STATUS
Considering 12/04/2018

TYPE
Copy

OCLC #
318616471


192177385

SOURCE
ILLiad

REQUEST DATE
12/04/2018

NEED BEFORE
01/03/2019

BORROWER
EKB

RECEIVE DATE

DUE DATE

LENDERS
*ALK

Compliments of the Alaska State Library

BIBLIOGRAPHIC INFORMATION

LOCAL ID

AUTHOR Cooper, John A.

ARTICLE AUTHOR Cooper, J. A. and C. A. Frasier.

TITLE Preliminary source apportionment of winter particulate mass in Juneau, Alaska. Volume 1, Final

ARTICLE TITLE Preliminary source apportionment of winter particulate mass in Juneau, Alaska. Volume 1,

IMPRINT Beaverton, Or. : NEA, Inc., [1983]

FORMAT Government Document

ISBN

EDITION

VOLUME

NUMBER

DATE 1983

PAGES

INTERLIBRARY LOAN INFORMATION

ALERT

AFFILIATION GAC/UL FEDLINK/CAHL/NC$A/LVIS/

COPYRIGHT US:CCL

VERIFIED <TN:29881><ODYSSEY:206.107.42.91/ILL> OCLC

MAX COST 0.00 USD

SHIPPED DATE 12/04/2018

LEND CHARGES Other - 0.00 USD

FAX NUMBER

LEND RESTRICTIONS

EMAIL libraryrtp.reprint@epa.gov

BORROWER NOTES ALL HELP APPRECIATED!!; Will gladly accept PDFs or TIFFs at libraryrtp.reprint@epa.gov . If UPS/FedEx use: 4930 Old Page Rd., Durham, NC 27703

ODYSSEY 206.107.42.91/ILL

ARIEL FTP

ARIEL EMAIL

BILL TO US EPA Main Library
109 T.W. Alexander Drive
Mail Code C267-01 ATTN: ILL
Research Triangle Park, NC, US 27711

LENDER NOTES Article Exchange.

BILLING NOTES Please do not send if there is a charge/fee.

SHIPPING INFORMATION

SHIP VIA Email or USPS. UPS/Fedex contact for alternate

SHIP TO US EPA RTP Library - ILL
4930 Old Page Road
Durham, NC, US 27703

RETURN VIA N/A

RETURN TO Interlibrary Loan
Alaska State Library
PO Box 110571
Juneau, AK, US 99811-0571

PRELIMINARY SOURCE APPORTIONMENT OF WINTER PARTICULATE MASS IN JUNEAU, ALASKA

VOLUME I

FINAL REPORT

Prepared for:

Alaska Department of Environmental Conservation
3220 Hospital Drive
Juneau, Alaska 99811

By:

John A. Cooper
and
Clifton A. Frazier

NEA, INC.
10950 S.W. 5th Street, Suite 380
Beaverton, Oregon 97005

June 13, 1983

EXECUTIVE SUMMARY

The city of Juneau is located on the southern coast of Alaska. The residential portion of the city extends inland from the opening of the Mendenhall Valley, where the airport and commercial portion of the city is located and is surrounded by high mountain ridges. This valley geography, plus frequent temperature inversions, which exist during much of the winter, prevent air pollutants from being dispersed and contribute to air quality degradation. Because of changes in source characteristics, the valley's residential area has experienced a substantial increase in suspended particulate mass levels in recent years. The most notable change in airshed emissions is associated with a large increase in the use of wood burning appliances for residential space heating. Although much of the recently observed decrease in air quality may be due to this source, its impact needs to be quantified as well as the impacts from other sources to assess the potential health implications and to develop cost-effective control strategies.

This study used chemical mass balance (CMB) receptor model methods to quantify the contribution of residential wood combustion (RWC) emissions to the Juneau-Mendenhall Valley. This method uses chemical fingerprints to identify each major source contributing to suspended particulate levels. The lead and bromine, for example, are commonly associated with the automotive exhaust fingerprint due to the combustion of leaded gasoline. On the other hand, aluminum, silicon, calcium, titanium, manganese, iron, etc. are associated with crustal sources such as road and windblown dust, while fine particle organic carbon, potassium, and zinc are associated with a RWC fingerprint.

These and other chemical features were measured on 53 glass fiber TSP filters which sampled particles at the Floyd Dryden School, Super Bear, and the Juneau Municipal Building sampling sites on high TSP days during the 1981, 1982, and 1983 heating seasons. The filters and the results were composited to develop average impact results for December, 1981 and 1982, at the three sites and on the basis of specific weather regimes.

The CMB source impact analysis results are summarized in the pie charts illustrated in Figures 1-11 for five December composites and six weather regimes. On the two highest TSP days in which it averaged 537 $\mu g/m^3$, crustal dust accounted for over 54% of the mass while RWC accounted for only 33%, 171 $\mu g/m^3$. These samples were collected in the fall during an extended period of dry calm weather. The next two highest TSP days occurred in the winter under similar weather conditions, but the average temperature was about 15° cooler. In this case, the RWC impact accounted for 78.8% (221 $\mu g/m^3$) of the TSP mass of 281 $\mu g/m^3$ and the crustal dust was below detection limits. The winter TSP levels were 256 $\mu g/m^3$ less while the RWC component was about 50 $\mu g/m^3$ more than observed in the fall.

The RWC impacts are highly correlated with temperature (correlation coefficient of 0.98) if the results from regime 6 are excluded. (Regime 6 was not included because it was originally selected as a day in March with a high potential for fugitive dust impacts.) The RWC impacts from the first five regimes during which calm weather prevailed could be explained by an equation of the form RWC = 198 $\mu g/m^3$ - 4.52 $\frac{\mu g}{m^3 °F}$ t, where t is the temperature in degrees Fahrenheit.

The results from this study clearly showed that RWC sources contributed between 100 and 230 $\mu g/m^3$ of fine particulate mass on cold, calm days and are responsible for between 40% and 90% of the TSP, depending mainly on the relative contribution of crustal dust sources such as road and parking lot dust. The dust contributions were much more variable ranging from less than detection limits to over 300 $\mu g/m^3$, depending mainly on ground conditions (dry, snow, or rain). RWC impacts were highest at the Floyd Dryden site and lowest at the Municipal Building site, while transportation source contributions were highest at the Super Bear site.

The contribution of distillate oil combustion sources could not be defined but an extreme upper limit could be established by assuming all of the sulfate was from this source. Although such upper limits may be high

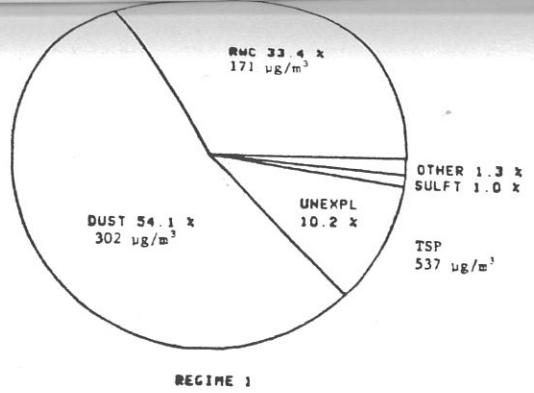

Figure 1. Average source contributions during highest exposure days in the Fall of 1982 when dry, cold and calm weather conditions prevailed. No snow cover or precipitation for preceeding week and average temperature of 10°.

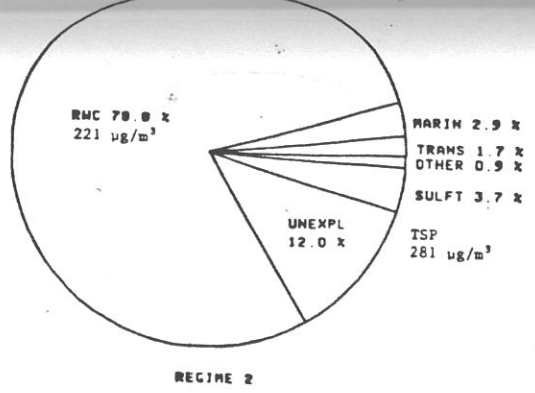

Figure 2. Average source contributions during highest exposure days during the 1981/1982 Winter. No snow cover or precipitation for preceeding week and average temperature of -5°.

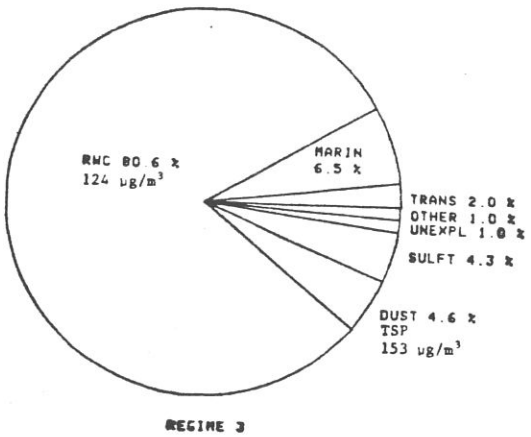

Figure 3. Average source contributions for Regime 3: cold, clear, calm days with average temperature of about 12°.

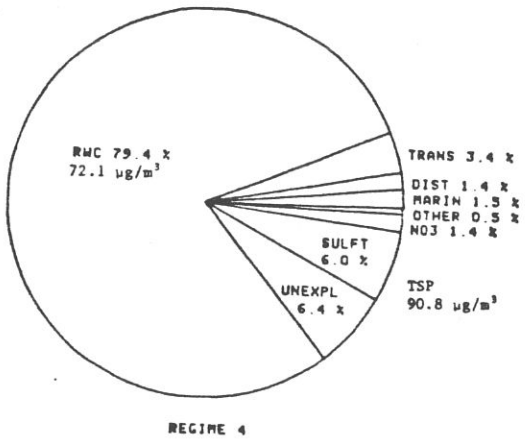

Figure 4. Average source contributions for Regime 4: clear, calm, warmer days with average temperature of 28°.

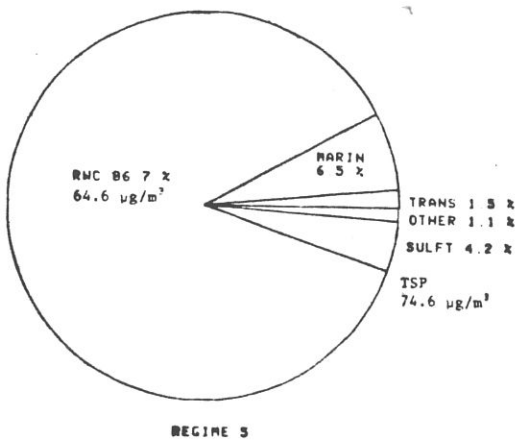

Figure 5. Average source contributions for Regime 5: snow/rain, calm days with average temperature of 30°.

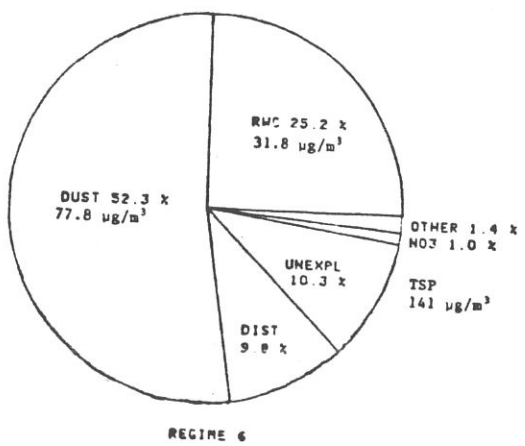

Figure 6. Average source contributions for Regime 6: dry, calm days with potential for high fugitive dust. Average temperature was 27°.

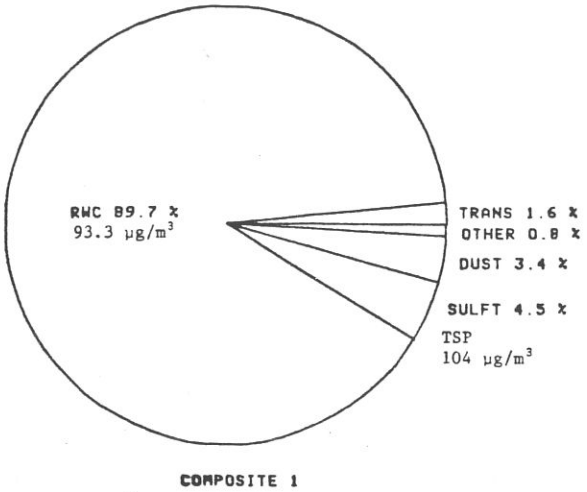

Figure 7. December, 1981, composite source contributions at Floyd Dryden.

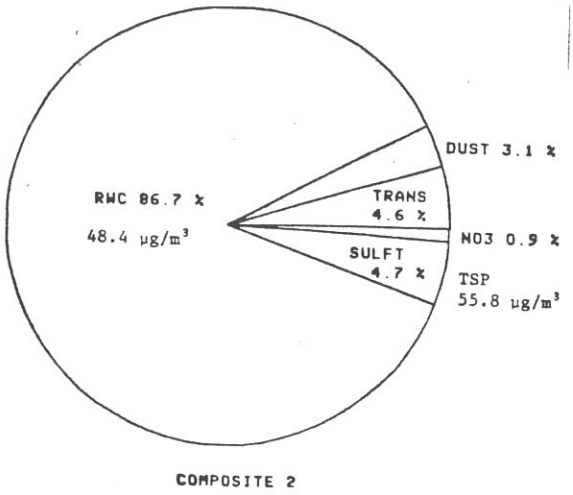

Figure 8. December, 1981, composite source contributions at Super Bear.

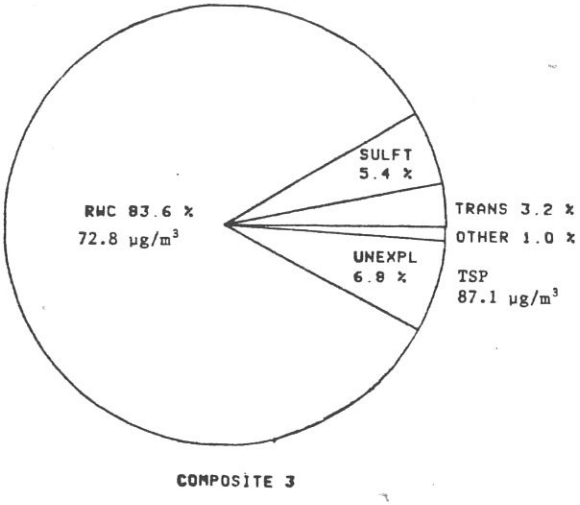

Figure 9. December, 1982, composite source contributions at Floyd Dryden.

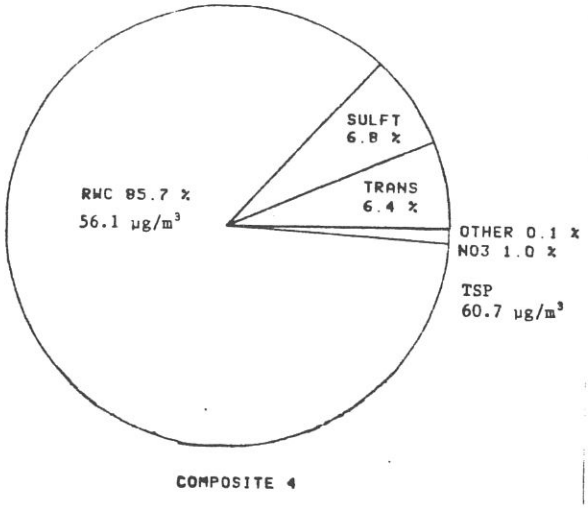

Figure 10. December, 1982, composite source contributions at Super Bear.

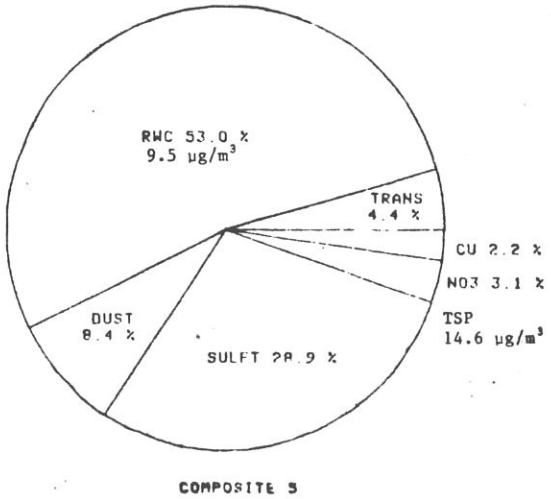

Figure 11. December, 1981, composite source contributions at the Juneau Municipal Building.

by 2 to 10 fold, it clearly shows that this is far from being one of the most significant sources and it probably contributes less than about 10 $\mu g/m^3$ in most cases.

Simple, low-cost, routine procedures for monitoring the impact of RWC sources can probably be developed and validated for the Mendenhall Valley and other relatively simple airsheds in Alaska. These procedures might be based on such measurements as visibility, gaseous species, graphitic carbon by optical means, OC/EC ratios, fine particle mass, etc. Whatever procedure is selected, it would first have to be validated by inter-comparison and correlation studies with other independent methods.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

The city of Juneau is located on the southern coast of Alaska. The residential portion of the city extends inland from the opening of the Mendenhall Valley, where the airport and commercial portion of the city is located and is surrounded by high mountain ridges. This valley geography, plus frequent temperature inversions, which exist during much of the winter, prevent air pollutants from being dispersed and contribute to air quality degradation. Because of changes in source characteristics, the valley's residential area has experienced a substantial increase in suspended particulate mass levels in recent years. The most notable change in airshed emissions is associated with a large increase in the use of wood burning appliances for residential space heating. Although much of the recently observed decrease in air quality may be due to this source, its impact needs to be quantified as well as the impacts from other sources to assess potential health implications and to develop cost-effective control strategies.

As a result of the likely resistance to controls, it is essential that a substantial data base be established to support the necessity to take action and establish a high level of confidence in the effectiveness of proposed controls. Since attainment of better air quality will probably require several years, trends must be established and improvements documented to maintain public support for anticipated controls.

The objective of this study is to use chemical mass balance (CMB) receptor model methods to provide a preliminary quantification of the contribution of sources to air quality degradation in the Juneau-Mendenhall Valley with special focus on residential wood combustion (RWC) appliances.

2.0 BACKGROUND

2.1 Methodology

The relationship between particulate emissions and ambient concentrations measured at a receptor (hi-vol sampler) site distant from the pollution source is a complicated one. Many variables, primarily meteorological make the direct

correlation between source emissions and ambient concentrations a poor one. Each of these variables is random in nature, will vary with space and time, and may combine with other variables in a nonlinear manner. Thus, any estimation of source impact on ambient loadings (mass collected on a hi-vol TSP filter) using dispersion modeling is approximate at best. The conceptualization of this complex and intractable "real-life" situation is a comparatively simple "model" based on physical principles which can be used to determine the average contribution of specific sources to particulate loadings.

It is possible to begin at either end of the system: The emission rates of a set of sources can be compiled, the appropriate transport parameters measured and incorporated into a source oriented model which will predict ambient concentrations at specified sampling sites and times.

On the other hand, one can start with ambient air particulate samples as collected at a receptor site by a representative sampling technique, determine some properties such as elemental composition of this sample which are unique to specific sources or source types and assign the origin of that fraction of the sample possessing a property to its appropriate source.

A chemical mass balance (CMB) receptor model was used in this study to identify source types and determine their contributions to ambient particulate levels. It is based on the conservation of aerosol mass from the time a chemical species is emitted from its source to the time it is measured at a receptor. That is, if p sources are emitting M_j mass of particles

$$m = \sum_{j=1}^{p} M_j$$

where m is the total mass of the particulate collected on a filter at a receptor site. It assumes the mass on the filter is a linear combination of the mass contributed from each of the sources.

The mass of a specific chemical species, m_i, is given by the following

$$m_i = \sum_{j=1}^{p} M_{ij} = \sum_{j=1}^{p}{}' F'_{ij} M_j \qquad 1$$

where M_{ij} is the mass of element i from source j and F'_{ij} is the fraction of chemical species i in the mass from source j collected at the receptor. It is usually assumed that

$$F'_{ij} = F_{ij}$$

where F_{ij} is the fraction of chemical i emitted by source j as measured at the source. The degree of validity in this assumption depends on the chemical and physical properties of the species and its potential for atmospheric modifications such as condensation, volatilization, chemical reactions, sedimentations, etc.

If we accept this equation, however, and divide both sides of equation 1 by the total mass of the deposit collected at the receptor site, it follows that

$$\frac{m_i}{m} = \sum_{j=1}^{p} F_{ij} \frac{M_j}{m}$$

$$C_i = \sum_{j=1}^{p} F_{ij} S_j \qquad 2$$

where C_i is the concentration of the chemical component i measured at the receptor (air filter, for example) and S_j is the source contribution; i.e., ratio of the mass contributed from source j to the total mass collected at the receptor site. In practice, it is this fraction of particulate pollution measured at a receptor due to source j, S_j, which is of primary interest in CMB calculations.

If the C_i and the F_{ij} at the receptor for all p of the source types suspected of affecting the receptor are known, and $p < n$ (n = number of chemical species), a set of n simultaneous equations exists from which the source type contribution S_j may be calculated by least squares methods. Further details are provided in Appendix A.

Implementation of a CMB analysis requires the formation of both ambient and source elemental data sets. The approach taken in this study was to use primarily literature values for source elemental profiles and to develop

ambient profiles based on the analysis of high volume (HV) total suspended particulate (TSP) glass fiber (GF) filters collected during the heating season.

2.2 Chemical and Physical Characteristics of Emissions

2.2.1 RWC Chemical Profile

Table 1 lists major chemical features associated with potential sources contributing to air particulate levels in Juneau. (Detailed source profiles are listed in Appendix F). These sources were selected from NEA's master source library on the basis of possible sources in the area. The first source profile listed, RWC, is a composite fingerprint used in Medford, Oregon (1). It is based on direct measurements of emissions from wood burning stoves and fireplaces burning local hard and soft woods. The slash burn source profile was measured during the Portland Aerosol Characterization Study (PACS) (2). Both profiles represent averages of results developed over the past five years as part of our aerosol characterization studies. Although the organic carbon (OC) and elemental carbon (EC) values were relatively constant, averaging about 50% and 10% respectively, the inorganic species were quite variable. The potassium, for example, ranged from less than a tenth of a percent to greater than one percent (3).

This is particularly important because the amount of mass attributed to a source is directly related to the percent composition. This usually isn't a problem when representative samples of emissions from a specific airshed can be obtained and the impact is relatively low. This, however, may be a problem in specific airsheds because of potential differences in species of wood burned, average moisture content, specific appliances used, ambient temperature differences and the level of impact predicted on the basis of emission inventories. This wasn't a major problem in this specific study because a substantial portion of the RWC source fitting pressure was associated with the organic and elemental carbon (OC/EC) species and the inorganic species were responsible for only a minor amount of fitting pressure.

Table 1

Summary of Major Elemental Features Associated With Fine Particles from Selected Sources (Percent)

Element	RWC[a]	Slash Burn[a]	Transportation[a]	Gasoline Auto Exh.[b]	Road Dust[a]	Soil[a]	Road Dust[c]	Resid. Oil[b]	Distil. Oil[b]
SO_4	.29	.33		1.3	.23	.06		48.1	13.2 ± 8.7
EC	12.8*	9.8	26.1		1.6	0.7		3.1	18 ± 5.7
OC	47.5*	59.2	43.1		8.7	3.7		7.0	18 ± 23
Al	.02	.14	.14	1.1	8.2*	8.9*	10.9	0.53	.31 ± .21
Si		.13	.59	0.82	24.8*	27.0*	32.8	0.46	.27 ± .32
S	.18	.13	3.92	.4	.32	.07	0.25	13.3	6.9 ± 2.6*
Cl	.51	.26	2.35	3.0			0.15		1.2 ± .9
K	.86*	.62		.07	.83	.75	1.46	.28	.02 ± .01
Ca	.07	.87	1.17	1.25	2.4*	1.8*	3.29	1.58	.5 ± .6
Ti			0.32		.54*	.7*	0.81	.11	
V							0.05	3.44*	.005 ± .002
Mn		.28			.12*	.18*	0.13	.05	.014 ± .010
Fe		.06	1.85	2.1	4.7*	5.5*	7.19	2.97	.12 ± .11
Ni				.02	.1	.007	0.01	5.36*	.009 ± .006
Cu				.07	.08	.03	0.01	.08	.17 ± .059
Zn	.04	.02	0.09	.35	.04	.011	0.07	.40	.029 ± .019
Br		.02	5.32*	5.0*			0.02	.01	.026 ± .028
Pb			13.8*	20*	.09		0.53	.11	.54 ± .51
NH_4		.22							
Pb/Br			0.39	0.25					
No. Measurements									

a. Medford source matrix, reference 1
b. Portland source matrix, reference 2
c. Based on resuspension of road dust from Juneau
* Key indicating elements

The Medford RWC fingerprint was used for Juneau because of its availability and limited resources which prevented more extensive direct source measurements. This fingerprint was successfully used in the Medford Aerosol Characterization Study (MACS)(1) in which 46% of the local respirable (< 2.5 μm) particles were associated with vegetative burning. Figure 1 shows a comparison between selected elements measured on Christmas Eve (1979) when the impact from RWC was expected to be substantial, and the RWC fingerprint. The K, Ca, Zn, OC, and EC all seem to be dominated by the RWC source while the Na, Al, S, SO_4, Cl, Br, Pb, and NO_3 seem to have substantial contributions from other sources such as oil, coal, and gasoline combustion. The K, Ca, Zn, OC, and EC could almost all be explained by the RWC fingerprint if it were normalized to the ambient K level.

It should also be noted that the particulate Cl and S are significant trace species and a substantial portion of these elements are emitted in the gaseous phase (5). Another important feature of RWC emissions is its fine particle nature as illustrated in Figure 2. Over 99% of the emissions are less than 2.5 μm (6).

2.2.2 Transportation and Automotive Exhaust

The transportation and automotive exhaust emissions listed in Table 1 are from the MACS and PACS (1,2). The transportation source is a composite of leaded and unleaded automotive exhaust, diesel exhaust and tire wear, while the PACS vehicle exhaust profile includes only gasoline exhaust based on tunnel studies (7) which includes some crustal elements from road dust. Development of such profiles for each airshed requires considerable information related to average fleet emissions, etc. The details of the procedure are outlined in Appendix B. The dominant features of this profile are Br and Pb which are relatively unique to this source. Thus, the transportation contribution can be well defined with these species.

The Medford transportation fingerprint was used for the Juneau samples. Although it includes some diesel exhaust and tire wear, these extra contributions are probably compensated by the use of potentially higher lead values

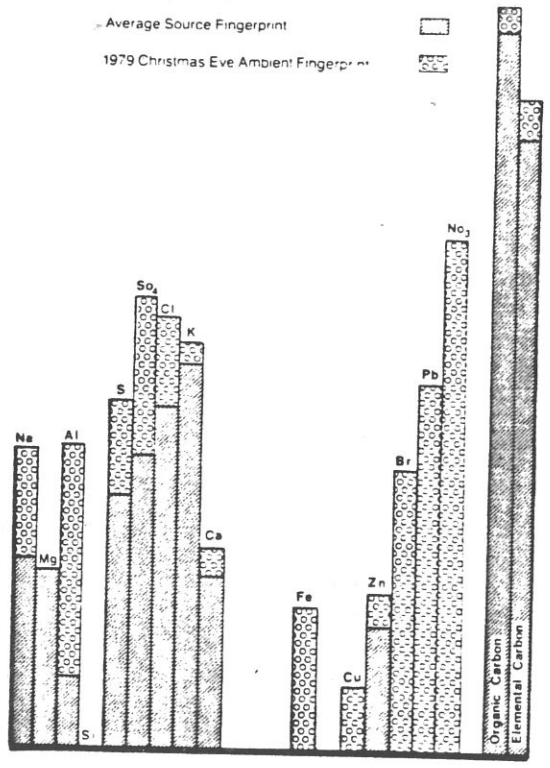

Figure 1. Comparison of the Medford RWC fingerprint with ambient fingerprint on Christmas Eve, 1979. From Reference 4.

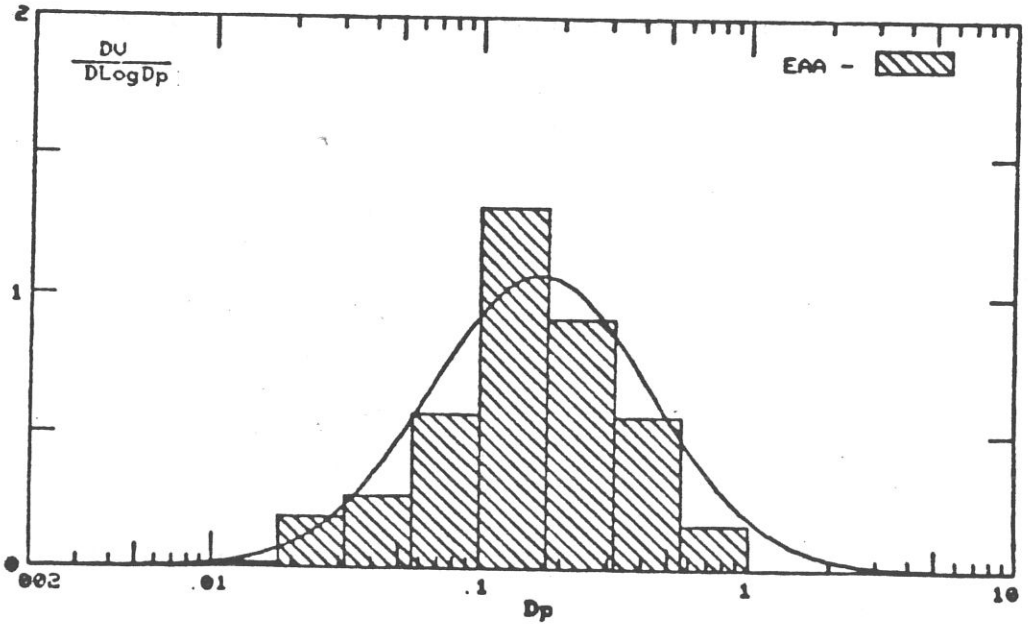

Figure 2. Size Distribution of Woodsmoke Particles Obtained with Electrical Aerosol Analyzer. From Reference 6.

than might actually exist because of a decline in the average lead in gasoline. These uncertainties, however, are not very significant since the total contribution of this source is only about 5% of the TSP.

2.2.3 Soil and Road Dust

About 50% of the TSP in a typical urban airshed is associated with crustal material from soil or road dust. Chemical fingerprints are easily developed for this source by resuspending bulk material collected from each airshed. The first road dust and soil fingerprints listed are from the MACS. The second road dust fingerprint was developed from a Juneau road dust sample. Clearly, Al, Si, and Fe are the most abundant elements. In contrast to the other combustion sources which emit mostly fine particles, the road dust consists mostly of coarse particles (> 95%).

3.0 RESULTS AND DISCUSSION

3.1 Ambient Aerosol Chemistry

Analysis results from 53 glass fiber TSP filters were used to establish an ambient data base for CMB source apportionment calculations. These filters were grouped into five composite sets and five exposure/weather regimes as indicated in Table 2. Each of the filters was analyzed by XRF and the results are listed in Appendix C. The five composite sets of filters and each of the individual filters making up the weather regimes were analyzed by ion chromatography (IC) and combustion for organic (OC) and elemental carbon (EC). The results for these analyses are listed in Appendix D along with results of the CMB calculations. (Carbon results are listed in Appendix H.)

The dominant chemical species was OC which typically accounted for about 40% of the mass. Sulfate, nitrate, Fe, EC, and Na were the next most abundant elements. Lead and Br were always well defined, substantially above blank levels and usually in about a 3:1 ratio typical of automotive exhaust. The Fe to Mn ratio was usually very close to the 56:1 measured in

Table 2

Filter Identification and Grouping Classification

Classification	Site	Date	Identification Codes ADEC	NEA
Floyd Dryden Composite December, 1981 Composite 1	1	12/9/81	1218839	P4438
	1	12/12/81	1218840	P4439
	1	12/15/81	1218843	P4419
	1	12/18/81	1218846	P4421
	1	12/21/81	1218848	P4423
	1	12/24/81	1218844	P4420
	1	12/27/81	2072988	P4408
	1	12/30/81	2072987	P4409
Super Bear Composite December, 1981 Composite 2	2	12/3/81	1218829	P4433
	2	12/6/81	1218836	P4436
	2	12/9/81	1218834	P4434
	2	12/12/81	1218835	P4435
	2	12/15/81	1218842	P4418
	2	12/18/81	1218847	P4422
	2	12/21/81	1218849	P4424
	2	12/24/81	1218838	P4437
	2	12/27/81	2072986	P4410
	2	12/30/81	2072991	P4406
Floyd Dryden Composite December, 1982 Composite 3	1	12/1/82	2075339	P4416
	1	12/4/82	2075337	P4417
	1	12/17/82	2075388	P4404
	1	12/10/82	2075784	P4391
	1	12/13/82	2075781	P4392
	1	12/16/82	2075776	P4395
	1	12/19/82	2075775	P4396
	1	12/22/82	2075771	P4398
	1	12/25/82	2075768	P4401
	1	12/28/82	2075766	P4402
	1	12/31/82	2075763	P4403
Super Bear Composite December, 1982 Composite 4	2	12/1/82	2075341	P4414
	2	12/4/82	2075790	P4425
	2	12/7/82	2075787	P4389
	2	12/10/82	2075786	P4390
	2	12/13/82	2075779	P4393
	2	12/16/82	2075778	P4394
	2	12/19/82	2075773	P4397
	2	12/22/82	2075770	P4399
	2	12/25/82	2075769	P4400

Table 2
-Continued-

Filter Identification and Grouping Classification

Classification	Site	Date	Identification Codes ADEC	NEA
Juneau Municipal Bldg.	3	12/1/82	2075351	P4427
December, 1982	3	12/7/82	2075350	P4428
Composite 5	3	12/31/82	2075348	P4429
Regime 1	2	11/22/82	2075377	P4413
Fall highest exposure	1	11/19/82	2075397	P4387
days when dry, cold &	1	11/22/82	2075378	P4388
calm weather prevailed. No snow cover or precipitation for preceding week and average temperature of 10°F.				
Regime 2	1	12/30/81	2072987	P4409
Winter highest exposure	1	1/2/82	2072993	P4405
days. No snow cover or precipitation for preceding week and average temperature of 10°F.				
Regime 3	1	12/9/81	1218839	P4438
Cold, clear, calm days	1	1/17/82	2072989	P4407
with average temperature	1	1/21/82	3397394	P4426
of 12°F.				
Regime 4				
Clear, calm, warmer days	1	2/7/81	2072967	P4411
with average temperature	2	2/17/82	2072960	P4412
of 28°F.	1	12/31/82	2075763	P4403
	1	2/16/82	3397875	P4431
Regime 5	1	11/28/82	2075340	P4415
Snow/rain, calm days	1	12/21/81	1218848	P4423
with average temperature of 30°F.	1	12/15/81	1218843	P4419
Regime 6	2	3/4/83	3397258	P4430
Dry, calm days in	1	3/4/83	339783	P4432
March with high potential for fugitive dust; average temperature of 27°F.				

the Juneau road dust sample and the OC to EC ratio was typically about 5:1 as observed for RWC emissions. The concentration of iron was much more variable than other species such as OC, EC, Br, and Pb. While the percent concentrations of these other species varied by about a factor of two, the Fe ranged from "zero" (< 0.01%) to over 5%.

High blank levels and variability in those blank levels substantially reduced the amount of information attainable for other elements such as Cl, Ca, Sr, Ba, etc. Sulfate and nitrate results should be considered as upper limits because of the potential for significant filter artifacts.

It should be noted that the Cl results listed as typically less than 0.05% do not include systematic uncertainties. The less than is actually about two orders of magnitude greater than indicated and is thought to be consistent with a marine source of Na.

3.2 CMB Source Apportionment

The results of the CMB source apportionment calculations are listed in Appendix D at the top of the computer printout for each filter as illustrated in Figure 3. The sample identification (P4387), site, size, etc. are listed at the top of the page followed by the listing of two effective variance fitting parameters, reduced chi square (0.548) and the degrees of freedom (D of F:7) which is the difference between the number of species used in the fit, 13 (the species with asterisks), and the number of sources used in the final calculation, 6.

The sources used in the final calculation and their contribution ($\mu g/m^3$ and percent) are listed next. Table 3 lists the source codes and their identifications used in this study. Although only a few sources are listed in Table 3, consideration of a much larger set of sources was used to construct this final set of sources used in this study.

Figure 3. Example of CMB Computer Printout

CMBDEQ RESULTS FOR CMB # P4387
TOTAL PARTICULATE FRACTION
SAMPLING DATE: 821119 SITE CODE: 01
SAMPLING DURATION: 24 HRS. WITH START HOUR: 0
SITE: FLOYD DRYDEN
EFFECTIVE VARIANCE FITTING. REDUCED CHI SQUARE: 0.548 D OF F: 7

CODE	SOURCE	FLG	UG/M3	%
1	RWC	*	122.755+-33.878	19.678+- 5.512
3	MARIN	*	11.415+- 4.842	1.830+- 0.781
4	DUST	*	433.360+-19.832	69.469+- 4.598
7	SULFT	*	1.908+- 0.429	0.306+- 0.070
8	NH4	*	0.233+- 0.031	0.037+- 0.005
9	NO3	*	0.698+- 0.091	0.112+- 0.016
	TOTAL:		570.368+-39.556	91.432+- 7.702

	SPECIE CODE		MEAS.	TOTAL UG/M3	SUSPENDED PERCENT	PARTICULATE CALC. UG/M3	RATIO	
1	OC	*	65.757+-	5.216	10.541	58.309+-16.940	0.887+-0.267	OC
2	EC	*	6.492+-	0.834	1.041	15.713+-10.311	2.420+-1.618	EC
3	NH4	*	0.233+-	0.020	0.037	0.233+- 0.024	1.000+-0.133	NH4
4	F		0.582+-	0.042	0.093	0.000+- 0.005	0.000+-0.008	F
5	NO3	*	0.698+-	0.058	0.112	0.698+- 0.070	1.000+-0.130	NO3
6	SO4	*	1.908+-	0.384	0.306	1.908+- 0.191	1.000+-0.225	SO4
7	NA	*	3.258+-	2.286	0.522	4.668+- 0.460	1.433+-1.015	NA
8	CL		<	0.048	---	5.854+- 1.305	0.000+-0.000	CL
9	K		0.558+-	0.207	0.090	7.560+- 0.932	9.999+-9.999	K
10	CA		<	0.083	---	14.500+- 0.758	0.000+-0.000	CA
11	TI	*	3.601+-	0.257	0.577	3.502+- 0.195	0.972+-0.088	TI
12	V	*	0.184+-	0.022	0.030	0.217+- 0.030	1.176+-0.216	V
13	CR	*	0.145+-	0.011	0.023	0.143+- 0.017	0.989+-0.141	CR
14	MN	*	0.520+-	0.037	0.083	0.559+- 0.035	1.075+-0.102	MN
15	FE	*	32.015+-	2.274	5.132	31.176+- 1.621	0.974+-0.086	FE
16	NI		0.033+-	0.003	0.005	0.061+- 0.013	1.838+-0.427	NI
17	CU	*	0.058+-	0.004	0.009	0.052+- 0.013	0.892+-0.234	CU
18	ZN		0.144+-	0.011	0.023	0.331+- 0.052	2.295+-0.401	ZN
19	GA		0.008+-	0.002	0.001	0.004+- 0.013	0.563+-1.701	GA
20	AS		<	0.005	---	0.026+- 0.061	0.000+-0.000	AS
21	SE		<	0.001	---	0.000+- 0.009	0.000+-0.000	SE
22	BR	*	0.124+-	0.009	0.020	0.110+- 0.014	0.881+-0.132	BR
23	RB		0.028+-	0.003	0.004	0.039+- 0.013	1.403+-0.494	RB
24	SR		0.216+-	0.016	0.035	0.225+- 0.022	1.041+-0.126	SR
25	Y		0.007+-	0.003	0.001	0.035+- 0.017	4.623+-2.889	Y
26	ZR		<	0.012	---	0.065+- 0.078	0.000+-0.000	ZR
27	CD		0.118+-	0.016	0.019	0.048+- 0.087	0.403+-0.735	CD
28	BA		1.081+-	0.118	0.173	1.205+- 0.689	1.114+-0.649	BA
29	LA		<	0.101	---	0.000+- 0.832	0.000+-0.000	LA
30	HG		0.002+-	0.002	0.000	0.022+- 0.017	8.667+-$10.5	HG
31	PB		0.444+-	0.032	0.071	2.292+- 0.143	5.159+-0.494	PB

MEAS. AMB. MASS (UG/M3): 623.8
* - FITTING ELEMENT

Table 3

List of the Source Codes and Source Descriptions

0001	RWC	RESIDENTIAL WOOD COMBUSTION (MACS)
0004	TRANS	TRANSPORTATION (MACS)
0015	MARIN	MARINE AIR (PACS)
0002	DUST	JUNEAU DUST
0005	RESID	RESIDUAL OIL (PACS)
0023	DIST	DISTILLATE OIL
0031	SULFT	SECONDARY SULFATE
0007	NH4	AMMONIUM
0003	NO3	SECONDARY NITRATE
0006	CU	COPPER

The next section of the printout lists the chemical species, their measured concentration in $\mu g/m^3$, and a one standard deviation uncertainty. The next column lists the measured percent contribution of each species, while the last two columns list the calculated concentrations and the ratio of calculated to measured concentration.

A large number of potential source combinations are often attempted before the most probable combination is established through an iterative procedure. The most probable combination of sources is identified by optimizing four primary fitting parameters: reduced chi square, degrees of freedom, percent mass explained, and the ratio of calculated to explained chemical mass. The best fit or most probable combination of sources explaining the aerosol mass is determined by minimizing the reduced chi square (usually less than 1.), maximizing the degrees of freedom, maximizing the percent mass explained up to 100%, and obtaining elemental ratios of about 1.0 within experimental error.

The fit illustrated in Figure 3 is quite good. It has a low reduced chi square, high number of degrees of freedom, explains over 90% of the mass, and most of the key and most reliable species ratios are 1.0 within experimental error. The most notable exception is lead, which is usually quite accurately measured even on glass fiber filters and is associated primarily with automotive exhaust. In this particular case, the transportation source could not be added because the Pb was already over explained with the sources used. This suggests the dust source, which is the only major source of lead in the list of sources shown in the Figure 3 fit, is not representative of the dust source impacting this particular sampling site. This problem only develops for lead and on a few days when the dust contribution is large. The lead concentration in the dust sample was 0.53%, nearly five fold greater than the lead concentration found in the fine fraction of road dust in Medford, Oregon, and 50% greater than the fine fraction road dust found in Portland, Oregon. This difference may be even more dramatic since the lead content of TSP road dust is typically lower than fine (< 2.5 μm) particle road dust.

Another key element of interest was K. This particular fit for K was quite poor, but the uncertainty is quite large. The reason for this is two fold. First, the analytical uncertainty is quite high for the ambient data because of blank impurity problems. Secondly, the variability in the K content of the source fingerprint is quite high and most of the fitting pressure is supplied by the OC and EC.

This particular filter, which recorded the highest TSP loading of 624 $\mu g/m^3$, was also selected for priority pollutant analysis by gas chromatography-mass spectroscopic analysis. The results from this analysis are listed in Table 4. Most of the species measured were less than detection limits. The species of most interest, because of its prevalent use as a common indicator of polycyclic organic matter, is benzo(a)pyrene (BaP). BaP has been shown to be typically in the range from about 0.01% to 0.03% in wood smoke (8,9). The concentration of BaP measured on this filter (4 $\mu g/g$ or 11 ng/m^3) is in good agreement with these previous results and confirms the source contribution of RWC indicated in Figure 3. That is, the percent BaP in Juneau's ambient RWC smoke would be 0.009% (0.011 ÷ 122.7).

The highest RWC source contribution calculated was 235 $\mu g/m^3$ (P4388) with several days approaching or exceeding 200 $\mu g/m^3$. Thus, BaP levels in the 20 ng/m^3 would not be unusual for the Juneau airshed. These levels can be put in perspective by comparing them to other regions of the country and their seasonal variability as is done in Tables 5 and 6. It should be noted that the data in these tables are based on 1969 measurements and there has been a steady decline in these levels over the past decade or so. It also needs to be emphasized that BaP is simply an indicator of polycyclic organic compounds that might be present. Other potentially toxic and hazardous compounds such as carbon monoxide, phenols, aldehydes, etc. would be expected to be present in about the same relative concentration as estimated by Cooper (8).

Figures 4-6 illustrate the results obtained on two days in the fall of 1982, November 19th and 22nd. This period, including several days immediately

Table 4

Priority Pollutant Analysis List

ACID COMPOUNDS	ug/g(ppm)	BASE/NEUTRAL COMPOUNDS	ug/g(ppm)
2,4,6-trichlorophenol	< 0.4	4-bromophenyl phenyl ether	< 0.4
p-chloro-m-cresol	< 0.4	bis(2-chloroisopropyl) ether	< 0.4
2-chlorophenol	< 0.4	bis(2-chlorethoxy)methane	< 0.4
2,4-dichlorophenol	< 0.4	hexachlorobutadiene	< 0.4
2,4-dimethylphenol	< 0.4	hexachlorocyclopentadiene	< 0.4
2-nitrophenol	< 0.4	isophorone	< 0.4
4-nitrophenol	< 0.4	napthalene	< 0.4
2,4-dinitrophenol	< 0.4	nitrobenzene	< 0.4
4,6-dinitro-2-methylphenol	< 0.4	N-nitrosodimethylamine	< 0.4
pentachlorophenol	< 0.4	N-nitrosodiphenylamine	< 0.4
phenol	< 0.4	N-nitrosodi-n-propylamine	< 0.4
BASE/NEUTRAL COMPOUNDS	ug/g(ppm)	bis(2-ethylhexyl)phthalate	6
acenaphthene	< 0.4	butyl benzyl phthalate	< 0.4
benzidine	< 0.4	di-n-butyl phthalate	5
1,2,4-trichlorobenzene	< 0.4	di-n-octyl phthalate	< 0.4
hexachlorobenzene	< 0.4	diethyl phthalate	1
hexachloroethane	< 0.4	dimethyl phthalate	< 0.4
bis(2-chloroethyl)ether	< 0.4	benzo(a)anthracene	< 0.4
2-chloronaphthalene	< 0.4	benzo(a)pyrene	4
1,2-dichlorobenzene	< 0.4	benzo(b)fluoranthene	2
1,3-dichlorobenzene	< 0.4	benzo(k)fluoranthene	< 0.4
1,4-dichlorobenzene	< 0.4	chrysene	5
3,3'-dichlorobenzidine	< 0.4	acenaphthylene	< 0.4
2,4-dinitrotoluene	< 0.4	anthracene	< 0.4
2,6-dinitrotoluene	< 0.4	benzo(ghi)perylene	< 0.4
2,2-diphenylhydrazine	< 0.4	fluorene	< 0.4
(as azobenzene)	< 0.4	phenanthrene	0.5
fluoranthene	9	dibenzo(a,h)anthracene	< 0.4
4-chlorophenyl phenyl ether	< 0.4	indeno(1,2,3-cd)pyrene	< 0.4
		pyrene	9

Table 5

Typical Values of Aerosol Concentration for Difference Geographic Areas (Annual Averages) (Based on 1969 data, Ref. 10)

Location	N, particles/cm³ [b]	Mass Concentration (m), µg/m³ [c]	Benzene-Soluble Fraction of m, µg m³	Benzo[a]pyrene Fraction of m, ng m³
Nonurban				
Continental				
General	10^3–10^4	20–80	1.1–2.2	–
California	10^3–10^4	39	2.8	0.48
Oregon	–	47	0.9	0.09
Colorado	10^3–10^4	14	1.1	0.11
Indiana	–	39	2.1	0.25
Maine	–	18	1.2	0.12
New York	–	29	1.8	0.25
So. Carolina	–	40	2.7	0.43
Maritime				
General	10^3–10^4	–	–	–
Pacific offshore	10^3–10^4	19–146	1.5–6.1 [d]	–
Oahu, Hawaii	10^3–10^4	10–49 [d]	0.7–6.3 [d,e]	–
Urban				
Continental				
General	10^3–10^6	>100	7	–
Los Angeles	10^3–10^6	93	12.5 [f]	1.87
Portland	–	72	6.6	2.60
Denver	10^3–10^5	110	9.0	2.52
Minneapolis	10^3–10^5	70	6.1	1.18
Chattanooga	–	105	6.9	4.18
New York	–	105	8.9	3.63
Greenville, S.C.	–	76	7.4	7.49
Maritime				
Honolulu, Hawaii	10^3–10^4	40	2.3	0.59
San Juan, Puerto Rico	–	77	6.9	1.42

Table 6

Seasonal Observations of Benzo(a)pyrene and Benzanthrone in Some U.S. Cities (Based on 1969 data, Ref. 10)

	Mass Concentration, ng/m³							
	Benzo[a]pyrene				Benzanthrone			
	Quarter				Quarter			
Site	1	2	3	4	1	2	3	4
Los Angeles	2.98	0.79	0.64	3.05	4.48	1.87	1.74	6.10
Medford, Oregon	2.60	2.18	1.45	9.97	8.14	1.69	2.92	9.69
Albuquerque, N.M.	1.02	0.23	0.29	2.95	1.47	0.57	0.67	3.34
Ashland, Ky.	21.17	6.38	6.21	9.80	12.17	3.69	5.47	6.64
Chicago	7.20	3.21	1.60	3.52	4.86	3.38	2.31	3.78
Nashville, Tenn.	5.73	1.76	0.77	2.93	4.76	2.04	1.62	5.68
Philadelphia	6.33	1.69	1.41	6.68	11.02	1.64	1.60	3.65
Pittsburgh, Pa.	21.32	18.27	6.04	9.37	9.28	4.75	3.10	3.91
Greenville, S.C.	19.60	2.84	0.66	4.91	15.52	2.70	1.56	8.46
Missouri (nonurban)	0.24	0.16	0.17	0.08	0.47	0.23	0	0.47
Pennsylvania (nonurban)	2.52	0.83	1.04	0.54	0.83	0.57	1.01	1.00

Figure 4. CMB Results for 11/22/82 at Super Bear

CMBDEQ RESULTS FOR CMB # P4413
TOTAL PARTICULATE FRACTION
SAMPLING DATE: 821122 SITE CODE: 02
SAMPLING DURATION: 24 HRS. WITH START HOUR: 0
SITE: SUPER BEAR
EFFECTIVE VARIANCE FITTING. REDUCED CHI SQUARE: 2.615 D OF F: 7

CODE	SOURCE	FLG	UG/M3	%
1	RWC	*	167.666+-44.685	42.995+-11.690
2	TRANS	*	4.973+- 1.074	1.275+- 0.284
4	DUST	*	152.687+- 7.441	39.154+- 2.844
7	SULFT	*	8.357+- 1.019	2.143+- 0.286
8	NH4	*	0.551+- 0.068	0.141+- 0.019
9	NO3	*	1.293+- 0.158	0.332+- 0.044
10	CU	*	0.029+- 0.007	0.007+- 0.002
	TOTAL:		335.555+-45.324	86.047+-12.512

CODE	SPECIE		MEAS.	TOTAL UG/M3	SUSPENDED PERCENT	PARTICULATE CALC. UG/M3	RATIO	
1	OC	*	105.934+-	8.696	27.165	79.642+-23.138	0.752+-0.227	OC
2	EC	*	17.432+-	2.236	4.470	21.461+-14.084	1.231+-0.823	EC
3	NH4	*	0.551+-	0.040	0.141	0.551+- 0.055	1.000+-0.123	NH4
4	F		0.670+-	0.432	0.172	0.000+- 0.002	0.000+-0.003	F
5	NO3	*	1.293+-	0.091	0.332	1.293+- 0.129	1.000+-0.122	NO3
6	SO4	*	8.357+-	0.583	2.143	8.357+- 0.836	1.000+-0.122	SO4
7	NA		<	2.349	---	0.139+- 0.077	0.069+-0.089	NA
8	CL		<	0.058	---	1.204+- 0.855	0.000+-0.000	CL
9	K	*	0.694+-	0.214	0.178	3.677+- 1.180	5.296+-2.354	K
10	CA		<	0.082	---	5.194+- 0.285	0.000+-0.000	CA
11	TI	*	1.473+-	0.105	0.378	1.250+- 0.069	0.848+-0.076	TI
12	V	*	0.095+-	0.009	0.024	0.076+- 0.011	0.799+-0.138	V
13	CR	*	0.044+-	0.004	0.011	0.050+- 0.006	1.145+-0.176	CR
14	MN	*	0.180+-	0.013	0.046	0.197+- 0.012	1.092+-0.104	MN
15	FE	*	11.178+-	0.794	2.866	11.076+- 0.572	0.991+-0.087	FE
16	NI		0.013+-	0.002	0.003	0.021+- 0.005	1.607+-0.420	NI
17	CU	*	0.047+-	0.004	0.012	0.047+- 0.006	1.000+-0.143	CU
18	ZN		0.116+-	0.009	0.030	0.167+- 0.063	1.440+-0.551	ZN
19	GA		<	0.002	---	0.002+- 0.005	2.545+-$12.7	GA
20	AS		<	0.009	---	0.009+- 0.021	1.992+-5.993	AS
21	SE		<	0.003	---	0.000+- 0.003	0.000+-0.000	SE
22	BR	*	0.491+-	0.035	0.126	0.295+- 0.105	0.601+-0.218	BR
23	RB		0.013+-	0.003	0.003	0.014+- 0.005	1.057+-0.431	RB
24	SR		0.057+-	0.005	0.015	0.079+- 0.008	1.398+-0.183	SR
25	Y		<	0.003	---	0.012+- 0.006	5.817+-9.101	Y
26	ZR		<	0.011	---	0.023+- 0.028	0.000+-0.000	ZR
27	CD		0.014+-	0.012	0.003	0.017+- 0.031	1.235+-2.515	CD
28	BA		0.333+-	0.087	0.085	0.424+- 0.243	1.276+-0.802	BA
29	LA		<	0.096	---	0.000+- 0.293	0.000+-3.951	LA
30	HG		<	0.002	---	0.008+- 0.006	0.000+-0.000	HG
31	PB	*	1.311+-	0.093	0.336	1.494+- 0.138	1.140+-0.133	PB

MEAS. AMB. MASS (UG/M3): 390.0

* - FITTING ELEMENT

CMBDEQ RESULTS FOR CMB # P4388
TOTAL PARTICULATE FRACTION
SAMPLING DATE: 821122 SITE CODE: 01
SAMPLING DURATION: 24 HRS. WITH START HOUR: 0
SITE: FLOYD DRYDEN
EFFECTIVE VARIANCE FITTING. REDUCED CHI SQUARE: 0.386 D OF F: 6

CODE	SOURCE	FLG	UG/M3	%
1	RWC	*	234.722+-64.728	39.298+-11.008
2	TRANS	*	3.383+- 1.396	0.566+- 0.235
4	DUST	*	322.997+-15.528	54.078+- 3.717
7	SULFT	*	8.286+- 1.014	1.387+- 0.183
8	NH4	*	0.368+- 0.045	0.062+- 0.008
9	NO3	*	1.854+- 0.227	0.310+- 0.041
10	CU	*	0.299+- 0.040	0.050+- 0.007
	TOTAL:		571.908+-66.587	95.752+-12.100

	SPECIE CODE		MEAS.	TOTAL UG/M3	SUSPENDED PERCENT	PARTICULATE CALC. UG/M3	RATIO	
1	OC	*	119.637+-	9.797	20.030	111.493+-32.391	0.932+-0.281	OC
2	EC	*	19.135+-	2.417	3.204	30.044+-19.716	1.570+-1.049	EC
3	NH4	*	0.368+-	0.026	0.062	0.368+- 0.037	1.000+-0.123	NH4
4	F		0.915+-	0.065	0.153	0.000+- 0.004	0.000+-0.004	F
5	NO3	*	1.854+-	0.130	0.310	1.854+- 0.185	1.000+-0.122	NO3
6	SO4	*	8.286+-	0.584	1.387	8.286+- 0.829	1.000+-0.122	SO4
7	NA	*	2.426+-	2.246	0.406	0.195+- 0.108	0.080+-0.087	NA
8	CL		<	0.049	---	1.768+- 1.198	0.000+-0.000	CL
9	K		1.030+-	0.208	0.172	6.747+- 1.665	6.551+-2.088	K
10	CA		<	0.081	---	10.823+- 0.580	0.000+-0.000	CA
11	TI	*	2.794+-	0.200	0.468	2.621+- 0.145	0.938+-0.085	TI
12	V	*	0.151+-	0.018	0.025	0.161+- 0.023	1.066+-0.198	V
13	CR	*	0.103+-	0.008	0.017	0.107+- 0.013	1.032+-0.150	CR
14	MN	*	0.396+-	0.028	0.066	0.417+- 0.026	1.052+-0.100	MN
15	FE	*	23.656+-	1.681	3.961	23.299+- 1.208	0.985+-0.087	FE
16	NI		0.023+-	0.002	0.004	0.045+- 0.010	1.924+-0.464	NI
17	CU	*	0.338+-	0.024	0.057	0.338+- 0.032	1.000+-0.118	CU
18	ZN		0.158+-	0.012	0.026	0.303+- 0.089	1.917+-0.581	ZN
19	GA		0.004+-	0.002	0.001	0.003+- 0.010	0.897+-2.802	GA
20	AS		<	0.006	---	0.019+- 0.045	9.999+-9.999	AS
21	SE		<	0.002	---	0.000+- 0.007	0.000+-6.249	SE
22	BR	*	0.243+-	0.017	0.041	0.245+- 0.072	1.004+-0.305	BR
23	RB		0.021+-	0.003	0.003	0.029+- 0.010	1.398+-0.513	RB
24	SR		0.147+-	0.011	0.025	0.168+- 0.016	1.142+-0.140	SR
25	Y		<	0.003	---	0.026+- 0.013	9.999+-9.999	Y
26	ZR		<	0.012	---	0.048+- 0.058	0.000+-0.000	ZR
27	CD		<	0.013	---	0.036+- 0.065	0.000+-0.000	CD
28	BA		0.656+-	0.098	0.110	0.898+- 0.514	1.369+-0.809	BA
29	LA		0.190+-	0.098	0.032	0.000+- 0.620	0.000+-3.261	LA
30	HG		<	0.002	---	0.016+- 0.013	0.000+-0.000	HG
31	PB		0.748+-	0.054	0.125	2.176+- 0.138	2.910+-0.279	PB

MEAS. AMB. MASS (UG/M3): 597.3
* - FITTING ELEMENT

Figure 8. CMB Results for 11/22/82 at Floyd Dryden - Alternate Fit

CMBDEQ RESULTS FOR CMB # P4388
TOTAL PARTICULATE FRACTION
SAMPLING DATE: 821122 SITE CODE: 01
SAMPLING DURATION: 24 HRS. WITH START HOUR: 0
SITE: FLOYD DRYDEN
EFFECTIVE VARIANCE FITTING. REDUCED CHI SQUARE: 0.268 D OF F: 5

CODE	SOURCE	FLG	UG/M3	%
1	RWC	*	233.616+-64.464	39.113+-10.963
2	TRANS	*	3.172+- 1.334	0.531+- 0.225
3	MARIN	*	5.568+- 5.651	0.474+- 0.947
4	DUST	*	323.034+-15.528	54.084+- 3.718
7	SULFT	*	8.286+- 1.014	1.387+- 0.183
8	NH4	*	0.368+- 0.045	0.062+- 0.008
9	NO3	*	1.854+- 0.227	0.310+- 0.041
10	CU	*	0.299+- 0.040	0.050+- 0.007
	TOTAL:		576.197+-66.569	96.470+-12.111

SPECIE CODE		MEAS.	TOTAL UG/M3	SUSPENDED PERCENT	PARTICULATE CALC. UG/M3	RATIO	
1	OC *	119.637+-	9.797	20.030	110.968+-32.239	0.928+-0.280	OC
2	EC *	19.135+-	2.417	3.204	29.903+-19.624	1.563+-1.044	EC
3	NH4*	0.368+-	0.026	0.062	0.368+- 0.037	1.000+-0.123	NH4
4	F	0.915+-	0.065	0.153	0.000+- 0.004	0.000+-0.004	F
5	NO3*	1.854+-	0.130	0.310	1.854+- 0.185	1.000+-0.122	NO3
6	SO4*	8.286+-	0.584	1.387	8.286+- 0.829	1.000+-0.122	SO4
7	NA *	2.426+-	2.246	0.406	2.421+- 0.247	0.998+-0.930	NA
8	CL	<	0.049	---	3.985+- 1.316	0.000+-0.000	CL
9	K	1.030+-	0.208	0.172	6.816+- 1.657	6.618+-2.091	K
10	CA	<	0.081	---	10.899+- 0.580	0.000+-0.000	CA
11	TI *	2.794+-	0.200	0.468	2.620+- 0.145	0.938+-0.085	TI
12	V *	0.151+-	0.018	0.025	0.162+- 0.023	1.066+-0.198	V
13	CR *	0.103+-	0.008	0.017	0.107+- 0.013	1.032+-0.150	CR
14	MN *	0.396+-	0.028	0.066	0.417+- 0.026	1.053+-0.100	MN
15	FE *	23.656+-	1.681	3.961	23.298+- 1.208	0.985+-0.087	FE
16	NI	0.023+-	0.002	0.004	0.045+- 0.010	1.924+-0.464	NI
17	CU *	0.338+-	0.024	0.057	0.338+- 0.032	1.000+-0.118	CU
18	ZN	0.158+-	0.012	0.026	0.302+- 0.089	1.913+-0.578	ZN
19	GA	0.004+-	0.002	0.001	0.003+- 0.010	0.897+-2.801	GA
20	AS	<	0.006	---	0.019+- 0.045	9.999+-9.999	AS
21	SE	<	0.002	---	0.000+- 0.007	0.000+-6.246	SE
22	BR *	0.243+-	0.017	0.041	0.244+- 0.068	1.004+-0.287	BR
23	RB	0.021+-	0.003	0.003	0.029+- 0.010	1.398+-0.512	RB
24	SR	0.147+-	0.011	0.025	0.168+- 0.016	1.142+-0.140	SR
25	Y	<	0.003	---	0.026+- 0.013	9.999+-9.999	Y
26	ZR	<	0.012	---	0.048+- 0.058	0.000+-0.000	ZR
27	CD	<	0.013	---	0.036+- 0.065	0.000+-0.000	CD
28	BA	0.656+-	0.098	0.110	0.898+- 0.514	1.369+-0.809	BA
29	LA	0.190+-	0.098	0.032	0.000+- 0.620	0.000+-3.261	LA
30	HG	<	0.002	---	0.016+- 0.013	0.000+-0.000	HG
31	PB	0.748+-	0.054	0.125	2.147+- 0.135	2.871+-0.273	PB

MEAS. AMB. MASS (UG/M3): 597.3

preceeding the days sampled, were characterized by dry, calm, low temperatures with no snow cover. RWC and DUST were the two dominate sources identified, each contributing about 40 to 50% of the mass.

On November 22nd, samples were collected at both the Super Bear and Floyd Dryden sites, Figures 4 and 5. Similar sources were found to contribute to both sites. The transportation source contribution was slightly greater at the Super Bear site, while the RWC impact was slightly greater at the Floyd Dryden site. The most significant difference was in the DUST contribution which was over two fold higher at the Floyd Dryden site than at the Super Bear location. This is even more suprising since the transportation contribution was nearly 50% greater at the Super Bear location. This suggests that a source other than road dust may be contributing the DUST at the Floyd Dryden site which may help explain the over prediction of Pb on days with high DUST contributions.

It should be noted that the CMB calculations were made completely independent of meteorological and other data. Only the source information was used to determine the best or most probable fit of the ambient data. Thus, comparison of CMB results with such data is a comparison of independent sets of information. Agreement or apparent reasonableness of the data provides additional support to the CMB conclusions. Contrasting data usually indicates some unknown in the system or erroneous information which can usually be resolved.

Figure 6 illustrates another group of sources fit to the November 22nd ambient data. In this case, a MARINE source was added to the sources used in the fit shown in Figure 5. Although the MARINE source contribution is reasonable (an impact of about 3 $\mu g/m^3$ was identified in Portland, Oregon), it was dropped in the final fit because the uncertainty in this source's contribution is slightly greater than the impact. This is a general fitting philosophy and may cause some systematic bias in the data.

Figures 7 and 8 illustrate another aspect of the CMB fitting procedure. Each figure illustrates the fit obtained using a slightly different set of sources. The main difference is in the use of SULFT (sulfate) in the fit shown in Figure 7 and DIST (distillate oil) in Figure 8. The distillate oil source provides an upper limit estimate for this source's contribution. It was used only on occasions, however, because it substantially overestimates its contribution because most of the fitting pressure is provided by sulfate which has both a substantial artifact and secondary aerosol contribution.

The source contributions are summarized in Tables 7-12 and are illustrated with pie charts in Figures 9-14. During the highest exposure days in the fall of 1982, under dry conditions, DUST contributed over 300 $\mu g/m^3$ of mass (54%) while this source contribution was below detection limits during the winter high exposure days. RWC impacts were higher in the winter, however, averaging about 226 $\mu g/m^3$ in the winter and about 170 $\mu g/m^3$ in the fall, when the average temperature was about 15° warmer.

RWC accounts for between 80 and 90% of the mass during meteorological regimes 3 through 5, while its percent contributions during dry conditions is reduced because of increased DUST levels. (The percent contributions listed in the pie charts may be slightly different from those in the tables because the table values were normalized to 100% for the pie charts.) The RWC impacts in $\mu g/m^3$ were strongly correlated with temperature for regimes 1-5 (correlation coefficient > 0.98). During calm weather regimes, the RWC impact could be predicted by the following linear function of temperature:

$$RWC = 198 - 4.52\ t$$

where t = temperature in degrees Fahrenheit.

The results for the composite samples (Figures 15-19) agree with the individual filters and are consistent with expectations based on source locations. For example, the lowest RWC impacts during December of 1982 were observed at the Municipal Building, 9.6 $\mu g/m^3$ (65%), as compared to 73 $\mu g/m^3$ (83%) at the Floyd Dryden site and 56 $\mu g/m^3$ (92%) at the Super Bear site.

Figure 7. CMB Results Using Sulfate Source

CMBDEQ RESULTS FOR CMB # P4409
TOTAL PARTICULATE FRACTION
SAMPLING DATE: 811230 SITE CODE: 01
SAMPLING DURATION: 24 HRS. WITH START HOUR: 0
SITE: FLOYD DRYDEN
EFFECTIVE VARIANCE FITTING. REDUCED CHI SQUARE: 1.593 D OF F: 4

CODE	SOURCE	FLG	UG/M3	%
1	RWC	*	211.094+-55.371	82.267+-22.029
2	TRANS	*	4.257+- 0.769	1.659+- 0.313
3	MARIN	*	7.712+- 5.368	3.005+- 2.098
7	SULFT	*	9.691+- 1.184	3.777+- 0.504
8	NH4	*	0.480+- 0.059	0.187+- 0.025
9	NO3	*	1.934+- 0.237	0.754+- 0.101
10	CU	*	0.061+- 0.008	0.024+- 0.003
	TOTAL:		235.228+-55.648	91.672+-22.242

CODE	SPECIE		MEAS.	TOTAL UG/M3	SUSPENDED PERCENT	PARTICULATE CALC. UG/M3	RATIO	
1	OC	*	105.380+-	8.915	41.069	100.270+-29.131	0.952+-0.288	OC
2	EC	*	29.745+-	3.563	11.592	27.020+-17.732	0.908+-0.606	EC
3	NH4	*	0.480+-	0.034	0.187	0.480+- 0.048	1.000+-0.122	NH4
4	F		0.608+-	0.043	0.237	0.000+- 0.002	0.000+-0.003	F
5	NO3	*	1.934+-	0.137	0.754	1.934+- 0.193	1.000+-0.123	NO3
6	SO4	*	9.691+-	0.681	3.777	9.691+- 0.969	1.000+-0.122	SO4
7	NA	*	3.411+-	2.136	1.329	3.260+- 0.323	0.956+-0.606	NA
8	CL		0.214+-	0.049	0.083	4.259+- 1.323	9.999+-9.999	CL
9	K	*	0.978+-	0.197	0.381	1.923+- 1.478	1.967+-1.563	K
10	CA		<	0.075	---	0.299+- 0.130	0.000+-0.000	CA
11	TI		<	0.003	---	0.014+- 0.005	0.000+-0.000	TI
12	V		<	0.001	---	0.000+- 0.002	0.000+-0.000	V
13	CR		<	0.001	---	0.000+- 0.002	0.000+-0.000	CR
14	MN	*	0.006+-	0.002	0.002	0.000+- 0.002	0.000+-0.330	MN
15	FE		<	0.012	---	0.079+- 0.034	0.000+-0.000	FE
16	NI		<	0.001	---	0.000+- 0.002	0.000+-0.000	NI
17	CU	*	0.061+-	0.005	0.024	0.061+- 0.006	1.000+-0.130	CU
18	ZN		0.138+-	0.010	0.054	0.082+- 0.078	0.593+-0.567	ZN
19	GA		<	0.001	---	0.000+- 0.002	0.000+-0.000	GA
20	AS		<	0.005	---	0.000+- 0.002	0.000+-0.000	AS
21	SE		<	0.001	---	0.000+- 0.002	0.000+-0.000	SE
22	BR	*	0.217+-	0.016	0.085	0.242+- 0.090	1.112+-0.421	BR
23	RB		<	0.002	---	0.000+- 0.002	0.000+-3.022	RB
24	SR		<	0.002	---	0.000+- 0.002	0.000+-0.000	SR
25	Y		<	0.002	---	0.000+- 0.002	0.000+-0.000	Y
26	ZR		<	0.010	---	0.000+- 0.002	0.000+-0.000	ZR
27	CD		<	0.011	---	0.000+- 0.002	0.000+-0.000	CD
28	BA		<	0.074	---	0.000+- 0.002	0.000+-0.000	BA
29	LA		<	0.086	---	0.000+- 0.002	0.000+-0.000	LA
30	HG		<	0.002	---	0.000+- 0.002	0.000+-0.000	HG
31	PB	*	0.603+-	0.043	0.235	0.587+- 0.110	0.974+-0.196	PB

MEAS. AMB. MASS (UG/M3): 256.6
* - FITTING ELEMENT

Figure 8. CMB Results Using Distillate Oil Source

```
CMBDEQ RESULTS FOR CMB # P4409
TOTAL  PARTICULATE FRACTION
 SAMPLING DATE: 811230   SITE CODE: 01
SAMPLING DURATION: 24 HRS. WITH START HOUR:  0
SITE: FLOYD DRYDEN
 EFFECTIVE VARIANCE FITTING.  REDUCED CHI SQUARE:   0.166 D OF F:  5
 CODE SOURCE FLG      UG/M3                  %
 ------------------------------------------------------------------
  1   RWC      * 190.994+-51.821    74.434+-20.590
  2   TRANS    *   3.260+- 1.068     1.271+- 0.422
  3   MARIN    *   8.103+- 5.378     3.158+- 2.103
  6   DIST     *  40.719+- 9.997    15.869+- 3.989
  8   NH4      *   0.480+- 0.059     0.187+- 0.025
  9   NO3      *   1.934+- 0.237     0.754+- 0.101
 ------------------------------------------------------------------
      TOTAL:     245.491+-53.061    95.672+-21.311

 SPECIE                TOTAL  SUSPENDED PARTICULATE
 CODE          MEAS. UG/M3   PERCENT  CALC. UG/M3        RATIO
 ------------------------------------------------------------------------------
   1 OC  * 105.380+- 8.915   41.069    98.052+-26.458  0.930+-0.263  OC
   2 EC  *  29.745+- 3.563   11.592    31.695+-18.556  1.066+-0.637  EC
   3 NH4*   0.480+- 0.034    0.187     0.480+- 0.048  1.000+-0.122  NH4
   4 F      0.608+- 0.043    0.237     0.000+- 0.002  0.000+-0.003  F
   5 NO3*   1.934+- 0.137    0.754     1.934+- 0.193  1.000+-0.123  NO3
   6 SO4*   9.691+- 0.681    3.777     8.470+- 3.201  0.874+-0.336  SO4
   7 NA  *  3.411+- 2.136    1.329     3.400+- 0.336  0.997+-0.632  NA
   8 CL     0.214+- 0.049    0.083     4.779+- 1.318  9.999+-9.999  CL
   9 K   *  0.978+- 0.197    0.381     1.763+- 1.337  1.803+-1.415  K
  10 CA          < 0.075      ---     0.483+- 0.253  0.000+-0.000  CA
  11 TI          < 0.003      ---     0.010+- 0.004  0.000+-0.000  TI
  12 V           < 0.001      ---     0.002+- 0.033  0.000+-0.000  V
  13 CR          < 0.001      ---     0.000+- 0.002  0.000+-0.000  CR
  14 MN *  0.006+- 0.002    0.002     0.006+- 0.004  0.891+-0.737  MN
  15 FE          < 0.012      ---     0.109+- 0.052  0.000+-0.000  FE
  16 NI          < 0.001      ---     0.004+- 0.003  0.000+-0.000  NI
  17 CU *  0.061+- 0.005    0.024     0.069+- 0.024  1.133+-0.404  CU
  18 ZN    0.138+- 0.010    0.054     0.085+- 0.071  0.618+-0.517  ZN
  19 GA          < 0.001      ---     0.000+- 0.002  0.000+-0.000  GA
  20 AS          < 0.005      ---     0.000+- 0.002  0.000+-0.000  AS
  21 SE          < 0.001      ---     0.000+- 0.002  0.000+-0.000  SE
  22 BR *  0.217+- 0.016    0.085     0.200+- 0.070  0.921+-0.328  BR
  23 RB          < 0.002      ---     0.000+- 0.002  0.000+-2.793  RB
  24 SR          < 0.002      ---     0.000+- 0.002  0.000+-0.000  SR
  25 Y           < 0.002      ---     0.000+- 0.002  0.000+-0.000  Y
  26 ZR          < 0.010      ---     0.000+- 0.002  0.000+-0.000  ZR
  27 CD          < 0.011      ---     0.000+- 0.002  0.000+-0.000  CD
  28 BA          < 0.074      ---     0.000+- 0.002  0.000+-0.000  BA
  29 LA          < 0.086      ---     0.000+- 0.002  0.000+-0.000  LA
  30 HG          < 0.002      ---     0.000+- 0.002  0.000+-0.000  HG
  31 PB *  0.603+- 0.043    0.235     0.670+- 0.224  1.110+-0.380  PB
 ------------------------------------------------------------------------------
MEAS. AMB. MASS (UG/M3):  256.6
  * - FITTING ELEMENT
```

Table 7

Average Source Contributions for Regime 1:
Fall Highest Exposure Days

REGIME 1
TOTAL PARTICLE FRACTION
SAMPLING PERIOD: 82/11/19 TO 82/11/22
NUMBER OF SAMPLES : 3
AVERAGE CHI-SQUARED : 1.45

SOURCE	MEAN	*A	*B	*C	MEAN	*A	#>MDC	%>MDC
	(UG/M3)				(PERCENT)			
RWC	171.27+-35.64	61.73	46.71		33.38+- 7.84		3	100.0
TRANS	2.79+- 1.47	2.54	0.82		0.61+- 0.37		2	66.0
MARIN	2.40+- 2.40	4.15	1.47		0.38+- 0.38		1	50.0
DUST	301.97+-80.80	$139.	14.22		54.07+- 8.61		3	100.0
SULFT	4.18+- 2.41	4.18	0.92		0.95+- 0.63		2	66.0
NH4	0.38+- 0.09	0.16	0.05		0.08+- 0.03		3	100.0
NO3	1.28+- 0.33	0.58	0.16		0.25+- 0.07		3	100.0
CU	0.11+- 0.10	0.16	0.02		0.02+- 0.02		2	66.0
UNEXPL	52.65+-12.90	22.34			10.25+- 2.73			
SUM	537.02				100.00			

AVE. MASS 537.02 UG/M3

Table 8

Average Source Contributions for Regime 2:
Winter Highest Exposure Days

REGIME 2
TOTAL PARTICLE FRACTION
SAMPLING PERIOD: 81/12/30 TO 82/01/02
NUMBER OF SAMPLES : 2
AVERAGE CHI-SQUARED : 1.17

SOURCE	MEAN	*A	*B	*C	MEAN	*A	#>MDC	%>MDC
	(UG/M3)				(PERCENT)			
RWC	220.56+- 9.46	13.38	57.96		78.77+- 3.49		2	100.0
TRANS	4.80+- 0.55	0.77	0.87		1.70+- 0.05		2	100.0
MARIN	8.23+- 0.52	0.73	5.37		2.93+- 0.07		2	100.0
SULFT	10.41+- 0.72	1.02	1.27		3.71+- 0.07		2	100.0
NH4	0.30+- 0.18	0.25	0.04		0.11+- 0.07		2	100.0
NO3	2.19+- 0.25	0.36	0.27		0.78+- 0.02		2	100.0
CU	0.07+- 0.01	0.02	0.01		0.03+- 0.00		2	100.0
UNEXPL	34.51+-13.14	18.59			11.96+- 3.63			
SUM	281.08				100.00			

AVE. MASS 281.08 UG/M3

*A - STANDARD DEVIATION OF THE MEAN (STANDARD ERROR)
*B - STANDARD DEVIATION OF THE DISTRIBUTION
*C - AVERAGE SOURCE CONTRIBUTION UNCERTAINTY

Table 9

Average Source Contributions for Regime 3:
Cold, Clear, Calm Days

REGIME 3
TOTAL PARTICLE FRACTION
SAMPLING PERIOD: 81/12/09 TO 82/01/21
NUMBER OF SAMPLES : 3
AVERAGE CHI-SQUARED : 0.55

SOURCE	MEAN	*A	*B	*C	MEAN	*A	#>MDC	%>MDC
	(UG/M3)				(PERCENT)			
RWC	129.37+-19.46	33.71	34.51		84.06+- 0.89		3	100.0
TRANS	3.14+- 0.30	0.51	0.56		2.13+- 0.37		3	100.0
MARIN	10.42+- 1.62	2.81	5.60		6.79+- 0.61		3	100.0
DUST	9.43+- 9.43	16.34	0.55		4.81+- 4.81		1	100.0
SULFT	6.62+- 0.62	1.08	0.83		4.44+- 0.67		3	100.0
NH4	0.13+- 0.11	0.19	0.02		0.07+- 0.06		2	100.0
NO3	1.30+- 0.21	0.36	0.16		0.89+- 0.20		3	100.0
CU	0.11+- 0.04	0.07	0.01		0.08+- 0.03		3	100.0
UNEXPL	1.33+- 0.77	1.33			1.01+- 0.60			
SUM	161.86				104.28			
AVE. MASS	153.47 UG/M3							

Table 10

Average Source Contributions for Regime 4:
Clear, Calm, Warmer Days

REGIME 4
SUMMAR PARTICLE FRACTION .
SAMPLING PERIOD: 81/02/07 TO 82/12/31
NUMBER OF SAMPLES : 4
AVERAGE CHI-SQUARED : 0.42

SOURCE	MEAN	*A	*B	*C	MEAN	*A	#>MDC	%>MDC
	(UG/M3)				(PERCENT)			
RWC	73.41+-13.62	27.24	19.74		80.98+- 5.18		4	100.0
TRANS	3.12+- 0.74	1.49	0.56		3.45+- 0.45		4	100.0
MARIN	1.77+- 1.77	3.54	1.23		1.56+- 1.56		1	100.0
DUST	0.18+- 0.18	0.36	0.06		0.41+- 0.41		1	25.0
DIST	1.66+- 1.66	3.33	0.61		1.46+- 1.46		1	100.0
SULFT	5.04+- 0.76	1.53	0.81		6.15+- 1.25		4	100.0
NO3	1.33+- 0.27	0.54	0.16		1.47+- 0.09		4	100.0
CU	0.06+- 0.02	0.04	0.01		0.07+- 0.03		3	75.0
UNEXPL	6.04+- 2.69	5.39			6.52+- 2.30			
SUM	92.61				102.06			
AVE. MASS	90.80 UG/M3							

*A - STANDARD DEVIATION OF THE MEAN (STANDARD ERROR)
*B - STANDARD DEVIATION OF THE DISTRIBUTION
*C - AVERAGE SOURCE CONTRIBUTION UNCERTAINTY

Table 11

Average Source Contributions for Regime 5:
Snow/Rain, Calm Days

REGIME 5
TOTAL PARTICLE FRACTION
SAMPLING PERIOD: 81/12/15 TO 82/11/28
NUMBER OF SAMPLES : 3
AVERAGE CHI-SQUARED : 0.65

SOURCE	MEAN	*A	*B	*C	MEAN	*A	#>MDC	%>MDC
	(UG/M3)				(PERCENT)			
RWC	83.22+-	7.95	13.78	22.32	122.04+-	20.93	3	100.0
TRANS	1.59+-	0.42	0.73	0.29	2.14+-	0.12	3	100.0
MARIN	5.99+-	3.05	5.28	3.62	9.10+-	5.96	2	100.0
SULFT	3.97+-	0.47	0.81	0.59	5.99+-	1.59	3	100.0
NH4	0.47+-	0.23	0.41	0.06	0.56+-	0.22	3	100.0
NO3	0.65+-	0.29	0.50	0.09	0.85+-	0.43	3	100.0
CU	0.08+-	0.02	0.03	0.01	0.13+-	0.05	3	100.0
UNEXPL	0.00+-	0.00	0.00		0.00+-	0.00		
SUM	95.97				140.81			

AVE. MASS 74.57 UG/M3

Table 12

Average Source Contributions for Regime 6:
Dry, Calm, Days with Potential
High Fugitive Dusts

REGIME 6
TOTAL PARTICLE FRACTION
SAMPLING PERIOD: 83/03/04 TO 83/03/04
NUMBER OF SAMPLES : 2
AVERAGE CHI-SQUARED : 1.02

SOURCE	MEAN	*A	*B	*C	MEAN	*A	#>MDC	%>MDC
	(UG/M3)				(PERCENT)			
RWC	31.79+-	6.99	9.88	9.20	25.24+-	6.04	2	100.0
TRANS	1.01+-	0.66	0.93	0.42	0.63+-	0.19	2	100.0
DUST	77.78+-	41.86	59.20	4.03	52.26+-	6.98	2	100.0
DIST	7.74+-	7.74	10.95	1.99	9.76+-	9.76	1	100.0
SULFT	1.15+-	1.15	1.62	0.24	0.57+-	0.57	1	50.0
NH4	0.14+-	0.14	0.20	0.06	0.18+-	0.18	1	100.0
NO3	1.22+-	0.18	0.26	0.15	1.00+-	0.31	2	100.0
CU	0.03+-	0.03	0.05	0.01	0.02+-	0.02	1	50.0
UNEXPL	19.77+-	18.34	25.94		10.34+-	8.53		
SUM	140.63				100.00			

AVE. MASS 140.63 UG/M3

*A - STANDARD DEVIATION OF THE MEAN (STANDARD ERROR)
*B - STANDARD DEVIATION OF THE DISTRIBUTION
*C - AVERAGE SOURCE CONTRIBUTION UNCERTAINTY

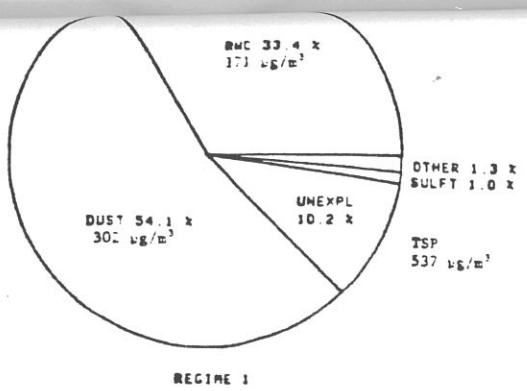

Figure 9. Average source contributions during highest exposure days in the Fall of 1982 when dry, cold and calm weather conditions prevailed. No snow cover or precipitation for preceeding week and average temperature of 10°.

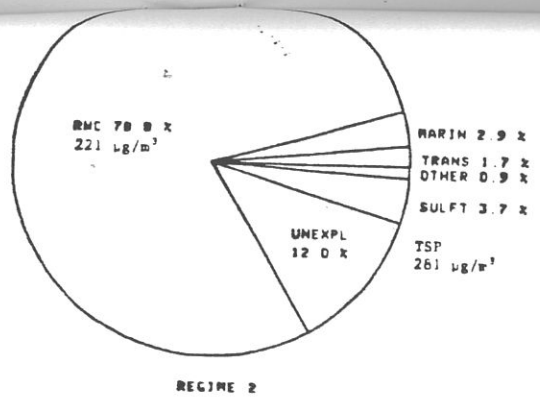

Figure 10. Average source contributions during highest exposure days during the 1981/1982 Winter. No snow cover or precipitation for preceeding week and average temperature of -5°.

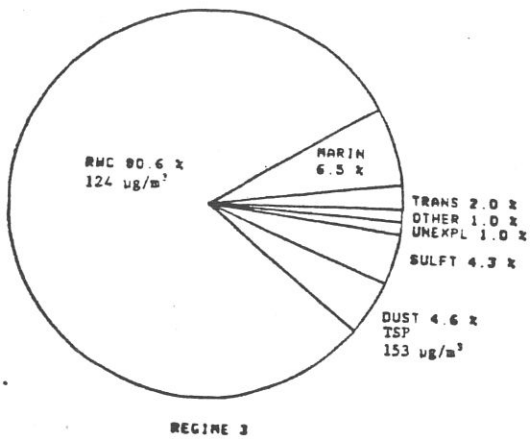

Figure 11. Average source contributions for Regime 3: cold, clear, calm days with average temperature of about 12°.

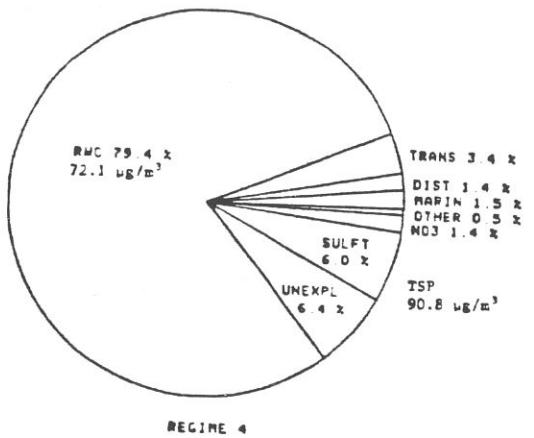

Figure 12. Average source contributions for Regime 4: clear, calm, warmer days with average temperature of 28°.

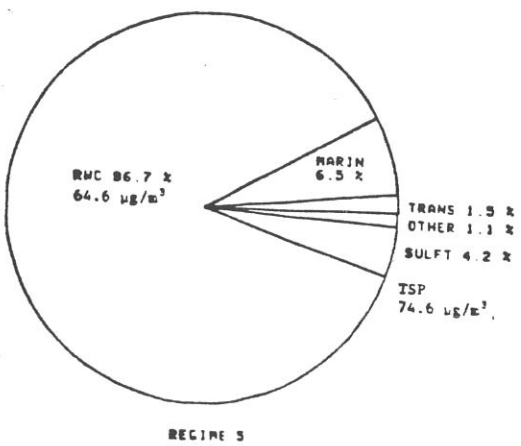

Figure 13. Average source contributions for Regime 5: snow/rain, calm days with average temperature of 30°.

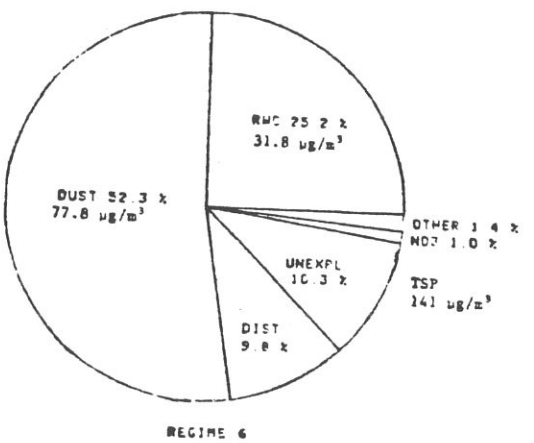

Figure 14. Average source contributions for Regime 6: dry, calm days with potential for high fugitive dust. Average temperature was 27°.

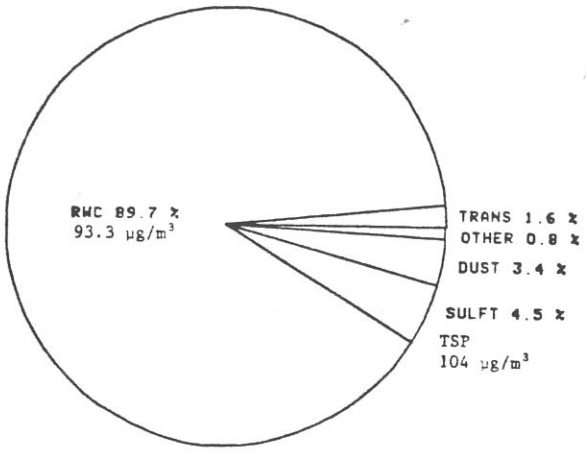

Figure 15. December, 1981, composite source contributions at Floyd Dryden.

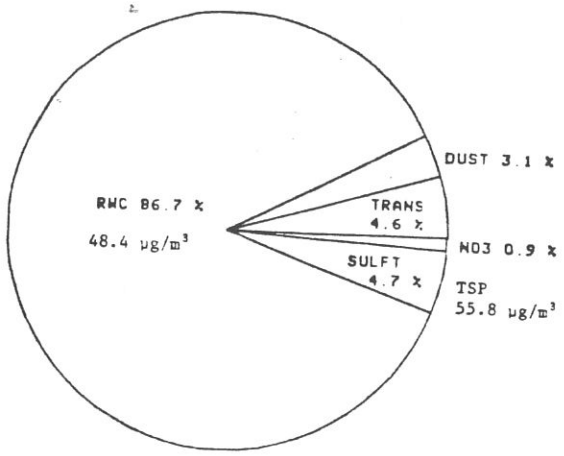

Figure 16. December, 1981, composite source contributions at Super Bear.

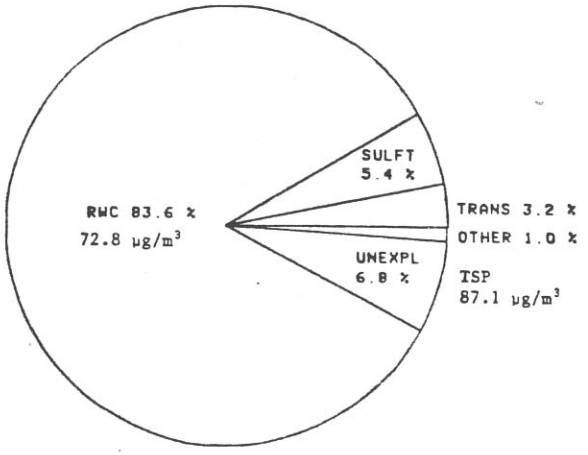

Figure 17. December, 1982, composite source contributions at Floyd Dryden.

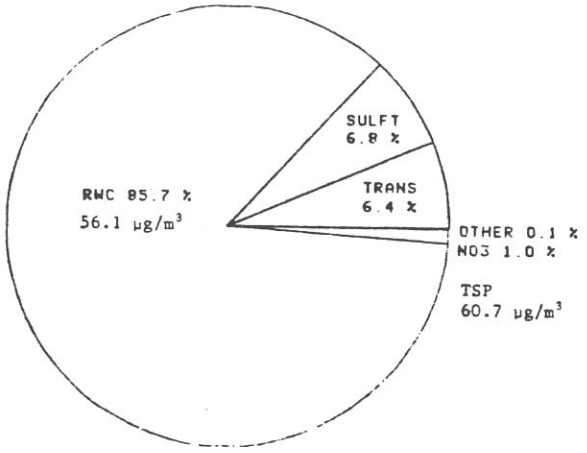

Figure 18. December, 1982, composite source contributions at Super Bear.

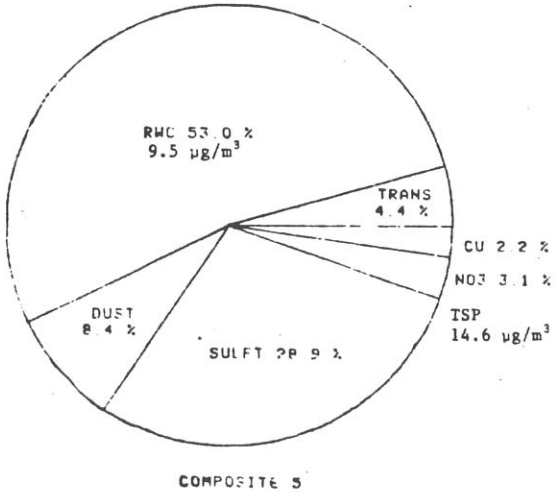

Figure 19. December, 1981, composite source contributions at the Juneau Municipal Building.

On the other hand, the transportation source contribution was lowest at the Floyd Dryden site, 2.8 $\mu g/m^3$, and highest at the Super Bear location, 4.2 $\mu g/m^3$. A similar pattern was noted for the December, 1981, composite samples.

4.0 CONCLUSIONS AND RECOMMENDATIONS

RWC sources typically contribute between 100 and 230 $\mu g/m^3$ of fine particulate mass on cold, calm days and are responsible for between 40% and 90% of the TSP, depending mainly on the relative contribution of crustal dust sources such as road and parking lot dust. The dust contributions were much more variable ranging from less than detection limits to over 300 $\mu g/m^3$, depending mainly on ground conditions (dry, snow, or rain). RWC impacts were highest at the Floyd Dryden site and lowest at the Municipal Building site, while transportation source contributions were highest at the Super Bear site.

The contribution of distillate oil combustion sources could not be defined but an extreme upper limit could be established by assuming all of the sulfate was from this source. Although such upper limits may be high by 2 to 10 fold, it clearly shows that this is far from being one of the most significant sources and it probably contributes less than about 10 $\mu g/m^3$ in most cases.

Simple, low-cost, routine procedures for monitoring the impact of RWC sources can probably be developed and validated for the Mendenhall Valley and other relatively simple airsheds in Alaska. Those procedures might be based on such measurements as visibility, gaseous species, graphitic carbon by optical means, OC/EC ratios, fine particle mass, etc. Whatever procedure is selected, it would first have to be validated by intercomparison and correlation studies with other independent methods.

The largest uncertainty in the results of this study is in the oil combustion contribution. This uncertainty could be reduced considerably by sampling with a dichotomous sampler and focusing elemental analysis on the fine particle fraction (< 2.5 μm) where over 95% of the mass from these two sources would be deposited. The contribution of all three fine particle sources (RWC, oil, and transportation) would be defined much more precisely. Radiocarbon analysis would add independent confirmation for the relative contributions of these particulate sources. Radiocarbon analysis of carbon monoxide can also provide the most accurate assessment of the contribution of RWC to this criteria pollutant.

5.0 REFERENCES

1. DeCesar, R.T. and J.A. Cooper, "Medford Aerosol Characterization Study (MACS)," Final report to Oregon Dept. of Envir. Quality., Oregon Graduate Center Report, Feb. 3, 1981.

2. Cooper, J.A. and J.G. Watson, "Portland Aerosol Characterization Study," Final report to Oregon Dept. of Envir. Quality, Oregon Graduate Center Report, July 31, 1979.

3. Watson, J.G., Chemical Element Balance Receptor Model Methodology for Assessing the Sources of Fine and Total Suspended Particulate Matter in Portland, Oregon, Thesis, Oregon Graduate Center, Feb., 1979.

4. Kowalczyk, J.F. and W.T. Greene, "New Techniques for Identifying Ambient Air Impacts from Residential Wood Heating," in Residential Solid Fuels, Ed. J.A. Cooper and D. Malek, Oregon Graduate Center, p. 469, 1982.

5. Zoller, W., Univ. of Maryland, Private communication, June, 1980.

6. Muhlbaier, J.L., "A Characterization of Emissions from Wood-Burning Fireplaces," in Residential Solid Fuels, Ed. J.A. Cooper and D. Malek, Oregon Graduate Center, p. 164, 1982.

7. Pierson, W.R. and W.W. Brachaczek, "Particulate Matter Associated with Vehicles on the Road," proc. Auto. Eng. Cong. and Expo., Detroit, MI, Feb. 12, 1976.

8. Cooper, J.A., "Environmental Impact of Residential Wood Combustion Emissions and Its Implications," J. Air Pollution Control Assoc., 30 p. 855, 1980.

9. Murphy, D.J., R.M. Buchan, and D.G. Fox, "Ambient Particulate and Benzo(a)Pyrene Concentrations from Residential Wood Combustion, In a Mountain Resort Community," in Residential Solid Fuels, Ed. J.A. Cooper and D. Malek, Oregon Graduate Center, p. 495, 1982.

10. Particulate Polycyclic Organic Matter, U.S. National Academy of Sciences, Washington, D.C., 1972.

Appendix I

Meteorological Regime Characteristics

Mendenhall Valley TSP Source Apportionment Study

Meteorological Characteristics of Selected Sample Days

I. Weather Regime I; Cold, Clear, Calm conditions Temperature 5-25°F

1. Floyd Dryden A 12/9/81 TSP = 196 ug/m^3 Filter # 1218834

   4 days since rain, no snow cover at airport

   Meteorology:

   Airport - Average Temperature = 22°F Ave. W.S. = 2.6 mph Ave. Dir. = 70°

   Floyd Dryden - no data

   Montana Creek Average Temp = 13°F Ave W.S.= calm Ave. Dir = calm

2. Floyd Dryden A 1/19/82 TSP = 136 ug/m^3 Filter # 2072989

   4 days since snow, 17" snow cover at airport

   Meteorology:

   Airport Average Temp. = 14°F Ave. W.S. = 5.2 mph Ave. Dir = 30°

   Floyd Dryden Ave. Temp = 6°F Ave. W.S. = calm Ave. Dir = calm

3. Floyd Dryden B 1/21/83 TSP= 129 ug/m^3 Filter # 3397394

   Very calm and stagnent, little or no snow cover, 2 days no precipitation

   Meteorology:

   Airport - Average Temp. = 22°F Ave. W.S. = calm Ave. Dir. =calm

   Floyd Dryden - no data

II. Weather Regime 2; Clear, calm, warmer Temperature 25-40°F

1) Floyd Dryden A 2/7/82 TSP = 118 ug/m^3 Filter # 2072967

Fog, 2 days since snow, 26" snow cover at airport

Meteorology:

Airport Average Temp = 28° Ave. W.S.= 1.7 mph Ave. Dir = 340°

Floyd Dryden Av. Temp = 20° Ave. W.S. Calm Ave. Dir calm

2) Super Bear 2/7/82 TSP = 114 ug/m^3 Filter # 2072960

Same as above

3) Floyd Dryden 12/31/82 TSP = 87 ug/m^3 Filter # 2075763

Fog and smoke, trace precipitation with melting snow cover, AIR ALERT,

Meteorological:

Airport Ave. Temp = 33°F Ave. W.S. = 2.5 mph Ave. Dir= 80°

Floyd Dryden - no data

4) Floyd Dryden 2/26/83 TSP = 44 ug/m^3 Filter # 3397875

Heavy fog, clear above, little or no snow cover, fog 2 previous days, no precipitation.

Meteorology:

Airport - Ave. Temp 36° Ave. W.S. = 1.2 mph Ave. Dir = 220°

Floyd Dryden Ave. Temp 36° Ave. W.S. = calm Ave Dir = calm

Montana Creek Ave. Temp 34° Ave. W.S.= calm Ave. Dir = calm

III Weather Regime 3 - Snow/rain, calm weather

1) Floyd Dryden B 11/28/82 TSP = 114 ug/m^3 Filter # 2075340

snow/rain mix, rain 1 of 2 previous days, no snow cover

Meteorology:

Airport Ave Temp =32° Ave. W.S. = 1.6 mph Ave Dir = 60°

Floyd Dryden Ave Temp = 30° Ave. W.S. = calm Ave. Dir = calm

2) Floyd Dryden A 12/21/81 TSP = 49 ug/m^3 filter # 1218848

Rain/drizzle, 7 days of previous rain, no snow cover

Meteorology:

Airport Ave Temp = 34° Ave W.S. = 7.6 mph Ave Dir = 100°

Floyd Dryden - no data

3) Floyd Dryden A 12/15/81 TSP = 60 ug/m^3 Filter # 1218843

Rain/snow mix, snow previous day, 6" snow cover

Meteorology:

Airport: Ave. Temp = 30° Ave. W.S. = 5.3 mph Ave. Dir = 90°

Floyd Dryden - no data

III Weather Regime 3 - Snow/rain, calm weather

1) Floyd Dryden B 11/28/82 TSP = 114 ug/m^3 Filter # 2075340

snow/rain mix, rain 1 of 2 previous days, no snow cover

Meteorology:

Airport Ave Temp =32° Ave. W.S. = 1.6 mph Ave Dir = 60°

Floyd Dryden Ave Temp = 30° Ave. W.S. = calm Ave. Dir = calm

2) Floyd Dryden A 12/21/81 TSP = 49 ug/m^3 filter # 1218848

Rain/drizzle, 7 days of previous rain, no snow cover

Meteorology:

Airport Ave Temp = 34° Ave W.S. = 7.6 mph Ave Dir = 100°

Floyd Dryden - no data

3) Floyd Dryden A 12/15/81 TSP = 60 ug/m^3 Filter # 1218843

Rain/snow mix, snow previous day, 6" snow cover

Meteorology:

Airport: Ave. Temp = 30° Ave. W.S. = 5.3 mph Ave. Dir = 90°

Floyd Dryden - no data

IV Weather Regime 4- Dry, calm with high potential fugitive dusts

1) Super Bear 3/4/83 TSP = 202 ug/m^3 Filter # 3397285

Dry, calm, morning and evening inversion w/smoke, no precipitation for 4 days, AIR ALERT

Meteorology:

Airport Ave. Temp = 34° Ave W.S. = 3.8 mph Ave. W.D. = 220°

Floyd Dryden Ave. Temp = 270° Ave. W.S. = 0.6 mph Ave. W.D. = 180°

2) Floyd Dryden B 3/4/83 TSP = 79 ug/m^3 Filter # 3397283

Same as above

V Highest Exposure Days

1) Super Bear 11/22/82 TSP = 390 ug/m^3 Filter # 2075377

Dry, cold, calm, 7 days no precipitation, no snow cover

Meteorology:

Airport Ave Temp = 19°F Ave W.S. = 0.9 mph Ave. Dir= 70°

Floyd Dryden Ave Temp = 7°F Ave W.S. = calm Ave Dir = calm

2) Floyd Dryden B 11/19/82 TSP = 624 ug/m^3 Filter # 2075397

Dry, cold, calm no precipitation 3 previous days, no snow cover

Meteorology:

Airport Ave Temp = 15° Ave W.S. = 9.1 Ave Dir = 120°

Floyd Dryden Ave Temp = 12° Ave. W.S. = 1/5 mph Ave Dir = 75°

3) Floyd Dryden A 11/22/82 TSP = 597 ug/m^3 Filter # 2075378

Same as # 1 above

4) Floyd Dryden A 12/30/81 TSP = 256 ug/m^3 Filter # 2072987

Cold, calm, 5 days since rain, no snow cover

Meteorology:

Airport Ave Temp = 6° Ave W.S = 10.1 Ave Dir = 90°

Floyd Dryden Ave Temp = -4° Ave W.S. = calm Ave Dir = calm

5) Floyd Dryden A 1/2/82 TSP = 306 ug/m^3 Filter # 2072993

Cold, calm 8 days since rain, no snow cover

Meteorology:

Airport Ave Temp = 6° Ave W.S. = 10.1 Ave. Dir = 110°
Floyd Dryden Ave Temp = -7° Ave W.S. = calm Ave Dir = calm