PROPOSED

State of California
CALIFORNIA AIR RESOURCES BOARD

Environmental Chamber Experiments to Improve Secondary Organic Aerosol Model Prediction

RESEARCH PROPOSAL

Resolution 18-42

October 26, 2018

Agenda Item No.: 18-8-1

WHEREAS, the California Air Resources Board (CARB or 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 2821-289, titled "Environmental Chamber Experiments to Improve Secondary Organic Aerosol Model Prediction," has been submitted by the University of California, Riverside for a total amount not to exceed $450,000;

WHEREAS, the Research Division staff has reviewed Proposal Number 2821-289 and finds that, in accordance with Health and Safety Code section 39701, the results of this study will aid in the improvement of regulatory air quality models used to develop the State Implementation Plan, and will enhance our ability to develop regulatory strategies that reduce ambient ozone and fine particulate matter; and

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee has reviewed and recommends funding the Research Proposal.

NOW, THEREFORE BE IT RESOLVED, that CARB, pursuant to the authority granted by Health and Safety Code section 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and staff and approves the Research Proposal.

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 Proposal as further described in Attachment A, in an amount not to exceed $450,000.

Resolution 18-42

October 25, 2018

Identification of Attachment to Board Resolution 18-42

Attachment A: "Environmental Chamber Experiments to Improve Secondary Organic Aerosol Model Prediction" Summary and Budget Summary

ATTACHMENT A

"Environmental Chamber Experiments to Improve Secondary Organic Aerosol Model Prediction"

Background

A major fraction of fine particular matter ($PM_{2.5}$) in the atmosphere is comprised of secondary organic aerosol (SOA), which is created in the atmosphere from the oxidation of a variety of volatile organic compounds (VOCs). The United States Environmental Protection Agency and CARB's research program have examined several critical areas (to understand the formation and aging of SOA) with the goal of improving the description and modeling of SOA, which led to fundamental changes in the direction of further research. However, further research is still needed to improve SOA modeling performance. The underestimation of model SOA compared with measured SOA suggested missing SOA precursors or underestimated atmospheric processing of organics in the model. Hence, characterization of the emissions and the oxidation pathways and products of these VOCs, especially the functionalized compound classes that are not traditionally measured in atmospheric monitoring, are important for improved understanding of the contributions of different sources to SOA or $PM_{2.5}$ at different locations. Overall, with the successful control of "low-hanging fruit", the control of a broader array of disparate sources becomes necessary.

Objective

The primary objective of this research project is twofold: 1) to understand as thoroughly as possible the effect of chamber variables on experimentally-measured SOA yields, and 2) to expand the suite of SOA experiments to volatile chemical products (VCPs) that have been identified as significant in the Los Angeles atmosphere.

Methods

For atmospheric air quality modeling, the environmental chamber serves as the sole source of data for determining yields of SOA from the oxidation of VOCs. In this research project, investigators will perform experimental comparison and theoretical analysis of SOA yield determination for a number of key emerging SOA systems by conducting identical VOC oxidation experiments in the California Institute of Technology (Caltech) and University of California, Riverside (UCR) environmental chambers. The second task is to improve SOA modeling based on chamber data. This task will evaluate the predictive capabilities of SOA formation mechanisms using the semi-empirical two-product model and the statistical oxidation model (SOM) model. The third task will identify key VOCs within volatile chemical products using recent consumer product surveys, recent ambient measurements, and the results from a previous CARB funded study on low vapor pressure volatile organic compounds to select VOCs considered high priority for evaluating SOA formation. Chamber experiments will be designed and conducted to characterize SOA formation from selected consumer products.

Expected Results
This research project will mount a groundbreaking experimental comparison and theoretical analysis of SOA formation. The major effort of this project will be to design and carry out the well-characterized environmental chamber experiments most needed to evaluate and improve the predictive capability of the SOA formation mechanism. Recent research concluded that non-vehicular sources (*e.g.,* volatile chemical products or food-derived cooking emissions) of reactive gas-phase organics in urban areas may now contribute a larger fraction of the total VOC emissions. These non-vehicular sources will also be characterized to better understand their impact on ambient SOA and $PM_{2.5}$ formation. At the end of this project, a final report along with raw and processed data will be provided to CARB.

Significance to the Board
A major fraction of $PM_{2.5}$ in the atmosphere is comprised of SOA. It is expected that SOA contributions will become more important in California due to the success of various air pollution control and mitigation strategies for traditional sources such as motor vehicles. Chemical composition of various SOA precursor sources are changing, and additional data are needed to improve SOA formation mechanisms in efforts to reduce the gap between real-world SOA observations and SOA model predictions. The results of this study will aid in the improvement of regulatory air quality models used to develop the State Implementation Plan and will enhance our ability to develop regulatory strategies that reduce ambient fine particulate matter.

Contractor:
University of California, Riverside

Contract Period:
36 months

Principal Investigator (PI):
David Cocker, Ph.D.

Contract Amount:
$450,000

Basis for Indirect Cost Rate:
The State and UC system have agreed to a twenty-five percent indirect cost rate.

Past Experience with this Principal Investigator:
Dr. David Cocker and his team (Dr. Seinfeld of Caltech and Dr. Cappa of UC Davis) are well suited to conduct this research project. As part of recently completed research project for CARB, Dr. Cocker's investigation focused on the evaporative flux of low vapor pressure volatile organic compounds (LVP-VOCs) from the use of consumer products. This past work is quite relevant to the current research project as chamber methodologies developed to investigate consumer products will be directly applicable to this study. Experimental chamber investigations of multiple VOCs from this prior work

will also be available to serve as a platform to commence evaluation of the performance of the environmental chambers for VOCs and will provide a basis set for the current proposed research project.

Prior Research Division Funding to the University of California, Riverside:

Year	2017	2016	2015
Funding	$ 450,818	$ 500,000	$ 0

B U D G E T S U M M A R Y

Contractor: University Of California, Riverside

Environmental Chamber Experiments to Improve Secondary Organic Aerosol Model Prediction

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	116,887	
2.	Subcontractors	$	250,000	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	2,500	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	14,500	
9.	Analyses	$	0	
10.	Miscellaneous	$	33,704	
	Total Direct Costs			$ 417,591
INDIRECT COSTS				
1.	Indirect (F&A) Cost	$	32,409	
	Total Indirect Costs			$ 32,409
TOTAL PROJECT COSTS				**$ 450,000**

ATTACHMENT 1

S U B C O N T R A C T O R' S B U D G E T S U M M A R Y

Subcontractor: California Institute of Technology

Description of subcontractor's responsibility: Caltech will be responsible for all aspects involving the characterization of the Caltech chamber, SOA experiments performed within, as well as direct the modeling efforts between the UCR, Caltech, and UC Davis groups.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	106,768	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	0	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	6,108	
9.	Analyses	$	0	
10.	Miscellaneous	$	58,905[1]	
	Total Direct Costs			$ 171,781
INDIRECT COSTS				
1.	Indirect (F&A) Cost	$	28,219	
	Total Indirect Costs			$ 28,219
TOTAL PROJECT COSTS				**$ 200,000**

Note

[1]Institute Policy is to provide each graduate student employee who meets a required average workweek with full tuition and fees. A portion of this cost is requested as a benefit (exempt from indirect costs) equivalent to 66 percent of the graduate research assistant salary.

ATTACHMENT 2

S U B C O N T R A C T O R' S B U D G E T S U M M A R Y

Subcontractor: University of California, Davis

Description of subcontractor's responsibility: Dr. Cappa will direct modeling efforts at UC Davis, and will provide support on modeling chamber data using the statistical oxidation model (SOM). The experimental data from the environmental chamber experiments at UCR and Caltech will be used to evaluate and parameterize the SOM.

DIRECT COSTS AND BENEFITS					
1.	Labor and Employee Fringe Benefits	$	35,988		
2.	Subcontractors	$	0		
3.	Equipment	$	0		
4.	Travel and Subsistence	$	2,010		
5.	Electronic Data Processing	$	0		
6.	Reproduction/Publication	$	2,002		
7.	Mail and Phone	$	0		
8.	Supplies	$	0		
9.	Analyses	$	0		
10.	Miscellaneous	$	0		
	Total Direct Costs			$	40,000
INDIRECT COSTS					
1. Indirect (F&A) Cost		$	10,000		
	Total Indirect Costs			$	10,000
TOTAL PROJECT COSTS				**$**	**50,000**