FIRE WEATHER OBSERVATORIES

IMPROVING MONITORING IN COMPLEX TERRAIN

Wildland fire is an increasing threat and a year-round occurrence in many areas of the U.S., especially the high plains and Western states, including Alaska.

The dangers associated with wildfire have prompted the National Weather Service to issue red flag warnings on days when the forecast calls for warm temperatures, low humidity, dried fuels (trees, brush, grasses) and strong winds.

The wind near the surface can change rapidly as the daytime boundary layer grows and mixes down stronger winds from aloft. In addition, the complex terrain in mountainous states creates diurnal mountain-valley circulations and downslope windstorms

These areas of the country also lack sufficient observations to make informed decisions about fire weather.

METHODOLOGY

To help fill some of these observing gaps, the Physical Sciences Laboratory (PSL), Global Systems Laboratory (GSL), Global Monitoring Laboratory (GML), and Air Resources Laboratory (ARL) will partner to build **four fixed boundary-layer observation facilities** and **two mobile units** equipped with similar instruments.

These facilities will better characterize the fire weather environment and help to conduct research on the physical processes that contribute to adverse fire weather conditions.

NOAA Research labs share a rich history of observing the boundary layer, surface energy fluxes, atmospheric radiation, and air chemistry. NOAA scientists have published numerous papers demonstrating the benefits of observationally based physical process understanding.

In addition, NOAA scientists have expertise in data asssimilation and model development. Thus, they are able to use these observations to improve the numerical weather prediction models that are run by the National Weather Service.

Fixed sites: Four fixed observing sites will be created in the intermountain western U.S. These sites will each be instrumented with:

- a 449-MHz Doppler radar wind profiler;
- an infrared spectrometer for thermodynamic profiling;
- a polarization sensitive ceilometer;
- surface radiation measurements;
- fast-response sonic anemometers and moisture probes measuring the surface turbulent fluxes of heat, water vapor, and momentum;
- standard surface meteorology sensors;
- soil moisture profiles; and
- trace gas/aerosol concentration measurements including PM2.5 and PM10 particulate matter concentrations.

continued >

BY THE NUMBERS

10M+ Acres burned nationwide in the year 2020, the most on record[1]

$10B+ Amount in damages in 2021 from Western wildfires alone, including the unexpected late December Marshall Fire[3]

The Marshall Fire destroyed more than 1,000 structures in Boulder County, CO, and surrounding unincorporated areas

$4.4B Approx. amount spent to fight wildfires by the U.S. in 2021[2]

86% increase over the 10-year average

[1] NCEI: www.ncei.noaa.gov/access/monitoring/monthly-report/fire/202013
[2] NIFC: www.nifc.gov/fire-information/statistics/suppression-costs
[3] NOAA: www.climate.gov/news-features/blogs/beyond-data/2021-us-billion-dollar-weather-and-climate-disasters-historical

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These fixed observatories will provide baseline meteorology and air chemistry measurements over four sites with differing climatological conditions and surface characteristics to learn more about the regional processes that lead to increased wildland fire probability and potential fire impacts on human health.

Mobile facilities: Two mobile observing units will be created, with instrumentation similar to that listed above for the fixed sites, except that the large Doppler radar wind profiler is replaced by a much more compact wind profiling Doppler lidar for this application.

Instrumentation for the mobile facilities will be transported in a trailer pulled by a pickup truck. Some of the instruments will be set up outside of the trailer during deployments.

These mobile facilities will be used to monitor atmospheric and terrestrial conditions closer to the fires (natural or prescribed) and can be used, for example, to simultaneously monitor conditions upwind and downwind of active wildfires. They also will augment the fixed sites by providing complementary information around those sites.

UAS: In addition to the above observing facilities, an Uncrewed Aircraft Systems (UAS) capability is being developed that will allow for low-altitude measurements of standard meteorological parameters (wind speed and direction, temperature, humidity and pressure), as well as turbulent fluxes. UAS will also be used for trace gas studies, aerosol concentrations, and surface characterizations such as albedo and fire front location among others.

The UAS could be deployed in conjunction with the mobile facilities, as well as independently if the mobile facilities are unavailable and/or for other applications. Both fixed-wing and copter platforms are being considered.

DATA SHARING

As much data as possible from the fixed sites, mobile facilities, and UAS will be communicated in near real-time back to data hub(s) in the David Skaggs Research Center in Boulder, Colorado.

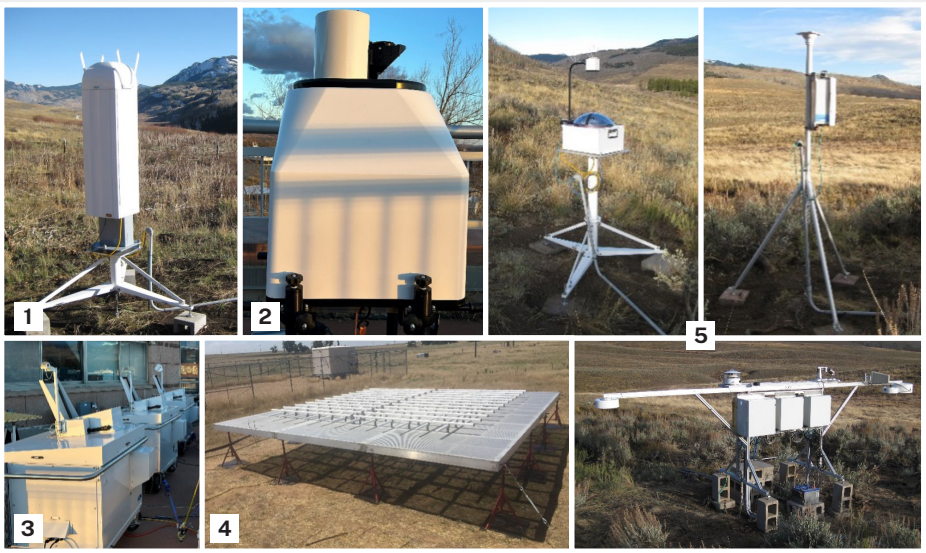
These data will be displayed online to monitor instrument health and to share the observations publicly with fire weather forecasters, firefighters, researchers, and other interested parties. Other datasets that require post processing will be made publicly available at the appropriate time.

All datasets will be archived for future public use and to support research objectives.

FUNDING

Funding for this work was provided by the FY22 Bipartisan Infrastructure Law (BIL) Provision 15, which according to the law “shall be used for observation and dissemination of infrastructure used for wildfire prediction, detection, and forecasting.”

Visit **bit.ly/NOAAWildfireBIL** for more funding information.



MEASUREMENT TOOLS

Some of the major instruments in the fixed and mobile fire weather observatories including the laser ceilometer (1), Doppler lidar (2), infrared spectrometers (3), 449-MHz Doppler radar wind profiler (4), and various instruments (5) to measure incoming and outgoing radiation and clouds.

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Wildfire photo by Robert Hyatt, NOAA’s National Weather Service • Instrument photos by NOAA/GML and NOAA/PSL • Icons by Font Awesome and Adobe Stock