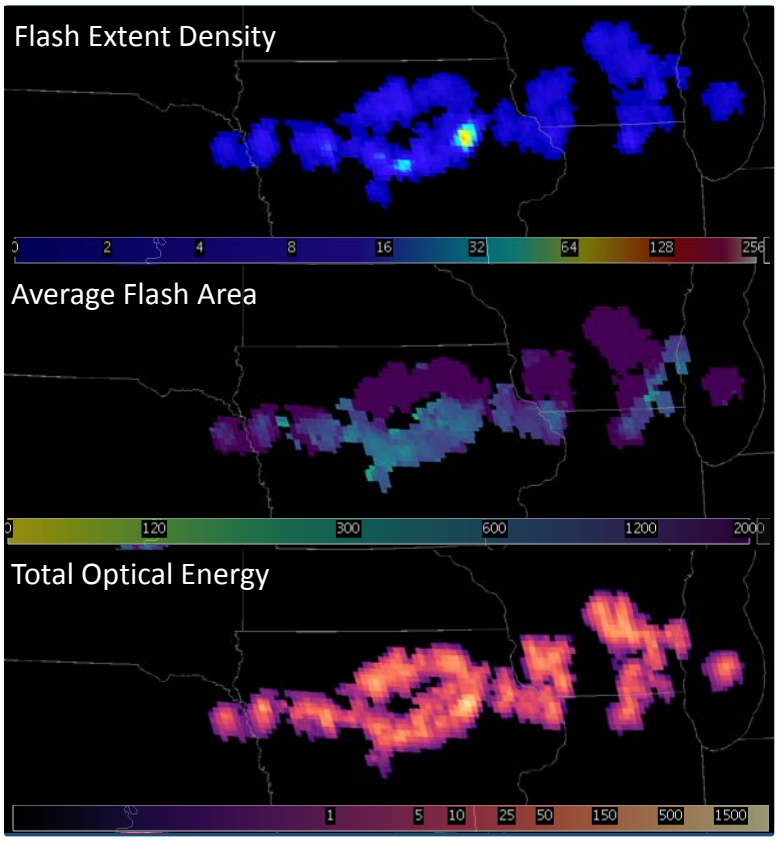
Geostationary Lightning Mapper: Gridded Products: AFA and TOE

Quick Guide

AFA and TOE Background

- Average flash area (AFA) is the average area of all GLM flashes spatially coincident with each 2×2 km grid cell during a specified time period
- AFA has units of km^2, with values ranging from a minimum of 1 pixel or ~64 km^2 to several thousand km^2 for regions with extensive stratiform flashes
- Total optical energy (TOE) is the sum of all optical energy that the GLM observes within each grid cell during a specified time period
- TOE has units of femtojoules (fJ; 10^{-15} J), with values on the order of decimals for the dimmest flashes to over 1000 fJ for regions with many bright flashes
- AFA and TOE complement flash extent density (FED) to maximize the insights provided by the GLM
- AFA and TOE also provide context for understanding GLM data quality and the subtleties of space-based optical lightning observations



Primary AFA Applications

- Detect/Monitor Thunderstorm Growth – the AFA color map accentuates small flashes to highlight the earliest flashes, AFA also provides a visual que to help quantify subsequent storm growth
- Observe the areal lightning extent – the AFA indicates the occurrence of large/long flashes and helps differentiate anvil/stratiform flashes from embedded, newly-developing convection
- Monitor convective mode and storm evolution – the AFA trends are indicative of storm life cycles [e.g., frequent small flashes within the most intense convection (< 300 km^2) and a tendency for larger flashes as storms weaken (> 600 km^2)]

Primary TOE Applications

- TOE directly depicts optical lightning observations – provides the most intuitive GLM portrayal
- Identify strengthening and weakening storms – forecasters have likened the use of TOE to watching a light bulb brighten/dim as the storms grow/decay
- Characterize convective scenes – the TOE helps make inferences regarding the surrounding cloud scene [e.g., the TOE helps distinguish between deep convection and the dimmer low level clouds it often illuminates (most common at night)]
- Analyze the cloud-to-ground lightning threat - TOE indicates lightning channel locations within extensive stratiform flashes, along which these flashes commonly strike ground [e.g., FED often illuminates large cloud areas (especially at night), TOE illustrates the actual lightning channel extent

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Version 1 – August 7, 2018

Geostationary Lightning Mapper: Gridded Products (FED)

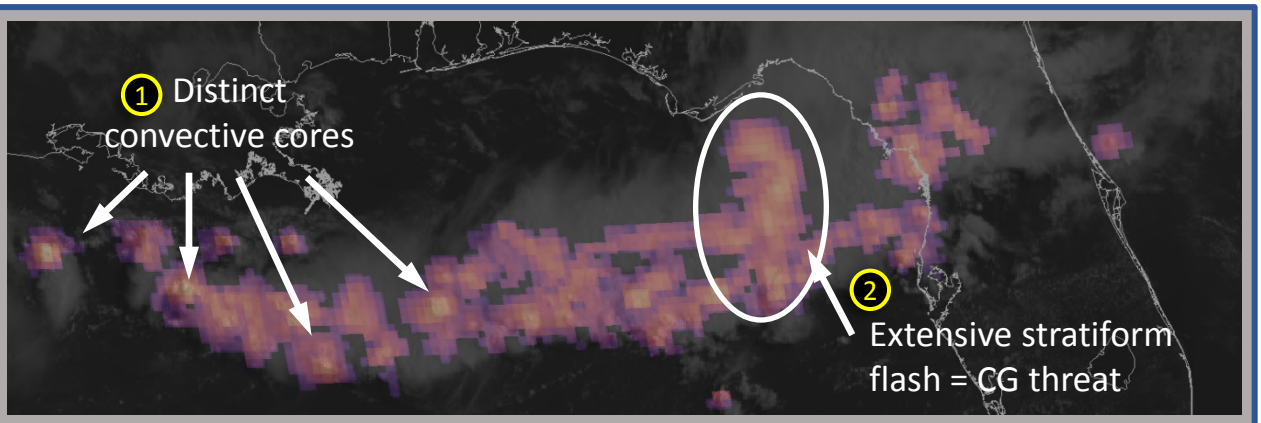
Quick Guide

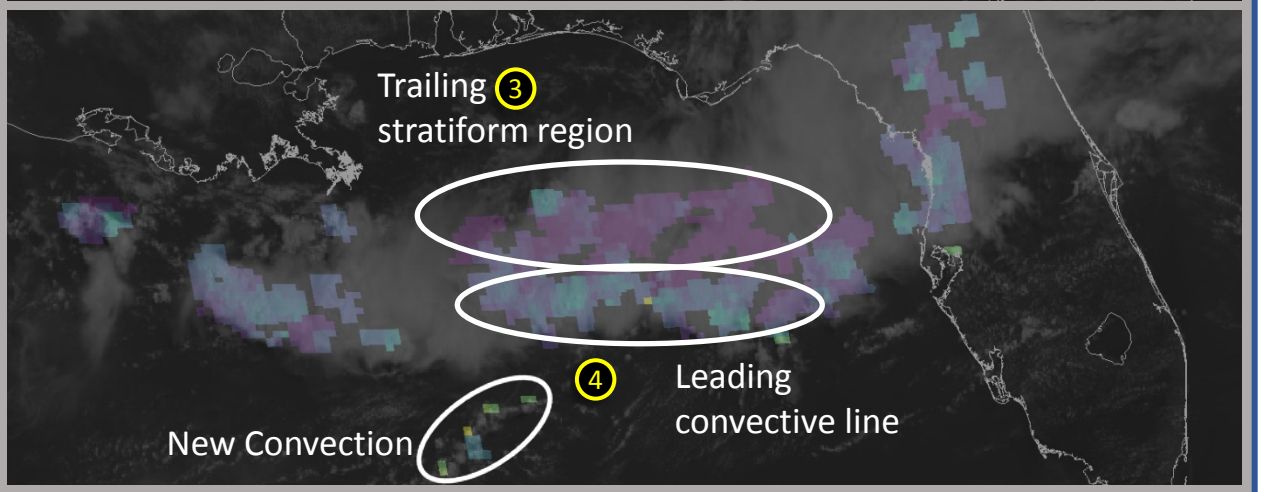
Bright TOE regions indicate

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

AFA reveals

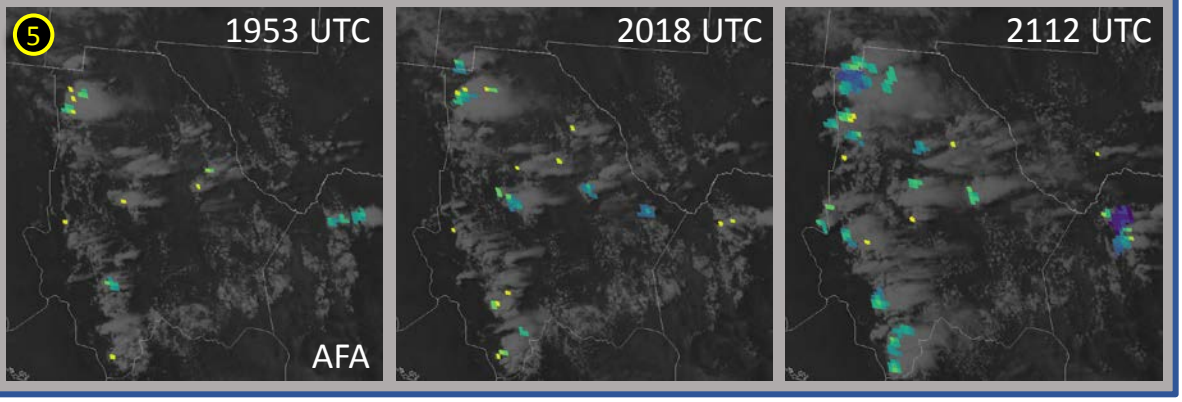
3. Large flashes in the stratiform / anvil regions and decaying storms
4. Small flashes in new convection (see below) and along the leading line





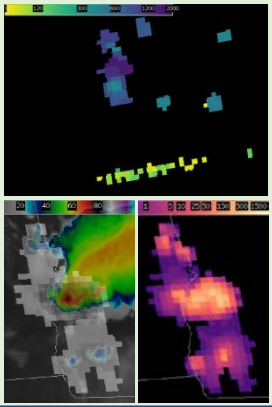
Detect and Monitor Storm Growth

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



Understanding Optical Observations

- AFA and TOE help understand how the optical lightning signals interact with the convective scene
- AFA makes false events along subarray boundaries very apparent (issue should be fixed during 2018)
- 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