GOES-16 SEISS MPS-HI Level 1b (L1b) Data Release
Full Data Quality
October 13, 2021
Updated: February 1, 2022
Read-Me for Data Users

The Peer Stakeholder - Product Validation Review (PS-PVR) for the GOES-16 Space Environment In-Situ Suite (SEISS) Magnetospheric Particle Sensor – High Energy (MPS-HI) L1b Provisional Maturity was held on October 13, 2021. As a result of this review, NOAA has confirmed that the MPS-HI L1b data are at Full Validation Maturity as of October 13, 2021.

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-16 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 MPS-HI L1b data prior to declaration of Provisional Maturity should be used. NCEI will reprocess and release the early mission data using up-to-date algorithms and look-up tables.

2. Cross-comparisons among the MPS-HI electron telescopes using five months of data (January-May 2021) give scale factors (SF) ranging from 0.676 to 2.275 depending on the energy and telescope. These SFs have not been applied to the data. An investigation into the temporal evolution of these SFs from 05/2018 to 03/2021, reveals mostly steady near-unity values for telescope 1, steady near-unity values with some exceptions for telescope 2, and variable, mostly higher than unity values for telescopes 3 and 5.

3. Cross-comparisons among the MPS-HI proton telescopes using five months of data (January-May 2021) give SFs ranging from 0.504 to 1.613 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. An investigation into the temporal evolution of these SFs from 05/2018 to 03/2021, reveals mostly steady near-unity values with some exceptions for telescopes 1 and 5, variable, mostly near-unity values for telescope 3, and oscillating with a period of 1 year, slightly above unity values for telescope 4.

4. Comparisons between >2 MeV electron fluxes observed by GOES-16 MPS-HI and GOES-13 EPEAD during the period January to October 2017 indicate reasonable agreement. Remaining differences may be due to the much larger field-of-view on GOES-13. Comparisons between >2 MeV electron fluxes observed by GOES-16 and -17 MPS-HI during the period June to September 2018 indicate excellent agreement.

5. Comparisons between GOES-16 MPS-HI electrons and GOES-13 MAGED electrons during the period January to October 2017 generally indicate good agreement, with some discrepancies, particularly between the lowest energy channels. The agreement improves during the period 12/12/2017-01/02/2018 when the two spacecraft were at a near-conjunction, separated only by 0.7 degrees longitude. A similar comparison between GOES-16 and GOES-17 MPS-HI electrons during the period June to September 2018 shows excellent agreement. An exception is channel E3 of telescope 4, for which the GOES-16 fluxes and spectral shape are out of family.

6. Comparisons between GOES-16 MPS-HI protons and GOES-13 MAGPD protons during the period January to October 2017 indicate that MAGPD fluxes are a factor of 2-3 too low. GOES-13 has been on-orbit since June 2006, i.e. over eleven years at the time of comparison, so radiation damage may be a factor. Similar comparisons between GOES-16 and GOES-17 MPS-HI protons show that GOES-16 proton fluxes are lower by a similar factor. The possibility of degradation of the GOES-16 proton channels is currently being investigated. Channel P1 of all telescopes is an exception for which the GOES-16 proton fluxes are out of family with the rest of the GOES-16 channels, and higher than the GOES-17 fluxes. The P1 discrepancy is under investigation.

7. Solar proton observations above 3.2 MeV (channels P10 and P11) are at least a factor of 2 lower than GOES-13 and -15 EPEAD observations, and lower than measurements in the same energy range by SEISS SGPS channels P3-P4. The reasons for these discrepancies are being investigated.

8. There is currently no sign of solar proton contamination of the electron channels. However, a suitable large SEP event with significant fluxes above 300 MeV would be needed to definitively determine this.

9. 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.

10. A preliminary analysis of GOES-16 proton data from channels 1-7 was performed after Post-Launch Test (PLT) over the quiet days (daily average Kp ≤ 1+) between 1/2/2018 and 2/15/2021. PLT was excluded due to a difference in the magnetic latitude at 90° West vs 75° West geographic longitude. The analysis indicates a decline in all channels in the reported daily average flux of 8% to 24% per year, where the values differ with proton telescope and energy band. The source of the decline is being reviewed. Data will be compared with GOES-T/18 proton data after launch planned for March 1, 2022. For more detailed information on the observed decline for different telescopes and energy bands please contact Frederick Rich, frederick.rich@ll.mit.edu, or Brent Parham, jparham@ll.mit.edu.

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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