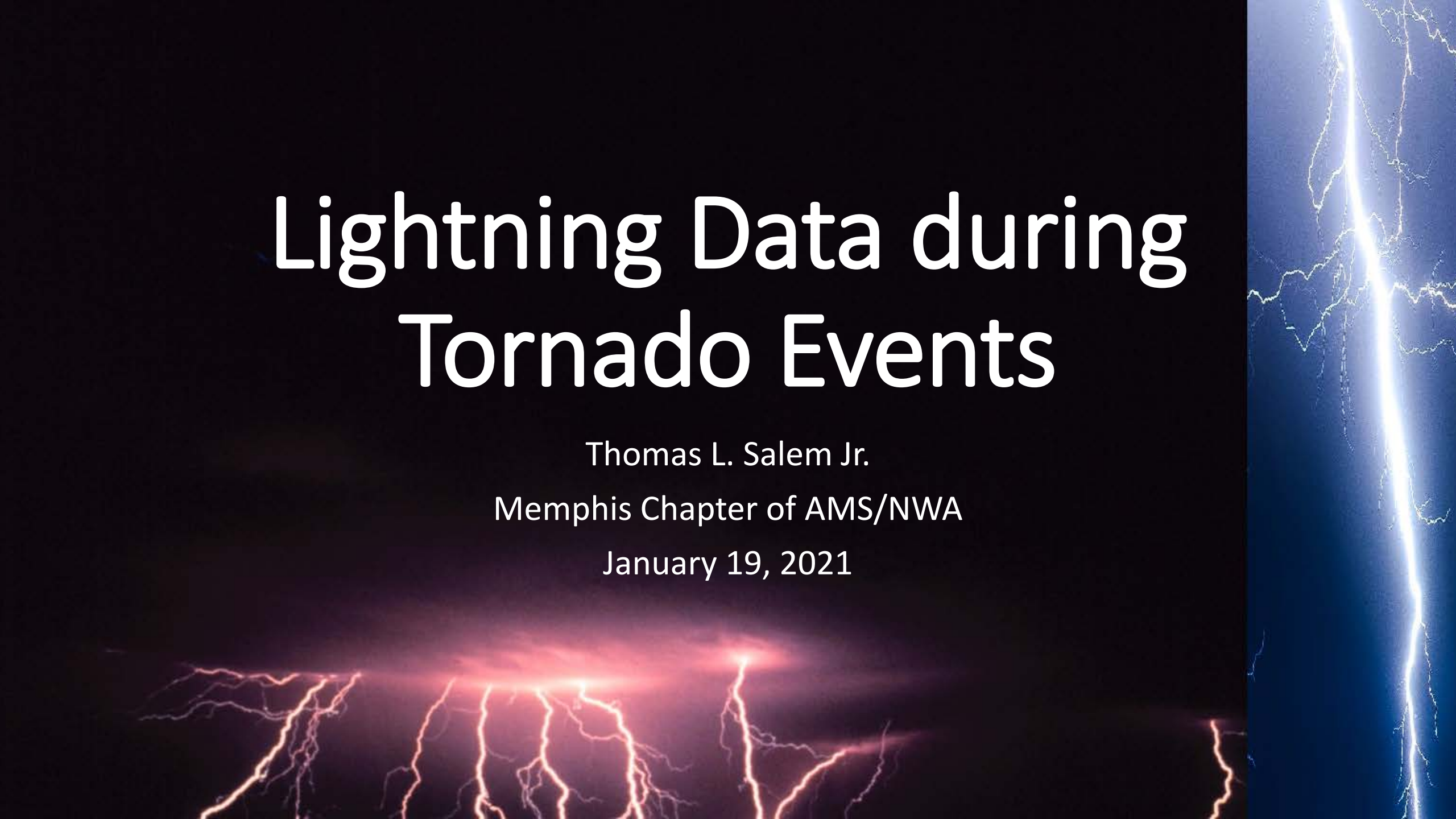


# Lightning Data during Tornado Events

Thomas L. Salem Jr.

Memphis Chapter of AMS/NWA

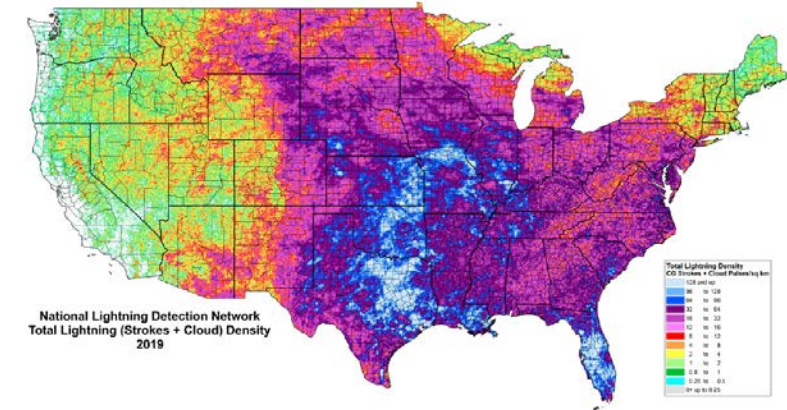
January 19, 2021



# Lightning Data

- Lightning Data Sources (Ground based sensors)
  - Vaisala
    - National Lightning Detection Network
  - Earth Networks
    - Total Lightning Network
- Geostationary Lightning Mapper
  - National Environmental Satellite, Data, and Information Service (NESDIS)

U.S. Total Lightning Density in 2019  
222,988,888 Events Detected



VAISALA

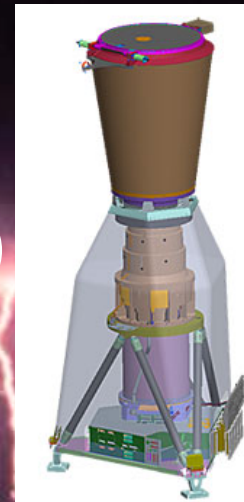
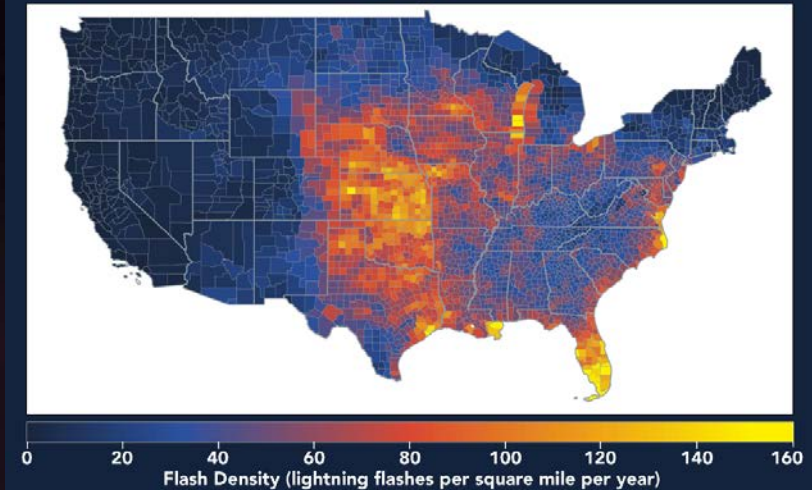
ANNUAL LIGHTNING REPORT 2019

© Vaisala 2020

From Vaisala 2019 Lightning Report ^^

From Earth Networks 2019 Lightning Report \V\

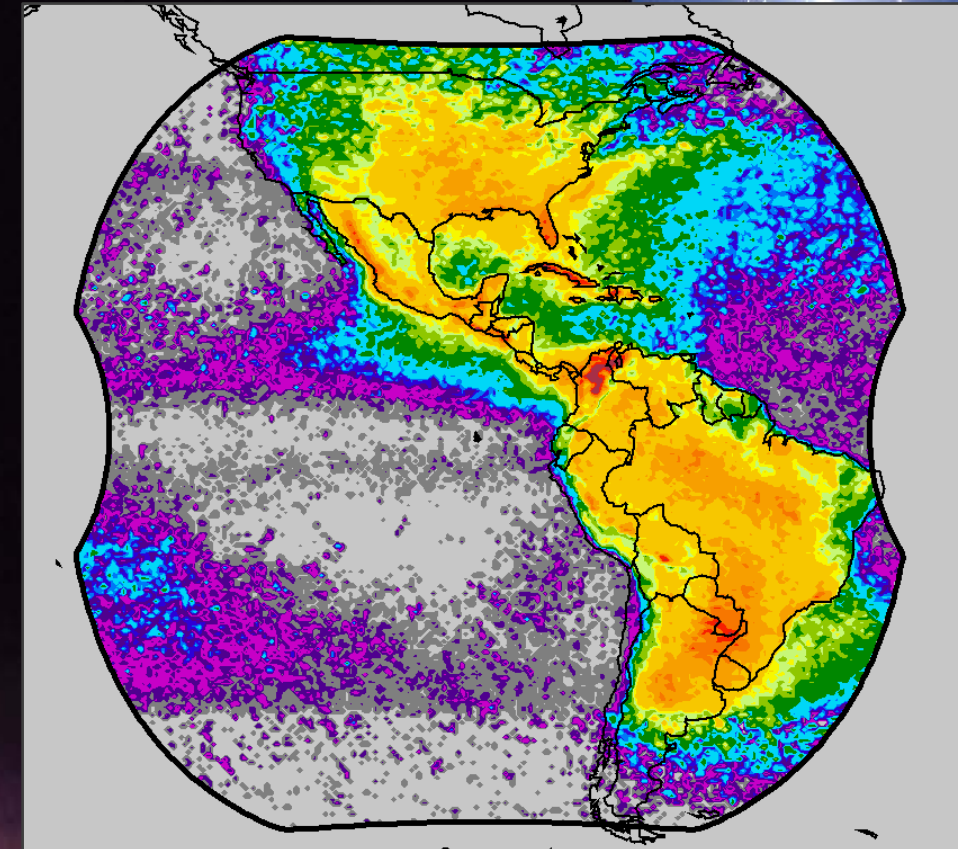
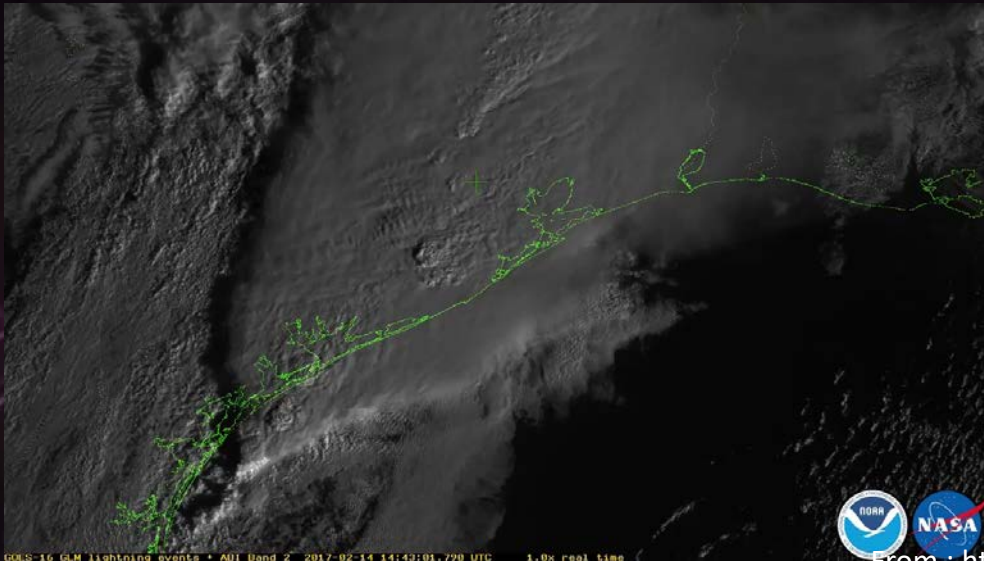
## TOTAL (CG+IC) FLASH DENSITY MAP






# Geostationary Lightning Mapper

- Lightning Detection from Satellite
  - Observes all lightning
  - Does not distinguish between cloud to ground and in-cloud differences
- Data every 20 seconds



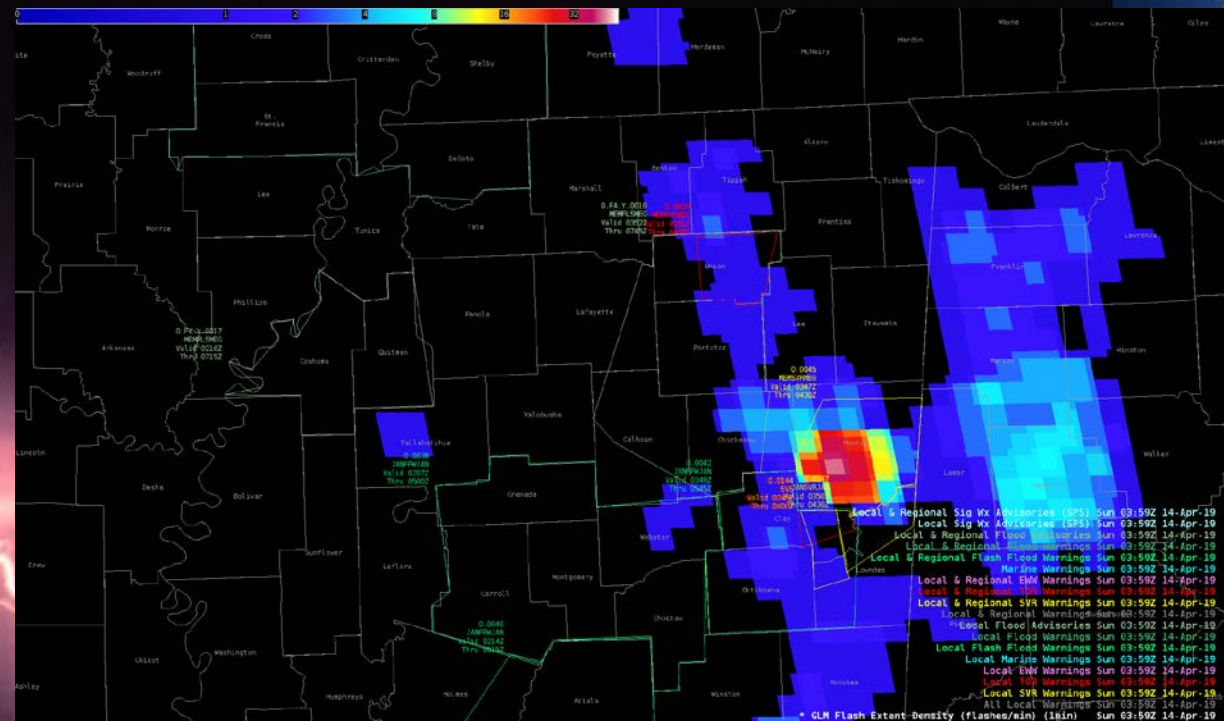
GLM Field of View

# Geostationary Lightning Mapper

- Samples the image: 2 millisecond sampling
  - Combined into a 20-second streaming product
  - 20-sec products summed into bins covering 1 minute
  - Output is in
- 

# Flash Extent density

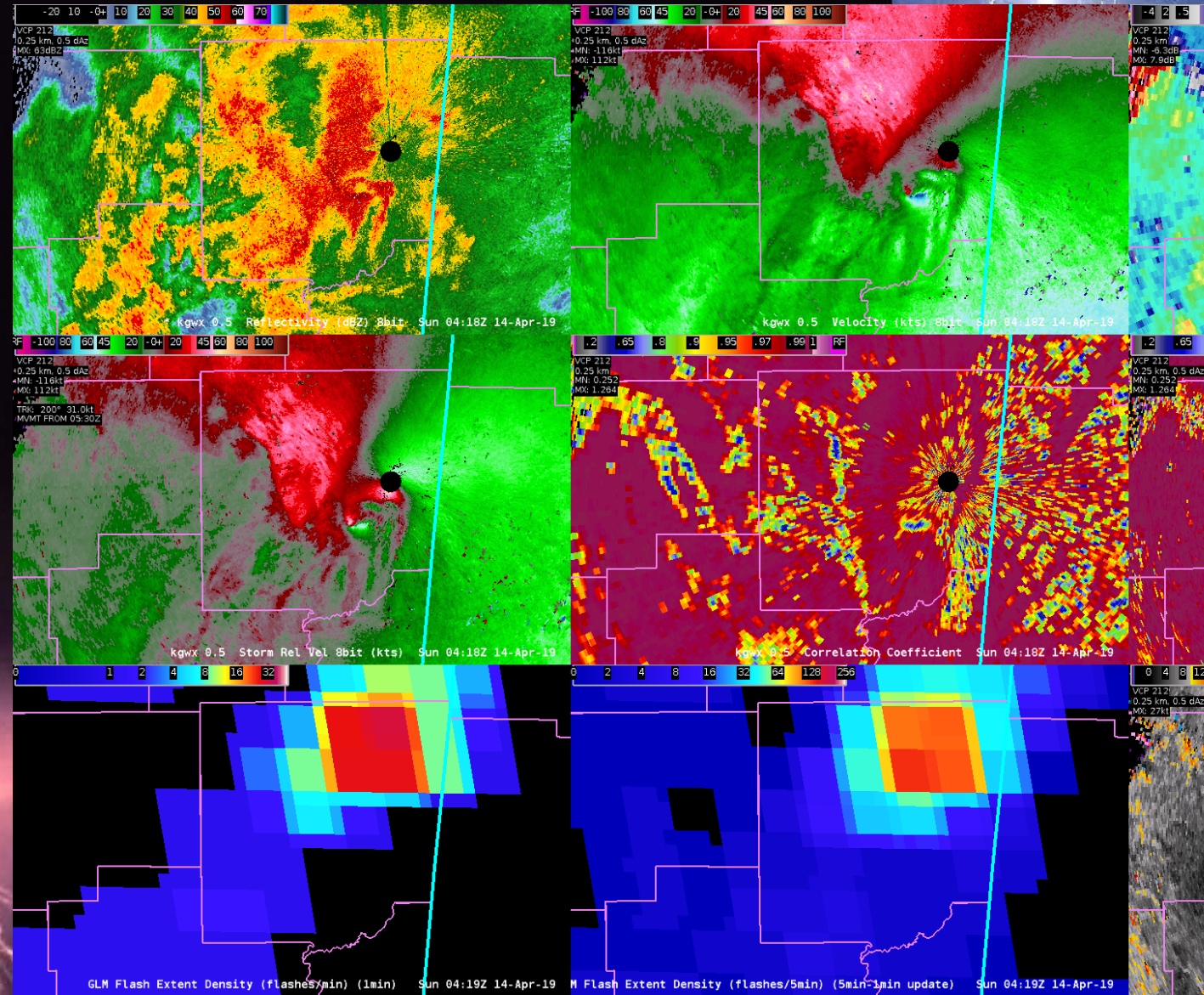
## Resolution - 8 km to 14 km





# Motivation Behind the Study

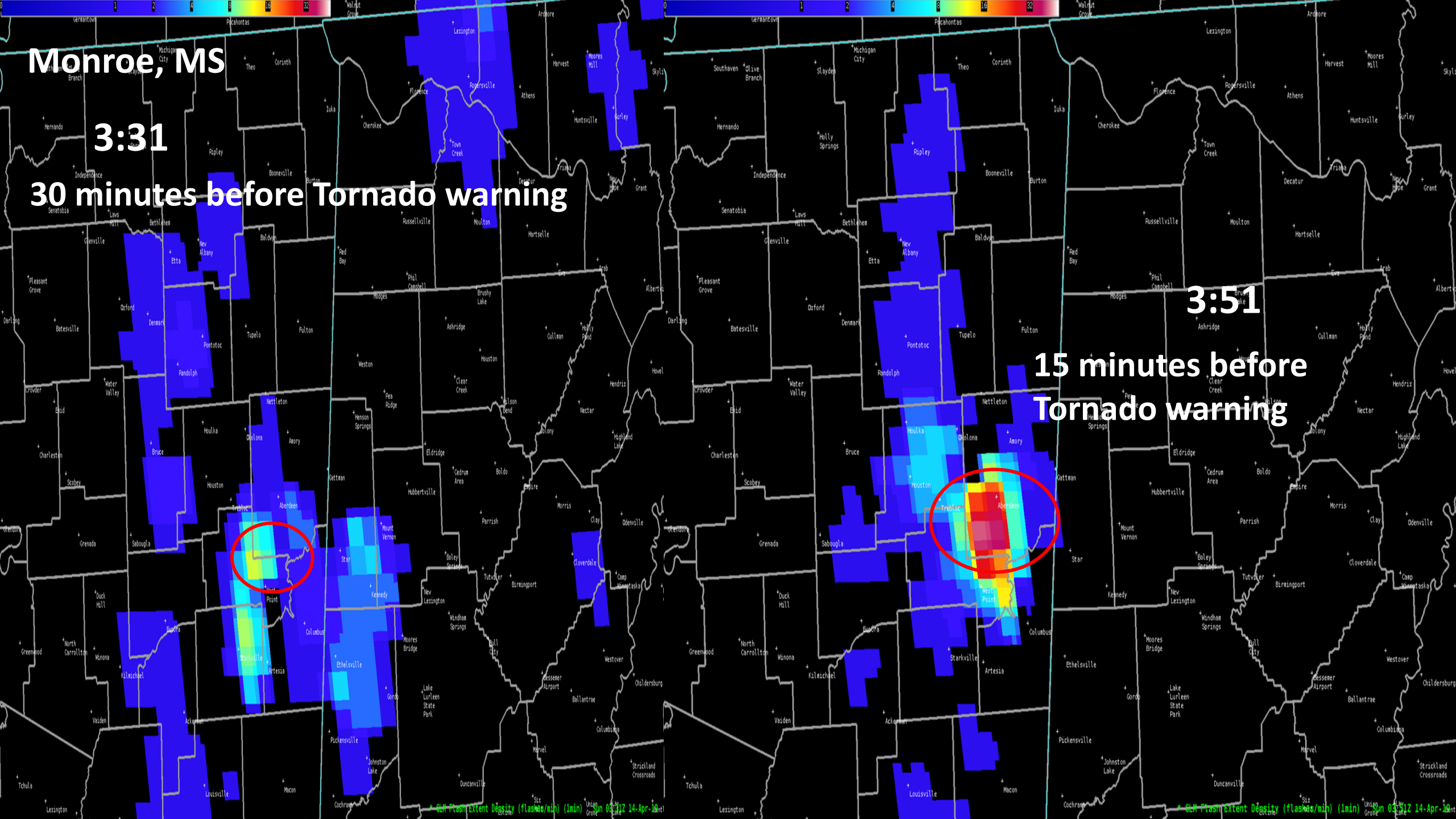
- April 13, 2019
- Monroe County, Mississippi



Monroe, MS

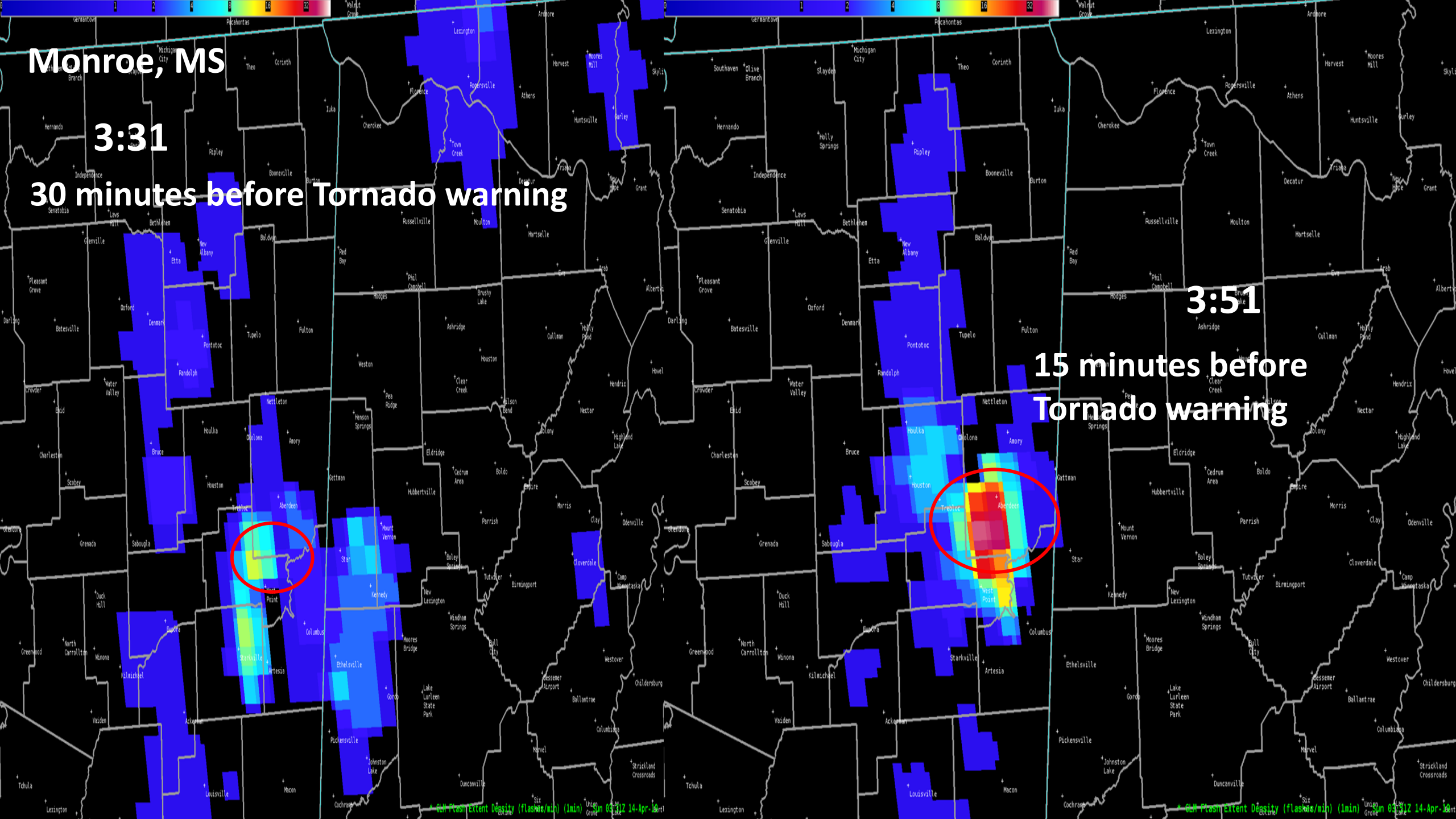
3:31

30 minutes before Tornado warning



3:51

15 minutes before  
Tornado warning

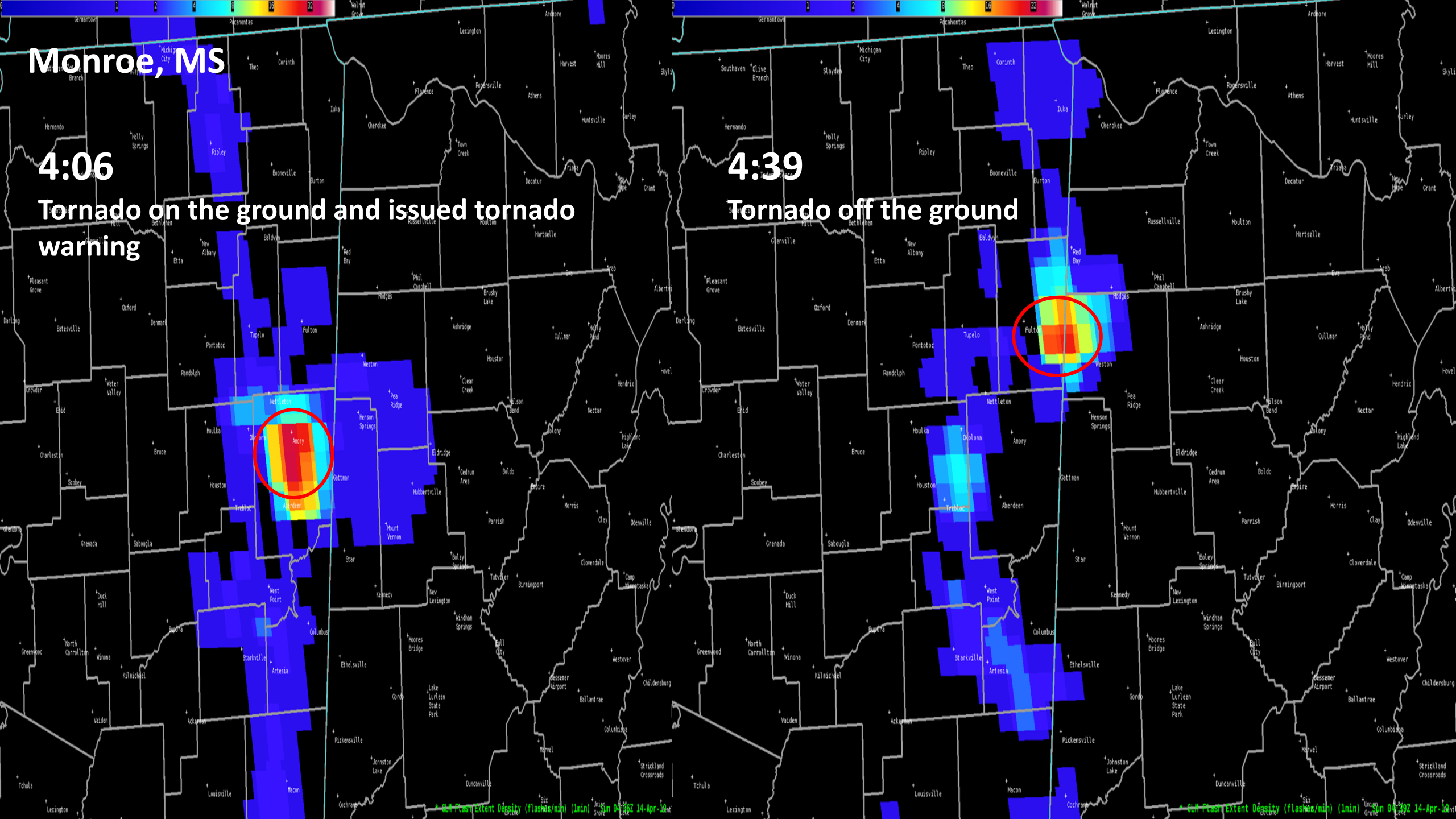




# Monroe, MS

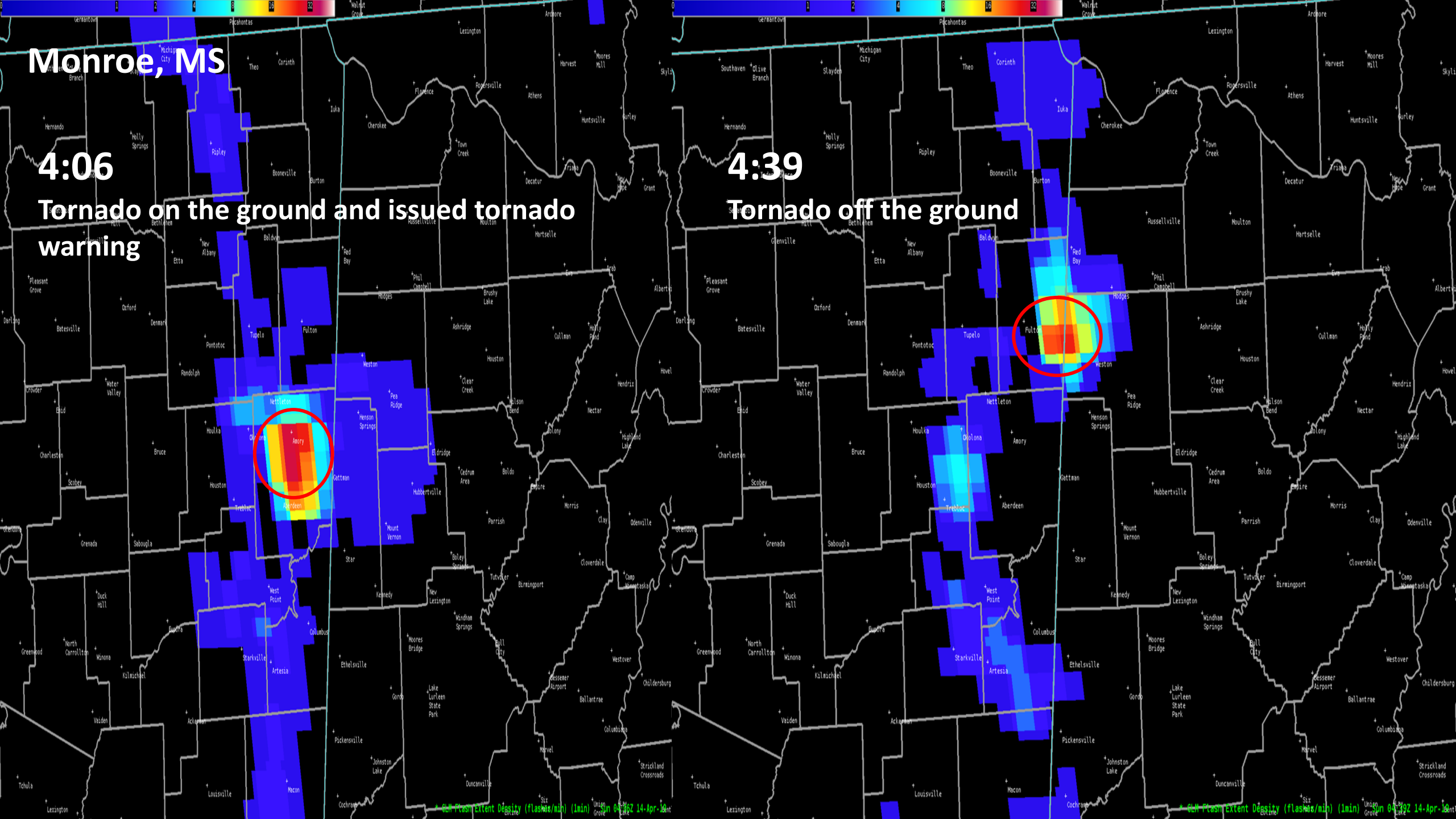
4:06

Tornado on the ground and issued tornado warning



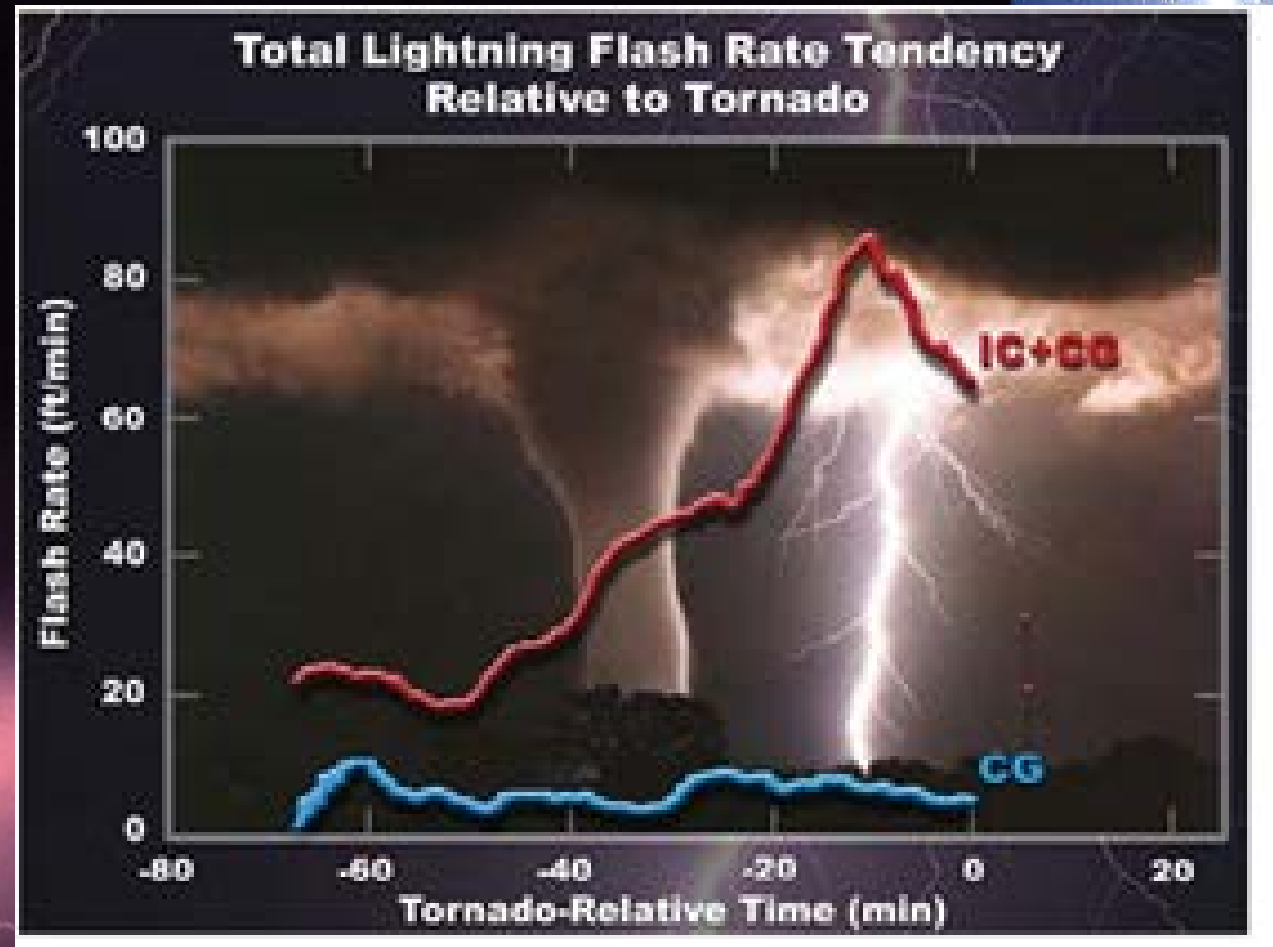
4:39

Tornado off the ground



# Relationship: Lightning & Tornadoes

- Increased Lightning associated with Tornadoes
  - Schultz et al. (2011) found increased lightning associated with tornadoes.
  - Goodman et al. (2013) states the GLM data will enhance tornado warnings



From Goodman et al. (2013)



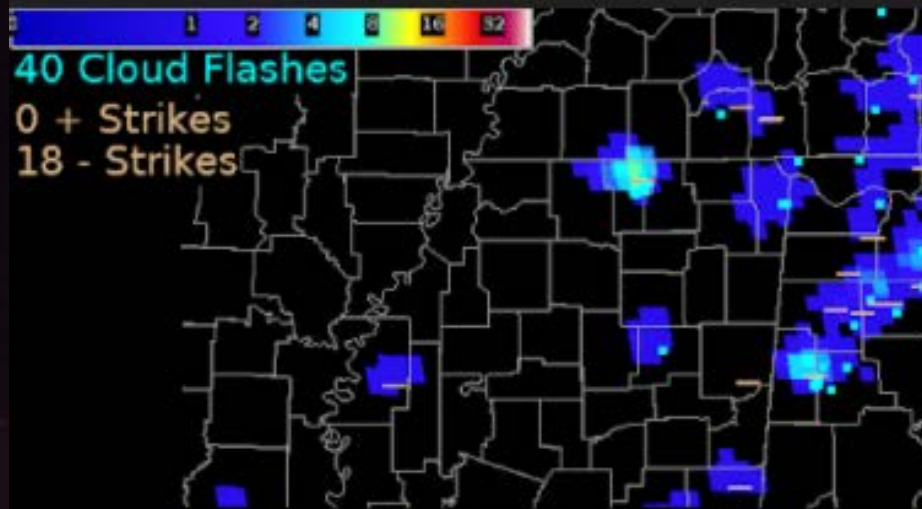
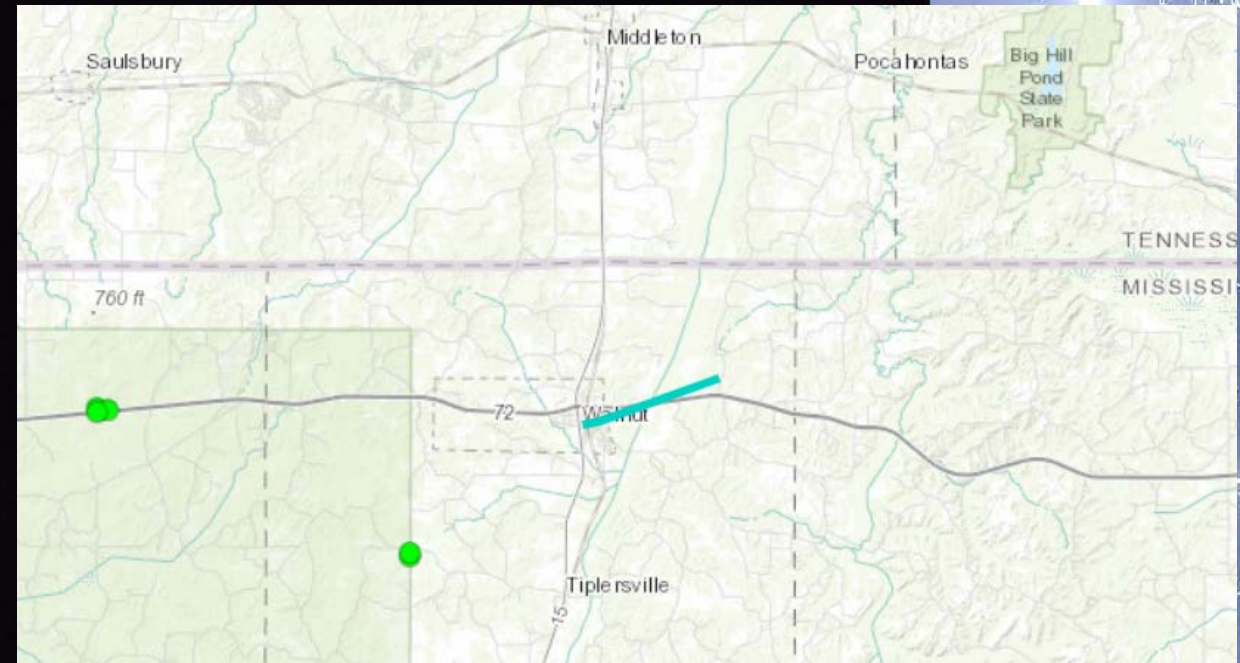
# Study for Mid-South

- Thanks to JaNia Dunbar, Scholar from Jackson State University
- Looked at a few tornadoes and the associated lightning
- Events:
  - March 9, 2019 – Tippah County
  - April 13, 2019 – Monroe County Tornadoes
  - December 16, 2019 – Lee and Union Counties
  - March 28, 2020 – Craighead County



# March 9, 2019

- Tornado in Tippah County – EF-0
- Peak Wind 85-90 MPH
- Path Length 2.2 miles
- Path Width ~ 250 yards



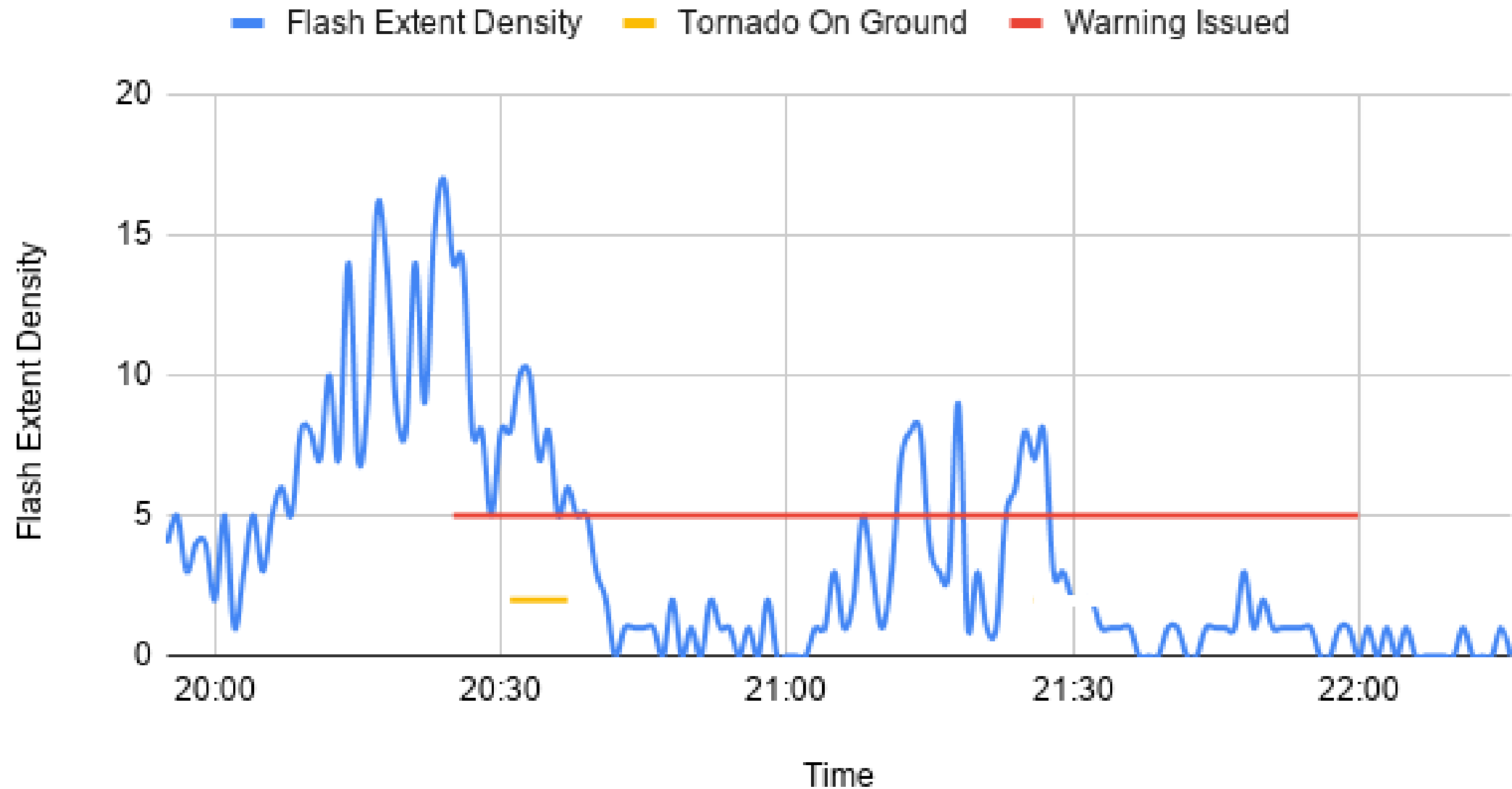
1 Minute Cloud to Ground ENTLN Lightning Plot Sat 20:16Z 09-Mar-19  
1 Minute Cloud Flash ENTLN Lightning Plot Sat 20:16Z 09-Mar-19  
1 Minute Pulse ENTLN Lightning Plot Sat 20:16Z 09-Mar-19  
• GLM Flash Extent Density (flashes/min) (1min) Sat 20:16Z 09-Mar-19



1 Minute Cloud to Ground ENTLN Lightning Plot Sat 20:16Z 09-Mar-19  
1 Minute Cloud Flash ENTLN Lightning Plot Sat 20:16Z 09-Mar-19  
1 Minute Pulse ENTLN Lightning Plot Sat 20:16Z 09-Mar-19  
knqa 0.5 Z 8bit Sat 20:16Z 09-Mar-19 + knqa 0.5 SRM Sat 20:16Z 09-Mar-19

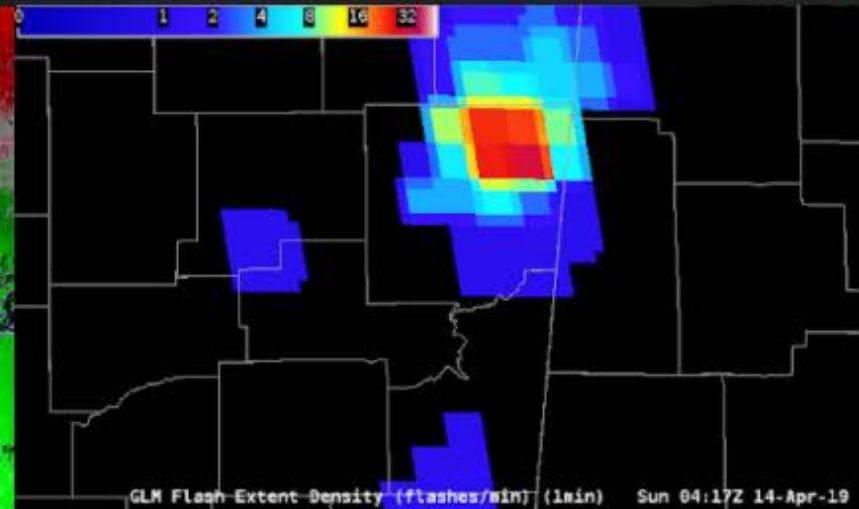
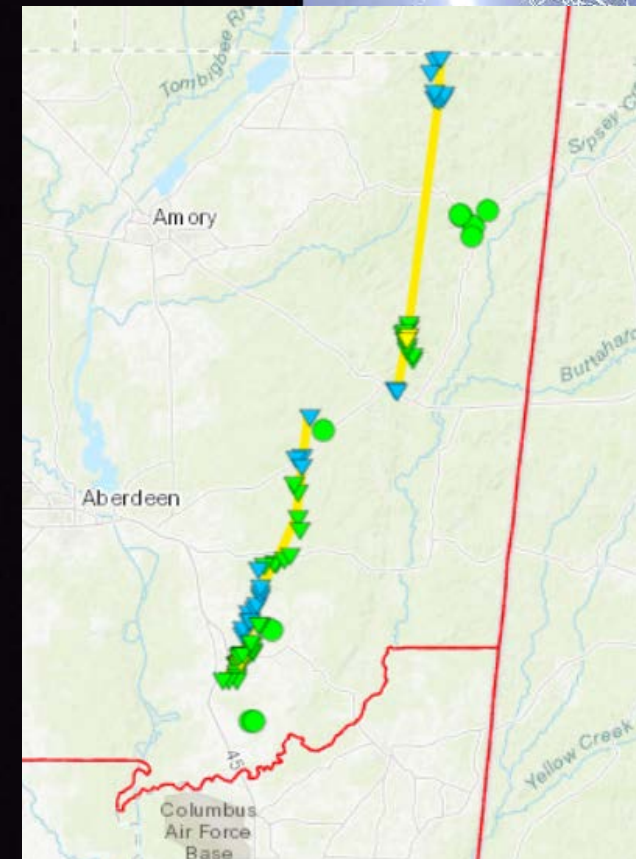


## March 9, 2019 Tippah, MS Hardin, TN McNairy, TN



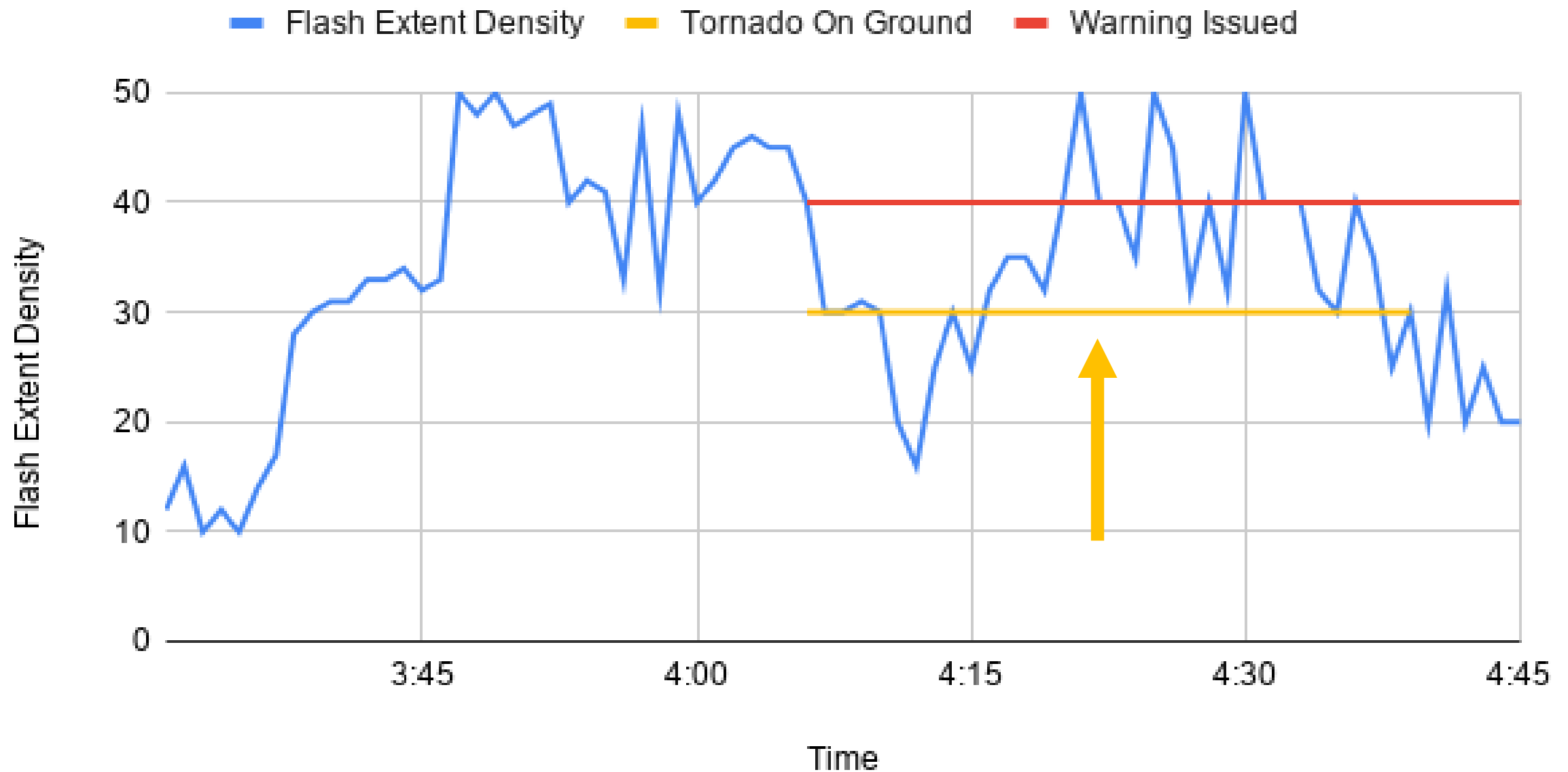
# April 13, 2019 (April 14 in UTC/Z)

- Two Tornadoes in Monroe County
- Both near the GWX radar
- EF-2 and EF-1
- 130 MPH and 100 MPH
- 11 miles and 13 miles



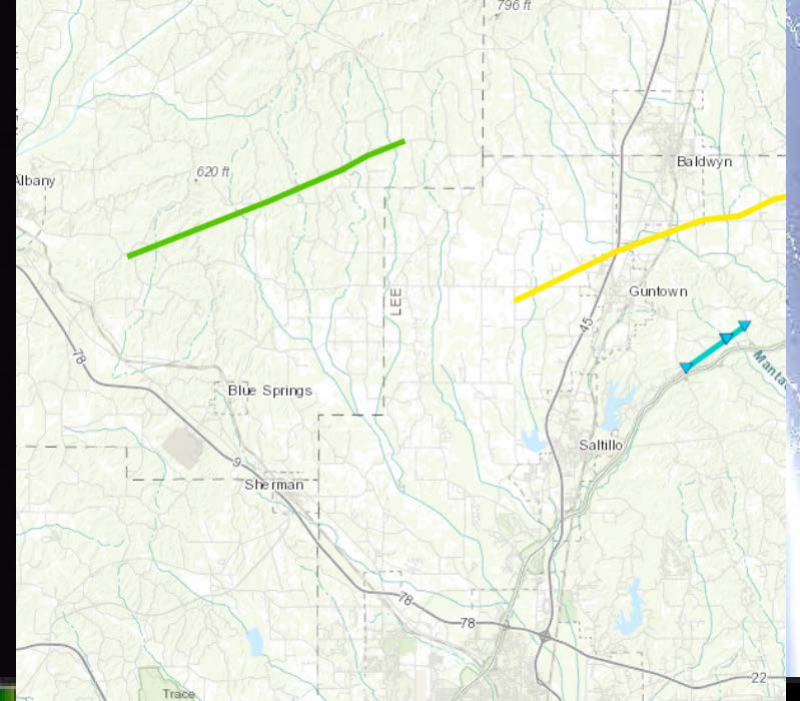


# Monroe MS, Itawamba MS April 14, 2019



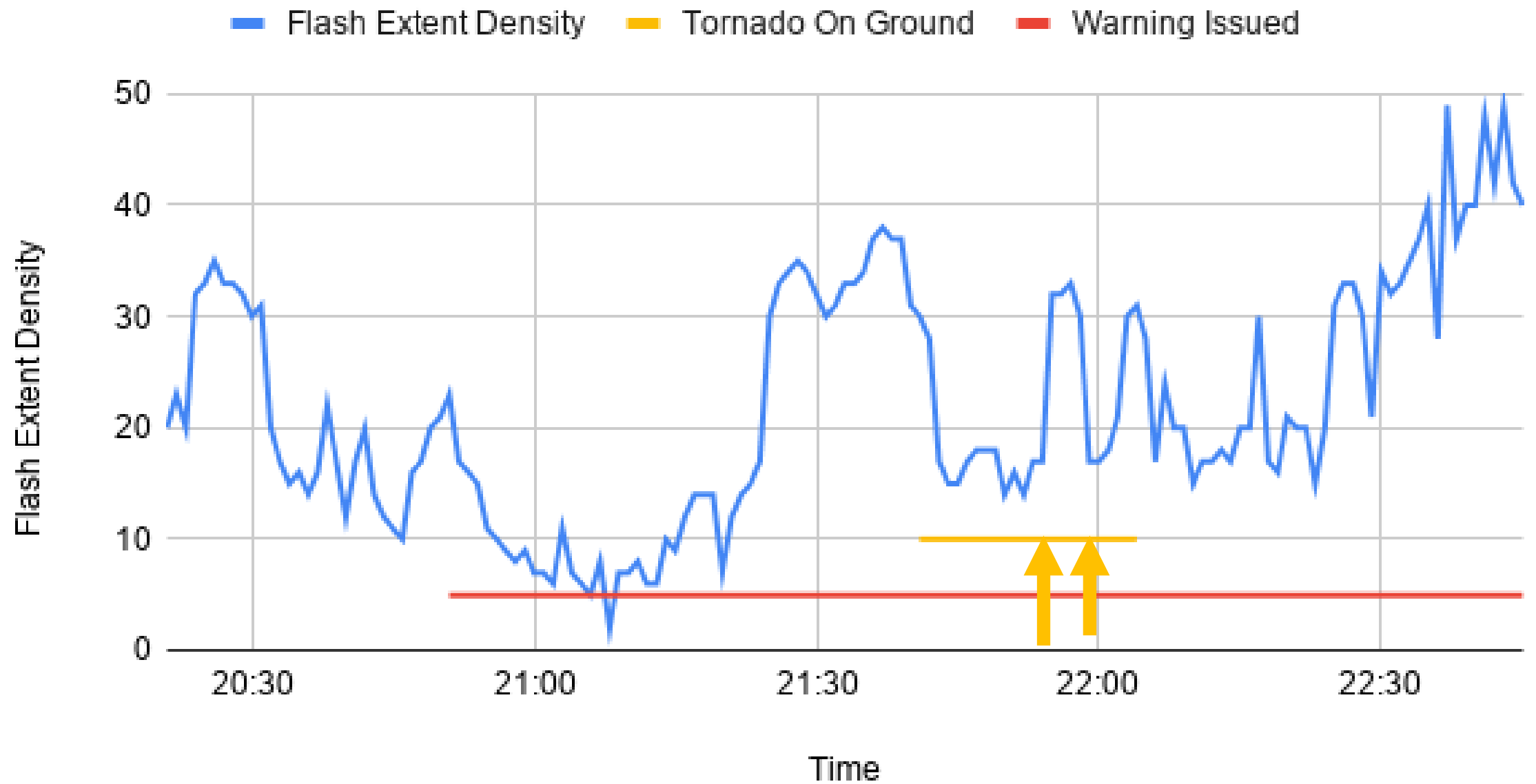
# December 16, 2019

- Three Tornadoes EF-2, EF-1, EF-0
- 115 mph, 90 mph, 75 mph
- 9 miles, 9 miles, 2 miles



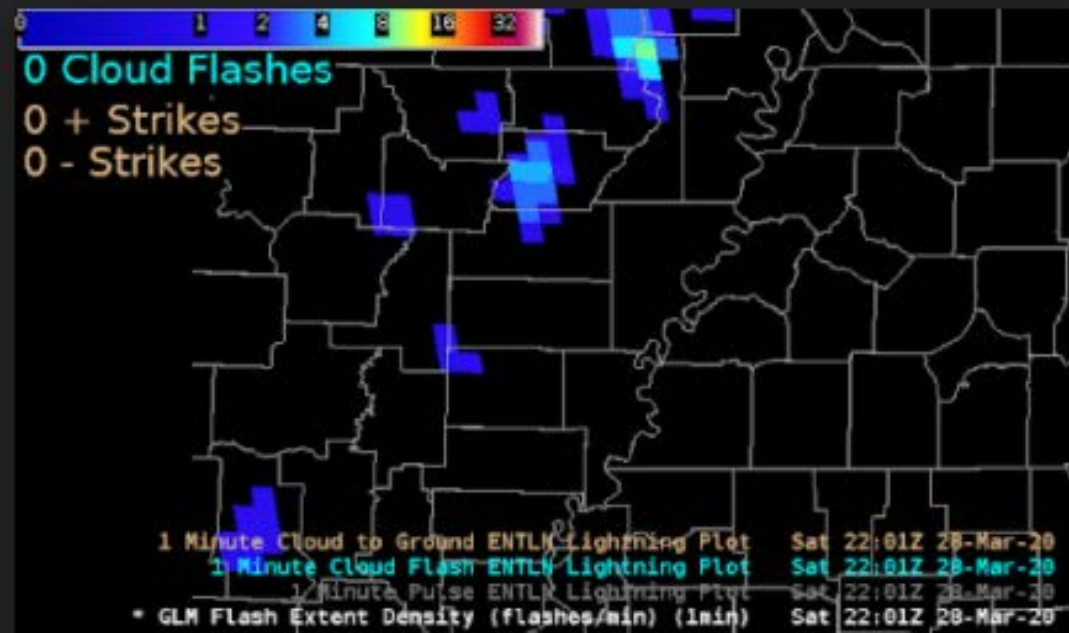
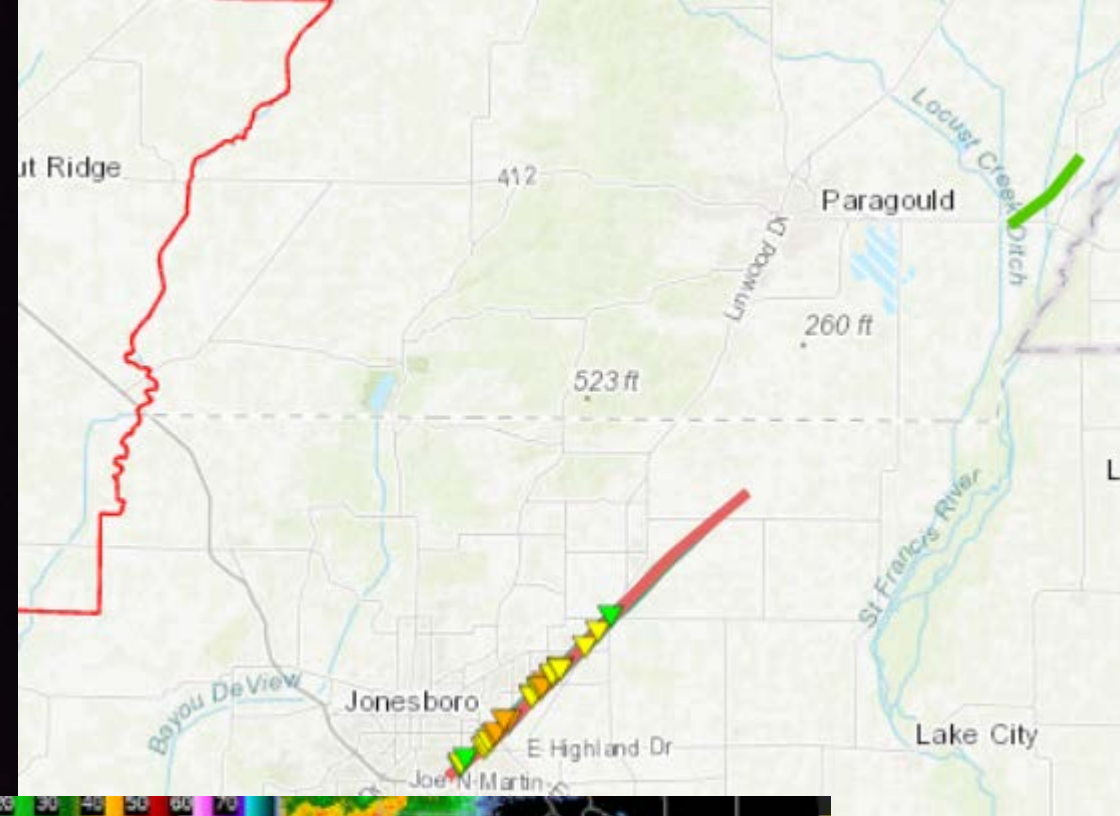


December 16, 2019



# March 28, 2020

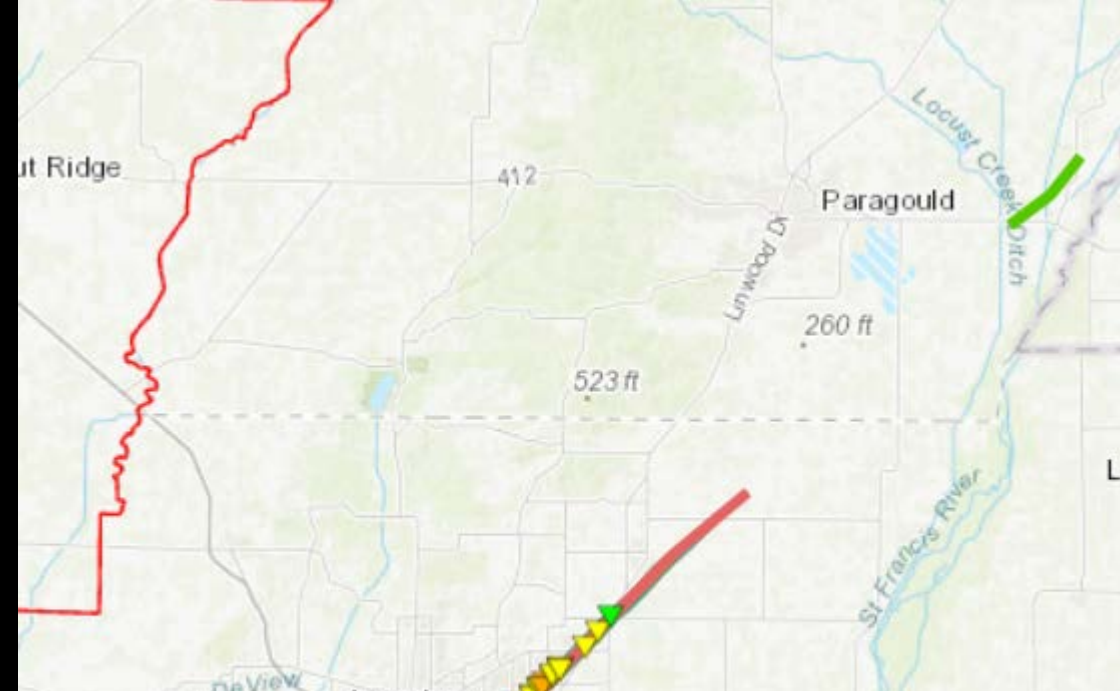
- Two Tornadoes (EF-3 and EF-1)
- 150 mph and 90 mph
- 12 miles and 3 miles



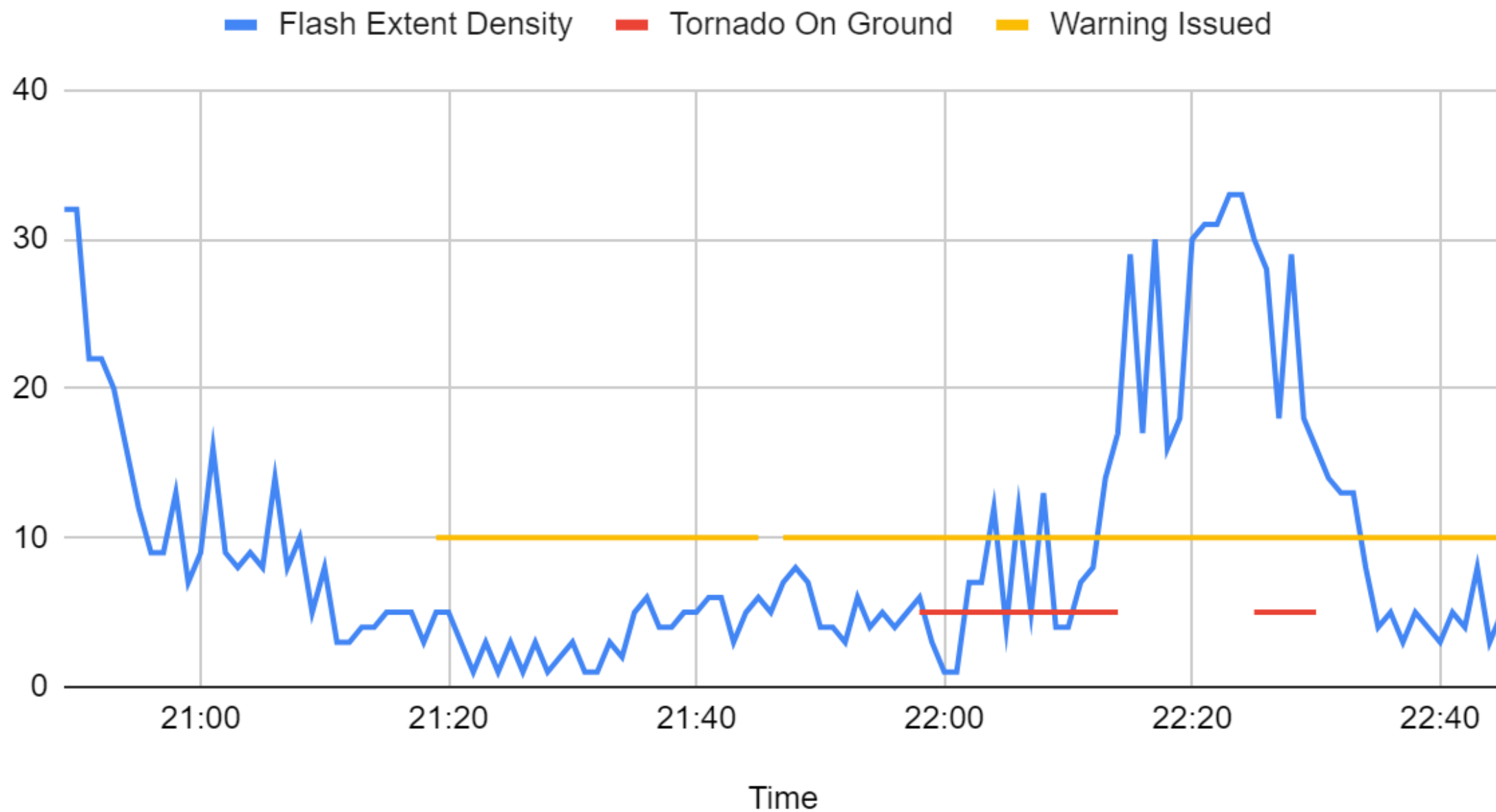


# March 28, 2020

- Two Tornadoes (EF-3 and EF-1)
- 150 mph and 90 mph
- 12 miles and 3 miles



March 28, 2020





# Summary

- Lightning tends to increase before tornadoes
  - Not always
  - Need to look for increases without tornadoes.
- The GLM data can help with seeing the stronger updrafts



# GLM Data

- GOES Image Viewer

- [https://www.star.nesdis.noaa.gov/GOES/conus\\_band.php?sat=G16&band=EXTENT&length=12](https://www.star.nesdis.noaa.gov/GOES/conus_band.php?sat=G16&band=EXTENT&length=12)

- RealEarth

- <https://realearth.ssec.wisc.edu/>

- Lightning Maps

- <https://www.lightningmaps.org>

