GLM Training for Operational Forecasters Overview: Present, Developing, and Future Work

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Present GOES-16/17 GLM Training

- NOAA/NWS VLAB GLM and STOR Communities have GLM operational information
  - Satellite Training and Operational Resources (STOR) houses quick briefs, quick guides, etc.
- VISIT (CIMSS & CIRA) have training sessions available on total lightning applications
  - FDTD Satellite Applications Webinars: NWS staff presenting operational applications of GLM imagery on topics such as non-supercell tornadoes (recorded live GoToMeetings which are also available on YouTube)
- NWS Office of Observations/TOWRS recently started Satellite Book Club webinars on new satellite capabilities – before they are formally added to the AWIPS software baseline
- GOES-R Foundational Course released 3 years ago is provided to every NWS forecaster and is still available in the Commerce Learning Center (CLC, only available to feds)
- NWS cohosts Lightning Working Group (LWG), a long-running very active group to coordinate operational issues with the GLM (and other total lightning) implementation and training

Present GOES-16/17 GLM Training

- Brian/NWS coordinated two 1-hour long demos of NWS AWIPS-in-the-Cloud to give many their first look at GLM grids & flash "points" (early September 2020)
- New training initiative has been started with COMET to provide more GLM training modules with GOES-R support
- Many organizations including the AMS, WMO, NWA have also facilitated training courses & workshops for forecasters
- Scott Rudlosky created a set of quick guides (2-page pdfs) & quick briefs (4 to 5 minute videos) during summer 2018, upgraded in 2019, covering:
  - GLM detection methods and event/group/flash methodology
  - How gridded products such as FED, TOE, and AFA are created
  - Data quality issues (POD ~70-80%, FAR > 5% caused by sun glint, solar intrusion, subarray boundary issues – "Bahama Bar", spacecraft maneuvers, etc.)
  - Geospatial considerations (gridded products not parallax corrected)

Present GLM Training Examples

Geostationary Lightning Mapper: Data Quality (May 2019) Quick Guide

GLM Data Quality Evolution

- GLM calibration and validation efforts continue with all known issues being worked (e.g., recently mitigated the "Bahama Bar" artifacts)
- The GLM appears to meet its performance requirements despite the data quality issues illustrated in this document
- False events (pg 1) and geospatial considerations (pg 2) are described

Performance Requirements

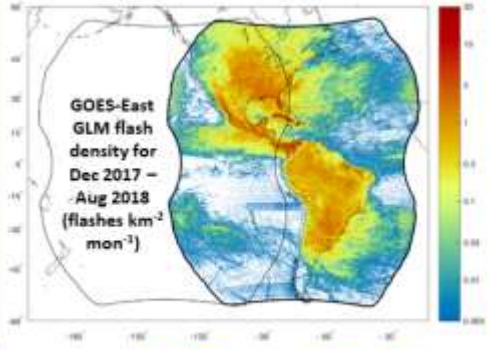
- Detection efficiency > 70%, averaged over full disk and 24 h
- Flash false alarm rate less than 5%, averaged over 24 hours
- Navigation error within ±112 microradians (~1/2 pixel or ~4 km)

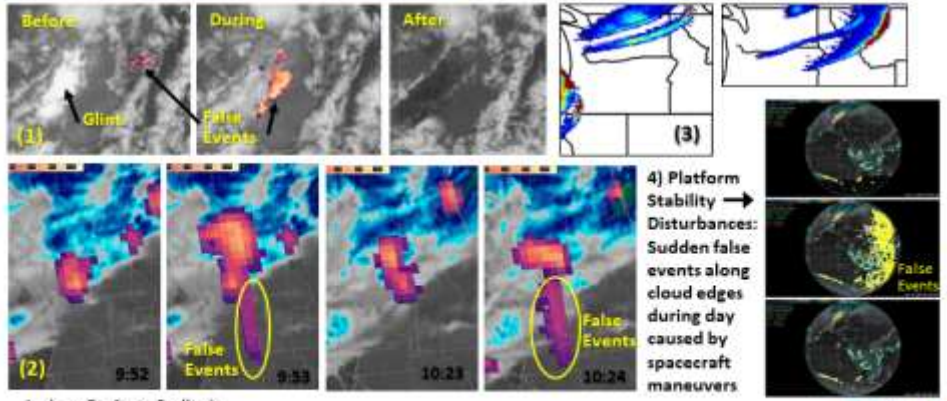
False GLM Event Sources

- GLM seeks to maximize detection efficiency while minimizing the false alarm rate
- False alarm rate is the number of false flash detections divided by the average true flash rate
- Each of the 56 subarrays are independently tuned
- Images below illustrate known false event sources

1) Sun glint – sunrise/sunset over the oceans and at satellite nadir / local noon over bodies of water
2) Rebound events (occur at night, indicative of flashes with continuing current = fire hazard)
3) Solar intrusion – transient false events that occur during the spring/fall eclipse seasons

GOES-East and GOES-West GLM Field of View





4) Platform Stability → Disturbances: Sudden false events along cloud edges during day caused by spacecraft maneuvers

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NESDIS

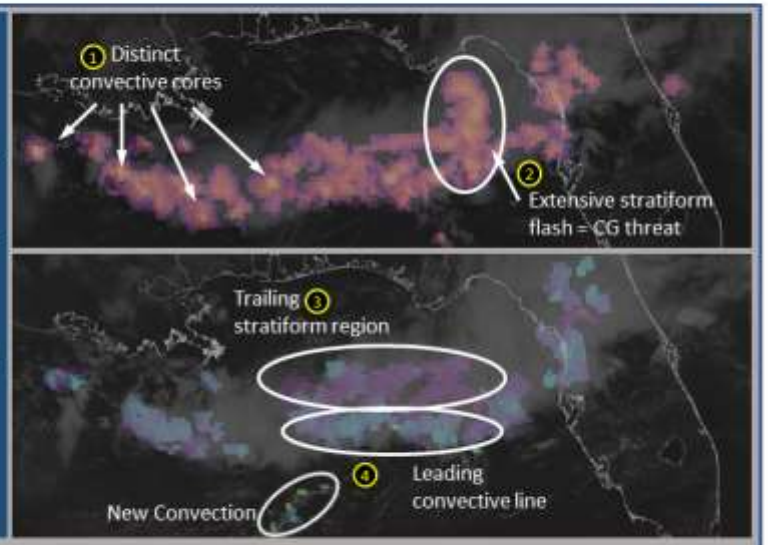
Geostationary Lightning Mapper: Gridded Products: AFA and TOE Quick Guide

Bright TOE regions indicate

1. The most energetic convective cores
2. Lightning channels within extensive flashes

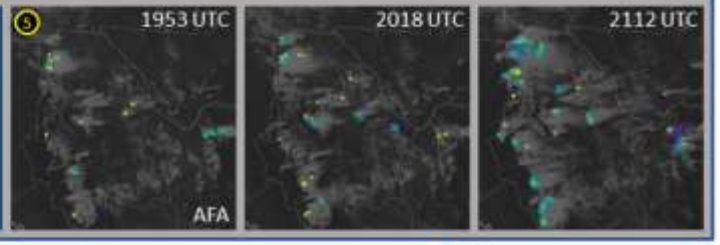
AFA reveals

3. Large flashes in the stratiform / anvil regions and decaying storms
4. Small flashes in new convection (see below) and along the leading line



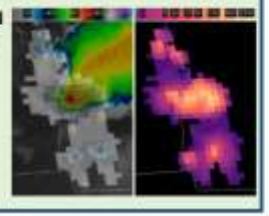
Detect and Monitor Storm Growth

5. AFA accentuates small flashes to highlight earliest convection, also provides a visual que to help quantify storm growth



Understanding Optical Emissions

- AFA and TOE help understand how the optical lightning signals interact with the convective scene
- For example, TOE helps confirms when dim areas in nocturnal scenes represent illuminated low-level clouds rather than lightning channels ahead of the storm



Additional Resources

GLM VLab Community:
https://go.usa.gov/xU5MF
GLM Faculty Virtual Course
NESDIS/STAR - CICS-MD
NASA SPoRT Home Page

Hyperlinks not available when viewing material in AIR Tool

Developing GLM Operational Training

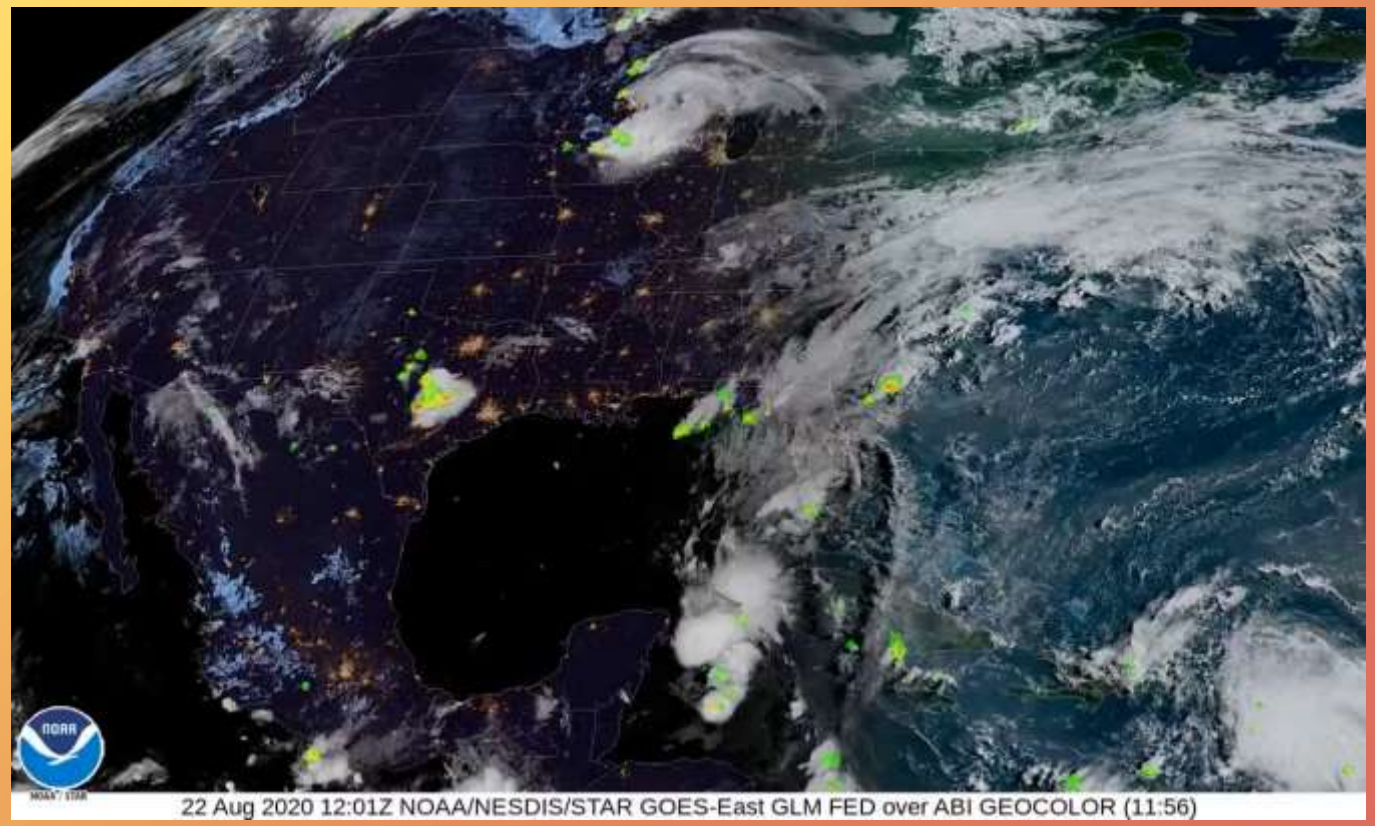
- Hazardous Weather Testbed (HWT) sessions with GLM gridded products provided useful operational forecaster feedback
- Additional quick guides and quick briefs are being developed
- New topics to focus on for operational users:
  - Addition of GOES-16/17 Full Disk – lightning data now available from New Zealand to African coast -> Edge of field of view (FOV) data quality issues
  - When to use GOES-16 vs. GOES-17 (103° W is good delineation, but not universal for all applications, e.g. dense hydrometeors)
  - Minimum vs. average flash area (in limbo until NWS WFOs install new AWIPS RPM)
  - Points for flash centroids will be parallax corrected. Gridded products are not parallax corrected – would be a good opportunity to explain parallax corrections in general
    - Usefulness of points still being assessed by groups such as the NWS Lightning Working Group and others

Developing GLM Operational Training

- NWS OCLO, OPG, and others are wrapping up the GLM Pre-Operational Demonstration started 2+ years ago
- NWS Lightning Working Group have very active bi-weekly meetings concerning GLM applications and the implementation and training for new GLM products for operational use within AWIPS
  - Some currently discussed topics:
    - Are flash centroid points useful to forecasters?
    - Since flash centroid points are parallax corrected, how would we train forecasters on how to use them correctly? Would having the GLM gridded products (not parallax corrected) not line up with these points be too confusing when forecasters are trying to make real-time decisions?
    - Are total optical energy (TOE) grids useful to NWS forecasters? What kind of forecast concerns can be assessed by TOE which cannot be assessed by other GLM grids/products?

Future GLM Operational Training

- New training will need to be developed as the operational GLMs continue to be improved & new techniques develop
- Future case studies will focus on using the GLMs integrated within the short-term forecast and warning decision processes
- GLM training & educational resources need continuing implementation (display & decision tools) to sustain progressive R2O & support in NWS
- Still uncovering & discovering the secrets of total lightning in NWS operations



CONUS imagery: https://www.star.nesdis.noaa.gov/GOES/conus.php?sat=G16
Full Disk imagery: https://www.star.nesdis.noaa.gov/GOES/fulldisk.php?sat=G16