GOES-16 ABI L2+ Fire and Hot Spot Characterization Release
Provisional Data Quality
April 24, 2018
Read-Me for Data Users

The GOES-R Peer/Stakeholder Product Validation Review (PS-PVR) for ABI L2+ Fire/Hot Spot Characterization (FHS) Provisional Maturity was held on March 30, 2018. As a result of this review and the PS-PVR panel recommended that the ABI Fire and Hot Spot Characterization (FHS) product be declared Provisional.

The ABI L2+ FHS consists of four product outputs: metadata mask, fire radiative power (FRP), instantaneous fire temperature, and instantaneous fire size. The metadata mask assigns a flag to every earth-navigated pixel that indicates its disposition with respect to the FHS algorithm. Not all of the fire classes are appropriate for all users. Operational users who have the lowest tolerance for false alarms should use the "processed" and "saturated" categories (mask codes 10, 11, 30, and 31), but understand there can still be false alarms. There are six categories assigned for fires and probable fires, and each has a temporally filtered equivalent that is the mask code plus 20:

- Processed fire pixel (codes 10 and 30): The highest fire confidence category, includes FRP, size, and temperature estimates.
- Saturated fire pixel (codes 11 and 31): Very high confidence fires, but the pixel was at instrument saturation so no properties could be determined.
- Cloud contaminated fire pixel (codes 12 and 32): A moderate confidence fire that appears to be partially obscured by cloud; intended for users with a high tolerance for false alarms.
- High probability fire pixel (codes 13 and 33): A possible fire with a lower thermal signature than needed to be deemed a Processed fire pixel; FRP is calculated for these pixels; intended for users with a high tolerance for false alarms; false alarms due to water clouds (see below) are common in this category.
- Medium probability fire pixel (codes 14 and 34): A medium confidence fire with a lower thermal signature than a High probability fire pixel would have for this pixel; intended for users with a high tolerance for false alarms; false alarms due to water clouds (see below) are common in this category.
- Low probability fire pixel (codes 15 and 35): Lowest confidence fire class, a large number of false alarms are to be expected, it is included as it also contains small and/or cooler fires; intended for users with a high tolerance for false alarms; false alarms due to water clouds (see below) are common in this category.

The temporally filtered classes are triggered if a fire was found within +/-1 pixel of the currently detected fire in the last 12 hours. The type of fire is assigned based on the most recent detection. Also included in the mask are flags that indicate why a pixel was excluded from consideration, including due to water, certain surface types, clouds, and bad data.

The FRP, size, and temperature fields represent the properties of a fire that would produce the same detected radiant energy for the pixel. Fires vary throughout their burn area in intensity, but the satellite measurement is a composite signal of the entire pixel. FRP, size, and temperature represent the composite properties of that pixel. A hypothetical fire with those properties would produce the same measured radiances. Due to this mixing of subpixel elements and diffraction in the sensor there are large error bars on these retrievals.

Be aware that when comparing simultaneous fire detections and characterizations from different sensors on different satellite platforms (e.g. GOES-R ABI vs. JPSS VIIRS) or even from compatible sensors on different satellites within a series (e.g. GOES-16 vs. GOES-17 ABI), there will be differences due to instrument characteristics, viewing geometry, or surface topography.

The FHS products are generated for every ABI Full Disk (FD) of the Earth and CONtiguous United States (CONUS) region. They are not generated for the Mesoscale (MESO) regions.

A full description and format of the FHS product can be found 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 the FHS products from GOES-16 ABI observations is described in detail in the "GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for Fire / Hot Spot Characterization" (https://www.goes-r.gov/products/ATBDs/baseline/baseline-fire-hot-spot-v2.0.pdf).

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 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 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.

Provisional 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 Provisional maturity Fire/Hot Spot Characterization product 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. This product is sensitive to upstream processing, such as the quality of the calibration and navigation of input ABI L1b data.

Known issues at the Provisional validation stage include:

1. False alarms are known to occur due to water clouds causing reflections that appear fire-like when either the cloud is isolated (typically over a cool surface) or it is overlaid by broken ice clouds, in both cases giving the appearance of hot spots that may be labelled fires, typically in the High, Medium, and Low probability categories – this occurs most frequently at higher latitudes.
2. False alarms due to surface heterogeneity, such as bare ground surrounded by vegetated fields, power plant cooling lakes, urban areas that are not properly screened out, coastlines, and others,

are known to occur and tend to recur in the same locations at certain times of year – these most frequently manifest as low probability and processed fires.

3. A known processing error in the cloud mask causes over-estimates of cloud cover over cold ground and was observed frequently early in Spring 2018. This affects the quality of the cloud mask and the detections of some fires in those regions. The fix will be implemented in 2018 (contact for information).
4. Missing values occur randomly due to upstream L1b issues, typically in the form of rectangular blocks.
5. Temporal filtering is not functioning properly, the earliest a fix will be implemented is late May 2018 – some temporally filtered fire codes may appear, particularly in the northwest of CONUS data, and these should be treated with care.
6. We currently recommend using categories 10, 11, 30 and 30 for operational use. The other fire categories, which represent a lower confidence in fire detection, may produce a number of false alarms that make these classes appropriate to use only by users with high tolerance of false alarms. For details see the discussion of the various fire categories above.

Please feel free to report any false alarms, missed fires, and other concerns to the AWG FHS science team.

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

Contacts for specific information on the ABI L2 FHS product:
Wayne MacKenzie wayne.mackenzie@noaa.gov
Jaime Daniels jaime.daniels@noaa.gov
Ivan Csiszar ivan.csiszar@noaa.gov
Wilfrid Schroeder wilfrid.schroeder@noaa.gov