CHARACTERIZATION OF PM2.5 EPISODES IN THE SAN JOAQUIN VALLEY BASED ON DATA COLLECTED DURING THE NASA DISCOVER-AQ STUDY IN THE WINTER OF 2013

I. OBJECTIVE

This project will update the conceptual model of PM2.5 formation in the San Joaquin Valley (SJV) during high PM episodes. In January/February 2013 NASA conducted a deployment of the DISCOVER-AQ project. The DISCOVER-AQ study collected airborne air quality data from multiple flights during two multi-day PM2.5 episodes. Analysis of this data and comparison with results from modeling of the same period will improve understanding of the chemistry and processes which form PM2.5 in the SJV during winter episodes. The enhanced understanding will be systemized into a conceptual model which will be used in evaluating and improving SJV PM2.5 modeling prior to the State Implementation Plan modeling for the revised PM2.5 standard of 12 $\mu g/m^3$ adopted by U.S. EPA in 2012.

II. BACKGROUND

The San Joaquin Valley has the most severe PM problem in California. In 2012, the peak annual PM2.5 concentration was 15.4 $\mu g/m^3$. High 24-hour PM2.5 concentrations during winter episodes drive the annual concentrations. In 2012, the 24-hour standard of 35 $\mu g/m^3$ was exceeded 29 times. To address this problem it is necessary to understand the sources and atmospheric processes which contribute to the high concentrations of PM2.5. PM2.5 particles are both emitted and formed through atmospheric reactions of precursor pollutants. Concentrations are highest in the SJV during the winter, when cool stable conditions and low wind speeds, coupled with the Valley's topography, limit dispersion of emissions and allow multi-day buildups of PM2.5 concentrations to occur. Recognizing the need for a conceptual framework to guide control strategy development, in the late 1990s ARB funded a study to distill the then current scientific understanding of PM sources and formation in the SJV into a conceptual model. In the subsequent decade and a half the model has been update with new findings. This year NASA deployed two aircraft and numerous surface instruments for a month in the SJV in an effort to better characterize surface PM concentrations. The resultant data set is of unprecedented richness in aloft measurements.

The NASA DISCOVERY-AQ study was designed to explore the ability of satellites to diagnose surface air quality by characterizing high PM2.5 concentrations and relating them to satellite observations. The DISCOVER-AQ deployment in the SJV occurred in January/February 2013 and created an extensive set of surface and aloft (aircraft) ambient data that further enhance the utility of the satellite data. This research project will perform advanced analysis on the San Joaquin Valley DISCOVER-AQ aircraft measurement data set, investigating the spatial and temporal distributions of the PM2.5 and its precursors, and their evolution during at least two extended episodes with high PM2.5 concentrations.

The data set collected during DISCOVER-AQ is unique in that it contains data from multiple flights during two PM episodes. Analysis of this data will, when compared with ARB's modeling, provide an unprecedented identification of strengths and weaknesses in ARB's conceptual model of PM episode formation in the San Joaquin Valley. The enhanced

understanding of PM2.5 formation in the SJV will be of immediate value for developing air quality attainment strategies.

III. Scope of Work

The objective of the project is to update the conceptual model for PM2.5 formation in the San Joaquin Valley during the winter months using further analysis of DISCOVER-AQ data and model/data comparisons.

The first task of this project will involve further analyses of data collected onboard the P-3B and B200 aircraft gathered during the field study. The project will collaborate with the DISCOVER-AQ scientists, seeking to build on existing and planning data analysis, not duplicate already funded work. This analysis should focus on elucidating the sources that contributed to the two episodes captured during DISCOVER-AQ.

ARB staff are currently modeling the high PM episodes that occurred during DISCOVER-AQ. The second task will be performing refinements of the ARB photochemical modeling of the study period suggested by the analysis of the aircraft data. This work will be done in collaboration with the modeling staff of ARB. The results of this modeling study should help improve our understanding of the atmospheric processes (including specific emissions sources) that led to the buildup/dissipation of the episodes.

The third task focuses on the updating of the conceptual model for PM2.5 formation in the San Joaquin Valley during the winter months. This update should include the results for the two tasks outlined above. It should also, to the extent possible, include the findings of the other investigators from the DISCOVER-AQ campaign.

IV. Deliverables

- Quarterly Progress Reports
- Draft and Final Reports
- Peer-reviewed journal article(s), as appropriate
- All data and analyses generated through the course of this project

V. Timeline

It is anticipated that this project will be completed 30 months from the start date. This allows 24 months for completion of all work through delivery of a draft final report. The last 6 months are for review of the draft final report by ARB staff and the Research Screening Committee (RSC), modification of the report by the contractor in response to ARB staff and RSC comments, and delivery of a revised final report and data files to the ARB.

VI. Budget: $200,000