GOES-16 SEISS SGPS Level 1b (L1b) Data Release
Full Data Quality
March 18, 2020
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 March 18, 2020. As a result of this review NOAA has confirmed that the SGPS L1b data are at Full Validation Maturity as of March 18, 2020.

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^{o} (full cone angle) fields of view, and T3 has a 90^{o} 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 activities are ongoing and the general research community is now encouraged to participate;
- Incremental product improvements may still be occurring;
- Users are engaged and user feedback is assessed;
- Product performance has been demonstrated through analysis of a small number of independent SEP measurements obtained from GOES-East (GOES-13) and GOES-West (GOES-15) in 2017;
- Products are operationally optimized, as necessary, considering mission parameters of cost and schedule, as compared to user 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, and tested;
- All known product anomalies are documented, and shared with the user community;
- All product testing, analysis, and results have been fully documented;
- Product considered operational.

Users of the GOES-16 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. No SGPS L1b data processed prior to declaration of Full Maturity (e.g., those available from CLASS) should be used. NCEI will reprocess and release the early mission data using the Full Maturity algorithm and look-up tables.

2. SGPS-X T1 and T3 exhibit temperature dependent variations in count rates up to ≈50%. The variations appear as sudden step changes in flux (2 per day) in T3 P8C-P11 and more gradual drops in T1 flux centered near 19h local time. A temperature correction scheme is being implemented downstream of L1b processing. The one- and five-minute averages output from level 2 (L2) processing will be temperature corrected. The L2 data is not available yet.

3. During the September 2017 solar energetic particle (SEP) events, SGPS+X P7 flux was anomalously low. It was about an order of magnitude low in comparison with SGPS-X P7 and with respect to the spectrum inferred from neighboring channels. The cause is yet unknown. Measurements from this channel should not be used.
3. SGPS+X P5 is low due to an overcorrection in L1b processing. The out-of-band removal coefficients are set too high. L1b flux from this channel should not be used until the coefficients are adjusted.
4. SGPS+X P5 is contaminated with electrons when radiation belt fluxes are elevated. The magnitude of the contamination with respect to solar proton fluxes during a SPE has not been fully characterized yet.
5. Some channels are not performing as characterized with beam calibrations; as a result, some geometric factors may need adjustment. For example, SGPS +X and -X P4 differ by about a factor of 4 during the 16-17 July 2017 SEP event, during a period when high solar wind dynamic pressure is expected to suppress geomagnetic cutoffs sufficiently that we should observe similar SEP fluxes in the east and west facing units.
6. There are frequent gaps in L1b data.
7. During the September 2017 SEP event, SGPS fluxes are about a factor of two higher than GOES-13 and -15 fluxes in the T3 energy range (83-500MeV). T1 and T2 fluxes are not systematically high or low, but have significant differences with GOES -13 and -15 in some cases.
8. Outside of SEP events, when SGPS observes galactic cosmic ray protons, the processed fluxes are too high for channels below P10, since the processing uses geometric factors derived for SEP spectra, in the derivation of which the high-energy response is neglected (i.e., background levels are higher than GCR fluxes in SGPS P1-P9 channels).
9. 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.

Literature

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.

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