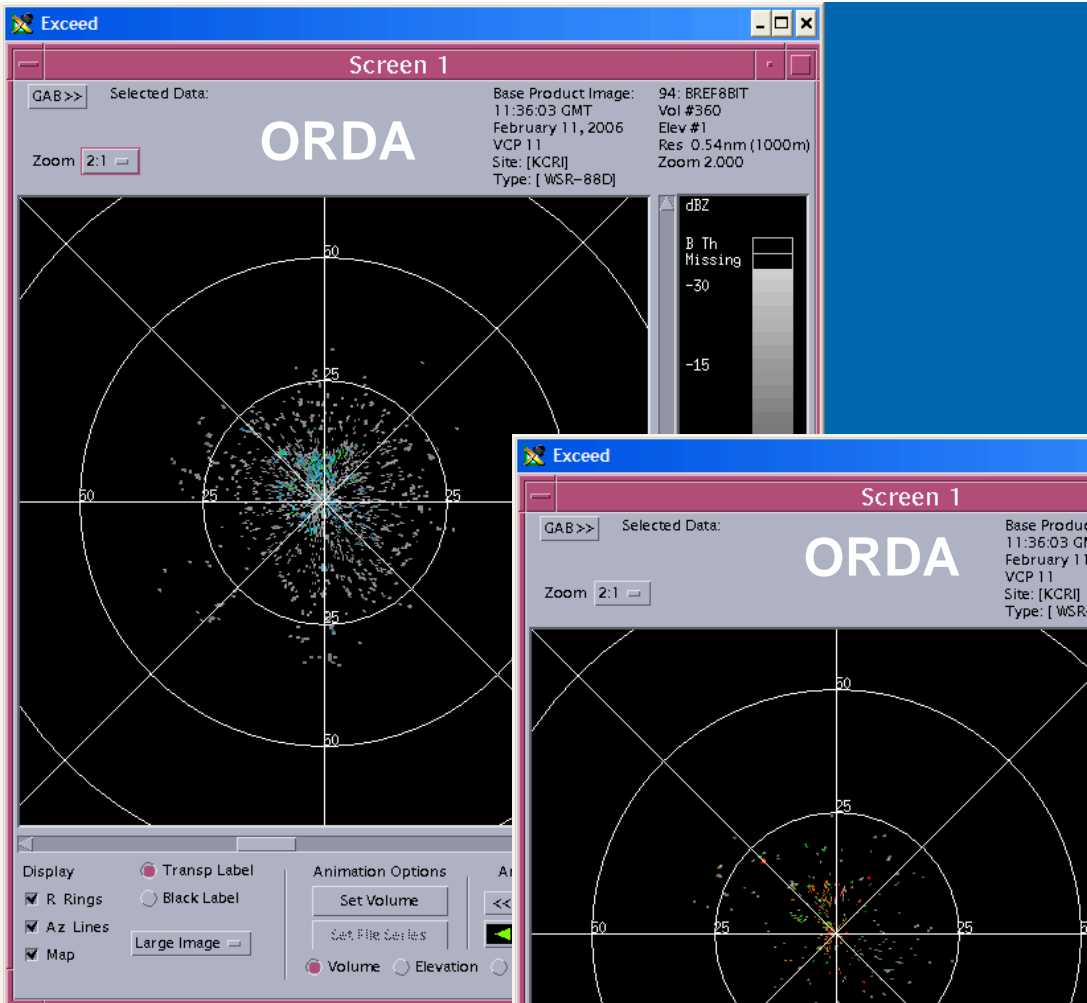
ev.ppt



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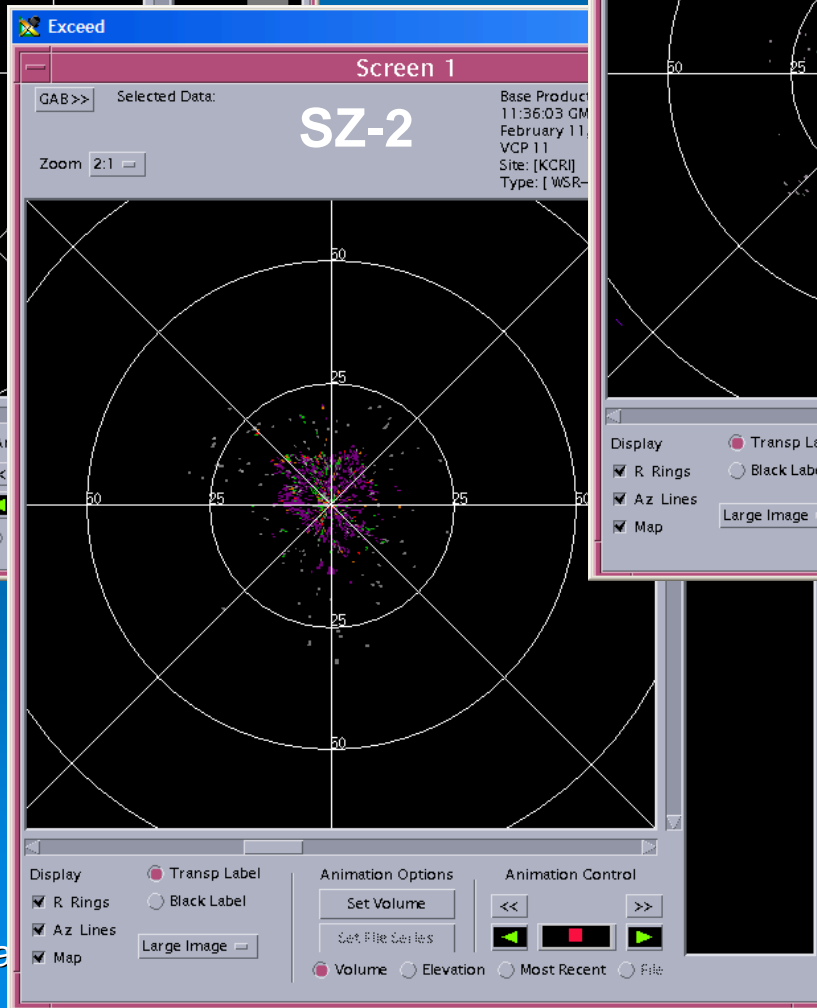
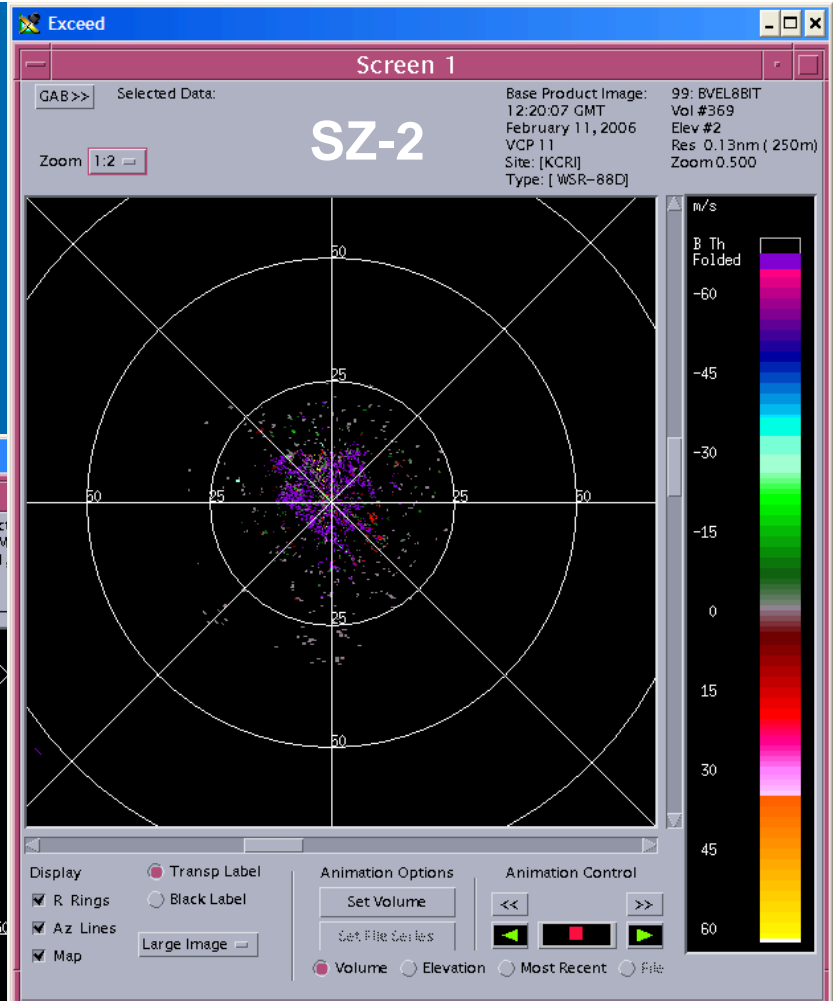
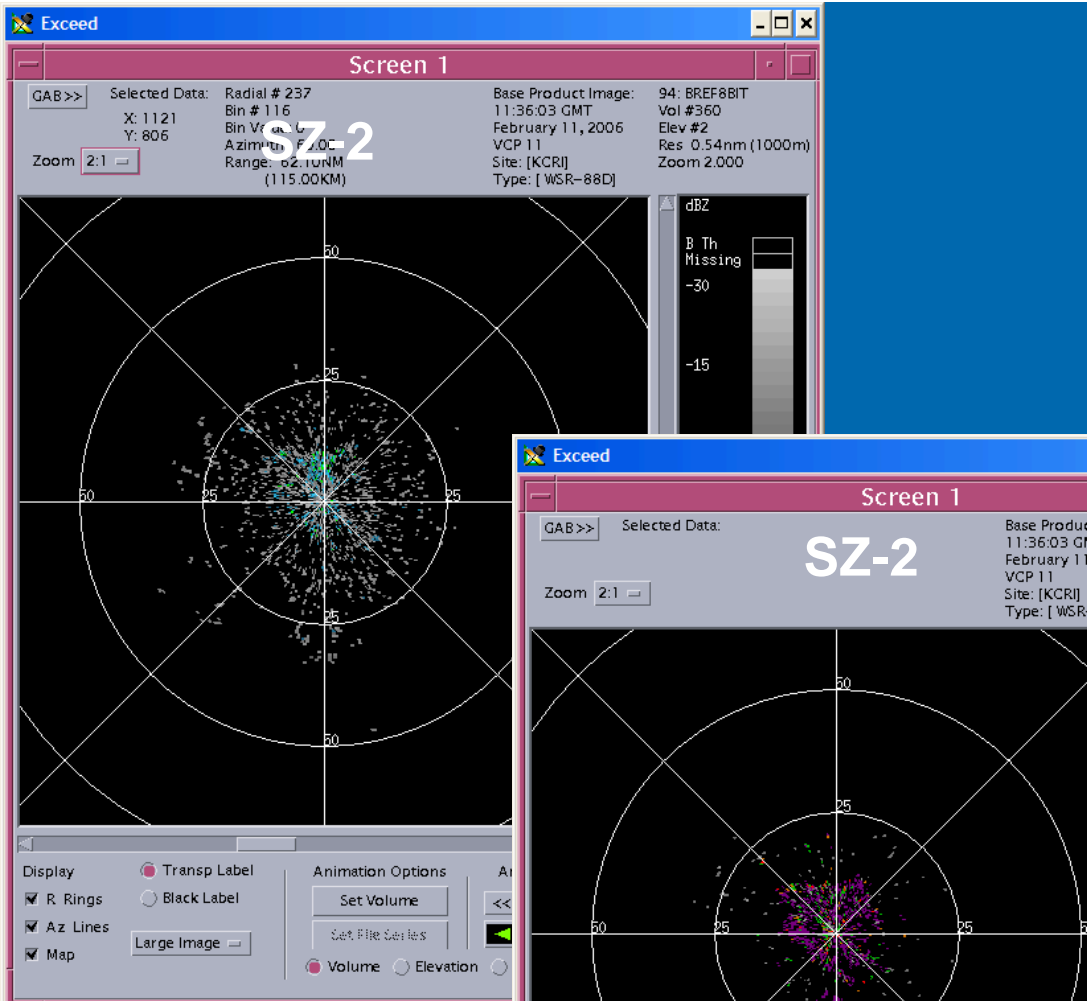
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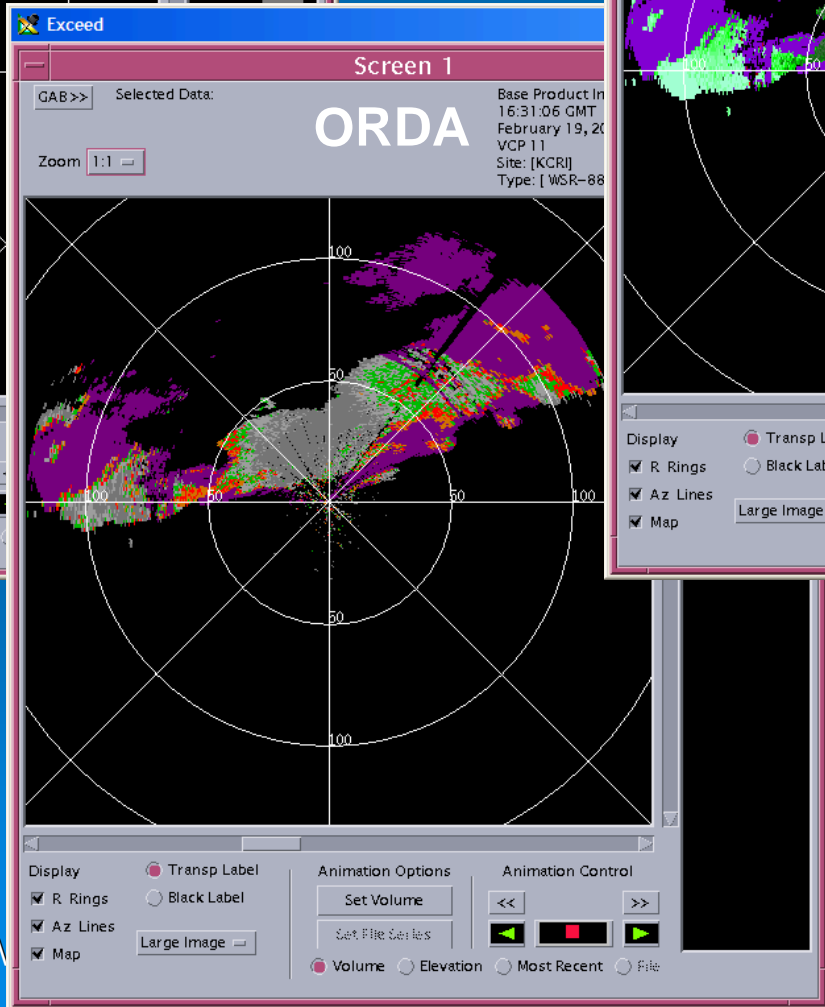
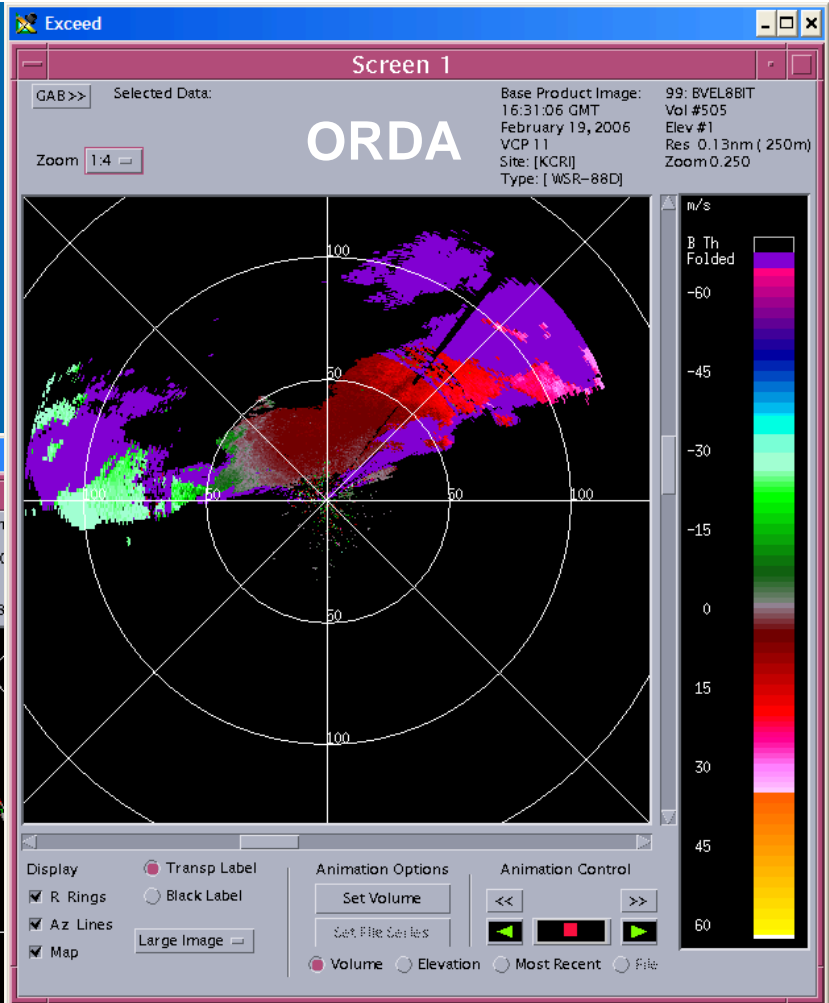
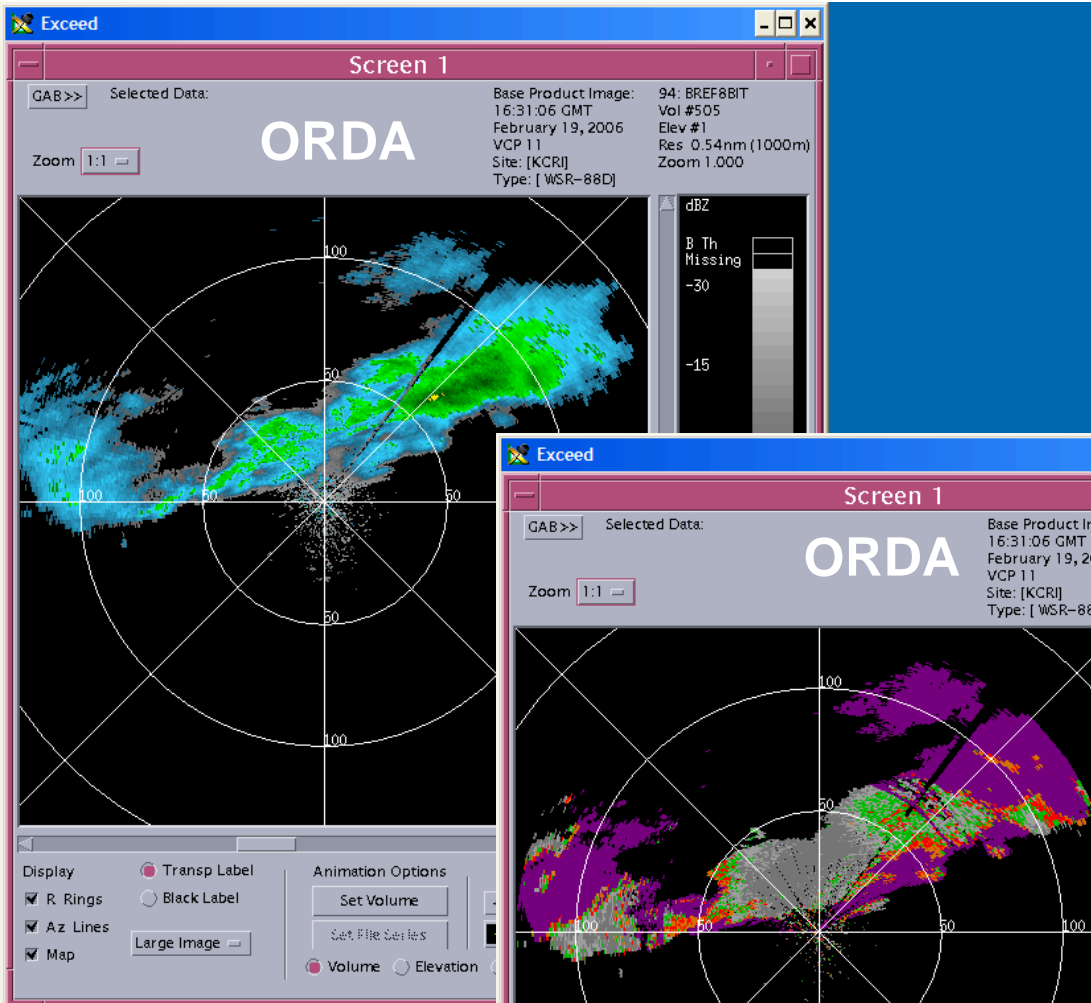
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Later Examples After Threshold Refinements (still under investigation)

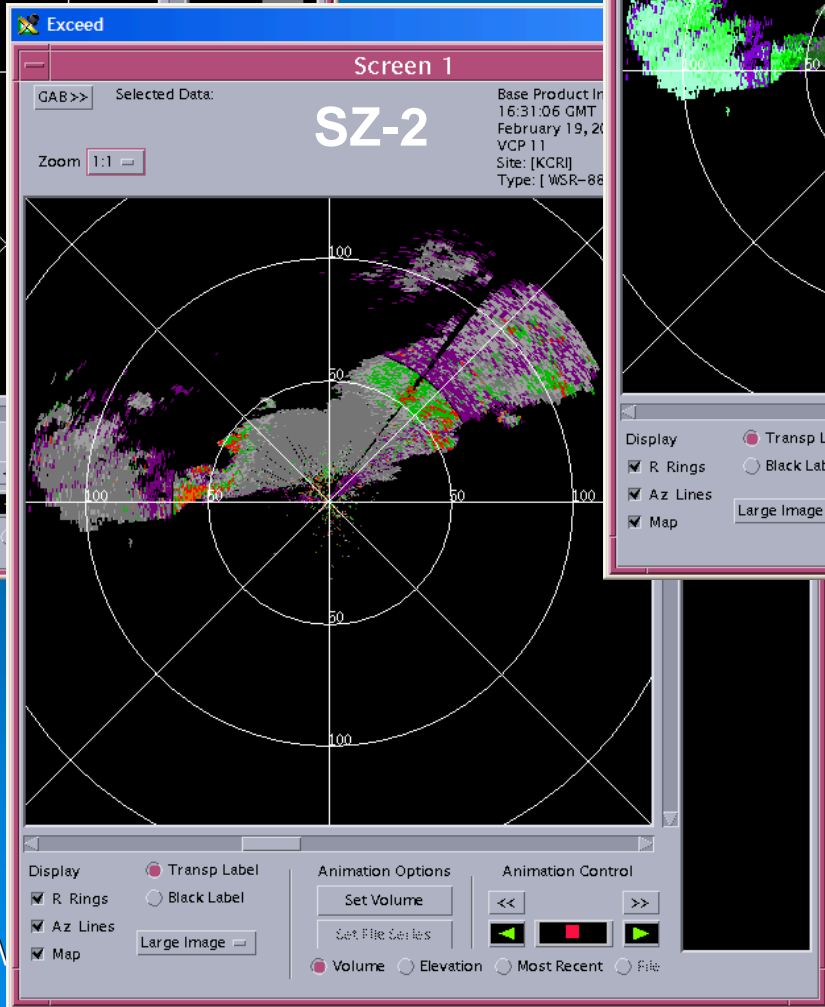
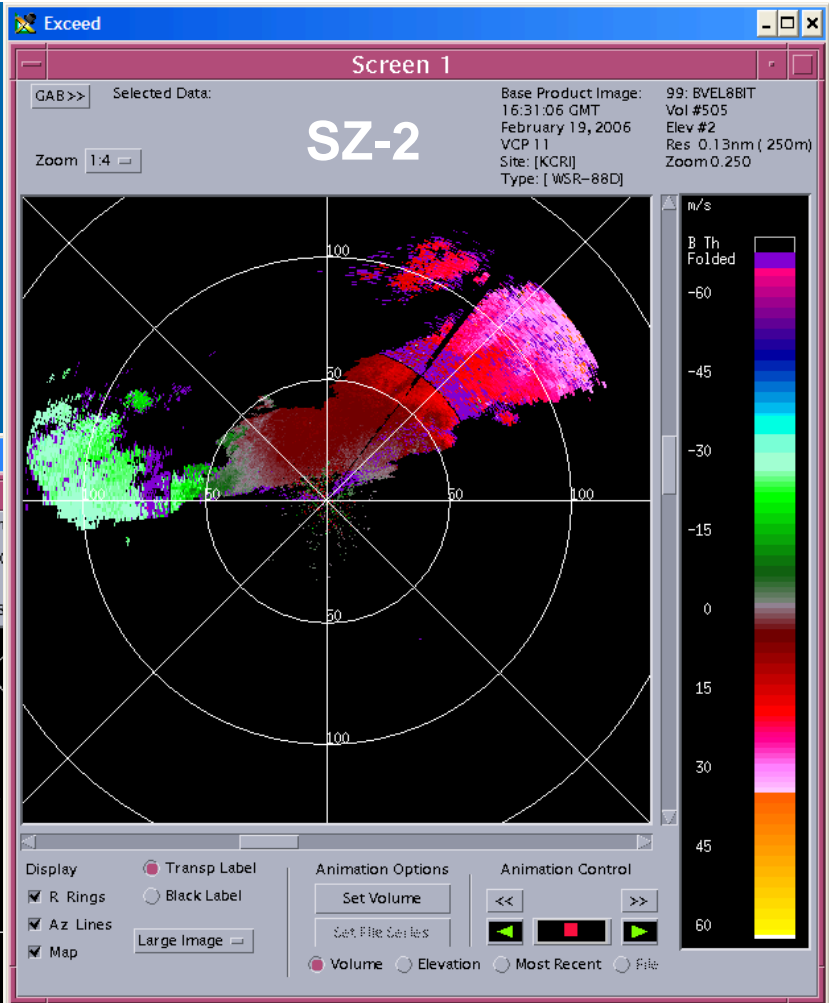


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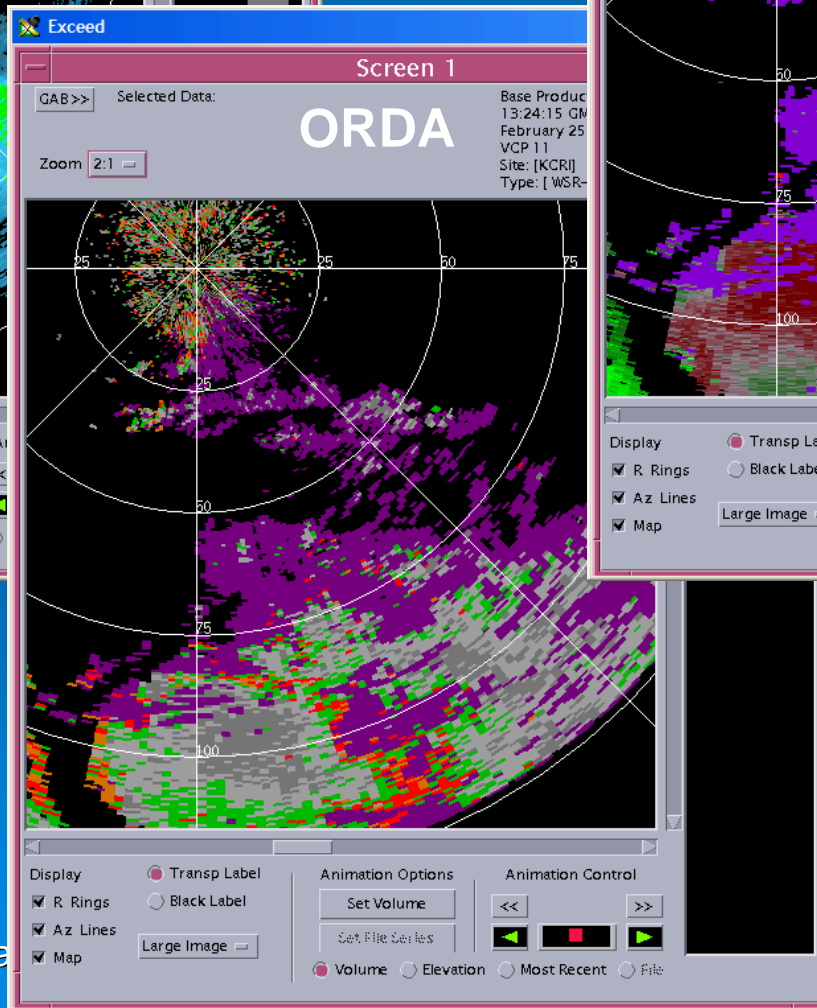
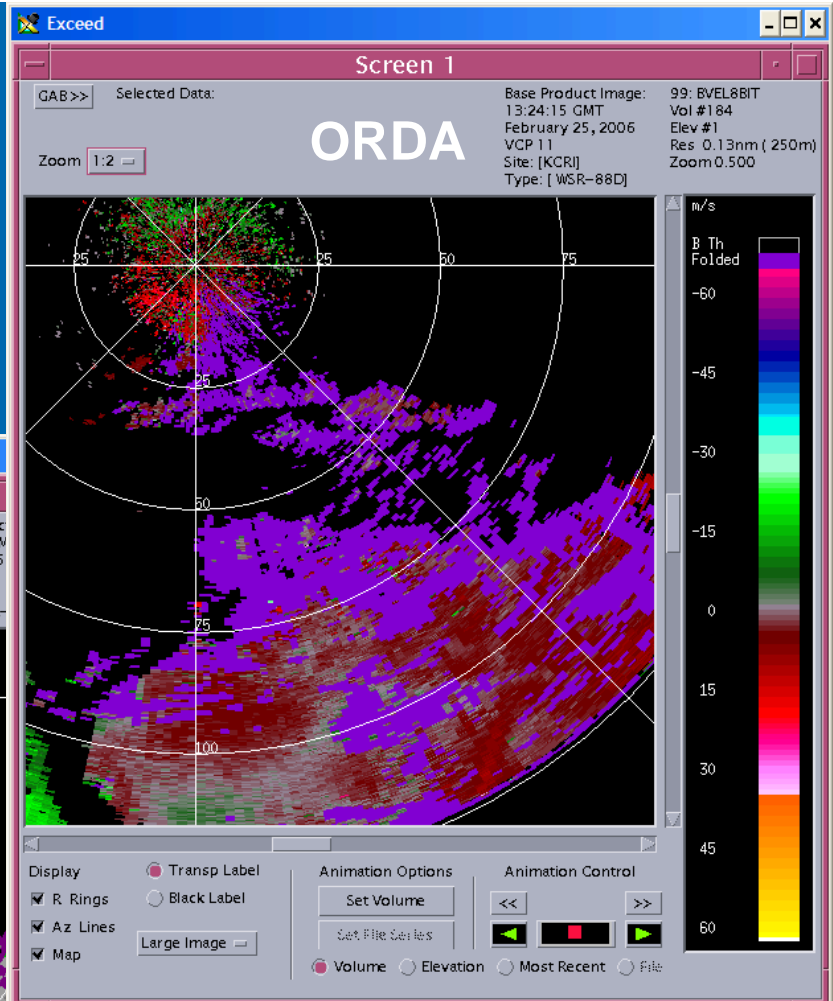
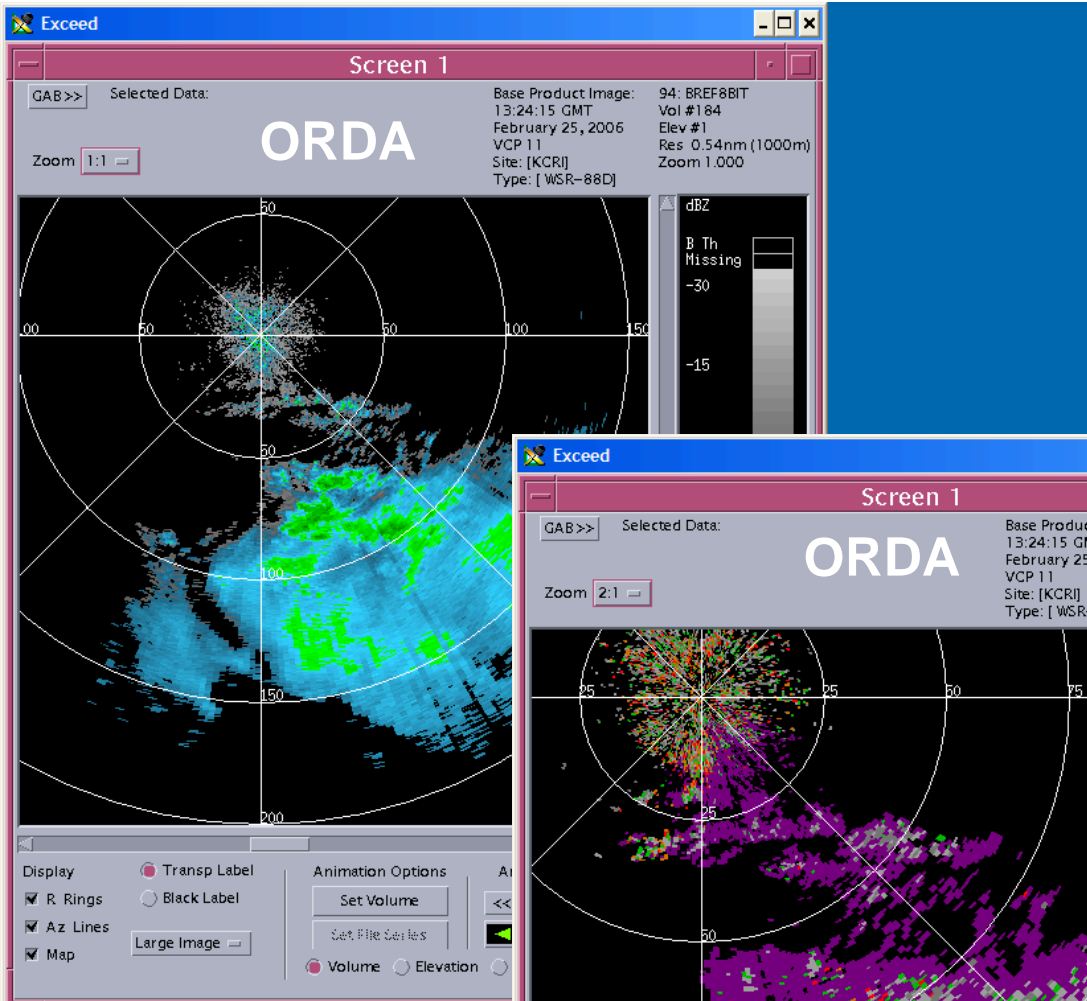


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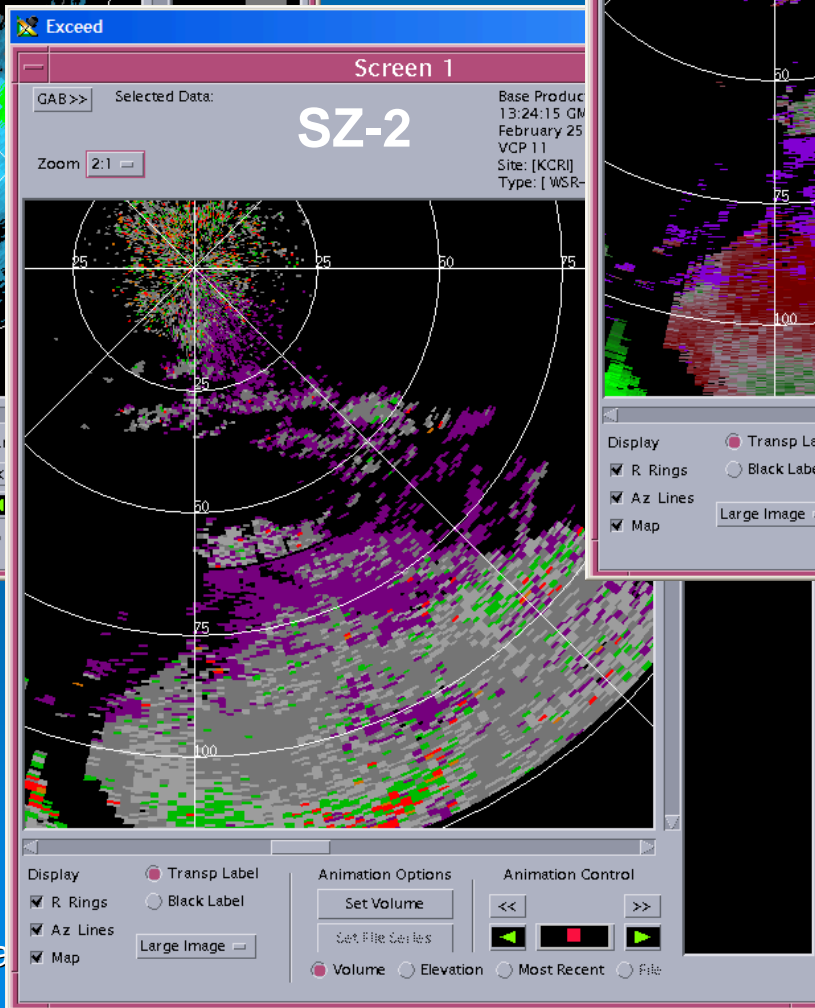
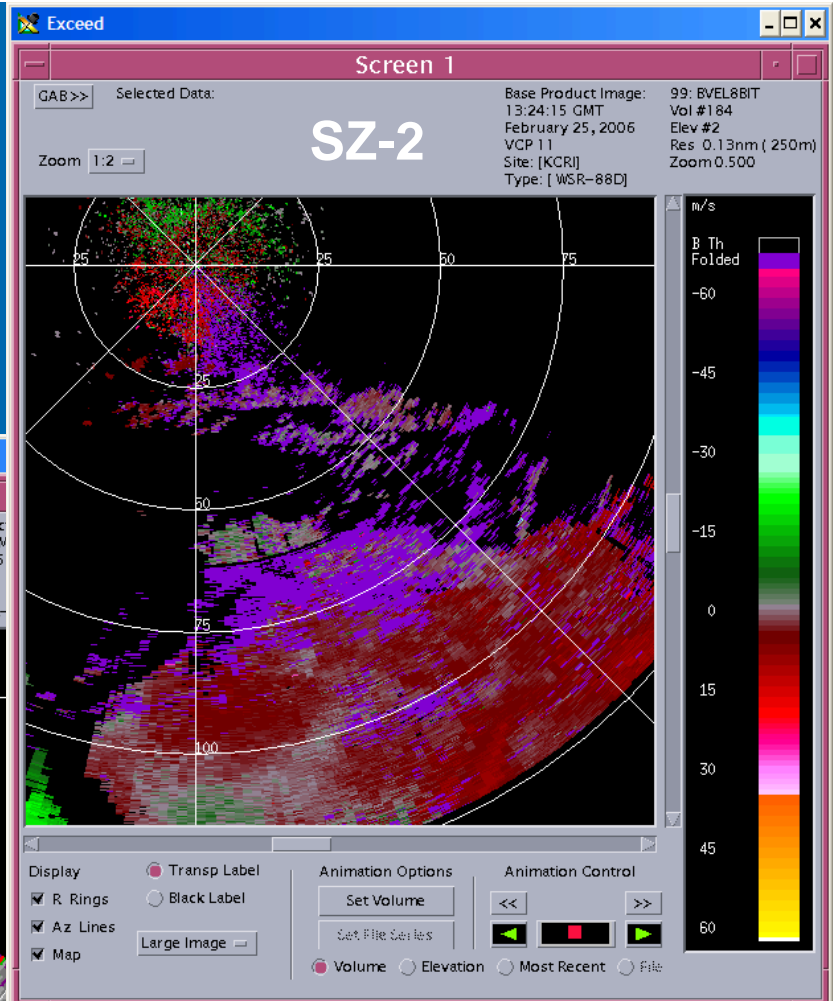
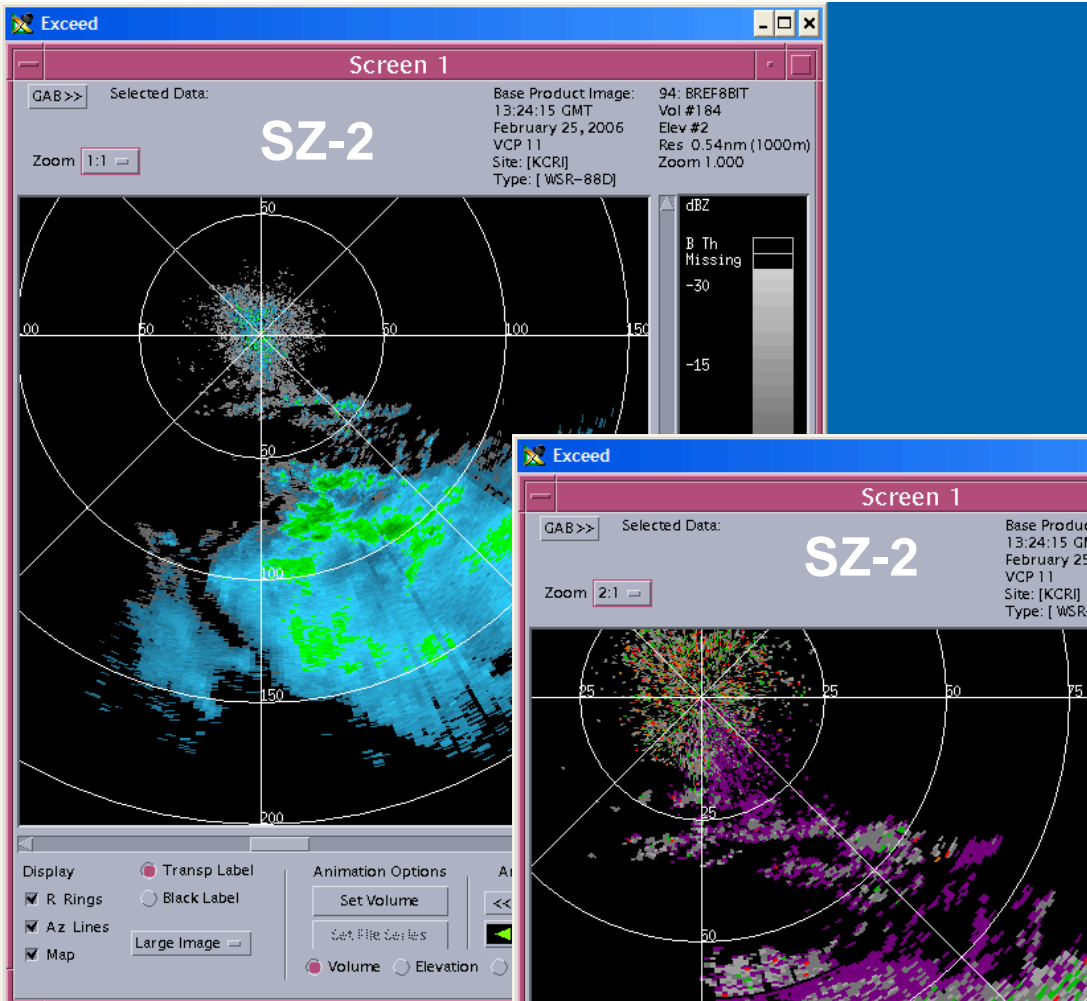


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14



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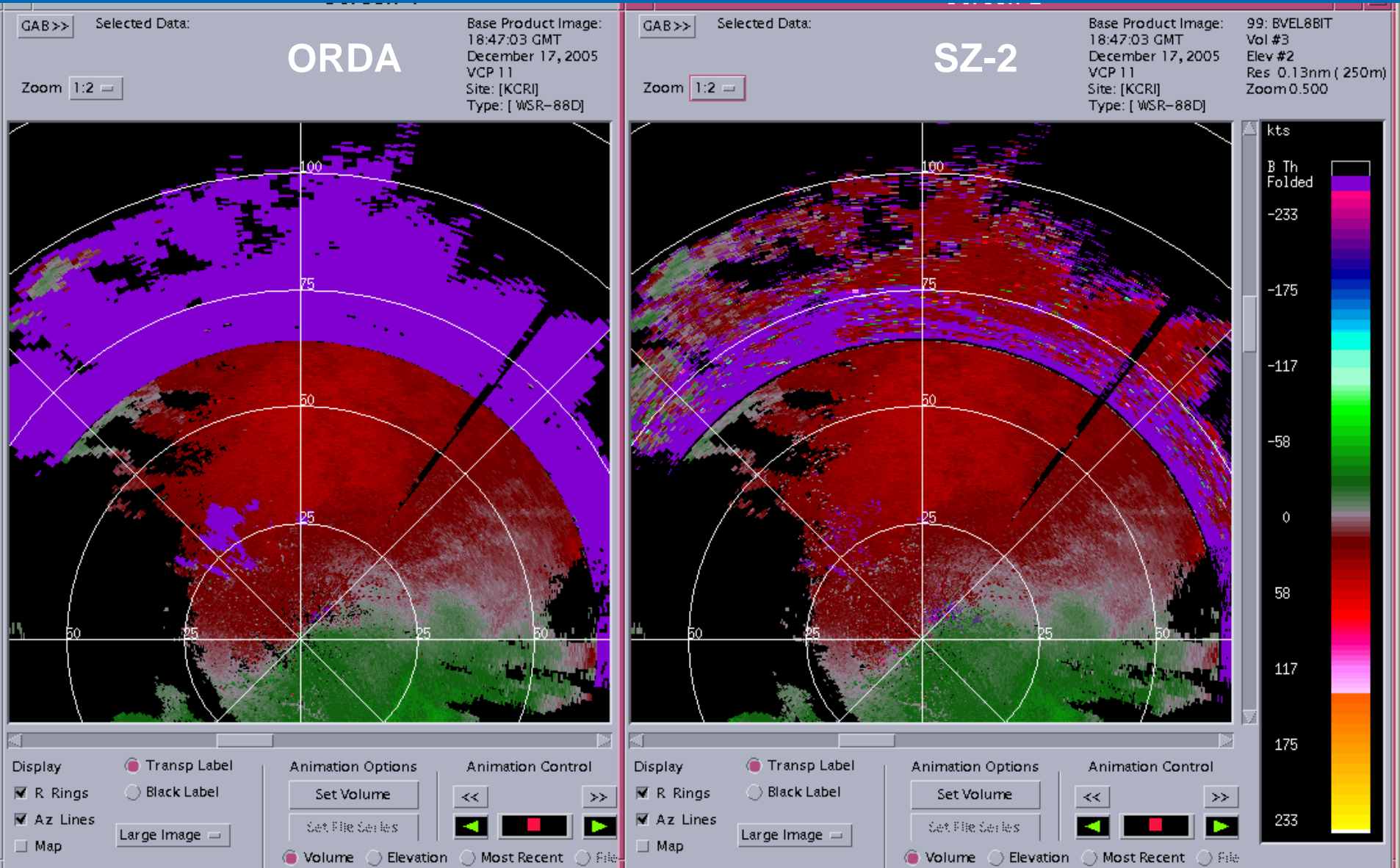
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Analysis Techniques for SZ-2

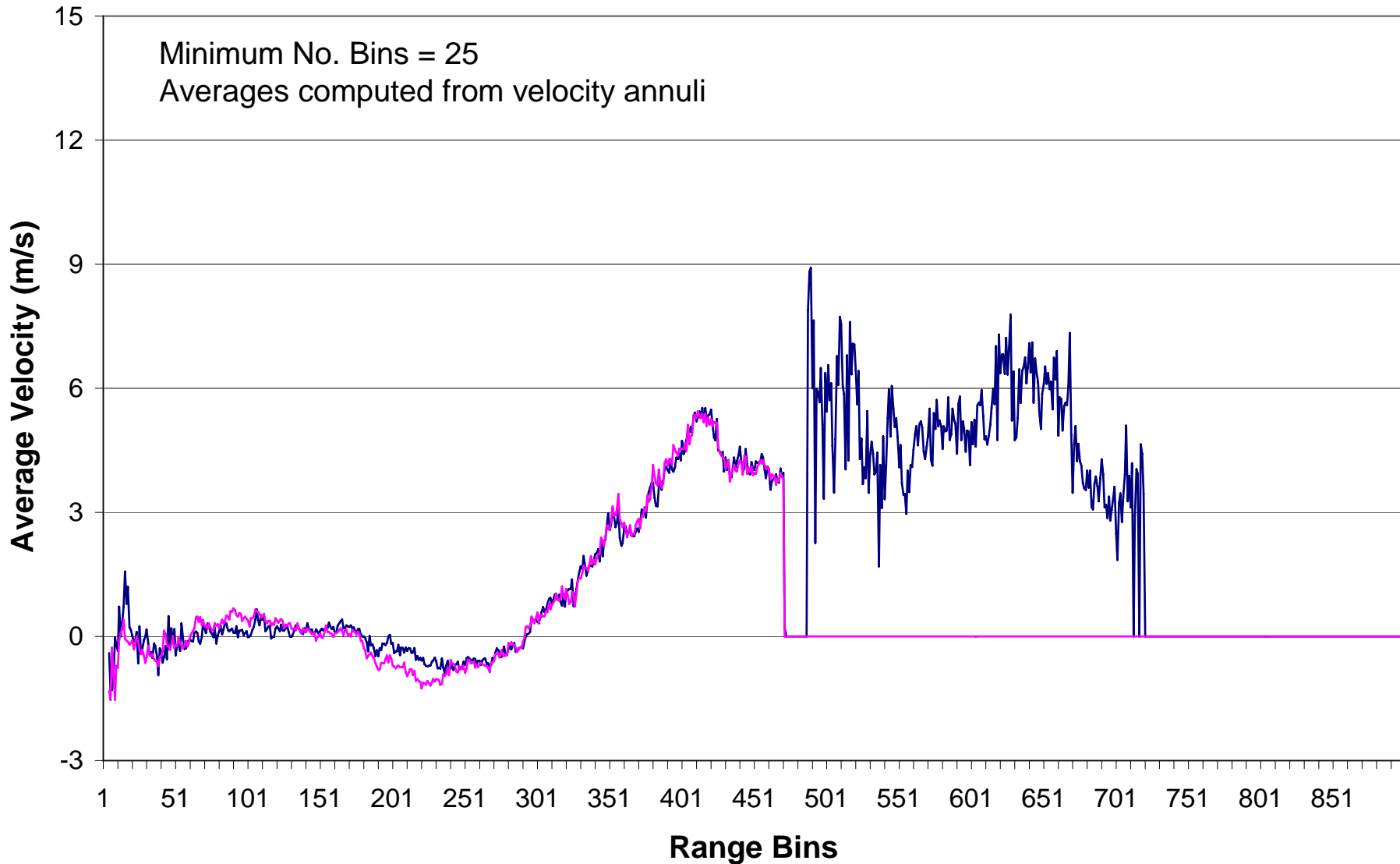
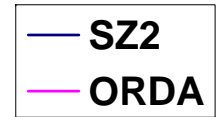
- Compare SZ-2 to ORDA and SZ-2 first trip to second trip
 - Histograms of reflectivity, velocity, and spectrum width
 - Bin counts and area comparisons of SZ-2 & ORDA velocity/spectrum width range folding reduction
 - Velocity & spectrum width averages & standard deviations computed as a function of range (i.e., all bins at a constant range, minimum 25 bins required)
 - Outlier computations for reflectivity, velocity, and spectrum width

17 December 2005, 18:47Z



Average Velocity v. Range

17 December 2005 1847Z



Computation of Outliers

Weights for Computing Outliers

| | Azm(N-1) | Azm(N) | Azm(N+1) |
|----------|-----------|-----------|-----------|
| Rng(M+1) | wt = 0.10 | wt = 0.15 | wt = 0.10 |
| Rng(M) | wt = 0.15 | | wt = 0.15 |
| Rng(M-1) | wt = 0.10 | wt = 0.15 | wt = 0.10 |

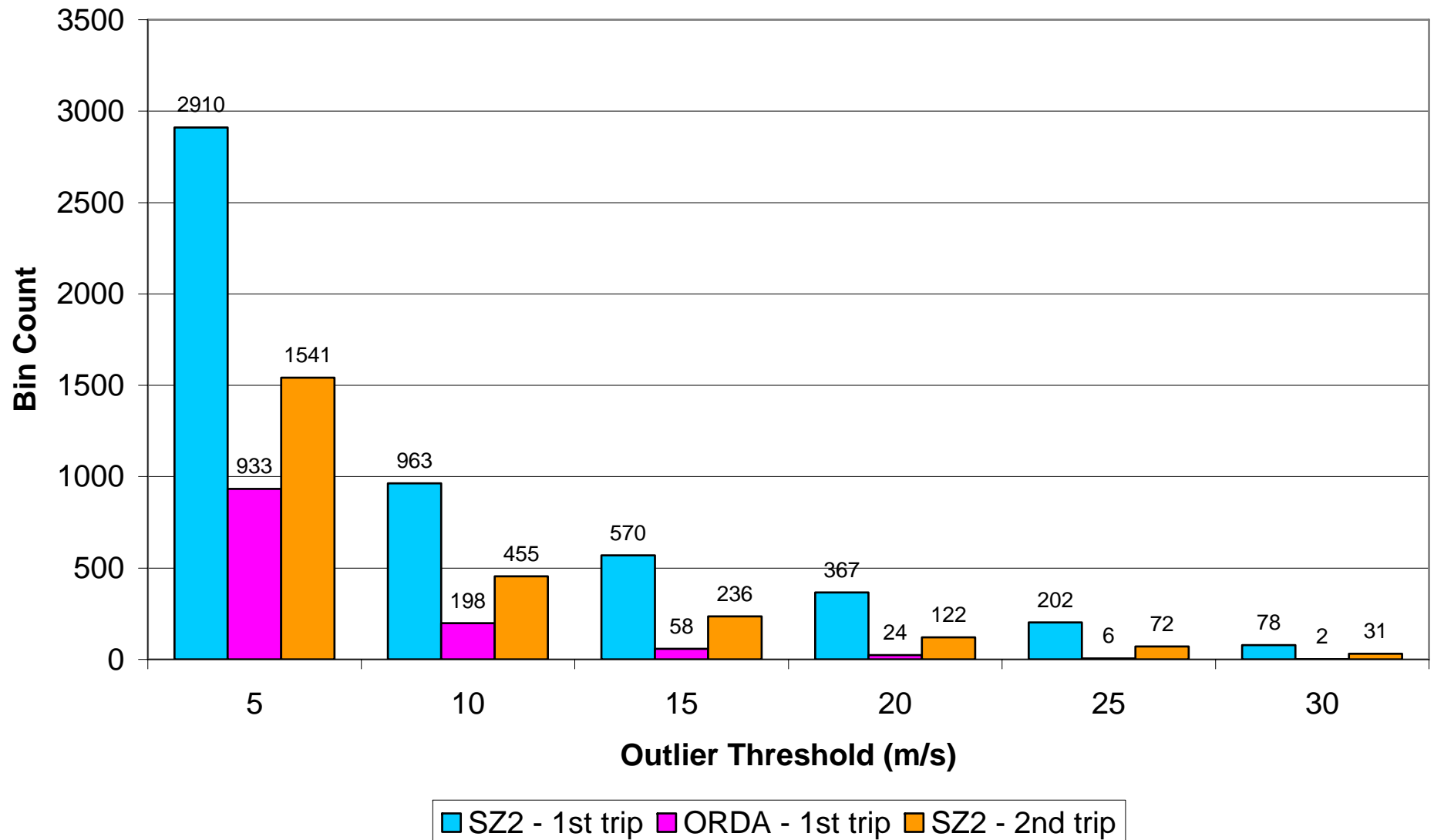
Sum of Wts > 0.50

Data is outlier if

$\text{abs}\{\text{Data}(N,M) - \text{Weighted Data Average}\} > \text{Threshold Data Difference}$

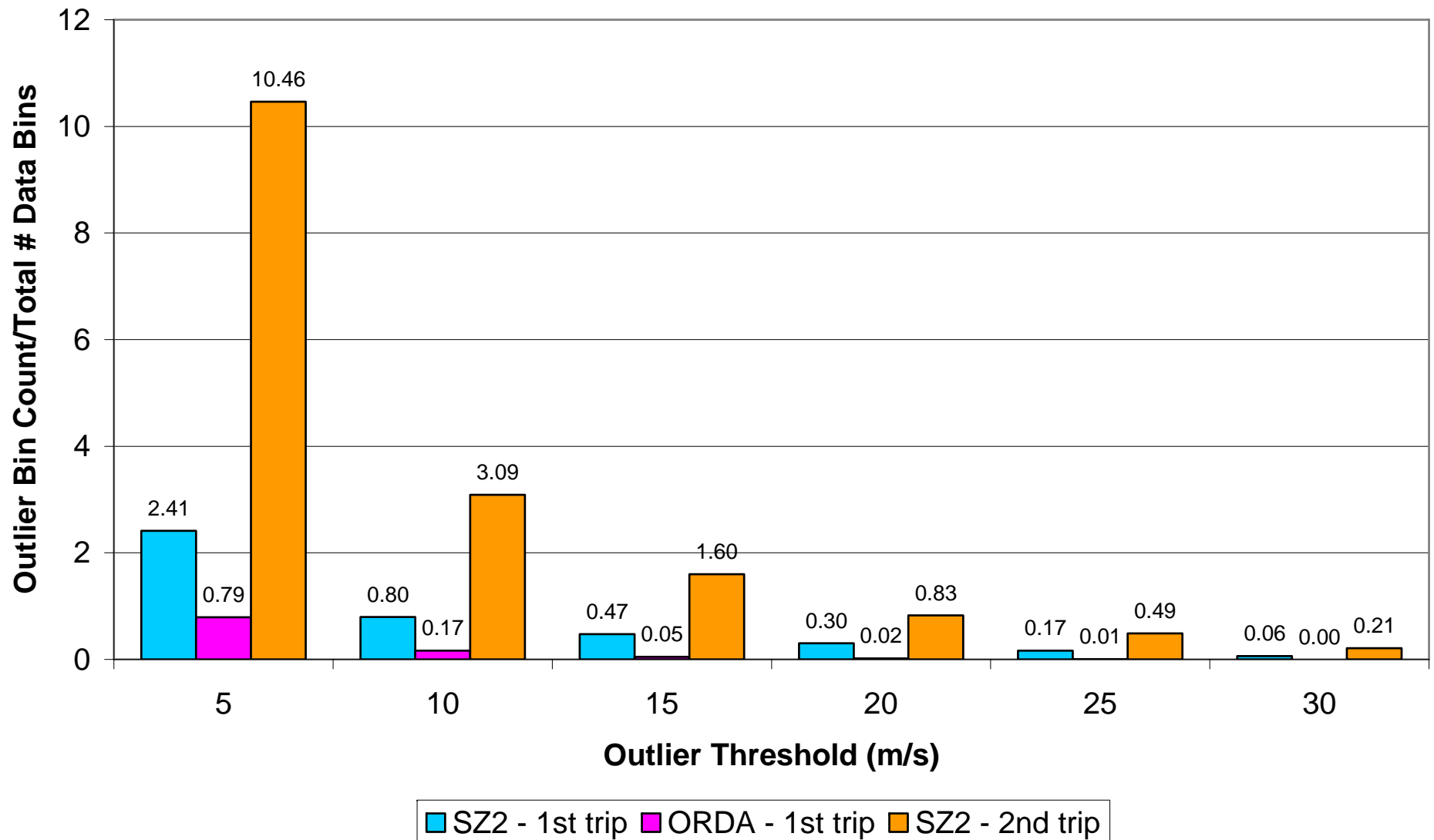
Comparison of SZ2 v. ORDA Velocity Outliers

KCRI 17 December 1847Z, PRF 8

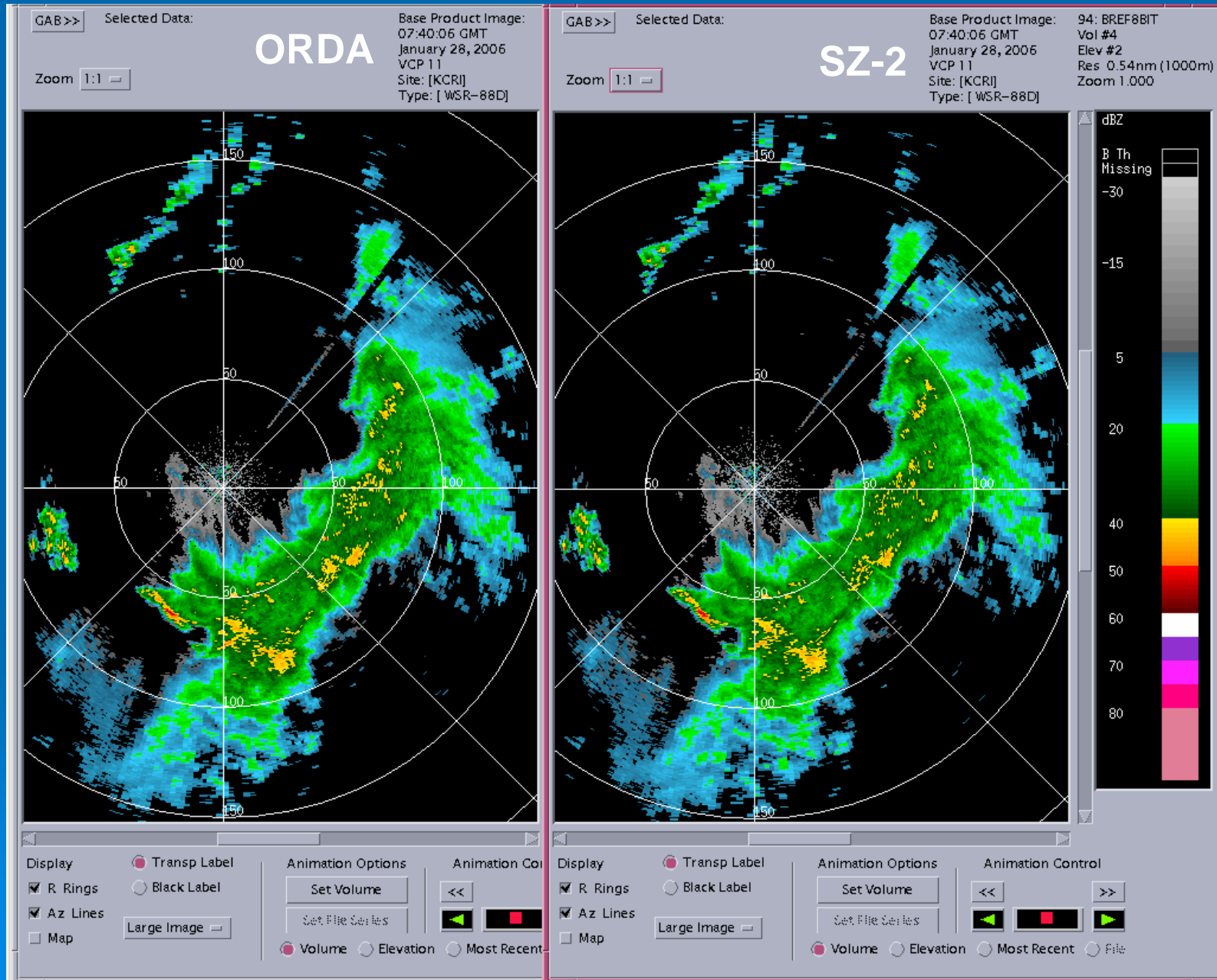


Comparison of SZ2 v. ORDA Velocity Outliers

KCRI 17 December 1847Z, PRF 8

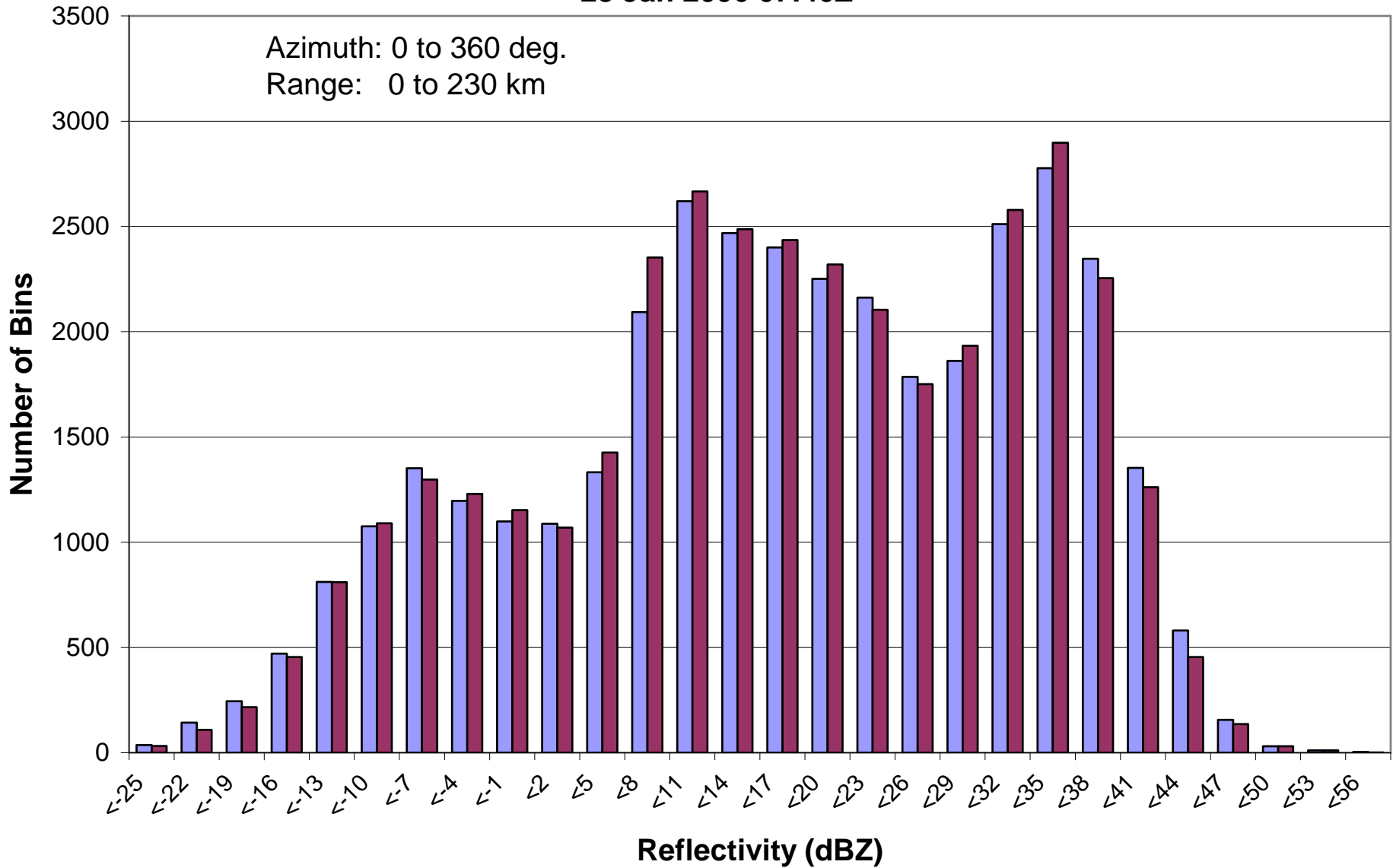
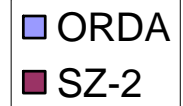


Reflectivity 28 January '06 07:40Z

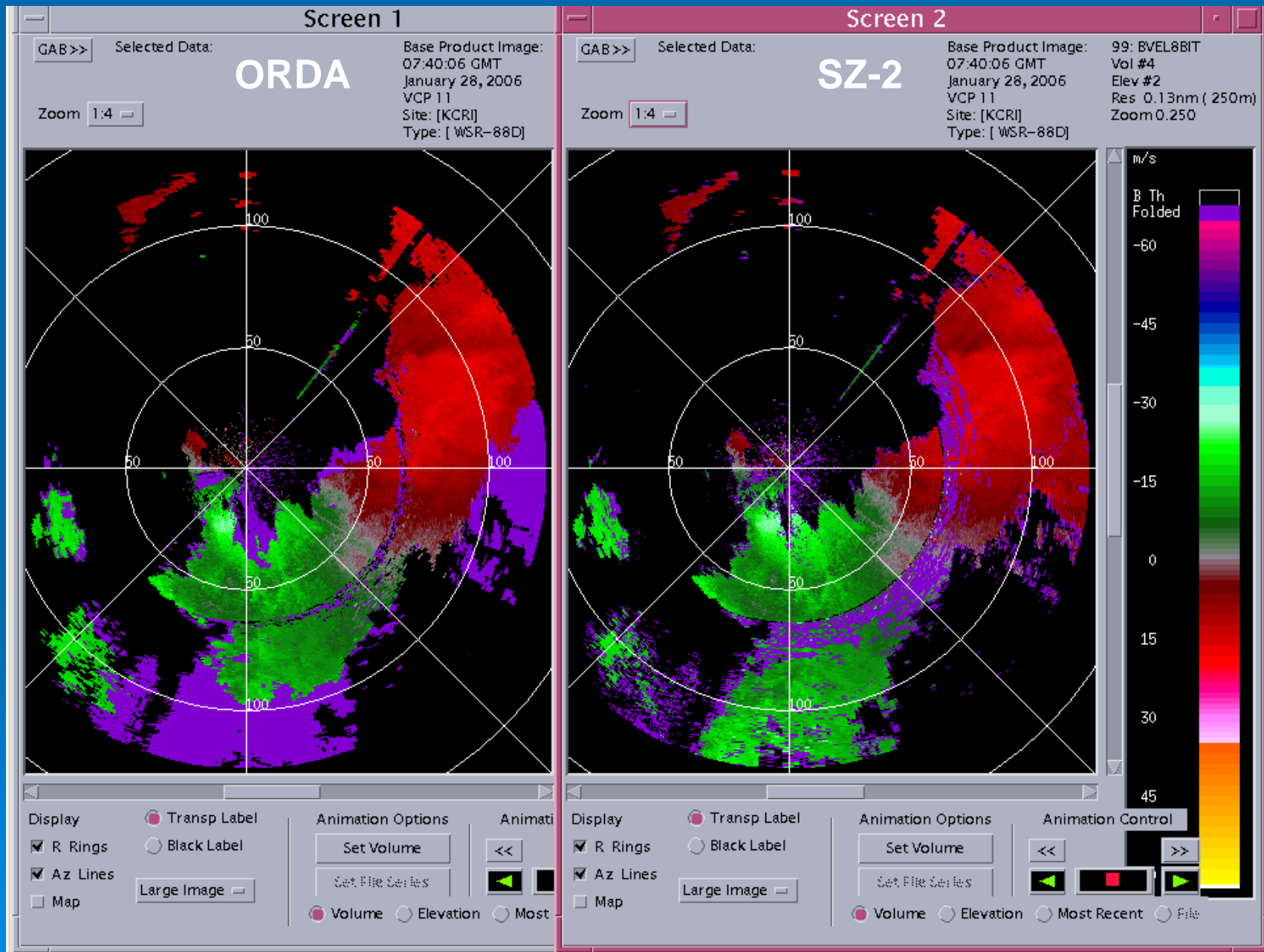


ORDA v. SZ-2 Reflectivity Histogram

28 Jan 2006 07:40Z

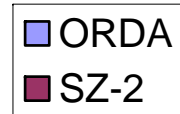


Velocity 28 January '06 07:40Z

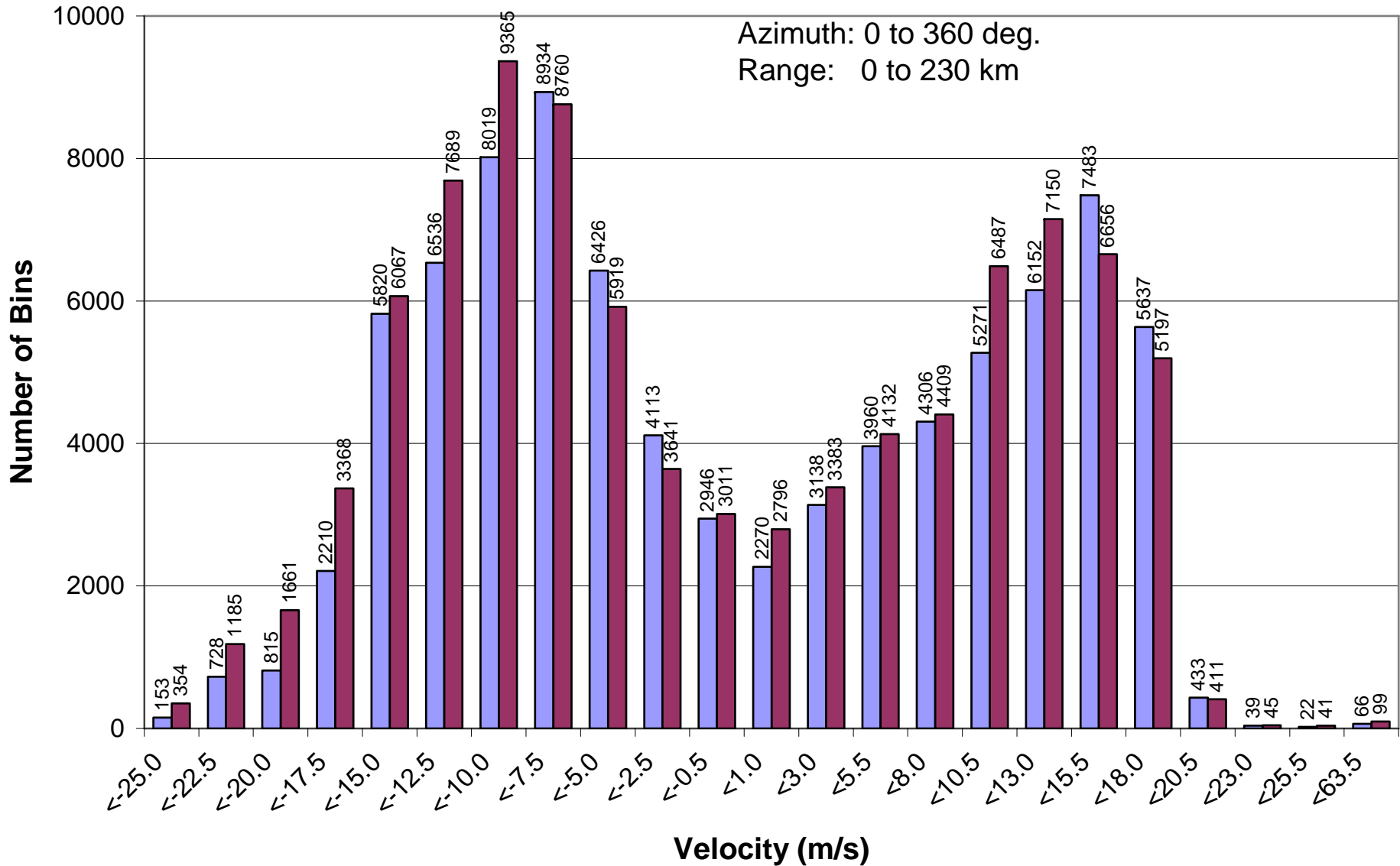


SZ-2 v. ORDA Velocity Histogram

28 Jan 2006 07:40Z



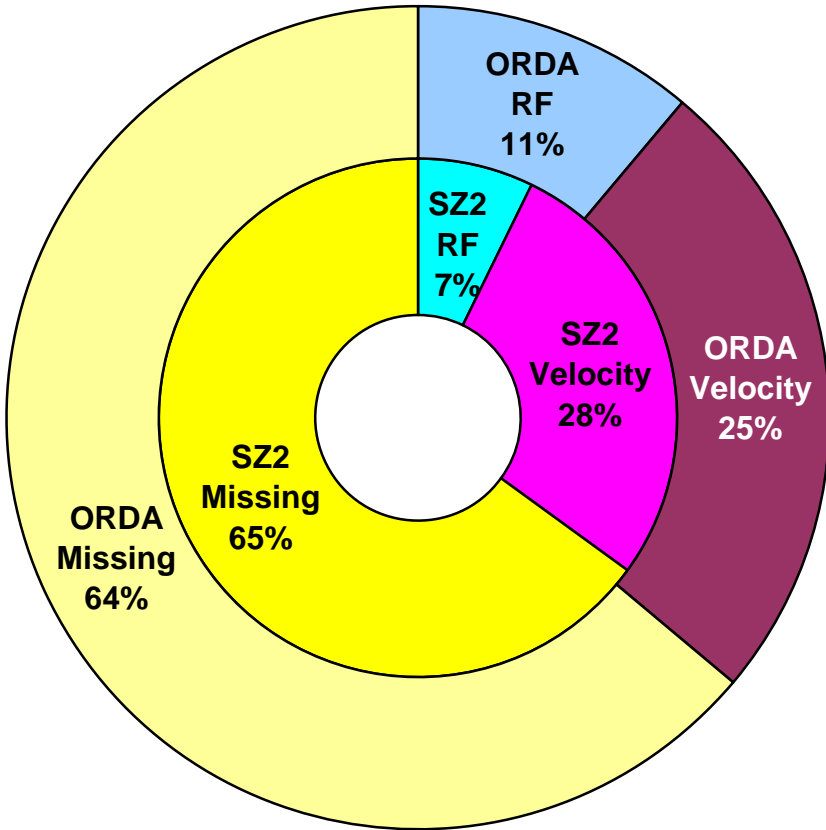
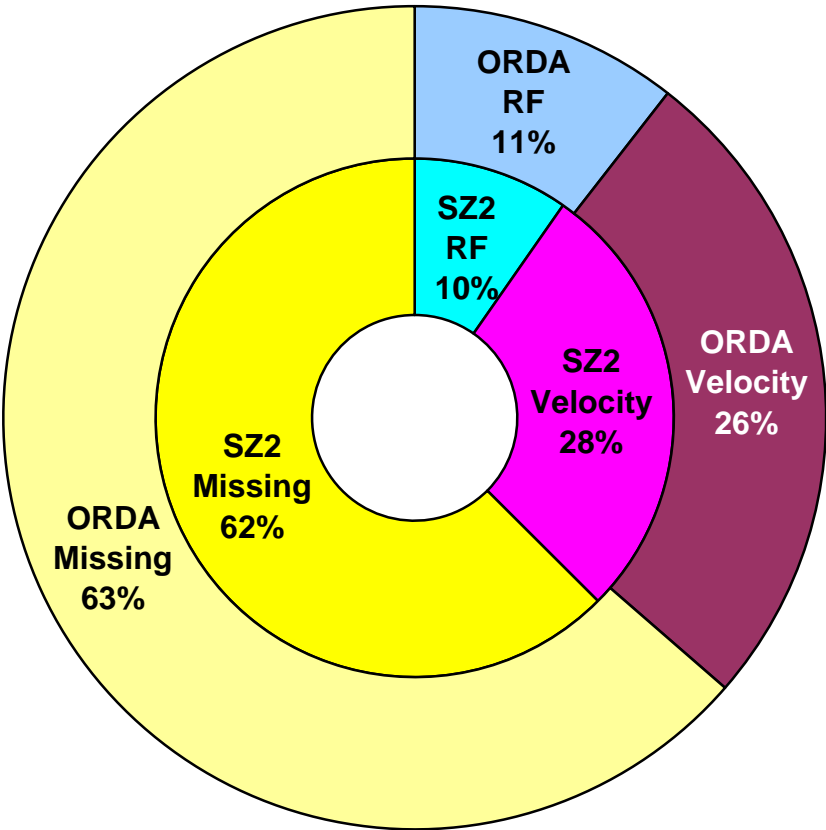
Azimuth: 0 to 360 deg.
Range: 0 to 230 km



Full Field 360 deg. x 920 bins

SZ2 v. ORDA Bin Count
28 January 2006 0740Z

SZ2 v. ORDA Area
28 January 2006 0740Z

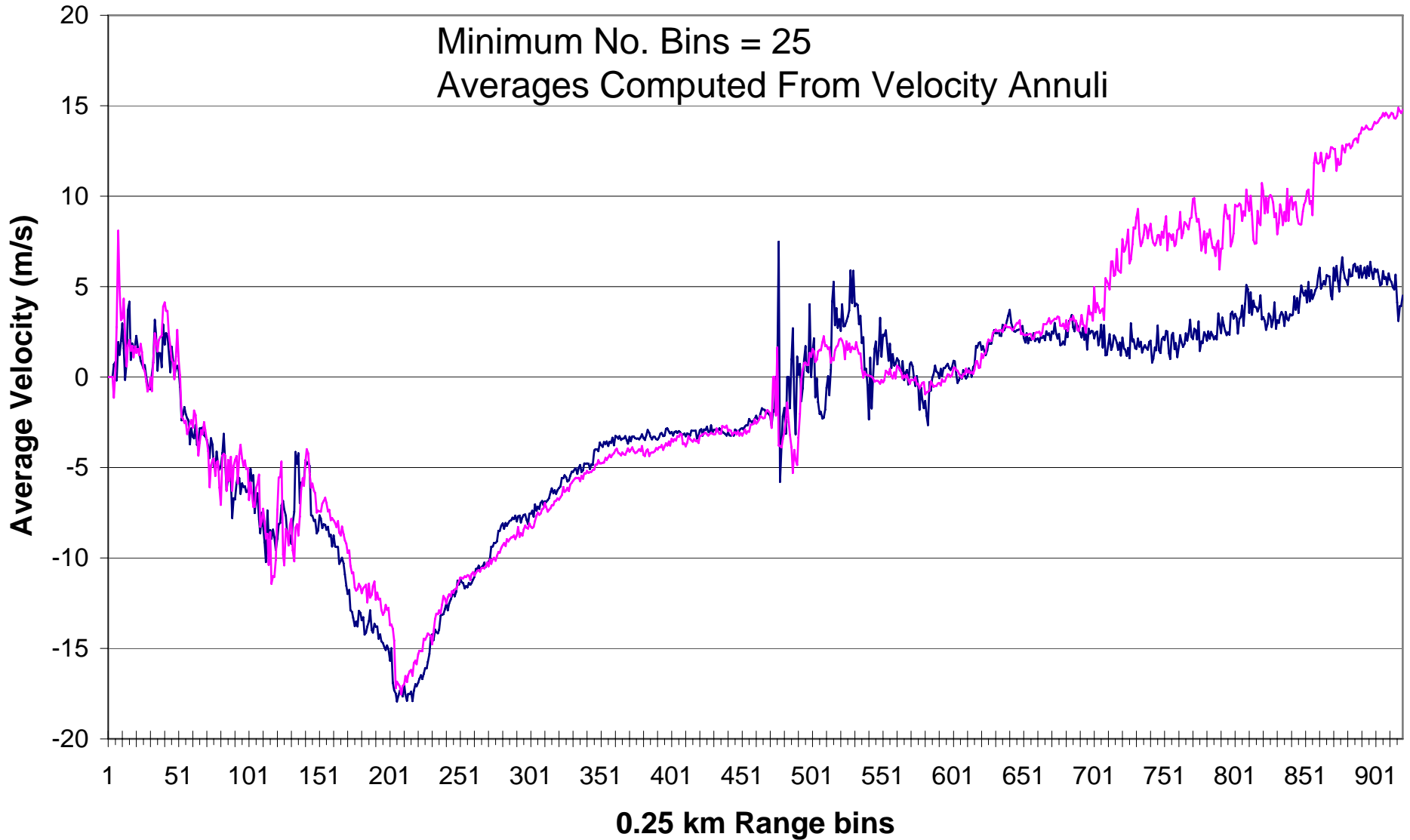
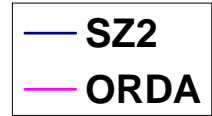


RF Velocity Missing

RF Velocity Missing

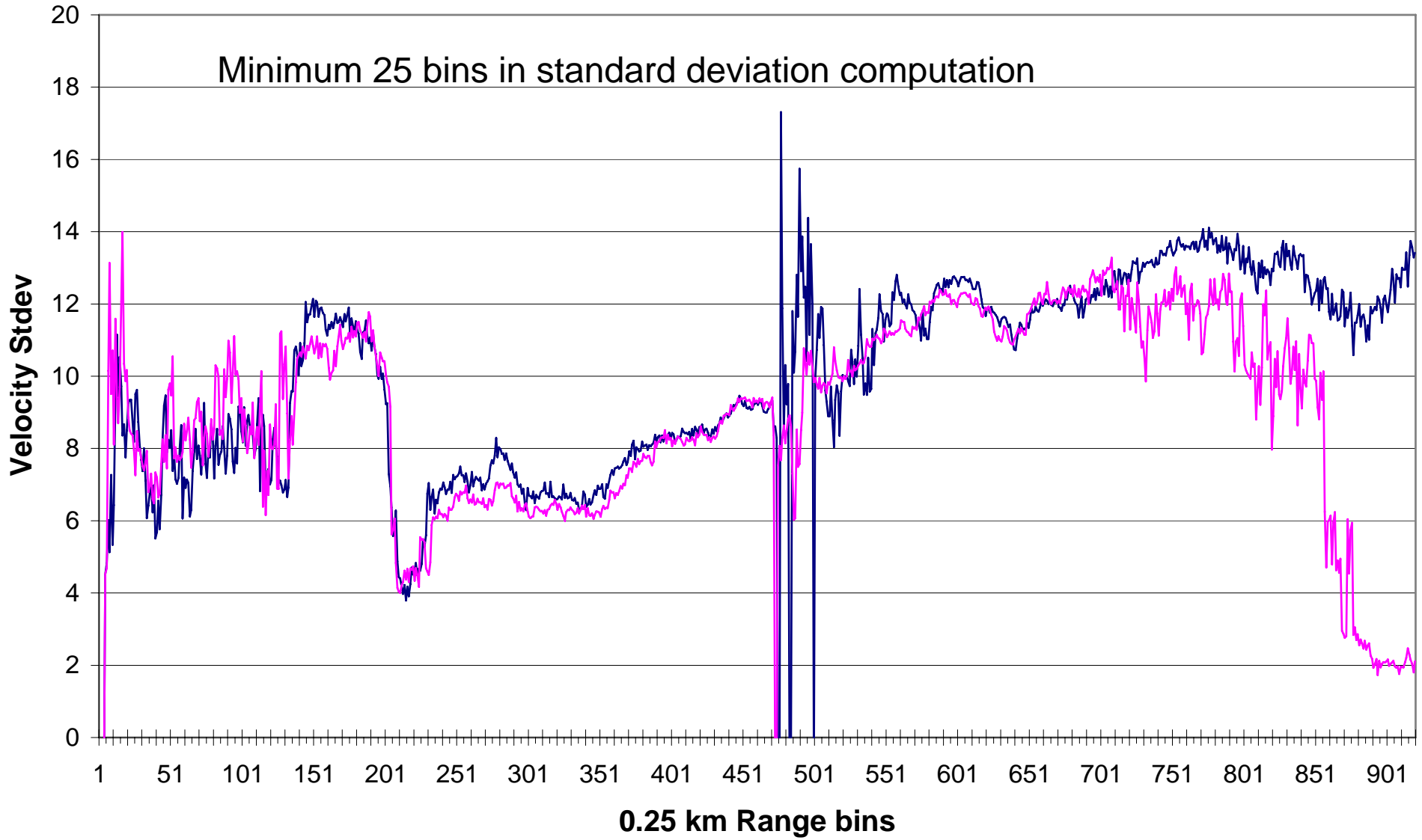
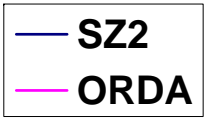
Average Velocity v. Range

28 January 2006 0740Z



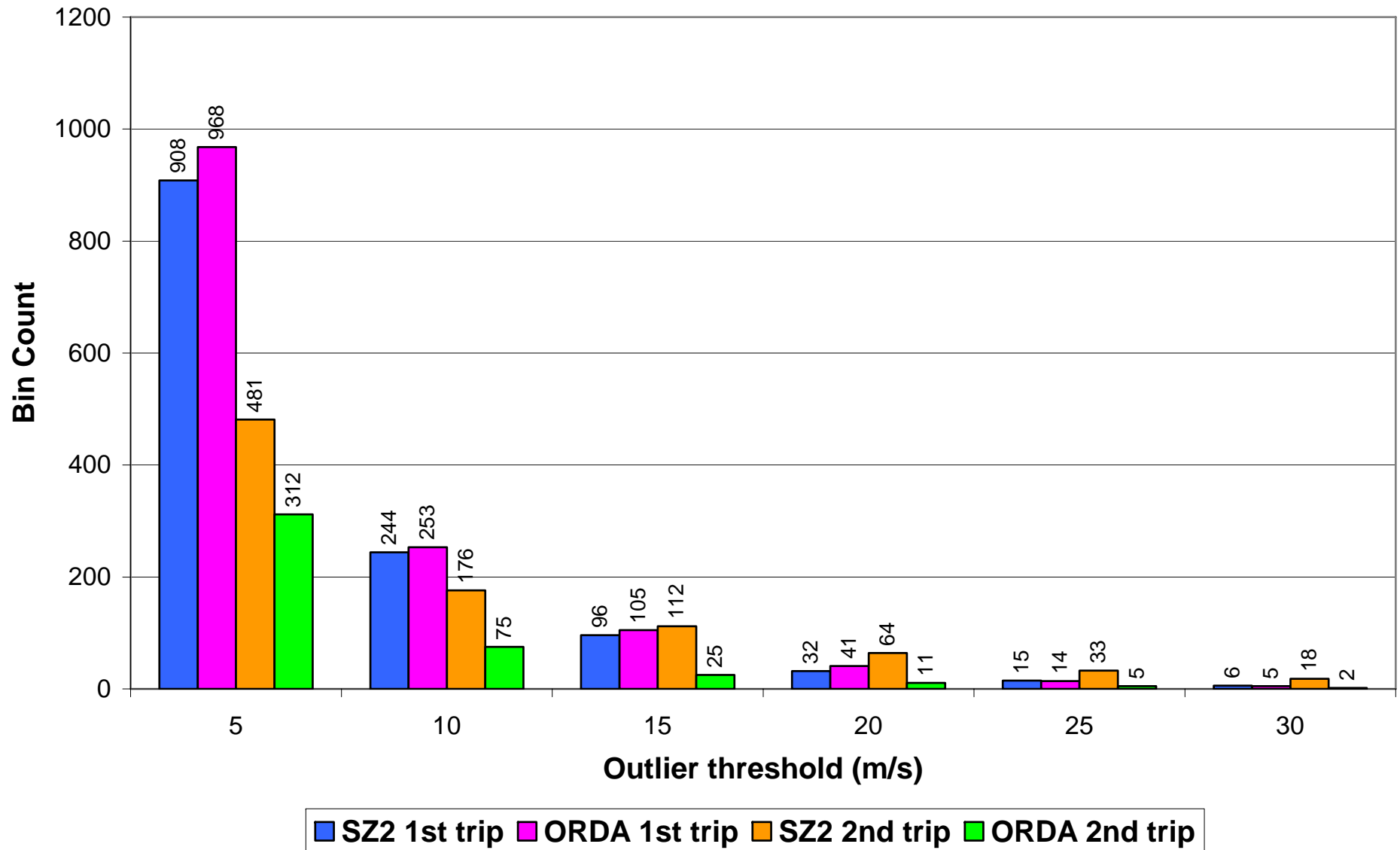
Velocity Stdev v. Range

28 January 2006 0740Z



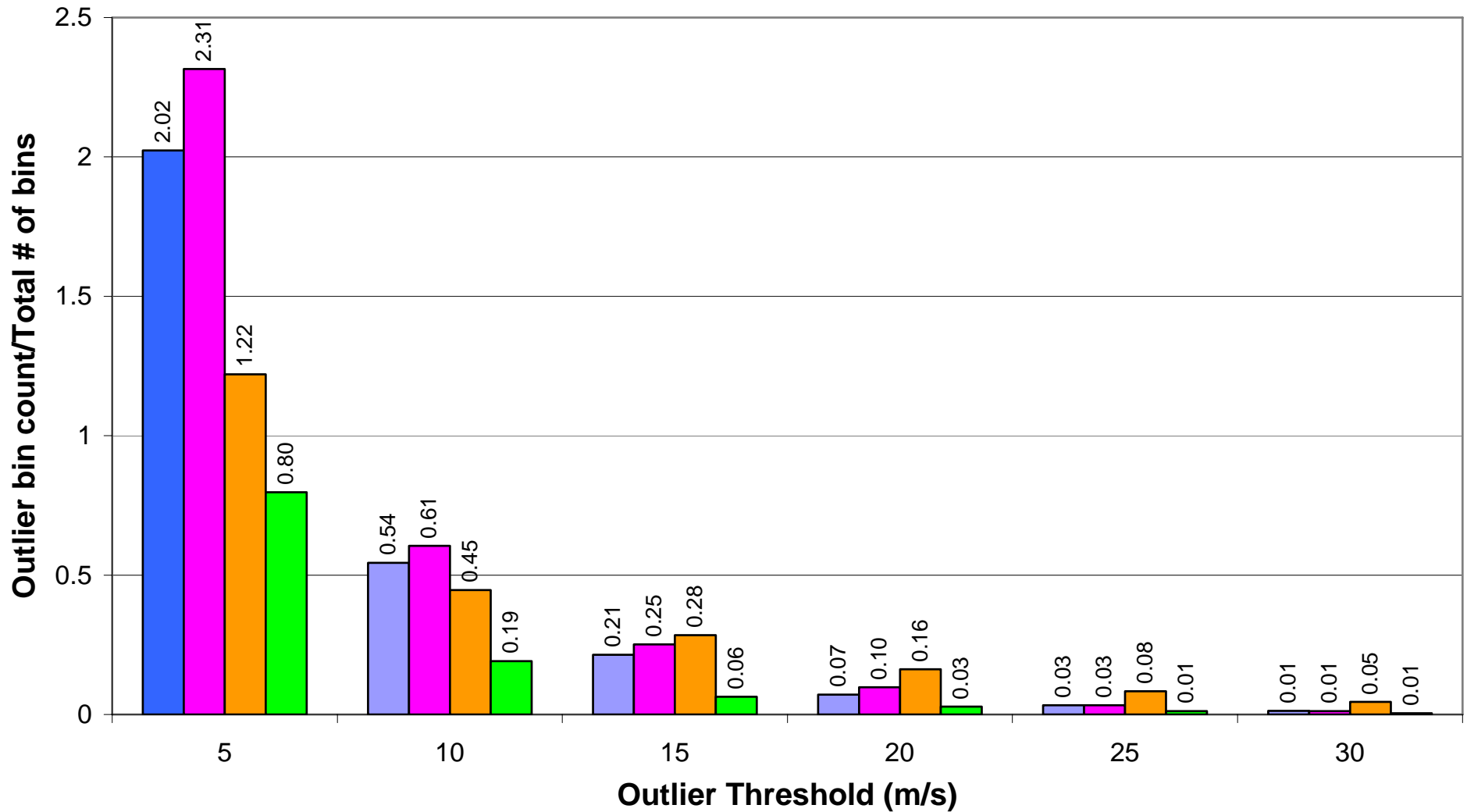
Comparison of SZ2 v. ORDA Velocity Outliers

28 January 2006 0740Z



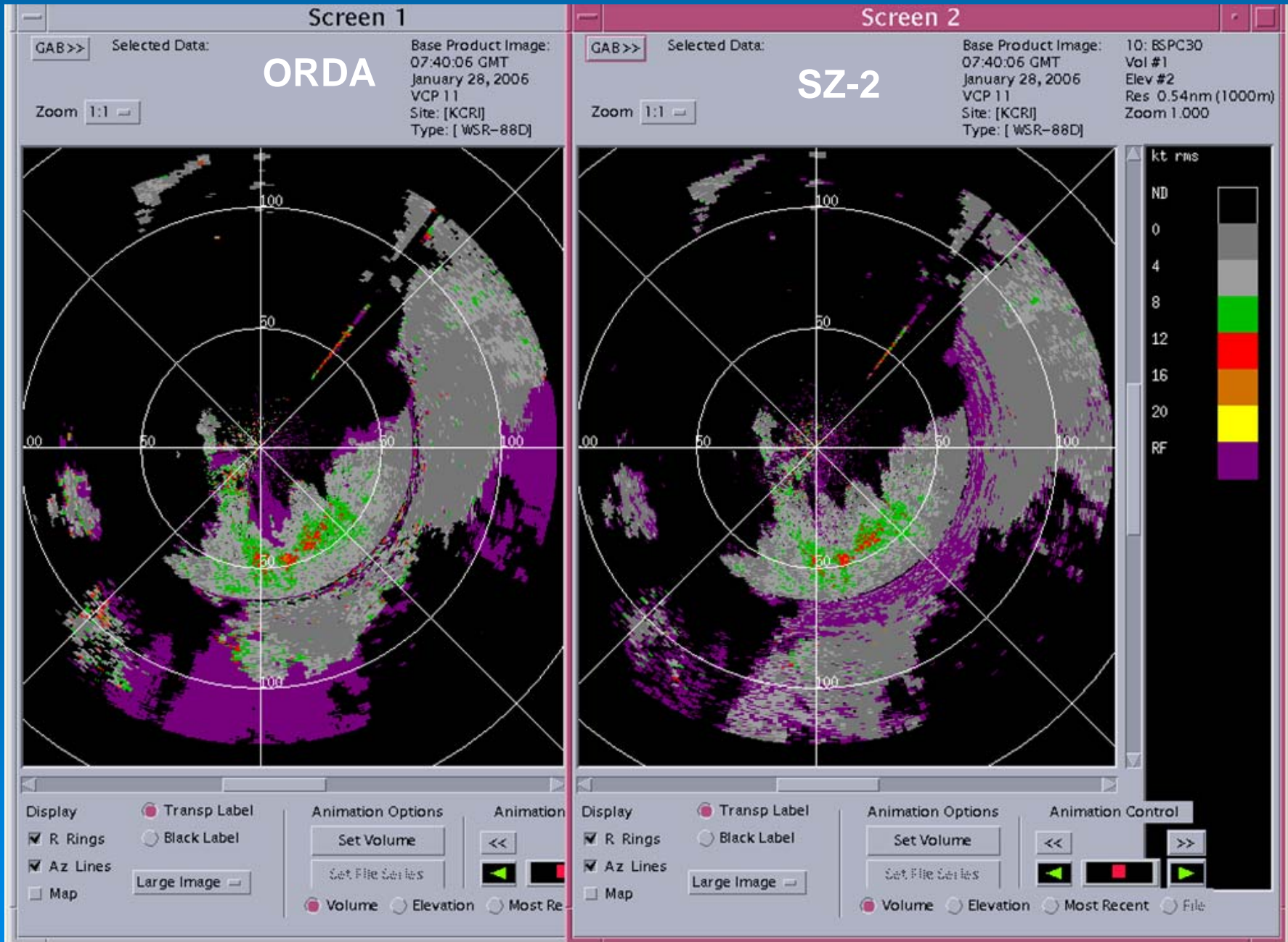
Comparison of SZ2 v. ORDA Velocity Outliers

28 January 2006 0740Z



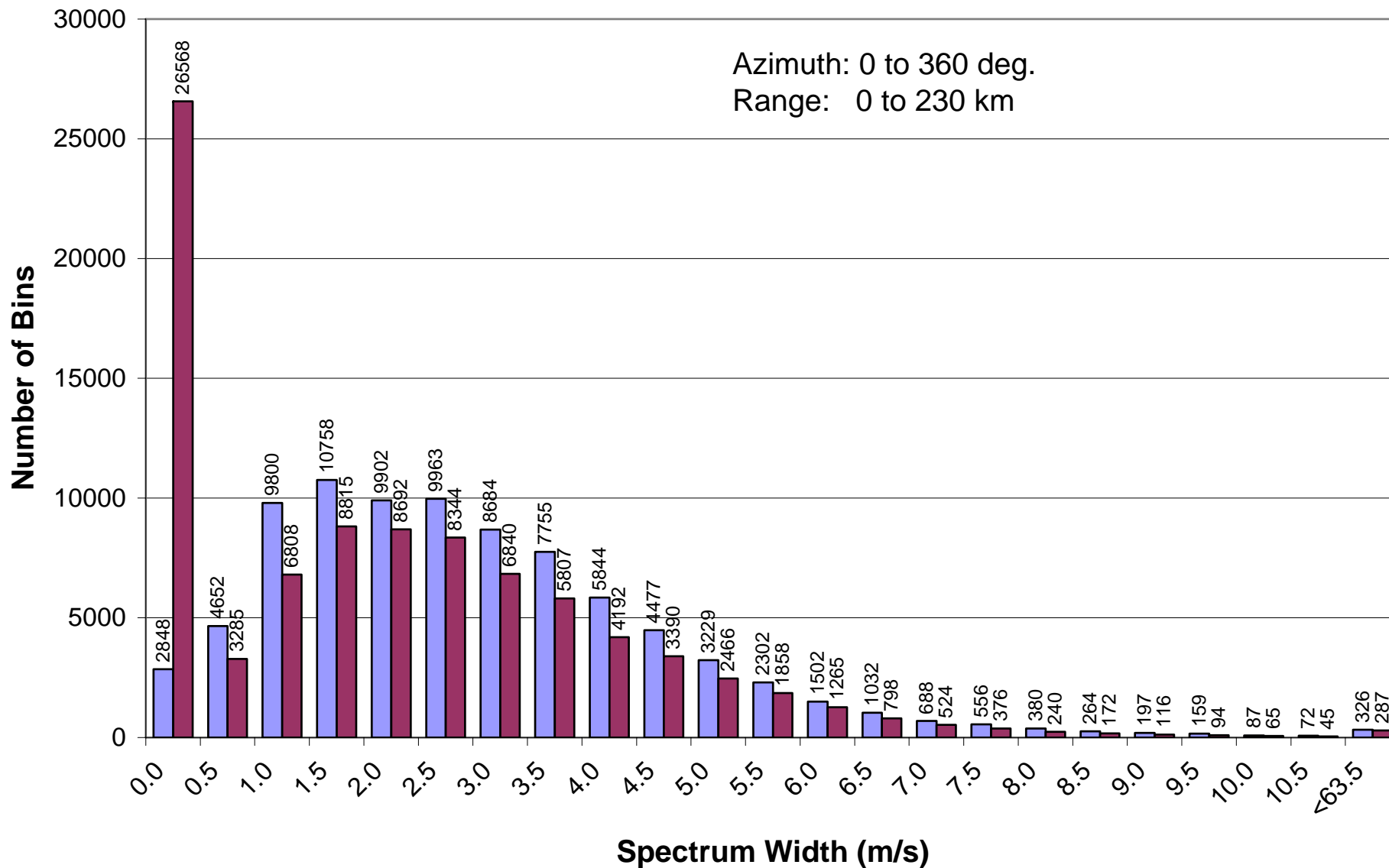
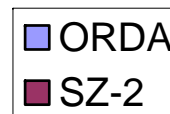
■ SZ2 1st trip ■ ORDA 1st trip ■ SZ2 2nd trip ■ ORDA 2nd trip

8-Level Spectrum Width 28 January '06 07:40Z

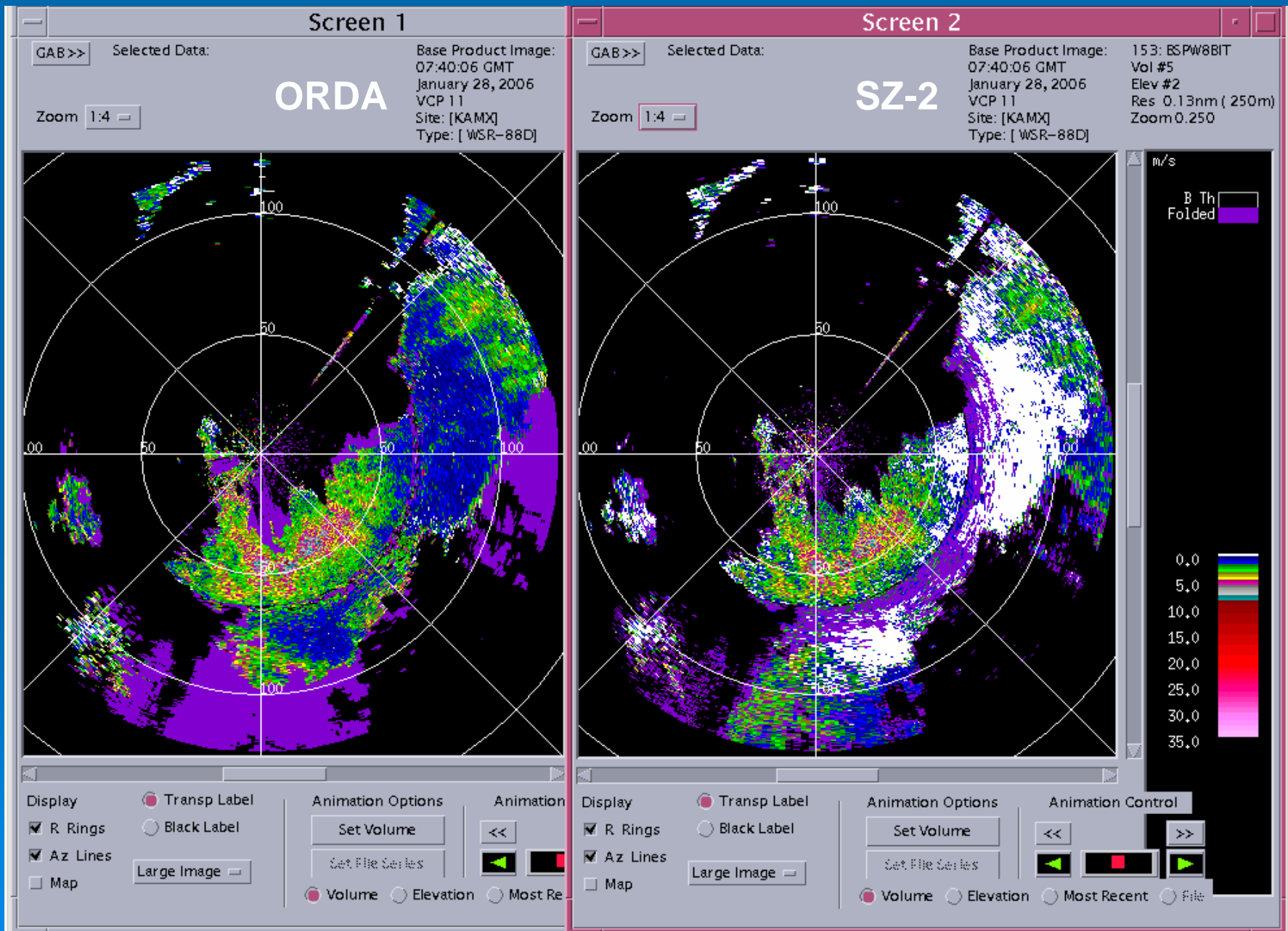


SZ-2 v. ORDA Spectrum Width Histogram

28 Jan 2006 07:40Z



Digital Spectrum Width 28 January '06 07:40Z



Status of Engineering Integration

- SZ-2 - ORDA integration in progress
- Initial data analysis is positive
- Some interest areas identified
 - Thresholds require optimization
 - Excess overlaid indication in low signal/strong clutter areas
 - Temporary engineering fix tested
 - Results positive
 - Increased overlaid indication at start of 2nd trip for some cases
 - Low spectrum width estimates (high number of zero values)
 - Clutter filtering in all bins
 - SZ-2 performs its own test for clutter
 - Increases number of zero velocity bins
 - Threshold adjustment reduces occurrence

Near-term Future Work

- Start comparing SZ-2 data with PRFs other than PRF 8 and to VCP 121 (Multi-PRF Dealiasing Algorithm)
- Test SZ-2 with Build 9 software esp. new VCPs
- Collect more storm cases

Summary

- The amount of echo recovered in strong, 2nd trip is impressive when compared to ORDA Doppler moments collected using PRF 8
- For the latest cases evaluated, the number of outliers in SZ-2 data are as few as or fewer than the number of ORDA outliers
- A large number of Spectrum Width values have a value of exactly zero in SZ-2 data (almost an order of magnitude $>$ than in the ORDA data)

Summary (cont'd)

- For some cases there continues to be a wider area of unrecoverable echo at the start of 2nd trip in SZ-2 than in the ORDA Doppler moments.
- SZ-2 must decide if it needs to use GMAP when clutter is declared in multiple trips. If thresholds are set incorrectly residual clutter may bias velocity to zero.
- A fix is being evaluated for the large number of range folded bins near the radar, especially when only strong, 1st trip echo is present in clutter censored regions.

Conclusions

- Results from initial data analysis are positive
- SZ-2 recovers a significant amount of data compared to ORDA Doppler moments collected using PRF 8
- Additional data cases and work on interest areas are needed

Plan

- Proceed with SZ-2 in Build 9
 - Continue investigating areas of interest
 - Collect more data cases
- Update TAC in fall 2006 on data quality testing and work performed on interest areas

End

