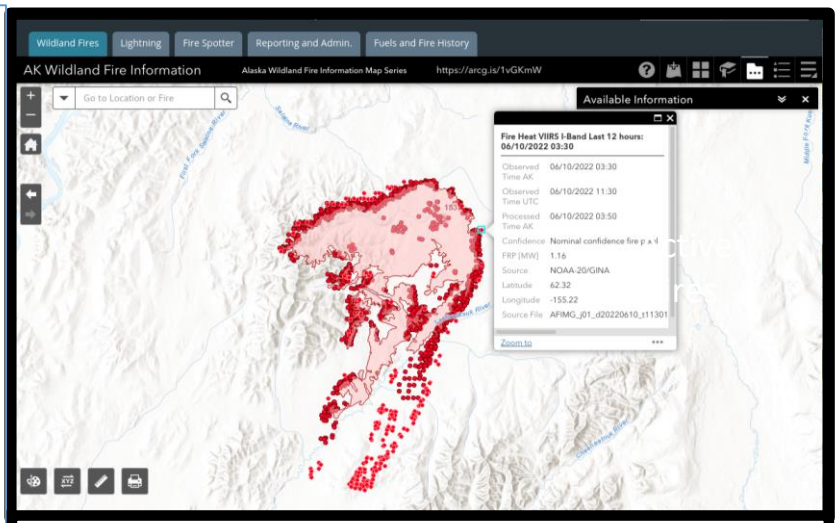
VIIRS Active Fires (VAF) Algorithm

Quick Guide

Why is VIIRS Active Fires Important?

The VAF algorithm provides critical information on significant thermal anomalies across the globe in high detail. It is within software that can be used as a background monitoring utility, continually examining satellite data for potential fires or heat points. VAF output includes fire location, confidence value, and intensity information such as Fire Radiative Power (FRP) which can assist fire response decisions such as the allocation of resources for mitigation efforts. Product information can be used as the basis of an alert system for new fires, or as a monitoring tool for evaluating the distribution, intensity, and evolution of existing fires.



ESRI ArcGIS plot of VIIRS VAF fire detections and the analyzed perimeter for the Tatlawiksuk fire in Alaska at 1900 UTC 10 Jun 2022. Red dots outlined in white are < 12 hrs old and black are 12-24 hrs.

VIIRS Active Fire algorithm and specifications

Algorithm	Wavelengths Used	Resolution	Coverage Frequency	Latency
The VIIRS Active Fire algorithm uses a combination of fixed and contextual tests to detect active fires and thermal anomalies both day and night. Detection criteria are based on 3.74 µm shortwave IR data refined with 11.5 µm longwave data. Three reflectance bands filter for high solar radiation during the day. Criteria is also refined by cloud and water classification schemes.	3.74 µm (I4 band) 11.5 µm (i5 band) 0.64 µm (I01 band) 0.86 µm (I02 band) 1.61 µm (i03 band) 4.05 µm (m13 band)	375 m 375 m 375 m 375 m 375 m 750 m	Varies with latitude from 2 VIIRS satellites (SNPP and NOAA-20). Alaska interior: 10-14 passes/day CONUS: 3-4 passes/day	Less than 30 min from Direct Broadcast sources

Impact on Operations

24-Hour Fire Detection: automated monitoring to identify and locate fire point sources day or night.
Remote Coverage: satellite observations detect fires where no other observations are available.
Frequent Coverage over High Latitudes: Polar satellites pass more often over Alaska & Canada.
High Spatial-Resolution: 375 meters.
Fire Radiative Power (FRP): Higher values equate to higher fire intensity and/or larger fires.
Additional features: identifies industrial burns, gas flares and volcano eruptions.
Persistent Anomalies: identifies common sources of non-wildfire heat sources, such as solar farms, volcanos, etc.

Limitations

Obscuration: clouds, smoke, and terrain may obscure or lower fire intensity values.
Missed Detections: fires too small or smoldering in duff.
False Alarms (day): reflected solar radiation from hot or bright surfaces that are not persistent anomalies. Missed cloud classifications.
False Alarms (night): reflected solar energy from cloud tops near the terminator. Hot smoke plumes.
Temporal Frequency: polar orbiting satellites have less frequent coverage over CONUS than geostationary satellites.

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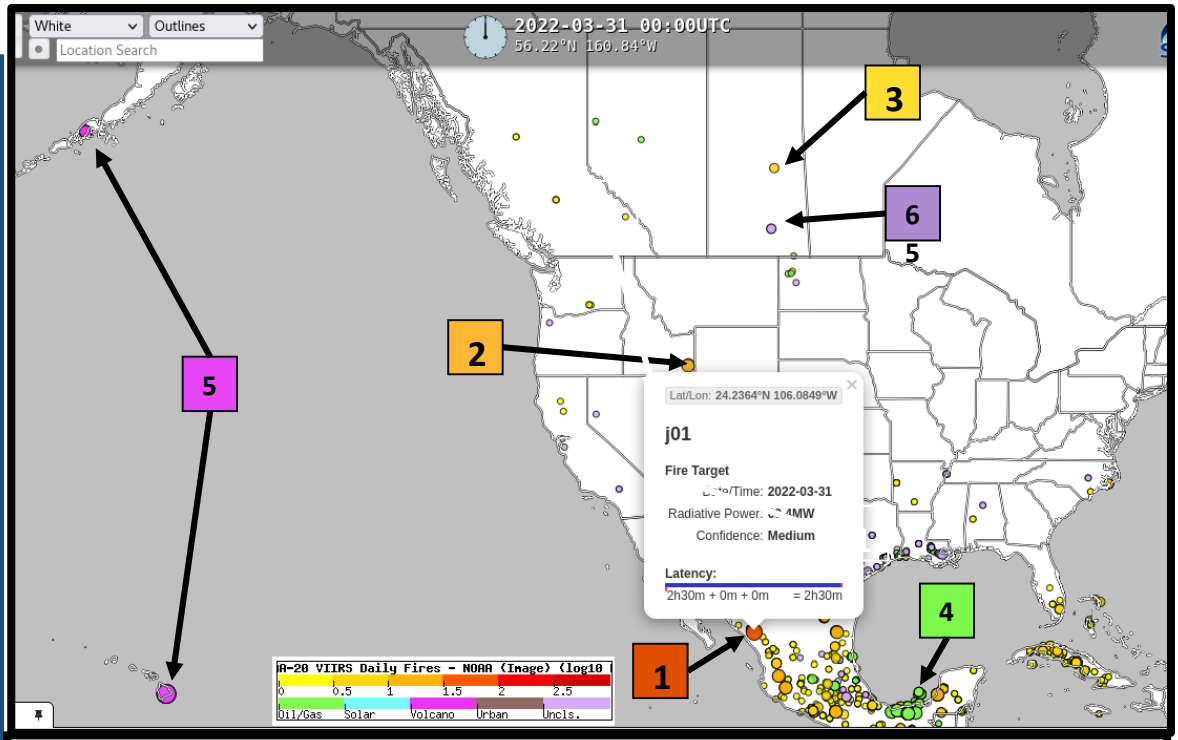
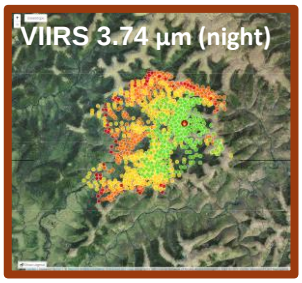
Image Interpretation*

1. **Fire Radiative Power:** *1.5-2.0 MW*
2. **Fire Radiative Power:** *1.0-1.5 MW*
3. **Fire Radiation Power:** 0.5-1.0 MW
4. **Oil/Gas Flares**
5. **Volcano**
6. **Unclassified**

** Point color legend shown at bottom of image.*



RealEarth plot (https://realearth.ssec.wisc.edu) of VIIRS Active Fires points for 0000 UTC 31 Mar 2022. Point colors are used for FRP intensity or for "Persistent Anomalies". Larger points indicate higher FRP. Clicking on a point launches a popup with additional information



Tips for Assessing VIIRS Active Fire Detections

Find the fire pixel location in the i04 (3.74 µm) band imagery:

- ❑ Check how it compares with its surroundings. Are there other fires in the area?
- ❑ Are there nearby clouds, terrain, or shadows that could be impacting the detection?
- ❑ Are there adjacent anomalously cold pixels suggesting fold-over from saturation?
- ❑ Are there persistent anomalies such as volcanoes, industrial sites, solar farms, etc?

Examine the VIIRS i05 (11.5 µm) at the location of the fire pixel:

- ❑ See if it's also warm or if there are corresponding cold pixels from cloud tops
- ❑ Are there clouds around the hot pixel especially in areas designated as "night"?
- ❑ Comparisons with i04 are especially important when reflectance bands are not available.

Examine the VIIRS i01 (0.64 µm) band and DayLandCloudFire RGB (day) or DNB (night)

- ❑ Check for clouds in the proximity of the hot pixels.
- ❑ Look for high reflectances, such as cloud tops, sun glint, solar farms, etc.
- ❑ Check the DNB for light from large burning fires at night.

Resources:

JPSS Quick Brief: VIIRS Active Fires Algorithm Basics and Anomalous Detections

JPSS Quick Guide: VIIRS 3.74 µm Shortwave IR Band for Fire Detection Quick Guide

SBC Seminar: The NOAA Operational VIIRS Active Fire Product

Seeing the Light, VIIRS in the Arctic Blog: Land of 10,000 Fires

CIMSS Satellite Blog: Wildfires in British Columbia