AMDA: Informational Briefing

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NEXRAD TAC

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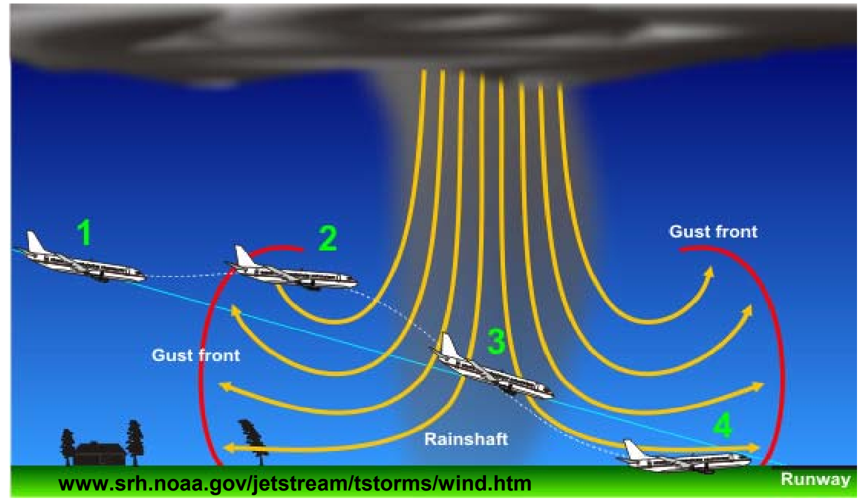
Outline

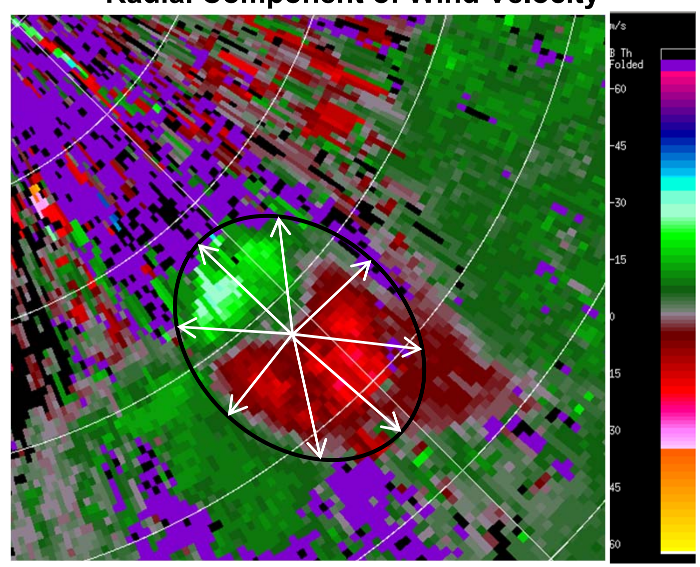
- Introduction
  - Goals of AMDA
  - Brief algorithm overview (current implementation)
- NEXRAD AMDA Performance
  - Validation approach
  - Results
  - Parameter Tuning for NEXRAD
- Future Improvements

Automated Microburst Detection Algorithm

- **Goal:**
  - Detect instances of moderate to severe wind shear which present a danger to aircraft
- **Microbursts:**
  - Definition: Minimum radial velocity differential threshold 15 $m\ s^{-1}$ (Wolfson et al. 1994)
- **Wind Shear:**
  - AMDA also issues detections for any wind shear exceeding a threshold of 7.5 $m\ s^{-1}$



Radial Component of Wind Velocity



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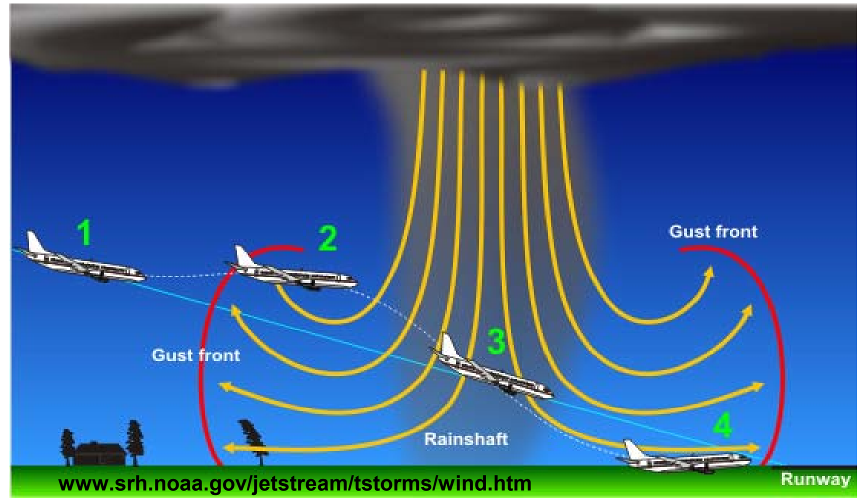
- **AMDA provides a polygon and a strength measurement for each detection**



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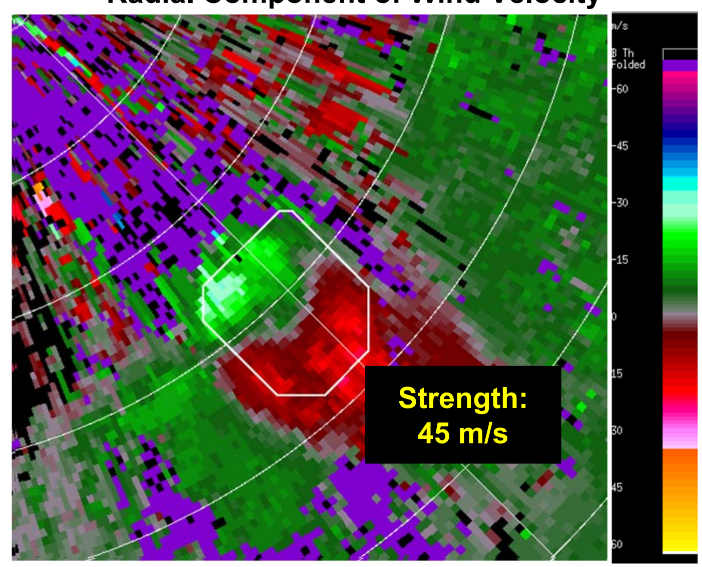
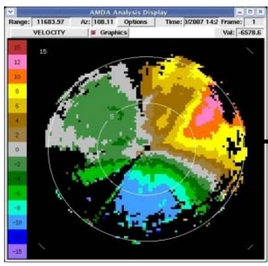
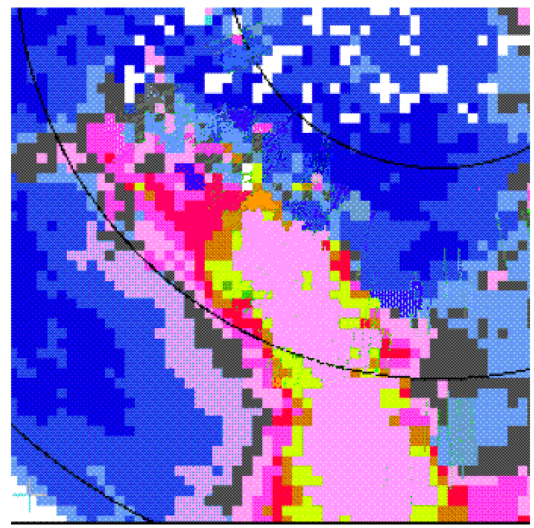


AMDA
Overview



Read a Scan of Base Data

Segment Detection



Segment Association

Segment Density Thresholding

Assimilate Evidence

MB Detections To Shape Algorithm & Display

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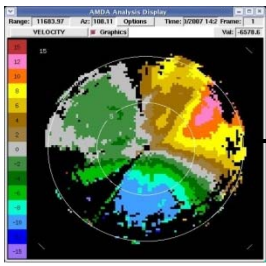
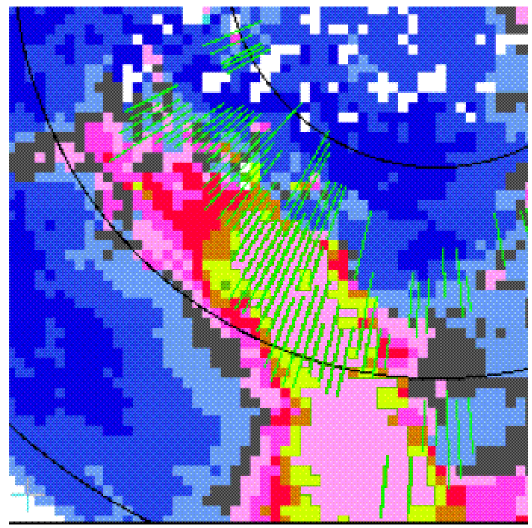
AMDA Segment Detection

Read a Scan of Base Data → Segment Detection

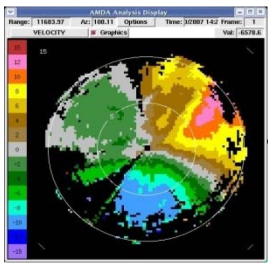




↓ Segment Association

↓ Segment Density Thresholding → Assimilate Evidence → MB Detections To Shape Algorithm & Display

AMDA Segment Association



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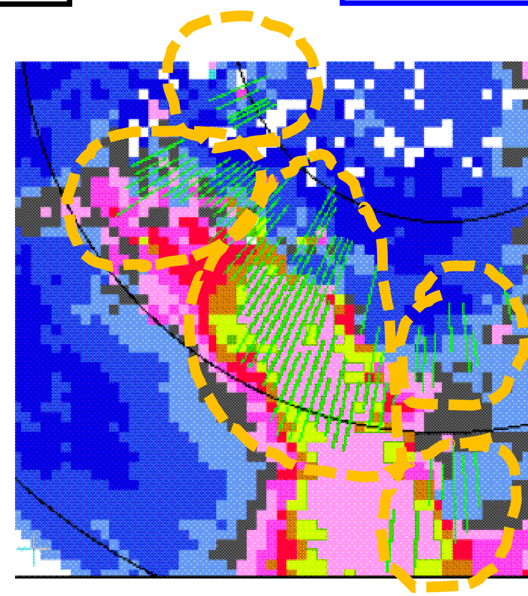

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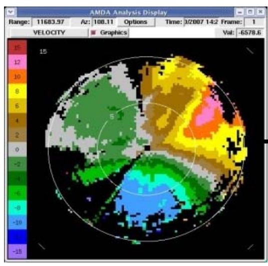
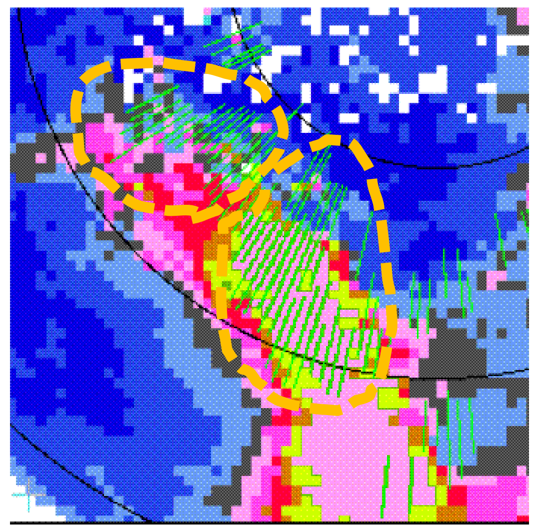
AMDA Segment Density Thresholding



Read a Scan of Base Data

→ Segment Detection

→ Segment Association



→ Segment Density Thresholding

→ Assimilate Evidence

→ MB Detections To Shape Algorithm & Display

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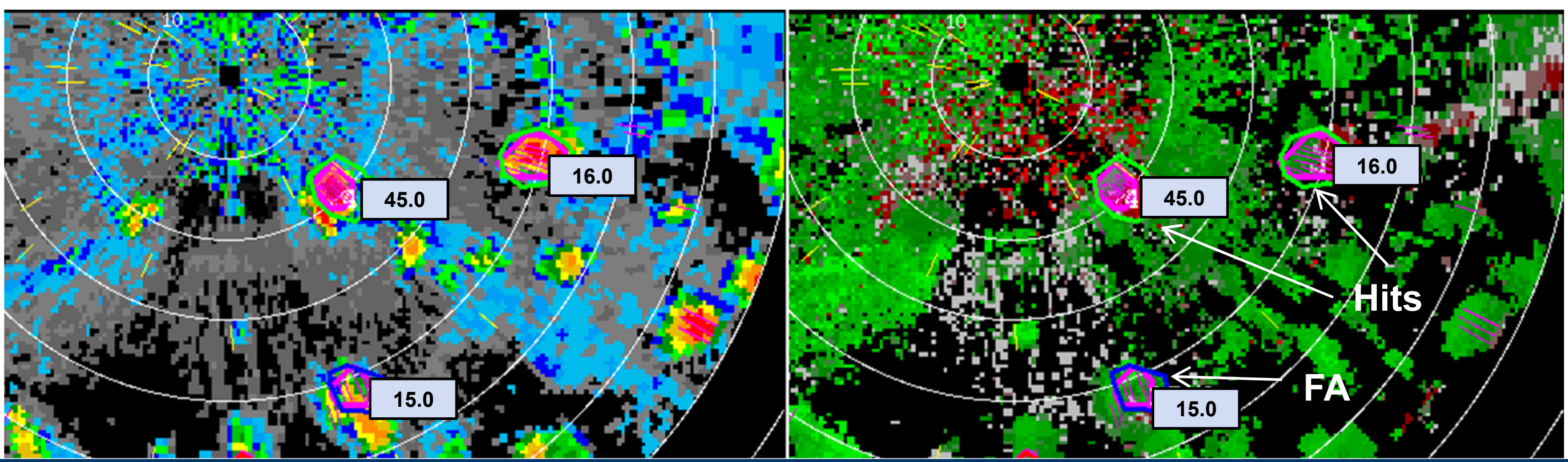
AMDA Human "Truthing"

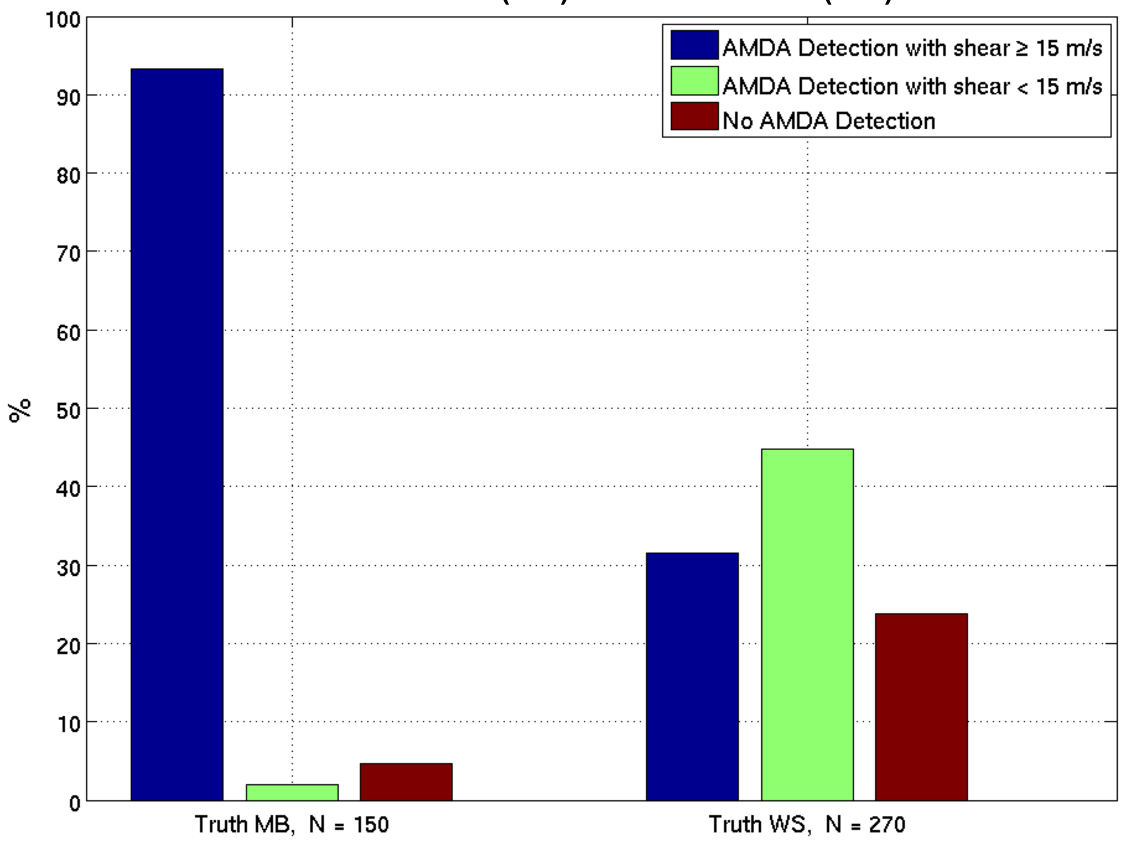
- Subjective analysis of radar reflectivity and velocity (0.5^o scans) by human observer
- Recorded microbursts and wind shear events
  - Sites include KFTG (Denver), KFWS (Dallas/Fort Worth), KIWA (Phoenix), KLSX (St. Louis), KTLX (Oklahoma City)
  - 150 total events with wind shear ≥ 15 m s^{-1}
  - 270 total events with wind shear between 7.5 m s^{-1} and 15 m s^{-1}
  - Continuing to add cases



AMDA Performance

(Detection Rate)

Probability of AMDA detections near human identified (Truth) microbursts (MB) and wind shear (WS)



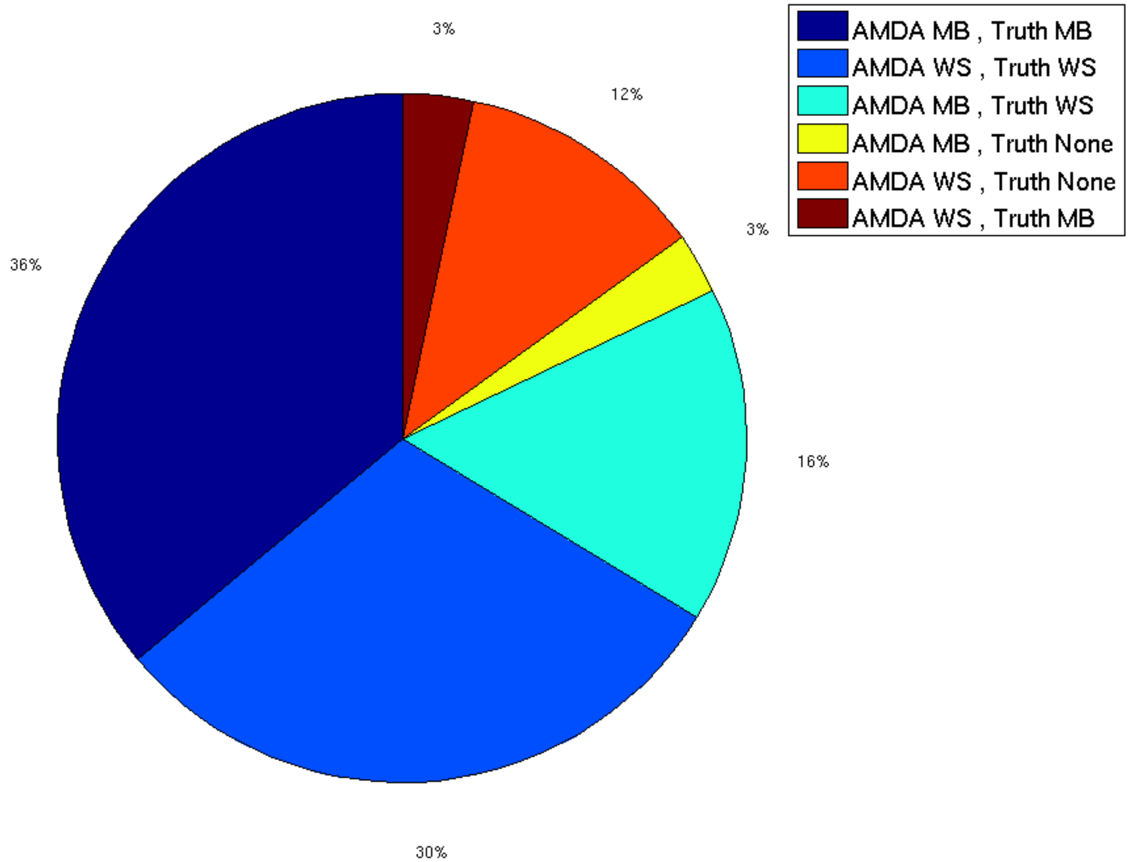
Probability of Detection

Shear ≥ 15 m/s	92%
Shear ≥ 7.5 m/s	88%

AMDA Performance

(False Alarms)

Presence of Truth MB/WS events near AMDA detections



AMDA Performance

(False Alarms)

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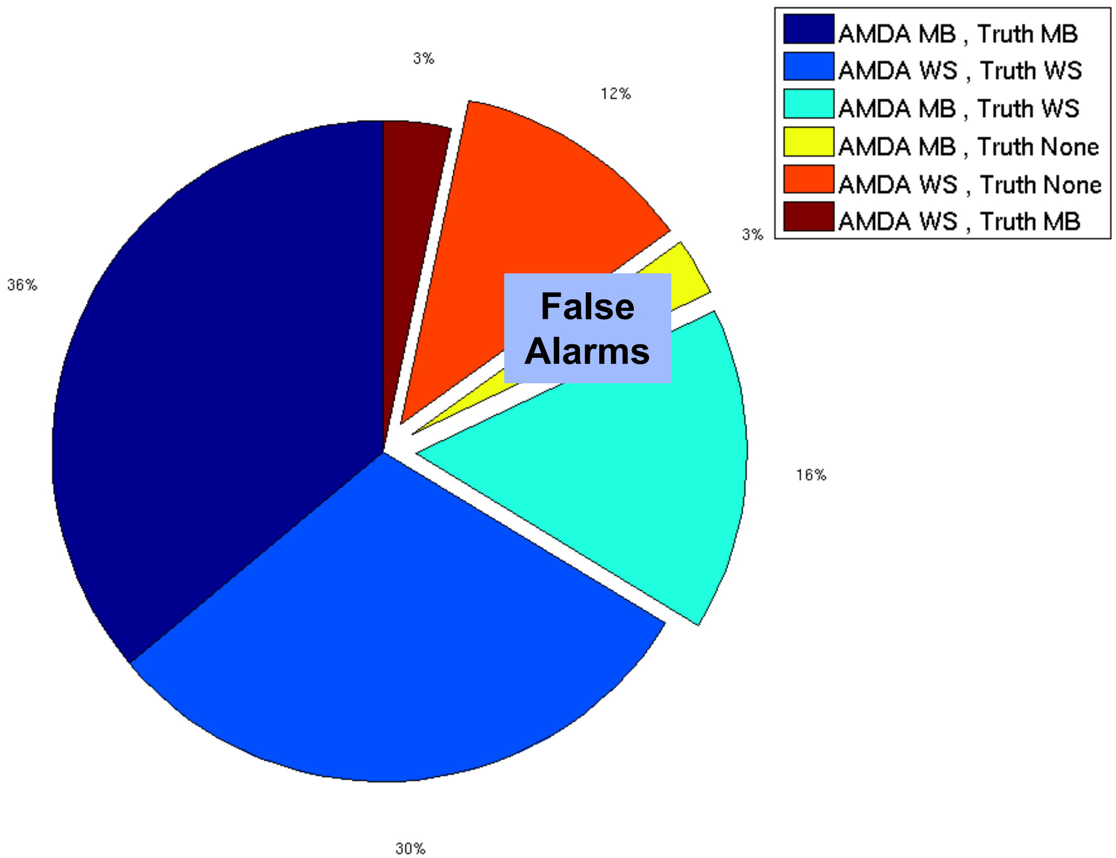
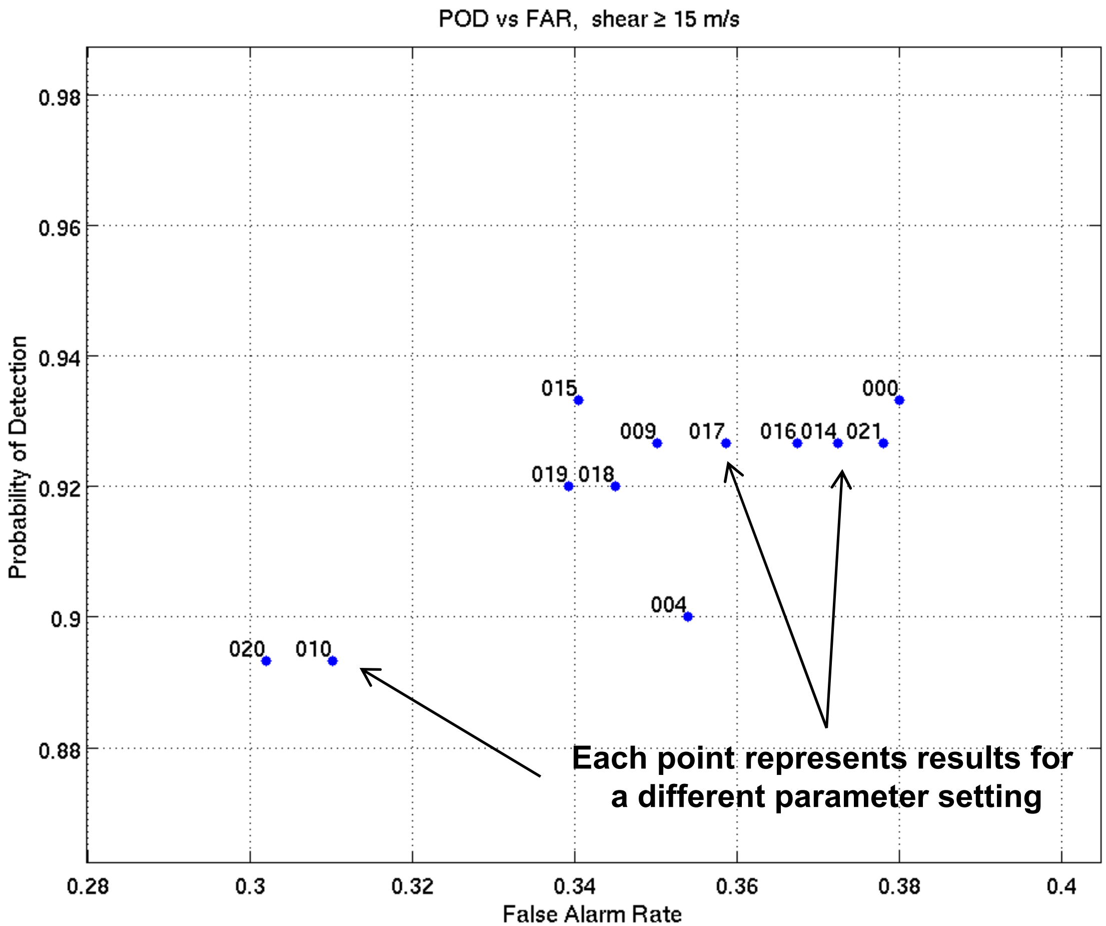


False Alarm Rates

Shear ≥ 15 m/s	34%
Shear ≥ 7.5 m/s	15%

AMDA Performance

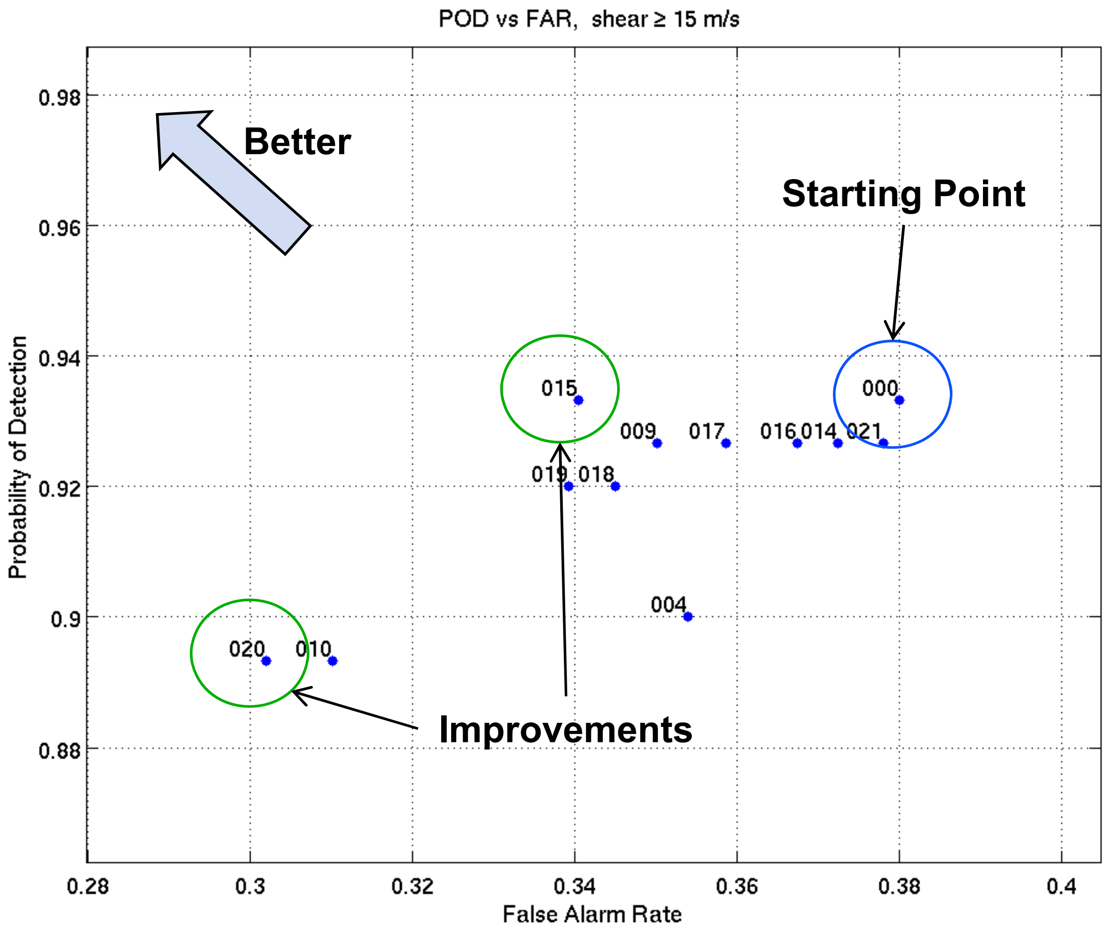
(Parameter Tuning)



Currently working with current AMDA parameters to decrease False alarm rate while maintaining high probability of detection

AMDA Performance

(Parameter Tuning)



Currently working with current AMDA parameters to decrease False alarm rate while maintaining high probability of detection

With the current parameters, able to lower false alarm rate without sacrificing too many true detections.

However: More work needs to be done to achieve the goal of 90%POD / 10%FAR

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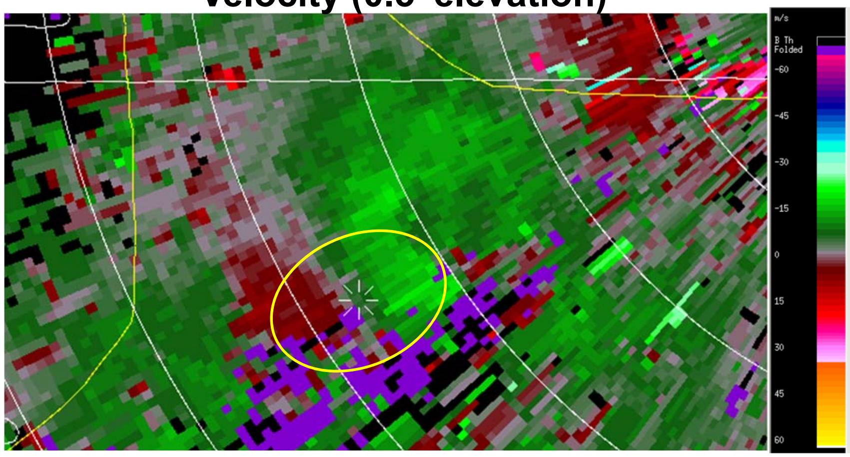
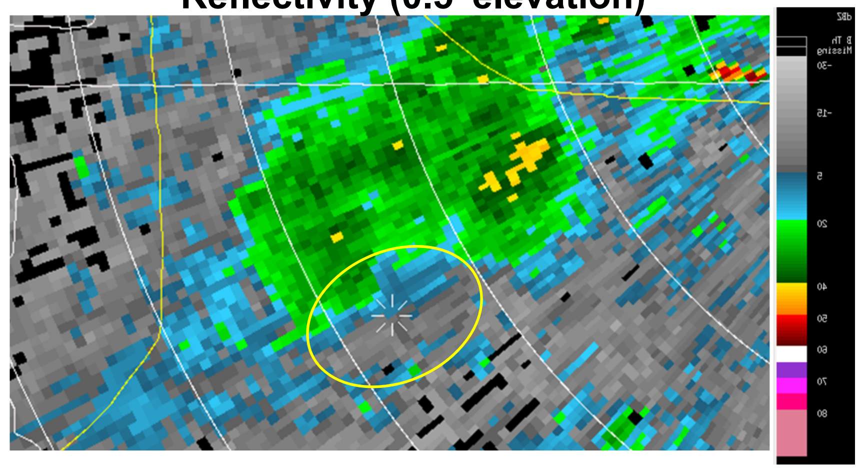
➡ **Future Improvements**

A Dry Case

Velocity (0.5° elevation)



Reflectivity (0.5° elevation)



- **Dry cases like this require lower reflectivity thresholds to trigger a detection**

A Dry Case

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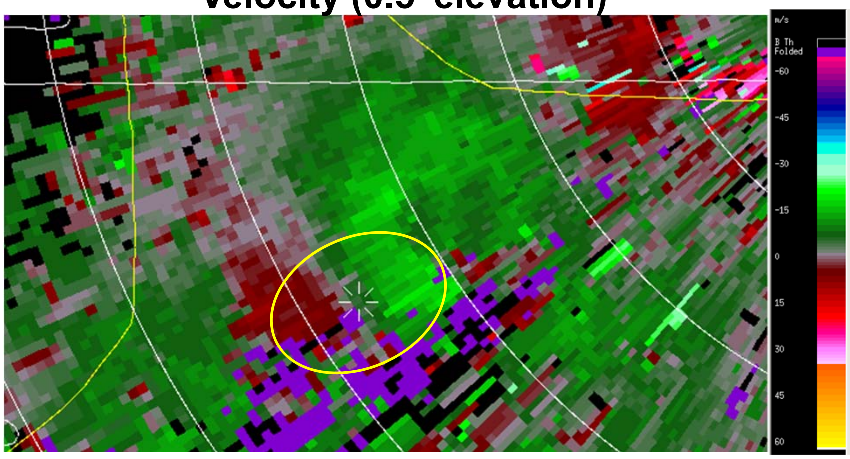
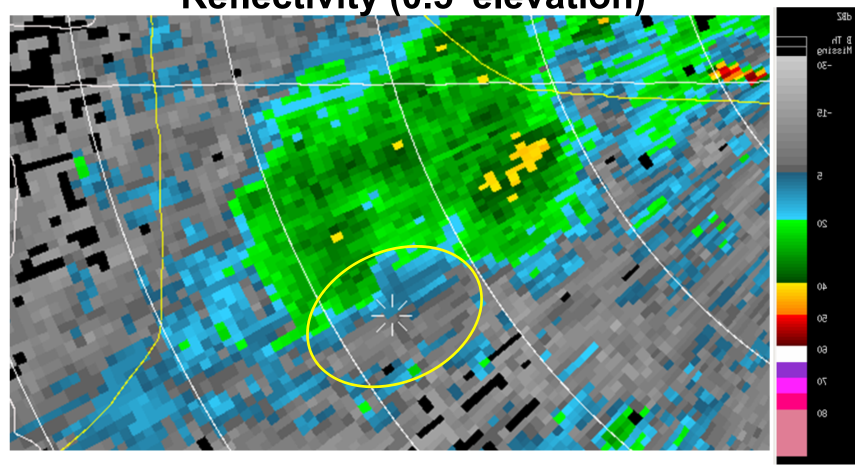
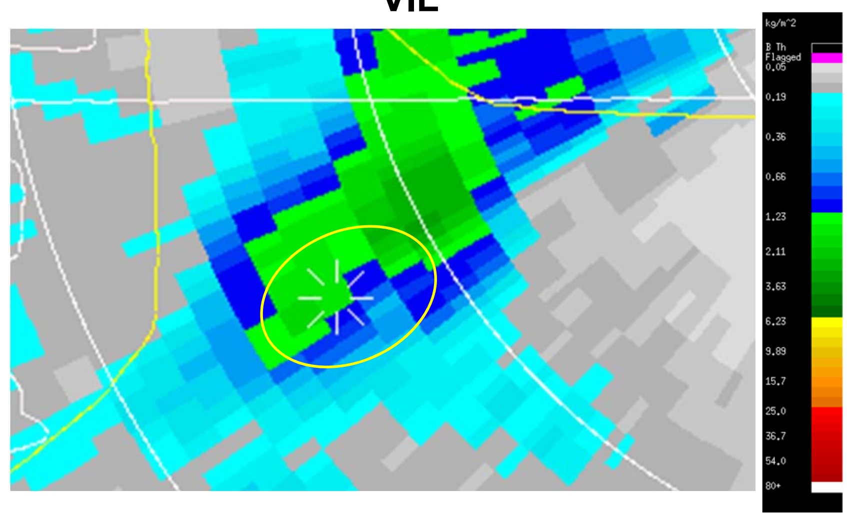


Reflectivity (0.5° elevation)



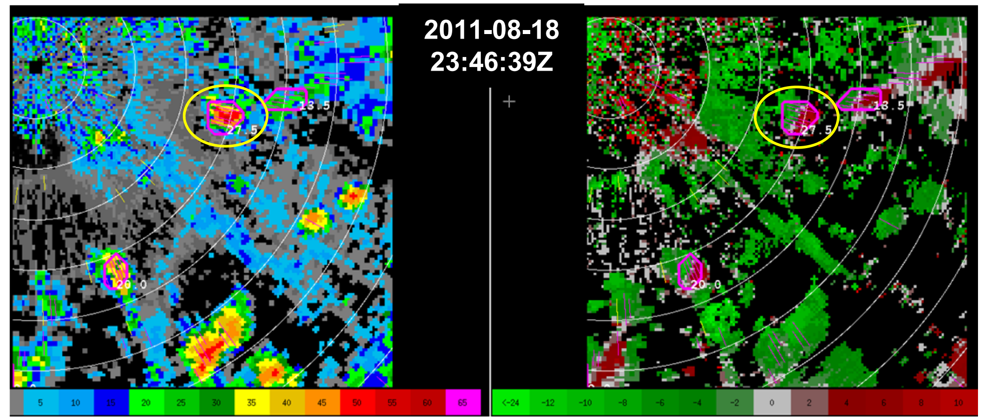
- **Dry cases like this require lower reflectivity thresholds needed for detections**
- **Looking into incorporating reflectivity from higher tilts (e.g. VIL) to help this problem**

VIL

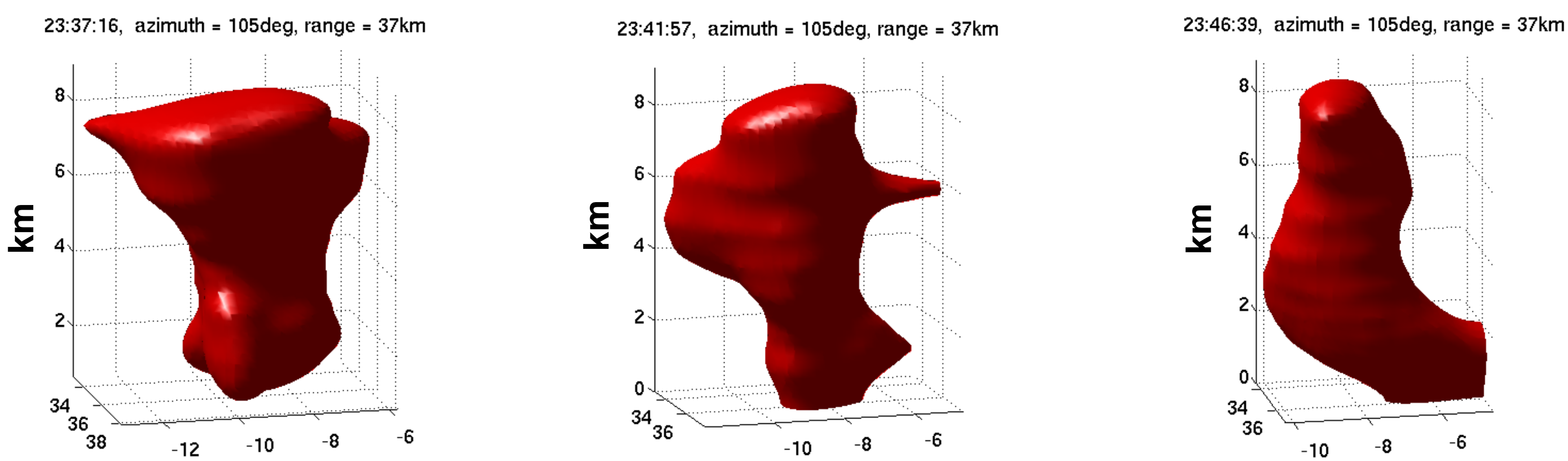


Future Improvements

- **Use information from higher tilts**
  - **Detecting reflectivity aloft could improve POD/FAR, especially in drier environments**
  - **Detecting descending cores could help detection**
  - **Predictive component?**



Isosurfaces of 40 dBZ reflectivity aloft



Future Improvements

(con't)

- **Environmental parameters (LI, CAPE, theta-e, etc..)**
  - Can be used to determine when conditions are right for microbursts (wet vs. dry conditions)
- **Dual-Pol enhancements**
  - Detection of hail aloft
- **Improved shear measurement**
  - Lower sensitivity to outliers in velocity measurements
- **Use of more frequent surface (0.5°) scanning**
  - Other implementations of AMDA had advantage of at least one surface scan every minute

Summary

- **AMDA provides real time wind shear and microburst detection from NEXRAD data**
- **Current performance is adequate, but has room for improvement**
  - **92% POD / 34% FAR for microbursts (shear ≥ 15 m s^{-1})**
  - **88% POD / 16% FAR for wind shear (shear ≥ 7.5 m s^{-1})**
- **Currently looking into ways of improving AMDA by decreasing false alarms**
  - **Information from higher tilts**
  - **Better shear measurements**
  - **Environmental parameters**