MPAR UPDATE

Presentation
for the

Spring 2011 TAC meeting

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Chief, Radar Research & Development Division

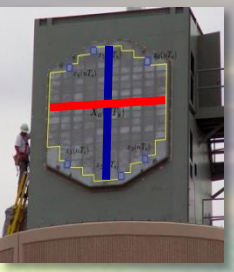
March 9, 2011

Spanky Kirsch (Passed away this pass December)

- Co-Chair of the OFCM MPAR Working Group and Great Supporter of the MPAR Program
- Grand organizer of the air surveillance between DOD, FAA and DHS.
- Supported research into wind turbine clutter

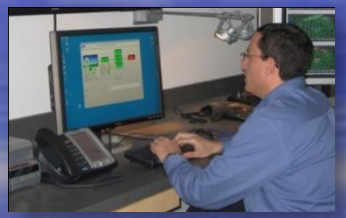
He will be greatly missed!

INITIAL SYSTEM UPGRADES



Radar Hardware

Radar Control Interface (client)



A/D Converters

Real Time Controller

Radar Control Interface (server)

Australia
Finland

Adaptive scanning

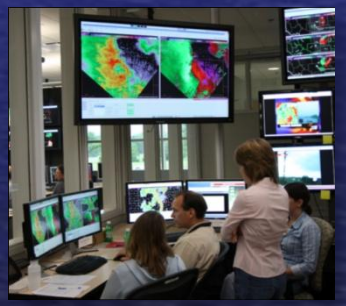
Status monitoring

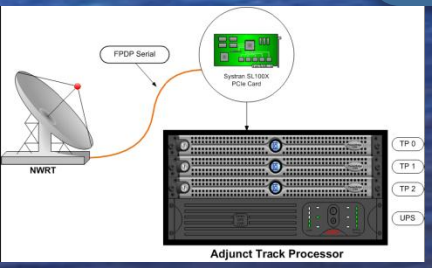
Archive

ATP Processor

DSP Cluster

Displays





Archive

Data
Control
Original
Upgraded

Current Work

- Modification to Real Time Controller (RTC)
  - LMCO and NSSL still working on Mv 5500 application software issues. Critical for scan strategies that require changing the PRTs frequently.
  - Continue design and porting of scanning functionality to the Digital Signal Processor (DSP) to support Adaptive Scanning
- Continued data analysis of NWRT Data & working on results from PARISE
  - Papers presented at AMS Annual Meeting
  - Continued forecaster evaluation of operational Utility of PAR technology

Current Work

- Continued work on Model Initialization with PAR data
- Continued work by OU Collaborators
  - Dual-Polarization element design
  - Eight Channel addition to the NWRT (Mono-pulse, Clutter channels) - Being Tested
  - Cylindrical Dual-Polarized PAR antenna
  - Mobile Imaging Radar
- Continued work on Wind Turbine Mitigation
  - Funded by DHS
- Dual-Polarized Fractional Sub-Array
  - Work is continuing with Basic Commerce Industries on building 12x12 panel – T/R module fabricated

Current Work

- Signal Processing
  - Adaptive range oversampling
  - Additional automatic calibration routines
- Adaptive Scanning
  - ADAPTS enhancements
    - i.e. Elevation-prioritized scanning
  - Manual schedule-based scanning
    - Modify scanning strategies and change acquisition parameters on the fly

Current Work

- Adaptive Scanning (continued)
  - Automatic schedule-based scanning
    - Remove from RTC and provided by Signal Processor
- Infrastructure:
  - Data formats – support NetCDF
  - Communication – Moving toward generic data formats

Current Work

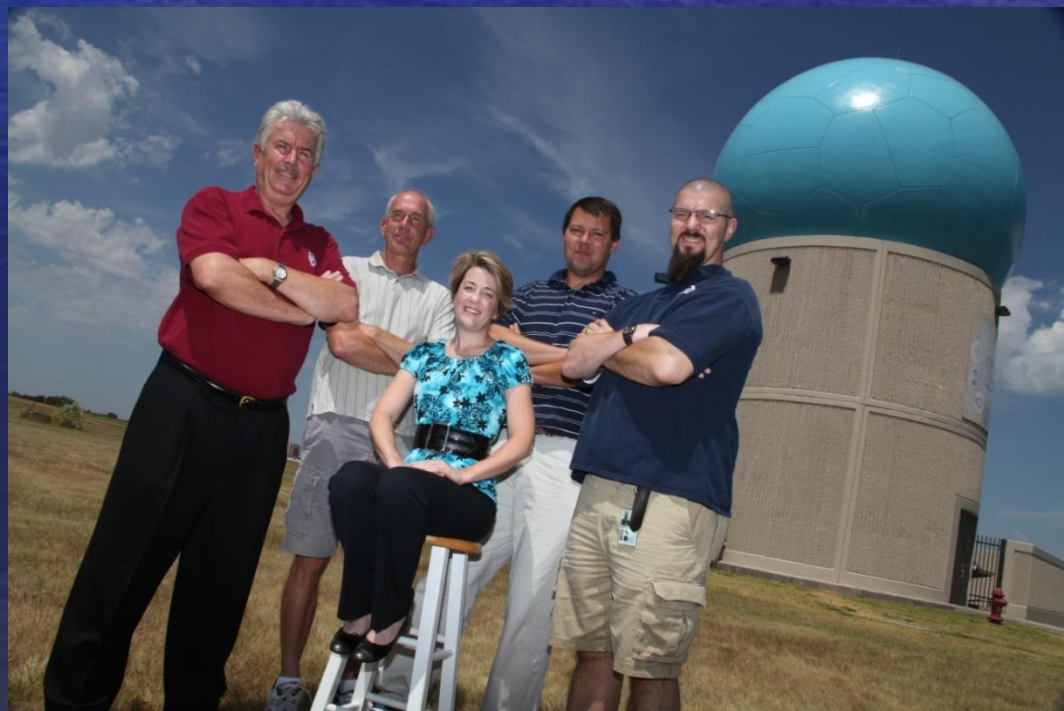
- Infrastructure (continued)
  - User Interface
  - Added new dual-quad core machine to cluster as the 5th node.
- Spring Data Collection & PARISE
  - Support for VORTEX-2

Current Work

- Data Collection 2010/Total
  - 2.8/11 TB of I&Q Data
  - 110.9 GB/5 TB of Moment Data
  - Archive includes:
    - 24 supercells, 11 tornadic
    - 25 MCSs, 2 tornadic , 4 with Severe Winds
    - 22 Pulse storms (microbursts, weak and strong)
    - 15 Scattered storms

22nd Vaisala Award

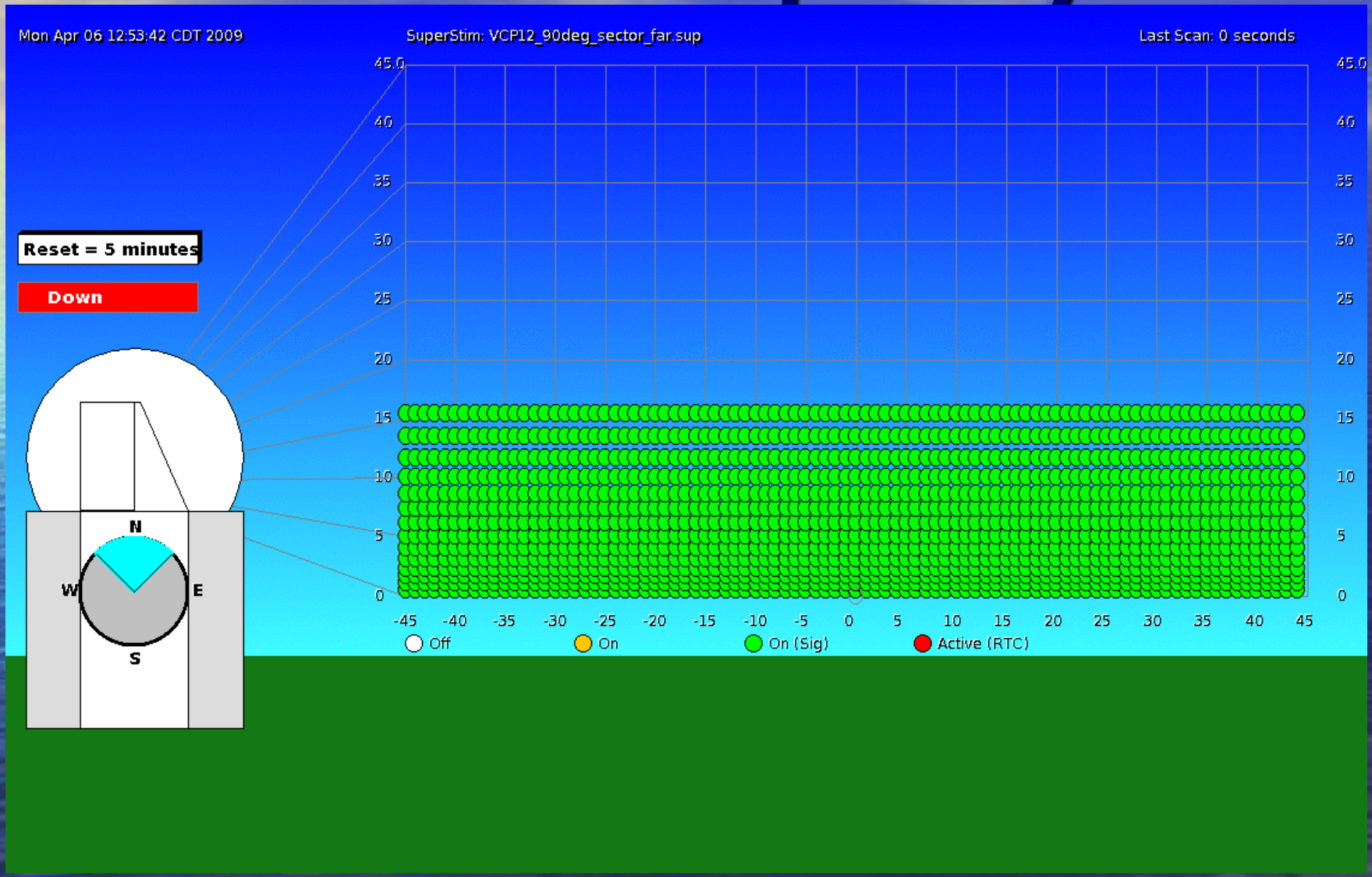
- "Rapid Sampling of Severe Storms by the NWRT Phased array Radar"
  - Weather & Forecasting, 2008



Technology Assessment Program (TAP)

- OFCM, FAA & NSSL – Continued work – Completed SOW
- Supported by GTRI and BCI
- Goals:
  - Determine challenges and risks for MPAR
  - Determine Path to minimize the risks
  - Implement risk reduction
- Areas of concern
  - Dual Polarization
  - Multi-frequency operations
  - Cost
  - Concept of operations

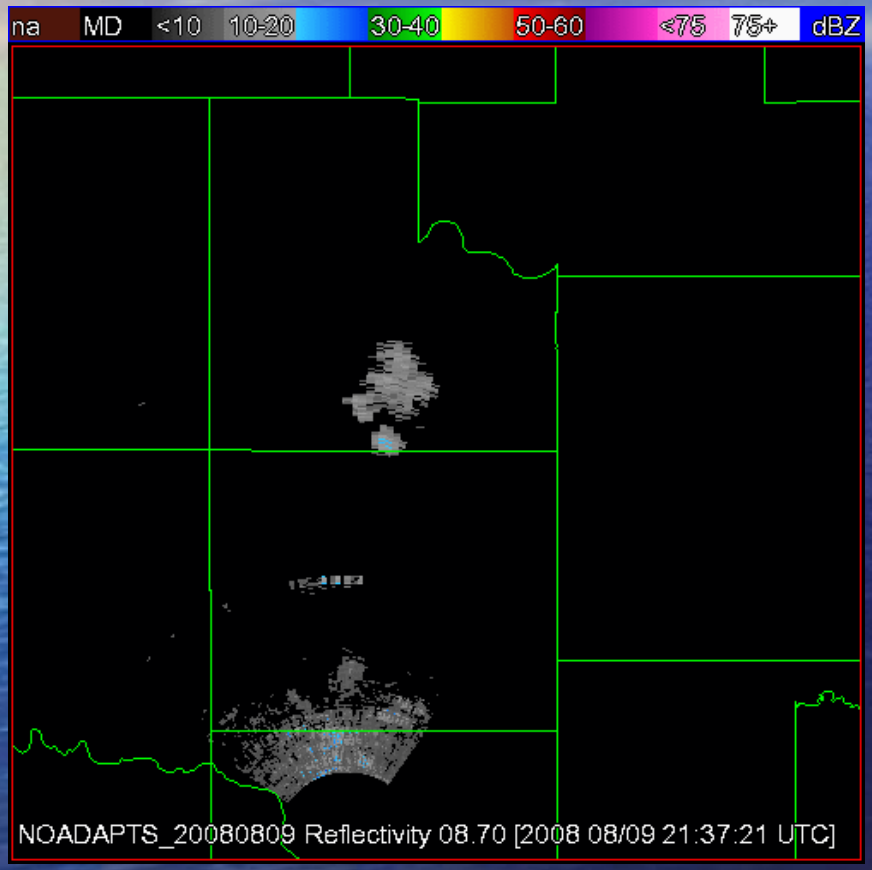
New Adaptive Scanning Capability



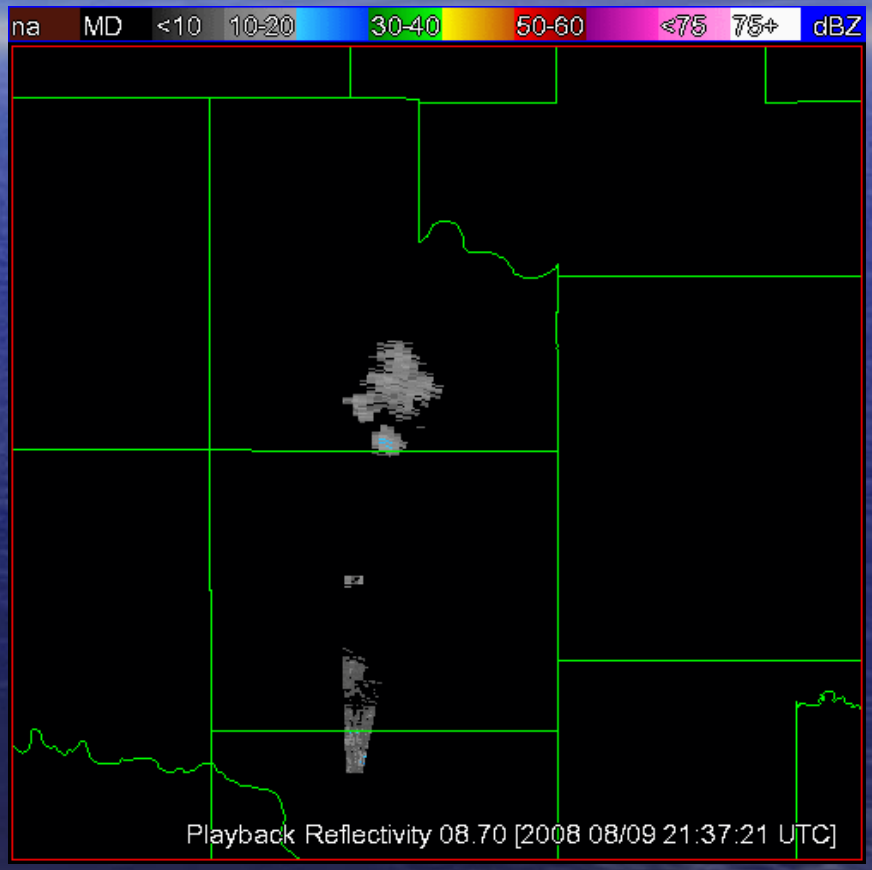
ADAPTS Performance

Qualitative

ADAPTS is **OFF**



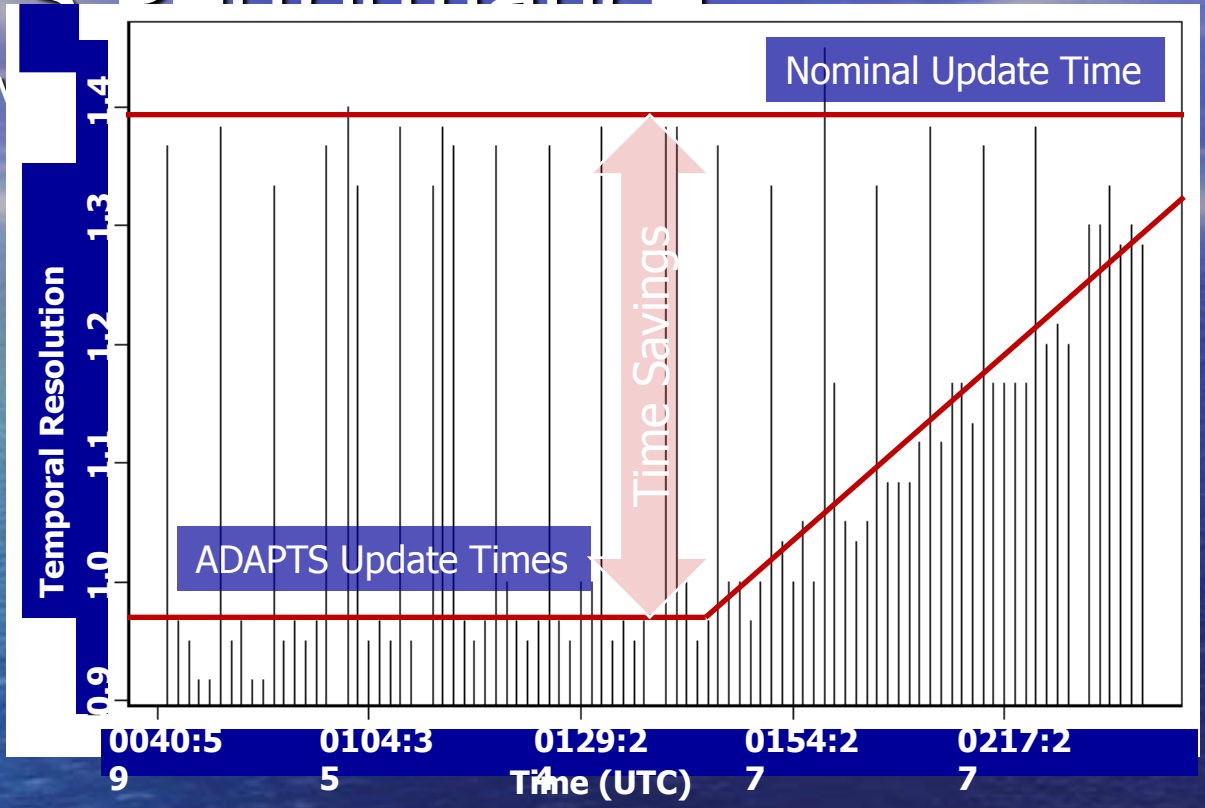
ADAPTS is **ON**

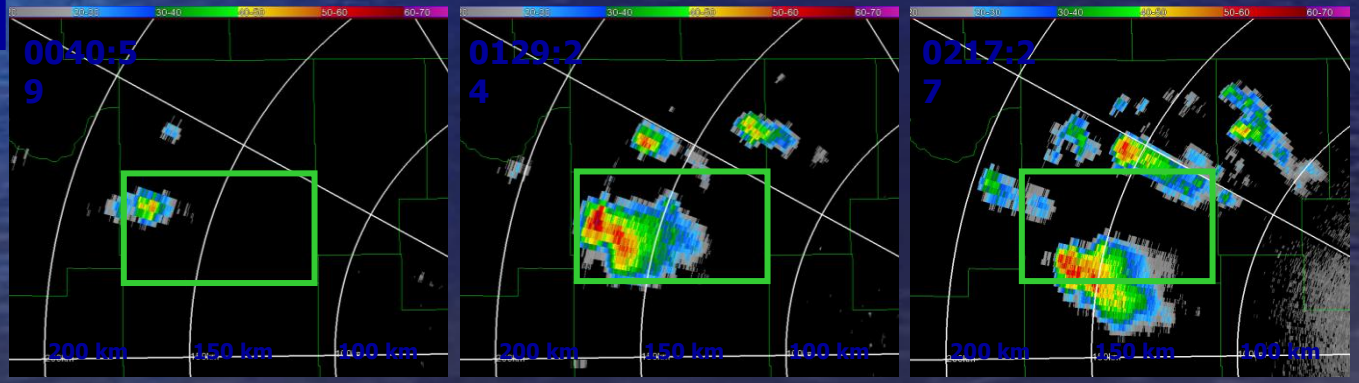


09 AUG 2008 – Reflectivity - 8.7 deg

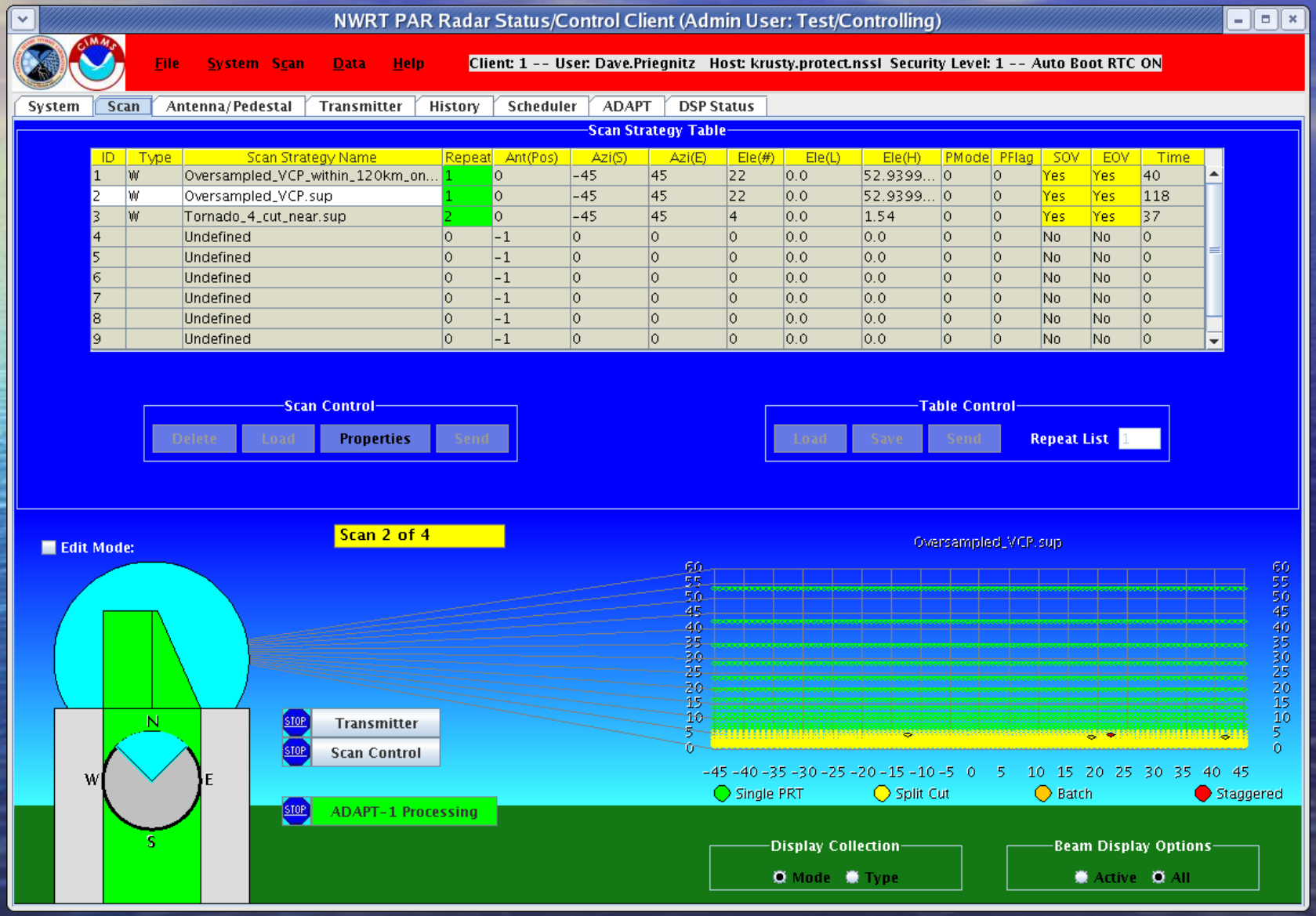
ADAPTS Performance

Quantitative Ev





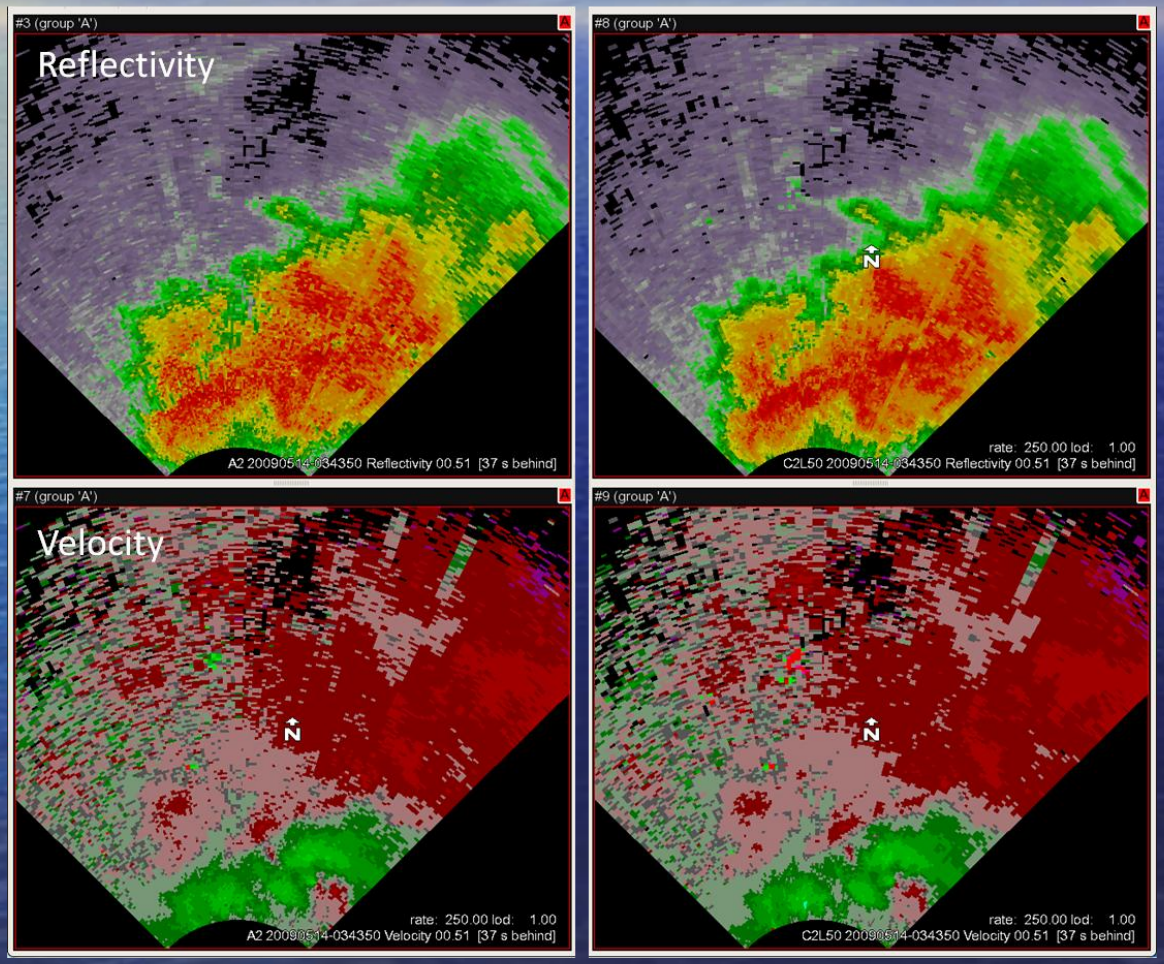
User Interface – Adaptive Scanning



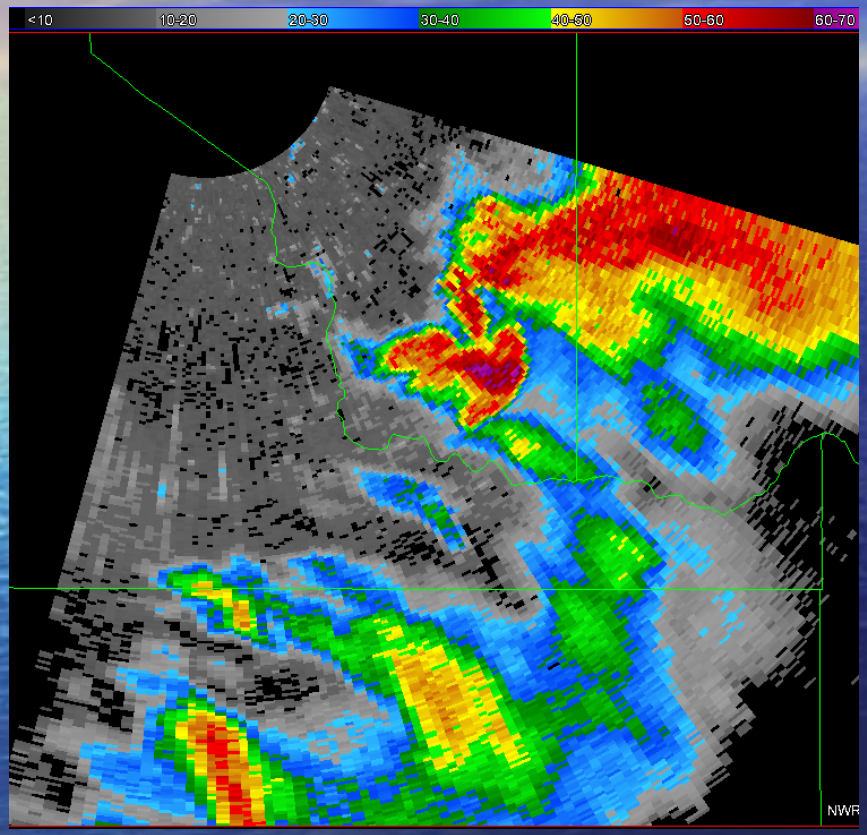
Range Oversampling

Standard Processing

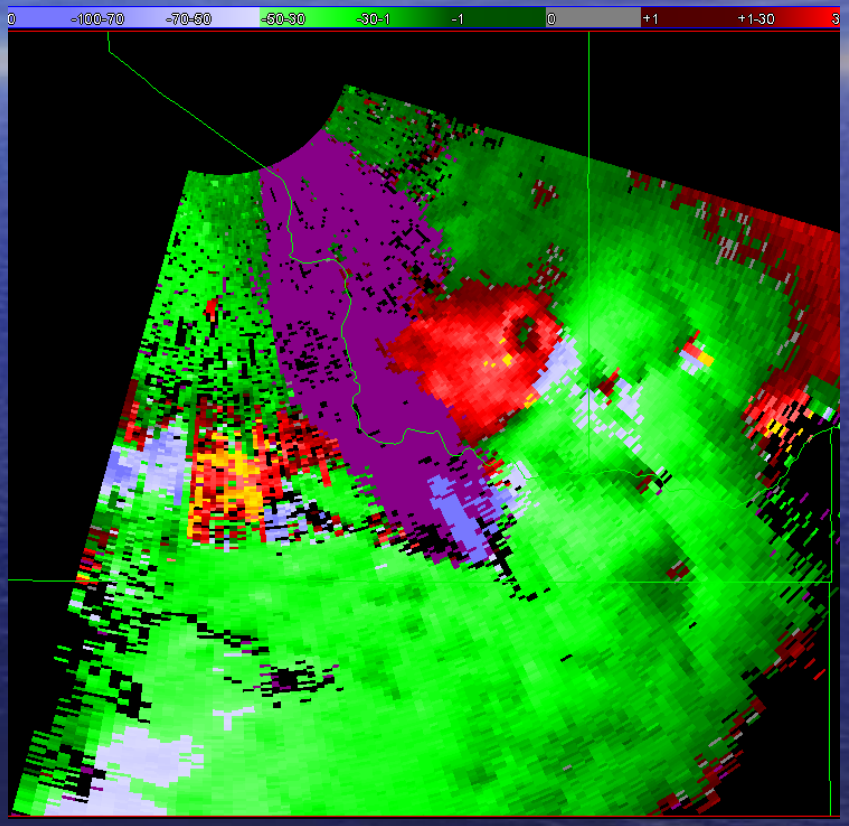
Range Oversampling Processing with 50% observation time



May 10, 2010

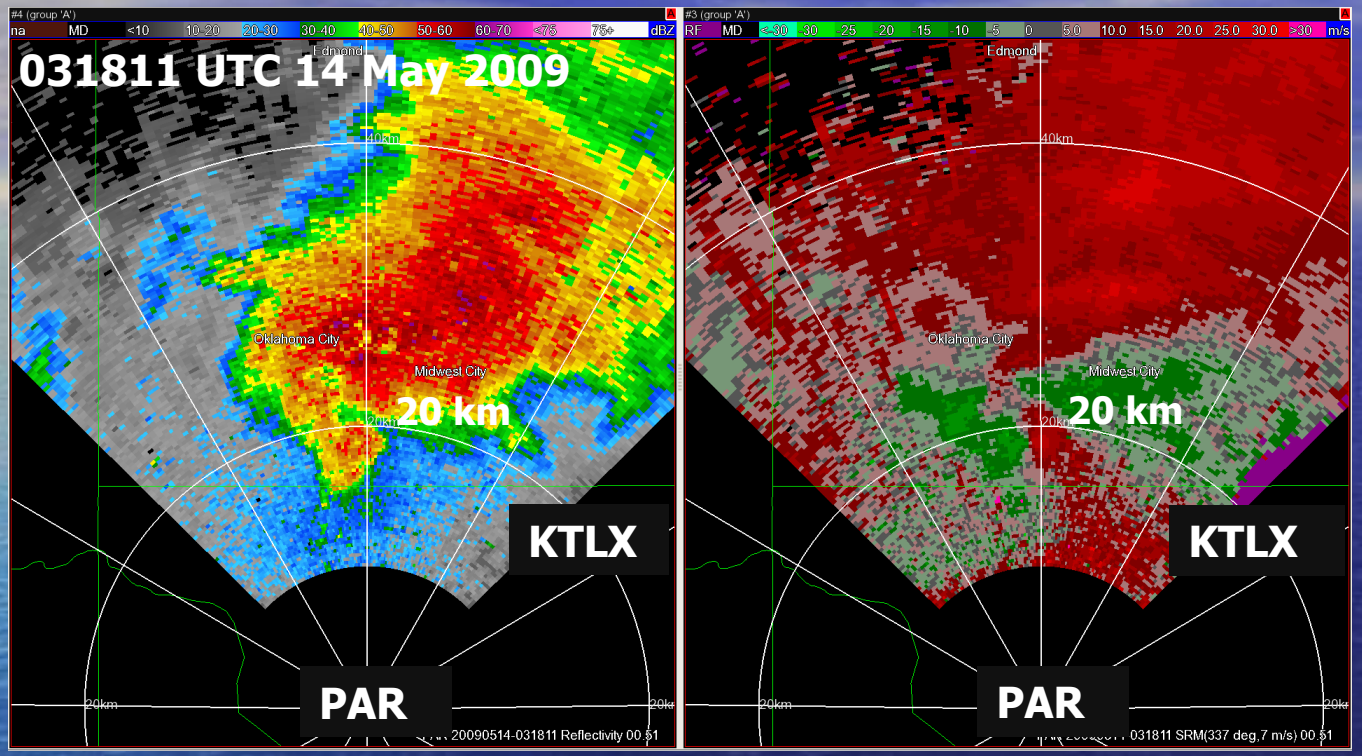


REFLECTIVITY



VELOCITY

More Firsts for NWRT PAR



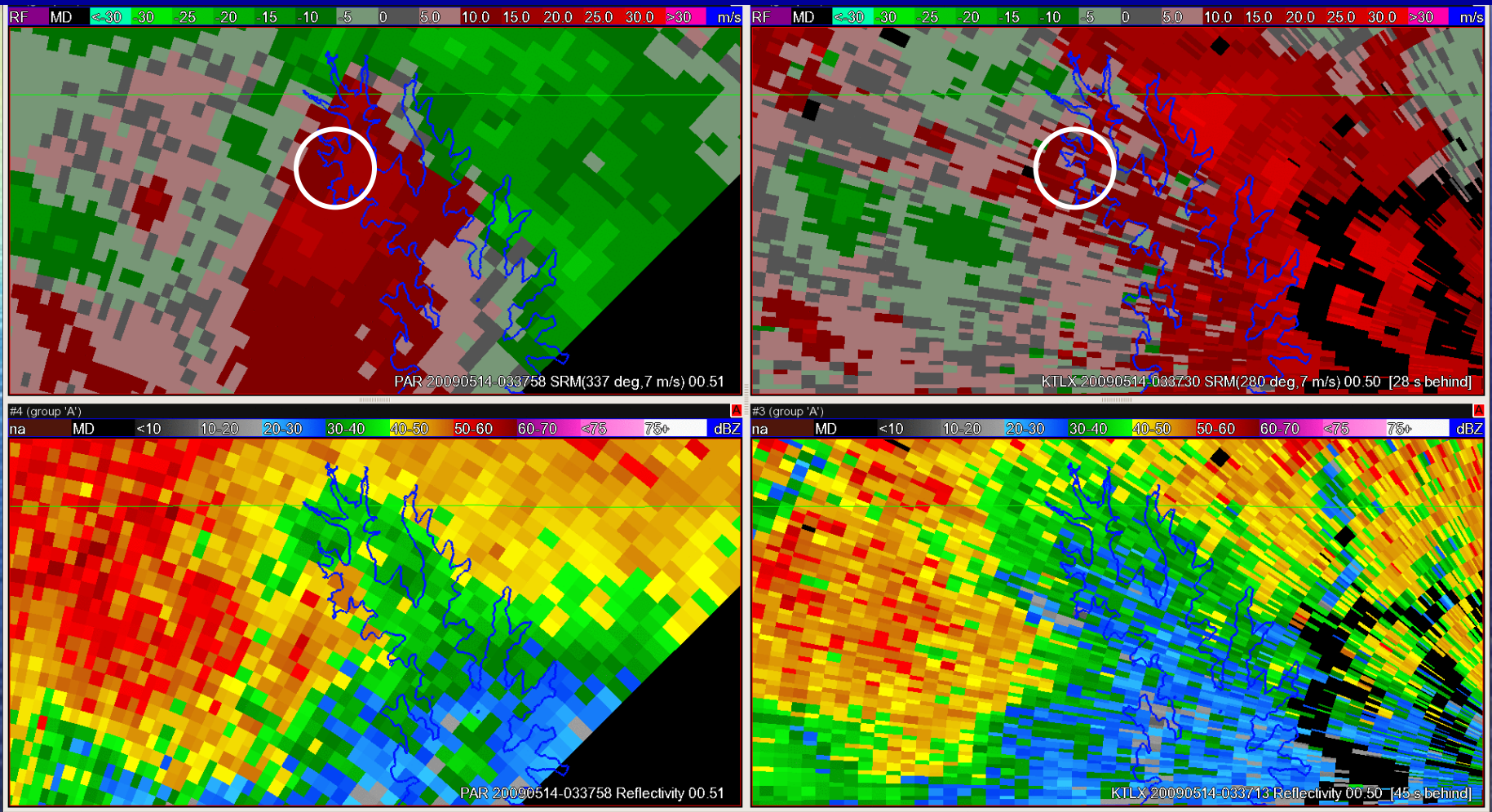
1. First tornadic supercell sampled within 40 km of PAR
   - mesocyclones & other vortices within 20 km

2. First supercell advantageously positioned for dual-Doppler analysis using PAR and KTLX

Did 43 s updates improve depiction of tornado cyclone evolution?

PAR: 43 s Updates

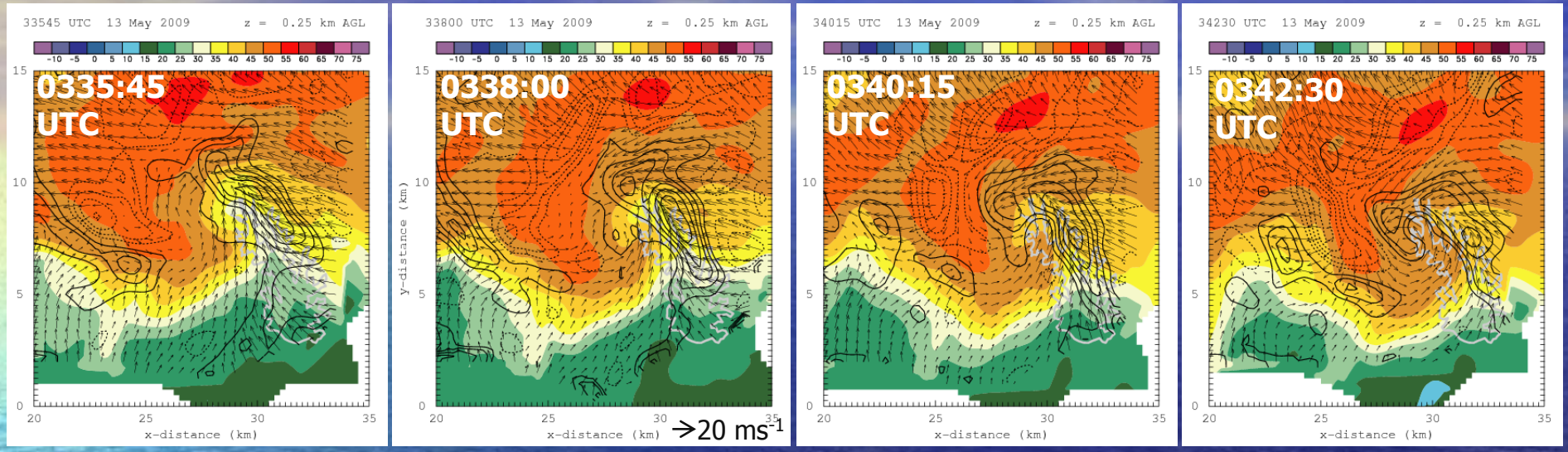
KTLX: 4.2 min Updates



250 m AGL, 0338:00 – 0346:15 UTC

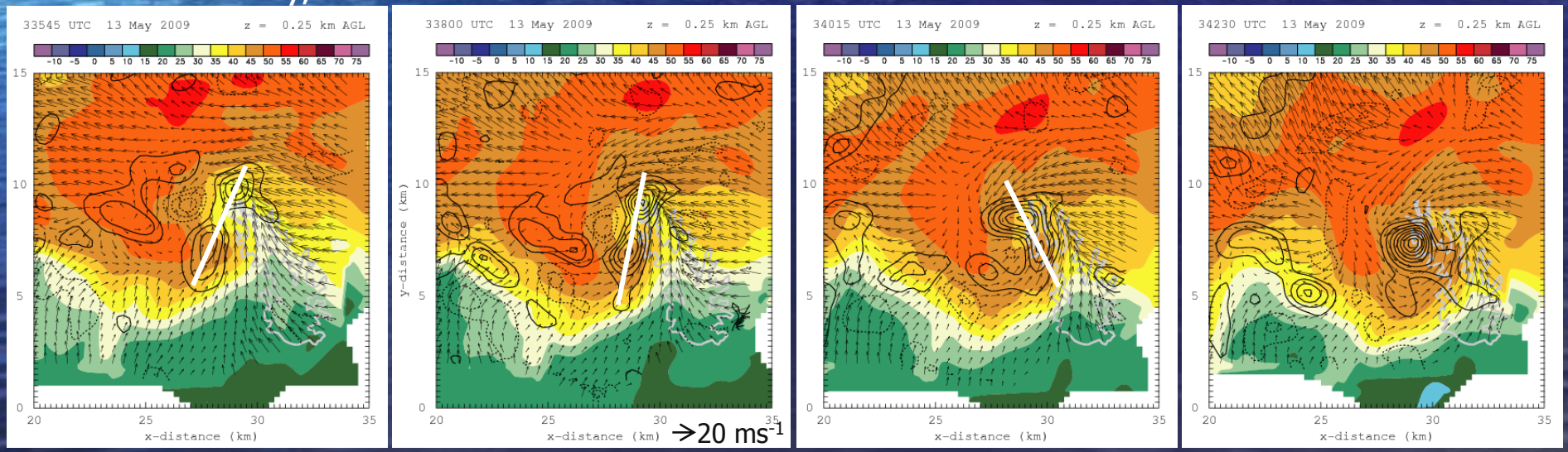
Vertical Velocity, 1 m s^{-1} contours

Storm-relative wind vectors



Vertical Vorticity, 5 x 10^{-3} s^{-1} contours

EF0 Tornado



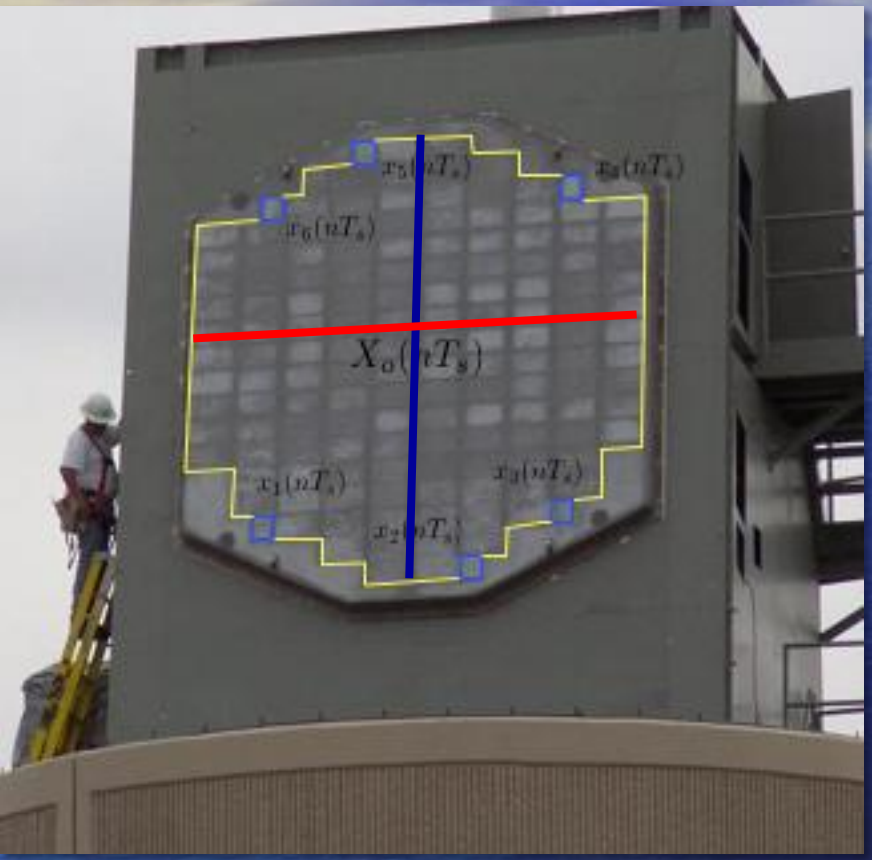
Conclusions

43 s updates at 0.5° provided depiction of tornado cyclone evolution superior to WSR-88D updates

The amplification of vertical vorticity assoc. w/ the tornado

- occurred during the occlusion phase, along axis of convergence
- evolution suggests vortex co-located with updraft became dominant likely in response to vortex stretching and merging with vortex center to its south

Multi- Receiver System



eight LNA's

eight downconverters

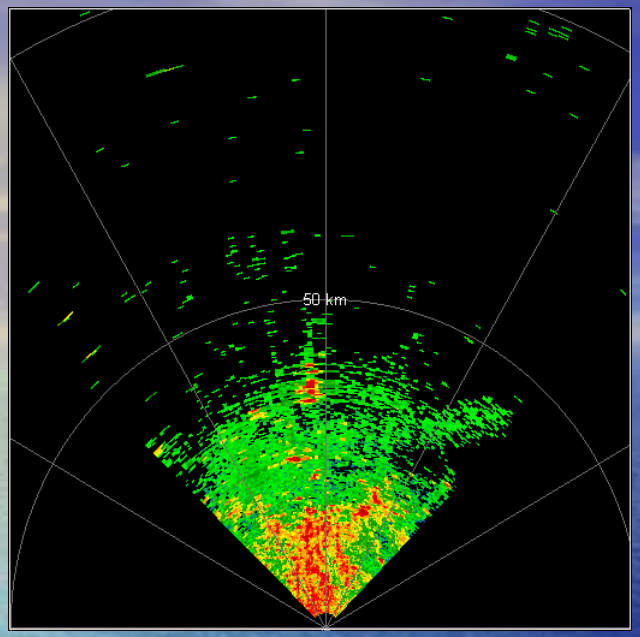
Installed rack w/ digital receivers

1 - Az Diff
1 - El Diff
} Monopulse

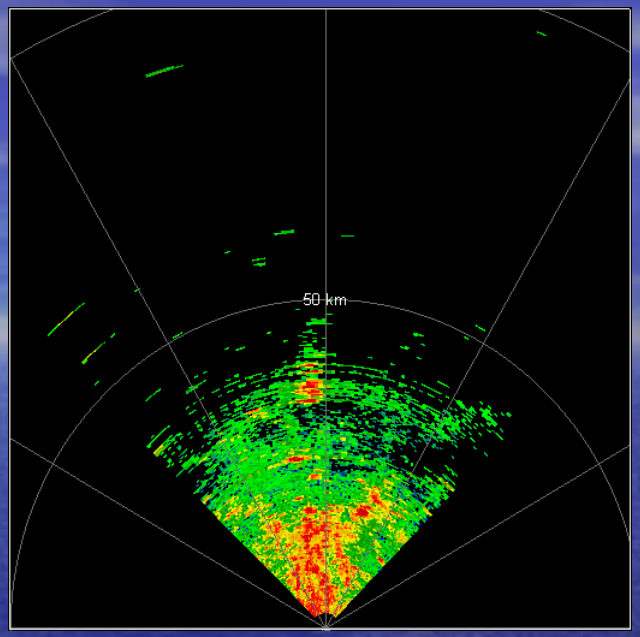
6 – Clutter Channels

Courtesy of Mark Yeary

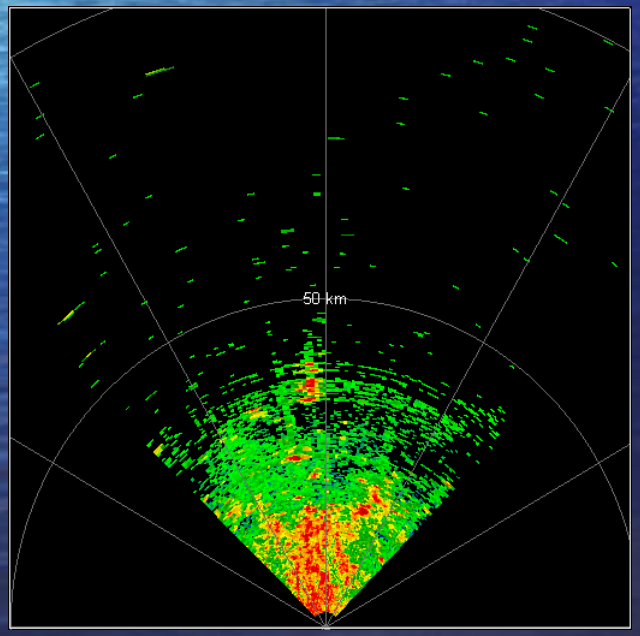
MCR 1: Sum



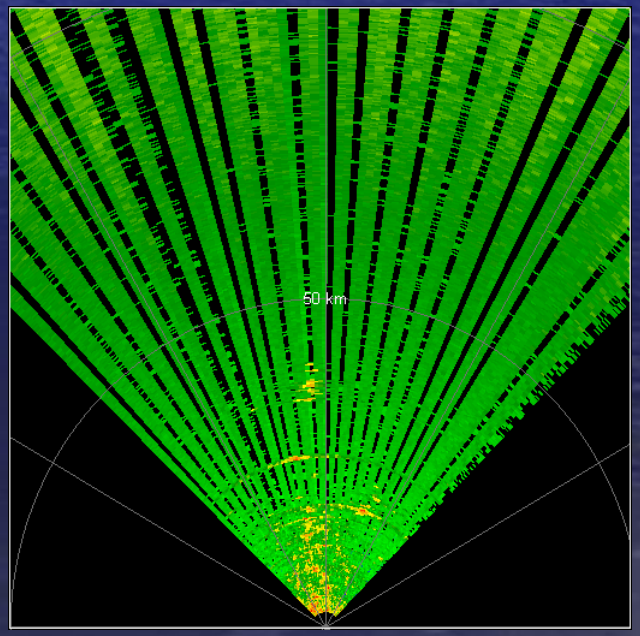
MCR 2: Delta Az



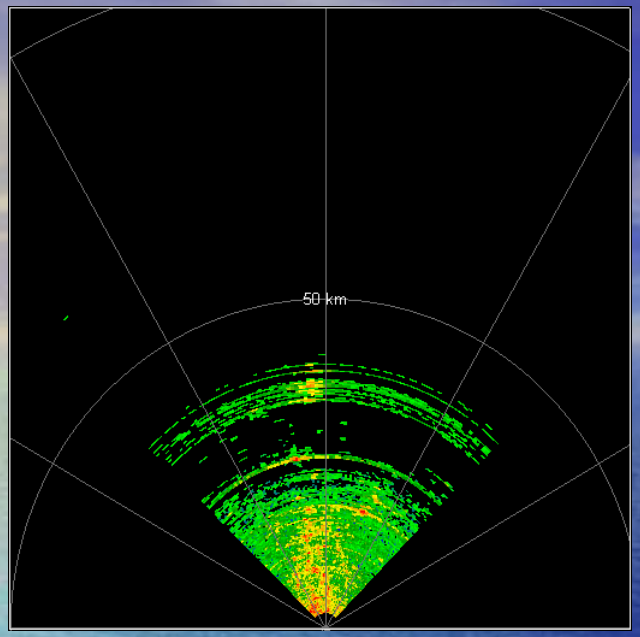
MCR 3: Delta El



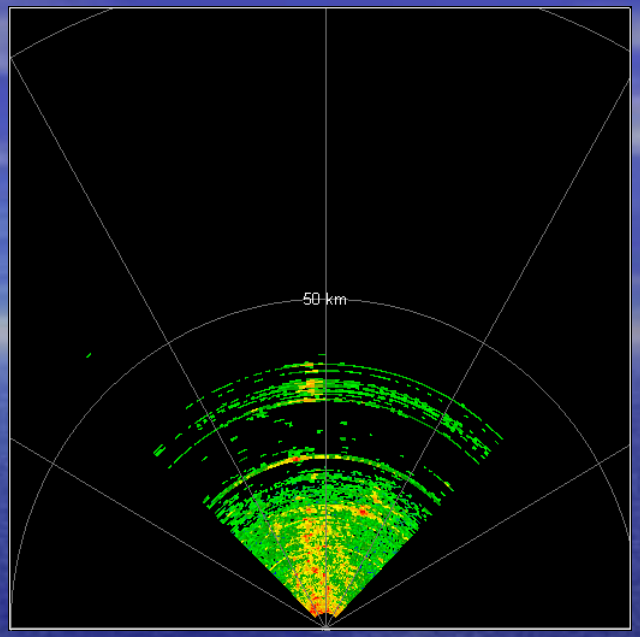
MCR 4: Sidelobe



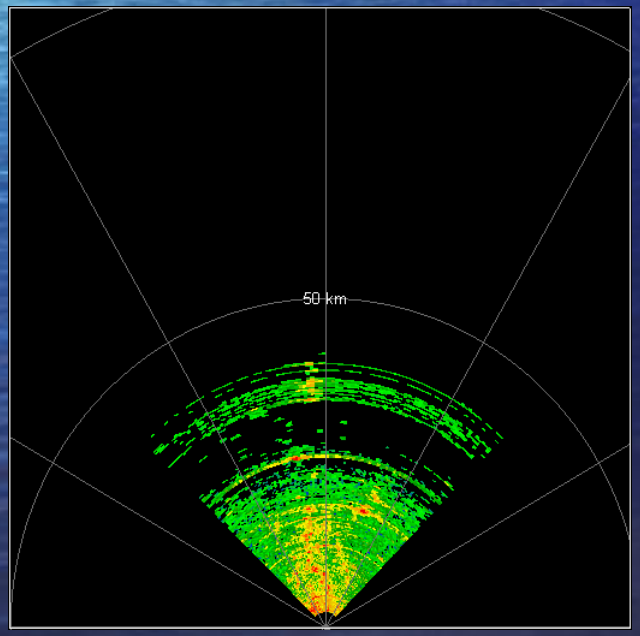
MCR 5: Sidelobe



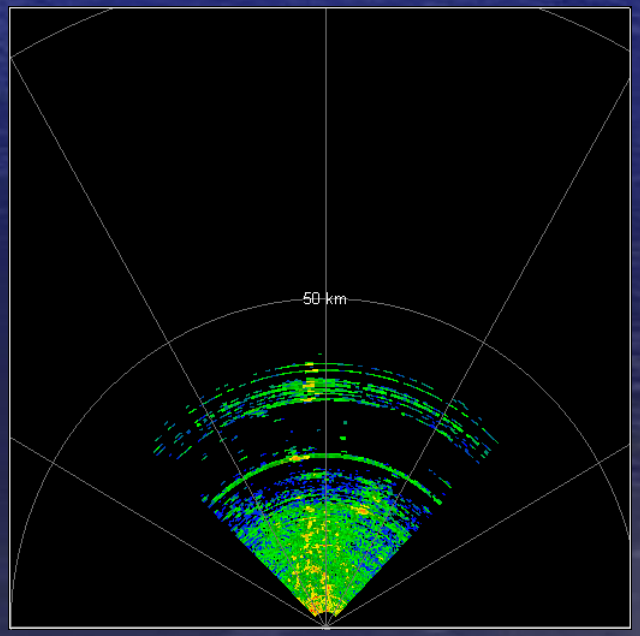
MCR 6: Sidelobe



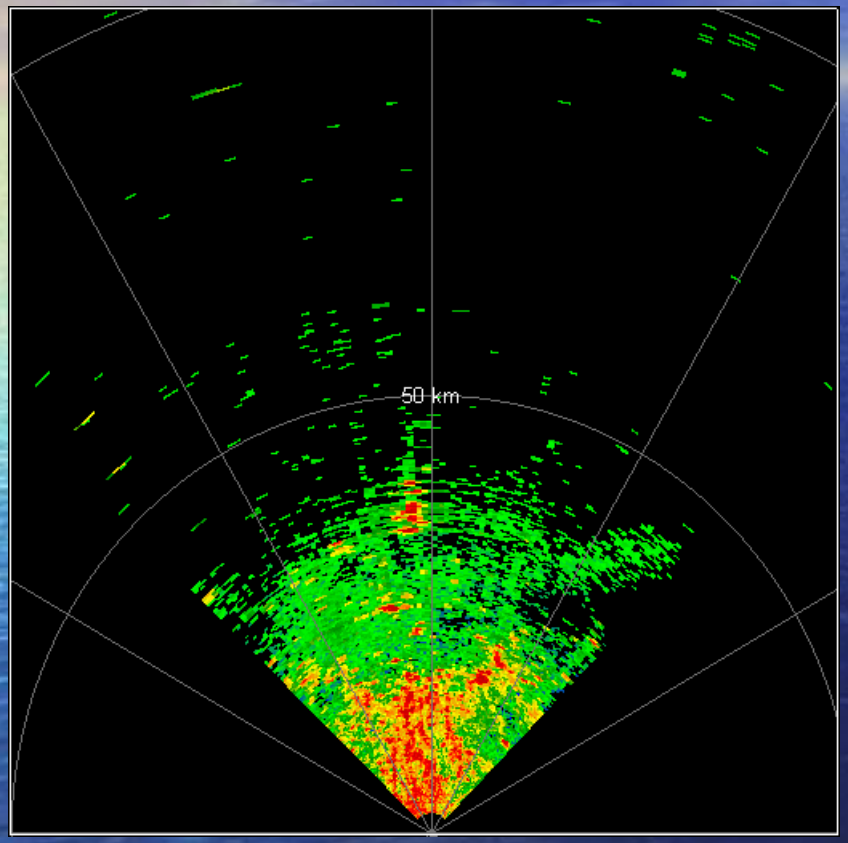
MCR 7: Sidelobe



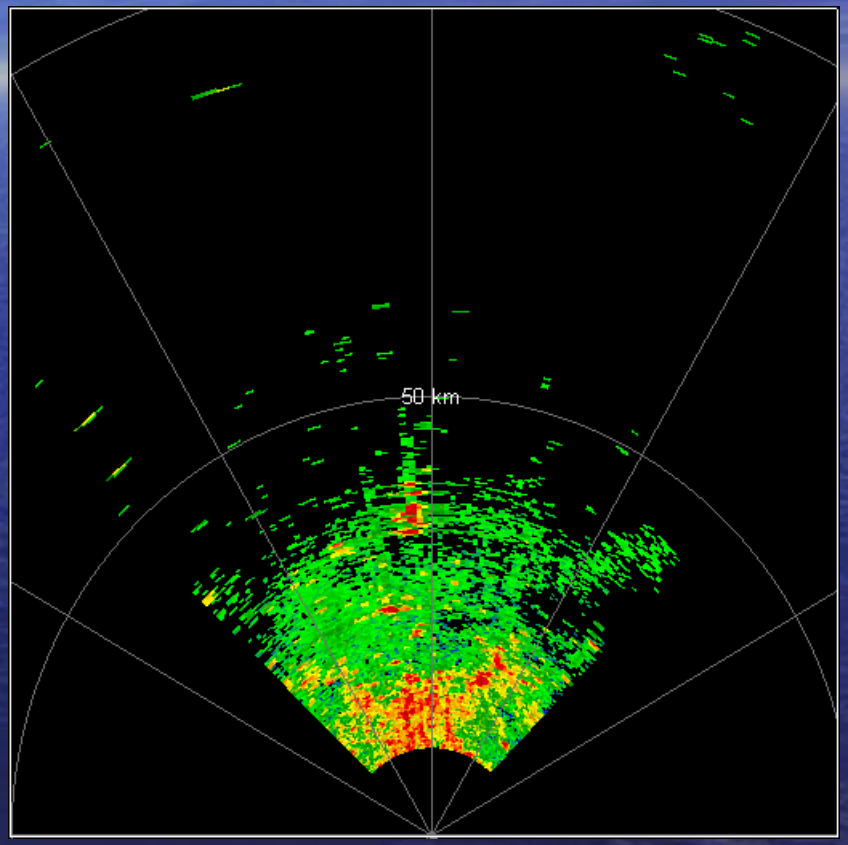
MCR 8: Sidelobe



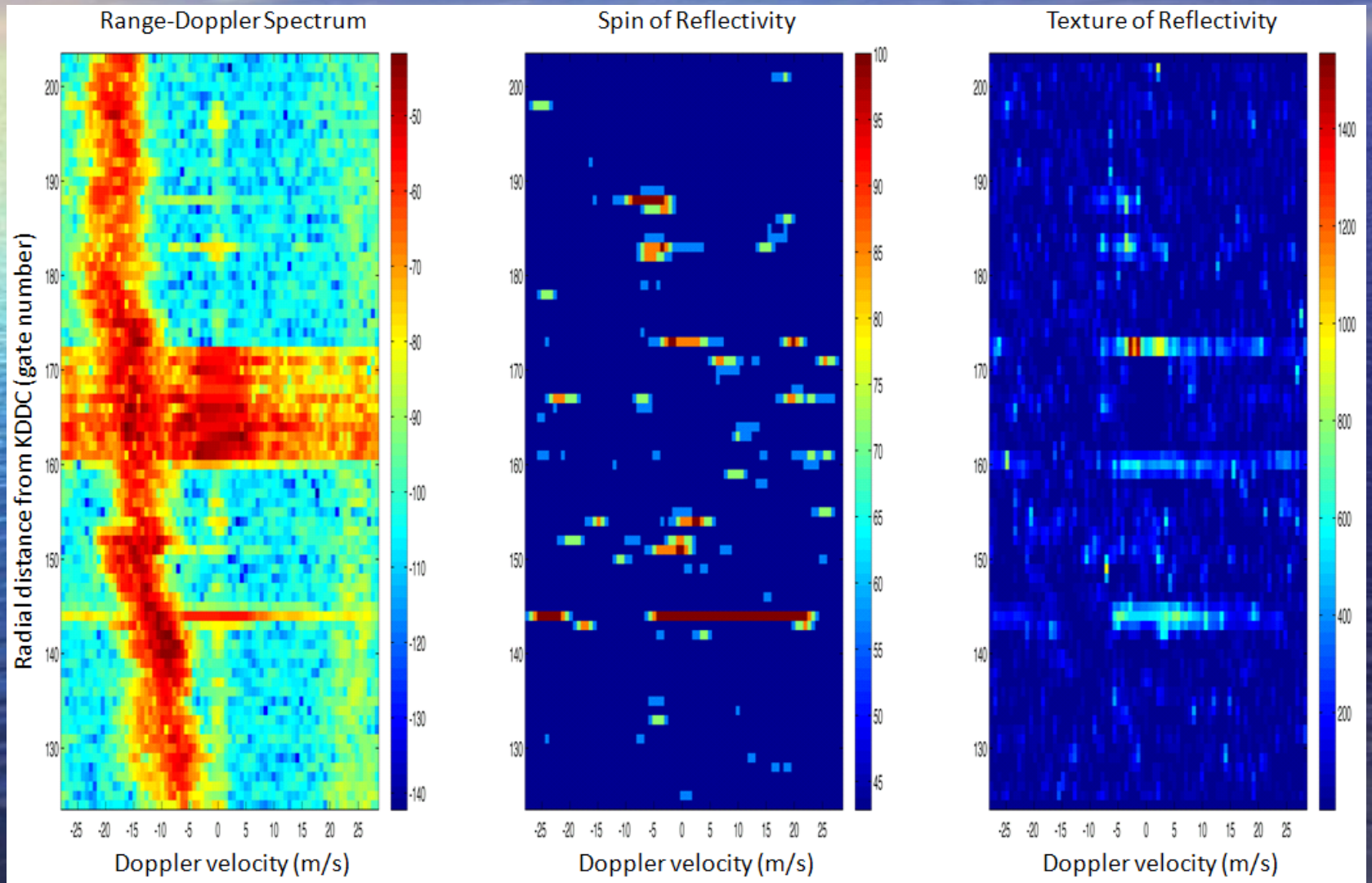
MCR 1: Sum



NWRT: Sum



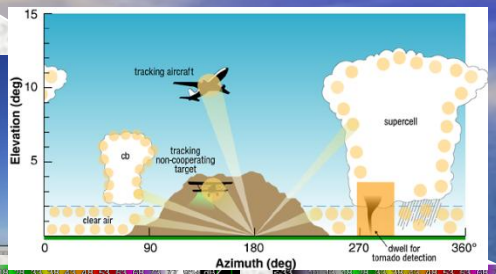
Wind Turbine Clutter Studies

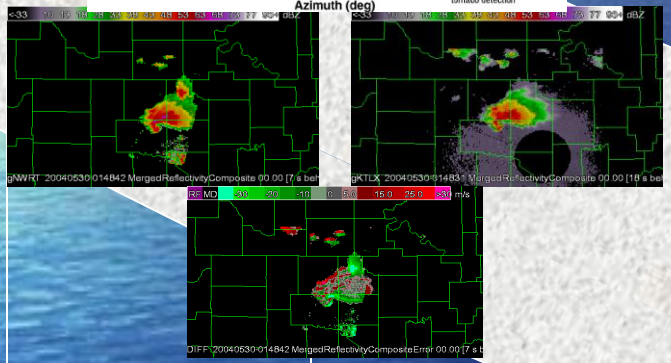


PLANS

- 2011 Spring Program
  - Work with Operational Meteorologists
    - Sampling procedures for severe wind and tornadoes
    - Database of Visualization techniques to aid in Warning Decision making
- Porting scan control from RTC to DSP
  - Facilitate Algorithm control of scanning strategies
- Optimization of scanning strategies based on range of storms from the radar
- Continued Risk Reduction on Dual-Polarized phased array radar systems

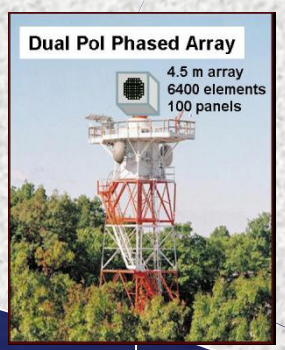
MPAR ROADMAP

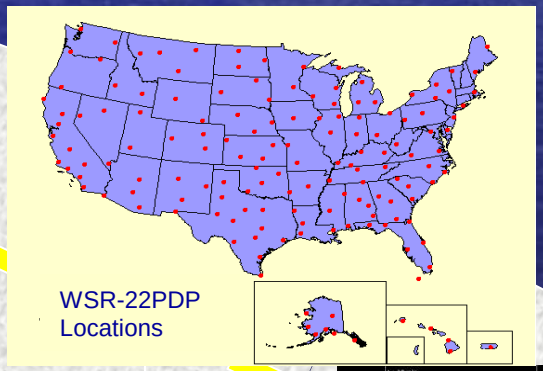


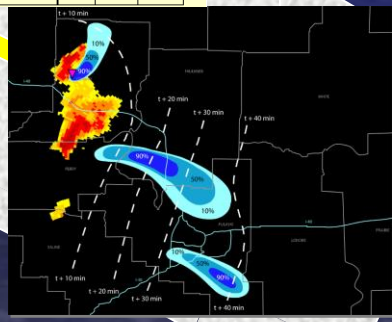


2 or 4 faced Prototype

2030







2004

2007

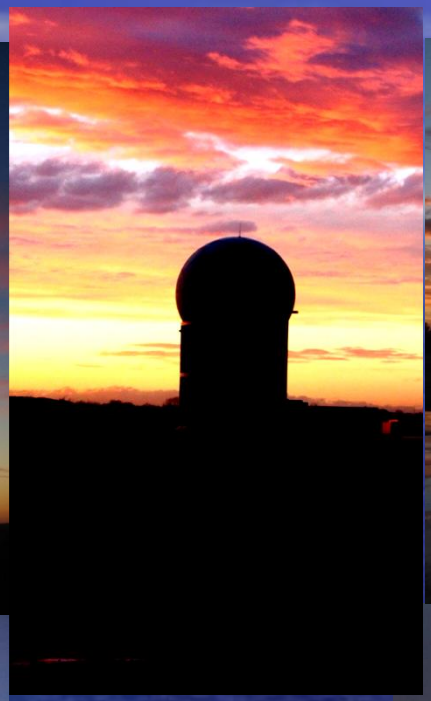
Dual-Polarized Sub-Array

2013

2018

2022

Questions?



R2D2 = Radar Research and Development Division

THANK YOU