GOES-17 GLM Level 2 (Events, Groups, Flashes) Release
Beta Data Quality
October 3, 2018
Read-Me for Data Users

The GOES-R Peer/Stakeholder Product Validation Review (PS-PVR) for GLM L2 Beta Maturity was held on October 2, 2018. As a result of this review, the PS-PVR panel chair declared the data was of Beta validation maturity and recommended that the GLM L2 data be included in GOES Rebroadcast (GRB) on October 3, 2018 at 1500 UTC.

The GLM L2 product consists of geo-located and time-stamped *events, groups, and flashes*, with associated calibrated optical amplitudes (in units of Joules).

Beta maturity, by definition, means that:
- Initial calibration applied (L1b);
- Rapid changes in product input tables / algorithms can be expected;
- Product quick looks and initial comparisons with ground truth data not adequate to determine product quality;
- Anomalies may be found in the product and the resolution strategy may not exist;
- Product is made available to users to gain familiarity with data formats and parameters (via GRB);
- Product has been minimally validated and may still contain significant errors; and
- Product is not optimized for operational use.

Beta users bear all responsibility for inspecting the data prior to use and for the manner in which the data are utilized. Persons desiring to use the GOES-17 GLM Beta-maturity L2 products for any reason, including but not limited to scientific and technical investigations, are encouraged to consult the GLM Calibration/Validation science team members for feasibility of the planned applications. Known issues being resolved include:

1. **Flash Detection:** GOES-17 GLM flash detection efficiency (FDE) over the field-of-view and over a 24 hr period averaged 67% to 71%, depending on the ground-network reference data employed in the validation. These values are below GOES-16 GLM FDE performance, so additional tuning of GOES-17 GLM is required. GOES-17 (and GOES-16) GLM show a notable depression in FDE extending from the US Great Plains to the Pacific Northwest, and the exact cause is presently unknown and is being examined. In addition, there is evidence that the FDE is substantially smaller in anomalous (i.e. inverted polarity) storms, and in severe (e.g., hail-producing) storms, or storms with deep liquid water path. In general, because the FDE associated with reference data is itself variable and typically below 100%, it is not always possible to exactly/unambiguously determine the GLM FDE in all cases.

2. **False Events:** Owing to the improvements to ground processing software in preparation for GOES-16 GLM Provisional Maturity, false events due to high energy radiation particles, aka "radiation dots" have been reduced by removing Single Group Flashes (SGFs), but future adjustments to this filter will be tested so as to mitigate removal of legitimate flashes. An Algorithm Discrepancy Report (ADR) was recently submitted that provides a plan for further improvement of the SGF filter. Similarly, false events due to the data handling issue that produced "duplicative dots" has been fully resolved. False events due to blooming, created from glint and/or solar intrusion, are still present but a blooming filter, and improvements to glint processing, have been developed, tested, and are planned for implementation by early next year. GOES-17 GLM has more hot pixels than GOES-16 GLM (i.e. 2 clusters occurring in two distinct regions).

3. **Position Errors:** GOES-17 GLM flash location errors are on par with latest GOES-16 GLM location error analyses. Parallax errors near the edges of the field-of-view are a persistent feature, but improvements have

already been achieved by optimizing the equator and pole parameters of the cloud-top "lightning ellipsoid" model parameters. Long-term plans are to replace the static "lightning ellipsoid" with monthly 3 degree resolution cloud-top surfaces that have, in detailed tests, proven to further mitigate parallax. Mitigation of INR inaccuracies due to <u>diurnal variations</u> has not yet been achieved.

4. **Timestamp:** The timestamp on events, groups, and flashes has now been fixed to properly account for the Time-Of-Flight (TOF) of the photons from cloud-top to sensor (effective when the DO.07.00.00 software version goes operational on approximately October 9, 2018). Therefore, users no longer need to perform their own TOF correction to the data following this implementation date. There are still time-order issues with L2 data event times (as well as group time, flash start time, and flash end time), but these issues normally do not pose any major problems for most analyses; a fix is planned for early next year.

5. **Family Links:** Family linkages refer to the correspondence between events, groups and flashes. For example, a "childless" group is a group with no events, and an "orphan" event is an event with no parent group. All downward family links have been fixed (effective when the DO.07.00.00 software version goes operational on approximately October 9, 2018). Upward family links will not be done, due to bandwidth constraints.

6. **Areas:** Improvements to group and flash area values are anticipated (effective when the DO.07.00.00 software version goes operational on approximately October 9, 2018).

7. **Unsigned Integer Read:** This is an issue that affects multiple instruments on GOES-16/17, and a pilot fix is being worked. The classic model for NetCDF does not support unsigned integers larger than 8 bits. Many of the variables in GOES-16/17 data files are unsigned integers that are either 16-bits or 32-bits. So, until a fix is achieved, we recommend using the following process to convert:
   • Retrieve the variable data (using low level routines).
   • If there is an attribute "_Unsigned" then cast the variable data to unsigned. This step must be completed before applying scale_factor and add_offset values to convert from scaled integer to science units. For example, when reading the NetCDF files, one has to MANUALLY read in the event lat/lon as an unsigned integer (using low level routines), and then manually take care of the scale and offset.

8. **Gridded Data & Data Quality Products:** These products are not yet available but are being developed, with plans for eventual submission to the Ground Segment via a formal Algorithm Discrepancy Report (ADR) along with fully tested meta-code.

9. **Data Recommended:** The Calibration Working Group (CWG) recommends that data on or after October 9, 2018 (i.e., the estimated date that software fixes in DO.07.00.00 go operational) is best to use.

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