

SCIENCE & TECH SPOTLIGHT: (Accessible Version)

# WILDFIRE DETECTION TECHNOLOGIES

GAO-25-108161, May 2025

## WHY THIS MATTERS

Wildfires are becoming more frequent and dangerous. Los Angeles County reported at least 30 deaths from the 2025 wildfires, and property and economic losses could exceed \$130 billion. Earlier wildfire detection could save lives and better protect communities.

## KEY TAKEAWAYS

- » Wildfire detection technologies are evolving, with improvements to satellites, sensors, and cameras.
- » Researchers continue to refine wildfire detection algorithms to more accurately detect wildfires.
- » Open policy questions include how to manage large amounts of data and how to balance deploying detection technology with other fire prevention measures.

## THE TECHNOLOGY

**What are they?** Wildfire detection technologies include satellites, aircraft, drones, cameras, and sensors that collect imagery or environmental data.

### How do they work?

**Satellites.** Satellites can capture images indicating fire over large areas. But image resolution is limited, clouds can interfere, and data lags may occur.

**Aircraft and drones.** Agencies often deploy aircraft when a fire is reported or suspected, and they are exploring the use of drones for this purpose. Some utility companies use drones to mitigate risk by inspecting downed power lines and tree branches touching wires, which can cause fires.

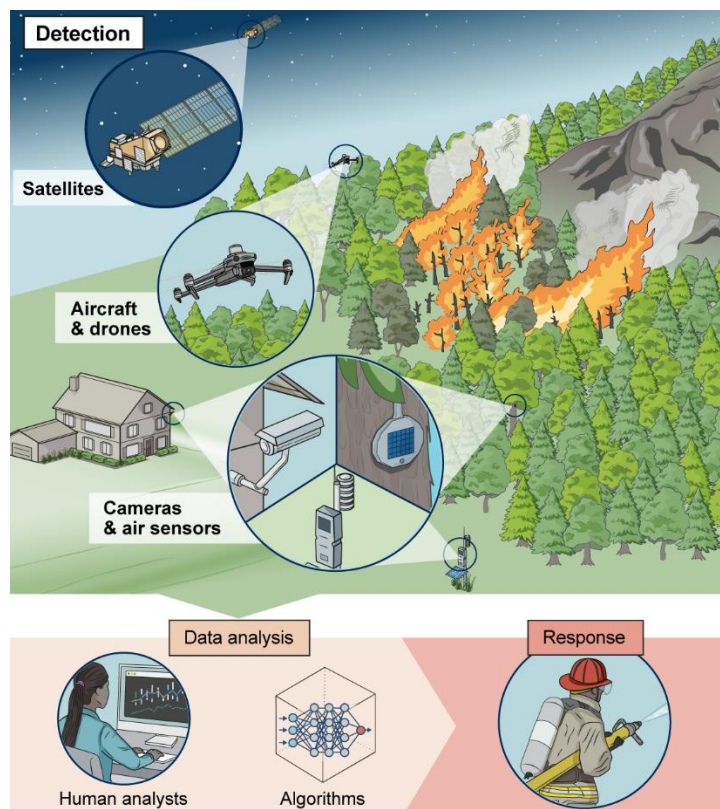
**Ground-based camera and sensor networks.** Cameras near wildlands can monitor for smoke or fire in real time. Sensors on



or near trees can look for changes in heat, humidity, or fine particulate solids that may indicate a fire. Cameras and sensors can be arranged in networks within areas of high fire risk, which may enable faster detection and response.

Data from these technologies can be analyzed by algorithms and human staff, with fire responders dispatched as needed (see figure).

Figure 1: Current and Emerging Wildfire Detection Technologies



Source: GAO (illustrations). | GAO-25-108161

**How mature are they?** U.S. government satellites have been used to detect wildfires for decades. But they were not designed for this purpose. Their altitudes and older sensors can make it hard for them to detect small fires before they escalate. Satellites have more often been used to track fire speed, direction, and size. A private nonprofit group launched a pilot satellite specifically for detecting wildfires in 2025. The group's



goals are to provide better resolution and faster data with 50 satellites in orbit by 2030, and to use artificial intelligence (AI) algorithms to spot fires.

The U.S. has used aircraft for wildfire detection since the 1920s. Today, they are used ad hoc when weather or seasonal conditions warrant the cost to fly patrols, but smoke and fire pose risks to pilots. Staffing issues may arise, since drone and aircraft pilots need specific training and certification.

The use of drones is being tested to address several safety issues before they can be widely adopted. These issues include flight range limitations and concerns about drones crashing if overtaken by smoke or fire.

Development and deployment of wildfire cameras and sensors are also in the early phases. For example, the Department of Homeland Security has an ongoing study of hundreds of sensors. In addition, in 2023 California began using an AI system to detect wildfires using images from over 1,100 cameras statewide. More sensors and camera coverage may improve detection, but verification and data transmission may be challenging in remote areas. Additionally, the precise location of any suspected wildfire may still need to be determined by trained personnel and firefighters.

Research is ongoing to increase the detection accuracy of algorithms and reduce false alerts, in part by using localized data from past wildfires and prescribed fires set to manage wildland vegetation. Some stakeholders have suggested the development of a unified tool to provide a real time common view of a wide range of wildfire data from federal, state, local, and private entities.

## OPPORTUNITIES

- **Faster detection.** Emerging technologies and improved detection algorithms may enable quicker response and could save lives and property.
- **Efficiency.** Improving wildfire detection accuracy could better direct responders and save costs.

## CHALLENGES

- **Deployment strategies.** The best mix of emerging technologies is not known because their effectiveness for detecting wildfires is still being assessed.
- **Data compatibility.** Public and private wildfire detection technologies and data may not be easily integrated and compatible for analyses and quick response.
- **Privacy and data security concerns.** Cameras and drones near residences may raise privacy concerns. If these technologies collect private data, those data may then need to be managed and safeguarded.

## POLICY CONTEXT AND QUESTIONS

- What combination of detection technologies could most cost-effectively maximize coverage and manage wildfire risk?
- How can data from the many and varied wildfire detection devices be securely accessed and analyzed to enable faster response?
- How should costs for wildfire detection technologies be balanced with costs for fire prevention management, such as clearing vegetation?

## SELECTED GAO WORK

Artificial Intelligence in Natural Hazard Modeling, [GAO-24-106213](#).

Air Quality Sensors, [GAO-24-106393](#).

## SELECTED REFERENCES

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Mohapatra, Ankita, and Timothy Trinh. 2022. "Early Wildfire Detection Technologies in Practice—a Review." *Sustainability* 14 (19): 12270. <https://doi.org/10.3390/su141912270>.

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