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Sources of Bay Area Fine Particles: A Chemical Mass Balance Analysis

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DISCLAIMER

This draft report presents the preliminary analysis of available data to provide information on Bay Area $PM_{2.5}$ sources for the Community Air Risk Evaluation (CARE) program and the District's activities to reduce exposure to fine particulate matter, as required by SB 656. Data were obtained from the field program of the California Regional Particulate Air Quality Study (CRPAQS) and from routine air monitoring stations. To estimate the contributions from various sources, a Chemical Mass Balance (CMB) analysis was conducted. Because of limitations in the data and uncertainties in the CMB analysis, some of the findings presented in this report should be viewed as preliminary. Certain assumptions, as described in the document, were made to aid the analysis. The validity of some of these assumptions is uncertain. While the District continues making additional routine particulate matter measurements, analyses similar to those presented in this report will be conducted and the findings of this report will be updated as appropriate.

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SUMMARY

Airborne particulate matter (PM) has serious adverse effects on health, even at the moderate concentrations generally experienced in the San Francisco Bay Area. This study utilizes measurements of ambient PM composition, along with information on Bay Area PM emissions to estimate what the major PM sources are and their approximate contributions to the total.

The focus of this study is a chemical mass balance (CMB) analysis where a computer model is used to apportion ambient PM collected on filters to a set of source categories. Each ambient filter contains particles less than or equal to 2.5 microns in diameter ($PM_{2.5}$) collected over a 24-hour period at a given site. The input data for the CMB model is a range of measurements of chemical species on the filter, and similar measurements made on filters with $PM_{2.5}$ from various source categories. The CMB model finds the mix of sources that best matches the ambient sample, chemical species by chemical species.

CMB analysis was limited to identifying source *categories*, such as fossil fuel combustion. In order to make finer distinctions, the CMB results were combined with the Bay Area Air Quality Management District's emissions inventory.

Methods

The ambient data were obtained from four different studies or agencies: 1) the California Regional PM Air Quality Study (CRPAQS), 2) the Speciated Trends Network, 3) the IMPROVE network, and 4) Bay Area Air Quality Management District (BAAQMD) routine measurements. The source profile data were obtained from CRPAQS, and from the California Air Resources Board (ARB) and BAAQMD sample collections.

Ambient data were collected from four BAAQMD monitoring sites – Bethel Island, Livermore, San Francisco, and San Jose. Data on background PM was available from a site in Point Reyes. The data were collected over a 14 month period, extending from December 1999 through January 2001. San Jose data for 2001 were added to provide a sense of how source contributions vary from year to year.

The chemical species measured included all elements with atomic numbers greater than or equal to sodium, certain ions, and elemental and organic carbon. The major chemical species measured were organic and elemental carbon, nitrate, sulfate, ammonium, chloride, sodium, aluminum, silicon, magnesium, iron, and calcium.

Source categories used in the CMB analysis included motor vehicles, wood burning, cooking, gun powder, tire and brake wear, geological dust, marine air, ammonium nitrate, and ammonium sulfate. CMB analysis is limited in that certain sources may occur at levels below the model's ability to detect and other combinations of sources may be effectively impossible to differentiate. In the initial CMB analysis it was found that PM from tire and brake wear never occurred above the limits of detection, and cooking could

not be differentiated from wood burning or motor exhaust. These sources were omitted from subsequent analysis.

Both national and California apply two PM standards – a 24-hour standard to protect against very high, short-term PM concentrations, and annual standards to protect against long-term exposure. To correspond to these standards, the CMB results are presented in terms of peak PM (the average of the 10 highest PM concentration samples for each site), and the annual average.

Results and Key Findings

This study found that for annual average $PM_{2.5}$, the three largest source categories are motor vehicle exhaust, wood burning and ammonium nitrate. Marine air and ammonium sulfate are also substantial contributors. Geological dust is a relatively minor component. Gun powder, which can be significant on New Year's Eve and July 4th, is a negligible part of the annual total.

The CMB results were also summarized for peak $PM_{2.5}$ – the average of the 10 highest $PM_{2.5}$ samples for each site. For peak $PM_{2.5}$, the top three source categories – motor vehicle, wood burning and ammonium nitrate – comprise more than 90% of the total; marine air and ammonium sulfate make up a much smaller percentage of the total.

The CMB analysis produced estimates of the contributions from source *categories*, but could not differentiate between wood smoke and cooking or between on-road, off-road, refinery, and power plant emissions. To refine these estimates, the CMB results were combined with the annual emissions inventory figures for the Bay Area. The combination apportions not only directly emitted $PM_{2.5}$. It also apportions the ammonium nitrate and ammonium sulfate by assuming that these are proportional to the emissions of NOx and SO_2 respectively.

The combined analysis showed that wood burning, on-road and off-road vehicles are the three largest sources of $PM_{2.5}$, each contributing about 20% to the annual $PM_{2.5}$ and 25% to the peak $PM_{2.5}$. Petroleum refining and marine air were also found to be large contributors.

Discussion

The currently available data, coupled with the above analysis, makes it possible to draw some conclusions with certainty, but still leaves some important questions unanswered. Although there are still many questions, the above analysis allows us to make some statements about Bay Area PM with a high degree of certainty:

- *Most anthropogenic PM_{10} and $PM_{2.5}$ derive from burning wood or fossil fuels.*
- *Geological dust is a small contributor to PM_{10} and a negligible contributor to $PM_{2.5}$. Tire/break wear is also a negligible $PM_{2.5}$ source.*

- *Peak PM occurs largely in winter. Reasons include more conducive meteorology, conditions favorable for ammonium nitrate production, and more wood burning.*
- *Ammonium nitrate contributes almost 40% to peak $PM_{2.5}$ and 20% to annual $PM_{2.5}$ on average.*
- *Carbonaceous PM, that is, PM directly emitted from burning, accounts for roughly half of peak PM_{10} and $PM_{2.5}$ and also annual $PM_{2.5}$.*
- *Ammonium sulfate contributes about 10% to annual $PM_{2.5}$, but only 5% to peak PM, on average.*

Some Remaining Issues

The items below represent issues that remain unresolved and suggestions for ways to resolve them.

- *There is a large uncertainty in the fractional contributions of carbonaceous PM from wood smoke, cooking and fossil fuel sources. A recent carbon-14 analysis showed that wood smoke and cooking constitute a larger percentage, and fossil fuels a smaller percentage, than the CMB analysis found. Unfortunately, such measurements could not be made for the $PM_{2.5}$ filters. C-14 measurements provide a reliable discriminant between these categories and should be included in future field studies.*
- *Some of the PM attributed to wood smoke may originate from other sources, such as cooking. Two studies would be valuable: a comprehensive study of residential wood burning in the Bay Area, and an analysis of $PM_{2.5}$ filters to examine hydrocarbon markers for wood smoke and cooking.*
- *There is large uncertainty in the apportionment of fossil fuel-derived carbonaceous PM into specific sources such as on-road mobile vs. construction equipment. There is similar uncertainty in the fraction derived from diesel exhaust vs. gasoline exhaust. Key measurements such as EC2 and PAHs could help discriminate among motor vehicle sources.*
- *Ammonium nitrate is a large component of Bay Area PM, but the benefits of reductions in precursor emissions of ammonia and NOx are still not quantified. Grid-based PM modeling is increasingly available to quantify the effects of precursor reductions on PM. Similar to photochemical models, PM models have the capacity to examine how changes in precursors might affect ammonium nitrate concentrations.*
- *The contributions of local sources vs. transported PM and precursors have not been determined. Several approaches might yield useful results. Simplest would be trajectory analysis, and studying the timing of high PM in different parts of the District. A more sophisticated approach is to use a PM grid model as mentioned above. Yet another approach would be to analyze the geological dust on filters for bacteria, which can show evidence of origin.*

1. INTRODUCTION

Airborne particulate matter (PM) has serious adverse effects on health. High levels of PM, especially $PM_{2.5}$, are correlated with exacerbations of respiratory problems such as asthma, increases in emergency room visits, and increases in respiratory and cardiac related deaths. Such effects have been noted even in the San Francisco Bay Area, which meets current national PM standards. The Bay Area does not meet the more stringent California PM standards.

In order to reduce the Bay Area's PM levels, it is necessary to know what the major sources are and their approximate contributions to the total PM. Many sources contribute to PM. Sources of direct, or *primary,* emissions include on-road and off-road vehicles, power plants, refineries, wood burning, and cooking, and dust from roads, fields, construction, and farming. PM also forms from chemical processes in the atmosphere. Earlier studies have shown that these *secondary particulates* constitute a sizeable fraction of the Bay Area's PM. The major secondary components are ammonium nitrate, formed from transformation of NOx and ammonia, and ammonium sulfate, formed from transformation of sulfur dioxide and ammonia.

This study analyzes speciated $PM_{2.5}$ recently collected at several Bay Area sites in a computer model (chemical mass balance, or CMB) to estimate the contributions of various sources to total PM. The analysis is summarized both annually and for peak PM to correspond with the annual and 24-hour PM standards. The results are studied together with BAAQMD emissions inventory estimates to provide a finer breakdown of source contributions. Carbon-14 analyses were also used to help distinguish between PM contributed by wood burning and fossil fuel combustion.

2. DATA

In order to conduct CMB analysis, both ambient and source profile data are needed. The ambient data were obtained from four different studies or agencies: 1) the California Regional PM Air Quality Study (CRPAQS), 2) the Speciated Trends Network, 3) the IMPROVE network, and 4) Bay Area Air Quality Management District (BAAQMD) routine measurements. The source profile data were obtained from CRPAQS, and from the California Air Resources Board (ARB) and BAAQMD sample collections.

2.1 Ambient Data

CRPAQS included speciated analysis of filters containing $PM_{2.5}$ samples collected over 24-hour periods from a variety of central California sites, including three in the Bay Area: Bethel Island (BI), Livermore (LI) and San Francisco (SF). The speciated analysis included measurement of elements, using X-Ray Fluorescence; ions, using ion chromatography; and elemental and organic carbon, using the IMPROVE methodology. Samples were collected on a 1-in-6 day schedule from December 1999 through January 2001.

The Speciated Trends Network (EPA 1999) collected speciated $PM_{2.5}$ at San Jose – 4th St. on a 1-in-3 day schedule. $PM_{2.5}$ data were obtained for years 2000 (SJ0) and 2001 (SJ1). The inclusion of 2001 data is used to investigate changes in source contributions from 2000 to 2001 at this site.

The BAAQMD routine monitoring network collected parallel gravimetric $PM_{2.5}$ data at Livermore, San Francisco and San Jose.

The IMPROVE network, which collects $PM_{2.5}$ data from national parks around the United States, provided data at Point Reyes (PR). These data were collected on a 1-in-3 day schedule. Most of the time, the Point Reyes site samples air coming onshore from the Pacific Ocean so typically its samples are representative of background PM.

Generally, the species measurements seemed consistent among the labs conducting data analyses as confirmed by an inter-lab comparison (EPA/NAREL 2002). The one exception is the measurement of carbon. There are two distinct approaches for carbon measurements: the NIOSH and IMPROVE methods. Although the total carbon measurements are similar, the NIOSH method attributes a much higher percentage of carbon to OC than the IMPROVE method (Chow et al. 2001). The source profiles as well as the CRPAQS and Point Reyes samples used the IMPROVE method, whereas the EPA/RTI samples were analyzed by the NIOSH method. In order to make the two sets of measurements more comparable, a conversion from NIOSH to IMPROVE was made as presented in Appendix A.

2.2 Source Profiles

CRPAQS source profile data included a range of samples: geological, woodsmoke, motor vehicle exhaust, cooking, and tire and brake wear. These profiles were combined with PM_{10} source profiles available from a previous District CMB analysis conducted in 1994. A subset of these profiles was used for CMB analysis, listed in Table 2.1.

Table 2.1. Source profiles used in CMB analysis

Source Abbrev.	Agency[a]	Description
SJ4PVRD	BAAQMD/DRI	Paved road dust from San Jose
BYRDC	BAAQMD/DRI	Paved road dust from selected sites around the Bay Area
ARB_DUST	CRPAQS	Paved road dust from around central California
AMSUL		Ammonium sulfate
AMNIT		Ammonium nitrate
NASUL		Sodium sulfate
NANIT		Sodium nitrate
MARINE		Marine air with intermediate aging
MAR0		Fully aged marine air
MAR100		Fresh marine air
GUNPOWDR		Gun powder
BYTUN4	BAAQMD/DRI	Composite motor vehicle exhaust profile
BYWS4	BAAQMD/DRI	Composite wood burning
WBOakEuc	CRPAQS	Oak & Eucalyptus wood burning
BurnWdAg	CRPAQS	Composite wood burning
WBOak	CRPAQS	Oak burning profile
WBEucal	CRPAQS	Eucalyptus burning
COOK	CRPAQS	Composite
CAMV	CRPAQS	CRPACS combined motor vehicle
TireBrke	CRPAQS	Tire and Brake wear

[a] Agency that collected the data: BAAQMD samples were collected in 1993, DRI (Desert Research Institute). No agency indicates that the source has a known chemical composition.

3. SUMMMARY STATISTICS

Before conducting the CMB analysis, some of the co-located measurements by BAAQMD, EPA and CRPAQS at Livermore, San Jose, and San Francisco were compared for consistency between different analysis methods. Available ambient data were summarized to better understand the seasonal distribution of $PM_{2.5}$, its composition, as well as the locations of its peak concentrations.

3.1 Total Mass Comparisons

A comparison of CRPAQS and BAAQMD total mass measurements shows a high degree of correlation for all 3 sites (LI, SJ and SF), but a substantial difference in magnitude for the LI and SF sites. In particular, the CRPAQS measurements average about 70-75% of the District measurements. The masses were also compared with the sums of the individual chemical species. The sums of species should be smaller than the total because not all species are included. Yet the CRPAQS masses were often less than the sum of species, whereas the BAAQMD masses were generally larger. (See Appendix B.) Because of the large discrepancies in the LI and SF measurements, their total mass measurements, along with Bethel Island's were adjusted by to be consistent with BAAQMD measurements. For San Jose, there was a slight difference in masses, with the

EPA measurements averaging about 105% of the District measurements. These measurements were not adjusted.

3.2 Seasonal Distribution of $PM_{2.5}$

The seasonal distribution of $PM_{2.5}$ was studied to better understand when the highest concentrations occur in the different regions of the District. The seasons were defined to correspond to the $PM_{2.5}$ season, namely for this study "winter" is defined to include November, December, and January. The other quarters follow from the definition of the winter quarter: "spring" is February, March and April; "summer" is May, June and July; and "autumn" is August, September and October.

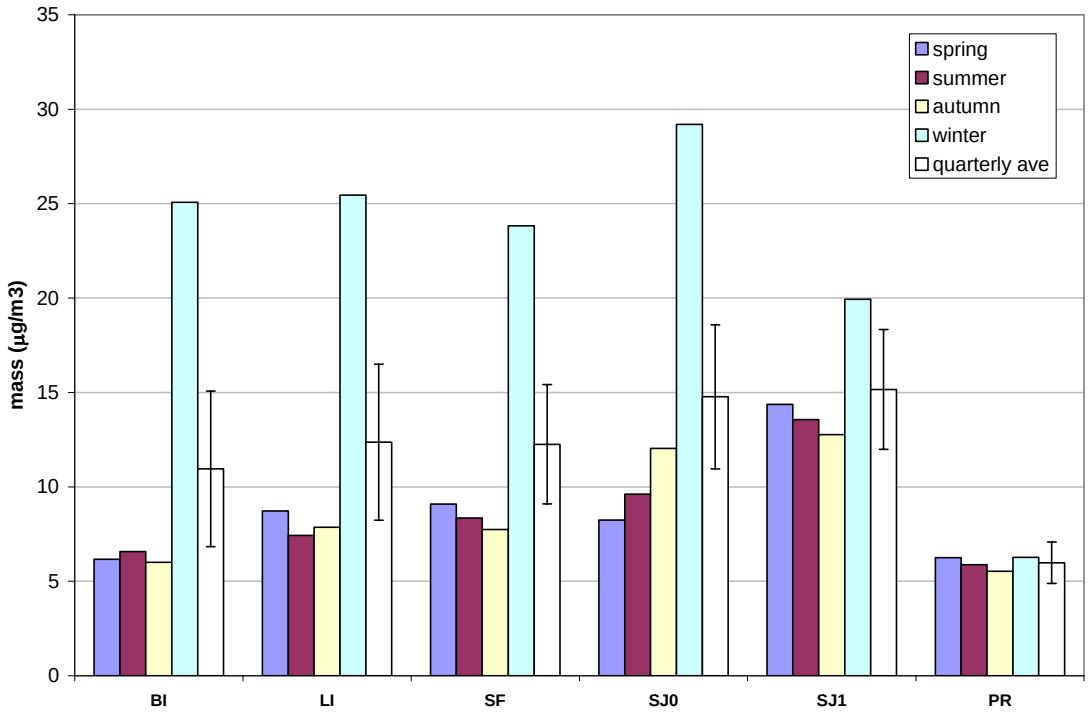

Figure 3.1. Quarterly averaged pm2.5 for special study sites. Data from 2000 except for 2001 for SJ1. Quarters are spring = Feb-Apr, summer = May-July, autumn=Aug-Oct, winter=Nov-Jan. Note: these quarters were chosen to correspond to the PM season rather than the standard definition of seasons. White bars are averages of the 4 quarters. Uncertainty bars represent 90% confidence intervals for the annual mean.

Figure 3.1 shows quarterly averages and the average of the four quarters. The figure shows a clear seasonal pattern, the winter quarterly average far exceeding those of the other quarters, except at Point Reyes. During the non-winter quarters, the 2000 average values are not much higher than those of the Point Reyes site. Note the large difference between 2000 and 2001 for San Jose, which is very likely due to meteorology. In particular, the winter quarter decreases from 2000 to 2001 whereas the other quarters increase. This suggests that the large differences in 2000 between the winter PM and the PM for other seasons at the non-Point Reyes sites are partly an artifact of 2000's meteorology.

The white bars show the means of the 4 quarters. Also shown are 90% confidence intervals for the means. Except for the Point Reyes background site, the confidence intervals for all the other sites straddle the national annual standard of 15 μg/m^3 and the state annual standard of 12 μg/m^3. Thus, the Bay Area is on the borderline for these standards.

3.3 Speciation of $PM_{2.5}$

Many $PM_{2.5}$ species were measured, but for a number of the elements, the concentrations rarely if ever exceed the limits of detection. Appendix C has a list of all species and the number of times the measured concentrations exceeded one and two standard errors. Those species whose concentrations exceeded 1 standard error in less than 10 samples were eliminated from further analysis because they would likely detract from the capacity of the CMB model to differentiate between sources.

Figure 3.2 shows the means of the remaining species, averaged across all sites, in decreasing order of magnitude. Also shown is the cumulative fraction of total mass. Organic carbon (OC) and Nitrate (NO_3) account for over 50% of the mass. Total carbon, that is, OC plus elemental carbon (EC), and NO_3 along with sulfate (SO_4) and ammonium (NH_4), account for almost 90% of the total. Thus, most Bay Area PM is either carbon or secondary PM.

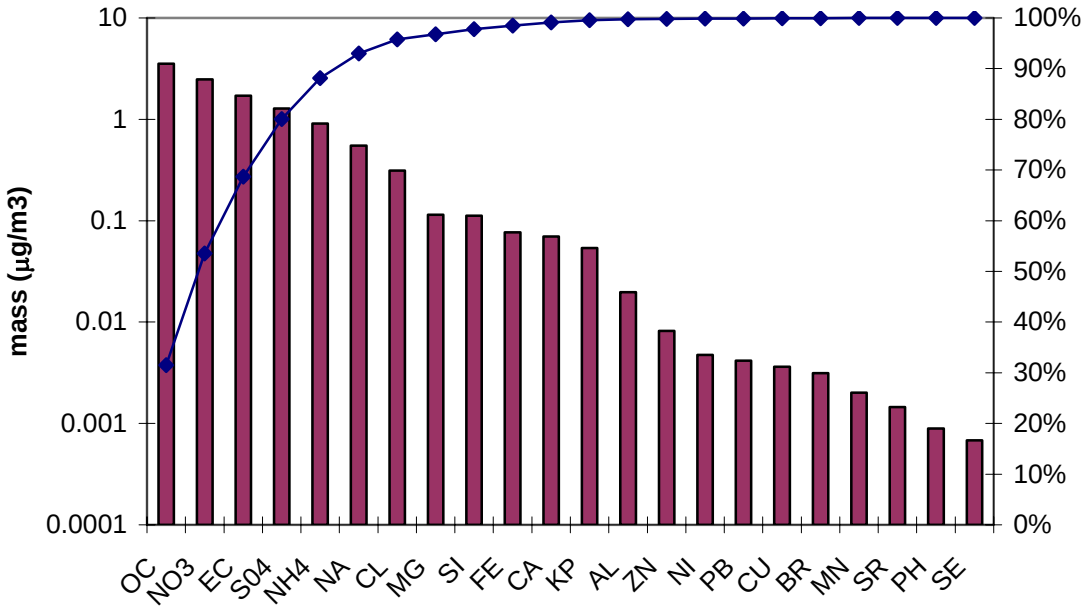

Figure 3.2. Mean mass contribution of $PM_{2.5}$ species averaged across all sites, along with cumulative contribution. Appendix C provides a list of compounds corresponding to the abbreviations on the horizontal axis.

Sodium and chlorine are the next greatest contributors, both present in marine air. Sodium is greater than chlorine because some chlorine is replaced by nitrate as the marine air mixes with air containing NOx. Elements associated with soil – notably silicon and aluminum – are present, but in small quantities, indicating that geological dust is not a large component of Bay Area $PM_{2.5}$.

Figure 3.3 shows boxplots of mass and the major species. Each box represents the range from the 25^{th} to 75^{th} percentile, with the horizontal line in the middle representing the median. The vertical lines above and below the box extend to the 95^{th} and 5^{th} percentiles. Asterisks beyond these lines represent extreme or outlying values of the distribution.

The figure shows large contributions of OC and to a lesser extent EC at every site except Point Reyes. Chloride and sodium are larger at Point Reyes than other Bay Area sites, clearly a result of the site's exposure to the sea breeze. The San Francisco site, which is also exposed to air off the ocean and bay, also has elevated levels of these species. The patterns for nitrate and sulfate are different, with nitrate occasionally showing very large values, whereas sulfate has essentially no outliers. Also, Point Reyes nitrate values are much lower than for the other sites, but its sulfate values are comparable, perhaps because sulfate is a component of marine air. Aluminum and silicon are elevated on a few occasions, but even for these, the concentrations are not that high, indicating that occasionally windblown dust contributes somewhat to $PM_{2.5}$ at these sites, but not in very large quantities.

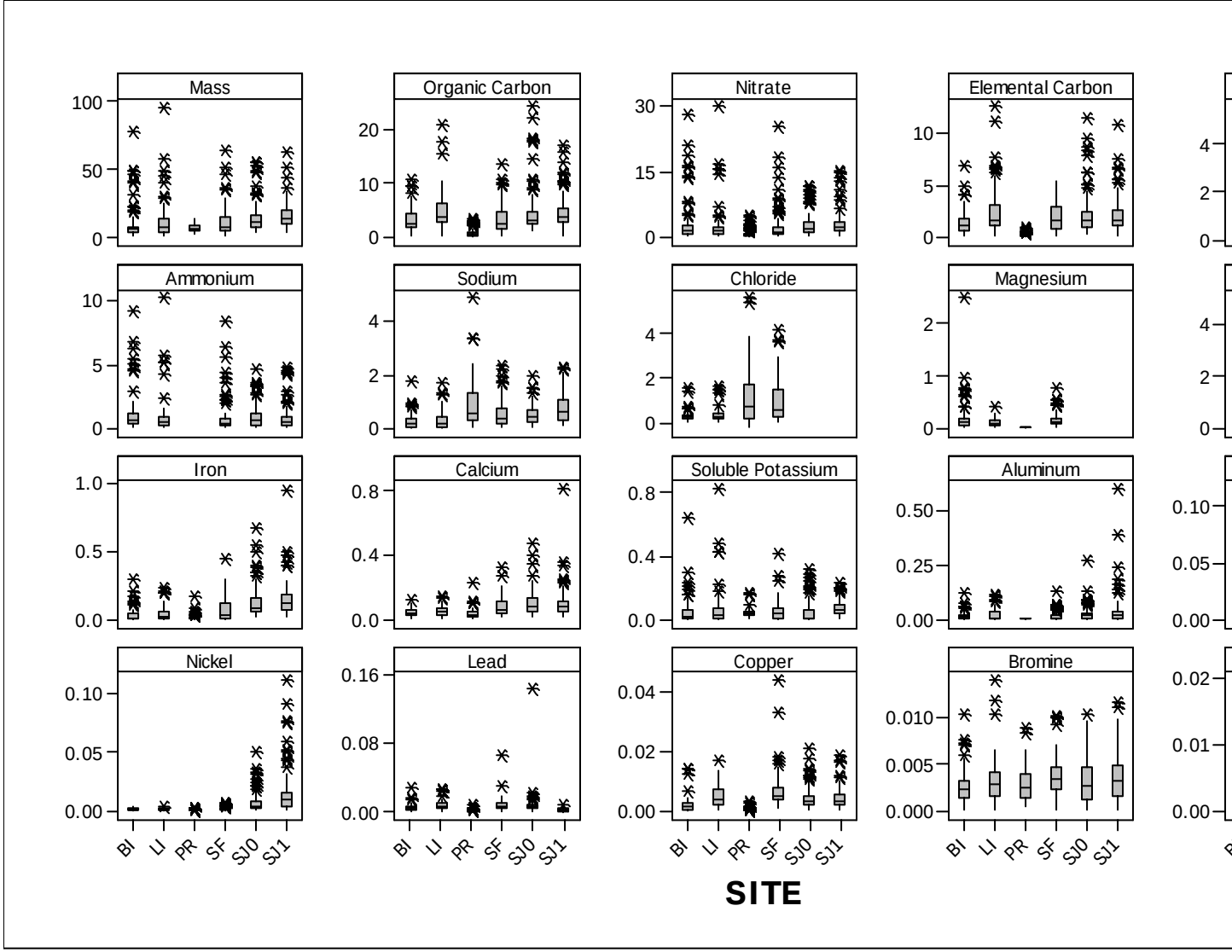

Figure 3.3. Boxplots of most abundant species by site ($\mu g/m^3$).

4. CHEMICAL MASS BALANCE (CMB) METHODOLOGY

CMB modeling provides a way of estimating the amount that various sources contribute to ambient PM concentrations. The CMB model is fit using a computer program whose inputs are source profiles and an ambient PM sample that have been analyzed for a variety of chemical components. The CMB model finds the mix of sources whose combined amounts of chemical components best approximates those on the ambient sample. In other words, the output of the CMB model includes estimates of the amounts (concentrations) from the various sources on the ambient filter.

The PM that deposits on an ambient filter sample comes from a wide variety of sources, only a few of which we have source profiles for. Even those sources, like wood smoke, auto exhaust or geological dust, exhibit infinite variations in the relative amounts of various constituents. To some extent, this variation is accounted for in the model, which incorporates the variability recorded in the source profiles. Yet, these uncertainties in the source profiles can affect the quality of the CMB results.

Species whose concentrations were below the limits of detection were not used for the CMB fit. Also, several species were measured both as ions and elements: potassium, chloride/chlorine, and sodium. Only one of the forms was used to avoid double counting. Similarly, sulfur was not fit because it duplicates sulfate. The table in Appendix C shows which species were used for fitting, except that not all the species were measured at every site. For example, ammonium was not measured at Point Reyes and therefore could not be used in the CMB analysis for that site.

CMB version 7 was used in this analysis (Watson *et al*. 1990). In previous applications of the CMB model, the approach used was to find the "best" fit using a variety of criteria – low chi-squared value, high R^2, all positive coefficients, all statistically significant coefficients, and lack of identifiability problems.[1] The weakness of this approach is that there may be more than one reasonable fit to a set of data.

The approach taken here was to find a weighted average of fits, weighting by the relative likelihood of the fit.[2] This process took several iterations to improve the likelihood function so that it better matched the actual distribution.[3]

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[1] A program was written to automate the application of the CMB model. Specifically, CMBRUNS.EXE is a program that generates a file with keystrokes that operate the CMB model, allowing it to be run in batch mode and to try a variety of fits. In particular, fits were made for every combination of the following sources: 1) marine/mar0/mar100/none, 2) bytun4/camv/none, 3) byws4/WBOakEu/WBOak/none, 4) amm. nitrate/none, 5) amm. sulfate/none, 6) cook/none, 7) BYRDC/ARB_DUST/none, 8) TireBreak/none, and 9) Gunpowder/none. The "none" option permitted running the model without this source, which is desirable because CMB7 estimated contributions can be statistically insignificant or even negative. This creates a total of 4,608 fits for each ambient sample.

[2] If the weights were statistical likelihoods, then this approach would have a Bayesian interpretation – attempting to approximate the mean of a posterior distribution for the model. This approach was tried but it had the weakness that the models themselves were uncertain. In particular, this approach led to situations where model A might produce estimated species contributions closer to the measured than for model B, yet model B would have a higher likelihood because its estimated uncertainties were less.

The method that was ultimately used was to define the likelihood as the product of two p-values:[4] the p-value associated with the chi-square statistic for goodness of fit of individual chemical species, and the p-value for the difference between estimated and measured mass. The p-values were set to zero if any of the estimated source coefficients were negative. These likelihoods provided the weights applied to different fits. (Appendix D provides the details.)

When the CMB model was applied using all source profiles, the results showed large uncertainties for some of the source categories. This indicated that the data should be reanalyzed with fewer categories. Details of the analysis with all source profiles and the rationale for dropping specific source profiles are explained in Appendix E. The profiles included in the analysis were: ammonium sulfate, ammonium nitrate, marine, road-dust, auto exhaust, wood smoke, and gun powder. Dropped from the analysis were the cooking and tire/brake wear profiles.

[3] For example, initially, the difference between the measured and calculated mass was assumed to have a Gaussian distribution. But it was found that, for some samples, the two values differed dramatically – many standard deviations apart, i.e., the Gaussian provides a poor fit and leads to unrealistic results. The likelihood was modified to minimize the effect of the Gaussian term in these cases. See Appendix 4 for details.

[4] p-values can be produced for statistical tests. A p-value represents the probability of seeing something at least as extreme as what was recorded given the null hypothesis were true. In this case, the null hypothesis is that the model is satisfactory. Small p-values indicate that the model is inadequate.

5. SOURCE APPORTIONMENT RESULTS

This section summarizes the results of the CMB analysis and relates these results to the annual and 24-hour standards. The annual standard is based on the average of the 4 quarterly averages, so the quarterly averaged results are presented. The 24-hour standard relates to peak $PM_{2.5}$ values, so the results for the samples with the 10 highest measured masses are presented. Individual fits are presented in Appendix F.

5.1 Annual Summary

Figure 5.1 shows the estimated annual mass contributions from different source categories for the various sites. The major categories at the non-background sites are direct, combustion-related, largely carbonaceous sources – fossil fuel and wood burning; and secondary, combustion-related sources – ammonium nitrate and ammonium sulfate.

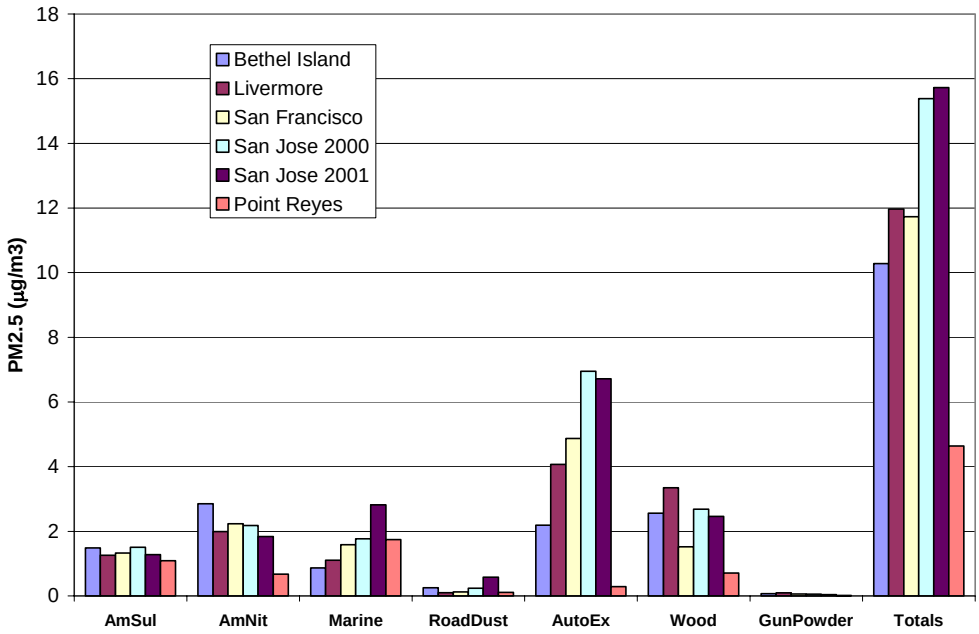

Figure 5.1. Estimated annual source contributions to Bay Area ambient PM2.5 for 2000 and San Jose 2001. Values are quarterly averaged means of individual CMB results. Totals are sums of individual source contributions.

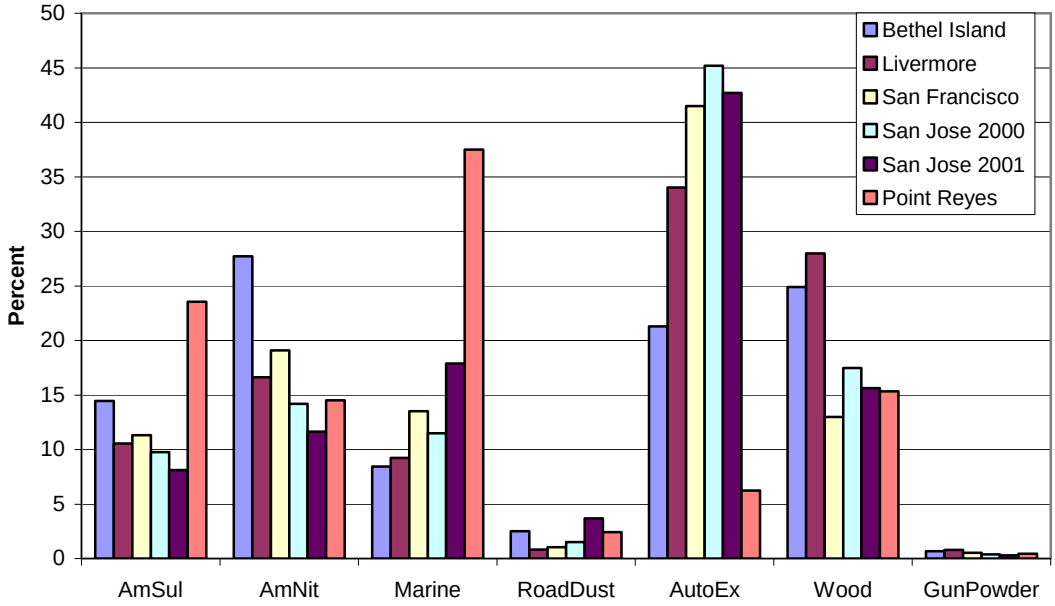

Figure 5.2. Estimated annual percentage contributions from various source categories. The values shown are the mass from individual source categories as a percentage of the total estimated mass. Thus, the percentages sum to 100% for each site.

Table 5.1. CMB results for annual $PM_{2.5}$ samples[a]

Conc. (μg/m^3)	Marine	Ammonium Sulfate	Ammonium Nitrate	Geological Dust	Motor Vehicle	Wood/plant burning	Gun Powder	Est. Total
Bethel Island	0.9	1.5	2.9	0.3	2.2	2.6	0.1	10.3
Livermore	1.1	1.3	2.0	0.1	4.1	3.3	0.1	12.0
San Francisco	1.6	1.3	2.2	0.1	4.9	1.5	0.1	11.7
San Jose 2000	1.8	1.5	2.2	0.2	7.0	2.7	0.1	15.4
San Jose 2001	2.8	1.3	1.8	0.6	6.7	2.5	0.0	15.7
Point Reyes	1.7	1.1	0.7	0.1	0.3	0.7	0.0	4.6
Percentages[b]								
Bethel Island	*8.4*	*14.5*	*27.7*	*2.5*	*21.3*	*24.9*	*0.7*	*100*
Livermore	*9.2*	*10.5*	*16.6*	*0.8*	*34.0*	*28.0*	*0.8*	*100*
San Francisco	*13.5*	*11.3*	*19.1*	*1.1*	*41.5*	*13.0*	*0.5*	*100*
San Jose 2000	*11.5*	*9.8*	*14.2*	*1.5*	*45.2*	*17.5*	*0.4*	*100*
San Jose 2001	*17.9*	*8.1*	*11.7*	*3.7*	*42.7*	*15.6*	*0.3*	*100*
Point Reyes	*37.5*	*23.5*	*14.5*	*2.4*	*6.2*	*15.3*	*0.4*	*100*
4 site average[c]	*10.7*	*11.5*	*19.4*	*1.5*	*35.5*	*20.8*	*0.6*	*100*

[a] Average of quarterly averages.
[b] Percentages of estimated mass.
[c] BI, SF LI, and SJ 2000.

For the urban sites, SF and SJ, and the suburban site LI, the auto exhaust category represents the largest single source, between 31% and 46% of the total. For Bethel Island largest category is ammonium nitrate, representing about 29% of the total. For Point Reyes, the largest category is marine air.

Wood burning is the second largest category for BI, LI and SJ2000. Ammonium sulfate and marine air are also important categories at all sites. The combined direct sources and secondary combustion sources constitute over 80% of the total for all 2000 sites except Point Reyes, and 78% for San Jose 2001. At no site does geological dust represent more than 3% of the total.

5.2 Peak Summary

Figure 5.3 shows the mass contributions for the 10 days at each site with the highest measured $PM_{2.5}$ masses, and Figure 5.4 shows the percent contributions.

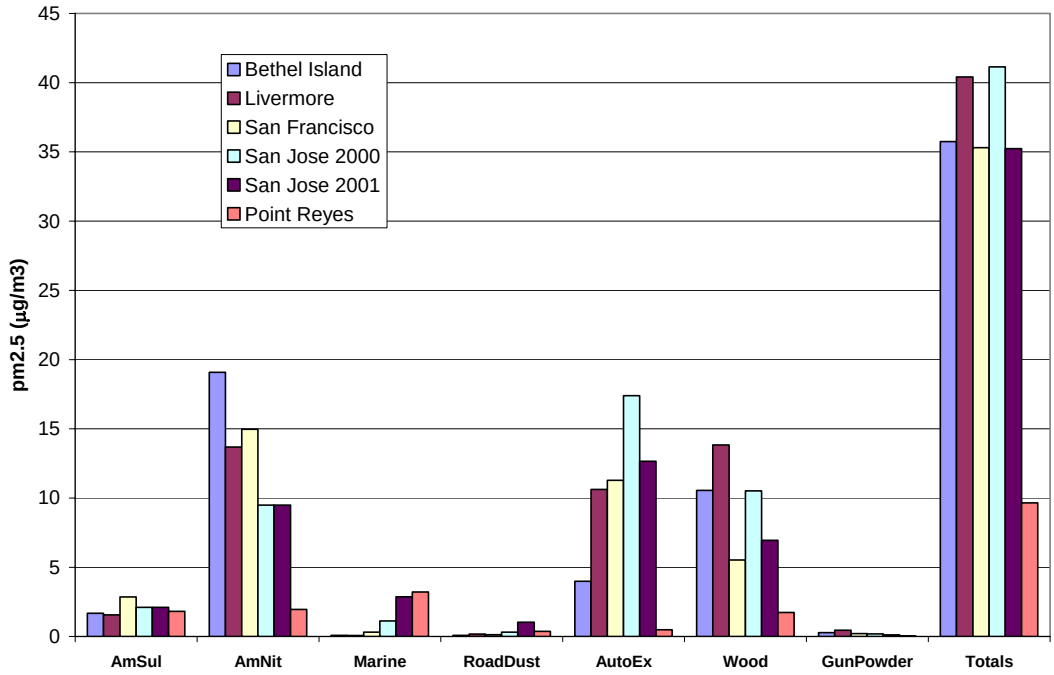

Figure 5.3. Estimated source contributions to peak Bay Area ambient PM2.5 for 2000 and San Jose 2001. Values are averages from 10 days with highest PM at each site. Totals are sums of individual source contributions.

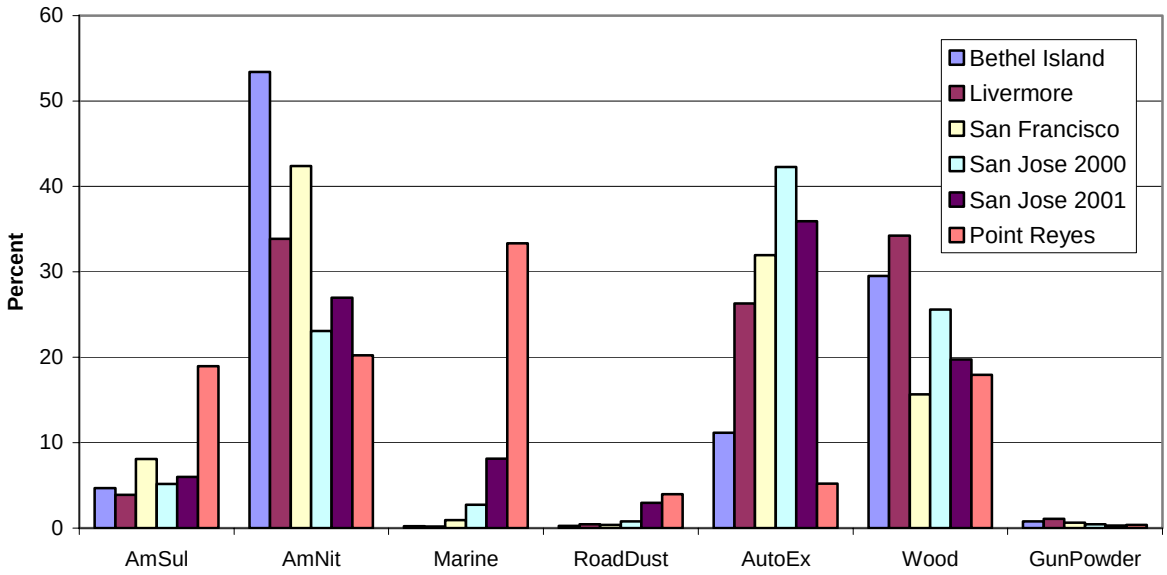

Figure 5.4. Estimated annual percentage contributions to peak PM2.5 from various source categories. The values shown are the mass from individual source categories as a percentage of the total estimated mass.

Table 5.2. CMB results for peak $PM_{2.5}$ samples[a]

Conc. (μg/m^3)	Marine	Ammonium Sulfate	Ammonium Nitrate	Geological Dust	Motor Vehicle	Wood/plant burning	Gun Powder	Est. Total
Bethel Island	0.1	1.7	19.1	0.1	4.0	10.5	0.3	35.7
Livermore	0.1	1.6	13.7	0.2	10.6	13.8	0.4	40.4
San Francisco	0.3	2.9	15.0	0.1	11.3	5.5	0.2	35.3
San Jose 2000	1.1	2.1	9.5	0.3	17.4	10.5	0.2	41.1
San Jose 2001	2.9	2.1	9.5	1.0	12.6	7.0	0.1	35.2
Point Reyes	3.2	1.8	2.0	0.4	0.5	1.7	0.0	9.6
Percentages[b]								
Bethel Island	*0.2*	*4.7*	*53.4*	*0.3*	*11.2*	*29.5*	*0.8*	*100*
Livermore	*0.2*	*3.9*	*33.9*	*0.4*	*26.3*	*34.2*	*1.1*	*100*
San Francisco	*0.9*	*8.1*	*42.4*	*0.4*	*32.0*	*15.6*	*0.6*	*100*
San Jose 2000	*2.7*	*5.2*	*23.1*	*0.8*	*42.3*	*25.6*	*0.4*	*100*
San Jose 2001	*8.1*	*6.0*	*27.0*	*2.9*	*35.9*	*19.7*	*0.3*	*100*
Point Reyes	*33.4*	*18.9*	*20.2*	*4.0*	*5.2*	*17.9*	*0.4*	*100*
4 site average[c]	*1.0*	*5.4*	*38.2*	*0.5*	*27.9*	*26.2*	*0.7*	*100*

[a] Average of results for 10 highest $PM_{2.5}$ measurements at each site.
[b] Percentages of estimated mass.
[c] BI, SF LI, and SJ 2000.

The pattern of source contributions to peak $PM_{2.5}$ is different from those of annual $PM_{2.5}$. In particular, ammonium nitrate represents a larger fraction – over 50% for Bethel Island, over 40% for San Francisco, and over 30% for Livermore. Woodsmoke is also a greater factor, representing over 30% for Livermore and almost 30% for Bethel Island. The

percent contribution of auto exhaust is smaller for peak $PM_{2.5}$ than for annual $PM_{2.5}$, although auto exhaust is still the largest single contributor for SJ2000. Ammonium sulfate, marine and geological dust are also smaller contributors to peak $PM_{2.5}$ than to the annual totals. Note that the total peak concentrations are between 35 - 40 $\mu g/m^3$ at all sites except Point Reyes whereas the annual total concentrations are highest at San Jose.

5.3 Analysis by Season

Figures 5.5a-5.5f show source contributions by season. As expected, the largest contributions occur in the winter quarter. Ammonium nitrate and either auto exhaust or wood smoke, or both, provide the dominant contribution to total $PM_{2.5}$ at every site, except Point Reyes.

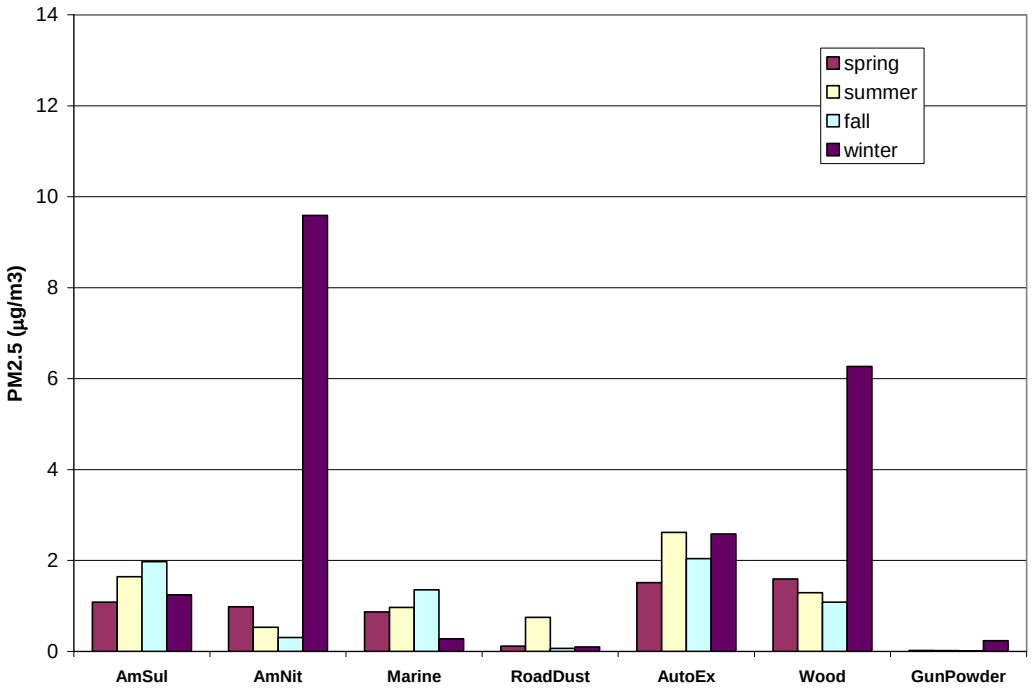

Figure 5.5a. Bethel Island PM2.5 source contributions by season. Values represent averages for the 4 pm seasons.

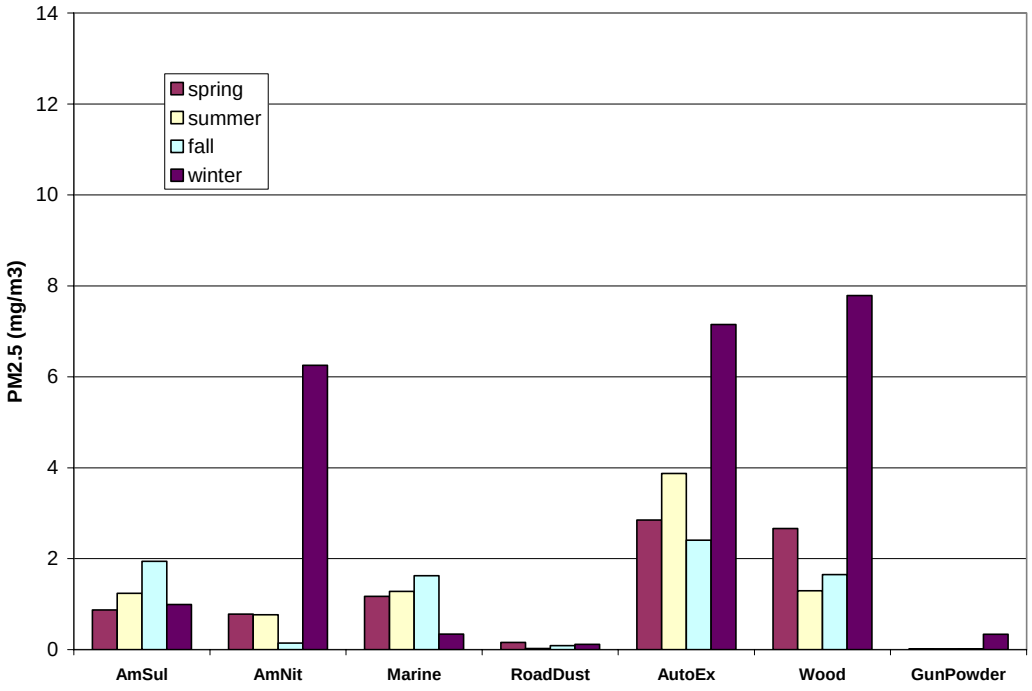

Figure 5.5b. Livermore PM2.5 source contributions by season. Values represent averages for the 4 pm seasons.

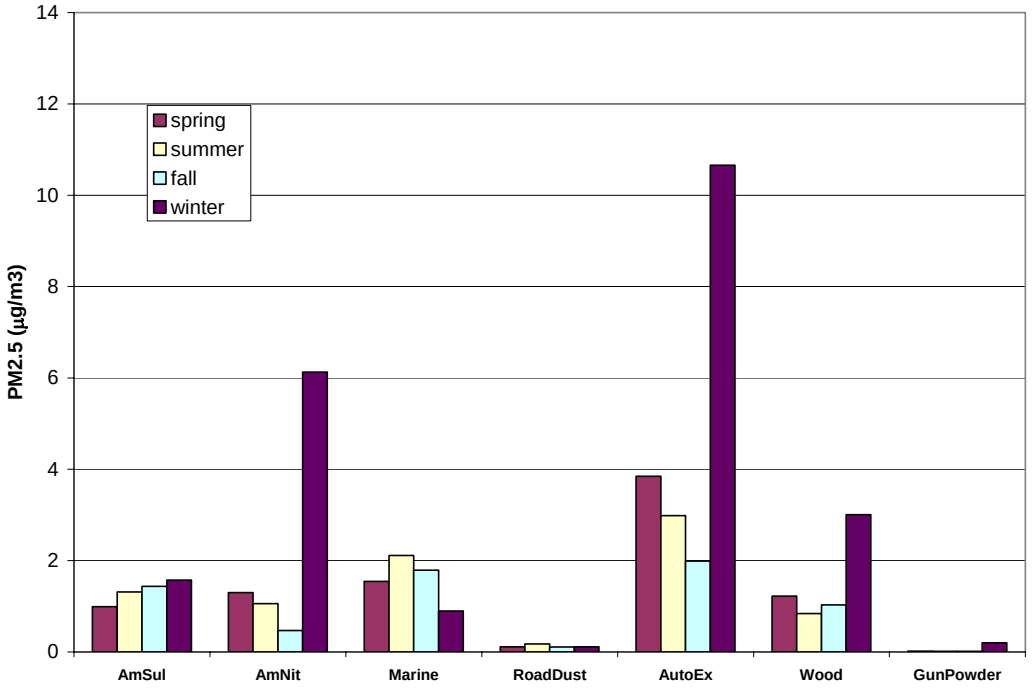

Figure 5.5c. San Francisco PM2.5 source contributions by season. Values represent averages for the 4 pm seasons.

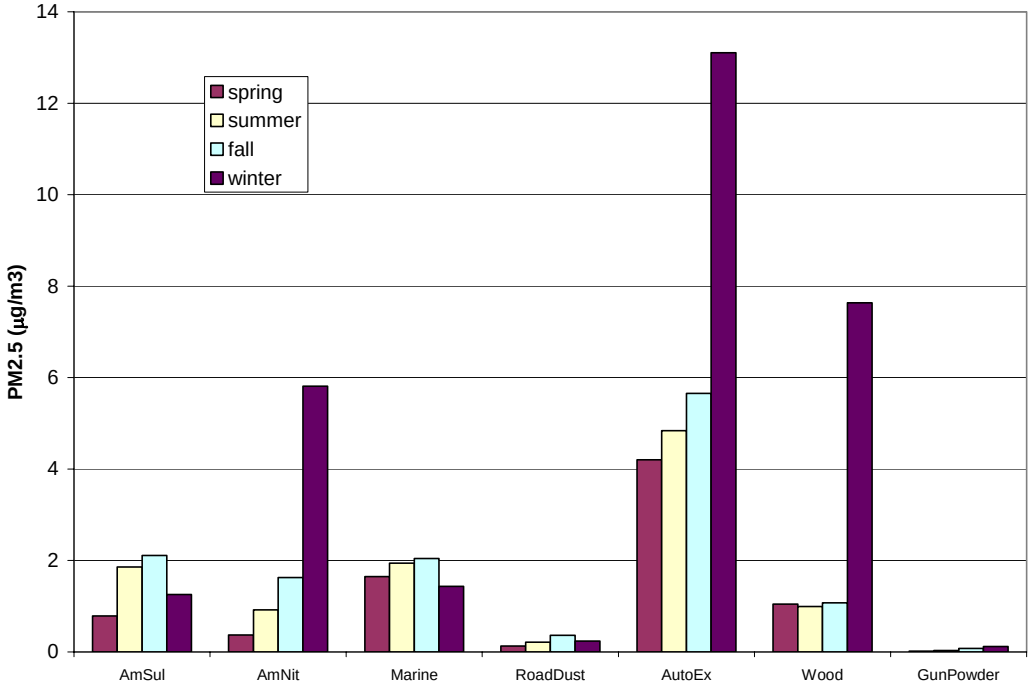

Figure 5.5d. San Jose 2000 PM2.5 source contributions by season. Values represent averages for the 4 pm seasons.

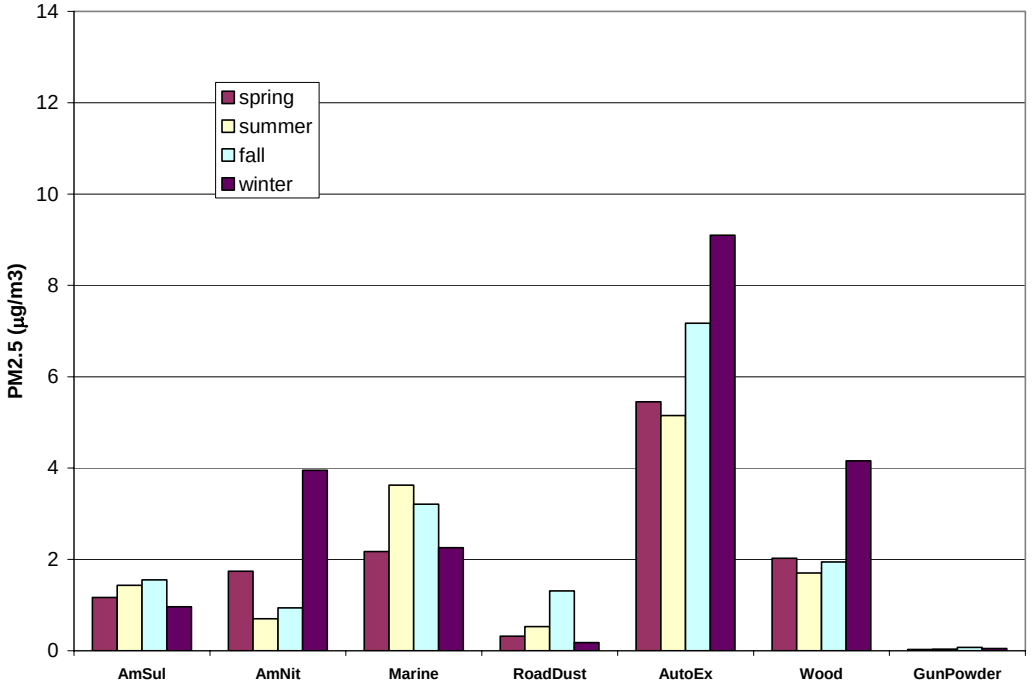

Figure 5.5e. San Jose 2001 PM2.5 source contributions by season. Values represent averages for the 4 pm seasons.

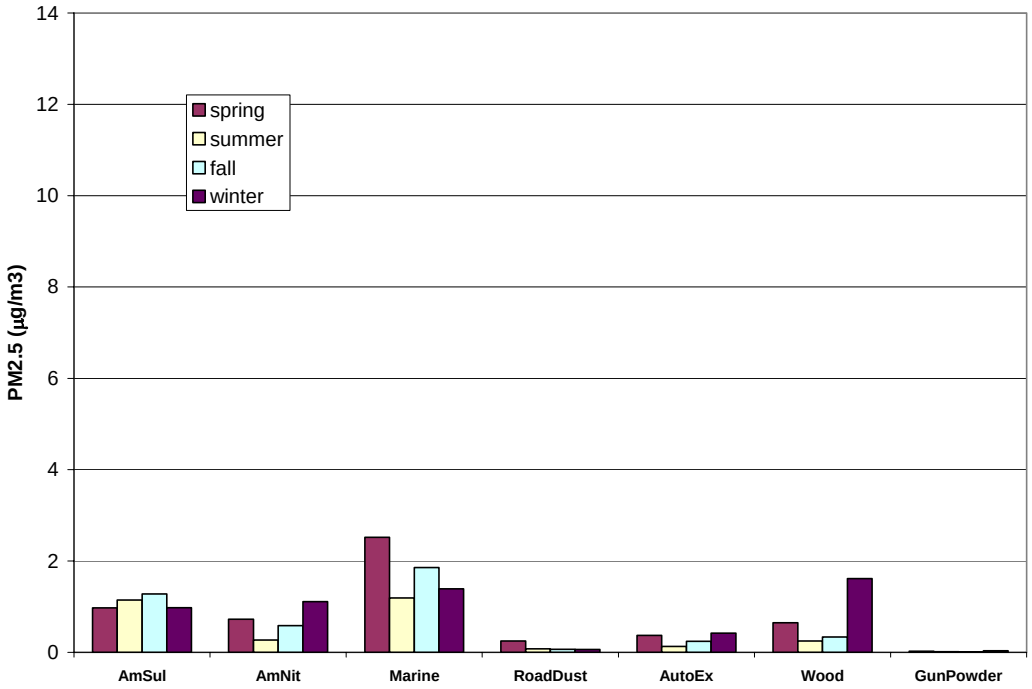

Figure 5.5f. Point Reyes PM2.5 source contributions by season. Values represent averages for the 4 pm seasons.

5.4 Comparisons with the Winter PM_{10} Field Study, 1992-94

In order to verify the findings of the current study, comparison was made to the results of a previous PM study. The BAAQMD conducted a study of wintertime PM_{10} from 1992 through 1994. Samples were collected from the same four sites (BI, LI, SF, and SJ) between 11/16/93 and 1/31/94. Samples with PM_{10} greater than 50 $\mu g/m^3$ were aggregated and analyzed for C-14 for each site. Aggregated profiles for wood smoke, auto exhaust, and geological dust were also analyzed for C-14. A CMB analysis was then performed on the aggregated samples. Table 5.3 shows the results.

Table 5.3. CMB results[a] for aggregated wintertime high PM_{10} samples, 11/93-1/94. Source: Fairley (1995)

Conc. ($\mu g/m^3$) (std. errors)	Marine	Ammonium Sulfate	Ammonium Nitrate	Geological Dust[b]	Motor Vehicle[c]	Wood/plant burning[d]	Est. Total	Meas. Total
Bethel Island	0.5 (0.4)	3.0 (0.2)	30.4 (0.6)	5.6 (0.7)	3.5 (0.9)	18.6 (2.3)	61.7 (2.4)	63.2 (1.1)
San Francisco	2.1 (0.4)	4.3 (0.2)	23.8 (0.5)	10.2 (1.2)	10.7 (1.8)	13.7 (2.0)	64.9 (2.4)	64.5 (1.0)
Livermore[e]	1.1 (0.4)	2.6 (0.3)	27.3 (0.5)	7.5 (0.7)	6.5 (2.2)	30.0 (2.7)	75.0 (2.8)	74.2 (1.0)
San Jose[e]	2.2 (0.5)	2.3 (0.3)	19.1 (0.6)	11.7 (1.2)	14.9 (2.0)	36.2 (3.5)	86.3 (3.7)	80.9 (1.1)
Percentages[f]								
Bethel Island	*0.9*	*4.9*	*49.3*	*9.1*	*5.7*	*30.1*	*100*	*102.4*
San Francisco	*3.2*	*6.7*	*36.7*	*15.8*	*16.5*	*21.2*	*100*	*99.4*
Livermore[e]	*1.4*	*3.5*	*36.4*	*10.0*	*8.7*	*40.0*	*100*	*98.9*
San Jose[e]	*2.6*	*2.6*	*22.1*	*13.5*	*17.3*	*41.9*	*100*	*93.7*
4 site average	*2.1*	*4.5*	*34.9*	*12.2*	*12.4*	*34.2*	*100*	*98.2*

[a] CMB estimates based on combined samples for days where $PM_{10} > 50\ \mu g/m^3$, using data collected 11/93 - 1/94. This analysis includes old and new carbon as species based on the University of Arizona C-14 analysis.

[b] Geological dust profile collected from various sites around the Bay Area, on and off road, mainly near the 4 sites.

[c] Motor vehicle profile collected in Caldecott Tunnel, adjusted to eliminate other sources. PM_{10} attributed to this profile is mainly auto exhaust, but the CMB model probably attributes PM_{10} from other fossil fuel burning (such as natural gas burning) to this source also.

[d] Wood/plant burning profile collected in three San Jose back yards of homes burning wood in their fireplaces. PM_{10} attributed to this profile is mainly from woodburning, but there may be some from agricultural burning and other sources also.

[e] The 2 samples for San Jose and Livermore are averaged.

[f] Percentages of estimated mass.

Figure 5.6 compares the percent of peak PM_{10} attributed to different source categories for the winter 92-94 field study with the percent peak $PM_{2.5}$ for different source categories for the present study.

Certain differences are expected because the comparison is between PM_{10} in the earlier study and $PM_{2.5}$ in the present study. One key difference is that most airborne geological dust is coarse – greater than 2.5 microns in diameter, so that a much higher percentage would be expected in PM_{10} than $PM_{2.5}$. Indeed, that appears to be the case: geological dust represents 12.2% of PM_{10} on average in the earlier study, and only 0.5% of $PM_{2.5}$ in the present study. Marine air also contains a large coarse fraction. Here, too, the earlier study has somewhat higher marine percentages overall (2.1% vs. 1.0%) and for every site except SJ.

For ammonium nitrate and ammonium sulfate, the results seem consistent between studies. The overall percentages are somewhat higher in the present study; this is expected, because most of this secondary PM is $PM_{2.5}$. The relationship of the sites is reasonably consistent, with BI registering the highest ammonium nitrate in both studies; SJ the lowest; and SF the highest ammonium sulfate. Note that there is an increase in the

percent contribution of ammonium sulfate, also secondary PM, at all sites, particularly at San Jose.

Figure 5.6 also shows larger contributions from fossil fuel combustion in the PM2.5 study and smaller contributions from wood burning and cooking. The causes are discussed in Section 6.2 below.

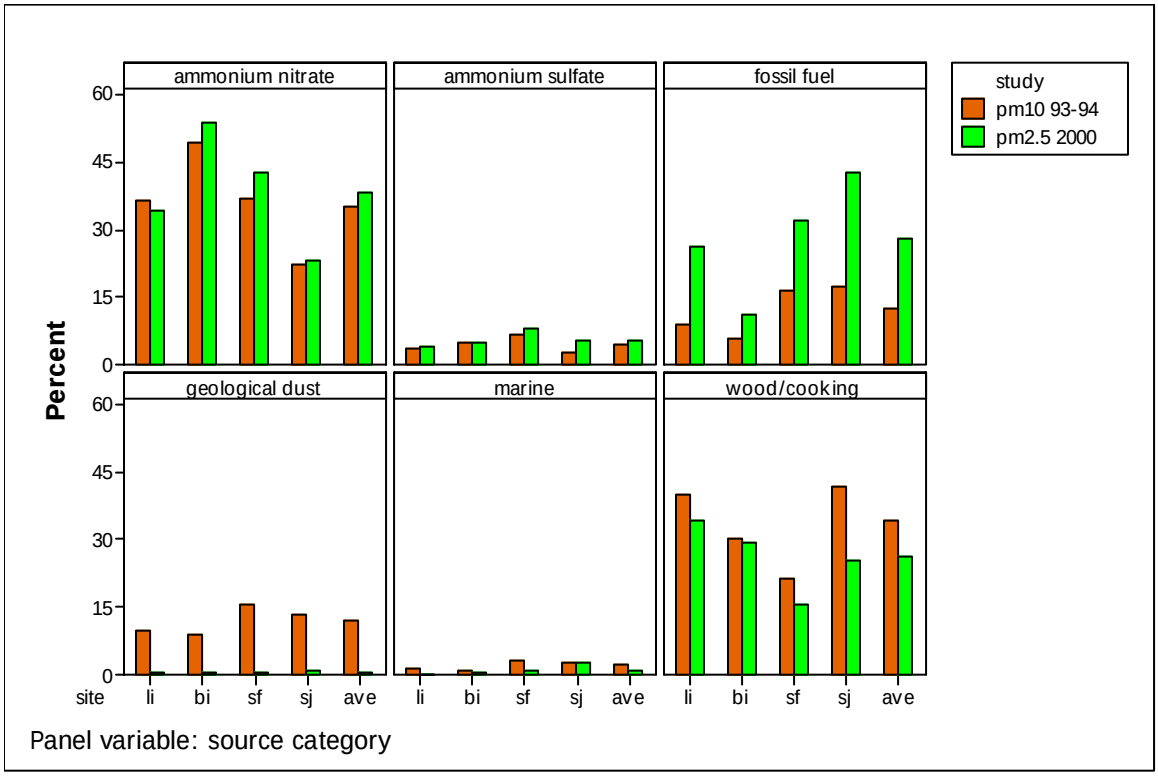

Figure 5.6. Comparison with percent source attributions from the winter 1992-94 field study.

6. REFINING SOURCE APPORTIONMENT WITH EMISSIONS INVENTORY ESTIMATES

CMB analysis with currently available data can only provide accurate distinctions between source categories, not specific sources. In an attempt to refine the source apportionments, emissions inventory estimates were combined with the CMB results. Specifically, the emissions inventory provides estimates of emissions within source categories. For the "wood smoke" category, the emissions inventory includes domestic burning (wood burning), (commercial) cooking, and waste burning. The "auto exhaust" category is more properly a "fossil fuel combustion" category. The major emissions inventory categories within this are on-road vehicles, off-road vehicles, aircraft, refineries, and power generation.[5] Some cooking PM may also be attributed to this category.

[5] In some of these, various subcategories have been combined. For example, "refineries" includes "basic refining processes," "flares," "other refining processes," and "oil refineries external combustion."

Table 6.1 shows the relative contributions of various sources based on the BAAQMD emissions inventory estimates created in 1999 and projected to 2001. The table presents four components of the emissions inventory: PM_{10} from combustion, PM_{10} from geological sources (such as road dust), NOx, and SO_2. The latter two are precursors to ammonium nitrate and ammonium sulfate, respectively. Information in the table was used to apportion the CMB source categories into more specific sources.

Table 6.1. Emissions inventory estimates of carbonaceous and secondary precursors (% of emission inventory* total)

	PM10 - combustion	NOx	SO_2	PM10- geological
Wood Burning	40	4	1	0
Cooking	13	0	0	0
Waste Burning	3	0	0	0
Fossil Fuel Combustors:				
On-road	*10*	*50*	*3*	*52*
Off-road	*20*	*29*	*28*	*24*
Aircraft	*5*	*4*	*1*	*0*
Refining	*6*	*5*	*53*	*0*
Power Generation	*3*	*4*	*1*	*0*
Fossil Fuel Total	44	91	85	76

* Emissions inventory estimates created in 1999 projected to 2001.

Table 6.1 shows that the emissions inventory attributes 40% of combustion PM_{10} to wood burning, 13% to cooking, 3% to waste burning, and 44% to fossil fuel burning. The CMB model may attribute particles from cooking to either the "wood burning" category or the "auto exhaust" category. The table also lists specific fossil fuel sources including on-road, off-road, aircraft, refining, and power generation. Particles from these sources are likely to be attributed to the "auto exhaust" CMB source category.

Note that the percentage estimated from wood burning alone is 40%, almost as large as all fossil fuel emissions. Since almost all combustion PM_{10} is actually $PM_{2.5}$, this should be the same or similar to the results for annual $PM_{2.5}$ in Table 5.1. However, in that table, the estimated 4-site percentage from "auto exhaust" is over 36% compared with 21% for "wood burning," so that CMB attributes considerably more to auto exhaust.[6]

Tables 6.2 and 6.3 combine the information in Table 6.1 with the 4-site totals of Tables 5.1 and 5.2, respectively. The percentages in the latter two tables are assumed to provide correct totals for each source category, and Table 6.1 is used to apportion PM to specific sources from within each source category. It is assumed that CMB attributes half of cooking PM to the "wood burning" category and half the "auto exhaust" category. The numbers in the body of these tables represent the percent of the total PM attributable to specific sources within each category. Thus, for example, 10% of total annual PM is attributed to the ammonium nitrate that derives from the NOx produced by on-road

[6] Of course, both source estimates could be correct, since the CMB results are limited to 4 specific sites, including two near heavy traffic.

vehicles. The numbers in right-hand column are the percent of total PM attributable to that specific source.

Table 6.2. Percent estimated total annual contribution from various sources.*

	Source category:						
Source	AmSul	AmNit	Marine	RoadDust	AutoEx	Wood	Totals
wood burning	0	1				18	19
cooking	0	0			5	3	7
on-road	0	10		1	7		18
off-road	3	6		0	14		23
refining	6	1			4		11
power plants	0	1			2		3
aircraft	0	1			3		4
marine			11				11
other	2	1	0	0	0	0	3
totals	12	19	11	1	35	21	99

* Totals add to 99% because some sources are omitted. Column total may not match due to rounding.

Table 6.3. Estimated percentage total peak contribution from various sources.*

	Source category:						
Source	AmSul	AmNit	Marine	RoadDust	AutoEx	Wood	Totals
wood burning	0	1				23	24
cooking	0	0			4	4	7
on-road	0	19		0	6		25
off-road	2	11		0	11		24
refining	3	2			3		8
power plants	0	1			2		3
aircraft	0	1			3		4
marine			1				1
other	1	2	0	0	0	0	3
totals	5	38	1	0	28	26	99

* Totals add to 99% because some sources are omitted. Column total may not match due to rounding.

Tables 6.2 and 6.3 suggest that the largest three sources for both annual and peak $PM_{2.5}$ concentrations are on-road vehicles, off-road vehicles and wood burning. Refining is also a large annual source of PM2.5 due to SO_2 emissions.

6.1 Recent Carbon-14 Results

The BAAQMD commissioned a carbon-14 (C-14) analysis of 15 PM_{10} filters for site/dates registering high PM concentrations (Fairley 2004). C-14 analysis yields the amount of "old" and "new" carbon on the filters. The carbon from fossil fuel is "old" whereas carbon from wood burning and cooking are (almost entirely) "new" carbon.

For every filter analyzed, new carbon comprised more than half of the total. This implies that wood burning/cooking constituted more than half the carbonaceous contribution. For

the 8 filters collected for site/days when $PM_{2.5}$ CMB analysis was done, the CMB-estimated woodsmoke/cooking fraction was much lower than the C-14 results would suggest: The median and mean of the CMB estimates for woodsmoke/cooking were both below 50%, whereas the C-14 analysis implied the median and mean should be 75-80%. The C-14 results are also more in line with the 92-94 PM_{10} study (Fairley 1995).

6.2 Contributions of Wood/cooking and Fossil Fuels

There is considerable uncertainty in fraction of $PM_{2.5}$ apportioned to fossil fuels vs. wood/cooking using only the chemical constituents typically measured for CMB. The Winter 1993-94 study incorporated C-14 information, providing a marker that well-separates these two categories. Both the winter study and the C-14 measurements of recent filters suggest that wood/cooking is a larger component of Bay Area PM than found in the present study using CMB. Additional backup is provided by the District's emissions inventory, which also attributes a larger fraction of directly emitted PM_{10} to wood burning.

It is possible that the balance of these sources has changed since 1994. However it seems likely that the present study overestimates the amount of fossil fuel $PM_{2.5}$ and underestimates the contributions from wood burning and cooking.

7. KEY FINDINGS AND OUTSTANDING ISSUES

The currently available data, coupled with the above analysis, makes it possible to draw some conclusions with certainty, but still leaves some important questions unanswered.

7.1 Key Findings

Although there are still many questions, the above analysis allows us to make some statements about Bay Area PM with a high degree of certainty:

- Most anthropogenic PM_{10} and $PM_{2.5}$ derive from burning wood or fossil fuels.
- Geological dust is a small contributor to PM_{10} and a negligible contributor to $PM_{2.5}$. Tire/break wear is also a negligible $PM_{2.5}$ source.
- Peak PM occurs largely in winter. Reasons include more conducive meteorology, conditions favorable for ammonium nitrate production, and wood burning.
- Ammonium nitrate is a major contributor to peak PM and a large contributor to annual PM.
- Carbonaceous PM, that is, PM directly emitted from burning, accounts for roughly half of peak PM_{10} and $PM_{2.5}$ and also annual $PM_{2.5}$.

- Ammonium sulfate is a substantial contributor to annual $PM_{2.5}$, but only a small contributor to peak PM.

7.2 Some Remaining Issues

This section discusses some remaining issues related Bay Area PM and suggests ways to address them. The items beside dots present the issues and those beside arrows present suggestions to address them.

- *There is a large uncertainty in the fractional contributions of carbonaceous PM from wood smoke, cooking and fossil fuel sources.* As mentioned in sections 6.1 and 6.2, the CMB analysis may have attributed too much of the carbonaceous $PM_{2.5}$ component to fossil fuels and not enough to wood burning/cooking.

→ *To reduce the uncertainty, C-14 measurements should be included in future field studies.* Specifically, parallel $PM_{2.5}$ filters should be collected, one designed for elemental analysis, one for ion analysis, and two for carbon analysis. The carbon filters would be analyzed for C-14 as well as OC/EC.[7]

- *Some of the PM attributed to wood smoke may originate from other sources, such as cooking.* The emissions inventory has a commercial cooking category, but not one for domestic cooking. Its estimates of wood burning emissions were derived from a study conducted in the mid-1980s. The C-14 analysis of recent filters included several filters collected in June, 2003. Even here "new" carbon predominated, yet it seems very unlikely that this is due to residential wood burning.

→ *Two studies would be valuable:* One is a comprehensive study of residential wood burning in the Bay Area, including a survey of wood burning usage and when people burn, and estimates of the number of homes with wood burning fireplaces or wood stoves. A second study would be to collect $PM_{2.5}$ on filters that would be analyzed for a range of hydrocarbons that have been found to be good markers for wood smoke and cooking.

- *There is large uncertainty in the apportionment of fossil fuel-derived carbonaceous PM into specific sources such as on-road mobile vs. construction equipment. There is similar uncertainty in the fraction derived from diesel exhaust vs. gasoline exhaust.*

→ *Key measurements such as EC2 and PAHs could help discriminate among motor vehicle sources.* If such measurements were available, then a CMB analysis might be able to provide estimates of the source contributions.

[7] The amounts of carbon collected for individual days might be too small for C-14 analysis, requiring that several be combined.

- *Ammonium nitrate is a large component of Bay Area PM, but the benefits of reductions in precursor emissions of ammonia and NOx are still not quantified.* Ammonium nitrate formation exhibits the same complexities as ozone formation, with many chemical reactions taking part.

→ *Grid-based PM modeling is increasingly available to quantify the effects of precursor reductions on PM*. Similar to photochemical models, PM models (e.g., Held *et al.* 2004) have the capacity to examine how changes in precursors might affect ammonium nitrate concentrations.

- *The contributions of local sources vs. transported PM and precursors have not been determined.*

→ *Several approaches might yield useful results*. Simplest would be trajectory analysis, and studying the timing of high PM in different parts of the District. A more sophisticated approach is to use a PM grid model as mentioned above. Yet another approach would be to analyze the geological dust on filters for bacteria, which can show evidence of origin.

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APPENDIX A. ADJUSTMENT OF OC AND EC DATA

Two different approaches have been developed to measure OC and EC on PM filters – the IMPROVE and NIOSH methods. Chow *et al*. (2001) showed that the NIOSH method attributes considerably more carbon to the OC fraction than the IMPROVE method does. CRPAQS and the Speciated Trends Network used the IMPROVE method for ambient samples, and CRPAQS and BAAQMD used the IMPROVE method for their source profiles. But the EPA has used the NIOSH method for its analysis of San Jose $PM_{2.5}$ filters. CMB analysis requires consistent source and ambient measurements, so one set of measurements had to be adjusted. The choice was made to modify the NIOSH measurements, simply because there were fewer datasets to change.

Comparisons showed that the fraction of IMPROVE-measured EC out of total OC+EC averaged at least double that of the NIOSH method. Figure A1 shows boxplots of the ratios of EC to TC = OC+EC. As can be seen, the NIOSH method EC fraction is considerably less than that of the IMPROVE sites. The median and mean ratios for the IMPROVE sites are all somewhat more than double the NIOSH site (Table A1). Also shown are the EC/TC ratios from the District's Wintertime 1993-94 PM_{10} Study, where all EC/OC measurements were done using the IMPROVE method. Although the ratios appear somewhat lower than they do at present, the ratios for SJ are certainly no lower than for the other sites. Thus, there is no reason to suspect that the EC fractions at San Jose are, in reality, systematically lower than for any of the other sites.

Because the $PM_{2.5}$ ratios for the IMPROVE sites in Table A1 are at least twice what they are for SJ, the decision was to adjust the SJ observations by doubling the EC numbers and subtracting off the corresponding amount from the OC, i.e., EC* = 2EC and OC* = OC – EC. The boxplot of the ratios of the adjusted EC/OC values is shown in Figure A1.

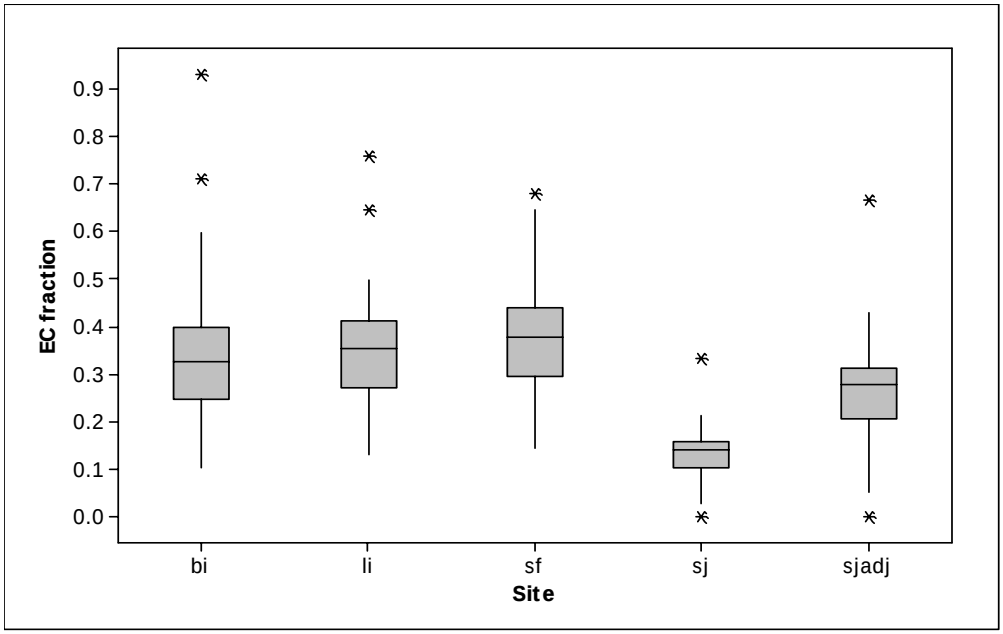

Figure A1. Comparisons of EC/TC ratios for the CRPAQS and EPA (SJ) sites. Also shown are the ratios after adjusting EC and OC.

Table A1. Mean and median EC/TC ratios

Site	n	mean ratio	median ratio	pm10 ratio*
SF	71	0.38	0.38	.28
LI	70	0.34	0.35	.24
BI	68	0.34	0.33	.22
SJ	188	0.13	0.14	.27

* From the Winter 1993-94 field study

APPENDIX B. COMPARISON OF MASS MEASUREMENTS

Various labs measured the data analyzed here. For some of these we have parallel measurements collected via the District's routine monitoring. In particular, simultaneous $PM_{2.5}$ mass measurements were made at District sites and two of the three CRPAQS sites, Livermore and San Francisco, and at the Speciation Trends Network data from the San Jose site.

The good news is that the correlations are quite high – 0.99 for Livermore and San Francisco, and 0.94 for San Jose. Figure B1 shows a plot of Livermore $PM_{2.5}$ mass measured by CARB versus mass as measured by the District.

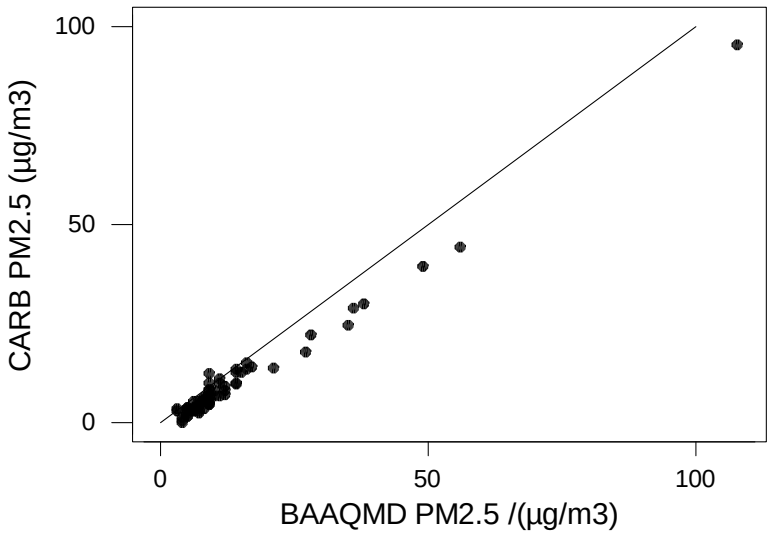

Figure B1. Comparison of $PM_{2.5}$ mass measured by CARB and BAAQMD for Livermore, 2000. Also shown, a 1-1 line.

There are serious discrepancies, however, in the magnitudes of the measured mass for Livermore and San Francisco. Table B1 shows comparative statistics between BAAQMD measurements and those of CARB. Included are mass measurements and also sums of the major individual species, including nitrate, sulfate, EC, OC, aluminum, silicon, sodium and chlorine, more precisely, all of the compounds used in CMB fitting listed in Appendix 3.

Table B1. Same-day comparisons of BAAQMD, CARB and EPA $PM_{2.5}$ measurements

		Mean			Median			Ratios: Other/BAAQMD			Ratios: Sum of Spec./BAAQMD		
Site	N	BAA QMD mass	Other Mass[a]	Sum of Spec.[b]	BAA QMD mass	Other mass[a]	Sum of Spec.[b]	Med -ian	Low CI	Upp CI	Med -ian	Low CI	Upp CI
LI	64	13.6	10.3	11.3	9.0	6.2	9.1	0.70	0.65	0.76	0.93	0.84	1.04
SF	64	14.3	11.5	12.0	9.0	7.2	8.6	0.73	0.67	0.79	0.87	0.81	0.94
SJ	126	14.3	15.4	14.0	11.0	11.8	11.7	1.06	1.03	1.11	1.06	1.03	1.09

[a] Other = CARB for LI and SF, and EPA (RTI International) for SJ.

[b] Sum of Spec. = Sum of all major components, including nitrate, sulfate, EC, OC, aluminum, silicon, sodium and chlorine.

The table shows that CARB $PM_{2.5}$ averages roughly 70% of BAAQMD. The ratio is somewhat higher for higher concentrations. For San Jose, the comparisons are much closer, with the EPA measurements averaging slightly higher than the District's. The sum of species should be less than the mass, because it omits, components like oxygen in soil and hydrogen in OC. Yet for LI and SF, the mean and median sum of species is larger than the CARB total mass, and the medians are actually close to the BAAQMD total mass. Also note that the ratios of the sum of species to BAAQMD mass are closer to 1 than the total mass. Therefore, it was assumed that the CARB masses were underestimated, and the LI, SF and BI measurements were adjusted by $1.1x + 1.9$, where x is the CARB measurement.

APPENDIX C. CHEMICAL SPECIES USED IN THE CMB MODEL

Table C1 shows the number of times the measured concentrations of various species exceeded 1 and 2 standard deviations. Also shown, by asterisks, are those species used for fitting by the CMB model.

Table C1. Chemical species – frequency above the limits of detection.

species id	species	#>1sd	#>2sd	used for CMB*	species id	species	#>1sd	#>2sd	used for CMB*
MS	mass	194	164		CU	copper	138	71	*
CL	chloride	139	67		ZN	zinc	134	108	*
NO3	nitrate	208	198	*	GA	gallium	1	0	
SO4	sulfate	208	202	*	AS	arsenic	0	0	
NH4	ammonium	187	170	*	SE	selenium	15	3	*
NA	sodium ion	158	140	*	BR	bromine	124	42	*
KP	potassium ion	107	73		RB	rubidium	1	0	
OC	organic carbon	178	139	*	SR	strontium	16	7	*
EC	elemental carbon	189	143	*	YT	yttrium	0	0	
NAX	sodium	79	43		ZR	zirconium	3	0	
MG	magnesium	104	33		MO	molybdenum	1	0	
AL	aluminum	34	6	*	PD	palladium	0	0	
SI	silicon	24	13	*	AG	silver	1	0	
PH	phosphorus	16	1		CD	cadmium	0	0	
SU	sulfur	208	208		IN	indium	0	0	
CL	chlorine	100	78	*	SN	tin	2	0	
KPX	potassium	162	82	*	SB	antimony	1	0	
CA	calcium	52	13	*	BA	barium	1	0	
TI	titanium	0	0		LA	lanthanum	0	0	
VA	vanadium	0	0		AU	gold	0	0	
CR	chromium	0	0		HG	mercury	0	0	
MN	manganese	13	3	*	TL	thallium	0	0	
FE	iron	47	24	*	PB	lead	55	13	*
CO	cobalt	0	0		UR	uranium	1	0	
NI	nickel	20	4	*					

* Asterisk indicates that the species was used in fitting the CMB model.

APPENDIX D. DETERMINING WEIGHTS APPLIED TO THE FITS

For each sample, a range of models were fit. As explained above, the results were summarized as a weighted average, where the weights were based on the product of two probabilities – a chi-square for how closely individual calculated species matched the measured species, and a Gaussian for the difference between the total measured mass and the calculated total.

One difficulty with this approach is that the true distribution of the chi-square statistic is difficult to estimate because it involves unknown statistical correlations among the chemical species. In other words, the chemical species are not statistically independent, and the lack of independence between chemical species suggests that the chi-square statistic might not have a chi-squared distribution. In fact, the CMB fits produced "chi-square" statistics that averaged about 0.5 whereas, if the model were correct, these statistics should be averaging about 1.0.[8]

A second issue is that a range of models is fit to the *same* sample. Some samples were inherently easy to fit, others difficult, so that, for some samples, a large number of chi-square statistics were very small, suggesting good fits, in others few if any chi-square statistics were small.

Thus, the approach of naively assuming that the chi-squared statistic has a chi-squared distribution yielded unrealistic probabilities.

The approach ultimately taken to fix this problem was to index the chi-square fits to the best fit, which was arbitrarily given a value of 12 – the 25th percentile of a chi-square with 17 degrees of freedom. Each other chi-square statistic, S, was adjusted to 12 times its ratio to the minimum: $12*S/S_{min}$. This adjusted value was then assumed to have a chi-squared distribution.

For the second p-value, the difference between the measured and calculated masses was assumed to a Gaussian distribution. However, occasionally there were large differences between the measured mass and any of the calculated masses – in a number of cases, the sum of the measured species was considerably larger than the measured mass, indicating that one or the other was substantially mismeasured. The problem that resulted was that in these cases, a model that fit badly for individual components nevertheless gave a better second p-value because the sum of the modeled species accidentally got closer to the mismeasured total PM.

To account for these anomalies, a "posterior" probability was calculated, for the likelihood that a problem had occurred. It was arbitrarily assumed that initially there is a 90% chance that the measurements are not grossly inaccurate. A reality check was then

[8] Actually, the statistic was had the form of a chi-square statistic divided by its degrees of freedom. Under the assumption that the terms in the chi-square come from a set of independent standard normal random variables, the expected value of a chi-square equals its degrees of freedom. So dividing by the degrees of freedom produces a statistic with mean 1.0.

performed, comparing the measured mass with the (adjusted) sum of the measured species. Specifically, the species were summed, except the OC and EC were multiplied by 4/3 to adjust for the fact that for two of the most common sources of ambient carbon – wood smoke and motor exhaust – the measured species account for about 75% of the measured mass (the remainder including oxygen and hydrogen), and Aluminum and Silicon were multiplied by 1/.6, to account for the fact that the measured geological species account for about 60% of the mass (much of the rest being oxygen).

A z-statistic was computed as the difference between the measured mass and sum of species (as described above), divided by their estimated standard error. A p-value was computed as p=2*Phi(|z|), and a posterior probability computed: p1 = .9p/(.9p+.1(1-p)). If p is close to 1.0, the posterior is also close to 1.0. If p is equal to 0.1, indicating some chance that there are serious measurement discrepancies, then the posterior probability is 0.5. If p is small, 0.01 or less, then the posterior is also small.

To adjust the second term for this posterior probability of erroneous measurements, the Gaussian was raised to the power of the posterior: $[\text{Phi}(w)]^{p1}$, where w = |measured mass – calculated mass|/(estimated sd of difference). If p1 is near 1, so there is good agreement between the measured mass and the sum of individual species, then Phi(w) is relatively unchanged. But if there is a large discrepancy, then p1 is small, thereby shrinking $[\text{Phi}(w)]^{p1}$ toward 1, so that this term doesn't play much of a role in the overall fit.

The weight for an individual fit equals the product of its two p-values, divided by the sum of all the 1,100 or so products of p-values (for which all estimated coefficients are positive). The coefficients reported for a given sample is the weighted average of the coefficients. The coefficients' standard errors are estimated as the square root of the weighted average of the individual variances, i.e., the squares of the standard errors provided by the model. The definition of the weights, w_i, can be summarized as follows:

$$w_i = r_i / \sum r_j$$

where $r_i = P(X > 12S_i/S_{min})* [\text{Phi}(w_i)]^{p1}$, and X is a chi-squared random variable with degrees of freedom = # of fitted species - # of fitted source categories.

APPENDIX E. INITIAL CMB RESULTS AND SOURCE CATEGORY SELECTION

The initial CMB results showed large uncertainties for some of the source categories. This indicated that the data should be reanalyzed with fewer categories. (See Section 5.) This appendix describes how this subset of source categories was chosen.

If several sources have similar relative quantities of chemical species, the CMB model will have difficulty distinguishing between them. This leads to an inflation in the associated standard errors, which is to say, uncertainties. Wood smoke from different tree species, for example, may have very similar source profiles, at least on the species measured for this analysis.[9]

In the initial CMB runs, only one source from a class was included at a time, e.g., only one woodsmoke profile and only one auto exhaust profile. However, identification problems persisted. In particular, the profiles of auto exhaust, wood smoke and cooking are similar enough that the CMB model may have difficulty distinguishing them. Of course, from the viewpoint of PM controls, the distinction is crucial. Thus, for the initial CMB runs, various combinations of these sources were tried.

In order to determine the magnitude of uncertainty, two quantities were estimated. One is the *total* uncertainty – the standard error of the quarterly averaged source coefficients. It was computed from the estimated coefficients themselves. If the coefficient average were a simple arithmetic mean, then this estimate would be the usual sample standard deviation. This standard error includes variation from 3 sources: model uncertainty, meteorological variation, and variation in underlying emissions.

The second quantity was estimated *model* uncertainty of the quarterly averaged source coefficients, based on combining estimated standard errors provided by the model for each coefficient for each fit. For a given coefficient and site, the combining formula was the square root of:

$$S^2_{ave} = \frac{1}{16}\sum_{i=1}^{4}\frac{1}{n_i^2}\sum_{j=1}^{n_i} s_{ij}^2$$

where n_i = number of fitted coefficients in quarter i, and s_{ij} = model estimated standard error for the jth sample in quarter i.

Figure D1 presents a comparison of total and model uncertainties for each source category for each site. For the top 3 source categories – ammonium nitrate, ammonium sulfate, and marine air – total uncertainty is much greater than modeled. This implies that the model had little difficulty in distinguishing these sources and, moreover, there

[9] Some differences can be found by speciating the organic carbon. However, this was not done for this study. Wood smoke and cooking can be differentiated from fossil fuel PM with Carbon-14 analysis. Some of this has been done for Bay Area PM, but not for this study.

was substantial true variability in the contribution from that source from sample to sample.

For the three correlated sources – auto exhaust, woodsmoke and cooking – the modeled uncertainties are sometimes as large or larger than the total. (Of course, the *actual* modeled uncertainty must be less than or equal to the *actual* total.) This indicates that the model has difficulty in distinguishing among them. At some sites, however, it does appear the model can distinguish the first two sources – LI and BI for woodsmoke and SJ and SF for auto exhaust. But at no site could the cooking source be distinguished above the model uncertainty. Therefore, the cooking profile was dropped in the final CMB runs.

The final three sources – geological dust, gunpowder and tire/brake wear – also showed modeled uncertainties as large as total. This is not due to confounding with other sources but instead because they occur at such low concentrations that they are difficult to measure, that is, their distinguishing chemical species are not above the limits of detection. For example, for geological dust, silicon and aluminum are key species, consisting of about 25% and 10% of total mass, respectively. In the samples analyzed, these species occurred above the limits of detection in only 24 and 34 out of 208 cases, respectively. However, the model was able to distinguish geological dust and gunpowder at some sites. Geological dust has a unique signature, so it can be readily differentiated from the other sources, even at low concentrations. For BI, LI, and SF, the highest estimated gunpowder concentration occurred on 1/1/2000, precisely when one might expect significant concentrations to appear,[10] so the attribution to this source appears genuine. But nowhere did tire/brake wear occur above the detection limits of the model. Therefore, the former two sources were retained, and tire/brake wear eliminated, in subsequent analysis.

[10] There were no January 1 or December 31 observations collected for San Jose for either 2000 or 2001. For Point Reyes, the 1/1/2000 CMB-estimated gunpowder was its 3rd highest.

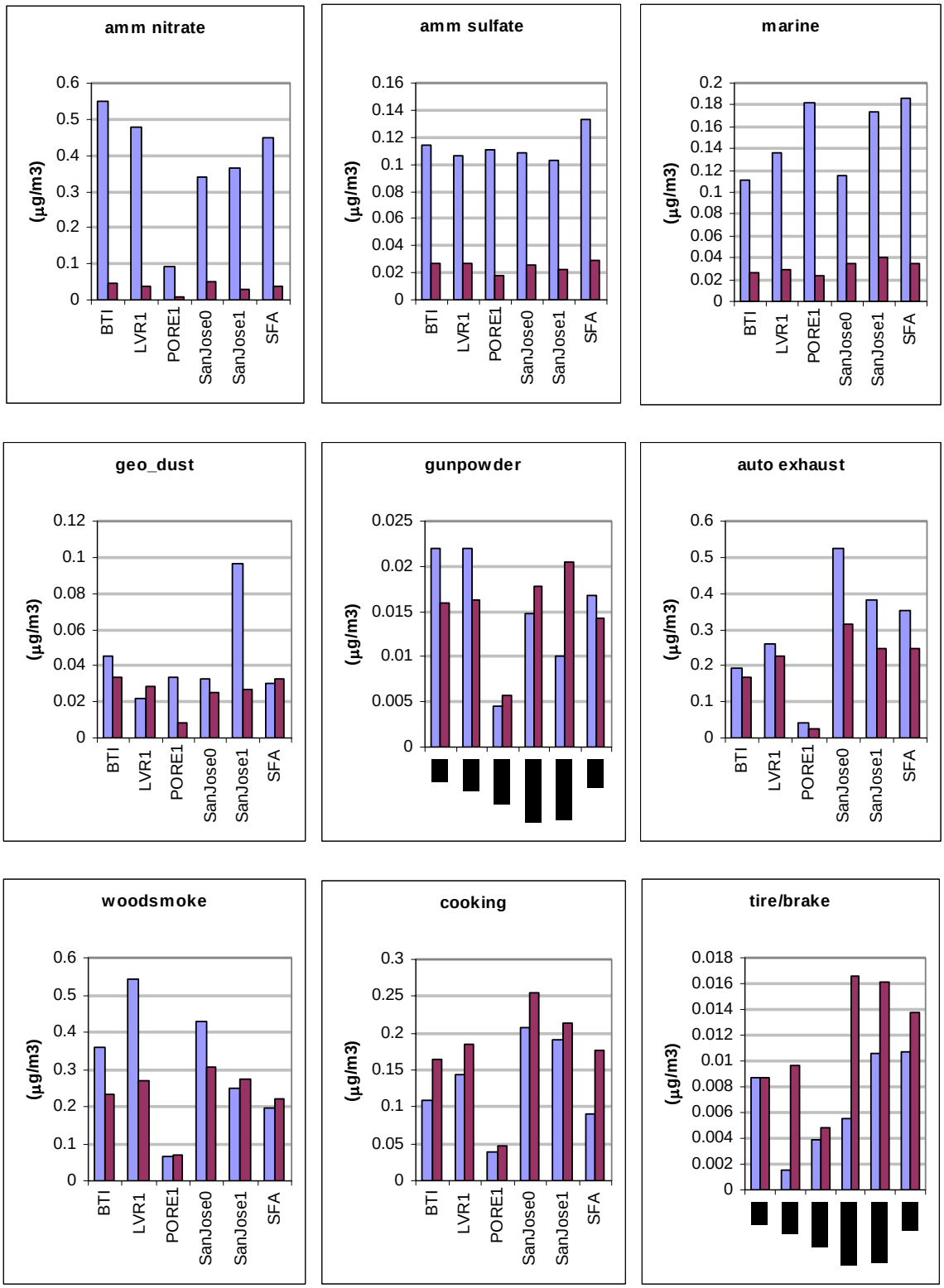

Figure E1. Comparison of model uncertainties with total uncertainty for fitted source categories. Blue lines = total uncertainty. Red lines = modeled.

APPENDIX F. INDIVIDUAL CMB FITS

Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
BTI	12/2/1999	3.9	6.8	0.13	0.98	0.65	1.43	0.53	0.20	1.30	2.65	0.03
BTI	12/8/1999	8.7	12.2	1.14	0.90	1.22	1.58	0.43	0.86	4.61	3.27	0.25
BTI	12/14/1999	4.6	8.3	0.09	0.97	0.75	0.96	0.01	0.08	0.95	5.51	0.00
BTI	12/20/1999	20.1	36.1	0.18	0.99	2.02	24.45	0.06	0.00	1.32	8.24	0.03
BTI	12/26/1999	48.4	47.4	0.21	0.99	1.86	27.26	0.09	0.03	0.78	17.38	0.00
BTI	1/1/2000	14.3	15.8	0.21	0.99	2.36	2.32	0.41	0.04	0.70	8.02	1.95
BTI	1/7/2000	40.5	35.1	0.14	1.00	2.09	17.80	0.07	0.13	0.21	14.11	0.69
BTI	1/13/2000	21.7	19.2	0.33	0.99	1.02	8.89	0.33	0.00	1.52	7.40	0.06
BTI	1/19/2000	6.9	6.1	0.14	0.99	0.64	4.55	0.04	0.01	0.36	0.46	0.01
BTI	1/25/2000	2.4	4.0	0.46	0.93	0.85	1.63	0.11	0.00	1.06	0.38	0.01
BTI	1/31/2000	6	6.4	0.05	0.99	0.58	0.53	1.66	0.00	1.65	1.92	0.01
BTI	2/6/2000	4.5	8.1	0.29	0.94	0.45	1.12	0.69	0.00	3.70	2.10	0.01
BTI	2/12/2000	0.2	1.7	0.21	0.80	0.08	0.58	0.12	0.00	0.29	0.62	0.01
BTI	2/18/2000	6.6	5.7	0.34	0.93	0.04	1.69	0.03	0.00	1.76	2.15	0.04
BTI	2/24/2000	0.2	2.3	0.14	0.93	0.39	0.75	0.20	0.00	0.77	0.19	0.01
BTI	3/1/2000	2.3	4.1	0.06	0.99	1.21	1.02	0.75	0.02	0.53	0.48	0.08
BTI	3/7/2000	3.4	5.2	0.01	1.00	1.15	1.40	1.36	0.00	0.94	0.26	0.05
BTI	3/13/2000	5	7.5	0.05	1.00	1.63	0.13	1.82	0.00	0.60	3.36	0.00
BTI	3/19/2000	3.3	4.5	0.34	0.94	0.75	0.59	1.21	0.01	0.80	1.08	0.01
BTI	3/25/2000	6.5	7.1	0.07	0.99	2.03	0.02	2.22	0.03	0.83	1.95	0.00
BTI	3/31/2000	3	6.0	0.26	0.92	0.83	0.37	0.05	1.12	0.59	3.07	0.02
BTI	4/6/2000	7.4	12.3	0.14	0.99	2.66	1.22	2.04	0.01	5.12	1.23	0.01
BTI	4/12/2000	3.2	5.8	0.24	0.96	1.25	1.15	0.05	0.30	1.88	1.18	0.03
BTI	4/18/2000	3.3	8.3	0.14	0.99	1.48	3.62	0.33	0.07	1.87	0.97	0.01
BTI	4/24/2000	3.9	4.9	0.44	0.90	0.85	0.55	0.69	0.20	1.01	1.61	0.02
BTI	4/30/2000	5.2	9.0	0.17	0.97	1.42	0.50	1.44	0.00	2.02	3.67	0.00
BTI	5/6/2000	1.7	2.7	0.41	0.85	0.75	0.21	0.61	0.47	0.27	0.36	0.01
BTI	5/12/2000	0.4	4.2	1.52	0.66	0.45	0.53	0.49	1.59	0.61	0.52	0.00
BTI	5/18/2000	5.6	7.9	0.24	0.96	1.26	0.00	1.56	0.08	1.01	3.99	0.00
BTI	5/24/2000	4.6	14.3	1.80	0.79	1.14	0.60	1.19	0.82	9.09	1.43	0.02
BTI	5/30/2000	6	7.8	0.25	0.97	1.07	1.51	1.39	0.71	1.66	1.45	0.02
BTI	6/5/2000	2.2	4.3	0.08	0.99	1.75	0.19	0.69	0.08	0.92	0.64	0.01
BTI	6/11/2000	1.9	4.6	0.60	0.88	0.96	0.60	0.67	0.42	0.73	1.20	0.01
BTI	6/17/2000	3.4	6.5	0.41	0.95	2.29	0.37	0.21	0.06	2.15	1.37	0.03
BTI	6/23/2000	11	10.9	1.45	0.89	1.08	2.55	4.06	0.15	2.13	0.97	0.02
BTI	6/29/2000	7.1	12.0	0.28	0.98	3.52	0.15	0.90	0.11	5.49	1.83	0.02
BTI	7/5/2000	0.8	5.9	1.81	0.64	0.97	0.12	0.08	1.36	1.69	1.65	0.06
BTI	7/11/2000	5.2	7.4	0.08	0.99	3.68	0.73	0.57	0.08	1.61	0.68	0.02
BTI	7/17/2000	7.3	8.4	1.14	0.91	2.85	0.11	0.83	1.70	2.16	0.71	0.01
BTI	7/23/2000	3.1	13.5	4.48	0.52	0.98	0.30	0.50	3.48	7.40	0.78	0.02
BTI	7/29/2000	3.2	7.0	0.18	0.97	1.92	0.00	0.78	0.11	2.35	1.84	0.01
BTI	8/4/2000	3.4	9.8	0.19	0.99	3.52	0.10	0.94	0.06	3.85	1.31	0.01
BTI	8/10/2000	0.1	6.2	0.07	0.99	2.59	0.09	0.58	0.00	0.70	2.20	0.00
BTI	8/16/2000	5.6	11.6	1.05	0.91	1.66	0.31	2.99	0.10	2.56	3.94	0.01
BTI	8/22/2000	6.5	12.3	0.12	0.99	3.96	0.27	2.63	0.00	5.10	0.34	0.01
BTI	8/28/2000	7.1	5.8	1.05	0.89	1.18	1.00	1.72	0.06	0.73	1.05	0.03
BTI	9/3/2000	2.4	4.1	0.29	0.96	1.31	0.77	0.74	0.17	0.58	0.51	0.00

Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
BTI	9/9/2000	5.1	10.0	0.43	0.95	1.77	0.00	2.60	0.00	3.79	1.86	0.01
BTI	9/15/2000	0.3	4.5	0.43	0.90	1.41	0.30	0.11	0.02	1.63	1.01	0.01
BTI	9/21/2000	2	7.0	0.17	0.98	2.24	0.18	0.83	0.01	3.45	0.25	0.00
BTI	9/27/2000	5.1	8.1	0.12	0.99	3.70	0.88	0.62	0.04	2.10	0.76	0.02
BTI	10/3/2000	8.7	10.4	0.28	0.98	2.34	0.33	3.34	0.01	3.40	0.98	0.01
BTI	10/9/2000	1.8	2.8	0.80	0.79	0.92	0.17	0.65	0.02	0.59	0.43	0.01
BTI	10/15/2000	4.4	4.7	0.95	0.89	2.04	0.04	1.11	0.26	0.94	0.25	0.01
BTI	10/21/2000	2.6	1.8	0.73	0.66	0.30	0.09	0.47	0.27	0.13	0.50	0.03
BTI	10/27/2000	0.7	3.7	0.28	0.91	0.69	0.10	0.96	0.00	1.10	0.84	0.01
BTI	11/2/2000	5.8	6.5	0.12	0.98	0.74	1.04	0.44	0.10	2.66	1.45	0.05
BTI	11/8/2000	1.7	8.9	0.05	0.99	0.62	0.22	1.76	0.03	1.88	4.32	0.07
BTI	11/14/2000	6.5	7.1	0.16	0.99	1.02	2.71	0.03	0.01	1.31	1.93	0.08
BTI	11/20/2000	48.7	41.3	0.26	0.99	1.53	20.67	0.00	0.37	15.41	2.54	0.80
BTI	11/26/2000	8.5	10.0	0.12	0.99	1.60	6.51	0.00	0.01	1.38	0.46	0.06
BTI	12/2/2000	18.6	15.7	0.18	0.99	0.79	5.53	0.01	0.01	1.25	8.00	0.06
BTI	12/20/2000	22	19.5	0.19	0.99	0.77	6.70	0.04	0.05	1.52	10.30	0.10
BTI	12/26/2000	30.4	25.3	0.26	0.99	1.42	10.53	0.01	0.02	1.96	11.33	0.04
BTI	1/1/2001	46.6	33.8	0.28	0.99	1.97	17.09	0.09	0.00	6.12	7.99	0.52
BTI	1/7/2001	77.9	62.4	0.35	0.99	2.89	36.53	0.05	0.01	8.65	13.85	0.43
BTI	1/19/2001	40.1	37.3	0.23	0.99	1.13	20.93	0.07	0.29	2.44	12.33	0.11
BTI	1/25/2001	0	1.6	0.23	0.83	0.15	0.62	0.17	0.02	0.35	0.27	0.01
LVR1	12/2/1999	12.8	15.9	0.29	0.94	0.70	0.71	0.80	0.01	4.73	8.87	0.04
LVR1	12/8/1999	15	13.3	0.13	0.97	0.38	0.68	0.25	0.02	9.06	2.49	0.41
LVR1	12/14/1999	14.6	22.6	0.30	0.94	0.78	1.11	0.06	0.15	12.38	7.96	0.13
LVR1	12/20/1999	13.9	17.8	0.22	0.99	0.76	5.62	0.05	0.17	7.20	3.86	0.08
LVR1	1/1/2000	12.7	10.5	0.28	0.98	1.14	0.00	0.40	0.10	1.15	5.51	2.18
LVR1	1/7/2000	57.9	58.8	0.32	0.99	2.36	21.18	0.11	0.60	6.65	27.39	0.51
LVR1	1/13/2000	9.6	15.0	0.55	0.90	0.40	1.02	0.16	0.07	10.71	2.31	0.37
LVR1	1/19/2000	4.5	7.7	0.22	0.98	0.66	2.66	0.04	0.02	2.54	1.73	0.04
LVR1	1/25/2000	3.7	6.6	0.23	0.96	0.79	1.02	0.58	0.00	2.77	1.42	0.01
LVR1	1/31/2000	5.8	7.6	0.22	0.96	0.15	0.91	1.05	0.02	3.44	1.97	0.03
LVR1	2/6/2000	13.5	12.9	0.11	0.98	0.75	1.11	0.97	0.00	0.72	9.35	0.00
LVR1	2/12/2000	0.6	2.1	0.30	0.65	0.06	0.18	0.22	0.00	0.94	0.72	0.02
LVR1	2/18/2000	10.1	16.1	0.18	0.99	0.90	2.96	0.02	0.00	8.37	3.85	0.05
LVR1	2/24/2000	2.5	5.3	0.27	0.88	0.20	0.85	0.04	0.00	3.52	0.68	0.02
LVR1	3/1/2000	12.5	10.9	0.18	0.98	1.18	1.14	1.04	0.01	6.01	1.50	0.03
LVR1	3/7/2000	4.2	5.4	1.04	0.82	0.45	0.70	1.10	0.00	1.98	1.13	0.02
LVR1	3/13/2000	6.9	10.1	0.47	0.94	1.19	0.00	2.70	0.01	3.85	2.30	0.03
LVR1	3/19/2000	5.6	7.4	0.92	0.90	0.22	1.34	3.06	0.01	1.67	1.05	0.01
LVR1	3/25/2000	5.6	9.8	0.27	0.97	1.69	0.00	2.23	0.00	3.25	2.65	0.01
LVR1	3/31/2000	3.5	5.6	0.32	0.88	0.81	0.12	0.04	1.01	0.35	3.30	0.01
LVR1	4/6/2000	10.1	10.8	0.16	0.99	2.43	0.81	2.40	0.24	2.26	2.71	0.01
LVR1	4/12/2000	3.8	8.6	0.36	0.90	0.93	0.18	0.27	0.75	5.40	1.04	0.06
LVR1	4/18/2000	3.3	8.1	0.33	0.95	0.77	1.50	0.36	0.05	1.88	3.51	0.00
LVR1	4/24/2000	5.3	7.8	0.53	0.92	0.81	0.38	1.42	0.20	1.53	3.43	0.01
LVR1	4/30/2000	5.4	6.7	0.55	0.92	0.72	0.43	1.70	0.14	0.99	2.73	0.01
LVR1	5/6/2000	3	5.4	0.14	0.97	0.95	0.15	0.96	0.13	2.44	0.71	0.02
LVR1	5/12/2000	3.1	5.3	0.42	0.80	0.36	0.15	0.56	0.00	2.80	1.41	0.01
LVR1	5/18/2000	6	14.5	0.27	0.96	1.28	0.00	2.33	0.01	9.44	1.46	0.01

LVR1	5/24/2000	4.8	9.2	0.76	0.93	0.88	1.88	1.09	0.00	4.50	0.87	0.00
LVR1	5/30/2000	8	11.3	0.64	0.93	0.31	1.51	3.31	0.01	4.63	1.53	0.01
Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
LVR1	6/5/2000	1.6	6.3	0.34	0.90	1.25	0.04	0.51	0.00	3.54	0.96	0.01
LVR1	6/11/2000	3.9	8.3	0.87	0.87	0.15	1.20	1.31	0.00	4.45	1.23	0.01
LVR1	6/17/2000	5.1	8.4	0.51	0.97	2.42	2.13	0.04	0.00	2.35	1.45	0.01
LVR1	6/23/2000	13.5	14.9	1.92	0.89	0.44	3.07	4.13	0.18	5.43	1.65	0.03
LVR1	6/29/2000	6.7	10.4	0.18	0.99	2.42	0.75	0.81	0.01	5.64	0.80	0.02
LVR1	7/5/2000	1.2	1.7	0.17	0.88	0.83	0.00	0.02	0.03	0.20	0.59	0.03
LVR1	7/11/2000	8.4	10.1	0.15	0.99	2.93	0.64	1.07	0.00	4.06	1.40	0.01
LVR1	7/17/2000	3.6	5.0	0.29	0.97	2.48	0.00	1.30	0.01	0.88	0.38	0.00
LVR1	7/23/2000	3.5	8.1	0.38	0.90	0.84	0.02	1.14	0.00	3.30	2.83	0.00
LVR1	7/29/2000	2.9	8.4	0.37	0.90	1.05	0.01	0.67	0.00	4.49	2.20	0.01
LVR1	8/4/2000	7.2	10.7	0.26	0.98	3.52	0.05	1.22	0.13	3.60	2.16	0.02
LVR1	8/10/2000	3.2	8.2	0.86	0.84	1.68	0.07	0.18	0.00	2.60	3.62	0.00
LVR1	8/16/2000	9.9	16.1	0.54	0.94	1.17	0.00	3.09	0.54	8.30	2.98	0.02
LVR1	8/22/2000	8	10.6	0.17	0.99	3.31	0.00	2.61	0.05	3.64	0.98	0.03
LVR1	8/28/2000	11.1	10.8	0.58	0.96	2.99	0.00	3.78	0.02	2.44	1.54	0.01
LVR1	9/3/2000	2.3	4.7	0.35	0.95	1.47	0.75	0.96	0.03	0.58	0.83	0.04
LVR1	9/9/2000	6.4	9.7	0.70	0.93	1.91	0.00	3.32	0.00	3.27	1.18	0.00
LVR1	9/21/2000	3	7.6	0.18	0.98	2.39	0.56	0.33	0.01	1.60	2.73	0.01
LVR1	9/27/2000	6.4	8.3	0.24	0.98	3.45	0.04	0.67	0.06	1.66	2.38	0.04
LVR1	10/3/2000	8	9.8	0.37	0.96	1.69	0.00	3.38	0.11	2.68	1.86	0.04
LVR1	10/9/2000	0	1.7	0.67	0.70	0.41	0.11	0.42	0.25	0.14	0.31	0.02
LVR1	10/15/2000	5.3	7.2	0.92	0.89	2.14	0.01	1.28	0.03	2.10	1.61	0.02
LVR1	10/21/2000	0	2.2	0.26	0.79	0.35	0.01	0.54	0.05	0.56	0.64	0.01
LVR1	10/27/2000	1.7	2.9	0.17	0.95	0.73	0.48	0.93	0.01	0.51	0.27	0.01
LVR1	11/2/2000	9.2	12.4	0.16	0.95	0.97	0.00	0.62	0.10	8.83	1.79	0.05
LVR1	11/8/2000	9.7	5.9	0.47	0.94	0.07	0.58	1.33	0.20	2.46	0.53	0.70
LVR1	11/14/2000	13.6	15.7	0.39	0.95	0.75	2.04	0.17	0.00	6.65	5.98	0.13
LVR1	11/20/2000	44.4	42.4	0.28	0.99	1.60	17.50	0.04	0.29	14.36	8.16	0.45
LVR1	11/26/2000	17.8	16.2	0.76	0.96	1.65	4.11	0.06	0.39	6.65	3.15	0.15
LVR1	12/2/2000	24.5	25.7	0.41	0.95	0.55	3.52	0.02	0.04	7.42	13.92	0.24
LVR1	12/8/2000	22.1	23.5	0.34	0.99	2.01	4.49	0.14	0.11	15.23	1.28	0.23
LVR1	12/14/2000	4.5	2.3	0.23	0.94	0.14	0.46	1.14	0.03	0.10	0.42	0.03
LVR1	12/20/2000	28.8	27.1	0.12	0.99	0.87	5.70	0.03	0.10	18.14	1.53	0.74
LVR1	12/26/2000	0	28.7	0.26	0.99	1.38	8.60	0.07	0.06	6.55	11.89	0.13
LVR1	1/1/2001	62.1	63.7	0.42	0.98	2.32	19.46	0.01	0.14	9.34	31.30	1.09
LVR1	1/7/2001	95.4	91.7	0.40	0.99	2.58	39.82	0.06	0.09	9.59	39.35	0.24
LVR1	1/13/2001	7	10.2	0.62	0.91	0.81	0.80	1.28	0.01	4.40	2.85	0.05
LVR1	1/19/2001	39.4	41.8	0.21	0.99	1.35	20.36	0.07	0.03	9.78	9.82	0.39
LVR1	1/25/2001	4.7	6.1	0.19	0.88	0.23	0.05	0.32	0.16	1.48	3.79	0.05
LVR1	1/31/2001	6.7	8.5	0.11	0.95	0.45	0.25	0.04	0.06	4.32	3.11	0.24
SFA	12/2/1999	6.9	9.5	0.19	0.97	0.35	0.47	1.65	0.00	5.33	1.69	0.02
SFA	12/8/1999	11.3	15.5	0.99	0.89	1.08	0.75	1.81	0.04	9.21	2.54	0.06
SFA	12/14/1999	18.5	21.9	0.48	0.94	1.23	1.13	1.18	0.06	13.84	4.36	0.09
SFA	12/20/1999	19.6	24.4	0.19	0.99	1.30	4.05	0.07	0.49	16.36	1.97	0.14
SFA	12/26/1999	63.4	56.3	0.33	0.99	3.05	32.93	0.08	0.03	6.20	13.99	0.06
SFA	1/1/2000	14.5	7.5	0.31	0.98	1.13	0.21	0.79	0.11	1.28	2.16	1.80
SFA	1/7/2000	36.1	33.1	0.35	0.99	2.57	13.63	0.34	0.30	10.65	4.95	0.69

Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
SFA	1/13/2000	11.5	13.2	0.45	0.91	0.65	0.54	0.85	0.10	8.85	2.10	0.07
SFA	1/19/2000	8.5	13.6	0.44	0.96	1.86	2.04	0.09	0.02	8.31	1.25	0.02
SFA	1/25/2000	2.6	4.5	0.26	0.91	0.80	0.13	0.78	0.00	2.07	0.72	0.01
SFA	1/31/2000	5.5	7.0	0.38	0.94	0.08	0.86	1.76	0.02	3.59	0.66	0.02
SFA	2/6/2000	8.6	11.3	0.13	0.99	2.15	1.19	1.36	0.01	5.46	1.15	0.02
SFA	2/12/2000	1.8	3.3	0.30	0.89	0.05	0.37	0.71	0.00	1.70	0.48	0.02
SFA	2/18/2000	12.1	15.3	0.31	0.98	1.32	3.45	0.06	0.19	9.57	0.64	0.04
SFA	2/24/2000	3.6	6.1	0.22	0.92	0.54	0.03	0.94	0.00	3.78	0.76	0.01
SFA	3/7/2000	4.4	4.7	0.31	0.95	0.40	0.70	1.24	0.03	1.97	0.39	0.01
SFA	3/13/2000	7.6	7.3	1.21	0.87	0.60	0.89	2.71	0.03	1.60	1.42	0.03
SFA	3/19/2000	6.7	6.6	0.45	0.93	0.19	0.14	4.20	0.00	1.04	1.03	0.01
SFA	3/25/2000	8.1	20.9	0.46	0.98	2.07	7.06	0.12	0.83	7.72	3.07	0.04
SFA	3/31/2000	5.9	6.7	1.41	0.65	0.60	0.13	0.41	0.00	1.76	3.79	0.01
SFA	4/6/2000	7.4	6.8	0.21	0.98	1.65	0.83	2.77	0.01	0.79	0.77	0.02
SFA	4/12/2000	6.9	8.6	0.26	0.98	2.28	0.13	1.58	0.33	3.50	0.75	0.01
SFA	4/18/2000	4	4.7	0.15	0.97	0.87	0.63	0.98	0.04	1.31	0.83	0.01
SFA	4/24/2000	8.3	18.5	0.80	0.91	0.50	1.44	2.41	0.00	12.90	1.24	0.01
SFA	4/30/2000	6	5.5	0.17	0.98	0.64	1.21	2.09	0.06	0.75	0.77	0.02
SFA	5/6/2000	2.1	9.2	1.46	0.79	0.72	0.63	0.80	0.82	5.42	0.83	0.02
SFA	5/12/2000	7.3	10.1	0.37	0.94	0.57	0.87	1.32	0.11	6.36	0.85	0.02
SFA	5/18/2000	11.7	16.6	1.07	0.93	1.08	1.97	3.88	0.82	7.75	1.04	0.03
SFA	5/24/2000	8.7	8.4	0.33	0.96	1.39	0.81	3.09	0.01	1.77	1.32	0.01
SFA	5/30/2000	14.8	14.0	0.65	0.93	0.79	0.68	5.12	0.07	6.36	1.02	0.01
SFA	6/5/2000	3	5.4	3.16	0.68	0.51	1.60	2.06	0.04	0.80	0.35	0.01
SFA	6/11/2000	3.9	7.1	0.61	0.90	0.32	0.60	2.22	0.00	3.20	0.76	0.01
SFA	6/17/2000	3.4	7.4	0.36	0.96	2.09	0.51	0.69	0.00	2.80	1.35	0.00
SFA	6/23/2000	9.6	9.8	0.90	0.91	1.49	0.49	5.29	0.02	1.36	1.13	0.01
SFA	6/29/2000	3.6	8.0	1.60	0.89	3.01	0.23	0.97	0.62	2.25	0.92	0.01
SFA	7/5/2000	1.4	3.3	1.40	0.78	0.52	1.63	0.32	0.01	0.43	0.35	0.02
SFA	7/11/2000	6.7	9.0	0.21	0.99	3.78	0.00	1.52	0.00	3.20	0.50	0.00
SFA	7/17/2000	6.1	6.4	0.37	0.97	2.64	0.59	1.55	0.00	1.25	0.38	0.01
SFA	7/23/2000	4.3	7.4	4.16	0.73	0.45	2.88	1.86	0.02	0.98	1.15	0.03
SFA	7/29/2000	1.2	5.2	3.68	0.65	0.33	2.36	0.99	0.01	0.80	0.65	0.01
SFA	8/4/2000	3.5	6.6	0.15	0.99	3.44	0.00	0.93	0.01	1.28	0.94	0.01
SFA	8/10/2000	1.5	5.6	0.67	0.84	1.40	0.25	0.22	0.00	0.16	3.57	0.00
SFA	8/16/2000	15.4	21.2	1.56	0.88	0.21	2.01	5.75	0.10	11.17	1.96	0.02
SFA	8/22/2000	5.4	10.3	0.49	0.96	3.34	0.00	2.04	0.04	3.52	1.31	0.02
SFA	8/28/2000	7.7	7.8	2.68	0.79	1.94	0.36	3.36	0.06	1.31	0.79	0.02
SFA	9/3/2000	3.5	3.5	0.36	0.95	1.59	0.32	1.21	0.01	0.14	0.19	0.01
SFA	9/9/2000	9.1	8.3	0.74	0.93	1.50	0.94	3.96	0.02	0.98	0.92	0.01
SFA	9/15/2000	2.5	2.1	0.34	0.84	1.09	0.04	0.10	0.01	0.37	0.51	0.00
SFA	9/21/2000	2.2	5.3	0.32	0.92	1.39	0.03	0.61	0.00	2.15	1.14	0.00
SFA	9/27/2000	6.2	7.1	0.93	0.91	2.86	0.03	0.71	0.01	2.16	1.27	0.01
SFA	10/3/2000	10.6	11.1	3.38	0.80	0.76	2.29	4.51	0.92	1.88	0.74	0.03
SFA	10/9/2000	0.7	3.3	0.94	0.82	0.81	0.06	1.08	0.18	0.88	0.30	0.01
SFA	10/15/2000	4.3	4.9	2.51	0.70	0.72	0.67	1.65	0.01	1.08	0.78	0.03
SFA	10/21/2000	3.1	3.3	0.30	0.94	0.16	0.13	2.09	0.06	0.67	0.17	0.01
SFA	10/27/2000	3.8	3.5	1.22	0.71	0.41	0.37	0.82	0.05	1.06	0.74	0.02
SFA	11/2/2000	16.3	18.3	0.97	0.88	1.19	0.08	1.79	0.23	13.60	1.08	0.32

Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
SFA	11/8/2000	7.6	8.2	0.61	0.92	0.10	0.73	3.77	0.03	1.73	1.76	0.06
SFA	11/14/2000	15	59.9	7.76	0.18	0.14	0.28	0.46	0.01	58.67	0.29	0.04
SFA	11/20/2000	28.9	30.1	0.56	0.98	2.00	9.74	0.27	0.14	13.57	4.24	0.16
SFA	11/26/2000	25.7	25.1	0.44	0.99	5.41	10.73	0.04	0.02	6.52	2.38	0.05
SFA	12/2/2000	14.2	17.0	0.27	0.98	1.66	2.99	0.11	0.08	11.14	0.64	0.35
SFA	12/8/2000	23.7	23.4	0.58	0.98	3.41	5.42	1.34	0.27	11.20	1.48	0.30
SFA	12/14/2000	4.3	9.0	0.99	0.86	0.37	0.34	2.36	0.00	4.84	1.09	0.02
SFA	12/20/2000	26.4	35.2	0.76	0.97	1.39	7.12	0.10	0.46	21.83	4.03	0.24
SFA	12/26/2000	26.2	27.0	0.37	0.99	2.19	8.68	0.16	0.09	10.84	4.91	0.14
SFA	1/1/2001	51.1	42.7	0.28	0.99	3.25	20.71	0.07	0.00	7.01	11.64	0.03
SFA	1/7/2001	45.5	45.0	0.35	0.99	3.45	23.44	0.87	0.01	11.36	5.57	0.27
SFA	1/13/2001	3.3	5.7	0.23	0.96	0.48	0.70	1.60	0.00	2.37	0.58	0.01
SFA	1/19/2001	35.1	35.0	0.16	1.00	1.79	17.28	0.02	0.00	13.61	2.02	0.30
SFA	1/25/2001	6.7	7.2	0.98	0.79	0.28	0.47	1.11	0.03	4.00	1.25	0.02
SFA	1/31/2001	9.7	14.1	0.34	0.93	1.23	0.00	0.74	0.42	9.73	1.87	0.13
SanJose	3/4/2000	12.5	10.8	1.06	0.89	0.67	0.00	3.22	0.09	5.42	1.41	0.01
SanJose	4/3/2000	14.1	14.4	0.59	0.96	2.66	0.86	2.36	0.26	6.97	1.21	0.03
SanJose	4/6/2000	16.2	15.5	0.21	0.99	2.95	4.30	2.38	0.26	4.81	0.80	0.03
SanJose	4/9/2000	4.4	3.7	1.77	0.79	0.64	0.00	0.52	0.11	2.15	0.22	0.00
SanJose	5/3/2000	7	7.1	1.12	0.91	1.32	0.38	1.00	0.53	3.48	0.36	0.01
SanJose	5/6/2000	5.1	5.9	2.76	0.66	0.18	0.00	1.66	0.08	2.62	1.32	0.01
SanJose	5/9/2000	4.9	3.6	1.49	0.81	0.57	0.00	0.51	0.08	2.22	0.19	0.00
SanJose	6/2/2000	18.2	16.0	1.15	0.93	3.55	1.35	3.08	0.49	6.07	1.37	0.05
SanJose	6/8/2000	5.7	4.8	3.29	0.63	0.07	0.21	0.94	0.12	3.09	0.32	0.02
SanJose	7/2/2000	7.5	6.8	1.44	0.89	1.53	0.09	2.31	0.05	1.15	1.67	0.00
SanJose	7/5/2000	3.5	5.0	1.58	0.85	0.78	0.08	0.21	0.22	1.76	1.72	0.23
SanJose	7/8/2000	8.1	8.1	0.87	0.93	1.58	0.73	0.59	0.23	4.30	0.60	0.03
SanJose	8/1/2000	16.8	19.3	0.19	0.99	2.55	0.03	5.96	0.35	9.86	0.53	0.01
SanJose	8/8/2000	8.1	11.6	0.48	0.97	2.29	3.13	1.02	0.30	4.59	0.23	0.01
SanJose	9/3/2000	6.8	7.6	1.60	0.90	1.26	0.05	1.11	0.19	1.79	2.01	1.14
SanJose	9/6/2000	10.8	11.5	0.31	0.97	1.33	0.00	1.76	0.24	7.73	0.48	0.01
SanJose	9/9/2000	9.9	10.4	1.04	0.92	1.74	0.00	4.13	0.07	3.99	0.45	0.00
SanJose	10/12/2000	11.8	14.1	0.45	0.97	1.54	2.50	1.68	0.26	7.39	0.71	0.04
SanJose	10/15/2000	13.8	14.4	0.32	0.98	2.76	5.32	1.58	0.08	2.83	1.87	0.02
SanJose	10/18/2000	8.1	11.6	0.08	0.99	1.61	1.89	1.66	0.16	5.62	0.60	0.02
SanJose	10/21/2000	5.3	5.7	1.87	0.81	0.02	0.46	1.81	0.12	2.35	0.90	0.03
SanJose	10/24/2000	8.7	9.0	0.78	0.94	1.61	0.00	1.54	0.91	3.90	1.02	0.02
SanJose	10/27/2000	9.2	10.1	0.25	0.99	1.18	1.94	1.29	0.08	4.64	0.97	0.01
SanJose	10/31/2000	12.8	17.5	0.09	0.99	0.79	2.36	1.15	0.22	12.09	0.87	0.08
SanJose	11/11/2000	20.8	22.9	0.17	0.99	1.05	4.25	1.10	0.05	5.12	11.34	0.01
SanJose	11/14/2000	12.4	15.1	0.22	0.98	1.45	1.17	2.41	0.17	7.21	2.63	0.06
SanJose	11/17/2000	30.5	28.1	0.39	0.97	0.66	5.46	0.36	0.44	15.80	5.16	0.24
SanJose	11/23/2000	32.4	29.3	0.18	0.99	2.47	8.68	0.89	0.02	6.02	11.22	0.02
SanJose	11/29/2000	11.6	13.4	0.79	0.94	0.62	1.71	1.07	0.13	7.54	2.25	0.08
SanJose	12/12/2000	11.6	12.8	1.14	0.89	0.80	0.23	2.76	0.06	7.25	1.69	0.01
SanJose	12/14/2000	8.1	8.6	2.83	0.72	0.33	0.37	2.39	0.04	5.02	0.49	0.00
SanJose	12/20/2000	47.5	49.0	0.61	0.96	1.36	13.60	0.78	0.54	25.25	7.27	0.25
SanJose	12/23/2000	30.5	26.3	0.90	0.86	1.23	0.34	1.46	0.08	5.98	17.18	0.01
SanJose	12/27/2000	54.8	56.4	0.58	0.95	0.82	12.62	0.91	0.41	30.38	10.85	0.42

SanJose	12/29/2000	55.3	55.8	0.29	0.98	1.45	14.16	0.56	0.47	18.27	20.90	0.02
SanJose	10/3/2000	10.8	13.3	1.76	0.89	1.72	1.34	3.22	0.49	4.80	1.64	0.06
SanJose	10/6/2000	26	28.8	0.28	0.99	7.39	10.79	2.92	0.20	6.18	1.13	0.20
SanJose	11/2/2000	19.3	20.4	0.30	0.98	1.37	2.51	1.82	0.18	10.92	3.48	0.13
SanJose	11/5/2000	13.1	13.9	0.47	0.97	1.69	3.54	3.20	0.07	3.67	1.74	0.01
Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
SanJose	11/8/2000	10.1	13.3	1.24	0.87	0.22	0.89	1.33	0.35	8.35	2.06	0.09
SanJose	12/2/2000	48.2	46.9	0.17	0.99	1.31	7.83	1.47	0.12	15.51	20.58	0.13
SanJose	12/5/2000	52.9	52.1	0.41	0.97	1.56	9.99	0.58	0.57	32.65	6.30	0.42
SanJose	12/8/2000	37.2	38.5	0.38	0.98	2.95	11.40	1.26	0.30	17.85	4.63	0.12
SanJose	2/10/2000	4.2	5.0	2.07	0.69	0.12	0.09	0.63	0.03	3.66	0.47	0.01
SanJose	2/17/2000	7.4	9.0	1.05	0.87	0.43	0.17	1.42	0.04	6.44	0.52	0.01
SanJose	2/21/2000	4.4	4.4	1.63	0.71	0.13	0.00	0.82	0.01	3.39	0.09	0.00
SanJose	2/27/2000	4.2	3.6	4.17	0.57	0.05	0.17	1.18	0.03	1.27	0.90	0.01
SanJose	3/10/2000	12.3	13.0	0.57	0.95	1.82	0.00	2.09	0.15	3.56	5.29	0.05
SanJose	3/16/2000	10.9	10.4	2.50	0.75	0.02	0.58	3.09	0.11	6.06	0.54	0.02
SanJose	3/22/2000	8.7	9.1	0.59	0.94	1.05	0.00	1.76	0.15	5.31	0.80	0.01
SanJose	3/28/2000	7.7	6.7	3.36	0.68	0.16	0.29	2.06	0.08	3.02	1.05	0.01
SanJose	4/12/2000	6.3	6.9	2.11	0.78	0.76	0.02	0.87	0.21	4.01	1.03	0.02
SanJose	4/15/2000	4.1	3.6	2.40	0.68	0.29	0.02	0.57	0.06	2.19	0.47	0.00
SanJose	4/18/2000	5.1	7.4	0.41	0.95	0.64	0.00	1.41	0.14	4.98	0.19	0.00
SanJose	4/21/2000	10.7	8.2	0.89	0.91	0.98	0.00	1.92	0.08	4.98	0.24	0.00
SanJose	4/24/2000	8.3	9.1	0.94	0.90	0.80	0.02	1.71	0.15	5.19	1.26	0.01
SanJose	4/27/2000	7.8	7.2	2.57	0.76	0.22	0.44	1.21	0.31	3.56	1.37	0.05
SanJose	4/30/2000	7.2	7.8	1.77	0.83	0.50	0.10	2.05	0.19	2.91	2.02	0.02
SanJose	5/12/2000	7.1	8.2	0.65	0.91	0.39	0.00	1.60	0.12	5.53	0.59	0.02
SanJose	5/16/2000	12.1	6.4	1.08	0.92	1.24	0.40	0.96	0.10	3.47	0.26	0.00
SanJose	5/18/2000	10.5	14.1	0.61	0.95	1.95	0.21	3.67	0.24	7.09	0.94	0.01
SanJose	5/21/2000	16.1	15.4	0.70	0.93	1.23	0.00	2.08	0.75	8.05	3.25	0.06
SanJose	5/24/2000	7.8	11.2	0.81	0.95	1.81	1.91	1.17	0.26	5.42	0.59	0.03
SanJose	5/27/2000	4.5	5.9	0.37	0.97	1.64	0.26	1.08	0.03	2.77	0.08	0.00
SanJose	5/31/2000	17.1	15.8	1.73	0.86	0.53	1.31	2.53	0.81	8.87	1.68	0.08
SanJose	6/11/2000	5.7	5.7	3.18	0.73	0.19	0.54	1.65	0.15	1.94	1.17	0.02
SanJose	6/14/2000	15.1	18.8	0.91	0.90	1.07	0.28	1.04	0.35	13.05	2.90	0.13
SanJose	6/17/2000	7.9	11.4	0.45	0.97	2.84	2.29	1.73	0.04	4.42	0.09	0.00
SanJose	6/20/2000	18.9	18.9	0.63	0.96	2.89	0.52	3.58	0.49	9.26	2.02	0.08
SanJose	6/23/2000	12.4	13.1	1.10	0.92	2.57	0.01	5.82	0.07	4.02	0.60	0.00
SanJose	6/27/2000	12.5	18.7	0.15	0.99	4.32	5.18	1.72	0.17	6.34	0.98	0.03
SanJose	6/29/2000	10.2	13.7	0.21	0.99	3.36	3.70	1.62	0.06	4.90	0.08	0.00
SanJose	7/11/2000	8.3	12.0	0.23	0.99	3.03	2.30	1.79	0.09	4.64	0.13	0.00
SanJose	7/14/2000	10.3	15.8	0.29	0.98	4.14	2.57	2.70	0.12	6.04	0.24	0.00
SanJose	7/20/2000	10.8	13.4	0.68	0.96	4.95	0.38	3.66	0.06	4.34	0.00	0.00
SanJose	7/23/2000	7.6	8.7	0.45	0.96	1.45	0.00	2.17	0.10	2.32	2.66	0.01
SanJose	7/26/2000	6.4	7.1	1.49	0.87	1.03	0.44	1.04	0.05	4.46	0.10	0.00
SanJose	7/29/2000	7.9	10.8	0.22	0.99	1.86	0.58	2.52	0.12	3.81	1.90	0.01
SanJose	8/10/2000	5.4	7.0	0.19	0.98	2.73	0.04	1.16	0.10	2.81	0.15	0.00
SanJose	8/13/2000	17.1	11.8	2.43	0.84	0.87	1.60	3.78	0.38	3.23	1.89	0.03
SanJose	8/16/2000	18.3	20.1	2.31	0.83	0.79	1.45	4.74	1.13	9.83	2.07	0.09
SanJose	8/19/2000	5.9	7.0	1.03	0.91	1.43	0.04	1.72	0.06	3.65	0.06	0.00
SanJose	8/22/2000	8.9	10.5	0.35	0.98	2.82	1.12	2.60	0.09	3.88	0.00	0.00

Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
SanJose	8/25/2000	9.7	10.8	0.20	0.98	1.83	0.01	2.94	0.07	5.77	0.18	0.00
SanJose	8/29/2000	14.5	12.2	1.57	0.91	2.34	1.44	2.29	0.45	4.65	1.03	0.05
SanJose	8/31/2000	13.8	9.9	1.63	0.90	2.39	1.07	1.83	0.29	3.57	0.76	0.02
SanJose	9/12/2000	20.8	21.6	2.16	0.83	4.66	1.06	0.91	0.27	13.43	1.23	0.03
SanJose	9/15/2000	5.6	7.5	0.51	0.96	1.97	0.18	1.16	0.22	3.76	0.24	0.01
SanJose	9/19/2000	24.4	22.9	0.73	0.95	2.44	0.08	2.66	3.05	13.39	1.25	0.07
SanJose	9/21/2000	6.5	6.1	0.56	0.95	2.10	0.00	0.89	0.04	3.04	0.08	0.00
SanJose	9/24/2000	0	10.9	0.55	0.97	2.18	1.99	0.88	0.11	3.18	2.51	0.02
SanJose	9/27/2000	10.9	15.1	0.97	0.95	3.15	5.10	0.60	0.35	4.99	0.89	0.07
SanJose	9/30/2000	17.5	17.0	2.44	0.83	1.69	2.20	0.31	0.17	7.14	5.41	0.07
SanJose	1/4/2001	62.1	54.9	0.39	1.00	1.31	18.34	1.11	0.42	23.91	9.66	0.19
SanJose	1/7/2001	30.2	31.5	0.27	1.00	2.99	15.05	1.46	0.09	1.55	10.39	0.00
SanJose	1/13/2001	19.1	18.7	0.62	0.96	0.79	2.10	1.09	0.12	6.23	8.34	0.01
SanJose	1/19/2001	43.1	45.7	0.28	1.00	1.65	16.35	0.92	0.17	18.14	8.35	0.16
SanJose	1/23/2001	6.6	7.8	0.15	0.99	1.13	0.12	1.68	0.10	4.10	0.66	0.01
SanJose	1/25/2001	7.9	8.0	0.43	0.94	0.30	0.00	1.23	0.05	5.69	0.67	0.01
SanJose	1/28/2001	32.9	28.7	0.20	0.99	1.00	3.97	0.69	0.04	6.33	16.69	0.04
SanJose	1/31/2001	19.5	24.6	0.25	0.99	0.65	2.91	0.56	0.22	16.33	3.88	0.09
SanJose	2/3/2001	50.5	51.1	0.56	0.99	1.91	18.33	0.54	0.48	18.63	11.08	0.16
SanJose	2/9/2001	7.6	7.0	2.09	0.80	0.21	0.42	0.89	0.10	4.84	0.53	0.01
SanJose	2/15/2001	16.1	16.8	0.26	1.00	1.04	5.14	1.10	0.25	8.24	1.04	0.01
SanJose	2/18/2001	10.8	7.5	0.83	0.94	0.71	0.36	1.35	0.04	4.83	0.22	0.00
SanJose	2/21/2001	8.2	6.5	2.35	0.79	0.19	0.52	1.65	0.04	4.04	0.03	0.00
SanJose	2/24/2001	6.8	6.1	2.17	0.78	0.01	0.39	1.82	0.03	3.62	0.24	0.00
SanJose	2/27/2001	13.4	14.8	0.68	0.93	0.93	0.05	1.45	0.14	8.63	3.46	0.13
SanJose	3/1/2001	11.4	10.4	1.07	0.92	1.02	0.28	2.30	0.12	4.27	2.39	0.01
SanJose	3/8/2001	11.9	13.8	1.24	0.94	3.33	0.86	3.58	0.10	2.42	3.48	0.05
SanJose	3/11/2001	12.6	13.6	0.70	0.96	2.21	0.94	4.55	0.08	3.64	2.18	0.01
SanJose	3/14/2001	21.2	21.2	0.49	0.99	3.15	4.77	4.07	0.26	7.13	1.81	0.02
SanJose	3/17/2001	15.5	12.0	1.74	0.87	0.74	0.47	2.81	0.16	5.80	1.97	0.02
SanJose	3/20/2001	12.7	14.3	0.45	0.98	1.64	1.83	1.45	0.27	7.61	1.49	0.03
SanJose	3/26/2001	18.9	10.3	2.83	0.80	0.27	1.31	4.15	0.25	2.97	1.34	0.01
SanJose	3/29/2001	10.3	8.6	1.00	0.91	0.93	0.01	1.58	0.16	5.09	0.78	0.01
SanJose	4/4/2001	0	10.9	0.39	0.98	1.10	0.97	2.23	0.23	5.42	0.90	0.01
SanJose	4/7/2001	10.1	5.4	1.04	0.88	0.27	0.39	1.32	0.09	2.68	0.64	0.01
SanJose	4/10/2001	10.7	11.0	1.98	0.88	0.64	0.84	2.05	0.12	6.38	0.93	0.01
SanJose	4/13/2001	15.1	8.7	1.44	0.88	0.18	0.93	2.68	0.12	3.84	0.95	0.02
SanJose	4/19/2001	8.2	8.1	0.74	0.94	0.71	0.00	1.02	2.33	1.80	2.20	0.01
SanJose	4/22/2001	13.8	15.9	1.04	0.93	1.95	0.03	3.27	0.98	3.98	5.67	0.03
SanJose	4/25/2001	11.8	16.2	0.12	0.99	2.72	0.89	3.04	0.85	7.12	1.58	0.04
SanJose	4/28/2001	14.5	6.4	1.59	0.87	0.92	0.31	1.02	0.11	2.33	1.68	0.01
SanJose	5/1/2001	15.8	12.4	1.50	0.93	0.24	1.67	4.54	0.52	4.16	1.25	0.06
SanJose	5/7/2001	19.4	20.3	1.33	0.89	1.32	0.02	2.76	2.12	9.68	4.26	0.13
SanJose	5/10/2001	25.9	23.6	0.30	0.98	2.46	0.02	8.21	0.79	9.36	2.73	0.03
SanJose	5/13/2001	7.1	7.2	0.44	0.97	2.38	0.00	1.53	0.33	2.14	0.80	0.01
SanJose	5/16/2001	8.4	7.5	1.83	0.90	1.16	0.54	1.26	0.25	2.93	1.39	0.02
SanJose	5/19/2001	22.1	17.2	3.53	0.83	1.16	1.45	6.38	0.75	4.70	2.68	0.06
SanJose	5/22/2001	14.2	17.0	0.22	0.99	4.12	2.57	2.82	0.12	5.11	2.21	0.02
SanJose	5/25/2001	13.2	12.9	0.37	0.98	2.32	1.02	2.58	0.38	5.67	0.89	0.05

SanJose	5/31/2001	20.6	16.8	0.27	0.98	2.11	0.00	3.10	1.24	9.07	1.20	0.04
SanJose	6/3/2001	12.2	9.0	1.90	0.91	0.03	1.43	3.97	0.22	2.23	1.09	0.02
SanJose	6/6/2001	9.4	10.9	1.16	0.91	1.20	0.06	1.98	0.44	5.93	1.23	0.03
SanJose	6/9/2001	9.5	8.3	1.33	0.92	1.51	0.24	1.77	0.12	2.59	2.01	0.03
SanJose	6/12/2001	4.9	5.4	3.71	0.80	0.38	0.60	1.70	0.08	2.27	0.34	0.00
SanJose	6/18/2001	14.2	14.8	2.83	0.80	0.89	0.26	5.19	0.24	5.16	3.00	0.02
SanJose	6/22/2001	14.4	15.2	2.89	0.78	1.08	0.06	6.45	0.25	5.77	1.62	0.01
Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
SanJose	6/27/2001	3.5	5.1	3.03	0.64	0.43	0.13	0.26	0.08	3.84	0.37	0.01
SanJose	6/30/2001	12.9	12.3	3.57	0.72	0.54	0.13	5.30	0.11	3.70	2.52	0.01
SanJose	7/3/2001	23.1	20.4	0.96	0.93	1.91	0.00	5.05	0.74	9.19	3.39	0.08
SanJose	7/6/2001	0	15.6	1.32	0.91	2.14	0.00	6.20	0.22	3.59	3.43	0.02
SanJose	7/12/2001	11.2	11.1	1.19	0.92	2.93	0.27	1.50	0.19	5.48	0.70	0.01
SanJose	7/18/2001	8.5	9.6	0.50	0.96	2.59	0.00	2.38	0.13	4.22	0.28	0.00
SanJose	7/21/2001	7.8	6.2	1.30	0.88	1.08	0.00	1.31	0.12	3.61	0.13	0.00
SanJose	7/24/2001	8.4	9.7	1.32	0.92	1.97	0.16	1.39	0.48	4.34	1.27	0.09
SanJose	7/30/2001	0	5.6	1.58	0.88	1.01	0.19	1.00	0.13	3.17	0.12	0.00
SanJose	8/2/2001	8.4	9.6	0.42	0.97	2.12	0.12	1.64	0.10	5.19	0.38	0.01
SanJose	8/5/2001	7.3	4.9	1.34	0.86	0.91	0.00	0.67	0.05	2.88	0.42	0.00
SanJose	8/8/2001	14.7	14.3	0.24	0.98	3.34	0.00	4.11	0.06	6.74	0.04	0.00
SanJose	8/11/2001	6.3	6.5	0.98	0.94	2.25	0.26	0.98	0.03	2.79	0.17	0.00
SanJose	8/14/2001	8.6	12.0	0.39	0.99	3.53	2.53	1.58	0.09	4.04	0.22	0.00
SanJose	8/17/2001	12.8	12.6	1.04	0.92	2.93	0.00	1.96	0.20	6.80	0.70	0.01
SanJose	8/23/2001	3.2	4.2	2.21	0.76	0.45	0.09	0.33	0.07	2.88	0.39	0.01
SanJose	8/26/2001	15.4	11.0	2.49	0.90	1.96	1.36	3.16	0.15	2.02	2.31	0.03
SanJose	8/29/2001	15.5	16.6	2.45	0.77	0.69	0.56	1.88	0.17	12.34	0.95	0.04
SanJose	9/1/2001	7.2	11.3	0.49	0.98	1.80	1.94	1.61	0.16	2.78	3.03	0.03
SanJose	9/10/2001	12.2	11.8	2.21	0.88	1.16	0.71	3.49	0.25	5.84	0.39	0.01
SanJose	9/19/2001	14.2	16.1	0.69	0.98	2.60	3.37	3.02	0.30	6.26	0.50	0.02
SanJose	9/22/2001	19.1	19.9	0.47	0.99	4.30	5.18	2.59	0.19	6.55	1.04	0.04
SanJose	9/25/2001	8.9	10.8	1.14	0.92	1.73	0.00	3.07	0.23	4.38	1.36	0.06
SanJose	9/28/2001	10.2	10.7	3.77	0.69	0.25	0.34	2.32	0.38	6.93	0.49	0.01
SanJose	10/4/2001	13.2	11.7	0.73	0.95	2.44	0.00	3.24	0.34	4.55	1.08	0.03
SanJose	10/7/2001	0	9.4	0.53	0.97	2.14	0.09	3.03	0.12	3.05	0.91	0.01
SanJose	10/10/2001	19	16.8	2.70	0.77	0.44	0.11	3.23	1.83	7.64	3.38	0.12
SanJose	10/13/2001	24.6	25.6	2.42	0.70	0.21	0.12	0.86	7.09	12.50	4.42	0.37
SanJose	10/16/2001	24.2	26.6	0.35	0.99	5.11	8.05	3.96	0.25	7.77	1.46	0.02
SanJose	10/22/2001	13.7	14.3	0.98	0.93	1.81	0.00	5.45	0.39	5.84	0.78	0.02
SanJose	10/25/2001	19.7	22.9	0.47	0.95	0.90	0.00	3.29	1.39	14.39	2.88	0.07
SanJose	10/28/2001	9.5	9.7	3.82	0.68	0.36	0.06	3.76	0.25	3.15	2.14	0.01
SanJose	10/31/2001	8.4	8.9	0.86	0.91	0.57	0.00	2.05	0.12	5.65	0.46	0.01
SanJose	11/3/2001	25.8	27.8	0.09	1.00	2.29	5.35	6.17	0.38	12.56	1.02	0.02
SanJose	11/6/2001	11.3	11.8	4.50	0.65	0.16	0.22	4.41	0.19	4.06	2.73	0.03
SanJose	11/9/2001	36.2	36.6	0.36	0.99	2.17	9.38	4.77	0.66	15.76	3.78	0.10
SanJose	11/15/2001	22.1	23.5	0.69	0.99	1.87	5.65	2.05	0.22	12.46	1.23	0.04
SanJose	11/18/2001	21.8	24.1	0.38	0.98	1.19	2.46	2.82	0.12	10.78	6.71	0.07
SanJose	11/21/2001	11.9	11.1	3.15	0.70	0.15	0.14	2.56	0.33	6.67	1.22	0.03
SanJose	11/27/2001	12.3	13.4	2.11	0.73	0.09	0.13	2.06	0.18	7.32	3.61	0.03
SanJose	12/3/2001	10.1	9.8	3.53	0.66	0.06	0.36	2.13	0.17	6.04	1.05	0.02
SanJose	12/6/2001	10.4	14.2	1.19	0.89	1.00	0.01	4.98	0.05	8.01	0.17	0.00

SanJose	12/9/2001	9.2	8.9	2.14	0.73	0.13	0.16	1.32	0.04	3.61	3.63	0.02
SanJose	12/12/2001	19.1	21.6	0.65	0.98	1.39	3.92	4.24	0.25	8.48	3.26	0.07
SanJose	12/15/2001	16.3	17.3	2.82	0.69	0.11	0.40	2.64	0.08	8.47	5.52	0.06
SanJose	12/18/2001	15.1	15.7	0.57	0.95	0.63	0.71	3.19	0.16	9.39	1.54	0.03
SanJose	12/21/2001	11.3	14.9	0.15	1.00	0.69	3.93	0.83	0.07	8.32	1.00	0.04
SanJose	12/27/2001	15.2	15.5	0.29	0.99	0.71	2.15	0.63	0.10	9.29	2.54	0.10
SanJose	12/30/2001	9.2	9.4	0.38	0.98	0.62	1.09	0.61	0.06	4.86	2.14	0.03
PORE1	1/1/2000	7.3	6.6	1.16	0.98	0.85	0.73	1.08	0.04	0.10	3.69	0.13
Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
PORE1	1/5/2000	4.5	3.3	1.27	0.94	0.25	0.32	0.88	0.02	0.18	1.65	0.02
PORE1	1/8/2000	3	2.8	0.11	0.99	0.20	0.21	1.31	0.00	0.00	1.07	0.00
PORE1	2/2/2000	8.1	8.3	0.71	0.99	1.07	4.67	0.31	0.03	0.70	1.46	0.04
PORE1	2/5/2000	5.8	4.5	0.50	0.99	0.50	0.46	2.68	0.03	0.40	0.40	0.00
PORE1	2/9/2000	2.5	2.2	0.76	0.99	0.95	0.29	0.42	0.02	0.16	0.34	0.01
PORE1	3/1/2000	5.2	4.5	0.32	0.99	0.72	0.44	3.04	0.03	0.12	0.15	0.00
PORE1	3/4/2000	7.6	6.6	0.99	0.96	0.46	0.43	4.43	0.01	0.89	0.42	0.00
PORE1	3/8/2000	2.5	2.2	0.57	0.97	0.26	0.12	1.27	0.02	0.08	0.43	0.00
PORE1	4/1/2000	11.2	10.6	0.34	0.99	1.32	0.38	1.59	3.06	0.52	3.63	0.06
PORE1	4/5/2000	8.4	7.3	0.73	0.99	2.89	0.83	1.53	1.27	0.09	0.50	0.16
PORE1	4/8/2000	4.9	4.6	2.58	0.96	2.12	0.20	1.10	0.29	0.21	0.67	0.04
PORE1	5/3/2000	3.3	3.0	1.17	0.98	1.25	0.45	0.71	0.21	0.13	0.20	0.05
PORE1	5/6/2000	3.8	3.3	0.88	0.98	0.74	0.31	1.41	0.09	0.34	0.37	0.01
PORE1	6/3/2000	6.6	5.1	1.72	0.97	2.44	0.37	1.41	0.09	0.22	0.52	0.02
PORE1	6/7/2000	2.1	1.5	3.04	0.94	0.74	0.03	0.23	0.07	0.10	0.33	0.02
PORE1	7/1/2000	6.4	4.2	0.28	0.99	1.34	0.49	2.34	0.01	0.00	0.00	0.00
PORE1	7/5/2000	1.9	1.3	1.32	0.97	0.59	0.15	0.42	0.03	0.02	0.04	0.00
PORE1	7/8/2000	4.1	3.2	1.94	0.97	1.83	0.24	0.66	0.01	0.12	0.37	0.01
PORE1	8/2/2000	10.2	8.6	1.18	0.98	3.44	2.06	1.98	0.14	0.43	0.56	0.02
PORE1	8/5/2000	2.8	2.0	1.88	0.96	0.85	0.18	0.48	0.02	0.11	0.33	0.00
PORE1	8/9/2000	3.8	3.2	1.61	0.97	1.87	0.26	0.81	0.02	0.03	0.21	0.00
PORE1	9/3/2000	4.3	3.9	1.13	0.98	1.52	0.76	1.36	0.02	0.12	0.07	0.00
PORE1	9/6/2000	5.3	5.0	0.62	0.99	1.47	1.00	1.35	0.08	0.43	0.62	0.01
PORE1	9/9/2000	8.7	6.8	0.92	0.97	1.34	0.77	4.51	0.02	0.10	0.09	0.00
PORE1	10/18/2000	1.8	1.8	0.48	0.98	0.61	0.22	0.85	0.04	0.03	0.05	0.00
PORE1	10/21/2000	7.4	5.0	0.51	0.96	0.12	0.18	4.59	0.01	0.06	0.09	0.00
PORE1	10/24/2000	5.7	5.6	1.13	0.98	1.91	0.07	1.59	0.37	0.93	0.75	0.03
PORE1	10/27/2000	3.6	3.5	0.82	0.98	0.77	0.62	0.88	0.04	0.34	0.84	0.00
PORE1	10/30/2000	3.5	2.6	0.46	0.97	0.14	0.32	2.01	0.00	0.07	0.10	0.00
PORE1	11/11/2000	5.3	4.0	0.59	0.98	0.62	0.06	1.18	0.04	0.15	1.86	0.05
PORE1	11/23/2000	12.9	9.6	0.67	0.98	2.65	0.66	2.60	0.03	0.46	3.18	0.02
PORE1	11/26/2000	4.5	4.7	0.13	1.00	0.90	0.99	1.20	0.05	0.22	1.34	0.02
PORE1	11/29/2000	3.9	3.5	0.73	0.97	0.57	0.39	2.22	0.00	0.10	0.17	0.00
PORE1	12/11/2000	3.4	3.2	0.44	0.99	0.76	0.00	0.66	0.03	0.06	1.70	0.00
PORE1	12/14/2000	5	3.4	1.60	0.95	0.65	0.24	2.31	0.04	0.07	0.14	0.00
PORE1	12/17/2000	5.2	4.3	0.52	0.99	0.47	0.55	2.31	0.01	0.37	0.57	0.00
PORE1	12/20/2000	8.2	8.2	1.21	0.98	1.07	2.40	0.00	0.58	1.31	2.65	0.19
PORE1	12/23/2000	6.3	5.2	0.33	0.99	0.67	0.81	2.40	0.04	0.60	0.70	0.01
PORE1	12/26/2000	12.5	11.8	0.52	0.99	1.57	5.93	0.35	0.07	0.40	3.47	0.04
PORE1	12/29/2000	13.3	11.4	2.11	0.96	1.06	5.27	0.70	0.11	1.08	3.08	0.10
PORE1	1/12/2000	3.7	3.2	0.63	0.98	0.20	0.46	1.69	0.03	0.50	0.33	0.00

PORE1	1/15/2000	3.3	3.6	0.30	0.99	0.94	0.09	1.04	0.04	0.44	1.03	0.02
PORE1	1/19/2000	1.4	1.6	0.38	0.99	0.50	0.40	0.17	0.00	0.36	0.16	0.01
PORE1	1/22/2000	5.3	4.9	0.44	0.99	2.09	1.28	0.44	0.02	0.42	0.59	0.01
PORE1	1/26/2000	2.8	2.3	0.12	1.00	0.32	0.22	1.07	0.01	0.11	0.55	0.00
PORE1	1/29/2000	6.1	6.2	1.07	0.98	1.23	1.27	0.66	0.07	1.33	1.62	0.05
PORE1	11/2/2000	3.7	3.0	0.12	1.00	0.45	0.33	1.26	0.10	0.12	0.77	0.00
PORE1	11/5/2000	6	4.9	0.45	0.99	0.38	0.80	3.17	0.01	0.11	0.45	0.00
PORE1	11/8/2000	9	6.3	0.44	0.98	0.20	0.42	4.25	0.01	0.08	1.36	0.00
PORE1	12/2/2000	6.9	5.2	1.17	0.95	0.55	0.18	1.21	0.05	0.46	2.64	0.12
Site	Date	MeasMass	CMassAve	ChisAve	RsqAve	AMSULc	AMNITc	Marine	Dust	Auto	Wood	GunP
PORE1	12/5/2000	7.5	12.0	1.08	0.98	3.08	2.80	0.20	0.08	0.68	5.10	0.06
PORE1	12/8/2000	11.9	10.5	0.66	0.99	3.12	2.09	1.78	0.14	1.17	2.14	0.10
PORE1	2/12/2000	4.3	3.1	1.37	0.94	0.12	0.22	1.94	0.01	0.46	0.32	0.00
PORE1	2/16/2000	4.3	3.5	0.45	0.99	0.34	0.54	1.47	0.02	0.19	0.92	0.00
PORE1	2/19/2000	4.1	3.8	1.31	0.96	0.60	0.60	0.26	0.07	0.97	1.23	0.04
PORE1	2/26/2000	3.1	2.6	0.63	0.98	0.72	0.27	1.47	0.04	0.06	0.08	0.00
PORE1	3/11/2000	7	5.7	1.00	0.96	0.40	0.36	4.57	0.00	0.18	0.19	0.00
PORE1	3/15/2000	6.5	5.7	0.74	0.98	0.41	0.77	4.00	0.03	0.24	0.26	0.00
PORE1	3/18/2000	12.5	10.6	1.07	0.97	0.43	0.67	9.03	0.00	0.25	0.22	0.00
PORE1	3/22/2000	8.4	8.2	0.28	0.99	1.61	1.89	3.54	0.05	0.40	0.74	0.00
PORE1	3/25/2000	6.6	6.8	0.35	0.99	1.62	1.37	2.60	0.07	0.63	0.54	0.01
PORE1	3/29/2000	12	9.7	0.61	0.99	0.57	0.93	7.09	0.06	0.48	0.62	0.00
PORE1	4/12/2000	4.7	4.7	1.05	0.98	2.55	0.01	0.75	0.16	0.70	0.50	0.03
PORE1	4/15/2000	3.2	2.6	1.07	0.98	0.82	0.36	0.70	0.03	0.30	0.34	0.01
PORE1	4/19/2000	3.8	3.2	1.31	0.98	1.32	0.39	0.78	0.18	0.14	0.35	0.02
PORE1	4/22/2000	4.7	3.9	0.17	1.00	1.24	0.48	1.35	0.44	0.03	0.33	0.06
PORE1	4/26/2000	8.9	7.7	0.37	0.99	0.89	0.93	3.31	0.21	1.00	1.27	0.04
PORE1	4/29/2000	7.7	5.1	0.42	0.99	0.37	0.54	3.82	0.06	0.11	0.18	0.00
PORE1	5/10/2000	4.6	3.0	0.72	0.96	0.25	0.14	2.33	0.09	0.09	0.14	0.00
PORE1	5/13/2000	3.5	3.3	1.74	0.97	1.09	0.44	0.73	0.17	0.41	0.46	0.02
PORE1	5/17/2000	8.9	7.4	0.28	0.99	1.96	0.74	3.57	0.23	0.17	0.70	0.01
PORE1	5/20/2000	7.6	6.3	0.27	0.99	0.78	0.43	4.33	0.09	0.25	0.42	0.00
PORE1	5/24/2000	7.5	6.2	0.30	0.99	1.79	0.56	3.41	0.06	0.13	0.20	0.00
PORE1	5/27/2000	2.3	2.0	1.13	0.98	1.22	0.28	0.41	0.04	0.02	0.06	0.01
PORE1	5/31/2000	10	6.6	0.44	0.99	1.14	0.61	4.25	0.18	0.11	0.28	0.00
PORE1	6/10/2000	6.7	4.0	0.53	0.99	0.59	0.25	2.86	0.01	0.13	0.13	0.00
PORE1	6/28/2000	6.5	5.4	1.64	0.97	4.33	0.01	0.61	0.03	0.10	0.24	0.01
PORE1	7/12/2000	5.8	4.4	1.06	0.98	2.91	0.02	0.87	0.05	0.30	0.26	0.01
PORE1	7/15/2000	11.4	7.0	0.61	0.99	2.99	0.90	2.80	0.03	0.12	0.13	0.00
PORE1	7/19/2000	8.8	5.9	0.56	0.99	2.01	0.78	2.81	0.04	0.08	0.13	0.00
PORE1	8/12/2000	9.9	6.4	0.25	0.99	1.95	0.67	3.27	0.02	0.13	0.32	0.00
PORE1	9/21/2000	1.4	1.6	1.49	0.96	0.80	0.21	0.41	0.00	0.03	0.10	0.01
PORE1	9/24/2000	5.7	5.8	0.46	0.99	4.07	0.01	0.98	0.06	0.35	0.29	0.02
PORE1	9/27/2000	5.3	5.5	0.67	0.99	3.47	0.00	1.15	0.14	0.30	0.45	0.03
PORE1	9/30/2000	8.9	6.9	1.10	0.95	0.25	0.43	6.06	0.00	0.09	0.08	0.00