CHEMICAL MASS BALANCE MODELING
FOR
SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT
PM_{10} STATE IMPLEMENTATION PLAN

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INTRODUCTION

A chemical mass balance model, CMB v.8 (CMB) was used to reconcile emissions sources with ambient air quality measurements. CMB modeling identifies possible emissions source contributions by chemical speciation. This requires both chemically speciated ambient data and the emissions source profiles that contribute to the air quality of a region. Chemically speciated ambient data was obtained from routine and CRPAQS (California Regional Particulate Air Quality Study) networks; source profiles were obtained from CRPAQS and other California sampling programs to support the San Joaquin Valley (SJV) PM_{10} State Implementation Plan (SIP.) Although CMB modeling cannot identify specific sources that contribute to secondary PM formation, it can estimate these contributions, as well as provide insight on the major contributors to primary PM10.

AMBIENT SAMPLE PREPARATION

1) **Routine Network Data.**
   The PM_{10} chemical composition data collected as part of the routine network utilized two different samplers: the size selective inlet (SSI) sampler for measuring ions (NO_3, SO_4, NH_4, K, Cl) and total carbon, and the dichotomous (dichot) sampler for measuring 30 elements by x-ray fluorescence (XRF.) The input files were constructed by combining SSI and dichot data. The concentrations of elements measured on a dichotomous sampler were scaled based on the ratio of SSI PM_{10} mass to dichot mass. Concentrations that varied by more than 20% were flagged and reexamined to determine if the data was appropriate to CMB modeling. Table 1 summarizes chemical composition data collected as part of the routine network between 1/1/1997 and 12/31/2001 where both SSI and dichotomous samplers were operated concurrently. All dichotomous samplers, except Fresno-1st, were phased out at the end of 2000. Some monitoring sites, including Corcoran, Taft, and Visalia, did not collect total carbon data. Other sites, such as Turlock, collected mass data only. Missing species concentrations were estimated using available data from other sites and/or time periods. As part of coming up with the best estimate, we asked the following questions:

1. What were the day-to-day changes in chemical composition during an episode?
2. What were the site-to-site variations in chemical composition during an episode?
3. What is the typical chemical composition for the season in question?

Section 3, "Estimating Chemical Composition for Modeling Exceedance Days", describes a detailed procedure used for estimating missing species concentrations.

Table 1. Routine SSI and Dichot Chemical Composition Data Collected Between 11/97 and 12/31/2000

SITE NAME	Code	Measured Species		
		Nitrate/ Sulfate	Total Carbon	Geological
Bakersfield-5558 California	BAC	X	X	X
Clovis - N. Villa	CLO	X		
Corcoran-Patterson Avenue[1]	COP	X		X
Corcoran-Van Dorsten[2]	COV	X		X
Fresno-1st Street	FSF	X	X	X
Modesto-I Street[3]	MIS	X	X	X
Modesto-14th Street	M14		X	X
Stockton-Hazelton Street	SOH	X	X	X
Taft College[4]	TAC	X		X
Turlock - S. Minaret St	TUR			
Visalia-N Church Street	VCS	X		X

Since it was not practical or necessary to model all of the available data, the criteria listed below were used to select only records applicable to modeling exceedances of the 24-hr standard:

a) Each episode that resulted in a violation of the 24-hr standard was identified. Unfortunately, none of the exceedances measured using a routine sampler had sufficient speciation data for CMB modeling. Therefore, the exceedance data was matched with an appropriate site/date that could be modeled based on representative meteorology and expected source contribution. This is further discussed in Section 3: “Estimating Chemical Composition for Modeling Exceedance Days”.
b) Each episode was bracketed to include exceedance days, days prior to an exceedance, and days following the exceedance. The extent of this bracketing was determined on a case-by-case basis, based on meteorology and data availability.

[1] Measurement of geological species was discontinued after March 2000.
[2] Site active between January 1997 and September 1998.
[3] Site active between January 1997 and August 1998.
[4] Measurement of geological species was discontinued in February 2000.

c) All monitoring sites that collected data during an episode, even those that that did not exceed the standard, were selected for CMB modeling.

Attachment 1 includes a complete list of routine candidate sites applicable to modeling exceedances of the 24-hr standard. Only the exceedance days and sites were used for the attainment demonstration. Other days and sites were used only in the sensitivity analysis.

2) <u>CRPAQS PM10 Chemical Speciation Data.</u>
The long-term routine monitoring network was supplemented by CRPAQS monitoring from late 1999 through early 2001. Unlike routine data that combines species from dichot and SSI samplers, the CRPAQS chemical composition data were collected using one type of sampler, a battery-powered Airmetrics Minivol sampler. Measurements of chemical species included 40 elements (Na to U) by XRF, ions (Cl, NO_3, SO_4, Na, K, NH_4), and organic and elemental carbon. The PM_{10} chemical composition data were collected as part of two programs described below:

a) The annual satellite PM_{10} network consisted of 14 months of every-sixth-day, 24-hr sampling at seven PM_{10} sites. These data were used to support the CMB modeling of exceedances of the 24-hr standard as well as annual standard. PM_{10} chemical composition measurements acquired at CRPAQS annual satellite sites are summarized in Table 2. Attachment 2 includes a complete list of sites along with the chemical composition data that were selected for CMB modeling following the criteria in Section 1 above.

Table 2. CRPAQS Chemical Composition Data Collected as Part of the Annual PM_{10} Program

Site	Code	Start Date	End Date	Obs. Count
Bakersfield-1120 Golden	BGS	12/23/1999	2/3/2001	63
Corcoran-Patterson Avenue	COP	12/5/1999	1/28/2001	65
Fresno Drummond	FSD	12/11/1999	1/28/2001	68
Hanford-Irwin St.	HAN	12/23/1999	1/28/2001	60
Modesto 14th St.	M14	12/5/1999	1/28/2001	68
Oildale-Manor	OLD	12/5/1999	2/3/2001	58
Visalia Church St.	VCS	12/5/1999	1/28/2001	61

The input files for modeling exceedances of the annual average standard were generated using CRPAQS data for the year 2000. Monthly data were averaged and formatted for CMB modeling. The monthly average source contribution estimates, as determined by the CMB model, were then averaged to create the annual average and thereby served as a basis for modeling exceedances of the annual standard.

b) The satellite fall intensive network included six emissions source dominated monitoring sites. The chemical composition data were collected on selected days between 10/9/2000 and 11/9/2000. Since the PM_{10} concentrations collected as part of this program were below the level of the 24-hr PM_{10} standard (with the maximum PM_{10} concentration of 124 ug/m3) and these data were source emissions dominated, they were only used as supplemental information for CMB modeling for sensitivity analysis.

3) <u>Estimating Chemical Composition for Modeling Exceedance Days</u>

The exceedance days and sites that were modeled using CMB are shown in Table 3. Those with data that had to be estimated are shown in italics. The following formulas were used in presenting the species information in the tables below:

Nitrate/Sulfate = (1.29*non-volatized nitrate) + (1.38*sulfate)
Total Carbon (TC) = (1.4*organic carbon (OC)) + elemental carbon (EC)
Geological = (1.89*aluminum) + (2.14*silicon) + (1.4*calcium) + (1.43*iron)

Table 3. Exceedance Days

Site	Date	Concentration (ug/m3)
January 1999		
OLD	*1/12/99*	*156*
October 1999		
COP	*10/21/99*	*174*
FSD	*10/21/99*	*162*
TUR	*10/21/99*	*157*
November 1999		
BGS	*11/14/99*	*183*
December 1999		
COP	*12/17/99*	*174*
FSD	12/23/99	168
HAN	12/23/99	156
Winter 2000-2001		
BAC	*1/1/01*	*186*
BAC	*1/4/01*	*190*
BAC	*1/7/01*	*159*
BGS	*1/1/01*	*205*
BGS	1/4/01	208
BGS	1/7/01	174
CLO	*1/1/01*	*155*
COP	*1/7/01*	*165*
FSD	*1/1/01*	*186*
FSD	1/4/01	159
FSF	*1/1/01*	*193*
HAN	*1/7/01*	*185*
M14	*1/7/01*	*158*
OLD	*1/1/01*	*158*
OLD	1/4/01	195

The procedures for estimating the chemical composition of missing species are described in Section 1. Specific information is presented below:

a) January 1999

On 1/12/99 only ammonium nitrate and sulfate were measured at the exceedance site. Since the January 1999 episode is similar to the winter 2000/2001 episode, the chemical composition data collected on 1/4/01 was used to fill in for the missing data.

Table 4. January 1999 - Assumptions

Site	Date	Assumptions for Estimating Chemical Composition
OLD	1/12/99	Used nitrate and sulfate data as is (89 ug/m3 accounting for 75% of PM_{10} mass). Used OLD data for 1/4/01 to fill in for the missing species. Multiplied each species by 0.8 to account for the difference in mass (195 ug/m3 vs. 156 ug/m3).

The measured and estimated concentrations are listed below in Table 5. Estimated concentrations are shown in bold.

Table 5. January 1999 - Measured and Estimated Concentrations

Site ID	Date	PM_{10}	Nitrate/Sulfate	Total Carbon	Geological	Sum of Species
OLD	1/4/01	195	119	28	43	190
OLD	1/12/99	156	89	**22.4**	**34.4**	**145.8**

b) October 1999

Only partial chemical composition data (no carbon) were available for COP and no composition data was available for either FSD or TUR. On 10/21/99 total carbon constituted 14% of PM_{10} mass at BAC, 15% at FSF, and 18% at M14.

Table 6. October 1999 - Assumptions

Site	Date	Assumptions for Estimating Chemical Composition
FSD	10/21/99	Used COP data for the same day. Multiplied each species, except TC and geological species, by the mass ratio (162/174) to adjust for difference in mass (162 ug/m3 at FSD vs. 174 ug/m3 at COP). TC estimated at 30 ug/m3 (18% of the mass based on comparison to M14). Geological species (Al, Si, Fe, and Ca) estimated using COP data based on the mass ratio and reduced by 5% (historical data showed that geological fraction at FSD is usually lower as compared to COP). The formula used to estimate geological species concentration was: (162/174)*0.95.
COP	10/21/99	Used nitrate, sulfate, and dichot data as is. Used 18 ug/m3 for the missing carbon data. This represented the highest carbon concentration measured in the San Joaquin Valley, excluding Modesto site, during October (based on 1997-2001 data).
TUR	10/21/99	Used M14 data for the same day. Multiplied by 1.2 to extrapolate from 132 ug/m3 at M14 to 157 ug/m3 at TUR.

The measured and estimated concentrations are listed below. Estimated concentrations are shown in bold.

Table 7. October 1999 - Measured and Estimated Concentrations

Site ID	Date	PM_{10}	Nitrate/Sulfate	Total Carbon	Geological	Sum of Species
FSF	10/21/99	121	17	18	43	78
FSD	10/21/99	162	**31**	**30**	**54.5**	**115**
COP	10/21/99	174	33	**18**	62	**113**
M14	10/21/99	132	19	24	47	90
TUR	10/21/99	157	**23**	**29**	**56**	**108**

c) November 1999

No chemical composition data was available for BGS. Since the 11/14/99 exceedance and the 1/4/01 exceedance at BGS were similar, the chemical composition data collected on 1/4/01 was used to fill in for the missing data.

Table 8. November 1999 - Assumptions

Site	Date	Assumptions for Estimating Chemical Composition
BGS	11/14/99	Used BGS data for 1/4/01 to fill in for the missing species. Multiplied each species (except elemental and organic carbon) by 0.88 to account for the difference in mass (208 ug/m3 vs. 183 ug/m3). Multiplied OC and EC by 0.75 for a carbon estimate that would better represent November conditions as compared to January (less woodburning). On 11/14/99 TC (unadjusted for missing oxygen and hydrogen) comprised 10% of PM_{10} mass at BAC and 12% at FSF. We selected an upper bound estimate (12% or 22 ug/m3) to represent TC at BGS. The organic and elemental carbon measured at BGS on 1/4/01 was multiplied by 0.75 to scale the concentrations down to 22 ug/m3. The estimated TC concentration for BGS on 11/14/99, adjusted for oxygen and hydrogen, was 28.5 ug/m3.

The measured and estimated concentrations are listed below. Estimated concentrations are shown in bold.

Table 9. November 1999 - Measured and Estimated Concentrations

Site ID	Date	PM_{10}	Nitrate/Sulfate	Total Carbon	Geological	Sum of Species
BGS	11/14/99	183	**93**	**28.5**	**41**	**162.5**
BGS	1/4/01	208	106	38	47	191

d) December 1999

No composition data was available for COP on the exceedance day of 12/17/99. The missing data was filled in by extrapolating from data obtained at the same site on 12/23/99.

Table 10. December 1999 - Assumptions

Site	Date	Assumptions for Estimating Chemical Composition
COP	12/17/99	Used COP data for 12/23/99 to fill in for missing species. Multiplied each species by 1.23 to account for the difference in mass (141 ug/m3 vs. 174 ug/m3).

The measured and estimated concentrations are listed below. Estimated concentrations are shown in bold.

Table 11. December 1999 - Measured and Estimated Concentrations

Site	Date	PM_{10}	Nitrate/Sulfate	Total Carbon	Geological	Sum of Species
COP	12/17/99	174	**87**	**35**	**54**	176
COP	12/23/99	141	70	28	44	142
FSD	12/23/99	168	68	47	44	159
HAN	12/23/99	156	80	35	44	159

e) Winter 2000 – 2001

For BAC on 1/1/01, 1/4/01, and 1/7/01, only XRF species were missing. For estimating XRF species, other than geological, dichot data for BAC on 12/29/00 was used. Data were adjusted based on the mass ratio and the downward trend in the percent of PM_{10} mass attributed to geological material between 12/29/00 and 1/1/01. The downward trend was established based on BGS data, which showed a decrease in the percent of PM_{10} mass attributed to geological material from 28% on 12/29/00 to 23% on 1/4/01. Assuming the same downward trend at BAC, 19% of PM_{10} mass attributable to geological material on 12/29/00 would decrease to 16% on 1/4/01. Since the concentration of this material was relatively stable at BAC between 1/1/01 and 1/7/01, the same percent reduction was applied to 1/4/01 and 1/7/01 as well. Geological species concentrations were estimated based on BGS data measured on 1/4/01 (concentrations noted in Table 13).

Only XRF species were missing at M14. We added dichot data equal to 8% of PM_{10} mass using data for 12/29/00.

For all other sites and days we extrapolated from 1/4/01 for any missing species.

Table 12. Winter 2000/2001 - Assumptions

Site	Date	Assumptions for Estimating Chemical Composition
CLO	1/1/01	Used nitrate and sulfate data as is, $PM_{2.5}$ carbon data to represent PM_{10} carbon, and geological from PM_{10} FSD for 1/4/01.
FSF	1/1/01	Only geological material was missing. For 1/7/01, used dichot data for all XRF species, except geological, as the dichot measurement on 1/1/01 was only about 50% of SSI measurement. Multiplied each species by 1.37 to adjust for difference in PM_{10} mass. Estimated geological species concentrations based on the data collected on 1/4/01 at FSD as part of CRPAQS. Multiplied each geological species at FSD by the mass ratio (193/159).
FSD	1/1/01	Used FSD data for 1/4/01. Multiplied each species by 1.17.
BAC	1/1/01	Only XRF data were missing. Used dichot data for BAC for 12/29/00 for all XRF species, except geological. Multiplied each XRF species by 1.1 to adjust for difference in mass and correct for lower contribution from geological material (percent of PM_{10} mass attributed to geological material was estimated to go down from 19% to 16% between 12/29/00 and 1/1/01). Estimated geological species concentrations based on the data collected on 1/4/01 at BGS as part of CRPAQS. Multiplied each geological species at BGS by the mass ratio (186/208).
BAC	1/4/01	Only XRF data were missing. Used dichot data for BAC for 12/29/00 for all XRF species, except geological. Multiplied each species by 1.13 to adjust for difference in mass and correct for lower contribution from geological material (percent of PM_{10} mass attributed to geological material was estimated to go down from 19% to 16% between 12/29/00 and 1/4/01). Estimated geological species concentrations based on the data collected on 1/4/01 at BGS as part of CRPAQS. Multiplied each geological species at BGS by the mass ratio (190/208).
BAC	1/7/01	Only XRF data were missing. Used dichot data for BAC for 12/29/00 for all XRF species, except geological. Multiplied each species by 0.94 to adjust for difference in mass and correct for lower contribution from geological material (percent of PM_{10} mass attributed to geological material was estimated to go down from 19% to 16% between 12/29/00 and 1/7/01). Estimated geological species concentrations based on the data collected on 1/4/01 at BGS as part of CRPAQS. Multiplied each geological species at BGS by the mass ratio (159/208).
BGS	1/1/01	Used BGS data for 1/4/01. Multiplied each species by mass ratio of 0.98 (205/208).
BGS	1/7/01	Used BGS data for 1/4/01. Multiplied each species by mass ratio of 0.84 (174/208).
OLD	1/1/01	Used OLD data for 1/4/01. Multiplied each species by mass ratio of 0.81 (158/195). (Concentrations of nitrate/sulfate estimated using this method compared very well with concentrations measured on 1/7/01.)
COP	1/7/01	Used COP data for 1/4/01. Multiplied each species by mass ratio of 1.195 (165/138). (Concentrations of nitrate/sulfate estimated using this method compared very well with concentrations measured on 1/7/01.)
HAN	1/7/01	Used HAN data for 1/4/01. Multiplied each species by mass ratio of 1.745 (185/106). (Concentrations of nitrate/sulfate estimated using this method compared very well with concentrations measured on 1/7/01).
M14	1/7/01	Only XRF data were missing. Used data for M14 for 12/29/00. Multiplied each species by mass ratio of 1.6 (158/99).

The measured and estimated concentrations are listed below. Estimated concentrations are shown in bold.

Table 13. Winter 2000/2001 - Measured and Estimated Concentrations

Site ID	Date	PM_{10}	Nitrate/Sulfate	Total Carbon	Geological	Sum of Species
CLO	1/1/2001	155	**77**	**37**	**29**	**143**
FSF	1/1/2001	193	76	51	**34**	**161**
FSF	1/7/2001	141	59	33	16	108
FSD	1/1/2001	186	**68**	**61**	**34**	**163**
FSD	1/4/2001	159	58	52	29	139
BAC	12/29/2000	140	55	27	27	109
BAC	1/1/2001	186	100	33	**42**	**175**
BAC	1/4/2001	190	98	30	**43**	**171**
BAC	1/7/2001	159	81	24	**36**	**141**
BGS	1/1/2001	205	**104**	**37**	**46**	**187**
BGS	1/4/2001	208	106	38	47	191
BGS	1/7/2001	174	**89**	**32**	**39**	**160**
OLD	1/1/2001	158	96	**23**	**35**	**154**
OLD	1/4/2001	195	119	28	43	190
COP	1/4/2001	138	78	23	26	127
COP	1/7/2001	165	93	**27**	**31**	**151**
HAN	1/4/2001	106	59	25	22	106
HAN	1/7/2001	185	105	**44**	**38**	**187**
M14	12/29/2000	99	46	29	8	83
M14	1/7/2001	158	88	26	**13**	**127**

SOURCE PROFILES

Based on emission inventory data and previous receptor modeling, the source types that contribute to PM_{10} in the San Joaquin Valley Air Basin include:

1. Geological material (fugitive dust from paved and unpaved roads, agriculture, construction, and vacant land).
2. Motor vehicle (exhaust, tire and brake wear).
3. Vegetative burning (residential wood burning, agricultural burning, and cooking).
4. Secondary particles (ammonium sulfate, ammonium nitrate, and organic compounds).

For each source type listed above, several subtypes were evaluated using CMB, including brake and tire wear, cooking, natural gas combustion, oil combustion, tire burning, and several subcategories of geological material (paved and unpaved road dust, agricultural operations, and construction). Since some of the source subtypes could not be distinguished from other sources, composite profiles were created to best represent the mixture of sources. Each of the composite profiles includes sources that are not easily distinguishable using commonly measured chemical species. Table 14 and Table 15 show the chemical composition of source profiles that were selected for CMB modeling. Since source profiles were obtained from different studies, not all of them had the same chemical species measured. The following sections describe the methodology for source profile selection and compositing.

Table 14. Fugitive Dust Source Profiles for CMB Modeling

Area/Month	Generic for SJV	Bakersfield/November	Bakersfield/January	Corcoran/October	Corcoran/December	Corcoran/January	Fresno/October	Fresno/December
Mnemonics	DUST	FDBACNOV	FDBACJAN	FDCOPOCT	FDCOPDEC	FDCOPJAN	FDFREOCT	FDFREDEC
Chloride (Cl-)	0.1327 ± 0.2849	±	±	0.2835 ± 0.5787	0.2420 ± 0.5787	0.2548 ± 0.5787	±	±
Nitrate (NO3-)	0.0973 ± 0.4209	0.0350 ± 0.1515	0.0450 ± 0.2253	0.1205 ± 0.6197	0.1205 ± 0.6197	0.1205 ± 0.6197	0.0263 ± 0.3193	0.0000 ± 0.3361
Phosphate (PO42-)	0.2754 ± 0.8106	±	±	0.5333 ± 1.7778	0.3556 ± 1.7778	0.3556 ± 1.7778	±	±
Sulfate (SO42-)	0.6224 ± 1.0766	0.3754 ± 0.2596	0.3232 ± 0.3198	0.3508 ± 0.2806	0.3395 ± 0.2806	0.3520 ± 0.2806	0.5145 ± 0.8244	0.5223 ± 0.8305
Ammonia (NH3)	±	±	±	±	±	±	±	±
Ammonium (NH4+)	0.1299 ± 0.1618	0.2152 ± 0.1737	0.2990 ± 0.3021	0.1800 ± 0.1348	0.2148 ± 0.1348	0.2363 ± 0.1348	0.0388 ± 0.1964	0.0285 ± 0.1009
Soluble Sodium (NA+)	0.2484 ± 0.4924	0.1789 ± 0.2218	0.0878 ± 0.0342	0.1805 ± 0.2466	0.1593 ± 0.2466	0.1631 ± 0.2466	0.1434 ± 0.0792	0.1838 ± 0.0717
Soluble Potassium (K+)	0.3263 ± 0.7110	0.5295 ± 1.1328	0.1576 ± 0.0487	0.4726 ± 1.2942	0.3428 ± 1.2942	0.3431 ± 1.2942	0.2586 ± 0.1327	0.2896 ± 0.1784
Organic Carbon (OC)	5.3827 ± 5.6885	9.3529 ± 5.6752	8.9405 ± 1.9850	5.3912 ± 7.3384	4.8679 ± 7.3384	5.0408 ± 7.3384	13.3915 ± 9.7731	15.8953 ± 12.6384
Elemental Carbon (EC)	0.3004 ± 0.4994	0.9039 ± 0.6569	1.2035 ± 1.0945	0.2101 ± 0.5069	0.2530 ± 0.5069	0.2894 ± 0.5069	1.7795 ± 1.5030	2.1829 ± 1.7928
Total Carbon (TC)	5.6830 ± 5.8802	10.2568 ± 5.7423	10.1440 ± 2.4890	5.6013 ± 7.3937	5.1208 ± 7.3937	5.3302 ± 7.3937	15.1709 ± 11.2605	18.0782 ± 14.4313
Sodium (Na)	0.3196 ± 0.4767	±	±	0.2199 ± 0.1604	0.2309 ± 0.1604	0.2410 ± 0.1604	±	±
Magnesium (Mg)	0.8458 ± 0.3210	±	±	0.8965 ± 0.5879	0.8601 ± 0.5879	0.8795 ± 0.5879	±	±
Aluminum (Al)	10.1908 ± 3.0775	8.1747 ± 2.4168	8.8333 ± 2.1655	10.8805 ± 3.7354	11.5542 ± 3.7354	11.7950 ± 3.7354	10.1763 ± 2.7407	9.9183 ± 2.6088
Silicon (Si)	31.3412 ± 10.0444	23.5229 ± 6.6262	23.9450 ± 6.3233	30.1021 ± 9.9697	31.7208 ± 9.9697	32.3157 ± 9.9697	28.1285 ± 9.3525	25.2404 ± 7.5867
Phosphorus (P)	0.3342 ± 0.9102	±	±	0.6829 ± 1.9583	0.4914 ± 1.9583	0.4953 ± 1.9583	±	±
Sulfur (S)	0.4231 ± 0.8053	0.3989 ± 0.1901	0.4191 ± 0.1910	0.2550 ± 0.1902	0.2562 ± 0.1902	0.2723 ± 0.1902	0.4476 ± 0.3611	0.4467 ± 0.2593
Chlorine (Cl)	0.0953 ± 0.2767	0.3344 ± 0.4656	0.2008 ± 0.0580	0.1979 ± 0.5772	0.1387 ± 0.5772	0.1387 ± 0.5772	0.1043 ± 0.0915	0.1280 ± 0.1131
Potassium (K)	2.8914 ± 0.8919	3.0953 ± 1.4272	2.8273 ± 0.6454	3.1403 ± 1.4530	3.0957 ± 1.4530	3.1755 ± 1.4530	2.5731 ± 1.0187	2.0048 ± 0.3620
Calcium (Ca)	3.4219 ± 1.7163	4.3174 ± 2.9795	3.5278 ± 0.6505	3.1485 ± 1.8363	3.0366 ± 1.8363	3.0789 ± 1.8363	3.0455 ± 0.5108	2.9558 ± 0.7668
Titanium (Ti)	0.4157 ± 0.0731	0.4326 ± 0.2126	0.4890 ± 0.3041	0.4913 ± 0.1731	0.5282 ± 0.1731	0.5441 ± 0.1731	0.4922 ± 0.0624	0.4883 ± 0.0514
Vanadium (V)	0.0079 ± 0.0381	0.0141 ± 0.0236	0.0163 ± 0.0340	0.0080 ± 0.0303	0.0086 ± 0.0303	0.0089 ± 0.0303	0.0226 ± 0.0231	0.0264 ± 0.0144
Chromium (Cr)	0.0026 ± 0.0114	0.0090 ± 0.0131	0.0096 ± 0.0206	0.0011 ± 0.0096	0.0013 ± 0.0096	0.0014 ± 0.0096	0.0201 ± 0.0165	0.0254 ± 0.0163
Manganese (Mn)	0.0857 ± 0.0209	0.1046 ± 0.0721	0.1216 ± 0.1095	0.0772 ± 0.0135	0.0790 ± 0.0135	0.0806 ± 0.0135	0.1119 ± 0.0125	0.1036 ± 0.0225
Iron (Fe)	4.9351 ± 0.8115	5.1572 ± 2.4574	5.8896 ± 3.3036	5.5029 ± 1.7259	5.7237 ± 1.7259	5.7549 ± 1.7259	5.3027 ± 0.6624	5.4184 ± 0.6438
Cobalt (Co)	0.0010 ± 0.0779	±	±	0.0019 ± 0.0829	0.0027 ± 0.0829	0.0032 ± 0.0829	±	±
Nickel (Ni)	0.0032 ± 0.0043	0.0047 ± 0.0043	0.0048 ± 0.0052	0.0008 ± 0.0026	0.0008 ± 0.0026	0.0008 ± 0.0026	0.0066 ± 0.0055	0.0092 ± 0.0029
Copper (Cu)	0.0145 ± 0.0088	0.0175 ± 0.0064	0.0206 ± 0.0107	0.0111 ± 0.0055	0.0112 ± 0.0055	0.0115 ± 0.0055	0.0170 ± 0.0049	0.0191 ± 0.0033
Zinc (Zn)	0.0519 ± 0.0643	0.0808 ± 0.0492	0.1113 ± 0.0145	0.0622 ± 0.0500	0.0780 ± 0.0500	0.0891 ± 0.0500	0.1350 ± 0.0951	0.1402 ± 0.1055
Gallium (Ga)	0.0004 ± 0.0027	±	±	0.0012 ± 0.0019	0.0012 ± 0.0019	0.0012 ± 0.0019	±	±
Arsenic (As)	0.0016 ± 0.0030	±	±	0.0022 ± 0.0024	0.0020 ± 0.0024	0.0019 ± 0.0024	±	±
Selenium (Se)	0.0002 ± 0.0015	±	±	0.0002 ± 0.0010	0.0002 ± 0.0010	0.0002 ± 0.0010	±	±
Bromine (Br)	0.0013 ± 0.0013	0.0039 ± 0.0040	0.0048 ± 0.0053	0.0015 ± 0.0018	0.0013 ± 0.0018	0.0013 ± 0.0018	0.0068 ± 0.0053	0.0082 ± 0.0063
Rubidium (Rb)	0.0134 ± 0.0031	±	±	0.0145 ± 0.0026	0.0150 ± 0.0026	0.0153 ± 0.0026	±	±
Strontium (Sr)	0.0328 ± 0.0097	±	±	0.0302 ± 0.0079	0.0304 ± 0.0079	0.0306 ± 0.0079	±	±
Yttrium (Y)	0.0024 ± 0.0015	±	±	0.0030 ± 0.0011	0.0032 ± 0.0011	0.0033 ± 0.0011	±	±
Zirconium (Zr)	0.0104 ± 0.0032	±	±	0.0095 ± 0.0038	0.0105 ± 0.0038	0.0111 ± 0.0038	±	±
Molybdenum (Mo)	0.0012 ± 0.0037	±	±	0.0012 ± 0.0026	0.0009 ± 0.0026	0.0006 ± 0.0026	±	±
Palladium (Pd)	0.0004 ± 0.0228	±	±	0.0002 ± 0.0163	0.0002 ± 0.0163	0.0002 ± 0.0163	±	±
Silver (Ag)	0.0007 ± 0.0268	±	±	0.0000 ± 0.0192	0.0000 ± 0.0192	0.0000 ± 0.0192	±	±
Cadmium (Cd)	0.0014 ± 0.0283	±	±	0.0003 ± 0.0203	0.0003 ± 0.0203	0.0003 ± 0.0203	±	±
Indium (In)	0.0003 ± 0.0318	±	±	0.0001 ± 0.0228	0.0000 ± 0.0228	0.0000 ± 0.0228	±	±
Tin (Sn)	0.0062 ± 0.0399	±	±	0.0017 ± 0.0286	0.0016 ± 0.0286	0.0016 ± 0.0286	±	±
Antimony (Sb)	0.0079 ± 0.0467	±	±	0.0024 ± 0.0333	0.0027 ± 0.0333	0.0030 ± 0.0333	±	±
Barium (Ba)	0.0758 ± 0.1517	±	±	0.0679 ± 0.1088	0.0719 ± 0.1088	0.0739 ± 0.1088	±	±
Lanthanum (La)	0.0432 ± 0.2225	±	±	0.0257 ± 0.1585	0.0249 ± 0.1585	0.0247 ± 0.1585	±	±
Gold (Au)	0.0003 ± 0.0055	±	±	0.0001 ± 0.0042	0.0001 ± 0.0042	0.0001 ± 0.0042	±	±
Mercury (Hg)	0.0007 ± 0.0033	±	±	0.0007 ± 0.0023	0.0007 ± 0.0023	0.0007 ± 0.0023	±	±
Thallium (Tl)	0.0004 ± 0.0032	±	±	0.0005 ± 0.0022	0.0005 ± 0.0022	0.0005 ± 0.0022	±	±
Lead (Pb)	0.0056 ± 0.0060	0.0572 ± 0.2865	0.0593 ± 0.1018	0.0067 ± 0.0063	0.0075 ± 0.0063	0.0080 ± 0.0063	0.1718 ± 0.1458	0.2089 ± 0.1807
Uranium (U)	0.0014 ± 0.0035	±	±	0.0015 ± 0.0026	0.0018 ± 0.0026	0.0021 ± 0.0026	±	±

Fugitive Dust Source Profiles for CMB Modeling (Continued)

Area/Month	Modesto/January	Oildale/January	Turlock/October	Fresno/Annual	Hanford/Annual	Kern/Annual	Visalia/Annual
Mnemonics	FDM14	FDOIL	FDTUR	FDFREANN	FDHANANN	FDKERANN	FDVCSANN
Chloride (Cl-)	0.1063 ± 0.1804	±	0.1291 ± 0.2370	±	0.2905 ± 0.5786	±	±
Nitrate (NO3-)	0.0000 ± 0.1778	0.1728 ± 0.5612	0.0398 ± 0.2332	0.0177 ± 0.2788	0.0602 ± 0.6220	0.0500 ± 0.1635	0.5350 ± 0.8801
Phosphate (PO42-)	0.0000 ± 0.0000	±	0.0223 ± 0.0536	±	0.5333 ± 1.7778	±	±
Sulfate (SO42-)	0.3946 ± 0.2246	0.4374 ± 0.3109	0.5824 ± 0.5262	0.5603 ± 0.7158	0.2801 ± 0.3278	0.4664 ± 0.2869	0.2725 ± 0.3582
Ammonia (NH3)	±	±	±	±	±	±	±
Ammonium (NH4+)	0.3030 ± 0.2229	0.0738 ± 0.0965	0.3131 ± 0.2835	0.0410 ± 0.1756	0.2212 ± 0.1492	0.1287 ± 0.2004	0.1250 ± 0.2179
Soluble Sodium (NA+)	0.1278 ± 0.0652	0.1959 ± 0.2110	0.1166 ± 0.0479	0.1667 ± 0.0735	0.1674 ± 0.2478	0.2554 ± 0.2388	0.4150 ± 0.5012
Soluble Potassium (K+)	0.1003 ± 0.0426	0.5407 ± 1.1261	0.1129 ± 0.0554	0.2689 ± 0.1191	0.4778 ± 1.2885	0.7961 ± 1.2537	0.6300 ± 0.9005
Organic Carbon (OC)	5.1404 ± 3.9169	7.7118 ± 5.7604	5.8783 ± 3.1689	14.3364 ± 8.6581	5.2122 ± 7.4936	10.2941 ± 5.3210	9.8325 ± 8.9002
Elemental Carbon (EC)	0.7319 ± 0.8206	0.2427 ± 0.4471	0.7142 ± 0.8839	1.9158 ± 1.2907	0.2811 ± 0.5188	0.6930 ± 0.7184	0.8075 ± 0.8413
Total Carbon (TC)	5.8722 ± 4.7351	7.9545 ± 5.7526	6.5925 ± 3.9902	16.2522 ± 9.9331	5.4932 ± 7.5183	10.9871 ± 5.0670	10.6400 ± 9.5544
Sodium (Na)	0.1596 ± 0.0722	±	0.2573 ± 0.1372	±	0.2151 ± 0.1608	±	±
Magnesium (Mg)	0.7901 ± 0.1068	±	0.7589 ± 0.0403	±	1.0435 ± 0.5089	±	±
Aluminum (Al)	10.7048 ± 3.2190	9.8345 ± 3.1254	10.2350 ± 3.0895	9.9696 ± 2.9544	10.8591 ± 3.6945	7.6744 ± 2.5296	7.8225 ± 3.7028
Silicon (Si)	29.8763 ± 9.4845	26.7123 ± 8.4305	30.2927 ± 9.6339	26.7660 ± 9.6262	30.5721 ± 10.0417	22.0516 ± 5.2890	19.1875 ± 8.1462
Phosphorus (P)	0.2682 ± 0.3211	±	0.2918 ± 0.3003	±	0.6821 ± 1.9578	±	±
Sulfur (S)	0.3055 ± 0.1724	0.2991 ± 0.1469	0.5187 ± 0.3645	0.4719 ± 0.3297	0.2445 ± 0.1946	0.4131 ± 0.1415	0.3400 ± 0.3281
Chlorine (Cl)	0.0670 ± 0.1161	0.2988 ± 0.4772	0.0681 ± 0.1152	0.1123 ± 0.0795	0.1878 ± 0.5772	0.4613 ± 0.4827	0.2500 ± 0.2609
Potassium (K)	2.6354 ± 0.5181	3.1668 ± 1.3894	2.9830 ± 0.5810	2.2958 ± 0.9203	3.0996 ± 1.5112	3.2636 ± 1.5926	2.7325 ± 0.4043
Calcium (Ca)	2.6988 ± 0.7989	4.5415 ± 2.6815	3.0631 ± 0.7204	3.0144 ± 0.6659	2.7038 ± 2.0238	5.5362 ± 3.0295	3.4375 ± 0.4205
Titanium (Ti)	0.4691 ± 0.1498	0.5657 ± 0.2108	0.4657 ± 0.1519	0.4849 ± 0.0528	0.4883 ± 0.1723	0.4400 ± 0.2448	0.6275 ± 0.2794
Vanadium (V)	0.0069 ± 0.0265	0.0253 ± 0.0274	0.0054 ± 0.0283	0.0237 ± 0.0219	0.0111 ± 0.0294	0.0187 ± 0.0224	0.0325 ± 0.0150
Chromium (Cr)	0.0028 ± 0.0080	0.0147 ± 0.0134	0.0012 ± 0.0086	0.0220 ± 0.0136	0.0036 ± 0.0090	0.0131 ± 0.0144	0.0250 ± 0.0100
Manganese (Mn)	0.0773 ± 0.0043	0.1372 ± 0.0716	0.0866 ± 0.0152	0.1072 ± 0.0179	0.0765 ± 0.0135	0.1078 ± 0.0824	0.1075 ± 0.0330
Iron (Fe)	5.3765 ± 0.9478	6.4555 ± 2.4510	5.0458 ± 1.1553	5.3032 ± 0.5787	5.3319 ± 1.6103	5.0877 ± 2.8375	6.1575 ± 2.7884
Cobalt (Co)	0.0017 ± 0.0846	±	0.0021 ± 0.0799	±	0.0024 ± 0.0791	±	±
Nickel (Ni)	0.0033 ± 0.0037	0.0057 ± 0.0049	0.0012 ± 0.0024	0.0077 ± 0.0046	0.0035 ± 0.0046	0.0058 ± 0.0049	0.0075 ± 0.0050
Copper (Cu)	0.0183 ± 0.0074	0.0109 ± 0.0051	0.0168 ± 0.0076	0.0180 ± 0.0042	0.0107 ± 0.0056	0.0146 ± 0.0072	0.0100 ± 0.0000
Zinc (Zn)	0.0887 ± 0.0544	0.0719 ± 0.0403	0.1225 ± 0.0935	0.1385 ± 0.0823	0.0713 ± 0.0501	0.0665 ± 0.0522	0.0950 ± 0.0819
Gallium (Ga)	0.0012 ± 0.0017	±	0.0010 ± 0.0019	±	0.0008 ± 0.0020	±	±
Arsenic (As)	0.0018 ± 0.0023	±	0.0015 ± 0.0027	±	0.0016 ± 0.0025	±	±
Selenium (Se)	0.0002 ± 0.0009	±	0.0002 ± 0.0011	±	0.0002 ± 0.0011	±	±
Bromine (Br)	0.0014 ± 0.0010	0.0051 ± 0.0040	0.0014 ± 0.0010	0.0073 ± 0.0046	0.0014 ± 0.0018	0.0042 ± 0.0043	0.0000 ± 0.0000
Rubidium (Rb)	0.0124 ± 0.0034	±	0.0140 ± 0.0029	±	0.0131 ± 0.0037	±	±
Strontium (Sr)	0.0274 ± 0.0045	±	0.0314 ± 0.0028	±	0.0254 ± 0.0099	±	±
Yttrium (Y)	0.0027 ± 0.0012	±	0.0026 ± 0.0012	±	0.0030 ± 0.0011	±	±
Zirconium (Zr)	0.0142 ± 0.0039	±	0.0144 ± 0.0037	±	0.0105 ± 0.0037	±	±
Molybdenum (Mo)	0.0004 ± 0.0024	±	0.0004 ± 0.0028	±	0.0006 ± 0.0028	±	±
Palladium (Pd)	0.0005 ± 0.0146	±	0.0001 ± 0.0168	±	0.0001 ± 0.0169	±	±
Silver (Ag)	0.0001 ± 0.0171	±	0.0002 ± 0.0196	±	0.0000 ± 0.0199	±	±
Cadmium (Cd)	0.0006 ± 0.0181	±	0.0002 ± 0.0208	±	0.0002 ± 0.0210	±	±
Indium (In)	0.0001 ± 0.0203	±	0.0000 ± 0.0234	±	0.0001 ± 0.0236	±	±
Tin (Sn)	0.0057 ± 0.0256	±	0.0067 ± 0.0294	±	0.0012 ± 0.0297	±	±
Antimony (Sb)	0.0087 ± 0.0297	±	0.0112 ± 0.0341	±	0.0022 ± 0.0345	±	±
Barium (Ba)	0.1106 ± 0.0778	±	0.1123 ± 0.0912	±	0.0656 ± 0.1136	±	±
Lanthanum (La)	0.0149 ± 0.1406	±	0.0139 ± 0.1619	±	0.0188 ± 0.1645	±	±
Gold (Au)	0.0002 ± 0.0045	±	0.0000 ± 0.0060	±	0.0004 ± 0.0043	±	±
Mercury (Hg)	0.0006 ± 0.0021	±	0.0008 ± 0.0024	±	0.0007 ± 0.0024	±	±
Thallium (Tl)	0.0003 ± 0.0020	±	0.0005 ± 0.0023	±	0.0005 ± 0.0023	±	±
Lead (Pb)	0.0090 ± 0.0065	0.0848 ± 0.2866	0.0101 ± 0.0053	0.1840 ± 0.1267	0.0060 ± 0.0064	0.0874 ± 0.3204	0.1175 ± 0.1493
Uranium (U)	0.0014 ± 0.0022	±	0.0018 ± 0.0027	±	0.0021 ± 0.0025	±	±

Table 15. Other Categories of Source Profiles for CMB Modeling

Category Mnemonics	Motor Vehicle Exhaust CAMV	Tire and Break Wear TireBrke	Vegetative Burning WBOakEuc	Vegetative Burning AgBWheat	Ammonium Nitrate AMNIT	Ammonium Sulfate AMSUL	Organic Carbon OC
Chloride (Cl-)	0.3101 ± 0.5964	0.1360 ± 0.0793	1.9019 ± 2.3403	8.2360 ± 1.3595	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Nitrate (NO3-)	0.2516 ± 0.4826	0.7310 ± 0.4922	0.5742 ± 0.0661	0.1647 ± 0.0175	77.5000 ± 7.7500	0.0000 ± 0.0000	0.0000 ± 0.0000
Phosphate (PO42-)	±	±	±	±	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Sulfate (SO42-)	0.7585 ± 0.8304	1.7765 ± 0.8686	1.3041 ± 0.8318	0.4383 ± 0.0422	0.0000 ± 0.0000	72.7000 ± 7.2700	0.0000 ± 0.0000
Ammonia (NH3)	±	±	2.0401 ± 1.7908	0.2719 ± 0.0350	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Ammonium (NH4+)	0.8077 ± 0.9702	0.5090 ± 0.3107	0.5832 ± 0.4667	0.5859 ± 0.0440	22.5500 ± 2.2550	27.3000 ± 2.7300	0.0000 ± 0.0000
Soluble Sodium (NA+)	±	0.3039 ± 0.1799	0.3833 ± 0.1520	0.5393 ± 0.0403	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Soluble Potassium (K+)	±	0.1346 ± 0.0710	2.8911 ± 0.4497	6.7935 ± 0.4962	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Organic Carbon (OC)	39.9006 ± 21.6042	30.4125 ± 9.2310	59.5824 ± 4.7535	57.0282 ± 4.5365	0.0000 ± 0.0000	0.0000 ± 0.0000	100.0000 ± 10.0000
Elemental Carbon (EC)	41.2797 ± 24.8290	7.3851 ± 2.2577	5.2016 ± 1.1170	10.3141 ± 0.8469	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Total Carbon (TC)	81.3235 ± 29.8023	37.7975 ± 11.4887	64.7840 ± 5.1338	67.3449 ± 5.3233	0.0000 ± 0.0000	0.0000 ± 0.0000	100.0000 ± 10.0000
Sodium (Na)	0.0934 ± 0.7803	0.0000 ± 0.1759	0.8753 ± 0.5740	0.0000 ± 0.5189	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Magnesium (Mg)	0.2825 ± 0.3212	0.4510 ± 0.2425	0.0223 ± 0.0679	0.0284 ± 0.0597	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Aluminum (Al)	0.3568 ± 0.5629	1.2129 ± 0.8138	0.0733 ± 0.0489	0.0739 ± 0.0087	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Silicon (Si)	2.3582 ± 2.3385	1.5450 ± 0.7461	0.2201 ± 0.0953	0.1287 ± 0.0098	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Phosphorus (P)	0.5385 ± 0.3709	0.0024 ± 0.0172	0.0000 ± 0.0076	0.0017 ± 0.0059	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Sulfur (S)	0.5360 ± 0.1941	1.1960 ± 0.3258	0.4121 ± 0.3260	0.1337 ± 0.0098	0.0000 ± 0.0000	24.2700 ± 2.4270	0.0000 ± 0.0000
Chlorine (Cl)	0.3220 ± 0.5331	0.0724 ± 0.0307	1.7220 ± 2.0160	6.1585 ± 0.4360	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Potassium (K)	0.0226 ± 0.1231	0.2680 ± 0.1526	2.8621 ± 0.9341	5.4967 ± 0.3891	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Calcium (Ca)	0.8183 ± 0.5229	0.7712 ± 0.4376	0.1484 ± 0.1025	0.1031 ± 0.0321	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Titanium (Ti)	0.0121 ± 0.4305	0.0929 ± 0.1499	0.0067 ± 0.0236	0.0053 ± 0.0130	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Vanadium (V)	0.0055 ± 0.2707	0.0000 ± 0.0667	0.0002 ± 0.0095	0.0000 ± 0.0076	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Chromium (Cr)	0.0071 ± 0.0475	0.0821 ± 0.0308	0.0021 ± 0.0030	0.0000 ± 0.0022	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Manganese (Mn)	0.0021 ± 0.0266	0.3417 ± 0.1766	0.0060 ± 0.0035	0.0024 ± 0.0004	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Iron (Fe)	2.0565 ± 1.7735	43.3272 ± 19.3830	0.0930 ± 0.0593	0.0687 ± 0.0049	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Cobalt (Co)	0.0000 ± 0.0352	0.0181 ± 0.3796	0.0002 ± 0.0018	0.0000 ± 0.0013	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Nickel (Ni)	0.0170 ± 0.0322	0.0000 ± 0.0088	0.0006 ± 0.0008	0.0001 ± 0.0008	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Copper (Cu)	0.0315 ± 0.0292	0.4849 ± 0.2919	0.0064 ± 0.0016	1.0241 ± 0.0725	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Zinc (Zn)	0.7860 ± 0.6524	1.4708 ± 1.0257	0.0426 ± 0.0180	0.0139 ± 0.0013	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Gallium (Ga)	0.0000 ± 0.0002	0.0025 ± 0.0046	0.0010 ± 0.0018	0.0000 ± 0.0010	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Arsenic (As)	0.0000 ± 0.0033	0.0000 ± 0.0068	0.0005 ± 0.0018	0.0006 ± 0.0008	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Selenium (Se)	0.0000 ± 0.0000	0.0003 ± 0.0025	0.0002 ± 0.0007	0.0001 ± 0.0004	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Bromine (Br)	0.0002 ± 0.0005	0.0069 ± 0.0045	0.0046 ± 0.0015	0.0337 ± 0.0024	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Rubidium (Rb)	0.0000 ± 0.0000	0.0067 ± 0.0041	0.0057 ± 0.0006	0.0003 ± 0.0013	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Strontium (Sr)	0.0000 ± 0.0000	0.5430 ± 0.2760	0.0013 ± 0.0004	0.0015 ± 0.0002	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Yttrium (Y)	0.0000 ± 0.0001	0.0003 ± 0.0028	0.0007 ± 0.0015	0.0003 ± 0.0008	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Zirconium (Zr)	0.0000 ± 0.0009	0.0053 ± 0.0136	0.0000 ± 0.0017	0.0015 ± 0.0003	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Molybdenum (Mo)	0.0000 ± 0.0009	0.0026 ± 0.0059	0.0000 ± 0.0029	0.0000 ± 0.0016	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Palladium (Pd)	0.0000 ± 0.2190	0.0004 ± 0.0195	0.0007 ± 0.0036	0.0000 ± 0.0018	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Silver (Ag)	0.0000 ± 0.2855	0.0093 ± 0.0236	0.0022 ± 0.0046	0.0011 ± 0.0021	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Cadmium (Cd)	0.0000 ± 0.2856	0.0019 ± 0.0247	0.0018 ± 0.0047	0.0014 ± 0.0022	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Indium (In)	0.0077 ± 0.2857	0.0114 ± 0.0267	0.0009 ± 0.0059	0.0000 ± 0.0030	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Tin (Sn)	0.0002 ± 0.4651	0.0346 ± 0.0326	0.0000 ± 0.0082	0.0028 ± 0.0042	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Antimony (Sb)	0.0052 ± 0.6450	0.0420 ± 0.0397	0.0006 ± 0.0097	0.0045 ± 0.0050	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Barium (Ba)	0.1010 ± 1.2963	1.7800 ± 1.2578	0.0192 ± 0.0465	0.0000 ± 0.0234	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Lanthanum (La)	0.0648 ± 1.5900	0.0000 ± 0.1839	0.0000 ± 0.0614	0.0163 ± 0.0317	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Gold (Au)	0.0000 ± 0.6031	0.0026 ± 0.0386	0.0008 ± 0.0029	0.0000 ± 0.0013	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Mercury (Hg)	0.0000 ± 0.0110	0.0000 ± 0.0061	0.0002 ± 0.0015	0.0000 ± 0.0008	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Thallium (Tl)	0.0000 ± 0.0014	0.0049 ± 0.0055	0.0004 ± 0.0016	0.0000 ± 0.0008	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Lead (Pb)	0.0292 ± 0.0449	0.0504 ± 0.0197	0.0046 ± 0.0025	0.0000 ± 0.0014	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000
Uranium (U)	0.0000 ± 0.0009	0.0000 ± 0.0055	0.0008 ± 0.0027	0.0012 ± 0.0015	0.0000 ± 0.0000	0.0000 ± 0.0000	0.0000 ± 0.0000

1) Geological Material

Geological material is a significant component of PM_{10} in the San Joaquin Valley. It comes from a variety of sources, including roads (paved and unpaved), agricultural operations such as land preparation and harvesting, construction, and soil erosion. The Central California Fugitive Dust Characterization Study acquired 47 samples from 37 areas. These included: 1) paved road dust from urban and rural areas, 2) unpaved road dust, 3) agricultural soil from five crop fields (almond, cotton, grape, safflower, and tomato), 4) dairy and feedlot soil, 5) salt buildup deposits from irrigation canal drainages, and 6) building construction/earthmoving soil.

In addition to these latest profiles, some older soil profiles collected in the Valley in the late 80's were also used to create composite profiles that best represent fugitive dust sources at each exceedance site in the San Joaquin Valley. Information on the relative fractions of paved and unpaved road dust, as well as agricultural dust, along with information on the seasonality of agricultural operations and predominant crop types were used to determine which source profiles to include in each composite. Site- and season-specific composite profiles were then used in the CMB analysis. Table 16 shows geological source profiles that were used to create the composite profiles. Table 18 lists all profiles included in the composites for each of the episodes and

Table 19 lists all profiles included in the composites created for modeling annual average concentrations.

Table 16. Summary of Geological Profiles Used in CMB Modeling

Profiles Collected as Part of the Central California Fugitive Dust Characterization Study (TSS12)

Source Type	Subtype	County	Sample ID	Latitude	Longitude	Soil Classification
Agricultural Soil	Cotton	Fresno	FDCOT1A	36º34'30"	120º05'12"	Chino Fine Sandy Loam
			FDCOT1C	36º34'43"	120º05'09"	Chino Fine Sandy Loam
			FDCOT2A	36º15'28"	119º59'45"	Cerini Clay Loam
			FDCOT2B	36º15'44"	119º59'47"	Cerini Clay Loam
			FDCOT2C	36º15'45"	120º00'14"	Cerini Clay Loam
		Kern	FDCOT3A	35º12'27"	119º16'42"	Copus Silty Clay
			FDCOT3B	35º12'05"	119º17'14"	Copus Silty Clay
			FDCOT3C	35º12'08"	119º16'20"	Copus Silty Clay
			FDCOT4A	35º08'59"	119º01'22"	Lokern Clay
		Kings	FDCOT5A	36º08'05"	119º58'56"	Westhaven Loam
	Tomato	Fresno	FDTOM1A	36º47'17"	120º26'24"	Panoche Silty Clay
			FDTOM1B	36º47'17"	120º26'00"	Panoche Silty Clay
			FDTOM2A	36º08'59"	119º30'27"	N/A
			FDTOM3A	36º08'59"	119º30'27"	N/A
	Almonds	Kern	FDALM1A	35º29'52"	119º09'31"	Driver Coarse Sandy Loam
			FDALM1B	35º29'47"	119º09'31"	Driver Coarse Sandy Loam
			FDALM1C	35º29'40"	119º09'12"	Driver Coarse Sandy Loam
		Fresno	FDALM2	36º35'28"	120º03'50"	N/A
		Kings	FDALM3	35º39'27"	119º53'39"	Kimberlina Fine Sandy Loam
		Madera	FDALM4	37º20'47"	120º43'25"	Dinuba Sandy Loam
	Grapes	Fresno	FDGRA1	36º38'51"	119º49'05"	Hesperia Fine Sandy Loam
		Madera	FDGRA2	36º53'03"	120º04'03"	N/A
	Safflower	Kings	FDSAF1	35º58'43"	119º39'41"	Tulare Clay
		Kern	FDSAF2	35º11'37"	119º15'39"	Zalvidea Sandy Clay Loam
			FDSAF3	35º09'09"	119º01'22"	Oldriver Loam
Animal Husbandry	Dairy	Kings	FDCTD1	36º07'13"	119º31'13"	Organic
		Fresno	FDCTD2	35º57'41"	119º39'08"	Organic
	Feedlot	Kern	FDCTF1	35º30'02"	119º06'30"	Organic
		Fresno	FDCTF2	36º15'10"	120º15'53"	Organic
Paved Road Dust	Urban	Kern	FDPVR1	36º18'09"	120º15'54"	Paved Road
	Rural	Kern	FDPVR3	35º36'07"	119º18'41"	Paved Road
		Tulare	FDPVR4	36º08'59"	119º30'27"	Paved Road
Unpaved Road Dust	Agricultural	Fresno	FDUPR1	36º34'45"	120º03'05"	Unpaved Road
		Kern	FDUPR3	35º12'08"	119º16'22"	Unpaved Road
	Public /Residential	Kings	FDUPR4	36º05'51"	119º35'09"	Unpaved Road
			FDUPR5	35º36'52"	119º41'35"	Unpaved Road
			FDUPR6	36º00'34"	119º58'03"	Unpaved Road
	Staging Area	Kings	FDSTA1	36º08'02"	119º58'56"	Unpaved Road
Disturbed Soil	Disturbed Land Salt Buildup	Kings	FDDIS1	35º50'20"	119º39'44"	Disturbed Land
		Kern	FDDIS2	35º09'05"	119º01'19"	Disturbed Land
	Construction Earthmoving	Fresno	FDCON1	36º47'07"	120º03'40"	Construction
		Madera	FDCON2	36º56'27"	120º03'26"	Construction

Table 17. Summary of Geological Profiles Used in CMB Modeling Cont.

Other Profiles From Library of Sources					
Source Type	**Subtype**	**County**	**Sample ID**	**Source**	**Soil Classification**
Agricultural Soil	Cotton/ Walnut	Tulare	SOIL04	Houck, et al, 1989	Visalia Agricultural Soil (Cotton/Walnut)
		Kern	SOIL31	Houck, et al, 1989	Kern, Agricultural
Paved Road Dust		Fresno	SOIL03	Houck, et al, 1989	Fresno Paved Road
		Tulare	SOIL08	Houck, et al, 1989	Visalia Paved Road
Unpaved Road	Urban	Tulare	SOIL07	Houck, et al, 1989	Visalia Urban Unpaved

Composite Profiles			
Source Type	**Subtype**	**Sample ID**	**Source**
Agricultural Soil	Almonds	FDALM	FDALM1 through FDALM4
	Cotton	FDCOT	FDCOT1 through FDCOT5
	Grapes	FDGRA	FDGRA1 through FDGRA3
	Safflower	FDSAF	FDSAF1 through FDSAF3
	Tomato	FDTOM	FDTOM1 through FDTOM3
Animal Husbandry	Dairy	FDCTD	FDCTD1 and FDCTD2
	Feedlot	FDCTF	FDCTF1 and FDCTF2
Paved Road Dust	Rural	FDPVR	FDPVR1 through FDPVR4
Unpaved Road Dust	Agricultural	FDUPRA	FDUPR1 through FDUPR3
	All	FDUPR	FDUPR1 through FDUPR6
Fugitive Dust, Resuspended Dust, Misc	Distrubed Land, Salt Buildup	FDDIS	FDDIS 1 and FDDIS2
	Construction, Earthmoving	FDCON	FDCON1 and FDCON2
	Resuspended Dust	RESUSP12	RESUSP1 and RESUSP2

Table 18. Episode Specific Geological Composite Source Profiles

Composite Profile ID	Sample ID	% Weight	Applicable Month/Area
DUST	Generic composite profile, which is an average of all profiles listed in Table 15.		
FDBACNOV	SOIL31	10	November / Bakersfield-Golden
	FDCOT	10	
	SOIL13	20	
	FDCTF	15	
	FDPVR1	45	
FDBACJAN	SOIL13	30	January / Bakersfield-Golden and Bakersfield-California
	FDPVR1	70	
FDOIL	SOIL31	10	January / Oildale
	FDPVR	20	
	SOIL13	40	
	FDCTF	15	
	FDUPR	15	
FDCOPOCT	FDCOT4	30	October / Corcoran
	FDPVR3	35	
	FDUPR	20	
	FDCTF	15	
FDCOPDEC	FDCOT4	20	December / Corcoran
	FDPVR3	50	
	FDUPR	20	
	FDCTF	10	
FDCOPJAN	FDCOT4	10	January / Corcoran.
	FDPVR3	60	
	FDUPR	20	
	FDCTF	10	
FDTUR	FDALM	.33 *100	October / Turlock
	FDPVR1	.33 *100	
	FDPVR3	.33 *100	
FDM14	FDTOM	.33 *100	January / Modesto
	FDPVR1	.33 *100	
	FDPVR3	.33 *100	
FDHANNOV	The same as FDCOPOCT		October / Hanford
FDHANDEC	The same as FDCOPDEC		December / Hanford
FDHANJAN	The same as FDCOPJAN		January / Hanford
FDFREOCT	FDALM	10	October / Fresno-Drummond
	FDGRA1	25	
	SOIL03	65	
FDFREDEC	FDTOM1	20	December and January / Clovis, Fresno-1st, and Fresno-Drummond
	SOIL03	80	

Table 19. Annual Geological Source Profiles

Composite Profile ID	Sample ID	% Weight	Applicable Month/Area
FDKERANN	SOIL31	25	Annual / Bakersfield
	FDPVR1	25	
	FDCTF	25	
	SOIL13	25	
FDHANANN	FDUPR	10	Annual / Hanford
	FDCTF	15	
	FDCOT5	30	
	FDPVR3	45	
FDVCSANN	SOIL04	25	Annual / Visalia
	SOIL07	25	
	SOIL08	25	
	VIDAIC	25	
FDFREANN	SOIL03	70	Annual / Fresno
	FDALM	10	
	FDGRA1	10	
	FDTOM1	10	

2) Motor Vehicle

The following documents summarize samples collected to represent the motor vehicle fleet in California:

1. “Measurement of Primary Particulate Matter Emissions from Light-Duty Motor Vehicles”, CRC Project No. E-24-2, Center for Environmental Research and Technology, College of Engineering, University of California, Riverside, December 1998.
2. “Characterization of Particulate Emissions from Gasoline Fueled Vehicles”, California Air Resources Board, Contract 94-319, September 1998.

Vehicles were tested over the FTP Cycle as part of the CRC project and over the Unified Cycle as part of the ARB project. Elemental and organic carbon were the primary constituents of the particulate matter concentrations. On average, organic carbon composed a larger fraction of the total carbon for the gasoline vehicles, while elemental carbon represented a larger fraction of the total carbon for the diesel vehicles. There was considerable variability from vehicle to vehicle, however, with some gasoline vehicles having higher percentages of elemental carbon than organic carbon and some diesel vehicles having higher percentages of organic carbon than elemental carbon (Table 19). The contribution of organic carbon was generally larger for the older, higher emitting vehicles.

In order to develop a source profile useful for receptor modeling, individual sample profiles were averaged to represent motor vehicle emissions for the San Joaquin Valley. The individual sample profiles were composited by source type and sub-type using the Department of Motor Vehicles and EMFAC2002 version 2.2 breakdown of the motor vehicle fleet. The breakdown numbers for the fleet are presented in Table 20.

Listed below are the different levels of subset grouping that were created in order to represent an average motor vehicle fleet:

1. Cars and trucks
2. Year bin (91-00, 81-90, and 65-80)
3. Exhaust control technology (Non-catalytic, catalytic, and diesel).

Table 21 shows variations in carbon as a weight percent of PM_{10} mass between groups and subgroups.

Table 19. Elemental and Organic Carbon for Gasoline and Diesel Vehicles (Weight Percent Mass)

Vehicle Type	Year Bin		Year, Make, and Model	OC	EC	TC
Truck	91-00	Catalyst	1997 Ford Windstar	6 ± 2	109 ± 16	115 ± 16
Car	91-00	Catalyst	1994 Dodge Spirit	51 ± 8	58 ± 6	110 ± 13
Car	91-00	Catalyst	1994 Dodge Shadow	18 ± 6	22 ± 2	40 ± 8
Truck	91-00	Catalyst	1994 Dodge Caravan	22 ± 4	50 ± 5	72 ± 9
Truck	91-00	Catalyst	1994 Chevrolet C1500 Suburban	11 ± 3	23 ± 3	34 ± 5
Truck	91-00	Catalyst	1992 Toyota Pick-up	52 ± 9	70 ± 10	122 ± 18
Truck	91-00	Catalyst	1992 Dodge Dakota LE	21 ± 4	58 ± 9	79 ± 12
Car	91-00	Catalyst	1991 Toyota Tercel	39 ± 8	53 ± 8	91 ± 15
Truck	91-00	Catalyst	1991 Toyota Pick-Up	13 ± 4	81 ± 12	94 ± 14
Truck	91-00	Catalyst	1991 Pontiac Transport	82 ± 11	6 ± 1	88 ± 13
Car	81-90	Catalyst	1990 Nissan Stanza	20 ± 3	46 ± 4	67 ± 7
Car	81-90	Catalyst	1990 Nissan Sentra	13 ± 4	92 ± 14	104 ± 16
Car	81-90	Catalyst	1990 Honda Accord EX	61 ± 9	16 ± 2	77 ± 10
Car	81-90	Catalyst	1990 Ford Tempo	15 ± 3	8 ± 1	24 ± 4
Truck	81-90	Catalyst	1990 Dodge Ram 250	34 ± 5	4 ± 1	38 ± 5
Car	81-90	Catalyst	1989 Toyota Celica	6 ± 7	29 ± 3	36 ± 8
Car	81-90	Catalyst	1989 Hyundai Excel GL	57 ± 8	1 ± 0	58 ± 8
Truck	81-90	Catalyst	1989 GMC Sierra1500	112 ± 17	7 ± 1	119 ± 18
Truck	81-90	Catalyst	1989 Dodge Caravan	87 ± 12	3 ± 0	90 ± 12
Car	81-90	Catalyst	1988 Mazda MX-6	26 ± 4	51 ± 8	77 ± 11
Truck	81-90	Catalyst	1988 Dodge Ram Royal	57 ± 9	39 ± 6	97 ± 15
Truck	81-90	Catalyst	1988 Dodge Caravan	88 ± 12	7 ± 1	95 ± 13
Car	81-90	Catalyst	1987 Buick Park Ave	23 ± 4	40 ± 4	63 ± 7
Car	81-90	Catalyst	1987 Acura Integra	51 ± 6	21 ± 2	73 ± 7
Car	81-90	Catalyst	1986 Chrysler 5th Ave	47 ± 6	79 ± 8	126 ± 14
Car	81-90	Catalyst	1986 Alfa Romeo Spider	63 ± 9	21 ± 3	84 ± 12
Truck	81-90	Catalyst	1985 Toyota Pick-up	51 ± 8	17 ± 3	68 ± 11
Car	81-90	Catalyst	1985 Oldsmobile Cutlass	46 ± 5	15 ± 2	61 ± 6
Truck	81-90	Catalyst	1985 Dodge Caravan	57 ± 8	6 ± 1	63 ± 8
Car	81-90	Catalyst	1985 Chevy Caprice	71 ± 8	10 ± 2	82 ± 9
Car	81-90	Catalyst	1985 Chevrolet Sprint	69 ± 9	13 ± 2	82 ± 11
Car	81-90	Catalyst	1984 Nissan Sentra	33 ± 3	36 ± 5	69 ± 7

Table 19. Elemental and Organic Carbon for Gasoline and Diesel Vehicles Cont. (Weight Percent Mass)

Vehicle Type	Year Bin		Year, Make, and Model	OC			EC			TC		
Car	81-90	Catalyst	1984 Mazda 626	74	±	7	28	±	3	102	±	10
Truck	81-90	Catalyst	1984 Dodge Ram	70	±	8	12	±	1	82	±	8
Car	81-90	Catalyst	1984 Buick Regal LTD	31	±	4	12	±	2	43	±	6
Truck	81-90	Catalyst	1981 Chevrolet G-10	78	±	11	10	±	2	88	±	12
Truck	81-90	Catalyst	1981 Chevrolet C-10	24	±	4	93	±	14	117	±	16
Car	65-80	Catalyst	1980 Honda Prelude	54	±	5	14	±	1	68	±	7
Truck	65-80	Catalyst	1980 Ford E350 Van	89	±	10	8	±	1	97	±	10
Car	65-80	Catalyst	1979 Plymouth Horizon	68	±	7	4	±	0	72	±	7
Car	65-80	Catalyst	1979 Nissa 280ZX	42	±	5	43	±	4	85	±	9
Car	65-80	Catalyst	1979 Ford Mustang	69	±	9	23	±	3	92	±	13
Car	65-80	Catalyst	1978 Toyota Corolla	69	±	8	37	±	6	106	±	11
Car	65-80	Catalyst	1978 Pontiac LeMans	95	±	9	8	±	1	102	±	11
Truck	65-80	Catalyst	1978 Chevrolet C-20 PU	76	±	10	4	±	1	80	±	11
Car	65-80	Catalyst	1977 Datsun 200 SX	37	±	4	34	±	3	70	±	7
Car	91-00	Diesel	1993 Mercedes 300D	13	±	2	70	±	7	83	±	9
Car	81-90	Diesel	1985 Mercedes 300D	88	±	10	89	±	9	177	±	18
Car	81-90	Diesel	1984 Volkswagen Rabbit	14	±	2	61	±	6	75	±	8
Car	81-90	Diesel	1984 Toyota Corolla	9	±	1	76	±	7	85	±	9
Car	81-90	Diesel	1984 Mercedes 300D	9	±	1	89	±	9	98	±	10
Truck	81-90	Diesel	1982 Volkswagen Vanagon	21	±	2	56	±	6	78	±	8
Car	81-90	Diesel	1982 Volkswagen Rabbit	32	±	4	37	±	4	69	±	7
Car	81-90	Diesel	1982 Mercedes Benz	28	±	3	38	±	4	66	±	7
Car	81-90	Diesel	1982 Mercedes 300 TD	11	±	1	102	±	10	113	±	11
Car	81-90	Diesel	1982 Isuzu I-Mark	17	±	2	59	±	6	76	±	8
Car	81-90	Diesel	1981 Peugeot 505 TD	11	±	1	48	±	5	59	±	6
Car	81-90	Diesel	1981 Mercedes 300 SD	12	±	1	72	±	7	84	±	9
Car	65-80	Diesel	1980 Volkswagen Rabbit	22	±	2	57	±	6	78	±	8
Car	65-80	Diesel	1980 Mercedes 300 TD	42	±	5	17	±	2	59	±	6
Car	65-80	Diesel	1980 Mercedes 240D	22	±	3	45	±	4	67	±	7
Car	65-80	Diesel	1979 Volswagen Rabbit	51	±	6	13	±	1	64	±	6
Car	65-80	Diesel	1977 Mercedes 300D	18	±	2	40	±	4	57	±	6
Car	65-80	No Catalyst	1979 Honda Civic	39	±	6	20	±	3	59	±	9
Truck	65-80	No Catalyst	1973 Ford Ranger	83	±	11	3	±	0	86	±	12
Truck	65-80	No Catalyst	1972 Chevy C-20 Pick-Up	69	±	8	5	±	0	74	±	8
Car	65-80	No Catalyst	1965 Ford Mustang	73	±	10	4	±	1	77	±	11

Table 20. 2000 Average San Joaquin Valley Air Basin Emissions in Tons per Day Based on Vehicle Miles Traveled in Thousands
Source: EMFAC2002 v2.2

Year Group	Light Duty Passenger Cars				Light Duty Trucks			
	Non-cat	Cat	Diesel	Total	Non-cat	Cat	Diesel	Total
91-00	0	26216	26	26242	0	18727	512	19239
81-90	0	10856	118	10975	0	6790	283	7073
65-80	829	771	51	1652	1202	918	19	2139
65-00	**829**	**37844**	**195**	**38869**	**1202**	**26435**	**814**	**28451**

Table 21. Elemental and Organic Carbon for Cars and Trucks Grouped by Year (Weight Percent Mass)

Vehicle Type	Year Bin	OC	EC	TC
Cars	91-00	36 ± 17	44 ± 20	81 ± 36
Cars	81-90	42 ± 22	31 ± 25	72 ± 25
Cars	65-80	58 ± 22	18 ± 13	76 ± 14
Cars	**65-00**	**38 ± 19**	**39 ± 21**	**78 ± 32**
Trucks	91-00	30 ± 28	57 ± 35	86 ± 29
Trucks	81-90	64 ± 26	21 ± 27	85 ± 24
Trucks	65-80	78 ± 10	5 ± 2	83 ± 11
Trucks	**65-00**	**42 ± 26**	**44 ± 30**	**86 ± 27**
Cars and Trucks	**65-00**	**40 ± 22**	**41 ± 25**	**81 ± 30**

3) Tire and Brake Wear

Tire and brake wear samples were collected as part of the “Development of a Gas and Particulate Matter Organic Speciation Profile Database” conducted by CE-CERT as part of CRPAQS. Two tire samples were collected but only one of them, Tire Test #1, was selected to represent tire wear. The other sample, Tire Test #2, was invalidated because the sum of species was much greater than the $PM_{2.5}$ mass. Three brake samples were collected: Brake Test #1, Replica of Test #1, and Brake Test #2. There was a very good agreement between Test #1 and its replica. The Brake Test #2 was not included in the average because the sum of species was much lower than the $PM_{2.5}$ mass and the chemical make up was very different than the one for Test #1 and its replica. Figure 1 and Figure 2, and show chemical composition of tire and brake wear samples.

The tire and brake wear profiles were sampled only in the $PM_{2.5}$ fraction. Since much of the PM_{10} mass resulting from tire and brake wear is in the $PM_{2.5}$ fraction, we would expect the PM_{10} and $PM_{2.5}$ profiles to be similar. Therefore the $PM_{2.5}$ profiles were used for modeling PM_{10} data.

Since the individual contributions from tire and brake wear were very small we created a composite profile by averaging the tire and brake wear contribution based on the emission inventory. Based on 2000 data (EMFAC 2002 v.2.2),

PM_{10} emissions from tire wear in the San Joaquin Valley were 0.86 tons per day and the brake wear emissions were 1.12 tons per day.

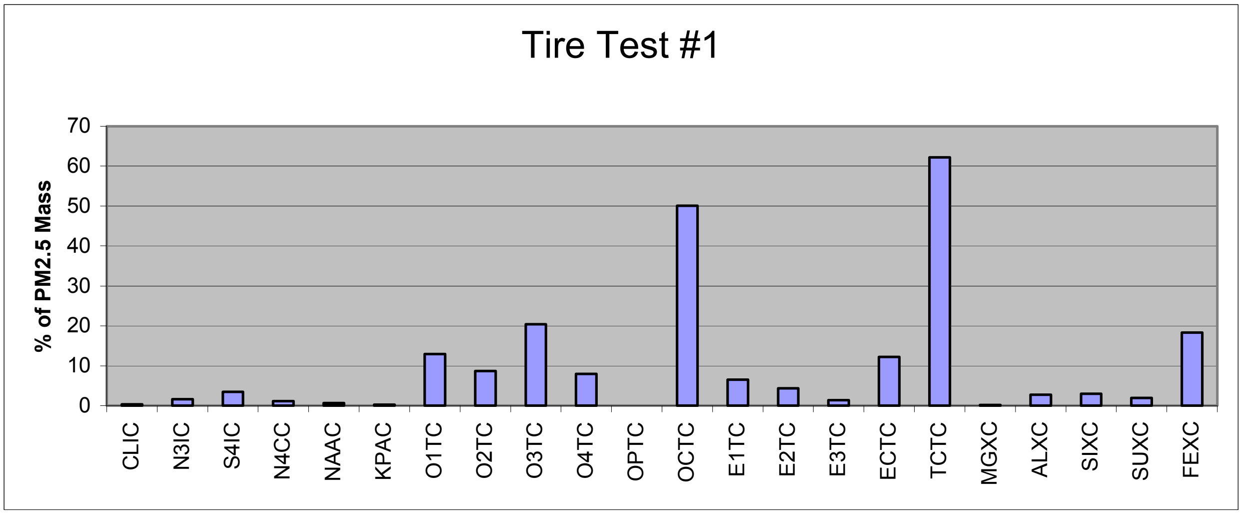
4) Wood Combustion

Residential and agricultural burning emissions were sampled as part of the "Development of a Gas and Particulate Matter Organic Speciation Profile Database" conducted by CE-CERT as part of CRPAQS. The residential wood combustion samples included oak, tamarack, eucalyptus, and almond. The agricultural burning included rice and wheat. Wood combustion profiles, just like the tire and brake wear profiles, were sampled only in the $PM_{2.5}$ fraction. Since almost all of the PM_{10} mass resulting from wood combustion is in the $PM_{2.5}$ fraction, we would expect the PM_{10} and $PM_{2.5}$ profiles to be similar. Therefore the $PM_{2.5}$ profiles were used for modeling PM_{10} data.

Since the oak and eucalyptus samples showed similar chemical composition, they were averaged together to represent variability from different source subtypes. The almond sample was similar to the oak and eucalyptus for most of the species, but showed major difference in the abundances of the carbon fractions. The tamarack differs from other wood burning profiles by having more elemental carbon and less organic carbon. Figure 4 and Figure 5show the chemical composition of wood burning samples.

Since rice and wheat samples showed significant differences in chemical composition, they were retained as individual profiles.

Figure 1. Source Profiles for Tire Test #1 and #2
(Selected Species Only)



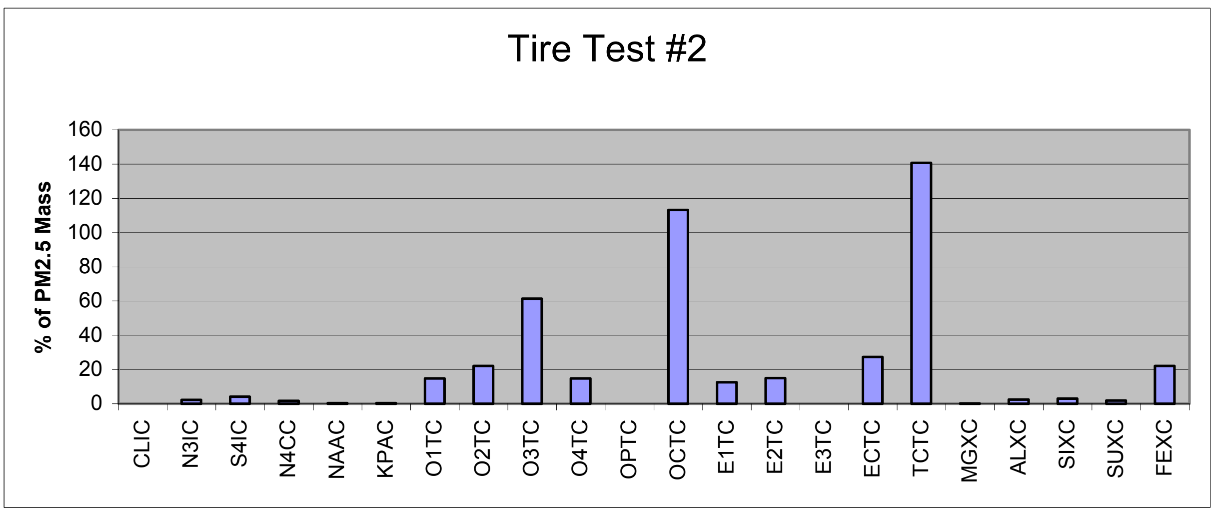
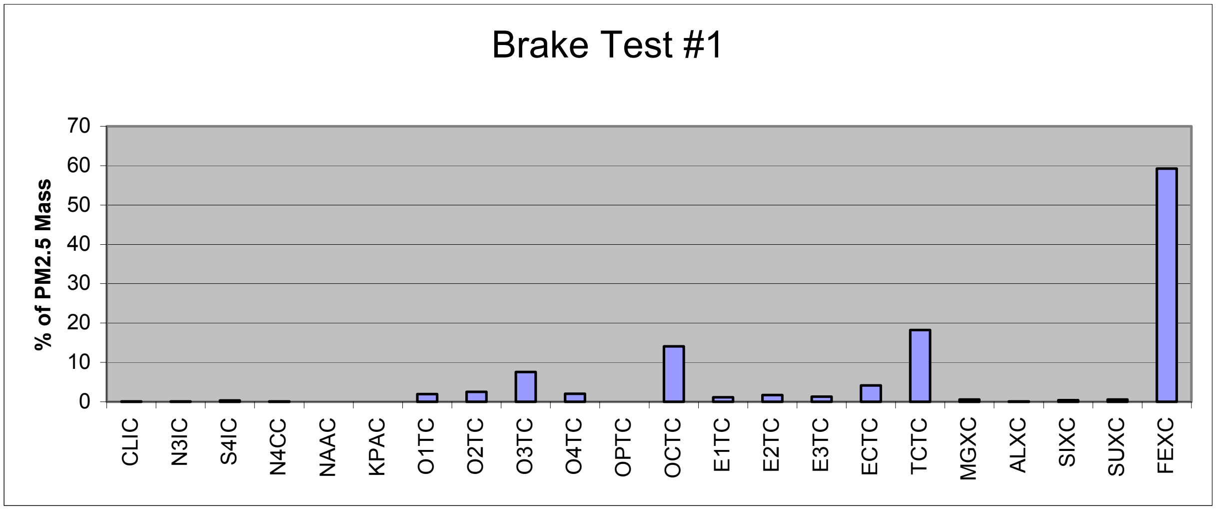


Figure 2. Source Profiles for Brake Test#1 and #1 Replicate (Selected Species Only)



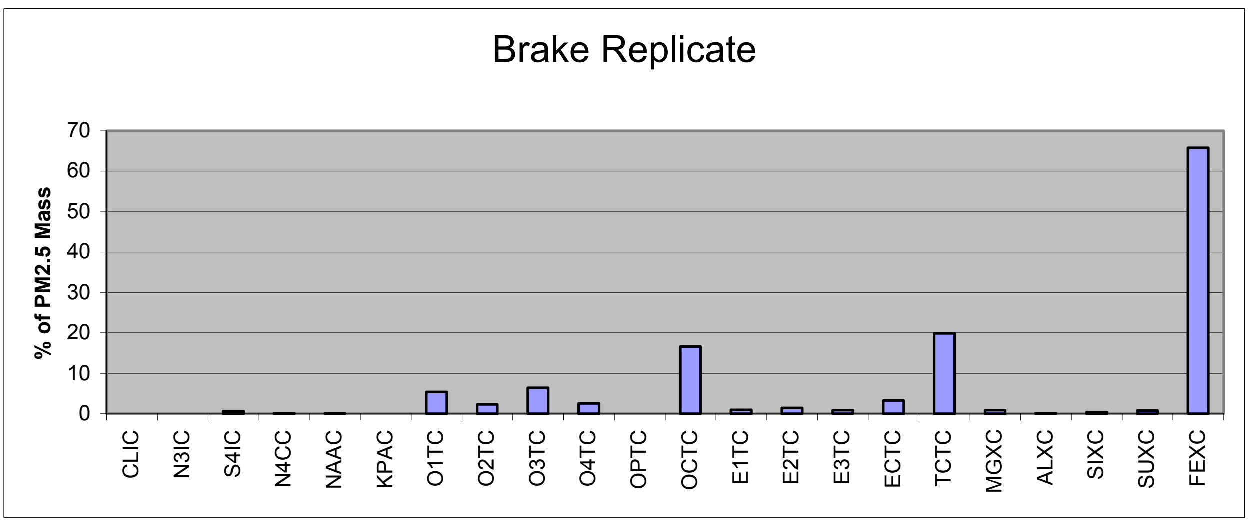


Figure 3. Source Profiles for Brake Test # 2
(Selected Species Only)

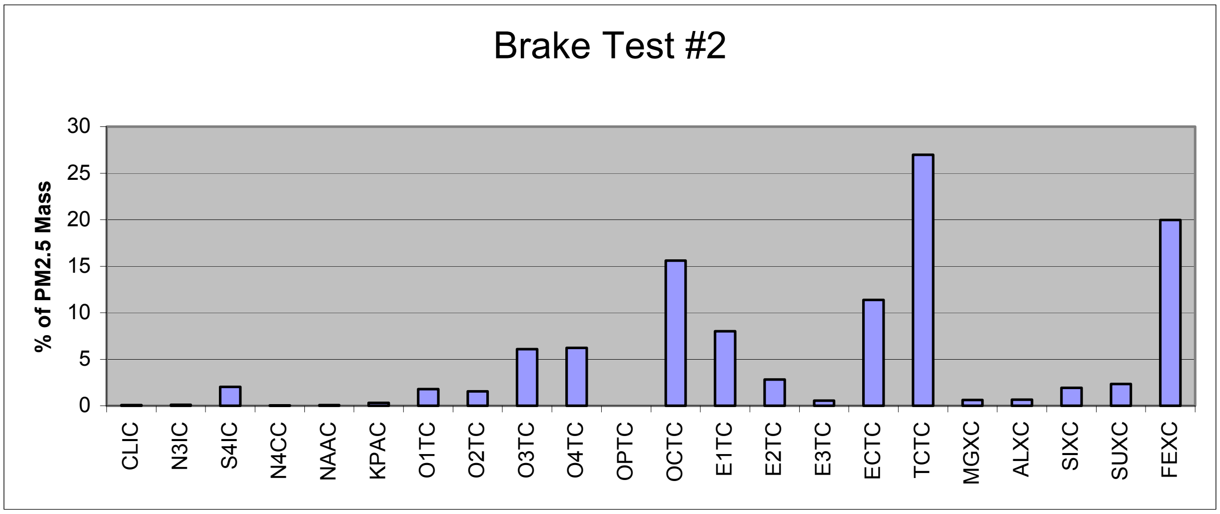
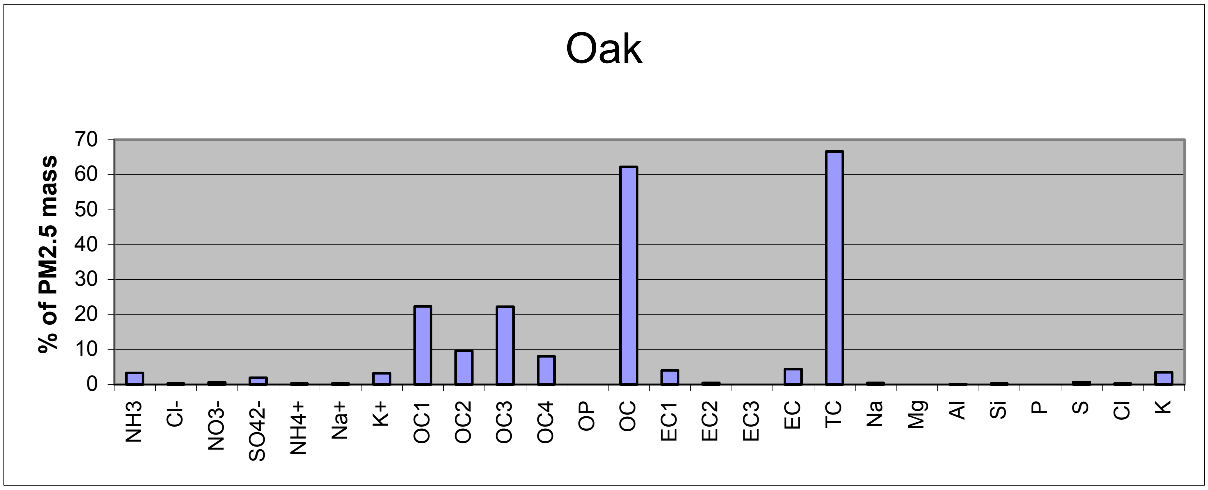


Figure 4. Source Profiles for Residential Wood Combustion of Oak and Eucalyptus (Selected Species Only)



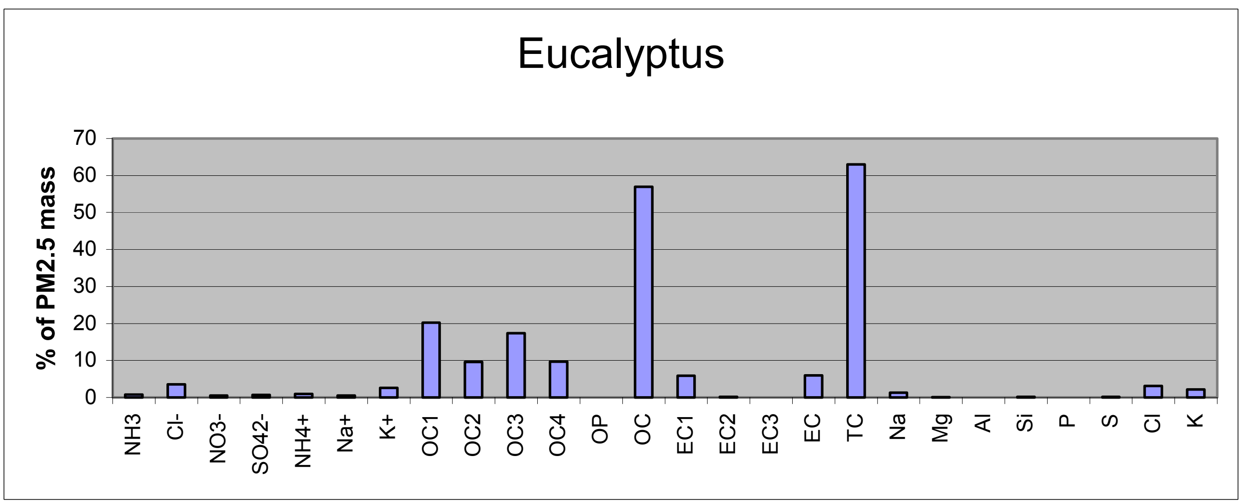
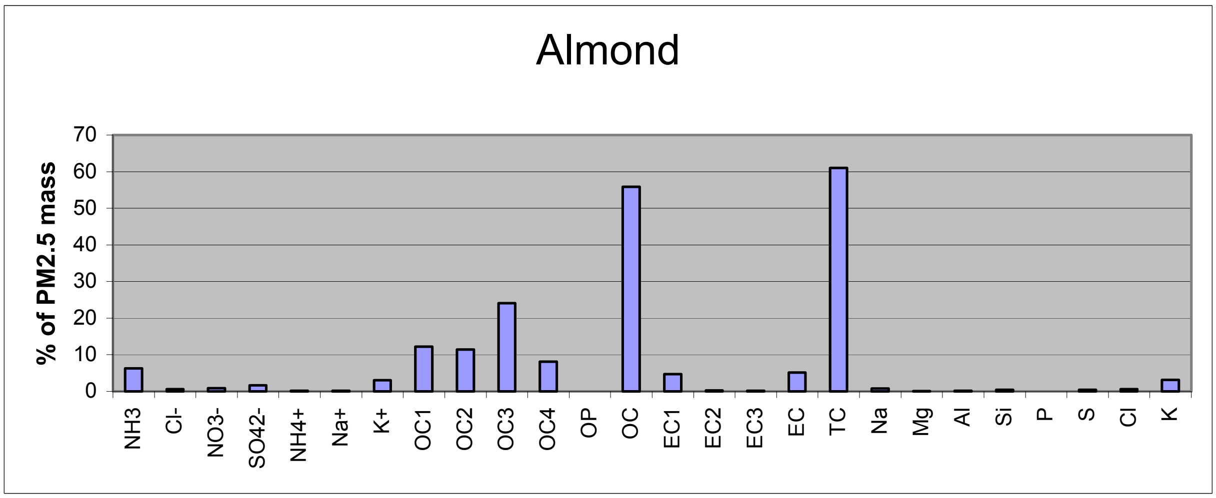


Figure 5. Source Profiles for Residential Wood Combustion of Almond and Tamarack (Selected Species Only)



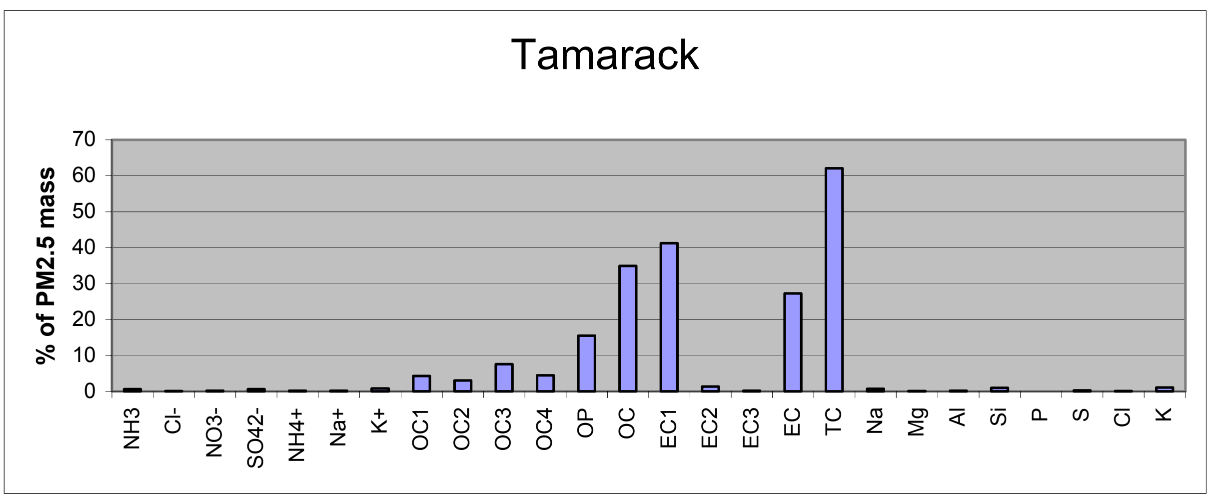
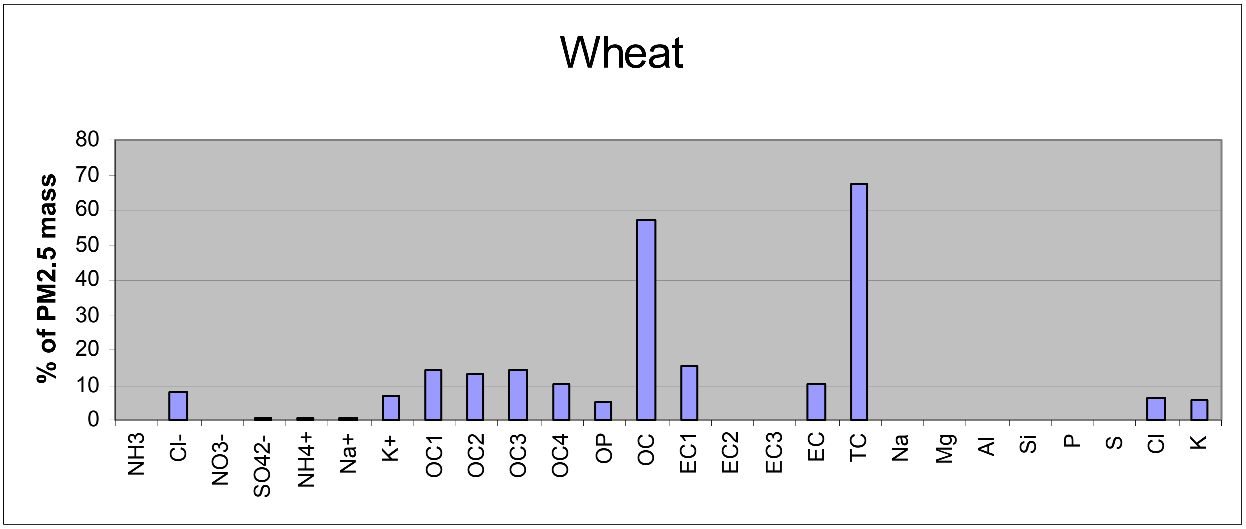
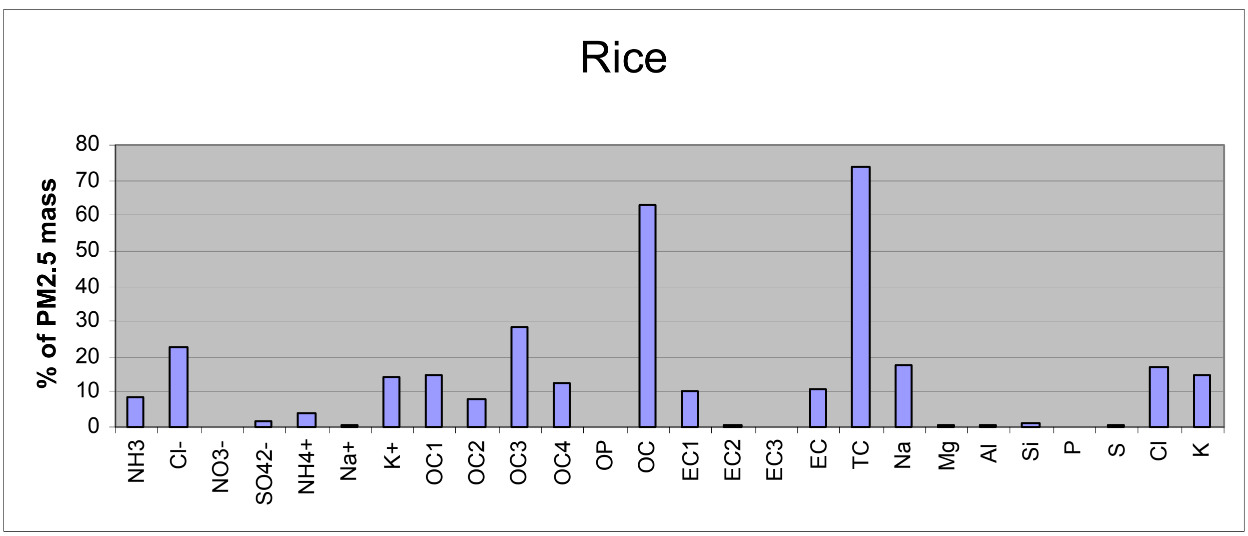


Figure 6. Source Profiles for Agricultural Burning of Wheat and Rice (Selected Species Only)





FITTING SPECIES

Source profiles were obtained from different studies resulting in some species were available in certain profiles but not in others. Therefore, only species available in all of the profiles were selected as fitting species. The list of fitting species was then further narrowed down based on those available in the ambient data. Two default sets were created:

1. Routine data with fewer species.
2. CRPAQS data with a complete set of species.

The main difference between the two sets was that carbon collected as part of the routine network was reported only as total carbon, while CRPAQS data included organic and elemental carbon. When selecting fitting species, only one of the different measurements of the same species was included in the fit. Therefore total carbon was selected as a fitting species for routine data while elemental and organic carbon were selected for CRPAQS. Ambient CRPAQS data also included carbon fraction concentrations but they could not be used in the CMB modeling because not all source profiles had measured their concentrations. Table 22 below includes a list of fitting species in each data set.

Table 22. Fitting Species

CMB Mnemonics	Symbol	Species Name	Routine	CRPAQS
NHCC	NH	Ammonia concentration		*
CLIC	CL	Chloride concentration	*	*
N3IC	N3	Nitrate concentration	*	*
S4IC	S4	Sulfate concentration	*	*
N4CC	N4	Ammonium concentration	*	*
NAAC	NA	Soluble Sodium concentration		*
KPAC	KP	Soluble Potassium concentration	*	*
OCTC	OC	Organic Carbon concentration		*
ECTC	EC	Elemental Carbon concentration		*
TCTC	TC	Total Carbon concentration	*	
NAXC	NA	Sodium concentration		*
MGXC	MG	Magnesium concentration		*
ALXC	AL	Aluminum concentration	*	*
SIXC	SI	Silicon concentration	*	*
PHXC	PH	Phosphorous concentration	*	*
SUXC	SU	Sulfur concentration	*	*
CLXC	CL	Chlorine concentration	*	*
KPXC	KP	Potassium concentration	*	*
CAXC	CA	Calcium concentration	*	*

Table 22. Fitting Species Cont.

CMB Mnemonics	Symbol	Species Name	Routine	CRPAQS
TIXC	TI	Titanium concentration	*	*
VAXC	VA	Vanadium concentration	*	*
CRXC	CR	Chromium concentration	*	*
MNXC	MN	Manganese concentration	*	*
FEXC	FE	Iron concentration	*	*
COXC	CO	Cobalt concentration	*	*
NIXC	NI	Nickel concentration	*	*
CUXC	CU	Copper concentration	*	*
ZNXC	ZN	Zinc concentration	*	*
GAXC	GA	Gallium concentration		*
ASXC	AS	Arsenic concentration	*	*
SEXC	SE	Selenium concentration	*	*
BRXC	BR	Bromine concentration	*	*
RBXC	RB	Rubidium concentration	*	*
SRXC	SR	Strontium concentration	*	*
YTXC	YT	Yttrium concentration	*	*
ZRXC	ZR	Zirconium concentration	*	*
MOXC	MO	Molybdenum concentration	*	*
PDXC	PD	Palladium concentration		*
AGXC	AG	Silver concentration		*
CDXC	CD	Cadmium concentration		*
INXC	IN	Indium concentration		*
SNXC	SN	Tin concentration	*	*
SBXC	SB	Antimony concentration	*	*
BAXC	BA	Barium concentration	*	*
LAXC	LA	Lanthanum concentration		*
AUXC	AU	Gold concentration		*
HGXC	HG	Mercury concentration	*	*
TLXC	TL	Thallium concentration		*
PBXC	PB	Lead concentration	*	*
URXC	UR	Uranium concentration	*	*

SENSITIVITY TESTING

The CMB estimates were tested to see how sensitive they were to the various input data. The sensitivity to changes in the source profiles was tested by running the model with different source profiles under a variety of scenarios described below. The outputs for each run were evaluated and compared to the ambient data.

1) Sensitivity to Temporal Changes

The annual PM_{10} and $PM_{2.5}$ data were used to evaluate the model's sensitivity to expected seasonal changes in emissions, especially with respect to vegetative burning and fugitive dust.

2) Site to Site Comparison

The source contribution estimates for different sites were compared with the location and timing expected from local sources. Some of the Special Purpose Monitoring sites established as part of CRPAQS to evaluate impacts of local emissions were especially valuable in site to site comparison, for example the Fresno Motor Vehicle site for evaluating mobile source contributions and the Fresno and Bakersfield residential sites where wood burning was expected to be higher.

3) Comparison of Source Contribution Estimates Using PM_{10} and $PM_{2.5}$

Parallel PM_{10} and $PM_{2.5}$ data were used to compare sources estimated using the following assumptions:

1. Since the majority of particles from motor vehicle exhaust and wood burning are in the fine fraction, we expected $PM_{2.5}$ and PM_{10} source contribution estimates to be similar. $PM_{2.5}$ estimates should not be greater than PM_{10}.
2. The majority of geological material should be in a coarse fraction. We expected to see PM_{10} estimates of geological material to be much greater than the $PM_{2.5}$ estimates.
3. Since some of the ammonium nitrate particles are in the coarse fraction, we expected the PM_{10} ammonium nitrate source estimates to be slightly greater than the $PM_{2.5}$ estimates. $PM_{2.5}$ estimates should not exceed PM_{10} estimates.

4) Diurnal Patterns

Diurnal $PM_{2.5}$ data were used to evaluate diurnal patterns in source estimates and to compare the estimates to diurnal changes in emission patterns. These were especially valuable for evaluating diurnal changes in motor vehicle and wood burning emissions.

5) Agricultural Burning versus Wood Burning

Agricultural burning and residential wood burning source profiles were similar enough that the CMB model could not distinguish one from the other using available chemical species. Therefore, only one source profile could be used at a time. Emission inventory data, shown in Table 23 below, were used to determine the appropriate wood burning and agricultural burning seasons. Wood burning profiles were used for the months from October to April, with agricultural burning profiles being used from May to September. Different combinations of sites and days were selected for modeling to represent the following combinations:

1. Days with agricultural burning but no wood burning.
2. Days with wood burning but no agricultural burning.
3. Days with agricultural and wood burning present.

6) Testing Other Source Profiles

Attempts were made for each model run to include, or substitute, other source profiles including cooking, sea salt, refineries, and natural gas. However, no signatures from these sources were detected or these sources were too similar to other sources and had to be excluded.

Table 23: 1999 PM_{10} Emissions from Vegetative Burning and Cooking in the San Joaquin Valley

Source	PM_{10} Emissions in Tons												
	Per Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WOOD COMBUSTION - WOOD STOVES	1604.2	400.5	265.6	126.7	99.6	13.4	8.2	0.0	0.0	2.4	14.6	241.2	431.8
WOOD COMBUSTION - FIREPLACES	2522.3	629.8	417.7	199.2	156.7	21.4	12.9	0.0	0.0	3.8	22.7	379.2	679.0
AGRICULTURAL BURNING - PRUNINGS	2573.0	289.4	254.3	322.9	210.6	89.1	85.9	85.5	82.6	114.8	94.9	520.2	422.8
AGRICULTURAL BURNING - FIELD CROPS	1008.9	4.9	5.5	135.3	53.9	12.2	95.8	247.0	46.8	67.3	181.2	133.5	25.2
RANGE IMPROVEMENT	8493.7	0.0	0.0	0.0	849.4	1698.7	1274.1	424.7	424.7	1698.7	1274.1	849.4	0.0
FOREST MANAGEMENT	2047.9	0.0	0.0	0.0	204.8	409.6	307.2	102.4	102.4	409.6	307.2	204.8	0.0
COMMERCIAL CHARBROILING	460.3	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
DEEP FAT FRYING	232.8	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4

MODEL PERFORMANCE MEASURES AND RESULTS

1) Performance Measures

The following criteria were used to evaluate the adequacy and applicability of the CMB modeling results:

Source Contribution Estimate (SCE)

SCE is the contribution of each source type to the total PM mass. The SCE should be greater than its standard error (STDERR).
[Target > 0.0 and > STDERR]

Standard Error (STDERR)

STDERR is an indicator of the uncertainty of each SCE. The STDERR should be much less than the SCE.
[Target << SCE]

Percent of Mass Accounted For (PERCENT MASS)

PERCENT MASS is the ratio of the sum of the SCEs to the measured mass of the sample. Unexplained mass can
[Target 80% to 120%]

R-Square (R-SQUARE)

R-SQUARE is a measure of the variance in the ambient species concentrations as explained by the calculated species concentrations. A low R-SQUARE indicates source profiles have not accounted for the variance in the ambient concentrations.
[Target 0.8 to 1.0]

Chi-Square (CHI-SQUARE)

CHI-SQUARE is a measure of goodness of fit (which is inversely proportional to the squares of the uncertainties in the source profiles and receptor data). A high CHI-SQUARE indicates at least one of the calculated species concentrations differs from the measured value by several uncertainty levels.
[Target 0.0 to 4.0]

T-Statistic (TSTAT)

TSTAT is the ratio of the SCE to the STDERR. A high number indicates a nonzero SCE.
[Target > 2.0]

Uncertainty/Similarity Clusters (U/S CLUSTERS)

U/S CLUSTERS give an indication of which groups of source profiles are either collinear or have very high uncertainties.

Sum of Combined Sources (SUM OF CLUSTER SOURCES)

SUM OF CLUSTER SOURCES represents the sum of the SCEs in the U/S CLUSTER with the standard error of the sum. A low standard error indicates that a composite profile can be created to represent the cluster.

Ratio of Residual to its Uncertainty (RATIO R/U)

R/U indicates the difference between the calculated and measured species concentration (residual R) divided by the uncertainty of the residual (U). A value greater than or equal to 2.0 indicates that one or more source profiles are contributing too much or too little to the species concentration. High R/U values are a cause of high CHI-SQUARE values.
[Target |<2.0|]

Ratio of Calculated to Measured Species (RATIO C/M)

C/M is the ratio of the calculated species concentration to the measured concentration, along with the standard error of the ratio. Ratios that deviate from 1.0 by more than two uncertainty intervals indicate an incorrect set of profiles is being used to explain the measured concentrations.
[Target 0.5 to 2.0]

2) **Model Results**

Performance measures for the modeled days are provided in Tables 24 and 25. On the exceedance dates noted in Table 24, the majority of sites met or exceeded performance criteria. Exceptions were Turlock on 10/21/99 and Modesto-14th on 1/7/01. For the annual average, all sites met the averaged performance criteria. Modesto-14th, Oildale, and Corcoran-Patterson all showed minimum performance criteria that did not meet the standards for certain months.

Table 24: CMB Performance Measures - by Site/Exceedance Day

Site	Date	% Mass	R^2	Chi^2
Oildale	1/12/99	*93.2*	*1.0*	*0.4*
Fresno-Drummond	10/21/99	*85.3*	*0.8*	*3.2*
Corcoran-Patterson	10/21/99	*93.3*	*0.8*	*2.7*
Turlock	10/21/99	*83.7*	***0.7***	***4.9***
Bakersfield-Golden	11/14/99	*96.7*	*0.9*	*0.9*
Corcoran-Patterson	12/17/99	*95.6*	*0.9*	*0.5*
Fresno-Drummond	12/23/99	*93.1*	*0.9*	*0.6*
Hanford	12/23/99	*103.1*	*0.9*	*0.5*
Clovis	1/1/01	*103.3*	*0.9*	*0.9*
Fresno-1st	1/1/01	*96.3*	*0.8*	*2.8*
Fresno-Drummond	1/1/01	*95.1*	*0.9*	*0.9*
Fresno-Drummond	1/4/01	*95.1*	*0.9*	*0.9*
Bakersfield-California	1/1/01	*100.9*	*0.8*	*3.0*
Bakersfield-California	1/4/01	*96.2*	*0.8*	*3.1*
Bakersfield-California	1/7/01	*96.1*	*0.8*	*3.1*
Bakersfield-Golden	1/1/01	*98.8*	*0.9*	*0.9*
Bakersfield-Golden	1/4/01	*98.8*	*0.9*	*0.9*
Bakersfield-Golden	1/7/01	*98.8*	*0.9*	*0.9*
Oildale	1/1/01	*102.7*	*1.0*	*0.4*
Oildale	1/4/01	*99.3*	*1.0*	*0.4*
Corcoran-Patterson	1/7/01	*94.9*	*1.0*	*0.4*
Hanford	1/7/01	*106.8*	*1.0*	*0.3*
Modesto-14th	1/7/01	*102.0*	***0.7***	*3.2*

Table 25: CMB Performance Measures - Annual Average

Site	% Mass			R^2			Chi^2		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Bakersfield-Golden	*93.7*	*114.1*	***134.1***	*0.8*	*0.9*	*1.0*	*0.2*	*0.6*	*1.9*
Corcoran-Patterson	*90.6*	*112.7*	***131.3***	***0.7***	*0.9*	*1.0*	*0.2*	*0.7*	*1.2*
Fresno-Drummond	*96.8*	*117.2*	***139.8***	*0.9*	*0.9*	*1.0*	*0.2*	*0.5*	*0.8*
Visalia-Church	*90.3*	*109.3*	***130.4***	*0.9*	*1.0*	*1.0*	*0.1*	*0.3*	*0.5*

The source contribution estimates for each of the exceedance days modeled and the annual average are provided in Tables 26 and 27. For the annual average, CMB results were obtained for the months of February through December of 2000, as well as January of 2001 (to give an entire year). Source profiles for agricultural burning were used for May through September, with wood burning profiles used the rest of the year. Results were then used to calculate the annual average for the four sites exceeding the annual average.

Table 26: CMB Source Apportionment - Exceedance Days

SITE	DATE	Mass (ug/m3)	% Mass	Wood Burning (ug/m3)	MV Exhaust (ug/m3)	Tires and Brakes (ug/m3)	Ammo nium Nitrate (ug/m3)	Ammo nium Sulfate (ug/m3)	Geolo-gical (ug/m3)
January 1999									
OLD	1/12/99	156	87.4	14.5	4.6	0.9	77.0	7.1	32.2
October 1999									
FSD	10/21/99	162	81.2	5.8	24.9		23.6	2.8	74.5
TUR	10/21/99	157	75.8	25.6	10.8	1.6	16.2	2.7	62.0
COP	10/21/99	174	88.7	18.2	15.4		24.6	3.5	92.7
November 1999									
BGS	11/14/99	183	91.1	16.5	6.1	1.9	85.3	6.3	50.6
December 1999									
COP	12/17/99	174	92.1	25.0	6.4	0.9	71.4	4.9	51.7
FSD	12/23/99	168	87.5	31.1	8.4	1.0	57.5	3.1	46.2
HAN	12/23/99	156	100.9	25.4	8.2	0.5	68.6	4.6	49.8
Winter 2000/2001									
CLO	1/1/01	155	95.7	23.2	13.7	2.1	74.8	4.4	30.2
FSF	1/1/01	193	90.9	33.9	25.5		73.9	3.8	38.3
FSD	1/1/01	186	87.9	40.1	18.5	2.5	62.4	5.0	35.1
FSD	1/4/01	159	87.9	34.3	15.8	2.1	53.4	4.3	30.0
BAC	1/1/01	186	100.3	38.5	2.0		92.3	5.6	48.2
BAC	1/4/01	190	95.2	33.4	2.6		89.7	5.4	49.7
BAC	1/7/01	159	95.1	26.3	2.2		76.9	4.1	41.8
BGS	1/1/01	205	93.6	23.3	6.7	1.3	95.4	7.0	58.2
BGS	1/4/01	208	93.6	23.6	6.8	1.3	96.6	7.1	58.9
BGS	1/7/01	174	93.6	19.8	5.7	1.1	81.0	6.0	49.4
OLD	1/1/01	158	97.1	14.5	4.7	0.9	93.9	6.5	32.8
OLD	1/4/01	195	93.8	17.8	5.9	1.1	109.8	7.7	40.7
COP	1/7/01	165	91.7	20.5	7.6	0.9	84.8	6.8	30.8
HAN	1/7/01	185	102.9	27.6	14.7	1.7	96.9	7.2	42.4
M14	1/7/01	158	89.8	30.2	5.4	4.7	83.9	7.4	10.4

Table 27: CMB Source Apportionment - Annual Averages

SITE	Mass (ug/m3)	% Mass	Wood Burning (ug/m3)	MV Exhaust (ug/m3)	Tires and Brakes (ug/m3)	Ammo nium Nitrate (ug/m3)	Ammo nium Sulfate (ug/m3)	Geolo-gical (ug/m3)
Based on CMB for Feb-Dec 2000 and Jan 2001								
BGS	44.3	98.9	4.8	3.3	1.0	7.6	2.6	23.9
FSD	37.1	99.4	4.5	3.3	0.5	7.4	2.3	18.1
HAN	39.4	104.2	4.6	3.0	0.4	8.3	2.6	21.5
VCS	40.4	99.3	4.8	3.0	0.3	8.5	2.7	19.8

PM10 Chemical Composition Data From The Routine Network

Site	Day of Week	Date	SSI PM10 ug/m3	% of PM10 Mass[a] SSI NitrSulf	SSI TC	Dichot[b] Geological	Sum Of Species	DICHOT Mass PM10 ug/m3	Fine ug/m3	% Fine
Fall 1997										
Bakersfield-5558 California Avenu	2	11/3/97	73	11	16	51	79	65	18	28
Bakersfield-5558 California Avenu	5	11/6/97	87	7	10	63	80	87	15	17
Bakersfield-5558 California Avenu	1	11/9/97	53	20	17	34	71	58	25	43
Bakersfield-5558 California Avenu	4	11/12/97	30	19	23	20	62	31	20	65
Corcoran-Patterson Avenue	6	10/31/97	102	14		51	65	90	23	26
Corcoran-Patterson Avenue	5	11/6/97	199	10		48	58	180	31	17
Corcoran-Van Dorsten Avenue	6	10/31/97	97	13		52	65	93	25	27
Corcoran-Van Dorsten Avenue	5	11/6/97	154	12		40	53	155	29	19
Fresno-1st Street	6	10/31/97	76	16	17	37	70	72	36	50
Fresno-1st Street	5	11/6/97	92	17	12	39	68	85	36	42
Modesto-I Street	6	10/31/97	21	15	19	45	79	20	6	30
Modesto-I Street	5	11/6/97	44	23	14	31	67	41	20	49
Modesto-I Street	4	11/12/97	29	25	21	9	54	35	26	74
Stockton-Hazelton Street	6	10/31/97	27	11	19	47	77	25	8	32
Stockton-Hazelton Street	5	11/6/97	32	17	16	35	67	34	14	41
Stockton-Hazelton Street	4	11/12/97	25	23	20	17	60	27	18	67
December 1998										
Bakersfield-Golden State Highway	5	12/31/98	159							
Visalia-N Church Street	5	12/31/98	160	53		9		139	115	83
Bakersfield-5558 California Avenu	3	12/22/98	44	39	20	10	70	48	40	83
Bakersfield-5558 California Avenu	2	12/28/98	112	49	18	11	78	115	89	77
Bakersfield-5558 California Avenu	5	12/31/98	148	54	14	9	77	151	122	81
Bakersfield-5558 California Avenu	7	1/9/99	93	47	17	9	74	90	67	74
Fresno-1st Street	5	12/31/98	104	52	15	5	73	100	88	88
Fresno-1st Street	4	1/6/99	36	33	28	6	67	41	36	88
Modesto-14th Street	5	12/31/98	80	51	14	6	71	81	69	85
Stockton-Hazelton Street	5	12/31/98	95	52	13	6	71	97	81	84
Mid January 1999										
Oildale-3311 Manor Street	3	1/12/99	156	57						
Bakersfield-5558 California Avenu	7	1/9/99	93	47	17	9	74	90	67	74
Bakersfield-5558 California Avenu	3	1/12/99	92	44	17	11	73	97	71	73
Bakersfield-5558 California Avenu	6	1/15/99	114	56	11	12	80	118	89	75
Bakersfield-5558 California Avenu	2	1/18/99	29	20	21	29	71	29	18	62
Fresno-1st Street	4	1/6/99	36	33	28	6	67	41	36	88

PM10 Chemical Composition Data From The Routine Network

Site	Day of Week	Date	SSI PM10 ug/m3	% of PM10 Mass[a] SSI NitrSulf	SSI TC	Dichot[b] Geological	Sum Of Species	DICHOT Mass PM10 ug/m3	Fine ug/m3	% Fine
Fall 1999										
Fresno-Drummond Street	5	10/21/99	162							
Turlock-S Minaret Street	5	10/21/99	157							
Corcoran-Patterson Avenue	6	10/15/99	127	10		51		122	24	20
Corcoran-Patterson Avenue	5	10/21/99	174	19		35		170	61	36
Bakersfield-5558 California Avenu	1	10/3/99	55	9	18	38	66	57	23	40
Bakersfield-5558 California Avenu	4	10/6/99	39	12	13	47	71	41	11	27
Bakersfield-5558 California Avenu	7	10/9/99	60	9	18	47	74	63	20	32
Bakersfield-5558 California Avenu	3	10/12/99	60	10	17	50	77	59	16	27
Bakersfield-5558 California Avenu	6	10/15/99	86	11	14	47	73	89	25	28
Bakersfield-5558 California Avenu	5	10/21/99	104	14	14	48	76	97	34	35
Bakersfield-5558 California Avenu	1	10/24/99	98	23	12	32	67	95	47	49
Bakersfield-5558 California Avenu	4	10/27/99	108	26	12	38	75	105	45	43
Bakersfield-5558 California Avenu	7	10/30/99	59	13	14	44	70	62	15	24
Fresno-1st Street	1	10/3/99	55	10	20	36	66	53	23	43
Fresno-1st Street	7	10/9/99	57	7	16	51	74	58	17	29
Fresno-1st Street	6	10/15/99	93	6	13	40	59	84	20	24
Fresno-1st Street	5	10/21/99	121	14	15	35	64	120	55	46
Fresno-1st Street	4	10/27/99	77	15	16	34	65	73	35	48
Modesto-14th Street	1	10/3/99	36	19	17	22	58	36	18	50
Modesto-14th Street	7	10/9/99	69	6	17	49	73	60	18	30
Modesto-14th Street	6	10/15/99	124	4	7	61	72	100	14	14
Modesto-14th Street	5	10/21/99	132	14	18	36	68	123	58	47
Modesto-14th Street	4	10/27/99	50	6	12	54	72	45	10	22
Stockton-Hazelton Street	6	10/15/99	123	3		62		92	13	14
Stockton-Hazelton Street	5	10/21/99	150	8		37		140	62	44
Stockton-Hazelton Street	4	10/27/99	33	11		49		32	9	28
November 1999										
Bakersfield-Golden State Highway	1	11/14/99	183						134[c]	73
Bakersfield-5558 California Avenu	2	11/8/99	15	15	20	33	69	12	5	42
Bakersfield-5558 California Avenu	5	11/11/99	93	32	14	15	60	89	60	67
Bakersfield-5558 California Avenu	1	11/14/99	138	45	10	12	68	133	90	68
Bakersfield-5558 California Avenu	4	11/17/99	20	12	20	37	70	21	9	43
Bakersfield-5558 California Avenu	7	11/20/99	22	10	23	11	43	26	20	77
Fresno-1st Street	3	11/2/99	77	16	14	36	66	84	38	45
Fresno-1st Street	2	11/8/99	15	10	33	22	66	14	8	57
Fresno-1st Street	1	11/14/99	124	37	12	9	58	135	105	78
Fresno-1st Street	7	11/20/99	19	9	26	9	44	23	18	78

PM10 Chemical Composition Data From The Routine Network

Site	Day of Week	Date	SSI PM10 ug/m3	% of PM10 Mass[a] SSI NitrSulf	SSI TC	Dichot[b] Geological	Sum Of Species	DICHOT Mass PM10 ug/m3	Fine ug/m3	% Fine
Modesto-14th Street	3	11/2/99	85	11	14	39	65	83	33	40
Modesto-14th Street	1	11/14/99	67	27	16	8	51	74	57	77
Winter 1999/2000										
Corcoran-Patterson Avenue	4	12/8/99	58	9		44	53	52	17	33
Corcoran-Patterson Avenue	3	12/14/99	49	6		42	48	46	19	41
Corcoran-Patterson Avenue	6	12/17/99	174							
Bakersfield-5558 California Avenu	1	12/5/99	61	12	21	31	65	61	35	57
Bakersfield-5558 California Avenu	4	12/8/99	47	15	23	36	75	49	22	45
Bakersfield-5558 California Avenu	3	12/14/99	41	10	34	28	72	41	25	61
Bakersfield-5558 California Avenu	6	12/17/99	111	37	18	20	74	124	83	67
Bakersfield-5558 California Avenu	2	12/20/99	97	37	19	17	73	102	69	68
Bakersfield-5558 California Avenu	5	12/23/99	109	26	17	25	67	114	69	61
Bakersfield-5558 California Avenu	1	12/26/99	109	34	17	14	65	104	79	76
Bakersfield-5558 California Avenu	4	12/29/99	103	22	19	24	65	96	61	64
Bakersfield-5558 California Avenu	3	1/4/00	71	8	24	28	60	80	49	61
Bakersfield-5558 California Avenu	6	1/7/00	116	20	19	15	55	122	93	76
Bakersfield-5558 California Avenu	2	1/10/00	63	6	21	29	55	65	38	58
Fresno-1st Street	4	12/8/99	51	9	24	26	59	52	31	60
Fresno-1st Street	3	12/14/99	71	4	37	18	58	75	56	75
Fresno-1st Street	7	1/1/00	113	37	18	8	63	112	94	84
Fresno-1st Street	6	1/7/00	138[d]	30	25	13	68	69	49	71
Modesto-14th Street	4	12/8/99	35	9	26	20	55	32	21	66
Modesto-14th Street	3	12/14/99	39	5	33	18	57	32	22	69
Modesto-14th Street	2	12/20/99	124	18	15	9	42	115	78	68
Modesto-14th Street	7	1/1/00	50	31	20	9	61	49	38	78
Modesto-14th Street	6	1/7/00	80	9	20	18	47	79	58	73
Visalia-N Church Street	4	12/8/99	57	9		35		49	25	51
Visalia-N Church Street	3	12/14/99	53	7		36		48	26	54
Visalia-N Church Street	2	12/20/99	152	34		16		134	96	72
Visalia-N Church Street	7	1/1/00	130	29		12		100	77	77
Winter 2000/2001										
Bakersfield-5558 California Avenu	1	12/17/00	50	43	16	13	72	55	38	69
Bakersfield-5558 California Avenu	7	12/23/00	57	29	25	14	68	62	38	61
Bakersfield-5558 California Avenu	3	12/26/00	88	32	24	18	73	93	61	66
Bakersfield-5558 California Avenu	6	12/29/00	140	39	19	19	78	144	98	68
Fresno-1st Street	3	12/26/00	92	22	36	7	64	85	73	86
Fresno-1st Street	2	1/1/01	193[d]	40	26	4	70	95	72	76
Fresno-1st Street	1	1/7/01	141	42	23	11	77	126	102	81

PM10 Chemical Composition Data From The Routine Network

Site	Day of Week	Date	SSI PM10 ug/m3	% of PM10 Mass[a] SSI NitrSulf	SSI TC	Dichot[b] Geological	Sum Of Species	DICHOT Mass PM10 ug/m3	Fine ug/m3	% Fine
Modesto-14th Street	4	12/20/00	80	20	33	13		81	62	77
Modesto-14th Street	3	12/26/00	75	18	37	9		75	62	83
November 2001										
Hanford-S Irwin Street	6	11/9/01	155							

Comments/Footnotes:
Highlighted records represent concentrations greater than 24-hr PM10 standard. Excedances for which we do not have nitrate/sulfate or geological data can't be modeled using CMB. Therefore, they are listed for information purposes only.

a The percent contribution from major categories of species was estimated by the following steps:
1. % Nitrate/Sulfate was estimated based on SSI data:
   (((1.29 x non-volatilized nitrate) + (1.38 x sulfate))/PM10)*100
2. % Total Carbon (TC) was estimated based on SSI data:
   (Total Carbon (as measured on an SSI filter)/PM10 Mass)*100
3. % Geological was estimated based on dichot data:
   First each geological species was scaled to the level of the SSI mass by multiplying concentration of each species by the ratio of PM10 mass measured on SSI to PM10 mass measured on dichot. Next, the percent contribution was calculated as follows:
   (((1.89 x aluminum Conc Scaled to SSI)+(2.14 x silicon Conc Scaled to SSI)+
   (1.4 x calcium Conc scaled to SSI)+(1.43 x iron Conc scaled to SSI))/PM10 Mass)*100
4. Sum of Species represents a sum of %Nitrate/Sulfate, %total carbon, and %geological.

b Dichot chemical measurements were scaled to SSI level based on the SSI to dichot ratio.

c PM2.5 measured using FRM

d Difference between SSI PM10 measurement and Dichot PM10 measurement greater than 20%.

PM10 Chemical Composition Data From The CRPAQS Network Period

Site	Day of Week	Date	CRPAQS PM10 ug/m3	% of PM10 Mass[a]				PM2.5		
				NitrSulf	TC	Geological	Sum Of Species	Mass ug/m3	% of PM10	Monitor
December 1999										
Bakersfield-1120 Golden Stat	5	12/23/99	136	39	24	36	100	74	54	Routine
Bakersfield-1120 Golden Stat	4	12/29/99	98	44	25	30	100	64	66	Routine
Bakersfield-1120 Golden Stat	3	1/4/00	72	39	43	35	117	49	67	Routine
Corcoran-Patterson Avenue	5	12/23/99	141	50	20	31	101			
Corcoran-Patterson Avenue	3	1/4/00	68	30	28	40	99			
Fresno Drummond	6	12/17/99	153	48	27	20	95			
Fresno Drummond	5	12/23/99	168	40	28	26	95			
Fresno Drummond	4	12/29/99	111	40	29	30	98			
Fresno Drummond	3	1/4/00	76	39	36	23	98			
Hanford-Irwin St.	5	12/23/99	156	52	23	28	103			
Hanford-Irwin St.	4	12/29/99	121	45	26	32	103			
Hanford-Irwin St.	3	1/4/00	82	35	35	34	105			
Modesto 14th St.	6	12/17/99	112	41	39	15	95	93	83	Routine
Modesto 14th St.	4	12/29/99	89	33	38	21	92	72	81	Routine
Modesto 14th St.	3	1/4/00	51	44	39	22	105	45	88	Routine
Oildale-Manor	5	12/23/99	108	64	20	34	118			
Oildale-Manor	4	12/29/99	91	48	22	33	102			
Oildale-Manor	3	1/4/00	65	42	28	39	109			
Visalia Church St.	4	12/29/99	96	54	26	26	107	72	75	Routine
Visalia Church St.	3	1/4/00	62	38	39	26	103	51	82	Routine
September 2000										
Bakersfield-1120 Golden Stat	4	9/6/00	45	11	41	69	121			
Bakersfield-1120 Golden Stat	3	9/12/00	143	11	25	64	100			
Bakersfield-1120 Golden Stat	1	9/24/00	48	8	29	72	110			
Corcoran-Patterson Avenue	4	9/6/00	37	9	30	74	113			
Corcoran-Patterson Avenue	3	9/12/00	85	15	24	72	112			
Corcoran-Patterson Avenue	2	9/18/00	55	12	32	59	103			
Corcoran-Patterson Avenue	1	9/24/00	38	15	35	70	120			
Fresno Drummond	4	9/6/00	37	11	47	77	135			
Fresno Drummond	3	9/12/00	85	12	33	78	122			
Fresno Drummond	2	9/18/00	65	11	35	72	117			
Fresno Drummond	1	9/24/00	40	14	39	68	121			
Hanford-Irwin St.	4	9/6/00	45	10	33	79	122			
Hanford-Irwin St.	3	9/12/00	110	16	23	74	114			
Hanford-Irwin St.	2	9/18/00	78	12	30	67	108			
Hanford-Irwin St.	1	9/24/00	37	16	36	77	129			
Modesto 14th St.	4	9/6/00	22	9	57	73	139	7	32	Routine
Modesto 14th St.	3	9/12/00	64	12	23	76	112	18	28	Routine
Modesto 14th St.	2	9/18/00	54	8	35	72	116	17	31	Routine
Modesto 14th St.	1	9/24/00	22	14	36	77	128	10	44	Routine
Oildale-Manor	1	9/24/00	41	10	23	72	105			
Visalia Church St.	4	9/6/00	51	9	29	35	74	10	20	Routine

Site	Day of Week	Date	CRPAQS PM10 ug/m3	% of PM10 Mass[a]				PM2.5		
				NitrSulf	TC	Geological	Sum Of Species	Mass ug/m3	% of PM10	Monitor
Visalia Church St.	3	9/12/00	100	20	19	68	107	30	30	Routine
Visalia Church St.	2	9/18/00	60	10	22	57	89	18	30	Routine
Visalia Church St.	1	9/24/00	25	19	38	53	111			
Winter 2000/2001										
Bakersfield-1120 Golden Stat	1	12/17/00	50	57	21	14	92	46	91	Routine
Bakersfield-1120 Golden Stat	7	12/23/00	72	30	26	12	67	44	61	Routine
Bakersfield-1120 Golden Stat	6	12/29/00	153	42	26	28	96	108	70	Routine
Bakersfield-1120 Golden Stat	5	1/4/01	208	51	18	23	92			
Bakersfield-1120 Golden Stat	4	1/10/01	20	27	40	35	102	13	65	Routine
Corcoran-Patterson Avenue	1	12/17/00	32	55	35	14	104	22	69	CRPAQS
Corcoran-Patterson Avenue	7	12/23/00	70	34	22	17	73	42	60	Routine
Corcoran-Patterson Avenue	6	12/29/00	111	50	22	20	92			
Corcoran-Patterson Avenue	5	1/4/01	138	57	17	19	93	99	72	CRPAQS
Corcoran-Patterson Avenue	4	1/10/01	21	30	31	18	79			
Fresno Drummond	1	12/17/00	37	49	29	7	85			
Fresno Drummond	7	12/23/00	85	38	28	12	79			
Fresno Drummond	6	12/29/00	120	42	28	19	89			
Fresno Drummond	5	1/4/01	159	37	33	18	87			
Hanford-Irwin St.	7	12/23/00	62	41	33	14	88			
Hanford-Irwin St.	6	12/29/00	101	43	23	20	86			
Hanford-Irwin St.	5	1/4/01	106	56	24	21	101			
Hanford-Irwin St.	4	1/10/01	11	47	37	16	99			
Modesto 14th St.	1	12/17/00	24	29	47	8	84	19	82	CRPAQS
Modesto 14th St.	7	12/23/00	44	26	52	8	86	38	86	Routine
Modesto 14th St.	6	12/29/00	99	46	29	8	83			
Modesto 14th St.	4	1/10/01	22	43	39	7	89	21	96	Routine
Oildale-Manor	1	12/17/00	49	54	20	13	87			
Oildale-Manor	7	12/23/00	48	48	21	11	80			
Oildale-Manor	6	12/29/00	133	45	18	25	87			
Oildale-Manor	5	1/4/01	195	61	14	22	97			
Visalia Church St.	1	12/17/00	32	62	29	6	96	28	89	CRPAQS
Visalia Church St.	7	12/23/00	81	39	23	14	76			
Visalia Church St.	6	12/29/00	104	52	23	17	92	94	90	Routine

Comments/Footnotes:

Highlighted records represent concentrations greater than 24-hr PM10 standard.

[a] The percent contribution from major categories of species was estimated by the following steps:

1. % Nitrate/Sulfate: ((1.29 x non-volatilized nitrate) + (1.38 x sulfate))/PM10Mass)*100
2. % Total Carbon (TC): (((1.4 x organic carbon) + EC)/PM10 Mass)*100
3. % Geological: (((1.89 x aluminum)+(2.14 x silicon)+(1.4 x calcium)+(1.43 x iron))/PM10Mass)*100
4. Sum of Species represents a sum of %Nitrate/Sulfate, %TC, and % geological.