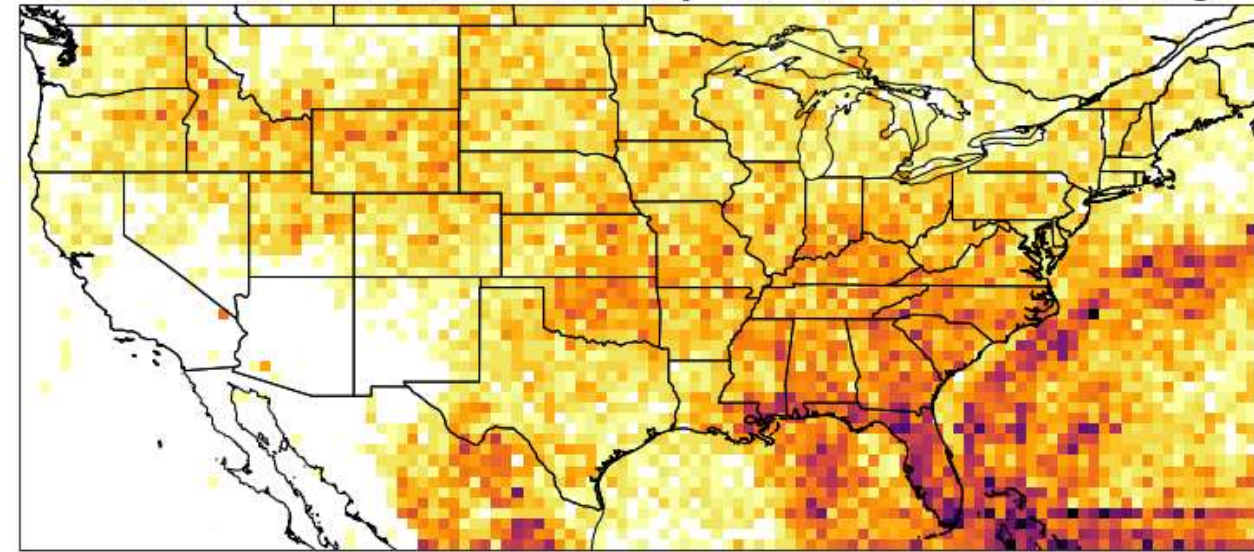
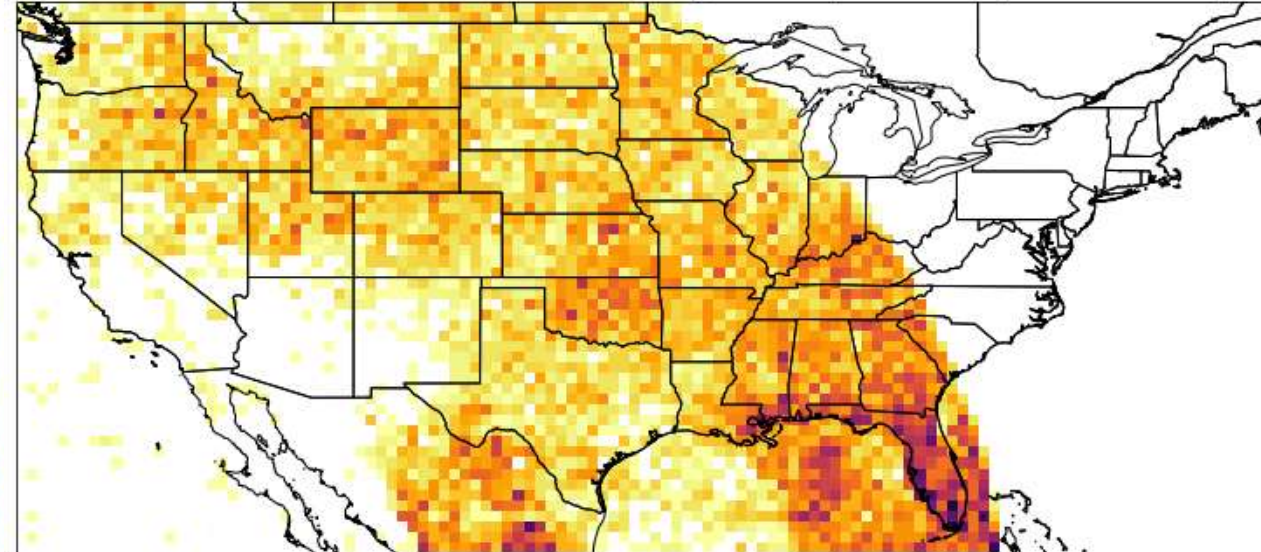


GOES-East GLM First Flash Events, May 2022 (n=23929, dx=0.5 deg)



GOES-West GLM First Flash Events, May 2022 (n=15600, dx=0.5 deg)



# Characterizing GLM First Flash Events: A Bulk Study Perspective

Kevin Thiel (CIWRO/SPC)

Collaborators: Kristin Calhoun (NSSL), Jacquelyn Ringhausen (CIWRO/NSSL), Michael Stock (CIWRO/NSSL)

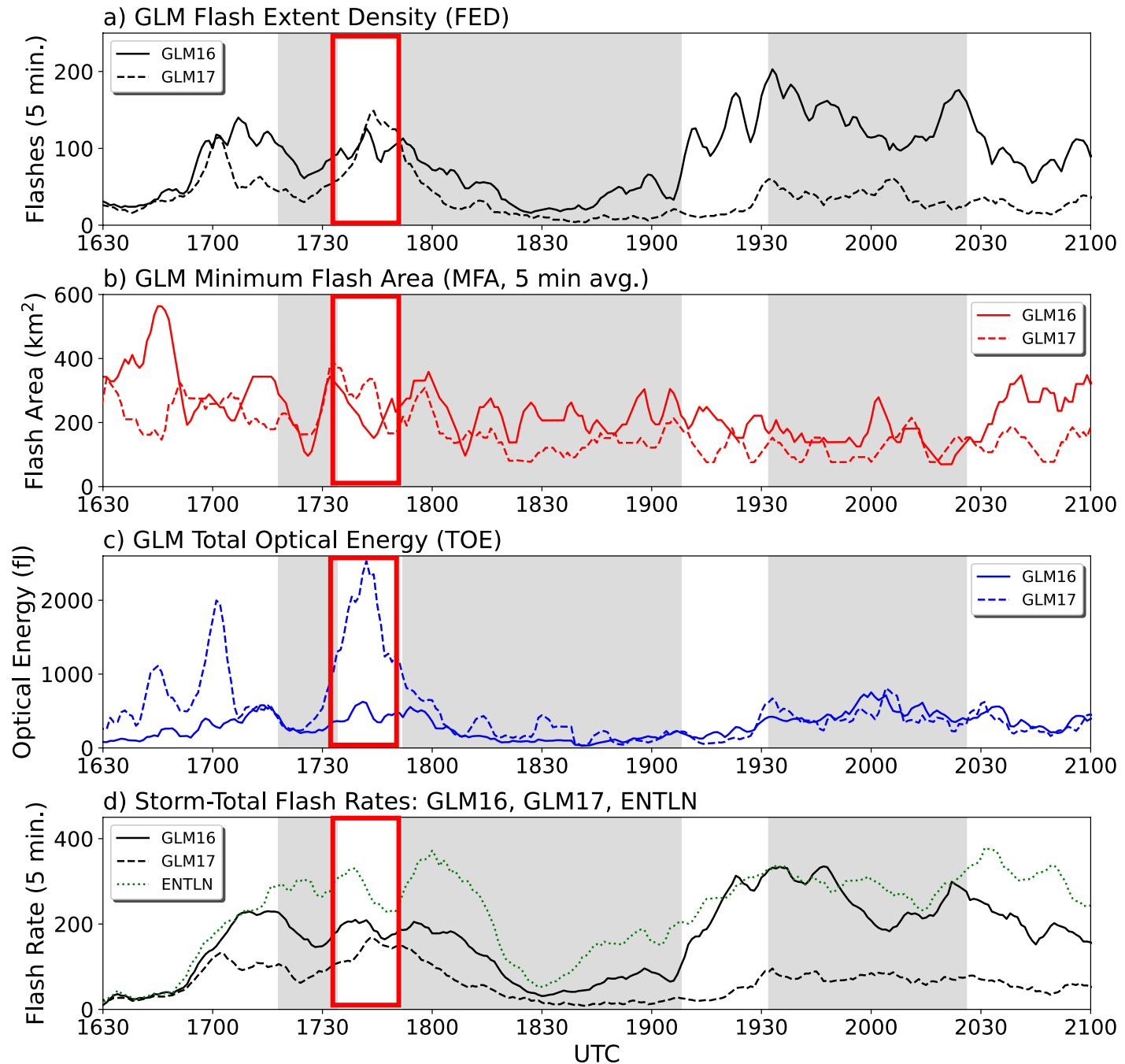


# Dual-GLM Observations of Individual Storms (Gridded Imagery)

## Alabama Supercell (25 March 2023)

- Three long track, violent tornadoes (grey bars)
- Discrete for its entire +4.5 hr life
- Similarities/differences of gridded GLM imagery

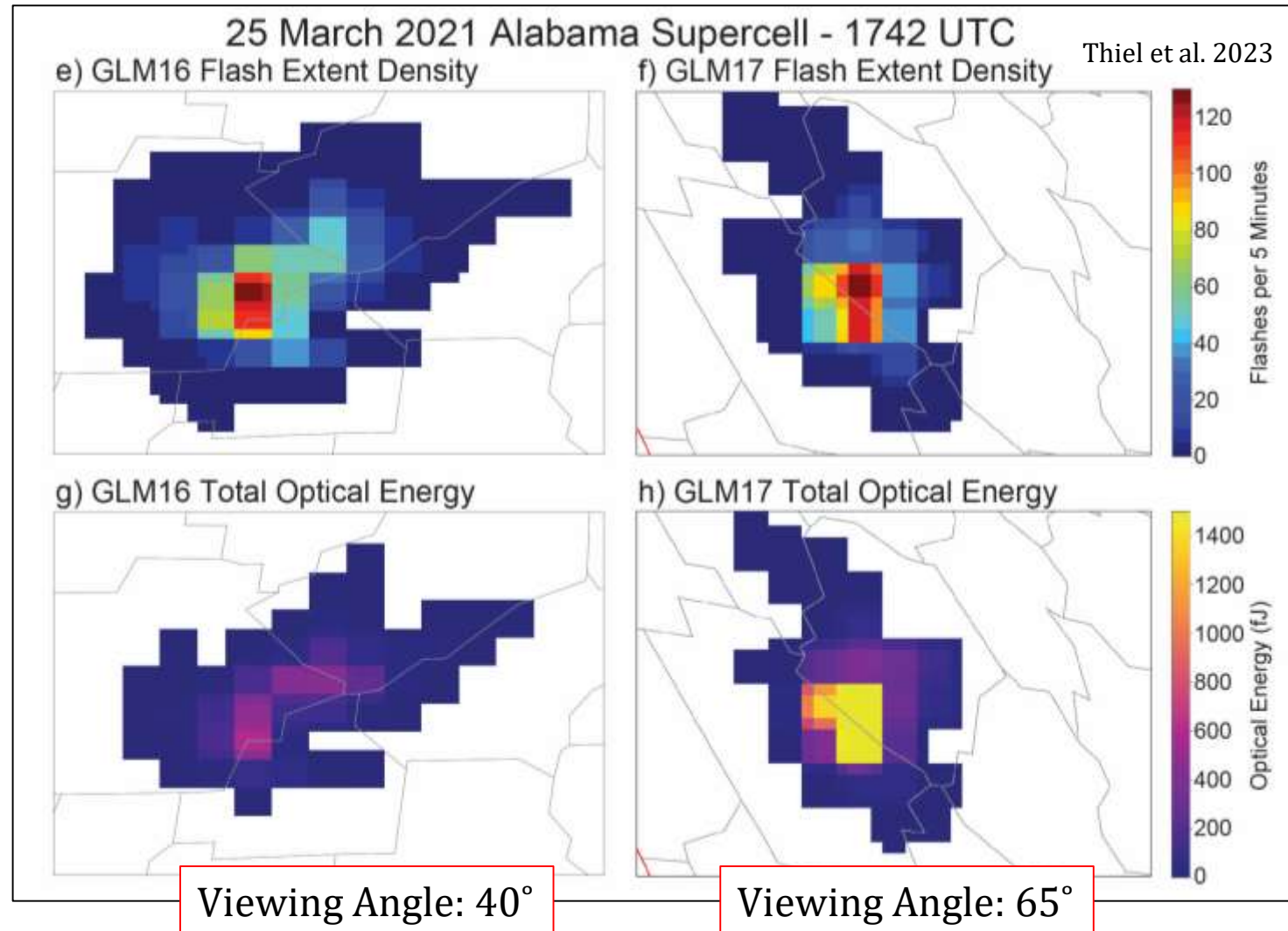
### 25 March 2021 Supercell Case - Alabama, Lightning Data



# Dual-GLM Observations of Individual Storms (Gridded Imagery)

## Alabama Supercell (25 March 2023)

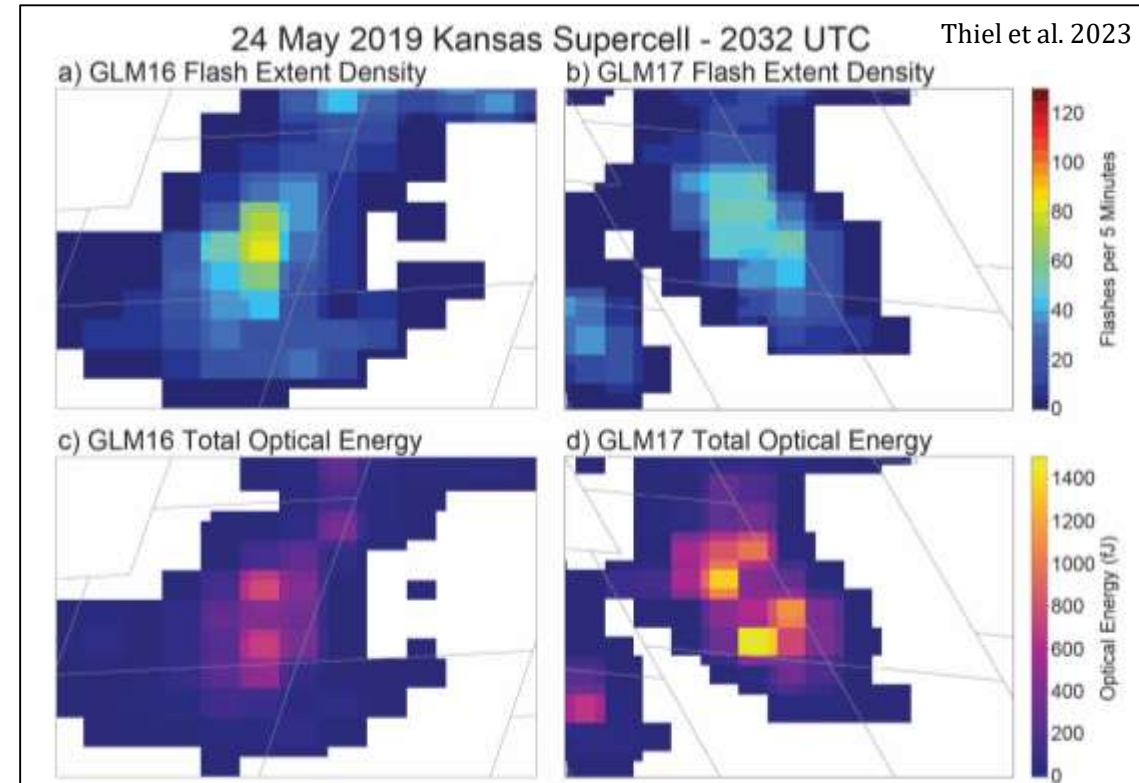
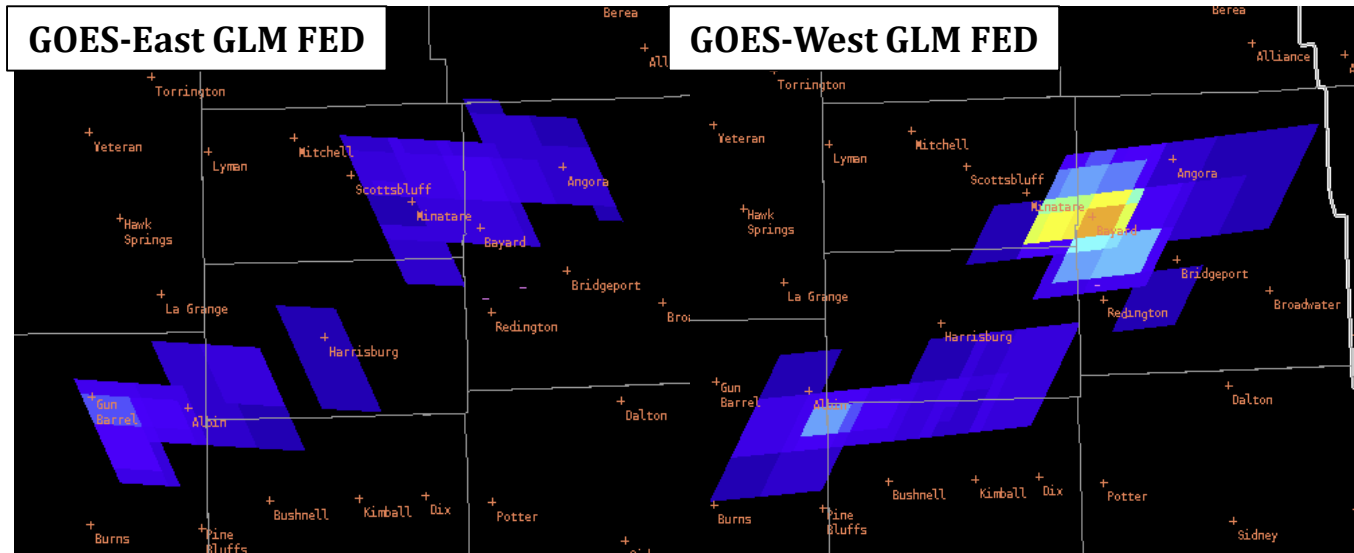
- Three long track, violent tornadoes (grey bars)
- Discrete for its entire +4.5 hr life
- Similarities/differences of gridded GLM imagery



# Do we see these differences in other places? **Yes**

## 2022 Satellite Proving Ground HWT

## Supercell Thunderstorm - May 2019



**'GOES-17 had the better angle to see lightning activity in these supercells developing over the high plains of WY and NE. Whereas GOES-16's perspective from further east had to punch through spreading anvils downstream of the main updraft that likely obscured the light emanating from the lightning'**

7 June 2022, Blog Post

<https://inside.nssl.noaa.gov/ewp/2022/06/24/glm-goes-16-vs-goes-17/>



# Takeaway

There's a need to characterize GLM flashes from *both* instruments.

Where to start?

The **first lightning flash** a thunderstorm produces.



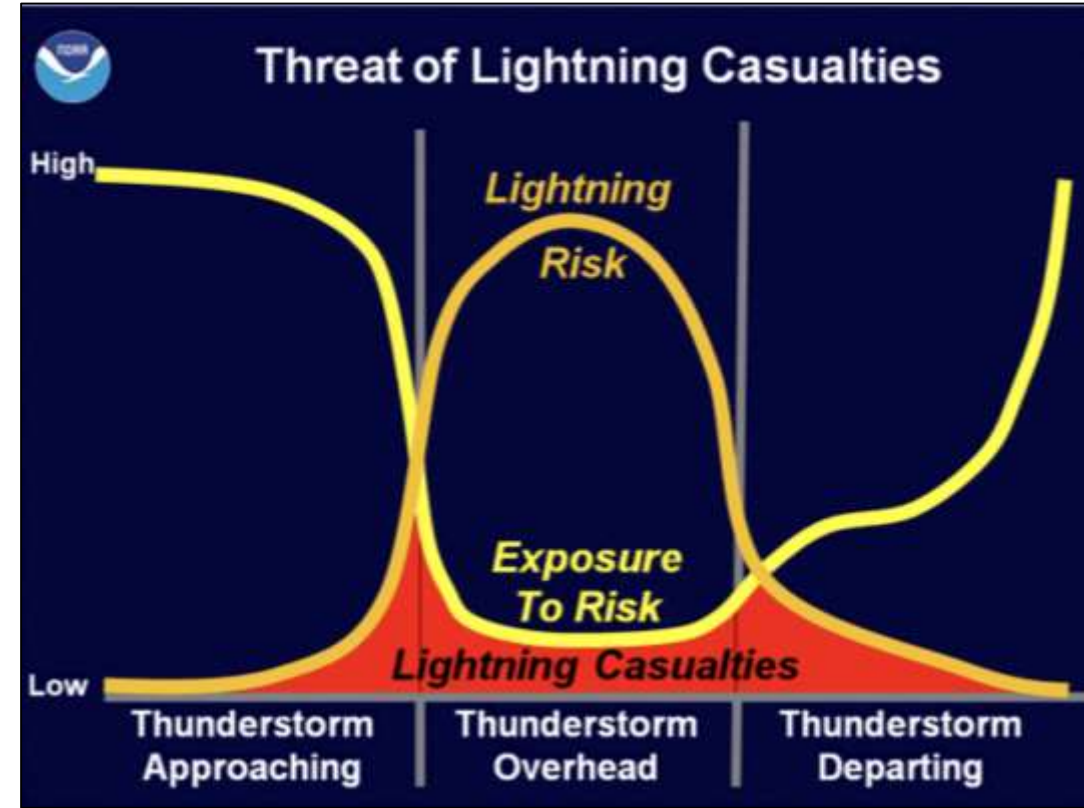
# Why the first flash?

Operationally:

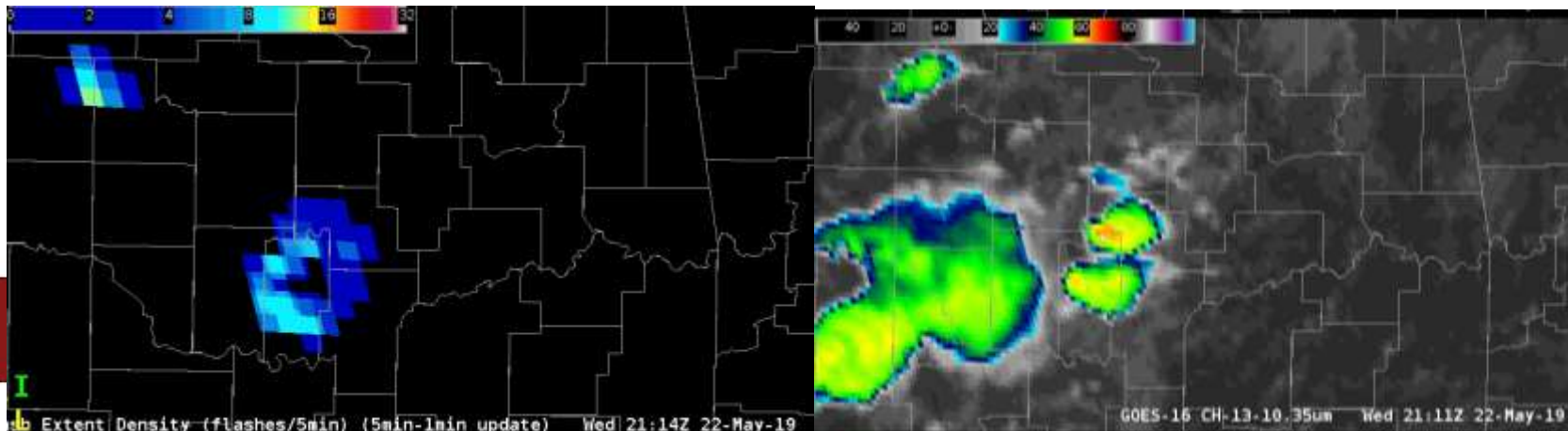
- Marker of initiating convection
- Public safety
- Validating CI methods (e.g. LightningCast)

Scientifically:

- 'Easy' to identify
- Intercomparisons w/satellite imagery, radar, other lightning location systems, etc.



[weather.gov/safety/lightning-safety-overview](https://weather.gov/safety/lightning-safety-overview)



# First Flash Research Questions

- How effective is the GLM (GOES-E/W) at observing first flashes compared to ground networks, other GLMs, etc.?
- What are the characteristics of GLM first flashes from the GLM, satellite imagery (ABI), radar (MRMS), and ground lightning networks? What can this tell us about CI?
- What are the characteristics of *missed* GLM first flashes?



# Building a database of 'first flash' events.

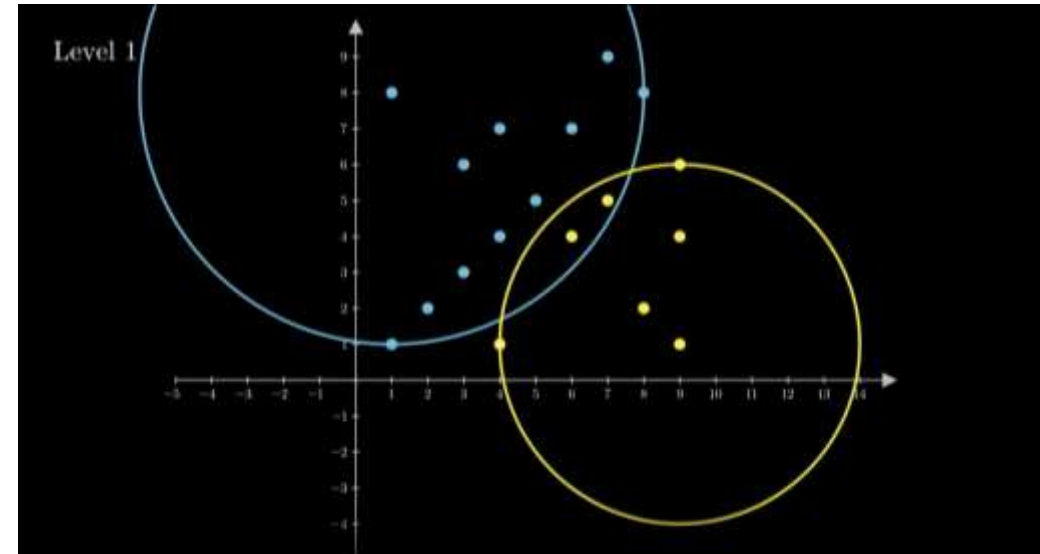
## First Flash Definition

**No** flashes located within **30 km** and the preceding **30 minutes**

1. Identify first flashes (GLM L2)
2. Collect flash, event, and group data
3. Collect ambient satellite/radar data
4. Compare with other GLM, ENTLN, and LMAs

Domain: CONUS, 2022

Ball Tree with haversine 'hyperspheres'



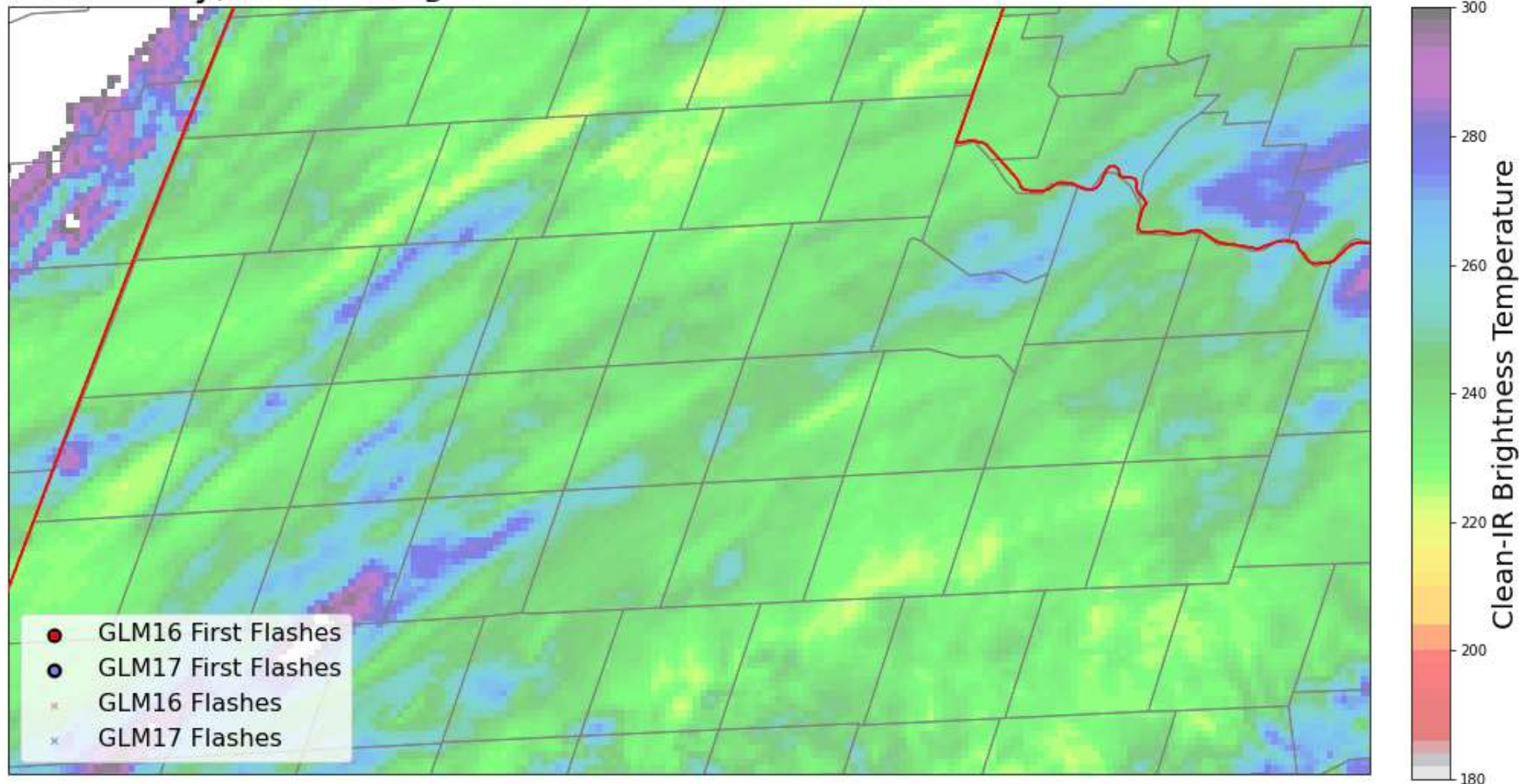
Source





# First Flash Identification in Action

Case Study, Clean-IR  $T_B$  2022-05-04 17:03:55 UTC



# A first attempt: May 2022

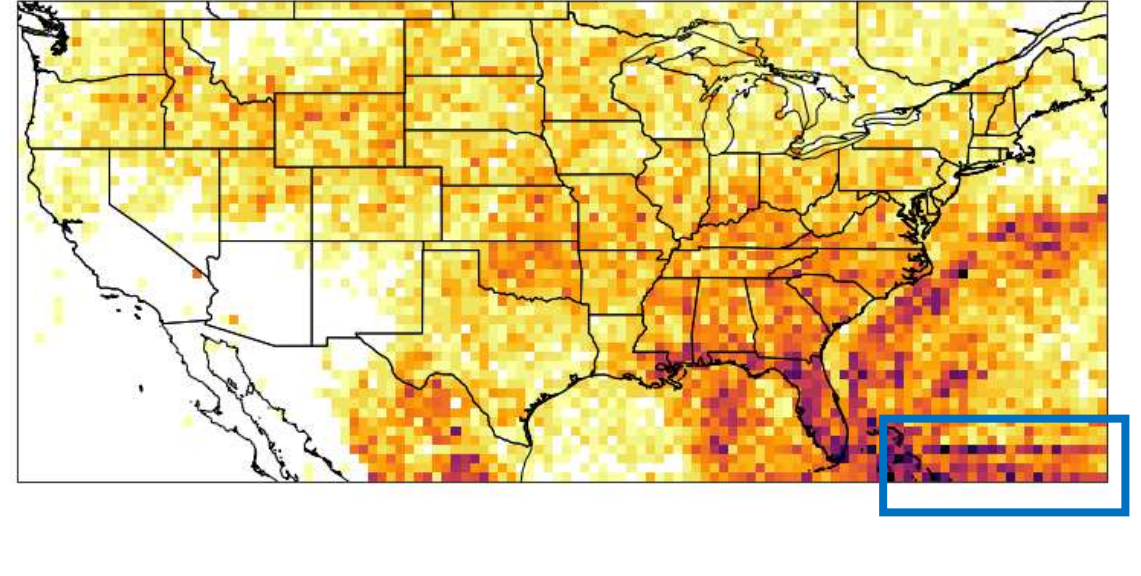
## GOES-East

- >23K first flash events
- Potential false events in Bahamas

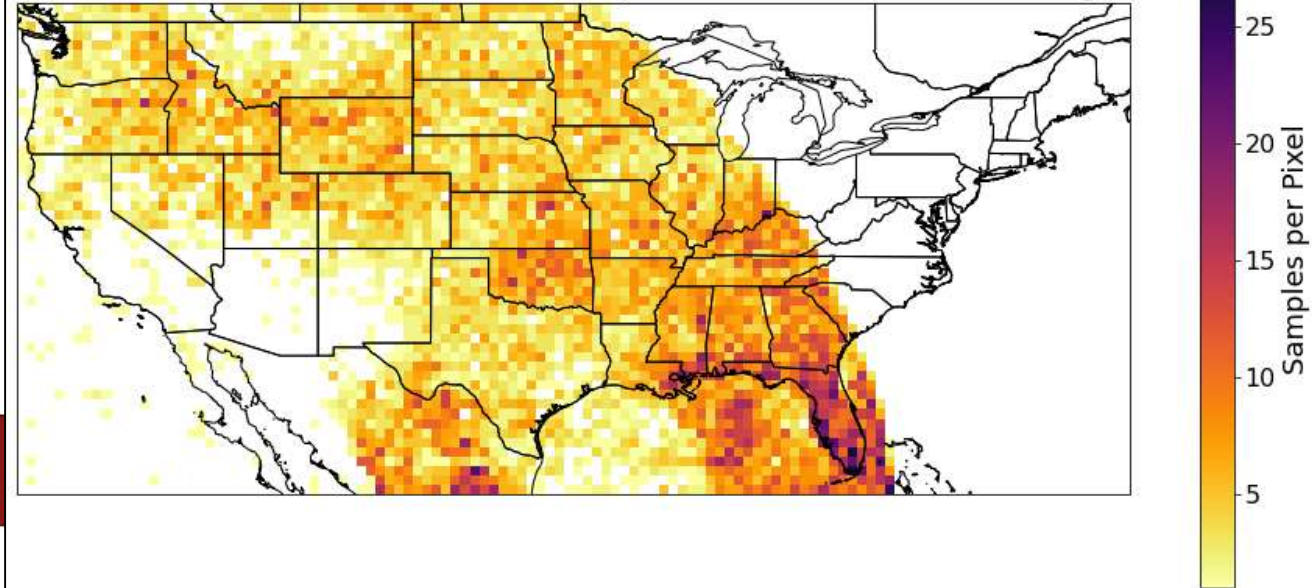
## GOES-West

- >15K first flash events
- Spatial agreement with GOES-East GLM

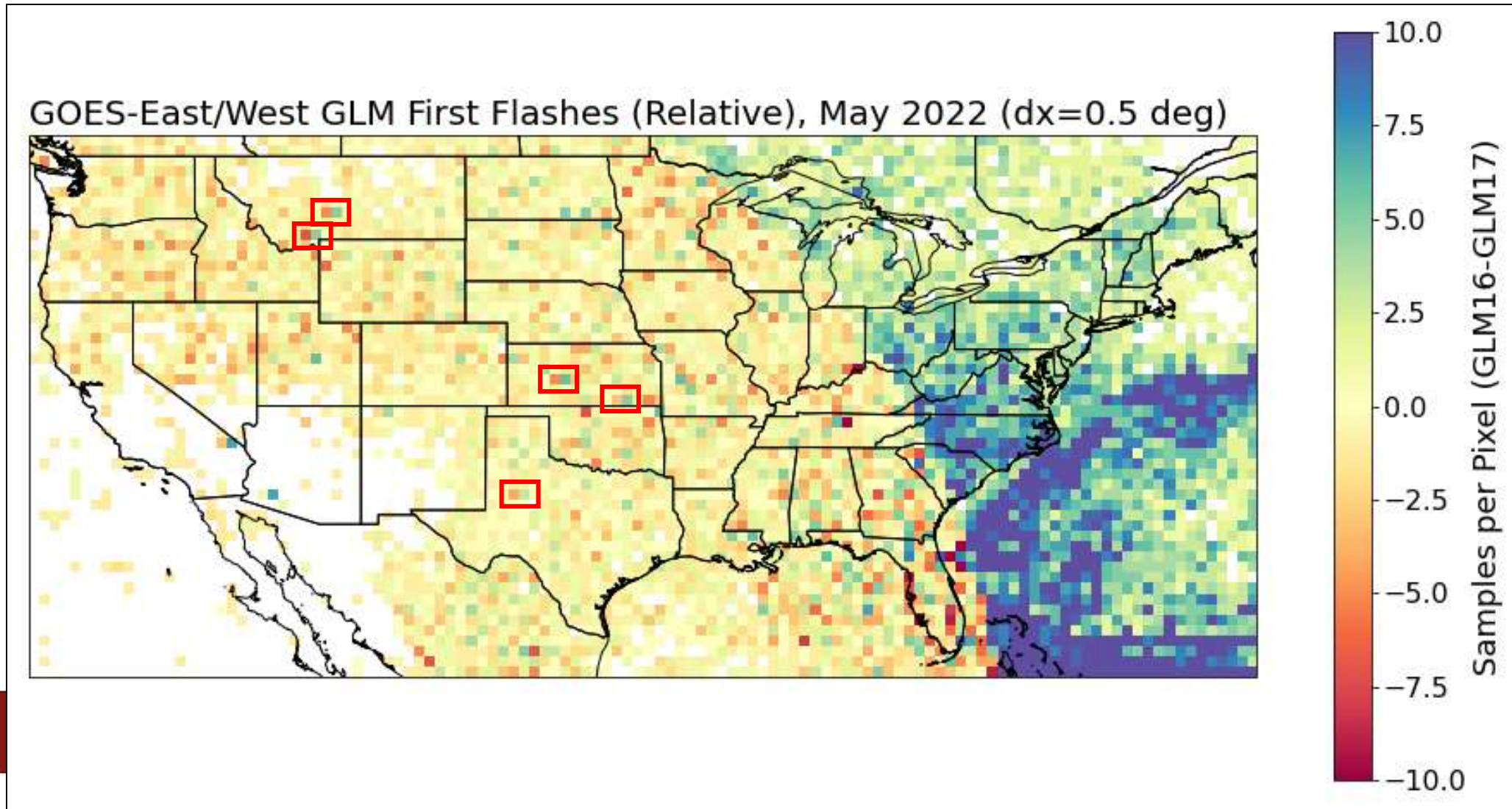
GOES-East GLM First Flash Events, May 2022 (n=23929, dx=0.5 deg)



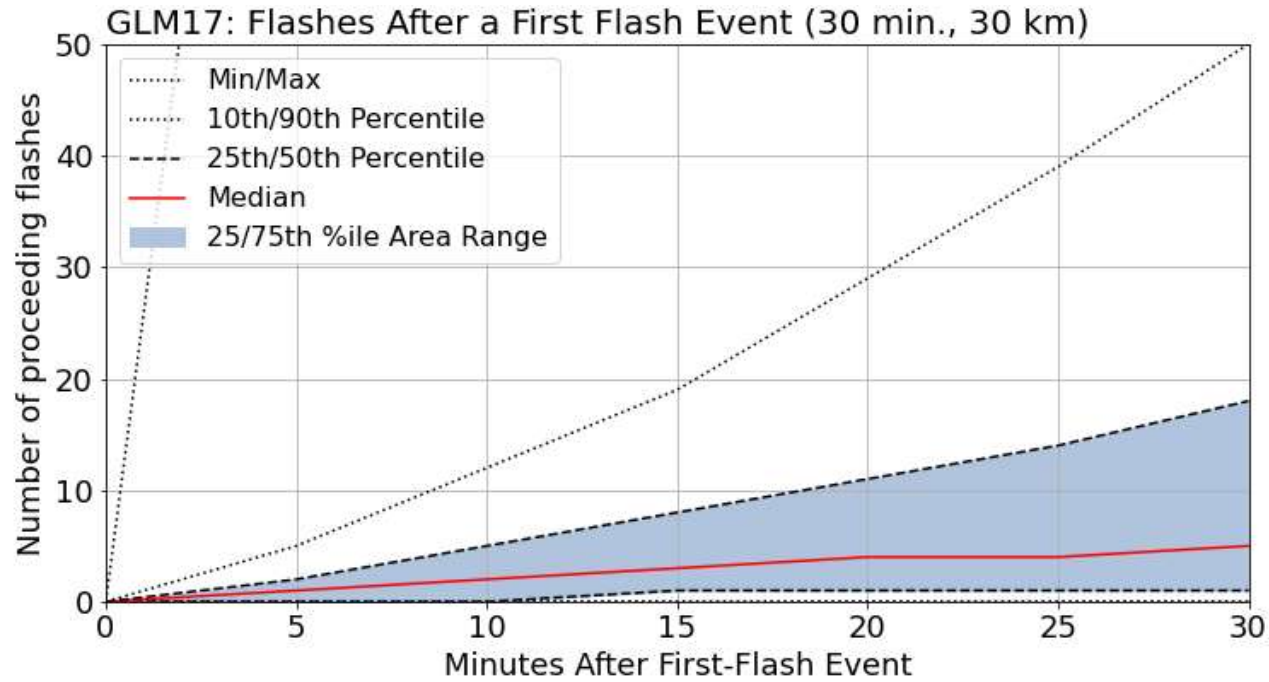
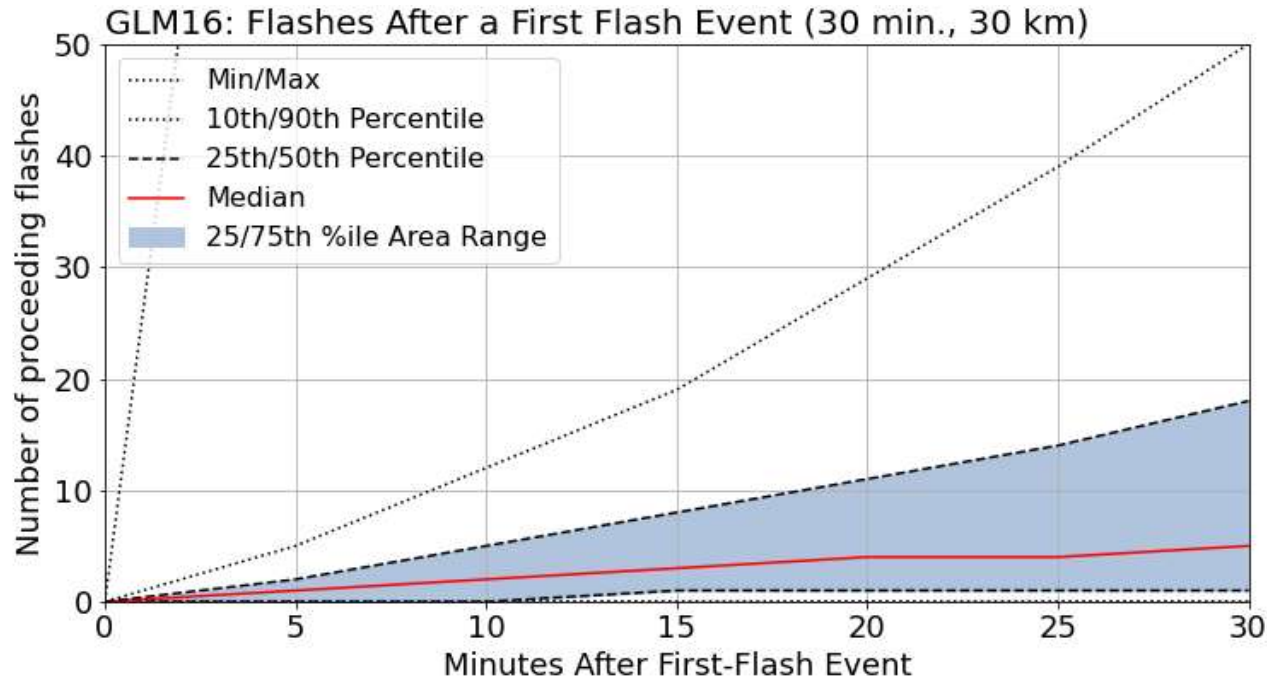
GOES-West GLM First Flash Events, May 2022 (n=15600, dx=0.5 deg)



# How do the flash distributions compare spatially?



# How do we know these storms involve 'successful' initiation?



# Next steps

- Increase the size of the GLM (16 & 17) first flash datasets to cover all of 2022.
  - Case studies to validate the first flash definition
  - Attempt to filter out false first flash events
- Repeat first flash identification for ground networks (ENTLN and LMA)
- Analyze flash characteristics in concert with radar/satellite

Case Study, Clean-IR T<sub>B</sub> 2022-05-04 17:03:55 UTC

