FACT SHEET

GOES-R
Fire Detection and Characterization

Why is it important to monitor fires using satellites?

Flames tower above the treeline next to Highway 63 south of Fort McMurray, Alberta, Canada, on May 7, 2016. Photo by Chris Schwarz, via the Government of Alberta.

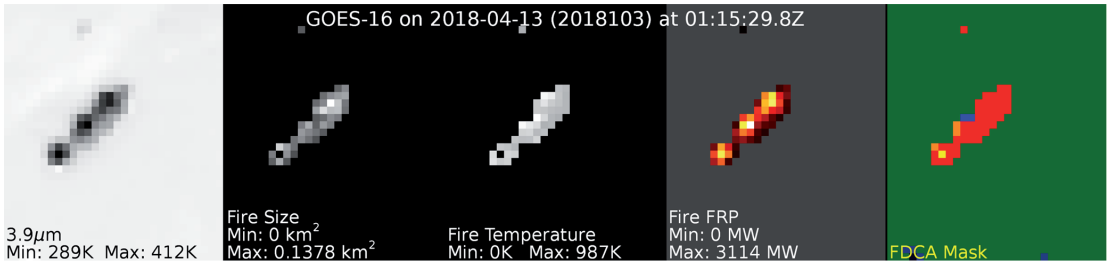
Fires, whether naturally occurring or manmade, have substantial impacts upon society. Wildfires can destroy vast tracts of land, releasing tons of aerosols and gases into the atmosphere, while destroying homes, wildlife habitats, and valuable resources. Recording and monitoring fires from ground-based observations is a labor intensive and expensive process that results in an incomplete record. Satellites allow for detecting and monitoring a range of fires, providing information about the location, duration, size, temperature, and power output of those fires that would otherwise be unavailable. With the GOES-R Series, this information can be used to track fires in real time, provide input data for air quality modeling, and help separate the impact of fires from other sources of pollution.

How do GOES-R Series satellites detect and characterize fires?

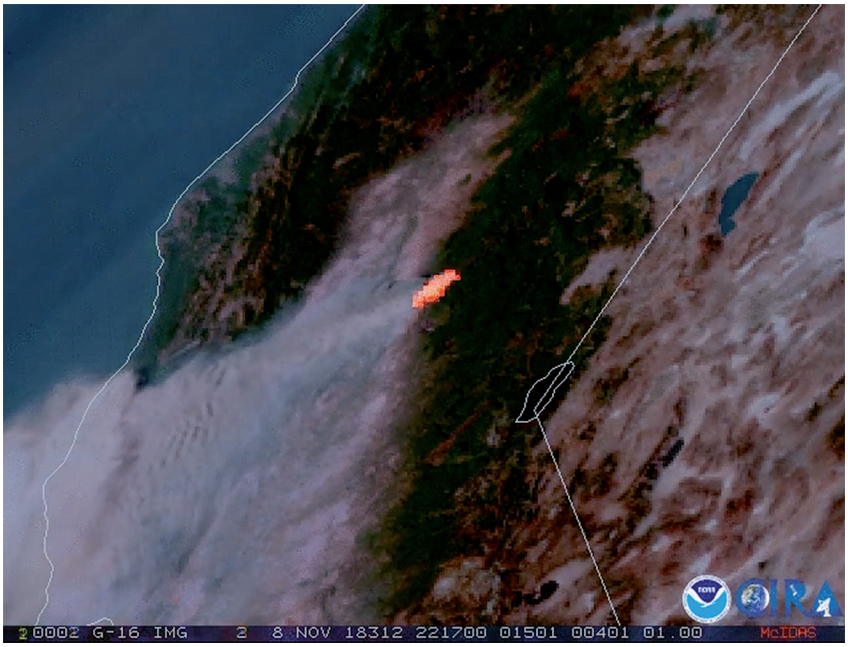
Fires produce a heat signature that is detectable by satellites even when the fires represent a small fraction of the satellite pixel. The GOES-R Series **Advanced Baseline Imager (ABI)** is capable of detecting heat signatures with improved time and space resolution, including smaller fires, compared to the previous GOES imager. ABI measures energy at different wavelengths, which is either reflected (visible and near infrared) or emitted (infrared) from Earth's surface. ABI represents a step forward in the ability of the hazards and air quality monitoring communities to detect fires and their properties. Fire properties can be measured in three ways: **size, temperature, and radiative power.**

The GOES-R **fire detection and characterization (FDC)** data product uses both visible and infrared (IR) ABI spectral channels (or bands) to locate fires and retrieve fire characteristics. Fires produce a stronger signal in mid-wave IR bands (around 4 μm) than they do in longwave IR bands (such as 11 μm). That differential response forms the basis for the GOES-R FDC product. The 3.9 μm ABI band is particularly useful for fire detection. Its shorter wavelength is sensitive to the hottest part of a fire pixel.

The FDC product looks for hot spots, attempts to determine the background temperature without fire present, corrects for solar contamination and water vapor attenuation, and provides fire characteristics for the detected



GOES-16 imagery of the Rhea Fire in Oklahoma on April 13, 2018, showing the ABI 3.9 μm shortwave infrared band (left column), and the various outputs of the fire detection and characterization product. From left: fire size, fire temperature, fire radiative power, and fire mask. Fire radiative power is shown in colors from black to red for 0 to 1000 megawatts (MW), red to yellow for 1000 to 2000 MW, and yellow to white for 2000-3000 MW. Credit: CIMSS



Fire hot spots and a large plume of smoke are seen in this GOES-16 fire temperature RGB imagery with GeoColor enhancement of the Camp Fire in northern California on November 8, 2018. Credit: NOAA/CIRA

fires. Once a fire is detected, fire size and temperature can be estimated. Radiative power is also calculated for the fire. Fire radiative power is directly related to fire size and temperature, but the different characteristics can be used in various applications.

Fire temperature red-green-blue (RGB) imagery is used to manually locate and monitor fire hot spots. This imagery is created using three shortwave and near-infrared ABI bands. Active hot spots show up as red, yellow and white as the fire grows increasingly hotter. Fire temperature RGB imagery can be made partially transparent and placed over a **GeoColor** enhancement, so both the fire's hot spots and smoke plumes are visible. GeoColor imagery combines data from multiple ABI bands to approximate how the human eye would see Earth from space. GeoColor imagery helps forecasters easily identify smoke from a fire.

What benefits do GOES-R fire applications provide?

New ABI channels provide more information to forecasters and improved resolution and rapid scanning deliver high-definition images as often as every minute. This means a much more detailed look at fire conditions, faster detection of hot spots, and the ability to track fire progression and spread in real time to detect changes in a fire's behavior and predict a fire's motion. **GOES-R Series satellites frequently detect fires before they are spotted on the ground – often before emergency notifications to 911.** The satellites are also used to pinpoint the exact location of a fire after reports of smoke.

GOES-R Series observations are not just valuable for detecting wildfires but are also critical to observing and monitoring smoke from those fires. The ability to monitor smoke plumes in near real-time is particularly useful in directing firefighting efforts from the air. Deploying airplanes and helicopters to spray fire retardant is often hampered due to poor visibility. GOES-R satellites can help guide decisions for deploying flights by providing information on the exact location and motion of smoke from a fire. The smoke detection and monitoring information also enable better air quality forecasts.

The benefits from GOES-R Series satellites aren't just seen during a fire but are also important in monitoring burn scars and predicting flash flood events from rain events after a fire. The satellites provide critical data for the entire lifecycle of a fire disaster – from drought to fire to floods and landslides.

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Related links:

FDC product information: https://go.usa.gov/xmsCV

FDC validation and data access: https://go.usa.gov/xmsCd

National Weather Service fire weather page: https://www.weather.gov/fire/