SCOS97-NARSTO AEROSOL PROGRAM
FIELD PLAN

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ABSTRACT

The 1997 Southern California Ozone Study-North American Research Strategy for Tropospheric Ozone (SCOS97-NARSTO) is an extensive monitoring study whose results will be used to improve modeling of ozone episodes in southern California. The SCOS97-NARSTO field study plan (Fujita et al., 1997, available on http://www.arb.ca.gov/scos/scos.htm) provides a conceptual model for the ozone episodes and transport scenarios of interest and specifies the data collection requirements for data analysis and modeling. It also describes the quality assurance, data validation, and data management needs.

The purpose of the SCOS97-NARSTO aerosol program is to develop a three-dimensional picture of the generation and evolution of typical late summer aerosols in the South Coast Air Basin (SoCAB). It is possible to do this by taking advantage of the enhanced monitoring support available during the SCOS97-NARSTO ozone study and deploying both advanced surface aerosol measurement equipment and airborne aerosol analyzers. The participants have various complementary interests, both regulatory and scientific, in understanding:

- Relationships between motor vehicle emissions and ambient aerosols;
- Processes of secondary aerosol formation, especially generation of organic and ammonium nitrate aerosols from gas-phase precursors;
- Contributions of various sources, particularly heavy-duty diesels, to both the primary and secondary particle burdens in the atmosphere;
- How aerosol size and composition change due to deposition, transport, and interactions with the various gas and particle sources distributed across the SoCAB;
- How ozone control strategies may influence aerosol formation; and
- How aerosol burdens influence ozone photochemistry (ultraviolet radiation flux attenuation or enhancement by aerosols).

This field study plan summarizes objectives, presents information existing on particulate matter and visibility networks, and describes a core measurement program. It also summarizes quality assurance and data management.

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1.0 INTRODUCTION

The 1997 Southern California Ozone Study-North American Research Strategy for Tropospheric Ozone (SCOS97-NARSTO) is an extensive monitoring study whose results will be used to improve modeling of ozone episodes in southern California. The SCOS97-NARSTO field study plan (Fujita et al., 1997, available on http://www.arb.ca.gov/scos/scos.htm) provides a conceptual model for the ozone episodes and transport scenarios of interest and specifies the data collection requirements for data analysis and modeling. It also describes the quality assurance, data validation, and data management needs.

During SCOS97-NARSTO, a dense network of upper-air meteorological profilers and surface aerometric stations will operate from June 16 through October 15, 1997. On 15 high-ozone days, additional intensive measurements will be made to characterize air quality at the surface and aloft. These daily and intensive operations will also provide meteorological and gaseous precursor data invaluable for characterizing the formation and transport of secondary aerosols, which are becoming relatively more important as the regulatory scope expands to include smaller particles (i.e., PM2.5).

Control programs necessary to reduce ambient concentrations of particulate matter (PM10 and PM2.5) require data on the origins of ambient aerosols, both to identify sources of primary particles, and to understand the processes that form secondary particles in the air. Real-time single particle analysis using aerosol time-of-flight mass spectrometry (ATOFMS) is capable of overcoming the shortcomings of filter sampling and providing aerosol data inaccessible by other techniques.

Mathematical air pollution models employing three-dimensional descriptions of the meteorology and chemistry of the ambient air of the South Coast Air Basin (SoCAB) are expected to play an important role in assessing the impacts of proposed air pollution control strategies. In many respects, the vertical distribution of gas- and aerosol-phase species holds a key to understanding the dynamics of air pollution in the SoCAB. Models that are used to evaluate emission reduction strategies have in the past had scant vertically resolved data with which to compare predictions of concentrations aloft and their spatial and temporal distributions. With the advent of small, highly instrumented aircraft capable of performing measurements aloft in large, complex regions like the SoCAB, aircraft sampling has become an essential component of field programs aimed at producing a comprehensive picture of the dynamics of pollutant formation during episodes of high ozone and high particulate matter concentrations.

2.0 OBJECTIVES

The SCOS97-NARSTO aerosol program will take advantage of the enhanced monitoring support available during the SCOS97-NARSTO ozone study period and will deploy both advanced surface measurement equipment and airborne aerosol analyzers to develop a three-dimensional picture of the generation and evolution of typical late summer aerosols in the SoCAB. The participants have various complementary interests, both regulatory and scientific, in understanding:

- Relationships between motor vehicle emissions and ambient aerosols;
- Processes of secondary aerosol formation, especially generation of organic and ammonium nitrate aerosols from gas-phase precursors;
- Contributions of various sources, particularly heavy-duty diesels, to both the primary and secondary particle burdens in the atmosphere;

- How aerosol size and composition change due to deposition, transport, and interactions with the various gas and particle sources distributed across the SoCAB;
- How ozone control strategies may influence aerosol formation; and
- How aerosol burdens influence ozone photochemistry (ultraviolet radiation flux attenuation or enhancement by aerosols as scattering of light by aerosols may increase or decrease the spherically integrated ultraviolet radiation flux and the photolytic rates relative to clear sky conditions).

In addition, the study provides opportunities to evaluate and refine some of the research tools available for aerosol analysis; among these research development goals are:

- Develop quantitative calibrations for capture and detection efficiencies for the ATOFMS, and relate impactor and filter organic carbon composition to organic carbon fragments measured by the ATOFMS;
- Refine and test algorithms to relate observed aerosol size and composition data to ultraviolet radiation flux in the mixed layer;
- Evaluate the stability of particulate nitrate samples and other artifacts in samples collected using the proposed Federal reference method (FRM) for PM2.5;
- Refine and extend the library of organic aerosol source profiles; and
- Improve aerosol models and source allocation schemes.

3.0 SCOPE OF WORK

The major tasks of the SCOS97-NARSTO aerosol program are to:

- Conduct advanced aerosol measurements at the surface -- including ATOFMS single-particle analysis, impactor sampling for size-resolved organic and inorganic chemistry, and aerosol sizing for mass distributions -- to characterize aerosols in coastal, mid-basin, and interior locations in the SoCAB;
- Use aircraft to measure vertical profiles of aerosol precursors and aerosol size and concentration, and to collect time-averaged aerosol samples for chemical analysis;
- Use continuous ammonia, nitric acid, aerosol nitrate measurements, and single particle measurements to observe their concentration-humidity-temperature phase dependence in ambient air;
- Deploy two of the newly developed PM2.5 FRM sampler types for comparison with "conventional" sampling techniques. Selected samples will be analyzed for nitrate to study nitrate losses from the two new methods;
- Develop speciated organic particulate profiles to distinguish between gasoline- and diesel-fueled vehicle exhaust contributions to ambient aerosol;
- Apply chemical species data from previous source sampling and current field studies to allocate primary organic and inorganic aerosol components to their sources in the SoCAB; and
- Evaluate photolysis sub-model performance against measured radiometer and actinometer data and incorporate an improved module into regulatory ozone models.

4.0 EXPERIMENTAL DESIGN

The experimental design focuses on ambient sampling along two trajectories and in a tunnel:

I. A general aerosol generation and evolution "trajectory" will begin in the emissions-rich central Los Angeles area, go to a mid-trajectory site in the San Gabriel Valley, and end in Riverside during the last two weeks of August.

II. A nitrate dynamics trajectory will run from Diamond Bar to the ammonia-source area in the Chino Basin, and end in Riverside during the first two weeks of September.

III. A sampling program at the Caldecott Tunnel in northern California to measure fine particle size distributions and chemistry will develop source profiles to discriminate between emissions from light-duty (primarily gasoline-fueled) and heavy-duty (mainly diesel-fueled) vehicles.

5.0 MEASUREMENT APPROACH

The aerosol and ultraviolet radiation studies are a cooperative effort funded by Air Resources Board (ARB), the Coordinating Research Council (CRC), the Electric Power Research Institute (EPRI), and the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). Participants include researchers from ARB (Mr. Curtis Schreiber and Ms. Thelma Yoosephiance), Aerosol Dynamics, Inc. (ADI, Dr. Susanne Hering), AtmAA, Inc. (Dr. Kochy Fong), Biospherics Research (Dr. Rei Rasmussen), Brigham Young University (Dr. Delbert Eatough), California Institute of Technology (Caltech, Dr. Glen Cass and Dr. John Seinfeld), Colorado State University (Dr. James Gibson), Desert Research Institute (Dr. Eric Fujita and Dr. John Watson), Harvard School of Public Health (Dr. Petros Koutrakis and Mr. George Allen), Princeton University (Dr. Lynn Russell), South Coast Air Quality Management District (SCAQMD, Mr. Joe Cassmassi), U.C. Berkeley (Dr. Robert Harley), U.C. Davis (Dr. Debbie Niemeier), U.C. Riverside (Dr. Janet Arey, Mr. Dennis Fitz, Dr. Kimberly Prather, and Dr. Ernesto Tuazon), U.S. EPA (Dr. William Barnard), and the U.S. Navy (Naval Research Lab and Naval Post Graduate School). See Appendix A for list of sponsors and measurement groups

The SCOS97-NARSTO aerosol program consists of four studies: an FRM nitrate loss study and a fine particle measurement/aerosol artifact study, two trajectory studies, a solar radiation study, and a tunnel study. The following outlines these four aerosol studies.

5.1 Fine Particle Measurements - an FRM Study

5.1.1 EPRI-Sponsored PM Measurements in Southern California

The objective of this study is to quantify the composition and amount of labile and volatile fine PM lost from single filter-based sampling (e.g., the proposed FRM) as a function of season and location. This study is in support of the overall goal of characterizing as accurately as possible the mass and composition of suspended fine particles at the point of inhalation. Six experiments are planned to be conducted at U.C. Riverside (Agricultural Operations site). The tentative start date is August 18, 1997 and the experiment will continue to ensure 30 days of sampling (i.e., 30+ days in the field). Table 1 lists aerosol monitoring instruments at the Agricultural Operations site.

Table 1

UCR-Ag Ops	Sampling Duration	Organization	Comments
PM10-TEOM	continuous	SCAQMD	Two collocated
Ozone	continuous	SCAQMD	
NOx	continuous	SCAQMD	
CO	continuous	SCAQMD	
HNO_3, HCL, HCOOH, CH_3COOH, PM2.5 mass, SO_4^{-2}, NH_4^+, NO_3^-, CL^-	Two-week integrated sampler	Children's Health Study site/ARB	
Real-time nitrate	continuous (8/16-9/1)	ADI	
PM2.5	24hr (10 am-10 am)	BYU	R&P FRM prototype
PM mass/ impactor	24hr	HSPH	PM2.5 and PM10 Harvard Impactor
HNO_3, HNO_2, NH_3, SO_2, strong H^+, SO_4^{-2}, NH_4^+, NO_3^-	24hr	HSPH	Annular denuder (HEADS)
PM2.5 mass	continuous	HSPH	CAMMS - filter pressure drop prototype
PM2.5 mass	continuous	BYU	TEOM sandwich prototype
PM2.5 mass	continuous	BYU/R&P	TEOM with desiccation prototype
EC, OC	24hr	BYU	Organic samplers (PC/BOSS, BIG BOSS)
EC , OC	24hr	HSPH	Pipe-bomb sampler, with and without gas phase stripper
BC Aethelometer	continuous, 5 min	HSPH	
Ultraviolet Radiation Aethelometer	continuous, 5 min	HSPH	Collocated with standard BC aethelometer
Nephelometer	continuous	HSPH/ARS	Unheated Optec with temperature and relative humidity

Harvard University will collect 24-hr samples by HEADS, modified HEADS for inorganic ions, denuded filters for organic and elemental carbon, Harvard impactors for PM10 and PM2.5 mass, and FRM sampler for PM2.5 mass. Brigham Young University will collect 24-hour samples for organics using their BOSS and BIG-BOSS systems, and for inorganic species using URG annular denuders and the R&P Chemspec automated denuder system. Real time instruments for particle mass include Harvard CAMMS, TEOM, and modified TEOM for PM2.5. Other real-time instruments are an aethelometer, an ambient temperature nephelometer, an ultraviolet wavelength particle absorption spectrometer, and, for the first two weeks, the ADI automated nitrate system. The same measurements will be made each day, with sample changes at 0600 PDT.

Experiments

1. Measure total fine particle mass by a single filter-based method (similar in principle to the FRM). This will be coordinated with EPA to obtain their FRM data for comparison {Harvard Impactor: HI}.

2. Measure air concentration of total fine particle mass in situ by a continuous method where the loss of labile substances is minimal {Continuous Ambient Mass Monitor System: CAMMS}.

3. Measure air concentrations of major ions and elements in gaseous and particulate form (with emphasis on gaseous nitrate and ammonia) as well as the amount of these substances which evaporate from filters during sampling using denuder-based sampling methods {Harvard/EPA Annular Denuder System: HEADS}.

4. Measure air concentrations of fine particulate organic and elemental carbon (OC and EC) including the amount of particulate organic material that evaporates from the filters during sampling using denuder-based sampling methods {Brigham Young Organic Sampling Systems: PC BOSS/BIG BOSS}.

5. Measure particulate nitrate concentrations continuously in the field using a research-grade continuous analyzer {Aerosol Dynamics, Inc. Automated Particle Nitrate Monitor}.

6. Quantify the evaporation of labile and volatile species from filters as a function of storage time, temperature, relative humidity and other factors using laboratory generated submicron particles containing ammonium nitrate and specific volatile organic compounds (e.g., glutaric acid).

The difference between Items 1 and 2 will characterize the magnitude of the error due to the loss of labile substances and Items 3 and 4 will enable quantitative explanations for this error. To characterize the precision of the observations and to deal with unplanned glitches in the field, each observable will be measured via redundant multiple samplers.

Item 5 provides higher time resolution nitrate data (continuous 5- to 10-minute averages) as compared to the 12-hour nitrate data in Item 3. Such data are valuable in relating air concentrations to fluctuating meteorology, especially in urban areas such as Los Angeles, where nitrate concentrations are high and their contribution to fine PM is large.

Item 6 will provide the most direct and definitive proof that specific compounds evaporate from filters during the course of sampling and before chemical analysis.

The experiments will be led by Professor Petros Koutrakis of Harvard School of Public Health (HSPH) and Prof. Delbert Eatough of Brigham Young University (BYU). Professor Koutrakis will serve as the principal investigator (PI) for atmospheric experiments Items 1 through 3 and for the laboratory experiment Item 6 (see the scope of work above). Professor Eatough will serve as PI for atmospheric experiment Item 4 and Dr. Susanne Hering of Aerosol Dynamics, Inc. (ADI) will serve as PI for Item 5. An independent field audit activity will be conducted by the Desert Research Institute (DRI) with Dr. Fred Rogers as PI for atmospheric experiments Items 1 through 5.

Dr. Pradeep Saxena of EPRI will serve as the Principal Investigator for planning and synthesis across all aspects of the study and in that role contribute to writing of the results in policy-relevant form. Ms. Mary Ann Allan of EPRI will manage the study and ensure that the work is being executed satisfactorily according to product specification, budget, and schedule.

5.1.2 ADI - FRM Nitrate Loss Study
The Federal reference method (FRM) nitrate loss study will be conducted by ADI and SCAQMD in conjunction with the trajectory study. Two FRM samplers will be operated alternatively at each of the three trajectory study sites. ADI will operate FRM samplers at Riverside Pierce Hall, and SCAQMD will operate samplers at other sites, namely downtown Los Angeles, Azusa, Diamond Bar, and Mira Loma. SCAQMD will pre- and post-weigh Teflon filters, and analyze filters by ion chromatography for nitrates.

5.2 Trajectory Studies
Two trajectories will be studied -- a vehicle emission-dominated trajectory and a nitrate-dominated trajectory. Each trajectory will be evaluated at three sites. The trajectory studies will be conducted between August 16 and September 14, 1997. Two consecutive days of measurements will be made each week. For the first two weeks, measurements will be made at downtown Los Angeles, Azusa, and Riverside-Pierce Hall, corresponding to a vehicle emission-dominated air trajectory. For the second two weeks, measurements will be made at Diamond Bar, Mira Loma, and Riverside, corresponding to a nitrate trajectory.

For the trajectory studies, selection of the days for sampling each week will be based on meteorological and air quality forecasts. U.C. Riverside will measure real-time single particle composition by ATOFMS at all three sites. Caltech will measure particle chemistry with 4- to 7- hour resolution by filter-based sampling, size-resolved particle chemistry by micro-orifice impactor sampling over one 4-hour period each day, and particle size distribution measurements by optical counters and electrical mobility in real-time. These measurements will be made at all three sites. ADI will make automated nitrate measurements at the Riverside Agricultural Operations (Ag Ops) site in August and at Mira Loma in September.

5.2.1 *Aerosol Time-of-Flight Mass Spectrometry (ATOFMS) Measurements of Individual Particles*

The new ATOFMS measurement technology permits sampling and experimentation (i.e., real-time measurement of the size and chemical composition of individual aerosol particles) that was previously prohibitively expensive or too time-consuming to be practical. ATOFMS can measure the aerodynamic size and chemical composition of up to 600 individual atmospheric particles per minute (50-100 under typical ambient conditions). These instruments permit direct observation of changes in ambient aerosols due to processes such as coagulation, condensation, evaporation, and heterogeneous gas/particle chemical reactions. Both the organic and inorganic content of individual aerosol particles can be determined. ATOFMS can be used to directly measure size and composition correlations for different particle sources, and to monitor particle transport and transformations. These instruments have demonstrated good correlation with measurements of ambient bulk samples collected by multi-stage impactors.

This instrument will be used in aerosol trajectory studies in conjunction with the SCOS97-NARSTO ozone study in SoCAB. This study will provide a wealth of data that will be used in development of source signatures for various PM sources, analysis of the temporal (diurnal, seasonal) variation in aerosols at Riverside ("aerosol climatology"), and studies of aerosol chemistry in ambient air.

5.2.2 *Characterization and Evolution of Secondary Aerosols During PM2.5 and PM10 Episodes*

The major objectives of these experiments are to examine the particle size distributions and chemical compositions of areas dominated by two important sources of PM10 and PM2.5 in the SoCAB: (1) primary motor vehicle exhaust emissions and (2) aerosol nitrate formed by the interaction of oxides of nitrogen emissions with ammonia near the Chino dairy area. A supporting objective is to calibrate the response of the novel ATOFMS instruments to atmospheric particles as measured under field sampling conditions with conventional sampling and analysis techniques. Such real-time particle analysis instruments, once calibrated for quantitative analysis, will make it possible to take enormous quantities of data quickly.

To investigate nitrate dynamics, urban aerosols will be sampled at Diamond Bar, then in the ammonia source area in the Chino dairy district, and finally in the nitrate-rich aerosol found at Riverside. In Chino basin, the Children's Health Study (CHS) operates a site at Jurupa Valley High School in Mira Loma with a 2-week integrated sampler (particles and acids), NO_x, O_3, TEOM, etc. The Mira Loma site was selected because there are large dairy farms just upwind (strong NH_3 source), and it is blessed with a continuous air quality record since 1993 at Jurupa Valley High School (CHS site) which is adjacent to the SCOS97-NARSTO aerosol monitoring site.

Operating at each sampling site will be PM10 and fine particle filter samplers, two micro-orifice impactors (MOI), an electrical aerosol analyzer (EAA), an optical particle counter (OCP), and the data acquisition computer used for EAA and OPC. All sampling will be in parallel with ATOFMS. The electrical analyzers will be TSI (Minneapolis, MN) Model 3030 modified for increased sensitivity. The optical particle counter will be Particle measuring Systems (Boulder, CO) Model ASASP-X 32 channel units. Data from these electronic particle size monitors will be integrated for comparison with the mass distributions measured by impaction and the ATOFMS particle counting data. Real-time data from the OPCs and EAAs will be used to confirm the aerosol measurements of the MOI samples and the ATOFMS data. The filter-based samples for bulk and elemental analyses will be operated on the same 5-sample per day schedule (i.e., from 1 am to 6 am, 6:20 to 10 am, 10:20 am to 2 pm, 2:20 pm to 6 pm, and 6:20 pm to 1 am). The electronic samplers will collect data continuously. Once set of impactor samples will be collected per day at each site.

The filter samples will be analyzed to determine particle mass (PM10 and PM2.5), bulk composition (elemental carbon and organic carbon), and inorganic species concentrations (sulfates, nitrates, ammonium, chloride, and trace metals). In addition, a denuder difference sampler will be analyzed for nitric acid, and stacked filter samples for gas-phase ammonia. Filter samples run in parallel will collect enough particulate matter for quantification of trace organic species by gas chromatography/mass spectrometry (GC/MS). The fine particle samples will be analyzed for at least the approximately 50 organic compounds used for the source apportionment method developed at Caltech. The impactor samples will be analyzed to determine particle mass, bulk composition (elemental carbon and organic carbon), and inorganic species concentrations (sulfates, nitrates, ammonium, chloride, and trace metals) of the fine aerosol segregated into size fractions.

This study will provide information regarding the size distribution and chemical composition of aerosols during episodes of high PM2.5 and PM10 concentrations. The ambient data collected in this study will also provide the basis for subsequent work to develop, evaluate, and improve airshed model which simulate the chemical and physical transformations that occur as particles age and travel in the atmosphere.

5.2.3 Measurement of Nitrogenous Species

The College of Engineering-Center for Environmental Research and Technology (CE-CERT) at the University of California, Riverside, will collect data on the concentrations of atmospheric nitrogenous species (NOy) which includes all species (e.g., nitrogen dioxide, peroxyacetyl nitrate [PAN], peroxypropyl nitrate [PPN], particulate nitrate, nitric acid, and nitrous acid) reduced to NO by a molybdenum catalyst at seven sites as a part of SCOS97-NARSTO.

At one site, Azusa, nitric acid and nitrogen dioxide will be measured during 15 Intensive Operating Periods (IOPs) with a tunable diode laser absorption spectrometer (TDLAS). At Mira Loma ammonia will be measured with a long-path Fourier transform infrared spectrometer (FT-IR) for two weeks, in early September. Denuder samples will also be collected at these two sites over three hour intervals (from 10 am to 7 pm) to quantify nitric acid and ammonia.

Aerosol Dynamics Inc. (ADI) will make automated nitrate measurements at the Riverside Agricultural Station in August and at Mira Loma in September. Data will be collected with 10 minutes time resolution over the entire measurement period. The analysis step will take an additional minute, yielding 5 nitrate measurements per hour.

The ADI particle nitrate monitor provides automatic measurements using an integrated collection and vaporization cell. It has two modes of operation: sampling and analysis. In the sampling mode the sampled airstream passes through an impactor to remove particles above 2.5 µm, a denuder to remove interfering gaseous species and a humidifier to enhance particle collections. The particles in the airstream are then deposited by impaction onto a metal strip housed in the collection and vaporization cell. In the analysis mode the sample air flow is stopped. A carrier gas is introduced into the collection and vaporization cell and passes through the cell into the gas analyzer. The metal strip on which the particles have been deposited, located inside the cell, is rapidly heated by capacitor discharge. The heating process is less than a second. The deposited particles are vaporized and the evolved species are carried to a gas-phase analyzer for quantitation. By selection of the carrier gas and the amount of heating, a selected constituent of the deposited particles is converted to a gas-phase species that may be quantitated by a standard commercial analyzer. For automated nitrate analysis, particulate nitrate can be converted to nitrogen oxides, which can be analyzed by chemluminescence using a molybdenum converter. Ambient air is sampled at a flow rate of 1 liter per minute.

5.3 Measurement and Modeling of Solar Radiation

Estimates of the spherically integrated solar radiation at specific frequencies are needed for calculation of photolytic rates for use in photochemical modeling of specific ozone episodes.
Two basic objectives are pursued with the combination of aerosol and radiation measurements.

The first objective is to provide the radiation and aerosol information needed to support evaluation, refinement, and testing of radiative transfer models. For this purpose, CE-CERT and others will make simultaneous spectral and broad-band radiation measurements and aerosol related measurements of several types at Mt. Wilson and CE-CERT as listed in Table 2. A complete data set for these purposes is desired for at least a two-day cloud-free period including times of both light and heavy aerosol burden. Ideally the period of complete measurements will include a complete ozone episode of interest for regional photochemical modeling and days with both light and heavy aerosol burden. These measurements will also support an intercomparison of methods for providing inputs for radiative transfer models of a type suitable for calculation of photolytic rates for use in models of tropospheric ozone and aerosols.

The second objective is to support application of regional air quality models of tropospheric ozone formation with better estimates of photolytic rates for an ozone episode of interest. Estimates of photolytic rates are needed throughout the modeling domain in four dimensions. Measurements at CE-CERT and Mt. Wilson include several collocated radiometers (total solar Eppley PSP and total solar Eppley 8-48 as well as Eppley UV) that match radiometers in widespread use throughout southern California in existing meteorological networks. Those networks, stations, and types of radiometers are shown in Table B-1 of Appendix B. The simpler measurements at CE-CERT and Mt. Wilson will be compared with the other measurements to examine their utility for estimation of photolytic rates. Along with aerosol measurements from the Pelican aerosol aircraft and from ground stations, the existing radiometer networks will be used, if feasible, to aid in estimating semi-quantitatively the spatial and temporal trends and differences in photolytic rates across the modeling domain.

Most of the measurements at CE-CERT and Mt. Wilson, including radiometers, nephelometers, aethelometer, and the ATOFMS, will operate continuously through the summer. Some of the radiometers will continuously provide both diffuse and total irradiance by use of automated scanning (Brewer spectral radiometer) and automated shading devices (Yankee multi-filter spectral radiometer) or by duplicate shaded and unshaded instruments (Eppley UV and Eppley 8-48).

Other measurements are labor intensive and will be operated only during limited intensive periods. The NO_2 actinometer will be operated during intensives. It measures the photolytic rate for NO_2

directly and can be used to estimate the spherically integrated radiation at that frequency of interest. Also during intensives the LiCor 1800 spectral radiometer will be manually shaded intermittently to get spectral scans of both diffuse and total irradiance. Estimates of broad-band and spectrally resolved radiance and irradiance, modeled based on the observed aerosols, will be compared with observations.

To test the instrument set up and provide initial data for evaluation of a radiative transfer model, a radiation intensive was conducted from June 29 to July 5; this was not an ozone IOP. Aerosol (single particle chemistry and size) and solar ultraviolet radiation data were simultaneously collected at Mount Wilson (elev. 1725m) and at CE-CERT (elev. 285m), U.C. Riverside. A wide variety of particle types were observed including clean "background" air, typical urban aerosols, smoke from a 2,200 acre wildfire in the San Gabriel Canyon, and Fourth of July fireworks.

To examine spatial differences in aerosols, Dr. Kim Prather operated the two portable ATOFMS, one at Mount Wilson and one at CE-CERT, as well as the ATOFMS at Pierce Hall, U.C. Riverside, that will be operated all summer and fall. CE-CERT operated the Brewer and LiCor radiometers and the NO_2 actinometer at CE-CERT. To independently assess the effect of aerosol, CE-CERT collocated radiometers with the ATOFMS, nephelometer, and MAPLE scattering aethelometer. In the same area CE-CERT replicated the Eppley solar and broad-band ultraviolet radiation network measurements to determine whether or not data from "routine" solar or ultraviolet radiation monitoring (e.g., PAMS sites) can provide spatial resolution of photolytic rates throughout the basin. The CE-CERT radiometers were operated both shaded and unshaded to get the diffuse/total ratio. Supporting solar radiometry and aerosol monitoring were also conducted at Mount Wilson to evaluate UV radiation and aerosol conditions above the mixed layer and to provide a baseline for estimating mixed layer UV attenuation.

During this initial period there were some problems with the siting of radiometers at Mt. Wilson and with operation of the Brewer, which are being remedied. Evaluation of this data and comparison with a radiative transfer model will be completed in early August and any changes in instrument set up will be completed and evaluated by mid August.

Intensive periods for radiation measurements will include any ozone intensives during the August 18 to September 12 period when the aerosol aircraft is scheduled for operation. As part of the primary (spiral-and-traverse) flight path the aircraft will provide essential information for radiation model inputs -- vertical profiles of aerosol size and concentration -- by making spirals near CE-CERT and Mt. Wilson once per flight (two times per day). The ground-based ATOFMS, aethelometer and nephelometers will provide continuous information on the aerosol burden and properties.

Table 2 SCOS97-NARSTO Radiation Instrumentation

	CE-CERT					
CE-CERT	Comparison	First Intensive	Second Intensive		Data	
	Study	6/29-7/5	IOPs	Routine	Collection	Comments
NO_2 Actinometer	1/hr	1/hr	1/hr			CE-CERT to provide
Brewer radiometer	continuous	continuous	continuous	continuous	PC/modem	On-site, running, limited data (prg problems)
Eppley UV	continuous(2)	continuous(2)	continuous	continuous	Campbell	Fresh calibration
Eppley UV (shadow band)			continuous	continuous	Campbell	On-Site
Eppley PSP (solar)	continuous	continuous	continuous	continuous	Campbell	Fresh calibration
Eppley (8-48 solar)	continuous(2)		continuous			
Eppley (8-48 solar with shadow band)	continuous(2)		continuous			
Licor (shaded/ unshaded)	1 spectra/hr	1spectra/hr	1 spectra/hr		PC	CTC
Multi-wavelength UV YANKEE Radiometer	continuous	continuous	continuous	continuous	Campbell	CSU, NREL
Aethelometer UV	continuous	continuous	continuous	continuous	Campbell	Lease from factory
PM 2.5 Collection	12 hour	12 hour	12 hour			CE-CERT; 47mm QAP
Portable ATOFMS	continuous	continuous				CE-CERT Kim Prather
ATOFMS**	continuous	continuous	continuous	continuous		Pierce Hall Kim Prather
MRI 1590 Integrating Nephelometer	continuous	continuous	continuous	continuous	Campbell	On-site
Video Camera	1/hr	1/hr	1/hr			CE-CERT to provide
Mt. Wilson						
Brewer radiometer	continuous	continuous	continuous	continuous	PC/Modem	Replaced
Eppley UV	continuous	continuous(2)	continuous	continuous	Campbell	
Eppley UV (shadow band)	continuous	continuous	continuous	continuous	Campbell	
Eppley PSP (solar)	continuous	continuous	continuous	continuous	Campbell	
Eppley (8-48 solar)			continuous			
Eppley (8-48 solar with shadow band)			continuous			
Multi-wavelength UV Yankee radiometer	continuous	continuous	continuous	continuous	Campbell	CSU, NREL
Portable ATOFMS	continuous	continuous				
NGN Nephelometer			continuous	continuous		
Video Camera	3/day?	3/day?	3/day?	3/day?	www	Currently operating?
COH/Paper Tape Sampler	continuous	continuous	continuous	continuous	Campbell?	ARB Lamp out
Ozone	continuous	continuous	continuous	continuous	Campbell	

** Pierce Hall/UCR about 2 miles southeast of CE-CERT

5.4 Aircraft Sampling to Determine Atmospheric Concentrations and Size Distributions of Particulate Matter and Other Pollutants

Between August 22 and September 12, the California Institute of Technology (Caltech) will obtain aircraft measurements of the concentrations and size distributions of particulate matter and its constituent chemical species. The Pelican aircraft is operated by the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS), a consortium of the Office of Naval Research (ONR), the Naval Postgraduate School (NPS), the California Institute of Technology (Caltech), and Princeton University. The CIRPAS will use the Pelican aircraft for low-altitude atmospheric observation. The Pelican is a modified Cessna 337 Skymaster that has been reconfigured as a single engine pusher to allow sampling of unperturbed air from over 70 percent of the aircraft and for a better field of view from the nose. With a standard payload of 330 lbs (150 kg) in an unobstructed nose cone, the Pelican can currently be operated in conventional on-board pilot mode. Wing hard points have been added to provide mounting pads for externally mounted payload pods or probes. Missions of approximately eight hours can be flown with on-board pilots flying over high population areas. During missions, real-time ground station access to scientific data and flight information from the Pelican will be available via satellite data link. The airplane has a 43 ft wingspan and is 37 ft in length. The aircraft will be housed at El Monte Airport in a hanger leased by Caltech.

The Pelican was designed to have the following capabilities:

- Optional piloting, i.e., conventional or as a remotely piloted aircraft (RPA)
- Endurance of up to 24 hours of RPA operations and 8 hours for onboard-piloted missions
- Range of 2500 km
- Mission altitude ranging from 20-4000 m
- Loiter speed as low as 40 m/s
- 150 kg payload for 24-hour missions - 500 kg for 2-hour missions
- Fuselage nose volume of 1 m^3
- Main cabin payload volume (for on-board piloted missions) of 0.33 m^3
- Standard wing mounts for interchangeable pylon-mounted payloads at 50 kg each
- Palletized instrument capability
- Payload power = 1 kW at 28 V
- Satellite interactive communications for over-the-horizon operations

Aerosol size distributions (in the range from 0.005 µm to 10 µm diameter) will be measured by an array of three instruments (RCAD, PCAS-100XP, and FSSP-300) with approximately 1-minute time resolution. PM2.5 particles will be sampled using three parallel sampling trains that will provide samples for determination of PM2.5 mass, inorganic ions (including ammonium, sulfate, nitrate, and chloride), organic and elemental carbon, and trace metal concentrations. Filter sampling for aerosol chemical composition will be performed on a one hour sampling duration. For a typical 8-hr flight mission, this will allow for about 7 to 8 series of filter samples per mission. The aircraft will also be outfitted with instrumentation to monitor vertical distributions of ozone and sulfur dioxide species. Table 3 summarizes the on-board instrumentation that will be available for the SCOS97-NARSTO aerosol program. Of particular importance are measurements of aerosol size distribution, aerosol composition, and ozone concentration.

<u>*Schedule*</u>

Caltech will have the Pelican aircraft committed to the sampling program for a 20-day period between August 22 and September 12, 1997. Caltech will fly missions with a total air time of 100 hours. This maximum scenario would involve one day offshore and 6 days of flying, in coordination with the 6 days of the trajectory study. Caltech/CIRPAS will make additional flights during UV radiation/ozone IOPs. Realistically, the aircraft sampling schedule cannot be planned absolutely ahead of time but it will depend on the meteorological conditions, etc. As we get closer to the actual intensive sampling dates we would plan carefully so that the Pelican would be involved in as many of the intensive days as possible.

Flight Plans

We have designed three flight plans: one offshore of Santa Monica and two inland -- one to characterize the evolution and spatial distribution of aerosol size and concentration between coast and the eastern basin, and one to investigate nitrate dynamics between Diamond Bar and Riverside.

Offshore

An over ocean flight plan was designed to determine “unperturbed” marine aerosols and the offshore aerosol gradients. This flight plan includes take off from El Monte airport and a traverse to Seal Beach where a spiral would be made. Additional spirals are planned near Catalina Island, San Nicolas Island, San Miguel Island, Anacapa Island, and Malibu. Where possible, spirals are near the surface monitoring, ozonesonde, or radar wind profiler sites. Dolphin flight patterns would be performed between spiral locations offshore, where the aircraft can fly low and where the horizontal pollutant gradients are not large. This has the advantage of covering large areas while still getting vertical characterization.

This flight plan is designed to make use of the continuous size and concentration measurements, and will not include filter measurements because of on-board space limitations created by the need to carry a life raft for emergency water landings.

This offshore flight plan will take about 5 hours, with an estimated time of departure of about 12:00 Pacific Daylight Time. Only one offshore flight will be made and it will be scheduled the day before an inland two-day aerosol intensive monitoring period. The flight plan for sampling marine aerosols is given in Table 4.

Inland

Due to differences in the time resolutions of continuous and filter-based measurements, the Pelican will fly two basic types of paths with different sampling objectives. The primary flight path is designed to characterize the three-dimensional aerosol distribution and flow conditions in the South Coast Air Basin (SoCAB), and to observe the evolution of the aerosol size and concentration as air is advected from the Pacific coast through the emissions-rich source region (Los Angeles coastal plain) and on to the receptor region represented by the eastern basin site at U.C. Riverside. This flight path consisting of spirals and traverses is detailed in Table 5. It is designed to make use of continuous size and concentration measurements, but will not be useful for filter measurements that require a one-hour sample. A typical flight will take 4 hours, but at least another hour or more of pre- and post-flight pilot time is needed for each flight. Typically, two flights per day will be performed, with the morning flight starting at about 06:00 Pacific Daylight Time (PDT) and the afternoon flight starting at about 13:00 PDT.

A secondary flight path to investigate nitrate dynamics will track urban aerosols from Diamond Bar through the ammonia source area in the Chino dairy district and on to sample the nitrate-rich aerosol found at Riverside. This path includes traverses and constant altitude orbits to match the one-hour sampling time for filter-based sampling that provides information on chemistry. Table 6 describes this nitrate-oriented flight path.

The spirals are proposed at locations where the Pelican aircraft can safely approach the ground, as close as possible to the intensive ground-level aerosol monitoring sites. Also, during intensive operational periods (IOPs) of SCOS97-NARSTO ozone program, the STI and UCD aircraft will make measurements of VOC, NO, NO_x, NO_y, ozone, sulfur dioxide, particle light scattering, solar radiation, and meteorological parameters not only in the Pelican aircraft flight area, but broader area of southern California as well. Flight plans of multiple aircraft are recommended to have overlapping segments at least once per day to allow intercomparisons between the systems. Thus, the Pelican flight plans are designed to sample near supporting or complementary measurement sites and to allow intercomparisons with measurements from surface stations or other aircraft.

Current plans call for the Pelican to take off from El Monte Airport to make an upward spiral then traverse to northern Santa Monica Bay where a downward spiral would be made just offshore. Please note that El Monte Airport class B airspace limitations will likely change in the near future; flight plans will be adjusted as needed. Also, we recommend pre-flight consultation with appropriate controllers at the Santa Monica tower, Ontario tower, Brackett tower, etc. to be coordinated with Jerry Anderson of STI. Additional spirals are scheduled near Altadena, Azusa, Cable Airport, Rialto Airport, Riverside Municipal Airport, Chino Airport, Fullerton Airport, and Seal Beach. To document the horizontal gradients to the extent practical, traverses between spiral locations should be at a constant (FAA minimum allowable) altitude as much as possible. The beginning and end points for the constant altitude portion of each traverse should be at clearly defined locations. Aircraft altitudes during some traverses may change in a consistent manner to get in position for the next spiral.

Spirals are used to document vertical pollutant gradients. In a spiral the aircraft climbs or descends in a turn with about a 2 km diameter, tracing a helix, at a rate of about 150 m/min (500 ft/min). Spirals should begin or end as near ground level as safety and FAA regulations allow. A flight plan for sampling environment I (3-D aerosol characterization) is given in Table 5.

The spiral near Altadena should begin near 1,000' above ground level to an altitude of about 7,000' -- well above the altitude of the Mt. Wilson observatory (5,791'). The upper levels of this spiral will be used to assess the aerosol load above the height of the solar radiation observations at Mt. Wilson. The lower levels of the Altadena spiral will allow a comparison with the observations from the spiral near Azusa. Additional ground-level radiation measurements will be made at U.C. Riverside (CE-CERT) and at Mt. Wilson during an August ozone and radiation IOP. Measurements are intended primarily to provide a data set suitable for evaluation of a radiative transfer model.

During flights that occur during IOPs for ozone episodes, the Pelican will spiral around the ozone lidar based at El Monte Airport at the start and end of the flight. This will intercompare the ozone and aerosol extinction measurements from both sampling platforms.

An orbit is a circular or elliptical path flown at a constant altitude above a fixed point on the ground. For the nitrate-oriented study (sampling environment II), orbits are planned during a two-day episode of ground-level sampling. Three sites -- Diamond Bar, Mira Loma, and U.C. Riverside -- have been selected in the SoCAB to examine the formation of fine nitrate particles.

For the nitrate study filter-based measurements are more important and this will require a sample duration of one hour, the aircraft would take off from El Monte Airport and make an upward spiral before traversing to Diamond Bar, Mira Loma, and U.C. Riverside. The Pelican aircraft would orbit at constant altitude above each of these locations to provide sufficient sample time for collection of integrated samples for chemical analyses. It would require 12 orbits over the same path with an orbit diameter of 5 km using the Pelican aircraft with an airspeed of 50 m/s. Altitudes for individual orbits should be between 300 to 350 m above ground level (1000 - 1200 ft above ground level). Please note that the flight starting time of 12:00 PDT is selected in order to coincide with Caltech (Dr. Cass's group) ground-level impactor sampling times.

The return traverse from Riverside to the El Monte Airport should be at a constant (FAA minimum) altitude as much as possible. The purpose of the indirect return path is to measure near surface aerosol concentrations over a greater area of the South Coast Air Basin, and especially to check transport along the Santa Ana river, which parallels the other major transport path between the Pacific ocean and Riverside . The general path suggested is from Riverside to Anaheim to offshore of Huntington Beach, then to Seal Beach, then inland northward back to the El Monte Airport, spiral down and land. For the spiral, orbit, and traverse flight paths, a typical flight path will take about 8 hours, allowing one flight per day. A flight plan for sampling environment II (nitrate-oriented study) is given in Table 6.

Table 3 details the Pelican aircraft instrumentation.
Table 4 details marine aerosols sampling flight plan.
Table 5 details a typical flight plan for sampling environment I (3-D aerosol characterization).
Table 6 details a typical flight plan for sampling environment II (nitrate-oriented study).

Table 3. Instrumentation on Caltech Pelican.

Parameter	Manufacturer	Model	Technique	Measurement Range	Resolution
Navigation	Trimble Navigation	TRANS Vector	GPS		
Altitude	Rockwell		radar altimeter		
Aerosol size distributions	Caltech	Radially Classified Aerosol Detector (RCAD)	Radial Differential Mobility Analyzer	0.005 to 0.15 μm	45 channels; 1 min
Aerosol size distributions	Particle Measuring Systems	Passive Cavity Aerosol Spectrometer PCASP-100X	Spectrometer	0.1 to 3.0 μm	15 channels; 1 sec
Cloud droplet size distributions	Particle Measuring Systems	Forward Scattering Spectrometer Probe FSSP-100	Forward Scattering Spectrometer	0.5 to 47.0 μm	15 channels; 1 sec
Cloud droplet size distributions	Particle Measuring Systems	OAP-260X	Spectrometer	21 to 260 μm	
Cloud droplet effective radius and liquid water content		PVM 100			
Residual particles from evaporated cloud droplets $\leq$ 7 μm	Stockholm University	Counter-flow Virtual Impacter (CVI)			
Aerosol light scattering between 7^O and 170^O at 450, 550, and 700 nm	TSI	multi-wavelength integrating nephelometer			
	NASA Ames	sun photometer			
Dimethyl sulfide, carbonyls sulfide, and SO_2	RVM Scientific		automated gas chromatography		
Ozone	Dasibi	1008-AH	u.v. photometry		
sulfate, nitrate, ammonium, chloride ions; metals; organic carbon, elemental carbon				2-hour sample	0.2 $\mu g/m^3$ for sulfate, nitrate, and ammonium ions; 0.7 $\mu g/m^3$ for organic C; 0.2 $\mu g/m^3$ for elemental C; 3.0 $\mu g/m^3$ for total mass
Temperature (static)	Rosemont	102			
Pressure (static)	Rosemont	1201			
Pressure (dynamic)	Setra	239			
Dew Point	Edgetech	137-C3	Hygrometer		
Solar radiation	Eppley	PSP; solar filtered w/ Schott Glass WG7		upward and downward; upward	
Ultraviolet radiation	Eppley	UVR		upward	

Table 4. Caltech Pelican aircraft offshore marine aerosol sampling flight path

Flight Activity	**Coordinates Lat-Long-Elve (deg, min; feet)**	**Distance (Miles)**	**Altitude (ft MSL)**	**Delta Time (minutes)**	**True Time**
Take-off from El Monte AP (EMT)	34 05, 118 02, 296				12:00
Traverse from EMT to Seal Beach (SB)	33 43, 118 06; 0	27	sfc - 1500	15	12:15
Spiral down & up			1500-100-5000	14	12:29
SB to N of Catalina Island (CAT)	33 28, 118 29; 0	28	5000-1000-6000		
Spiral down			6000-100	13	13:09
CAT to San Nicolas Island (NIC)	33 13, 119 35; 0	66	100-3000-100-6000	45	13:54
Spiral down			6000-100	13	14:08
NIC to SW of San Miguel Island (SMI)	33 45, 120 35; 0	68	100-3000-100-6000	46	14:54
Spiral down			6000-100	13	15:08
SMI to SW of anacapa Island (ANA)	33 55, 119 30; 0	63	100-3000-100-6000	44	15:52
Spiral down			600-100	13	16:06
ANA to S of Malibu	34 02, 118 35; 0	53	100-4000-100-4000	40	16:46
Spiral down			4000-100	8	16:55
Malibu to El Monte AP	34 05, 118 02, 296	32	100-1500-sfc	18	17:14

Note: Vertical rates of 500 ft/min or less are desired.

Table 5. Caltech Pelican aircraft typical flight plan for sampling environment I. Airspeed 100 mph (~50 m/sec)

Flight activity	Coordinates Elevation (ft)	Distances (miles)	Altitude (ft MSL)	Delta time (minutes)	True time
Pre-flight preparation				10	06:00 a.m.
Take-off from El Monte AP	296				06:10
Upward spiral at El Monte AP			sfc - 5000	10	06:20
El Monte AP to N. Santa Monica Bay	0	30	5000-4000-2500	18	06:38
Spiral down at Santa Monica Bay			4000 - 100	8	06:46
N.Santa Monica to Altadena area	1200	30	100-2000-2500	18	07:04
Spiral up at Altadena area			2500 - 7000	10	07:14
Altadena to Mt. Wilson	5,791	5	7000	3	07:17
Mt. Wilson to Azusa	610	10	7000	6	07:23
Spiral down at Azusa			7000 - 1750	11	07:34
Azusa to Cable AP	1450	13	1750-2500-sfc	12	07:46
Spiral up at Cable AP			sfc - 7000	11	07:57
Cable AP to Rialto AP	1438	20	7000	12	08:09
Spiral down at Rialto AP			7000 - sfc	11	08:20
Rialto AP to Riverside AP	764	13	sfc - 7000	12	08:32
Spiral down at Riverside AP			7000 - sfc	13	08:45
Riverside AP to Chino AP	650	15	sfc - 7000	13	08:58
Spiral down at Chino AP			7000 - sfc	13	09:11
Chino AP to Fullerton AP	96	15	sfc - 5000	10	09:21
Spiral down at Fullerton AP			5000 - sfc	10	09:31
Fullerton AP to Seal Beach	0	15	sfc - 5000	10	09:41
Spiral down at Sea Beach			5000 - 1500	7	09:48
Seal Beach to El Monte AP	296	25	500-1500-5000	20	10:08
Spiral down, land at El Monte AP, and aircraft shut down Repeat flight at 1300 PDT	296		5000 - sfc	20	10:28

Note: Vertical rates of 500 ft/min or less are desired.
Underline indicates preferred altitude for constant altitude portion of traverse.

Table 6. Caltech Pelican aircraft typical flight plan for sampling environment II
Airspeed 100 mph (~ 50 m/sec)

Flight activity	**Coordinates Elevation (ft)**	**Distances (miles)**	**Altitude (ft MSL)**	**Delta time (minutes)**	**True time**
Pre-flight preparation				10	12:00 p.m.
Take-off from El Monte AP	296				12:10
Upward spiral at El Monte AP			sfc - 5000	10	12:20
El Monte AP to Diamond Bar	1000	15	5000 - 2000	9	12:29
Orbit at Diamond Bar			2000	60	13:29
Diamond Bar to Mira Loma	750	20	2000	12	13:41
Orbit at Mira Loma			2000	60	14:41
Mira Loma to U.C. Riverside	1080	8	2000	5	14:46
Orbit at U.C. Riverside			2000	60	15:46
U.C. Riverside to El Monte AP through Anaheim and Seal Beach	296	75	2000-1500-5000	50	16:36
Spiral down, land at El Monte AP, and aircraft shut down	296		5000 - sfc	20	16:56

Note: Vertical rates of 500 ft/min or less are desired.
Underline indicates preferred altitude for constant altitude portion of traverse.

5.5 Tunnel Study

Monitoring at Caldecott Tunnel east of Oakland to develop organic aerosol “signatures” for light-duty gasoline vehicles (LDGV) and heavy-duty diesel vehicles (HDDV). Four days of sampling will occur in late October or early November 1997. Six-hour samples will be collected in the center bore (dominated by light-duty vehicles) and in a side bore (dominated by heavy-duty vehicles). Data on the gas-phase precursors (i.e., CO, CO_2, speciated hydrocarbons, speciated carbonyls) and fleet characteristics (i.e., count, model year, manufacture) will also be collected.

Deborah Gross of U.C. Riverside and Jonathan Allen of Caltech have reconnoitered the Caldecott Fan House sampling site. Provided access and power supply by Caltrans, the site will work well. Rob Harley or his students will help to make arrangements with Caltrans. Debbie Niemeier (U.C. Davis) will collect traffic information, and Rei Rassmussen (CO2, C1-C12 hydrocarbons), Kochy Fung (C1-C7 carbonyls, and Barbara Zielinska (semi-volatiles) will conduct VOC analysis.

This information will then be applied to SCOS97-NARSTO aerosol sample data collected in the SoCAB to attempt a chemical mass balance (CMB) estimate of each vehicle class’ contribution to ambient carbonaceous PM2.5 at multiple sites.

6.0 PARTICULATE MATTER RELATED-MEASUREMENTS

The intensive aerosol and radiation studies will be conducted at ten sites in southern California: i.e., Los Angeles North-Main, Mount Wilson, Azusa (2 sites), Diamond Bar, Mira Loma (in Chino area, 2 sites), and 3 sites at U.C. Riverside (CE-CERT, Pierce Hall, and Ag Operations) during two sampling schedules, August 18 through August 29, and September 2 through September 14. Table 7 provides information on site locations. Field readiness status for the SCOS97- NARSTO aerosol program is available on http:\\www.agmd.gov/SCOS97/.

Table 7

Site ID	Data Source & Site name	Site Number	Latitude DD	MM	SS		Longitude DD	MM	SS		Elevation (m)
MWS	NWS Mount Wilson		34.00	13.0	30.00	34.23	118.00	3.00	0.00	118.05	1725
AZSA	SCAQMD*AZUSA-803 N Loren Ave	60370002	34.00	8.00	9.00	34.14	117.00	55.00	22.00	117.92	183
AZSP	SCOS97 Aerosol 780 North Todd		34.00	8.00	9.00	34.14	117.00	55.00	22.00	117.92	183
DBAR	SCAQMD*Diamond Bar-21865 E COPLEY	60370206	33.00	57.0	28.00	33.96	117.00	50.00	31.00	117.84	300
LANM	SCAQMD*Los Angeles-1630 N MAIN ST	60371193	34.00	4.00	1.00	34.07	118.00	14.00	31.00	118.24	87
CHIN	Jurupa Valley School 10551 Bellegrave Ave	5212	34.00	0.12	0.00	34.00	117.00	31.35	0.00	117.52	225
CHIM	Mira Loma - Union Pacific 4500 Eliwanda		34.00	0.12	0.00	34.00	117.00	31.35	0.00	117.52	225
RICH	CHS U.C. Riverside Ag Operations	4162	33.00	57.7	0.00	33.96	117.00	19.90	0.00	117.33	314
RIPH	U.C. Riverside Pierce Hall		33.97	0.00	0.00	33.97	117.32	0.00	0.00	117.32	324
RICE	U.C. Riverside CE-CERT		33.99	0.00	0.00	33.99	117.34	0.00	0.00	117.34	285

The following summarizes the information on particulate matter related-monitoring at selected sites in southern California during the SCOS97-NARSTO aerosol program. Additional information on routine particulate and radiation monitoring and analysis method are in Appendix B.

Riverside-UCR (three sites: Ag Operations, CE-CERT, and Pierce Hall)

Ag Operations

- PM10-TEOM, continuous, two collocated - SCAQMD
- Ozone, continuous - SCAQMD
- NOx, continuous - SCAQMD
- CO, continuous - SCAQMD
- HNO3, HCL, HCOOH, CH3COOH, PM2.5(mass, NH4+, CL-, NO3-, SO4=), two-week integrated sampler, Children's Health Study/ARB
- Real-time nitrate, continuous (8/16-29) - ADI
- PM2.5 mass, 24-hour (6 am-6 am), R&P FRM Prototype - BYU
- PM2.5 and PM10 mass, 24hr (6 am), Harvard impactor - HSPH
- HNO3, HNO2, NH3, SO2, strong H+, SO4=, NH4+, NO3-, 24hr (6 am), Annular denuder (HEADS) - HSPH
- PM2.5 mass, continuous, CAMMS (filter pressure drop prototype) - HSPH
- PM2.5 mass, continuous, TEOM sandwich Prototype - BYU
- PM2.5 mass, continuous, TEOM with desiccation Prototype - BYU/R&P
- EC, OC, 24hr (6 am), Organic sampler (PC/BOSS, BIG BOSS) - BYU
- EC, OC, 24hr (6 am), Pipe-bomb sampler, with and without gas phase stripper - HSPH
- BC Aethelometer, continuous(5 min) - HSPH
- UV Aethelometer, continuous (5 min), collocated with standard BC Aethelometer - HSPH
- Nephelometer, continuous, unheated Optec with temperature and relative humidity - HSPH/ARS

CE-CERT

- NO_2 Actinometer, 1-hour, during radiation/ozone IOP
- Brewer radiometer, continuous
- Eppley UV, continuous
- Eppley UV (shadow band), continuous
- Eppley PSP (solar), continuous
- Eppley (8-48 solar), continuous
- Eppley (8-48 solar with shadow band), continuous
- Licor (shaded/ unshaded), 1 spectra-hour
- Multi-wavelength UV YANKEE Radiometer, continuous
- Aethelometer UV, continuous, all summer
- 1590 Integrating Nephelometer, continuous
- Video Camera, 1-hour
- PM 2.5 Collection, 12-hour, 47 mm QAP
- Single particle analyzer, portable ATOFMS, only during the first intensive radiation period (6/29-7/5)
- HNO3, NH3, hour intervals (10 am - 7 pm), CE-CERT denuder sampler
- HNO3, continuous, TECO 42CY CE-CERT August 16-September 14

Pierce Hall

- ATOFMS, continuous, all summer - Prof. Prather
- PM2.5 mass, 24-hour, two Federal reference method (FRM), August 18 - September 14
- PM2.5 organic, 5 samples per day, cyclone-filter sampler, 8/18-9/2 - Caltech
- PM2.5 inorganic (mass, trace metals, SO4=, NO3-, NH4+, HNO3, EC, OC), 5 samples per day, cyclone-filter/denude sampler, 8/18-9/2 - Caltech
- PM10 (mass, trace metals, SO4=, NO3-, NH4+, HN3, EC, OC), 5 samples per day, cyclone-filter sampler, 8/18-9/2 - Caltech
- Size-resolved aerosol (mass, ionic species, trace element), 5 samples per day, micro-orifice Impactor (MOI), 8/18-9/2 - Caltech
- Size-resolved aerosol (mass, organic carbon and elemental carbon), 5 samples per day, micro-orifice impactor (MOI), 8/18-9/2 - Caltech
- Particle size/number, continuous, electrical aerosol analyzer (EAA, TSI model 3030), 8/18-9/2 - Caltech
- Particle size/number, continuous, optical particle counter (OPC, model ASASP-X32), 8/18-9/2 - Caltech

Mira Loma (in Chino Basin - two sites)

Union Pacific - Aerosol site September 2-14

- Real time particle nitrate, continuous, ADI
- ATOFMS, continuous, Prof. Prather
- HNO3, NH3, continuous, Long-path Fourier transform infrared spectrometer (FTIR) - CE-CERT
- HNO3, continuous, TECO 42CY - CE-CERT
- PAH, continuous, Prof. Arey
- PM2.5 organic, 5 samples per day, cyclone-filter sampler, - Caltech
- PM2.5 inorganic (mass, trace metals, SO4=, NO3-, NH4+, HNO3, EC, OC), 5 samples per day, cyclone-filter/denude sampler - Caltech
- PM10 (mass, trace metals, SO4=, NO3-, NH4+, HN3, EC, OC), 5 samples per day, cyclone-filter sampler - Caltech
- Size-resolved aerosol (mass, ionic species, trace element), 5 samples per day, micro-orifice Impactor (MOI) - Caltech
- Size-resolved aerosol (mass, organic carbon and elemental carbon), 5 samples per day, micro-orifice impactor (MOI) - Caltech
- Particle size/number, continuous, electrical aerosol analyzer (EAA, TSI model 3030) - Caltech
- Particle size/number, continuous, optical particle counter (OPC, model ASASP-X32) - Caltech

ARB Children's Health Study at the Jurupa Valley School

- Nitric acid, hydrochloric acid, formic acid, and acetic acids: PM2.5 mass and ammonium, chloride nitrate, and sulfate, two-week integrated sampler
- PM10 mass, continuous, TEOM
- Ozone and NO_x, continuous

AZUSA (two sites)

SCOS97 Aerosol site 780 Todd Avenue

- ATOFMS, continuous, ozone IOSs - Prof. Prather
- PM2.5 organic, 5 samples per day, cyclone-filter sampler, 8/18-9/2 - Caltech

- PM2.5 inorganic (mass, trace metals, SO4=, NO3-, NH4+, HNO3, EC, OC), 5 samples per day, cyclone-filter/denude sampler, 8/18-9/2 - Caltech
- PM10 (mass, trace metals, SO4=, NO3-, NH4+, HN3, EC, OC), 5 samples per day, cyclone-filter sampler, 8/18-9/2 - Caltech
- Size-resolved aerosol (mass, ionic species, trace element), 5 samples per day, micro-orifice Impactor (MOI), 8/18-9/2 - Caltech
- Size-resolved aerosol (mass, organic carbon and elemental carbon), 5 samples per day, micro-orifice impactor (MOI), 8/18-9/2 - Caltech
- Particle size/number, continuous, electrical aerosol analyzer (EAA, TSI model 3030), 8/18-9/2- Caltech
- Particle size/number, continuous, optical particle counter (OPC, model ASASP-X32), 8/18-9/2 - Caltech

<u>SCAQMD site 803 N-Loren</u>

- PM2.5 mass, 24-hour, two Federal reference method (FRM), August 18 - September 14
- Ammonia and nitric acid, continuous, Tunable Diode laser Absorption Spectrometer (TDLAS) CE-CERT
- Ammonia and nitric acid, three hour intervals (10 am - 7 pm) denuder sampler - CE-CERT
- Nitric Acid, continuous, TECO 42CY - CE-CERT
- PM10 mass, continuous, Beta Attenuation Monitor (BAM) sampler
- PM10 mass, sulfate, nitrate, and chloride, 24-hour average every sixth day, High Volume Size Selective Inlet (SSI) sampler
- PM2.5 and PM10 mass, and elemental, 24-hour average data every sixth day, Dichotomous sampler
- PM2.5 mass, nitrate, ammonium, sulfate, chloride, sodium, magnesium, calcium, and potassium 24-hour average every sixth day, California Acid Deposition Monitoring Program (CADMP)
- Total Suspended Particulate Matter (TSP): mass, sulfate, and nitrate, 24-hour average every sixth day, High Volume sampler without the size selective inlet
- Coefficient of Haze, 2-hour average continuous, AISI Tape sampler
- Light Scattering Coefficient, nephelometer

Diamond Bar 21865 E Copley

- PM2.5 mass, 24-hour, two Federal reference method (FRM), August 18 - September 14
- PM2.5 organic, 5 samples per day, cyclone-filter sampler - Caltech (9/2-9/12)
- PM2.5 inorganic (mass, trace metals, SO4=, NO3-, NH4+, HNO3, EC, OC), 5 samples per day, cyclone-filter/denude sampler - Caltech
- PM10 (mass, trace metals, SO4=, NO3-, NH4+, HN3, EC, OC), 5 samples per day, cyclone-filter sampler - Caltech
- Size-resolved aerosol (mass, ionic species, trace element), 5 samples per day, micro-orifice Impactor (MOI) - Caltech
- Size-resolved aerosol (mass, organic carbon and elemental carbon), 5 samples per day, micro-orifice impactor (MOI) - Caltech
- Particle size/number, continuous, electrical aerosol analyzer (EAA, TSI model 3030) - Caltech
- Particle size/number, continuous, optical particle counter (OPC, model ASASP-X32) - Caltech

- PM2.5 and PM10 mass, elemental data, elemental carbon and organic carbon, sulfate, nitrate, chloride, ammonium, potassium, ammonia, nitric acid, 24-hour average every sixth day, PTEP instrument

Central Los Angeles - 1630 North Main

- ATOFMS for IOPs.
- PM2.5 organic, 5 samples per day, cyclone-filter sampler, 8/18-9/2, - Caltech
- PM2.5 inorganic (mass, trace metals, SO4=, NO3-, NH4+, HNO3, EC, OC), 5 samples per day, cyclone-filter/denude sampler, 8/18-9/2 - Caltech
- PM10 (mass, trace metals, SO4=, NO3-, NH4+, HN3, EC, OC), 5 samples per day, cyclone-filter sampler, 8/18-9/2 - Caltech
- Size-resolved aerosol (mass, ionic species, trace element), 5 samples per day, micro-orifice Impactor (MOI), 8/18-9/2 - Caltech
- Size-resolved aerosol (mass, organic carbon and elemental carbon), 5 samples per day, micro-orifice impactor (MOI), 8/18-9/2 - Caltech
- Particle size/number, continuous, electrical aerosol analyzer (EAA, TSI model 3030), 8/18-9/2- Caltech
- Particle size/number, continuous, optical particle counter (OPC, model ASASP-X32), 8/18-9/2 - Caltech
- PM10 mass, continuous, TEOM sampler
- PM10 mass, sulfate, nitrate, and chloride, 24-hour average every sixth day, High Volume Size Selective Inlet (SSI) sampler
- PM2.5 mass, nitrate, ammonium, sulfate, chloride, sodium, magnesium, calcium, and potassium 24-hour average every sixth day, California Acid Deposition Monitoring Program (CADMP)
- Total Suspended Particulate Matter (TSP): mass, sulfate, and nitrate, 24-hour average every sixth day, High Volume sampler without the size selective inlet

7.0 SITE OPERATIONS

As of August 18, 1997, the monitoring site arrangements are as follows (in alphabetic order):
Ag Ops (U.C. Riverside) - ADI, BYU, HSPS have all set up in existing shelters at the site. Site setup has been coordinated by Dennis Fitz at CE-CERT and Roger Atkinson at SAPRC.

Azusa - For the general urban trajectory experiment (August 18-29) ATOFMS and Caltech equipment have been housed in a mobile lab belonging to SCAQMD (AKA the "meat wagon") and located at the secondary site (a commercial lot one street west from the Azusa SCAQMD site, 780 Todd Avenue). Site setup is being coordinated by Rudy Eden at SCAQMD. A security guard is available for evening and night hours (5 pm to 8 am)

Diamond Bar - The "meat wagon" will be relocated to SCAQMD headquarters at Diamond Bar for the nitrate trajectory experiments (September 2-14). Site setup has been coordinated by Rudy Eden. SCAQMD security will have surveillance camera, make periodic checks, and be instructed to identify and clear any persons approaching “meatwagon” outside normal working hours.

Los Angeles North Main - For the general urban trajectory experiment (August 18-29), ATOFMS and Caltech’s equipment have been housed at the SCAQMD site. There is also adequate space and power for SAPRC (Arey) to collect VOC samples. Site setup has been coordinated by Rudy Eden at SCAQMD.

Mira Loma - For nitrate-oriented study (September 2-14), Mira Loma secondary site (4500 Etiwanda Avenue) will house Caltech and UCR as well as CE-CERT (continuous nitric acid), SAPRC (continuous ammonia), and ADI (continuous nitrate) in a trailer being readied at SAPRC. Trailer will be located at the Union Pacific railroad new car distribution facility at Mira Loma, approximately half a kilometer north of the Mira Loma Children's Health Study site at Jurupa Valley High School; measurements O_3 and NOx are being made at the latter site. Site setup is being coordinated by Dennis Fitz at CE-CERT and Deborah Gross of U.C. Riverside Chemistry department. All investigators should submit names and affiliation to U.P. site security through Tony VanCuren of ARB.

Tables C-1 and C-2 of Appendix C summarize space and electrical power requirements for the aerosol samplers that will be used during the SCOS97-NARSTO aerosol program.

8.0 FORECAST AND DECISION PROTOCOL

In general the highest fine particle mass concentrations occur during the cooler months of the year, not in the middle of the summer photochemical smog season in the SoCAB. Typical meteorological characteristics of a high PM10 day in the SoCAB include: a well developed upper-level ridge of high pressure, strong elevated subsidence inversions, low level stratus and fog, and a nearly neutral surface and boundary layer wind field.

The trajectory study and aircraft measurements will rely on forecasts from the SCAQMD for selecting the best two days of each week for intensive sampling. This will be done by consultation among Professors Glen Cass and John Seinfeld of Caltech, Joe Cassmassi of SCAQMD, professor Kim Prather of U.C. Riverside, Dr Susanne Hering of ADI, and ARB staff each Friday, and will reconfirm each successive day until sampling begins. The intensive sampling will not begin for at least 33 hours after the announcement via phone recording or after completion of a 48-hour intensive sampling period. The decisions will be posted on the phone machine at (909) 396-3786. The decision protocol and communication procedures will be discussed in a separate field study protocol document

9.0 QUALITY ASSURANCE PROCEDURES

Crucial to attaining the objectives of the SCOS97-NARSTO aerosol monitoring project is the implementation of a strong external quality assurance (QA) program designed to ensure the collection of data of known accuracy, precision, and validity through independent system and performance audits. The QA manager and the QA team are responsible for developing efficient methods for quantifying the accuracy, precision, and validity of air quality and meteorological data in the SCOS97-NARSTO aerosol data archive, and to ensure that the measurement methods and the quality control (QC) procedures implemented by the contractors will meet the pre-designed data quality objectives. The data collection goal of the methods developed by the QA team is that at least 90 percent of the field measurements would meet the accuracy, precision, and validity requirements for SCOS97-NARSTO aerosol modeling and data analysis.

Quality assurance personnel from the ARB, South Coast Air Quality Management District, and desert Research Institute will conduct system and performance audits of surface air quality and meteorological measurements. These efforts will be directed by Ms. Alice Westerinen for the ARB, Mr. Bill Bope for the SCAQMD, and Dr. Fred Rogers of DRI. The following is a summary of the field performance audits to be conducted during the field study.

Field system and performance audits should be performed at monitoring sites at the onset of the measurement program. Results of QA audits may indicate deficiencies in a measurement process. One goal of the QA plan is the rapid resolution (within 48 hours) of any such deficiencies in order to reduce data uncertainty and/or the amount of data loss. Thus, special measures should be taken for processing and reporting field audit results quickly. All initial audits should be performed as soon as possible and no later than within a few weeks of the measurement system coming on line. Auditors should process the audit results using portable field computers and download the results to the QA manager via phone lines.

Field System Audits at Surface Monitoring Sites

Prior to the start of the field study, the auditors should obtain all pertinent forms and documents, their latest revisions, and information needed to perform the audits. These forms and documents should include Standard Operating Procedures (SOPs), instrument manuals, logbooks, chain-of-custody records, data sheets, control charts, and maintenance records.

Aerosol Sampler Flow Rate Audits

Desert Research Institute (DRI) staff, Drs. Fred Rogers and John Bowen, will conduct flow rate performance audits for the SCOS97-NARSTO aerosol samplers at U.C. Riverside (AgOps and Pierce Hall) on August 18 and at LA-North Main and Azusa on August 19.

DRI staff have prepared different air flow rate measurement transfer standards for use in this audit. These transfer standards have been calibrated in DRI's Quality Assurance laboratory in Reno. The standards include a bubble-type flow calibrator, and several calibrated orifices covering several flow ranges. These devices have been calibrated against primary standards such as Roots Meters.

In the field, DRI staff will follow the normal flow audit procedure of measuring flows with the sampler in as normal an operational configuration as possible. This requires that the SCOS97-NARSTO investigators set up the sampler with a filter pack or cassette available for the audit. Flows are then checked with the investigator-supplied filter pack or cassette in place, and with the sampler set for nominal flow. All flows should be established by pumps or other devices provided by the investigator, in the same sampler configuration as will be used for the SCOS97-NARSTO study. The investigator should have a corresponding flow measurement device (e.g., rotameter) available for comparison if necessary.

DRI staff will record data both in a notebook, and also on a laptop computer as appropriate, with photos and voice recorder backups detailing the audit.

Meteorological Instrument Audits

Performance audits of wind instruments should be performed by applying synchronous motors with different rotation rates while monitoring the digital acquisition system (DAS) reading, and aligning the wind direction with an angle calibrator. Temperature should be checked against an aspirated thermometer traceable to standards from the National Institute of Standards and Testing (NIST), and an aspirated psychrometer using an NIST-traceable thermometer for relative humidity.

Solar Radiation Instrument Audits
An audit pyranometer should be zeroed and readings should be taken with the audit instrument placed next to the station pyranometer. A comparison should be made between the hourly average readings of the two instruments.

Ozone Analyzer Audits
Ozone audits should be performed using a calibrated ozone transfer standard instrument with the capability to generate at least five standard ozone concentrations and one zero concentration. Readings should be recorded from the analyzer, DAS, and strip chart (where available). A linear regression of measured versus audit results should analyzed to determine linearity of response. The average percent difference between the audit standard and analyzer should be determined.

Nephelometer Audits
Nephelometers and other light-scattering instrumentation should be audited using Freon 134b or Freon 22. Zero air should be introduced into each instrument, followed by audit Freon. Zero and Freon readings should be recorded, and the percent difference between the nominal and measured values should be determined.

All audit results will be entered on QA forms and into an audit computer. Instrument performance will be assessed by comparing the percent differences to EPA criteria as shown in Table 8. The reports will present the expected instrument responses, the actual instrument responses, and their differences. For those instruments that exceed the criteria, the auditor will issue an Air Quality Data Action (AQDA). The site operator will be required to respond to the AQDA by detailing the actions done to correct instrumental problems found during the audit.

Table 8
Audit Criteria-Continuous Gas Analyzer

Quantity	**Measure**	**Excellent**	**Satisfactory**	**Unsatisfactory**
Difference	Percent	0 - ±5	±(5 - 15)	<-15,>15

Audit Criteria - Meteorological Sensors

Sensor	**Satisfactory**
Wind speed	±0.25 m/s for WS ≤ 5.0 m/s ±5% value for WS>5.0 m/s; not to exceed 2.5 m/s
Wind Speed (starting threshold)	<0.5 m/s
Wind Direction	±5 degree relative to True North
Wind Direction (starting threshold)	<0.5 m/s
Temperature	±0.5 ^{o}C
Dew Point	±1.5 ^{o}C
Dew Point (in fog)	±0.5 ^{o}C
Solar Radiation	greater of ±5% or ±25 w/m^2
Pressure	±10 mb (±7.5 mmHg)

1.0 Participants

1.1 Collection of Ambient Audit Samples

(1.)Desert Research Institute (Fred Rogers, 702/677-3178 or John Bowen,702/677-31?? ; Fax – 702/677-3157) mailing address: P.O. Box 60220 Reno, NV 89506 shipping address: 5625 Fox Avenue, Reno, NV 89506

(2).Air Resources Board, Monitoring and Laboratory Division (Alice Westerinen, awesteri@arb.ca.gov, 916/324-6191 Fax – 916/327-8217) 1309 T Street Sacramento, CA 95812.

1.2 Participating Laboratories

(1.)Desert Research Institute (Richard T. Egami, 702/677-3165 or Charles Whitaker,702/677-3186 ; Fax – 702/677-3157) mailing address: P.O. Box 60220 Reno, NV 89506 shipping address: 5625 Fox Avenue, Reno, NV 89506

(2.)UCR (Dr. Kim Prather, prather@citrus.ucr.edu, 909/787-3143 Fax 909/787-4483) Department of Chemistry, University of California, Riverside, CA 92521.

(3.) Caltech (Dr. Glen Cass, glen@eql.caltech.edu, 818/395-6888 Fax 818/395-2940) California Institute of Technology, Pasadena, CA 91125.

(4.) Caltech (Dr. John Sienfeld, john_seinfeld@starbase1.caltech.edu, 818/395-4635 Fax 818/585-1729) California Institute of Technology, Pasadena, CA 91125.

(5.) CE-CERT (Mr. Dennis Fitz, dfitz@helium.ucr.edu, 909/781-5781 Fax 909/781-5790) CE-CERT U.C. Riverside, CA 92521.

(6.)Aerosol Dynamics Inc. (Dr. Susanne Hering, aerosol@dnai.com, 510/649-9360 Fax 510/649-9260) 2329 Fourth Street, Berkeley, CA 94710.

(7.)South Coast Air Quality Management District (Steve Barbosa, sbarbosa@ aqmd.gov, 909/396-2171, Fax 909/396-2175) 21865 E. Copley Dr., Diamond Bar, CA 91765-4182.

2.0 Specific Objectives and Approach

2.1 ARB will review SOPs to identify differences in analytical methods and procedures that may cause differences in the data produced by participating laboratories.

2.2 Determine significant systematic biases. For a valid certification, it is required that the standard differ by less than ± 1.5 percent from past certification values and the slopes and intercept fall within one standard deviation of the equation for last six certifications.

3.0 Management and Communication Protocol.

3.1 Air Resources Board, Monitoring and Laboratory Division will arrange for collection of ambient samples.

3.2 ARB will prepare a summary report for review by participants.

10.0 DATA TRANSFER, MANAGEMENT, AND VALIDATION

Data used for data analysis and modeling in SCOS97-NARSTO derive from measurements made as part of the study as well as from other sources. The execution of the field study plan involves several investigators at different locations, each providing validated measurements that are integrated with those from others. Common communications, data management, and validation conventions are needed to allow this information to be gathered and disseminated in an efficient manner. These conventions will be described in a separate data management document that will be distributed in near future.

11.0 DATA ANALYSIS AND MODELING

One of the major goals of this study is to determine the relative contributions of source sub-categories such as gasoline engine exhaust, diesel exhaust, woodsmoke, food cooking aerosol, road dust, and secondary organic aerosol to fine particle concentrations in the SoCAB. To meet this goal, Dr. Glen Cass of Caltech will calculate source contributions to the fine organic aerosol concentrations and to overall primary fine particle mass concentrations at the three sampling sites for the four two-day episodes which are the focus of this study. Source apportionment of fine organic aerosol and fine aerosol mass concentration will be achieved by applying a chemical mass balance model based on molecular markers that relates source contributions to airborne fine particle mass concentrations. Source emission profiles compiled by Caltech for auto exhaust, food cooking, natural gas combustion, tire dust, brake dust, and other source types will be used to calculate source contributions to the fine particle mixture in the SoCAB.

Dr. Robert Harley of University of California, Berkeley will review the state of the science in radiative transfer modeling in support of photolysis calculations for photochemical models, will develop an improved photolysis module and appropriate procedures for developing inputs from routinely available monitoring data, and will evaluate the photolysis module performance against observations from spectral radiometers and an NO_2 actinometer. In two ultraviolet radiation experiments, measurements are intended primarily for providing a data set suitable for evaluation of a radiative transfer model that would be suitable for estimating the actinic flux for calculation of photolytic rates for use in modeling the formation of tropospheric ozone. Secondarily, additional measurements will test the feasibility of estimation of actinic flux and photolytic rates (temporally and spatially resolved) throughout the SCOS97-NARSTO modeling domain in support of photochemical modeling using existing and enhanced radiation observations.

The ambient data collected in this study will provide the basis for subsequent work to develop, evaluate, and improve air quality airshed models which simulate the chemical and physical transformations that occur as particles age and travel in the atmosphere.

12.0 SCOS97-NARSTO DATA EXCHANGE AGREEMENT

1997 SOUTHERN CALIFORNIA OZONE STUDY-NARSTO
DATA EXCHANGE AGREEMENT
MAY 14, 1997

The purpose of the SCOS97-NARSTO Data Exchange Agreement is to ensure timely and complete availability of the data collected as part of the study and proper attribution of data used in analyses, model applications, and publications.

1. The data collected will eventually be available to the public and the scientific community. Before final publication, however, the data will be made available to the SCOS97-NARSTO participants (i.e, sponsors, contractors, other measurement groups). It is expected that each participant will submit non-Aerometric Information Retrieval System (AIRS) data to the Data Manager within six months of the end of the field campaign. Speciated hydrocarbon and particle data may take up to six months longer. Data should be submitted in the specified format and should be reviewed and validated by the participant prior to submission. Participants will keep the sampling and processing documentation for their own data for five years after the field campaign.

2. All data in the SCOS97-NARSTO data archive will be available to any participant on request. No participant should publish analyses or data sets which include data of other participants unless they have the permission of the other participants who provided the data or the data have been released to the public. Participants may distribute or publish their own data at any time subject to the conditions in 4, below.

3. The sources of data should be cited whenever data are used in publications. If a substantial amount of data from other participants is used, that participant should be given the option of being included as a co-author on resulting publications.

4. Prior to submission for presentation or publication, manuscripts resulting from SCOS97-NARSTO should be submitted to the relevant measurement groups and to the Air Resources Board for distribution to all SCOS97-NARSTO sponsors for comment. Each measurement group and sponsor will have 30 days from receipt of the manuscript to submit their comments to the senior author. The authors should give sincere consideration to all comments. If the comments are not incorporated into the manuscript, the commentator may submit their remarks separately to the journal to which the original manuscript will be submitted.

We agree to abide by the principles of the SCOS97-NARSTO Data Exchange Agreement.

SIGNATURE DATE

NAME

TITLE

ORGANIZATION

APPENDICES

Appendix A
List of Sponsors and Measurement Groups

1997 Southern California Ozone Study-NARSTO
Aerosol Distribution List Organized by Sponsors and Participants
Name, Organization, Phone Number, Fax Number, and E-Mail Address

Aerosol Dynamics Inc.				
Dr. Susanne V. Hering	ADI	(510) 649-9360	(510) 649-9260	aerosol@dnai.com
Air Resources Board-Monitoring and Laboratory Division				
Mr. Curtis Schreiber	ARB-MLD	(626) 575-6856	(626) 350-6468	?? cschreib@arb.ca.gov
Ms. Thelma Yoosephiance	ARB-MLD	(626) 575-6991	(626) 350-6468	tyooseph@arb.ca.gov
Air Resources Board-Research Division				
SCOS97-NARSTO Field Manager	ARB-RD	(916) 322-3935	(916) 322-4357	scos-fm@arb.ca.gov
Mr. Bart E. Croes	ARB-RD	(916) 323-1534	(916) 322-4357	bcroes@arb.ca.gov
Dr. Nehzat Motallebi	ARB-RD	(916) 324-1744	(916) 322-4357	nmotalle@arb.ca.gov
Mr. Jim Pederson	ARB-RD	(916) 322-7221	(916) 322-4357	jrpeders@arb.ca.gov
Mr. Tony VanCuren	ARB-RD	(916) 327-1511	(916) 322-4357	rvancura@arb.ca.gov
Brigham Young University				
Professor Delbert Eatough	BYU	(801) 378-6040	(801) 378-??	delbert_eatough@byu.edu
California Institute of Technology				
Professor Glen R. Cass	CIT	(626) 395-6888	(626) 395-2940	glen@eql.caltech.edu
Professor Richard Flagan	CIT	(626) 395-6095	(626) 585-??	flagan@cheme.caltech.edu
Professor John H. Seinfeld	CIT	(626) 395-4635	(626) 585-1729	john_seinfeld@starbase1.caltech.edu
Dr. Jonathan Allen	CIT	(626) 395-6891	(626) 395-2940	jon@eql.caltech.edu
Ms. Lara Hughes	CIT	(626) 395-3946	(626) 395-2940	lara@cco.caltech.edu
Ms. Andrea Wilson	CIT	(626) 395-6868	(626) 395-2940	andrea@eql.caltech.edu
College of Engineering-Center for Environmental Research and Technology				
Mr. Dennis Fitz	CE-CERT	(909) 781-5781	(909) 781-5790	dfitz@cert.ucr.edu hwhuling@aol.com
Dr. William P. L. Carter	CE-CERT	(909) 781-5797	(909) 781-5790	bill_carter@helium.ucr.edu
Mr. John F. Collins	CE-CERT	(909) 781-5793	(909) 781-5790	jcollins@cert.ucr.edu
Mr. Kurt Bumiller	CE-CERT	(909) 781-5796	(909) 781-5790	kurt.bumiller@ucr.edu
Mr. Michael Boeck	CE-CERT	(909) 781-5722	(909) 781-5790	mjb@helium.ucr.edu
Mr. Michael McClanahan	CE-CERT	(909) 781-5746	(909) 781-5790	michael.mcclanahan@ucr.edu
Dr. Matthew J. Barth	CE-CERT	(909) 781-5782	(909) 781-5790	barth@helium.ucr.edu
Mr. Mitchell Boretz	CE-CERT	(909) 781-5785	(909) 781-5790	mitch@cert.ucr.edu
Dr. Timothy J. Truex	CE-CERT	(909) 781-5721	(909) 781-5790	truex@helium.ucr.edu
Colorado State University				
Dr. James H. Gibson	ColoradoSt	(970) 491-3611	(970) 491-3601	jimg@nrel.colostate.edu
Dr. George Janson	ColoradoSt	(970) 491-3621	(970) 491-3601	georgej@nrel.colostate.edu
Coordinating Research Council				
Mr. Timothy C. Belian	CRC	(770) 396-3400	(770) 396-3404	tbelian@crcao.com
Dr. S. Kent Hoekman	Chevron	(415) 894-3060	(415) 894-2075	skho@chevron.com
Mr. Rory MacArthur	Chevron	(415) 894-3050	(415) 894-2075	rrym@chevron.com
Desert Research Institute				
Dr. Eric M. Fujita	DRI	(702) 677-3311	(702) 677-3316	ericf@sage.dri.edu
Dr. John Watson	DRI	(702) 677-3166	(702) 677-3191	jwatson@sage.dri.edu
Electric Power Research Institute				
Dr. Peter K. Mueller	EPRI	(415) 855-2586	(415) 855-1069	pmueller@epri.com
Ms. Mary Ann Allan	EPRI	(415) 855-2591	(415) 855-1069	mallan@epri.com
Mr. Aaron Bator	EPRI	(415) 855-2721	(415) 855-1069	abator@epri.com
Dr. Pradeep Saxena	EPRI	(415) 855-2591	(415) 855-1069	psaxena@epri.com
Harvard School of Public Health				
Professor Petros Koutrakis	Harvard	(617) 432-1268	(617) 432-0497	petros@hsph.harvard.edu
Mr. George Allen	Harvard	(617) 432-1946	(617) 432-0497	gallen@sparc6a.harvard.edu
Mount Wilson Institute				
Mr. Robert Cadman	Mt. Wilson	(818) 440-9016	??	cadman@mtwilson.edu
National Center for Atmospheric Research				
Dr. Sasha Madronich	NCAR	(303) 497-1430	(303) 497-1400	sasha@ucar.edu

National Oceanic & Atmospheric Administration				
Dr. Clark King	NOAA-RWP	(303) 497-6381	(303) 497-6101	cking@etl.noaa.gov
Portland State University				
Professor Robert J. O'Brien	PortlandSt	(503) 725-4264	(503) 725-3888	baro@odin.cc.pdx.edu
Princeton University				
Professor Lynn Russell	Princeton	(609) 258-1144	(609) 258-0211	lrussell@princeton.edu
Sonoma Technology Inc.				
Dr. Donald L. Blumenthal	STI	(707) 527-9372	(707) 527-9398	don@sonomatech.com
South Coast Air Quality Management District				
Mr. Joe Cassmassi	SCAQMD	(909) 396-3155	(909) 396-3252	jcassmassi@aqmd.gov
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Dr. Xinqiu Zhang	SCAQMD	(909) 396-3158	(909) 396-3252	xzhang@aqmd.gov
Mr. Melvin D. Zeldin	SCAQMD	(909) 396-3058	(909) 396-2099	mzeldin@aqmd.gov
Mr. Rudy Eden	SCAQMD	(909) 396-2391	(909) 396-2099	reden@aqmd.gov
Mr. Steve Barbosa	SCAQMD	(909) 396-2171	(909) 396-2175	sbarbosa@aqmd.gov
Southern California Edison				
Dr. Robert J. Farber	SCE	(626) 302-9693	(626) 302-9730	farber@sce.com
Mr. Stan Marsh	SCE	(626) 302-9711	(626) 302-9730	marsh@sce.com
Dr. Vince Mirabella	SCE	(626) 302-9748	(626) 302-9730	mirabeva@sce.com
Dr. James Young	SCE	(626) 302-9191	(626) 302-9730	young@sce.com
University of California, Berkeley				
Professor Robert A. Harley	UCB	(510) 643-9168	(510) 642-7483	harley@ce.berkeley.edu
University of California, Davis				
Professor Debbie A. Niemeier	UCD	(916) 752-8918	(916) 752-7872	dniemeier@ucdavis.edu
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Mr. Matt J. Korve	UCD	(916) 752-??	(916) 752-7872	mjkorve@ucdavis.edu
University of California, Riverside				
Professor Janet Arey	UCR	(909) 787-3502	(909) 787-5004	arey@mail.ucr.edu
Professor Roger Atkinson	UCR	(909) 787-4191	(909) 787-5004	ratkins@mail.ucr.edu
Dr. Anni Reissell	UCR	(909) 787-4684	(909) 787-5004	reissell@ucrac1.ucr.edu
Ms. Susan V. Inong	UCR	(909) 787-5141	(909) 787-5004	inong@ucrac1.ucr.edu
Professor Kimberly A. Prather	UCR	(909) 787-3143	(909) 787-4713	prather@citrus.ucr.edu
Dr. Eric Gard	UCR	(909) 787-3568	(909) 787-4713	garderic@citrus.ucr.edu
Dr. Deborah Gross	UCR	(909) 787-3568	(909) 787-4713	dgross@galaxy.ucr.edu
Dr. Ernesto Tuazon	UCR	(909) 787-5140	(909) 787-5004	ectuazon@ucrac1.ucr.edu
University of Georgia				
Professor John Rives	UGeorgia	(706) 542-5755	(706) 542-2492	jrives@hal.physast.uga.edu
Professor Wanfeng Mou	UGeorgia	(706) 542-6768	(706) 542-2492	wmou@hal.physast.uga.edu
U.S. Department of Energy-National Renewable Energy Laboratory				
Ms. Michelle Bergin	DOE-NREL	(303) 275-4429	(303) 275-4415	mbergin@nrel.gov
U.S. Environmental Protection Agency-Office of Research and Development				
Dr. William F. Barnard	USEPA-ORD	(919) 541-2205	(919) 541-0239	barnard.william@epamail.epa.gov
U.S. Navy				
Mr. Jay Rosenthal	USN-Pt. Mugu	(805) 989-7893	(805) 989-4817	rosentj@mugu.navy.mil
Mr. Terry Battalino	USN-Pt. Mugu	(805) 989-8383	(805) 989-4817	battalt@mugu.navy.mil
Dr. Doug Jensen	USN-EOPACE	(619) 553-1415	(619) 553-1417	djensen@nosc.mil

Appendix B
PARTICULATE MATTER AND VISIBILITY NETWORKS IN SOUTHERN CALIFORNIA

1. **California Acid Deposition Monitoring Program (CADMP)**

24-hour average PM2.5 mass - CADMP sampler every sixth day at LA-N. Main, North Long Beach, and Azusa.

Ion analysis - nitrate, ammonium, sulfate, chloride, sodium, magnesium, calcium, and potassium at all three sites.

(Operations - Curtis Schreiber at 818-575-6856 or cschreiber@arb.ca.gov)
(Data Management - Bart Croes at 916-323-1534 or bcroes@arb.ca.gov, Nehzat Motallebi at 916-324-1744 or nmotalle@arb.ca.gov)

2. **Children's Health Study**

24-hour average PM2.5 mass - A Two-Week integrated sampler, samplers were deployed late 1994 and anticipated running them up to 2000. 12 samplers in use: 8 in the South Coast Area (Lancaster [operated by Mojave Desert AQMD starting July 1, 1997], Lake Arrowhead, Glendora, Upland, Mira Lomo, Riverside-UCR, Long Beach, and Lake Elsinore), 1 in San Diego county (Alpine), 1 in San Luis Obispo County (Atoscadero), and 2 in Santa Barbara County (Santa Maria and Lompoc).

Ion analysis - ammonium, chloride, nitrate, and sulfate at all twelve sites.

Hourly PM10 mass - Tapered Element Oscillating Microbalance (TEOM) sampler at all twelve sites.

(Operations - Cindy Stover at 916-327-2960 cstover@arb.ca.gov)
(Data Management - Cindy Stover at 916-327-2960 and Clint Taylor at 916-323-1527)

3. **South Coast AQMD**

a. Los Angeles County

24-hour average PM10 mass - High Volume Size Selective Inlet (SSI) sampler every sixth day at six sites: Azusa, Burbank-West Palm Avenue, Hawthorne, Los Angeles-North Main, North Long Beach, and Santa Clarita County Fire Station.

Ion analysis - sulfate, nitrate, and chloride at all six sites. Also, elemental carbon and organic carbon using some type of laser technique.

24-hour average PM2.5 and PM10 mass, and elemental data - Dichotomous sampler every sixth day at Azusa and North Long Beach.

Total Suspended Particulate Matter (TSP) mass, sulfate, and nitrate - High Volume sampler without the size selective inlet at Azusa, Hawthorne, Los Angeles-North Main, Lynwood, North Long Beach, Pasadena-South Wilson Avenue, Pico Rivera, and West Los Angeles-VA Hospital (no nitrate).

Hourly PM10 mass - TEOM sampler at Azusa, Burbank-West Palm Avenue, Glendora-Laurel, Hawthorne, Los Angeles-North Main, and North Long Beach.

Coefficient of Haze - AISI Tape sampler at Azusa.

Light Scattering Coefficient - Nephelometer at Azusa.

(Operations - South Coast AQMD)
(Data Management - Ron Rothacker at 916-324-7672)

b. Orange County

24-hour average PM10 mass - SSI sampler every sixth day at Anaheim-Harbor Blvd and El Toro.

Ion analysis - sulfate, nitrate, and chloride at both sites.

Total Suspended Particulate Matter (TSP) mass, sulfate, and nitrate - High Volume sampler without the size selective inlet at Anaheim-Harbor Blvd.

Hourly PM10 mass - TEOM sampler at Anaheim-Harbor Blvd.

(Operations - South Coast AQMD)
(Data Management - Ron Rothacker at 916-324-7672)

c. Riverside County

24-hour average PM10 mass - SSI sampler every sixth day at Banning-North Allesandro, Noroco-Norconian, Perris, and Riverside-Rubidoux.

Ion analysis - sulfate, nitrate, and chloride at Banning-North Allesandro, Lake Elsinore-West First Street, Noroco-Norconian, Perris, and Riverside-Rubidoux.

24-hour average PM2.5 and PM10 mass, and elemental data - Dichotomous sampler every sixth day at Riverside-Rubidoux.

Total Suspended Particulate Matter (TSP) mass, sulfate, and nitrate - High Volume sampler without the size selective inlet at Riverside-Magnolia and Riverside-Rubidoux.

Hourly PM10 mass - TEOM sampler at Lake Elsinore-West First Street and Riverside-Rubidoux.

(Operations - South Coast AQMD)
(Data Management - Ron Rothacker at 916-324-7672)

d. San Bernardino County

24-hour average PM10 mass - SSI sampler every sixth day at five sites: Fontana-Arrow Highway, Lake Gregory, Ontario-Airport, Redlands-Dearborn, and San Bernardino-4th Street.

Ion analysis - sulfate, nitrate, and chloride at all five sites.

Total Suspended Particulate Matter (TSP) mass, sulfate, and nitrate - High Volume sampler without the size selective inlet at Fontana-Arrow Highway, San Bernardino-4th Street, and Upland.

Hourly PM10 mass - TEOM sampler at Upland.

Coefficient of Haze - AISI Tape sampler at San Bernardino-4th Street.

Light Scattering Coefficient - Nephelometer at San Bernardino-4th Street.

(Operations - South Coast AQMD)
(Data Management - Ron Rothacker at 916-324-7672)

Additional Measurements

PTEP instrument every sixth day at Diamond Bar and Rubidoux - 24-hour average PM2.5 and PM10 mass, elemental data, elemental carbon and organic carbon, sulfate, nitrate, chloride, ammonium, potassium, ammonia, nitric acid.

24-hour average PM2.5 and PM10 mass, and elemental data - Dichotomous sampler every sixth day at Victorville-Armagosa Road.

Data not reported to AIRS.

4. **Mojave Desert AQMD**

a. Kern County

24-hour average PM10 mass - SSI sampler every sixth day at China Lake-Powerline Road, Inyoken-Airport, Mojave-Poole Street, and Ridgecrest-Las Flores Avenue.

Ion analysis - sulfate, nitrate, chloride, ammonium, and potassium at China Lake-Powerline Road and Mojave-Poole Street.

(Operations - Kern County APCD, Great Basin Unified APCD, and California ARB)

(Data Management - Ron Rothacker at 916-324-7672)

b. Los Angeles County

24-hour average PM10 mass - SSI sampler every sixth day at Lancaster-West Pondera Street.

Ion analysis - sulfate, nitrate, and chloride at Lancaster-West Pondera Street.

Hourly PM10 mass - TEOM sampler at Lancaster-West Pondera Street.

(Operations - South Coast AQMD)
(Data Management - Ron Rothacker at 916-324-7672)

c. San Bernardino County

24-hour average PM10 mass - SSI sampler every sixth day at six sites: Barstow, Hesperia-Olive Street, Lucerne Valley-Middle School, Trona-Athol, Twentynine Palms-6136 Adobe Road, and Victorville-Armargosa Road.

Ion analysis - sulfate, nitrate, and chloride at all six sites.

Total Suspended Particulate Matter (TSP) mass, sulfate, and nitrate - High Volume sampler without the size selective inlet at Trona-Athol.

24-hour average PM2.5 and PM10 mass, and elemental data - Dichotomous sampler every sixth day at Victorville-Armagosa Road.

(Operations - Mojave Desert AQMD)
(Data Management - Ron Rothacker at 916-324-7672)

5. **San Luis Obispo County APCD**

24-hour average PM10 mass - High Volume Size Selective Inlet (SSI) sampler every sixth day at seven sites: Arroyo Grande-Ralcoa Way, Atacadero-Lewis Avenue, Morro Bay, Nipomo-Guadalupe Road, Nipomo-South Wilson Street, Paso Robles-Santa Fe Avenue, San Luis Obispo-Marsh Street.

Ion analysis - sulfate, nitrate, chloride, ammonium, and potassium at San Luis Obispo-Marsh Street; potassium at Arroyo Grande-Ralcoa Way.

24-hour average PM2.5 and PM10 mass, and elemental data - Dichotomous sampler every sixth day at Arroyo Grande-Ralcoa Way since September 1995.

Hourly PM10 mass - Tapered Element Oscillating Microbalance (TEOM) sampler at Atacadero-Lewis Avenue.

Coefficient of Haze - AISI Tape sampler at San Luis Obispo-Marsh Street.

(Operations - Unocal/Xontech, San Luis Obispo County APCD, and California ARB)
(Data Management - Ron Rothacker at 916-324-7672)

6. **Santa Barbara County APCD**

24-hour average PM10 mass - SSI sampler every sixth day at 13 sites: El Capitan Beach, Exxon Site 10-UCSB West Campus, Gaviota East, Gaviota GTC-Site C, Gaviota West, Las Flores Canyon #1 and #2, Lomoc-South H Street, Point Conception Lighthouse, Santa Barbara-West Carrillo Street, Santa Maria Library, Vandenberg AFB-STS Power Plant, and Vandenberg AFB-Watt Rd.

Ion analysis - sulfate, nitrate, chloride, ammonium, and potassium at Santa Maria-Library.

Hourly PM10 mass - TEOM sampler at Santa Maria Broadway.

Coefficient of Haze - AISI Tape sampler at Santa Maria Broadway and Santa Barbara-West Carrillo Street.

(Operations - Santa Barbara County APCD, PSD contractor, California ARB)
(Data Management - Ron Rothacker at 916-324-7672)

7. **Ventura County APCD**

24-hour average PM10 mass - SSI sampler every sixth day at six sites: El Rio-Rio Mesa School #2, Ojai-Ojai Avenue, Piru-2 miles SW, Simi Valley-Cochran Street, Thousand Oaks-Moorpark Road, and Ventura-East Main Street.

Ion analysis - sulfate, nitrate, chloride, ammonium, and potassium at El Rio-Rio Mesa School # 2 and Simi Valley-Cochran Street.

Total Suspended Particulate Matter (TSP) mass - High Volume sampler without the size selective inlet at Simi Valley-Cochran Street.

Coefficient of Haze - AISI Tape sampler at Ventura County West Casitas Pass.

(Operations - Ventura county APCD and California ARB)
(Data Management - Ron Rothacker at 916-324-7672)

8. **San Diego County APCD**

24-hour average PM10 mass - SSI sampler every sixth day at seven sites: Chula Vista, El Cajon-Redwood Avenue, Escondido-Valley Parkway, Oceanside-Mission Avenue, Otay Mesa-Paseo International, San Diego-Overland Avenue, and San Diego-12th Avenue.

Ion analysis - sulfate, nitrate, chloride, ammonium, and potassium at El Cajon-Redwood Avenue and Oceanside-Mission Avenue.

Total Suspended Particulate Matter (TSP) mass, sulfate, and nitrate - High Volume sampler without the size selective inlet at Chula Vista (mass only), El Cajon-Redwood Avenue, and San Diego-12th Avenue.

Coefficient of Haze - AISI Tape sampler at El Cajon-Redwood Avenue, Oceanside-Mission Avenue, San Diego-Overland Avenue, and San Diego-12th Avenue.

(Operations - San Diego County APCD)
(Data Management - Ron Rothacker at 916-324-7672)

9. **Imperial County APCD**

a. Imperial County

24-hour average PM10 mass - SSI sampler every sixth day at eleven sites: Bombay Beach, Brawley-Main Street, Calexico-East, Calexico-Ethel Street, Calexico-Grant Street, El Centro-9th Street, Mesquite-Harris Road, Niland-English Road, Seeley-3 miles SW, Westmoreland-west 1st-Street, and Winterhaven-2nd Avenue.

Ion analysis - sulfate, nitrate, chloride, ammonium, and potassium at Brawley-Main Street, Calexico-East, Calexico-Ethel Street, Calexico-Grant Street, and El Centro-9th Street.

24-hour average PM2.5 and PM10 mass, and elemental data - Dichotomous sampler every sixth day at Calexico-Ethel Street.

Coefficient of Haze - AISI Tape sampler at Calexico-Ethel Street.

(Operations - Imperial County APCD and California ARB)
(Data Management - Ron Rothacker at 916-324-7672)

b. Riverside County

24-hour average PM10 mass - SSI sampler every sixth day at Indio-Jackson Street and Palm Spring-Fire Station.

Ion analysis - sulfate, nitrate, and chloride at both sites.

Hourly PM10 mass - TEOM sampler at Indio-Jackson Street.

(Operations - South Coast AQMD)
(Data Management - Ron Rothacker at 916-324-7672)

10. <u>Mexico</u>

24-hour average PM10 mass - SSI sampler every sixth day at twelve sites: Tijuana -- ITT-Institute Tecnologico de Tijuana, La Mesa, Playas de Tijuana, Rosarito Playas, Centro de Salud, Colef. Mexicali -- ITM-Instituto Tecnologico de Mexicali, UABC-Universidad Autonoma de Baja California, CEBTIS # 21, COBACH, CONALEP, Progresso.

Total Suspended Particulate Matter (TSP) mass - High Volume sampler without the size selective inlet at the same 12 sites.

(Operations - Tracer Technologies, Inc. and California ARB)
(Data Management - Mark Fuentes at 619-645-5233 or mfuentes@arb.ca.gov)

Table B-1. Radiometers distributed over SCOS97-NARSTO Domain

Sitename	Agency	Ultraviolet Radiation	Total Solar Radiation	Direct-beam Solar
Lancaster ?	moj/scaqmd		type?	
Joshua Tree	mojave		type?	
Victorville	mojave		type?	
Point Mugu	navy		LiCor LI200s	
Laguna Peak	navy		LiCor LI200s	
Santa Cruz Island	navy		LiCor LI200s	
San Miguel Island	navy		LiCor LI200s	
San Nicolas Island	navy		LiCor LI200s	
San Clemente Island	navy		LiCor LI200s	
Calexico	salton sea		type?	
Azusa	scaqmd	Eppley UV 6676 (ordered)	Kipp & Zonin (ordered)	
Banning Airport	scaqmd	Eppley UV 6676 (ordered)	Kipp & Zonin (ordered)	
Burbank	scaqmd	Eppley UV 6676 (ordered)	Kipp & Zonin (ordered)	
Hawthorne	scaqmd	Eppley UV 6676 (ordered)	Kipp & Zonin (ordered)	
Pico Rivera	scaqmd	Eppley UV 6676 (ordered)	Kipp & Zonin (ordered)	
Upland	scaqmd	Eppley UV 6676 (ordered)	Kipp & Zonin (ordered)	
LA No. Main	scaqmd/arb		type?	
Barstow	sce		Eppley 8-48	
Bishop	sce		Eppley 8-48	
Blythe	sce		Eppley 8-48	
Long Beach	sce		Eppley 8-48	
Mammoth	sce		Eppley 8-48	
Moor Park	sce		Eppley 8-48	
Palm Spriings	sce		Eppley 8-48	
Ridgecrest	sce		Eppley 8-48	
San Jacinto (Romoland)	sce		Eppley 8-48	
Santa Ana	sce		Eppley 8-48	
Goleta	sce		Eppley 8-48	
Valencia	sce		Eppley 8-48	
Ventura	sce		Eppley 8-48	
Westminster (Huntington)	sce		Eppley 8-48	
El Segundo	sce		Eppley 8-48	
Lancaster	sce		Eppley 8-48	
Rialto	sce		Eppley 8-48	
Rosemead	sce		Eppley 8-48	
San Dimas (azusa)	sce		Eppley 8-48	
Victorville	sce		Eppley 8-48	
Arrowhead (Rimforest)	sce		Eppley 8-48	
Yucca Valley	sce		Eppley 8-48	
Kearney Mesa	sdapcd		not purchased	
No. San Diego	sdapcd		not purchased	

Bakersfield	simp		Eppley PSP	none
Cholame	simp		Eppley PSP	EppNIP + LI2020 trkr
Carrisa Plains	simp		Eppley PSP	EppNIP + LI2020 trkr
Cuyama	simp		Eppley PSP	EppNIP + LI2020 trkr
Arvin, Bear Mtn	sjvuapcd		type?	
Bakersfield-Golden State	sjvuapcd		type?	
Bakersfield-California Av	sjvuapcd		type?	
Atascadero	slo apcd		type?	
El Rio	vapcd		LiCor LI200s	
Emma Wood State Beach	vapcd		LiCor LI200s	
Ojai	vapcd		LiCor LI200s	
Piru	vapcd		LiCor LI200s	
Simi Valley-Cochran	vapcd	Eppley UV (not operating)	LiCor LI200s	
Simi Valley Upper Air	vapcd		LiCor LI200s	
Bishop	cimis		LiCor LI200s	
Bishop	cimis		LiCor LI200s	
Santa Maria	cimis		LiCor LI200s	
Calipatria	cimis		LiCor LI200s	
Riverside	cimis		LiCor LI200s	
San Diego	cimis		LiCor LI200s	
Oceanside	cimis		LiCor LI200s	
Thermal	cimis		LiCor LI200s	
San Luis Obispo	cimis		LiCor LI200s	
Blackwells Corner	cimis		LiCor LI200s	
Palm Desert	cimis		LiCor LI200s	
Temecula	cimis		LiCor LI200s	
Santa Ynez	cimis		LiCor LI200s	
San Diego	cimis		LiCor LI200s	
Goleta Foothills	cimis		LiCor LI200s	
Seeley	cimis		LiCor LI200s	
Palo Verde	cimis		LiCor LI200s	
Escondido	cimis		LiCor LI200s	
Irvine	cimis		LiCor LI200s	
Betteravia	cimis		LiCor LI200s	
Pomona	cimis		LiCor LI200s	
Claremonte	cimis		LiCor LI200s	
Meloland	cimis		LiCor LI200s	
Lamont	cimis		LiCor LI200s	
Port Hueneme	cimis		LiCor LI200s	
Ramona	cimis		LiCor LI200s	
Santa Monica	cimis		LiCor LI200s	
Piru	cimis		LiCor LI200s	
El Dorado	cimis		LiCor LI200s	
Westlands	cimis		LiCor LI200s	
Newberry Springs	cimis		LiCor LI200s	

Appendix C
SCOS97-NARSTO Aerosol Measurement Space and Power Requirements

Table C-1

SCOS97-NARSTO Instrumentation Inventory											
Mira Loma Temporary Site											
Experimenter / Parameters	**Device**	**Indoor Power**		**Outdoor Power**		**Inside space requirements**			**Outside space requirements**		
		110V Amps	**220V Amps**	**110V Amps**	**220V Amps**	**Height**	**Depth**	**Width**	**Height**	**Depth**	**Width**
CE-CERT											
NOy, HNO3	TECO 42CY	7				8.62"	23"	16.75"	32"	8"	12"
UCR											
Single Particles	ATOFMS		30			70"	30"	70"			
		30									
Caltech/ADI											
Particle Size/Number	Optical Particle Counter	7				10	22	22			
Particle Size/Number	Electrical Aerosol Analyzer	7				10	22	22			
Data	PC	5				18	22	22			
ADI						72" Counter Top w/ storage under					
Real-time Nitrate	Filter/heater	7									
	TECO-42	7									
Calibration P.C.		6									
Outdoor											
PM10	Impactor			7					24"	12"	36"
PM2.5 Organic	Cyclone-Filter			7					24"	12"	36"
PM2.5 Inorganic	Cyclone-Filter			7					24"	12"	36"
HNO4/NH3	Denuder/Filter			7					24"	12"	36"
Size-resolved Aerosol	MOI #1			7					24"	12"	36"
	MOI #2			7					24"	12"	36"
PM2.5 (Contingency)	FRM #1			7					36"	36"?	36"?
	FRM #2			7					36"	36"?	36"?
Trailer (non-sampler)											
Lights		10		10							
Air Conditioning					45						
Air Conditioning					45						

Trailer Totals		Indoor Power		Outdoor Power							
		110V Amps	220V Amps	110V Amps	220V Amps						
	Amps	94	30	66	90				Open	36"	72" + access all 4 sides
	Connections	10	1	9	2						
	Circuits	?	1	?	2						
SAPRC (Subpanel)											
NH3	FTIR			30	30						
Air Conditioning					45						
Power Service (Totals)		**110V (All)**	**220V (All)**								
	Amperage	196	195								
	Amps (220v Service)	293									

Table C-2

SCOS97-NARSTO Specialty Measurements Requirements											
Nitrogen Species											
Parameters	**Device Name**			**Inside location space requirements**				**Outside location space requirements**			
		circuit	**voltage**	**Height**	**Depth**	**Width**	**Weight**	**Depth**	**Height**	**Width**	**Site**
NOy, HNO3	TECO 42CY	~7 Amp	110 V	8.62"	23"	16.75"	60 lbs.	8"	32"	12"	Azusa, Banning, LA North Main, Diamond Bar, Riverside
HNO3 & NO2	TDLAS	2 - 20 Amp	220 V	4'	8'	2'	-	2'	2'	2'	Azusa
		1 - 20 Amp	110 V								
HNO3 & NH3	Denuder	~3 Amps	110 V	Equivalent to a Hi-Vol and will be placed on the roof							Azusa, Riverside
PAN, PPN, PERC, Meth Chlor	GC Analyzer	1 - 20 Amp (~5 amps)	110 V	2'	2'	2'	-	-	-	-	Azusa
VOC	Cans	1 - 20 Amp	110 V	a few square feet							Azusa, LA North Main, Burbank, Pine Mt.?, Mt Baldy Village?
VOCs	Continuous GC	2 - 50 Amp	220 V	Trailer 20ft long 8 ft high, should fit in front of station behind fence.							Azusa (start August 27)
Radiocarbon	Hi vols	use trailer circuits						2 - high vols			Azusa
Isoprene, Terpenes, MVK	4 X Adsorbent sampler	1 - 20 Amp (~10 amps)	110 V	a few square feet							Azusa, Banning, Pine Mountain, Mt Baldy Village?
PAH	2 X Hi-vol	2 - 20 Amp	110 V					2- high vols			Azusa, Banning, LA North Main (part time), Riverside
Hydroxy Carbonyls	PFBHA impingers	1 - 20 Amp	110 V					Similar to a high vol			Azusa (start at end of August)
Total reactive carbon	GC/FID	2 - 20 Amp	110 V	4' x 4' footprint on a desktop							Azusa (start at end of August)
Other	Many of the instruments require bottled gases. Need to know how to order and send bottles to stations.										
SCOS97-NARSTO Aerosol Program											
Parameter	**Device Name**	**Circuits**	**Volts**	**Indoor Height**	**Indoor Depth.**	**Indoor Width**	**Weight**	**Outside Depth**	**Outside Height**	**Outside Width**	**Site(s)**
PM2.5	FRM	7 Amp?	110 V?				?	36"?	Open to air	36"?	Azusa* (District may already have on-site)
UCR											
Single Particles	ATOFMS	1 - 30 Amp	220 V	70"	30"	70"	600Lbs				Azusa* (8/16-29), LA North Main (8/16-29), Pirece Hall (all summer), Diamond Bar(9/2-14), Mira Loma*(9/2-14)

		1 - 30 Amp	110 V								**Also O3 IOPs at LA, DB, ML* - as space permits**
PM10	TEOM	10 Amp?	110 V?	48*	24"	24"	50lb?		Inlet only		LA, Diamond Bar or Mira Loma* (1 only, as needed)
Caltech/ADI											
Indoor											
Size-resolved Aerosol	MOI #1										Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
	MOI #2										Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
Particle Size/Number	Optical Particle Counter										Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
Particle Size/Number	Electrical Aerosol Analyzer										Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
Data	PC										Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
Indoor Total		25 Amp	110 V	48"	32"	70" bench space					Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(-14), Mira Loma*(9/2-14)
Outdoor											
PM10	Impactor						30 lb?	12"	Open to air	36"	Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
PM2.5 Organic	Cyclone-Filter						30 lb?	12"	Open to air	36"	Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
PM2.5 Inorganic	Cyclone-Filter						30 lb?	12"	Open to air	36"	Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
HNO3/NH3	Denuder/Filter						30 lb?	12"	Open to air	36"	Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
Outdoor Total		25 Amp	110 V								Azusa* (8/16-29), LA North Main (8/16-29), Pierce Hall (8/16-29), Diamond Bar(9/2-14), Mira Loma*(9/2-14)
Continuous NH3	FTIR (Tuazon)	2 x 15 Amp	110 V					10'	6'	100'	Mira Loma
											Azusa* is Azusa alternate site (Todd Ave)