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Determination of Elemental Carbon and Organic Carbon Concentrations During the Southern California Children's Health Study, 1999-2001

Contract Number 01-309

Lynn G. Salmon, Paul R. Mayo, and Glen R. Cass[†]
Environmental Science and Engineering

John H. Seinfeld
Chemical Engineering

California Institute of Technology
Pasadena, CA 91125

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[†]Deceased

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Abstract

Since 1994, a network of air monitoring sites have been operating as part of the Southern California Children's Health Study, a large epidemiological investigation of the long-term effects of air pollutant exposure on respiratory disease within a population of more than 5600 California school children. We previously reported the results of chemical analysis of particulate organic carbon (OC) and elemental carbon (EC) samples taken at twelve air monitoring sites in the southern half of the state of California over the 5-year period 1994-1998. Samples for the Children's Health Study continue to be collected over consecutive two week averaging times with sample collection scheduled to end in June, 2004 marking completion of the 10 year study. This report presents the particulate organic carbon (OC) and elemental carbon (EC) concentrations measured during the intermediate three years of this monitoring program (1999-2001). Annual average PM_{10}-equivalent elemental (black) carbon particle concentrations range from 0.05 - 1.74 μg m^{-3} over the communities and years studied while annual average organic carbon concentrations are in the range 1.50 - 17.51 μg m^{-3}. The overall fine particle concentrations show a coherent spatial pattern with very low mass concentrations (circa 5-9 μg m^{-3}) and aerosol carbon concentrations at the northern and southern-most monitoring sites. The highest annual average mass concentrations were found at Mira Loma, Riverside, and Upland, downwind of the Los Angeles-Long Beach urban complex ranging from 18.5 to 27.8 μg m^{-3} from 1999-2001. Carbonaceous aerosols account for 24 to 62 percent of fine particle concentrations between the sites studied.

Executive Summary

0.1 Background

Particulate organic carbon (OC) and elemental carbon (EC) concentrations are measured at twelve air monitoring sites in the southern half of the state of California over the 10-year period 1994-2004. These air monitoring sites are part of the network that supports the Southern California Children's Health Study, a large epidemiological investigation of the effects of air pollutant exposure on respiratory disease within a population of more than 5600 California school children. Other pollutants measured are ozone, nitrogen dioxide, PM_{10} mass, $PM_{2.5}$ mass and ions (nitrate, sulfate, ammonium) and gas-phase acids (hydrochloric, nitric, formic, acetic). The communities studied range from mountainous (Alpine, Lake Arrowhead) to desert (Lancaster) to rural near-coastal areas (Lompoc, Santa Maria) to sites such as Long Beach, Glendora and San Dimas within the Los Angeles County urban area plus Mira Loma and Riverside in the urban plume downwind of the Los Angeles-Long Beach area. Data through the end of year 2001 is incorporated in this report.

0.2 Methods

Organic and elemental carbon particle samples were collected on quartz fiber filters through which ambient air was drawn for two weeks. After each two week interval, new quartz fiber filters were installed at each sampling location in the Children's Health Study sampling network. The quartz fiber filters were analyzed for OC and EC content by thermal evolution and combustion. The primary carbon particle cassette used during the study did not have a defined size cut, but was determined to have a broad cut-point of approximately 10 μm after comparison with reference samplers having known size cuts (Salmon et al., 2001). A separate carbon particle cassette with a $PM_{2.2}$ size cut was introduced in late 2000 and operated side-by-side with the primary carbon particle cassette in use since the inception of the study. Linear regression analysis was performed on the carbon data obtained during the portion of the study when both type cassettes were operating side-by-side in order to determine correction factors that are used to estimate the fine particle concentrations of the primary Two-Week Sampler data.

0.3 Results

Annual average PM_{10}-equivalent elemental (black) carbon particle concentrations range from 0.05 - 1.74 μg m^{-3} over the communities and years studied while annual average organic carbon concentrations are in the range 1.50 - 17.51 μg m^{-3}. The coastal sites generally show winter season EC and OC concentration peaks while the mountainous and some inland sites show summer seasonal peaks; both conditions are consistent with seasonal changes in wind direction and mixing depth. Carbonaceous aerosols account for 24 to 62 percent of fine particle concentrations between the sites studied. The overall fine particle concentrations show a coherent spatial pattern with very low mass concentrations (circa 5-9 μg m^{-3}) and aerosol carbon concentrations at the northern and southern-most monitoring sites, reaching the highest annual average concentration of 35.8 μg m^{-3} fine particulate mass including 6.7 μg m^{-3} estimated organic compound mass in 1995 at Mira Loma downwind of the Los Angeles-Long Beach urban complex. The nearby, Upland site had the highest annual average concentration of organic compound mass with 8.1 μg m^{-3} estimated for 1995. There was a decrease in annual average fine particle mass and carbonaceous aerosol concentrations at the urban sites from 1994-1998, followed by increased concentrations at the sites during the period 1999-2001. The relative chemical composition of the aerosol did not change appreciably over that same period of time. Since all aerosol components are affected about equally, the most likely reason for the decline was milder weather with lower mean temperatures in the late 1990s. Warmer temperatures returned to Southern California during 1999-2001 and with higher temperatures and bright sunlight comes photochemical smog. Organic compounds are one of the main primary pollutants found in photochemical smog.

0.4 Conclusions

Yearly maximum EC concentrations were found at the Long Beach site during 6 of the 8 years studied, however the highest annual average EC concentrations were found inland at Mira Loma since 1996. Upland and Riverside were also among the communities with high EC levels. EC is produced in combustion processes and strongly influenced by diesel engine exhaust which is prevalent in all of these communities. Long Beach is close to the heavy industry and traffic in the Los Angeles/Long Beach harbor area while Mira Loma, Upland and Riverside are home to numerous warehouse distribution centers serviced by thousands of diesel trucks each day. Newer diesel engines and improved diesel fuels have been introduced into the vehicle fleet over the last 10 years which should have reduced EC levels. However, EC concentrations for 1999-2001 have shown a gradual increase in EC concentrations and at most sites, 2001 levels are equal or greater to what they had been in 1994 suggesting that these measures alone are not sufficient to substantially reduce EC levels.

EC concentrations are of utmost concern since diesel soot is a major contributor to cancer risk, and health studies suggest children living in Mira Loma, which has the highest particulate levels in Southern California, are more likely to suffer respiratory problems because their lungs develop more slowly than do those of children elsewhere. New regulations on diesel emissions standards have been approved in California that should dramatically cut pollution from big-rigs, trash trucks and delivery vans in the near future. The new rules will require diesel engines to be equipped with tailpipe controls. The controls will be phased in beginning with the 2007 model year, and by 2010, they are supposed to eliminate 90 percent of the smog-forming nitrogen oxide and particulate emissions from diesel vehicles.

In general, both OC and EC concentrations were highest at the Los Angeles Basin sites and lowest at the sites in the outlying areas (San Luis Obispo, Santa Barbara, and San Diego Counties), the mountain site at Lake Arrowhead, and the desert site at Lancaster. There were also decreasing elemental carbon to total carbon (TC = EC + OC) ratios moving from west to east across the Los Angeles Basin. This can be attributed to the fact that as an airmass moves across the basin the organic fraction can be enhanced by the formation of secondary organic aerosol as a result of condensation from the gas phase. Elemental carbon, conversely, is introduced to the atmosphere solely via the direct or primary emission of particles.

OC annual average concentrations dropped with time over the 1994 through 1998 period, but concentrations at all sites increased in 1999 and annual average concentrations at the end of 2001 remain higher than in 1998, which had the lowest OC concentrations of the years studied. The most likely reason for the OC decline was likely milder weather with lower mean temperatures in the late 1990s. Warmer temperatures returned to Southern California during 1999-2001 and with higher temperatures and bright sunlight comes photochemical smog. Organic compounds are one of the main primary pollutants found in photochemical smog.

Studies have found associations between outdoor air pollution exposure and prevalence of respiratory diseases as well associations between mortality rates and particulate

air pollution in metropolitan areas in the United States (Pope, 2000). There is increasing epidemiological evidence pointing toward health risks from particulate air pollution, especially fine particulate matter. However, organic and elemental carbon measurements with a fine particle size cut were not taken as part of the Children's Health Study until the introduction of the Leg D cassettes near the end of year 2000. Preliminary comparisons of EC concentrations taken side-by-side with Leg C and Leg D cassettes show problems with lower than expected EC concentrations as measured with the Leg D cassettes. It is strongly suggested that additional testing be done to determine the cause of the EC reduction on the Leg D cassettes, since obtaining reliable fine particle $PM_{2.5}$ data is of vital importance.

The organic and elemental carbon particle data show seasonal and annual variations as well as spatial ranges in carbon particle concentrations across the southern half of California. With carbonaceous aerosols accounting for 24 to 62 percent of fine particle concentrations, it is clear that measurement of carbon species should be included in multi-year, multi-location studies of particulate concentrations.

1 Introduction

Beginning in 1994, filter samples were collected and analyzed as part of the Southern California Children's Health Study (Peters et al., 1999). The Children's Health Study is a 10-year study of the long-term effects of exposure to air pollution in children, organized by researchers at the University of Southern California (USC) under the support of the California Air Resources Board. The concentrations of major pollutants are monitored and the respiratory health of more than 5,600 children is followed. Ongoing research by personnel at USC involves analysis of data on PM_{10} and fine particle ($PM_{2.5}$) mass, nitrate, sulfate, and ammonium ion concentrations, as well as gas-phase ozone, nitrogen dioxide, formic acid, acetic acid, and nitric acid.

At Caltech, we previously reported results from the chemical analysis of particulate organic carbon (OC) and elemental carbon (EC) samples taken at twelve air monitoring sites in the southern half of the state of California over the 5-year period 1994-1998 (Salmon et al., 2001). Samples for the Children's Health Study continue to be collected over consecutive two week averaging times, with analysis for gravimetric fine particle mass and chemical analysis for ionic species being performed by Los Amigos Research and Education Institute (LAREI). Sample collection will end in June, 2004 marking completion of the 10 year study. This report presents the particulate organic carbon (OC) and elemental carbon (EC) concentrations measured during the intermediate three years of this monitoring program (1999-2001).

During the 1999-2001 period, samples were collected in 12 locations throughout Southern California (Alpine, Atascadero, Glendora, Lake Arrowhead, Lake Elsinore, Lancaster, Lompoc, Long Beach, Mira Loma, Riverside, Santa Maria, and Upland), as shown in Figure 1. Sampling at the original San Dimas site was discontinued in 1996 and replaced with the near by Glendora site. These sites were selected to represent exposure extremes for one or more pollutants and to cover a large enough geographical area and a long enough time period to document spatial and temporal variations. Among the sites are mountain (Alpine, Lake Arrowhead), desert (Lancaster), and other rural locations (Lompoc, Santa Maria, Atascadero).

Epidemiological studies have found an association between human health effects and fine particle concentrations (Dockery et al., 1993; Pope et al., 1995ab; Guaderman et al., 2002). A large fraction of the fine particulate mass in the atmosphere is made up of organic and elemental carbon particles (Gray et al., 1986; Solomon et al., 1988; Hannigan et al., 1996; Kaplan and Gordon, 1994; Christoforou et al., 2000) and particular organic compounds have been identified as a possible health hazard; for example, PAHs have been shown to be carcinogenic in animals (Seinfeld and Pandis, 1998). Airborne carbon particles also lead to reduced visibility via the process of light scattering and absorption (Larson et al., 1989).

Fine particle elemental carbon (EC), also referred to as black carbon, is only produced in combustion processes. Particulate organic carbon (OC) is emitted directly from combustion processes, from industrial processes, and from fugitive area-wide sources; OC also can be formed by atmospheric chemical reactions (secondary formation). Atmospheric

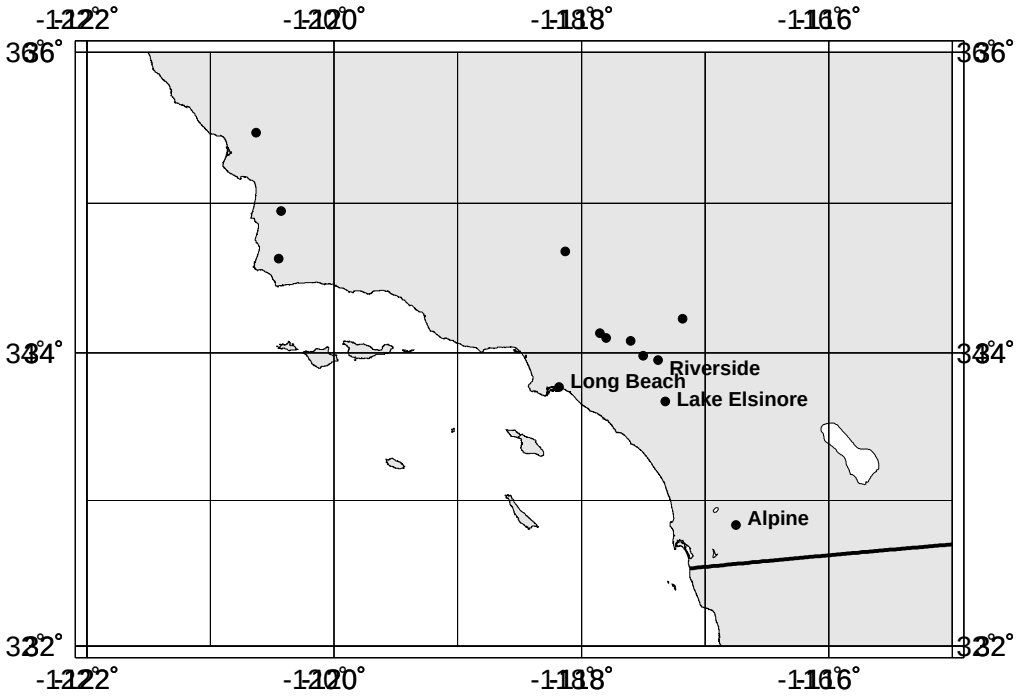

Figure 1: Southern California Children's Health Study ambient air quality monitoring sites.

carbon particle sources include gasoline and diesel powered vehicle exhaust, meat cooking, fireplaces, paved road dust, forest fires, spray painting, cigarette smoke, and a host of other sources.

The purposes of this paper are to add the analysis of particulate organic and elemental carbon to the other data collected during the Children's Health Study (CHS), to present OC/EC concentration data over the intermediate three years of the sampling campaign (1999-2001), to re-examine particle size cut issues involving the Two-Week Sampler used for particle collection in the CHS, and to detail spatial and temporal variations in OC and EC concentrations throughout Southern California in relationship to fine particle mass and other aerosol chemical components.

2 Experimental Procedures

Organic and elemental carbon particle samples were collected on 47 mm diameter, pre-baked quartz fiber filters (Pallflex 2500 QAO) through which ambient air was drawn at a flow rate of 1.3 lpm using the Two-Week sampler designed by Hering (Lurmann et al., 1994). The quartz fiber filters were placed in Leg C of the Two-Week Sampler in Savilex Teflon filter holders mounted 2 m above ground level and placed facing downward beneath Teflon hoods to shield them from rain and sun. The samplers were run continuously and filters were collected and replaced at two-week intervals. Following collection, filter samples were placed in annealed foil-lined petri dishes, sealed with Teflon tape, and stored in a freezer prior to analysis. In addition to Leg C used for the OC/EC samples, the Two-Week Sampler originally had two other independent sampling legs including Leg A which employs Teflon filters from which fine aerosol mass and ionic species measurements are made. Each Teflon filter is preceded by an oiled impactor in order to deliberately obtain a particle size cut at 2.5 μm particle diameter and thus collect fine particle ($PM_{2.5}$) samples for mass, sulfates, nitrates, and ammonium ion. $PM_{2.5}$ is fine particulate matter with aerodynamic diameter less than 2.5 μm.

Leg A also contains a glass honeycomb denuder coated with sodium carbonate that is analyzed directly by ion chromatography for nitric and hydrochloric acid. Leg B of the Two-Week sampler contains a filter pack for the collection of formic and acetic acids.

In order to avoid possible organics contamination from the anti-bounce coating used in the impactors, the inlet to Leg C of the sampler containing the quartz fiber filter for carbon particle analysis consisted solely of a cylindrical tube 6 mm in diameter and 2.5 cm long. This sampler using no impactor was determined to have a broad cut-point of approximately 10 μm in aerodynamic diameter after comparison with reference samplers having known size cuts (Salmon et al., 2001). The reference samplers included an open-face filter holder for total suspended particulate matter (TSP) collection, a Sierra-Anderson low volume PM10 sampling head with filters downstream (Solomon et al., 1989), and an AIHL cyclone separator (John and Reischl, 1980) operated to achieve a 2.5 μm diameter particle size cut.

A fourth sampling leg, Leg D, was added to the sampling configuration containing an independent, parallel quartz fiber filter that is also analyzed for organic and elemental

carbon. The sampling cassette in Leg D is installed after an oiled impactor that produces a sharp cut-point of 2.2 μm in aerodynamic diameter (Sioutas, et al., 1999). Blank tests were used to verify that organics contamination were minimal (Taylor, 2001). Leg C remains in the same configuration in use since the inception of the study. The impactor-equipped cassette in Leg D has been in use alongside the non-impactor-equipped cassette in Leg C since mid-September, 2000. The results from both cassettes are compared and used to estimate the fine particle fraction of the carbon analyzed from portions of the study employing only the PM_{10} equivalent samples obtained from Leg C.

Quartz fiber filters are analyzed for OC and EC content by the thermal evolution and combustion technique of Birch and Cary (1996). In this thermal-optical organic and elemental carbon concentration measurement method, 1.5 cm^2 rectangular filter punches are first placed in a temperature and atmosphere-controlled oven. The analysis process occurs in two stages. In the first stage, the temperature is raised progressively to approximately 850^{o}C in a pure helium atmosphere in order to volatilize organic carbon from the sample. The volatilized carbon is oxidized catalytically to CO_2, which is then reduced to CH_4. The CH_4 is then quantified using a flame ionization detector (FID). During this process, the filter may darken somewhat due to production of artifact EC by pyrolysis. Elemental carbon measurement and correction for any artifact EC formed by pyrolysis during OC analysis are accomplished during stage two. At the beginning of this second stage of analysis, the oven temperature is initially reduced, a 4% oxygen, 96% helium mixture is introduced, and the temperature is then raised progressively to approximately 900^{o}C. As the black elemental carbon is oxidized and CO_2 is evolved, there is an increase in filter transmittance. In order to correct for any contribution to the elemental carbon present due to OC pyrolysis during stage 1 of the analysis, the amount of EC oxidation necessary to return the filter to its initial transmittance is first measured. The point at which the filter transmittance equals its initial value is taken to be the point at which the actual EC begins to evolve from the sample. Any EC oxidized prior to that point is assumed to be due to OC pyrolysis earlier in the analysis and thus is added to the OC concentration measured in the first step of this analysis.

This analysis method is known as the NIOSH (National Institute of Occupational Safety and Health) protocol and has been employed by our group for nearly 20 years. A second protocol, the IMPROVE (Interagency Monitoring of Protected Visual Environments) protocol is also used for carbon measurements. The analysis method in the IMPROVE protocol is the same as that described above, however, the EC fraction is calculated by allocating part of the OC evolving at 850^{o}C to EC rather than OC. This results in EC values approximately twice as large when the IMPROVE protocol is used. The protocols are equivalent for total carbon, however. For a detailed comparison of the two protocols see Chow et al., (2001).

The effect of long freezer storage time on OC/EC results has been investigated by our laboratory. Samples originally analyzed in 1997 have been stored frozen and new punches were analyzed in 2001 for signs of sample degradation. As seen in Table 1, the differences over time are well below the calculated error bars.

Replicate analyses were also performed on a number of samples from each site for

samples from both Leg C and Leg D. For each replicate analysis a second sample punch was analyzed at the end of the project. Comparison of the initial and final sample runs on 74 samples shows excellent agreement as seen in Figure 2.

Table 1. Effect of Freezer Storage on OC/EC Results of Archived Samples

Sample ID	Date Analyzed	Organic Carbon (ug cm^{-2})	Elemental Carbon (ug cm^{-2})	Total Carbon (ug cm^{-2})
A-970428	8-01-1997	3.47 ± 0.37	0.29 ± 0.21	3.76 ± 0.49
A-970428	4-16-2001	3.17 ± 0.36	0.21 ± 0.21	3.37 ± 0.47
B-970416	8-01-1997	5.89 ± 0.49	1.18 ± 0.29	7.07 ± 0.65
B-970416	4-20-2001	5.53 ± 0.48	1.14 ± 0.26	6.66 ± 0.63
C-970410	8-01-1997	5.52 ± 0.48	1.49 ± 0.27	7.00 ± 0.65
C-970410	4-16-2001	5.04 ± 0.45	1.13 ± 0.26	6.18 ± 0.61
D-970422	8-01-1997	6.02 ± 0.50	1.73 ± 0.29	7.75 ± 0.69
D-970422	4-16-2001	5.32 ± 0.47	1.48 ± 0.27	6.81 ± 0.64
E-970814	9-30-1997	5.51 ± 0.48	1.11 ± 0.25	6.62 ± 0.63
E-970814	4-16-2001	5.19 ± 0.46	0.62 ± 0.23	5.81 ± 0.59
F-971212	12-30-1997	13.00 ± 0.85	1.21 ± 0.26	14.21 ± 1.01
F-971212	4-16-2001	13.04 ± 0.85	1.27 ± 0.26	14.31 ± 1.02
G-971118	12-29-1997	12.19 ± 0.81	3.80 ± 0.39	15.99 ± 1.10
G-971118	4-16-2001	12.49 ± 0.82	3.50 ± 0.38	15.99 ± 1.10
H-970430	12-30-1997	5.61 ± 0.48	1.81 ± 0.29	7.42 ± 0.67
H-970430	4-20-2001	5.30 ± 0.47	1.31 ± 0.27	6.61 ± 0.63
I-970709	12-31-1997	5.78 ± 0.49	0.38 ± 0.22	6.16 ± 0.61
I-970709	4-20-2001	5.43 ± 0.47	0.20 ± 0.21	5.63 ± 0.58
J-970727	12-30-1997	4.63 ± 0.43	0.31 ± 0.22	4.93 ± 0.55
J-970727	4-20-2001	4.15 ± 0.41	0.25 ± 0.21	4.41 ± 0.52

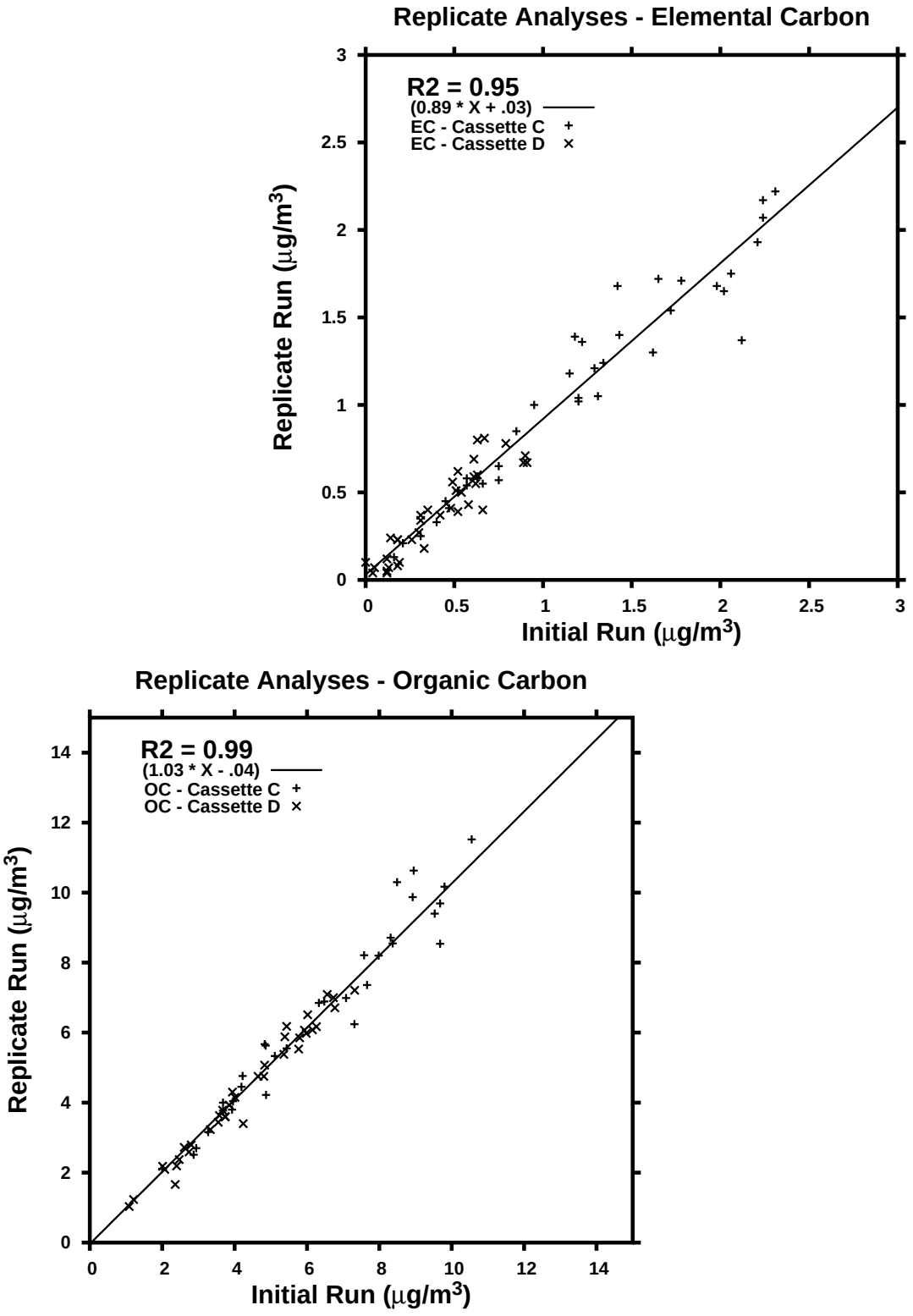

Figure 2: Replicate sample analyses.

3 Results and Discussion

3.1 Leg C PM10 OC/EC concentration data during 1999-2001

Annual average PM_{10} elemental carbon particle concentrations for the years 1999-2001 across the Children's Health Study monitoring network ranged from 0.11 μg m^{-3} to 1.56 μg m^{-3}, as shown in Table 2. The lowest average EC concentrations for each year continued to be found at the rural, coastal Lompoc site. Since 1996, the highest EC concentrations were found inland at Mira Loma. During the initial two years of the study, 1994-1995, higher EC concentrations were found at Long Beach, which is close to the heavy industry and traffic in the Los Angeles/Long Beach harbor area. The data showed a decline in EC concentrations from 1994 to 1998 consistent with newer diesel engines and improved diesel fuels being introduced into the vehicle fleet. However, EC concentrations for 1999-2001 have shown a gradual increase in EC concentrations and at most sites, 2001 levels are equal or greater to what they had been in 1994.

Annual average PM_{10} organic carbon particle concentrations ranged from 1.73 to 17.51 μg m^{-3} between stations in 1999-2001. The lowest annual average OC concentrations were consistently found at Lompoc, while the highest annual average concentrations were found at Mira Loma. In general, both OC and EC concentrations were highest at the Los Angeles Basin sites and lowest at the sites in the outlying areas (San Luis Obispo, Santa Barbara, and San Diego Counties), the mountain site at Lake Arrowhead, and the desert site at Lancaster. There are also decreasing elemental carbon to total carbon (TC = EC + OC) ratios moving from west to east across the Los Angeles Basin. This can be attributed to the fact that as an airmass moves across the basin the organic fraction can be enhanced by the formation of secondary organic aerosol as a result of condensation from the gas phase. Elemental carbon, conversely, is introduced to the atmosphere solely via the direct or primary emission of particles. There were lower OC annual average concentrations with time over the 1994 through 1998 period, but OC concentrations at all sites increased in 1999 (see Figure 3). While concentrations have dropped a little from 1999 through 2001, annual average concentrations at the end of 2001 remain higher than in 1998, which had the lowest OC concentrations of the years studied possibly due to milder weather with lower mean temperatures that year. Warmer temperatures returned to Southern California during 1999-2001 and with higher temperatures and bright sunlight comes photochemical smog. Organic compounds are one of the main primary pollutants found in photochemical smog.

Figures 4 through 6 show the time series of bi-weekly measurements of elemental carbon over the period 1994-2001. Each data point on these plots represents a two-week sampling period. Gaps in the data indicate sampling periods during which OC/EC samples were labeled as invalid by the station operators; in many cases this designation signified that the duration of sampling was insufficient (due to a power failure for example).

EC typifies direct particle emissions from primary sources and is strongly influenced by diesel engine exhaust in Southern California (Cass and Gray, 1995; Schauer et al., 1996, Gray and Cass, 1998). Elemental carbon concentrations typically show a strong seasonal

Table 2. Statistical Description of Annual Average PM10 Carbon Concentrations measured on Leg C using Two-Week Samplers (μg m^{-3})

Year	No. of Carbon Samples	— Organic Carbon — OC sample population mean ± SD	Max OC	Min OC	— Elemental Carbon — EC sample population mean ± SD	Max EC	Min EC
Alpine:							
1994	22	3.56 ± 1.00	6.16	1.83	0.38 ± 0.11	0.62	0.17
1995	23	4.41 ± 1.95	10.10	1.52	0.51 ± 0.19	0.85	0.24
1996	26	3.12 ± 1.10	5.67	1.44	0.42 ± 0.21	1.05	0.16
1997	24	3.19 ± 1.01	5.41	1.70	0.39 ± 0.13	0.62	0.15
1998	26	2.84 ± 1.19	5.33	1.17	0.28 ± 0.10	0.46	0.14
1999	26	3.76 ± 1.10	6.29	2.19	0.41 ± 0.12	0.67	0.16
2000	22	3.39 ± 0.94	5.63	2.45	0.41 ± 0.08	0.63	0.27
2001	25	3.34 ± 0.97	4.83	1.65	0.45 ± 0.13	0.65	0.20
Atascadero:							
1994	26	5.27 ± 2.77	10.78	0.85	0.44 ± 0.24	0.87	0.03
1995	24	5.18 ± 1.87	9.06	2.72	0.51 ± 0.24	1.08	0.21
1996	23	3.89 ± 1.14	6.05	2.20	0.36 ± 0.15	0.73	0.11
1997	26	3.96 ± 1.31	7.06	2.28	0.41 ± 0.14	0.66	0.17
1998	26	3.68 ± 1.79	8.55	1.48	0.26 ± 0.17	0.70	0.02
1999	24	4.85 ± 2.41	11.29	2.15	0.40 ± 0.28	1.00	0.03
2000	26	4.56 ± 2.70	12.62	1.91	0.41 ± 0.24	0.91	0.12
2001	26	4.35 ± 1.95	11.59	2.33	0.41 ± 0.24	1.10	0.14
San Dimas:							
1994	26	8.22 ± 2.10	12.17	4.33	1.18 ± 0.29	1.76	0.70
1995	23	9.12 ± 2.88	15.44	4.17	1.51 ± 0.50	3.00	0.88
1996	23	6.90 ± 1.93	11.40	4.05	1.11 ± 0.35	1.96	0.51
Glendora:							
1996	25	7.15 ± 2.27	11.89	4.21	0.90 ± 0.26	1.43	0.43
1997	23	5.90 ± 1.30	8.60	4.03	0.82 ± 0.25	1.29	0.52
1998	25	5.25 ± 1.85	8.96	2.97	0.64 ± 0.26	1.14	0.29
1999	26	7.40 ± 1.98	11.99	3.88	0.95 ± 0.32	1.61	0.41
2000	26	6.35 ± 1.54	9.94	3.74	0.88 ± 0.22	1.40	0.52
2001	27	5.91 ± 1.66	9.67	3.21	1.00 ± 0.39	2.12	0.36
Lake Arrowhead:							
1994	19	3.96 ± 1.76	7.13	1.69	0.33 ± 0.15	0.60	0.12
1995	14	2.95 ± 1.21	5.05	1.14	0.42 ± 0.20	0.80	0.10
1996	21	3.24 ± 2.19	9.23	0.68	0.45 ± 0.33	1.63	0.07
1997	25	2.75 ± 1.70	6.91	0.34	0.31 ± 0.18	0.80	0.08
1998	19	2.73 ± 1.77	6.58	0.63	0.27 ± 0.15	0.60	0.07
1999	23	3.52 ± 1.82	6.57	0.85	0.33 ± 0.14	0.63	0.10
2000	24	2.67 ± 1.52	6.21	0.74	0.27 ± 0.12	0.61	0.08
2001	23	3.07 ± 1.96	9.50	0.82	0.30 ± 0.13	0.53	0.11

Table 2. (continued)

Year	No. of Carbon Samples	Organic Carbon: OC sample population mean ± SD	Organic Carbon: Max OC	Organic Carbon: Min OC	Elemental Carbon: EC sample population mean ± SD	Elemental Carbon: Max EC	Elemental Carbon: Min EC
Lake Elsinore:							
1994	23	5.33 ± 1.95	11.74	2.57	0.67 ± 0.16	1.09	0.40
1995	24	6.09 ± 2.35	10.66	2.01	0.82 ± 0.31	1.56	0.29
1996	24	4.43 ± 1.09	6.69	2.41	0.64 ± 0.22	0.98	0.18
1997	25	4.55 ± 1.05	6.07	2.90	0.64 ± 0.20	1.08	0.27
1998	26	4.13 ± 1.57	6.91	1.82	0.49 ± 0.18	0.82	0.19
1999	26	5.38 ± 1.43	8.00	2.95	0.71 ± 0.25	1.25	0.30
2000	26	4.85 ± 1.37	8.22	2.20	0.68 ± 0.21	1.25	0.42
2001	25	5.10 ± 1.62	8.32	2.19	0.81 ± 0.29	1.38	0.34
Lancaster:							
1994	25	6.57 ± 2.59	14.72	3.01	0.66 ± 0.33	1.56	0.22
1995	24	7.17 ± 2.62	15.02	3.29	0.79 ± 0.32	1.49	0.39
1996	25	5.67 ± 1.45	8.55	3.14	0.57 ± 0.19	0.98	0.18
1997	24	4.95 ± 1.19	7.43	2.78	0.54 ± 0.14	0.77	0.25
1998	26	4.92 ± 1.68	7.75	2.34	0.48 ± 0.15	0.85	0.28
1999	26	6.25 ± 2.34	11.46	2.21	0.58 ± 0.28	1.13	0.21
2000	26	5.34 ± 1.89	9.81	2.66	0.57 ± 0.29	1.26	0.25
2001	26	5.60 ± 1.69	11.14	3.15	0.70 ± 0.34	1.77	0.26
Lompoc:							
1994	25	2.05 ± 1.35	4.69	0.52	0.14 ± 0.12	0.44	0.00
1995	23	2.10 ± 1.07	4.09	0.21	0.15 ± 0.12	0.33	0.00
1996	26	1.82 ± 0.73	3.59	0.73	0.13 ± 0.10	0.34	0.00
1997	24	1.87 ± 0.96	4.60	0.69	0.15 ± 0.09	0.35	0.03
1998	26	1.50 ± 0.82	3.46	0.53	0.05 ± 0.07	0.26	0.00
1999	23	1.97 ± 1.26	4.80	0.63	0.12 ± 0.10	0.36	0.00
2000	26	1.92 ± 1.06	4.59	0.75	0.12 ± 0.10	0.37	0.00
2001	26	1.73 ± 0.75	3.51	0.79	0.11 ± 0.10	0.35	0.00
Long Beach:							
1994	26	7.98 ± 4.46	20.92	2.94	1.40 ± 0.61	3.10	0.75
1995	24	7.41 ± 3.11	16.15	3.19	1.74 ± 0.55	3.12	0.83
1996	13	5.21 ± 2.69	13.42	2.81	1.01 ± 0.54	2.48	0.41
1997	25	6.20 ± 2.95	14.22	2.90	1.24 ± 0.53	2.16	0.35
1998	25	5.98 ± 3.38	15.22	2.53	0.93 ± 0.45	2.03	0.33
1999	26	7.41 ± 3.91	18.73	3.23	1.33 ± 0.68	3.11	0.47
2000	25	6.64 ± 3.98	17.06	3.26	1.37 ± 0.67	3.43	0.62
2001	27	6.42 ± 3.55	15.21	3.11	1.45 ± 0.58	2.95	0.70

Table 2. (continued)

Year	No. of Carbon Samples	Organic Carbon: OC sample population mean ± SD	Max OC	Min OC	Elemental Carbon: EC sample population mean ± SD	Max EC	Min EC
Mira Loma:							
1994	24	14.48 ± 5.77	27.88	5.67	1.23 ± 0.39	2.34	0.54
1995	22	15.67 ± 7.87	28.24	6.19	1.51 ± 0.76	3.49	0.64
1996	25	15.35 ± 6.43	31.49	6.09	1.30 ± 0.41	2.31	0.57
1997	26	14.52 ± 5.23	22.47	7.41	1.32 ± 0.37	2.34	0.46
1998	24	13.77 ± 7.38	28.18	4.16	1.08 ± 0.45	1.96	0.32
1999	24	17.51 ± 7.26	30.83	5.95	1.53 ± 0.68	2.92	0.58
2000	25	15.05 ± 6.17	25.12	6.19	1.43 ± 0.49	2.56	0.81
2001	26	15.91 ± 6.81	28.03	6.02	1.56 ± 0.56	2.68	0.68
Riverside:							
1994	25	7.34 ± 2.05	11.54	4.09	0.96 ± 0.27	1.59	0.56
1995	23	8.79 ± 3.67	16.54	3.50	1.19 ± 0.44	2.41	0.67
1996	26	6.83 ± 2.08	11.91	3.89	0.98 ± 0.29	1.62	0.47
1997	26	6.47 ± 1.91	10.82	3.65	0.97 ± 0.27	1.78	0.59
1998	26	5.66 ± 2.15	9.54	2.47	0.74 ± 0.24	1.05	0.21
1999	26	7.72 ± 2.26	12.14	4.14	1.03 ± 0.32	1.68	0.48
2000	26	6.95 ± 1.92	10.63	3.52	1.00 ± 0.23	1.52	0.59
2001	26	6.89 ± 2.02	10.03	3.02	1.05 ± 0.42	2.01	0.50
Santa Maria:							
1994	26	3.45 ± 1.25	6.37	1.90	0.33 ± 0.14	0.59	0.09
1995	24	3.82 ± 1.09	6.46	2.04	0.43 ± 0.10	0.62	0.24
1996	24	3.08 ± 0.90	4.83	1.69	0.35 ± 0.17	0.76	0.04
1997	26	3.13 ± 0.85	4.72	1.83	0.35 ± 0.12	0.62	0.18
1998	26	2.95 ± 0.92	5.17	1.85	0.18 ± 0.10	0.37	0.00
1999	23	3.60 ± 1.33	6.40	1.80	0.28 ± 0.19	0.83	0.01
2000	26	3.50 ± 1.34	7.28	1.73	0.32 ± 0.12	0.58	0.12
2001	26	3.48 ± 0.97	5.04	1.99	0.40 ± 0.13	0.67	0.19
Upland:							
1994	26	8.90 ± 2.39	13.18	4.35	1.18 ± 0.30	1.69	0.64
1995	23	10.63 ± 3.99	18.13	4.00	1.51 ± 0.51	2.61	0.71
1996	25	8.11 ± 2.19	12.99	4.33	1.23 ± 0.40	2.14	0.62
1997	25	7.88 ± 1.92	13.07	5.42	1.14 ± 0.31	1.88	0.42
1998	25	6.71 ± 2.24	10.60	3.58	0.89 ± 0.32	1.48	0.39
1999	26	9.35 ± 2.41	13.39	5.28	1.28 ± 0.45	1.97	0.54
2000	26	8.28 ± 1.94	12.79	5.07	1.22 ± 0.28	1.73	0.73
2001	27	8.11 ± 2.07	12.58	4.20	1.39 ± 0.45	2.31	0.71

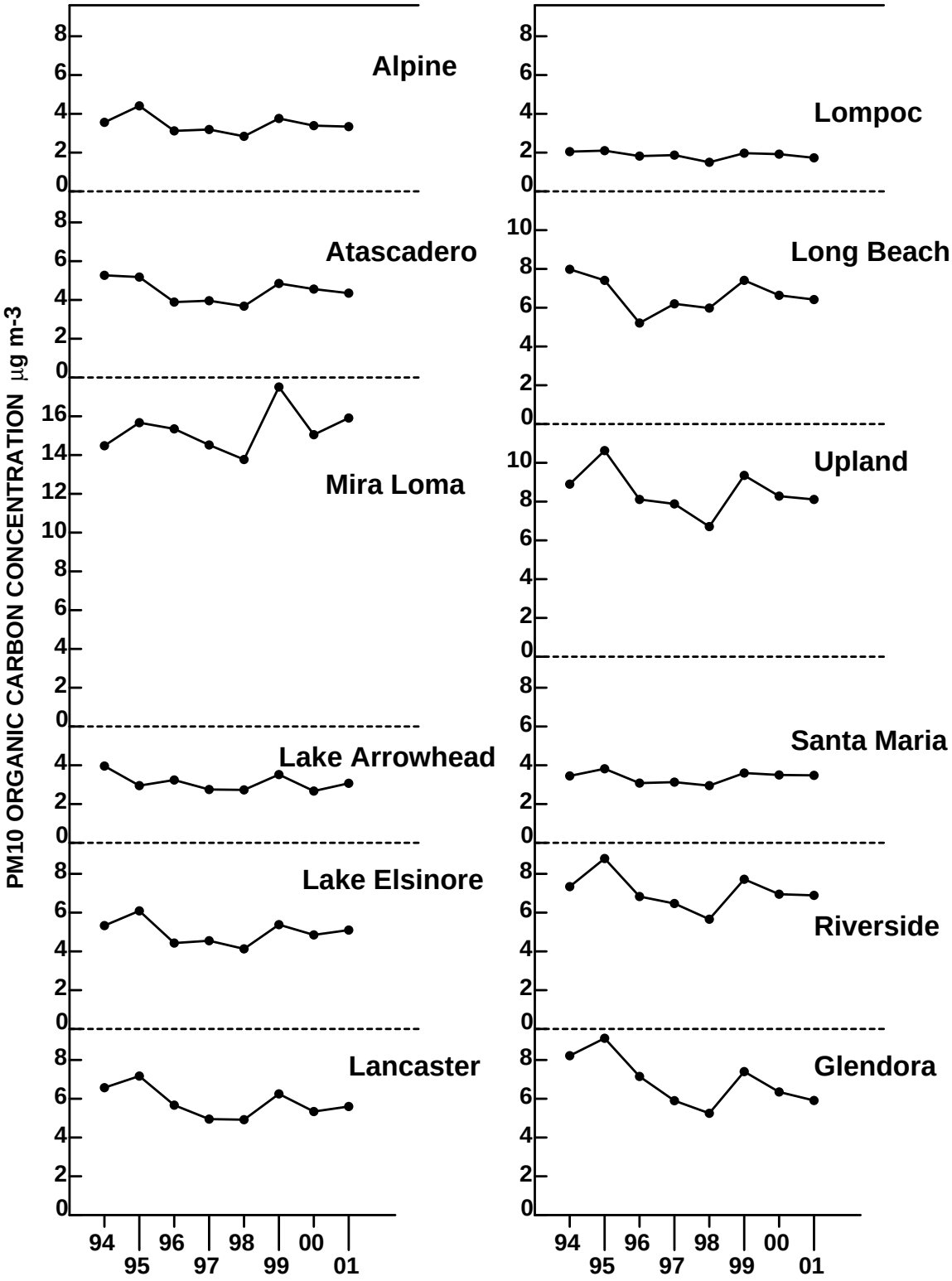

Figure 3: Annual average PM_{10} organic carbon, 1994-2001.

variation with high concentrations in the winter and decreased concentrations in the spring and summer, especially at Long Beach, Lancaster and the coastal sites in San Luis Obispo and Santa Barbara counties. That seasonal variation is not as pronounced at Riverside and other locations farther inland. At Lake Arrowhead and Alpine the situation is reversed with higher EC concentrations found during the summer than during the winter months. However, at Alpine this is not as pronounced during the later years of sampling.

Fine particle organic species in Los Angeles have been shown to be mostly due to emissions from primary sources (Gray and Cass, 1998; Hildemann et al., 1993; Schauer et al., 1996). Therefore, it is not surprising that particulate organic compound concentrations follow a seasonal direction that is similar to EC as shown in the bi-weekly time series measurements in Figures 7 through 9. Again, during the stagnant winter months, high OC concentrations are observed at many of the coastal and rural sites with lower concentrations observed during the spring and summer months. Notable exceptions occur in the mountain sites which experience summer maxima. This seasonal difference between coastal and inland sites in the Los Angeles area has been explained previously by Gray et al. (1986). In the winter, the net air mass motion is toward the offshore direction thereby placing sites like Long Beach downwind of the city at a time when wind speeds are slow and early morning surface temperature inversions are common. In the summer, the prevailing wind direction is reversed and strong on-shore flow transports aerosol from the Los Angeles Basin deep into the mountains. Other inland sites such as Mira Loma have high OC concentrations during the summer months as well.

The presence of carbonate carbon on some of the Leg C samples was investigated. The carbonate carbon peak, which can be seen in the sample thermograms during analysis, is from calcium carbonate and can be estimated by manually integrating the peak which would otherwise be lumped in with the organic carbon concentration calculated by the instrument. Carbonate carbon levels are typically low (1-2% of total carbon) and found primarily at Mira Loma and neighboring sampling sites of Riverside, Upland, and Glendora. Lancaster also shows slight carbonate carbon concentrations during winter months. Complete data including carbonate carbon concentrations is given in Appendix A.

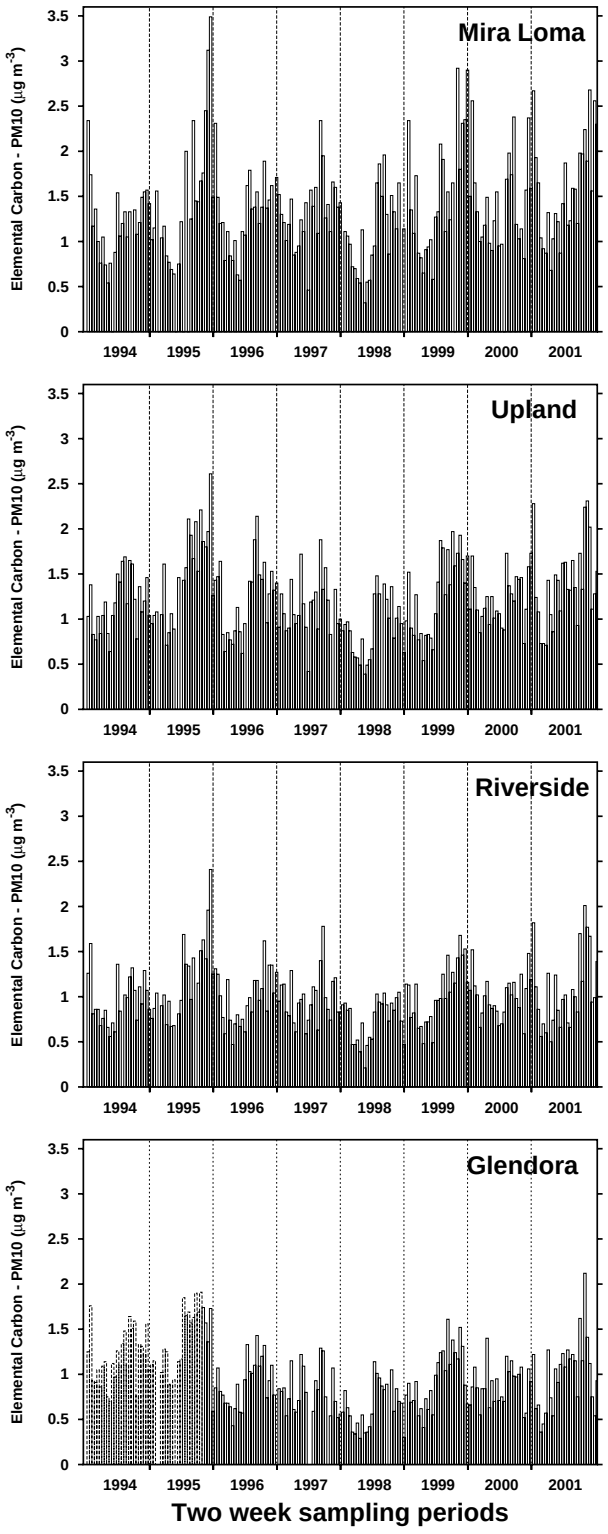

Figure 4: Time series of 2-week average PM_{10} elemental carbon concentrations found in Southern California at Mira Loma, Upland, Riverside and Glendora. (Glendora includes data from the San Dimas site for 1994 and 1995.)

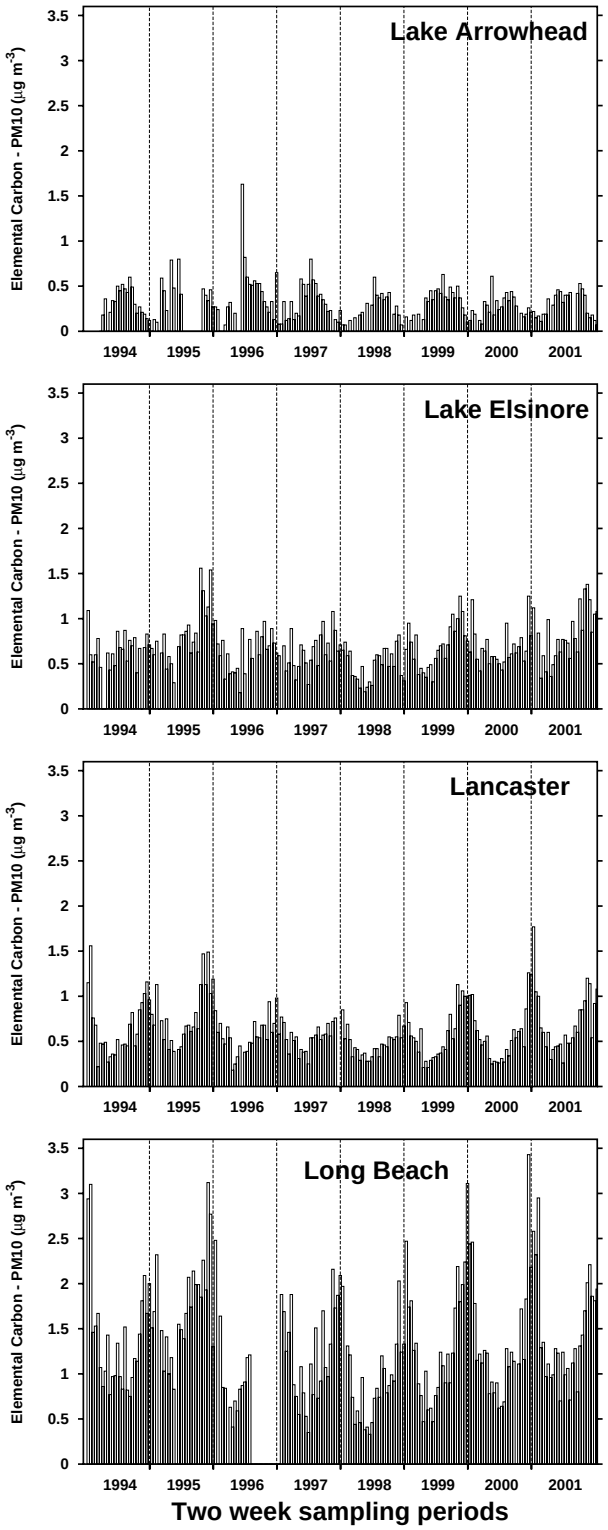

Figure 5: Time series of 2-week average PM_{10} elemental carbon concentrations found in Southern California at Lake Arrowhead, Lake Elsinore, Lancaster, and Long Beach.

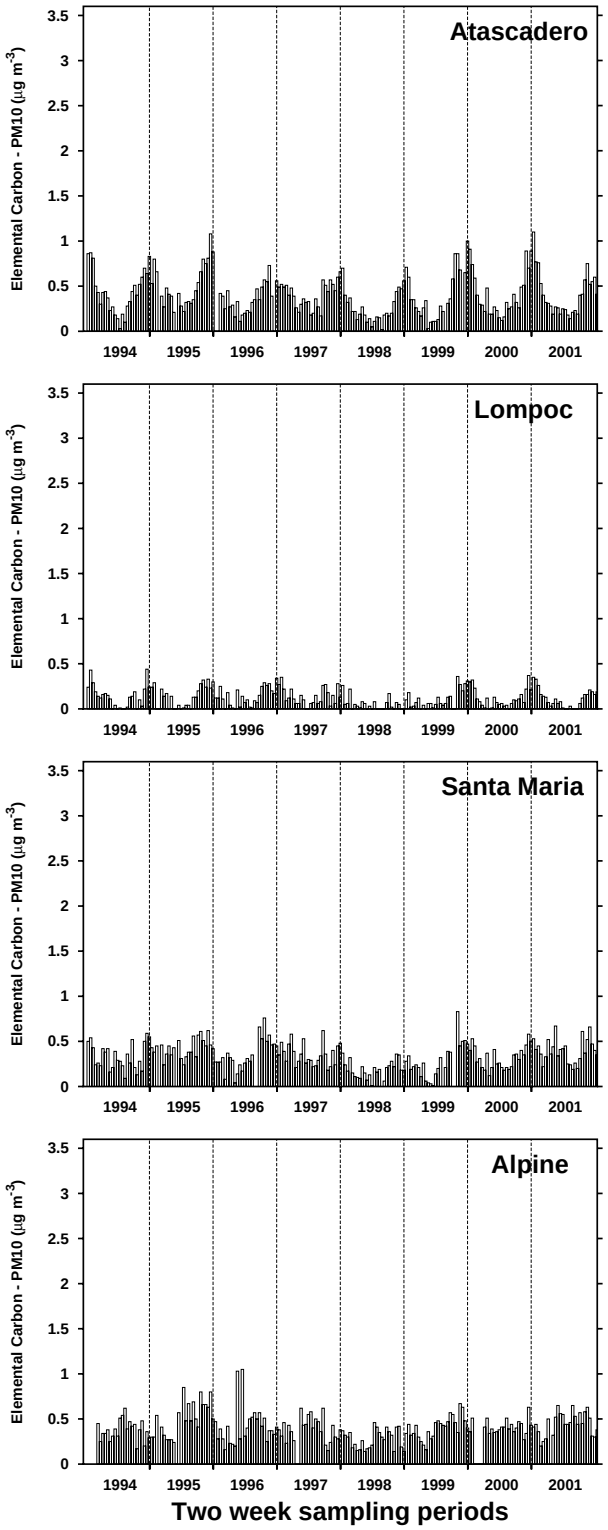

Figure 6: Time series of 2-week average PM_{10} elemental carbon concentrations found in Southern California at Atascadero, Lompoc, Santa Maria, and Alpine.

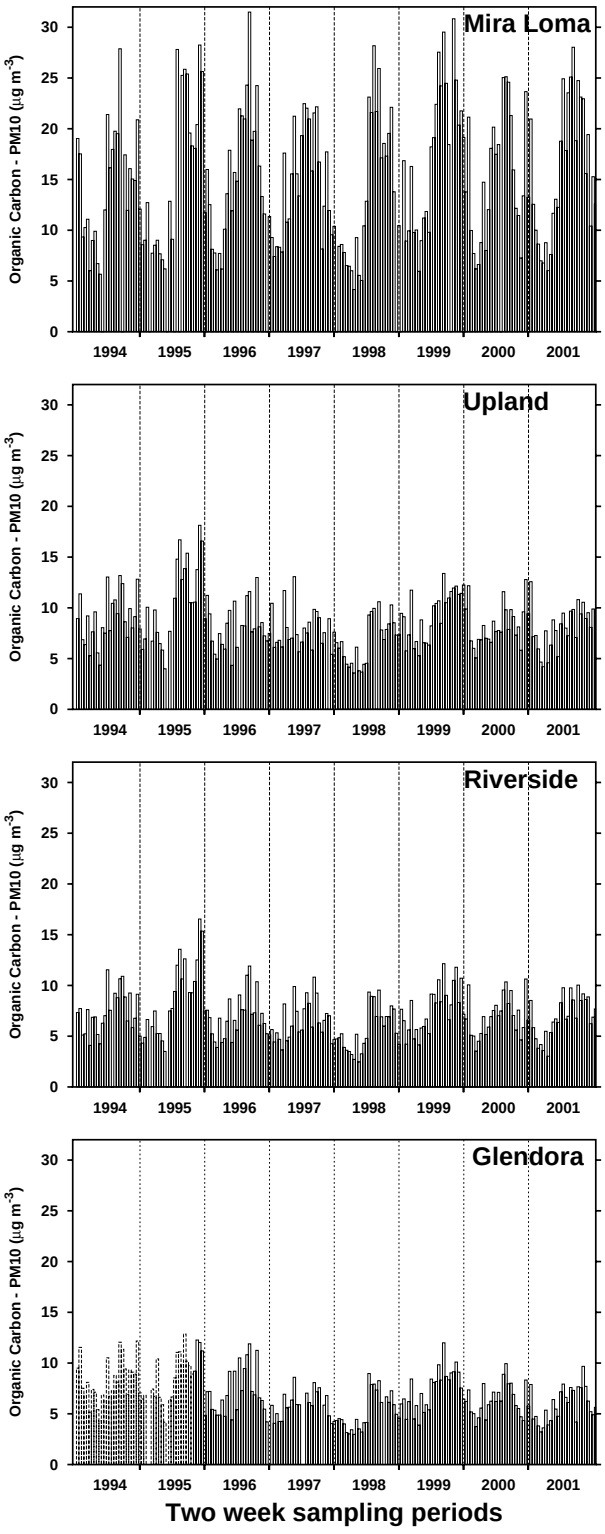

Figure 7: Time series of 2-week average PM_{10} organic carbon concentrations found in Southern California at Mira Loma, Upland, Riverside, and Glendora. (Glendora includes data from the San Dimas site for 1994 and 1995.)

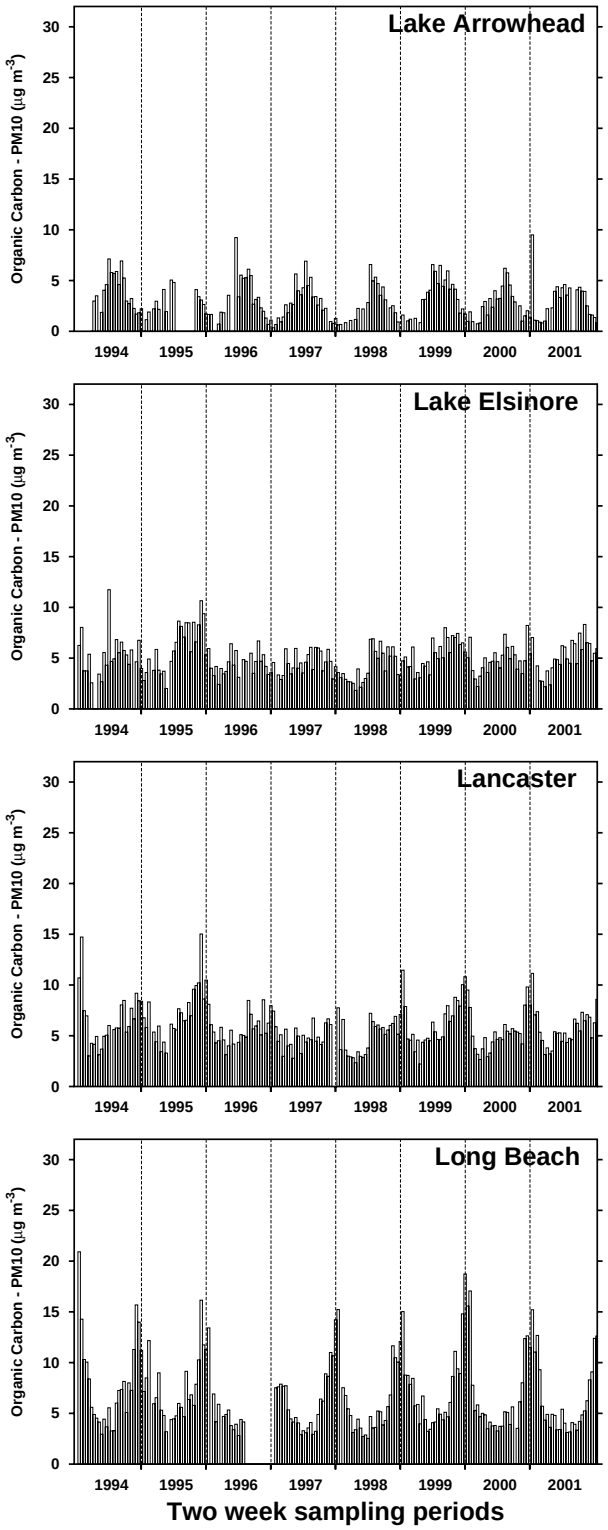

Figure 8: Time series of 2-week average PM_{10} organic carbon concentrations found in Southern California at Lake Arrowhead, Lake Elsinore, Lancaster, and Long Beach.

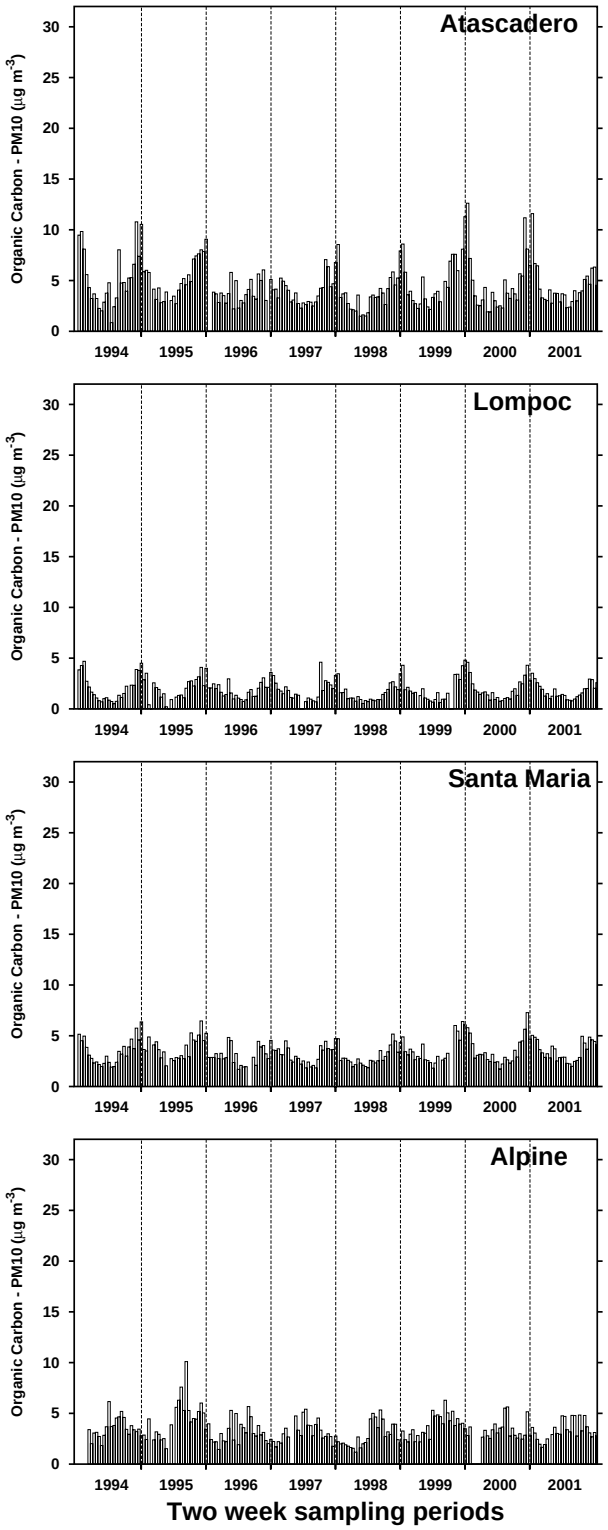

Figure 9: Time series of 2-week average PM_{10} organic carbon concentrations found in Southern California at Atascadero, Lompoc, Santa Maria, and Alpine.

3.2 Leg D PM2.2 OC/EC concentration data during 2000-2001

The Leg D Two-Week cassette for collection of fine particle OC/EC was introduced at the end of year 2000, and 2001 is the first complete year for these samples. Year 2000 samples are not considered for discussion because of problems encountered with the operation of the impactors. Annual average $PM_{2.2}$ elemental carbon particle concentrations for 2001 across the Children's Health Study monitoring network ranged from 0.08 μg m^{-3} to 0.78 μg m^{-3} as shown in Table 3. As was the case with PM_{10} samples, the lowest average EC concentrations for the year were found at the Lompoc site and the highest EC concentrations were found at the Mira Loma site. Strong seasonal variations with much higher EC concentrations in the winter months are present at Long Beach and Mira Loma, the two sites with the highest overall EC concentrations. This seasonal variation can also be seen at many of the other sites as shown in the bi-weekly time series measurements of elemental carbon in Figures 10 and 11. Elemental carbon seasonal variations are very similar to those found with the Leg C samples. However, overall EC concentrations measured with the Leg D cassette are typically found to be 45-60% of the EC concentrations measured with the Leg C cassette over the same time period. This is lower than expected and will be discussed in greater detail in section 3.3.

Bi-weekly time series plots of organic carbon are shown in Figures 12 and 13. Annual average $PM_{2.2}$ organic carbon particle concentrations for 2001 ranged from 1.10 μg m^{-3} to 5.36 μg m^{-3}. Lompoc again demonstrated the lowest organic carbon concentrations. The highest organic carbon concentrations were found at Mira Loma, however, Upland was a close second with 5.32 μg m^{-3}. OC concentrations measured with the Leg D cassette were typically found to be in the range 63-78% of those measured with the Leg C cassette. This was as expected, since a greater amount of OC is present in the 2.2 μm to 10 μm size range due in part to the presence of humic material and plant fragments in soil dust and road dust.

Table 3. Statistical Description of Annual Average Fine Carbon Concentrations measured on Leg D using Two-Week Samplers (μg m^{-3})

Site Year	No. of Carbon Samples	— Organic Carbon — OC sample population mean ± SD	Max OC	Min OC	— Elemental Carbon — EC sample population mean ± SD	Max EC	Min EC
Alpine:							
2001	26	2.40 ± 0.73	3.82	1.24	0.19 ± 0.05	0.31	0.09
Atascadero:							
2001	26	2.91 ± 1.77	9.10	1.42	0.28 ± 0.19	0.97	0.06
Glendora:							
2001	27	4.20 ± 1.21	5.99	2.08	0.43 ± 0.18	0.94	0.23
Lake Arrowhead:							
2001	20	2.66 ± 1.75	8.23	0.57	0.14 ± 0.07	0.25	0.03
Lake Elsinore:							
2001	25	3.51 ± 1.04	5.37	1.62	0.42 ± 0.22	1.04	0.15
Lancaster:							
2001	26	3.81 ± 1.25	8.26	2.14	0.40 ± 0.24	1.22	0.14
Lompoc:							
2001	26	1.10 ± 0.54	2.70	0.50	0.08 ± 0.08	0.29	0.00
Long Beach:							
2001	25	4.12 ± 2.26	9.89	1.83	0.67 ± 0.60	2.31	0.14
Mira Loma:							
2001	26	5.36 ± 1.70	9.84	2.53	0.78 ± 0.55	2.75	0.22
Riverside:							
2001	26	4.23 ± 1.11	6.24	2.00	0.53 ± 0.30	1.53	0.14
Santa Maria:							
2001	26	1.66 ± 0.66	3.01	0.78	0.21 ± 0.10	0.39	0.04
Upland:							
2001	26	5.32 ± 1.32	7.56	2.73	0.62 ± 0.21	1.05	0.25

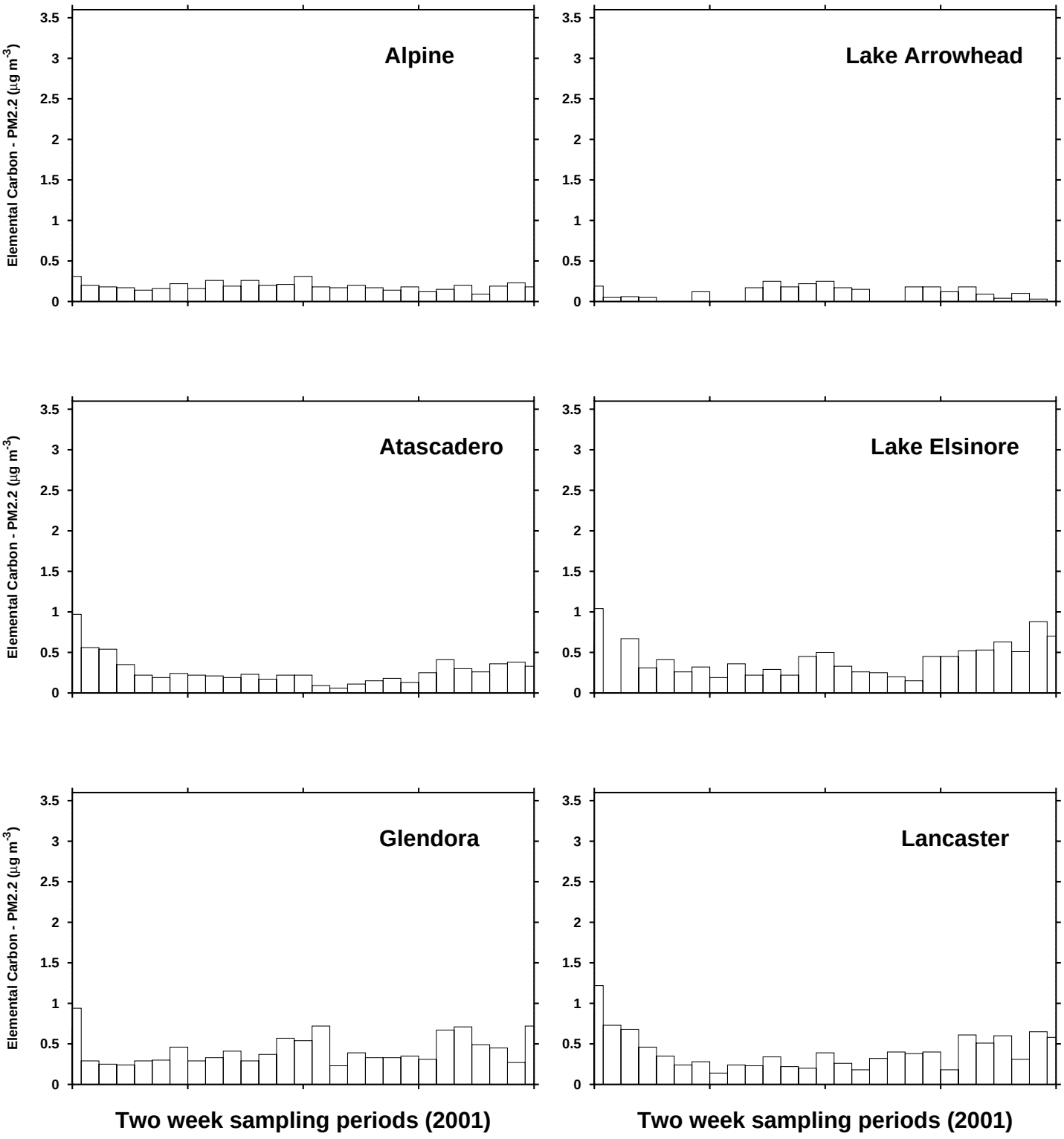

Figure 10: Time series of 2-week average $PM_{2.2}$ elemental carbon concentrations found in Southern California at Alpine, Atascadero, Glendora, Lake Arrowhead, Lake Elsinore and Lancaster.

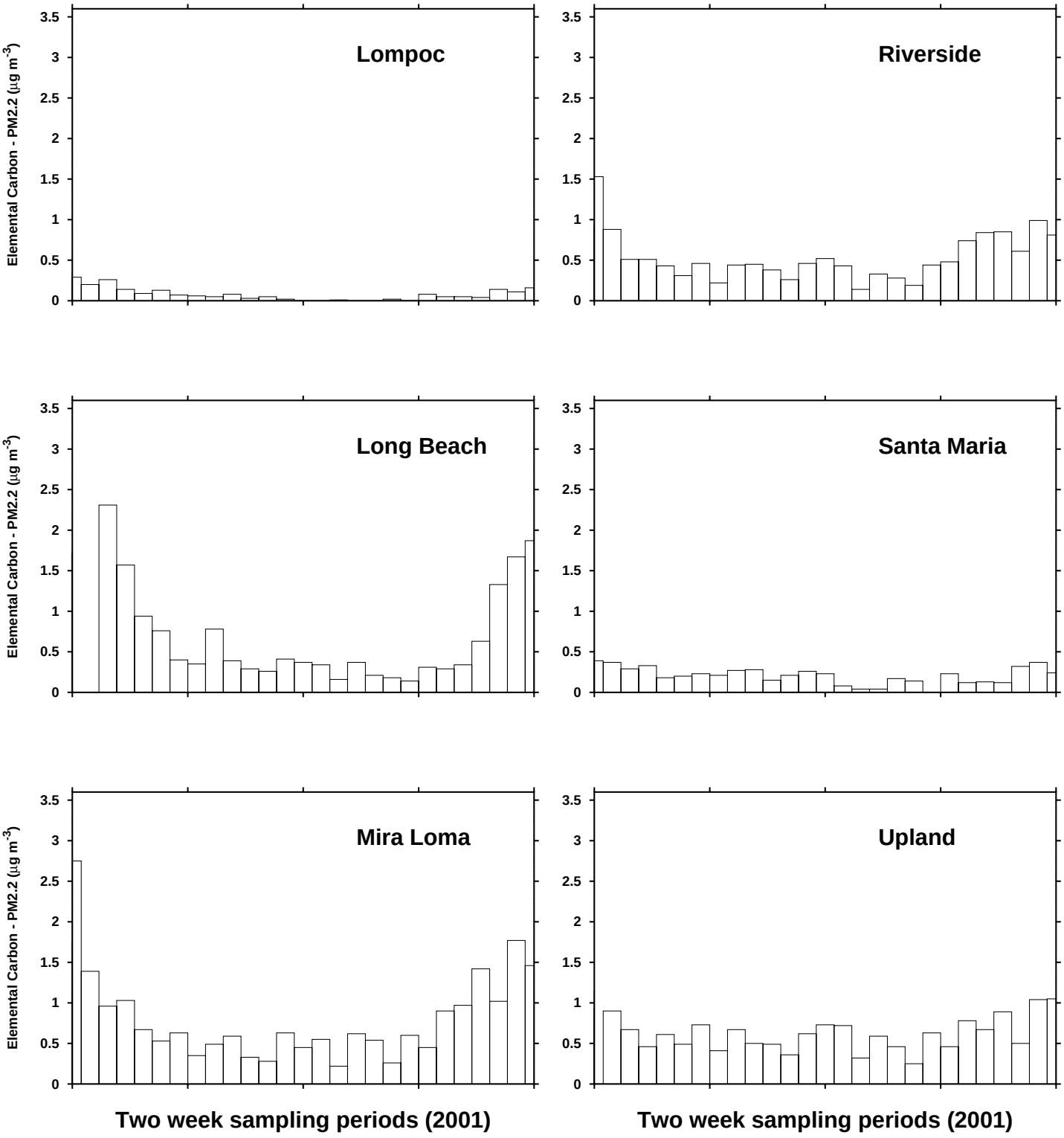

Figure 11: Time series of 2-week average $PM_{2.2}$ elemental carbon concentrations found in Southern California at Lompoc, Long Beach, Mira Loma, Riverside, Santa Maria, and Upland.

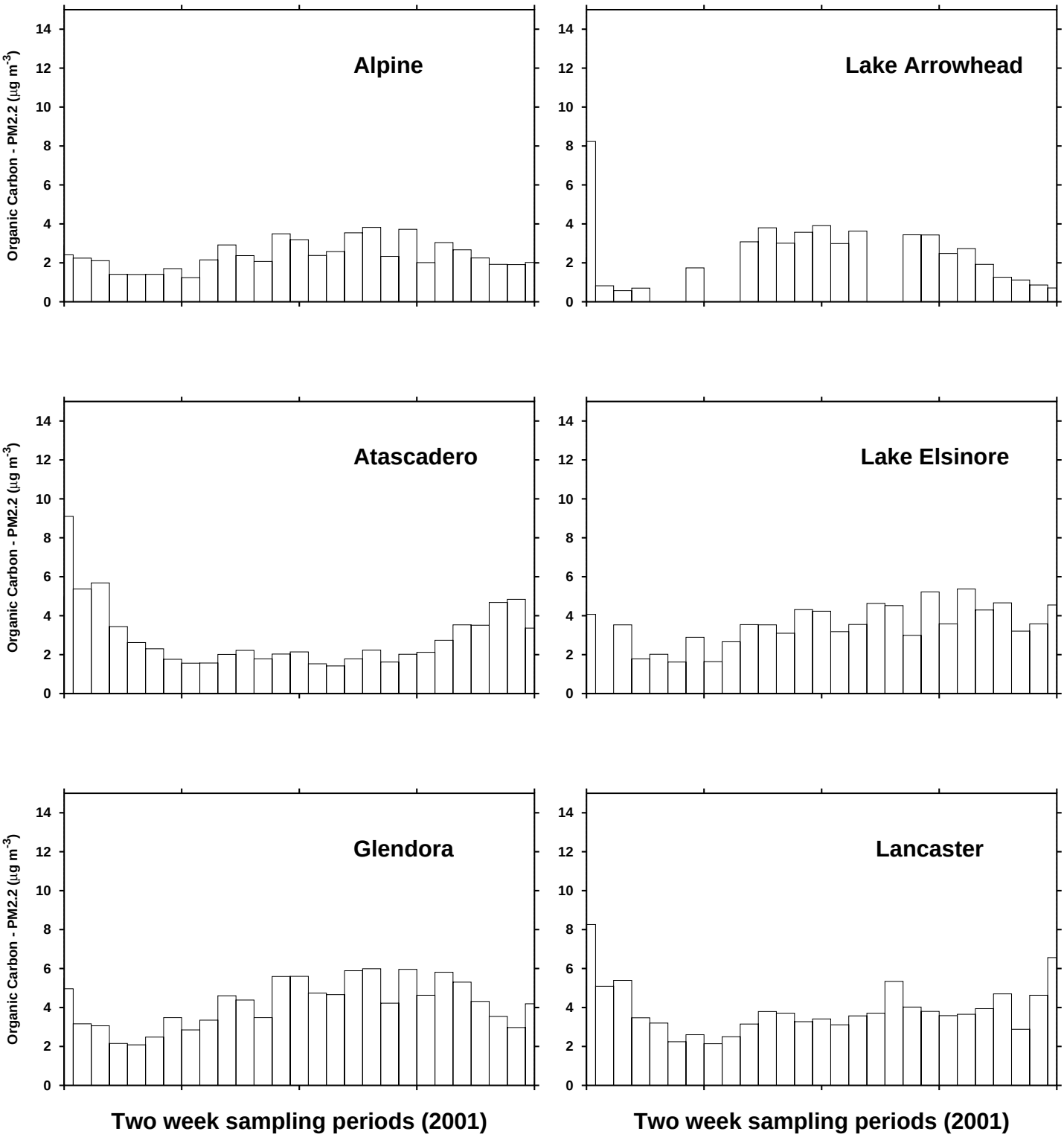

Figure 12: Time series of 2-week average $PM_{2.2}$ organic carbon concentrations found in Southern California at Alpine, Atascadero, Glendora, Lake Arrowhead, Lake Elsinore and Lancaster.

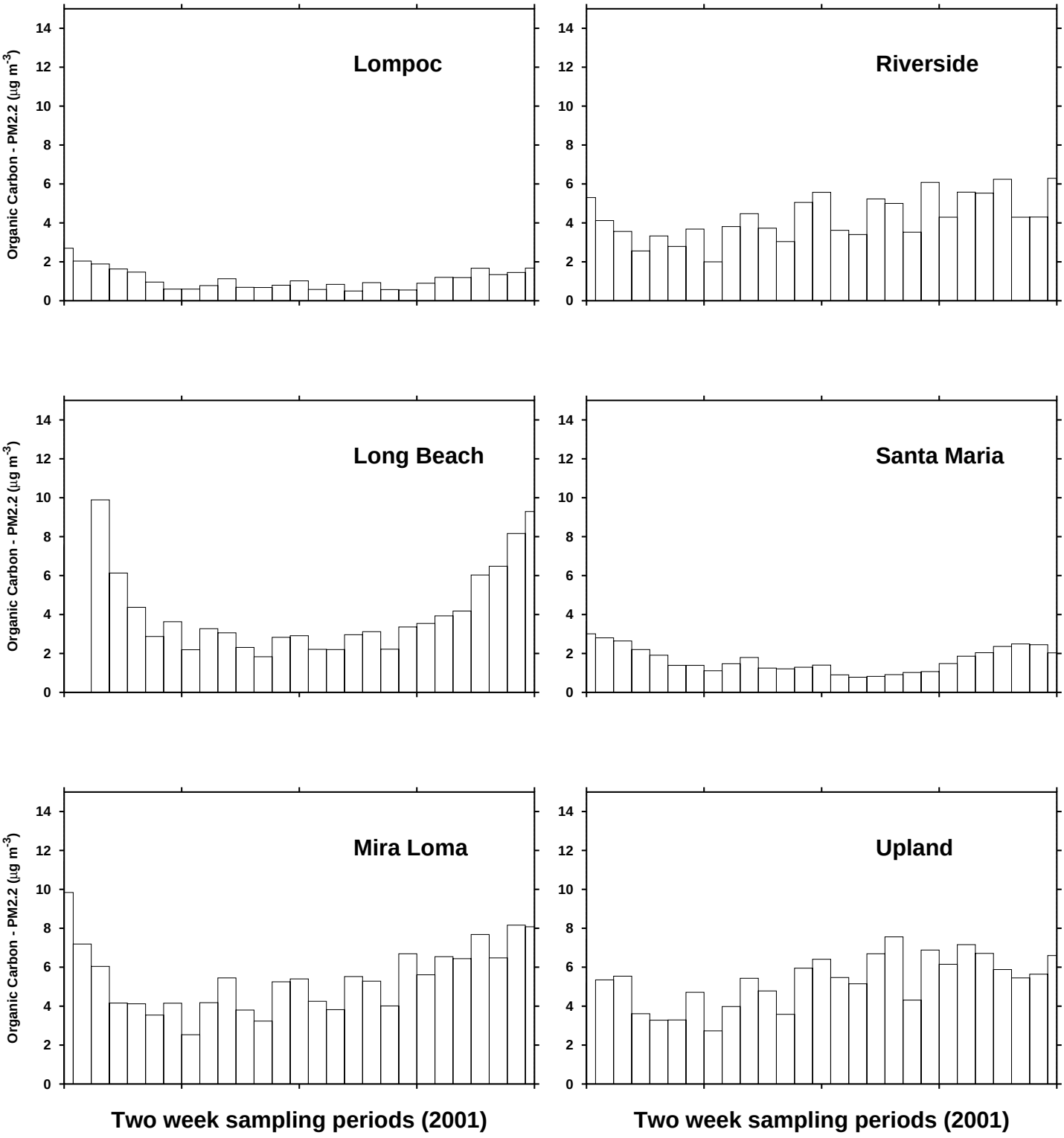

Figure 13: Time series of 2-week average $PM_{2.2}$ organic carbon concentrations found in Southern California at Lompoc, Long Beach, Mira Loma, Riverside, Santa Maria, and Upland.

3.3 Leg C vs. Leg D comparison

The fine particle mass concentration, nitrate, sulfate, and ammonium ion concentration measurements available from the Children's Health Study database were acquired downstream of impactors having a 2.5 micron size cut. However, organic and elemental carbon data with a similar size cut was not available until the introduction of the Leg D cassettes near the end of year 2000. Therefore, to determine the contribution of fine particle carbon species to the fine particulate matter and construct pie charts representing the chemical composition of the fine material collected at the Children's Health Study sampling sites on dates before the fine particle carbon data was available, the measured PM_{10}-equivalent OC and EC concentrations are adjusted to the extent possible to estimate a $PM_{2.5}$ size cut ($PM_{2.5}$ = particulate matter with aerodynamic diameter less than 2.5 μm). It is assumed that the 2.2 μm cut-point of Leg D is close enough to the 2.5 μm cut-point of the Leg used to collect particles for mass and ion measurements for both to be considered equivalent.

3.3.1 Organic carbon

In the previous report, the factor of 0.78 was used to convert the data from the approximate PM_{10} size cut of the Leg C cassettes to an estimated $PM_{2.5}$ fraction. This factor was derived by collocating the CHS Two-Week sample holder with $PM_{2.5}$, PM_{10}, and TSP samplers over a 10 week period at a single location in Pasadena, California. Clearly, the relative impact of coarse particles will vary significantly across sites and over time such that this would only be a good estimate for locations and times with similar coarse material in the atmosphere. Since the addition of the Leg D $PM_{2.2}$ cassettes in late 2000, we have side-by-side data and can now use site specific factors to obtain a better correction factor to apply to the 1994-2000 Leg C data. Since only a little over a year's worth of side-by-side comparison samples are currently available, it is too soon to examine seasonal effects on the correction factor, but that is a logical next step once the year 2002-2004 samples are analyzed at a future time.

Linear regression analysis was performed on the organic carbon measured side-by-side on samples from Leg C and Leg D with Leg C as the independent variable. These results are given in Table 4 and presented graphically in Figure 14 for better visualization. Good correlations are found at all sites except Mira Loma which has much higher concentrations of organic carbon on the Leg C samples than on the Leg D samples. This is not an unusual result since the amount of resuspended crustal material (road dust and soil debris) will dominate the coarse particle carbon. It is also important to remember that the Leg C sample is really a TSP-like sample and can be impacted by bigger than PM_{10} material. Sites that are impacted by a lot of crustal material will tend to have poorer agreement between the effective PM_{10} OC and $PM_{2.2}$ OC. This would suggest that Mira Loma is impacted by crustal material more than the other sites based on a review of site specific OC data.

Table 4. Linear Regression Comparison of Organic Carbon – Leg C vs. Leg D

Site	Number	Leg D/Leg C	Slope	Intercept	Correlation	R^2
Alpine	30	0.73	0.65	0.25	0.93	0.86
Atascadero	29	0.65	0.88	-0.90	0.96	0.93
Glendora	32	0.70	0.67	0.19	0.92	0.84
Lake Arrowhead	23	0.78	0.87	-0.20	0.99	0.98
Lake Elsinore	58	0.69	0.61	0.36	0.95	0.90
Lancaster	33	0.69	0.68	0.04	0.93	0.87
Lompoc	33	0.63	0.70	-0.13	0.94	0.88
Long Beach	30	0.68	0.69	-0.03	0.97	0.95
Mira Loma	33	0.40	0.13	3.51	0.43	0.19
Riverside	64	0.63	0.51	0.73	0.87	0.77
Santa Maria	33	0.47	0.59	-0.41	0.92	0.85
Upland	31	0.65	0.59	0.52	0.90	0.82

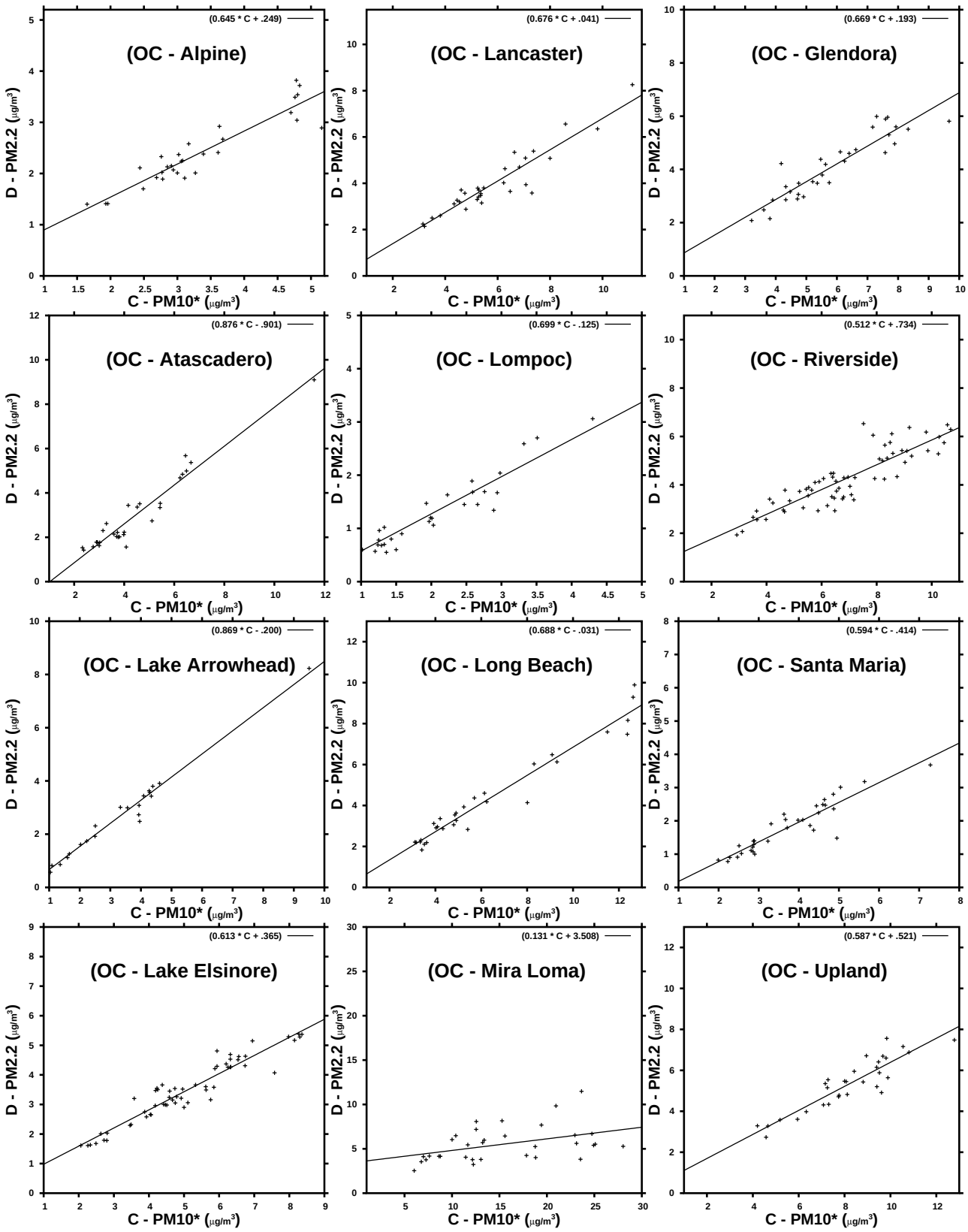

Figure 14: Linear regression comparison of Leg C vs Leg D organic carbon.

3.3.2 Elemental carbon

Previous findings show that more than 90 percent of airborne EC mass is found in sub-micrometer particles (Seinfeld and Pandis, 1998). In our previous report (Salmon et al., 2001) fine particle samples were collected downstream of an AIHL cyclone for comparison with the Leg C Two-Week Sampler during a 10-week test. Those measurements showed that EC concentrations measured with the fine particle sampler were on average 98% of those measured with the Leg C Two-Week sampler. Thus, very little adjustment of EC measurements was thought to be required to convert Leg C EC values for comparison with other $PM_{2.5}$ concentrations.

However, as seen in the linear regression analysis in Table 5 and Figure 15, larger EC concentrations are being determined from Leg C than from Leg D cassettes and there is poor correlation between the two cassettes at most sites. Some possible explanations for the EC concentrations to be greater on Leg C cassettes than on Leg D cassettes include:

1. The impact of tire wear which does contain some EC could be a factor. If the samples contain PM greater than 10 μm then the impact of tire wear could be greater at some locations.

2. The $PM_{2.2}$ impactor upstream of Leg D could be affecting the sample and causing possible particle loss.

3. There is also carbonate carbon present on some of the Leg C cassettes. The carbonate carbon peak seen in the sample thermograms is from calcium carbonate, however, other carbonate compounds (such as magnesium carbonate) evolve under different conditions. To this end, it is plausible that other carbonate compounds present in soil are being reported as EC on the Leg C cassettes. Again, this goes back to the fact that the samples are not really a precise PM_{10} cut and in the presence of a lot of crustal material may be impacted more from crustal material than a typical PM_{10}. However, only 5 of the 12 sites show any carbonate carbon present and poor correlation between EC measured on Leg C vs. Leg D cassettes is evident at sites with no carbonate carbon.

It is not possible to calculate site specific correction factors for Leg C to Leg D EC based on the correlation coefficients from linear regression analyses (Cohen, 1988). At the present time, no attempt at EC correction will be attempted and the elemental carbon (EC) concentrations from the Leg C cassettes will be used as they represent the maximum possible values for fine particle EC.

It is strongly suggested that additional testing be done to determine the cause of the EC reduction on the Leg D cassettes. Perhaps by side-by-side sampling with samples downstream of AIHL cyclones or other proven $PM_{2.5}$ sampling methods. Previous co-located sampling comparisons of particle-phase organic compounds measured with Leg C cassettes and Caltech samplers (Manchester et al., 1995) show excellent agreement between the two, suggesting that the problem most likely rests with the Leg D portion of the Two-Week Sampler.

Table 5. Linear Regression Comparison of Elemental Carbon – Leg C vs. Leg D

Site	Number	Leg D/Leg C	Slope	Intercept	Correlation	R^2
Alpine	30	0.49	0.10	0.16	0.24	0.06
Atascadero	29	0.69	0.68	-0.00	0.90	0.82
Glendora	32	0.49	0.24	0.21	0.51	0.26
Lake Arrowhead	23	0.45	0.38	0.02	0.75	0.57
Lake Elsinore	58	0.56	0.46	0.07	0.64	0.41
Lancaster	33	0.60	0.68	-0.06	0.91	0.82
Lompoc	33	0.86	0.76	-0.00	0.89	0.79
Long Beach	30	0.49	0.83	-0.44	0.69	0.48
Mira Loma	33	0.53	0.70	-0.25	0.74	0.55
Riverside	64	0.53	0.42	0.11	0.61	0.77
Santa Maria	33	0.57	0.44	0.05	0.50	0.25
Upland	31	0.50	0.22	0.35	0.40	0.16

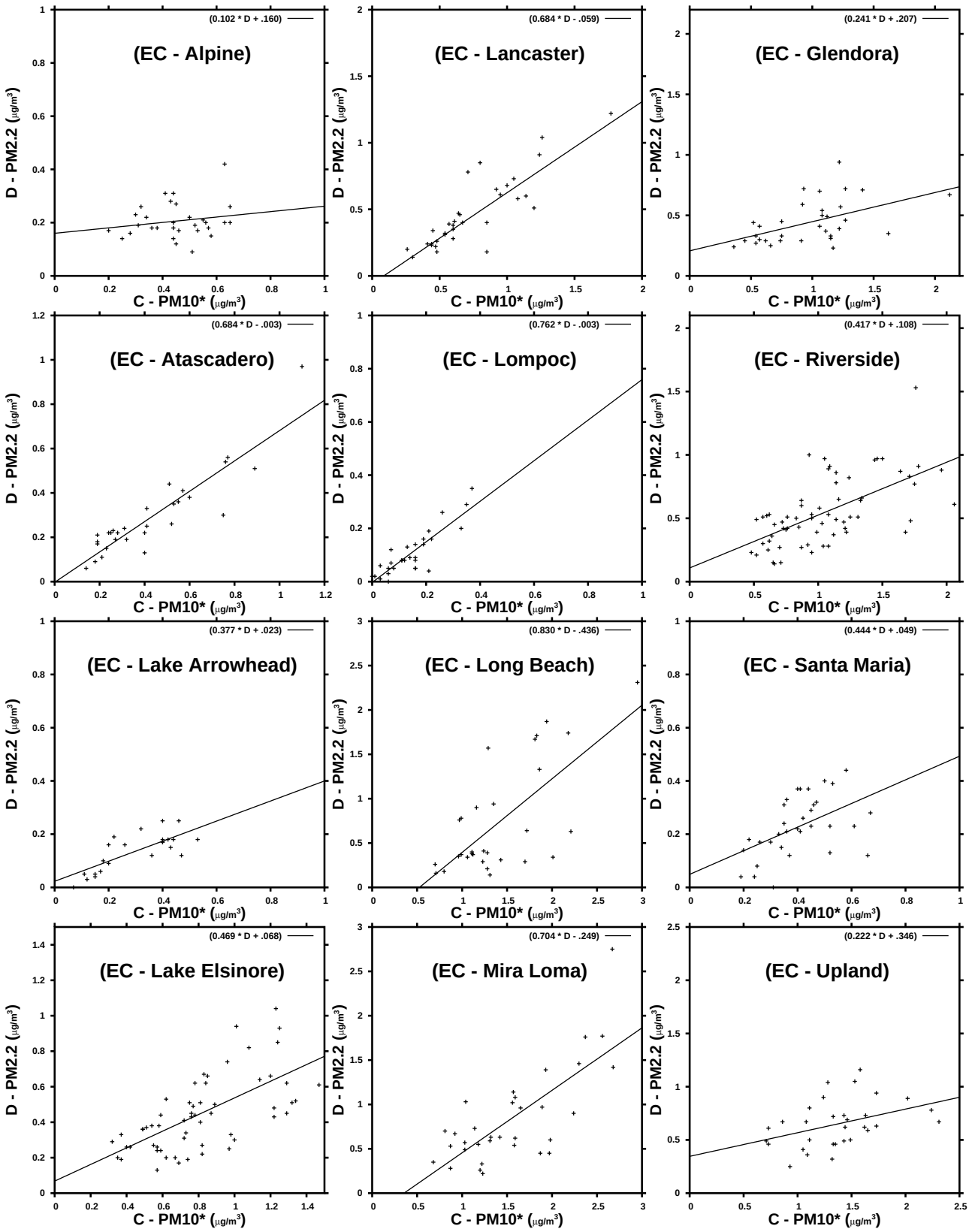

Figure 15: Linear regression comparison of Leg C vs Leg D elemental carbon.

3.4 Mass balance

The estimated annual average fine particle ($PM_{2.5}$) organic compound and elemental carbon concentrations are given alongside fine particle mass and ionic species concentrations determined from samples taken on the other legs of the Two-Week samplers in Table 6.

For years 1994-2000, PM2.5 OC was estimated from Leg C organic carbon measurements using correction factors based on site specific side-by-side Leg C and Leg D samples. For year 2001, both the estimated fine particle OC concentration from Leg C samples and the fine particle OC concentration measured by Leg D samples are given in Table 6.

To convert the Leg C Two-Week Sampler measurements to $PM_{2.5}$ values, the measured OC concentrations from the Leg C samples were adjusted by the site specific correction factors obtained by the linear regression analysis to yield estimated $PM_{2.5}$ OC concentrations. The Leg C data will be adjusted by the slope and intercept values shown in Table 4 for each site including Mira Loma.

In addition, to account for oxygen and hydrogen associated with organic material, the adjusted OC concentrations were next multiplied by 1.2 to estimate the organic matter concentrations. Factors used to convert organic carbon into organic mass in other studies range from 1.2 to 1.4 (Gray et al., 1986). The lower value was chosen for this study since a higher conversion factor would have resulted in a greater incidence of over-balanced mass.

The elemental carbon (EC) concentrations from the Leg C samples are used without any conversion factor. These values are considered to represent an upper bound for the EC concentrations. Lower annual average EC concentrations determined from Leg D samples are given for comparison in Table 6.

A mass balance can be constructed by subtracting the concentrations of all of the measured components from the measured mass concentration to determine the amount of "other" material not accounted for in the analyses that were performed. Figures 16-18 show the relative quantity of the $PM_{2.5}$ mass contributed by each of the major chemical species measured at each site during each year, 1999-2001. Data from years 1994-1998 are presented in Figures 19-23. In cases where the sum of the mass of species identified chemically exceeds by a small amount the mass measured gravimetrically, the species contributions are presented as a percentage of the total mass of identified species. The sum of individual species measured can exceed gravimetric mass measured due to experimental uncertainties on all quantities measured. "Other" in the pie charts represents the remainder of the measured mass after all of the identified components have been subtracted. Lompoc and Santa Maria have the largest amounts of "other" material from species not measured in this study. Other components that are not accounted for in this study include mineral dust and other trace metals as well as sodium ion, which could be present from sea salt aerosol at coastal sites .

The combined mass of EC plus organic matter averaged at each site over all five years accounts for 24 to 62 percent of $PM_{2.5}$ mass at the various sites. Riverside (28%) and Lompoc (24%) lie at the low end of this range; at the high end of the range are Lancaster (62% organics plus EC) and Atascadero (57% organics plus EC). With the

exception of Riverside, the concentrations of organic compounds plus EC at Los Angeles Basin sites lie between 32 and 45 percent of $PM_{2.5}$ mass. Previous findings have placed the average of organics plus EC for the Los Angeles Basin at approximately 40 percent of fine particle mass (Gray et al., 1986), consistent with the present findings. The apparent lower relative carbon content at Riverside can be explained by the higher $PM_{2.5}$ ammonium nitrate concentration at the site. Higher carbon content percentages are found at mountain and desert sites, as well as sites further north and south. These higher percentages of carbonaceous aerosol at the outlying sites are accompanied by lower absolute carbon particle concentrations as well as lower absolute concentrations of fine particle mass, sulfate, nitrate, and ammonium ions.

Table 6. Annual Average Fine Particle ($PM_{2.5}$) Mass Concentrations ($\mu g\ m^{-3}$)

Year	Fine Mass	Fine Organic Material[a]	Fine Elemental Carbon[b]	Nitrate	Sulfate	Ammonium
Alpine:						
1994	9.04	3.05	0.38	2.03	2.06	1.23
1995	8.54	3.71	0.51	1.84	1.84	1.10
1996	9.03	2.71	0.42	1.56	1.74	0.87
1997	7.78	2.77	0.39	1.67	1.57	0.88
1998	7.51	2.50	0.28	1.48	1.29	0.76
1999	8.48	3.21	0.41	1.77	1.48	0.86
2000	7.04	2.92	0.41	1.53	1.47	0.81
2001	9.50	2.88	0.45	1.82	1.83	1.01
2001[c]		2.87	0.19			
Atascadero:						
1994	7.94	4.46	0.44	1.99	0.77	0.80
1995	7.35	4.36	0.51	1.41	0.99	0.70
1996	7.07	3.01	0.36	1.23	0.83	0.58
1997	7.41	3.08	0.41	1.43	0.69	0.55
1998	7.12	2.79	0.26	1.34	0.68	0.54
1999	7.97	4.01	0.40	1.96	0.83	0.69
2000	7.25	3.71	0.41	1.66	0.74	0.62
2001	8.69	3.49	0.41	1.92	0.84	0.68
2001[c]		3.49	0.28			
San Dimas:						
1994	22.53	6.83	1.18	8.26	2.84	3.40
1995	24.22	7.55	1.51	9.32	3.26	3.70
1996	19.93	5.77	1.11	6.48	2.74	2.56
Glendora:						
1996	19.46	5.97	0.90	5.74	2.92	2.43
1997	15.11	4.97	0.82	5.37	2.04	1.85
1998	14.06	4.45	0.64	4.97	1.87	1.72
1999	17.66	6.17	0.95	6.97	2.28	2.33
2000	15.39	5.33	0.88	5.94	2.06	2.03
2001	18.72	4.97	1.00	7.11	2.65	2.47
2001[c]		5.04	0.43			
Lake Arrowhead:						
1994	10.55	3.89	0.33	3.30	1.23	1.46
1995	7.53	2.83	0.42	2.54	0.77	1.01
1996	8.27	3.14	0.45	2.17	1.17	0.95
1997	8.38	2.63	0.31	2.24	1.14	0.97
1998	7.79	2.61	0.27	1.99	0.92	0.87
1999	7.37	3.43	0.33	2.07	0.86	0.83
2000	6.24	2.55	0.27	1.80	0.73	0.76
2001	6.64	2.97	0.30	1.88	0.88	0.82
2001[c]		3.20	0.14			

Table 6. (continued)

Year	Fine Mass	Fine Organic Material[a]	Fine Elemental Carbon[b]	Nitrate	Sulfate	Ammonium
Lake Elsinore:						
1994	13.94	4.36	0.67	3.94	2.02	1.76
1995	14.95	4.92	0.82	4.82	2.44	2.15
1996	12.85	3.69	0.64	3.21	1.97	1.41
1997	12.36	3.78	0.64	3.01	1.99	1.38
1998	10.76	3.48	0.49	2.83	1.49	1.24
1999	12.47	4.40	0.71	3.69	1.71	1.52
2000	11.36	4.01	0.68	3.25	1.56	1.37
2001	14.39	4.19	0.81	4.15	2.02	1.76
2001[c]		4.21	0.42			
Lancaster:						
1994	9.26	5.38	0.66	2.71	0.95	1.14
1995	8.57	5.87	0.79	2.26	1.10	1.00
1996	8.29	4.65	0.57	1.75	0.90	0.73
1997	7.80	4.07	0.54	1.92	0.91	0.83
1998	7.59	4.04	0.48	1.88	0.92	0.84
1999	7.55	5.12	0.58	1.96	0.79	0.77
2000	7.14	4.38	0.57	2.06	0.89	0.84
2001	8.64	4.59	0.70	2.37	0.96	0.93
2001[c]		4.58	0.40			
Lompoc:						
1994	5.93	1.57	0.14	0.81	1.04	0.43
1995	6.01	1.61	0.15	0.83	1.34	0.50
1996	6.71	1.38	0.13	0.79	1.10	0.42
1997	5.26	1.42	0.15	0.74	0.99	0.34
1998	4.77	1.11	0.05	0.67	0.85	0.32
1999	5.05	1.51	0.12	0.74	0.93	0.35
2000	5.31	1.46	0.12	0.71	1.02	0.37
2001	5.97	1.30	0.11	0.82	1.13	0.36
2001[c]		1.32	0.09			
Long Beach:						
1994	16.68	6.55	1.40	5.93	2.77	2.58
1995	22.16	6.08	1.74	7.19	3.87	3.17
1996	14.08	4.27	1.01	3.82	2.81	1.73
1997	17.18	5.08	1.24	4.60	2.85	1.91
1998	15.19	4.90	0.93	4.09	2.04	1.62
1999	17.60	6.08	1.33	5.17	2.58	2.07
2000	16.15	5.44	1.37	4.72	2.41	1.94
2001	19.07	5.26	1.45	5.17	3.34	2.38
2001[c]		4.94	0.67			

Table 6. (continued)

Year	Fine Mass	Fine Organic Material[a]	Fine Elemental Carbon[b]	Nitrate	Sulfate	Ammonium
Mira Loma:						
1994	31.64	6.49	1.23	13.61	2.91	4.89
1995	35.78	6.68	1.51	16.10	3.07	5.76
1996	30.23	6.63	1.30	11.33	2.88	4.10
1997	25.62	6.50	1.32	9.68	2.36	3.35
1998	24.63	6.38	1.08	9.44	2.09	3.35
1999	27.77	6.96	1.53	11.35	2.44	3.94
2000	26.54	6.58	1.43	10.53	2.29	3.67
2001	29.84	6.71	1.56	12.22	2.72	4.24
2001[c]		6.43	0.78			
Riverside:						
1994	25.80	5.39	0.96	10.98	2.52	4.13
1995	26.47	6.28	1.19	11.70	2.66	4.27
1996	22.41	5.07	0.98	8.67	2.43	3.14
1997	19.71	4.86	0.97	7.41	2.14	2.77
1998	19.30	4.36	0.74	7.19	1.90	2.67
1999	22.06	5.62	1.03	9.11	2.23	3.23
2000	20.19	5.15	1.00	8.17	2.04	2.98
2001	22.15	5.11	1.05	9.09	2.30	3.30
2001[c]		5.08	0.53			
Santa Maria:						
1994	6.93	1.96	0.33	1.43	1.28	0.68
1995	8.40	2.23	0.43	1.68	1.71	0.92
1996	6.95	1.70	0.35	1.21	1.39	0.57
1997	6.72	1.74	0.35	1.22	1.39	0.54
1998	6.58	1.61	0.18	1.15	1.18	0.53
1999	6.77	2.07	0.28	1.30	1.16	0.54
2000	6.90	2.00	0.32	1.30	1.27	0.56
2001	7.60	1.98	0.40	1.41	1.44	0.60
2001[c]		1.99	0.21			
Upland:						
1994	24.13	6.89	1.18	9.16	2.55	3.72
1995	27.12	8.11	1.51	10.68	3.01	4.04
1996	22.40	6.34	1.23	7.85	2.59	2.97
1997	19.51	6.17	1.14	6.47	2.31	2.45
1998	18.16	5.35	0.89	6.26	1.75	2.29
1999	20.44	7.21	1.28	7.44	2.14	2.71
2000	18.51	6.46	1.22	6.75	2.07	2.49
2001	23.91	6.34	1.39	8.43	2.64	3.16
2001[c]		6.38	0.62			

a. Organic carbon fine particle concentrations from Leg C samples estimated using correction factors based on collocated sampling with Leg D samplers. Organic carbon is multiplied by 1.2 to compensate for O and H associated with organic matter.
b. Elemental carbon concentrations from Leg C samples unless otherwise noted.
c. Organic and elemental carbon fine particle concentrations from Leg D samples.

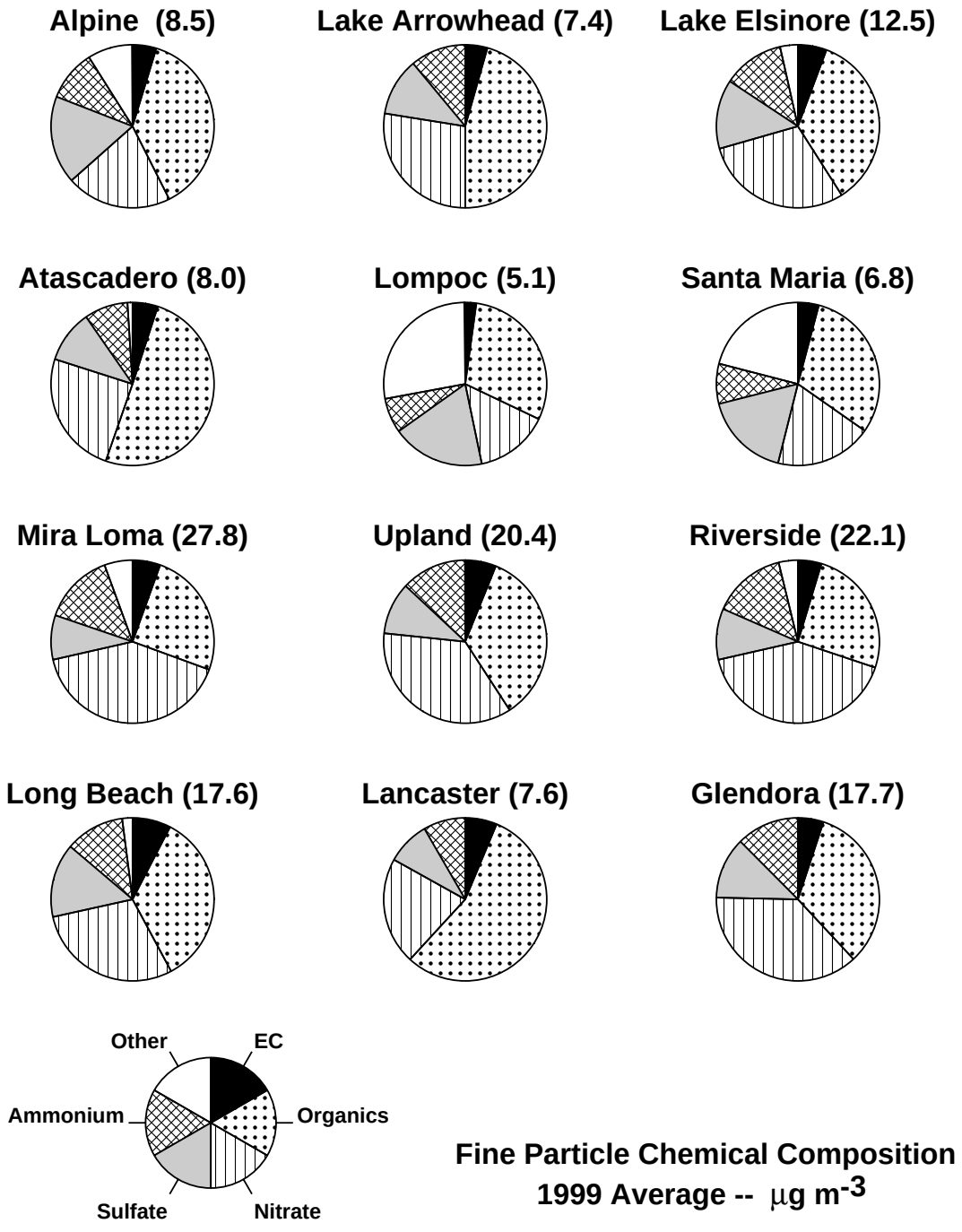

Figure 16: Chemical composition of 1999 annual airborne fine particle concentrations.

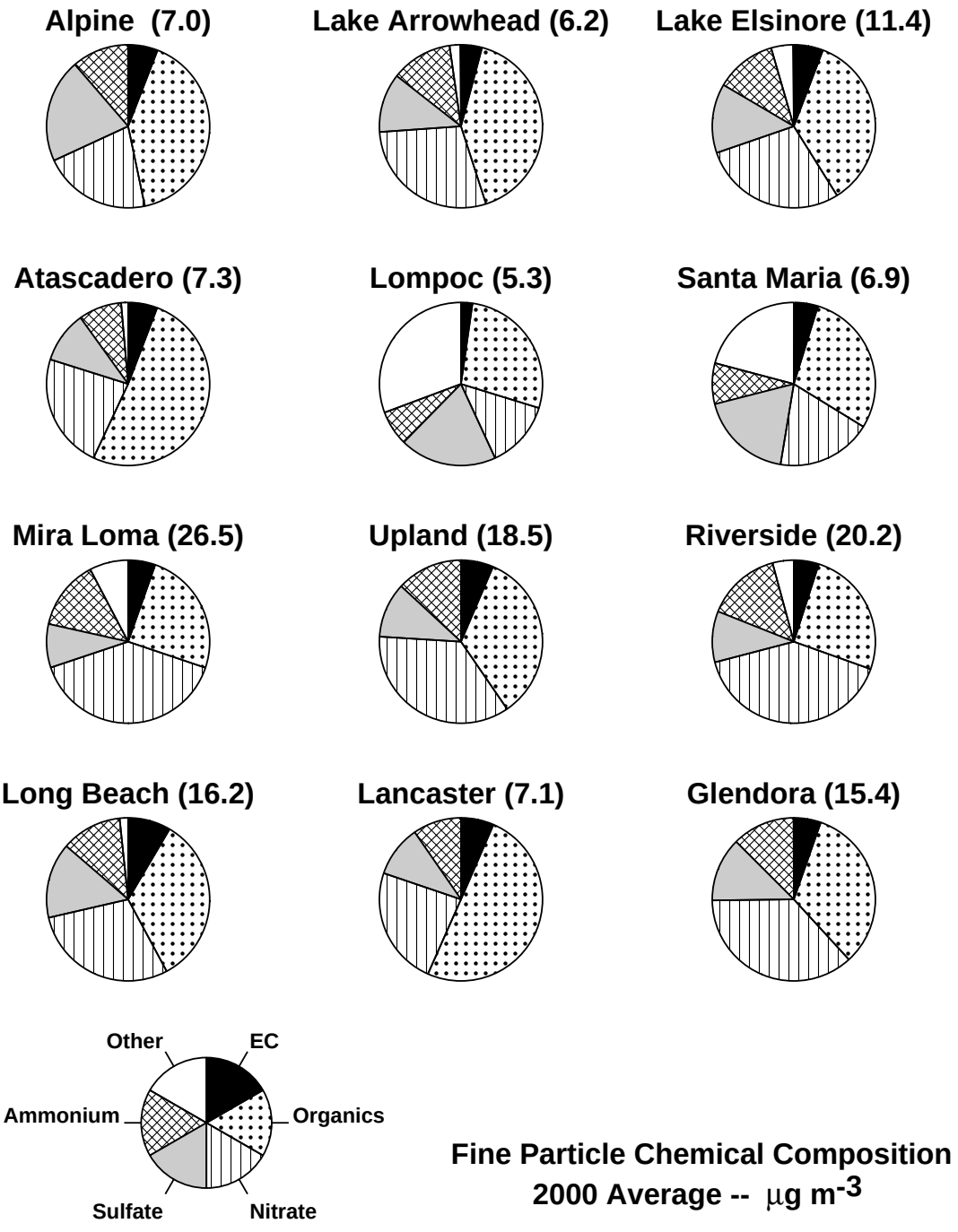

Figure 17: Chemical composition of 2000 annual airborne fine particle concentrations.

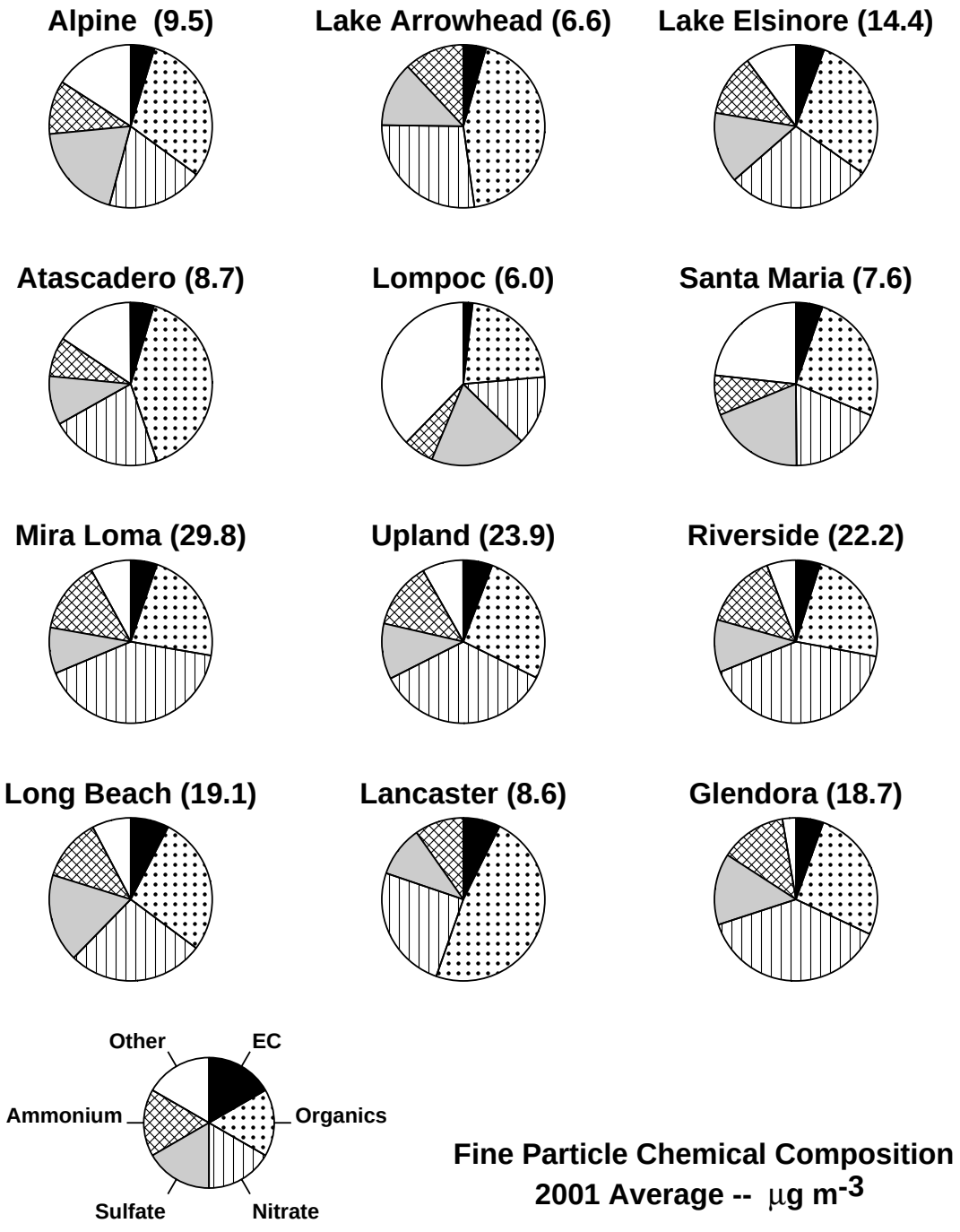

Figure 18: Chemical composition of 2001 annual airborne fine particle concentrations.

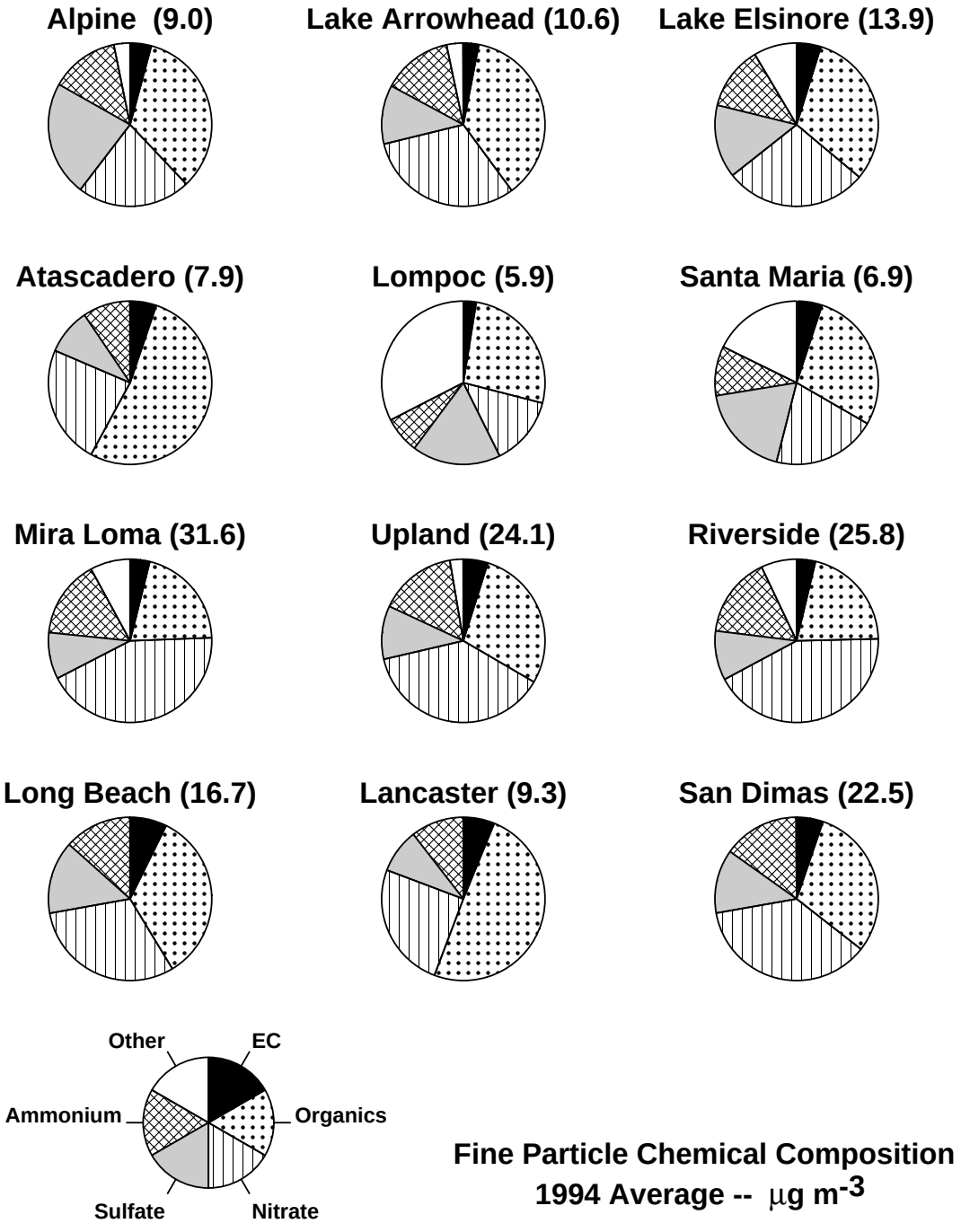

Figure 19: Chemical composition of 1994 annual airborne fine particle concentrations.

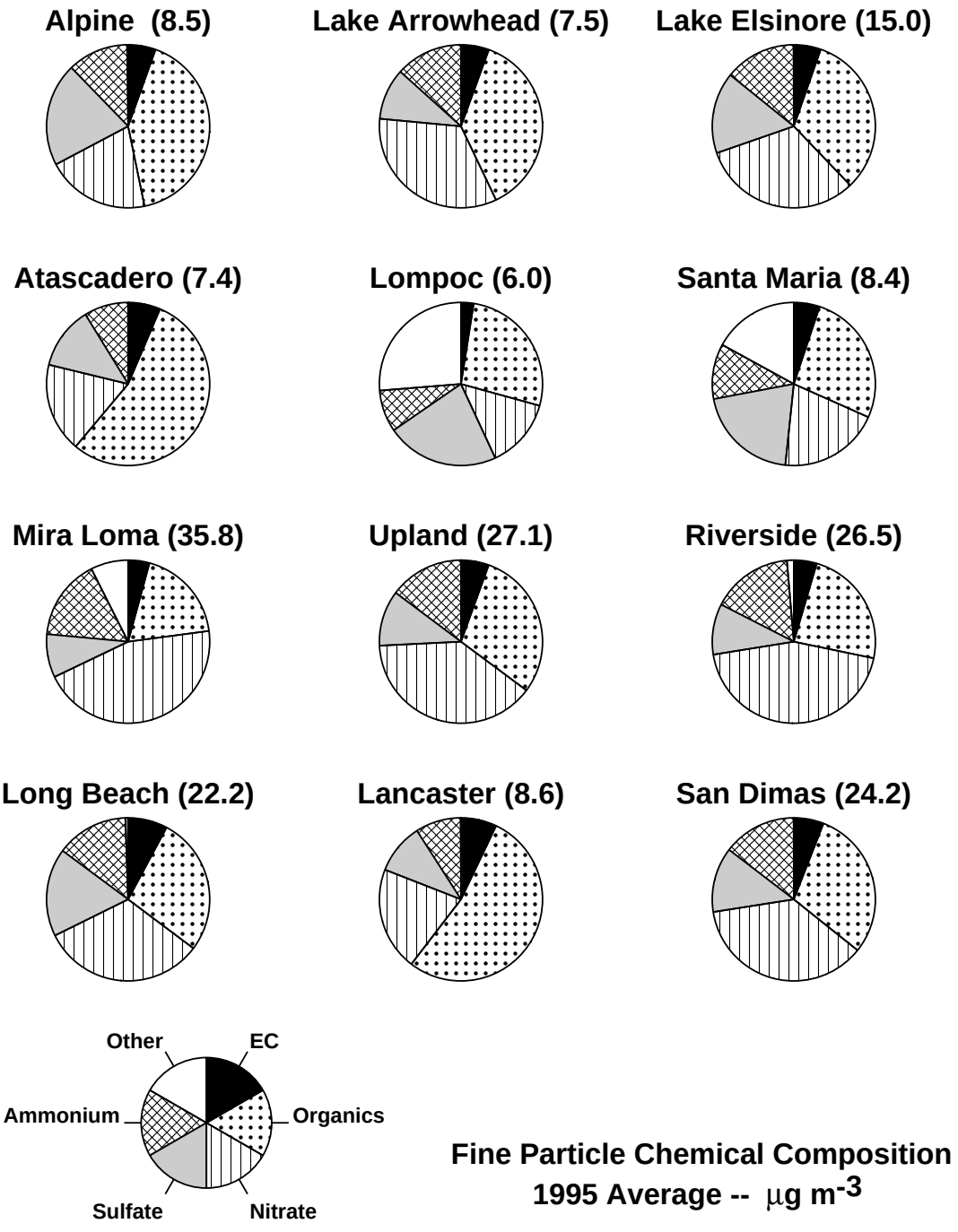

Figure 20: Chemical composition of 1995 annual airborne fine particle concentrations.

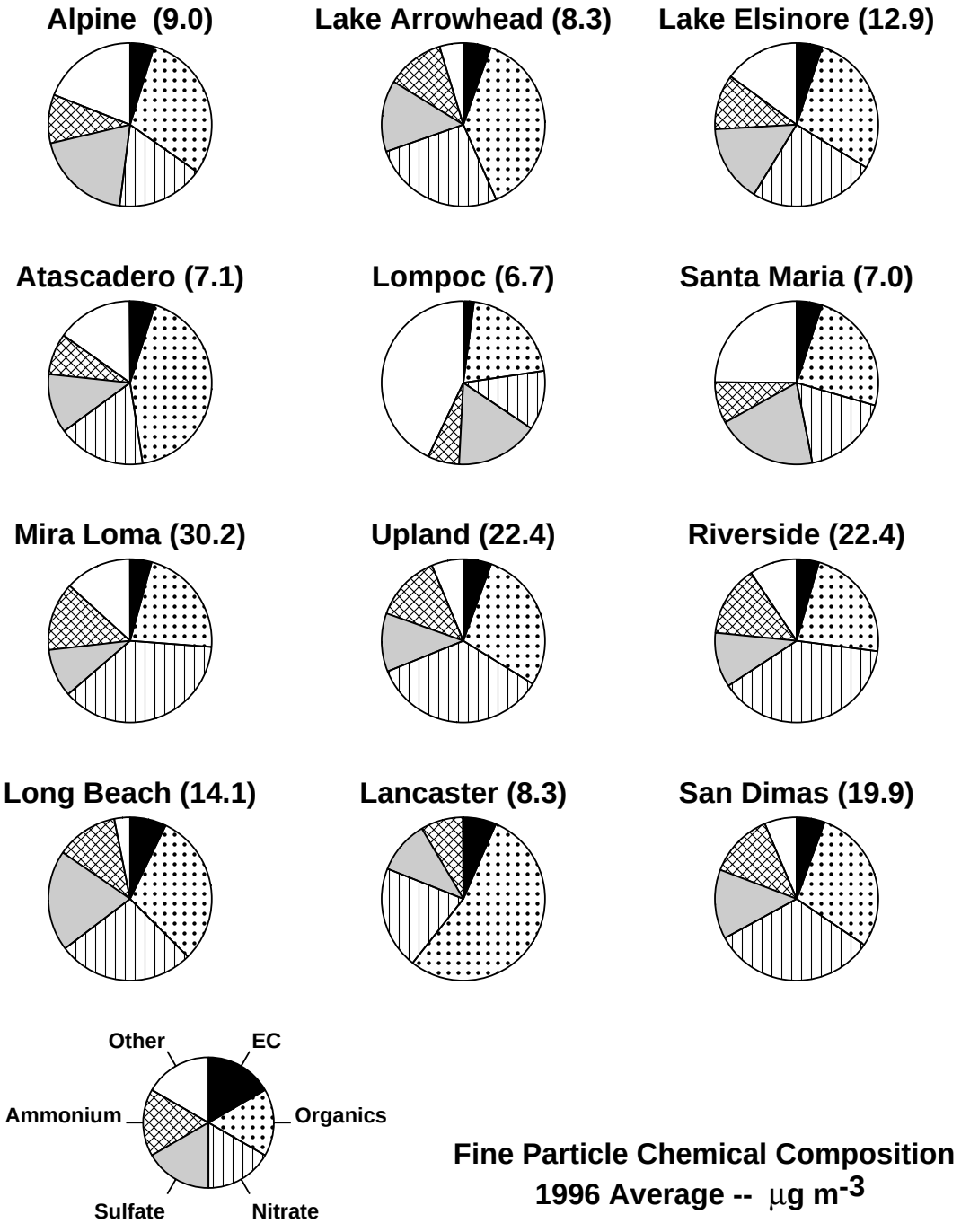

Figure 21: Chemical composition of 1996 annual airborne fine particle concentrations.

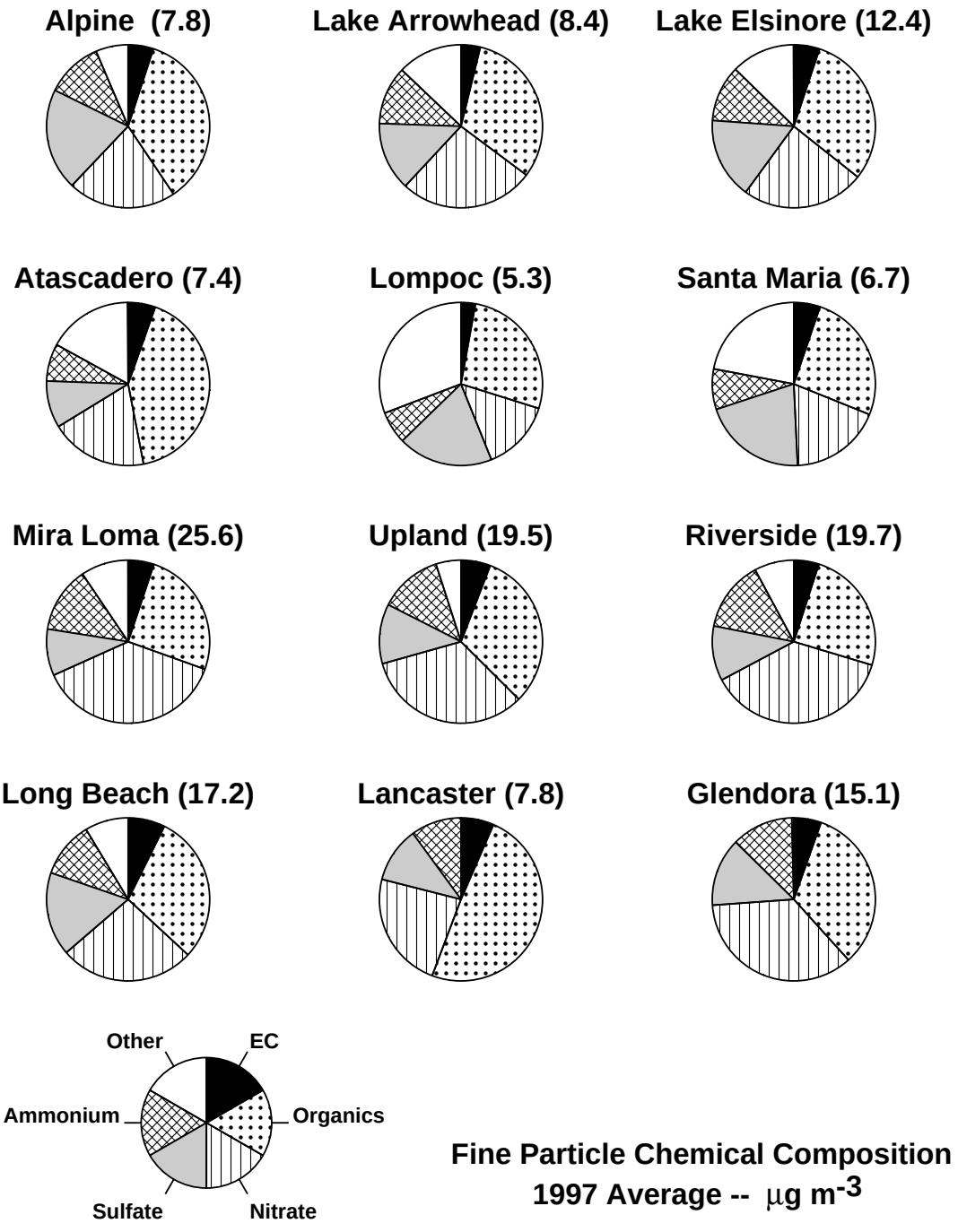

Figure 22: Chemical composition of 1997 annual airborne fine particle concentrations.

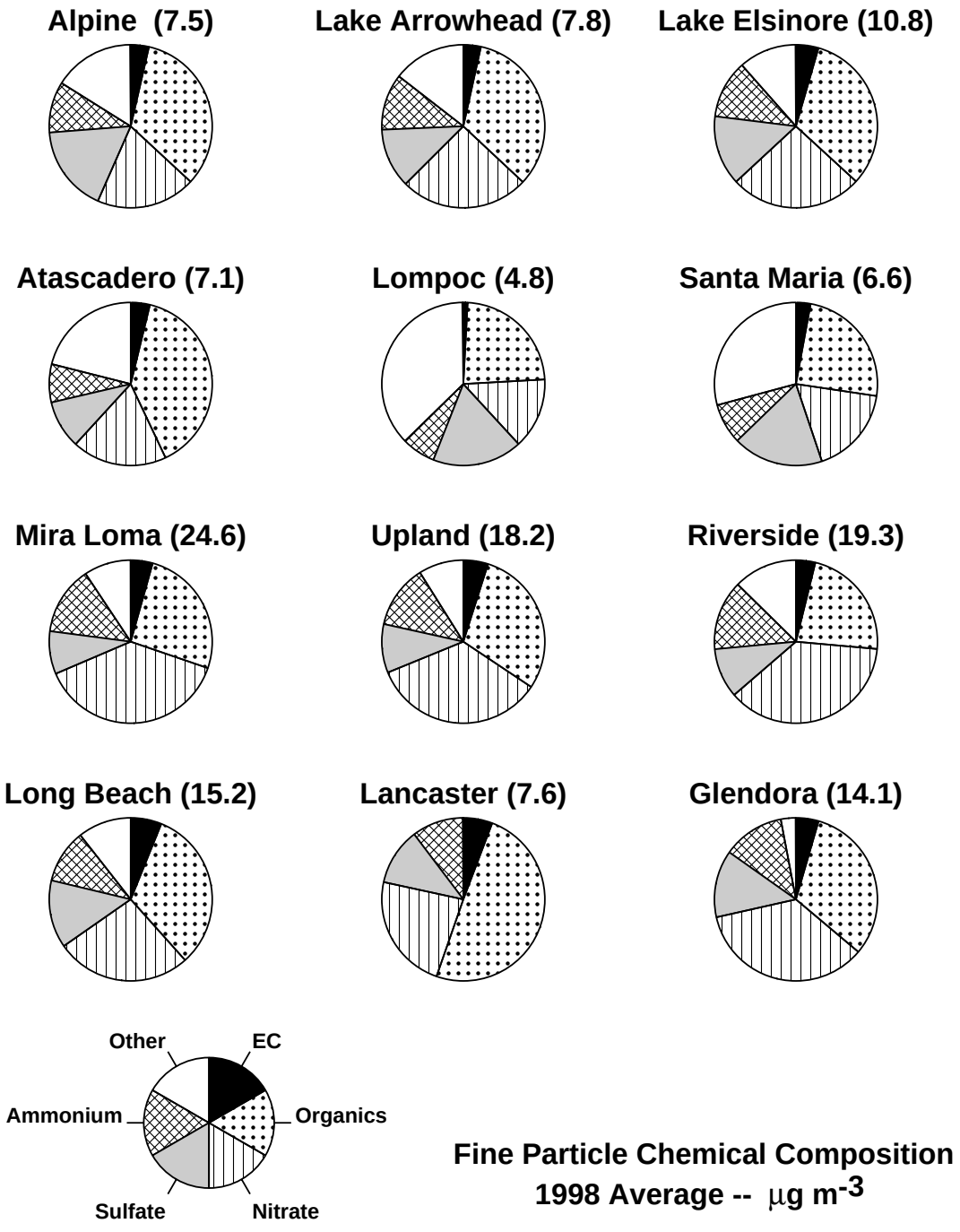

Figure 23: Chemical composition of 1998 annual airborne fine particle concentrations.

4 Summary and Conclusions

A network of air monitoring sites have been operating as part of the Southern California Children's Health Study since 1994. This is a large epidemiological investigation of the long-term effects of air pollutant exposure on respiratory disease within a population of more than 5600 California school children. Among the sites studied are mountain (Alpine, Lake Arrowhead, Lake Elsinore), desert (Lancaster), and other rural locations (Lompoc, Santa Maria, Atascadero) as well as Long Beach, Glendora and San Dimas within the Los Angeles County urban area plus Upland, Mira Loma, and Riverside in the urban plume downwind of the Los Angeles-Long Beach area. These sites represent exposure extremes for one or more pollutants and cover a large enough geographical area and a long enough time period to document spatial and temporal variations (Peters et al., 1999). Data through the end of year 2001 has been presented in this report. Samples for the Children's Health Study continue to be collected over consecutive two week averaging times.

Particulate organic carbon (OC) and elemental carbon (EC) samples were collected on quartz fiber filters through which ambient air was drawn for two weeks. After each two week interval, new quartz fiber filters were installed at each sampling location in the Children's Health Study sampling network. The quartz fiber filters were analyzed for OC and EC content by thermal evolution and combustion. The primary carbon particle cassette (Leg C) used during the study did not have a defined size cut, but was determined to have a broad cut-point of approximately 10 μm after comparison with reference samplers having known size cuts (Salmon et al., 2001). A separate carbon particle cassette (Leg D) with a $PM_{2.2}$ size cut was introduced in late 2000 and operated side-by-side with the primary carbon particle cassette in use since the inception of the study. In addition to carbon species, concentrations of PM_{10} and fine particle ($PM_{2.5}$) mass, nitrate, sulfate, and ammonium ion concentrations, as well as gas-phase ozone, nitrogen dioxide, formic acid, acetic acid, and nitric acid have been measured continuously since 1994.

From 1994 through 2001, annual average PM_{10}-equivalent elemental (black) carbon particle concentrations ranged from 0.05 to 1.74 μg m^{-3} at the communities studied. The lowest EC concentrations during all years were consistently measured at the rural, coastal Lompoc site. Yearly maximum EC concentrations were found at the Long Beach site during 6 of the 8 years studied, however the highest annual average EC concentrations were found inland at Mira Loma since 1996. Upland and Riverside were also among the communities with high EC levels. EC is produced in combustion processes and strongly influenced by diesel engine exhaust which is prevalent in all of these communities. Long Beach is close to the heavy industry and traffic in the Los Angeles/Long Beach harbor area while Mira Loma, Upland and Riverside are home to numerous warehouse distribution centers serviced by thousands of diesel trucks each day. Newer diesel engines and improved diesel fuels have been introduced into the vehicle fleet over the last 10 years which should have reduced EC levels. However, EC concentrations for 1999-2001 have shown a gradual increase in EC concentrations and at most sites, 2001 levels are equal or greater to what they had been in 1994 suggesting that these measures alone are not sufficient to address the problem, especially in communities like those in Riverside county that are experiencing increased truck traffic with the building of more and more giant distribution centers.

EC concentrations are of utmost concern since diesel soot is a major contributor to cancer risk, and health studies suggest children living in Mira Loma, which has the highest particulate levels in Southern California, are more likely to suffer respiratory problems because their lungs develop more slowly than do those of children elsewhere. New regulations on diesel emissions standards have been approved in California that should dramatically cut pollution from big-rigs, trash trucks and delivery vans in the near future. The new rules will require diesel engines to be equipped with tailpipe controls. The controls will be phased in beginning with the 2007 model year, and by 2010, they are supposed to eliminate 90 percent of the smog-forming nitrogen oxide and particulate emissions from diesel vehicles.

Annual average PM_{10}-equivalent particulate organic carbon concentrations were in the range 1.5 to 17.5 μg m^{-3} during 1994 through 2001. The maximum 2-week OC concentration of 31.5 μg m^{-3} was measured at Mira Loma in 1996 and Mira Loma had the highest organic carbon concentrations of any site in this study. The lowest annual average OC concentrations were consistently found at Lompoc. In general, both OC and EC concentrations were highest at the Los Angeles Basin sites and lowest at the sites in the outlying areas (San Luis Obispo, Santa Barbara, and San Diego Counties), the mountain site at Lake Arrowhead, and the desert site at Lancaster. There were also decreasing elemental carbon to total carbon (TC = EC + OC) ratios moving from west to east across the Los Angeles Basin. This can be attributed to the fact that as an airmass moves across the basin the organic fraction can be enhanced by the formation of secondary organic aerosol as a result of condensation from the gas phase. Elemental carbon, conversely, is introduced to the atmosphere solely via the direct or primary emission of particles.

OC annual average concentrations dropped with time over the 1994 through 1998 period, but concentrations at all sites increased in 1999 and annual average concentrations at the end of 2001 remain higher than in 1998, which had the lowest OC concentrations of the years studied. The most likely reason for the OC decline was likely milder weather with lower mean temperatures in the late 1990s. Warmer temperatures returned to Southern California during 1999-2001 and with higher temperatures and bright sunlight comes photochemical smog. Organic compounds are one of the main primary pollutants found in photochemical smog.

Studies have found associations between outdoor air pollution exposure and prevalence of respiratory diseases as well associations between mortality rates and particulate air pollution in metropolitan areas in the United States (Pope, 2000). There is increasing epidemiological evidence pointing toward health risks from particulate air pollution, especially fine particulate matter. However, organic and elemental carbon measurements with a fine particle size cut were not taken as part of the Children's Health Study until the introduction of the Leg D cassettes near the end of year 2000. Preliminary comparisons of EC concentrations taken side-by-side with Leg C and Leg D cassettes show problems with lower than expected EC concentrations as measured with the Leg D cassettes. It is strongly suggested that additional testing be done to determine the cause of the EC reduction on the Leg D cassettes, since obtaining reliable fine particle $PM_{2.5}$ data is of vital importance.

The organic and elemental carbon particle data show seasonal and annual variations

as well as spatial ranges in carbon particle concentrations across the southern half of California. With carbonaceous aerosols accounting for 24 to 62 percent of fine particle concentrations, it is clear that measurement of carbon species should be included in multi-year, multi-location studies of particulate concentrations.

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Appendix A – Leg C Data

Organic carbon, elemental carbon, carbonate carbon, and total carbon concentrations for CHS Leg C samples with an effective PM_{10} size cut. Sites with co-located samplers have been averaged. Missing values are indicated by -99.00.

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Alpine	132	981223	990107	3.26	.34	.00	3.60
Atascadero	132	981222	990106	8.60	.71	.00	9.31
Glendora	132	981222	990106	5.98	.77	.00	6.74
Lake-Arrowhead	132	981223	990107	1.60	.16	.00	1.77
Lake-Elsinore	132	981223	990107	4.73	.66	.00	5.39
Lancaster	132	981223	990105	11.46	.93	.00	12.39
Lompoc	132	981223	990106	4.30	.10	.00	4.40
Long-Beach	132	981224	990106	15.02	2.47	.00	17.50
Mira-Loma	132	981223	990106	-99.00	-99.00	-99.00	-99.00
Riverside	132	981223	990107	7.65	1.14	.00	8.79
Santa-Maria	132	981223	990106	4.89	.28	.00	5.18
Upland	132	981222	990106	9.46	.98	.00	10.43
Alpine	133	990107	990121	2.40	.44	.00	2.83
Atascadero	133	990106	990121	5.82	.60	.04	6.47
Glendora	133	990106	990120	6.47	.90	.11	7.48
Lake-Arrowhead	133	990107	990121	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	133	990107	990121	5.12	.95	.00	6.08
Lancaster	133	990105	990120	7.88	.71	.16	8.74
Lompoc	133	990106	990121	1.89	.18	.00	2.07
Long-Beach	133	990106	990120	8.76	1.74	.12	10.62
Mira-Loma	133	990106	990120	16.85	2.34	.57	19.76
Riverside	133	990107	990121	6.53	1.13	.15	7.80
Santa-Maria	133	990106	990121	3.43	.34	.00	3.77
Upland	133	990106	990120	9.12	1.52	.21	10.85
Alpine	134	990121	990204	2.19	.32	.00	2.51
Atascadero	134	990121	990203	3.60	.35	.04	3.99
Glendora	134	990120	990203	4.45	.69	.07	5.21
Lake-Arrowhead	134	990121	990204	1.03	.12	.00	1.15
Lake-Elsinore	134	990121	990204	4.13	.74	.00	4.87
Lancaster	134	990120	990202	4.68	.56	.06	5.30
Lompoc	134	990121	990203	2.13	.02	.00	2.15
Long-Beach	134	990120	990203	8.74	1.81	.12	10.66
Mira-Loma	134	990120	990203	8.92	1.35	.09	10.36
Riverside	134	990121	990204	4.21	.77	.00	4.98
Santa-Maria	134	990121	990203	3.12	.19	.00	3.31
Upland	134	990120	990203	5.75	.90	.13	6.78
Alpine	135	990204	990218	2.95	.34	.00	3.29
Atascadero	135	990203	990218	3.95	.35	.10	4.41

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Glendora	135	990203	990217	6.20	.71	.00	6.91
Lake-Arrowhead	135	990204	990218	1.19	.18	.00	1.36
Lake-Elsinore	135	990204	990218	4.17	.55	.00	4.73
Lancaster	135	990202	990217	4.56	.54	.00	5.10
Lompoc	135	990203	990217	1.75	.03	.00	1.78
Long-Beach	135	990203	990217	7.85	1.26	.00	9.12
Mira-Loma	135	990203	990217	9.94	1.09	.00	11.03
Riverside	135	990204	990218	5.62	.82	.00	6.44
Santa-Maria	135	990203	990217	3.68	.22	.00	3.90
Upland	135	990203	990217	7.34	.82	.00	8.16
Alpine	136	990218	990304	3.39	.43	.00	3.82
Atascadero	136	990218	990303	3.03	.26	.00	3.29
Glendora	136	990217	990303	8.43	.92	.00	9.35
Lake-Arrowhead	136	990218	990304	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	136	990218	990304	6.10	.82	.00	6.92
Lancaster	136	990217	990302	5.14	.50	.00	5.64
Lompoc	136	990217	990303	1.54	.07	.00	1.61
Long-Beach	136	990217	990303	8.45	1.34	.00	9.79
Mira-Loma	136	990217	990303	16.28	1.73	.05	18.06
Riverside	136	990218	990304	8.52	1.14	.00	9.66
Santa-Maria	136	990217	990303	3.41	.24	.00	3.65
Upland	136	990217	990303	11.74	1.27	.00	13.01
Alpine	137	990304	990318	2.20	.30	.00	2.51
Atascadero	137	990303	990316	2.72	.22	.00	2.94
Glendora	137	990303	990318	4.49	.54	.00	5.03
Lake-Arrowhead	137	990304	990317	1.28	.19	.00	1.47
Lake-Elsinore	137	990304	990317	2.95	.38	.00	3.33
Lancaster	137	990302	990317	3.42	.38	.00	3.80
Lompoc	137	990303	990317	1.63	.12	.00	1.75
Long-Beach	137	990303	990319	5.73	.89	.00	6.62
Mira-Loma	137	990303	990317	9.77	.87	.00	10.64
Riverside	137	990304	990318	4.73	.65	.00	5.38
Santa-Maria	137	990303	990317	2.64	.21	.00	2.85
Upland	137	990303	990317	5.98	.77	.00	6.74
Alpine	138	990318	990401	2.81	.25	.00	3.06
Atascadero	138	990316	990331	2.25	.17	.00	2.42
Glendora	138	990318	990331	5.81	.62	.00	6.43
Lake-Arrowhead	138	990317	990401	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	138	990317	990331	3.58	.45	.00	4.03
Lancaster	138	990317	990330	4.57	.64	.00	5.21
Lompoc	138	990317	990331	.00	.00	.00	.00
Long-Beach	138	990319	990331	5.88	.76	.00	6.64
Mira-Loma	138	990317	990331	10.02	.82	.00	10.84
Riverside	138	990318	990401	5.65	.67	.00	6.32
Santa-Maria	138	990317	990331	2.96	.11	.00	3.07

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Upland	138	990317	990331	6.68	.84	.00	7.53
Alpine	139	990401	990415	2.19	.21	.00	2.39
Atascadero	139	990331	990413	2.70	.26	.00	2.96
Glendora	139	990331	990414	3.88	.41	.00	4.29
Lake-Arrowhead	139	990401	990415	.85	.13	.00	.98
Lake-Elsinore	139	990331	990415	3.06	.40	.00	3.46
Lancaster	139	990330	990413	2.21	.21	.00	2.42
Lompoc	139	990331	990414	1.31	.04	.00	1.36
Long-Beach	139	990331	990414	3.96	.47	.00	4.43
Mira-Loma	139	990331	990414	5.95	.65	.00	6.60
Riverside	139	990401	990415	4.14	.48	.00	4.61
Santa-Maria	139	990331	990414	2.76	.26	.00	3.02
Upland	139	990331	990414	5.28	.54	.00	5.83
Alpine	140	990415	990429	3.13	.16	.00	3.29
Atascadero	140	990413	990427	5.35	.34	.00	5.69
Glendora	140	990414	990428	7.00	.73	.00	7.74
Lake-Arrowhead	140	990415	990429	3.13	.37	.00	3.50
Lake-Elsinore	140	990415	990429	4.47	.35	.00	4.82
Lancaster	140	990413	990428	4.36	.28	.00	4.64
Lompoc	140	990414	990428	1.99	.00	.00	1.99
Long-Beach	140	990414	990428	6.71	1.03	.00	7.74
Mira-Loma	140	990414	990428	8.97	.91	.00	9.88
Riverside	140	990415	990429	5.81	.72	.00	6.53
Santa-Maria	140	990414	990428	4.18	.06	.00	4.24
Upland	140	990414	990428	8.81	.82	.00	9.63
Alpine	141	990429	990513	3.04	.36	.00	3.40
Atascadero	141	990427	990512	3.19	.03	.00	3.22
Glendora	141	990428	990512	5.13	.61	.00	5.74
Lake-Arrowhead	141	990429	990513	3.15	.33	.00	3.48
Lake-Elsinore	141	990429	990512	4.21	.46	.00	4.66
Lancaster	141	990428	990511	4.58	.21	.00	4.79
Lompoc	141	990428	990511	1.07	.06	.00	1.13
Long-Beach	141	990428	990513	4.39	.60	.00	4.99
Mira-Loma	141	990428	990513	11.20	.94	.00	12.14
Riverside	141	990429	990512	5.96	.72	.00	6.68
Santa-Maria	141	990428	990511	2.63	.04	.00	2.67
Upland	141	990428	990512	6.56	.83	.00	7.39
Alpine	142	990513	990527	3.79	.28	.00	4.07
Atascadero	142	990512	990525	2.40	.10	.00	2.50
Glendora	142	990512	990526	5.89	.82	.00	6.71
Lake-Arrowhead	142	990513	990527	3.85	.45	.00	4.30
Lake-Elsinore	142	990512	990526	4.64	.49	.00	5.13
Lancaster	142	990511	990525	4.76	.29	.00	5.05
Lompoc	142	990511	990526	.95	.06	.00	1.01
Long-Beach	142	990513	990527	3.23	.62	.00	3.85

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Mira-Loma	142	990513	990527	11.84	1.02	.00	12.87
Riverside	142	990512	990526	6.69	.78	.00	7.47
Santa-Maria	142	990511	990526	2.55	.03	.00	2.58
Upland	142	990512	990526	6.53	.79	.00	7.32
Alpine	143	990527	990610	2.44	.31	.00	2.75
Atascadero	143	990525	990608	2.15	.11	.00	2.25
Glendora	143	990526	990609	5.39	.55	.00	5.94
Lake-Arrowhead	143	990527	990610	4.05	.35	.00	4.40
Lake-Elsinore	143	990526	990610	3.35	.30	.00	3.65
Lancaster	143	990525	990608	4.51	.32	.00	4.82
Lompoc	143	990526	990609	.78	.01	.00	.79
Long-Beach	143	990527	990609	3.43	.47	.00	3.90
Mira-Loma	143	990527	990610	9.79	.58	.00	10.37
Riverside	143	990526	990610	5.26	.49	.00	5.75
Santa-Maria	143	990526	990609	2.35	.01	.00	2.36
Upland	143	990526	990609	6.33	.66	.00	6.99
Alpine	144	990610	990624	5.30	.46	.00	5.75
Atascadero	144	990608	990624	3.34	.11	.00	3.45
Glendora	144	990609	990623	8.42	.99	.00	9.41
Lake-Arrowhead	144	990610	990624	6.57	.45	.00	7.02
Lake-Elsinore	144	990610	990623	6.99	.56	.00	7.55
Lancaster	144	990608	990622	6.34	.33	.00	6.67
Lompoc	144	990609	990622	.66	.05	.00	.70
Long-Beach	144	990609	990624	4.08	.76	.00	4.83
Mira-Loma	144	990610	990624	18.21	1.27	.00	19.48
Riverside	144	990610	990623	9.15	.96	.00	10.11
Santa-Maria	144	990609	990622	1.80	.14	.00	1.94
Upland	144	990609	990623	8.22	1.06	.00	9.28
Alpine	145	990624	990708	4.73	.48	.00	5.21
Atascadero	145	990624	990708	3.70	.13	.00	3.84
Glendora	145	990623	990707	8.08	1.13	.00	9.21
Lake-Arrowhead	145	990624	990708	5.91	.47	.00	6.38
Lake-Elsinore	145	990623	990708	5.54	.65	.00	6.19
Lancaster	145	990622	990707	5.38	.36	.00	5.75
Lompoc	145	990622	990708	.93	.13	.00	1.06
Long-Beach	145	990624	990707	4.15	.85	.00	5.00
Mira-Loma	145	990624	990708	19.12	1.33	.16	20.61
Riverside	145	990623	990708	9.12	.96	.00	10.08
Santa-Maria	145	990622	990708	2.31	.20	.00	2.51
Upland	145	990623	990707	10.20	1.41	.00	11.61
Alpine	146	990708	990722	4.85	.45	.00	5.29
Atascadero	146	990708	990721	3.94	.28	.00	4.22
Glendora	146	990707	990721	8.18	1.24	.00	9.42
Lake-Arrowhead	146	990708	990722	4.70	.42	.00	5.12
Lake-Elsinore	146	990708	990721	4.95	.70	.00	5.65

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Lancaster	146	990707	990720	4.64	.37	.00	5.01
Lompoc	146	990708	990721	1.60	.06	.00	1.66
Long-Beach	146	990707	990722	5.45	1.24	.00	6.69
Mira-Loma	146	990708	990722	22.40	2.08	.22	24.70
Riverside	146	990708	990721	8.27	.98	.00	9.25
Santa-Maria	146	990708	990721	2.97	.32	.00	3.29
Upland	146	990707	990721	10.43	1.87	.00	12.30
Alpine	147	990722	990805	4.68	.43	.00	5.11
Atascadero	147	990721	990804	2.91	.22	.00	3.13
Glendora	147	990721	990804	9.83	1.26	.00	11.09
Lake-Arrowhead	147	990722	990805	6.49	.63	.00	7.13
Lake-Elsinore	147	990721	990804	6.15	.72	.00	6.86
Lancaster	147	990720	990803	4.61	.44	.00	5.05
Lompoc	147	990721	990804	.63	.04	.00	.67
Long-Beach	147	990722	990805	4.92	1.09	.00	6.01
Mira-Loma	147	990722	990805	27.54	1.91	.20	29.65
Riverside	147	990721	990804	10.56	1.25	.00	11.81
Santa-Maria	147	990721	990804	-99.00	-99.00	-99.00	-99.00
Upland	147	990721	990804	10.69	1.79	.00	12.48
Alpine	148	990805	990819	3.97	.42	.00	4.39
Atascadero	148	990804	990818	-99.00	-99.00	-99.00	-99.00
Glendora	148	990804	990818	8.31	1.04	.00	9.35
Lake-Arrowhead	148	990805	990819	4.43	.38	.00	4.81
Lake-Elsinore	148	990804	990818	5.03	.56	.00	5.59
Lancaster	148	990803	990817	4.89	.41	.00	5.30
Lompoc	148	990804	990819	.95	.06	.00	1.01
Long-Beach	148	990805	990819	4.36	.90	.00	5.26
Mira-Loma	148	990805	990818	24.21	1.11	.23	25.55
Riverside	148	990804	990818	8.39	.98	.00	9.37
Santa-Maria	148	990807	990819	2.60	.21	.00	2.81
Upland	148	990804	990818	8.47	1.27	.00	9.74
Alpine	149	990819	990901	6.29	.47	.00	6.76
Atascadero	149	990818	990902	4.92	.31	.00	5.23
Glendora	149	990818	990901	11.99	1.61	.00	13.60
Lake-Arrowhead	149	990819	990902	5.06	.35	.00	5.41
Lake-Elsinore	149	990818	990902	8.00	.88	.00	8.88
Lancaster	149	990817	990901	7.16	.62	.00	7.79
Lompoc	149	990819	990831	.96	.13	.00	1.09
Long-Beach	149	990819	990901	5.11	1.22	.00	6.33
Mira-Loma	149	990818	990901	29.52	1.55	.23	31.31
Riverside	149	990818	990902	12.14	1.46	.00	13.60
Santa-Maria	149	990819	990831	2.79	.39	.00	3.17
Upland	149	990818	990901	13.39	1.77	.00	15.16
Alpine	150	990901	990916	5.05	.57	.00	5.62
Atascadero	150	990902	990915	4.32	.36	.00	4.68

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Glendora	150	990901	990915	8.68	1.11	.00	9.79
Lake-Arrowhead	150	990902	990916	5.95	.49	.00	6.44
Lake-Elsinore	150	990902	990916	7.04	.91	.00	7.95
Lancaster	150	990901	990914	7.96	.80	.00	8.76
Lompoc	150	990831	990914	1.54	.14	.00	1.68
Long-Beach	150	990901	990916	4.66	.90	.00	5.56
Mira-Loma	150	990901	990916	24.47	1.24	.22	25.92
Riverside	150	990902	990916	9.02	1.05	.00	10.07
Santa-Maria	150	990831	990914	3.27	.38	.00	3.65
Upland	150	990901	990915	10.51	1.38	.00	11.88
Alpine	151	990916	990930	4.27	.55	.00	4.82
Atascadero	151	990915	990929	6.91	.58	.00	7.49
Glendora	151	990915	990930	8.35	1.38	.00	9.73
Lake-Arrowhead	151	990916	990929	4.15	.43	.00	4.58
Lake-Elsinore	151	990916	990930	5.55	1.05	.00	6.60
Lancaster	151	990914	990929	6.42	.53	.00	6.94
Lompoc	151			-99.00	-99.00	-99.00	-99.00
Long-Beach	151	990916	990929	6.08	1.23	.00	7.31
Mira-Loma	151	990916	990929	18.44	1.65	.09	20.18
Riverside	151	990917	990928	6.62	1.27	.00	7.89
Santa-Maria	151			-99.00	-99.00	-99.00	-99.00
Upland	151	990915	990930	10.97	1.97	.00	12.94
Alpine	152	990930	991014	5.21	.46	.00	5.67
Atascadero	152	990929	991012	7.59	.86	.00	8.45
Glendora	152	990930	991013	9.03	1.24	.00	10.27
Lake-Arrowhead	152	990929	991014	4.62	.37	.00	4.99
Lake-Elsinore	152	990930	991014	7.22	.86	.00	8.09
Lancaster	152	990929	991013	6.96	.64	.00	7.61
Lompoc	152			-99.00	-99.00	-99.00	-99.00
Long-Beach	152	990929	991012	8.64	1.73	.00	10.37
Mira-Loma	152	990929	991014	-99.00	-99.00	-99.00	-99.00
Riverside	152	990928	991013	8.09	1.15	.00	9.24
Santa-Maria	152			-99.00	-99.00	-99.00	-99.00
Upland	152	990930	991013	11.61	1.59	.00	13.20
Alpine	153	991014	991028	3.80	.35	.00	4.15
Atascadero	153	991012	991027	7.59	.86	.00	8.45
Glendora	153	991013	991027	9.14	1.17	.00	10.30
Lake-Arrowhead	153	991014	991028	4.15	.50	.00	4.65
Lake-Elsinore	153	991014	991028	7.04	1.00	.00	8.04
Lancaster	153	991013	991026	8.79	1.13	.06	9.97
Lompoc	153	991014	991027	3.40	.36	.00	3.76
Long-Beach	153	991012	991028	11.11	2.19	.00	13.30
Mira-Loma	153	991014	991027	30.83	2.92	.40	34.15
Riverside	153	991013	991028	10.50	1.43	.00	11.93
Santa-Maria	153	991014	991027	6.01	.83	.00	6.84

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Upland	153	991013	991027	11.95	1.73	.00	13.68
Alpine	154	991028	991109	4.48	.67	.00	5.15
Atascadero	154	991027	991109	5.98	.68	.00	6.66
Glendora	154	991027	991109	10.10	1.52	.00	11.63
Lake-Arrowhead	154	991028	991110	3.14	.37	.00	3.51
Lake-Elsinore	154	991028	991109	7.44	1.25	.00	8.69
Lancaster	154	991026	991109	8.46	.90	.00	9.37
Lompoc	154	991027	991110	3.41	.27	.00	3.68
Long-Beach	154	991028	991108	9.39	1.80	.00	11.19
Mira-Loma	154	991027	991110	24.79	1.80	.19	26.79
Riverside	154	991028	991109	11.79	1.68	.00	13.47
Santa-Maria	154	991027	991110	5.46	.45	.00	5.91
Upland	154	991027	991109	12.14	1.93	.00	14.08
Alpine	155	991109	991123	3.94	.63	.00	4.57
Atascadero	155	991109	991124	-99.00	-99.00	-99.00	-99.00
Glendora	155	991109	991123	9.11	1.31	.00	10.41
Lake-Arrowhead	155	991110	991124	1.79	.26	.00	2.05
Lake-Elsinore	155	991109	991123	6.34	1.08	.00	7.41
Lancaster	155	991109	991123	7.92	1.06	.00	8.98
Lompoc	155	991110	991124	2.90	.20	.00	3.10
Long-Beach	155	991108	991123	8.92	1.99	.00	10.91
Mira-Loma	155	991110	991124	20.35	2.31	.20	22.87
Riverside	155	991109	991126	8.31	1.46	.00	9.76
Santa-Maria	155	991110	991124	4.56	.50	.00	5.06
Upland	155	991109	991126	11.32	1.66	.00	12.98
Alpine	156	991123	991208	4.02	.48	.00	4.50
Atascadero	156	991124	991208	8.09	.65	.00	8.74
Glendora	156	991123	991208	7.54	.88	.00	8.41
Lake-Arrowhead	156	991124	991209	2.20	.18	.00	2.37
Lake-Elsinore	156	991123	991208	6.51	.81	.00	7.32
Lancaster	156	991123	991207	10.03	1.00	.07	11.10
Lompoc	156	991124	991208	4.26	.28	.00	4.54
Long-Beach	156	991123	991209	14.80	2.24	.00	17.05
Mira-Loma	156	991124	991208	21.76	2.35	.17	24.28
Riverside	156	991126	991208	10.72	1.53	.09	12.35
Santa-Maria	156	991124	991208	6.40	.51	.00	6.91
Upland	156	991126	991208	11.43	1.40	.00	12.83
Alpine	157	991208	991222	3.49	.40	.00	3.89
Atascadero	157	991208	991222	11.29	1.00	.00	12.29
Glendora	157	991208	991221	6.44	.67	.00	7.11
Lake-Arrowhead	157	991209	991222	1.70	.10	.00	1.80
Lake-Elsinore	157	991208	991222	5.59	.75	.00	6.34
Lancaster	157	991207	991221	10.82	1.00	.07	11.89
Lompoc	157	991208	991222	4.80	.31	.00	5.11
Long-Beach	157	991209	991223	18.73	3.11	.00	21.83

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Mira-Loma	157	991208	991222	19.14	2.90	.33	22.37
Riverside	157	991208	991222	7.16	1.16	.00	8.32
Santa-Maria	157	991208	991222	6.07	.47	.00	6.54
Upland	157	991208	991221	12.25	1.70	.00	13.95
Alpine	158	991222	000106	2.81	.36	.00	3.18
Atascadero	158	991222	000105	12.62	.91	.00	13.53
Glendora	158	991221	000106	6.21	.66	.00	6.86
Lake-Arrowhead	158	991222	000107	.98	.12	.00	1.10
Lake-Elsinore	158	991222	000105	5.04	.63	.00	5.67
Lancaster	158	991221	000104	9.51	1.01	.00	10.53
Lompoc	158	991222	000105	4.59	.30	.00	4.89
Long-Beach	158	991223	000105	15.57	2.44	.00	18.01
Mira-Loma	158	991222	000106	13.77	1.50	.14	15.40
Riverside	158	991222	000105	6.69	1.07	.00	7.76
Santa-Maria	158	991222	000105	5.79	.40	.00	6.19
Upland	158	991221	000106	9.88	1.11	.00	10.99
Alpine	159	000106	000120	3.66	.51	.00	4.17
Atascadero	159	000105	000120	7.18	.74	.00	7.92
Glendora	159	000106	000119	7.35	.86	.00	8.21
Lake-Arrowhead	159	000107	000120	1.92	.23	.00	2.15
Lake-Elsinore	159	000105	000120	7.06	1.21	.00	8.27
Lancaster	159	000104	000120	7.79	1.02	.00	8.81
Lompoc	159	000105	000119	3.59	.32	.00	3.92
Long-Beach	159	000105	000119	17.06	2.46	.00	19.52
Mira-Loma	159	000106	000120	21.14	2.56	.14	23.84
Riverside	159	000105	000120	10.06	1.52	.00	11.58
Santa-Maria	159	000105	000119	5.27	.53	.00	5.80
Upland	159	000106	000119	12.18	1.70	.00	13.88
Alpine	160			-99.00	-99.00	-99.00	-99.00
Atascadero	160	000120	000202	5.03	.59	.00	5.62
Glendora	160	000119	000202	5.18	1.08	.00	6.26
Lake-Arrowhead	160	000120	000203	.95	.19	.00	1.15
Lake-Elsinore	160	000120	000202	3.77	.83	.00	4.60
Lancaster	160	000120	000201	4.96	.73	.00	5.69
Lompoc	160	000119	000202	2.47	.23	.00	2.70
Long-Beach	160	000119	000203	7.77	1.78	.00	9.55
Mira-Loma	160	000120	000203	9.97	1.65	.07	11.68
Riverside	160	000120	000203	5.09	1.12	.00	6.21
Santa-Maria	160	000119	000202	4.22	.45	.00	4.67
Upland	160	000119	000203	6.74	1.35	.00	8.09
Alpine	161			-99.00	-99.00	-99.00	-99.00
Atascadero	161	000202	000215	3.49	.40	.00	3.89
Glendora	161	000202	000216	5.02	.85	.00	5.87
Lake-Arrowhead	161	000203	000217	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	161	000202	000216	2.95	.55	.00	3.49

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Lancaster	161	000201	000215	3.73	.62	.00	4.35
Lompoc	161	000202	000217	1.85	.11	.00	1.96
Long-Beach	161	000203	000215	5.27	1.15	.00	6.42
Mira-Loma	161	000203	000217	7.70	1.33	.00	9.04
Riverside	161	000203	000216	5.02	1.02	.00	6.04
Santa-Maria	161	000202	000217	2.80	.27	.00	3.07
Upland	161	000203	000216	6.01	1.10	.00	7.11
Alpine	162			-99.00	-99.00	-99.00	-99.00
Atascadero	162	000215	000301	2.57	.30	.00	2.87
Glendora	162	000216	000302	3.74	.55	.00	4.29
Lake-Arrowhead	162	000217	000301	.74	.12	.00	.86
Lake-Elsinore	162	000216	000301	2.20	.42	.00	2.61
Lancaster	162	000215	000229	3.17	.52	.00	3.68
Lompoc	162	000217	000302	1.66	.08	.00	1.73
Long-Beach	162	000215	000303	5.83	1.22	.00	7.06
Mira-Loma	162	000217	000301	6.19	1.00	.00	7.19
Riverside	162	000216	000301	3.52	.66	.00	4.18
Santa-Maria	162	000217	000302	3.07	.31	.00	3.37
Upland	162	000216	000302	5.07	.85	.00	5.91
Alpine	163			-99.00	-99.00	-99.00	-99.00
Atascadero	163	000301	000315	2.52	.29	.00	2.81
Glendora	163	000302	000316	4.61	.84	.00	5.46
Lake-Arrowhead	163	000301	000315	.83	.08	.00	.92
Lake-Elsinore	163	000301	000316	3.23	.67	.00	3.90
Lancaster	163	000229	000314	2.66	.46	.00	3.12
Lompoc	163	000302	000315	1.43	.04	.00	1.47
Long-Beach	163	000303	000315	4.67	1.12	.00	5.79
Mira-Loma	163	000301	000316	6.62	1.05	.00	7.67
Riverside	163	000301	000315	4.50	.82	.00	5.31
Santa-Maria	163	000302	000315	3.17	.21	.00	3.39
Upland	163	000302	000315	6.89	1.03	.00	7.92
Alpine	164	000316	000330	2.65	.41	.00	3.06
Atascadero	164	000315	000329	3.09	.22	.00	3.30
Glendora	164	000316	000329	5.57	.84	.00	6.41
Lake-Arrowhead	164	000315	000329	2.44	.33	.00	2.77
Lake-Elsinore	164	000316	000330	4.06	.64	.00	4.70
Lancaster	164	000314	000329	3.71	.50	.00	4.21
Lompoc	164	000315	000330	1.58	.01	.00	1.60
Long-Beach	164	000315	000329	5.00	1.26	.00	6.26
Mira-Loma	164	000316	000330	8.78	1.18	.07	10.03
Riverside	164	000315	000329	5.27	1.01	.00	6.27
Santa-Maria	164	000315	000330	3.12	.18	.00	3.30
Upland	164	000315	000329	6.85	1.12	.00	7.97
Alpine	165	000330	000413	3.33	.51	.00	3.84
Atascadero	165	000329	000412	4.32	.48	.00	4.80

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Glendora	165	000329	000411	7.98	1.40	.00	9.37
Lake-Arrowhead	165	000329	000413	2.94	.29	.00	3.23
Lake-Elsinore	165	000330	000412	5.03	.77	.00	5.81
Lancaster	165	000329	000411	4.82	.56	.00	5.37
Lompoc	165	000330	000412	1.68	.12	.00	1.81
Long-Beach	165	000329	000411	4.86	1.23	.00	6.09
Mira-Loma	165	000330	000412	14.73	1.49	.12	16.35
Riverside	165	000329	000412	6.93	1.17	.00	8.11
Santa-Maria	165	000330	000412	3.33	.37	.00	3.70
Upland	165	000329	000411	8.26	1.25	.00	9.51
Alpine	166	000413	000427	2.79	.34	.00	3.14
Atascadero	166	000412	000426	1.91	.19	.00	2.10
Glendora	166	000411	000425	4.39	.63	.00	5.02
Lake-Arrowhead	166	000413	000427	1.59	.21	.00	1.80
Lake-Elsinore	166	000412	000426	3.58	.50	.00	4.08
Lancaster	166	000411	000425	2.94	.31	.00	3.25
Lompoc	166	000412	000426	1.38	.00	.00	1.38
Long-Beach	166	000411	000425	3.49	.78	.00	4.27
Mira-Loma	166	000412	000426	8.00	.98	.00	8.99
Riverside	166	000412	000426	5.17	.91	.00	6.08
Santa-Maria	166	000412	000426	2.65	.12	.00	2.77
Upland	166	000411	000427	7.00	.94	.00	7.94
Alpine	167	000427	000511	2.53	.39	.00	2.92
Atascadero	167	000426	000510	1.91	.19	.00	2.10
Glendora	167	000425	000509	5.89	.93	.00	6.82
Lake-Arrowhead	167	000427	000511	3.23	.61	.00	3.84
Lake-Elsinore	167	000426	000510	4.58	.58	.00	5.16
Lancaster	167	000425	000510	3.30	.25	.00	3.55
Lompoc	167	000426	000510	.87	.01	.00	.88
Long-Beach	167	000425	000509	4.14	.91	.00	5.04
Mira-Loma	167	000426	000510	12.03	.90	.00	12.93
Riverside	167	000426	000510	5.89	.87	.00	6.76
Santa-Maria	167	000426	000510	2.46	.21	.00	2.67
Upland	167	000427	000511	6.92	1.25	.00	8.17
Alpine	168	000511	000524	3.38	.35	.00	3.74
Atascadero	168	000510	000523	3.84	.27	.00	4.11
Glendora	168	000509	000523	6.24	.70	.00	6.94
Lake-Arrowhead	168	000511	000525	2.36	.18	.00	2.54
Lake-Elsinore	168	000510	000524	4.69	.58	.00	5.27
Lancaster	168	000510	000524	4.39	.28	.00	4.67
Lompoc	168	000510	000525	1.60	.13	.00	1.74
Long-Beach	168	000509	000523	3.76	.79	.00	4.56
Mira-Loma	168	000510	000524	18.07	1.23	.11	19.42
Riverside	168	000510	000524	6.93	.90	.00	7.83
Santa-Maria	168	000510	000525	3.17	.41	.00	3.58

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Upland	168	000511	000525	6.60	1.01	.00	7.60
Alpine	169	000524	000608	3.96	.36	.00	4.33
Atascadero	169	000523	000606	3.01	.23	.00	3.24
Glendora	169	000523	000606	7.14	.95	.02	8.11
Lake-Arrowhead	169	000525	000608	4.00	.34	.00	4.34
Lake-Elsinore	169	000524	000607	5.53	.55	.00	6.09
Lancaster	169	000524	000606	5.38	.27	.00	5.65
Lompoc	169	000525	000607	.93	.07	.00	1.00
Long-Beach	169	000523	000606	3.81	.90	.00	4.71
Mira-Loma	169	000524	000607	20.16	1.55	.21	21.92
Riverside	169	000524	000608	7.53	.84	.00	8.38
Santa-Maria	169	000525	000607	2.38	.25	.00	2.63
Upland	169	000525	000606	8.69	1.09	.06	9.85
Alpine	170	000608	000622	3.06	.38	.00	3.44
Atascadero	170	000606	000621	2.38	.15	.00	2.54
Glendora	170	000606	000620	6.21	.71	.00	6.92
Lake-Arrowhead	170	000608	000622	3.17	.24	.00	3.42
Lake-Elsinore	170	000607	000621	4.65	.50	.00	5.15
Lancaster	170	000606	000620	4.64	.26	.00	4.90
Lompoc	170	000607	000621	1.12	.05	.00	1.17
Long-Beach	170	000606	000620	3.26	.62	.00	3.88
Mira-Loma	170	000607	000621	17.48	.95	.10	18.52
Riverside	170	000608	000621	8.05	.68	.00	8.73
Santa-Maria	170	000607	000621	2.44	.26	.00	2.70
Upland	170	000606	000622	7.66	1.06	.01	8.73
Alpine	171	000622	000706	3.55	.41	.00	3.96
Atascadero	171	000621	000706	2.51	.12	.00	2.63
Glendora	171	000620	000703	7.11	.75	.00	7.87
Lake-Arrowhead	171	000622	000706	3.24	.27	.00	3.51
Lake-Elsinore	171	000621	000705	4.04	.43	.00	4.47
Lancaster	171	000620	000705	4.81	.31	.00	5.12
Lompoc	171	000621	000705	.75	.06	.00	.81
Long-Beach	171	000620	000703	3.72	.64	.00	4.37
Mira-Loma	171	000621	000705	18.44	.97	.09	19.49
Riverside	171	000621	000705	7.02	.70	.00	7.72
Santa-Maria	171	000621	000705	1.73	.21	.00	1.94
Upland	171	000622	000706	7.76	.90	.00	8.66
Alpine	172	000706	000720	3.65	.41	.00	4.06
Atascadero	172	000706	000719	2.29	.16	.00	2.46
Glendora	172	000703	000718	6.25	.70	.00	6.96
Lake-Arrowhead	172	000706	000720	4.46	.37	.00	4.83
Lake-Elsinore	172	000705	000719	5.29	.52	.00	5.80
Lancaster	172	000705	000718	4.61	.27	.00	4.88
Lompoc	172	000705	000719	.81	.03	.00	.84
Long-Beach	172	000703	000718	3.73	.69	.00	4.42

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Mira-Loma	172	000705	000719	-99.00	-99.00	-99.00	-99.00
Riverside	172	000705	000720	7.49	.83	.02	8.35
Santa-Maria	172	000705	000719	2.22	.18	.00	2.40
Upland	172	000706	000718	7.60	.88	.00	8.48
Alpine	173	000720	000803	5.52	.51	.00	6.03
Atascadero	173	000719	000802	5.07	.32	.00	5.38
Glendora	173	000718	000801	8.89	1.20	.00	10.09
Lake-Arrowhead	173	000720	000803	6.21	.43	.00	6.64
Lake-Elsinore	173	000719	000802	7.35	.95	.00	8.30
Lancaster	173	000718	000802	6.11	.41	.00	6.52
Lompoc	173	000719	000802	1.03	.04	.00	1.07
Long-Beach	173	000718	000801	5.16	1.28	.00	6.44
Mira-Loma	173	000719	000802	25.04	1.69	.27	27.01
Riverside	173	000720	000803	9.55	1.10	.06	10.72
Santa-Maria	173	000719	000802	2.88	.21	.00	3.09
Upland	173	000718	000801	11.59	1.73	.09	13.41
Alpine	174	000803	000817	5.63	.39	.00	6.02
Atascadero	174	000802	000816	3.75	.25	.00	4.00
Glendora	174	000801	000814	9.94	1.03	.00	10.97
Lake-Arrowhead	174	000803	000816	5.76	.34	.00	6.10
Lake-Elsinore	174	000802	000815	6.06	.57	.00	6.63
Lancaster	174	000802	000817	5.44	.34	.00	5.79
Lompoc	174	000802	000816	1.11	.00	.00	1.11
Long-Beach	174	000801	000814	5.09	1.08	.00	6.17
Mira-Loma	174	000802	000815	25.12	1.98	.24	27.33
Riverside	174	000803	000816	10.35	1.15	.06	11.56
Santa-Maria	174	000802	000816	2.63	.19	.00	2.82
Upland	174	000801	000816	9.81	1.37	.07	11.25
Alpine	175	000817	000831	2.77	.44	.00	3.21
Atascadero	175	000816	000830	3.24	.27	.00	3.51
Glendora	175	000814	000830	7.95	1.15	.00	9.10
Lake-Arrowhead	175	000816	000829	4.56	.44	.00	5.00
Lake-Elsinore	175	000815	000831	4.95	.61	.00	5.56
Lancaster	175	000817	000829	5.19	.51	.00	5.70
Lompoc	175	000816	000830	.98	.06	.00	1.04
Long-Beach	175	000814	000831	3.91	1.24	.00	5.16
Mira-Loma	175	000815	000830	24.58	1.74	.17	26.49
Riverside	175	000816	000830	8.22	1.02	.00	9.24
Santa-Maria	175	000816	000830	2.31	.22	.00	2.54
Upland	175	000816	000830	7.87	1.28	.00	9.15
Alpine	176	000831	000914	3.55	.36	.00	3.90
Atascadero	176	000830	000914	4.21	.41	.00	4.62
Glendora	176	000830	000912	8.02	.98	.00	9.00
Lake-Arrowhead	176	000829	000914	3.44	.38	.00	3.82
Lake-Elsinore	176	000831	000913	6.16	.72	.00	6.88

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Lancaster	176	000829	000913	5.70	.63	.00	6.32
Lompoc	176	000830	000914	1.74	.10	.00	1.83
Long-Beach	176	000831	000912	5.64	1.14	.00	6.78
Mira-Loma	176	000830	000913	21.30	2.38	.19	23.86
Riverside	176	000830	000914	9.50	1.16	.00	10.66
Santa-Maria	176	000830	000915	2.52	.35	.00	2.87
Upland	176	000830	000912	9.82	1.20	.00	11.03
Alpine	177	000914	000928	2.84	.40	.00	3.23
Atascadero	177	000914	000927	3.69	.32	.00	4.01
Glendora	177	000912	000926	6.91	.97	.00	7.88
Lake-Arrowhead	177	000914	000927	2.90	.28	.00	3.19
Lake-Elsinore	177	000913	000928	5.33	.62	.00	5.95
Lancaster	177	000913	000926	5.47	.54	.00	6.01
Lompoc	177	000914	000927	1.99	.09	.00	2.08
Long-Beach	177	000913	000926	-99.00	-99.00	-99.00	-99.00
Mira-Loma	177	000913	000928	15.94	1.19	.18	17.31
Riverside	177	000914	000927	7.04	.98	.00	8.03
Santa-Maria	177	000915	000927	3.57	.36	.00	3.93
Upland	177	000912	000926	9.14	1.47	.00	10.61
Alpine	178	000928	001011	2.55	.47	.00	3.02
Atascadero	178	000927	001011	3.07	.26	.00	3.33
Glendora	178	000926	001010	5.81	1.00	.00	6.81
Lake-Arrowhead	178	000927	001012	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	178	000928	001011	3.91	.69	.00	4.61
Lancaster	178	000926	001011	5.36	.61	.00	5.97
Lompoc	178	000927	001012	1.33	.11	.00	1.45
Long-Beach	178	000926	001011	3.52	1.11	.00	4.63
Mira-Loma	178	000928	001010	12.16	1.03	.00	13.19
Riverside	178	000927	001012	5.60	.88	.00	6.48
Santa-Maria	178	000927	001012	2.90	.30	.00	3.20
Upland	178	000926	001010	7.31	1.44	.00	8.75
Alpine	179	001011	001026	3.00	.45	.00	3.45
Atascadero	179	001011	001025	5.67	.49	.00	6.16
Glendora	179	001010	001024	5.52	1.08	.00	6.60
Lake-Arrowhead	179	001012	001025	2.51	.20	.00	2.71
Lake-Elsinore	179	001011	001026	4.73	.79	.00	5.52
Lancaster	179	001011	001025	5.22	.64	.00	5.85
Lompoc	179	001012	001026	2.66	.16	.00	2.82
Long-Beach	179	001011	001024	6.14	1.72	.00	7.86
Mira-Loma	179	001010	001026	11.45	1.14	.00	12.58
Riverside	179	001012	001025	7.57	1.25	.00	8.82
Santa-Maria	179	001012	001026	4.37	.40	.00	4.77
Upland	179	001010	001025	8.12	1.46	.00	9.59
Alpine	180	001026	001109	2.45	.27	.00	2.72
Atascadero	180	001025	001108	5.43	.51	.00	5.95

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Glendora	180	001024	001107	4.71	.52	.00	5.24
Lake-Arrowhead	180	001025	001107	.99	.16	.00	1.15
Lake-Elsinore	180	001026	001106	3.47	.53	.00	4.00
Lancaster	180	001025	001107	4.19	.44	.00	4.62
Lompoc	180	001026	001109	2.47	.07	.00	2.54
Long-Beach	180	001024	001106	8.01	1.16	.00	9.17
Mira-Loma	180	001026	001108	7.26	.81	.12	8.19
Riverside	180	001025	001108	4.63	.59	.00	5.22
Santa-Maria	180	001026	001109	4.49	.35	.00	4.84
Upland	180	001025	001107	5.82	.73	.00	6.54
Alpine	181	001109	001122	2.85	.34	.00	3.19
Atascadero	181	001108	001122	11.18	.89	.00	12.07
Glendora	181	001107	001120	4.33	.57	.00	4.90
Lake-Arrowhead	181	001107	001121	1.53	.19	.00	1.72
Lake-Elsinore	181	001106	001122	4.75	.64	.00	5.38
Lancaster	181	001107	001122	8.02	.86	.00	8.88
Lompoc	181	001109	001122	3.32	.22	.00	3.55
Long-Beach	181	001106	001120	12.37	1.83	.00	14.19
Mira-Loma	181	001108	001122	13.39	1.57	.20	15.17
Riverside	181	001108	001121	5.85	1.09	.00	6.94
Santa-Maria	181	001109	001122	5.64	.46	.00	6.10
Upland	181	001107	001122	9.61	1.11	.00	10.72
Alpine	182	001122	001207	5.16	.63	.00	5.78
Atascadero	182	001122	001206	8.10	.70	.00	8.80
Glendora	182	001120	001205	8.33	1.06	.00	9.39
Lake-Arrowhead	182	001121	001206	2.03	.26	.00	2.29
Lake-Elsinore	182	001122	001207	8.22	1.25	.00	9.47
Lancaster	182	001122	001205	9.81	1.26	.06	11.13
Lompoc	182	001122	001207	4.30	.37	.00	4.68
Long-Beach	182	001120	001205	12.64	3.43	.12	16.19
Mira-Loma	182	001122	001207	23.65	2.37	.25	26.28
Riverside	182	001121	001206	10.63	1.48	.00	12.11
Santa-Maria	182	001122	001207	7.28	.58	.00	7.85
Upland	182	001122	001205	12.79	1.58	.04	14.42
Alpine	183	001207	001221	2.78	.43	.00	3.21
Atascadero	183	001206	001221	6.49	.89	.00	7.39
Glendora	183	001205	001220	5.75	.92	.00	6.68
Lake-Arrowhead	183	001206	001219	1.32	.21	.00	1.53
Lake-Elsinore	183	001207	001221	5.43	.81	.00	6.24
Lancaster	183	001205	001220	8.00	1.24	.08	9.31
Lompoc	183	001207	001220	2.76	.21	.00	2.96
Long-Beach	183	001205	001218	11.50	2.18	.04	13.72
Mira-Loma	183	001207	001220	13.23	1.59	.12	14.94
Riverside	183	001206	001219	6.58	1.19	.00	7.77
Santa-Maria	183	001207	001220	4.66	.50	.00	5.16

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Upland	183	001205	001218	9.41	1.73	.14	11.28
Alpine	184	001221	010104	3.61	.41	.00	4.02
Atascadero	184	001221	010104	11.59	1.10	.10	12.79
Glendora	184	001220	010102	7.89	1.22	.11	9.22
Lake-Arrowhead	184	001219	010103	9.50	.22	.00	9.72
Lake-Elsinore	184	001221	010104	7.03	1.12	.00	8.14
Lancaster	184	001220	010103	11.14	1.77	.16	13.07
Lompoc	184	001220	010104	3.51	.35	.00	3.86
Long-Beach	184	001218	010102	15.21	2.58	.11	17.91
Mira-Loma	184	001220	010104	20.96	2.67	.22	23.85
Riverside	184	001219	010103	8.52	1.82	.08	10.42
Santa-Maria	184	001220	010103	5.04	.53	.00	5.58
Upland	184	001218	010102	12.58	2.28	.16	15.02
Alpine	185	010104	010118	3.06	.44	.00	3.51
Atascadero	185	010104	010117	6.67	.77	.00	7.44
Glendora	185	010102	010116	4.47	.62	.00	5.09
Lake-Arrowhead	185	010103	010118	1.09	.15	.00	1.25
Lake-Elsinore	185	010104	010118	-99.00	-99.00	-99.00	-99.00
Lancaster	185	010103	010117	7.06	1.05	.00	8.11
Lompoc	185	010104	010118	2.98	.33	.00	3.31
Long-Beach	185	010102	010116	11.03	2.32	.10	13.45
Mira-Loma	185	010104	010117	12.55	1.93	.18	14.66
Riverside	185	010103	010117	5.84	1.11	.03	6.98
Santa-Maria	185	010103	010118	4.86	.41	.00	5.26
Upland	185	010102	010116	7.16	1.24	.07	8.47
Alpine	186	010118	010201	2.44	.36	.00	2.81
Atascadero	186	010117	010131	6.45	.76	.00	7.22
Glendora	186	010116	010130	4.74	.66	.00	5.39
Lake-Arrowhead	186	010118	010201	1.04	.17	.00	1.21
Lake-Elsinore	186	010118	010131	4.24	.84	.00	5.08
Lancaster	186	010117	010130	7.37	1.00	.08	8.45
Lompoc	186	010118	010131	2.58	.26	.00	2.84
Long-Beach	186	010116	010130	12.68	2.95	.12	15.76
Mira-Loma	186	010117	010131	10.01	1.65	.10	11.76
Riverside	186	010117	010201	4.75	.86	.00	5.61
Santa-Maria	186	010118	010131	4.64	.45	.00	5.09
Upland	186	010116	010130	7.28	1.08	.06	8.41
Alpine	187	010201	010215	1.96	.20	.00	2.16
Atascadero	187	010131	010214	4.16	.53	.00	4.69
Glendora	187	010130	010213	3.81	.36	.00	4.17
Lake-Arrowhead	187	010201	010215	.90	.11	.00	1.01
Lake-Elsinore	187	010131	010214	2.76	.34	.00	3.11
Lancaster	187	010130	010213	5.35	.65	.00	6.00
Lompoc	187	010131	010214	2.23	.16	.00	2.39
Long-Beach	187	010130	010213	9.30	1.29	.00	10.59

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Mira-Loma	187	010131	010214	8.63	1.04	.04	9.71
Riverside	187	010201	010215	3.81	.56	.00	4.37
Santa-Maria	187	010131	010214	3.63	.36	.00	3.99
Upland	187	010130	010213	5.95	.73	.00	6.68
Alpine	188	010215	010301	1.65	.25	.00	1.90
Atascadero	188	010214	010301	3.29	.40	.00	3.69
Glendora	188	010213	010228	3.21	.45	.00	3.66
Lake-Arrowhead	188	010215	010301	.82	.19	.00	1.01
Lake-Elsinore	188	010214	010228	2.72	.59	.00	3.31
Lancaster	188	010213	010227	4.54	.60	.00	5.14
Lompoc	188	010214	010228	1.93	.14	.00	2.07
Long-Beach	188	010213	010227	5.70	1.35	.00	7.05
Mira-Loma	188	010214	010227	6.99	.92	.05	7.95
Riverside	188	010215	010301	4.17	.70	.00	4.87
Santa-Maria	188	010214	010228	3.31	.22	.00	3.53
Upland	188	010213	010228	4.66	.73	.00	5.40
Alpine	189	010301	010312	1.93	.28	.00	2.21
Atascadero	189	010301	010314	3.15	.32	.00	3.47
Glendora	189	010228	010313	3.61	.57	.00	4.18
Lake-Arrowhead	189	010301	010315	1.00	.19	.00	1.18
Lake-Elsinore	189	010228	010314	2.19	.41	.00	2.60
Lancaster	189	010227	010313	3.15	.44	.00	3.58
Lompoc	189	010228	010314	1.26	.13	.00	1.39
Long-Beach	189	010227	010313	4.33	.97	.00	5.30
Mira-Loma	189	010227	010314	6.77	.87	.04	7.68
Riverside	189	010301	010315	3.58	.60	.00	4.17
Santa-Maria	189	010228	010314	2.87	.33	.00	3.20
Upland	189	010228	010313	4.20	.71	.00	4.90
Alpine	190	010316	010329	2.49	.50	.00	2.99
Atascadero	190	010314	010327	3.02	.31	.00	3.34
Glendora	190	010313	010327	5.36	1.27	.00	6.63
Lake-Arrowhead	190	010315	010329	2.23	.36	.00	2.59
Lake-Elsinore	190	010314	010328	3.75	.99	.00	4.74
Lancaster	190	010313	010327	3.81	.60	.00	4.41
Lompoc	190	010314	010328	1.50	.07	.00	1.58
Long-Beach	190	010313	010327	4.90	1.11	.00	6.01
Mira-Loma	190	010314	010328	8.77	1.32	.07	10.16
Riverside	190	010315	010329	5.48	1.26	.00	6.74
Santa-Maria	190	010314	010328	3.23	.52	.00	3.75
Upland	190	010313	010327	7.74	1.43	.00	9.17
Alpine	191	010329	010412	-99.00	-99.00	-99.00	-99.00
Atascadero	191	010327	010411	4.08	.28	.00	4.35
Glendora	191	010327	010410	3.90	.74	.00	4.64
Lake-Arrowhead	191	010329	010412	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	191	010328	010411	2.37	.36	.00	2.73

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Lancaster	191	010327	010411	3.21	.30	.00	3.51
Lompoc	191	010328	010412	1.02	.03	.00	1.06
Long-Beach	191	010327	010410	3.62	.96	.00	4.58
Mira-Loma	191	010328	010411	6.02	.68	.00	6.70
Riverside	191	010329	010412	3.02	.50	.00	3.52
Santa-Maria	191	010328	010412	2.81	.36	.00	3.17
Upland	191	010327	010412	4.58	1.05	.00	5.64
Alpine	192	010412	010426	2.91	.32	.00	3.23
Atascadero	192	010411	010425	2.76	.19	.00	2.95
Glendora	192	010410	010424	4.33	.54	.00	4.86
Lake-Arrowhead	192	010413	010426	2.31	.29	.00	2.60
Lake-Elsinore	192	010411	010425	4.05	.49	.00	4.54
Lancaster	192	010411	010424	3.50	.41	.00	3.91
Lompoc	192	010412	010425	1.25	.06	.00	1.31
Long-Beach	192	010410	010424	4.91	.99	.00	5.91
Mira-Loma	192	010411	010425	7.61	1.03	.07	8.70
Riverside	192	010412	010426	5.36	.74	.00	6.11
Santa-Maria	192	010412	010425	3.98	.44	.00	4.42
Upland	192	010412	010424	6.33	.86	.00	7.19
Alpine	193	010426	010510	3.63	.52	.00	4.15
Atascadero	193	010425	010508	3.76	.27	.00	4.04
Glendora	193	010424	010508	6.40	1.06	.00	7.46
Lake-Arrowhead	193	010426	010510	3.94	.40	.00	4.34
Lake-Elsinore	193	010425	010509	4.91	.59	.00	5.50
Lancaster	193	010424	010508	5.39	.44	.00	5.83
Lompoc	193	010425	010509	1.97	.11	.00	2.08
Long-Beach	193	010424	010508	4.80	1.28	.00	6.08
Mira-Loma	193	010425	010509	11.67	1.31	.12	13.09
Riverside	193	010426	010510	6.39	1.24	.04	7.67
Santa-Maria	193	010425	010509	3.71	.67	.00	4.38
Upland	193	010424	010508	8.81	1.49	.10	10.40
Alpine	194	010510	010524	3.02	.65	.00	3.67
Atascadero	194	010508	010524	3.73	.26	.00	3.98
Glendora	194	010508	010522	5.47	.91	.00	6.38
Lake-Arrowhead	194	010510	010524	4.39	.46	.00	4.85
Lake-Elsinore	194	010509	010523	4.85	.77	.00	5.62
Lancaster	194	010508	010522	5.24	.45	.00	5.70
Lompoc	194	010509	010523	1.24	.06	.00	1.30
Long-Beach	194	010508	010522	3.37	1.23	.00	4.61
Mira-Loma	194	010509	010523	13.05	1.22	.14	14.41
Riverside	194	010510	010524	6.70	.85	.00	7.55
Santa-Maria	194	010509	010523	2.51	.34	.00	2.85
Upland	194	010508	010523	7.76	1.43	.00	9.19
Alpine	195	010524	010607	2.94	.56	.00	3.50
Atascadero	195	010524	010607	2.89	.19	.00	3.09

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Glendora	195	010522	010605	4.75	1.11	.00	5.85
Lake-Arrowhead	195	010524	010607	3.33	.44	.00	3.77
Lake-Elsinore	195	010523	010606	4.38	.63	.00	5.01
Lancaster	195	010522	010605	5.28	.47	.00	5.76
Lompoc	195	010523	010606	1.29	.08	.00	1.37
Long-Beach	195	010522	010605	3.41	.70	.00	4.11
Mira-Loma	195	010523	010606	12.25	.87	.13	13.24
Riverside	195	010524	010607	6.35	.66	.00	7.00
Santa-Maria	195	010523	010606	2.85	.41	.00	3.26
Upland	195	010523	010605	5.19	1.09	.00	6.29
Alpine	196	010607	010621	4.76	.55	.00	5.32
Atascadero	196	010607	010620	3.70	.25	.00	3.95
Glendora	196	010605	010619	7.17	1.23	.06	8.46
Lake-Arrowhead	196	010607	010621	4.29	.32	.00	4.62
Lake-Elsinore	196	010606	010620	6.23	.77	.00	7.00
Lancaster	196	010605	010619	4.45	.26	.00	4.72
Lompoc	196	010606	010620	1.43	.01	.00	1.43
Long-Beach	196	010605	010619	5.41	1.24	.00	6.65
Mira-Loma	196	010606	010620	18.77	1.42	.21	20.39
Riverside	196	010607	010621	8.30	.97	.07	9.34
Santa-Maria	196	010606	010620	2.88	.42	.00	3.30
Upland	196	010605	010619	8.42	1.62	.08	10.12
Alpine	197	010621	010705	4.70	.44	.00	5.15
Atascadero	197	010620	010704	3.59	.24	.00	3.84
Glendora	197	010619	010702	7.93	1.08	.07	9.08
Lake-Arrowhead	197	010621	010705	4.61	.40	.00	5.01
Lake-Elsinore	197	010620	010703	6.10	.76	.00	6.85
Lancaster	197	010619	010703	5.27	.57	.00	5.83
Lompoc	197	010620	010705	1.33	.00	.00	1.33
Long-Beach	197	010619	010702	4.03	.99	.00	5.01
Mira-Loma	197	010620	010703	24.92	1.87	.31	27.09
Riverside	197	010621	010705	9.77	1.02	.10	10.89
Santa-Maria	197	010620	010705	2.89	.45	.00	3.34
Upland	197	010619	010702	9.48	1.63	.10	11.21
Alpine	198	010705	010719	3.39	.44	.00	3.83
Atascadero	198	010704	010719	2.33	.18	.00	2.51
Glendora	198	010702	010717	6.62	1.27	.02	7.92
Lake-Arrowhead	198	010705	010719	3.56	.40	.00	3.96
Lake-Elsinore	198	010703	010718	4.92	.73	.00	5.65
Lancaster	198	010703	010717	4.34	.48	.00	4.82
Lompoc	198	010705	010718	.89	.00	.00	.89
Long-Beach	198	010702	010717	3.11	1.06	.00	4.17
Mira-Loma	198	010703	010718	17.85	1.18	.24	19.26
Riverside	198	010705	010719	6.67	.71	.04	7.42
Santa-Maria	198	010705	010718	2.28	.25	.00	2.53

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Upland	198	010702	010717	8.00	1.33	.03	9.36
Alpine	199	010719	010802	3.17	.46	.00	3.62
Atascadero	199	010719	010801	2.38	.14	.00	2.51
Glendora	199	010717	010731	6.11	1.17	.00	7.28
Lake-Arrowhead	199	010719	010802	4.27	.43	.00	4.70
Lake-Elsinore	199	010718	010801	4.49	.56	.00	5.04
Lancaster	199	010717	010731	4.75	.48	.00	5.23
Lompoc	199	010718	010802	.85	.03	.00	.88
Long-Beach	199	010717	010731	3.16	.71	.00	3.88
Mira-Loma	199	010718	010801	23.54	1.23	.32	25.09
Riverside	199	010719	010802	6.96	.66	.03	7.65
Santa-Maria	199	010718	010802	2.23	.24	.00	2.47
Upland	199	010717	010731	7.25	1.32	.06	8.63
Alpine	200	010802	010816	4.80	.65	.00	5.45
Atascadero	200	010801	010815	2.93	.21	.00	3.13
Glendora	200	010731	010814	7.59	1.22	.05	8.86
Lake-Arrowhead	200	010802	010816	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	200	010801	010815	6.75	.97	.06	7.78
Lancaster	200	010731	010814	4.61	.54	.00	5.15
Lompoc	200	010802	010815	.79	.00	.00	.79
Long-Beach	200	010731	010814	4.09	1.12	.00	5.21
Mira-Loma	200	010801	010815	25.09	1.59	.42	27.10
Riverside	200	010802	010816	9.76	1.08	.19	11.02
Santa-Maria	200	010802	010815	1.99	.19	.00	2.18
Upland	200	010731	010814	9.67	1.65	.08	11.40
Alpine	201	010816	010829	4.78	.53	.00	5.31
Atascadero	201	010815	010830	4.00	.23	.00	4.22
Glendora	201	010814	010829	7.30	1.15	.04	8.48
Lake-Arrowhead	201	010816	010830	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	201	010815	010829	6.43	.78	.00	7.21
Lancaster	201	010814	010828	6.64	.67	.09	7.40
Lompoc	201	010815	010829	.97	.00	.00	.97
Long-Beach	201	010814	010828	3.93	1.28	.00	5.21
Mira-Loma	201	010815	010829	28.03	1.58	.66	30.27
Riverside	201	010816	010830	8.56	1.00	.11	9.67
Santa-Maria	201	010815	010829	2.47	.26	.00	2.73
Upland	201	010814	010828	9.84	1.35	.08	11.28
Alpine	202	010829	010913	2.76	.44	.00	3.20
Atascadero	202	010830	010911	3.00	.19	.00	3.19
Glendora	202	010829	010910	4.18	.75	.00	4.94
Lake-Arrowhead	202	010830	010913	4.09	.42	.00	4.50
Lake-Elsinore	202	010829	010912	4.46	.63	.00	5.09
Lancaster	202	010828	010911	6.23	.60	.00	6.82
Lompoc	202	010829	010912	1.20	.00	.00	1.20
Long-Beach	202	010828	010910	3.34	.80	.00	4.14

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Mira-Loma	202	010829	010911	18.82	1.20	.24	20.26
Riverside	202	010830	010913	6.77	.83	.02	7.62
Santa-Maria	202	010829	010912	2.57	.20	.00	2.77
Upland	202	010828	010910	7.08	.93	.05	8.07
Alpine	203	010913	010927	4.83	.57	.00	5.40
Atascadero	203	010911	010926	3.81	.40	.00	4.21
Glendora	203	010910	010925	7.66	1.62	.11	9.38
Lake-Arrowhead	203	010913	010927	4.34	.53	.00	4.87
Lake-Elsinore	203	010912	010926	7.47	1.22	.00	8.69
Lancaster	203	010911	010926	5.47	.85	.00	6.32
Lompoc	203	010912	010926	1.36	.06	.00	1.42
Long-Beach	203	010910	010925	4.21	1.31	.00	5.53
Mira-Loma	203	010911	010926	24.74	1.98	.69	27.41
Riverside	203	010913	010927	10.03	1.70	.16	11.89
Santa-Maria	203	010912	010926	2.86	.31	.00	3.17
Upland	203	010910	010925	10.81	1.73	.17	12.71
Alpine	204	010927	011011	3.27	.45	.00	3.72
Atascadero	204	010926	011010	3.98	.41	.00	4.39
Glendora	204	010925	011009	7.58	1.15	.10	8.83
Lake-Arrowhead	204	010927	011010	3.96	.47	.00	4.43
Lake-Elsinore	204	010926	011011	5.85	.87	.00	6.72
Lancaster	204	010926	011010	7.31	.85	.00	8.16
Lompoc	204	010926	011011	1.58	.12	.00	1.69
Long-Beach	204	010925	011009	4.85	1.43	.00	6.29
Mira-Loma	204	010926	011011	23.12	1.97	.61	25.70
Riverside	204	010927	011010	8.51	1.17	.13	9.81
Santa-Maria	204	010926	011011	4.95	.61	.00	5.56
Upland	204	010925	011009	9.40	1.33	.13	10.86
Alpine	205	011011	011025	4.79	.58	.00	5.37
Atascadero	205	011010	011024	5.11	.57	.00	5.68
Glendora	205	011009	011023	9.67	2.12	.17	11.97
Lake-Arrowhead	205	011010	011025	3.93	.40	.00	4.33
Lake-Elsinore	205	011011	011024	8.32	1.33	.00	9.64
Lancaster	205	011010	011023	6.48	.95	.13	7.55
Lompoc	205	011011	011024	1.99	.16	.00	2.15
Long-Beach	205	011009	011023	5.24	1.70	.00	6.95
Mira-Loma	205	011011	011024	22.95	2.24	.66	25.85
Riverside	205	011010	011025	9.17	2.01	.14	11.33
Santa-Maria	205	011011	011024	4.28	.37	.00	4.65
Upland	205	011009	011023	10.55	2.24	.19	12.98
Alpine	206	011025	011108	3.68	.63	.00	4.31
Atascadero	206	011024	011110	5.44	.75	.09	6.29
Glendora	206	011023	011106	7.70	1.41	.12	9.23
Lake-Arrowhead	206	011025	011108	2.50	.20	.00	2.69
Lake-Elsinore	206	011024	011107	6.53	1.38	.00	7.91

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Lancaster	206	011023	011107	7.08	1.20	.14	8.43
Lompoc	206	011024	011107	2.01	.16	.00	2.17
Long-Beach	206	011023	011106	6.24	2.01	.00	8.24
Mira-Loma	206	011024	011107	15.58	1.89	.32	17.80
Riverside	206	011025	011108	8.61	1.77	.13	10.50
Santa-Maria	206	011024	011107	3.67	.52	.00	4.20
Upland	206	011023	011106	8.95	2.31	.15	11.40
Alpine	207	011108	011121	3.08	.51	.00	3.60
Atascadero	207	011110	011120	4.62	.52	.00	5.14
Glendora	207	011106	011119	6.25	1.12	.12	7.49
Lake-Arrowhead	207	011108	011121	1.66	.15	.00	1.81
Lake-Elsinore	207	011107	011120	6.44	1.21	.00	7.66
Lancaster	207	011107	011120	6.83	1.14	.14	8.12
Lompoc	207	011107	011120	2.94	.21	.00	3.14
Long-Beach	207	011106	011119	8.30	2.21	.12	10.63
Mira-Loma	207	011107	011120	19.42	2.68	.52	22.61
Riverside	207	011108	011121	8.87	1.67	.16	10.70
Santa-Maria	207	011107	011120	4.87	.66	.00	5.52
Upland	207	011106	011119	9.52	2.02	.21	11.75
Alpine	208	011121	011206	2.69	.31	.00	3.00
Atascadero	208	011120	011205	6.23	.55	.00	6.77
Glendora	208	011119	011204	5.21	.75	.09	6.05
Lake-Arrowhead	208	011121	011206	1.60	.18	.00	1.77
Lake-Elsinore	208	011120	011205	4.73	.85	.00	5.58
Lancaster	208	011120	011205	4.79	.54	.00	5.34
Lompoc	208	011120	011205	2.89	.19	.00	3.09
Long-Beach	208	011119	011204	9.09	1.86	.10	11.05
Mira-Loma	208	011120	011205	10.40	1.56	.20	12.16
Riverside	208	011121	011206	6.23	.94	.08	7.26
Santa-Maria	208	011120	011205	4.60	.47	.00	5.08
Upland	208	011119	011204	8.07	1.11	.13	9.31
Alpine	209	011206	011220	3.11	.30	.00	3.41
Atascadero	209	011205	011219	6.33	.60	.12	7.05
Glendora	209	011204	011218	4.91	.54	.07	5.52
Lake-Arrowhead	209	011206	011220	1.36	.12	.00	1.48
Lake-Elsinore	209	011205	011219	5.48	1.05	.00	6.53
Lancaster	209	011205	011218	6.28	.92	.13	7.33
Lancaster II	209	011205	011218	5.02	.78	.00	5.81
Lompoc	209	011205	011219	2.03	.16	.00	2.19
Long-Beach	209	011204	011218	12.39	1.81	.20	14.39
Mira-Loma	209	011205	011219	15.27	2.56	.36	18.20
Riverside	209	011206	011220	6.88	.99	.10	7.98
Santa-Maria	209	011205	011219	4.44	.40	.00	4.84
Upland	209	011204	011218	9.89	1.28	.19	11.37
Alpine	210	011220	020103	2.77	.38	.00	3.15

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Atascadero	210	011219	020103	4.52	.41	.00	4.93
Glendora	210	011218	011231	5.63	.93	.12	6.69
Lake-Arrowhead	210	011220	020102	.83	.07	.00	.89
Lake-Elsinore	210	011219	020103	5.94	1.08	.00	7.02
Lancaster	210	011218	020102	8.59	1.08	.16	9.83
Lancaster II	210	011218	020102	5.03	.85	.09	5.98
Lompoc	210	011219	020102	2.59	.19	.00	2.77
Long-Beach	210	011218	011231	12.62	1.94	.15	14.71
Mira-Loma	210	011219	020103	12.56	2.30	.31	15.17
Riverside	210	011220	020102	7.69	1.39	.15	9.23
Santa-Maria	210	011219	020102	4.10	.35	.00	4.45
Upland	210	011218	011231	9.81	1.53	.92	12.27

Appendix B – Leg D Data

Organic carbon, elemental carbon, carbonate carbon, and total carbon concentrations for CHS Leg D samples with an effective $PM_{2.5}$ size cut. Sites with co-located samplers have been averaged. Missing values are indicated by -99.00.

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Alpine	178	000928	001011	-99.00	-99.00	-99.00	-99.00
Atascadero	178	000927	001011	-99.00	-99.00	-99.00	-99.00
Glendora	178	000926	001010	-99.00	-99.00	-99.00	-99.00
Lake-Arrowhead	178	000927	001012	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	178	000928	001011	2.75	.41	.00	3.15
Lancaster	178	000926	001011	3.55	.41	.00	3.96
Lompoc	178	000927	001012	.70	.08	.00	.78
Long-Beach	178	000926	001011	2.11	.38	.00	2.49
Mira-Loma	178	000928	001010	3.78	.57	.00	4.34
Riverside	178	000927	001012	2.99	.44	.00	3.43
Santa-Maria	178	000927	001012	1.00	.17	.00	1.17
Upland	178	000926	001010	4.34	.62	.00	4.96
Alpine	179	001011	001026	2.01	.27	.00	2.28
Atascadero	179	001011	001025	-99.00	-99.00	-99.00	-99.00
Glendora	179	001010	001024	3.79	.50	.00	4.28
Lake-Arrowhead	179	001012	001025	2.31	.16	.00	2.47
Lake-Elsinore	179	001011	001026	2.95	.41	.00	3.36
Lancaster	179	001011	001025	3.30	.47	.00	3.77
Lompoc	179	001012	001026	1.45	.09	.00	1.54
Long-Beach	179	001011	001024	4.60	.64	.00	5.24
Mira-Loma	179	001010	001026	4.05	.73	.00	4.78
Riverside	179	001012	001025	4.28	.65	.00	4.93
Santa-Maria	179	001012	001026	1.72	.22	.00	1.93
Upland	179	001010	001025	4.82	.69	.00	5.50
Alpine	180	001026	001109	-99.00	-99.00	-99.00	-99.00
Atascadero	180	001025	001108	3.34	.44	.00	3.78
Glendora	180	001024	001107	2.89	.44	.00	3.34
Lake-Arrowhead	180	001025	001107	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	180	001026	001106	2.31	.38	.00	2.69
Lancaster	180	001025	001107	-99.00	-99.00	-99.00	-99.00
Lompoc	180	001026	001109	1.45	.12	.00	1.57
Long-Beach	180	001024	001106	5.69	1.23	.00	6.92

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Mira-Loma	180	001026	001108	3.76	.70	.00	4.47
Riverside	180	001025	001108	2.93	.52	.00	3.45
Santa-Maria	180	001026	001109	2.24	.31	.00	2.56
Upland	180	001025	001107	-99.00	-99.00	-99.00	-99.00
Alpine	181	001109	001122	2.13	.22	.00	2.35
Atascadero	181	001108	001122	-99.00	-99.00	-99.00	-99.00
Glendora	181	001107	001120	2.86	.41	.00	3.27
Lake-Arrowhead	181	001107	001121	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	181	001106	001122	3.05	.53	.00	3.58
Lancaster	181	001107	001122	-99.00	-99.00	-99.00	-99.00
Lompoc	181	001109	001122	2.59	.16	.00	2.75
Long-Beach	181	001106	001120	7.48	1.71	.00	9.19
Mira-Loma	181	001108	001122	5.98	1.14	.00	7.12
Riverside	181	001108	001121	3.78	.91	.00	4.69
Santa-Maria	181	001109	001122	3.18	.31	.00	3.49
Upland	181	001107	001122	4.91	.80	.00	5.71
Alpine	182	001122	001207	2.89	.42	.00	3.32
Atascadero	182	001122	001206	-99.00	-99.00	-99.00	-99.00
Glendora	182	001120	001205	5.51	.70	.00	6.21
Lake-Arrowhead	182	001121	001206	1.61	.16	.00	1.77
Lake-Elsinore	182	001122	001207	5.22	.89	.00	6.12
Lancaster	182	001122	001205	6.35	1.04	.00	7.39
Lompoc	182	001122	001207	3.06	.35	.00	3.41
Long-Beach	182	001120	001205	-99.00	-99.00	-99.00	-99.00
Mira-Loma	182	001122	001207	11.48	1.76	.00	13.24
Riverside	182	001121	001206	6.38	.97	.00	7.35
Santa-Maria	182	001122	001207	3.68	.44	.00	4.12
Upland	182	001122	001205	7.48	1.16	.00	8.65
Alpine	183	001207	001221	1.89	.28	.00	2.18
Atascadero	183	001206	001221	4.99	.51	.00	5.50
Glendora	183	001205	001220	3.50	.59	.00	4.09
Lake-Arrowhead	183	001206	001219	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	183	001207	001221	3.11	.62	.00	3.73
Lancaster	183	001205	001220	5.08	.91	.00	5.99
Lompoc	183	001207	001220	1.69	.19	.00	1.87
Long-Beach	183	001205	001218	7.59	1.74	.00	9.33
Mira-Loma	183	001207	001220	5.70	1.08	.00	6.78
Riverside	183	001206	001219	4.00	.80	.00	4.80
Santa-Maria	183	001207	001220	2.47	.40	.00	2.88
Upland	183	001205	001218	5.20	.94	.00	6.14

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Alpine	184	001221	010104	2.41	.31	.00	2.72
Atascadero	184	001221	010104	9.10	.97	.00	10.07
Glendora	184	001220	010102	4.96	.94	.00	5.90
Lake-Arrowhead	184	001219	010103	8.23	.19	.00	8.42
Lake-Elsinore	184	001221	010104	4.07	1.04	.00	5.11
Lancaster	184	001220	010103	8.26	1.22	.00	9.47
Lompoc	184	001220	010104	2.70	.29	.00	2.99
Long-Beach	184	001218	010102	-99.00	-99.00	-99.00	-99.00
Mira-Loma	184	001220	010104	9.84	2.75	.00	12.60
Riverside	184	001219	010103	5.30	1.53	.00	6.83
Santa-Maria	184	001220	010103	3.01	.39	.00	3.39
Upland	184	001218	010102	-99.00	-99.00	-99.00	-99.00
Alpine	185	010104	010118	2.24	.20	.00	2.44
Atascadero	185	010104	010117	5.37	.56	.00	5.93
Glendora	185	010102	010116	3.16	.29	.00	3.45
Lake-Arrowhead	185	010103	010118	.82	.05	.00	.88
Lake-Elsinore	185	010104	010118	-99.00	-99.00	-99.00	-99.00
Lancaster	185	010103	010117	5.09	.73	.00	5.82
Lompoc	185	010104	010118	2.04	.20	.00	2.24
Long-Beach	185	010102	010116	-99.00	-99.00	-99.00	-99.00
Mira-Loma	185	010104	010117	7.19	1.39	.00	8.58
Riverside	185	010103	010117	4.12	.88	.00	4.99
Santa-Maria	185	010103	010118	2.80	.37	.00	3.17
Upland	185	010102	010116	5.35	.90	.00	6.25
Alpine	186	010118	010201	2.11	.18	.00	2.28
Atascadero	186	010117	010131	5.68	.54	.00	6.22
Glendora	186	010116	010130	3.06	.25	.00	3.31
Lake-Arrowhead	186	010118	010201	.57	.06	.00	.62
Lake-Elsinore	186	010118	010131	3.53	.67	.00	4.19
Lancaster	186	010117	010130	5.39	.68	.00	6.07
Lompoc	186	010118	010131	1.89	.26	.00	2.15
Long-Beach	186	010116	010130	9.89	2.31	.00	12.21
Mira-Loma	186	010117	010131	6.04	.96	.00	7.00
Riverside	186	010117	010201	3.56	.51	.00	4.07
Santa-Maria	186	010118	010131	2.64	.29	.00	2.93
Upland	186	010116	010130	5.54	.67	.00	6.20
Alpine	187	010201	010215	1.41	.17	.00	1.59
Atascadero	187	010131	010214	3.44	.35	.00	3.79
Glendora	187	010130	010213	2.15	.24	.00	2.39
Lake-Arrowhead	187	010201	010215	.70	.05	.00	.75

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Lake-Elsinore	187	010131	010214	1.78	.31	.00	2.10
Lancaster	187	010130	010213	3.47	.46	.00	3.93
Lompoc	187	010131	010214	1.63	.14	.00	1.77
Long-Beach	187	010130	010213	6.13	1.57	.00	7.70
Mira-Loma	187	010131	010214	4.16	1.03	.00	5.20
Riverside	187	010201	010215	2.56	.51	.00	3.07
Santa-Maria	187	010131	010214	2.20	.33	.00	2.53
Upland	187	010130	010213	3.61	.46	.00	4.07
Alpine	188	010215	010301	1.40	.14	.00	1.55
Atascadero	188	010214	010301	2.62	.22	.00	2.84
Glendora	188	010213	010228	2.08	.29	.00	2.36
Lake-Arrowhead	188	010215	010301	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	188	010214	010228	2.02	.41	.00	2.43
Lancaster	188	010213	010227	3.20	.35	.00	3.54
Lompoc	188	010214	010228	1.47	.09	.00	1.56
Long-Beach	188	010213	010227	4.37	.94	.00	5.31
Mira-Loma	188	010214	010227	4.12	.67	.00	4.79
Riverside	188	010215	010301	3.33	.43	.00	3.76
Santa-Maria	188	010214	010228	1.91	.18	.00	2.09
Upland	188	010213	010228	3.28	.61	.00	3.89
Alpine	189	010301	010312	1.41	.16	.00	1.57
Atascadero	189	010301	010314	2.30	.19	.00	2.49
Glendora	189	010228	010313	2.48	.30	.00	2.78
Lake-Arrowhead	189	010301	010315	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	189	010228	010314	1.62	.26	.00	1.88
Lancaster	189	010227	010313	2.24	.24	.00	2.48
Lompoc	189	010228	010314	.96	.13	.00	1.09
Long-Beach	189	010227	010313	2.87	.76	.00	3.62
Mira-Loma	189	010227	010314	3.54	.53	.00	4.08
Riverside	189	010301	010315	2.79	.31	.00	3.10
Santa-Maria	189	010228	010314	1.39	.20	.00	1.59
Upland	189	010228	010313	3.29	.49	.00	3.78
Alpine	190	010316	010329	1.70	.22	.00	1.92
Atascadero	190	010314	010327	1.76	.24	.00	2.00
Glendora	190	010313	010327	3.48	.46	.00	3.94
Lake-Arrowhead	190	010315	010329	1.74	.12	.00	1.86
Lake-Elsinore	190	010314	010328	2.89	.32	.00	3.21
Lancaster	190	010313	010327	2.60	.28	.00	2.88
Lompoc	190	010314	010328	.60	.07	.00	.66
Long-Beach	190	010313	010327	3.63	.40	.00	4.03

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Mira-Loma	190	010314	010328	4.15	.63	.00	4.78
Riverside	190	010315	010329	3.68	.46	.00	4.15
Santa-Maria	190	010314	010328	1.39	.23	.00	1.62
Upland	190	010313	010327	4.71	.73	.00	5.44
Alpine	191	010329	010412	1.24	.16	.00	1.41
Atascadero	191	010327	010411	1.56	.22	.00	1.77
Glendora	191	010327	010410	2.85	.29	.00	3.15
Lake-Arrowhead	191	010329	010412	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	191	010328	010411	1.64	.19	.00	1.84
Lancaster	191	010327	010411	2.14	.14	.00	2.28
Lompoc	191	010328	010412	.60	.06	.00	.65
Long-Beach	191	010327	010410	2.19	.35	.00	2.55
Mira-Loma	191	010328	010411	2.53	.35	.00	2.88
Riverside	191	010329	010412	2.00	.22	.00	2.22
Santa-Maria	191	010328	010412	1.11	.21	.00	1.32
Upland	191	010327	010412	2.73	.41	.00	3.14
Alpine	192	010412	010426	2.15	.26	.00	2.41
Atascadero	192	010411	010425	1.57	.21	.00	1.77
Glendora	192	010410	010424	3.35	.33	.00	3.68
Lake-Arrowhead	192	010413	010426	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	192	010411	010425	2.66	.36	.00	3.02
Lancaster	192	010411	010424	2.50	.24	.00	2.74
Lompoc	192	010412	010425	.78	.05	.00	.82
Long-Beach	192	010410	010424	3.27	.78	.00	4.06
Mira-Loma	192	010411	010425	4.18	.49	.00	4.67
Riverside	192	010412	010426	3.81	.44	.00	4.25
Santa-Maria	192	010412	010425	1.47	.27	.00	1.74
Upland	192	010412	010424	3.98	.67	.00	4.65
Alpine	193	010426	010510	2.92	.19	.00	3.11
Atascadero	193	010425	010508	2.01	.19	.00	2.19
Glendora	193	010424	010508	4.60	.41	.00	5.01
Lake-Arrowhead	193	010426	010510	3.08	.17	.00	3.25
Lake-Elsinore	193	010425	010509	3.54	.22	.00	3.76
Lancaster	193	010424	010508	3.15	.23	.00	3.38
Lompoc	193	010425	010509	1.13	.08	.00	1.21
Long-Beach	193	010424	010508	3.06	.39	.00	3.45
Mira-Loma	193	010425	010509	5.45	.59	.00	6.04
Riverside	193	010426	010510	4.47	.45	.00	4.93
Santa-Maria	193	010425	010509	1.79	.28	.00	2.07
Upland	193	010424	010508	5.43	.50	.00	5.93

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Alpine	194	010510	010524	2.37	.26	.00	2.62
Atascadero	194	010508	010524	2.22	.23	.00	2.45
Glendora	194	010508	010522	4.38	.29	.00	4.67
Lake-Arrowhead	194	010510	010524	3.80	.25	.00	4.05
Lake-Elsinore	194	010509	010523	3.53	.29	.00	3.82
Lancaster	194	010508	010522	3.79	.34	.00	4.13
Lompoc	194	010509	010523	.69	.03	.00	.72
Long-Beach	194	010508	010522	2.31	.29	.00	2.60
Mira-Loma	194	010509	010523	3.80	.33	.00	4.14
Riverside	194	010510	010524	3.73	.38	.00	4.11
Santa-Maria	194	010509	010523	1.25	.15	.00	1.40
Upland	194	010508	010523	4.78	.49	.00	5.27
Alpine	195	010524	010607	2.07	.20	.00	2.27
Atascadero	195	010524	010607	1.78	.17	.00	1.95
Glendora	195	010522	010605	3.48	.37	.00	3.85
Lake-Arrowhead	195	010524	010607	3.01	.18	.00	3.19
Lake-Elsinore	195	010523	010606	3.10	.22	.00	3.32
Lancaster	195	010522	010605	3.71	.22	.00	3.93
Lompoc	195	010523	010606	.68	.05	.00	.73
Long-Beach	195	010522	010605	1.83	.26	.00	2.09
Mira-Loma	195	010523	010606	3.23	.28	.00	3.51
Riverside	195	010524	010607	3.04	.26	.00	3.29
Santa-Maria	195	010523	010606	1.21	.21	.00	1.42
Upland	195	010523	010605	3.58	.36	.00	3.93
Alpine	196	010607	010621	3.49	.21	.00	3.69
Atascadero	196	010607	010620	2.03	.22	.00	2.25
Glendora	196	010605	010619	5.59	.57	.00	6.15
Lake-Arrowhead	196	010607	010621	3.57	.22	.00	3.78
Lake-Elsinore	196	010606	010620	4.31	.45	.00	4.76
Lancaster	196	010605	010619	3.27	.20	.00	3.47
Lompoc	196	010606	010620	.80	.02	.00	.83
Long-Beach	196	010605	010619	2.83	.41	.00	3.23
Mira-Loma	196	010606	010620	5.25	.63	.00	5.89
Riverside	196	010607	010621	5.05	.46	.00	5.51
Santa-Maria	196	010606	010620	1.29	.26	.00	1.54
Upland	196	010605	010619	5.95	.62	.00	6.57
Alpine	197	010621	010705	3.19	.31	.00	3.50
Atascadero	197	010620	010704	2.14	.22	.00	2.36
Glendora	197	010619	010702	5.60	.54	.00	6.13
Lake-Arrowhead	197	010621	010705	3.91	.25	.00	4.15

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Lake-Elsinore	197	010620	010703	4.23	.50	.00	4.73
Lancaster	197	010619	010703	3.41	.39	.00	3.80
Lompoc	197	010620	010705	1.02	.00	.00	1.02
Long-Beach	197	010619	010702	2.91	.37	.00	3.28
Mira-Loma	197	010620	010703	5.40	.45	.00	5.85
Riverside	197	010621	010705	5.57	.52	.00	6.09
Santa-Maria	197	010620	010705	1.40	.23	.00	1.63
Upland	197	010619	010702	6.41	.73	.00	7.13
Alpine	198	010705	010719	2.38	.18	.00	2.56
Atascadero	198	010704	010719	1.53	.09	.00	1.61
Glendora	198	010702	010717	4.74	.72	.00	5.46
Lake-Arrowhead	198	010705	010719	2.99	.17	.00	3.16
Lake-Elsinore	198	010703	010718	3.18	.33	.00	3.51
Lancaster	198	010703	010717	3.11	.26	.00	3.37
Lompoc	198	010705	010718	.58	.00	.00	.58
Long-Beach	198	010702	010717	2.21	.34	.00	2.55
Mira-Loma	198	010703	010718	4.25	.55	.00	4.79
Riverside	198	010705	010719	3.62	.43	.00	4.05
Santa-Maria	198	010705	010718	.90	.08	.00	.98
Upland	198	010702	010717	5.47	.72	.00	6.19
Alpine	199	010719	010802	2.58	.17	.00	2.76
Atascadero	199	010719	010801	1.42	.06	.00	1.48
Glendora	199	010717	010731	4.66	.23	.00	4.89
Lake-Arrowhead	199	010719	010802	3.63	.15	.00	3.78
Lake-Elsinore	199	010718	010801	3.55	.26	.00	3.82
Lancaster	199	010717	010731	3.57	.18	.00	3.75
Lompoc	199	010718	010802	.84	.01	.00	.85
Long-Beach	199	010717	010731	2.20	.16	.00	2.37
Mira-Loma	199	010718	010801	3.82	.22	.00	4.04
Riverside	199	010719	010802	3.40	.14	.00	3.55
Santa-Maria	199	010718	010802	.78	.04	.00	.82
Upland	199	010717	010731	5.15	.32	.00	5.48
Alpine	200	010802	010816	3.54	.20	.00	3.74
Atascadero	200	010801	010815	1.78	.11	.00	1.89
Glendora	200	010731	010814	5.89	.39	.00	6.28
Lake-Arrowhead	200	010802	010816	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	200	010801	010815	4.63	.25	.00	4.87
Lancaster	200	010731	010814	3.71	.32	.00	4.03
Lompoc	200	010802	010815	.50	.00	.00	.50
Long-Beach	200	010731	010814	2.96	.37	.00	3.32

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Mira-Loma	200	010801	010815	5.52	.62	.00	6.14
Riverside	200	010802	010816	5.23	.33	.00	5.56
Santa-Maria	200	010802	010815	.82	.04	.00	.86
Upland	200	010731	010814	6.69	.59	.00	7.27
Alpine	201	010816	010829	3.82	.17	.00	4.00
Atascadero	201	010815	010830	2.23	.15	.00	2.38
Glendora	201	010814	010829	5.99	.33	.00	6.32
Lake-Arrowhead	201	010816	010830	-99.00	-99.00	-99.00	-99.00
Lake-Elsinore	201	010815	010829	4.52	.20	.00	4.72
Lancaster	201	010814	010828	5.34	.40	.00	5.74
Lompoc	201	010815	010829	.93	.00	.00	.93
Long-Beach	201	010814	010828	3.12	.21	.00	3.33
Mira-Loma	201	010815	010829	5.28	.54	.00	5.82
Riverside	201	010816	010830	5.00	.28	.00	5.28
Santa-Maria	201	010815	010829	.91	.17	.00	1.08
Upland	201	010814	010828	7.56	.46	.00	8.03
Alpine	202	010829	010913	2.33	.14	.00	2.46
Atascadero	202	010830	010911	1.62	.18	.00	1.80
Glendora	202	010829	010910	4.22	.33	.00	4.55
Lake-Arrowhead	202	010830	010913	3.44	.18	.00	3.62
Lake-Elsinore	202	010829	010912	2.99	.15	.00	3.13
Lancaster	202	010828	010911	4.02	.38	.00	4.40
Lompoc	202	010829	010912	.57	.02	.00	.59
Long-Beach	202	010828	010910	2.22	.18	.00	2.40
Mira-Loma	202	010829	010911	4.01	.26	.00	4.27
Riverside	202	010830	010913	3.52	.19	.00	3.71
Santa-Maria	202	010829	010912	1.02	.14	.00	1.16
Upland	202	010828	010910	4.31	.25	.00	4.55
Alpine	203	010913	010927	3.72	.18	.00	3.90
Atascadero	203	010911	010926	2.02	.13	.00	2.15
Glendora	203	010910	010925	5.96	.35	.00	6.31
Lake-Arrowhead	203	010913	010927	3.43	.18	.00	3.60
Lake-Elsinore	203	010912	010926	5.22	.45	.00	5.67
Lancaster	203	010911	010926	3.80	.40	.00	4.21
Lompoc	203	010912	010926	.55	.00	.00	.55
Long-Beach	203	010910	010925	3.36	.14	.00	3.51
Mira-Loma	203	010911	010926	6.69	.60	.00	7.29
Riverside	203	010913	010927	6.08	.44	.00	6.52
Santa-Maria	203	010912	010926	1.07	.00	.00	1.07
Upland	203	010910	010925	6.88	.63	.00	7.51

Site	Period	Start Date	End Date	Organic Carbon $\mu g\ m^{-3}$	Elemental Carbon $\mu g\ m^{-3}$	Carbonate Carbon $\mu g\ m^{-3}$	Total Carbon $\mu g\ m^{-3}$
Alpine	204	010927	011011	2.01	.12	.00	2.13
Atascadero	204	010926	011010	2.12	.25	.00	2.37
Glendora	204	010925	011009	4.63	.31	.00	4.94
Lake-Arrowhead	204	010927	011010	2.48	.12	.00	2.60
Lake-Elsinore	204	010926	011011	3.58	.45	.00	4.03
Lancaster	204	010926	011010	3.58	.18	.00	3.76
Lompoc	204	010926	011011	.90	.08	.00	.98
Long-Beach	204	010925	011009	3.54	.31	.00	3.85
Mira-Loma	204	010926	011011	5.61	.45	.00	6.07
Riverside	204	010927	011010	4.29	.48	.00	4.77
Santa-Maria	204	010926	011011	1.48	.23	.00	1.72
Upland	204	010925	011009	6.15	.46	.00	6.61
Alpine	205	011011	011025	3.04	.15	.00	3.19
Atascadero	205	011010	011024	2.74	.41	.00	3.15
Glendora	205	011009	011023	5.81	.67	.00	6.48
Lake-Arrowhead	205	011010	011025	2.73	.18	.00	2.91
Lake-Elsinore	205	011011	011024	5.37	.52	.00	5.89
Lancaster	205	011010	011023	3.65	.61	.00	4.26
Lompoc	205	011011	011024	1.20	.05	.00	1.25
Long-Beach	205	011009	011023	3.93	.29	.00	4.22
Mira-Loma	205	011011	011024	6.54	.90	.00	7.44
Riverside	205	011010	011025	5.58	.74	.00	6.32
Santa-Maria	205	011011	011024	1.86	.12	.00	1.98
Upland	205	011009	011023	7.16	.78	.00	7.94
Alpine	206	011025	011108	2.67	.20	.00	2.86
Atascadero	206	011024	011110	3.53	.30	.00	3.83
Glendora	206	011023	011106	5.30	.71	.00	6.01
Lake-Arrowhead	206	011025	011108	1.92	.09	.00	2.01
Lake-Elsinore	206	011024	011107	4.29	.53	.00	4.82
Lancaster	206	011023	011107	3.94	.51	.00	4.45
Lompoc	206	011024	011107	1.19	.05	.00	1.24
Long-Beach	206	011023	011106	4.18	.34	.00	4.53
Mira-Loma	206	011024	011107	6.44	.97	.00	7.41
Riverside	206	011025	011108	5.53	.84	.00	6.37
Santa-Maria	206	011024	011107	2.04	.13	.00	2.17
Upland	206	011023	011106	6.71	.67	.00	7.38
Alpine	207	011108	011121	2.25	.09	.00	2.34
Atascadero	207	011110	011120	3.51	.26	.00	3.78
Glendora	207	011106	011119	4.31	.49	.00	4.80
Lake-Arrowhead	207	011108	011121	1.26	.04	.00	1.30

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Lake-Elsinore	207	011107	011120	4.66	.63	.00	5.29
Lancaster	207	011107	011120	4.70	.60	.00	5.30
Lompoc	207	011107	011120	1.67	.04	.00	1.71
Long-Beach	207	011106	011119	6.03	.63	.00	6.66
Mira-Loma	207	011107	011120	7.68	1.42	.00	9.10
Riverside	207	011108	011121	6.24	.85	.00	7.09
Santa-Maria	207	011107	011120	2.36	.12	.00	2.48
Upland	207	011106	011119	5.88	.89	.00	6.77
Alpine	208	011121	011206	1.92	.19	.00	2.11
Atascadero	208	011120	011205	4.68	.36	.00	5.04
Glendora	208	011119	011204	3.54	.45	.00	3.99
Lake-Arrowhead	208	011121	011206	1.12	.10	.00	1.22
Lake-Elsinore	208	011120	011205	3.21	.51	.00	3.71
Lancaster	208	011120	011205	2.88	.31	.00	3.19
Lompoc	208	011120	011205	1.34	.14	.00	1.48
Long-Beach	208	011119	011204	6.48	1.33	.00	7.80
Mira-Loma	208	011120	011205	6.48	1.02	.00	7.50
Riverside	208	011121	011206	4.29	.61	.00	4.90
Santa-Maria	208	011120	011205	2.49	.32	.00	2.81
Upland	208	011119	011204	5.45	.50	.00	5.95
Alpine	209	011206	011220	1.91	.23	.00	2.14
Atascadero	209	011205	011219	4.84	.38	.00	5.22
Glendora	209	011204	011218	2.97	.27	.00	3.24
Lake-Arrowhead	209	011206	011220	.86	.03	.00	.89
Lake-Elsinore	209	011205	011219	3.58	.88	.00	4.46
Lancaster	209	011205	011218	4.63	.65	.00	5.28
Lancaster II	209	011205	011218	3.55	.46	.00	4.01
Lompoc	209	011205	011219	1.45	.11	.00	1.56
Long-Beach	209	011204	011218	8.16	1.67	.00	9.83
Mira-Loma	209	011205	011219	8.16	1.77	.00	9.94
Riverside	209	011206	011220	4.30	.99	.00	5.29
Santa-Maria	209	011205	011219	2.45	.37	.00	2.81
Upland	209	011204	011218	5.64	1.04	.00	6.68
Alpine	210	011220	020103	2.02	.18	.00	2.20
Atascadero	210	011219	020103	3.36	.33	.00	3.69
Glendora	210	011218	011231	4.19	.72	.00	4.90
Lake-Arrowhead	210	011220	020102	.71	.00	.00	.72
Lake-Elsinore	210	011219	020103	4.55	.70	.00	5.24
Lancaster	210	011218	020102	6.56	.58	.00	7.15
Lancaster II	210	011218	020102	4.05	.56	.00	4.61

Site	Period	Start Date	End Date	Organic Carbon μg m^{-3}	Elemental Carbon μg m^{-3}	Carbonate Carbon μg m^{-3}	Total Carbon μg m^{-3}
Lompoc	210	011219	020102	1.68	.16	.00	1.84
Long-Beach	210	011218	011231	9.29	1.87	.00	11.16
Mira-Loma	210	011219	020103	8.08	1.46	.00	9.55
Riverside	210	011220	020102	6.29	.81	.00	7.10
Santa-Maria	210	011219	020102	2.03	.24	.00	2.27
Upland	210	011218	011231	6.60	1.05	.00	7.65