American Lung Association

Something in the Air

How Communities Are Tracking the Air They Breathe

A "State of the Air" Supplemental Report

Tracing the Smoke: Wildfire Pollution in Real Time

Index

Wildfire smoke has become a defining air quality challenge across the United States, creating rapidly changing conditions that can elevate both immediate health risks and long-term exposure concerns. These impacts are more difficult to characterize in communities where monitoring coverage is sparse, and localized information is limited. As smoke events become more frequent and prolonged, wildfire smoke demonstrates—often with urgency—how hyperlocal, community-generated data can support health decisions during conditions that shift faster than traditional monitoring systems are designed to capture.

The two case studies featured in this section—Clean Air Methow's Clean Air Ambassadors (CAA) program in Washington and the PurpleAirs in Schools Program in Montana—identify how communities experience wildfire smoke and use real-time data to coordinate protective actions that support both active response and sustained preparedness through locally operated, partnership-based monitoring networks. Together, they show how cross-agency monitoring programs enable decision makers to translate accessible data into proactive public health strategies and rapid-response systems. They also reveal how sustained sensor programs—through long-term operation, maintenance, and data quality assurance—strengthen public communication, reflect local needs and reinforce existing safeguards during environmental crises. In this report, terms relating to community sensors (e.g., hyperlocal, low-cost, real-time) are used interchangeably to describe affordable air monitoring devices widely deployed by communities, organizations, and affiliated partner agencies to track neighborhood-scale air pollution. Community-focused sensor programs inform personal safety decisions and help document pollution exposure before, during and after smoke events. This data can also support community advocacy for resources and initiatives that strengthen prevention and preparedness for future events. The two subsequent case studies that follow broaden this lens, illustrating additional pathways for integrating community monitoring into a modern, resilient air quality framework. Together, they build on this entry point, showing the utility of community-driven monitoring during periods of increased pollution and their ability to foster partnerships, inform policy, guide investments, and make air quality data more accessible and actionable.

Wildfire Smoke Is a Growing Public Health Crisis

Wildfire activity continues to increase in frequency, severity and duration, expanding the scale and extent of population exposure to smoke. On average, 70,000 wildfires occur across the United States every year (Department of Homeland Security [DHS], 2025). These fires burn millions of acres annually, destroying infrastructure, disrupting communities and claiming lives. The resulting economic, environmental, and social impacts are long-lasting, affecting public health, ecosystems, and regional stability well beyond the fires themselves. In an era of intensifying wildfires, the air we breathe has become an even more critical public health concern.

Wildfires are now the dominant force behind many of the nation's most dangerous particle-pollution days, driving unprecedented numbers of "very unhealthy" and "hazardous" air days as classified using the U.S. Environmental Protection Agency's (EPA) standardized Air Quality Index (AQI). According to the American Lung Association's "State of the Air" 2025 report, nearly half of Americans—approximately 156 million people—now live in places that received failing grades for ozone (O3) and/or particle pollution. Dozens of metropolitan areas are now experiencing their worst-ever levels of fine particle pollution ($PM_{2.5}$). This significant rise in risk from wildfire smoke reflects the convergence of extreme heat, prolonged drought, high-wind conditions and increasingly volatile fire behavior—factors that drive sustained periods of dangerous air quality nationwide, a trend expected to intensify as climate change accelerates and hotter, drier conditions fuel more frequent fires and longer periods of heavy smoke.

Together, these dynamics mean more people are breathing more wildfire smoke more often, and frequently without timely, local air quality information to guide their decisions. The EPA notes that wildfire smoke "can travel hundreds to thousands of miles, impacting air quality nationwide" (U.S. EPA, 2024b). Smoke does not respect county lines, monitor locations or agency boundaries: it pools in mountain valleys, shifts quickly and unevenly with changing winds, and can blanket communities far from the flames. In many of these places, the nearest regulatory monitor may sit miles away, upwind or in a different airshed altogether. When wildfires smoke surges, the regional AQI may read "moderate," but local conditions and exposure risk can vary greatly. This gap is particularly acute in communities already facing heightened vulnerability during wildfire events. In rural valleys, in small towns, on tribal lands, and in under-resourced neighborhoods there are often fewer regulatory monitors, less access to health care, and fewer options for avoiding exposure. The most impacted communities may lack access to data that reflect the true severity of smoke exposure and may not receive prompt, tailored guidance or response-relevant resources.

Community-based monitoring offers a way to change that. Research demonstrates that these monitoring networks can capture $PM_{2.5}$ concentrations with high spatial and temporal resolution during wildfire events, providing detail that traditional networks are not designed to capture on their own (Stampfer et al., 2024). This section, *Tracing the Smoke: Wildfire Pollution in Real Time*, explores how community-based sensor networks, forged through partnerships among grassroots organizations, researchers and public agencies, are reshaping how we prepare for, respond to, and recover from wildfire smoke events. Deployed through partnerships at homes, schools, clinics and tribal facilities, community-based sensors can supply local policymakers with data needed to track fast-moving smoke and guide timely responses. These responses can include adjusting outdoor activities, opening up clean-air shelters, or distributing masks and air cleaners to those most at risk, including children, older adults, pregnant individuals, outdoor workers and people with heart or lung conditions. Across the U.S., community-led monitoring initiatives demonstrate how participatory approaches are extending beyond a technical tool to serve as a form of collective resilience. To understand why this information is critical, it is important to recognize what wildfire smoke is made of and the health risks it creates.

> Por La Creación's El Aire Que Respiramos ("The Air We Breathe") program offers one illustrative example, showing how accessible $PM_{2.5}$ monitoring—paired with education and storytelling—can elevate community voices and translate air quality data into personal, public, and policy-relevant action across multiple states.

Pollutants

Wildfire smoke is a complex and dynamic mixture of gases, particulate matter, water vapor and other pollutants that can affect human health through multiple pathways. Some of these pollutants are regulated because of their toxicity and potential to cause serious health effects. Hazardous air pollutants (HAPs) are one such category, defined under the Clean Air Act to include certain toxic gases and particle-bound compounds that are emitted from industrial sources – and are also present in wildfire smoke.

Wildfire Gases	Wildfire Acids & Compounds	Particulate Matter	Secondary Pollutants
• Carbon Monoxide (CO) • Ammonia (NH_3) • Nitrogen Oxides (NOx) • Volatile Organic Compounds (VOCs) • Polyaromatic Hydrocarbons (PAHs) • Sulfur dioxide (SO_2)	• Sulfuric Acid • Inorganic Compounds: • Ammonium Sulfate • Ammonium Nitrate • Sodium Chloride • Organic chemicals, soil or dust particles, metals & biological materials (e.g., pollen and mold spores) (Badger, 2025).	Particulate matter refers to a mixture of solid particles and liquid droplets suspended in the air that vary in size, composition, and origin. • $PM_{2.5}$ (fine particulate matter) consists of particles 2.5 micrometers or smaller • PM_{10} inhalable particles, with diameters that are generally 10 micrometers and smaller	• Ozone (O_3) • Secondary Organic Aerosols (SOA)

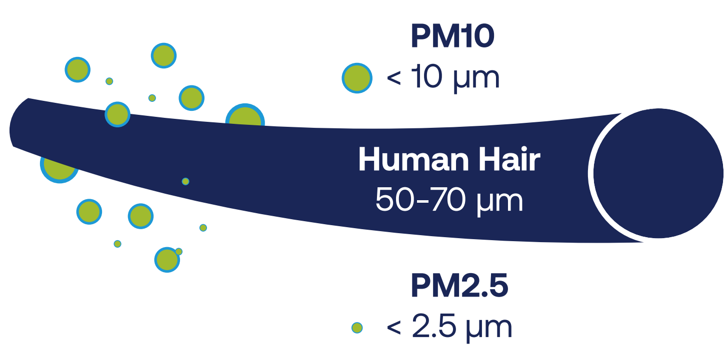
$PM_{2.5}$ is a primary component of wildfire smoke, as decades of research and evidence link exposure to well-documented serious health effects. Ground-level ozone is a secondary pollutant that is not emitted directly by wildfires but forms through atmospheric reactions involving NO_x and VOCs in the presence of sunlight, allowing ozone to accumulate and persist far downwind of fire activity (Badger, 2025). With strong summertime solar radiation, warm temperatures and stagnant air, ozone and SOA concentrations can increase substantially far from the fire source. Ozone formation depends on the timing, composition and atmospheric processing of smoke, as concentrations can vary widely, making the impacts less predictable but no less consequential for public health (U.S. EPA, 2025b). Escalating wildfire activity has produced larger and more prolonged smoke events, making wildfires a dominant driver of seasonal and episodic $PM_{2.5}$ events across the U.S. and pushing concentrations well beyond health-based standards.

Health Effects

Wildfire smoke can travel hundreds to thousands of miles, and recent increases in wildfire activity have amplified both the duration and intensity of exposure, extending health impacts far beyond fire-affected regions. As smoke moves, it carries a complex mix of pollutants that pose risks to a wide range of populations. HAPs present in wildfire smoke may contribute to adverse health effects in infants, children, pregnant people, older adults, individuals with existing lung and heart disease, and those engaging in outdoor or physical activity. VOCs in smoke can cause respiratory irritation, organ damage and, in some cases, cancer, affecting health both through direct exposure and through their indirect role as precursors to ground-level ozone.

Ozone concentrations may also be elevated during wildfire smoke events, which can lead to a range of respiratory effects such as reductions in lung function, inflammation of the airways, chest pain, coughing, wheezing and shortness of breath—even in healthy people. These effects can be more serious in individuals who have asthma and other lung diseases (U.S. EPA, 2025b).

During major smoke events, $PM_{2.5}$ levels can surge far above normal with little warning. Studies show that wildfire-related $PM_{2.5}$ is often more toxic and more episodically intense than particle pollution from traffic or industry (O'Dell et al., 2023). These tiny particles can bypass the body's defenses, travel deep into the lungs and enter the bloodstream, where they can trigger inflammation and systemic effects. Short-term $PM_{2.5}$ exposure from wildfire smoke can trigger irritation of the eyes and airways, asthma complications, cardiovascular stress, and premature mortality (U.S. EPA, 2025b). Rapid $PM_{2.5}$ spikes can increase emergency department visits and create chronic obstructive pulmonary disease (COPD), pneumonia, and cardiovascular complications—especially among individuals who are more susceptible to adverse health effects (U.S. EPA, 2024b).



Long-term exposure to $PM_{2.5}$ is associated with heart attacks, strokes, asthma attacks, bronchitis and other respiratory conditions, as well as adverse birth outcomes and the worsening of chronic illnesses. Repeated wildfire smoke episodes now contribute to chronic bronchitis, accelerated lung-function decline, and increased all-cause mortality—especially in regions exposed over multiple seasons (O'Dell et al., 2023). Smoke containing evaluated levels of both ozone and $PM_{2.5}$ pose more severe health impacts than exposure to either pollutant alone (Cooper et al., 2024). Children are particularly vulnerable, as developing lungs increase sensitivity to high-smoke days, with prolonged episodes linked to higher rates of bronchitis, wheezing, and breathing difficulties.

In addition to contaminating the air with toxic pollutants, wildfires also simultaneously impact the climate by releasing large quantities of carbon dioxide and other greenhouse gases into the atmosphere.

Why Real-Time, Hyperlocal Data Is Needed

In today's shifting regulatory climate, collaboration across grassroots organizations, researchers and public agencies has never been more essential. These collaborations make it possible to secure grants, build capacity and deploy tools that extend hyperlocal sensor data into the hands of residents, while also translating that data into formats that inform decision makers and institutional responses. Grounding this work in transparency, shared goals and mutual trust helps ensure that air quality data moves beyond collection alone. When communities and agencies understand how data are gathered, shared and used, that information can be clearly communicated and applied to prevent harm, support emergency response and guide policy change. From rapid response networks to co-designed public dashboards, these alliances help transform environmental data into meaningful protection—not just measurements.

Regulatory Monitoring

To understand why these hyperlocal systems are so crucial, it's important to look at the current federal monitoring framework—what it provides and where its limitations create gaps that communities are increasingly working to fill. The national regulatory air monitoring network plays a central role in assessing air quality and supporting air pollution management across the United States. This system is anchored in the National Ambient Air Quality Standards (NAAQS), which require the EPA, in partnership with state, local and tribal air agencies, to monitor six criteria pollutants: $PM_{2.5}$, PM_{10}, Ozone, CO, NO_2, and SO_2 (U.S. EPA, 2024c).

Federal Reference Method (FRM) and Federal Equivalent Method (FEM) monitors are U.S. EPA-approved devices for accurately measuring criteria air pollutants—forming the backbone of the U.S.'s regulatory air quality monitoring system. These instruments are designed to meet strict performance, calibration and quality assurance requirements to ensure data accuracy, consistency and comparability across locations and over time. This network consists of strategically located monitoring stations designed to characterize population exposure, support regulatory decisions and track long-term air quality trends. As of 2025, the U.S. operates approximately 1,000 regulatory-grade $PM_{2.5}$ monitors (U.S. EPA, 2024a). In addition to supporting regulatory compliance, data collected by FRM and FEM monitors are stored in EPA's Air Quality System (AQS) and used to generate AQI values that inform the public when air pollution reaches levels that may require protective action. (U.S. EPA, 2024c).

Regulatory-grade monitoring remains the gold standard used to demonstrate NAAQS compliance and to validate and quality assure air quality sensors. Regulatory networks also provide data essential for regional context and long-term statewide trends analysis. However, gaps in coverage and limitations in network design prevent regulatory monitors from capturing hyperlocal, episodic events and rapid neighborhood-scale variability during dynamic pollution conditions, such as wildfire smoke. For example, ozone monitors can detect hourly, regional changes influenced by wildfire-related VOCs and NO_x, but their siting limits insight into fine-scale conditions. At the same time, $PM_{2.5}$ concentrations can shift rapidly over short distances as smoke plumes move across populated areas, creating local exposure patterns that are better captured by complementary monitoring systems such as community-based sensors.

Emerging Wildfire Smoke Monitoring Tools

Agencies are increasingly using specialized monitoring tools that augment existing regulatory networks. These efforts are intended to supplement—not replace—regulatory-grade data by enhancing the ability to track smoke movement, intensity and community-level impacts in real time.

DHS "Sniffing" Wildfire Detection

The Department of Homeland Security Science and Technology Directorate (DHS-S&T), along with the Federal Emergency Management Agency (FEMA), U.S. Fire Administration (USFA), industry partners, and state and local fire agencies continue to develop new capabilities for reducing wildfire impact. From 2021 to 2024, federal agencies deployed specialized wildfire sensors focused on early ignition detection to support community protection and public safety. These advanced sensors use particulate, gas and environmental measurements—paired with artificial intelligence—to "sniff out" fires within seconds, often before they're visible (DHS, 2025). While critical for emergency response, these systems were designed to identify wildfire ignition rather than to characterize evolving smoke exposures.

Wildfire Smoke Air Monitoring Response Technology (WSMART)

U.S. EPA and various commercial vendors focus on tracking wildfire smoke after ignition. Their sensors monitor $PM_{2.5}$ levels over wide areas, helping assess exposure, inform public health alerts and guide protective actions. The WSMART loan program supports state, local and tribal air agencies by providing supplemental air monitoring equipment in wildfire-affected areas. WSMART offers a range of stationary and mobile air monitoring systems, including PurpleAir and multipollutant systems from manufacturers like Outpost Environmental and QuantAQ, Inc. These supplemental sensor technologies primarily measure $PM_{2.5}$, CO, total VOCs (tVOCs), and in some systems, black carbon. Available systems include two stationary configurations—a $PM_{2.5}$ sensor and a multipollutant unit measuring $PM_{2.5}$, CO and other gases—as well as a portable option, the Vehicle Add-on Mobile Monitoring System (VAMMS), which provides high-resolution, GPS-linked air quality data (U.S. EPA, 2025c). EPA provides technical support, training and data visualization tools for agencies borrowing equipment, including opportunities to test equipment outside the fire season to strengthen preparedness and expand use during prescribed burns. As of January 14, 2026, new loan requests were temporarily on hold, pending further operational project updates.

State Agency-Run Monitoring

In addition, wildfire-prone states across the West have expanded their own state agency–run monitoring systems to supplement the federal network and address gaps in coverage. Oregon's Department of Environmental Quality (ODEQ) operates a statewide smoke-monitoring framework that combines permanent regulatory monitors with ODEQ-deployed temporary "smoke monitors" during active fires and integrates corrected PurpleAir data into the state-managed Oregon Smoke Blog and public smoke map (ODEQ, 2024). In addition, California's Air Resources Board (CARB) operates the state's regulatory monitoring system and supplements it with state-owned rapid-deployment air monitoring trailers, low-cost sensor networks and statewide smoke-communication tools such as Smoke Spotter and AQ View, providing real-time information during major fire events (CARB, 2024).

These efforts underscore the importance of collaboration across departments, air agencies, governments, Tribal Nations, researchers and community organizations, each of which carries a critical piece of the wildfire-response puzzle. No single system can meet the speed, scale and distribution challenges posed by today's smoke events, but together these partnerships can create a more adaptive and resilient monitoring infrastructure. This multilevel coordination is the foundation on which the next generation of air-quality tools is being built, and it is central to the case studies that follow.

In practice, community-driven wildfire smoke data can be used by federal, state and local agencies in several complementary ways. Agencies may integrate validated sensor data into existing public-facing smoke and air quality maps to improve spatial coverage and timeliness. They can use real-time sensor trends to inform public health advisories, school and outdoor activity guidance and workplace protections, while also incorporating sensor networks into emergency response operations to support awareness during active fire and smoke events. Over the longer term, agencies can embed sensor data into state hazard-mitigation plans, climate resilience strategies and emergency-response protocols to guide preparedness planning, resource deployment and post-event evaluation.

These approaches are supported by detailed recommendations and an accompanying resource toolkit that outline practical pathways for operationalizing data for decision-making, communication and preparedness.

Community Sensor Networks

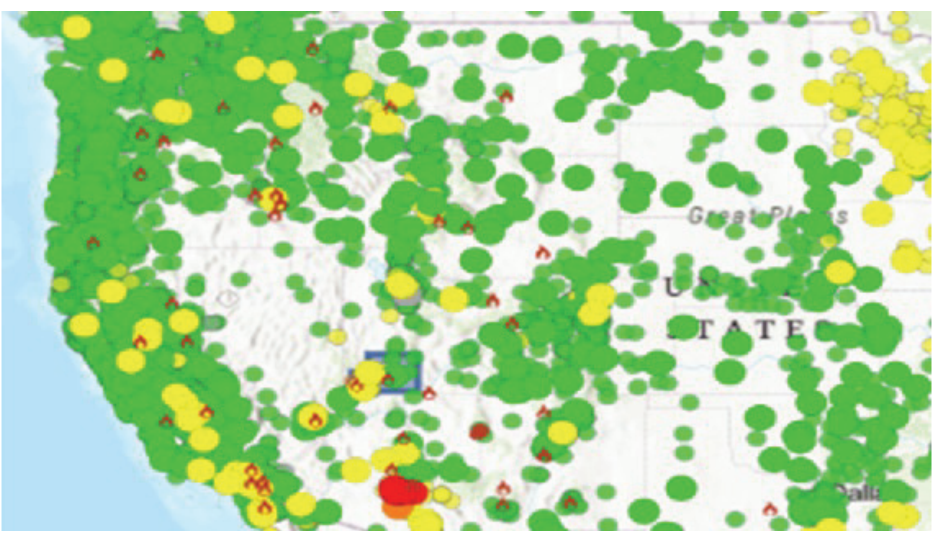
These case studies focus on $PM_{2.5}$ because it is the pollutant most often measured by community sensors and the EPA criteria pollutant used to assess health impacts from wildfire smoke, making it the most operationally useful indicator for tracking smoke exposure and informing real-time decisions.

The case studies focus on Clarity and PurpleAir sensors, which are commercial sensors integrated into the U.S. EPA's Fire & Smoke Map. Clarity sensors are built for wildfire conditions, using solar power, cellular connectivity and weather-resistant enclosures to operate reliably without external power or Wi-Fi. Clarity's Node-S extends $PM_{2.5}$ monitoring into remote or infrastructure-limited areas, and in July 2025 it became the second commercial sensor approved for inclusion on the U.S. EPA's Fire & Smoke Map (Clarity Movement Co., 2025). PurpleAir sensors estimate $PM_{2.5}$ using laser-based optical particle counters that detect how airborne particles scatter light inside the sensing chamber. Dual laser channels provide built-in redundancy and quality checks, and the device averages their readings for greater stability. The compact, weather-resistant units operate continuously outdoors, updating data about every 120 seconds and transmitting it via Wi-Fi to publicly accessible maps. PurpleAir was first incorporated into the U.S. EPA Fire & Smoke Map in 2020, when EPA introduced a national correction factor for displaying adjusted PurpleAir readings alongside FRM/FEM monitors.

As founder of Purple Air Adrian Dybwad explained, **"We want to offer our free, real-time maps to assist the public when dealing with traumatic disasters created by wildfires."** Communities across the country are using PurpleAir, Clarity and other low-cost sensors not as perfect instruments, but as sources of immediate information that can drive action during smoke events.

U.S. EPA Fire & Smoke Map

The U.S. EPA and U.S. Forest Service developed the AirNow Fire and Smoke Map to provide the public with information on fire locations, smoke plumes, near real-time air quality, smoke outlooks and actions people can take to protect their health — all in one place. The map combines data from satellite imagery, ground-based sensors and modeled smoke forecasts. Used for rapid response, information sharing, and coordination during wildfire events, they provide tools for action, communication and protection, and are accessible to decision makers and the public (U.S. EPA, 2025d). As burned acreage and smoke exposure grow each year, residents, schools, clinics and governments can use this tool to interpret shifting conditions and make informed choices about work or school closures, outdoor activity, ventilation and protective equipment. These sensors, often sampling every one to two minutes, provide families with information when they need it most. This is why community monitoring projects are essential for local resilience.



the daily cycle of emissions (NASA, 2024). Meanwhile, TROPOMI measures air quality and atmospheric gases in the troposphere, which is the lowest layer of Earth's atmosphere where most weather and human activities occur. It uses spectrometry to analyze Earth's surface and atmosphere, identifying the absorption patterns of pollutants.

Ground-based monitors, while highly accurate, have limited spatial coverage due to their fixed locations and typically measure air quality within a few kilometers of their installation sites. In contrast, satellites offer higher-resolution data and broader coverage, allowing for the detection of detailed pollution patterns across vast regions. By imaging trace gas concentrations over the Earth's surface in a fine spatial grid, they provide a more comprehensive view of air quality variations. Data from satellites is processed using algorithms that account for factors such as cloud cover, surface reflectance and atmospheric scattering, enhancing the accuracy of NO_2 measurements (Holloway et al., 2021).

Satellites enable improved understanding of temporal and spatial pollution patterns, allowing satellite data to closely align with ground-level measurements and effectively capture localized pollution hotspots to inform targeted pollution control strategies (NASA, 2022). **Figure 3** visualizes county rankings for NO_2 across the U.S. based on satellite data from 2020–2022 *(see Methodology for data analysis conducted by the University of Wisconsin-Madison)*. Each pollution category represents a separate percentile range rather than a cumulative total. For example, the "dirtiest 2%" includes NO_2 values between the 98th and 99th percentile but does not include the "dirtiest 1%," which only includes values at or above the 99th percentile. Similarly, the "dirtiest 5%" covers values from the 95th to 98th percentile, meaning it excludes the dirtiest 2% and 1%, ensuring no overlap between categories.

Limitations of Sensors

Community sensor devices respond to humidity, temperature and particle composition in ways regulatory instruments do not. As a result, their raw measurements of can overestimate or underestimate true $PM_{2.5}$ concentrations depending on wildfire smoke composition, ambient moisture and regional aerosol types. Regulatory-grade monitors and community sensors can complement each other, but operate on fundamentally different principles, serve different purposes, and produce data that cannot be directly compared without careful correction. Sensor performance may also decline over time due to environmental exposure, requiring periodic maintenance. The data these tools provide are user-friendly, but effective interpretation depends on scientific guidance and community education to ensure accurate understanding and to avoid misinterpretation. Power or internet outages during wildfires can interrupt data transmission—one reason many networks rely on solar and cellular setups. Community-based sensors are only effective when paired with reliable platforms that translate real-time data into actionable guidance. Without tools to interpret and deliver this information, communities may be left without the insight needed for health decisions or emergency responses. Offering clear

> "A critical step is understanding what low-cost sensors can reliably measure and the value they provide—while also recognizing their limitations. Asking what these sensors do and don't do, and what practical use their data has, is a big and necessary question for any community." — George Wyeth, a former EPA attorney for 27 years, now assisting the Environmental Protection Network.

visualizations, maps, time-series trends and infographics, these platforms are designed for non-expert audiences, making technical information more relatable, accessible, and responsive. Multiple entry points—like mobile-friendly dashboards, downloadable data and multilingual content—ensure that people with varying needs can access and use the information.

Despite their limitations, community sensors—when properly maintained and paired with accessible platforms—fill a critical gap by providing minute-by-minute visibility in areas with limited regulatory monitoring, enabling health agencies, emergency responders and the public to make rapid, potentially lifesaving decisions during fast-changing wildfire conditions.

Case Studies

According to the 2025 "State of the Air" rankings, counties in Washington and Montana are represented eight times among the top 25 most polluted counties for both the short-term and annual $PM_{2.5}$ categories. In these contexts, wildfire smoke has emerged as a defining air quality challenge, and the case studies that follow examine how these monitoring programs, coordinative efforts and data-sharing approaches are the catalyst to reduce local exposure.

Clean Air Methow Clean Air Ambassador program- Washington

The Methow Valley sits on the eastern flank of Washington's North Cascades, carved by glacial and river processes that created a long, narrow basin running roughly 60 miles from Mazama through Winthrop and Twisp toward the Columbia River (U.S. Census Bureau, 2024). Situated in Okanogan County, it is one of the state's most wildfire-prone regions. Okanogan County's population of roughly 45,000 includes nearly 25% older adults, 21% Latino residents, and 12% Native Americans —groups with elevated vulnerability to smoke exposure and particle pollution (Washington State Department of Ecology, 2025c). The Methow Valley's geography—characterized by deep mountain bowls and narrow canyon corridors—restricts air movement, particularly overnight when strong temperature inversions form and cold, dense air settles along the valley floor. During wildfire season, these inversions can lock heavy smoke near the ground for hours or days, with smoke funneled through narrow passes, pooling in basin-like pockets and recirculating with shifting nighttime winds. Smoke impacts in the Methow Valley are driven both by local fires and by smoke transported from regional wildfires across the North Cascades, eastern Washington, and southern British Columbia, prolonging exposure even when no fire is burning nearby. The regions continental climate intensifies these conditions: hot, dry summers, low annual precipitation and increasingly early snowmelt extend periods of dry fuels and contribute to a wildfire season that now commonly stretches from late spring into October. Limited road access and long travel distances further constrain residents' ability to avoid smoke exposure, increasing reliance on local, real-time information to guide daily activities, school operations and health-protective decisions. This combination of topography and climate

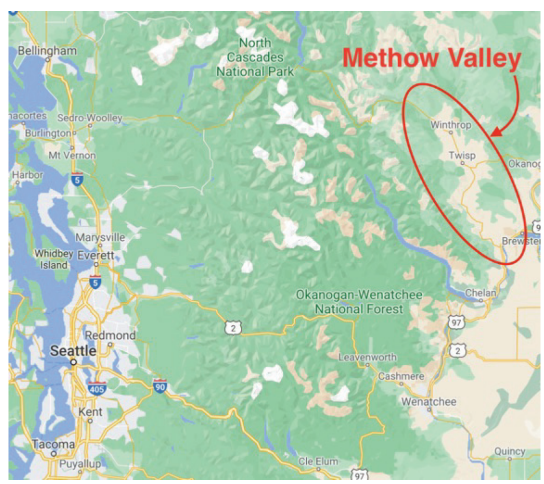


Figure 2: Map of Methow Valley, WA

produces sharp, hyperlocal smoke gradients that are not captured by the two regulatory monitors located in Twisp and Winthrop—shown in the circle on **Figure 3** (Washington State Department of Ecology, 2025b). In Washington, air Pollution is tracked through the Washington Ambient Air Monitoring Network, operated by the Department of Ecology and partner agencies. As of July 2025, this network included about 70 monitoring sites and incorporates FRM/FEM monitors required for federal compliance, as well as special-purpose monitors for wildfire smoke, ozone and tribal air quality (Washington State Department of Ecology, 2025b). To expand smoke preparedness, Washington launched SensWA— a statewide network of low-cost $PM_{2.5}$ sensors funded through the Climate Commitment Act (Washington State Department of Ecology, 2025b). As of mid-2025 there were roughly over 63 SensWA sensors deployed and reporting $PM_{2.5}$ (Washington State Department of Ecology, 2025a). Many of these sensors are positioned in places without regulatory monitors, while many others were collocated with FRM/FEM instruments to support calibration and data validation. Despite these expansions, the state's 2025 Ambient Air Monitoring Network Assessment concludes that Washington's regulatory system still cannot capture neighborhood-scale smoke variations across mountain valleys and rural regions. Community-based monitoring is identified as essential for filling these gaps—especially as smoke event concentrations can shift dramatically within minutes (Washington State Department of Ecology, 2025b). The Methow Valley exemplifies these challenges.

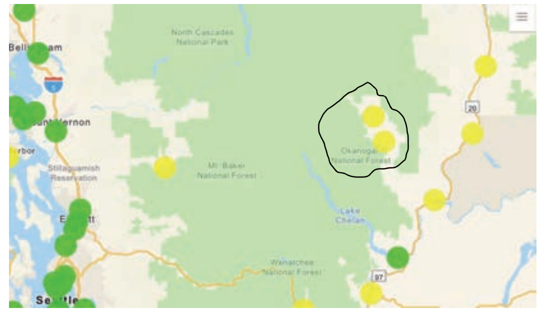


Figure 3: Washington Department of Ecology Regulatory Monitors (2026)

Founded in 2013 under the fiscal sponsorship of the Methow Valley Citizens Council, a 501(c)(3) nonprofit organization, Clean Air Methow worked in collaboration with air quality managers and scientific guidance from Liz Walker, PhD, Principal of Smoke Ready Solutions and Affiliate Assistant Professor in the Department of Occupational and Environmental Health Sciences at the University of Washington. In 2018, Clean Air Methow launched the Clean Air Ambassadors (CAA) program, anchoring a long-term framework for community-led public health protection strategies grounded in local action. Originally launched in the Methow Valley, the PurpleAir sensor network and CAA program expanded into an Okanogan County–wide effort. By spring 2022, it managed one of the largest rural PurpleAir sensor networks in the state, with CAA hosting and maintaining over 35 sensors across the Methow and Okanogan Valleys, spanning approximately 60 miles (Clean Air Methow, 2022). Through this work, the program integrated technical rigor with community capacity-building to help residents navigate wildfire smoke, winter woodsmoke and complex local microclimates. While the CAA sensor network remains deployed and active, the program is currently dormant due to the absence of dedicated funding and staffing capacity, with plans to resume as new funding opportunities become available.

Despite the current pause in funding, the program's staged deployment model and community partnerships established a lasting foundation for future monitoring efforts. This integrated approach was carried out through a phased expansion of the community sensor network. **Figure 4** depicts Phase I and Phase II of the CAA program.

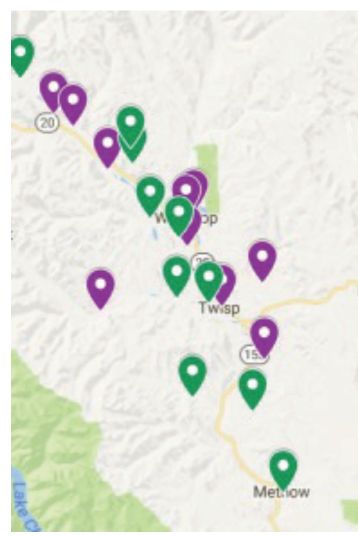


Figure 4: CAA Phase I sensors (purple) and Phase II sensors (green)

Phase I shows the initial deployment of air quality sensors across the Methow Valley, while Phase II expanded the network to additional locations and elevations, increasing spatial coverage and the ability to capture localized smoke conditions. This phased expansion was paired with intentional community recruitment. The CAA program strategically engaged volunteer residents across diverse elevations, populations and neighborhoods to ensure broad geographic and demographic representation. These low-cost sensors were hosted by community members, including those without scientific backgrounds. Ambassadors received training to maintain instruments and interpret data for practical decision-making, including interpreting $PM_{2.5}$ trends and data, applying EPA correction factors and understanding differences between real-time and 24-hour averages (Clean Air Methow, 2020). This training component was a defining feature of the program, turning residents into trusted local data stewards. In practice, ambassadors not only maintained sensors but also taught neighbors about smoke readiness, assisted with clean-air room setup, provided real-time local observations during fires, helped extend monitoring coverage across remote areas and supported community education on wildfire smoke and indoor air quality improvements, using portable sensors and air cleaners (Clean Air Methow, 2022). Participants were included in hands-on workshops, seasonal smoke-preparedness campaigns and events focused on high-efficiency particulate air (HEPA) filtration and mask use (Clean Air Methow, 2023). The program also incorporated student interns that were selected to help conduct academic research towards the improvement of smoke readiness, risk communication and disaster preparedness and response.

> "In Okanogan County, our network of purple air monitors really helps the community navigate fire season. Real-time, reliable information about fire and smoke activity is crucial to maintaining a sense of safety and agency." — Liz Walker, PhD, Principal, Smoke Ready Solutions, and Affiliate Assistant Professor, Department of Occupational and Environmental Health Sciences, University of Washington

During the years it was active, the CAA program expanded beyond monitoring and supported broader resilience efforts—including guidance on clean-air shelters and partnerships with clinics and senior centers to protect medically vulnerable residents. The program supported school air quality protocols by including local schools as sensor hosts, giving administrators decision-making tools and information to determine whether conditions were safe for outdoor recess and athletic activities (Clean Air Methow, 2022).

During major wildfire seasons, Clean Air Methow's sensors were often the most-viewed stations on the Washington PurpleAir map, capturing rapid smoke spikes that were not reflected in nearby federal monitors. When active, the CAA program grew from a small woodsmoke-awareness effort into a regional hub for smoke preparedness, public education and sensor deployment, supported by an online dashboard with forecast interpretations and decision tools that supplement state messaging during smoke emergencies. The program became a model for how rural communities with limited regulatory coverage can build their own reliable, real-time air quality infrastructure. By blending scientific oversight with community participation, the Methow Valley built one of the most durable and trusted wildfire-smoke monitoring systems in the rural West—a model for rural, tribal and underserved communities nationwide.

What Community Monitoring Enabled in the Methow Valley

- Application of EPA-endorsed $PM_{2.5}$ correction factors to improve data usability.
- Data-literacy education for residents and sensor hosts.
- Guidance on interpreting real-time versus 24-hour $PM_{2.5}$ averages.
- Indoor air quality strategies, including the use of HEPA air cleaners.
- Outreach and support during severe wildfire smoke events.
- Public dashboards that integrated corrected sensor data, alerts and forecasts.

Clean Air Methow's experience highlights a broader vulnerability shared by many community wildfire preparedness efforts: without sustained funding and staffing support, even well-established programs face challenges maintaining continuity over time. This underscores the importance of stable investment to support smoke readiness and long-term public health protection. What Clean Air Methow established—community relationships, monitoring infrastructure and practical strategies—provides a strong operational foundation to build on when securing new funding and staffing, offering a model for communities nationwide facing similar funding disruptions.

Public-Facing Dashboards

Clean Air Methow had maintained a publicly accessible air quality dashboard that integrated regulatory data, corrected PurpleAir readings and local PurpleAir data. The dashboard helped support decisions on school activities, outdoor work, masking, ventilation and whether to shelter indoors during smoke episodes. Wildfire Ready Neighbors was also available to help residents and community members access real-time data on their air quality. Tools like this function as more than transparency mechanisms; they serve as instruments of accountability, accessibility and knowledge, enabling community members to ask more data-informed questions, support policy responses and build air qualityliteracy. Across the West, similar dashboards—such as Montana's "Today's Air," Oregon's "Air Quality Index Map," and California's AQ View—demonstrate that clear visualization is critical during wildfire events. Residents consistently seek real-time clarity on conditions at the block or valley level—not just the regional averages displayed on traditional AQI tools. These dashboards translate dense data into practical guidance, bridging the gap between measurement and action.

> "Rigorous data quality control and community training are what turn sensors into decisions." — Liz Walker, PhD, Principal, Smoke Ready Solutions, and Affiliate Assistant Professor, Department of Occupational and Environmental Health Sciences, University of Washington

Durability through Collaboration

Clean Air Methow sustained its work through community partnerships, local champions and creative outreach models, resulting in an adaptive network that tracked pollution, activated local response, shaped public understanding, supported climate resilience and advanced regional air quality policy grounded in lived experience. During its operation, the program also contributed to regional and statewide policy discussions, including communications related to prescribed burning, smoke complaint documentation, wildfire response planning and the integration of low-cost air quality sensors into public health decision-making. These activities reinforced how community-based monitoring functioned as both an information network and a public health intervention.

As noted, the region has maintained relationships with local institutions and community partners, preserving the groundwork for future efforts pending renewed funding. The program's trajectory underscores that community monitoring systems can be sustained through trust, transparency and shared ownership even as funding disruptions constrain operations (Clean Air Methow, 2023). With strong local leadership, cross-agency cooperation and shared commitments to public health, these collaborations provide continuity when funding fluctuates, technology evolves or wildfire seasons intensify.

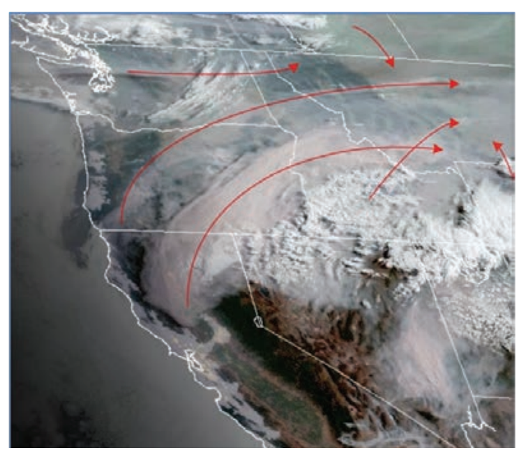
Rapid Response Networks

Clean Air Methow demonstrates how community-based monitoring can fill major geographic gaps in federal and state systems, generate minute-to-minute $PM_{2.5}$ data, strengthen emergency response, improve smoke literacy and mobilize residents during severe smoke episodes—functions that form the backbone of emerging community-centered rapid response networks as wildfire seasons grow longer and more unpredictable.

In moments of instability, community-sourced data becomes a form of collective resilience—helping communities document harm, coordinate response and advocate for protection. These networks use hyperlocal data to guide school and workplace decisions, activate clean-air shelters, support real-time communication through dashboards and alerts, and help residents understand shifting conditions at the neighborhood level. They also foster preparedness and policy development by documenting lived experience and ensuring communities can act quickly during extreme smoke events. Importantly, they build redundancy into wildfire communication systems—using radio, local check-in networks, bulletin boards and pre-established neighborhood pathways to deliver safety information when power or cell service fails. Together, these capabilities show how monitoring can move beyond data collection to function as an integrated early-warning, decision-support and public health protection system grounded in the needs and realities of wildfire-affected communities.

PurpleAirs in Schools Program, Montana

Montana is one of the most wildfire smoke-impacted states in the country—a vast, sparsely populated landscape where long fire seasons, dense forest fuels, recurring drought and prevailing westerly winds drive some of the nation's highest concentrations of smoke-derived $PM_{2.5}$ (O'Dell et al., 2021). With just over 1.13 million residents spread across more than 147,000 square miles—only 7.4 people per square mile— Montana's communities are widely dispersed, leaving many rural and tribal areas far from regulatory-grade air quality monitors (American Community Survey [ACS], 2024). Montana's vast landscape is characterized by steep, forested mountains and narrow valleys in the west and semi-arid plains in the east— this complex geography can trap air pollution from wildfire smoke for days or even weeks.



Satellite image of smoke transport into Montana from across state lines (National Oceanic and Atmospheric Administration [NOAA], 2024).

While regulatory monitoring coverage in Montana is primarily determined by population and regulatory requirements rather than terrain, the state's varied geography can intensify localized smoke behavior and impacts. The state is approximately 88–89% White, with 6–7% identifying as American Indian or Alaska Native. Its 684 public schools serve roughly 149,000 students, about 11% of whom are American Indian (ACS, 2024). In most of Montana's counties, 10-20% of the citizens are living below the poverty level; counties with the highest percentages, upwards of 30%, are often located on or near tribal lands. **Figure 5** shows the percentile of residents over the age of 64, plotted alongside prevalence of heart disease, asthma, and a representation of medically underserved areas in Montana. Elevated baseline risk factors, such as these, contribute to increased susceptibility to wildfire smoke exposure among Montana residents. Montana has long faced limited access to air quality monitoring, driven in part by funding constraints and the challenges of covering a large sparsely populated state. These gaps disproportionately affect communities located far from regulatory-grade monitors, where immediate air quality information can be lifesaving. Wildfires within Montana and across the region generate the vast majority of the state's $PM_{2.5}$ burden; one recent assessment estimates that about 85% of the smoke-derived $PM_{2.5}$ emissions from within the Montana's state borders come from wildfires, dwarfing contributions from prescribed burning (10 times less), woodstove emissions (12 times less) and the state's largest industrial $PM_{2.5}$ source (100 times less) (Montana Department of Environmental Quality [MTDEQ], 2025). MTDEQ operates a robust regulatory monitoring network that meets and exceeds all Clean Air Act requirements, but there is also a recognized need for more localized sensor data to support public health and safety decision making. This has prompted increased interest in community-scale data. The PurpleAirs in Schools Program is a compelling example of cross-sector collaboration to build community resilience in the face of intensifying wildfire smoke. Led by the MTDEQ in partnership with the University of Montana (UM), the initiative was designed to address spatial limitations in the state's regulatory ambient air monitoring network by deploying additional sensors in key locations, particularly in communities where real-time air quality information was previously unavailable. The project focuses on $PM_{2.5}$, the pollutant of greatest health concern for Montana's population, and is underpinned by MTDEQ's established capacity to operate and maintain a statewide air monitoring network across a large geographic area.

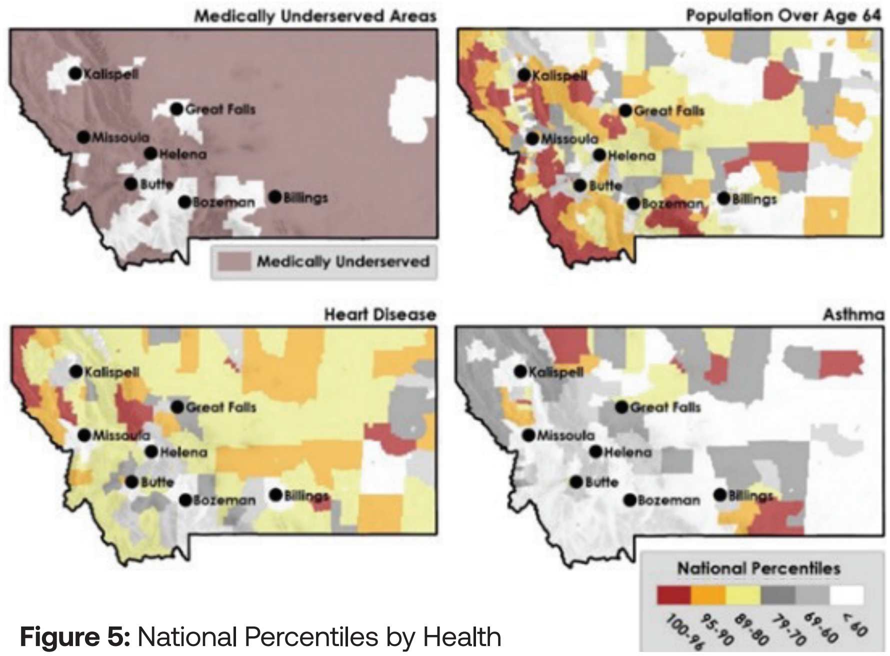


Figure 5: National Percentiles by Health Indicator (used in PurleAirs assessment)

> "Wildfire smoke has become the primary air quality challenge in Montana. Even though we experience many days of very clean air, smoke now drives the most severe and widespread health impacts across the state."
>
> — Bo Wilkins, MTDEQ Air Quality Bureau Chief, Bo Wilkins

The program launched with a goal of deploying 200 sensors and, within the first two years, enrolled more than 100 schools, with over 78 installing and operating air sensors in locations without prior monitoring. Two monitors were placed at each school that signed up, one indoors and one outdoors. Program funds were used to advance three primary objectives, including 1] expanding statewide monitoring coverage for vulnerable and underrepresented populations, 2] fostering sustained partnerships with schools, tribal communities, and local organizations, and 3] expanding air quality awareness through participatory, science-led monitoring tools and resources. The project was designed not only to monitor $PM_{2.5}$ pollution from wildfire smoke indoors and outdoors, but also to empower schools with information that can guide decisions about outdoor activities and student safety. Most of the sensors that deployed are PurpleAir sensors, selected for their affordability, publicly accessible data, minimal maintenance requirements and suitability for broad spatial coverage. While PurpleAir sensors produce a less robust data product than regulatory-grade instruments, if a correction algorithm is applied to the raw data, they will correctly report the AQI health concern color category more than 90% of the time.

> "The pollutant of greatest concern in Montana is wildfire smoke. To inform the public we need to be responsive to that."
>
> — Bo Wilkins, MTDEQ Air Quality Bureau Chief, Bo Wilkins

MTDEQ determined that the benefits of using low-cost sensor data to represent and reach previously unmonitored communities outweighed concerns related to data precision, particularly for outreach, education and health-protective decision-making. The map on **Figure 6** (below) shows the location of MTDEQ's primary/regulatory monitoring sites without the support of a sensor network. **Figure 7** (also below) shows MTDEQ's goal map for sensor deployment. To date, about 80 of these sensors are online and reporting live data, mostly from schools around the state. This map demonstrates how the addition of community-based sensors substantially increases spatial coverage, fills critical gaps between regulatory monitors and enables more localized tracking of wildfire smoke across the state. To ensure this expanded network translates into timely, practical decision-making, the program was designed with clear pathways for how sensor data are shared and used. Outdoor sensor data are publicly available on the AirNow Fire & Smoke Map,

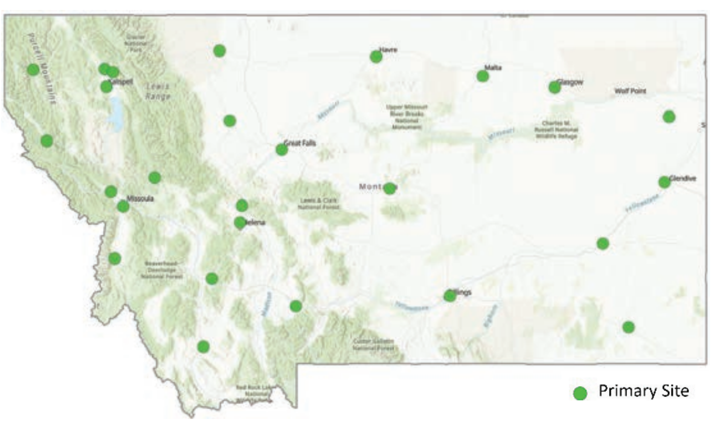


Figure 6: MTDEQ primary and regulatory monitoring locations

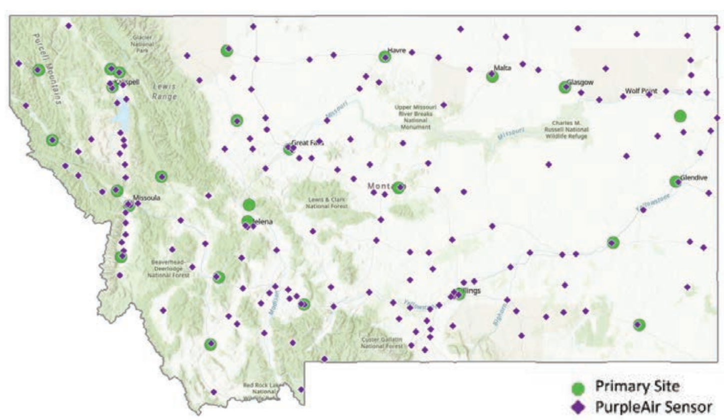


Figure 7: MTDEQ's goal map for sensor deployment

allowing residents to track changing conditions and respond accordingly. Indoor sensor data are kept private for school use, enabling administrators, athletic directors and teachers to make localized decisions regarding outdoor activities, practices and events. Each participating school receives a start-up kit that includes sensors and guidance on proper siting, installation, maintenance and data interpretation. Schools receive a link for a personalized dashboard displaying the school's data along with activity guidelines for current AQI conditions. In some districts, sensor data are also incorporated into science curricula to increase student awareness of air pollution and health. By partnering with schools that serve as trusted community hubs, the program extends benefits beyond students and staff, serving as a reliable source of local air quality information for the broader community.

> "Regulatory monitors are essential, but they're expensive and designed to represent regional conditions. Low-cost sensors give us a practical way to understand what's happening at the community level and to deliver information with real, lifesaving potential."
>
> — Kelly Dorsi, PhD, Section Supervisor, Air Research & Monitoring, MTDEQ.

Residents frequently contact schools and the MTDEQ for updates, creating opportunities to share health guidance and connect community members to nearby monitoring data. While initially designed to support school-based decision-making, the initiative is evolving to strengthen community-wide preparedness and education. This coordinated effort bridges multiple sectors— public health, education and air quality. Collaboration has been central to the program's success, bringing together public health departments, climate resilience organizations and the Montana High School Association (MHSA), with outreach conducted through county health conferences and direct engagement with school nurses, athletic directors and science educators. The UM research partners developed a custom dashboard that applies

> "Schools are trusted anchors in communities. When a school has a sensor, it doesn't just support students—it becomes a source of information for the entire community." — Keri Nauman, MTDEQ, Community Air Monitoring Coordinator

EPA-endorsed correction factors to community-based sensor data—adjusting raw measurements to better reflect actual $PM_{2.5}$ concentrations—and pairing that data with clear, health-based activity recommendations for schools, ensuring data is reliable and easy to use. In doing so, the PurpleAirs in Schools Program offers a scalable model for community sensor deployment that supports immediate health-protective decisions and strengthens long-term environmental literacy. It also demonstrates the importance of tribal and rural inclusion, school-based infrastructure and multi-agency collaboration for protecting public health in a changing climate. This program works because it brings together regulatory expertise, public health research and on-the-ground partners. No single organization could do this alone.

> "Linking community air monitoring with health research helps translate data into meaningful guidance—especially for understanding cumulative and long-term smoke exposure." — Bo Wilkins

Durability Through Collaboration

Montana's wildfire smoke monitoring effort is sustained through layered, cross-sector partnerships that distribute responsibility, expertise and resources across institutions rather than concentrating them within a single program or funding source. MTDEQ provides regulatory oversight and technical expertise, complemented by UM's Research Education on Air and Climate Change Health (REACH) program's public health research and education leadership. The MHSA offers a trusted, statewide network of schools that anchor monitoring in local communities. Together, these partners share knowledge, equipment, data infrastructure, training and outreach, allowing the sensor network to continue operating and expanding even as individual grants fluctuate or priorities shift. This collaborative structure is particularly well suited to Montana's geography and wildfire smoke reality. In a state where smoke sources are unpredictable, monitoring gaps are widespread and regulatory networks are necessarily sparse, durability depends on flexibility and shared ownership. By providing sensors to schools, leveraging existing community relationships and integrating public-health messaging alongside air quality data, the program creates a monitoring system that reflects how Montanans actually experience wildfire smoke—across seasons, across jurisdictions and across landscapes. Importantly, this approach allows the network to persist beyond individual fire seasons or emergency response windows. It supports year-round smoke awareness, with the capacity to rapidly scale activities during severe wildfire seasons and maintain community engagement in lower-smoke years. Montana's model demonstrates how collaboration can transform low-cost sensor networks from short-term pilot projects into durable public-health infrastructure—capable of adapting to increasing wildfire impacts while continuing to serve under-resourced communities over the long term.

> "This novel $PM_{2.5}$ monitoring network throughout Montana schools provides an opportunity for students to learn about the impacts of wildfire smoke and other sources of air pollution in their communities. The monitoring results provide an opportunity for teachers to discuss solutions to air pollution issues, including things that students can do on an individual basis to protect their health and the health of their community."
>
> — Tony Ward, professor, School of Public and Community Health Sciences, University of Montana.

Rapid Response Networks

In a large, rural state with highly variable smoke conditions, schools and other trusted community hubs have become the cornerstone of rapid response to wildfire smoke. The PurpleAir in Schools network captures sharp smoke gradients between valleys, towns and school districts—often revealing conditions that differ dramatically over short distances and change within hours. From individuals learning when to wear a mask or keep children indoors, to communities presenting monthly pollution trends to elected officials, hyperlocal data bridges the gap between personal health impacts and public accountability.

This hyperlocal visibility allows MTDEQ, agency partners and community leaders to coordinate timely advisories, adjust outdoor events and respond to worsening conditions that would otherwise go undetected by the sparse regulatory network. Rapid response networks also support indoor decision-making. By pairing indoor and outdoor sensor data, schools can identify smoke infiltration, assess the effectiveness of existing heating, ventilation and air conditioning (HVAC) systems and connect with available public health resources and mitigation programs. Over time, this continuous feedback loop strengthens preparedness by linking monitoring, education, communication and intervention—particularly during prolonged smoke episodes when exposure risks accumulate.

Together, these networks function as a statewide early-warning and decision-support system, where community-scale monitoring can move beyond awareness alone to enable faster, more coordinated public-health responses—particularly in communities where emergency and monitoring infrastructure are limited.

Conclusions

Wildfire smoke has become one of the defining air quality challenges of our time, reshaping how communities understand, experience and respond to air pollution. The case studies in this report—Clean Air Methow's CAA program in Washington and the PurpleAirs in Schools Program in Montana—demonstrate how community-driven data systems support prompt and health-protective measures, sustain engagement across seasons and strengthen smoke readiness beyond episodic events. Community data is strongest when institutions support it responsibly—pairing local knowledge with open dashboards, technical rigor and shared decision-making.

Through expanded sensor networks, trusted partnerships and accessible data tools, communities are bolstering the capacity, knowledge and situational awareness needed to reduce exposure and respond effectively during wildfire smoke events. Across these efforts, locally developed approaches weave together current data, lived experience and storytelling to help translate numbers into meaning, sustain community engagement and provide policymakers with the context needed to act. This reflects a broader shift in how evidence is generated and used, showing how community-led data reshapes dynamics by recognizing residents as stewards and holders of knowledge rather than passive data sources. In moments of uncertainty, this shift strengthens shared trust, accountability and collective resilience by grounding action in everyday realities and community authority.

These lessons point to a broader takeaway: community monitoring functions as a complementary layer—helping address localized information gaps—while operating alongside and reinforcing the federal regulatory framework. Science-backed, health protective $PM_{2.5}$ standards play a critical role in today's age of large, prolonged, multi-source smoke events: they reduce background pollution, lessen cumulative exposure and help ensure that communities are not already burdened before wildfire smoke arrives. EPA's regulatory monitoring network and NAAQS provide protection through a standardized and legally enforceable framework that local systems alone cannot. While regulatory standards provide this foundational, population-level protection, community monitoring offers the localized resolution and data granularity needed for day-to-day decision-making and ongoing protection during rapidly changing conditions.

As wildfire seasons grow longer and smoke concentrations vary sharply over small spatial and temporal scales, the nation needs both: a robust federal framework grounded in strong NAAQS and community-based systems capable of capturing rapid fine-scale variability. This combined approach closes long-standing monitoring gaps in rural, tribal and underserved regions while embedding community-generated data into preparedness, response and decision pathways that endure beyond a single smoke season.

From Response to Recovery

Community-driven monitoring is increasingly extending beyond immediate wildfire smoke response to inform air quality conditions during recovery, cleanup and rebuilding phases. As smoke exposure has become a recurring, seasonal reality in many regions, understanding the longer-term health implications of these exposures is critical. Even after fires are extinguished, resuspended ash, fine particulate matter and debris-related dust can continue to affect air quality and pose ongoing health risks. Community-based monitoring helps define this next phase of wildfire science by enabling rapid post-fire assessment, sustained tracking of pollution and swift public-health guidance during recovery.

Post-Fire Community Monitoring

An example of this approach, the PHOENIX Project (Post-fire airborne Hazard Observation Environmental Network for Integrated Xposure-monitoring) was launched following the 2025 Eaton Canyon Fire in Altadena, California and led by the California Institute of Technology and local partners. As of March 2025, the project deployed an initial network of 19 solar-powered, cellular-connected community sensors made by QuantAQ, with plans to expand to approximately 25 sensors across the burn area. These sensors measure particulate matter across multiple size ranges, including ($PM_{1.0}$), $PM_{2.5}$ and PM_{10} and were designed to provide real-time air quality information during debris removal, cleanup and rebuilding, when post-fire dust and ash pose ongoing risks (Fesenmaier, 2025). By capturing highly localized particulate conditions after containment, PHOENIX complements federal and state recovery efforts while illustrating exposure awareness and health-protective actions during post-fire recovery phases.

By carrying air quality monitoring into the recovery phase, these efforts redefine wildfire assessment as a sustained public health function rather than a momentary emergency response. This expanded lens enables pollution exposure data to directly inform recovery decisions, rebuilding strategies and long-term community protection across the entire arc of wildfire impacts.

Even as community-based wildfire smoke monitoring proves its value, many programs face persistent funding and staffing challenges. Maintaining partnerships, transparent data practices and cross-agency collaboration often depend on grassroots' advocacy and sustained local engagement during funding gaps. These pressures are widespread across community sensor efforts, underscoring the need for clearer pathways to continuity and scale. Building on these lessons, the recommendations that follow outline practical actions to help stabilize and sustain this work over time. Together, they translate the insights and case studies presented here into practical, multi-level actions—advancing a vision of cleaner air that is informed by science, responsive to community needs and strengthened by the voices and experiences of those most affected by wildfire smoke.

Recommendations

Wildfire seasons are becoming longer, more unpredictable and more hazardous, and communities are increasingly relying on their own networks, partnerships and novel approaches to stay informed and protected—particularly to integrate local data into state and federal systems. To strengthen protection during smoke events, expand access to real-time local data and ensure that monitoring networks remain resilient even when grants end or budgets shift, the American Lung Association offers the following calls to action:

Federal Government

- Implement and enforce science-based, health-protective NAAQS, including the 2024 updated $PM_{2.5}$ standard.
- Strengthen hazardous air pollutant standards and enforcement. Expand fenceline monitoring requirements to more stationary sources of hazardous air pollutants.
- Adequately fund state, local and tribal air agencies to sustain robust regulatory monitoring networks, including staffing, data platforms and infrastructure.
- Invest in dedicated, multi-year funding for community-led monitoring, supported across federal agencies (e.g., EPA, FEMA, USDA and others). Include investments in technical assistance hubs that provide calibration and collocation support, QA/QC protocols, quality assurance and data interpretation guidance. Support ongoing research into best practices.
- Develop guidance on minimum performance, documentation and transparency standards to integrate validated, community monitoring data into federal air quality decisions, including enforcement, inspections, permitting, compliance and rulemaking.
- Establish frameworks to utilize community-scale data for public health communications, emergency response and preparedness, and post-event evaluations.
- Building on the success of the EPA U.S. Fire and Smoke Map, improve and modernize federal data platforms to display validated and corrected community monitoring data alongside regulatory measurements. Permanently fund and expand federal wildfire smoke monitoring programs, including EPA's WSMART.
- Support cross-agency coordination among air agencies, transportation authorities, port and freight authorities and land-use and zoning regulators to integrate community monitoring into decision-making.

States

- Ensure stable, state-level funding streams, beyond short-term grants and projects, for community monitoring. Sustain cross-agency partnerships that build local expertise and tailor to local needs.
- Partner with universities, air agencies and research institutions to provide technical support – including sensor deployment, data hosting, calibration and validation, assessment and maintenance, data useability and hands-on training—for community, school and tribal monitoring programs.
- Integrate properly corrected community sensor data into dashboards, maps, public advisories and communication platforms that support incident-response systems, neighborhood-level messaging, school and outdoor activity guidance, emergency response decisions, post-event assessments and inclusion in state resilience planning.
- Establish frameworks that formalize community participation and transparency in air quality decision-making, including defining how community input informs agency actions and ensuring feedback loops between residents

and decision-makers. Ensure a pathway for community-generated data to be used to identify high exposure areas.

- Use quality-assured community data to inform state permitting decisions, cumulative-impact analyses and targeted inspections, and formalize how neighborhood-scale monitoring feeds into state air quality programs to support enforcement screening, mitigation prioritization, emergency monitoring plans, transportation planning and land-use strategies. SIPs can remain anchored to regulatory monitoring for NAAQS compliance while using quality-assured community data to identify hotspots and better target where emission reductions can be applied.
- Support Tribal sovereignty in air monitoring by strengthening EPA State and Tribal Assistance Grant (STAG) support for tribal air programs, including sustained funding for staff, operations and data ownership and use.

Local Governments

- Commit sustained funding to support the full lifecycle of community air monitoring, including sensor maintenance and replacement, staff capacity and training, partnerships, public data platforms and ongoing engagement that links monitoring to public health and emergency response.
- Coordinate across cities, counties, regional agencies, public health and emergency planners and neighboring jurisdictions to align monitoring with pollution patterns, enabling residents and agencies to co-develop priorities, review data and guide mitigation strategies.
- Embed air quality monitoring into local emergency management and hazard-mitigation plans by establishing formal cross-department protocols that define how community sensor networks are used in public communications, emergency operations, recovery planning and future preparedness, require agencies to use real-time data to guide coordinated response during major pollution events, and document lessons learned to improve future decision making.
    - Wildfire smoke: Use data to guide decisions on outdoor activities, worker safety, school and childcare operations, ventilation and clean-air shelter activation.
    - Heavy-duty trucks: Apply data to inform truck routing, idling enforcement, curb management, port operations and roadway design.
    - Point-source pollution: Integrate data into investigations, permitting review, public comment processes and facility-level mitigation actions.
- Regularly review monitoring data to identify areas of elevated concentrations, dominant sources and exposure trends, and conduct after-action reviews following major events to refine communication, sensor placement, outreach and resource deployment.
- Preserve quality-assured community data for public comment and, when needed, legal review, strengthening the administrative record with real-world exposure evidence.
- Support community events and volunteer networks—including schools, faith-based organizations and health clinics—to engage residents as sensor hosts and data stewards.
- Use transparent, plain-language and multilingual reporting tools with visuals and maps to support public understanding and informed participation in policy discussions.

Individuals/Community Groups

- Collaborate with academic entities, public health organizations, government agencies and commercial vendors to secure multi-year grant funding support for deploying monitoring projects and sustaining staffing, data

- Bolster community capacity and support through coordination with local schools, tribal, faith-based and neighborhood organizations in under-resourced or rural areas.
- Use publicly accessible air quality data, supported by cross-sector partnerships, to deliver clear findings, actionable requests and health-protective protocols to local municipal boards, school boards, commissions and decision-making bodies.
- Apply neighborhood-scale data to advocate for health-protective actions, including emergency alerts, clean-air shelter activation and smoke-day school and work adjustments, truck rerouting, idling restrictions, buffer zones near homes and schools, and stronger fenceline monitoring, permit modifications, targeted inspections, health symptom tracking and enforceable mitigation during permit renewals or expansions.
- Build data literacy by training local staff, volunteers, leaders and residents to interpret corrected data, document pollution events and communicate findings effectively, while establishing clear governance structures over roles, authority and data ownerships.
- Plan for the full data lifecycle and continuous improvement—from defining monitoring questions and selecting sensors to placement, calibration and maintenance; data collection, backup and useability; to quality assurance and sustained use of results.
- Document and apply lessons learned to improve communication strategies, locally tailored data models, resource deployment and long-term operation and sustainability.
- Maintain public-facing dashboards that integrate sensor data and forecasts with plain-language health guidance, designed to be mobile-friendly, multilingual and accessible to non-experts.
- Educate residents on local emergency preparedness and response protocols, including the communication channels used to deliver rapid public alerts during pollution events.

References

Badger, M. S. (2025, February 28). Rising health impacts of wildfire smoke exposure. American College of Osteopathic Internists. https://www.acoi.org/blog/rising-health-impacts-wildfire-smoke-exposure

California Air Resources Board. (2024). Air monitoring and wildfire smoke programs. California Air Resources Board. https://ww2.arb.ca.gov/our-work/programs/wildfires

Clarity Movement Co. (2025, July 23). Clarity approved for EPA's Fire & Smoke Map: A major milestone for indicative air quality monitoring. Clarity Movement Co. Blog. https://www.clarity.io/blog/clarity-approved-for-epas-fire-and-smoke-map-a-major-milestone-for-indicative-air-quality-monitoring

Clean Air Methow. (2020). About Clean Air Methow. https://www.cleanairmethow.org/about

Clean Air Methow. (2022). Clean Air Ambassador Network. https://www.cleanairmethow.org/get-involved
Cooper, O. R., Chang, K.-L., Bates, K., Brown, S. S., Chace, W. S., Coggon, M. M., Gorchov

Negron, A. M., Middlebrook, A. M., Peischl, J., Piasecki, A., Schafer, N., Stockwell, C. E., Wang, S., et al. (2024). Early season 2023 wildfires generated record-breaking surface ozone anomalies across the U.S. Upper Midwest. Geophysical Research Letters, 51, e2024GL111481. https://doi.org/10.1029/2024GL111481

Department of Homeland Security, Science and Technology Directorate. (2025, April 22). Technology to reduce the impacts of wildfires. U.S. Department of Homeland Security. https://www.dhs.gov/science-and-technology/technology-reduce-impacts-wildfires

Fesenmaier, K. (2025, March 19). PHOENIX Air Monitoring Project in Altadena rises from the ashes. California Institute of Technology. https://www.caltech.edu/about/news/phoenix-air-monitoring-project-in-altadena-rises-from-the-ashes

Krupnick, A., Richardson, N., Wibbenmeyer, M., & Zhu, Y. (2025). Wildfire smoke, the Clean Air Act, and the Exceptional Events Rule: Implications and policy alternatives. Environmental Science & Technology, 59(6). https://pubs.acs.org/doi/10.1021/ Acs.est.4c08946

Montana Department of Environmental Quality. (2023). PurpleAir in Schools program overview. Montana DEQ. https://deq.mt.gov/air/Programs/monitoring

Montana Department of Environmental Quality. (2025). 2025 5-year air quality monitoring network assessment (p. 33). https://deq.mt.gov/files/Air/AirMonitoring/Documents/2025_MNA.pdf

National Oceanic and Atmospheric Administration (NOAA). (2024). GOES-18 Pacific Northwest GeoColor sector images. https://www.star.nesdis.noaa.gov/goes/sector_band.php?sat=G18&sector=pnw&band=GEOCOLOR&length=24

References

O'Dell, K., Bilsback, K., Ford, B., Martenies, S. E., Magzamen, S., Fischer, E. V., & Pierce, J.R. (2021). Estimated mortality and morbidity attributable to smoke plumes in the United States: Not just a western U.S. problem. GeoHealth, 5(9), e2021GH000457. https://doi.org/10.1029/2021GH000457

O'Dell, K., Ford, B., Fischer, E. V., & Pierce, J. R. (2023). Intensifying wildfire smoke pollution in the western United States. Proceedings of the National Academy of Sciences, 120(22), e2218778120. https://pubmed.ncbi.nlm.nih.gov/30681842/

Oregon Department of Environmental Quality. (2024). Air quality and smoke monitoring in Oregon. Oregon DEQ. https://www.oregon.gov/deq

PurpleAir. (2025). PurpleAir Air Quality Monitoring. https://www2.purpleair.com/

Stampfer, O., Zuidema, C., Allen, R. W., Fox, J., Sampson, P., Seto, E., & Karr, C. J. (2025).

Practical considerations for using low-cost sensors to assess wildfire smoke exposure in school and childcare settings. Journal of Exposure Science & Environmental Epidemiology, 35(2), 157–168. https://www.nature.com/articles/s41370-024-00677-8

U.S. Census Bureau. (2024). QuickFacts: Okanogan County, Washington. U.S. Department of Commerce. https://www.census.gov/quickfacts/okanogancountywashington

U.S. Environmental Protection Agency. (2024a, December 17). What is the difference between parameter codes 88101 and 88502 for $PM_{2.5}$ monitors? https://www.epa.gov/outdoor-air-quality-data/what-difference-between-parameter-codes-88101-and-88502-pm25-monitors

U.S. Environmental Protection Agency. (2024b). EPA's research efforts to protect public and environmental health: Wildland fire smoke. https://www.epa.gov/air-research/wildland-fire-research-protect-health-and-environment

U.S. Environmental Protection Agency. (2024c). National Ambient Air Quality Standards (NAAQS): Criteria air pollutants. https://www.epa.gov/naaqs

U.S. Environmental Protection Agency. (2025a, October 21). Why wildfire smoke is a health concern. https://www.epa.gov/wildfire-smoke-course/wildfire-smoke-and-why-it-health-concern

U.S. Environmental Protection Agency. (2025b, October 14). Health effects attributed to wildfire smoke. U.S. EPA. https://www.epa.gov/wildfire-smoke-course/health-effects- attributed-wildfire-smoke-0

References

U.S. Environmental Protection Agency. (2025c, May 14). Wildfire Smoke Air Monitoring Response Technology (WSMART). https://www.epa.gov/air-sensor-toolbox/wildfire-smoke-air-monitoring-response-technology-wsmart

U.S. Environmental Protection Agency (2025d). AirNow Fire and Smoke Map: Information and resources. AirNow. https://www.airnow.gov/fasm-info/

Washington State Department of Ecology. (2025a, May 5). It's Air Quality Awareness Week! https://ecology.wa.gov/blog/may-2025/it-s-air-quality-awareness-week

Washington State Department of Ecology. (2025b). 2025 Ambient Air Monitoring Network assessment. https://apps.ecology.wa.gov/publications/summarypages/2502019.html

Washington State Department of Ecology. (2025c). 2025 Report: Overburdened communities highly impacted by air pollution. https://apps.ecology.wa.gov/publications/UIPages/documents/2502039.pdf

Something in the Air

Tracing the Smoke: Wildfire Pollution in Real Time

A "State of the Air" Supplemental Report

55 W. Wacker Drive, Suite 1150 | Chicago, IL 60601 | Ph: 312-801-7630 | Lung.org