GOES-18 SEISS MPS-HI Level 1b (L1b) Data Release
Full Data Quality
November 16, 2023
Read-Me for Data Users

The Peer Stakeholder - Product Validation Review (PS-PVR) for the GOES-18 Space Environment In-Situ Suite (SEISS) Magnetospheric Particle Sensor – High Energy (MPS-HI) L1b Full Maturity was held on November 16, 2023. As a result of this review, the PS-PVR panel chair has declared that the MPS-HI L1b data are at Full Validation Maturity as of November 16, 2023.

The MPS-HI L1b data product consists of 50 keV – 4 MeV electron fluxes and 80 keV – 12 MeV proton fluxes. MPS-HI consists of 5 electron solid-state (silicon detector) telescopes and 5 proton solid-state (silicon detector) telescopes with 30-degree full-width conical fields-of-view, arranged in a north-to-south fan with field-of-view centers separated by 35 degrees.

Each electron telescope reports 10 differential channels plus a >2 MeV integral channel. Each proton telescope reports 7 channels in the 80 keV – 1 MeV range and 4 channels in the 1-12 MeV range. The highest three energy channels generally register counts above backgrounds only during solar energetic particle (SEP) events.

In addition, there are two dosimeters that distinguish dose from particles depositing < 1 MeV and > 1 MeV under domes of 250 and 100 mil aluminum shielding.

Full validation maturity, by definition, 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, considering mission parameters of cost, schedule, and technical competence as compared to user expectations;
- All known product anomalies are documented and shared with the user community;
- Product is operational.

Users of the GOES-18 MPS-HI L1b data bear responsibility for inspecting the data and understanding the known caveats prior to use. Below is the list of caveats that have been identified and are under analysis. Solutions are in development and testing.

1. No real-time MPS-HI L1b data prior to declaration of Provisional Maturity (available from CLASS) should be used. NCEI reprocessed and released the early mission data using up-to-date

algorithms and look-up tables. The reprocessed data can be found at https://data.ngdc.noaa.gov/platforms/solar-space-observing-satellites/goes/goes18/l1b/seis-l1b-mpsh_science/

2. Cross-comparisons among the MPS-HI electron telescopes using three months of data (September 7 to December 6, 2022) give scale factors (SF) ranging from 0.630 to 1.233 depending on the energy and telescope. These SFs have not been applied to the data, and might be revised following the application of this cross-comparison method to a longer period of data.

3. Cross-comparisons among the MPS-HI proton telescopes using three months of data (September 7 to December 6, 2022) give SFs ranging from 0.723 to 1.287 depending on the energy and telescope. Some of these differences may be due to the finite gyroradii effects of the protons, particularly at higher energies, which has not been accounted for in the present analysis. These SFs have not been applied to the data, and might be revised following the application of this cross-comparison method to a longer period of data.

4. Comparisons between >2 MeV electron fluxes observed by GOES-17 and GOES-18 MPS-HI during the period of June 7 to September 5, 2022, when the two spacecraft were only 0.4 degrees of longitude apart, show good agreement above the Space Weather Prediction Center (SWPC) alert level of 1000 particle flux units. The agreement is better for telescopes 2, 3, and 4 with near-unity ratios between GOES-17 and GOES-18, while telescopes 1 and 5 show lower GOES-17 fluxes. SWPC uses the >2 MeV fluxes from telescope 4 for its alerts.

5. Comparisons between GOES-17 and GOES-18 MPS-HI electron differential channels during the period of September 7 to December 6, 2022 (three months), show excellent agreement, with the vast majority of channel/telescope pair flux ratios being close to 1. A small exception is telescope 5, for which the GOES-18 fluxes in certain channels are slightly lower than GOES-17.

6. Comparisons between GOES-17 and GOES-18 MPS-HI proton differential channels P1-P7 (80 keV – 1 MeV) during the period of September 7 to December 6, 2022 (three months), show that GOES-17 proton fluxes are lower by a factor of 2-4. The possibility of degradation of the GOES-17 proton channels is currently being investigated.

7. Comparisons of solar proton observations by GOES-16, GOES-17, and GOES-18 MPS-HI channels P8 (1-1.9 MeV) and P9 (1.9-3.2 MeV) show good agreement for most cases, within 20% (with a few exceptions). Comparisons of GOES-16 and GOES-18 P10 (3.2-6.5 MeV) and P11 (6.5-12 MeV) channels show that the GOES-18 fluxes are much higher than GOES-16. Similar comparisons of GOES-17 and GOES-18 P10 and P11 channels show similar fluxes.

8. Comparison of a Solar Energetic Particle (SEP) event (February 26-28, 2023) observed by GOES-18 MPS-HI P8-P11 (1-12 MeV) and GOES-18 SGPS P1-P4 (1-12 MeV) channels, show lower MPS-HI fluxes for P8-P10 (1-6.5 MeV) and similar fluxes for MPS-HI P11 and SGPS P4 (6.5-12 MeV). The MPS-HI and SGPS sensors have different look directions, but during an SEP event under high solar wind dynamic pressure and during a geomagnetic storm (as in the February 26-28, 2023, event) isotropy should have been reached, and thus all units should have seen the same SEP fluxes, MPS-

HI and SGPS alike. The MPS-HI and SGPS spare sensors are due for beam calibration at the Brookhaven National Laboratory (BNL) in early December 2023.

9. Evaluation of the GOES-18 MPS-HI electron channel E9-E11 (>1970 keV) backgrounds during a four-month period (September 1 to December 31, 2022), shows that the method used to estimate the backgrounds is successful in reducing the originally high backgrounds assumed to be due to Galactic Cosmic Rays (GCRs). An evaluation of the association between the E9-E11 backgrounds and the SGPS-X P11 (>500 MeV) proton fluxes for the entire GOES-16 mission (nearly 7 years of data), shows that the MPS-HI E9-E11 backgrounds are following the SGPS-X P11 fluxes (at least for some telescopes), the latter due to GCRs. Further evaluation of the GOES-18 E9-E11 backgrounds shows the same relation to the GOES-18 SGPS-X P11 fluxes. The backgrounds will be re-evaluated again for a longer time period, to ascertain the consistency of the current methodology, and assess the need or not of an MPS-HI Look-Up Table (LUT) update.
10. Comparisons between particle detectors with different energy channels must include careful estimation of the effective energies of the channels. The broader the channels, the more sensitive such estimates are to assumptions.

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NCEI website for GOES-R Space Weather data (provides daily aggregations of MPS-HI L1b data):
https://www.ngdc.noaa.gov/stp/satellite/goes-r.html