

Utilizing the Geostationary Lightning Mapper for Lightning Safety

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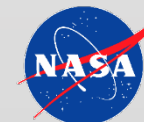
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⁴Earth System Science Center, University of Alabama in Huntsville,

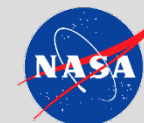


Many thanks to our emergency manager collaborators!



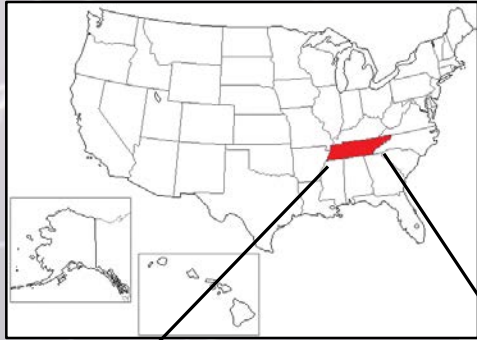
Outline

- Collaborative Partners
- What is the Geostationary Lightning Mapper (GLM)?
- Initial observations (Density Products)
- Lightning safety with GLM
- The 30 minute lightning hazard product
- Goal: Basic understanding of and how to use the lightning hazard product



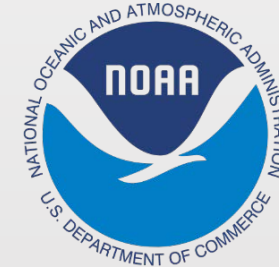
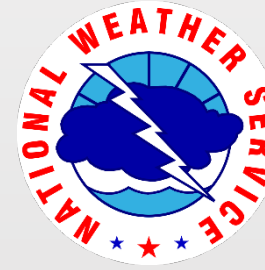
Collaborative Partners

United States

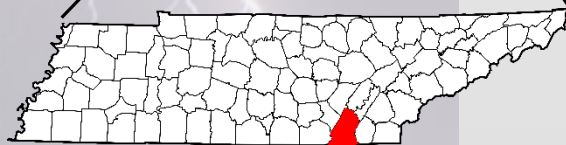


FEMA

National-scale response



Tennessee



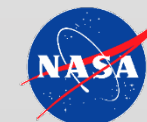
State-scale response



County/City-scale response

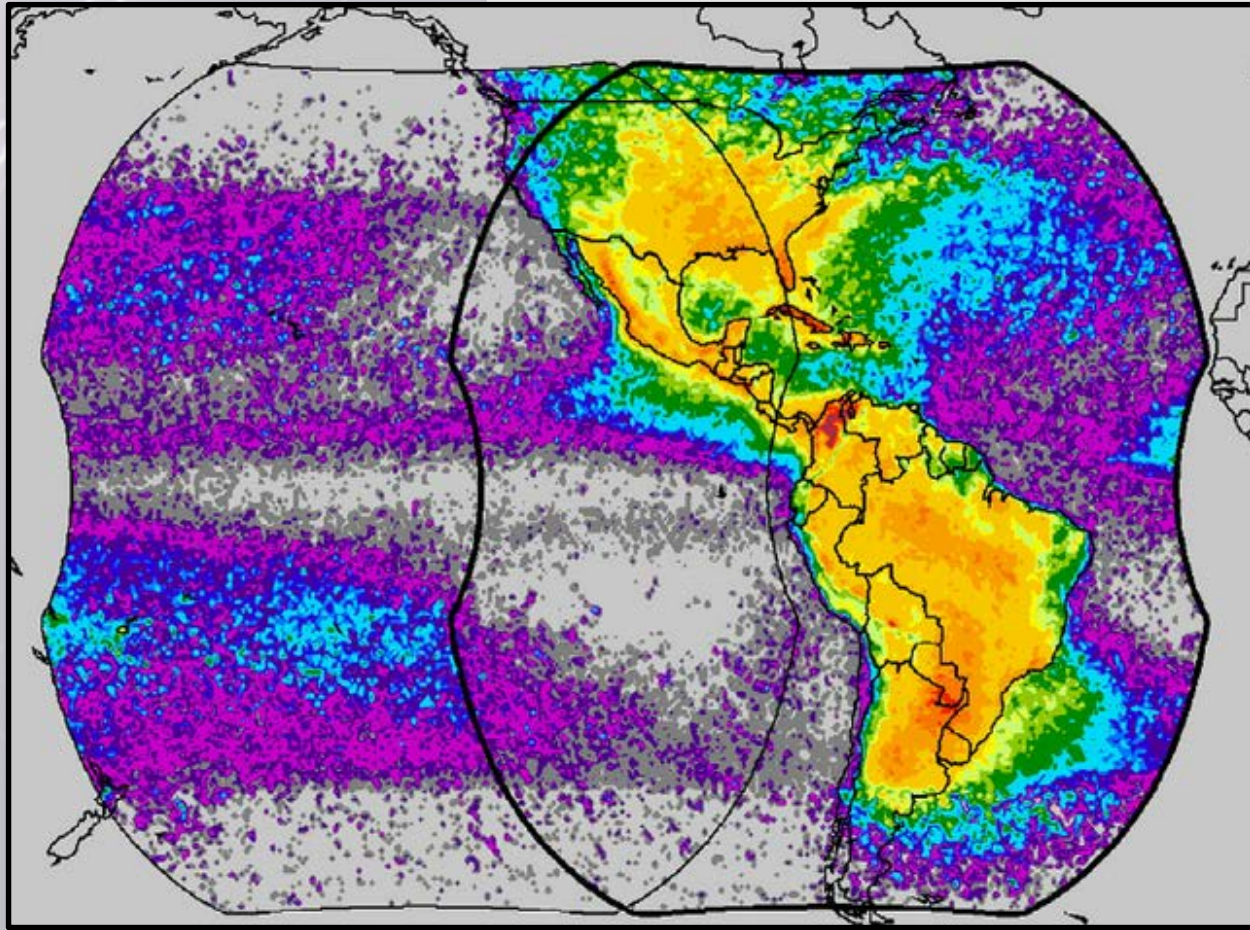


- United States National Weather Service coordinates at all levels
- NASA SPoRT partnering with the U.S. National Weather Service and three County/City-scale emergency managers
- Final goal to work with state and federal emergency managers



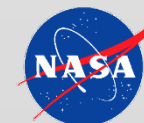
Hamilton County / City of Chattanooga

The Geostationary Lightning Mapper (GLM)



GLM field of view for GOES-16 and -17

- Large digital camera to detect cloud top brightness differences
- Covers 54° N/S
- Observes both intra-cloud and cloud-to-ground lightning – Does not distinguish the difference
- Specifications: >70% detection over the full disk over 24 hours (>90% at night)
 - Initial review exceeding specifications



What Does the GLM Observe?



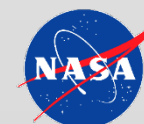
Overhead view of lightning from the International Space Station



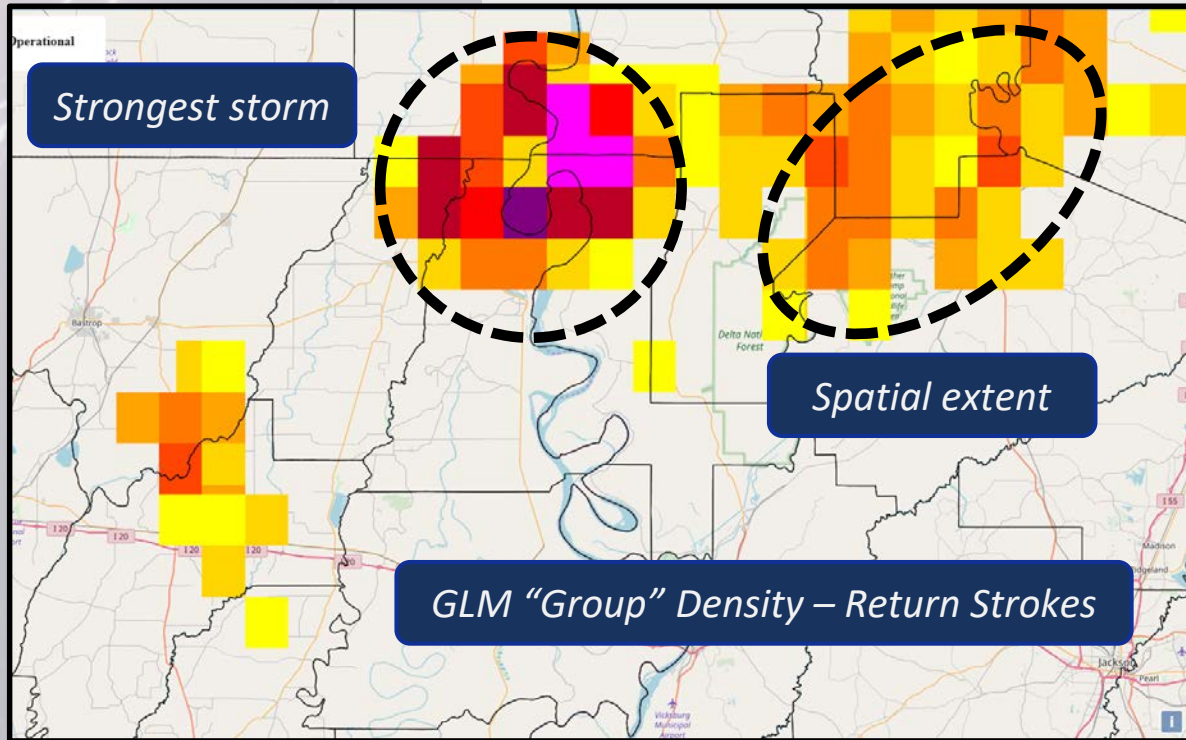
Side view of lightning from the International Space Station

Examples courtesy of NASA and ESA

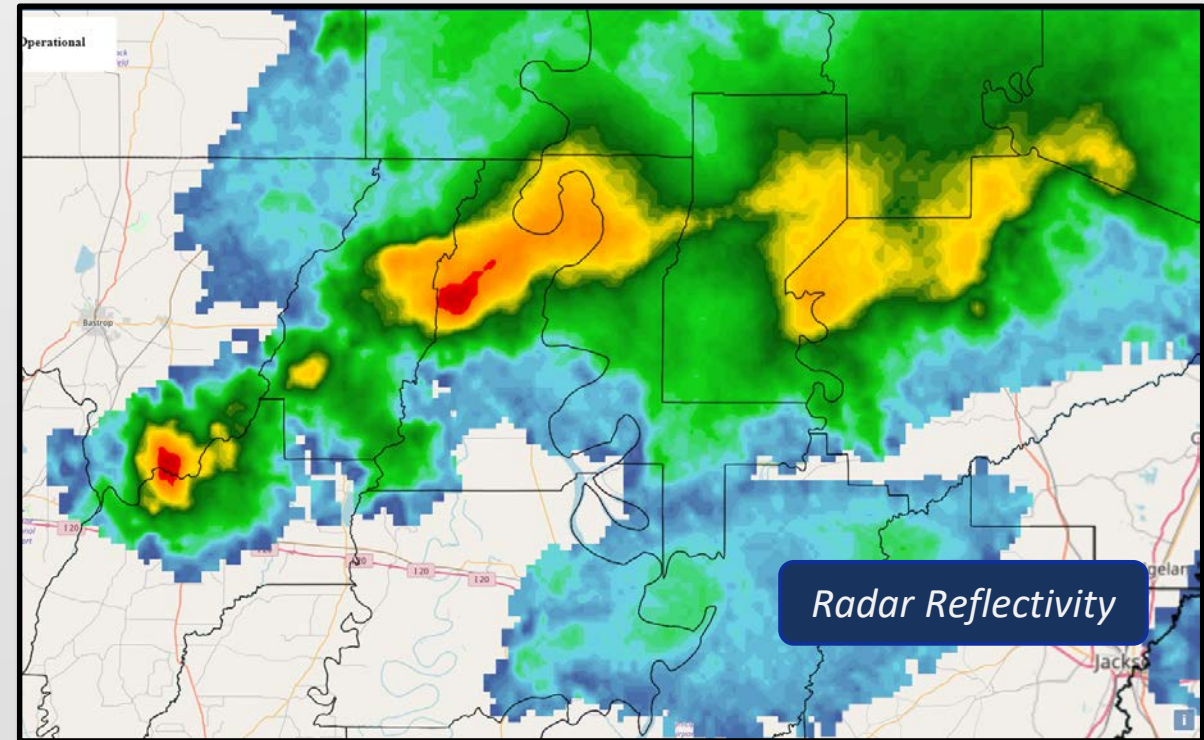
- GLM very different than ground-based networks
- Observes light emitted through a cloud by a lightning flash
- Results in the lightning flash appearing as a “pool of light” in the cloud
- Shows spatial extent of lightning and not a single point



Initial Observations: Density Products

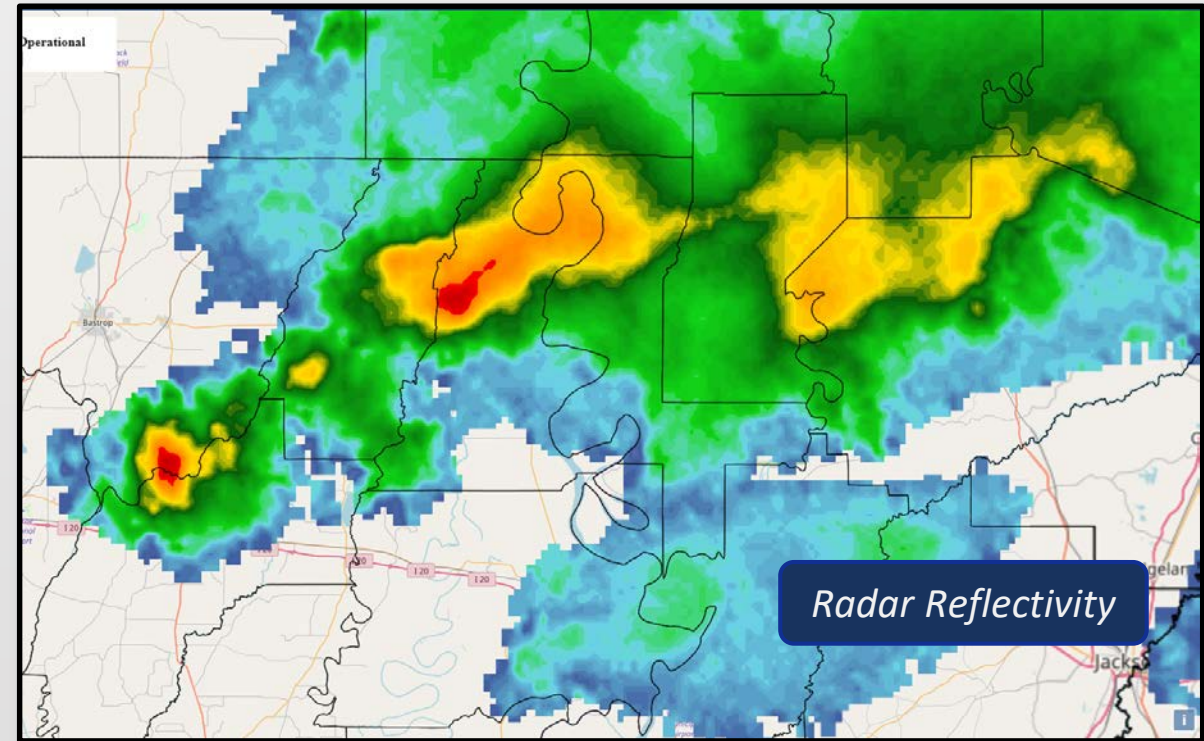
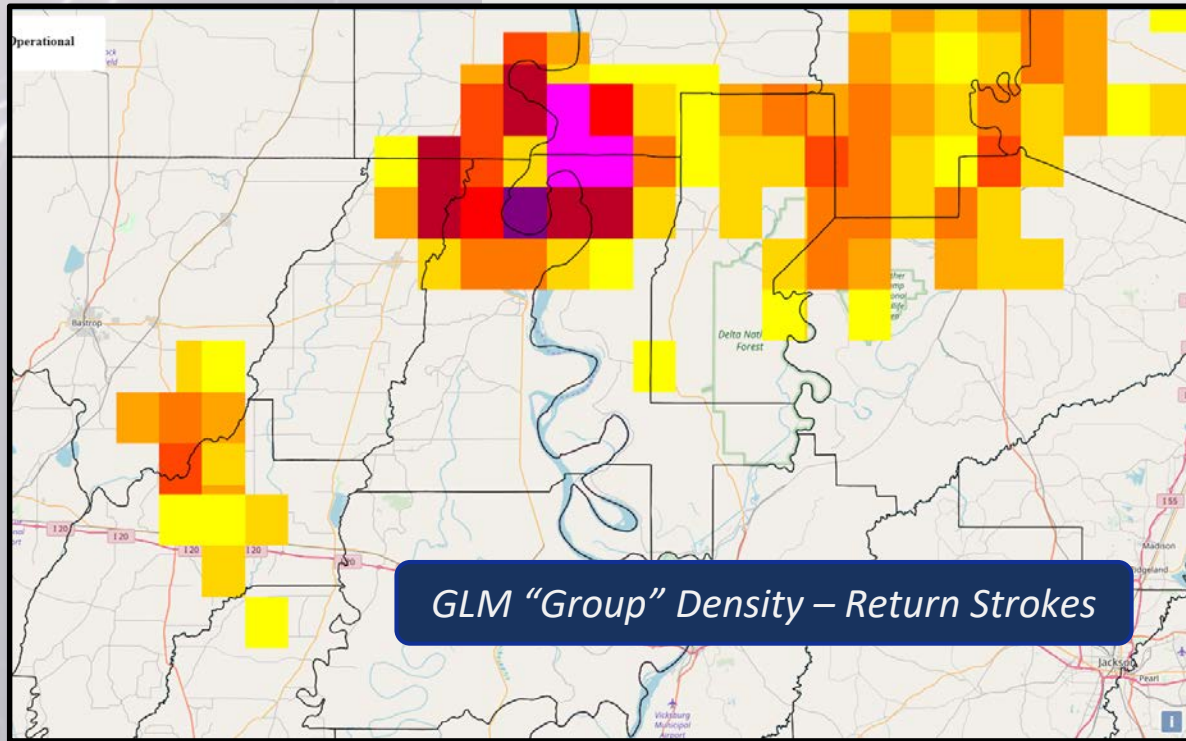


- Available every minute
- Highlights strongest storms
- Also shows spatial extent

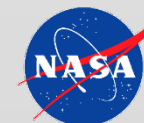


- GLM and radar excellent to use in combination with one another

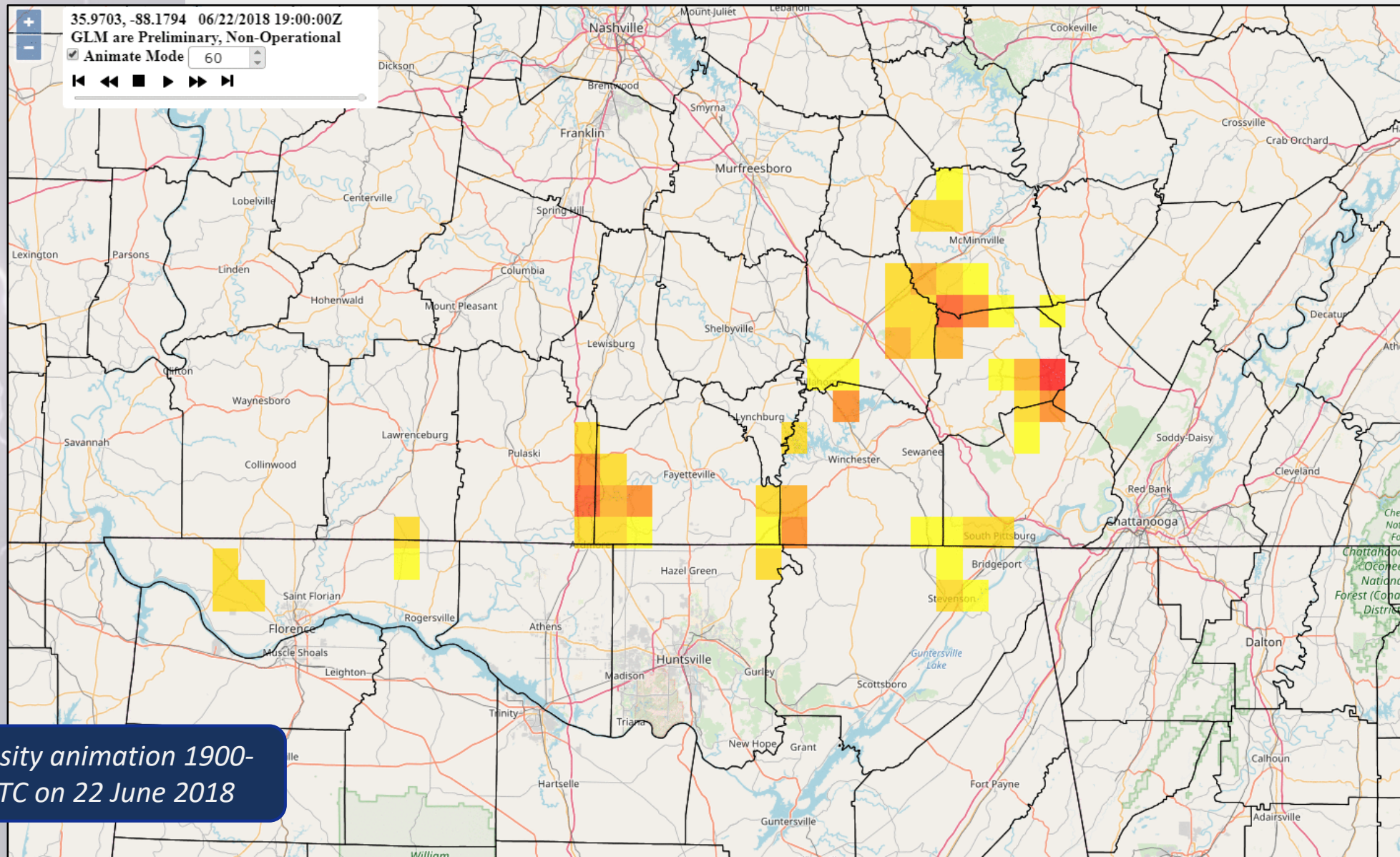
Utility of the Density Product



- Density product very good at monitoring storm intensity
- See where storm may be growing or weakening
- Provides spatial extent, but need an animation to see extent over time
 - Loops could be difficult with limited data availability in the field

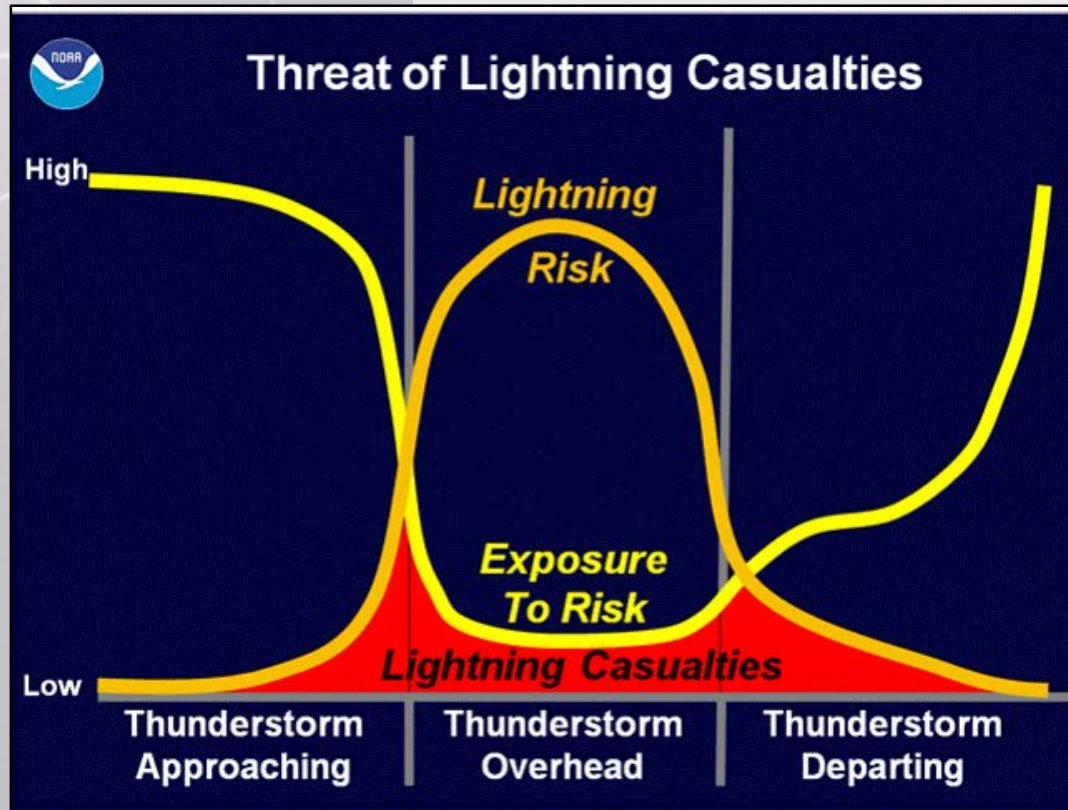


Density Product Animation



GLM density animation 1900-
1950 UTC on 22 June 2018

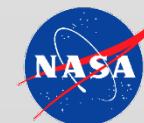
Lightning Safety Information



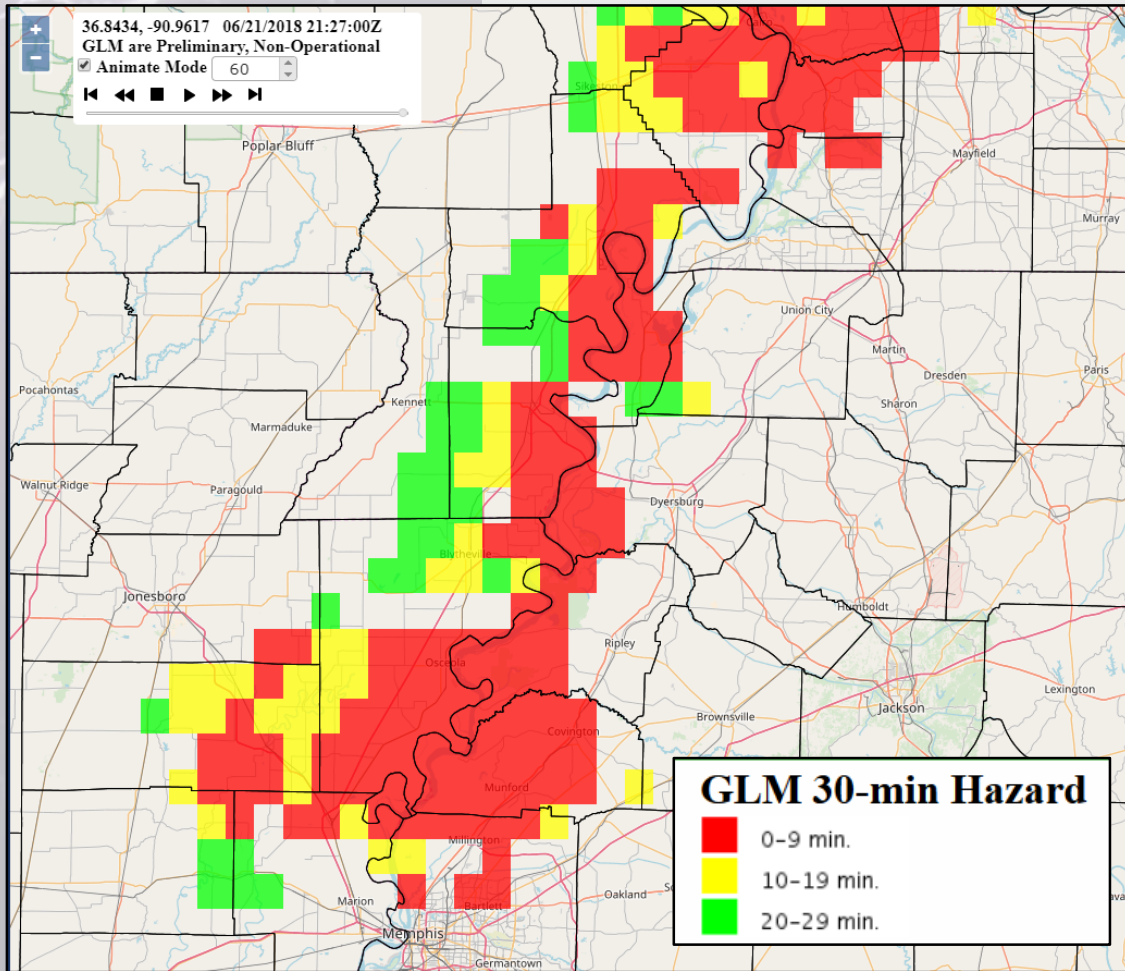
Courtesy of NOAA's lightning safety page

www.lightningsafety.noaa.gov/safety-overview.shtml

- Graphic of lightning casualty occurrence versus
 - Location relative to thunderstorm
 - Risk of lightning
 - Exposure to risk (i.e., are people indoors)
- Key point:
 - People are in shelter when lightning risk obvious
 - Many casualties occur when threat of lightning is low, but individuals' exposure is high
- Emergency managers have asked for a visualization tool to show location, extent, and time of lightning
- SPoRT created the 30 minute hazard or "stoplight" product
 - Uses 30 min rule (stay indoors for 30 minutes after last lightning)

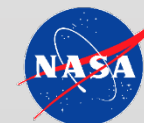


30 Minute Lightning Hazard Product

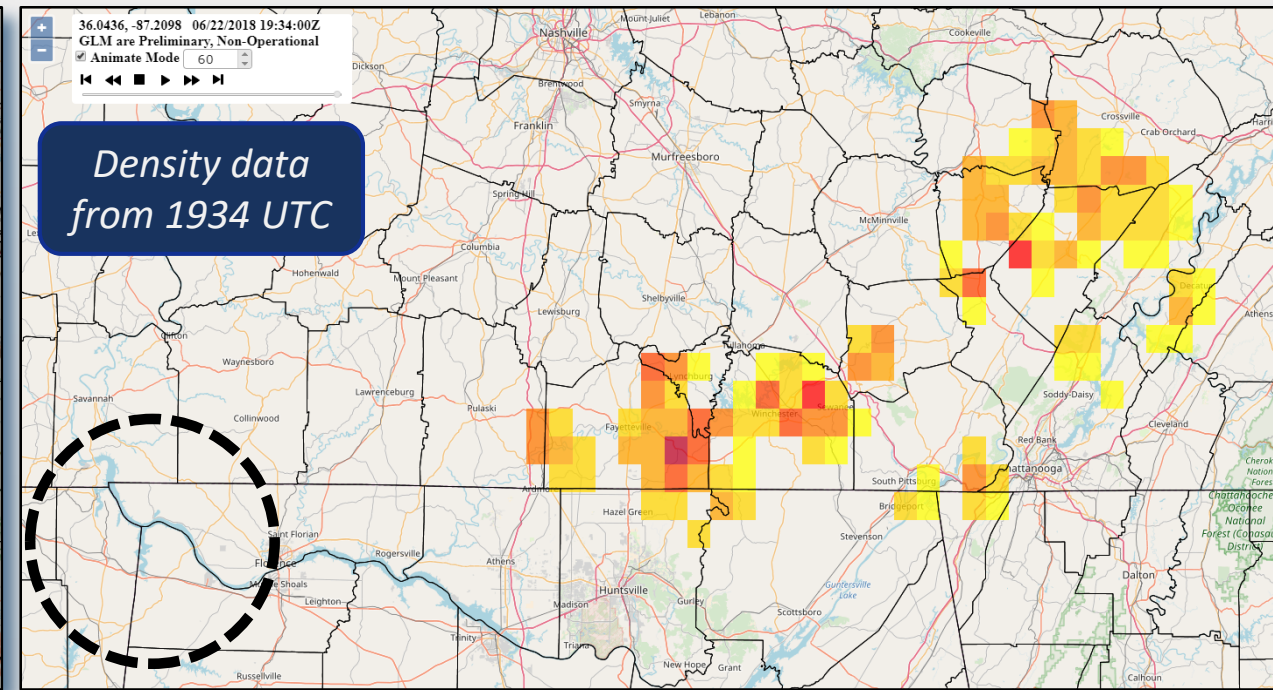
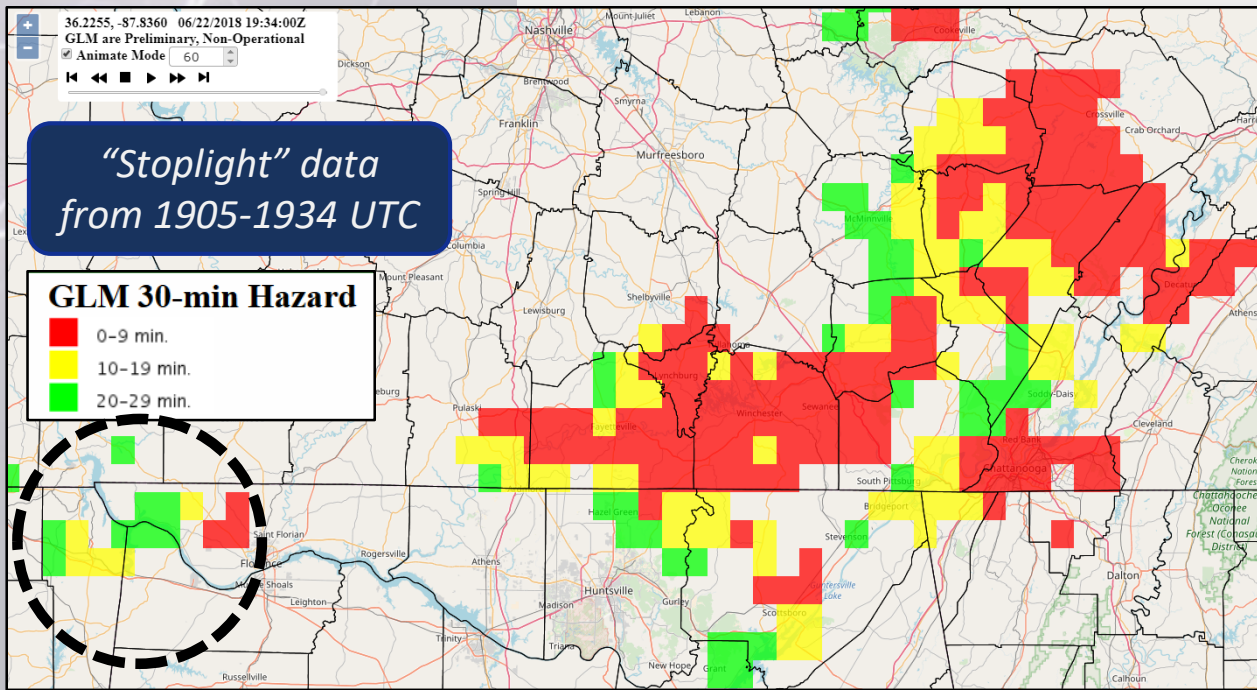


- Uses space-based Geostationary Lightning Mapper (GLM)
 - Public data – Can share on social media
- Resolution of $\sim 10 \text{ km}^2$
- Uses 30 minutes of GLM observations and updates every minute
- Any grid box with GLM observations is marked based on most recent flash
 - 0-9 minutes – Red
 - 10-19 minutes – Yellow
 - 20-29 minutes – Green
- Initial response indicates green should be changed as it suggests “all clear”

Example of the 30 minute lightning hazard product in western Tennessee (21 June 2018)

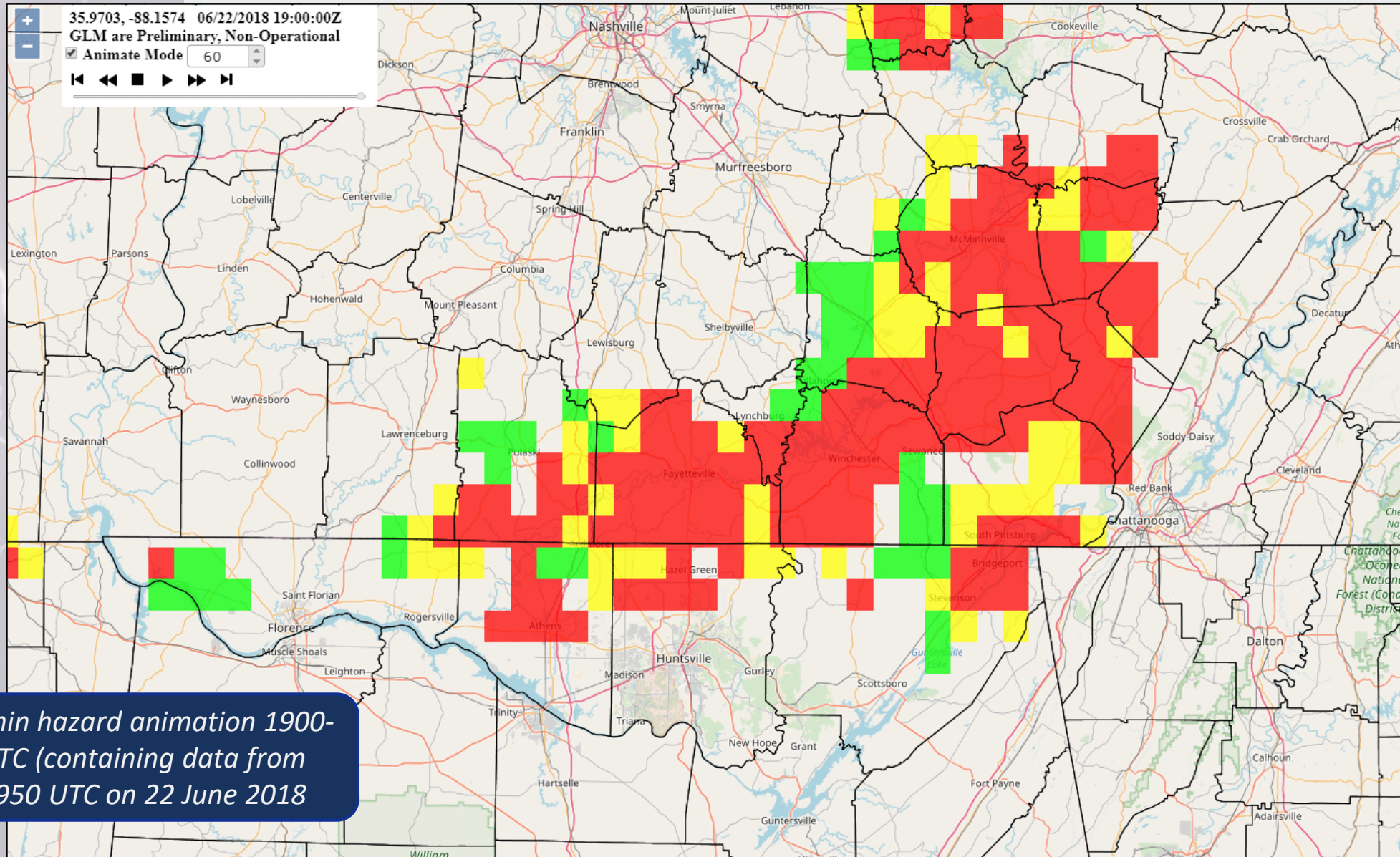


Using the Hazard Tool for Lightning Safety



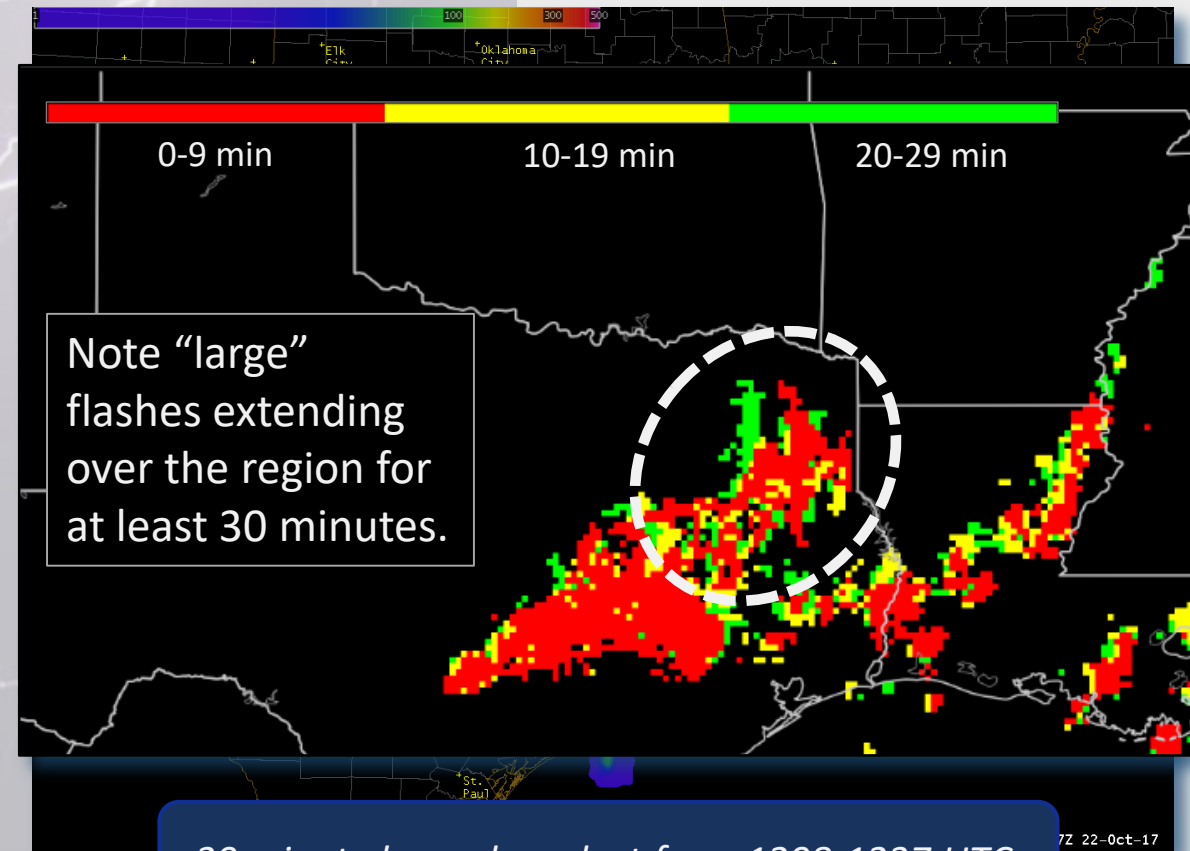
- Density product (every minute) highlights strongest storms and current spatial extent
- Hazard display shows where lightning has been for the past 30 minutes
 - Note activity seen in NW Alabama, but not with density – Red indicates developing storm
 - General motion can be inferred (green to red) – Slow moving in Tennessee
 - Green next to red starkly illustrates threat of lightning over 30 minutes
 - Single large flashes will remain on display for 30 minutes

30 Minute Lightning Hazard Animation



GLM 30 min hazard animation 1900-1950 UTC (containing data from 1831-1950 UTC on 22 June 2018)

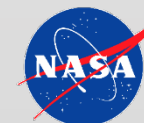
Importance of 30 Minutes and Spatial Extent



30 minute hazard product from 1208-1237 UTC.

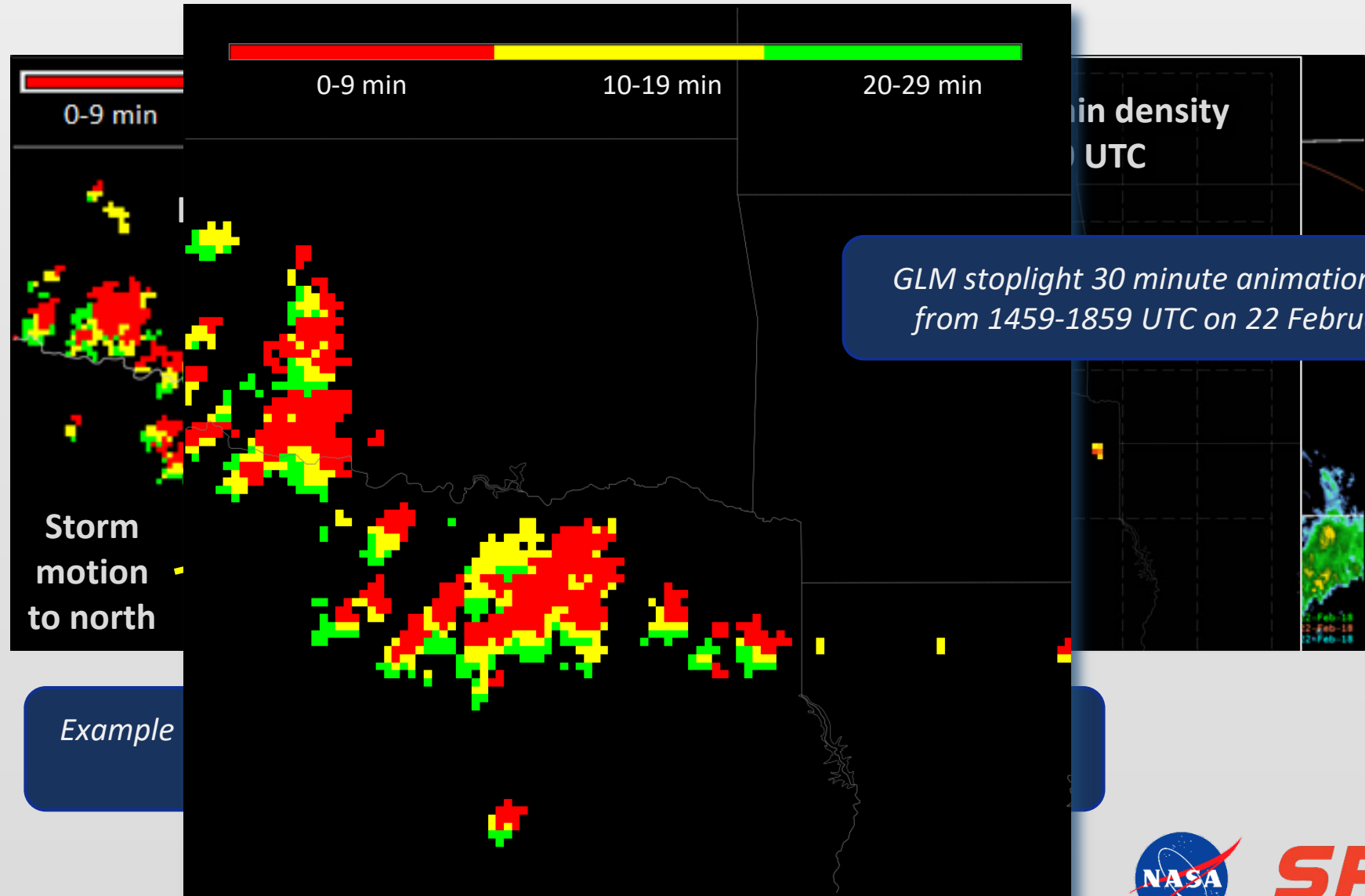
*Lightning flash in Texas observed by GLM extending 160+ km.
(1 minute of observations at 1237 UTC.)*

- Timing very critical with lightning safety
- Threat exists before and after storm's passage
- Balance safety with impacts of being shut down
- Upcoming publication information: Delay between two lightning flashes in the same area
 - Case study used ~708 thousand pairs of flashes
 - 9.5% > 10 minutes
 - 3.5% > 20 minutes
 - 1.4% > 30 minutes
- Public 30 minute rule of thumb good, but non-zero threat beyond 30 minutes
- Long flashes (spatial extent) could account for some of these

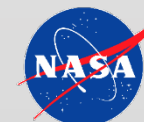


Additional Example

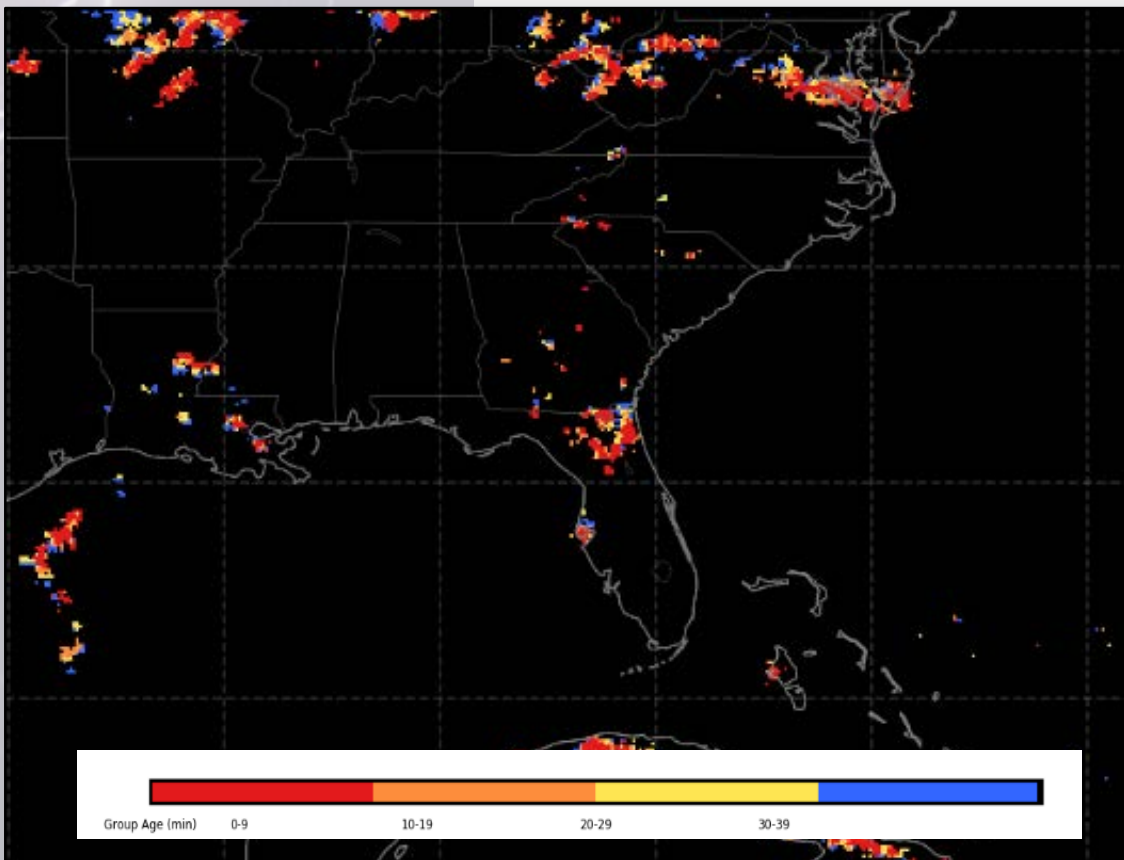
Upcoming
National
Weather
Association
Journal of
Operational
Meteorology
Stano et al.
(2018)



Example

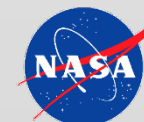


Summary



*Updated 30 minute lightning hazard product “quick look” example.
Adds 30-39 min range (blue) and changed color brackets*

- Lightning Hazard Product shows age and extent of all lightning for the past 30 minutes
 - Uses 10 minute bins (0-9, 10-19, 20-29)
 - Based on 30 minute safety rule
 - Developed from emergency manager requests
- Shows 30 minutes of data and updates every minute
- “At a glance” ability to determine age and coverage
- Future options (example to left):
 - Remove green as the 20-29 minute age
 - Add a 30-39 minute age band?



Questions and Web Links

- Dr. Geoffrey Stano: geoffrey.stano@nasa.gov
- More details to come in the National Weather Association's Journal of Operational Meteorology Stano et al. (2018 – Submitted)
- “Quick Look” web pages:
 - Density: <https://weather.msfc.nasa.gov/cgi-bin/sportPublishData.pl?dataset=goeseastglm&product=group&loc=conus>
 - 30 min Hazard: <https://weather.msfc.nasa.gov/cgi-bin/sportPublishData.pl?dataset=goeseastglmstoplight&product=group>
- Web mapping server
 - NASA-safety: <https://weather.msfc.nasa.gov/viewer/viewer.html?config=nasa-safety>
 - EMA-safety: <https://weather.msfc.nasa.gov/viewer/viewer.html?config=ema-safety>

