



January 28, 2025

Fire Weather: Background and Forecasting

Fire weather refers to conditions that influence whether a fire ignites, how it behaves, and how it can be contained. Record-breaking wildfires, especially in the western United States, continue to cause loss of life and property damages estimated in the billions of dollars. Congress continues to show interest in supporting fire weather forecasting, monitoring, communication, and research and may consider whether, and if so how, to alter federal agency roles, funding, and activities related to fire weather to further protect U.S. lives and property.

Congress has authorized the Secretary of Commerce, acting through the National Oceanic and Atmospheric Administration’s (NOAA’s) Administrator, to forecast weather and issue storm warnings (15 U.S.C. §313), including for fire weather. NOAA’s fire weather activities span multiple subagencies or line offices, including the National Environmental Satellite, Data, and Information System (NESDIS); National Weather Service (NWS); and Office of Oceanic and Atmospheric Research (OAR). These activities occur at headquarters, regional centers, and local weather forecast offices (WFOs) and are coordinated through the intra-agency NOAA Fire Observation, Research, and Services Team. Meteorologists and analysts at the National Interagency Coordination Center (NICC; an intergovernmental group focused on mobilizing wildfire resources) and its 10 regional centers also provide operational fire weather services. This In Focus provides information on NOAA’s fire-weather-related activities and potential congressional considerations.

Before the Fire

Before a fire, NESDIS, NWS, and OAR focus on observations, prediction, and forecasting. These NOAA line offices use observational platforms and models to detect and monitor wildfires and provide daily decision support services (forecast advice and interpretation) to the land management and emergency response communities, providing updates as information becomes available. NOAA scientists also track variables that may contribute to fire weather, such as temperature, precipitation, wind speed, humidity, and weather patterns.

Multiple environmental conditions must occur simultaneously to produce extreme fire weather. These include lightning, interaction between dry and moist air, strong winds, and very low relative humidity. The thresholds for each may differ depending on the geographic area (e.g., average weather conditions in Los Angeles are different from those in Detroit). NOAA researchers and meteorologists produce a range of fire weather condition outlooks and forecasts, including

- annual to seasonal El Niño and La Niña outlooks (weather systems that influence drought conditions);
- seasonal to 6- to 10-day temperature and precipitation outlooks;
- seasonal to weekly drought outlooks;
- 1- to 8-day fire weather outlooks; and
- 1- to 4-day forecasts, which include alerts, watches, and warnings.

Some of the information in the outlooks and forecasts is incorporated in NICC monthly and weekly “significant fire potential” outlooks, among other federal forecasts and decision support services.

During the Fire

NOAA forecasters share observations and forecasts on fire weather conditions as a wildfire progresses. These forecasts include those listed above as well as spot-specific forecasts for wildfire responders. In some cases, NOAA deploys incident meteorologists (IMETs) to a fire command center to provide on-site weather and environmental information. NOAA also uses observational platforms and models to detect, monitor, and model smoke and air quality associated with fires.

Communication

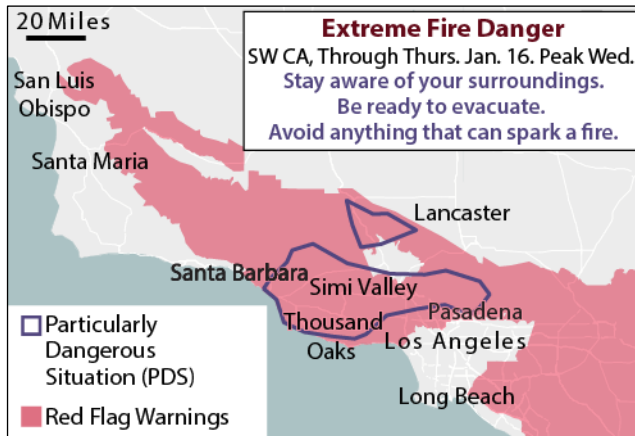
NOAA forecasters issue warnings and watches when the combination of weather conditions and dry vegetation indicates extreme fire danger or fire behavior. Forecasters issue *Red Flag Warnings* when there is an impending or occurring fire weather event and they are highly confident “that weather and fuel conditions consistent with [event] criteria will occur in 48 hours or less.” When there is a high potential that an event will occur, forecasters issue *Fire Weather Watches* 18 to 96 hours before the expected onset. Each WFO determines the specific criteria for its area. For example, the Los Angeles/Oxnard, CA, WFO (**Figure 1**) issues a Red Flag Warning when there is dry vegetation along with

- a combination of (a) relative humidity of 15% or below and (b) sustained winds of 15 miles per hour (mph) or greater (or gusts at 25 mph or greater) over more than six hours and/or
- widespread (area covered) and/or significant (in terms of number of strikes) dry lightning.

Forecasters have the discretion to issue a Red Flag Warning outside of the specific criteria. In rare cases, the Red Flag Warning may designate an area as being in a “Particularly

Dangerous Situation,” such as when warning criteria are greatly exceeded and/or near record levels (Figure 1).

Figure 1. Red Flag Warnings in Los Angeles, CA
January 14, 2025



Source: CRS adapted from NOAA NWS, Los Angeles, CA, Weather Forecast Office, “Red Flag Warnings,” January 14, 2025.

NOAA uses several channels to communicate warnings to the public: local television and radio stations, cable television systems, cell phone applications, and NOAA Weather Radio All Hazards (NWR). NWS maintains and operates NWR, a nationwide network of radio stations continuously broadcasting weather information directly from the nearest WFO. NWR messages also may be disseminated nationwide through the Emergency Alert System, which requires media broadcasters to receive and rebroadcast emergency messages. NWS also can transmit messages through the Wireless Emergency Alerts system, which sends emergency text messages to cell phones of participating carriers in the NWS warning area.

Research

NOAA programs primarily within NESDIS and OAR focus on fire weather research to improve observations, detection, modeling, forecasting, communications, and instrument development, among other activities. NESDIS research activities focus on training and calibrating fire weather prediction models, detecting fire via weather satellites, optimizing satellite information for forecasting, and long-term monitoring. OAR research activities include field studies, data collection, and monitoring; understanding connections between climate and wildfire; advancing forecast systems and decision support services; and improving air quality and fire weather modeling. NOAA’s Fire Weather Testbed (FWT), a new collaboration between OAR, NWS, and NESDIS and the broader fire weather community, aims to accelerate the development and delivery of products, technologies, and communication strategies to users, including forecasters and emergency responders.

NOAA collaborates with other federal entities, including land management agencies (e.g., U.S. Forest Service) and science agencies (e.g., National Aeronautics and Space Administration), on fire weather research through various interagency groups (e.g., National Interagency Fire Center) and memoranda of understanding.

Congressional Considerations

Typically, NOAA’s fire-weather-related activities have been funded as part of its broader base programs, rather than via fire weather funds provided by Congress through a specific budget line item. The 118th Congress directed NOAA to support certain fire-weather-related activities through report language accompanying appropriations acts. In the explanatory statement accompanying P.L. 117-328, Congress provided NOAA with funding to develop a collaborative and integrated fire weather research program including an FWT. The House report accompanying its version of the FY2023 appropriations bill also encouraged NOAA to improve wildfire information dissemination to partners. In the explanatory statement accompanying P.L. 118-42, Congress requested that the agency continue its fire weather research collaboration. Congress also appropriated \$100 million for use from FY2022 through FY2026 for wildfire prediction, detection, observation, modeling, forecasting, and communication through P.L. 117-58. The 119th Congress could continue allowing NOAA to fund most of its fire weather activities under broader budget line items, with exceptions, or establish a NOAA-wide fire weather program with its own budget line item, among other potential actions.

Legislation introduced in the 118th Congress would have authorized new or codified existing NOAA fire-weather-related activities. Some bills would have statutorily established fire weather services, an FWT, and IMETs at NOAA, as well as interagency and advisory groups focused on wildfire-related topics (e.g., H.R. 4584, H.R. 4866, and S. 4343). Some of these bills also would have defined the roles of other federal agencies in wildfire science and research, required certain reports, evaluated a wildfire risk rating system, and authorized appropriations, among other provisions. Other bills in the 118th Congress focused more narrowly on matters such as observation techniques for fire-weather-related uses (e.g., H.R. 3560 and S. 5361).

Stakeholders such as the NOAA Science Advisory Board (2021), the Federation of American Scientists (2023), and the Wildland Fire Mitigation and Management Commission (2023) have recommended additional actions NOAA and Congress could take to improve the agency’s fire weather forecasting. NOAA has moved forward on some recommendations (e.g., to advance fire weather and air quality prediction and NOAA accomplishments in FY2023 related to the recommendation). Publicly available information is insufficient for tracking progress on other recommendations. If Congress is interested in better understanding the agency’s plans and progress, it could mandate that NOAA develop fire weather strategic and implementation plans, an annual report on the agency’s fire weather activities, an assessment of NOAA activities by the Government Accountability Office, or other actions.

Additional considerations may relate to jurisdiction and broader changes to NOAA’s activities. Some observers have noted that federal fire-weather-related activities addressed in broader bills may span the jurisdiction of multiple House and Senate authorizing committees. NOAA’s fire weather activities also may be impacted by legislation addressing weather forecasting activities more broadly (e.g., H.R. 6093 in the 118th Congress).

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