

Smoke Monitoring Network on 2006 Northern California Fires

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Abstract—Long-duration fire activity during the 2006 northern California fire season presented an excellent opportunity to create a temporary air-quality/smoke-monitoring network in the complex terrain across northwestern California. The network was established through cooperative interagency coordination of Federal officials, the California Air Resources Board (CARB), and local Air Pollution Control Districts (APCDs). This network addressed concerns over air quality and potential firefighter- and citizen-health issues. Equipment deployed included real time PM_{2.5} monitors (EBAMs and DataRAM's) at seven stations. The reported network data were posted daily on the Internet (in the public domain). The archived field-gathered data set will also provide a database for future research and verification of modeled Blue Sky output for particulate concentrations (run by the University of Nevada, Reno). Lessons learned from establishing and supporting such a temporary network will help make future projects more successful. Overall, the network data were well received, especially by local residents.

Introduction

In July and early August 2006, a long-term, multifire episode developed in northwestern California over adjacent areas of the Shasta-Trinity, Six Rivers, and Klamath National Forests. Based on previous experience with dense smoke events that occurred in 1977, 1987, 1999, and 2002 under similar fire regimes, fire and air quality officials soon concluded that significant amounts of smoke were likely to blanket the area for a minimum of several weeks.

A closer look at the physical shape of the terrain in the area (fig. 1) shows that deep river valleys with steep hillsides are typical in this region. This creates efficient “smoke traps,” especially overnight when inversions become established, and local downslope, downdrainage winds carry smoke through the terrain and valleys. Dense smoke can limit the amount of daytime sunshine that reaches the ground, which in turn can inhibit the atmospheric mixing possible due to surface heating by the sun. Without much daytime mixing, smoke can linger in these canyons and valleys, creating long periods of poor air quality conditions. Lower sun angles and longer days in late summer also exacerbate these conditions.

Smoke Monitoring Network

A quantitative sampling network had never been used to monitor heavy smoke events during previous long-term fire episodes in the area (Fontana 2007). In 2006, however, a temporary smoke monitoring network was

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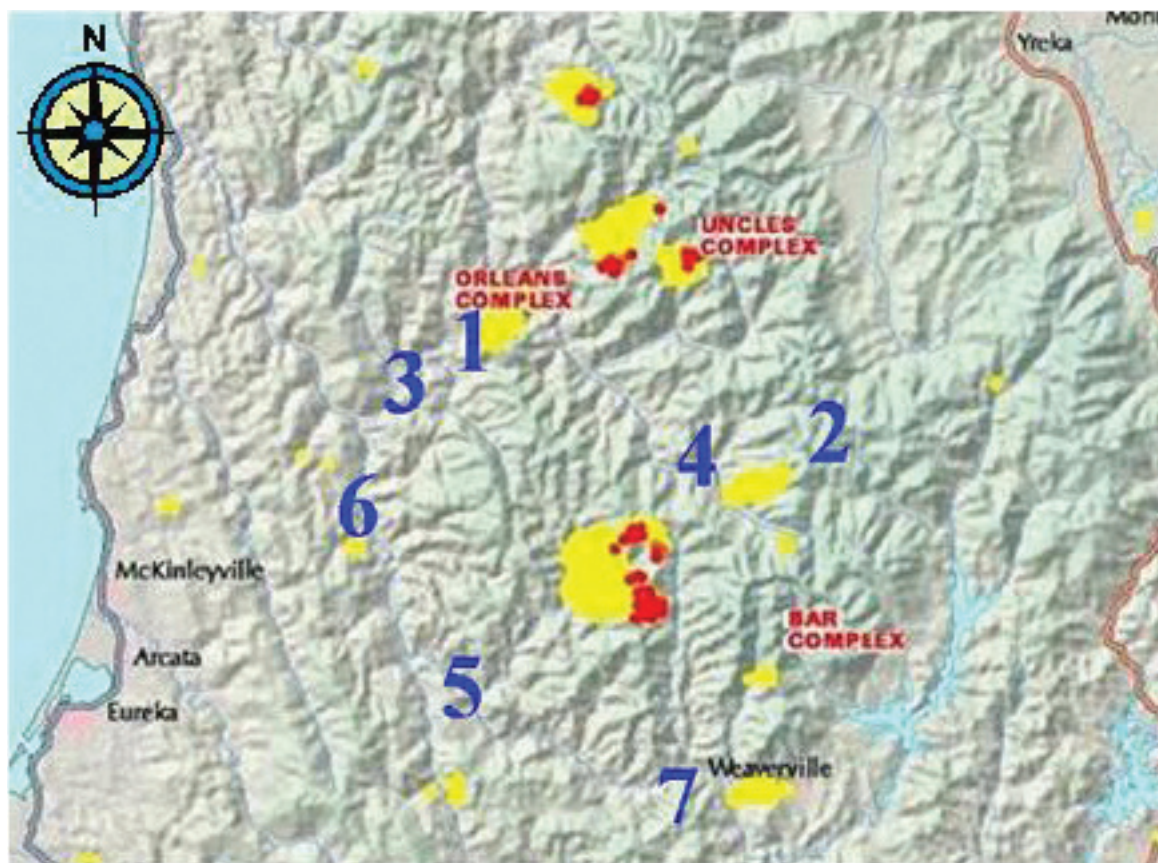


Figure 1—This map of the project area in northwestern California shows the sampling sites: (1) Somes Bar, (2) Callahan, (3) Orleans, (4) Petersburg, (5) Burnt Ranch, (6) Willow Creek, (7) Junction City.

deployed for the first time through cooperative interagency actions between local air quality district, Federal, and State officials. Initial discussions and development of an action plan were done via conference calls. The principal cooperating agencies included the North Coast Unified and Shasta County Air Quality Management Districts, Siskiyou County Air Pollution Control District, USDA Forest Service, USDI Bureau of Land Management, California Air Resources Board (CARB), and the California Department of Forestry and Fire Protection (CDF).

The network monitored $PM_{2.5}$ values from August through October using both EBAMs and DataRAMs provided by several agencies (USDA Forest Service, BLM, CARB). Most of the monitors were borrowed from operations outside the local area. The seven sampling sites (fig. 1) were chosen after considering population center locations, likely areas of the largest or longest lasting fires, and local meteorology. None of the sampling locations were existing full-time air quality monitoring sites. A contract agreement was set up with Air Resource Specialists, Inc., of Boulder, CO, to have them do onsite calibrations of the sampling units to ensure as accurate and comparatively equal data as possible.

Local Air Quality Management District (AQMD), Air Pollution Control District (APCD), and fire officials were concerned about both the exposure duration and $PM_{2.5}$ concentrations experienced by local residents and firefighters. Although there are published Environmental Protection Agency

(EPA) standards relating $PM_{2.5}$ concentrations to human health (reflected in table 1), there are no established Federal or documented CDF standards or policies uniformly applying those values to firefighter activities.

A daily summary text product with expected weather affecting dispersion and the previous 3 days' peak $PM_{2.5}$ concentrations at each site was produced collaboratively by Redding Fire Weather Center and CARB meteorologists (tables 1 and 2). It was posted on the Redding Fire Weather Center Web site by 1400 hours (2 p.m.) daily.

The 2 months of detailed information the network yielded has been archived and will be used for future research and verification of modeled Blue Sky output for particulate concentrations (run by the University of Nevada, Reno, for the northern California area).

Challenges Encountered

Network maintenance and logistical support were somewhat problematic at times during this project, in part because there were no other examples of such networks used on large fires that we could emulate. Some of the instruments required a person to report the observed values, and it was difficult at times to find someone who could reliably perform the necessary duties daily. Unfortunately there were occasional data gaps when some paper sensor tapes ran out or sampling was rendered invalid because of holes in the tape. Overall, however, most of these issues were resolved fairly soon, and the data input became quite consistent.

Table 1—Air Quality Guide for Fine Particulate Matter ($PM_{2.5}$) Pollution. This table was included at the end of the daily summary product (source: CARB). The assumption was that supplying local citizens with air quality information would help them decide which actions to take to address their individual health situation.

24-hr average concentration (ug/m3)	Air quality index	Air quality category	Cautionary statement
0 - 15	Up to 50	Good	None
>15 - 40	51-100	Moderate	Unusually sensitive people should consider reducing prolonged or heavy exertion.
>40 - 65	101-150	Unhealthy for sensitive groups	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.
>65 - 150	151-200	Unhealthy	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
>150 - 250	201-300	Very unhealthy	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.
>250 - 500	301-500	Hazardous	Everyone should avoid all physical activity outdoors. People with heart or lung disease, older adults, and children should remain indoors and keep activity levels low.

Table 2—Sample content of the daily product posted on the Web site.**SMOKE SUMMARY FOR NORTHERN CALIFORNIA WILDFIRE AREAS**

**Tuesday October 31, 2006
1400 PST**

**Issued by the Redding Predictive Service Unit in cooperation with the California Air
Resources Board**

**For Air Quality Advisories in your area, please call your local air district at the
following numbers...**

DISCUSSION: A weak high pressure ridge that has been over northern CA for the past several days will drift east on Wednesday as a Pacific storm approaches the north coast. There should be little change in smoke concentrations today from Monday's readings. On Wednesday stability will decrease as southwesterly winds increase, leading to better mixing and lower smoke concentrations. Higher humidity and occasional rain from Wednesday night through Saturday should reduce smoke production and smoke concentrations.

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LATEST PM 2.5 MEASUREMENTS
(micrograms per cubic meter)
All data are preliminary

SOMES BAR

Date	1-hr Peak/Time	24hr Average	Air Quality
10/30/06	61/0900	7	Good
10/29/06	76/0900	13	Good
10/28/06	55/0900	17	Moderate

ORLEANS

Date	1-hr Peak/Time	24hr Average	Air Quality
10/30/06	37/2200	13	Good
10/29/06	29/0300	15	Moderate
10/28/06	33/0700	16	Moderate

Overall air quality numbers are mainly in the Good category. A weak disturbance making its way into the north state will keep air quality numbers in the same range tomorrow through the end of the week.

Depending on where you are, you may or may not be impacted, and the situation could change very quickly. If you see or smell smoke, consider restricting your outside activities. Until the weather conditions change and the smoke conditions improve, individuals should consider taking the following actions:

- Healthy people should delay strenuous exercise, particularly when they can see or smell smoke
- Children and the elderly should consider avoiding outdoor activities, particularly prolonged outdoor exertion
- People with heart or upper respiratory illnesses should remain indoors
- Asthmatics should follow their asthma management plan
- Contact your doctor if you have symptoms such as chest pain, chest tightness, shortness of breath, or severe fatigue
- Keep airways moist by drinking lots of water

See the table below for advice that is specific to each air quality category....[see table 1]

Conclusions

The time, effort, and costs involved with creating and maintaining a temporary smoke monitoring network make such projects most feasible only during long-term large fire incidents. Providing summarized information via the Internet is efficient and, in this case at least, was reportedly well received by the public. Establishing some monitoring network parameters and plans ahead of time would help define its operation. For instance, outlining the environmental conditions that warrant when/where to establish a network, and prearranging equipment loans and cooperators to help with network maintenance, could all be preestablished protocols. These actions would help expedite network deployment and minimize data gaps during its operation.

References

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