Geostationary Lightning Mapper: Introduction and Overview

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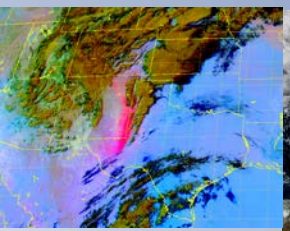
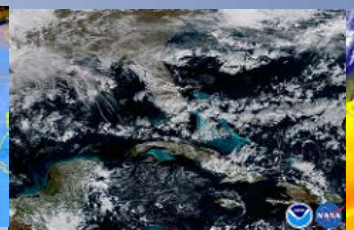
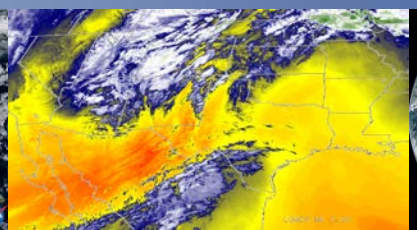
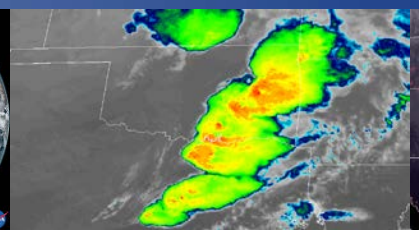
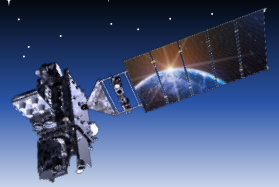







A Short Outline

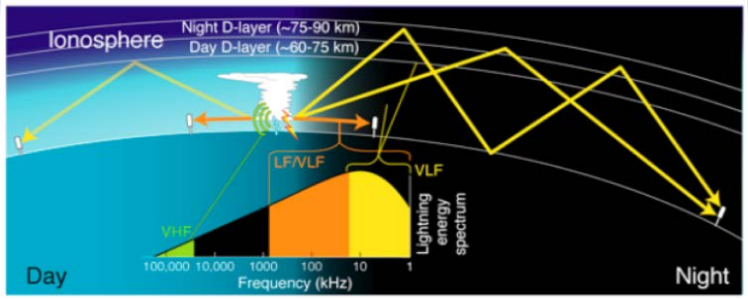


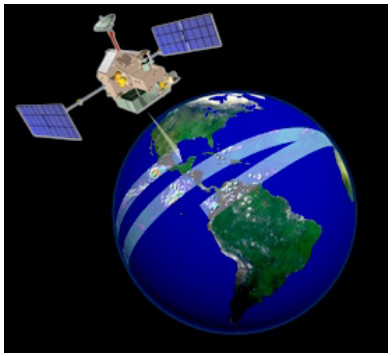
Today for the Geostationary Lightning Mapper (GLM):

- Detecting lightning and what is total lightning?
- What is the Geostationary Lightning Mapper?
- Why is it important?
- Basic GLM observations

- Two short, hands-on activities after this introduction
  - Severe weather event
  - Lightning safety event

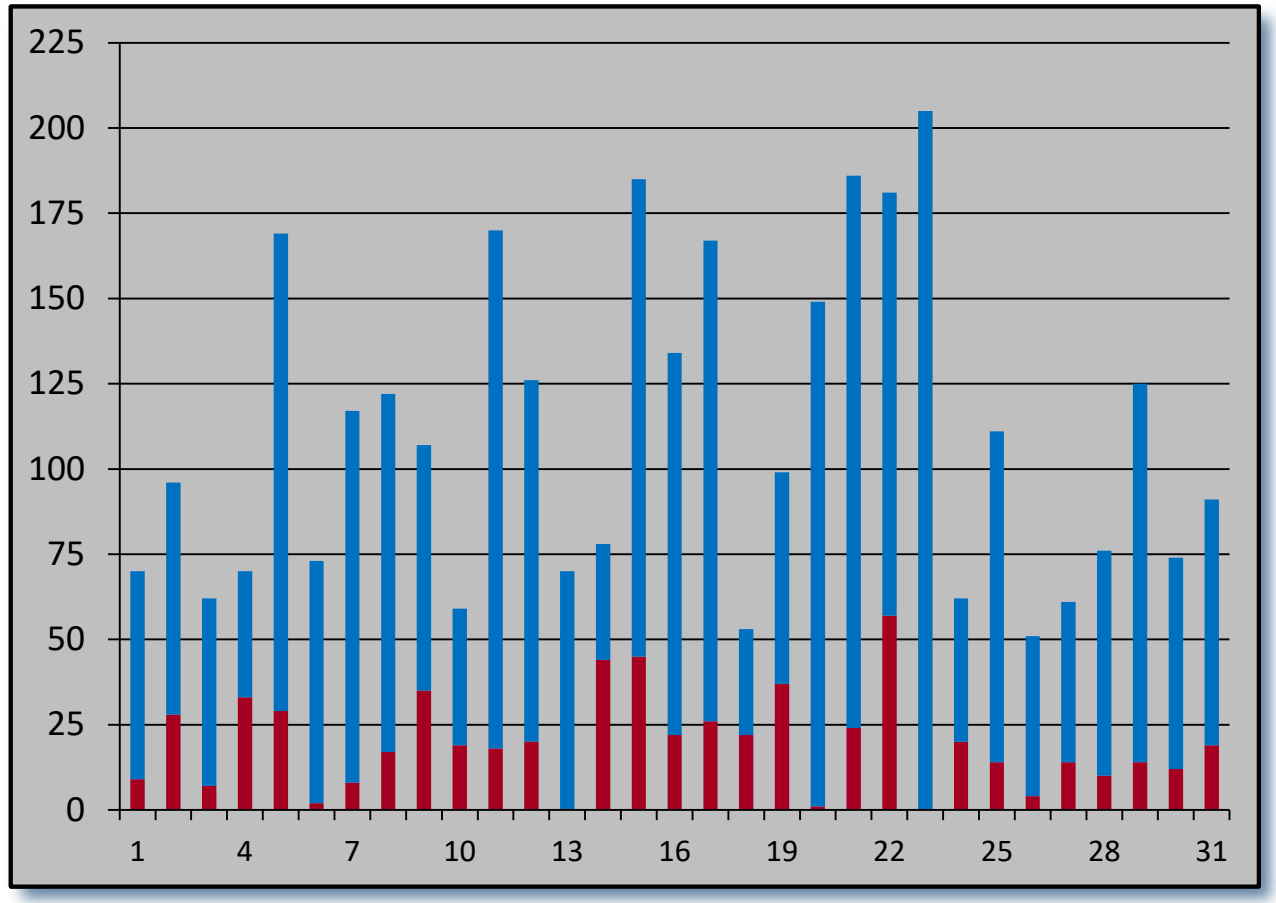
Lightning Detection Methods





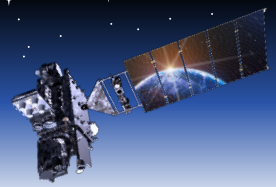
- Ground-based lightning detection networks observe radio waves generated by lightning (low to very high frequency)
  - Most primarily observe cloud-to-ground
  - Work best with numerous sensors
- Space-based lightning sensors observe optical emissions from lightning at cloud top
  - All low Earth orbiters prior to GOES-16
  - Best detection at night, but advances (such as with GOES-16) have greatly improved daytime detection

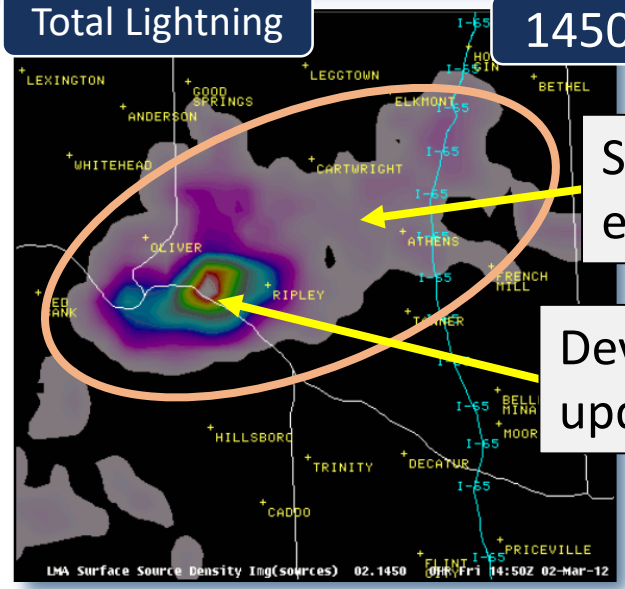
Total Lightning

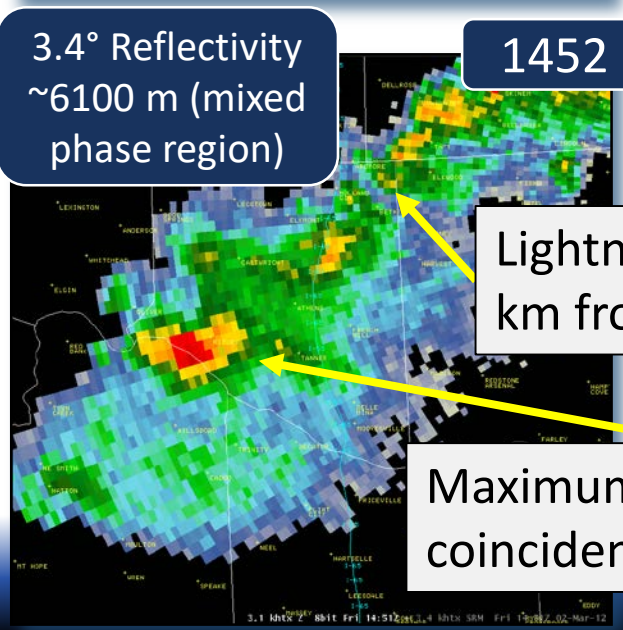


- Combination of cloud-to-ground and intra-cloud observations
- Intra-cloud typically far outnumbers cloud-to-ground in any given storm
- Provides several capabilities …

Total Lightning … In a Flash







Physical Reasoning

- Updraft in mixed phase region (above -10˚C)
- Stronger, deeper updraft = More lightning
- Increase = Strengthening updraft

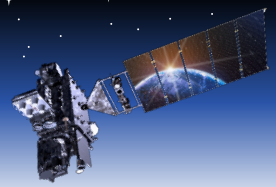
Applications

- Rapid increases = Lightning jumps (potential for severe weather)
- Safety: Extent / lead time on first CG
- Aviation: Monitor convection

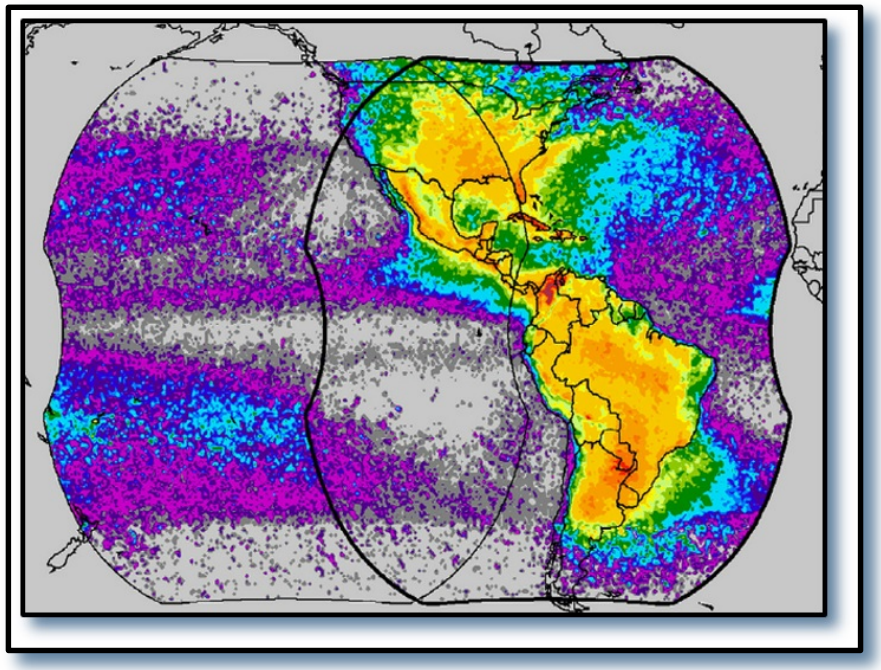
Key to Training

- Connect GLM to radar in order to fit conceptual model

Geostationary Lightning Mapper



GLM field of view for initial calibration and validation

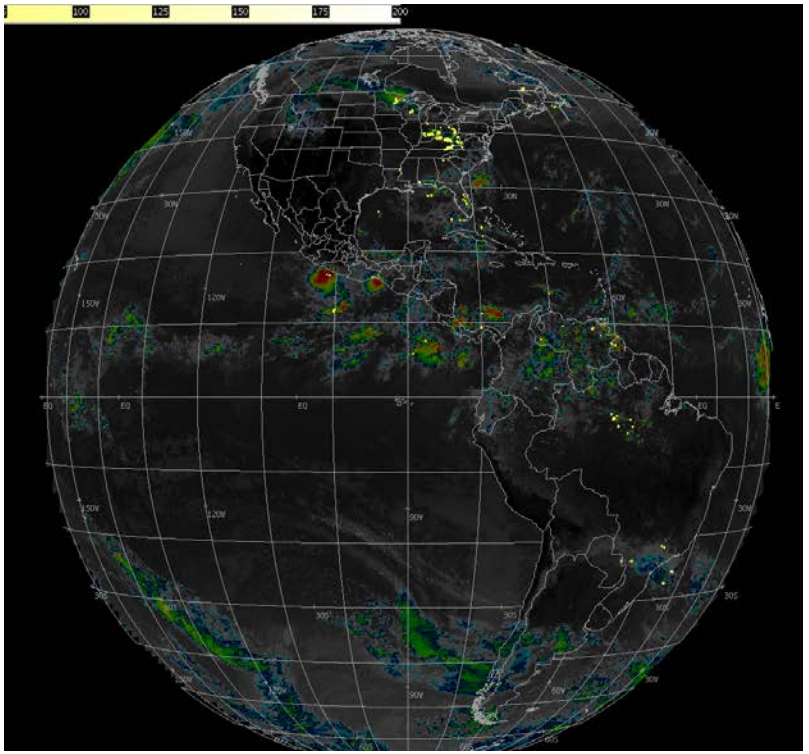


Lightning climatology from OTD and TRMM-LIS (1995-2005)

- Large digital camera to detect cloud top brightness differences per pixel
- 8 km at nadir to 14 km at the edge
- Intra-cloud and cloud-to-ground obs
  - Does ***NOT*** distinguish the difference
- GOES-16 is first to carry GLM
  - Available through 2036 with GOES-U
- Specifications:
  - 70% total flash detection over 24 hours over entire field of view
  - 5% false alarm rate
  - GLM is likely to exceed design specs

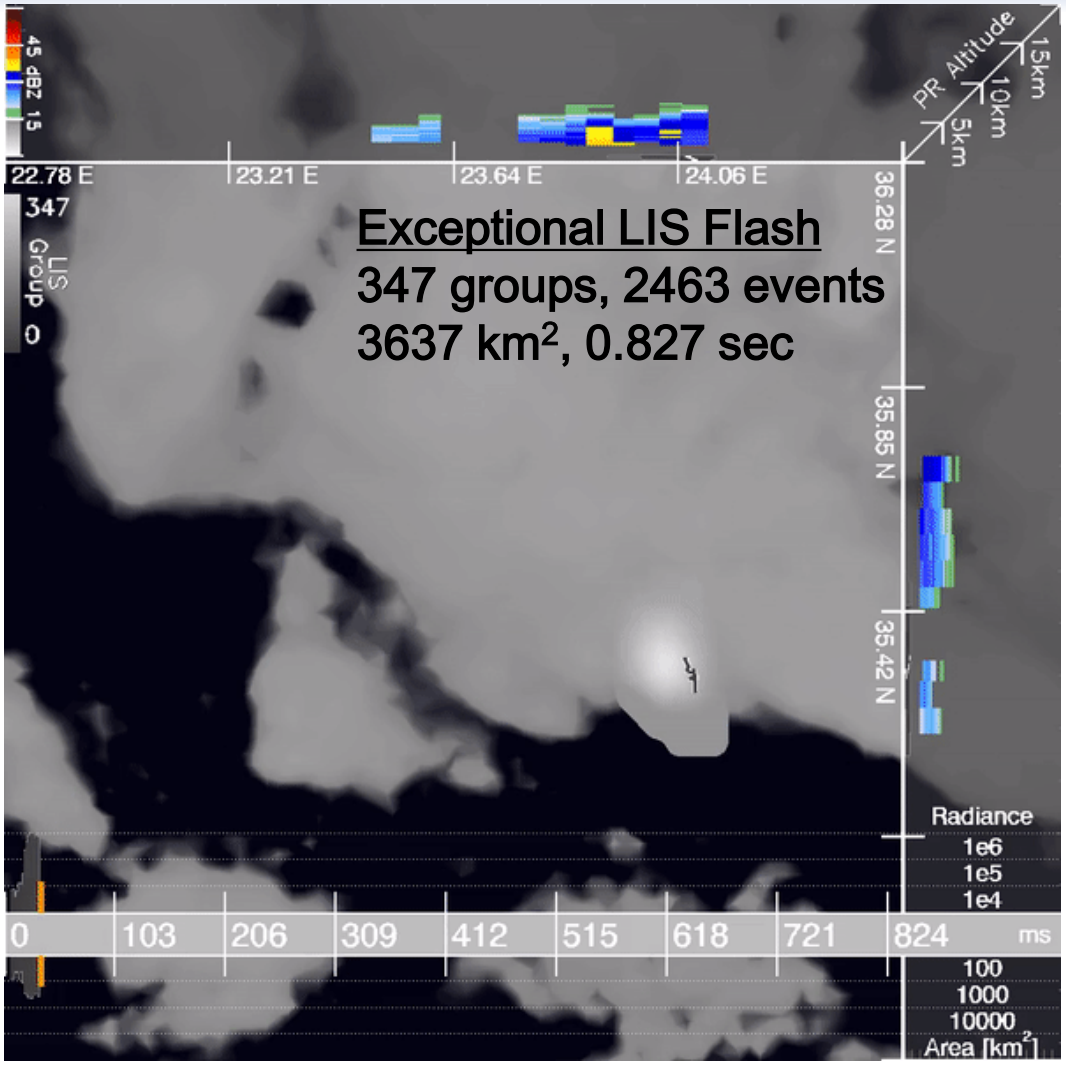
Why Have the GLM?

- Continuous full disk total lightning observations
  - 54˚ N/S with 20 second latency
  - Valuable in data sparse regions, especially to supplement radar
- Intra-cloud typically precedes cloud-to-ground
- Areal extent of the lightning threat
- Monitor convection
  - Track cells embedded in larger features
  - Monitor storm strength
  - Identify convective cells
- Insights into tropical cyclone intensity



Example animation of GLM over the full disk.

GLM Detection Methodology

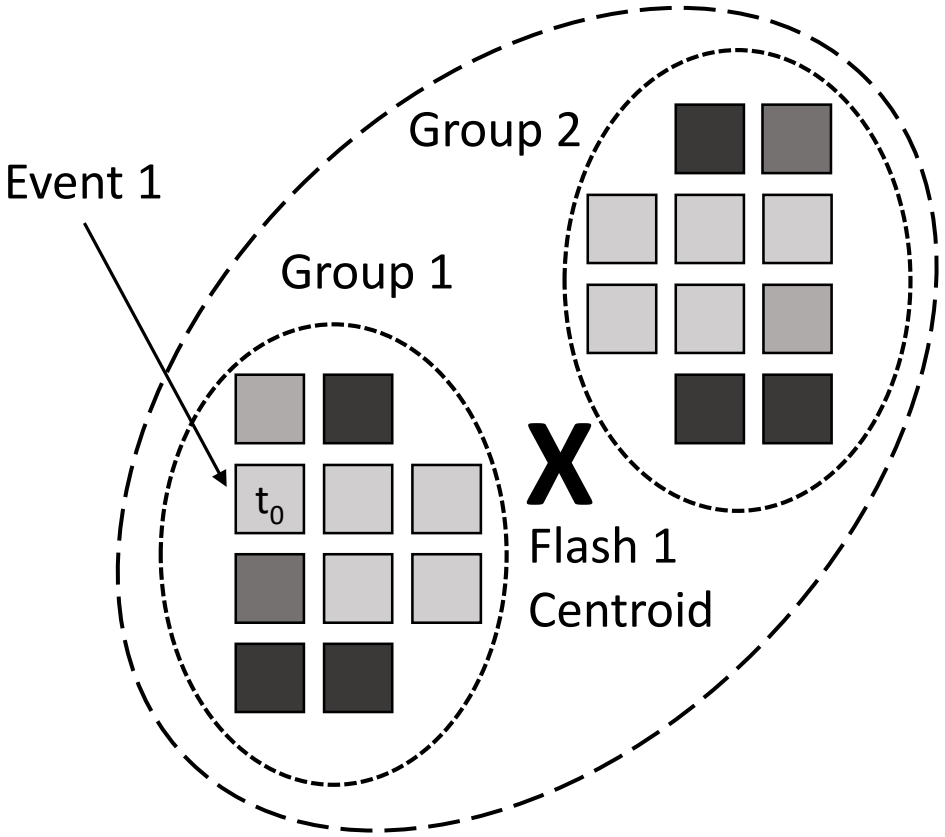


Demo of how lightning is viewed by the GLM using TRMM-Lightning Imaging Sensor observations

- GLM produces a background image every 2 min
- Each pixel "looks" for changes in brightness versus the background
  - Every 2 ms
  - Illuminated pixel is an "Event"
- Quality controls reduce noise
- Events basis for derived observations
  - Groups and flashes (next slide)
- Also observe optical power
  - Future research activity

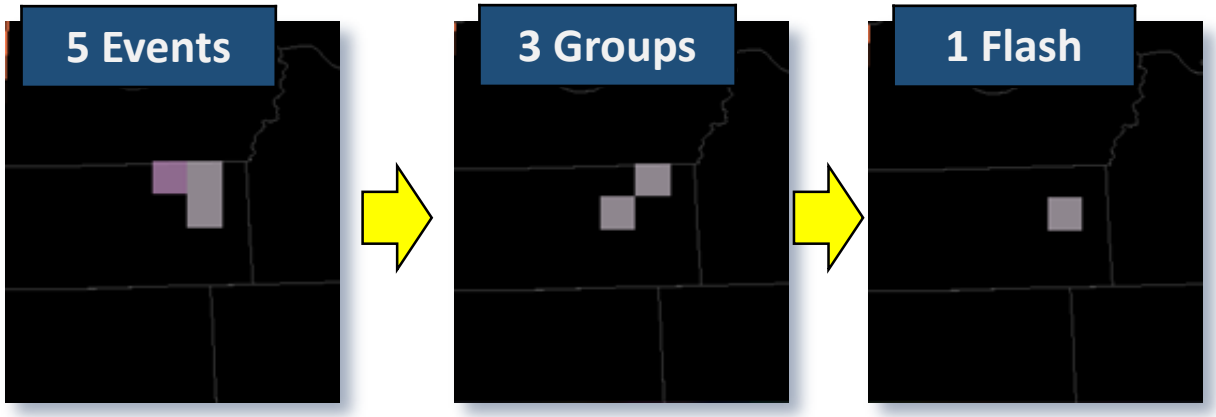
GLM Observation Definitions

A lightning flash as viewed from space.



Flash 1

GLM Observation Definitions

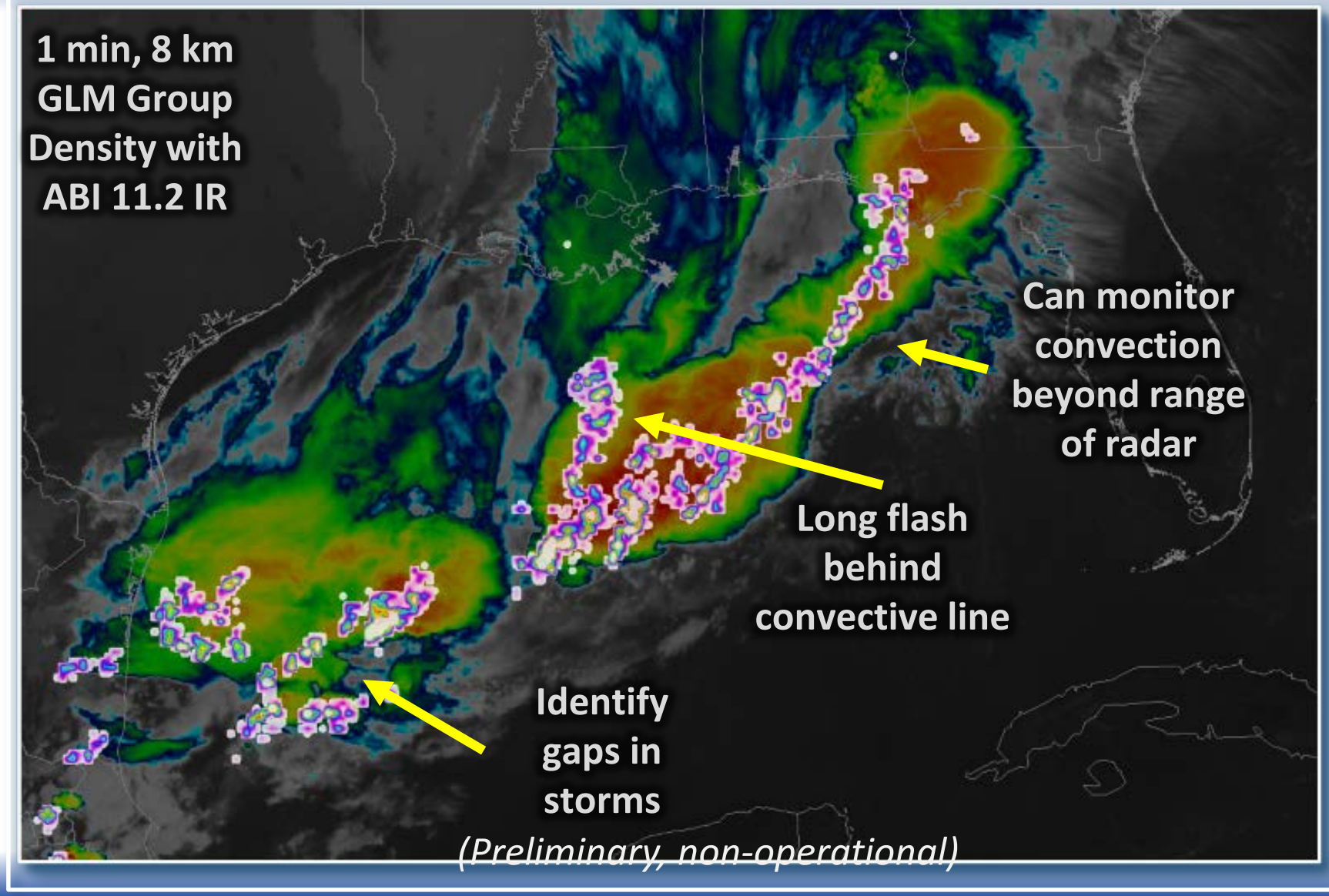


Event: Any illuminated pixel in 2 ms period that exceeds the background threshold.

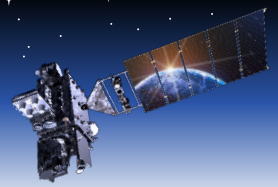
Group Centroid: Optically weighted cluster of events in time and space. Equivalent to return strokes.

Flash Centroid: Optically weighted cluster of groups (based on events) in time and space separated by less than 330 ms and 16.5 km.

GLM Example Image



Summary / Discussion



- GOES-16 GLM is the first lightning mapper in geostationary orbit
- Provides continuous, full disk total lightning measurements
- GLM observes optical emissions of lightning from the cloud top
  - Reports events, groups, and flashes
- Wide range of operational applications
  - Severe weather decision support
  - Lightning safety
  - Aviation and tropical meteorology applications
- GLM has a tremendous variety of efforts for new research

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