

State of California  
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-70

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2600-250, entitled "Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines" has been submitted by the University of Southern California;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

Proposal Number 2600-250 entitled "Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines," submitted by University of Southern California, for a total amount not to exceed \$461,334.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

Proposal Number 2600-250 entitled "Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines," submitted by University of Southern California, for a total amount not to exceed \$461,334.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed \$461,334.

I hereby certify that the above is a true and correct copy of Resolution 05-70, as adopted by the Air Resources Board.

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Lori Andreoni, Clerk of the Board

## ATTACHMENT A

### “Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines”

#### Background

Particulate matter (PM) appears to be the most significant contributor to the adverse health effects of air pollution, due to its links to excess mortality and cardiovascular and respiratory illness. The strongest links between PM and adverse effects are for the mass-based measures, PM<sub>2.5</sub> and PM<sub>10</sub>, but there is growing concern that particle number, usually dominated by the particles in the ultrafine (UF) size range (<0.1 μm), may also have important health effects. They appear to be of potentially greater relative toxicity than larger particles because of their ability to directly penetrate cell membranes, their relatively high adsorption of organic components, and their relatively high deposition efficiency in the lung.

Particle numbers typically show poor correlation with PM mass measures and appear to decline more sharply with distance from the source than do PM<sub>10</sub> or PM<sub>2.5</sub> mass concentrations. For example, one study found little or no correlation between particle number and mass in the South Coast Air Basin. Another study found very sharp UF number concentration gradients downwind and adjacent to both the gasoline vehicle-dominated 405 freeway and the heavily diesel-traveled 710 freeway in Los Angeles, with 3 to 4 times higher concentrations near the freeways compared to 100 meters away. In general, UF particle numbers in urban ambient air appear to be driven by combustion of fossil fuels, particularly motor vehicles.

Besides primary combustion sources, a recent study suggests that photochemical secondary formation of UF particles can be a primary UF particle source during summer months, leading to significant long-range transport well away from primary sources.

#### Objective

The overall objective of this study is to better characterize the spatial and temporal variability of UF particles near sources at the community level and in locations of interest in Southern California. Specific objectives include:

1. Quantifying the effect of specific local sources and evaluating their relative importance compared to urban background
2. Developing predictive models based on meteorological and source characteristics, and,
3. Determining if freeway sound walls and tree lines themselves have an important impact.

#### Methods

Researchers at USC propose to use 10 to 12 ARB-owned 3022A condensation particle counters (CPCs) to measure UF particle number variability at 10 to 12 sites clustered within a 3000 meter radius. This will be done in both the Wilmington area of Los

Angeles and in Riverside. The Wilmington area measurements will be used to determine the importance of mobile source, refinery, and port activity on UF particle concentrations, relative to urban background, while the Riverside measurements will investigate the importance of secondary UF particle formation and transport. Each of the two communities will be monitored for two separate three-month periods, in both summer and winter seasons. Wilmington measurements will coincide with other concurrent Wilmington projects. Each CPC will be accompanied by its own, low-cost meteorological station, collecting time-resolved wind speed and direction, temperature, and humidity. These meteorological measurements will allow more accurate triangulation and back-trajectory calculations to evaluate specific sources

The effect of sound walls and tree lines on UF particle concentrations will also be studied. Two 2-week periods of intensive monitoring campaigns will be conducted, one two-week period at a freeway at ground level and another at a tree line. Measurements will be conducted at locations near breaks in the freeway wall or tree line, close enough together to have similar conditions, but far enough away to avoid edge conditions for the wall impacted side. Upwind and several downwind locations will be measured with CPCs, along with CO/CO<sub>2</sub> measurements and nephelometers for relative PM mass concentration changes.

### **Expected Results**

Results from this study will determine the relative importance compared to background of local and regional UF particle sources in the Wilmington/Long Beach area and the relative importance of local, regional, and secondary formation of UF particles in the Riverside area. Also, the study will produce predictive models that will define the most important associations between UF concentrations and source types, source strengths, meteorological conditions, and distance. Results will also characterize the effect of freeway sound walls and tree lines on the downwind UF particle concentrations due to mobile sources.

### **Significance to the Board**

Results from this study will help the ARB understand the relative importance compared to background of specific UF particle sources and their concentrations at the community level. It will also aid the ARB in predicting UF particle concentrations in other urban areas of California. These are both important first steps in better understanding UF particle exposures and the resulting health impacts, both being prerequisites in the eventual determination of whether an UF air quality standard would be justifiable. Results from the freeway sound wall and tree line investigations will determine whether measures taken to reduce freeway noise impacts and aesthetic impacts also have any air quality benefits.

**Contractor:**  
University of Southern California

**Contract Period:**  
24 months

**Principal Investigator (PI):**  
Costas Sioutas, Sc.D.

**Contract Amount:**  
\$461,334

**Cofunding:**  
USC has secured separate US EPA funding that will enhance specific source evaluations for this project.

**Basis for Indirect Cost Rate:**  
The State and the University of Southern California have agreed to a 30 percent indirect cost rate. This is the lowest rate they offer to any funding organization.

**Past Experience with this Principal Investigator:**  
ARB staff have extensive previous experience with Dr. Sioutas. His expertise is based on developing technologies for measuring the physicochemical characteristics of air pollutants and determining their toxic properties. Staff's past experience with Dr. Sioutas has been positive and productive.

**Prior Research Division Funding to USC:**

Year	2005	2004	2003
Funding	\$0	\$0	\$0

## BUDGET SUMMARY

University of Southern California

“Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines”

### **DIRECT COSTS AND BENEFITS**

1.	Labor and Employee Fringe Benefits	\$	231,840
2.	Subcontractors	\$	0
3.	Equipment	\$	24,000
4.	Travel and Subsistence	\$	4,340
5.	Electronic Data Processing	\$	0
6.	Reproduction/Publication	\$	0
7.	Mail and Phone	\$	0
8.	Supplies	\$	105,200 <sup>1</sup>
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>0</u>
	Total Direct Costs		\$365,380

### **INDIRECT COSTS**

1.	Overhead	\$	95,954
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	0
4.	Fee or Profit	\$	<u>0</u>
	Total Indirect Costs		<u>\$ 95,954</u>

### **TOTAL PROJECT COSTS**

**\$461,334**

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#### <sup>1</sup> Materials and Supply Details:

CPC servicing and calibration, 18 at \$3,500 ea	\$63,000
Laptop computers to log data, 12 at \$1600	\$19,200
Meteorological stations, 12 at \$500	\$ 6,000
Siting costs for power, security, compensation	\$12,000
Hardware and spare parts	<u>\$ 5,000</u>
TOTAL	\$105,200