GOES-19 SEISS MPS-HI Level 1b (L1b) Data Release
Provisional Data Quality
February 14, 2025
Read-Me for Data Users

The Peer Stakeholder - Product Validation Review (PS-PVR) for the GOES-19 Space Environment In-Situ Suite (SEISS) Magnetospheric Particle Sensor – High Energy (MPS-HI) L1b Provisional Maturity was held on February 14, 2025. As a result of this review, the PS-PVR panel chair has declared that the MPS-HI L1b data are at Provisional Validation Maturity as of February 14, 2025.

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.

Provisional validation maturity, by definition, means:

- Validation and quality assurance activities are ongoing, and the general research community is now encouraged to participate.
- Severe algorithm anomalies are identified and under analysis. Solutions to anomalies are in development and testing.
- Incremental product improvements may still be occurring.
- Users are engaged in the Customer Forums, and user feedback is assessed.
- Product performance has been demonstrated through analysis of a small number of independent measurements obtained from selected locations, periods, and associated ground-truth/field program efforts.
- Product analysis is sufficient to communicate product performance to users relative to expectations.
- Documentation of product performance exists that includes recommended remediation strategies for all anomalies and weaknesses. Any algorithm changes associated with severe anomalies have been documented, implemented, tested, and shared with the user community.
- Testing has been fully documented;
- Product is ready for operational use and for use in comprehensive calibration/validation activities and product optimization.

Users of the GOES-19 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 during periods when the same flux is expected in telescopes under comparison, using two months of data (September 1 to October 31, 2024), give scale factors (SFs) ranging from 0.751 to 1.175 depending on the energy and telescope (when there are enough pitch angle matches). 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 during periods when the same flux is expected in telescopes under comparison, using two months of data (September 1 to October 31, 2024), reveal two proton telescope families. Comparison of Telescope 1 with the reference telescope (Telescope 2) give SFs ranging from 0.784 to 1.239 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. Comparison of Telescopes 3-5 with the reference telescope give SFs ranging from 1.336 to 2.962. These large SFs are consistent with the lower fluxes reported by Telescopes 3-5, which will be actively investigated and reported back at Full Validation. All the above 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-16 and GOES-19 MPS-HI during the month of September 2024 show that the ratio of GOES-16/GOES-19 has a distribution with a median at 0.72 for the equatorial pointing Telescope 4. Telescopes 1, 2, 3, and 5 have ratio distributions with medians 0.85, 0.76, 0.78, and 0.69, respectively. These results indicate lower fluxes at the older GOES-16 MPS-HI unit. However, the calibration effort was hampered by insufficient amount of high-energy electron fluxes since the GOES-19 launch.
5. Comparisons between GOES-16 and GOES-19 MPS-HI electron differential channels during the period of August 23 to November 9, 2024 (approximately 2.5 months), show good agreement in general, with some lower GOES-16 fluxes. There are also some channel/telescope pairs for which GOES-19 has somewhat lower fluxes. The E9-E10 channel results were affected by the lack of adequate high fluxes observed by both instruments.
6. Comparisons between GOES-16 and GOES-19 MPS-HI proton channels P1-P5 show that GOES-16 proton fluxes are lower by a factor of 4-10. The possibility of degradation of the GOES-16 proton channels is currently being investigated. New evidence from the comparison of GOES-16 and GOES-19 during the geomagnetic storm and solar energetic particle (SEP) event of October 9-11, 2024, suggests that the main cause of the proton channel degradation is a shift of the channel

effective energies to higher values, as opposed to a loss of the detector gain. Characterization of the effective energy shift as a function of energy and time is the new priority.

7. Comparison of a Solar Energetic Particle (SEP) event (October 9-11, 2024) observed by GOES-19 MPS-HI P8-P11 (1-12 MeV) and GOES-19 SGPS P1-P4 (1-12 MeV) channels, show similar MPS-HI and SGPS fluxes for all channels and Telescopes 1 and 2. The same comparison shows lower MPS-HI fluxes for all channels and Telescopes 3-5, pointing again to two different MPS-HI proton telescope families. This discrepancy is under investigation.
8. Evaluation of the GOES-19 MPS-HI electron channel E9-E11 backgrounds during a two-month period (September 1 to October 31, 2024), 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). GCR backgrounds in these channels have been decreasing since solar minimum, and, based on analysis of GOES-16 data, the change in the GCR energy spectrum that this decrease represents may be affecting the background correction factors. The backgrounds are actively being evaluated, to ascertain the consistency of the current methodology, or to adapt the technique to better estimate the MPS-HI E9-E11 backgrounds.
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.

Full inter-calibration results are presented in instrument performance reviews available at https://www.noaasis.noaa.gov/GOES/product_quality.html by sequentially selecting menu items: GOES-16, -17 or -18 PS-PVRs, SEISS tab, “Magnetospheric e-/p+: High Energy”, then Provisional or Full “Science Presentation”.

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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