

GOES-18 GMAG Level 1b (L1b) Release
Full Data Quality
Read-Me for Data Users
September 27, 2023

The GOES-18 Peer Stakeholder Product Validation Review (PS-PVR) for GMAG L1b Full Validation Maturity was held on September 27, 2023. The result of this review was the PS-PVR panel chair recommending that the GMAG L1b data be declared Full Validation maturity.

The L1b data products derived from Goddard Magnetometer (GMAG) are vector measurements of the geomagnetic field sampled at 10 Hz from the inboard and outboard magnetometers.

The GOES-18 GMAG L1b Full maturity data products continue to be suitable for operational use with documented known considerations and implementation of critical fixes. Product performance has been demonstrated through analysis of a number of independent measurements obtained from select locations, periods, and comparisons to nearby spacecraft and magnetic field models. The product was calibrated and validated to the extent allowed within resources available. Users bear all responsibility for inspecting the data prior to use and for the manner in which the data are utilized.

The L1b GOES-18 data set released on the NCEI website (listed below) includes a correction for arcjet contamination. However, it is highly recommended that users use the arcjet flag described below to flag the periods contaminated by arcjet firings. The correction matrices may not effectively remove all arcjet firing effects, so corrected variables should be used with caution. For details on the arcjet contamination and correction algorithm see Califf et al. (2019, 2020).

Full Validation means:

- Validation, quality assurance, and anomaly resolution activities are ongoing;
- Incremental product improvements may still be occurring;
- Users are engaged and user feedback is assessed;
- Product performance for all products is defined and documented over a wide range of representative conditions via ongoing ground-truth and validation efforts;
- Products are operationally optimized, as necessary, given the resources and time available;
- All known product anomalies are documented and shared with the user community;
- The product is operational.

We recommend that persons using the GOES-18 GMAG Full Validation maturity L1b products for scientific and technical investigations, particularly model validation, model development, and plasma waves analysis, contact the responsible NOAA scientists before making definitive scientific or technical conclusions derived directly from the GMAG data.

Cautions, known issues, and issues under work for resolution at Full maturity status:

1. Data files that are dated prior to December 14, 2022 have timestamps in the GMAG L1b product that occur at irregular intervals in the 10Hz datasets. The difference between consecutive timestamps varies throughout the dataset. This causes issues in the L2+ processing. Caution should be used when using 1) L1b 10Hz datasets prior to December 14, 2022 and 2) L2 Hires products produced prior to October 19, 2022. The data values in GMAG L1b products are not

affected by the irregular timestamps (i.e., this does not cause fill values). This issue was corrected in the L1b products on December 14, 2022 and the L2 processing algorithms were corrected on October 19, 2022.

2. Users should note that calibrations and corrections to GEOS-18 magnetometer data products have been done incrementally. Below is a list of when certain calibrations and corrections were included in the L1b products. Data prior to the date listed will NOT include the calibration or update. All data after the date listed WILL include the calibration or update.
 - a. August 8, 2022: zero-offset and alignment calibrations applied
 - b. November 11, 2022: arcjet correction matrices optimized and applied to OB / IB *_corrected variables
 - c. December 14, 2022: irregular timestamp (above) correction applied
3. The outboard and inboard sensors (OB_* or IB_*) can be used for science and technical investigations.
4. The L1b files contain magnetic field variables that have “uncorrected” or “corrected” added to the variables name. In addition, an arcjet flag was added to the data quality flag (DQF) variable that covers the period where arcjets are fired and contaminate the magnetic field observations. Hence, it is highly recommended that users use the arcjet flag data quality bit named `potentially_degraded_due_to_arcjet_firing_qf` to flag the periods contaminated by arcjet firings.
5. The `amb_mag*` variables in the L1b files refer to the best observation of the geomagnetic field, which is currently set to the outboard sensor values. This product is being further studied for ongoing improvements. This variable should be the default magnetic field observation used by users for science and technical investigations.

Contact for further information: OSPO User Services at SPSD.UserServices@noaa.gov

More information concerning the available variables and flags can be found in the netCDF file metadata. Data inquiries can be submitted to goesr.mag@noaa.gov. NCEI contact for specific information on the GMAG L1b data:

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NCEI website for GOES-R Space Weather data: <https://www.ngdc.noaa.gov/stp/satellite/goes-r.html>

References:

Califf, S., Early, D., Grotenhuis, M., Loto'aniu, T. M., and Kronenwetter, J. (2020) Correcting the arcjet thruster disturbance in GOES-16 magnetometer data. *Space Weather*, 18, doi:10.1029/2019SW002347.

Califf, S., Loto'aniu, T. M., Early, D., and Grotenhuis, M. (2019) Arcjet Thruster Influence on Local Magnetic Field Measurements from a Geostationary Satellite, *Journal of Spacecraft and Rockets*, Vol. 57, No. 1, doi:10.2514/1.A34546