USGS
science for a changing world

Wildland Fire Science—
Supporting Wildland Fire and Land Management

The U.S. Geological Survey's Wildland Fire Science Program produces fundamental information to identify the causes of wildfires, understand the impacts and benefits of both wildfires and prescribed fires, and help prevent and manage larger, catastrophic events. Our fire scientists provide information and develop tools that are widely used by stakeholders to make decisions before, during, and after wildfires in desert, grassland, tundra, wetland, and forest ecosystems across the United States.

Why is Fire Science Needed?

Wildfires are expensive and have massive impacts on people—causing the loss of homes, livelihoods, and lives—yet fire in wildlands is essential to reduce future wildfire risk, improve wildlife habitat, and manage fire-adapted species in many ecosystems across the country. Fire and land managers are faced with emerging natural resource challenges that U.S. Geological Survey (USGS) science can address. These challenges offer opportunities for engagement of USGS fire scientists to provide current, credible, and essential information and tools. Emerging issues in fire science include—

- *Changing climate and more extreme weather*—Warming temperatures, drought, and erratic precipitation increase the intensity and size of fires, lengthen fire seasons, and hinder the recovery of vegetation.

- *Development in wildlands*—Increased development in wildlands makes it more expensive and complex to manage fires and reduce risk.

- *Effects of invasive plant species and of insect and disease outbreaks*—Invasive plant species change fire frequency, size, and risk, while insect and disease outbreaks increase fire risk, threaten forestry uses, and challenge habitat recovery.

- *Accumulation of fuels*—Over 100 years of fire suppression has resulted in fuel accumulation, which raises fire severity and increases vulnerability to insects and disease.

- *High costs of fighting fires*—Increased costs are incurred because multiple challenges require complex management solutions.

2018 U.S. Wildland Fire Facts

- $3.1 billion in Federal fire suppression costs
- Over $1 billion in State fire suppression costs
- 8.7 million acres burned in wildfires (compared with the 20-year average of 6.9 million acres)
- 25,790 structures burned
- $11.4 billion in claimed losses from California fires alone
- More than 120 fatalities (including 19 firefighters)
- 6.4 million acres burned in planned fires, prescribed to reduce future fire risks.

USGS Fire Science

USGS fire science helps land, fire, and emergency managers by providing new knowledge, data, and tools to promote cost-effective and informed fire management. Active areas of research include—

- *Wildland fire behavior and risk management*—Wildland fire patterns; wildfire risk-reduction strategies by means of fuel treatments to reduce the amount of combustible material, and fire breaks to help contain the spread of fires; effects of invasive plant species and of insects and diseases on fire patterns; risk mitigation in wildland/urban interfaces.

- *Fire ecology, fire effects, and restoration of post-fire ecosystems*—Effects of wildfires and fuel treatments on plants, animals, and ecosystems; impacts of changing weather and climate on the occurrence and effects of wildfires; beneficial effects of fire; post-fire recovery and restoration.

- *Risk assessments for human health, public safety, and the Nation's infrastructure*—Assessment of health risks from smoke, ash, and particulates; post-fire flooding and debris-flow hazard assessment, early warning, and mitigation; fire effects on water quality and quantity and on water-supply systems.

- *Remote sensing and geospatial tools and data*—Aerial and satellite imagery (such as Landsat); broad suite of data and tools used by fire incident teams (LANDFIRE, MTBS, GeoMac); technology research (new sensors, unmanned aerial vehicles, data archives, and tools).

A pine forest in the southeastern U.S., shown here, requires wildland fire to remain healthy.

USGS Fire Science is Used Before, During, and After a Wildfire

Before a Fire:

Before wildfires occur, USGS scientists seek to understand the roles that fire plays in different ecosystems and regions. They also determine how different fire management techniques affect fire risks, wildlife, ecosystems, and watersheds. Results of the research include data and tools that help managers develop and implement fire and fuel management plans.

Upper left: Invasive cheatgrass replaces the native sagebrush community, leading to higher incidence and severity of wildfires. *Upper right*: A drip torch is used to ignite a prescribed fire. *Lower*: Oblique-view lidar map of vegetation, which can be used before fires to plan fuel treatments.

93 m

Tree Canopy Height

2 m
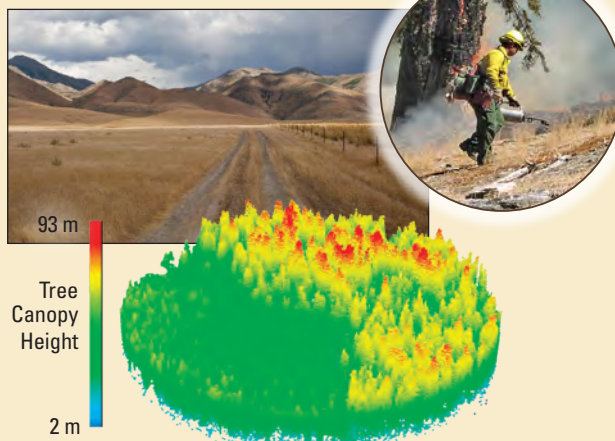
During a Fire:

The USGS and collaborators produce extensive datasets and tools to detect wildfires, monitor the progress of a fire, and model fire and smoke behavior. They also determine health and safety implications from smoke and ash, and develop new fire science applications with emerging technology (for example, through the use of satellites and sensors).
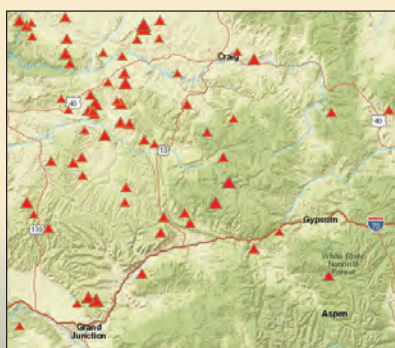
Left: Unmanned aerial vehicle (drone) with sensors hovers to monitor an active fire. *Right:* Landsat images before and after a wildfire. Reddish tones represent burned areas.

Landsat 5, June 24, 2011   Landsat 7, July 2, 2011

0   5   10 Miles

After a Fire:

USGS scientists study direct effects of fires (loss of vegetation and ground cover) and their indirect consequences (post-fire debris flows and flooding). They identify additional health and safety implications, and determine the potential impact to stakeholders and local economies. They also identify ways to help managers restore landscapes after fires.

The USGS maintains a database of wildfire occurrences from throughout the U.S. to document fire history. Map shows fires in western Colorado between 2010 and 2018.

Scientist examines a post-fire debris flow.

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For more information:
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The USGS collaborates with the U.S. Forest Service, the Joint Fire Science Program, NASA, NOAA, the U.S. Department of Defense, universities, other science organizations, and fire and land managers to produce information, data, and tools that are useful to communities, Tribes, States, and Federal agencies.