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U.S. Satellite Capabilities for Tracking the Wildfire Life Cycle

Satellite capabilities support virtually every stage of the wildfire life cycle: characterizing the prefire environment (e.g., seasonal climate predictions, vegetation); detecting and monitoring wildfires and smoke; and assessing postfire hazards (e.g., debris flows, flash floods) and ecosystem recovery. The National Oceanic and Atmospheric Administration (NOAA) notes that certain satellites provide "information about the location, duration, size, temperature, and power output of those fires that would otherwise be unavailable" through ground-based sensors, aerial drones, or aircraft. These approaches may provide complementary data to satellites, particularly when satellite data are limited in spatial and/or *temporal* (i.e., the time between observations of the same area) resolution and given the money and time to develop and deploy new satellites.

NOAA, the National Aeronautics and Space Administration (NASA), and the U.S. Geological Survey (USGS) contribute to satellite observations across the wildfire life cycle, including detecting and monitoring fires in *near real-time* (NRT; i.e., data available within about one to three hours). Some bills introduced in the 119th Congress seek to improve satellite observations with the aim of increasing U.S. resilience to the harmful effects of wildfires (e.g., H.R. 527, H.R. 753, H.R. 5782/S. 91). This In Focus describes current and planned U.S. civil satellite observation systems that may contribute data relevant to the wildfire lifecycle.

Satellite Wildfire Applications

Satellites can collect environmental information about fire weather and fuel (e.g., grasses, brush, timber) condition (e.g., live versus dead biomass, soil and biomass moisture content). These pre-wildfire observations, among others, guide predictions of the likelihood and intensity of wildfire outbreaks. Land managers and scientists can use post-wildfire satellite observations to assess wildfires' severity, extent, and impact. The assessments may inform efforts to improve safety, limit damage, support postfire hazard risk assessments, and monitor landscape recovery.

Satellites also can be used to detect wildfires, generally in concert with existing wildfire detection techniques. Some satellites can make NRT observations to support early wildfire detection, which increases the likelihood of timely response. First responders depend on NRT observations to plan firefighting operations and to inform firefighters' situational awareness during the fire. To be useful for these purposes, satellites must provide data with the necessary frequency and spatial resolution to users on the ground. *Data latency*, the total time between data acquisition and public availability, may vary among satellite missions and may affect the use of observations for wildfire applications.

Both geostationary orbit (GEO) and low-Earth orbit (LEO) satellites provide wildfire-related observations but do so at different spatial and temporal resolutions. GEO satellites remain over the same location on the Earth and provide continuous coverage of a large area but at a lower resolution relative to LEO satellites, due to their altitude. LEO satellites provide a more limited field of view, as they are closer to the Earth. Their proximity to the Earth, however, allows for relatively higher spatial resolution. LEO satellites complete several orbits per day; each orbit allows data collection for different locations and times of day, but observations at each location have a lower temporal resolution (less frequent observations). To achieve similar spatial or temporal coverage as a GEO satellite, multiple LEO satellites (i.e., a *constellation)* may be needed. Coupling LEO and GEO data may provide a more comprehensive approach to tracking the wildfire life cycle.

NOAA GEO Satellites

NOAA's Geostationary Operational Environmental Satellites (GOES)-R Series host the Advanced Baseline Imager (ABI), which produces a scan of the Earth every 60 seconds (s) with a spatial resolution of 500 to 2,000 meters (m). ABI's data help experts detect smoke plumes and heat signatures to identify and respond to fires in NRT. Monitoring smoke in NRT is useful in directing firefighting efforts and protecting public health. GOES-R Series satellites also host a lightning mapper (GLM) which collects data on the frequency, location, and extent of lightning, a common wildfire ignition source.

NOAA anticipates its future GEO satellite mission, Geostationary Extended Observations (GeoXO), will include a new imager (GXI) that is more advanced compared with ABI. GXI may detect wildfires a quarter of the size of those ABI can detect while providing data to first responders more quickly. NOAA aims to launch the first GeoXO satellite carrying GXI in 2034. In 2026, the Trump Administration "discontinued" the procurement of a GeoXO lightning mapper (LMX) for budgetary reasons. LMX would have been an improved version of GLM. For more information, see CRS Report R49026, *NOAA's Geostationary Extended Observations (GeoXO) Satellite Program and Issues for Congress*.

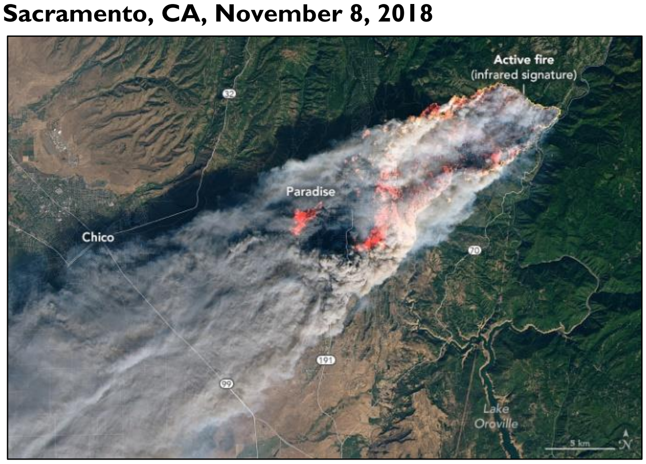
Selected U.S. LEO Satellites

NOAA's Joint Polar Satellite System (JPSS), a fleet of three LEO satellites, provides global observations twice a day for short- and long-term weather forecasts. JPSS satellites host the Visible Infrared Imaging Radiometer Suite (VIIRS), which has a 375 m spatial resolution. At this resolution, VIIRS can detect small, low-temperature fires. VIIRS also has a Day-Night Band that enhances the detection of nighttime fires. VIIRS data are available in *ultra real-time* (URT; i.e., data available within minutes), with a data latency of about 50 s, a speed that rivals nonsatellite wildfire detection methods. NOAA plans to launch one of its future polar-orbiting satellites, JPSS-4, in 2027 with the current generation of VIIRS.

NASA's Aqua and Terra satellites host instruments used for wildfire detection and response. NASA expects those satellites to cease operations by late 2026/early 2027 and has encouraged users to use data products from JPSS's VIIRS. Some Members have raised concerns over the pending transition.

Under the Sustainable Land Imaging Program, NASA develops and launches Landsat satellites and the USGS operates the satellites and manages their data. Landsats 8 and 9 host the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS)—both instruments have been used for wildfire-related applications (**Figure 1**). OLI imagery helps scientists assess vegetation characteristics and land cover change—factors used to understand wildfire risk and ecosystem recovery. TIRS detects heat anomalies that can help spot wildfires. USGS uses both TIRS and OLI to produce highly detailed maps of burned areas following a wildfire, which are used to assess risk of post-wildfire debris flows and monitor landscape recovery. While Landsat data generally have a data latency of four hours or more, a Landsat Fire and Thermal Anomalies product provides OLI data for fire detection within 30 to 60 minutes. NASA and the USGS are developing a follow-on "super-spectral" Landsat mission to launch in 2031 that is to improve its wildfire-related applications. Initially proposed by the Biden Administration as Landsat Next, a three-satellite constellation, the Trump Administration restructured the mission to Landsat 10, comprising a single satellite. A single-satellite mission would have lower temporal resolution compared with a three-satellite mission.

Figure 1. Landsat 8 Image of the Camp Fire near Sacramento, CA, November 8, 2018



Source: NASA Earth Observatory.

The U.S.-India NASA-ISRO Synthetic Aperture Radar (NISAR) mission provides information about vegetation, fuel condition, and soil moisture over the entire planet every 12 days with a 200 m resolution. NISAR also provides observations at times when imagers are ineffective (e.g., during cloudy conditions or at nighttime).

Issues for Congress

New satellite missions pose several challenges, including the need for multiyear appropriations and the inherent risks of developing new technology. Conversely, the retirement of operational satellites may pose data continuity challenges.

Congress may continue its oversight of whether and how future federal earth observation satellites may contribute to tracking wildfires. For example, in March 2026, NASA announced its new Explorer for Artemis Geology, Lunar, and Earth (EAGLE) program, a series of satellites used to study the Earth and Moon. NASA expects to launch the program's first satellite in 2028 and its second satellite two to three years later. Both satellites could be used to detect and monitor wildfires.

To reduce federal spending, the Trump Administration has proposed to modify some future satellite missions by including current rather than improved instruments in certain missions or eliminating instruments or satellites from missions (e.g., GeoXO and Landsat). Some of these proposed modifications may impact wildfire forecasting and response. At issue for Congress is weighing the potential cost savings against maintaining or advancing data frequency and resolution for federal agency wildfire objectives. Congress could direct these savings toward other wildfire science priorities. Congress also may consider the consequences of a potential data gap associated with elimination of certain instruments and reduced satellite coverage.

Federal partnerships with U.S. commercial providers may help fill wildfire data gaps. S. 306 and S. 3923 in the 119th Congress would direct NOAA to fill fire weather data gaps via commercial data buys. In July 2026, NOAA entered into a $2.51 million contract with a California-based company to buy data for a Wildfire Imagery Pilot via the agency's Commercial Data Program. Alternatively, Congress may direct federal science agencies to review the potential applications of existing, in-orbit federal instruments not initially designed for wildfire use. For example, scientists proved an "unexpected" capability to monitor global changes in vegetation using an instrument on NASA's Plankton, Aerosol, Cloud, and ocean Ecosystem (PACE) satellite. Other PACE instruments have been used to study wildfire smoke particulates. PACE's original mission objective focuses on monitoring ocean health, air quality, and climate change.

Congress also may consider interagency efforts to disseminate wildfire data to federal and nonfederal response agencies. For example, the Fire Information for Resource Management System, a joint effort between NASA and the U.S. Forest Service, uses data collected from various satellites to provide NRT detection of wildfires in the United States and Canada. Alternatively, S. 140 and S. 1462 in the 119th Congress would create a pilot program to test and deploy technologies for wildfire prevention, detection, communication, and mitigation.

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