

GOES-16 ABI L2+ Shortwave Radiation Budget (SRB)

Full Data Quality

May 28, 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-16 Shortwave Radiation Budget (SRB) is considered Full Validation maturity as of October 23, 2020.

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. All products are reported in units of W m^{-2} , and all represent instantaneous values at the time indicated in the files. The Enterprise Algorithm went operational on April 17, 2024. Starting with the update of the Baseline Algorithm to the Enterprise Algorithm, the new 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 14:30 UTC on April 17, 2024, and distribution of PAR started at 19:10 UTC on April 26, 2024.

- *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 Continental 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 domain. Starting April 17, 2024, RSR, DSR, and PAR are produced at the 2-km ABI pixel resolution.
- *Quality:* An evaluation of GOES-16 RSR, DSR, and PAR 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 network indicates that the mean biases are less than 60 W m^{-2} . In the low and mid ranges (fluxes less than about 500 W m^{-2}) the DSR biases are positive and generally less than 30 W m^{-2} , they become negative in the high range. The standard deviation of biases is less than 130 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-16 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. MESO DSR product may have large errors due to low-quality broadband clear-sky composite TOA albedo needed in the retrieval.

- b. MESO DSR occasionally may include only fill values.
 - c. 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.

Known PUG issues:

1. The current version (v2.4, July 2022) of the PUG describes only the Baseline SRB products.

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