GOES-17 ABI Level 1b (L1b) and Cloud and Moisture Imagery (CMI) Products Release
Provisional Data Quality
November 28, 2018
Read-Me for Data Users

The GOES-R Provisional Peer/Stakeholder Product Validation Review (PS-PVR) for ABI L1b and CMI Beta Maturity was held on November 28, 2018. As a result of this review, the panel chair declared Provisional validation maturity for GOES-17 ABI Level 1b (L1b) and Cloud and Moisture Imagery (CMI) products as of November 28, 2018. Additional information can be found at the website: https://www.goes-r.gov/users/transitionToOperations17.html.

The ABI L1b and CMI data products are calibrated and geo-located radiances of the 16 ABI bands over the Full Disk (FD) of the Earth, the Contiguous United States (CONUS) sector for GOES-EAST and the Pacific United States (PACUS) sector for GOES-WEST, the Mesoscale (MESO) sectors, and certain instrument calibration and engineer data. By definition, Provisional maturity 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 communicate product performance to users 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 share with the user community.
- Testing has been fully documented.
- Product is ready for operational use and for use in comprehensive cal/val activities and product optimization.

Users of Provisional data bear 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 Provisional L1b and CMI products for any reason, including but not limited to scientific and technical investigations, are encouraged to gather more information from the GOES-R program and other web pages. Full description and format of the L1b and CMI products are in the Product Definition and User's Guide (PUG) document (http://www.goes-r.gov/products/docs/PUG-L2+-vol5.pdf). The algorithm used to derive CMI from GOES-17 ABI observations is described in the "GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for Cloud and Moisture Imagery (CMIP)" (http://www.goes-r.gov/products/ATBDs/baseline/Imagery_v2.0_no_color.pdf).

Known issues currently being investigated include:

1. An anomaly with the GOES-17 ABI Loop Heat Pipe (LHP) prevents the instrument cooling system from maintaining the desired operating temperature at all times of the year. In addition, the thermal stability is not maintained for some parts of the instrument during certain periods of the day and year.
    a. For 13-14 hours a day, the Focal Plane Module (FPM) is maintained at a stable but elevated temperature (compared to GOES-16). During this period of time, it seems that the LHP anomaly:
        i. Does not affect the Imager Navigation and Registration (INR) performance for all channels.
        ii. Does not affect the accuracy of radiometric calibration performance for Channels 1-15.
        iii. May have caused a warm bias of up to 0.4 K for Channel 16.
        iv. Does not increase noise in Channels 1-6.
        v. Led to higher noise in Channels 7-16 when compared to GOES-16. Four of these channels still meet the Mission Requirements; four nearly meeting the requirement; and Channels 12 and 16 are substantially noisier than GOES-16.
    b. For the other 10-11 hours a day, the FPM temperature rises each night. During the roughly 100 days centered on the vernal and autumnal equinoxes:
        i. INR performance may remain nominal.
        ii. Radiometric calibration performance is less well known, but is further degraded and sometimes unusable for Channels 8-16.
        iii. The peak of the FPM temperatures occurs about 20 days before and after the equinox as shown in Figure 1. The “valleys” in Figure 1 result from the spacecraft being eclipsed by the Earth. The small discontinuities at the bottom of each “valley” results from spacecraft yaw-flip maneuvers which are executed to reduce FPM temperatures.

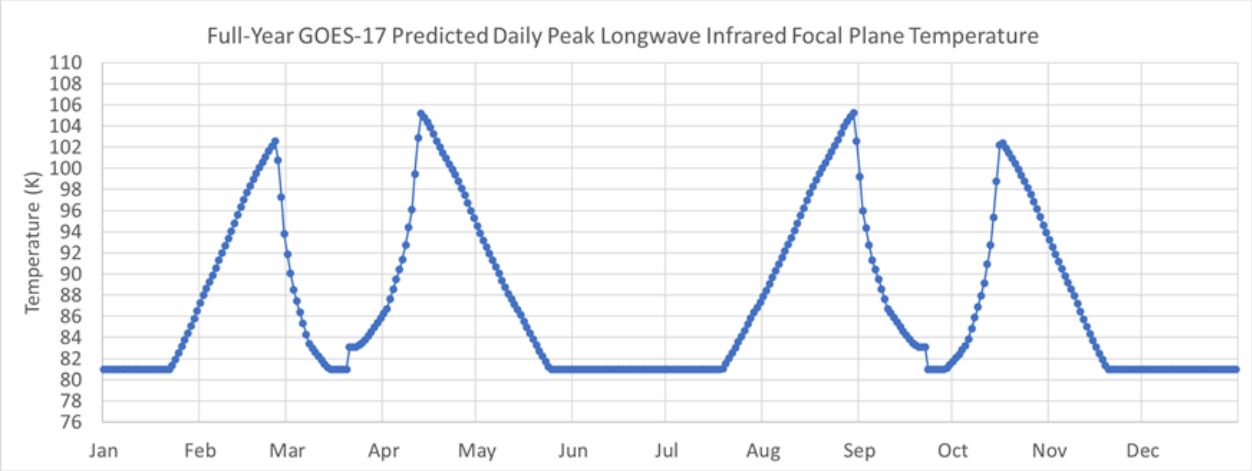

Figure 1. GOES-17 predicted daily maximum longwave focal plane module (FPM) temperature. Courtesy of Harris Corporation. These are approximate maximum daily FPM temperatures. The plot demonstrates the annual seasonal pattern expected due to the warming of the instrument. On a given day, the FPM temperature is stable around 81K most of the day and is only elevated for part of the night. That period varies with the seasons, with the longest duration (~9 hours) on the hottest peak days of the year and the shortest duration (~3 hours) during the coolest peak days. The cooling due to spacecraft eclipse by Earth during the vernal and autumnal equinox are apparent. The estimated times when yaw flips will occur during the equinoxes are seen as sharp discontinuities in March and September. In general, the hotter the FPM temperature, the larger the impact on ABI bands 8-16 quality and ultimately, availability.

2. Stray light exists for Visible and Near IR (VNIR) bands approximately one hour before and after satellite local midnight during the eclipse season before the vernal (spring) equinox and after the autumnal (fall) equinox, and may exist in other days of the year. Effects include:
    a. Significant stray light for Channels 1-6 (VNIR) approximately one hour before and after satellite local midnight for approximately forty days before and after the vernal (spring) and autumnal (fall) equinox, and may exist in other days of the year.
    b. Stray light for Channel 7 approximately one hour before and after satellite local midnight for approximately forty days before and after the vernal (spring) and autumnal (fall) equinox within the Zone of Reduced Data Quality (ZRDQ).
3. Two channels are brighter than commonly accepted values by more than 5% (the accuracy requirement):
    a. Channel 2 (0.64 µm) radiances are approximately 8.9% brighter.
    b. Channel 5 (1.61 µm) radiances are approximately 5.5% brighter.
4. Channel 3 (0.86 µm) radiance may vary slowly by up to 5%. For example, an object with reflectance of 80% may appear as 78% at one time and 82% some months later. This may also happen to Channels 2 & 1 (0.64 µm & 0.47 µm) but to a much lesser degree (~1%).
5. Striping can be seen in ABI Channels 5 (1.61 µm) and 8, 9, 10 (water vapor), 12 (9.61 µm) and 16 (13.3 µm).
6. Bias for many VNIR channels seems negatively correlated with scene radiance, i.e., the darker the scene, the more likely that the ABI radiances have positive bias, and vice versa.
7. Channel 1 (0.47 µm) radiances may be higher on the west end than on the east end by up to 1%. For example, an object with reflectance of 80% may appear as 80.4% on an extreme west location and 79.6% on an extreme east position.

8. When the ABI is operating in Mode 3 (flex mode), remnants of periodic infrared calibration anomalies (PICA) may exist for several channels, especially for Channel 12 (9.6 µm) and Channel 10 (7.4 µm). This is seen through radiance or brightness temperature for every 3rd CONUS image being slightly lower than the other two. It is thought a similar error exists in FD and MESO images but is more difficult to visualize.
9. ABI Channels 8, 9, 10 (water vapor), 11 (8.5 µm), and 12 (9.65 µm) radiance may vary among the swaths. This may cause banding.
10. There may be artificially cold pixels surrounding hot spots in Channel 7 (3.9 µm).

For CMI, all the issues noted above for the radiances are valid, in addition to the following:

1. Currently there are no data quality flags based on focal plane temperatures.

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

Contacts for specific information on the ABI data:
ABI L1b CWG Team Lead: Fred Wu (xiangqian.wu@noaa.gov)
ABI CMI AWG Team Lead: Tim Schmit (tim.j.schmit@noaa.gov)