Geostationary Lightning Mapper: Definitions and Detection Methods

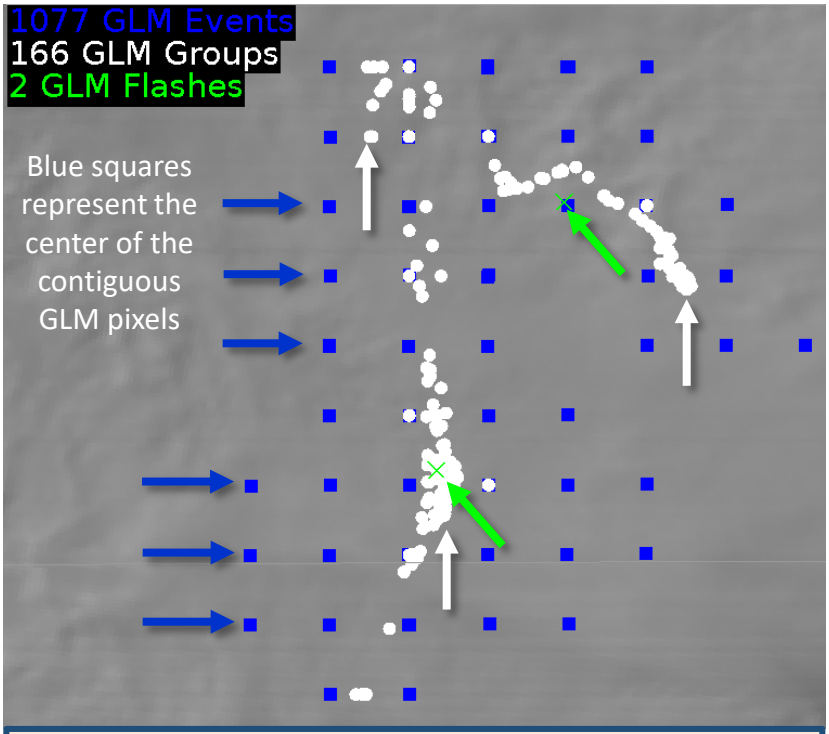
Quick Guide

GLM Detection Methods

- The GLM detects changes in brightness every ~2 ms relative to a continuously updating background image
- Individual pixels illuminated above the background threshold during 2 ms frames are termed GLM events
- Filters then remove non-lightning events leaving only those most likely to be lightning
- Lightning Cluster Filter Algorithm combines events into groups and groups into flashes

GLM Definitions

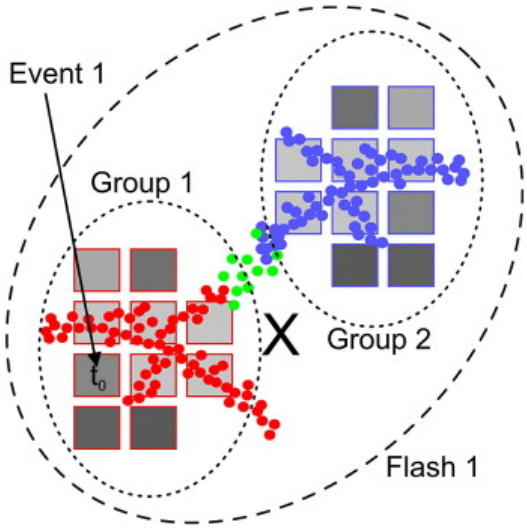
- Event: occurrence of a single pixel exceeding the detection threshold during one ~2 ms frame
- Group: 1+ simultaneous GLM events observed in adjacent (neighboring/diagonal) pixels
- Flash: 1 or more sequential groups separated by less than 330 ms and 16.5 km
- GLM flash rates are most closely tied to updraft and storm evolution, and GLM event locations best depict the spatial extent



- Green X's depict the location of two GLM flashes
- GLM groups appear as white dots (which typically do not occur at the center of GLM pixels)
- GLM events are depicted as blue squares on the GLM fixed grid – there were >1000 GLM events during these 2 GLM flashes, only 50 pixels were illuminated, so most pixels were illuminated for multiple 2 ms frames

Event, Group, and Flash Locations

- While GLM events are reported as the center points of GLM pixels, the group and flash locations represent radiance weighted centroids
- In this image the red, green, and blue dots represent a lightning mapping array depiction of a lightning flash; the red squares with grey shades indicate GLM events with lighter shades being brighter
- The GLM flash location considers the brightness of all events from both groups to locate the brightest part of the flash, or radiance weighted centroid, indicated by the black X in this image
- Note that the flash location may not always fall along the lightning channel, but will always fall within the flash footprint



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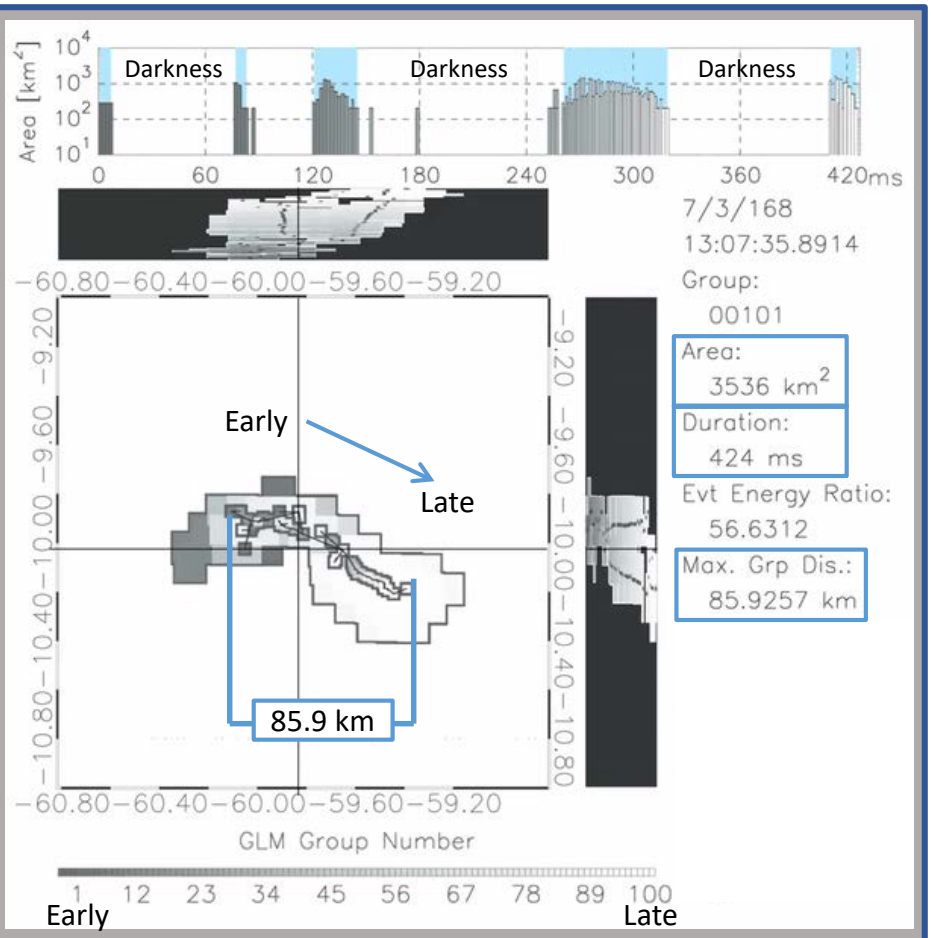
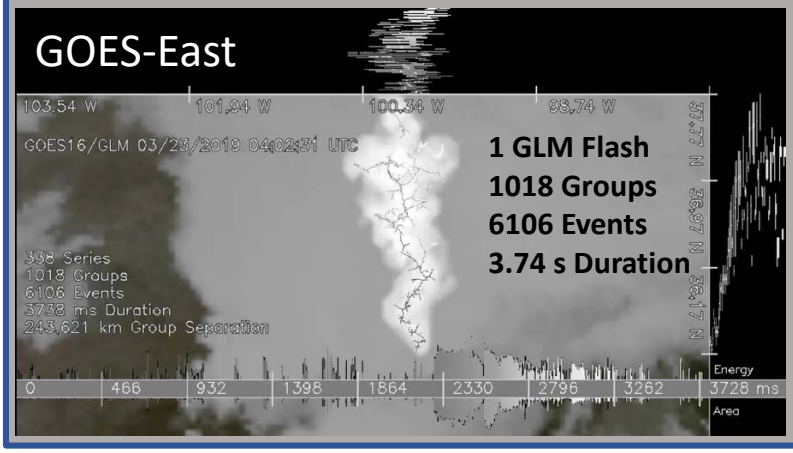
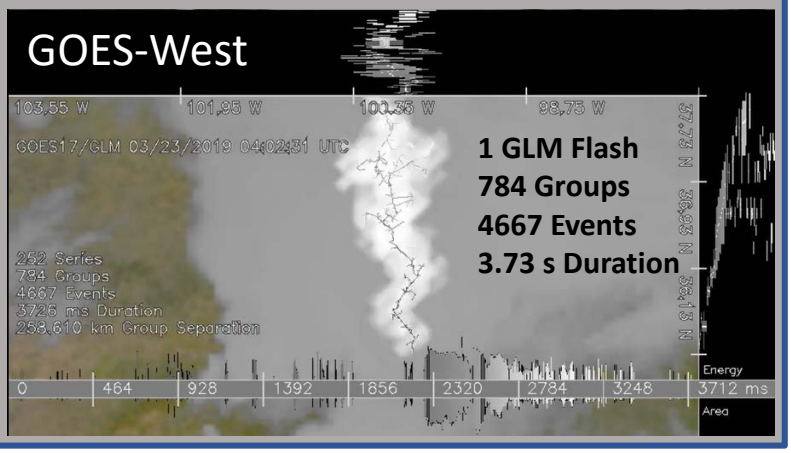
- The GLM maps the extent of the cloud illuminated by individual lightning flashes
- Despite a relatively coarse spatial resolution, the GLM provides rapid temporal updates, allowing it to map flash structure
- Groups within individual flashes are connected to create flash skeletons
- This image depicts the evolution of one flash in space and time, the top panel illustrates an important feature of most lightning flashes, this 0.4 second flash produces discrete optical emissions separated by periods of darkness
- This is an example of how optical GLM lightning observations provide helpful insights into the flash structure, these insights can in turn be used to make inferences regarding lightning physics and storm structure







Observing Exceptional GLM Flashes

- Flash skeletons (see example above) clearly illustrate that the GLM is an imager rather than a detector
- The variety of lightning composition and time evolution provide important insights into convective mode and storm structure
- Scientists are working to quantify this information to develop products that aid forecasters (e.g., gridded GLM products)

Additional Information

GLM Virtual Lab Community:
https://vlab.ncep.noaa.gov/web/geostationary-lightning-mapper

Imagery Examples:
https://twitter.com/goesglm
https://twitter.com/weatherarchive