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)
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

From: https://www.nesdis.noaa.gov/content/goes-16-lightning-mapper-animations
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
March 9, 2019 Tippah, MS Hardin, TN McNairy, TN

- Flash Extent Density
- Tornado On Ground
- Warning Issued

Flash Extent Density

Time

20:00 20:30 21:00 21:30 22:00
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
December 16, 2019

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

- Flash Extent Density
- Tornado On Ground
- Warning Issued
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

• RealEarth
  • https://realearth.ssec.wisc.edu/

• Lightning Maps
  • https://www.lightningmaps.org