State of California
AIR RESOURCES BOARD

Characterizing the Climate Impacts of Brown Carbon

RESEARCH PROPOSAL

Resolution 14-8

May 22, 2014

Agenda Item No.: 14-4-1

WHEREAS, the Air Resources Board (ARB) 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 2769–278, titled "Characterizing the Climate Impacts of Brown Carbon," has been submitted by the University of California, San Diego; and

WHEREAS, the Research Division staff has reviewed Proposal Number 2769-278 and finds that in accordance with Health and Safety Code section 39701, the focus of the research study will help to identify sources of Brown Carbon (BrC) and quantify its relative contribution to the absorption of solar radiation by particulate matter (PM). This will allow for improved assessment of the potential climate benefit of reducing specific PM sources with high organic carbon emissions that are determined to be large contributors to BrC. The results of this study will help ARB to determine the climate benefit of the ongoing mitigation of BrC emission sources in California. Research Division staff recommends this proposal for approval.

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee recommends for funding:

> Proposal Number 2769-278, entitled "Characterizing the Climate Impacts of Brown Carbon," submitted by the University of California, San Diego, for a total amount not to exceed $452,500.

NOW, THEREFORE BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and Research Division Staff and approves the following:

> Proposal Number 2769–278 titled "Characterizing the Climate Impacts of Brown Carbon," submitted by the University of California, San Diego, for a total amount not to exceed $452,500.

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 $452,500.

I hereby certify that the above is a true and correct copy of Resolution 14-8 as adopted by the Air Resources Board.

Tracy Jensen

Tracy Jensen, Clerk of the Board

ATTACHMENT A

"Characterizing the Climate Impacts of Brown Carbon"

Background

Airborne particulate matter (PM) is one of the main drivers of human health impacts associated with air pollution exposure, and also plays an important role in the climate system. Among the various types of PM, carbonaceous PM, containing organic carbon (OC) and black carbon (BC), is especially important because of both its abundance in the atmosphere and its health effects, which are the focus of increasing interest. With respect to the climate impacts of PM, BC is the principal absorber of visible solar radiation in the atmosphere, whereas OC is often described as light-reflecting. However, recent studies show that certain OC fractions can also absorb solar radiation efficiently, although they differ from typical BC; these fractions are referred to as brown carbon (BrC).

Although BrC is pervasive in the atmosphere, neither its sources nor the extent to which it contributes to direct aerosol climate forcing are well understood. Brown carbon emissions released from residential, agricultural, and wildfire burning activities are highly seasonal or episodic, and are thus a poorly characterized fraction of PM2.5 in California. Because their emissions are highest in the winter months when air quality is worst in the San Joaquin Valley and Sierra foothill communities, quantifying their role in the atmosphere is essential both to improving local air quality and to understanding their net impact on the climate.

Objective

This research project will characterize the extent to which BrC contributes to climate forcing in California, identify likely sources of BrC in the State, and assess BrC's contribution to regional and global climate impacts.

Methods

Through a multi-institutional collaboration, this research study will identify and characterize the contribution of BrC to climate forcing in California by (1) applying advanced instrumentation that will provide unprecedented chemical and optical characterization of BrC sources, (2) quantifying the BrC organic components from burning emissions and from atmospheric formation of secondary components at two California locations, and (3) examining the globally and regionally-averaged climate response of BrC. The proposed research will include measurements at two California sites and investigates at least two types of BrC (e.g. residential burning and urban secondary organic aerosols). BrC particles and their sources will be chemically characterized and quantified to attribute the measured mass of BrC to sources based on trace elemental signatures. These results will be used to develop climate model simulations to examine the globally and regionally-averaged climate response of BrC.

Expected Results
This research study will help to identify sources of BrC and quantify its relative contribution to the absorption of solar radiation by PM. This will allow for improved assessment of the potential climate benefit of reducing specific PM sources with high organic carbon emissions that are determined to be large contributors to BrC.

Significance to the Board
This project will improve ARB's understanding of the fundamental processes that dominate brown carbon formation and its evolution in the atmosphere, and help to determine the potential climate benefit of mitigating sources of brown carbon emissions in California. This research will also provide useful new measurements and analysis of immediate value for developing air quality attainment strategies in California and the development of State Implementation Plans, and for understanding the pathways leading to secondary organic aerosols.

Contractor:
University of California, San Diego

Contract Period:
36 months

Principal Investigator:
Lynn Russell, Ph.D.

Contract Amount:
$452,500

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

Past Experience with this Principal Investigator:
Professor Lynn Russell will serve as the principal investigator, coordinating and synthesizing the effort for the overall project. Her 15 plus years of experience in aerosol science and strong publication record make her ideal to fulfill this role. Professor Russell has successfully completed several projects for ARB and showed exceptional effort to produce valuable reports.

Prior Research Division Funding to University of California, San Diego:

Year	2013	2012	2011
Funding	$ 0	$ 24,080	$ 0

BUDGET SUMMARY

University of California, San Diego

"Characterizing the Climate Impacts of Brown Carbon"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 152,097	
2.	Subcontractors	$ 252,500[1]	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 6,720	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 1,250	
8.	Supplies	$ 9,331	
9.	Analyses	$ 3,500	
10.	Miscellaneous	$ 11,625	
	Total Direct Costs		$ 437,023
INDIRECT COSTS			
1.	Overhead	$ 15,477	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 15,477
TOTAL PROJECT COSTS			**$ 452,500**

[1] The subcontractors will play critical roles in this project by performing measurements and analyzing and interpreting the results. The subcontractors will also conduct comprehensive data analysis and employ sophisticated regional and global climate models that are uniquely suited to the objectives of this project.

ATTACHMENT 1

SUBCONTRACTORS' BUDGET SUMMARY

University of California, Davis (UCD)

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 160,850	
2.	Subcontractors	$ 50,000[1]	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 8,991	
5.	Electronic Data Processing	$ 8,525	
6.	Reproduction/Publication	$ 1,452	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 2,000	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$ 231,818
INDIRECT COSTS			
1.	Overhead	$ 20,682	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 20,682
TOTAL PROJECT COSTS			**$ 252,500**

[1] UCD investigators will apply advanced instrumentation that will provide unprecedented chemical and optical characterization of brown carbon sources and investigate its formation pathways. They will also apply source-oriented model, weather research and forecasting model coupled with chemistry, which provides unique capabilities in linking climate impacts with specific aerosol sources.

ATTACHMENT 2

SUBCONTRACTORS' BUDGET SUMMARY

Dr. Mark Z. Jacobson, independent subcontractor
Scientific Collaborator at Stanford

The subcontractor will run and analyze two types of 3-D computer simulations: (1) global simulations to simulate the climate response of brown carbon, and (2) nested global-regional simulations focusing on California to examine the spatial distribution, optical properties, radiative effects, and human exposure to brown carbon in the state. Twenty-year global simulations (2010-2030) will be simulated with and without brown carbon to examine the globally and regionally-averaged climate impact of brown carbon. The work proposed here will complement ongoing work by Jacobson funded under the National Science Foundation titled, "Effects of Absorbing Aerosols on Clouds: Satellite and Modeling Analysis."

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 50,000	
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	$ 0	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$ 50,000
INDIRECT COSTS			
1.	Overhead	$ 0	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 0
TOTAL PROJECT COSTS			**$ 50,000**