Update on Two-Dimensional Velocity Dealiasing Algorithm

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Presentation to
NEXRAD Technical Advisory Committee

Outline

- Review of 2-Dimensional Velocity Dealiasing Algorithm
- Changes to the 2 dimensional velocity dealiasing algorithm (VDEAL) since the November 2009 Technical Advisory Committee meeting
- Test results
  - NSSL evaluation & example
  - ROC evaluation & examples
- Field test summer & fall 2011

2-Dimensional Velocity Dealiasing Algorithm (VDEAL)

- Uses least-squares approach to dealias velocity discontinuities simultaneously on a full velocity field
- Develops its own wind profile– doesn't use RPG's Environmental Wind Table
- Develops a coarse (sub-sampled) global solution and then resolves discontinuities in smaller regions
- Assigns more weight to velocity differences near $\pm 2V_N$

Changes to VDEAL Since Fall ‘09

- First and last radials are connected azimuthally – improves background wind field estimate
- Velocity differences with low spectrum width values are given greater weight than those with high spectrum width values
- Velocity values from side-lobe contamination are temporarily removed during dealiasing
- Regions connected by a narrow bridge of data are dealiased separately

Comparison of NSSL and ROC Analyses

NSSL

- All elevation angles
- Examined both 1 deg and ½ deg resolution velocity products
- Evaluated 1 clear-air; 5 precipitation events
  - VCPs 12, 31 & 212
  - Hurricane, squall line, storms, & frontal boundaries
  - ~920 1 deg velocity products
  - ~200 ½ deg velocity products

ROC

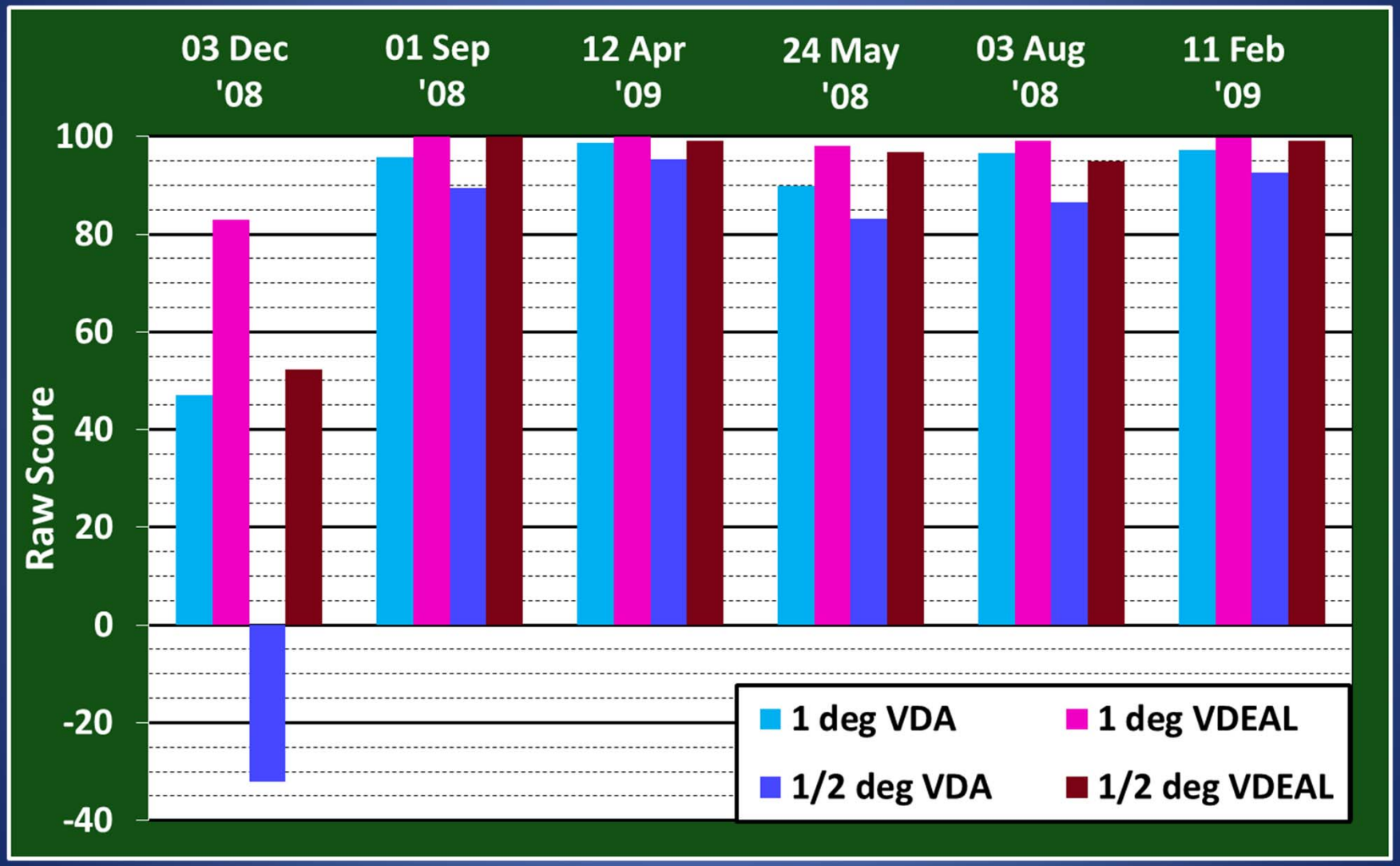
- 0.5 deg elevation angle
- Examined only 1 deg resolution velocity products
- Evaluated 15 precipitation events
  - VCPs 11, 12, 21, & 212
  - Hurricanes, squall lines, & tornadic storms
  - 520 1 deg velocity products

Scoring Methodology Used by NSSL and ROC

Each velocity product image starts with a score of 100 from which points are subtracted as follows:

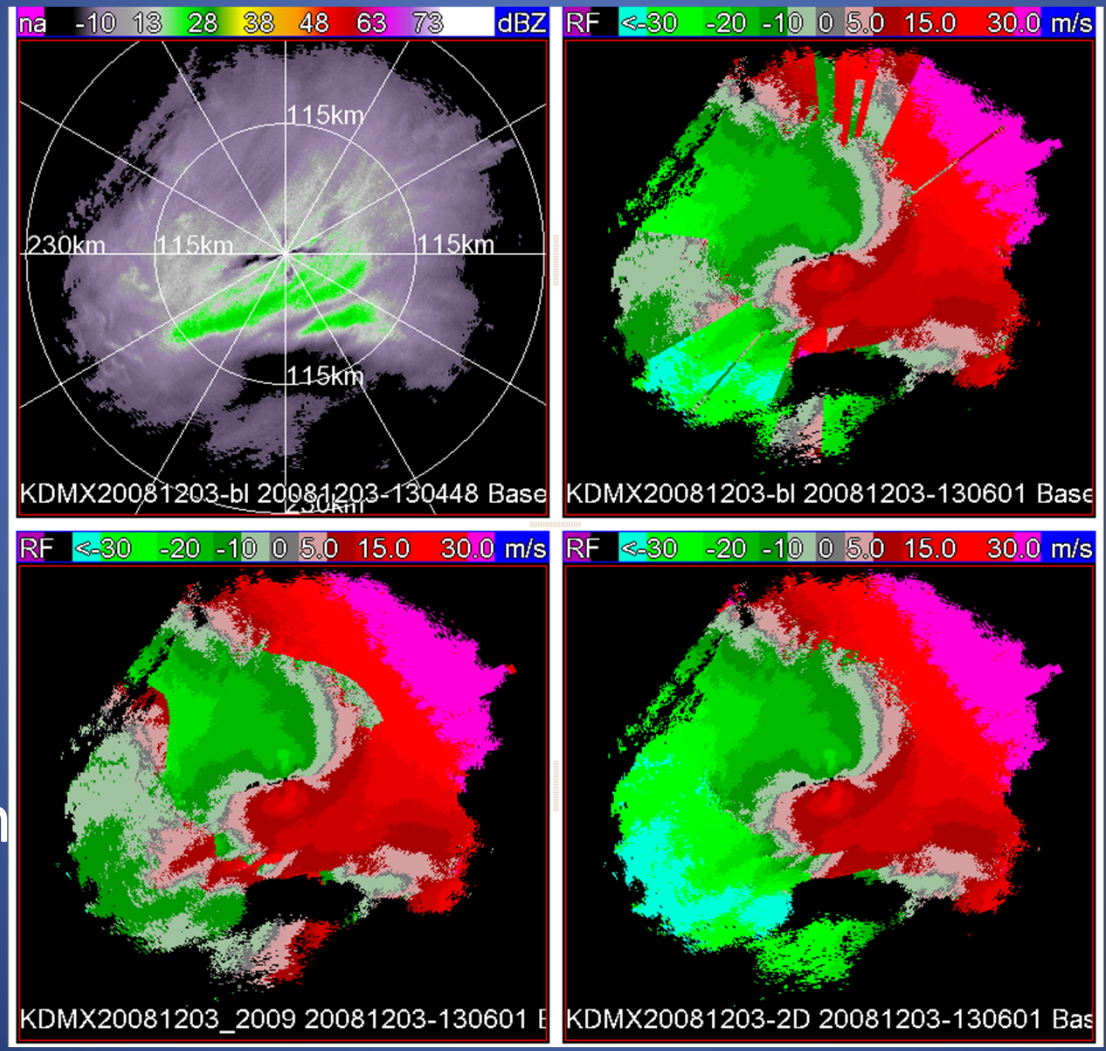
Description of Error	**Penalty**
Single gate or 2 adjacent gates	–1
Small radial spike (<3 km in length)	–2
Very small patch	–2 to –3
Small patch	–4 to –8
Large patch	–8 to –12
Swath of ~20°	–12 to –16
Swath of ~40°	–26 to –30
Swath of ~60°	–32 to –38
Swath of ~90° or larger	–40 to –50

NSSL Results



KDMX, 3 Dec '08, 13:02Z, VCP 31, 1.5° Elv
Frontal Boundary South of Radar

Reflectivity image

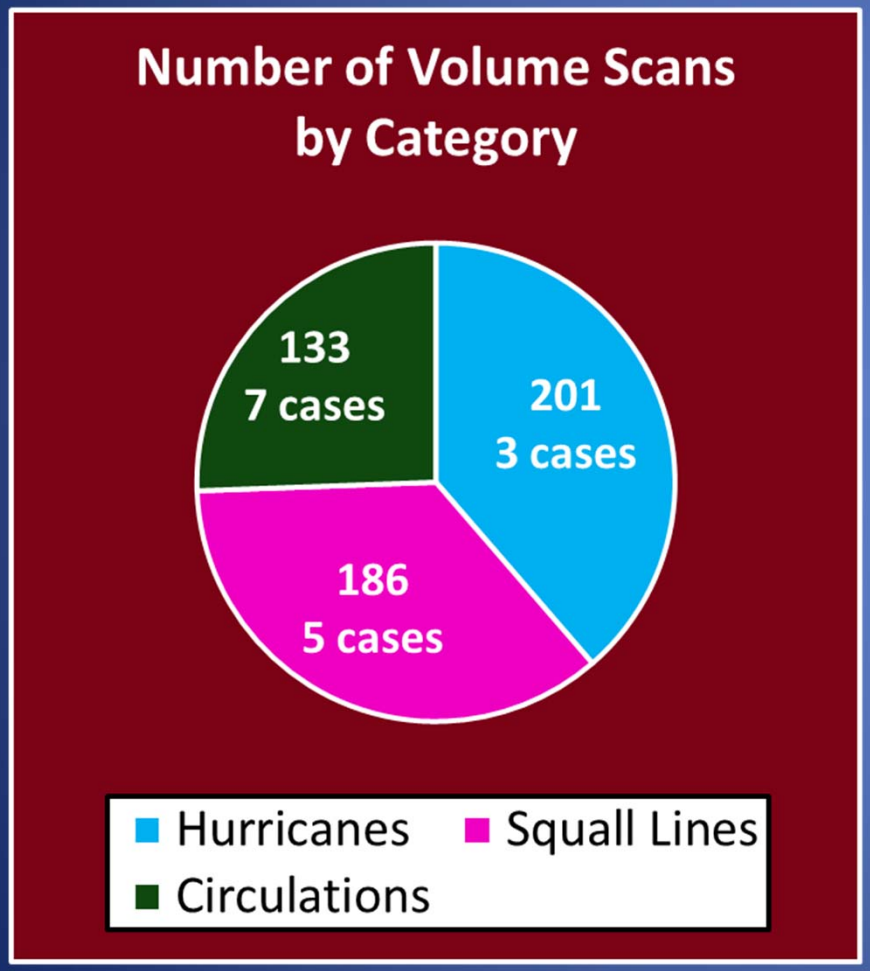


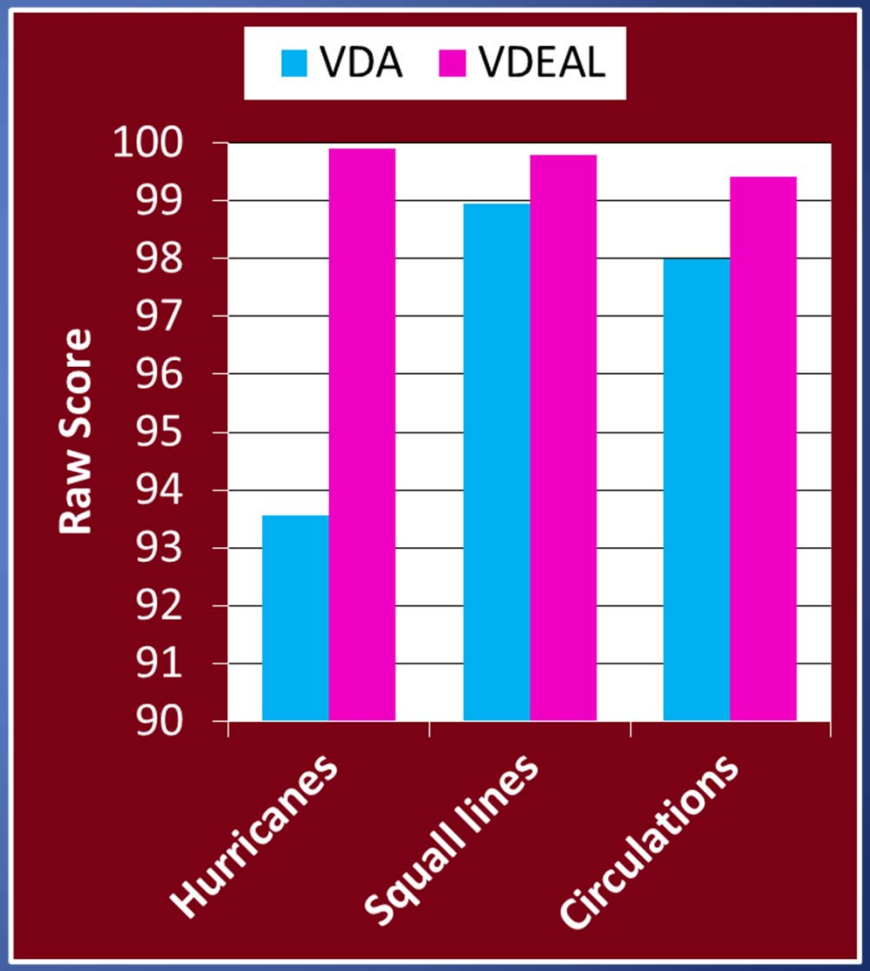
Velocity image from Baseline VDA

Velocity image from early version 2-D VDEAL

Velocity image from new version 2-D VDEAL

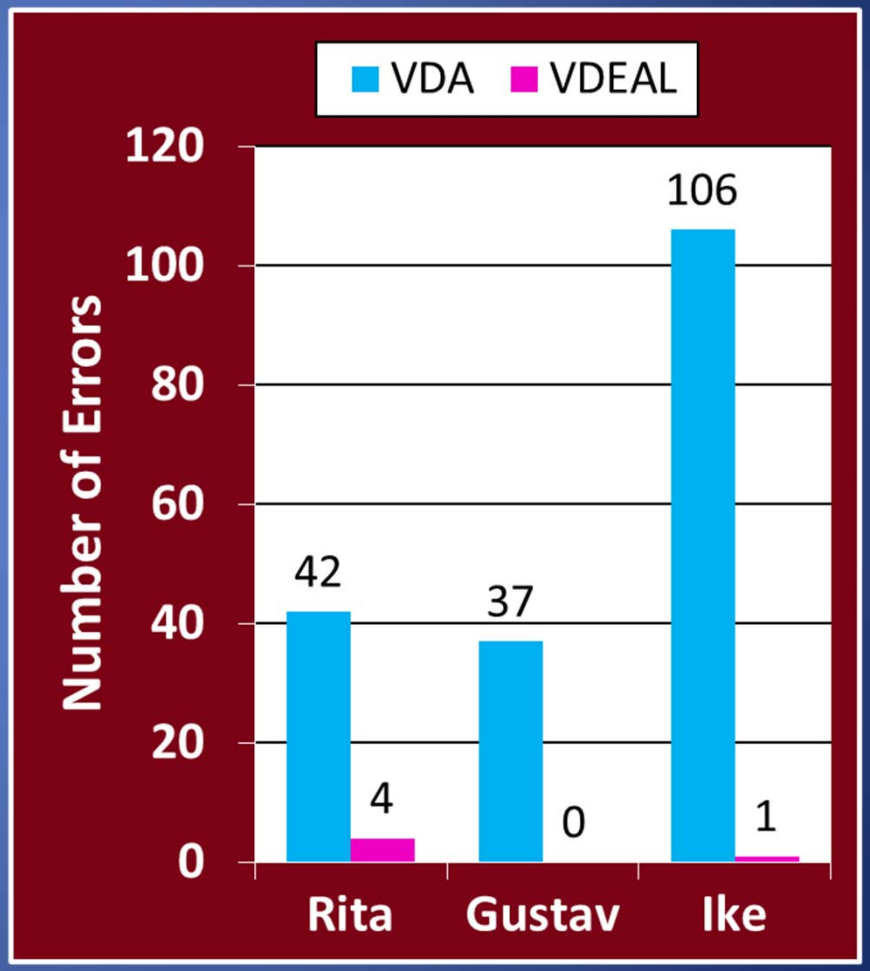
ROC Results


Number of Volume Scans by Category
133
7 cases
201
3 cases
186
5 cases
Hurricanes
Squall Lines
Circulations


VDA
VDEAL
Raw Score
100
99
98
97
96
95
94
93
92
91
90
Hurricanes
Squall lines
Circulations

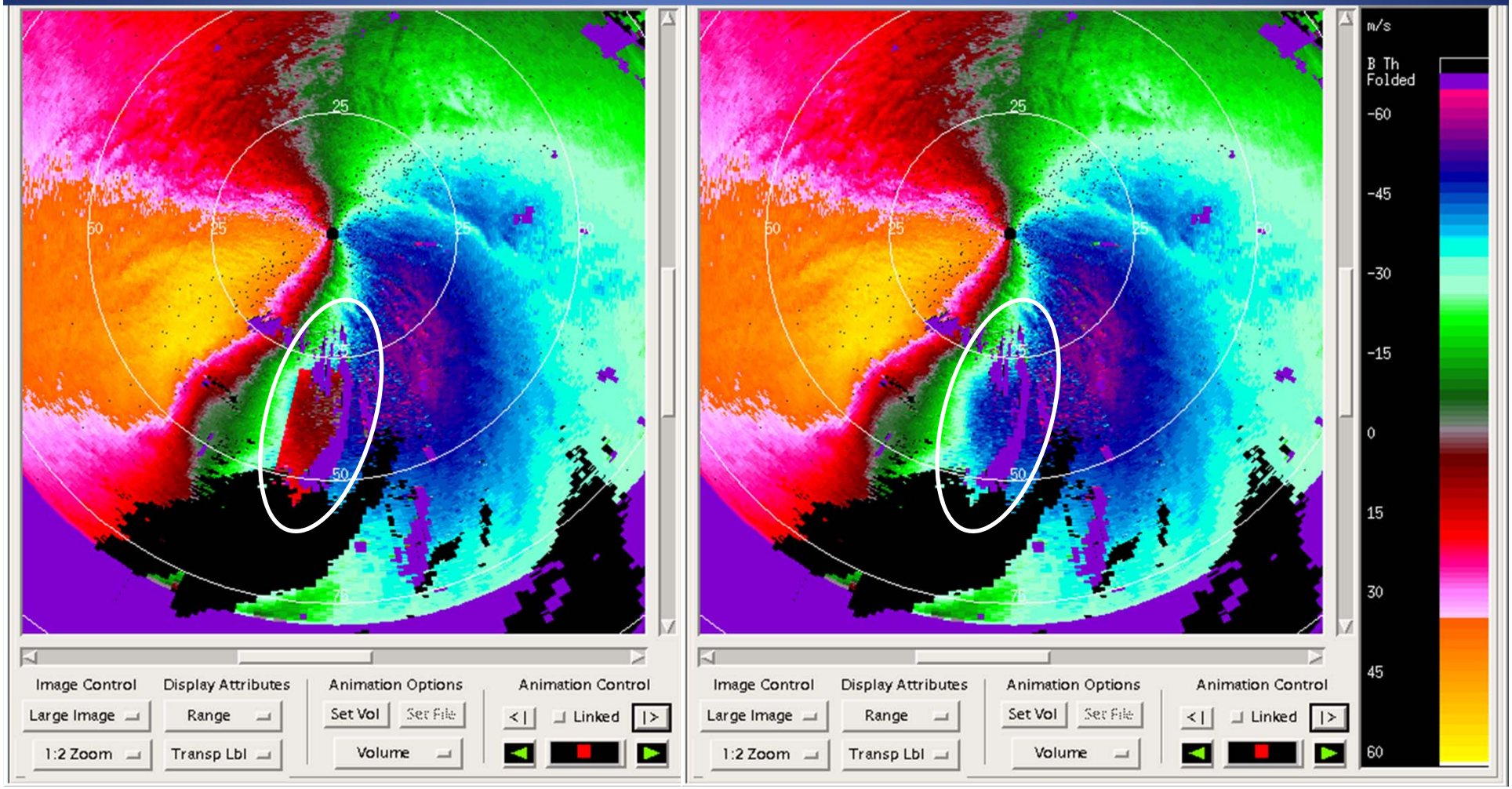
ROC Results (Cont'd)
Hurricane Analysis

- Hurricane Rita (KLCH)
  - 24 September 2005
  - 62 Volumes
  - VCP 21
- Hurricane Gustav (KLIX)
  - 1 September 2008
  - 39 Volumes
  - VCP 212
- Hurricane Ike (KHGX)
  - 13 September 2008
  - 100 Volumes
  - VCP 212



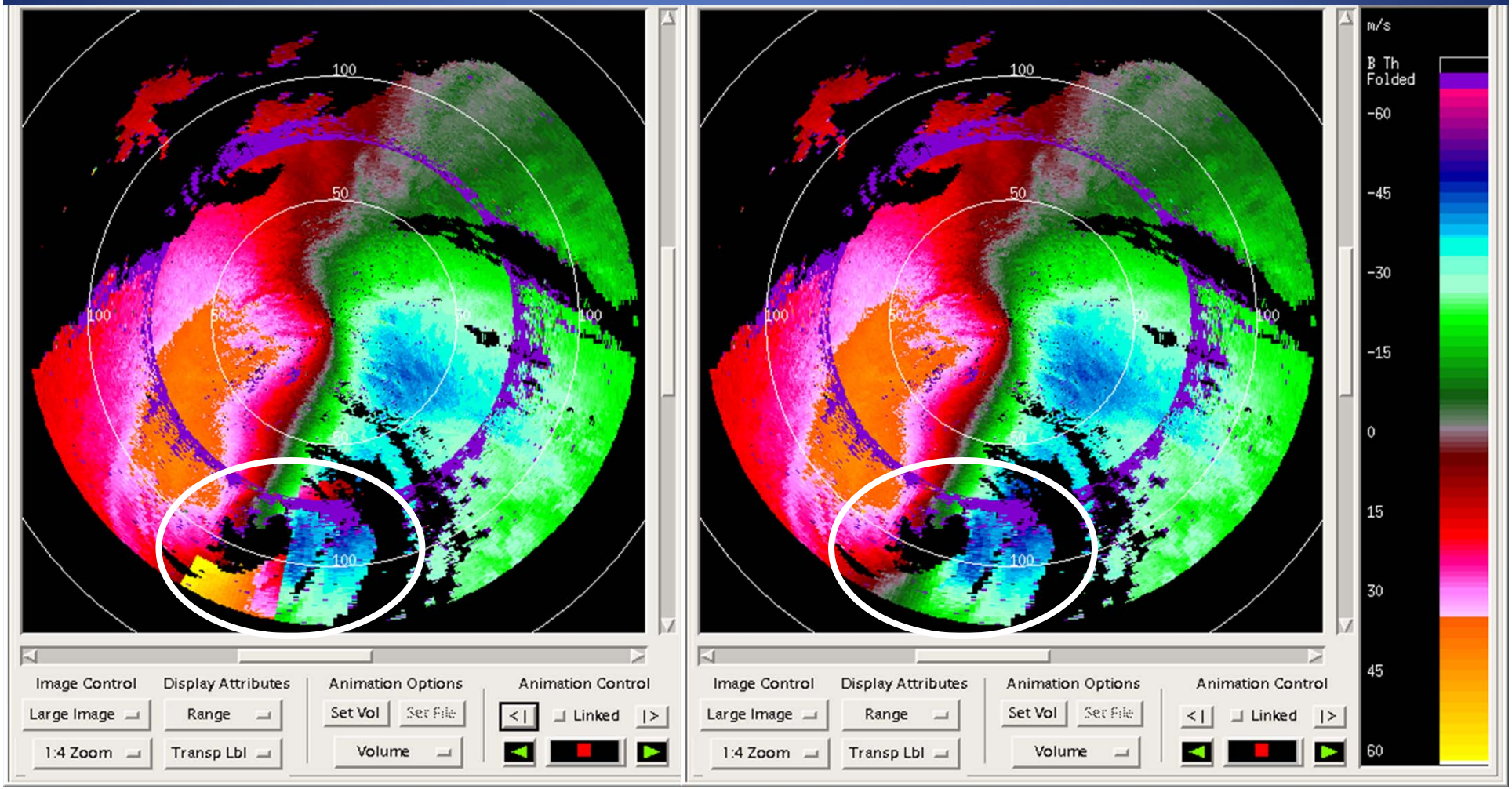
KLCH Hurricane Rita
24 Sep 2005, 06:33Z, VCP 212

Baseline VDA **2-D VDEAL**



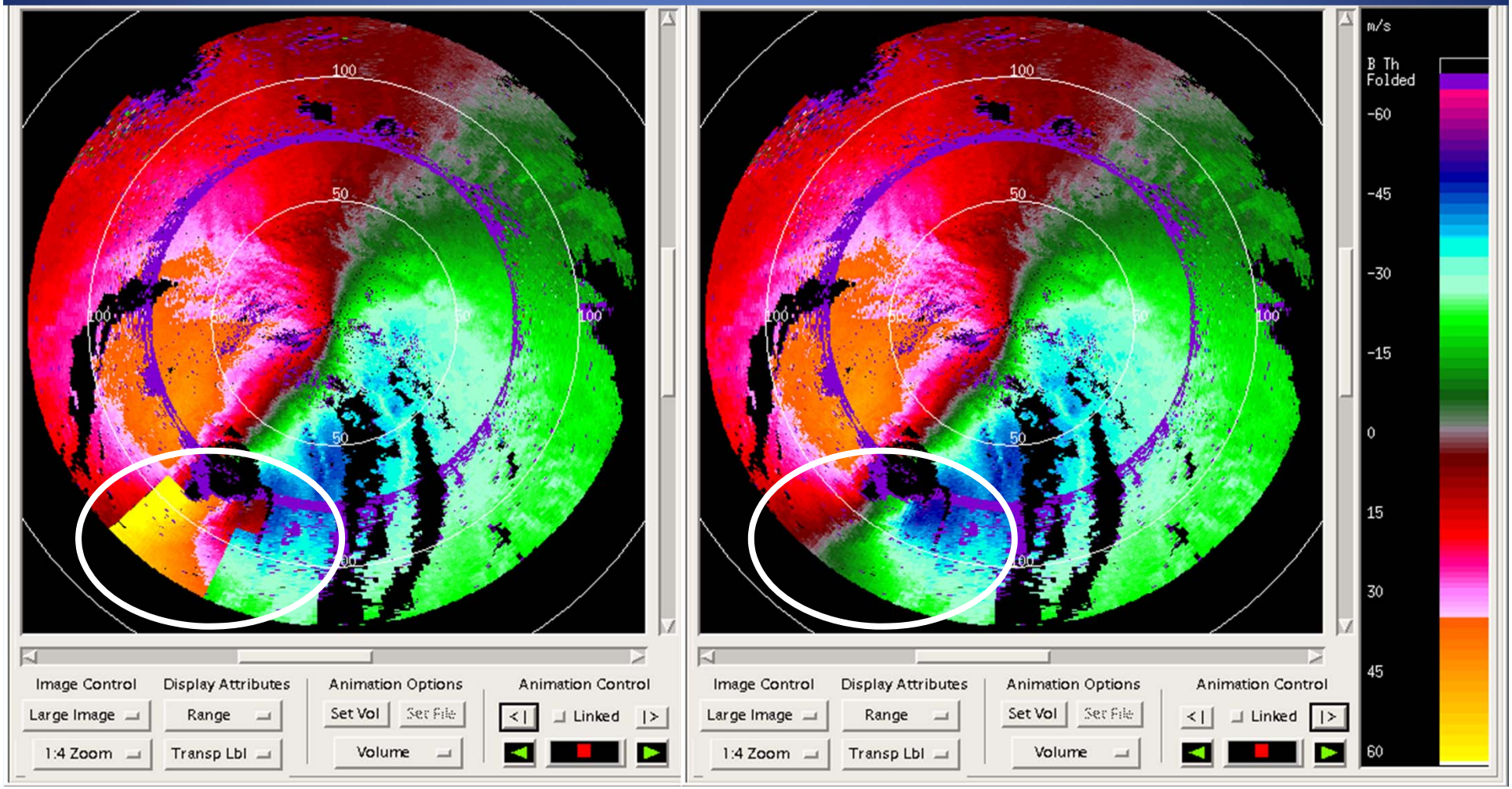
KLIX Hurricane Gustav
1 Sep 2008, 13:17Z, VCP 212

Baseline VDA **2-D VDEAL**



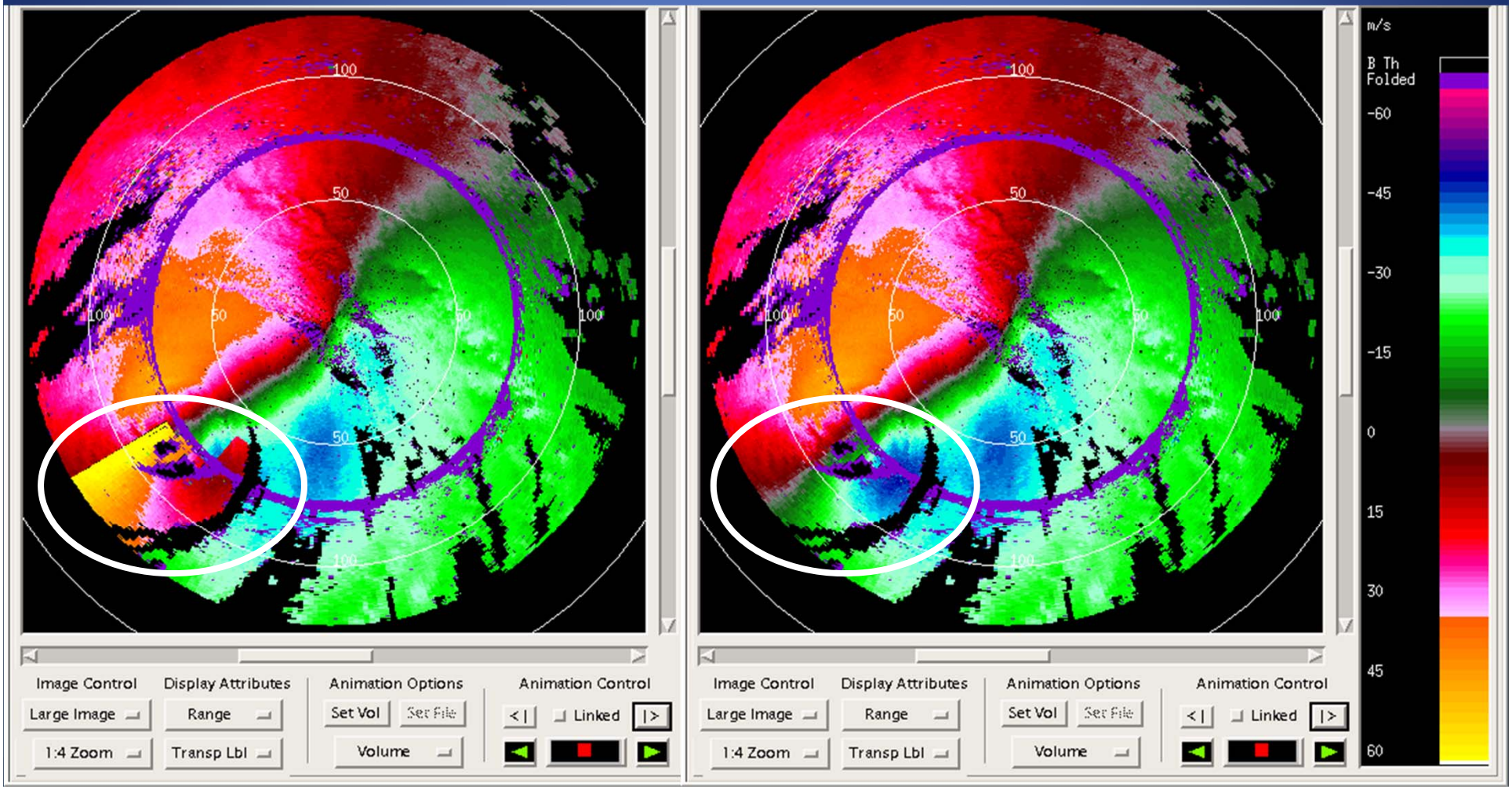
KLIX Hurricane Gustav
1 Sep 2008, 15:16Z, VCP 212

Baseline VDA **2-D VDEAL**



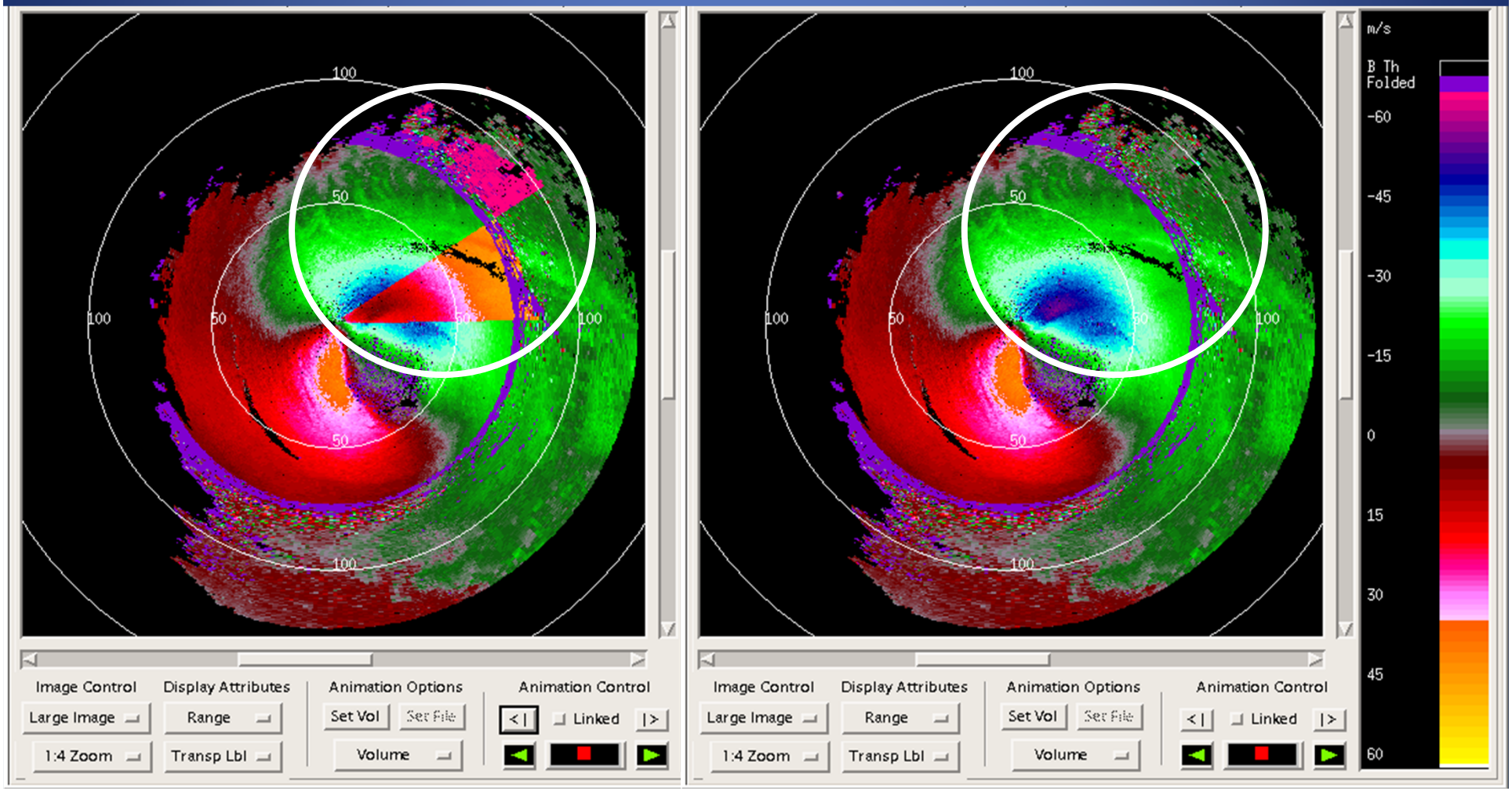
KLIX Hurricane Gustav
1 Sep 2008, 16:47Z, VCP 212

Baseline VDA **2-D VDEAL**



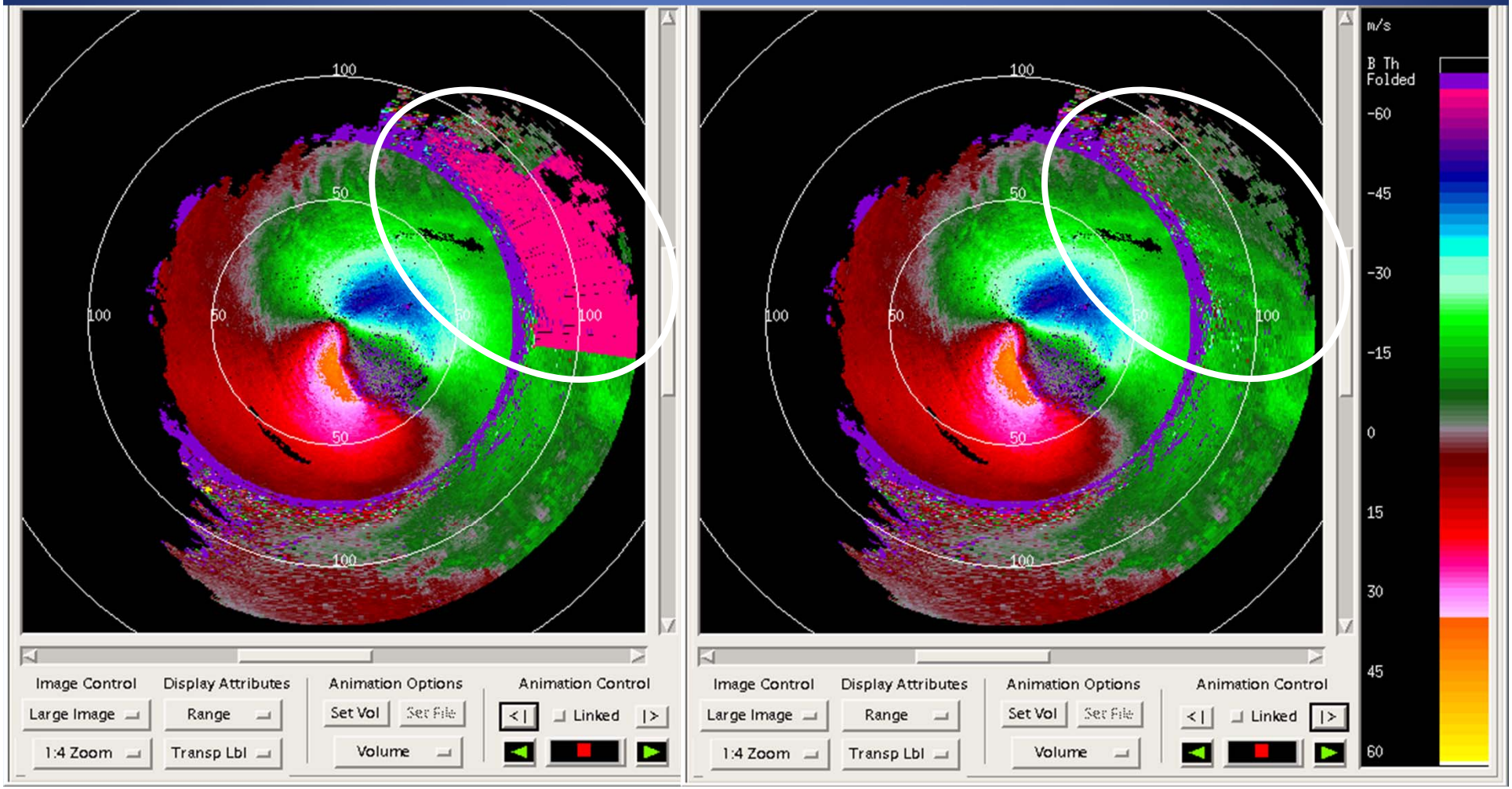
KHGX Hurricane Ike
13 Sep 2008, 06:12Z, VCP 212

Baseline VDA **2-D VDEAL**



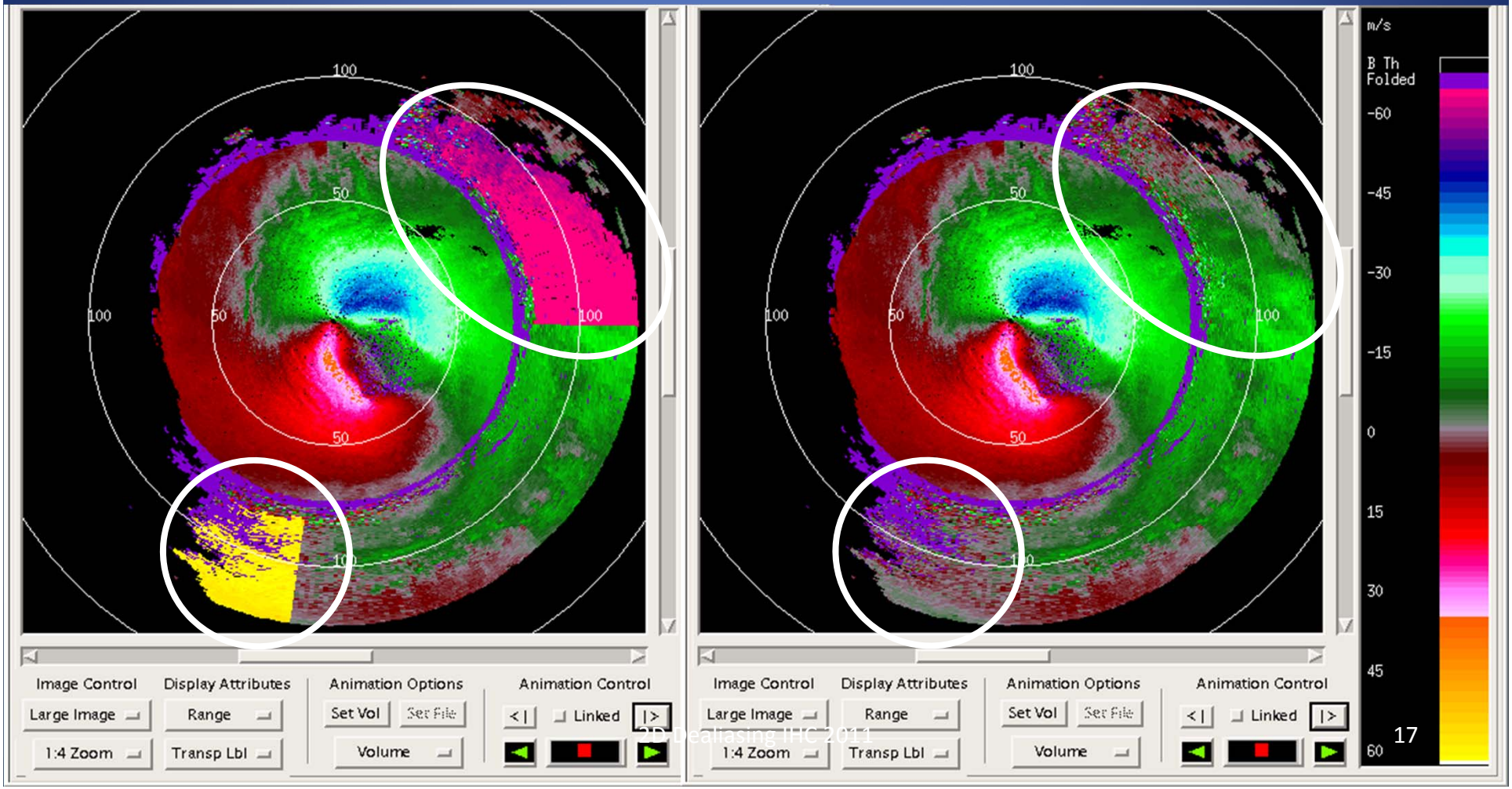
KHGX Hurricane Ike
13 Sep 2008, 06:21Z, VCP 212

Baseline VDA **2-D VDEAL**



KHGX Hurricane Ike
13 Sep 2008, 06:45Z, VCP 212

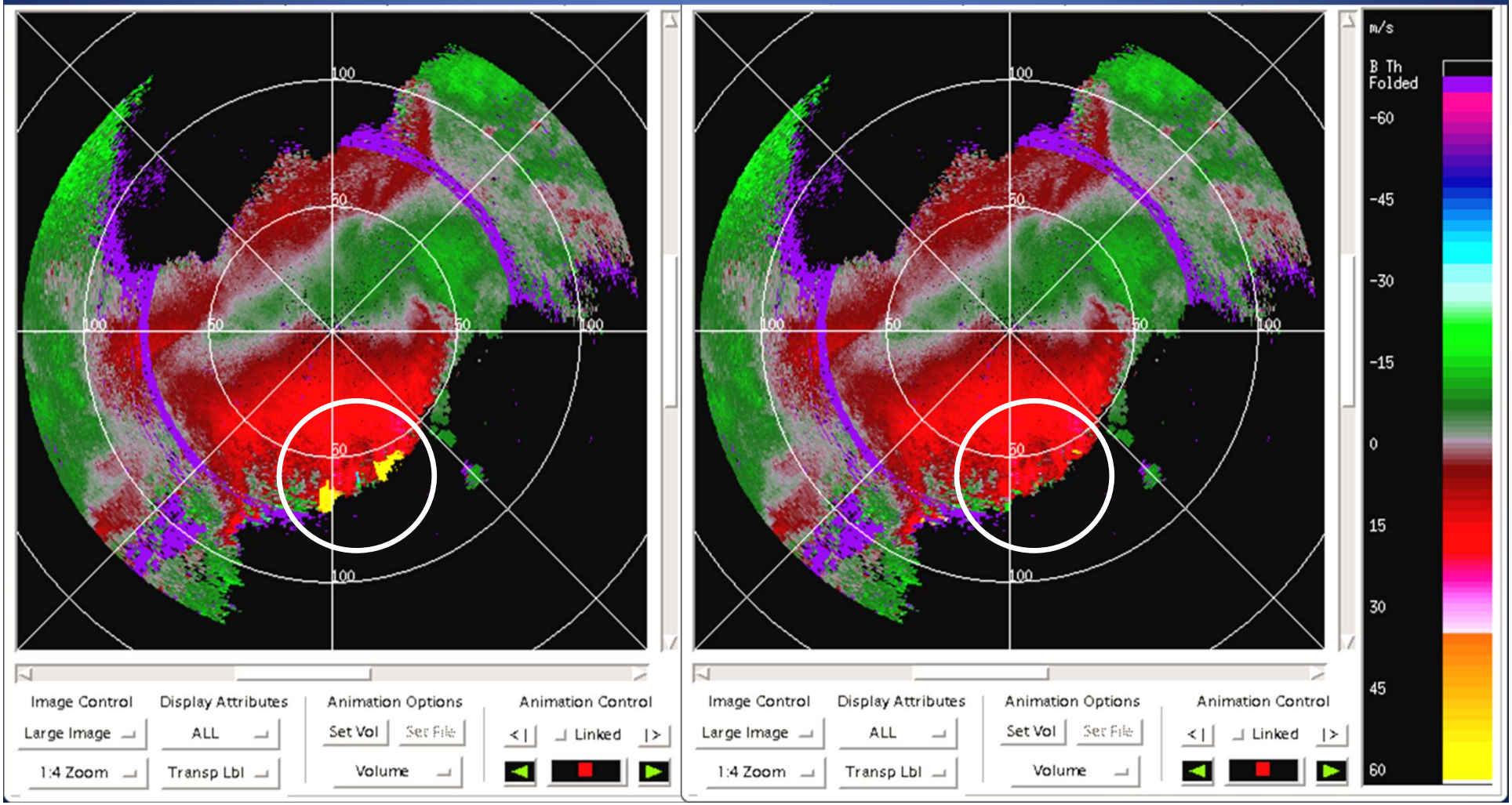
Baseline VDA **2-D VDEAL**



Outflow Boundary, Norman, OK

Baseline VDA

2-D VDEAL



Field Test of VDEAL

- Field test to run 1 June to 1 December, 2011
  - Coincide with hurricane season
  - Toggle will allow sites to switch between baseline VDA and new 2-D VDEAL
  - Looking for participation from 8+ sites
    - 4+ coastal
    - 2 mountainous
    - 2 other interior sites

Goals of VDEAL Field Test

- Obtain field experience with VDEAL at new sites under a broad range of meteorological conditions
- Obtain feedback from operational users
- Determine if VDEAL can replace the VDA for most VCPs or simply be an option

Exceptions

  - ***VCP 121 will continue to use the MPDA***
  - ***PRF sectoring will invoke VDA***

Tentative Field Test Schedule

- December 2010/January 2011 obtain approval to conduct field test
- February to May 2011
  - Assemble test team
  - Formulate test plans/evaluation criteria
  - Solicit participation from field sites
- June 1 to December 1, 2011 – conduct field test and begin data evaluation
- December 2011 to March 2012 – conclude data evaluation, write final report, make recommendation
- If successful, determine when to deploy

Questions?

Supplemental Slides

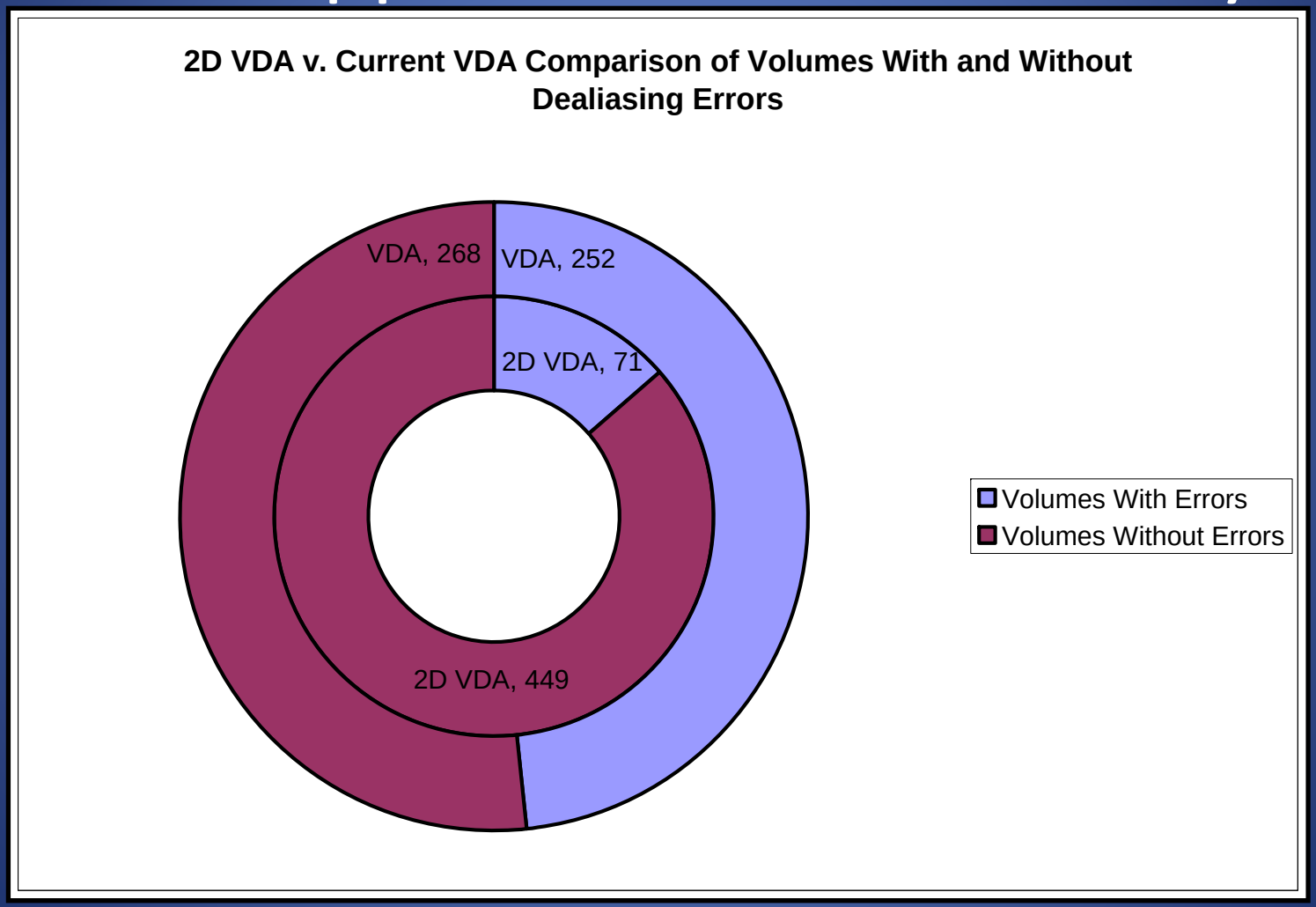
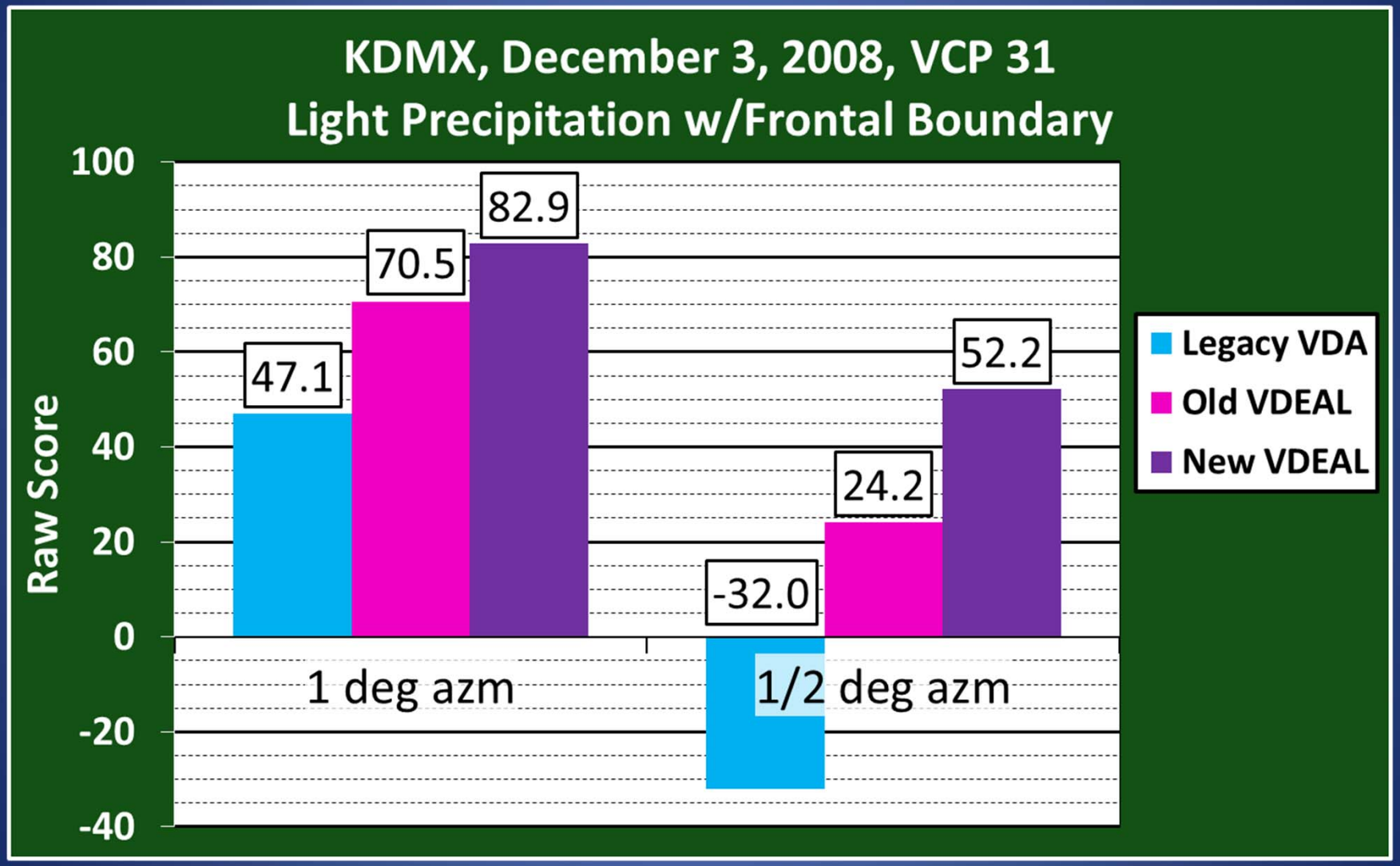
Baseline Velocity Dealiasing Algorithm (VDA)

- Applies algorithm sequentially on a radial by radial basis
  - Saves a copy of last good dealiased radial
- Uses Environmental Wind Table to provide initial value for dealiasing
- Dealiasing proceeds along a radial using nearby velocity bins or an average of nearby bins that have already bin dealiased
- Checks for and attempts to correct unrealistic radial or azimuthal shears
- Assigns original velocity values to unresolved velocity bins

Baseline Multiple PRF Dealiasing Algorithm (MPDA)

- Algorithm sequentially acquires up to 3 velocity scans each with a different Nyquist velocity at the same elevation angle
- Uses environmental wind data to help with dealiasing
- First dealiases 3 velocity values, where available, for the same point in space to find a solution
- If no solution found from previous step, dealiases pairs of velocities from the 3 estimates or if there are only 2 velocities are available
- If no solution found from the previous step, dealiases velocity data where only 1 value is available
- Finally, If no acceptable solution found, puts in the best fitting velocity from any velocity field into the dealiased velocity field
- Checks between steps for unrealistic shears and isolated bins
- Values put in the output velocity field provide reference values for downstream dealiasing

Bulk Statistics VDA vs VDEAL from Applications Branch Study



NSSL Results (Cont'd)