

## Carbonaceous Aerosols and Radiative Effects Study

During the month of June, the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Climate Research Facility will deploy a Gulfstream-1 (G-1) research aircraft and two instrumented ground stations in California, as part of the Carbonaceous Aerosols and Radiative Effects Study (CARES). The instruments will gather trace gas, aerosol, and meteorological measurements around the Sacramento metropolitan area that will allow researchers to investigate the ways in which atmospheric aerosols and their climate-affecting properties evolve as they travel and age. This study will obtain new process-level knowledge important for scientists working on both regional and global models used to simulate climate change.

An "urban plume" refers to air that becomes distinct from the surrounding air as it passes over and mixes with material from an urban area. During summer, the transport of the urban plume above Sacramento is controlled by regular wind patterns that draw polluted air to the northeast, over oak and pine trees in the Sierra Nevada's Blodgett Forest area, by late afternoon. Because of this consistency, the Sacramento-Blodgett Forest corridor is ideally suited for sampling aerosol and precursor trace gases as they evolve during transit. The location will also allow scientists to study the results of planned agricultural fires around Sacramento, as well as any natural wildfires.

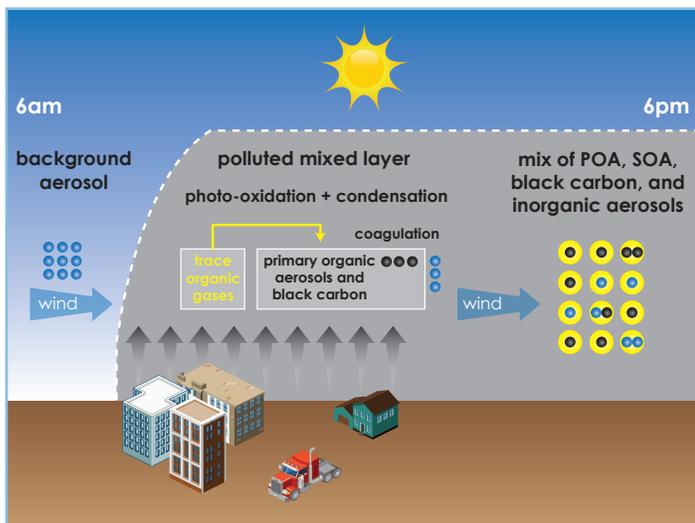


Measurements taken at two ground sites (T0 and T1) and from the G-1 aircraft will measure air as it flows northeast from Sacramento to the Blodgett Forest area.

### Science Objective

This field campaign is designed to increase scientific knowledge about the evolution of black carbon, primary organic aerosols (POA), and secondary organic aerosols (SOA) from both man-made and biogenic sources. Black carbon and primary organic aerosols are emitted directly into the atmosphere through diesel and gasoline vehicle exhaust, as well as during meat cooking and biomass burning; secondary organic aerosols are formed through complex interactions between trace organic gases and pre-existing aerosols in the atmosphere.

Several studies have shown that current models significantly underpredict SOA formation in the urban atmosphere and the upper troposphere. Evolution (or aging) of black carbon aerosol and its optical properties are also poorly represented in current models. The knowledge gained from detailed analysis of the data gathered during CARES will be integrated into regional and global aerosol models used to simulate the ways that aerosols affect climate.



## Locations

Coordinated airborne and ground-based instruments will gather information about aerosol size, composition, chemistry, and their optical and cloud formation properties.

**Aircraft:** Coordinated by the ARM Aerial Facility, the Gulfstream-1 (G-1) aircraft will conduct regular flights through and around the Sacramento plume. Morning flight patterns are designed to sample either morning emissions from Sacramento as they flow northwest, or San Francisco Bay Area emissions if the airflow is moving toward Sacramento. Afternoon flight patterns will then sample the aged emissions depending on the morning flight pattern selected for that day. During the campaign, the G-1 will be based out of McClellan Airport, located about 12 kilometers northeast of downtown Sacramento, California.

**Ground Sites:** Instruments at two ground sites will gather a nearly identical set of trace gas and aerosol measurements. American River College, a community college, is approximately 14 km northeast of downtown Sacramento, and Northside School, a K-8 school located in Cool, California, is approximately 52 km northeast of downtown Sacramento. Instrumentation installed at each site will measure emissions originating in Sacramento and transported via airflow toward the Sierras.

## Recovery Act

During the CARES campaign, the G-1 aircraft will carry several instruments purchased through the American Recovery and Reinvestment Act of 2009. The Ultra-High Sensitivity Aerosol Spectrometer measures aerosol number and size. Two other instruments, the Single Particle Soot Photometer and the Photo-Acoustic Soot Spectrometer, gather measurements about black carbon, including mass, size, composition, and absorption of light by aerosols.

At the ground sites, a new Humidigraph, a Cloud Condensation Nuclei Counter, a Scanning Mobility Particle Sizer, and an upgraded 915-MHz wind profiling radar will be deployed to gather additional information about the aerosols' ability to take up water and to form cloud droplets. Using these new instruments in a field campaign will help improve their future performance.

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The Ultra-High Sensitivity Aerosol Spectrometer is one of the new instruments installed on the G-1 that will be used during CARES.

## Collaboration

CARES scientists will have the opportunity to collaborate with investigators from the California Air Resources Board, the National Oceanic and Atmospheric Administration, and the California Energy Commission, who are conducting a major field study, CalNex 2010, in the Central Valley and Southern California regions in summer 2010. Coordinating activities during the period when the two campaigns overlap will allow researchers to compare data.

<http://campaign.arm.gov/cares/>

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