State of California
AIR RESOURCES BOARD

Ozone in the Lower Atmosphere and its Contribution to High Ozone Concentrations at Ground-Level in the Southern San Joaquin Valley

RESEARCH PROPOSAL

Resolution 14-21

July 24, 2014

Agenda Item No.: 14-6-1

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 2777-279, titled "Ozone in the Lower Atmosphere and its Contribution to High Ozone Concentrations at Ground-Level in the Southern San Joaquin Valley" has been submitted by the University of California, Davis; and

WHEREAS, the Research Division staff has reviewed Proposal Number 2777-279 and finds that in accordance with Health and Safety Code Section 39701, research is needed to better characterize conditions aloft during episodes with high ozone concentrations at the surface in order to improve air quality modeling for State Implementation Plans;

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

> Proposal Number 2777-279 titled "Ozone in the Lower Atmosphere and its Contribution to High Ozone Concentrations at Ground-Level in the Southern San Joaquin Valley," submitted by the University of California, Davis, for a total amount not to exceed $300,021.

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 recommendations of the Research Screening Committee and Research Division staff and approves the following:

> Proposal Number 2777-279 entitled "Ozone in the Lower Atmosphere and its Contribution to High Ozone Concentrations at Ground-Level in the Southern San Joaquin Valley," submitted by the University of California, Davis for a total amount not to exceed $300,021.

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 $300,021.

I hereby certify that the above is a true and correct copy of Resolution 14-21 as adopted by the Air Resources Board.

/s/

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Tracy Jensen, Clerk of the Board

ATTACHMENT A

"Ozone in the Lower Atmosphere and its Contribution to High Ozone Concentrations at Ground-Level in the Southern San Joaquin Valley"

Background

The San Joaquin Valley (SJV) is one of two areas nationally that have an "Extreme" nonattainment classification with respect to the National Ambient Air Quality Standard (NAAQS) for ozone. To attain the standard, it is imperative to better understand how the various sources of ozone contribute to the high concentrations. During the evening and night, atmospheric processes (e.g., nocturnal temperature inversions, low-level jets of air flowing through the SJV) can cause the air aloft and the surface layer of air to have different physical and chemical characteristics. During the night, differences in emissions and atmospheric processes can cause significantly different pollutant concentrations in the two layers. While the surface layer of air is generally characterized by the routine air quality monitoring network, the isolated air a few tens to hundreds of meters above it is unknown or poorly characterized. In addition, air quality models frequently have difficulty replicating the conditions associated with temperature inversions and the mixing processes that break them. Air quality and meteorological measurements are needed to characterize conditions aloft during episodes with high ozone concentrations at the surface in order to ascertain if the ozone modeling for the State Implementation Plan (SIP) is adequately characterizing these critical atmospheric processes.

Objective

The primary objective of this research is to make air quality and meteorological measurements aloft (in the lowest 1500 meters of the atmosphere) on days associated with forecasts of high ozone concentrations at ground-level sites. Of particular interest is the influence that the carryover of polluted air aloft from one day has on the succeeding day's ozone concentrations. This research is needed to better characterize the roles that various sources of ozone aloft play in causing exceedances of the National Ambient Air Quality Standard in the southern San Joaquin Valley.

Methods

University of California, Davis (UCD) personnel will collaborate with meteorologists (at ARB and the San Joaquin Valley Air Pollution Control District) to monitor the synoptic meteorological conditions throughout the summer with the goal of forecasting poor air quality for the southern SJV. With advanced notice of anticipated poor air quality (e.g., 2-day forecast), UCD will collect measurements of ozone and other parameters with an aircraft (for 3 consecutive days) during each deployment, which will occur approximately once every three weeks of the ozone season (June-September). To provide additional context for each deployment (5 in total), UCD will also collect data during the aircraft transits between the home base (Lincoln) and the field base (Bakersfield).

Over three consecutive days, UCD will conduct four flights per day, with each flight collecting data to estimate vertical, horizontal, and temporal gradients (necessary for estimation of the terms in the ozone budget equation). The flights will occur at various altitudes and locations between Fresno and the southern terminus of the Valley. Approximately 10 hours of measurements of conditions aloft will be made during each

sampling day. The four flights per day will be conducted at various times of particular interest to understanding the diurnal dynamics of ozone in the southern SJV: in the early morning before photochemistry begins, in mid-morning when solar heating mixes the surface air with the air aloft, in the early afternoon when atmospheric mixing is deepest, in the early evening when the nocturnal boundary layer is forming, and in the late evening when air aloft is rapidly moving through the SJV.

Data to be collected and quality-assured include horizontal winds, relative humidity, temperature, ozone, nitrogen dioxide, methane, and ethane, all at 2-second resolution or better (equivalent to spatial resolution of ~125 m in the horizontal, 5 m in the vertical given typical cruising speeds and ascent/descent rates).

The proposed project will provide a new paradigm with which to improve air quality modeling efforts. For example, measurements will be made aloft during critical periods of the diurnal ozone cycle. In addition, by measuring the explicit terms of the ozone budget equation, this project will test specific model components (both transport and photochemistry) and quantify the contribution of O_3 aloft to the next day's maximum concentration at the surface. The measurements from this project will help to ensure that the ozone SIP modeling is adequately characterizing these critical atmospheric processes.

Expected Results
The research will provide ARB with aerometric measurements characterizing the vertical mixing of O_3 and other pollutants in the layer of air aloft at night, which the routine monitoring network cannot characterize, into the boundary layer of air near the Earth's surface during the morning. This research will also characterize the horizontal advection of air masses, information which is vital for successful air quality modeling.

Significance to the Board
The research results will inform ARB scientists and policy makers regarding the impacts that ozone aloft has on peak ozone concentrations near the earth's surface when they approach or exceed ambient air quality standards.

Contractor:
University of California, Davis

Contract Period:
30 months

Principal Investigator (PI):
Ian Faloona, Ph.D.

Contract Amount:
$300,021

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

Past Experience with the Principal Investigator:
Professor Ian Faloona has previously conducted two small research projects for ARB. Both projects investigated the impacts of offshore sulfur emissions. The first project (2005) entailed primarily a literature review of onshore sulfur impacts from offshore sources while the second project (2006) attempted to quantify the impact of ship emissions and involved onshore air quality and meteorological monitoring, as well as a survey of boat owner operations (and tracking with GPS). More recently, Professor Faloona's activities have included aircraft monitoring under contracts with PG&E and the San Joaquin Valley Air Pollution Control District.

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

Year	**2013**	**2012**	**2011**
Funding	$1,131,716	$4,949,363	$1,394,560

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

University of California, Davis

"Ozone in the Lower Atmosphere and its Contribution to High Ozone Concentrations at Ground-Level in the Southern San Joaquin Valley"

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	152,635	
2.	Subcontractors	$	116,550	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	9,930	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Materials & Supplies	$	2,500	
9.	Analyses	$	0	
10.	Miscellaneous	$	2,075[1]	
Total Direct Costs				$ 283,690
INDIRECT COSTS				
1.	Overhead	$	16,331	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$ 16,331
TOTAL PROJECT COSTS				**$ 300,021**

[1] Costs for publicizing results: journal fees for required paper; scientific conference registrations

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: Scientific Aviation, Inc.

Description of subcontractor's responsibility: For this project, Scientific Aviation will provide a single-engine aircraft (modified for making air quality and meteorological measurements); instrumentation for measuring ozone, nitrogen dioxide, methane, ethane, air temperature, relative humidity, and wind speed & direction; and two pilots. Scientific Aviation will collect approximately 175 hours of aerometric data during the project, which calls for five 3-day deployments in the southern San Joaquin Valley during the summer of 2015 with additional measurements the day before and after each deployment as the aircraft is ferried to and from its base airport in the Sacramento area.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	0	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	2,800	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	0	
9.	Analyses	$	0	
10.	Miscellaneous	$	113,750[2]	
	Total Direct Costs			$ 116,550
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				**$ 116,550**

[2] The full operational cost associated with making aircraft measurements in 2015 is anticipated to be $650/hour. The line item costs (e.g., aircraft maintenance, pilots, monitoring equipment, fuel, insurance, hanger fees, aviation chart subscription, data loggers) are based on actual cost rates in previous years.