Future GLM Instrument Performance

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Tewa Kpulun

LOCKHEED MARTIN

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Bahama Bars

- GOES-16 and 17 both have “Bahama bars”
  - A false lightning artifact first seen in G16 GLM channel 43, but also present in several other subarrays due to excess noise under high illumination caused by overshoot
- This artifact was removed by deploying a new 2nd level threshold filter in PR 07.08.00 with progressively higher thresholds in the affected rows
  - GOES-16 GLM onboard thresholds remained elevated in the affected channels
- Future GLMs (FM3R and FM4R): hardware design modifications were made to help improve the overshoot seen in previous flight models

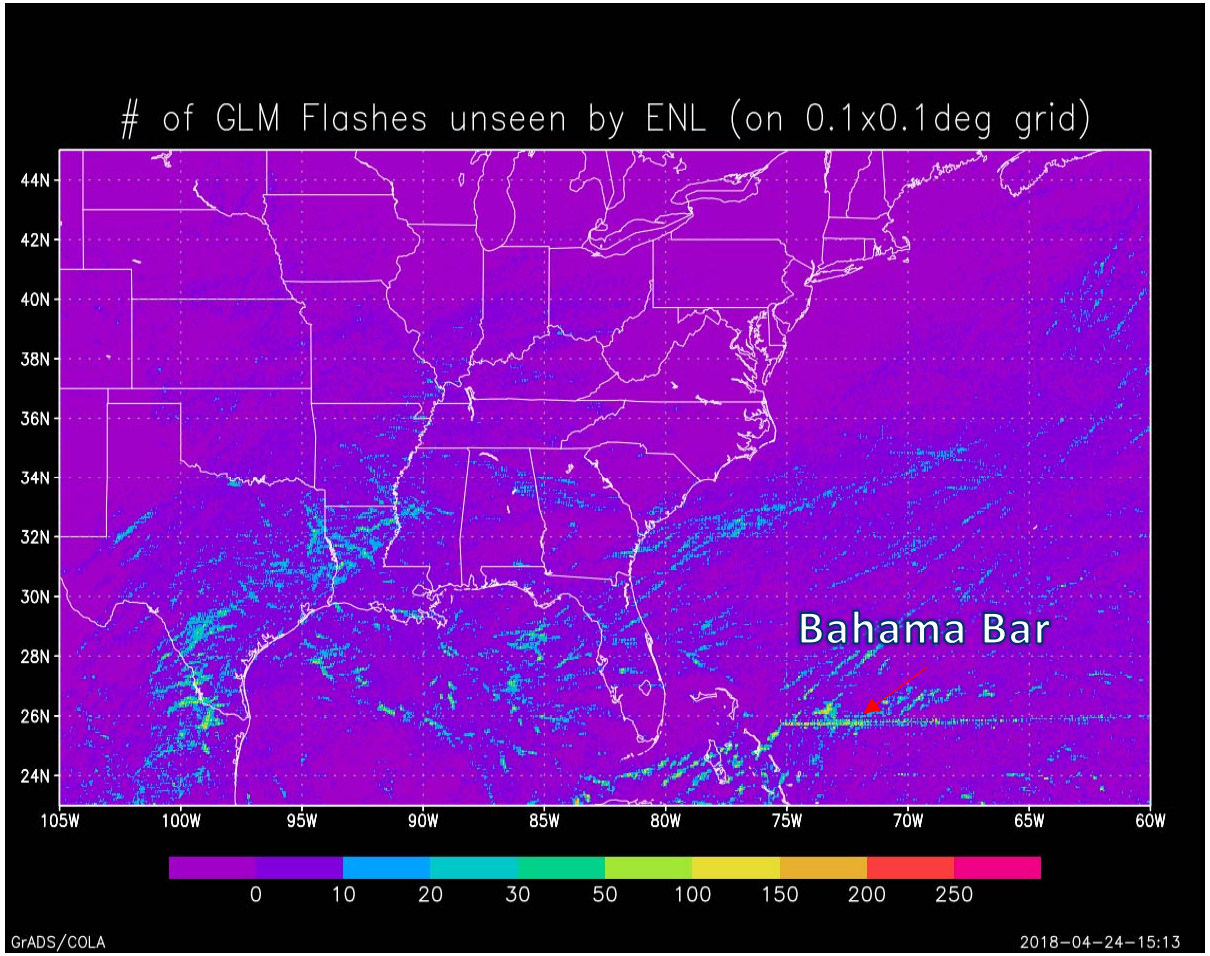


Figure 1: Bahama bar artifact observed in GLM lightning (channel 43)

Ground Testing Comparison: FM2 and FM4R

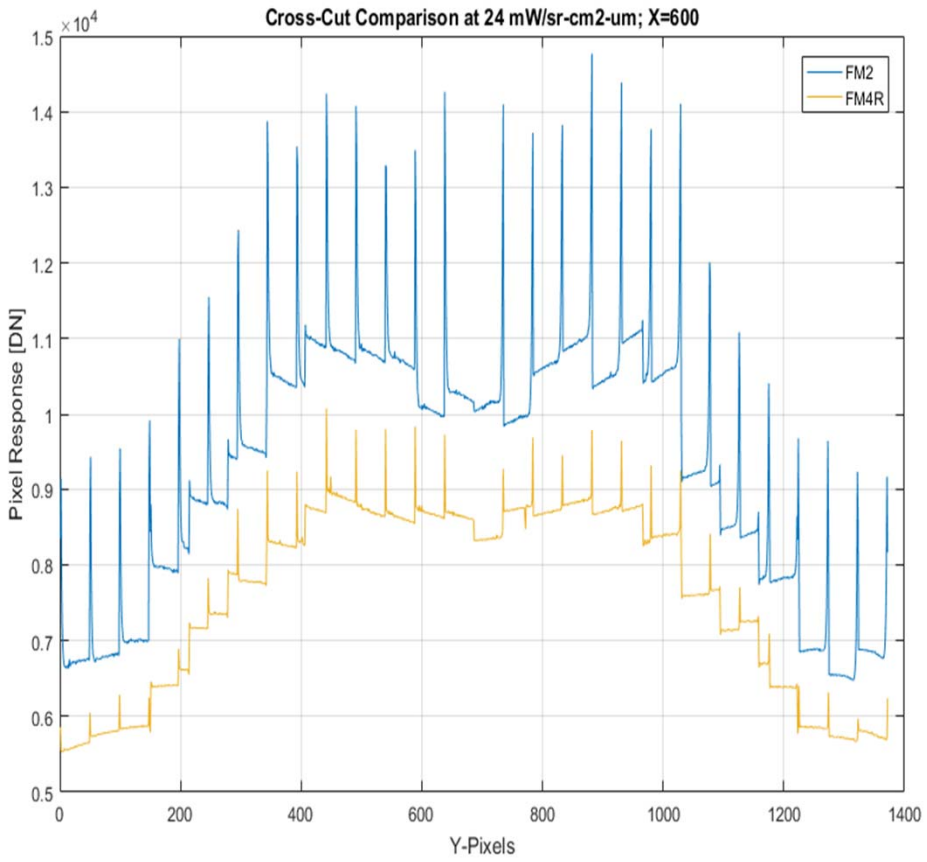


Figure 2

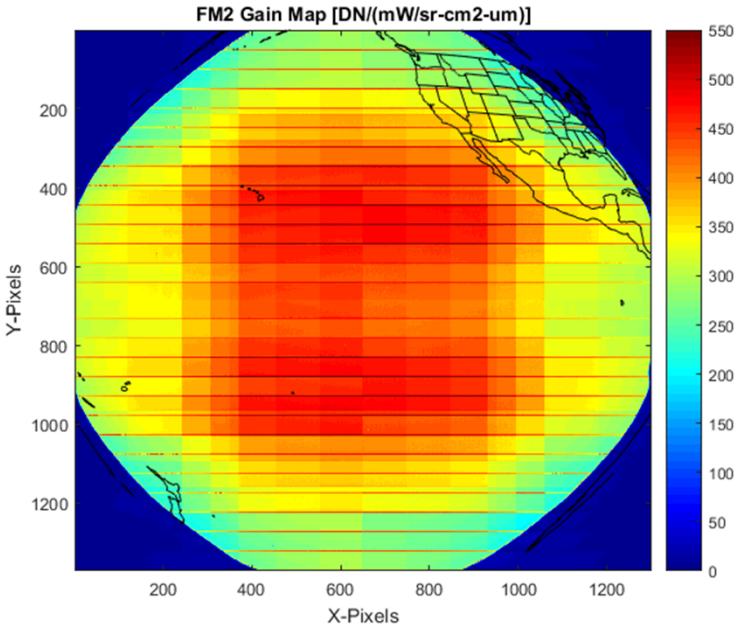


Figure 3

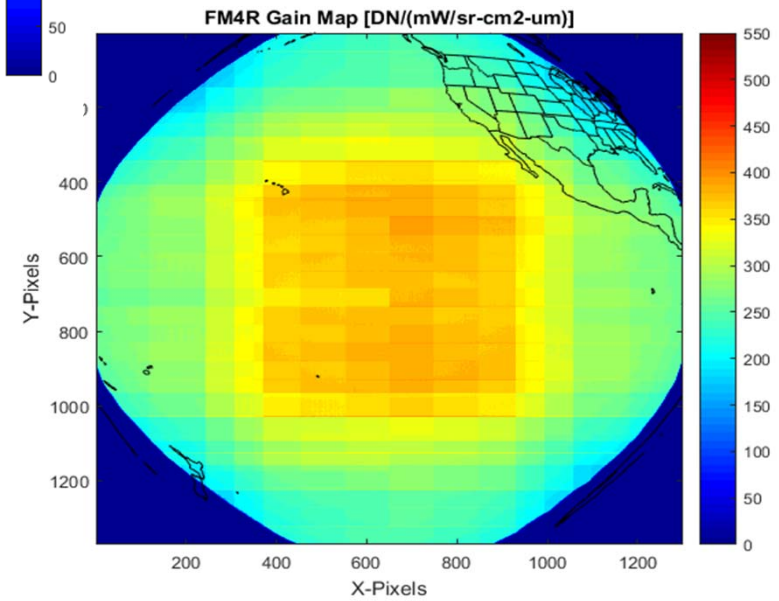
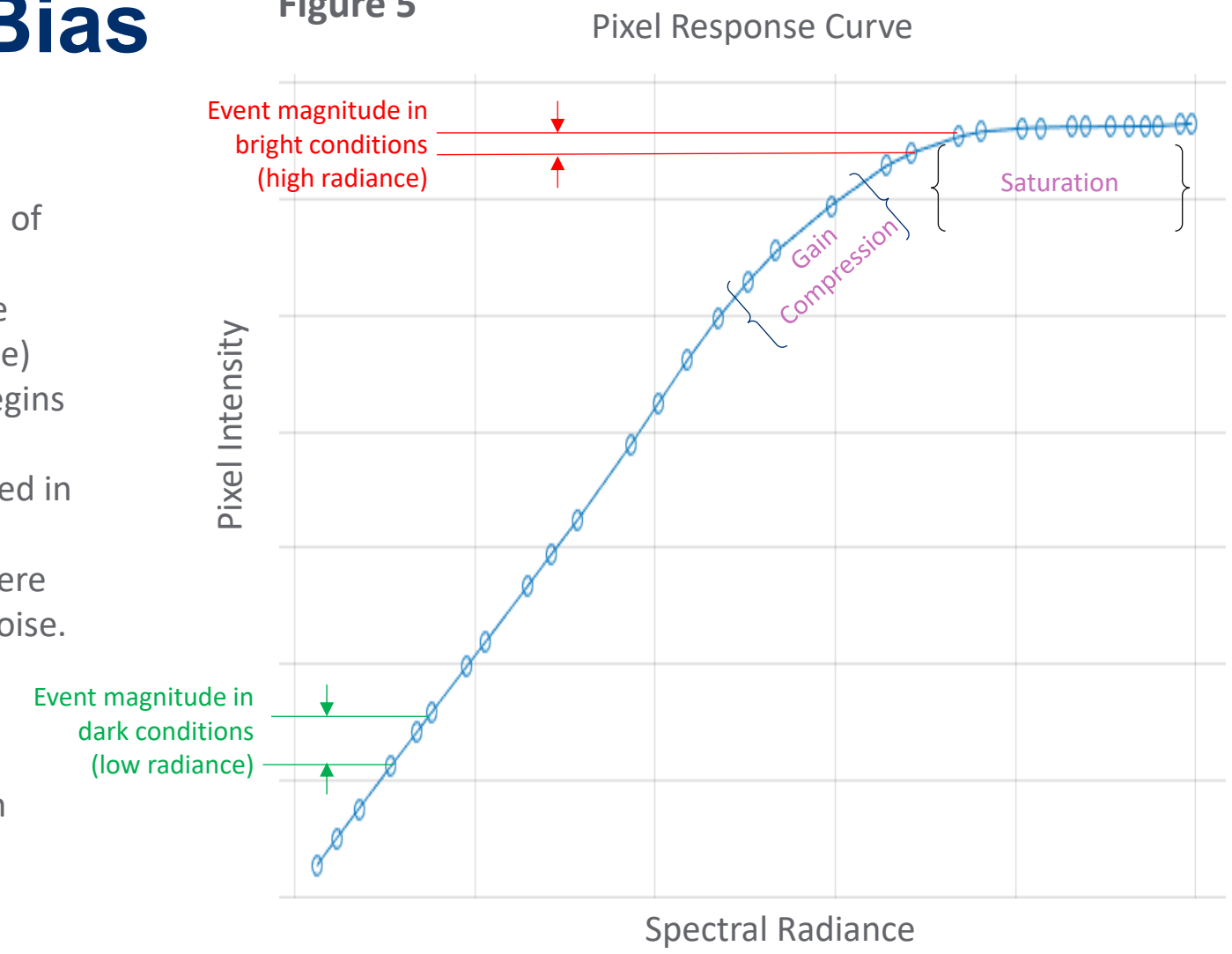


Figure 4

GLM Vrd Reset Drain Bias

- Vrd design modifications reduce overshoot/undershoot
- A side effect of this change is an early roll-off and saturation of the CCD output voltage
  - Gain compression : the location at which the response curve deviates from linearity and the gain (DN/radiance) decreases. For most 30x30 pixels, gain compression begins ~26 mW/sr-cm2-um.
- FM3R was re-calibrated with new timing settings that resulted in lower detection thresholds
  - At higher radiance values the thresholds decrease, where saturation compresses the instrument response and noise. The thresholds fall while maintaining a constant TNR(Threshold-to-Noise Ratio) of 4.3
- FM3R detection efficiency [DE] results were improved by reducing the thresholds in the compression regime and with much lower night time thresholds.

Figure 5



Accounted for in calibration data books; no effect anticipated on L2 lightning data product

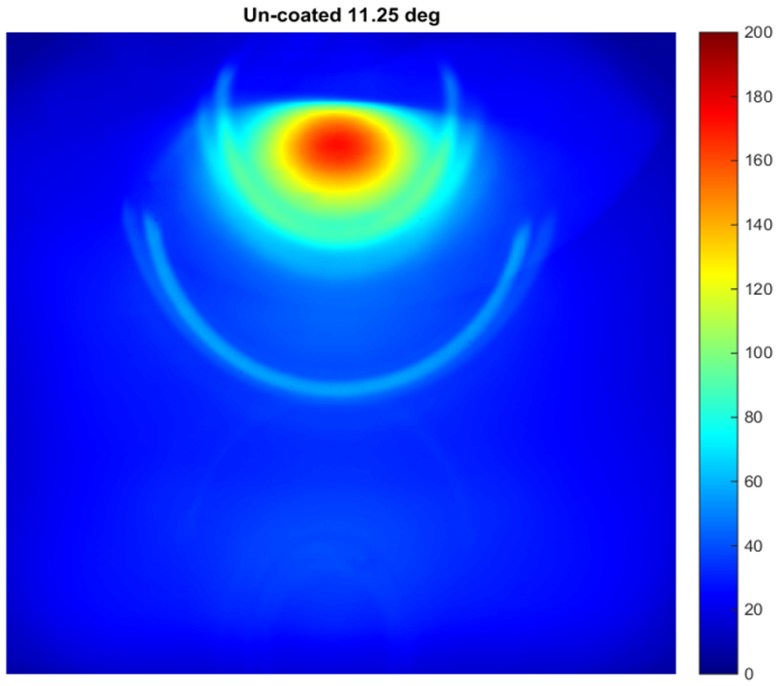
Instrument Performance at Solar Noon

- Used FM3R static response and threshold values to predict how FM3R would perceive FM1 raw Earth background images at different simulated cases
- High lightning rates in Amazon basin near satellite noon near Earth perihelion (highest radiance)
  - Case A: 2018-11-02 16:50 to 17:10 Z
  - Case B: 2018-11-06 16:50 to 17:10 Z
- High lightning rates over CONUS near satellite noon
  - Case C: 2019-05-09 16:50 to 17:10 Z
  - Case D: 2019-05-18 16:50 to 17:10 Z

Case	Noon Event DE Loss (percent)			Noon Flash DE Loss (percent)		
	Full Disk	30x30*	CONUS	**Full Disk**	**30x30***	**CONUS**
A	1 - 11	2 - 16	0	0 - 4	0 - 5	0
B	1 - 10	1 - 14	0	0 - 3	0 - 4	0
C	1 - 2	6 - 12	0	0 - 1	2 - 3	0
D	1- 2	7 - 11	0	0 - 1	1 - 3	0

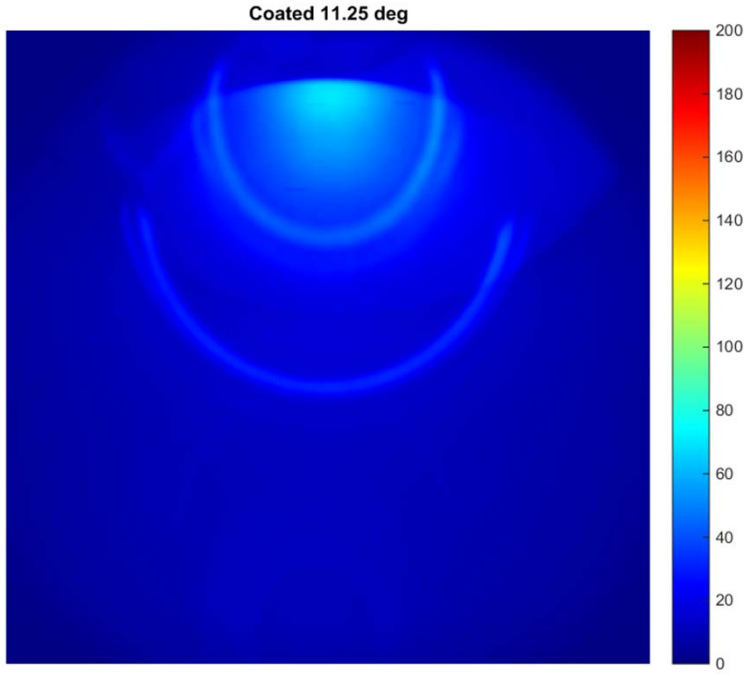
* 30x30: largest pixels in the GLM image near subsatellite point.

Stray Light Mitigation



Pre-Repair: FM3 Uncoated

Figure 6



Post-Repair: FM3 Coated **Figure 7**

- When the sun shines into the GLM optics, unwanted stray light can reach the focal plane.
- In FM1 and FM2, the dominant source of stray light is a total internal reflection at Lens 7.
- A black coating was applied to the edge of Lens 7 to mitigate this issue.
- Stray light testing for Lens Assembly (LA) was performed for off-axis sun angles of 9 -12 degrees.
- 50% reduction in stray light is sufficient to prevent pixel saturation due to Lens 7 total internal reflection

FM3R and FM4R performance is improved under eclipse season solar intrusion conditions.

The Future

- “Bahama bar” artifact is mitigated at the source
- GOES-T and GOES-U instruments have lower threshold values and much reduced overshoot/undershoot:
  - Better dynamic range under high illumination from lower thresholds
  - Consistently better DE at night
- Stray light impact reduced by 50%

Future GLM models (FM3R and FM4R) are calibrated for optimal performance.

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