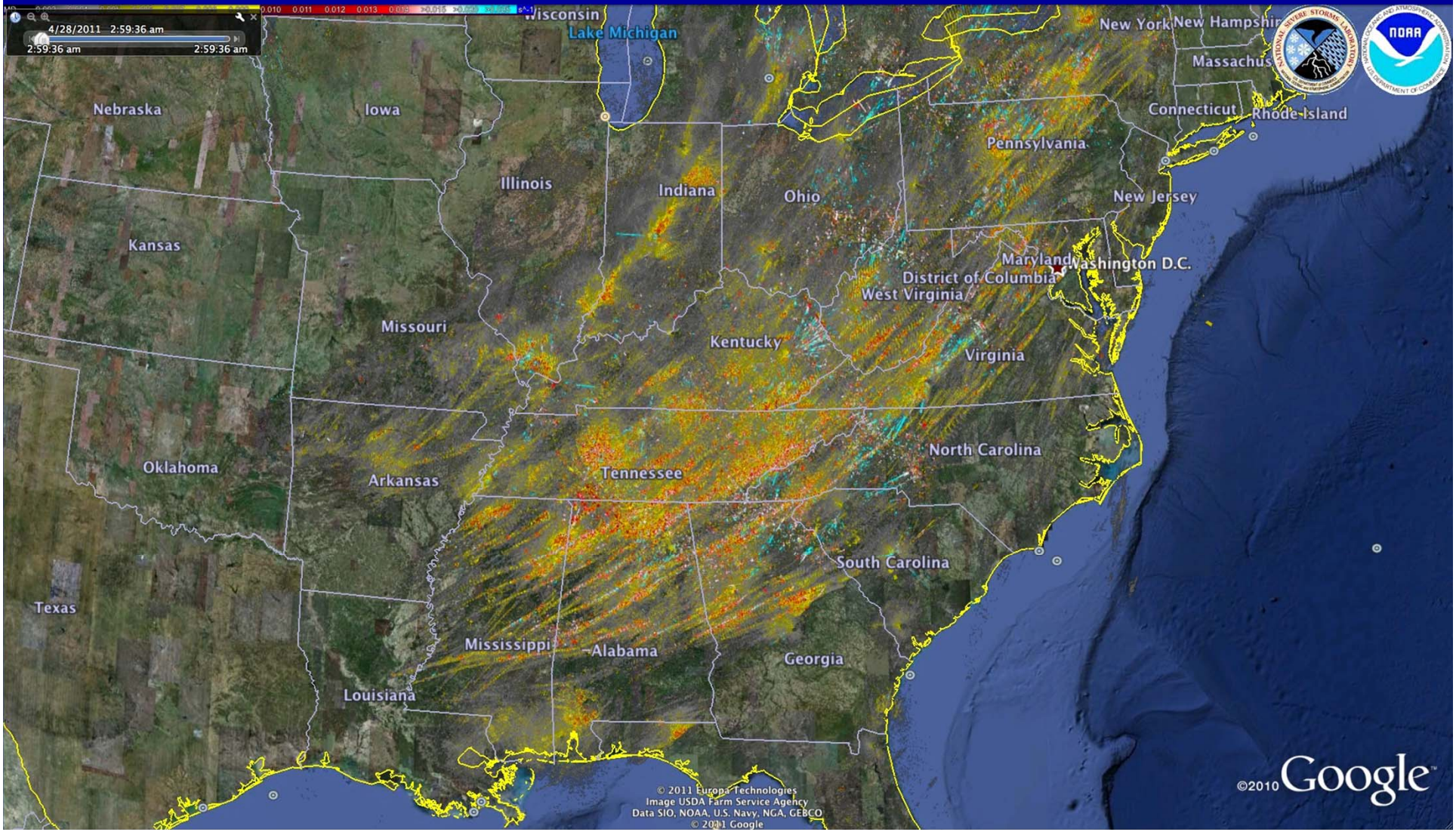
# NEXRAD in the 2011 Service assessments

Jim LaDue WDTB

NEXRAD TAC

Feb 2012

# 2011-04-27


4/28/2011 2:59:36 am
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Wisconsin
Lake Michigan
New York
New Hampshir
Massachus
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Iowa
Connecticut
Rhode Island
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Illinois
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New Jersey
Kansas
Maryland
Washington D.C.
District of Columbia
West Virginia
Missouri
Kentucky
Virginia
North Carolina
Oklahoma
Arkansas
Tennessee
South Carolina
Texas
Mississippi
Alabama
Georgia
Louisiana
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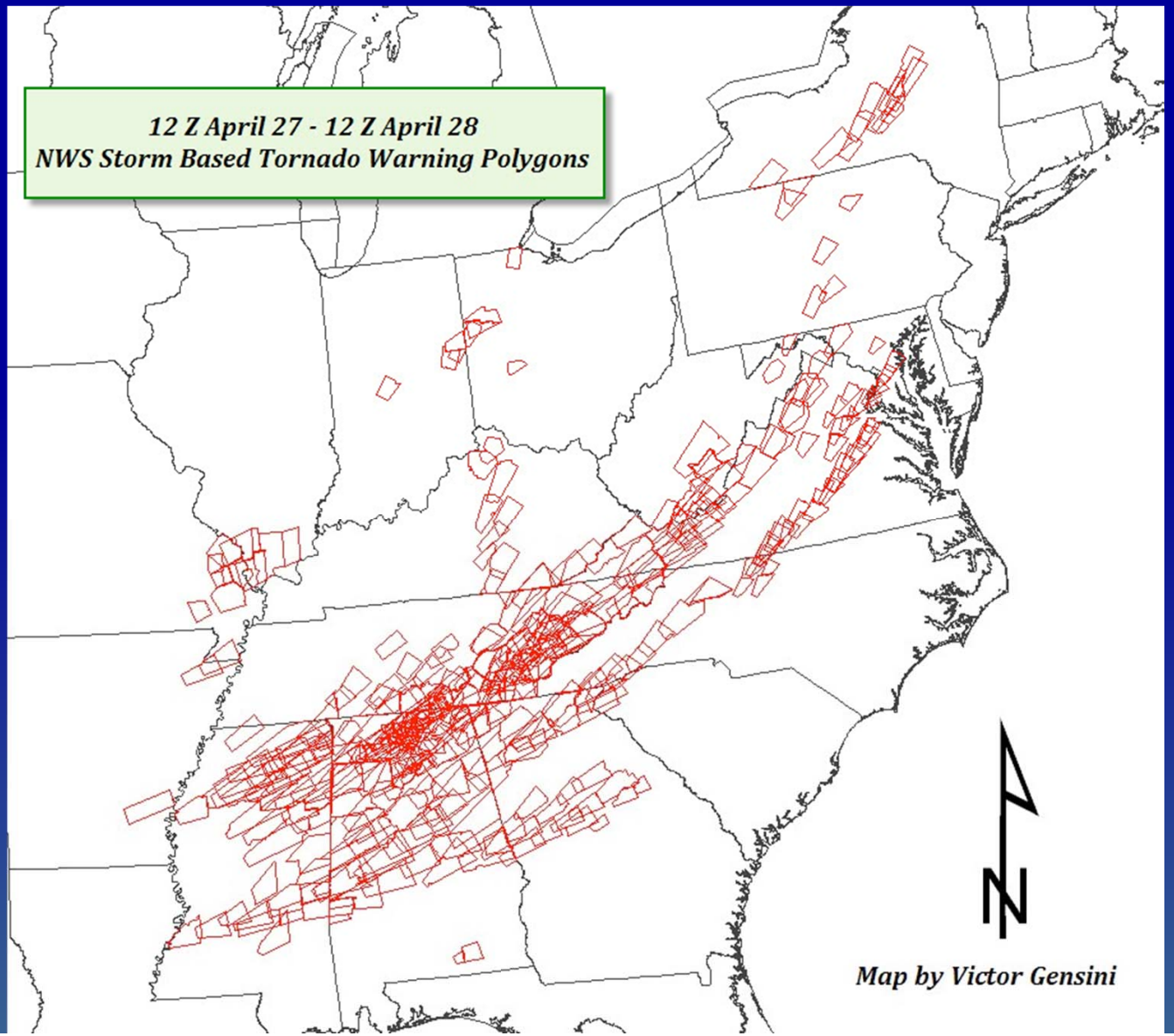
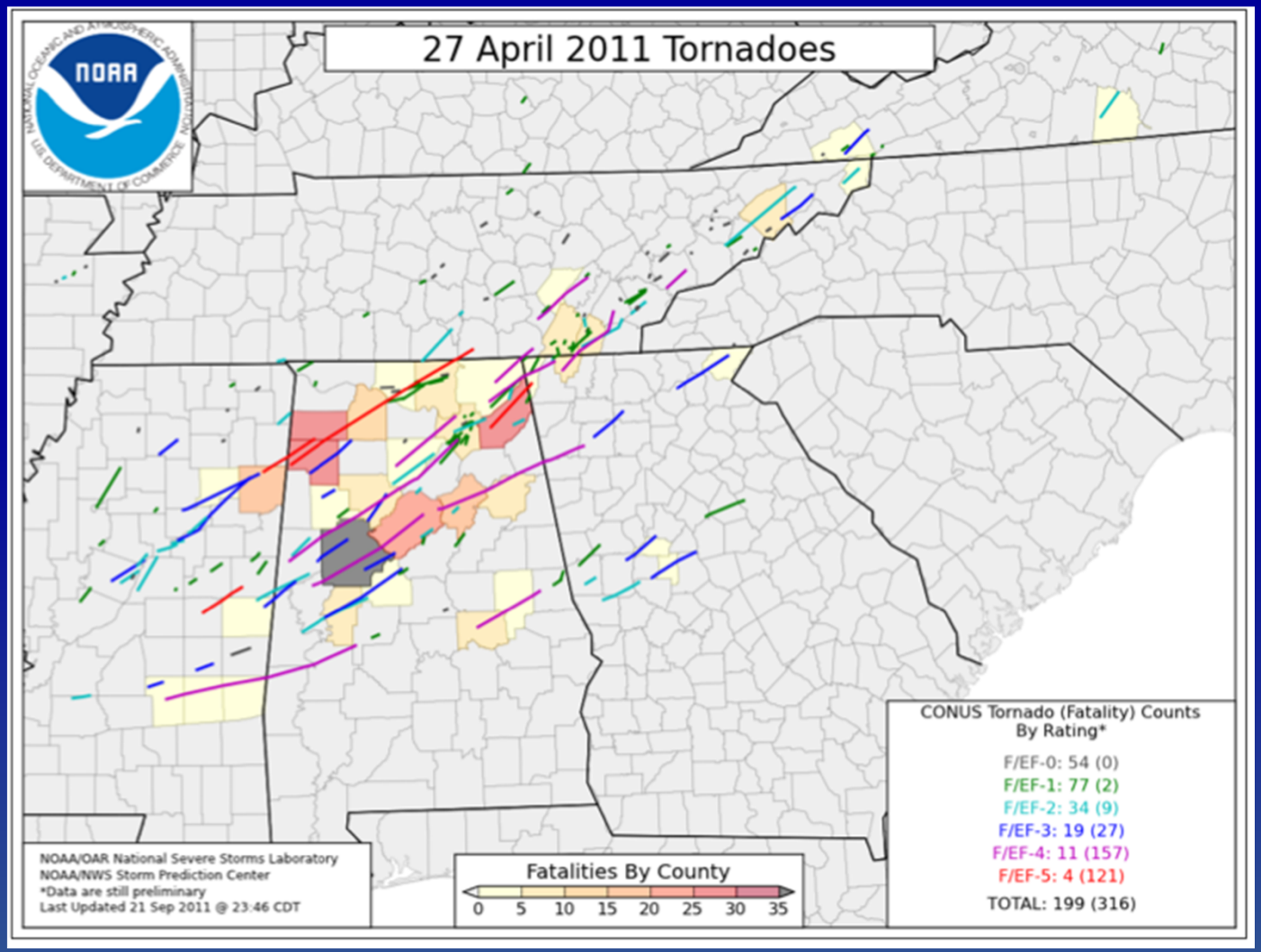
# Tornado warnings 2011-04-27



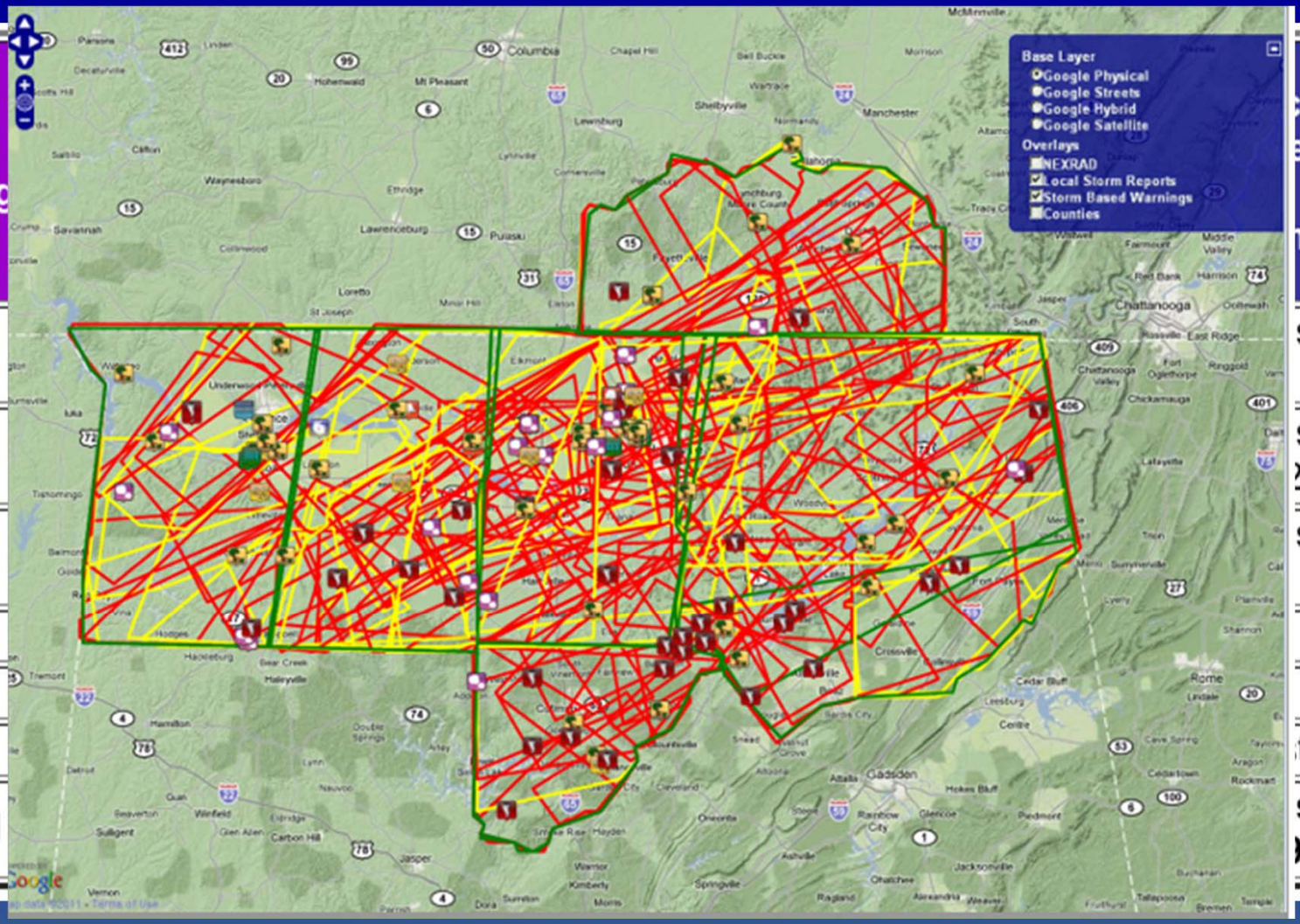
# Tracks and fatalities




Map courtesy Patrick Marsh

# Impact to the NWS Huntsville CWA

| EF-Rating |
| --- |
| EF-5 |
| EF-4 |
| EF-3 |
| EF-2 |
| EF-1 |
| EF-0 |
| Total |



# VCP selection

- VCPs used
  - Apr 27
    - KJAN
    - kgyx
    - khtx
    - kbhm
    - kffc
  - May 22
    - ksgf

# WSR-88D issues: KMRX

- On the night of April 26, suffered an oil pump failure.
- The ET staff worked through the night and successfully repaired KMRX, which was operational through the event.

# WSR-88D issues: KBMX

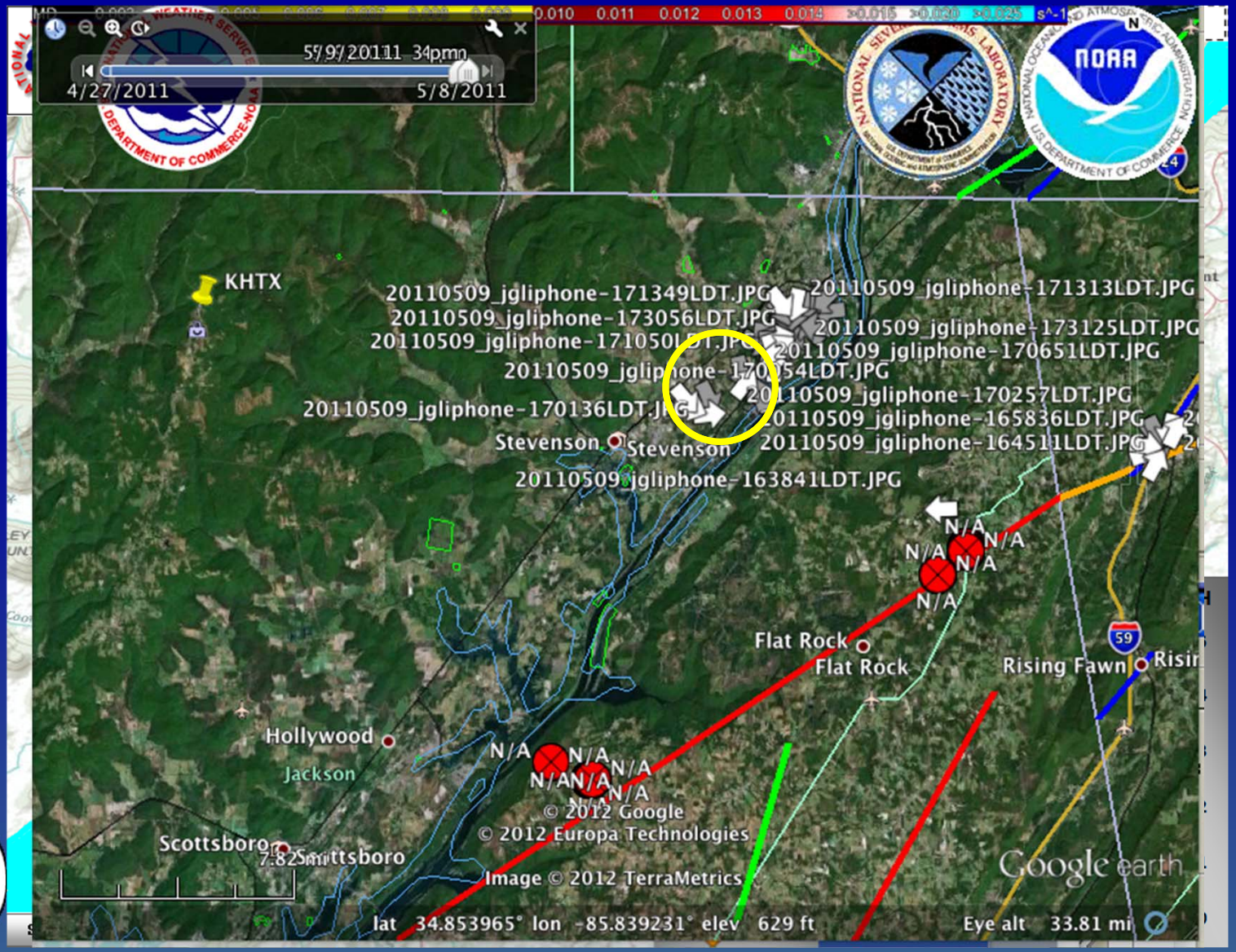
- The WSR-88D Doppler weather radar in Birmingham, AL (KBMX) went down
- ETs, as part of the severe weather operations team, restored the radar after approximately 10 minutes.

# WSR-88D issues: KHTX

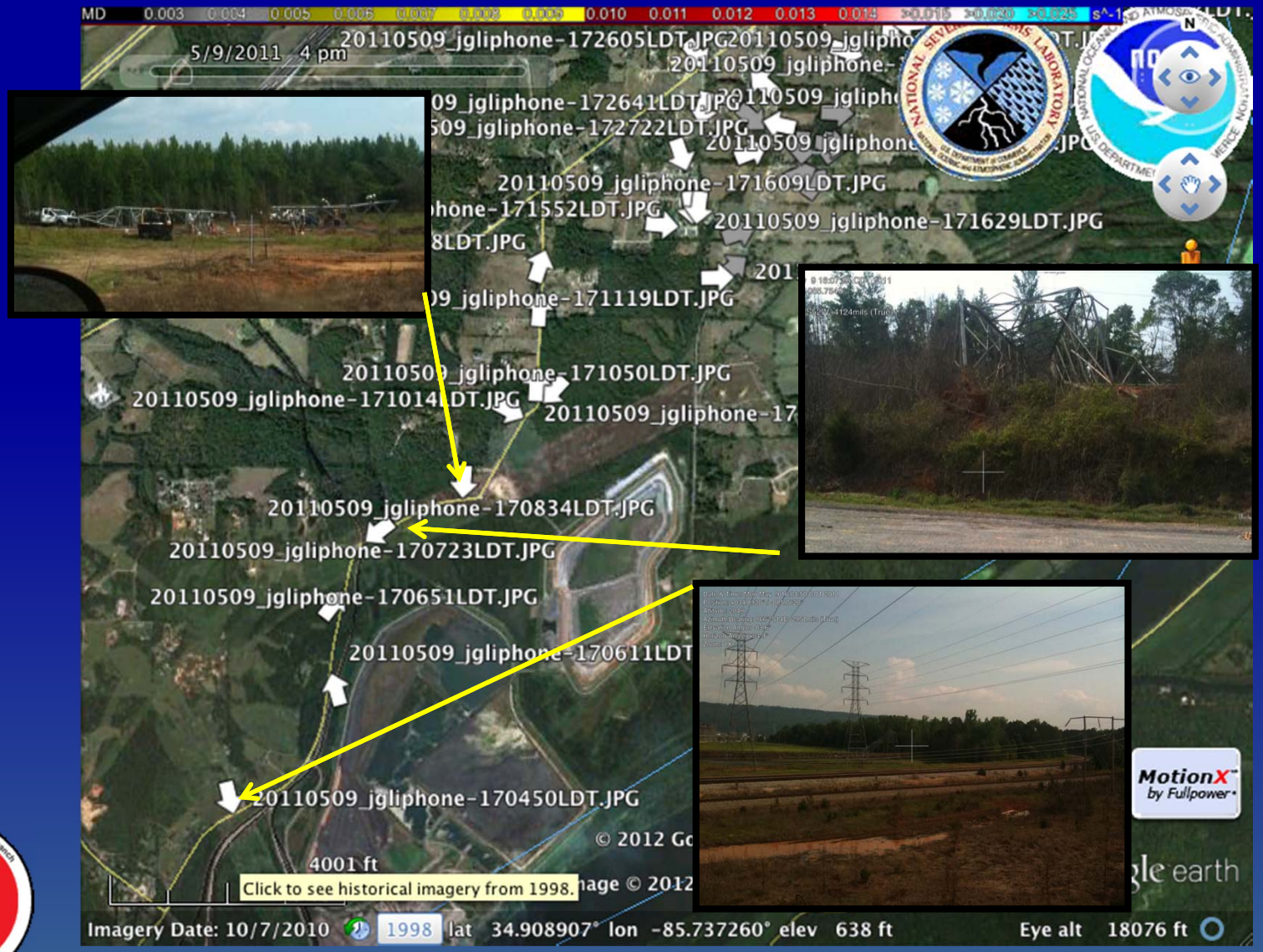
- Comms failure at 2215 UTC 4/27
  - ATT fiber optic link was a single point of failure
  - KOHX, 82 nm north-northwest.
  - KFFC, 87 nm southeast.

- At the time of failure
  - Three violent tornadoes in progress (eastern Jackson county, AL; Cullman-Blount county line; east side of Tuscaloosa)
  - Four more supercells with tornado warnings

# Tornado track likely responsible



# KHTX Comms failure cause: massive power outags



# Denial of KHTX service

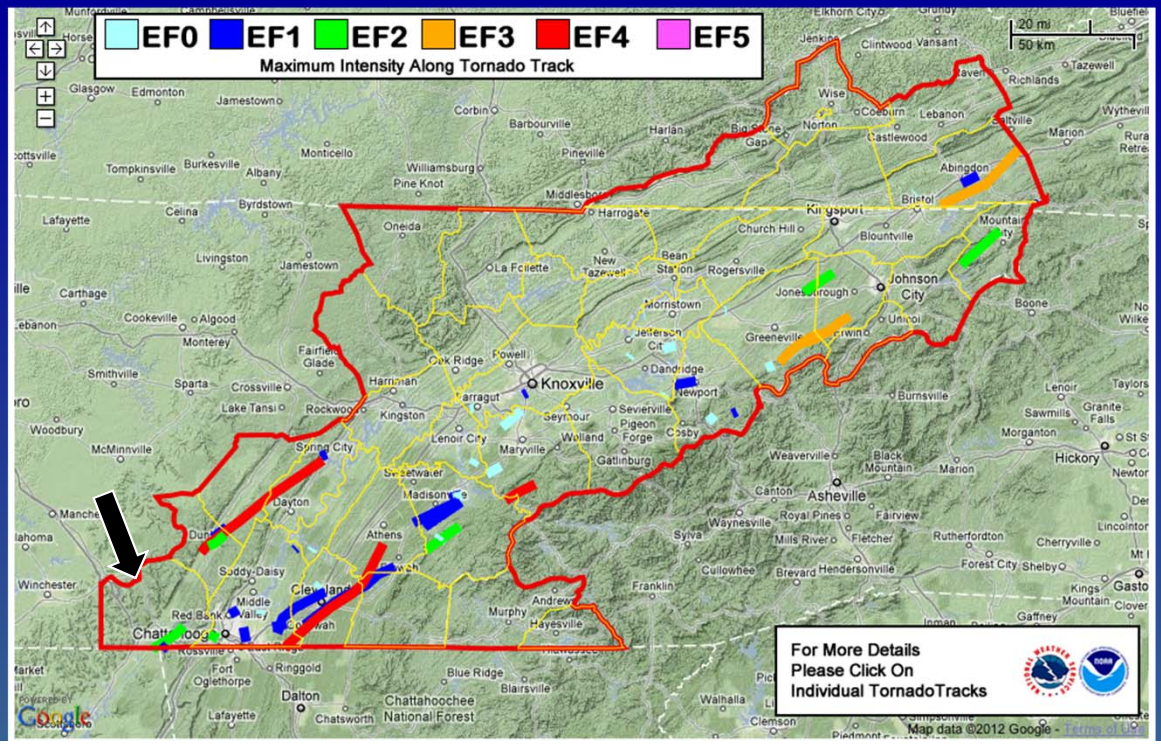
- How did the offices compensate
- Impact on media
- How the storms looked with alternative radar

# Impact to offices

- Morristown, TN
  - it made awareness more difficult, but due to upstream reports of tornadoes and significant damage the warning decisions were relatively easy. The MRX staff used the WSR-88Ds at KOHX and KMRX as backup radars.
- Peachtree City, GA
  - The staff at WFO FFC stated that it made warning operations more difficult for their northwestern counties in Georgia, and they had to use the WSR-88D at KFFC as a backup radar for the area.
- Huntsville, AL
  - Most experienced warning forecaster took over responsibility for northeast AL.  Used KOHX, KFFC as backup.

# Impacts to EMs

- Steve Lamb, Marion Co, TN:
  - HTX radar outage hindered safety decisions for first responders.
  - Also mentioned KHTX going down before

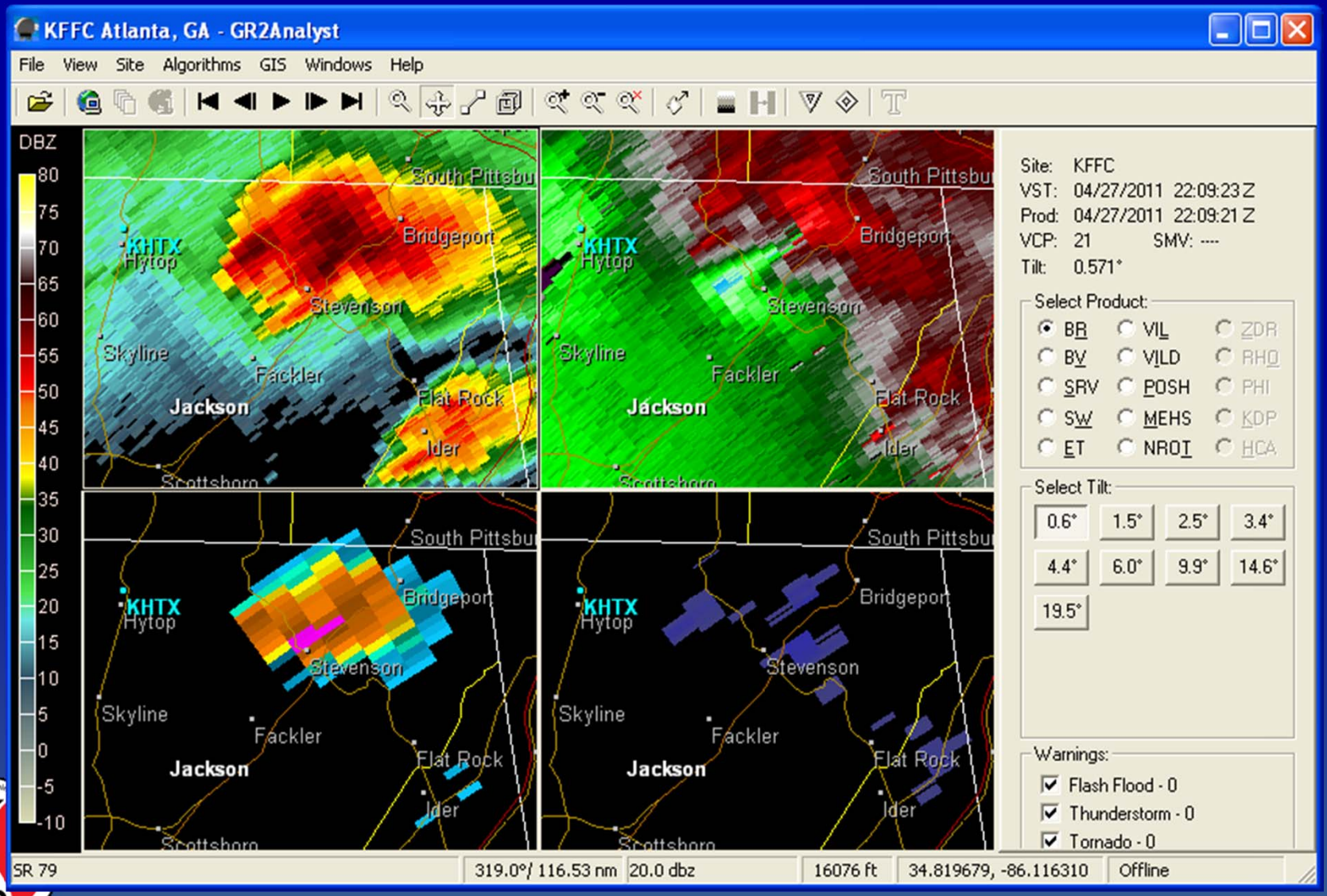


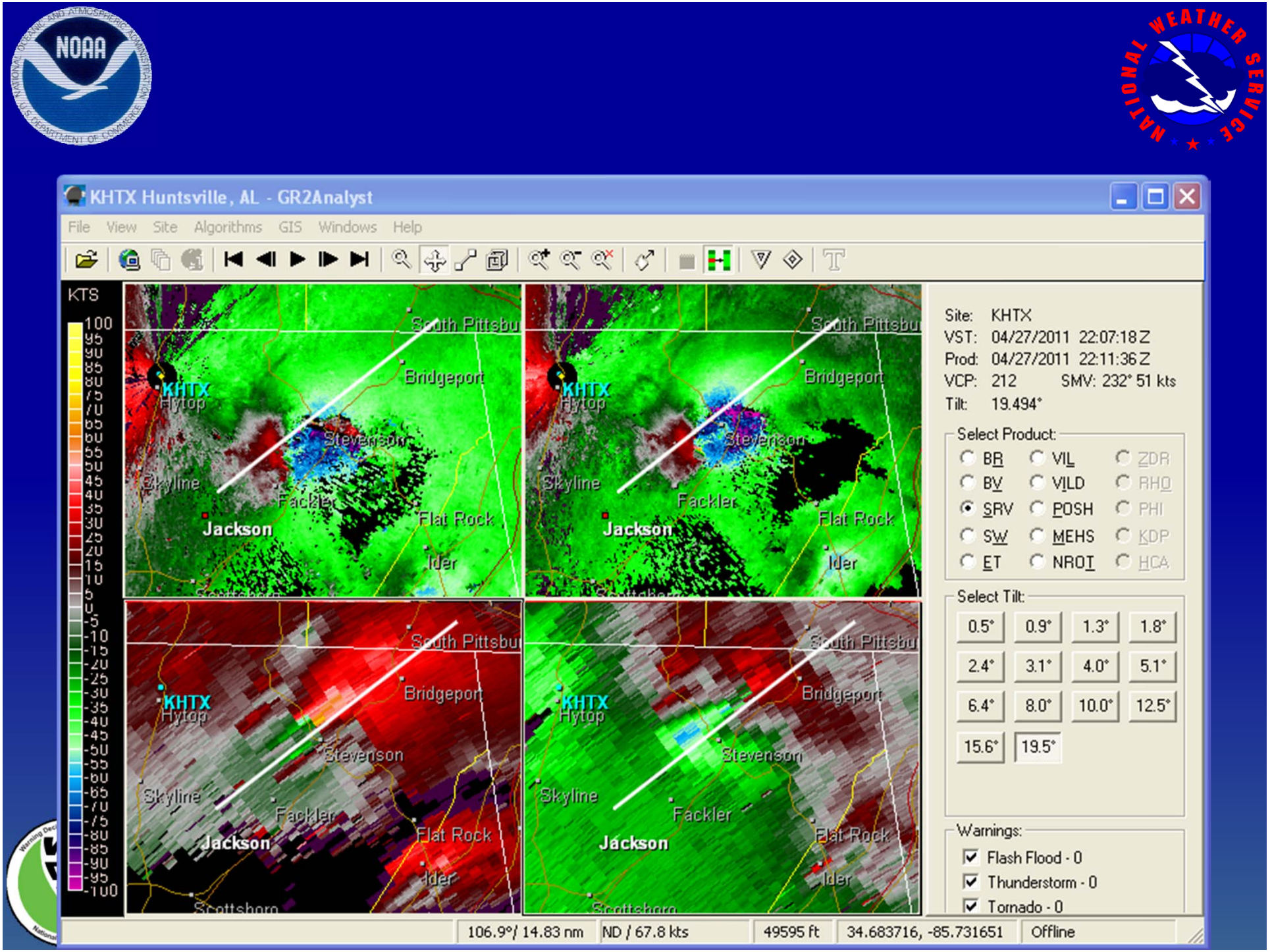
# Chattanooga media badly impacted by loss of KHTX


Figure 4-1 Thirty-two geographical areas identified by public comments as being concerned about degradation of service in connection with NEXRAD coverage, decommissioning of existing radars, and/or associated weather office consolidations and closures. Courtesy of NWS.

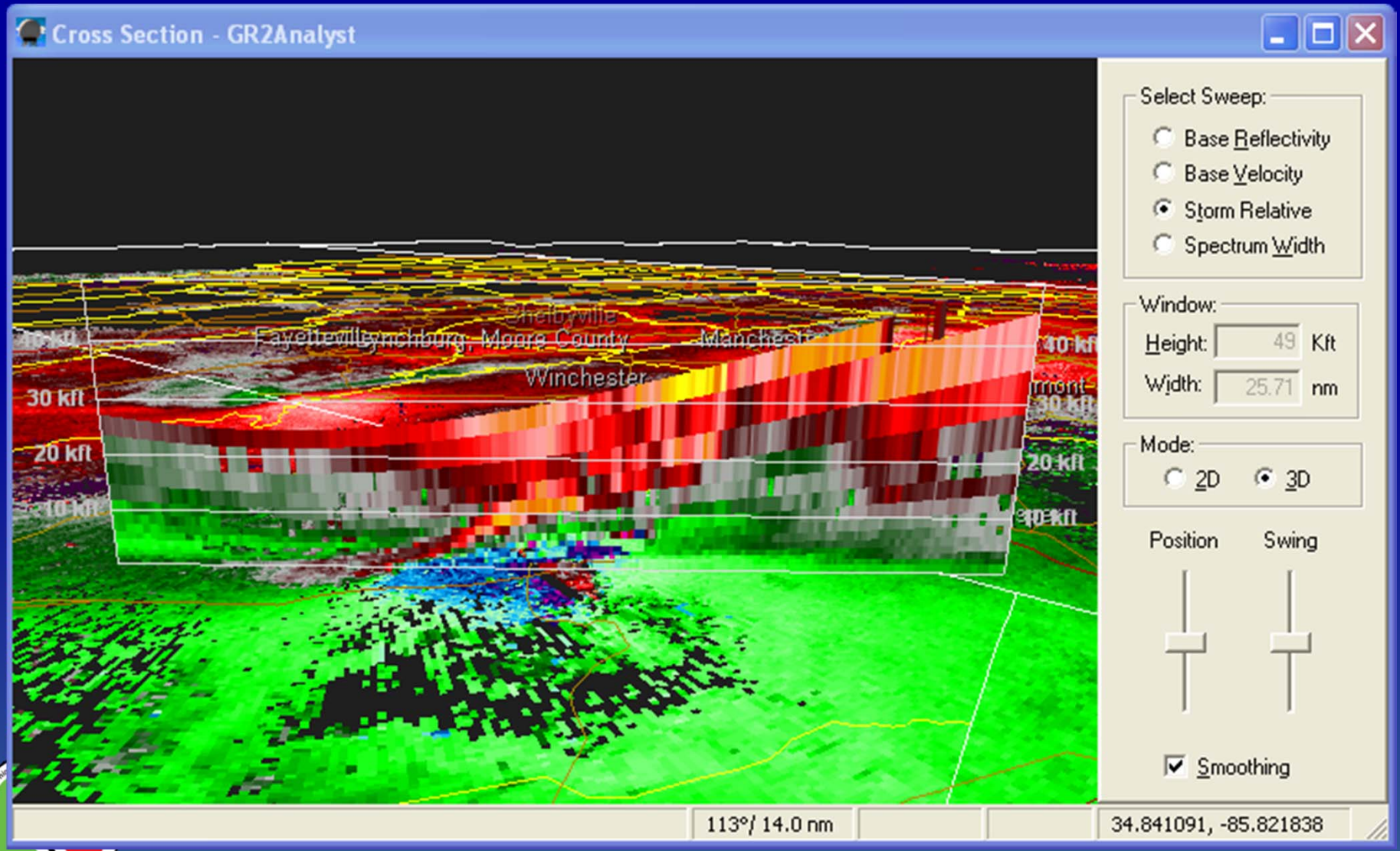
http://www.nap.edu/catalog.php?record_id=9056

# Comparing KHTX with KFFC




KHTX Huntsville, AL - GR2Analyst
File View Site Algorithms GIS Windows Help
KTS
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 -5 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85 -90 -95 -100
KHTX
Hytop
Bridgeport
Stevenson
Skyline
Fackler
Jackson
Flat Rock
Ider
Scottsboro
Site: KHTX
VST: 04/27/2011 22:07:18Z
Prod: 04/27/2011 22:11:36Z
VCP: 212 SMV: 232° 51 kts
Tilt: 19.494°
Select Product:
BR VIL ZDR
BV VILD RHO
SRV POSH PHI
SW MEHS KDP
ET NROT HCA
Select Tilt:
0.5° 0.9° 1.3° 1.8°
2.4° 3.1° 4.0° 5.1°
6.4° 8.0° 10.0° 12.5°
15.6° 19.5°
Warnings:
Flash Flood - 0
Thunderstorm - 0
Tornado - 0
106.9°/ 14.83 nm
ND / 67.8 kts
49595 ft
34.683716, -85.731651
Offline

# 2209-2011 UTC



# KHTX finding and recommendation

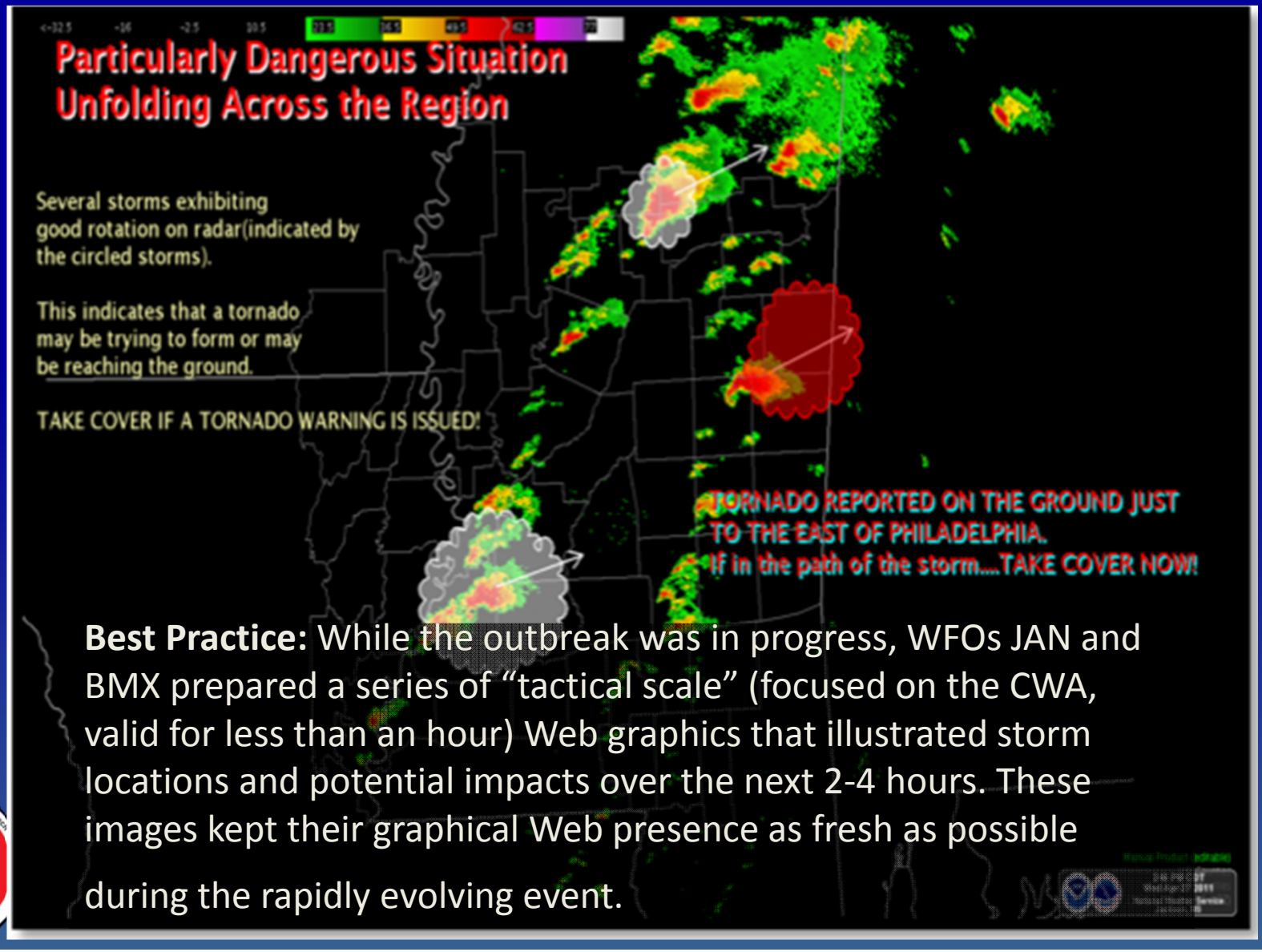
- Finding 4:
  - There was no redundancy along a portion of the fiber-optic communications link between the KHTX radar and WFO HUN. This means there is no access to these radar data when the fiber-optic communications link is down.

- Recommendation 4:
  - NWS should ensure alternative methods of data delivery to the WFOs from all remote radars.

# Indirect impacts of comms to NEXRAD

- WFO BMX was threatened by a tornado.
- WFO FFC, the primary backup for WFO BMX, had problems displaying low-level, super-resolution radar data from the KBMX radar and could not assume backup.
- WFO HUN was asked to provide backup.
  - They were already overwhelmed.
- NCF fixed WFO FFC's comms problems
- Recommendation:  Need tertiary backup

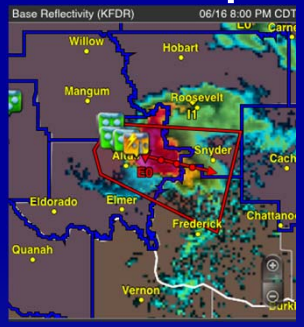
# Using NEXRAD in decision support



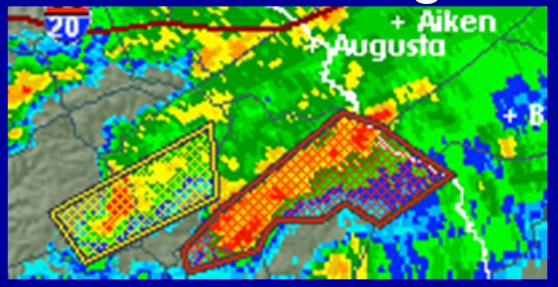

**Best Practice:** While the outbreak was in progress, WFOs JAN and BMX prepared a series of "tactical scale" (focused on the CWA, valid for less than an hour) Web graphics that illustrated storm locations and potential impacts over the next 2-4 hours. These images kept their graphical Web presence as fresh as possible during the rapidly evolving event.

# Use of NEXRAD by EMs

## Wxtap

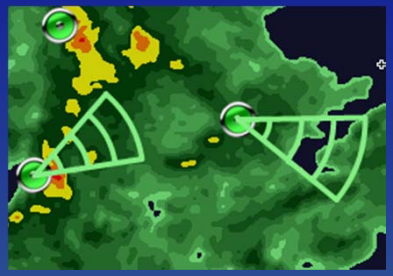



## NWS Ridge

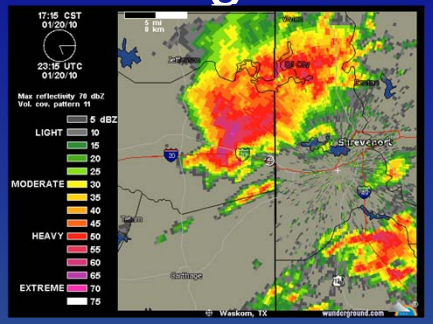



Other sites too but not mentioned

## intellicast



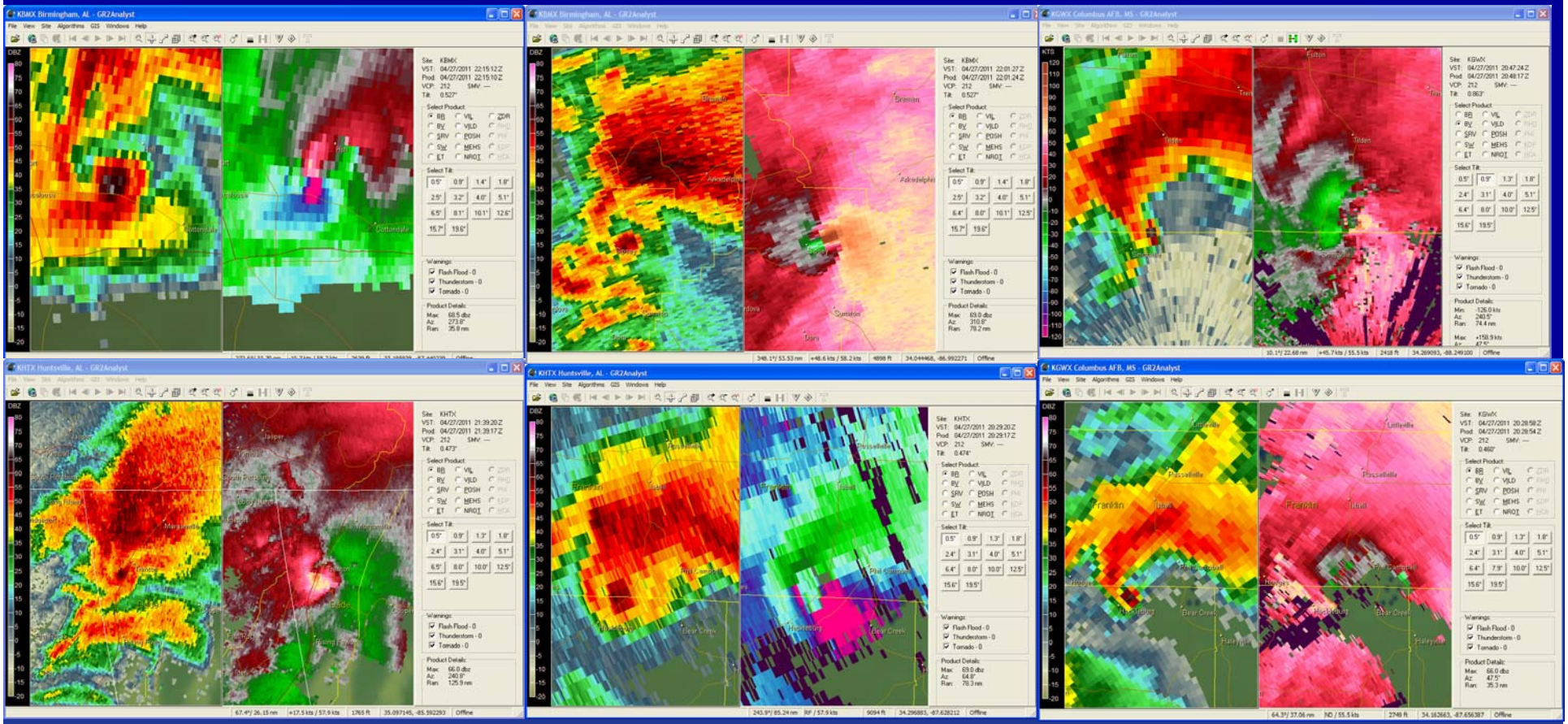
## Weather underground



# 88D VCP usage

- KDGX, KGWX, KHTX, KMRX, KBMX, KFFC
  - All switched to 212 during warning ops

# Debris balls



# Apr 27 Debris balls

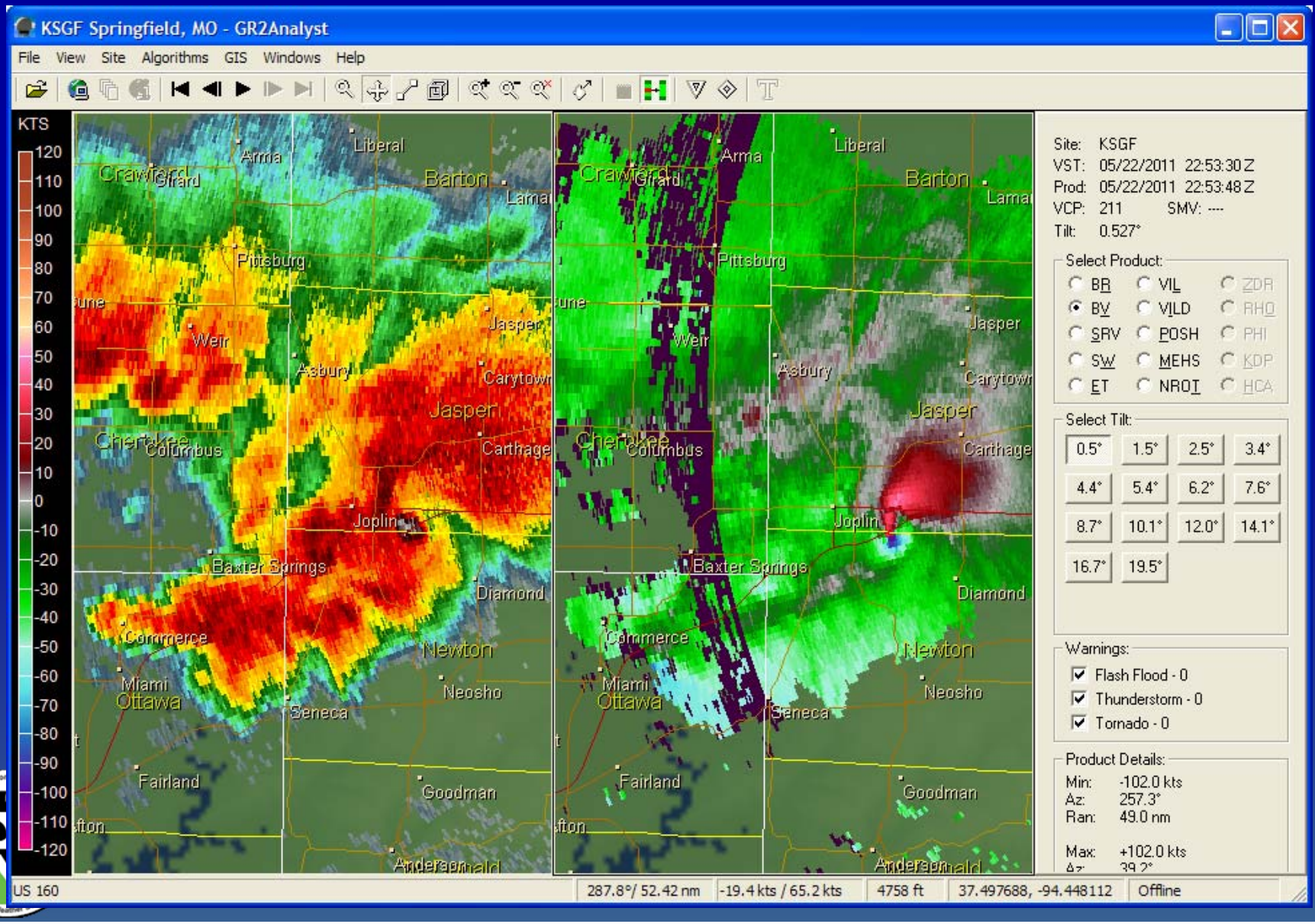
(via Greg Forbes)

| | April 27-28 | Other April-June Cases* | Total |
|---|---|---|---|
| EF5 | 3 of 3** | 2 of 2 | 5 of 5 |
| EF4 | 7 of 10 | 3 of 3 | 10 of 13 |
| EF3 | 11 of 12 | 9 of 10 | 20 of 22 |
| EF2 | 2 of 12 | 5 of 12 | 7 of 24 |
| EF1 | 1 of 22 | 1 of 19 | 2 of 41 |
| EF0 | 1? of 16 | 0 of 10 | 1? of 26 |
| EF3-5 | 84% | 93% | 88% |
| EF2 | 17% | 42% | 29% |
| EF0-1 | 3-5% | 3% | 3-4% |

*May 24 OK; Apr 22 MO; Apr 16-17 NC/VA; June 1 MA; May 24 MO

**One of the EF5 tornadoes on April 27 was undetectable, radar down

# 2011-05-22 Joplin, MO tornado



# VCP usage finding

- **Finding #9**: Radar data acquisition was compromised across key geographic locations; mainly, owing from Volume Coverage Pattern (VCP) selection at both KSGF and KINX. In this case, **velocity data was obscured on KSGF upstream of Joplin near a critical warning decision point** – and KINX velocity data was obscured over Joplin during the height of the tornado event.

- **Recommendation #9**: WFO warning operations **should make use of the more effective/adaptable VCP 12** and manually select appropriate Pulse Repetition Frequencies (PRF) to remove range obscured velocity data and mitigate compromised radar datasets.

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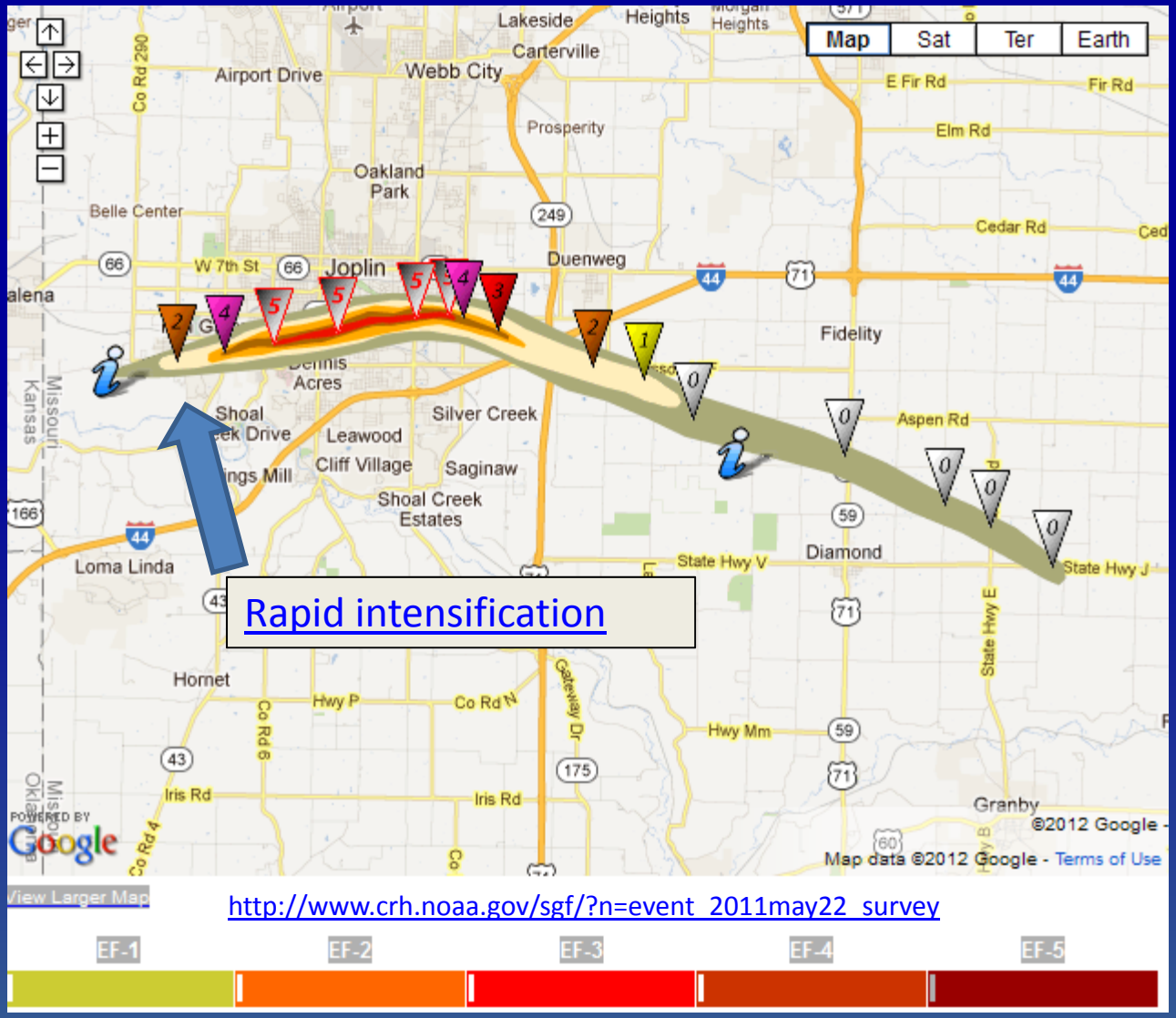
# 2011-05-22 Joplin

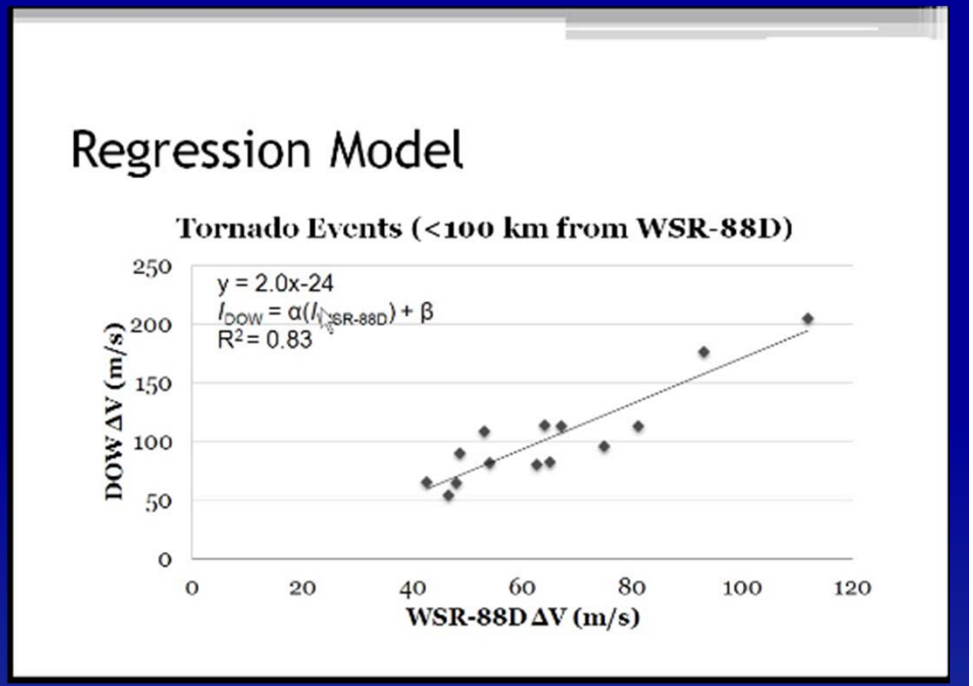


# Scanning rate finding

- **Finding #10:** Low level rotational intensification and tornadogenesis occurred very rapidly with the Joplin tornado from 529 PM CDT to tornado touchdown around 534 pm CDT and the beginning of EF-4 damage around 538 PM CDT. Limited scans at lowest elevation slices during this time **impacted the WFO ability to quickly ascertain the magnitude of the tornado**.
- **Recommendation #10:** To enhance the ability to monitor rapid tornadogenesis and tornado intensification, NWS should develop and implement additional hybrid WSR-88D VCP strategies that **allow for more continuous sampling near the surface** (e.g., 1-minute lowest elevation sampling).

# Can we estimate tornado intensity via WSR-88D?

- Constraints
  - Tornado confirmed
  - Range < 100 km
  - ~zero offset
    - 6 scans?
- Can we use for detection?




Toth, Trapp, Wurman and Kosiba, 2011

Their objective was to use radar to better verify a tornado strength using ΔV that already occurred.

# Tornado intensity via dual-pol products