

Sierra Nevada Framework Smoke Monitoring: Testing Implementation Through a Pilot Program

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An increasing need to treat hazardous fuel conditions in the Sierra Nevada combined with a geographic relationship to surrounding air basins with very serious air quality issues has resulted in challenges for land management and air regulatory agencies. A series of policies, plans and regulations at federal, state, and local levels addresses issues that require attention in order to increase treatment with prescribed fire while protecting public health. Monitoring fine particles (PM_{10}) produced by smoke provides land management and regulatory agencies with information necessary to avoid significant community impacts. Recently, new filter-based monitoring systems have been developed. Met One's BAM-1020 beta attenuation mass monitor is a federal reference method that meets the EPA requirements for monitoring PM_{10} compliance, but can be limited in use by land management agencies due to a lack of portability and reliance on line power. Met One's E-BAM is a portable real-time beta gauge. While not a federal reference method, the EBAM has shown strong correlation with BAM data and is highly portable. A pilot program has been developed to test the utility, accuracy, reliability, and data management requirements of these instruments in a comprehensive network. The test network will include three fixed-site BAMs in sensitive communities and approximately 10 portable EBAMs that will be deployed in communities as needed to characterize the impacts of smoke from prescribed fire and wildland fire.

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INTRODUCTION

California has a significant number of sources that emit fine particles (defined as particles with an aerometric diameter of $10\ \mu\text{m}$ (PM_{10}) and $2.5\ \mu\text{m}$ ($PM_{2.5}$) and smaller, respectively). The climatic, meteorological, and geographic features in many parts of the state provide suitable conditions for these pollutants to accumulate and reach serious levels. Fine particle concentrations in much of the state are at levels that cause respiratory illness and premature human mortality. About half of the state, primarily central and southern California, does not attain the federal PM_{10} and $PM_{2.5}$ standards. Virtually all of the state, with the exception of Siskiyou and Lake counties, is non-attainment or unclassified for the more stringent California PM_{10} standard.

California is divided into 35 regulatory air pollution control districts with oversight provided by the California Air Resources Board (CARB) and the US Environmental Protection Agency (EPA). This regulatory framework is considered effective at developing local accountability and

control strategies tailored to local issues. However, it also presents a very challenging and complex environment to land management agencies attempting to manage an increasing fuels issue. California leads the nation in aggressive strategies to reduce air emissions, and with major emitting industrial sources largely controlled, the focus is now on smaller sources.

Generally there is good public support both for air quality and for the need to reduce hazardous fuels. However, when the two issues are seen to conflict, the urban population is often more air quality sensitive, and is pitted against more fire-sensitive rural communities. In this setting of air quality and fuels issues the public increasingly expects agencies charged with the stewardship of these resources to resolve conflicts and negotiate a path that protects public health, maintains public safety, and protects forest resources. High quality information, including monitoring of fine particles, is necessary to help define the operational area that can accomplish fuels reduction while minimizing the impacts of smoke on air quality.

ISSUES LEADING TO THE INVESTMENT

A successful smoke monitoring program can lead to a wealth of information adding more certainty to issues related to public health, and a better understanding

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of spatial and temporal trends that effect community exposure.

Irrespective of regulatory requirements, Forest Service managers require smoke monitoring information to assist in better fire management, air quality stewardship, and maintaining good community relationships. Some of the management questions that a monitoring program can help answer include:

What are the tradeoffs between prescribed fire and wildfire impacts? A better understanding of emission production and exposure of wildfire and prescribed fire is necessary to fully understand the role of prescribed fire in eventually reducing emissions generated from wildfire.

How does urban air pollution and smoke contribute to visibility impairment? Visibility in national forests, especially in Class I wilderness areas, is an important resource and wilderness value. Understanding the entire mixture of pollutants and sources will be critical in working with states to improve visibility.

What is the natural and current background of smoke? Comparing current background of smoke and PM concentrations with pre-European estimates will be important in defining natural background. Natural background may be used to determine regulatory allocations.

What is the impact on communities and public health? This is the essence of regulatory pressure on public land agencies, and monitoring is necessary for informed decisions to protect public health.

What is the public tolerance? In addition to regulations for prescribed fire California regulates actions that create public nuisances. More monitoring data will help understand thresholds of public tolerance that differ from health thresholds.

How can monitoring contribute to the testing and validation of models? Models being developed to predict smoke dispersion, such as the Blue Sky smoke model, can be validated if the modeling domain is characterized with monitoring.

What mitigation and contingencies are the most successful in minimizing smoke and public exposure? The Forest Service has developed guidelines and training to institute measures that can be effective in reducing emissions. Monitoring in conjunction with these mitigations can validate their effectiveness.

In addition to management needs, regulatory requirements and policy in California dictate or strongly recommend monitoring in some situations. California's Title 17 (Smoke Management Guidelines for Agricultural and Prescribed Burning) has provided the template for

local regulations and requires smoke management plans to include appropriate monitoring, which may include visual monitoring, ambient particulate matter monitoring or other monitoring approved by the district for:

- (1) projects greater than 250 acres (101 ha);
- (2) projects that will continue burning or producing smoke overnight;
- (3) projects conducted near smoke sensitive areas; or
- (4) as otherwise required by the district (CARB 2001).

Monitoring data also contributes to more informed regulatory decisions. Serious air quality issues in California require action with or without data and often daily regulatory decisions, such as burn-day allocations, are supported by meteorology data, but not air quality data. Air quality monitoring data can also be used to test, validate, and adjust PM₁₀ reduction strategies.

PILOT STUDY DESIGN

The Forest Service has experimented with a number of particulate samplers over the last 20 years with varying success. Nephelometer based optical monitors have been used with some success, but California has expressed more support for filter-based monitoring systems such as MetOne Instruments BAM 1020 and E-BAM samplers. These systems measure a radioactive isotope passing through filter paper before and after particles are deposited on the filter (Trent 2003).

The southern Sierra Nevada National Forests have steadily emerged as a candidate to test monitoring equipment due to serious fuels issues and the proximity to the San Joaquin Valley Air Basin, which is one of the most severely polluted air basins in the United States. An approach to characterizing smoke in the Sierra Nevada was developed during the Sierra Nevada Framework project and suggested different approaches for regional scale characterization and project level / community characterization. The Sierra Nevada Framework smoke monitoring study plan recommends using the Interagency Monitoring for Protected Visual Environments (IMPROVE) monitoring network in coordination with the state network to examine regional scale trends. The study plan recommends using BAM 1020 and E-BAM technology to evaluate community impacts. The Sierra Nevada Smoke Monitoring Pilot (SNSMP) was designed to test the study plan recommendations.

BAM 1020 instruments were installed where the objective was to monitor year-round background, and where a secure site with line power was available. These instruments are located on the Sequoia National Forest in the communities of Pinehurst, Springville, and Kernville. The BAM 1020 is an EPA approved equivalent method

for PM_{10} . Seven additional tripod mounted E-BAMs were deployed on the Sequoia, Sierra, Stanislaus, and Inyo National Forests. E-BAMs, although not an EPA approved “equivalent monitoring method”, provide quality data and portability, allowing good flexibility in deployment for short-term smoke events. These tripod mounted instruments also require line power. In addition three portable solar powered E-BAMs mounted on trailers are available for events where line power is not available. Some of the E-BAMs are equipped with basic meteorological instrumentation, including wind speed and direction, air temperature, relative humidity, barometric pressure, solar radiation, and precipitation.

DATA DELIVERY

Particle data related to monitoring smoke is most useful in near real-time. Data that can be returned to land management and air regulatory agencies in near real-time allows for fire management strategies that can reduce smoke production or alter the transport. It also provides information to air regulatory agencies that can be used to better manage allocations and more information for burn day designations.

The SNSMP is testing the use of satellite modems via ORBCOMM combined with data delivery to a Web page that satisfies the real-time needs. The Website can be accessed at <http://www.satguard.com/usfs4>. Graphics of one, eight, and twenty-four hour averages are displayed along

with tabular data details. Air Resource Specialists, Inc., in Fort Collins, Colorado provides data quality assurance reviews, monthly and annual data reports, and equipment support for the project.

PILOT REVIEW

The SNSMP is planned to continue through March 2006. At that time the Region 5 Forest Service Air Program will review the durability, portability, maintenance, and data delivery of the network. In addition, we will review how well the instrumentation was used by air regulatory agencies and the Forest Service to improve coordination and make more informed decisions.

REFERENCES

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