

This document lists all known GLM-related changes to the Ground System (GS) software since initial deployment. The GS makes fixes through series of ADRs and WRs. Some fixes are minor while others take longer to diagnose and remedy. The WRs are implemented in new versions of the GS software that are first deployed in the Development Environment (DE) then the Operational Environment (OE). New versions are indicated by three sets of integers (e.g., DO 04.04.02). The first is the GS software version, the second indicates software patches, and the third signifies emergency patches. The Product Readiness and Operations (PRO) team developed a system to integrate less complicated fixes into the GS outside of the more rigorous GS process. The PRO team makes changes to the GS software and releases (PR) patches that follow the same numbering system. Most updates to the lookup tables (e.g., Rev G LUTs) follow the PR path. The following list is complete as of the date referenced above, and this document will be periodically updated.

**GOES-R GLM Data Validation-Level Dates**

<b>GOES-R Satellite</b>	<b>Validation-Level</b>	<b>Date</b>
GOES-16	Beta	07/05/17
GOES-16	Provisional	01/19/18
GOES-17	Beta	10/02/18
GOES-16	Full	11/01/18
GOES-17	Provisional	12/20/18
GOES-17	Full	Approx. 12/18

**Ground Segment Update Schedule:**

<b>Software Build</b>	<b>Date</b>	<b>Time (UTC) (16/17)</b>
<a href="#">DO.04.02.00</a>	01/13/17	15:00
<a href="#">DO.04.03.00</a>	02/17/17	21:53
<a href="#">DO.04.04.00/.01</a>	04/24/17	19:52
<a href="#">PR.04.04.07</a>	06/28/17	20:00
<a href="#">DO.05.00.00</a>	07/24/17	17:00
<a href="#">PR.05.00.01</a>	09/07/17	18:41
<a href="#">DO.06.00.00</a>	10/31/17	17:22
<a href="#">PR.06.00.02</a>	11/21/17	18:41
<a href="#">DO.06.02.00</a>	11/28/17	16:46
<a href="#">PR.06.02.03</a>	12/14/17	15:10

PR.06.02.04	12/14/17	
<a href="#">PR.06.02.05</a>	01/10/18	21:46
<a href="#">PR.06.07.00</a>	02/21/18	
<a href="#">DO.06.03.00</a>	06/19/18	15:27
<a href="#">DO.07.00.00</a>	10/15/18	
<a href="#">PR.07.01.00</a>	10/29/18	
<a href="#">PR.07.02.00</a>	11/05/18	19:25
<a href="#">PR.07.03.00</a>	11/15/18	18:48
DO.07.01.00	01/18/19	
<a href="#">PR.07.08.00</a>	02/27/19	19:46
DO.07.02.00	04/18/19	
<a href="#">PR.07.10.05</a>	04/30/19	15:19
<a href="#">DO.08.00.00</a>	07/25/19	15:11 / 17:21
<a href="#">DO.09.00.00</a>	TBD	

**Table 1: ADR/WRs Resolved in DO.04.02 (01/13/17)**

WR	Description
1948	GLM Group Energy Values are all set to the minimum value
1948 1950 2284	GLM energy discrepancies
2267	Improve GLM LCFA algorithm error-handling
2284	Different units between GLM L1b and GLM L2
1935	GLM Eastern RTEP mapping appears incorrect
1937	GLM L2+ product metadata errors
3556	Update GLM Navigation Parameters
3557	Update GLM RTEP Map

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**Table 2: ADR/WRs Resolved in DO.04.03 (02/17/17)**

WR	Description
3315	Zero Pixels at RTEP corners in GLM Background Image
3702	GLM not producing background images

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Table 3: **ADR/WRs Resolved in DO.04.04.00/.01 (04/24/17)**

WR	Description
1949	GLM appears to have Timing Artifacts
2061	GLM OP - Change Event Filter Order to match GLM CDRL-80 Rev F
2063	GLM OP - Implement Overshoot Filter
2064	GLM OP - Implement Solar Glint Filter
2065	GLM OP - Implement Crosstalk Filter
2066	GLM OP - Update event energy computation
2067	GLM OP - Update Block-Level Metadata
2068	GLM OP - Update INR Implementation to GLM CDRL-46 Rev H
2234	Event and group count variables differ from the events, group data arrays
3033	GLM L2+ start/end times incorrect, ETE4b using MVTDS-Synthetic data
4255	GLM LCFA file names have invalid start/end date times and don't meet latency requirements

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Table 4: **ADR/WRs Resolved in PR.04.04.07 (06/28/17)**

WR	Description
	<p>Implement GOES-16 GLM FM1 CDRL079 Rev G</p> <p>Rev G Change Table:</p> <p>Submitted HDF5 files for all 3 positions, and both sides of the instrument with the final PLT determined INR parameters for FM1. Interim updates for event filter parameters and corrections to the radiometric calibration are also included. The changes to the HDF5 file are as follows:</p> <ol style="list-style-type: none"> <li>1. Added latest thresholds</li> <li>2. Set all A/B optical distortion coefficients to 0</li> <li>3. Updated PIT to remove ambiguous coasts (padded with the final value to be the same variable size as previous release)</li> <li>4. Updated coastline ID observation start and stop times</li> <li>5. Updated max solar angle</li> <li>6. Updated all coherency filter parameters</li> <li>7. Updated glint update period</li> <li>8. Updated mask slightly (3 pixels changed)</li> <li>9. Corrected errors in calibration table – no more negative calibration coefficients</li> <li>10. Updated coastline ID parameters: water threshold, midnight offset, initial alignment values, bipod coefficients, earth rotation rate (more significant figures), and earth rotation angle offset (more significant figures), water min, min coastline pixels</li> </ol>

	<p>11. Updated the second level thresholds to correct an indexing error In addition to the updates to the HDF5 file, included with this CDRL submission is an update to the primary side calibration table to be used for GLM backgrounds described in section 5.2 and originally submitted under rev C. The calibration table included in the HDF5 file is for events only.</p>
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**Table 5: ADR/WRs Resolved in DO.05.00 (07/24/17)**

WR	Description
1935	GLM Eastern RTEP mapping appears incorrect
1937	GLM L2+ product metadata errors
3556	Update GLM Navigation Parameters
3557	Update GLM RTEP Map

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**Table 6: ADR/WRs Resolved in PR.05.00.01 (09/07/17)**

WR	Description
	<p>Implement GOES-16 GLM FM1 CDRL079 Rev H</p> <p>Rev H Change Table:</p> <p>Updated parameters for most of the event filtering parameters per GLM-004 test report (GLM06593), and added data quality algorithm parameters based on the preliminary data quality product described in GLM06090 under CDRL038 rev B.</p> <p>Detailed list of changes:</p> <ol style="list-style-type: none"> <li>1. Updated second level thresholds to reapply the minimum on board threshold for that channel</li> <li>2. Updated overshoot filter LUT based on on-orbit data</li> <li>3. Updated contrast leakage parameters to essentially turn off the filter</li> <li>4. Updated glint filter parameters</li> <li>5. Updated coherency filter parameters <ul style="list-style-type: none"> <li>Probability table based on on-orbit thresholds and higher amplitudes remaining after the second level threshold removes low amplitude events</li> </ul> </li> <li>6. Updated CCD frame transfer filter parameters to essentially turn off the filter</li> <li>7. Added data quality parameters</li> <li>8. Incorporated scaling changes into temperature conversion coefficients to mitigate focal length calculation errors that were causing nav issues (significant change)</li> </ol>

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Table 7: **ADR/WRs Resolved in DO.06.00 (10/31/17)**

WR	Description
5140	Banded Structure in Group Geolocation GLM L2 – Fixed “Charlie Brown” stripes in L2 groups – also should greatly reduce the splitting of individual GLM flashes
2062	GLM OP - Implement data formatter burst filter
4017	GLM INR update to CDRL 46 Rev K
2691	Abnormally large group areas in the L2+ products
4589	Time offset of events, groups and flashes, GLM L2+ (only corrected in L1b)
4709	Baseline: GLM CALINR update to CDRL 79 Rev H

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Table 8: **ADR/WRs Resolved in PR.06.00.02 (11/21/17)**

WR	Description
	GLM L2 event time now has changed scale_factor = 1 millisecond

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Table 9: **ADR/WRs Resolved in DO.06.02 (11/28/17)**

WR	Description
4762	Radiation ‘dots’, removing single-group flashes
4780	Duplicate events - Duplication dots are no longer present
5162	GLM E-W Event Navigation Error
5284	Interim solution - GLM Event Geolocation Does Not Match Vendor Results

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Table 10: **ADR/WRs Resolved in PR.06.02.03 (12/14/17 or PR.06.03.00 12/15/17)**

WR	Description
5545	GLM LUT update for East. Update to glint filter spot amplification and contrast leakage GS parameters ***Included fix to GLM Data Burst Filter – fixed issue of crash induced empty files***

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Table 11: **ADR/WRs Resolved in PR.06.05.00 (01/10/18)**

WR	Description
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5426	Improves the GLM L1b algorithm by fixing the second level threshold filter and the overshoot filter. A new rpm is installed to fix these issues.
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Table 12: **ADR/WRs Resolved in PR.06.07.00 (01/29/18) or PR.06.08.01 (02/21/18)**

WR	Description
5301	GLM LUT pre-launch update for GOES-S

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Table 13: **ADR/WR Resolved in DO.06.03 (06/19/18)**

WR	Description
4762	Radiation 'dots', removing single-group flashes
4948	Lightning L2 event time scale_factor is incorrect – PRO Type 1
5399	The GLM L1 EFRC service periodically crashes when processing live data

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Table 14: **ADR/WRs Resolved in DO.07.00 (10/15/18)**

WR	Description
3561	Update GLM EFRC Algorithm to use updated CALINR format provided by GLM Flight
4477	GLM L2 LCFA product has 'n/a' for production_data_source
4507	Use adjusted event times in Lightning L2+ product (TOF & associated)
4696	Group and flash areas GLM L2 (Discrepancy 20% between GS & LM) areas
5545	GLM L1b LUT update for East- PRO Release Type 1
5525 4695	Orphan and childless events and groups in GLM L2 & Family Links

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Table 15: **ADR/WRs Resolved in PR.07.01.00 (10/29/18)**

WR	Description
6217	Update GOES-16 GLM LUT to CDRL 79 Rev J Updated lightning ellipsoid values (solves ADR637 (Parallax Lite)) New 2 <sup>nd</sup> -level threshold filter w/32 levels/pixel to mitigate Bahama Bar

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Table 16: **ADR/WRs Resolved in PR.07.02.00 (11/05/18)**

WR	Description
5930	An overflow valve for when 'burst event' will cause an abnormal amount of false events to be registered in the L1b file. This surge of events causes L2 processing to bog down due to the large number events to process. The result is empty L2 files for a large period of time (multiple hours) while the algorithm either catches up or is restarted.

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Table 17: **ADR/WRs Resolved in PR.07.03.00 (11/15/18)**

WR	Description
6749	Update GOES-17 GLM LUT to CDRL079 Rev C (GLM FM2) Updated the flat 2nd level threshold to mute the hot pixels

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Table 18: **ADR/WRs Resolved in PR.07.08.00 (02/27/19)**

WR	Description
6097	Implement GLM 2 <sup>nd</sup> -level threshold filter code change (for optimal threshold adjustment)
6098	Implement GLM Data Burst filter code change (allows variable number of RTEPs within a Data Formatter to observe a data burst instead of the fixed value of four (4))

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Table 19: **ADR/WRs Resolved in PR.07.10.05 (04/30/19)**

WR	Description
	<p>GOES-16 GLM FM1 CDRL 79 Rev K LUT</p> <ul style="list-style-type: none"> <li>Updated the coherency probability LUT to bias it 3 DN above the average RTEP threshold. False alarms from subarrays with higher noise (subarray 35 in particular) were causing problems for forecasters, so the probability table needs to be closer to the higher noise subarrays rather than a true average.</li> <li>Turned the contrast leakage filter back on. The jitter test is now run, and the leakage fraction is set to 1.0.</li> <li>Updated the second level threshold to better handle the "Bahama Bar" phenomena in subarrays 7, 19, 20, 26, 35, 47, 48 and 54.</li> </ul>
	<p>GOES-17 GLM FM2 CDRL 79 Rev D LUT</p> <ul style="list-style-type: none"> <li>Enabled contrast leakage filter with leakage fraction = 2.0</li> <li>Updated second level thresholds to balance threshold-to-noise ratio, to better suppress hot pixel false events, and to suppress "Bahama Bar" false lightning artifacts</li> </ul>

	<ul style="list-style-type: none"> <li>• Updated radiometric calibration to remove NaN values</li> <li>• Updated ZRDQ parameters for the data quality product based on PLT-006 test</li> </ul>
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Table 20: **ADR/WRs Resolved in DO.08.00.00 (07/25/19)**

WR	Description
ADR373/WR4758	GLM L1b INR – GLM Event Geolocation Does Not Match Vendor Results – Minor corrections to the GLM event navigation implementation.
ADR374/WR4697	GLM L1b – GLM Blooming Filter – This adds the Blooming Filter to the suite of false event filters used in the GLM L1b ground processing algorithm to remove false lightning event detections. The blooming filter removes false events which can occur during solar glint and solar intrusion.
	GLM L1b – LUT Filenames not Traceable to Metadata - ABI GLM – ABI and GLM metadata will now include the names of the LUTs used in production.
ADR701/WR6116	GLM L2 – GLM L2+ LCFA Product's Yaw Flip Flag is fill – The GLM L2 product will now output the correct yaw flip state. It was previously fill.

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#### **Active-Outstanding ADR/WRs**

- ADR375/WR4705: Time Order, GLM L2
- ADR519/WR5480: GLM Lightning LCFA L2 Radiation filter threshold
- ADR549/WR6412: Eliminate GLM L1b dependency on APIDs 384 and 385
- ADR844/WR6681: GLM L2 lightning needs \_unsigned attribute on time offsets
- ADR879: Incorrect GOES-17 GLM L2+ Event Longitude Values

#### **Dormant-Outstanding ADR/WRs**

- ADR461: GLM L2 Data Quality Product
- ADR645: GLM Full-Parallax Compensation
- ADR646: GLM Gridded Product
- ADR650: Diurnal Compensation to GLM GPA Lightning Product Locations

#### **Glossary**

ADR	Algorithm Deficiency Report
Cal/Val	Calibration and Validation Efforts and/or Team
DE	Development Environment
DO	Data Operations



EFRC	Event Filter and Radiometric Calibration – a component of the GS implementation of GLM GPA
GLM	Geostationary Lightning Mapper
GLM OP	GLM Operational Prototype
GPA	Ground Processing Algorithm
GS	Ground Segment
LUT	Look-Up Table
OE	Operational Environment
PRO	Product Readiness and Operations Team
PR	PRO Release
WR	Work Request

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