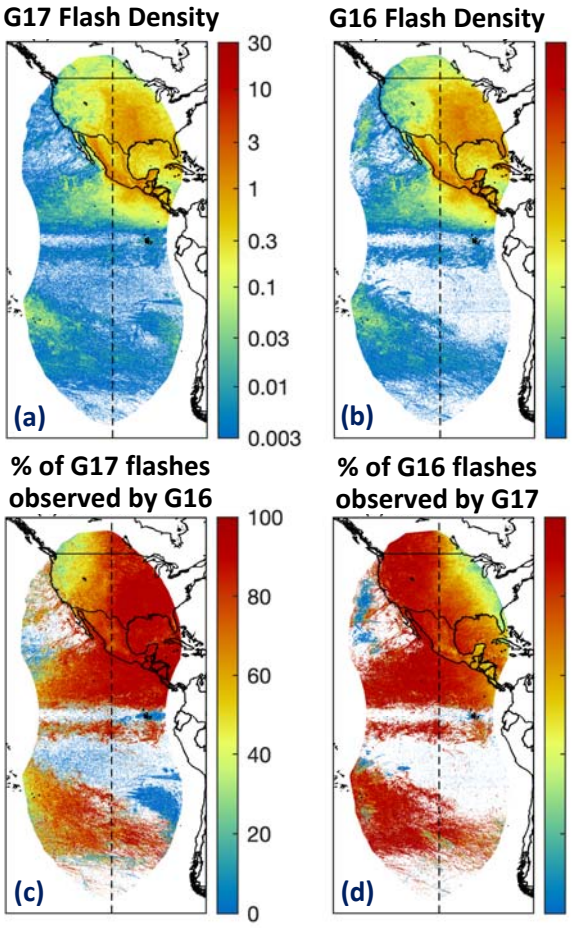
Geostationary Lightning Mapper: Full Disk Data Quality Quick Guide

GLM Performance Variability

- Understanding GLM performance variability is key to confidently applying these data
- Both GLMs meet design specifications of > 70% detection efficiency (DE) and < 5% false alarm rate (FAR) when averaged over the full disk across 24 hours
- GLMs perform best at night, when optical sources are more clearly distinguishable from dark backgrounds
- Environmental conditions that reduce the amount of light reaching cloud top reduce the GLM DE
- Low GLM DE has been found in some severe storms with very high mid-altitude reflectivity, especially electrically anomalous storms (recognizable by inconsistency with ground-based networks)
- Flash size and duration are also key parameters influencing GLM DE (i.e., easier to detect larger, longer lasting, more energetic flashes)
- GLM DE drops off near the edge of the field of view (FOV), especially over land (e.g., northwest CONUS, Fig. 1c), which relates to larger pixels and steeper viewing angles reducing instrument sensitivity



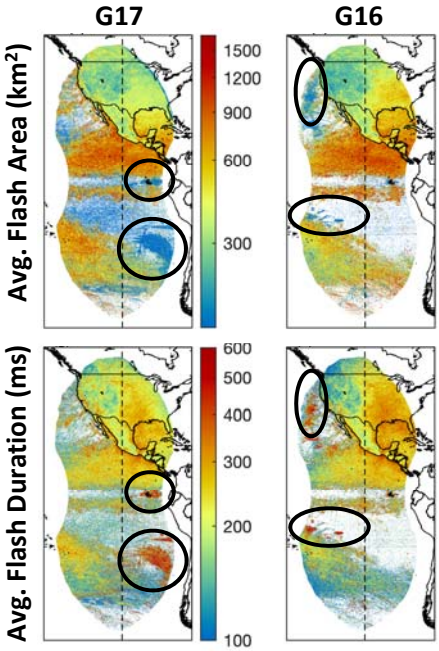
Main Sources of False GLM Flashes

- Most false GLM flashes occur in common locations at predictable times, knowledge of the types of GLM artifacts and where/when they occur can help mitigate uncertainties while applying these data

1) Sun glint – sunrise/sunset over the oceans, and at satellite nadir / local noon over calm bodies of water (sometimes even solar farms)
2) Solar intrusion – stray light leads to transient false events and temporary blind spots during the spring/fall eclipse seasons (see page 2)
3) Inconsistencies along subarray boundaries (e.g., "Bahamas Bar", see page 2)
4) Radiation dots (high energy particles impacting the instrument focal plane)
5) Bright meteors, also termed bolides (can help confirm reports/inquiries)

- Sun glint and solar intrusion artifacts do not occur in the same places or times for G16/G17, so these artifacts appear as blue shades in Fig. 1c,d (above); also appear as anomalously small (blue), long duration (red) flashes in Fig. 2 (right)

Fig. 1. *Above,* ***Fig. 2****. Below*



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Improving GLM Performance

- Efforts continue toward fine tuning the GLMs through onboard adjustments and software modifications
- Updates seek to remove or reduce artifacts related to Sun glint, solar intrusion, inconsistencies at subarray boundaries, and/or disturbances to platform stability
- The second-level threshold filter (applied on 4/20/19) helped mitigate the "Bahamas Bar" artifacts (Fig. 3 – purple ovals highlight before/after examples)
- The blooming filter (implemented on 7/25/19) quenches the rapid growth of Sun glint (mid/low latitudes) and solar intrusion (high latitudes) artifacts (Fig. 3 – black ovals highlight before/after examples)
- False events are still detected in these places, but are much less pronounced with proper filters in place
- Continued improvements are expected as researchers continue finding ways to increase DE and reduce FAR

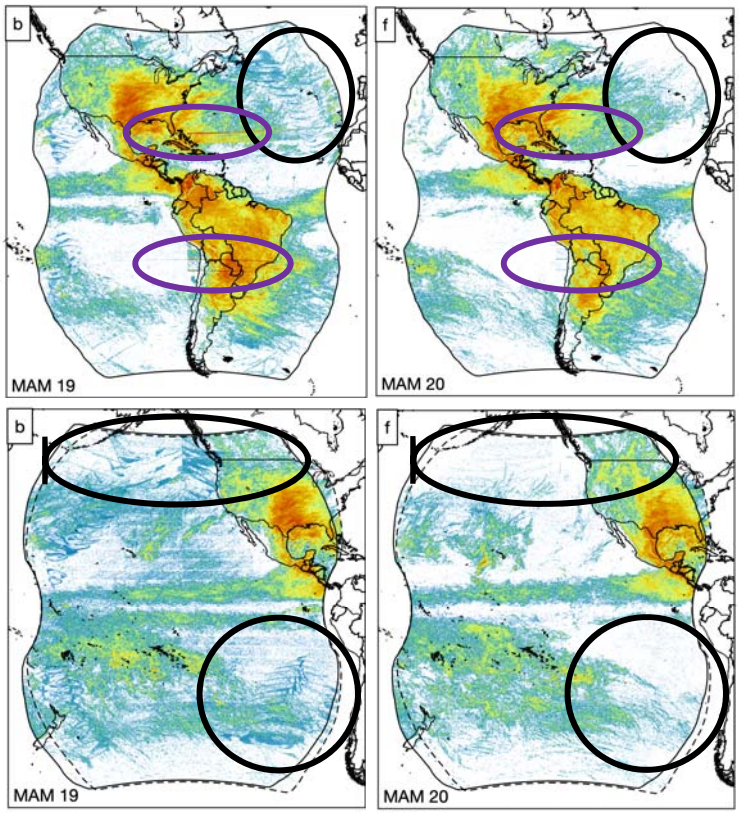

***Fig. 3**. March, April, May G16 (top) and G17 (bottom) flash densities before (left) and after (right) fixes*

Additional Considerations

- GLM DE ultimately depends on lightning flash characteristics, how efficiently light travels from the lightning channels to the cloud top, the resulting optical contrast at cloud top, and the relative position in the field of view (i.e., both pixel geometry and viewing angle)
- Most false events are abnormal, so using multiple GLM gridded products helps distinguish false flashes from real lightning (Fig. 4)
- Suppressing the "Bahamas Bar" artifacts introduces/worsens an "inverse Bar" artifact that results in greatly diminished DE along the same subarray boundaries (~2 h before/after solar noon, Fig. 5)
- Solar intrusion during eclipse season results in both false events and saturation (transient blind regions) for ~45 minutes before and after satellite local midnight (~0500 UTC for GOES-East)
- Eclipse season is approximately ~45 days before/after the vernal (~20 March) and autumnal (~23 September) equinox
- Users are encouraged to consult all sources of lightning information (i.e., both GLMs and any available ground-based networks) during warning operations to account for known limitations

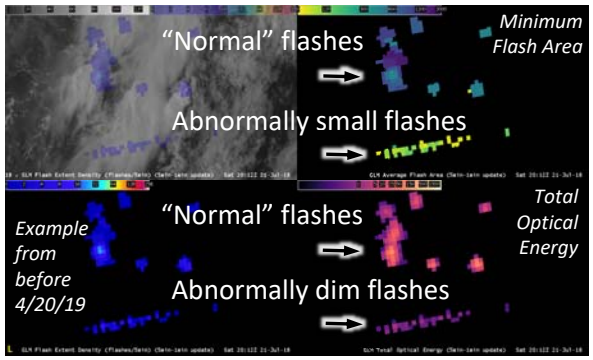

***Fig. 4**. "Bahamas Bar" Artifact results in anomalously, small, dim flashes*

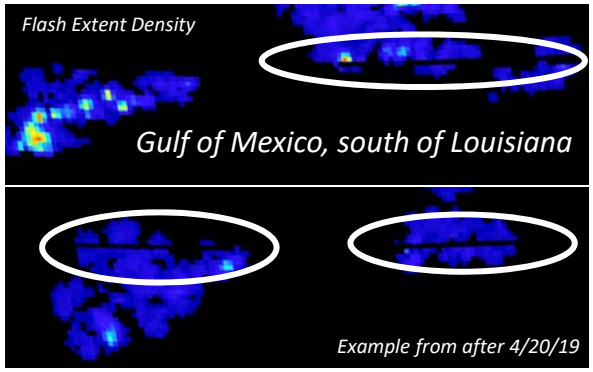

***Fig. 5**. Example Inverse Bar artifact worsened by the "Bahamas Bar" fix*