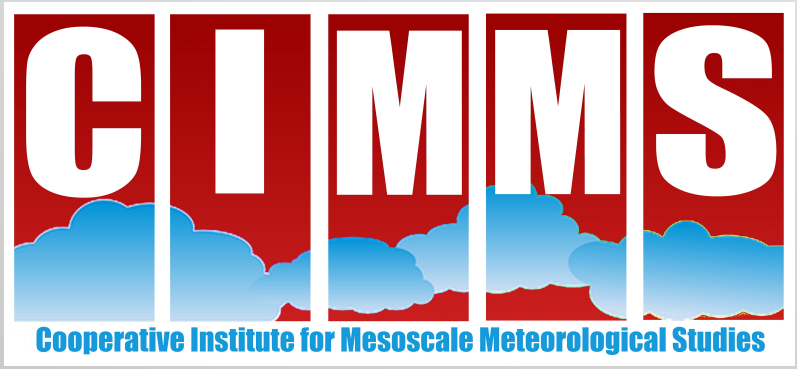
# New Mesocyclone Detection Algorithm

*-Training Module-*

2019 HWT EWP – Satellite & Radar Experiment



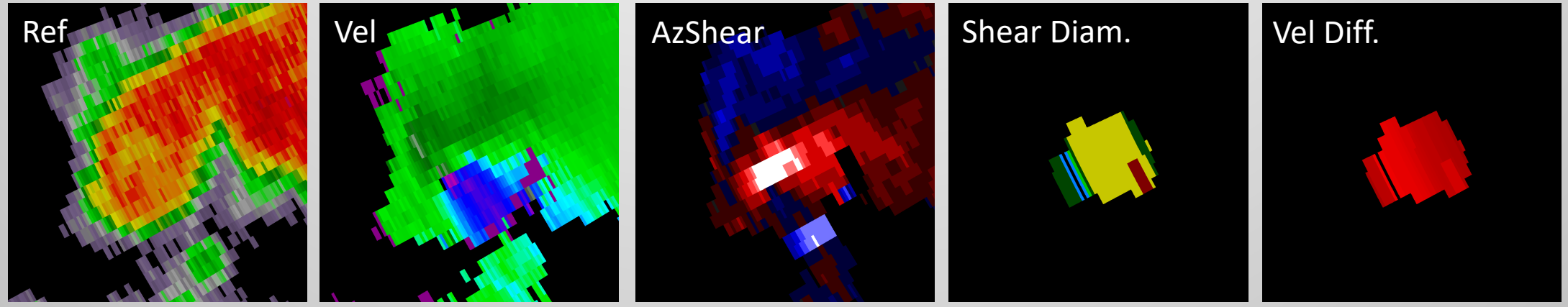


# New Mesocyclone Detection Algorithm (NMDA) - Background

- 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: Az*Shear (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 >= 2 km* | *Delta-V >= 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 <u>least three</u> 2D detections in height, except:
  - if SAILSx3 and first cut occurs after 0.9° -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

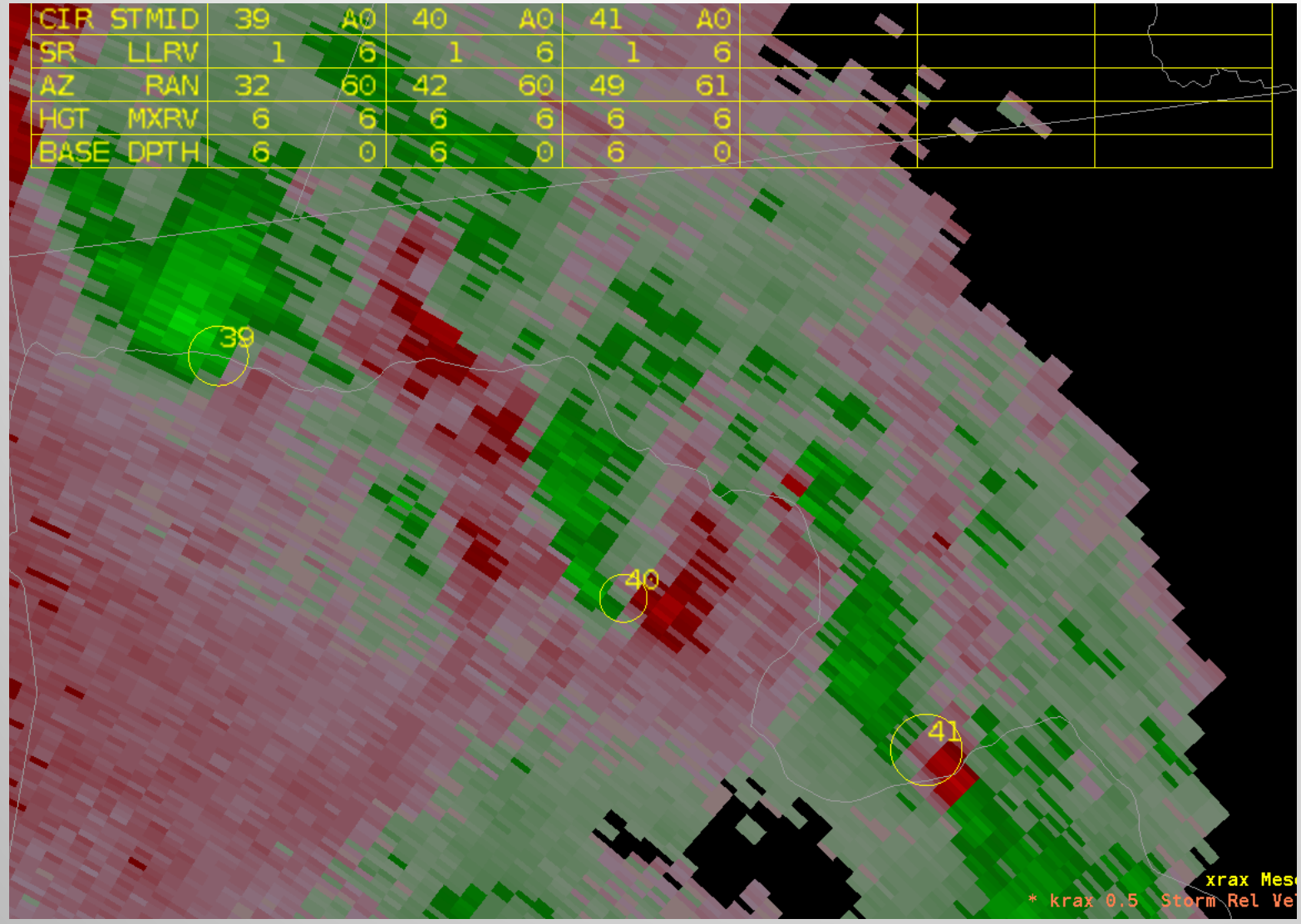
- Just like the current MDA, can identify mesocyclones and track with time
- Only tracks cyclonic rotation (*anti-cyclonic under development*)
- Integrates SAILS (*MRLE still under development*)
- Caveats:
  - Identification and tracking of some QLCS circulations (small diameter and shallow)
  - Occasional 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 >= 5
  - Height > 1 km ARL -&- Base of Detection NOT on Lowest Tilt
- *Thick Circle w/ Spikes*
  - Strength Rank >= 5
  - Height <= 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

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

**Conversion tables to decipher detection information in the NMDA Table**

| CIR | STMID | 39 | A0 | 40 | A0 | 41 | A0 |
|---|---|---|---|---|---|---|---|
| SR | LLRV | 1 | 6 | 1 | 6 | 1 | 6 |
| AZ | RAN | 32 | 60 | 42 | 60 | 49 | 61 |
| HGT | MXRV | 6 | 6 | 6 | 6 | 6 | 6 |
| BASE | DPTH | 6 | 0 | 6 | 0 | 6 | 0 |

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