



*Read-me for Data Users*

**MEMORANDUM FOR:** The JPSS Program Record

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**SUBJECT:** NOAA-20 VIIRS Active Fire EDR validated maturity status  
**DATE:** 1/27/2020

### **Validated maturity status declaration for VIIRS Active Fire EDR**

**Review Date:** 2/6/2020  
**Effective Date:** 12/5/2019  
**Operational System:** NDE 2.0.20

The JPSS Algorithm Maturity Readiness Review Board approved the release of the VIIRS M-band Active Fire product to the public with a Validated maturity level quality as of 12/05/2019 (effective date), based on JPSS Validation Maturity Review held on 02/06/2020 (<https://drive.google.com/open?id=1Mao3lm9fBdqjmZx4sj-4dtyB8FntpRaG>).

The Joint Polar Satellite System-1 (JPSS-1) satellite was successfully launched on November 18, 2017 and renamed NOAA-20 after it reached polar orbit. With the same design as that of the Suomi NPP Visible Infrared Imaging Radiometer Suite (VIIRS), NOAA-20 VIIRS is a cross-track scanning radiometer with 22 channels at wavelengths ranging from 0.41 to 12.5  $\mu\text{m}$ , enabling global measurements of clouds, ocean and land surface temperatures, detection of aerosols and fires, as well as low light from human settlements and other light sources at night.

On January 3, 2018, the NOAA-20 VIIRS started providing earth scene measurements for the mid-wave infrared and thermal bands. By January 5, the data quality enabled the generation of the VIIRS active fire product for evaluation purposes. Based on evaluation presented to the NOAA JPSS program, the NOAA-20 VIIRS NDE Active Fire product is was considered to have Beta maturity with an effectivity date of January 5, 2018. Improvements to the input VIIRS SDR data allowed the VIIRS SDR product to reach Provisional maturity on February 19, 2018. Further evaluation of the VIIRS Active Fire product provided evidence of adequate performance consistent with Provisional maturity. Therefore the product is declared to have Provisional maturity with an effective date of February 19, 2018. Users are however advised of a data gap or degraded data quality on 3/12-16/2018 during the on-orbit procedure for warming the long-wave infrared dewar (see Readme for NOAA-20 Provisional maturity for details).

On December 5, 2019, the NESDIS Data Exploitation (NDE) system deployed a new version of the operational product. This product, in addition to minor algorithm improvements, includes flags of potential false detections due to radiative signal from non-fire sources or persistent thermal anomalies. Further evaluation of the VIIRS Active Fire product, including the performance of the new persistent anomaly flag provided evidence of adequate performance consistent with Validated maturity.

#### **1. Maturity stage definition**

The Definition of Validated maturity stage is available at the JPSS Algorithm Maturity Matrix webpage: <https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>

#### **2. Algorithm Description:**

The NDE VIIRS Active Fire product is consistent with the MODIS Collection 6 algorithm and

includes (1) a 2-dimensional array representing fire and thematic classes for each pixel (2) fire radiative power (FRP) for each pixel identified as “fire” by the fire detection algorithm. Pixels with potential false detections due to non-fire sources or persistent thermal anomalies are flagged. The algorithm processes all daytime and nighttime VIIRS pixels globally. The detection algorithm uses a hybrid approach to detect fires based on fixed thresholds and dynamically adjusted contextual tests. The retrieval of FRP is based on a single-band algorithm, using radiometric information from VIIRS band M13.

The image classification product (fire mask) is the primary science data set consisting of a two dimensional array with same size as the input VIIRS 750 m data used by the fire algorithm. The VIIRS AF fire mask contains nine different pixel classes; three of those classes are used to flag fire-affected pixels along with their detection confidence. FRP retrievals and other supporting data such as fire pixel image element [x] and [y], and latitude/longitude are stored in vector format, each containing  $N$  records describing the number of fire pixels detected. The product is generated in netCDF4 format.

Detailed information on the content of the netCDF4 data file is available in the NDE VIIRS Active Fire EDR Algorithm Theoretical Basis document <https://www.star.nesdis.noaa.gov/jpss/fires.php>

[The processing algorithms and the output data formats for VIIRS on Suomi NPP and NOAA-20 are identical.](#)

### **Product requirements/Exclusions (L1RDS)**

VIIRS Active Fire product requirements are documented in the Joint Polar Satellite System (JPSS) Level 1 Requirements Supplement (L1RDS). The current version of the L1RDS is available at [http://www.jpss.noaa.gov/technical\\_documents.html](http://www.jpss.noaa.gov/technical_documents.html). The NDE VIIRS Active Fire product meets the full set of JPSS Level 1 requirements. VIIRS Active Fire product requirements are also documented in the JPSS ESPC Requirements Document (JERD) Volume 2: Science Requirements Version 2.0.

### **Quality flags**

The various bits within the two-dimensional Quality Assessment (QA) array within the netCDF4 product file describe various aspects of the observing and environmental conditions and the corresponding performance of the various steps in the active fire detection algorithm. The QA array now includes flags for non-fire sources or persistent thermal anomalies. The fire mask array variable also includes an indication of missing or non-processed data. Additionally, fire detections are provided based on their detection confidence value in the fire mask array variable (values 7 to 9). Further details on the QA bits and detection confidence are described in the NDE Active Fire Algorithm Theoretical Basis Document available at <https://www.star.nesdis.noaa.gov/jpss/fires.php> .

### **Product evaluation/validation**

VIIRS AF algorithm retrieval errors are validated using coincident ground-based and high spatial resolution airborne reference data acquired over prescribed fires as well as other fires of opportunity (e.g., wildfires). Currently, availability of quality reference fire data is limited to test-case studies involving ground and airborne sampling of relatively small (<1000 ha) active fires. The VIIRS AF data quality assessment also builds on product inter-comparison using near-coincident active fire data from other spaceborne instruments of similar or higher spatial resolution. Product inter-comparison



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results using Suomi NPP VIIRS and NOAA-20 VIIRS near-coincident active fire data showed high level of agreement between the two products, allowing for tracing back the accuracy of the NOAA-20 VIIRS active fire product to the more extensively validated Suomi NPP active fire product. Evaluation for Validated maturity also included comparison of relative detection performance between the operational 750m product and the experimental 375m VIIRS I/M band “hybrid” product. The results again indicated close agreement in relative detection performance between Suomi NPP and NOAA-20. Limited comparisons with high-resolution airborne imagery have also been performed and confirmed the accuracy of the spatial distribution of VIIRS fire detections.

### **Product availability/reliability**

The NOAA-20 NDE VIIRS Active Fire data is currently in NDE operations. Daily maps of the product are available at the STAR JPSS Long-term Monitoring website at [https://www.star.nesdis.noaa.gov/jpss/n20/products\\_activeFires.php](https://www.star.nesdis.noaa.gov/jpss/n20/products_activeFires.php) . The VIIRS active fire product is also displayed in the NOAA NESDIS JSTAR Mapper system (<https://www.star.nesdis.noaa.gov/jpss/mapper/>).

### **Algorithm performance dependence**

The performance of the VIIRS Active Fire product largely depends on the performance of the VIIRS SDR product. Past issues included dual-gain calibration mismatch, look-up table and quality flag errors (see product maturity documents of the IDPS Suomi NPP VIIRS Active Fire product). The performance of the NOAA-20 VIIRS SDR is deemed to be adequate so that these past issues are not present in the NOAA-20 product.

### **Known errors/issues/limitations**

The algorithm used by the NDE VIIRS Active Fire product is tuned to minimize omission and commission errors globally. Therefore, regionally tuned algorithms may produce better detection results.

### **3. Changes since last maturity stage**

This is the Validated maturity declaration of the NOAA-20 NDE VIIRS Active Fire product. Changes since the last maturity stage include the addition of flags for non-fire and persistent anomaly sources. Validated maturity is declared based on more extensive evaluation and monitoring of the product.

### **4. Review board recommendations**

N/A

### **5. Path Forward/Future Plan**

The NOAA JPSS Active Fire team continues product validation and product improvements, including implementation of multi-band hybrid algorithms.

### **6. Additional Items to note**

None.

Additional information is available in the Active Fire algorithm theoretical basis document (ATBD) and validation maturity review briefing, which can be accessed at:



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<https://www.star.nesdis.noaa.gov/jpss/Docs.php>

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