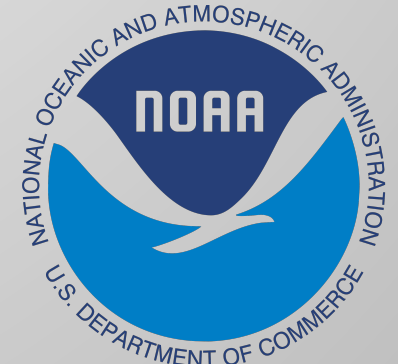
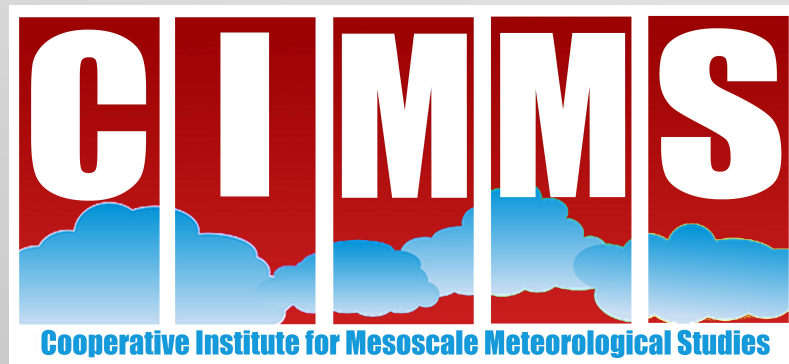


# New Mesocyclone Detection Algorithm

*-Training Module-*

2019 HWT EWP – Satellite & Radar Experiment

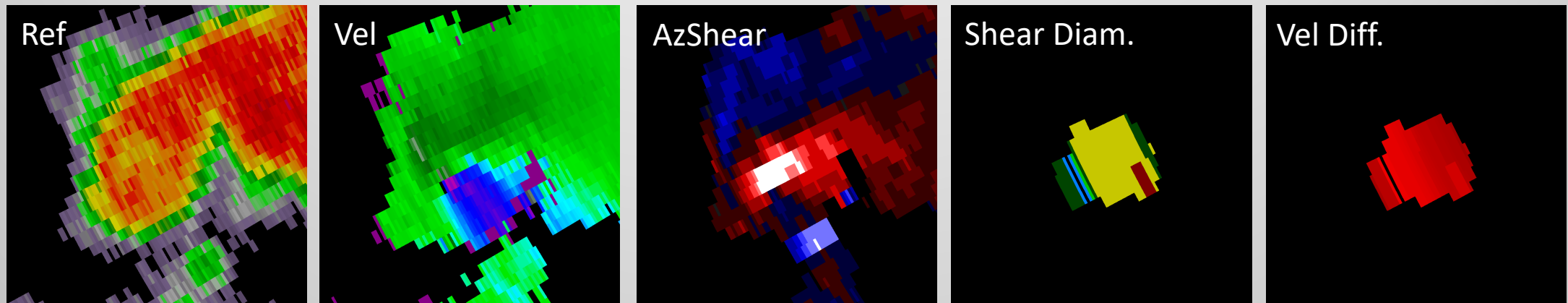


# New Mesocyclone Detection Algorithm (NMDA) - Background

- Tasked by the NWS Radar Operations Center (ROC) to modernize the suite of WSR-88D single-radar severe weather algorithms
- Construct a new “engine” for the current MDA within the WSR-88D ORPG
- Utilizes single-radar velocity-derived azimuthal shear (AzShear) product as the main catalyst for creating detections
- Development and testing within WDSS-II (backbone of MRMS)
- Displayed within AWIPS-II utilizing the current MD framework

# NMDA – Technical Details (1/2)

- **Uses 6 products to detect and track**
  - Main: *AzShear (main catalyst), Smoothed Shear Diameter, & Smoothed Velocity Difference*
  - Quality Control: *Reflectivity & Spectrum Width*
  - Tracking: *Rapid Refresh (RAP) derived Sounding Table (0-6 km storm rel. motion)*



# NMDA – Technical Details (2/2)

## Step 1: Creates 2D detections (each tilt)

1. Initial Objects:  $AzShear > 0.006$  |  $Shear\ Diameter \geq 2\ km$  |  $Delta-V \geq 5\ km$
2. AzShear Maximums of Initial Objects (*could be multiple maximums per object - QLCS*)
3. QC using SPW/REF ratio -&- Proximity Check To Other Maximums (*shear diameter*)

## Step 2: Creates 3D detections from 2D detections

- At end of volume -or- with each new SAILS cut (*MRLE still under development*)
- All 3D detections must be at least three 2D detections in height, except:
  - if SAILSx3 and first cut occurs after  $0.9^\circ$  -or- 3D detection is  $> 100\ km$  from radar
- All 2D detections used must be below 8 km in height

## Step 3: Tracks 3D detections between volumes and SAILS cuts

- Uses only the RAP derived 0-6 km storm relative motive for tracking
- Past 3D detections stored in memory for 10 minutes → in case radar error or range folding

# NMDA – Performance Notes

- Just like the current MDA, can identify mesocyclones and track with time
- Only tracks cyclonic rotation (*anti-cyclonic under development*)
- Integrates SAILS (*MRLE still under development*)
- Caveats:
  - Identification and tracking of some QLCS circulations (small diameter and shallow)
  - Occasional false detections within high-velocity stratiform rain fields
  - If a circulation is large, a neighborhood check to remove multiple detections of the same area of rotation will sometimes remove nearby detections of independent rotation

# NMDA - Evaluation

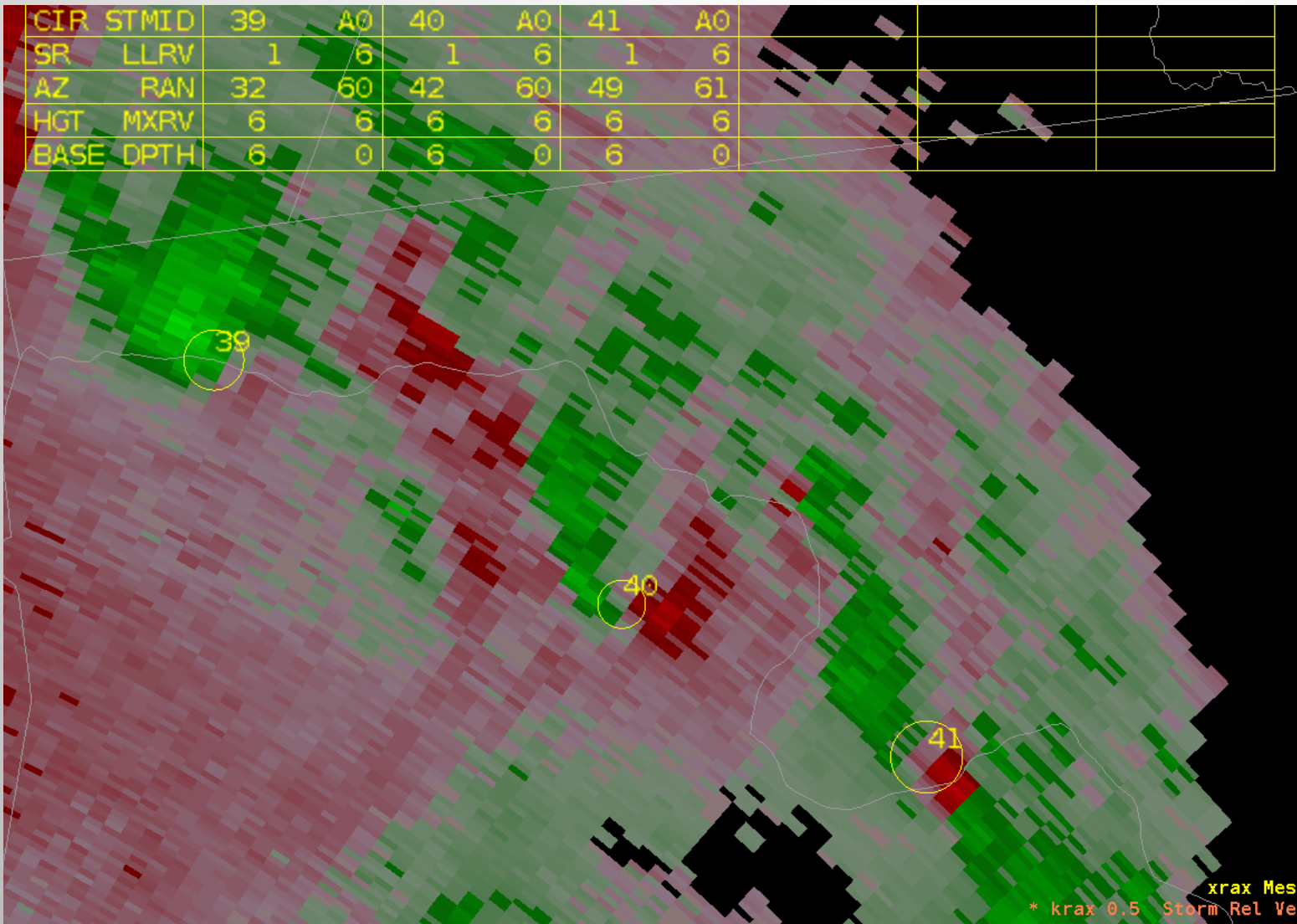
- **Evaluation:**

- *Compare NMDA to the existing MDA products - Mesocyclone (MD) and Digital Mesocyclone (DMD) – within the AWIPS-II environment*

- NMDA products will be under the “EWP” header on the AWIPS-II toolbar

- Each radar will have the MD, DMD, and NMDA grouped together for easy access to all three
- NMDA will be listed as “X---”, with the three dashed representing the three letter radar identifier

# NMDA – AWIPS-II Visualization



Uses the existing structure of MD product for AWIPS-II visualization

3 Different Icons → *Uses part of existing MD icons*

- *Thin Circle*
  - Strength Rank < 5
- *Thick Circle*
  - Strength Rank  $\geq$  5
  - Height > 1 km ARL -&- Base of Detection NOT on Lowest Tilt
- *Thick Circle w/ Spikes*
  - Strength Rank  $\geq$  5
  - Height  $\leq$  1 km ARL -or- Base of Detection ON Lowest Tilt

Increase magnification and change color to more easily view NMDA icons and the detection table.



# NMDA – AWIPS-II Detection Table

<b>Circulation ID (CIR)</b>	0 - 999
<b>SCIT ID (STMID)</b>	None (always A0)
<b>Strength Rank (SR)</b>	1 – 25  AzShear Val ( $s^{-1}$ )   SR 0.006 – 0.0069   1 0.007 – 0.0079   2 0.008 – 0.0089   3 ----- 0.028 – 0.029   24 >= 0.03   25
<b>Low Level Rotation Value (LLRV)</b>	AzShear ( $s^{-1}$ ) * 1000  0.006 = 6 0.01 = 10
<b>Radar Azimuth (AZ)</b>	Degrees (same as MD)
<b>Range from Radar (RAN)</b>	Nautical Miles (same as MD)

Conversion tables to decipher detection information in the NMDA Table

<b>CIR</b>	<b>STMID</b>	39	A0	40	A0	41	A0
<b>SR</b>	<b>LLRV</b>	1	6	1	6	1	6
<b>AZ</b>	<b>RAN</b>	32	60	42	60	49	61
<b>HGT</b>	<b>MXRV</b>	6	6	6	6	6	6
<b>BASE</b>	<b>DPTH</b>	6	0	6	0	6	0

<b>Height of Maximum Rotation (HGT)</b>	Kilofeet (same as MD)
<b>Maximum Rotation Value (MXRV)</b>	AzShear ( $s^{-1}$ ) * 1000  Same conversion as LLRV
<b>Height of Detection Base (BASE)</b>	Kilofeet (same as MD)
<b>Depth of Detection (DPTH) **</b>	Kilofeet (same as MD)

\*\* Will be zero if detection is just one 2D detection deep

**NOTE: If more than 6 detections are present, center click the loaded product name in the AWIPS-II display to cycle detections through the table.**