Overview of GLM Data (Level-0 through Level-2+) and False Alarm Mitigation

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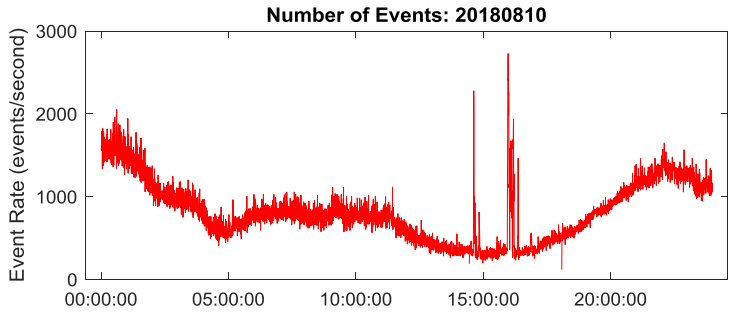
Geostationary Lightning Mapper

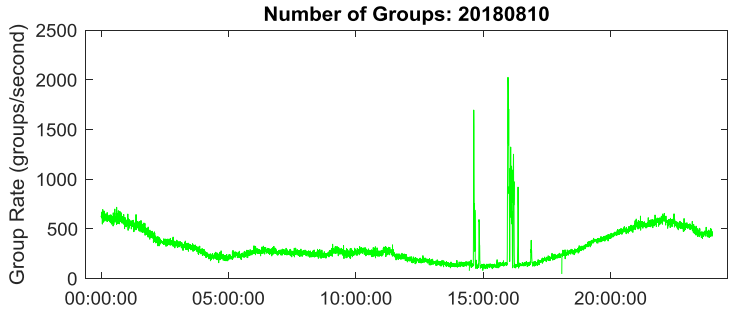
- Detection System
  - Instrument produced by LMATC (Palo Alto, CA)
    - Instrument senses near-IR emissions from excited oxygen atoms in spectral band λ = 777.4 nm produced by lightning
    - If signal is greater than a threshold, send signal to Ground System (GS) for further processing
  - Process signals to determine whether signal is “true” (= lightning) or “false” based on ground processing algorithm (GPA) provided by instrument vendor and implemented by GS
  - Cluster “true” signal (events) into groups and flashes using lightning cluster filter algorithm provided by algorithm working group (LCFA) and implemented by GS
  - Distribute lightning data product to the public
- System Requirements
  - Flash Detection Efficiency: greater than 70% total flash detection in 24-hr period
  - **False Alarm Rate: less than 5% false alarms (flashes) in 24-hr period**
  - Dynamic Range: greater than 100:1 at all times
  - Location Accuracy: within 5 km (3σ) at nadir

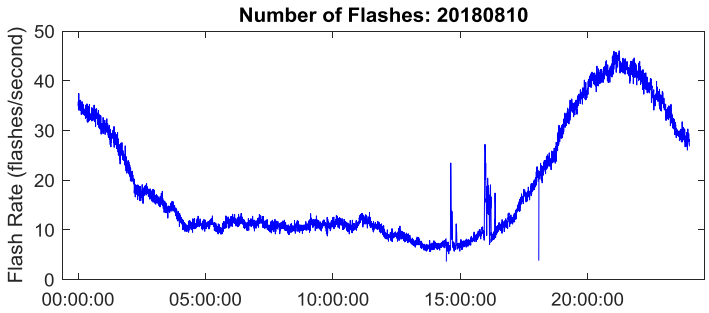
GLM L2+ Data Products
2018-08-10 00:00:00 through 23:59:40

- Data product files generated by Ground Segment
- All available files contained data
- Spikes produced by blooming pixels due to solar glint
  - Spikes at ~ 14:40 and ~ 16:05
- Flash exceedances (35 spikes):
  - Total time = 00:32:00
  - Approximate FAR < 1%
  - FAR approximated by deviations to running average
- Three periods with no product files (< 2min)
  - Low number of products follow product outage

False alarm met for this 24-hr period



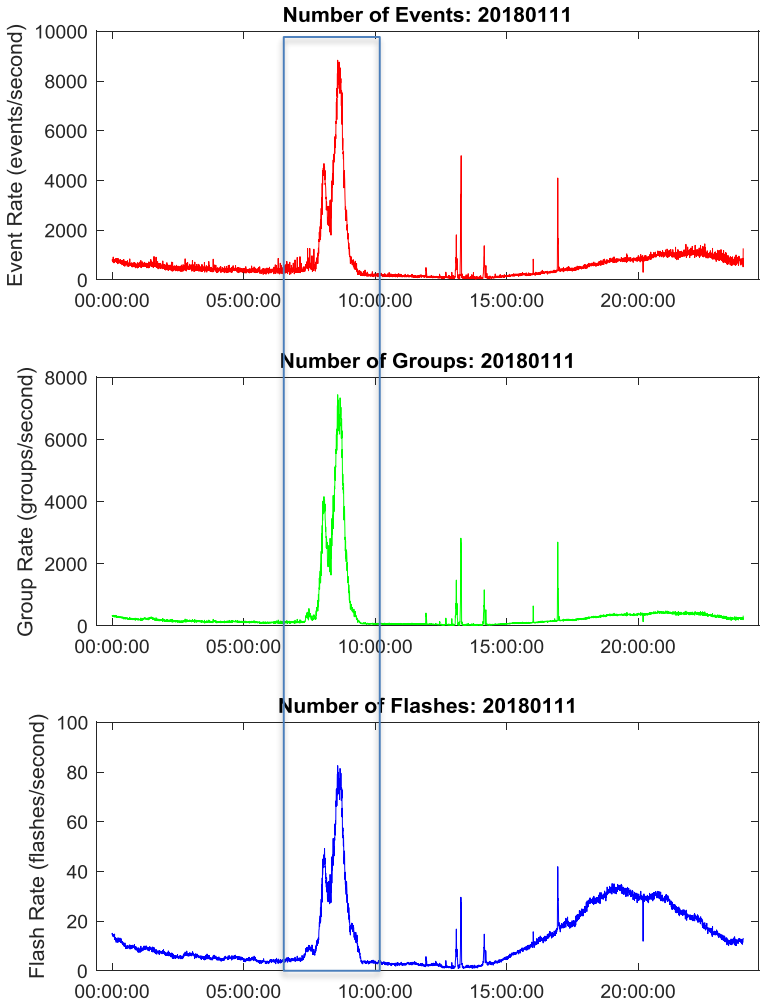




GLM L2+ Data Products
2018-01-11 00:00:00 through 23:59:40

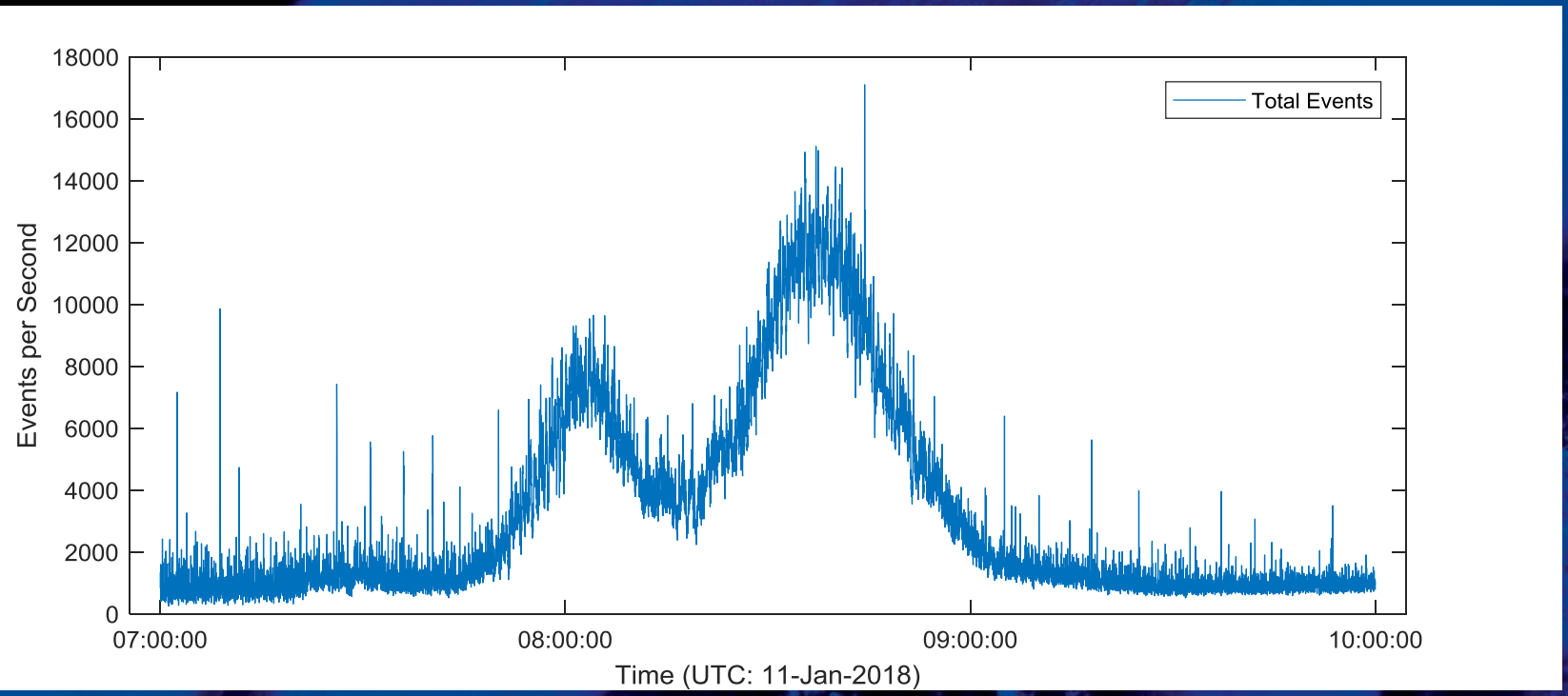
- Data product files generated by Ground Segment
- All available files contained data
- Extended sunrise solar glint period (07:20 – 09:10 UTC)
  - Flash exceedances (53 spikes):
  - Total time = 01:03:40
  - Running average approximates FAR < 1%
- Small changes in flash rate caused FAR code to underestimate false alarms
  - Investigate this glint period using GLM Level-zero (L0) data and local copy of GPA
  - Test blooming filter created by instrument vendor
- One (1) period with no product files
  - Amount of time: 00:00:20
  - Low number of products follow the product outage

False alarm **not** met for this 24-hr period



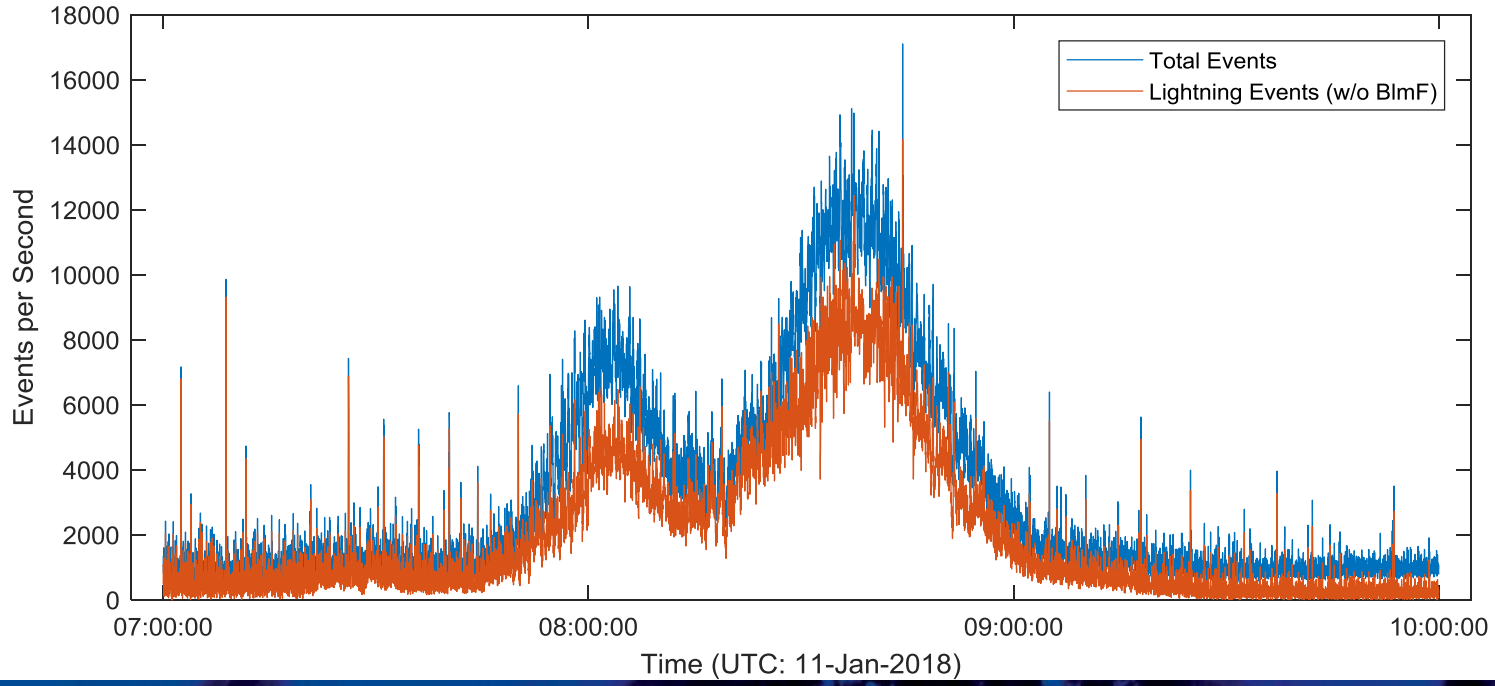
GLM L0 Events
2018-01-11 07:00 – 10:00 UTC

- GLM raw events at input to ground processing algorithm (blue)



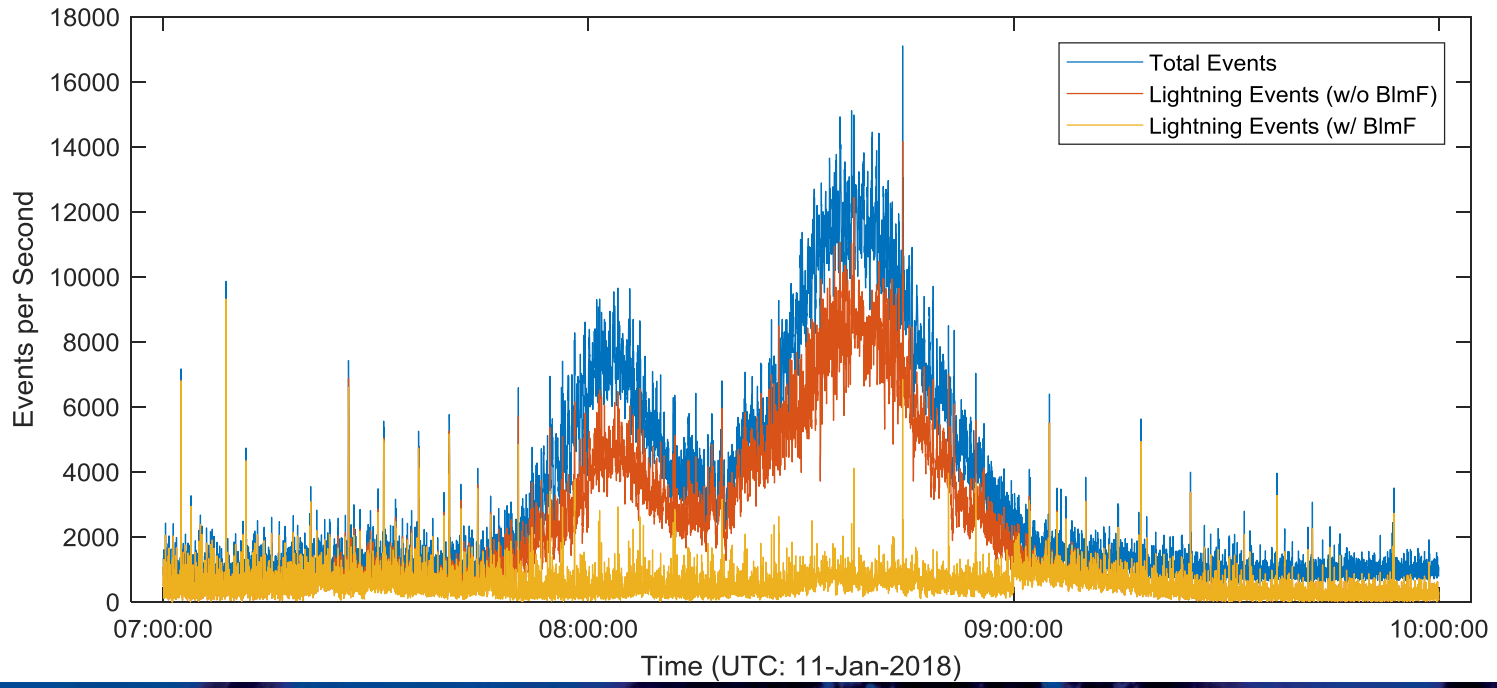
GLM L0/L2+ Events
2018-01-11 07:00 – 10:00 UTC

- GLM raw events at input to ground processing algorithm (blue)
- GLM lightning events at output of offline GPA
  - Without blooming filter (with GS GPA settings) (red)



GLM L0/L2+ Events
2018-01-11 07:00 – 10:00 UTC

- GLM raw events at input to ground processing algorithm (blue)
- GLM lightning events at output of offline GPA
  - Without blooming filter (red)
  - With GLM-vendor blooming filter implemented offline (yellow)



False Event Rate
2018-01-11 07:00 -10:00 UTC

- Executed offline GLM GPA event filters on solar glint period with (yellow) and without (orange) blooming filter for three-hour period

	Blooming Filter Status	
	OFF	ON
Lightning Events	22,440,003	5,867,642
False Events	12,081,709	28,654,070
Total Events	34,521,712	34,521,712

- Without blooming filter, the number of false lightning events is the difference between the OFF and ON cases
  - False event rate (w/o BlmgF) = Lightning Events (OFF – ON)/Lightning Events(OFF)

FER = 74 %

- Treating all lightning events outside of 3-hr glint period as true lightning, the 24-hr false event rate

FER(24-Hr) = 25 %

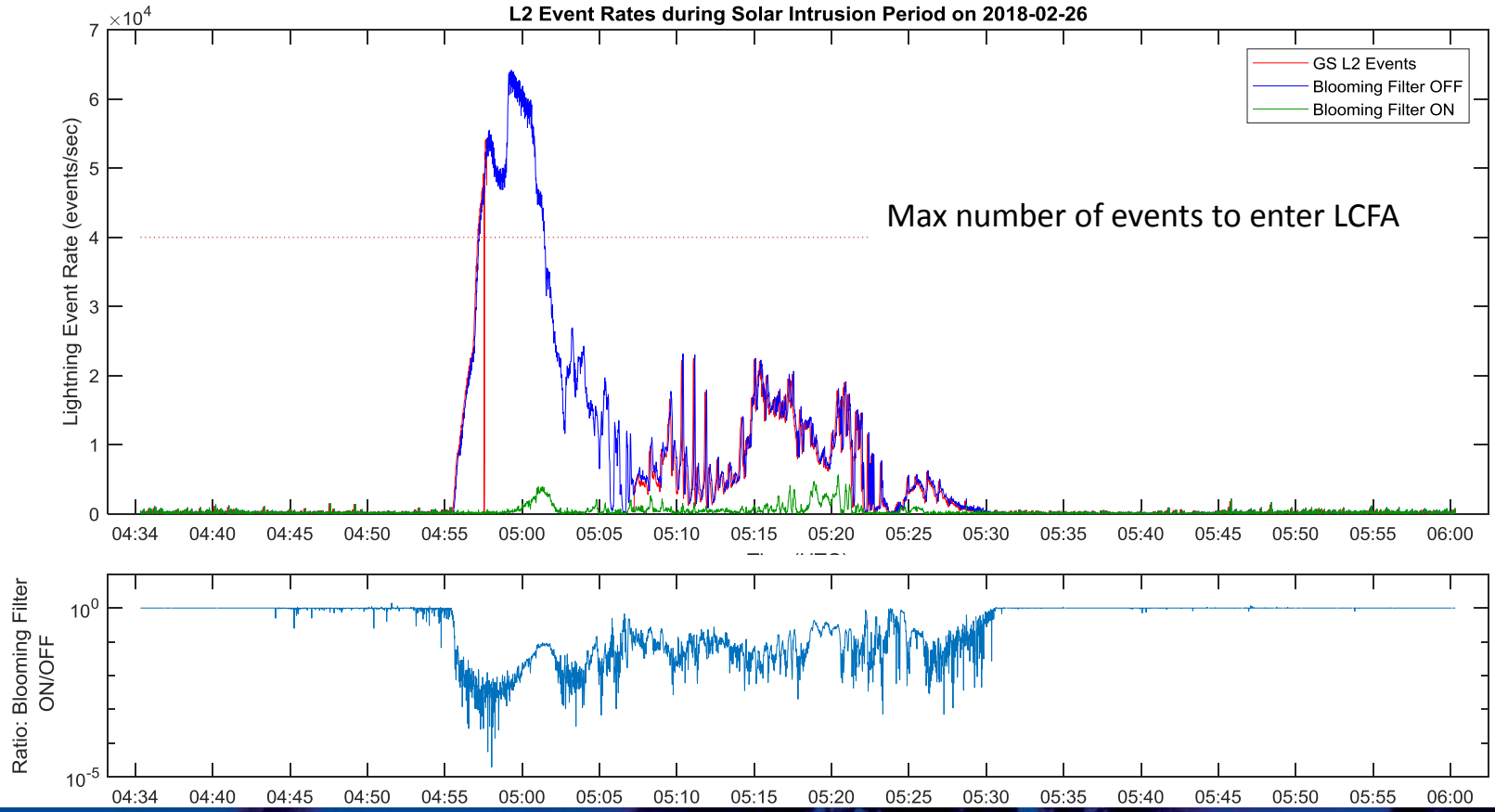
- FER correlated as an upper-bound to False Alarm Rate

5% FAR is not met without blooming filter

GLM L2+ Events
2018-02-26 04:35 – 06:00 UTC

- Executed Blooming Filter on GLM L0 events from solar intrusion period on 2018-02-26
- Significant reduction in lightning events
- Below maximum number of lightning events to enter LCFA (GLM L2+ algorithm)
- Good comparison of GS lightning events with offline processing without blooming filter

Reduces likelihood of data dropouts from solar glint and solar intrusion conditions



GLM False Alarm Rate Summary and Path Forward

- Significant improvement to False Event Rate demonstrated with offline-GPA using the GLM-vendor blooming filter
  - FER reduction correlated with an upper-bound to False Alarm Rate reduction
  - Reduces data dropouts from solar glint and solar intrusion conditions
- Ground Segment scheduled implementation of blooming filter for data operations nominally in early 2019 (DO.08)
  - Implementation to occur before Full Validation PS-PVR
    - Peer Stakeholder Product Validation Review
  - CWG to test GLM data following GS blooming filter implementation for operational false alarm rate