

GOES-18 ABI L2+ Shortwave Radiation Budget (SRB)

Full Data Quality

December 9, 2024

Read-Me for Data Users

GOES-R Advanced Baseline Imager (ABI) L2+ products will achieve Full Validation maturity by default after two years of Provisional and Operational use with no major anomalies reported (minor product improvements may still be occurring). As a result, GOES-18 Shortwave Radiation Budget (SRB) is considered Full Validation maturity as of January 4, 2025.

The ABI L2+ SRB product includes the Reflected Shortwave Radiation: Top of Atmosphere (RSR), Downward Shortwave Radiation: Surface (DSR), associated quality flags, mean, maximum, minimum, and standard deviation. RSR and DSR are, respectively, the instantaneous shortwave (0.2 – 4.0 μm) radiative fluxes reflected to space at the top of atmosphere (TOA) and transmitted to the Earth's surface. Starting with the update of the Baseline Algorithm to the Enterprise Algorithm on April 17, 2024, a new product, the Photosynthetically Active Radiation (PAR) product, became available as an output of the SRB algorithm, and is considered Provisional maturity. PAR is the instantaneous visible (0.4 – 0.7 μm) radiative flux transmitted to the Earth's surface. The Enterprise DSR and RSR products became available at 16:40 UTC on April 17, 2024, and distribution of PAR started at 19:10 UTC on April 26, 2024. All products are reported in units of W m^{-2} , and all represent instantaneous values at the time indicated in the files.

- *Measurement range:* 0 to 1300 W m^{-2} for RSR, 0 to 1500 W m^{-2} for DSR, and 0 to 700 W m^{-2} for PAR.
- *Temporal coverage:* RSR, DSR, and PAR retrievals are produced only during daytime with solar zenith angles less than 90 degrees.
- *Refresh:* RSR and DSR are produced once per hour from the Baseline Algorithm until April 17, 2024, after which date RSR, DSR, and PAR are produced every 10 minutes from the Enterprise Algorithm.
- *Spatial coverage:* Until April 17, 2024, RSR were produced in the Full Disk (FD) and in the Contiguous United States (CONUS) domains, and DSR was produced in FD, CONUS, and Mesoscale domains. After April 17, 2024, RSR, DSR, and PAR are produced only in the FD domain. Low solar and satellite elevation (zenith angle larger than 70°) reduces the spatial coverage in the good-quality RSR, DSR, and PAR data.
- *Spatial resolution:* Until April 17, 2024, RSR were produced on a global equal-angle latitude/longitude grid at a 0.25-degree (25 km) spatial resolution in the FD and CONUS domains. DSR was also produced on a global equal-angle latitude/longitude grid but at a 0.50-degree (50 km) resolution for FD, at 0.25-degree (25 km) for CONUS, and at 0.05-degree (5 km) for the Mesoscale (MESO) domain. Starting April 17, 2024, RSR, DSR, and PAR are produced at the 2-km ABI pixel resolution.

GOES-18 RSR, DSR, and PAR are evaluated with RSR from the NASA Fast Longwave And SHortwave Radiative Fluxes (FLASHFlux) product, with DSR measured at the ground in the Surface Radiation Budget Network (SURFRAD) and in the Solar Radiation Network (SOLRAD), and with PAR measured at the

ground in SURFRAD. The Baseline DSR average bias (accuracy) and standard deviation of biases (precision) are generally less than 50 W m^{-2} and 100 W m^{-2} , respectively. These for RSR are 90 W m^{-2} and 130 W m^{-2} . The accuracy and precision of the Enterprise products are generally better, DSR biases and standard deviation of biases are less than 30 W m^{-2} and 80 W m^{-2} , respectively. These for RSR are 50 W m^{-2} and 100 W m^{-2} . The accuracy and precision of the Enterprise PAR product are generally less than 40 W m^{-2} .

In general, the good quality retrievals are recommended for quantitative applications due to their better overall performance. Compared to the products from the Baseline Algorithm, the quality from the Enterprise Algorithm is improved as a result of updating the way the TOA broadband (shortwave) albedo needed in the retrieval process is determined from the narrow-band ABI reflectances.

The product quality is sensitive to upstream processing, such as the quality of calibration, navigation, cloud mask, snow mask, and total precipitable water.

A full description and format of the RSR and DSR products from the Baseline Algorithm is in the Product Definition and User's Guide (PUG) Volume 5: Level 2+ Products, located on OSPO's GOES-R documents webpage: <https://www.ospo.noaa.gov/Organization/Documents/goes-r.html>. The Enterprise Algorithm descriptions for RSR, DSR, and PAR will be added to a future PUG version. The enterprise algorithms used for deriving RSR, DSR, and PAR from ABI observations are described in the "Algorithm Theoretical Basis Document for Downward Shortwave Radiation (Surface), and Reflected Shortwave Radiation (TOA), Enterprise Processing System (EPS) Version", located on STAR's GOES-R ATBD webpage: https://www.star.nesdis.noaa.gov/goesr/documentation_ATBDs.php. The baseline ATBD can be found there as well.

Full maturity, by definition, means that:

- 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 bear all responsibility for inspecting the data prior to use and for the manner in which the data are utilized. Persons desiring to use the GOES-18 ABI RSR, DSR, and PAR products for any reason, including but not limited to scientific and technical investigations, are encouraged to consult the NOAA algorithm working group (AWG) scientists for feasibility of the planned applications.

Known product issues:

1. Products from the Baseline Algorithm (pre-April 17, 2024, not produced after this date):
 - a. GOES-18 MESO DSR product is frequently missing or has only missing values. When available and has valid (non-missing) values it is mapped to the wrong geographical location, and may have large errors (due to application of a low-quality broadband clear-sky composite TOA albedo). Users should not use the GOES-18 MESO product.
 - b. Incorrect statistics (mean, maximum, minimum, and standard deviation) in Mode 4 CONUS metadata.
2. Inconsistent units (percent) in some metadata variables. For example, variable "image_cloud_fraction" states the units are percent, but the data are fraction within 0 and 1.
3. The variable "algorithm_dynamic_input_data_container", meant to list names of dynamic input data files required to run the SRB algorithm, is not set (null) for dynamic NWP total column ozone and total precipitable water, and for global snow mask.
4. The retrieval algorithm uses coefficients for converting narrowband reflectances to broadband albedos that have been derived for GOES-16 not for GOES-18.
5. DQF attributes 'percent_good_quality_qf' and 'percent_degraded_or_invalid_qf' may have incorrect values. They also represent fraction not percent.
6. The continuous dynamic ancillary data, clear-sky instantaneous TOA albedo time-series, is reset and loses previous data from time to time; this negatively impacts retrieval quality.

Known PUG issues:

1. The current version (v2.5, June 2024) of the PUG describes only the Baseline SRB products, and thus domains and spatial and temporal resolutions in it do not apply to the Enterprise products. It does not describe the PAR product either.

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