Issue Paper prepared for the 2017 Western States Air Quality Modeling Workshop
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Western States Fire Research and Modeling

Background

Uncontrolled wildfires and the use of prescribed burning as a means of fire control, ecosystem restoration/maintenance, or agricultural cycling are increasingly raising questions related to potential impacts on ambient air quality, land management, effects on ecosystem services, and public health. Climate change is increasing the likelihood and severity of wildfires, which in turn impact climate through the emission of pollutants that contribute to short-lived climate forcers. In addition to potential direct loss of life and personal injury during fires, property damage and smoke hazards, fires affect air pollutants locally, regionally, and globally as the plumes are atmospherically transported and dispersed. Fire generated emissions affect ambient levels of pollutants with known deleterious human health impacts including particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), ozone (O_3), and numerous air toxics. These pollutants can cause cardiopulmonary health impacts (Diaz, 2015) leading to increased hospital admissions for asthma and increased rate of heart failure in exposed populations (Rappold et al., 2011). Fires emit toxic compounds that are known to have negative impacts on human health and the contribution of fires to modeled air toxics for exposure assessments is increasingly important (U.S. Environmental Protection Agency, 2015). Many counties in the western U.S. exceed levels of the O_3 and PM National Ambient Air Quality Standards (NAAQS) and mandatory Class I areas (e.g., most National Parks and some Wilderness Areas) must make reasonable progress towards natural visibility conditions under the Regional Haze Rule. It is important to adequately determine the contribution from wildland fires to O_3 and $PM_{2.5}$ for air quality planning purposes to develop effective strategies to meet the level of the NAAQS, regional haze goals, and other purposes such as supporting an exceptional events demonstration.

Western Regions Air Research Workshop

A virtual workshop was held on August 23-24, 2016 between the US EPA Regional offices, US EPA ORD, and US EPA OAQPS to discuss and prioritize research needs for the western United States from the perspective of the Regional offices. This forum was also intended to provide an opportunity to identify areas of collaboration and where US EPA ORD Air Climate and Energy National Program Office could provide support. The research priorities discussed during this workshop are outlined below along with near-term outcomes that have resulted based on discussions from that workshop at the time this version of the issue paper was generated.

#	Research Topic Area	Near-Term Outcome
1	Further, providing support for measurements being made in upcoming fire related field studies including FIREX, FIRECHEM, and FASMEE so that regulatory tools (e.g. emissions models, photochemical models, statistical models) can be evaluated and developed.	US EPA ORD plans to continue engagement with other federal partners toward participation in these field studies. Currently, the field study data is planned for use in model evaluation and development. Expansion of this role is a possibility if interest and resources allow.
2	Research into understanding what easily deployable low-cost sensor technology provides robust information about wildland fire air quality impacts to enhance future monitoring of episodic wildland fire events to improve health impact messaging to the public.	US EPA ORD has reached out to staff at Region 9 to pursue a potential RARE project that would involve deploying multiple measurement devices during a wildland fire event with reference method devices. This idea is preliminary and planning has just begun so scope and details are not set.
3	Support for better understanding and quantifying wildland fire impacts on O3, PM, and haze in the western U.S.	
4	Synthesis of measurements taken as part of the 2016 CABOTS field study in central California is needed to quantify wildland fire impacts in that area compared to local and long range transport.	US EPA ORD is currently working with staff at Region 9 to acquire measurement data from the CABOTS field study with the intention of doing data analysis to look for wildland fire impacts on O3 in California and possibly develop a model evaluation test case.

Air quality impacts

Research Topics/Needs/Desired Outcomes

- Develop a methodology for determining whether unmanaged wildland fire or a particular program of prescribed fire, in a particular landscape, is better from a human health inhalation perspective and from a climate forcing perspective
- Estimate how much wildfires contribute to background ozone and haze
- Improved models representing wildland fires to determine whether a specific fire led to non-compliance with a NAAQS: advanced photochemical grid modeling is needed to quantify impacts; also need simpler tools to determine wildland fire impacts on routine ambient measurements.
- Improved wildland fire emissions estimates by fuel type and combustion component
- Need an emphasis on taking relevant field data, chamber data, and published information and updating air quality photochemical and statistical models

Photochemical grid models are important tools for quantifying the differential impacts from fire on primary and secondarily formed pollutants and how that could change in the future based

on a changing climate. Future field measurements (ground and air) of upcoming fires will help evaluate and develop models. Work is needed toward improving fire plume rise, O3 chemistry (and smoke attenuation of photolysis rates), and PM chemistry (especially organic aerosol treatment) in photochemical models.

Fire emission inventories are critically important toward better characterization of fire impacts in models. Satellite data has helped improve wildfire emissions estimation and simulation in models. NEI emissions have recently split fires into smoldering and flaming categories. New methods have been developed for estimating emissions from agricultural burning. Need to evaluate NEI and new approaches for wildland and agricultural fire characterization. Need to continue reviewing literature and using chamber and field study measurements to improve fire emissions estimates, VOC and PM speciation profiles, and emissions with respect to combustion efficiency (flaming to smoldering).

EPA ORD labs and others are making chamber and field measurements of fire emissions, and the challenge is to incorporate that information into emission inventories, emissions models, and photochemical models to better represent fire impacts on human health.

Need to investigate the conditions under which the use of particular programs of prescribed fire as a land management tool may potentially lead to less emissions and prevent water supply damage and remobilization of legacy pollutants but research toward this has been lacking.

Public education and outreach, integration of social sciences & environmental justice

Research Topics/Needs

- Can research help to determine the utility of successful communication strategies in reducing public health burden related to smoke exposure?
- What communication strategies during smoke events are successful (near and further away from the fire)?
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Human behavior, both on societal and individuals, affects people's smoke exposure. Communication is a way to reduce health burdens, especially for those that are episodic and transient in nature (like wildfires and local prescribed fires). New research looking at the integration of public health messaging with environmental models toward understanding how those messages change the health burden. Measurements are key to good health messaging. While it is easy for people close to a fire to see smoke, we're not characterizing the elevated exposure and risk to those downwind well. California has a Wildfire Monitoring Communication tool that superimposes PM readings into AQI messaging. Air Resource Advisors provide an opportunity for health messaging—the U.S. Forest Service is currently training people to go into

the field and educate public on air quality and incorporating health messaging into wildfire emergency response.
Examples of wildland fire communication to the public are provided below.

1. Link to the web site for the wildfire work that R9 has done with California Clean Air Response Planning Alliance (CARPA).
    a. http://www.arb.ca.gov/carpa/carpa.htm
2. And companion document "Wildfire Smoke Response Coordination – Best Practices Being Implemented by Agencies in California"
    a. http://www.arb.ca.gov/carpa/cawildfiresmokeresponsecoordinationaug14.pdf

References

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U.S. Environmental Protection Agency, 2015. Technical Support Document EPA's 2011 National-scale Air Toxics Assessment. https://www.epa.gov/national-air-toxics-assessment/2011-national-air-toxics-assessment.