GOES-17 ABI L2+ Shortwave Radiation Budget (SRB) Release
Provisional Data Quality
June 27, 2019
Read-Me for Data Users

The GOES-R Peer Stakeholder - Product Validation Review (PS-PVR) for GOES-17 Advanced Baseline Imager (ABI) L2+ Shortwave Radiation Budget (SRB) Provisional Maturity was held on June 27, 2019. As a result of this review, the PS-PVR panel recommended that the ABI SRB product be declared Provisional Maturity for the cold, stable periods of the day.

Cold periods are those that are minimally impacted by the GOES-17 Loop Heat Pipe (LHP) anomaly that results in insufficient cooling of the detectors on the long-wave infrared (LWIR) focal plane module (FPM). For evaluation of the GOES-17 SRB product, the cool period was identified as all daytime observations excluding times when the LWIR channels are predicted to be saturated. These dates and times are listed in the Table below, which is a shortened version of the one at https://www.goes-r.gov/users/GOES-17-ABI-Performance.html#channelSaturationPredictions.

2019 ABI CHANNEL SATURATION PREDICTIONS	
Date Range	*Time of Day*
1 Jan – 26 Feb	Saturation can occur daily between 0830-1730 UTC with peak saturation occurring at approximately 1300 UTC.
26 Feb – 20 Mar	Saturation can occur daily between 0900-1700 UTC with peak saturation occurring at approximately 1300 UTC.
20 Mar – 13 Apr	Saturation can occur daily between 0900-1700 UTC with peak saturation occurring at approximately 1300 UTC.
13 Apr – 26 May	Saturation can occur daily between 0900-1700 UTC with peak saturation occurring at approximately 1300 UTC.
26 May – 20 Jul	No channel saturation
20 July - 30 Aug	Saturation can occur daily between 0900-1700 UTC with peak saturation occurring at approximately 1300 UTC.
30 Aug - 23 Sep	Saturation can occur daily between 0930-1630 UTC with peak saturation occurring at approximately 1300 UTC.
23 Sep - 16 Oct	Saturation can occur daily between 0900-1700 UTC with peak saturation occurring at approximately 1300 UTC.

16 Oct - 12 Dec	Saturation can occur daily between 0900-1700 UTC with peak saturation occurring at approximately 1300 UTC.

The GOES-R Series Level I Requirements (LIRD) are not yet updated to reflect the operational Mode 6; however, for completeness the LIRD requirements are stated here: Downward Shortwave Radiation at Surface shall be produced every 60 minutes for Full Disk, CONUS, and Mesoscale. Reflected Shortwave Radiation at TOA shall be produced every 60 minutes for Full Disk and CONUS.

GOES-17 was placed into Mode 6 on April 2, 2019. The cadence of L2 products for Mode 6 is different from Mode 3 and the official requirements defined in the GOES-R L1RD. However, the cadence of Shortwave Radiation product did not change, they are still produced every 60 minutes for all required domains.

The ABI L2+ SRB product includes the Reflected Shortwave Radiation: Top of Atmosphere (RSR) and the 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. Both are reported in units of W m^{-2}.

- *Measurement range*: 0 to 1300 W m^{-2} for RSR and 0 to 1500 W m^{-2} for DSR.
- *Temporal coverage*: RSR and DSR retrievals are produced only during daytime with solar zenith angles less than 90 degrees.
- *Refresh*: RSR and DSR are produced once per hour; they represent instantaneous fluxes at the time indicated in the files, they are not hourly averages.
- *Spatial coverage*: RSR is produced in the Full Disk (FD) and in the Continental United States (CONUS) domains. DSR is produced in FD, CONUS, and Mesoscale domains.

  Retrievals are performed for all daytime grid-cells containing any mixture of clear and cloudy pixels both over land and water.

  Low solar and satellite elevation (zenith angle larger than 70^{o}) reduces the spatial coverage in the good-quality RSR and DSR data.
- *Spatial resolution*: RSR is produced on a global equal-angle latitude/longitude grid at a 0.05-degree (25 km) spatial resolution in the FD and CONUS domains. DSR is 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.
- *Quality*: A preliminary evaluation of GOES-17 RSR and DSR with RSR from the NASA Fast Longwave And SHortwave Radiative Fluxes (FLASHFlux) product and with DSR measured at the ground in the Surface Radiation Budget Network (SURFRAD) and the Solar Radiation Network (SOLRAD) for the period February 12 – May 31, 2019 indicates that the FD and CONUS mean biases are less than 20 W m^{-2}. In the low and mid ranges (fluxes less than about 500 W m^{-2}) the biases are generally positive and

less than 30 W m^{-2}; they become negative in the high range. The standard deviation of biases are somewhat larger than the requirement, but generally less than 135 W m^{-2}.

MESO DSR product was not evaluated because it is incorrectly mapped and frequently missing. Therefore, the GOES-17 MESO product is not recommended to be used at this time.

In general, the good quality retrievals are recommended for quantitative applications due to their better overall performance. The performance is expected to be further improved by 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.

Full description and format of the RSR and DSR products is in the Product Definition and User's Guide (PUG) document (http://www.goes-r.gov/products/docs/PUG-L2+-vol5.pdf). The algorithms used for deriving RSR and DSR from ABI observations are described in the "GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for Downward Shortwave Radiation (Surface), and Reflected Shortwave Radiation (TOA)" (https://www.star.nesdis.noaa.gov/goesr/docs/ATBD/SWRad.pdf). Based on the results summarized above under *Quality* the GOES-17 SRB product starting March 24, 2019 (after a reset of clear-sky composite albedos on February 25, 2019) meet the Provisional maturity definition for the cold, stable periods of the days.

Provisional maturity, by definition, means that:

- Validation 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;
- Product performance has been demonstrated through analysis of a small number of independent measurements obtained from select locations, periods, and associated ground truth or field campaign efforts;
- Product analysis is sufficient to establish product performance relative to expectations (Performance Baseline);
- 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; and
- Product is ready for operational use and for use in comprehensive cal/val activities and product optimization.

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-17 ABI RSR and DSR 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. GOES-17 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 current GOES-17 MESO product.
2. When the source of total precipitable water (TPW) is the ABI sounding errors in DSR and RSR are larger than those when the source is NWP. This is because TPW from ABI is not converted to the unit the SRB algorithm is expecting.
3. Incorrect statistics (mean, maximum, minimum and standard deviation) in M4 CONUS metadata.
4. Inconsistent units (percent) and valid range (0, 1) in some metadata variables. For example, variable "image_cloud_fraction" states the units are percent, but the data are fraction within 0 and 1.
5. The variable "algorithm_dynamic_input_data_container", meant to list names of dynamic input data files required to run the SRB algorithm, is currently not set (null) for dynamic NWP total column ozone and total precipitable water.

Known PUG issues:

1. Accuracy and precision requirements for low end RSR are missing in Table 5.25.1. Accuracy: 110 W/m^2 at low end of range (<200 W/m^2); Precision: 100 W/m^2 for low end of range (<200 W/m^2).
2. The values for longitude offsets 'add offset for lon' in row "Full Disk West" of Table 4.3.7-2 are incorrectly given as 141.625 for 0.25 degrees and 141.75 for 0.5 degrees. The correct values are -218.375 and -218.25, respectively.

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

Contacts for specific information on the ABI L2 SRB product:
Istvan Laszlo istvan.laszlo@noaa.gov
Jaime Daniels jaime.daniels@noaa.gov