EPA Tools & Resources Webinar
Wildland Fire Research to Protect Health and the Environment
Q&A

1. **Did the research at Rocky Mountain Research also study emissions from prescribed burning? If not, is there research on prescribed burning planned?**
   Yes, the study did include emissions from (simulated) prescribed burns. Thirty-three controlled burns were conducted at the Rocky Mountain Research combustion facility. The goal was to measure emissions for targeted organic aerosols and carbohydrates from Ponderosa pine fuels. Varying concentrations of smoke from burning biomass fuels (typical of the western U.S.) under different combustion conditions (e.g., smoldering, flaming) were produced in the chamber to quantify speciated primary organic aerosols from the controlled combustion of Ponderosa pine needles and fine woody debris. During that chamber study we quantified and published (Urbanski 2022) emissions from fuels and fuel beds that simulated both wildfire and prescribed fires. To the extent that chamber studies serve as useful surrogates for real world fires, we discussed the differences in the observed emissions and potential real-world impacts.

   In another study, researchers, in collaboration with U.S. Forest Service (USFS), the Department of the Interior (DOI) and the National Institute of Standards and Technology (NIST), assessed air quality and health impacts of prescribed fire compared to wildfire. Through two case study fires (Timber Crater 6 Fire, Oregon and Rough Fire, California), the assessment used emissions data, air quality modeling, and health impact analyses to examine the corresponding air quality and public health impacts due to actual fires and hypothetical fire scenarios based on different fire management strategies, as well as prescribed fire activity. The EPA report *Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire (CAIF): A Case Study in the Western U.S.* (EPA CAIF report) delves into your question from a modeling case study perspective.

   We will continue to think about future research involving emissions from prescribed burns.

2. **One slide referenced to the "USFS Rocky Mountain Cache" - I am unfamiliar with this term, can you give an overview of what the USFS Rocky Mountain Cache might be?**
   The slide referenced the "Rocky Mountain Research combustion facility."
   "Cache" in the wildfire context usually refers to air quality measurement instrumentation (typically PM2.5) that is deployed with air resource advisors to large incidents. This instrument cache is held in Boise, ID by the National Interagency Fire Center (NIFC) under the Interagency Wildland Fire Air Quality Response Program (IWFAQRP) which is discussed in Chapter 4 of the EPA CAIF report.

   The Rocky Mountain Research Station does not have a cache for deployment but only has instrumentation for their own research activities. Any reference to a "cache" by the webinar speaker was a misstatement.

3. **We observed high level of PM2.5 but normal level of black carbon during long-range transported smoke events. Is this caused by burning conditions? Or any possible explanation?**

To date all the data analysis work we have done on black carbon from fires is from fresh emissions. It is available in a series of papers (e.g., Baker 2019, Long 2021) from the EPA/USFS chamber studies and Kansas grass burning studies.
Future analysis is planned on black carbon data from the three Mobile Ambient Smoke Investigation Capability (MASIC) study sites.

4. **Have you looked into the correlation of opacity of various fuel types to experienced particulate matter (PM) concentration? It seems as if purple air units and car units would be burned in the fire, versus imagery which can be captured from afar.**
We assume that you are referring to aerosol optical depth (AOD). Available satellite aerosol data (also discussed in chapter 4 of the EPA CAIF Report) are based on measured aerosol optical depth and then modeled to equivalent surface level PM2.5 in various NOAA and NASA data "products." These products have been used by EPA in epidemiology studies (Rappold 2011) to determine when smoke may have impacted specific locations. These products are also used in the AirNow Fire and Smoke page products for both current conditions, in which NOAA/NASA product models are adjusted to contemporary surface monitoring data (data fusion), and for future modeled predictions of smoke impact locations.

EPA has developed the Remote Sensing Information Gateway (RSIG3D) tool to make EPA regulatory monitoring data, sensor data, and NASA/NOAA satellite products available for integration and analysis (https://www.epa.gov/hesc/remote-sensing-information-gateway). EPA researchers will be using all the available tools for the Mobile Ambient Smoke Investigation Capability (MASIC) (https://www.epa.gov/air-research/ambient-air-quality-source-measurement-and-emissions-factors-research) study data analysis.

More resources are available at the NASA Applied Remote Sensing Training Program (ARSET) web site (https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset), including the slide decks from the recent EPA training session (https://appliedsciences.nasa.gov/join-mission/training/english/arset-nasa-air-quality-focused-remote-sensing-epa-applications).

5. **Are PurpleAir sensor data now considered to be reliable?**
Past research has shown that PurpleAir sensors observe and report trends in fine particulate matter (PM2.5) concentrations similarly to regulatory-grade monitors but that quality assurance steps and data correction of the PurpleAir data are necessary to improve the comparability of the two datasets. The quality assurance steps and data correction methods are used when displaying PurpleAir PM2.5 data on EPA's Fire and Smoke Map (see details here). More information at EPA's work to develop these methods can be found in two peer-reviewed papers (Barkjohn 2021, Barkjohn 2022) and on EPA's Air Sensor Toolbox https://www.epa.gov/air-sensor-toolbox/technical-approaches-sensor-data-airnow-fire-and-smoke-map. These sensors do not accurately measure the largest particles in the PM2.5 size range (0-2.5 µg) so they will not measure accurately during dust impacts.

6. **How is the Smoke Sense app related to EPA's AirNow app? It could've been more convenient if a single app with combined functionalities.**

Thanks for the comment. We have received similar feedback regarding the combining of apps/tools, i.e., that a single combined app/tool is less confusing and more user friendly than several standalone ones. While Smoke Sense and AirNow share real-time AQI reporting, their purposes are quite different. Smoke Sense provides additional information about ways users can reduce their exposures to smoke. Smoke Sense collects information from its users about experiences with smoke, health symptoms, and smoke exposure reducing actions, whereas the AirNow app does not. As a result, the design and functionality of the two apps are different and serve different user audiences.

7. **What is the current coverage of the PurpleAir sensor network that is available to the EPA outside of Western US?**
   The complete PurpleAir network map is available at map.purpleair.com. A map of the publicly reporting, outdoor PurpleAir sensors passing EPA's quality assurance checks are displayed on the Fire and Smoke Map. We estimate that there are currently approximately 15,000 public PurpleAir sensors operating outdoors within the US, with about 70% of those operating within the Western half of the US.

8. **I've heard that EnviroFlash is not going to be supported in the future and that some of that application's functionalities will instead be made part of AirNow. I'm particularly interested in whether or not there have been discussions on maintaining the air quality advisories and daily forecasting tools in the future. Will the air quality advisories and daily forecasting tools be continued? If that function is continued, would it be possible to include Purple Air sensor data for those alerts?**
   Our plan is to move the EnviroFlash functionality into a future version of the AirNow app; we will NOT be discontinuing our support of advisories or forecasts. In fact, we will be exploring making those features sub-daily so that forecasts can be tailored for rapidly changing air quality events. We do not currently have a plan to incorporate sensor data into forecasting tools, but that is something to consider. As we develop new air quality systems, we will certainly look at more ways to use sensor data.

9. **Would it be useful to attach some type of air monitors to fire trucks engaged in wildland urban interface (WUI) fires to assess levels of possible toxicants?**
   The continuous instruments we use in our mobile monitors are not able to detect toxic pollutants that might be unique to WUI fires. We currently rely on taking samples using filters, sorbent tubes, or canisters that are acquired at field sites and analyzed in a lab to identify toxic pollutants. This sort of sampling does not lend itself to mobile monitoring on a fire truck as it would be difficult to determine what came from the truck's engines versus what came from the fire.

10. **In biomonitoring studies of firefighters who were deployed to WUI fires in California, levels of heavy metals in biospecimens tended to be greater than levels found as average for US population in National Health and Nutrition Examination Survey (NHANES) biomonitoring program. Any plans to conduct biomonitoring studies in communities downwind from WUI or wildland fires?**

At this point we do not have plans to conduct biomonitoring studies in communities downwind from fires. It would be challenging to conduct a targeted WUI biomonitoring study since these fires cannot be predicted, so we would not know when and where people would be exposed to WUI fire emissions.

11. **Have you determined the sources of lead during the fires in the structure fires? Possibly auto batteries?**
    We mentioned the work of an EPA research team who found that lead (Pb) and other metals can be mobilized from infrastructure-destroying fires in the WUI, whereas Pb is normally mobilized in much lower concentrations when natural fuels are burned. https://doi.org/10.1021/acs.est.2c02099

    Fires at the wildland urban interface (WUI) can burn structures and vehicles that also impact mobilization of toxic metals. Vehicle batteries are a likely source. The average modern light-duty vehicle contains a lead acid battery from 6-16 kg, and a battery is about ~70 percent lead by mass. [See National Academy of Science report.] Lead has many current and historical uses in a variety of products. In addition to batteries, lead was historically used in pipes and paint, all of which may contribute to the bulk of lead contained in a household. Lead may also be present in lesser amounts in electronics, ammunition, fishing equipment, jewelry, toys and hobby supplies.

    Another source could be the remobilization of lead from the soil that is released during burning. Lead can be at elevated levels in the soil and vegetation from historical deposition from the use of leaded gasoline or from other lead sources, such as smelters.

12. **Do auto emissions residuals contribute to wildfire pollution levels?**
    Auto emissions can contribute to pollution levels, both in the presence of, and in the absence of, wildfires.

13. **Do we understand enough about whether exposure is proportional to harm, or is there a ceiling on harm, after which it doesn't matter how much more wildfire smoke we breathe as the human body is already as damaged as it can be?**
    Everyone responds differently to wildfire smoke. Some individuals experience health effects at lower concentrations, while others may not have effects until concentrations are higher. However, as exposures increase, so does the likelihood of experiencing health effects.

    For the human exposure versus harm question, this has not been fully addressed in an experimental setting. It is still unknown if there is a ceiling on harm, or if there is an impact of underlying preexisting health conditions.

14. **Are you doing any work on cumulative impacts - what happens when you're hit year after year by wildfires?**
    To date, our understanding about the health effects associated with wildfire smoke exposure stems from studies examining primarily short-term (daily) ambient PM2.5 exposure (PM2.5 is a main component of wildfire smoke) and studies examining daily exposures to wildfire smoke. Studies have not yet been able to examine the health implications of wildfire smoke over multiple fire seasons. However, there is some evidence indicating that exposure to a multi-

month wildfire smoke event may lead to changes in lung function in subsequent years, indicating that people exposed to wildfire smoke in one season may be at increased risk of experiencing health effects in response to an additional smoke exposure in a subsequent season (Orr 2020).

Research has shown that short and long-term exposures to PM2.5 can be harmful to people's health, and are causally linked to cardiovascular effects and premature death, and likely to be causally linked to respiratory and nervous system effects; these were considered in EPA's 2019 PM Integrated Science Assessment.

15. **Is there any research on the compounding impacts of wildfire smoke + ozone (or other urban pollutants)? Currently, the health recommendations only consider the impact of one pollutant at a time.**
    While we are unaware of research specifically on compounding health effects of wildfire smoke + ozone, there is research (Kalashnikov 2022) on increasing trends in simultaneous exposures to both PM2.5 and ozone resulting from increases in severity and extent of wildfires.

    Researchers have recognized the importance of addressing multi-pollutant exposures in conducting air pollution health research (Dominici 2010).

16. **Do you know of organizations that are regularly using indoor air sensors for making a smoke preparedness plan? We are conducting a Purple Air and purifier project and curious if EPA is supporting development of smoke planning.**
    We are not aware of any programs that are currently using sensors as part of a smoke preparedness plan. However, in 2022, EPA released guidelines for using indoor air sensors in schools, which may be a resource for programs that are looking to include indoor sensors during smoke events. See Section 3 in the Children's Health and Wildfire Smoke Exposure Workshop Summary.

    EPA is also working with several communities to pilot our Smoke Ready Communities initiative. A goal of this initiative is to support county partners in their efforts to increase public health readiness for wildland fire smoke events, using a collaborative approach to create a local smoke response plan.

17. **Do you have a list of best indoor air cleaners?**
    We cannot recommend specific products, but we have suggestions on do-it-yourself (DIY) air cleaners based on our research.

    More information on Grants for Wildfire Smoke Preparedness in Community Buildings (closing May 9, 2023) and additional information on selecting air cleaners is available at https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq

18. **What is the shroud addition to the GOOD box fan/filter combo?**
    The shroud was constructed out of the cardboard box that the fan came in at time of purchase.

The do-it-yourself (DIY) air cleaners (various combinations of a box fan and furnace filter) and the clean air delivery rate of the different DIY designs is available in this paper (Holder 2022), and the paper's supporting information section.

19. **Regarding the monitor loan program, are they ever loaned to non-profits working in Air Quality**
    To find available loan programs, visit https://www.epa.gov/air-sensor-toolbox/air-sensor-loan-programs, and use the "Find an Air Sensor Loan Program." The search includes programs established by EPA, both independently and through collaborations with libraries, tribes, museums, etc. (Since each loan program was developed independently, eligibility and equipment vary, but the purpose is for the public to have access to air sensors for supplemental monitoring and educational purposes.) As a courtesy, EPA also includes air sensor loan programs (that we know about) that are offered through other government agencies and nonprofits.

    If the question is specifically about the Wildfire Smoke Air Monitoring Response Technology (WSMART) pilot, then possibly. In 2022, WSMART provided air monitoring technologies to 29 loan recipients, supporting response to wildfire smoke in eight states (California, Oregon, Washington, Nevada, Idaho, Colorado, North Dakota, and Alaska). The loans are currently available to state, local, and tribal air organizations and recipients have flexibility on where the monitors can be used. While recipients cannot officially transfer a loan, they can collaborate with local partners, such as community groups and non-profits, on the measurement locations and request local partner participation in the data collection.

    For background, WSMART is part of a federal government response to address the growing threat of wildfires and related smoke impacts that are a public health concern in the United States and recognizes that, in many areas affected by wildfire smoke, air monitoring data may be limited or absent. Supplemental monitoring technologies can help air monitoring organizations gather timely data to assess smoke impacts and provide public health information.

20. **On the WSMART slide, you mentioned "building data transform and analysis tools." Can you describe who is building them and what language/tools they are designed for: R, python, javascript, Excel?**
    EPA provides a web application, Real Time Geospatial Data Viewer (RETIGO https://www.epa.gov/hesc/real-time-geospatial-data-viewer-retigo). RETIGO is under development to better support the visualization of data collected with the WSMART program. In addition, we are developing R Shiny apps that can be provided with the loan equipment to allow WSMART loan users additional data analysis options.

21. **Could the current monitoring data be used to develop a process to link wildfire impacts in the air to water resources? For example, using satellite imagery that could be overlayed with watershed map layers to assess the potential for particle and contaminant deposition within a watershed to end up as run-off flowing into drinking water sources?**
    NOAA currently produces satellite-based imagery and products to track smoke plumes from wildland fires. Monitoring data, collected both on the ground and with aircraft, can be used to refine deposition processes to quantify effects on drinking water sources with the aid of landscape models such as VELMA. (Note that contaminant deposition, such as black carbon

deposition, particularly on snow-covered landscapes, and nitrogen deposition, is important to other ecosystem services.)

A recently published deposition study by NOAA (Campbell 2022) shows the very large contribution of fires to downwind deposition of reactive nitrogen. In this case study for the 2020 California fires, annual reactive nitrogen deposition increased approximately 80%. This contribution is significant in the context of ecosystem critical loads and associated impacts. We would need more ground-based and aircraft measurements to specifically look at deposition during smoke episodes. Improvements to regional chemical transport models (like CMAQ) are also needed for a more accurate depiction of dry deposition to ecosystems during smoke episodes.

22. **Were results of T640 performance under smoke conditions discussed, or will those be discussed in a different webinar?**
    Results for T640 performance were not discussed during this webinar. However, the T640 results have been published (Long 2022).

23. **Earlier you mentioned sensors for unpiloted aerial systems. Please elaborate. I pilot UAS for NASA and have mounted different type sensor onto the platforms.**
    EPA does not have the authority to buy or operate UAS but has a cooperative agreement to conduct aerial sampling using UAS/drones. Drones have been equipped with Kolibri, an air emission sensor/sampler instrument developed by EPA researchers that weighs up to eight pounds. It has a high-resolution video camera, a forward-facing thermal IR camera, and can be used to sample gas and particle emissions, including carbon dioxide (CO2), carbon monoxide (CO), nitrogen and sulfur oxides (NOx/SOx), volatile and semi-volatile organic compounds (SVOCs, VOCs), polycylic aromatic hydrocarbons (PAHs), particulate matter (PM), bioaerosols, and PM metals. Recently, it has been used to characterize emissions from prescribed burns at the Tall Timbers Research Station in Florida, and at the Tallgrass Prairie Nature Preserve in the Flint Hills region of Kansas.

24. **Our community is in the 95th percentile for PM 2.5 from wildfire smoke and would qualify for an Environmental Justice (EJ) EPA grant, could you post more information on what grant in these EJ offerings city government qualifies for?**
    Information on the Environmental Justice grants is available at https://www.epa.gov/environmentaljustice/environmental-justice-grants-funding-and-technical-assistance. The informational video on the same website explains the different grants, what is still coming, and who can apply.

25. **Is any work being done to sample radiological/radioactive content of wildfire smoke?**
    None is planned at this time.

26. **Are data from MODIS of NASA fused in EPA's algorithms? These are in use in some countries in Europe.**
    MODIS (Moderate Resolution Imaging Spectroradiometer) is one of many satellite data products that are used to develop EPA's fire inventory. MODIS detects have been used, along with on-

the-ground fire activity, to develop area burned estimates and also help with timing of the burn/fire. When we don't have on-the-ground fire activity with a MODIS detect, we use assumptions for area burned based on the fuel identified at that detect location.