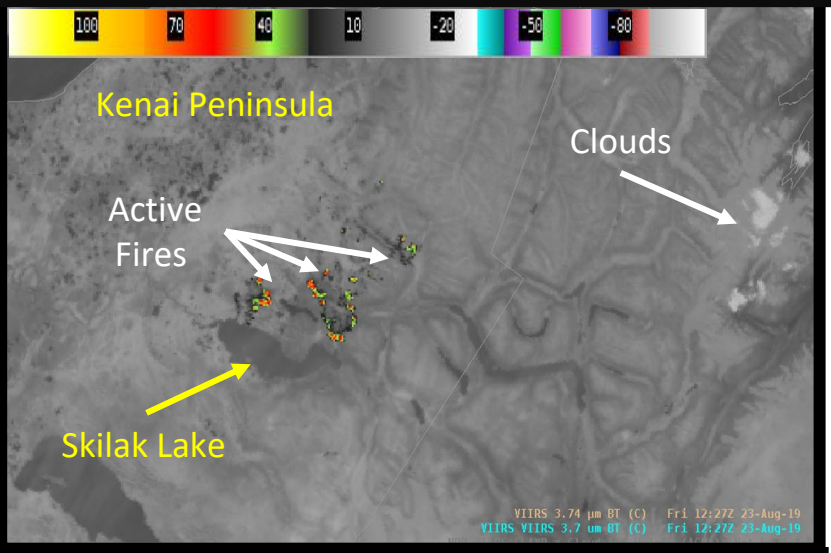
VIIRS 3.74 µm Shortwave IR Band For Fire Detection

Quick Guide

Why is the VIIRS 3.74 µm Channel Important for Fire Detection?

The VIIRS 3.74 µm "Shortwave IR" channel is highly sensitive to the short wavelength energy emissions of fires; these emissions can be detected day and night, making this channel ideal for monitoring wildland fires. It is the basis for most fire-related products. While solar radiation reflected by clouds or the Earth's surface does contribute to the total daytime energy measured in the channel, the signal from fires is usually much stronger. This shortwave IR band is also used to identify areas of fog/low stratus at night. *Note: The colormap used for all examples has brightness temperatures increasing from right to left, from green, to red, to yellow. Pastel shades are cold.*

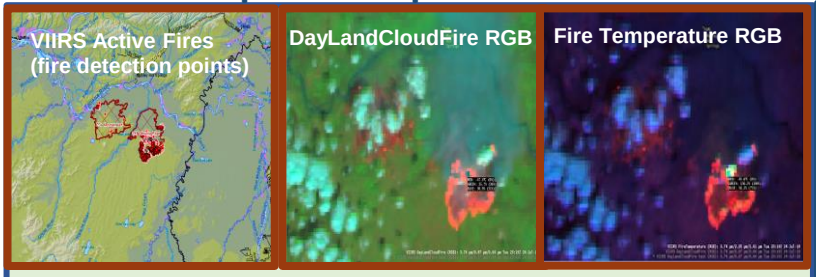


VIIRS 3.74 µm image of the Swan Lake Fire in Alaska at 1227Z 23 Aug 2019. This night view is not complicated with added solar radiation. The colormap highlights higher temperatures: green<red<yellow(hottest).

VIIRS 3.74 µm Attribute Comparison to other Satellites/Sensors

Satellite	Sensor	Channel	Central Wavelength (µm)	Resolution	Orbital Type	Saturation
SNPP & NOAA-20	VIIRS	i04	3.74 µm (infrared)	375m	Polar	95 °C
SNPP & NOAA-20	VIIRS	m13	4.05 µm (infrared)	750m	Polar	326 °C
Terra & Aqua	MODIS	20	3.75 µm (infrared)	1000m	Polar	227 °C
Metop-B & C, NPOES-18 & 19	AVHRR	3b	3.74 µm (infrared)	1000m	Polar	48-58 °C
GOES-16 & 17	ABI	7	3.9 µm (infrared)	2000m	Geostationary	137 °C

Impact on Operations



Multiple Products: The 3.74 µm channel is the primary input for many fire-related products and RGBs, such as the examples shown above.

24-Hour Fire Detection: Day or night, wildland fires emit "shortwave IR" energy.

High Spatial-Resolution: 375 meters.

Provides Thermal Information: Brightness temperatures show the hottest points of a fire.

Limitations

Day/Night Differences: Daytime reflected solar energy adds to the detected 3.74 µm radiation. Reflective features will be warmer than at night, making it difficult to differentiate clouds, smoke, and small fires. High clouds appear warm.

Sensor Saturation: Large or intense fires may exceed the sensor maximum of 368 °K (95 °C), producing unrealistic cold-pixel temperatures through "fold-over".

Cloud or Dense Smoke Obscuration: As an infrared channel, the 3.74 µm channel may have difficulty detecting fires below dense clouds or smoke.

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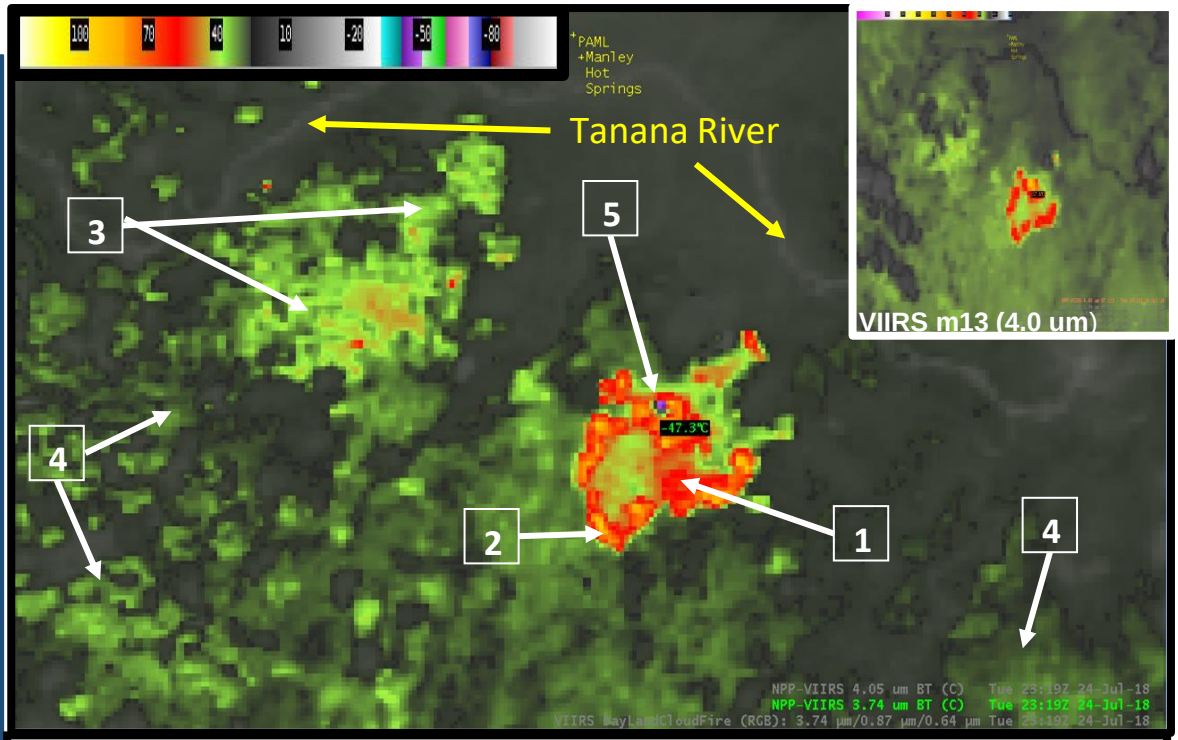
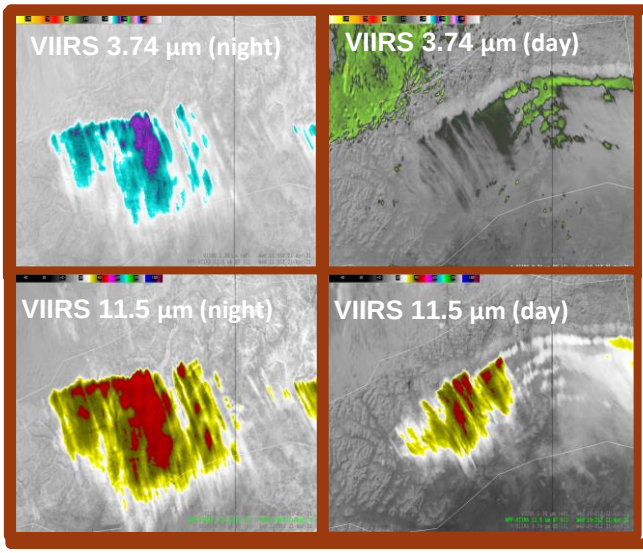
Image Interpretation*

1. **Fire Perimeter:** *BT 50-65 ℃*
2. **Fire Inner Core:** *BT 80-95 ℃*
3. **Small fires or hot ground from previous burns:** *BT 35-40 ℃*
4. **Warm ground from solar radiation or old fires:** *BT 25-35 ℃*
5. **Abnormally cold pixel in center of fire due to sensor saturation:** *BT -47 ℃*

** Colormap legend shown in upper left corner of image.*



VIIRS 3.74 µm image of Zitziana River Fire in Alaska at 2319Z 24 Jul 2019. Yellow pixels show the most intense part of the fire perimeter. Abnormally cold pixels in the center of the fire are caused by sensor saturation. The VIIRS 4.0 µm "m13" band (upper-right inset) has no saturated pixels for this fire but has lower spatial resolution.



Daytime Fire identification Must Consider Clouds/Smoke

The upper row of images are the VIIRS 3.74 µm channel on 21 Apr 2021. At left is a nighttime pass at 1155 UTC and right a daytime pass 1921 UTC. Cirrus is present on the south side of the Brooks Range (Alaska) in both passes. At night, the sensor only receives emitted radiation, so high cirrus is very cold, but during the day both emitted and reflected radiation is received. High cirrus reflect considerable solar energy that the sensor interprets as warm brightness temperatures. To determine if clouds are present, compare the 3.74 µm channel with the 11.5 µm (bottom row), which only senses emitted radiation. Also, visible or near-IR channels will show features that strongly reflect solar energy.

Resources:

VIIRS Imagery and Visualization Team Blog: A Wild Week of Wildfires

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

CIMSS Satellite Blog: Wildfires in British Columbia

VIIRS Active Fire Quick Guide

Hyperlinks not available when viewing material in AIR Tool