

GOES-18 SEISS SGPS Level 1b (L1b) Data Release
Full Data Quality
September 13, 2023
Read-Me for Data Users

The GOES-R Peer Stakeholder - Product Validation Review (PS-PVR) for Space Environment In-Situ Suite (SEISS) Solar and Galactic Proton Sensor (SGPS) L1b Full Maturity was held on September 13, 2023. As a result of this review, NOAA has confirmed that the SGPS L1b data are at Full Validation Maturity.

There are two SGPS sensor units mounted on each GOES-R series spacecraft, facing in the spacecraft -X and +X directions. When the spacecraft is not in the yaw-flipped configuration SGPS-X faces west and SGPS+X faces east. Each SGPS unit has three solid-state (silicon detector) telescopes T1, T2, and T3 for measuring 1-25, 25-80, and 80-500 MeV protons, respectively. All three telescopes have the same look direction (i.e., +X or -X). T1 and T2 have 60° (full cone angle) fields of view, and T3 has a 90° field of view. Each unit measures 1-500 MeV proton fluxes in 13 logarithmically spaced differential channels (P1-P10) and >500 proton flux in a single integral channel (P11). The L1b data product is one-second cadence fluxes. The channels generally register counts above backgrounds only during solar energetic particle events, except for P11 which measures galactic cosmic rays in the absence of a solar particle event.

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 is defined and documented over a wide range of representative conditions via ongoing validation efforts.
- Product is 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 SGPS 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. GOES-18 SGPS+X T3 P8C, P9, P10 and P11 channels exhibit temperature dependent fluctuations in count rates up to ~30%. At time of writing, these diurnal variations in count rates and reported fluxes have minima near 6 UTC and maxima near 18 UTC. A temperature correction scheme, successfully applied to GOES-16 SGPS, has been implemented downstream of L1b processing. The temperature correction has not been applied to GOES-18 SGPS data yet. The GOES-18 SGPS one- and five-minute averages output from level 2 (L2) processing will be temperature corrected in the future. This will be done retrospectively to all GOES-18 SGPS L2 data since GOES-18 SGPS data was declared to be at Provisional Validation Maturity on September 13, 2022.

3. SGPS-X and +X P5 are contaminated with electrons when radiation belt fluxes are elevated. The magnitude of the contamination is very small with respect to solar proton fluxes during a moderate SEP event.
4. Some channels are not performing as characterized with beam calibrations; as a result, some geometric factors may need adjustment (TBD). GOES-18 SGPS-X P8C and P9 are reporting a factor of 2-3 high with respect to other SGPS units. SGPS+X P10 showed little to no response during the 2022-2023 SEP events, while SGPS P10 fluxes from GOES-18 SGPS-X and other SGPS units were in good agreement. GOES-18 SGPS T1 channels agree exceptionally well with GOES-16 and -17 units.
5. There are frequent gaps in L1b data.
6. During the September 2017 SEP event, GOES-16 SGPS reported fluxes were about a factor of two higher than GOES-13 and -15 fluxes in the T3 energy range (83-500MeV). T1 and T2 fluxes were not systematically high or low, but had significant differences with GOES -13 and -15 in some cases. Most GOES-18 SGPS channels are reporting similarly to GOES-16 SGPS.
7. SGPS P1-P9 differential channels were designed and calibrated to measure SPE spectra. Outside of SEP events, when SGPS observes galactic cosmic ray protons, background fluxes reported from these channels are much higher than actual GCR fluxes.
8. Occasionally records in the L1b NetCDF files are not chronologically ordered. This is typically manifested as two chronologically swapped records. A naive time series reading routine may cause the data to be plotted or analyzed incorrectly. We suggest sorting the NetCDF records with respect to their timestamps prior to plotting or time series analysis.

Pre-launch SEISS overview:

Dichter, B. K., Galica, G. E., McGarity, J. O., Tsui, S., Golightly, M. J., Lopate, C., Connell, J. J. (2015). Specification, design and calibration of the space weather suite of instruments on the NOAA GOES-R program spacecraft. *IEEE Transactions on Nuclear Science*, 62(6), 2776–2783.

Comprehensive review of SGPS measurements:

Kress, B. T., Rodriguez, J. V., Boudouridis, A., Onsager, T. G., Dichter, B. K., Galica, G. E., & Tsui, S. (2021). Observations from NOAA's newest solar proton sensor. *Space Weather*, 19, e2021SW002750. <https://doi.org/10.1029/2021SW002750>

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

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

NCEI contacts for specific information on the SGPS L1b data:

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