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Project Summary

Toxic Chemicals in the Environment: A Program of Field Measurements

H. B. Singh, R. J. Ferek, L. J. Salas, and K. C. Nitz

An environmental mobile laboratory was instrumented and employed to perform a series of eight field studies of one-to-three weeks duration during which around-the-clock measurements of organic chemicals were performed in six United States sites under a variety of meteorological conditions. Field studies involved on-site analysis of 29 organic chemicals, many of which are mutagens or suspect carcinogens. Chemicals measured included chlorofluorocarbons, halomethanes, haloethanes, halopropanes, chlorinated alkenes, aromatic hydrocarbons, organic nitrogen compounds and aldehydes. The measured data are reported as mixing ratios and interpreted in the context of their mean diurnal behavior and chemical removal rates. Except for aromatic hydrocarbons and aldehydes, average concentrations of measured species were in the 0-to-5 ppb range. The average concentration range for aromatics and aldehydes was in the 0-25 ppb range. Maximum measured concentrations were typically 5 to 10 times the mean values. Typical diurnal profiles showed highest concentrations in the night and early morning hours. Minimum values observed in the afternoon were probably due to deep vertical mixing. Studies in San Jose, CA, clearly showed the effect of meteorology with mean concentrations rising four to seven times normal values under stagnant conditions. Ambient data suggest that aldehydes are less abundant in winter. Interpretation of aromatic hydrocarbon data from southern California showed that the prevailing hydroxyl radical concentrations of 2.6 x 10^6 molec. cm^{-3} in February are not significantly different from values determined for summer. Analysis of historic data further suggests that the concentrations of benzene (the dominant toxic chemical in ambient air) have declined by a factor of about 10 in the ambient air of southern California over the last two decades.

This Project Summary was developed by EPA's Atmospheric Sciences Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Over the last three decades large amounts of a growing number of synthetic organic chemicals have been released into the ambient environment. Urban atmospheres contain a complex mixture of chemicals, many of which are known to be toxic at concentrations significantly higher than those encountered in typical ambient atmospheres. The degree to which the general ambient environment contributes to human cancer is a matter of both active research and debate. A report from the Office of the U.S. Surgeon General concluded that "toxic chemicals are adding to the disease burden of the United States in a significant, although as yet not precisely defined way" (U.S.S.G., 1980). The process of understanding the risks associated with exposure to potentially hazardous chemicals requires a determination of the ranges of concentrations that can be found in the ambient air.

This study was initiated primarily to measure the atmospheric concentrations of a variety of potentially hazardous

gaseous organic chemicals* at selected urban locations under varying meteorological and source-strength conditions. The chemicals were sampled and analyzed on site using a suitably outfitted mobile laboratory. The overall program of analytical methods development, field measurements, data collection, and data analysis is expected to provide information that will permit a better assessment of the atmospheric abundance and chemistry of this potentially harmful group of chemicals.

Procedures

Because of problems associated with surface reactions, the integrity of an air sample is best maintained when only nominal amounts of air samples are collected, and the time between collection and analysis is kept to a minimum. In this study, an on-site field analysis program was devised to meet these requirements. The sampling manifold was all stainless steel with a variable inlet height.(Always, the sampling manifold was adjusted to be higher than nearby structures; a typical manifold inlet height was 5 m above ground.) For pumping and pressuring air samples, a special stainless-steel metal bellows compression pump (Model MB 158) was always used. For the analysis of aldehydes, surface air was sampled in an all-glass apparatus.

For all of the measured halogenated species and organic nitrogen compounds, electron-capture detector (ECD) gas chromatography (GC) was the primary means of analysis. The aromatic hydrocarbons were measured using flame-ionization detector (FID) gas chromatography. Formaldehyde and acetaldehyde were measured by analyzing the 2,4-dinitrophenylhydrazine derivatives formed by reaction of 2,4-dinitrophenylhydrazine (DNPH) with aldehydes, using high-performance liquid chromatographic (HPLC) methods.

All GC channels were equipped with stainless-steel sampling valves and could be operated either with a direct sampling loop or with a preconcentration trap. In no instance was a sample size of greater than one liter used. Usually, sample volumes of 500 ml or less were satisfactory.

Two types of sampling procedures were employed. During the first five field programs, an on line 2-liter SUMMA^R polished stainless steel canister was pressurized to 32 psi during a three to five minute period, and this air was used for GC analysis.

*The term "hazardous chemicals" as used here is not intended to imply that a proven human health hazard exists. Usually, toxicity studies are incomplete or inconclusive and involve extrapolation of animal data to humans.

During the last three field programs at San Jose, CA, a different sampling arrangement was used to provide two-hourly integrated samples. An evacuated 6-liter SUMMA^R polished stainless steel canister was slowly pressurized using a metal bellows pump and a mass flow controller. In this manner, about 18 liters (STP) of air were pumped into the 6-liter canister over a two-hour period.

Eight field studies were performed in the following six select urban environments in the continental United States:

- Philadelphia, Pennsylvania
- Staten Island, New York
- Downey, California
- Houston, Texas
- Denver, Colorado
- San Jose, California

Within the above cities, specific sites were chosen that represented an open urban area. Large point sources or topographical features that could affect the representativeness of the measurements were avoided. Every attempt was made to select sites that could be expected to be indicative of general pollution levels prevalent in the area. It must be emphasized that only one site within each of the selected cities was monitored. The data collected here, while perhaps typical of general ambient environment, are truly representative only of the specific site monitored.

The site locations and the periods of field measurements are shown in Table 1. On the average each field study was of roughly two weeks duration with a range of one to three weeks. Based on our past experience we believed that significant night and daytime differences were likely in the abundance of organic chemicals. Thus we concluded that despite the logistical difficulty, a 24-hour measurement schedule offered the most efficient means to collect the maximum amount of data needed to characterize the burden of toxic organic chemicals in the ambient air. Additionally, night abundances of trace chemicals were likely to provide important information about the sources and sinks of measured species. Therefore, a 24-hour-per-day, seven-days-a-week measurement schedule was followed during all field programs.

Results

The data collected during these studies have been compiled, validated, and statistically summarized. The statistical summaries of all field data are presented in Tables 2, 3, and 4. All concentrations are expressed in units of parts per trillion by volume (pptv - 10^{-12} v/v). Quantities tabulated are the means and standard deviations (one sigma), maximum and minimum concentrations, and the number of positive (nonzero) measurements as well as the total number of measurements performed. These statistics include all measured data. When the concentration was below our detectable limit, it was assigned a value of zero. Usually, values were not below detection.

Conclusions and Recommendations

The measurements were analyzed to see if seasonal cycles or long-term trends were discernible in the data. The role of seasonal cycles was examined by considering the concentrations of selected anthropogenic species as measured at the San Jose site during April, August, and December. During the December experiment, a high-pressure system blanketed the area pushing carbon monoxide levels to 14 ppm (the highest in five years). A mixing depth of less than 20 meters was frequently encountered. Although emissions of these chemicals probably vary seasonally, there is every indication that this is a small change compared to the effect of the meteorological parameters observed during the December experiment. This four-to-six fold increase implies local sources and shallow mixed layer. For chemicals like carbon tetrachloride, where little or no local sources may exist, the atmospheric levels are nearly invariant. Further analysis is needed to establish the relationship between ambient levels and meteorological conditions. It is not possible from this data to conclude that winter levels in San Jose are typically higher than summer levels. To the extent that the boundary layer is deeper during summer, it is reasonable to assume that reduced summer levels may prevail. Superimposed on the meteorological conditions are variations in emissions (which are also not known for any given city) and chemical removal processes.

Data from four cities which were revisited after several years were also analyzed. One can perhaps conclude that the levels of methylene chloride and trichloroethylene have declined over the last four to five years. However, no definitive seasonal or long-term trends can be established without a clear knowledge of the emissions and meteorological conditions. While detailed meteorological analysis is beyond the scope of this study, it may be possible to analyze these data in the future in the context of prevailing meteorology. Any attempt to estimate

human exposure from these measurements must also employ meteorological analysis for temporal extrapolation.

Because of the source complexity and wide variations in meteorological parameters, short-term experiments such as those performed here are inadequate for establishing long-term trends.

Although these studies were of short-term duration, our practice of around-the-clock operation allowed for extensive data collection. The degree of temporal and spatial variability in the atmospheric abundance of toxic chemicals is clear from data presented. Typical concentrations of most chemicals measured were in the sub-ppb range with the exception of aromatic hydrocarbons and formaldehyde (where average concentrations in the 1-to-25 ppb range were encountered). For most predominantly man-made chemicals, average concentrations in urban atmospheres were one-to-two orders of magnitude higher than in clean remote atmospheres.

Meteorology appeared to play a strong role in the average abundance as well as in the diurnal behavior of these chemicals. Typical diurnal profiles showed highest concentrations in the night and early morning hours and minimum values in the afternoon, probably due to deep vertical mixing at this time. The diurnal patterns in San Jose were somewhat different but they also clearly showed the effect of meteorology on the abundance of chemicals. Mean concentrations under severe stagnant conditions encountered at San Jose rose to 4-to-7 times normal values. Ambient data suggest that aldehydes are less abundant in winter compared to summer months. Interpretation of aromatic hydrocarbon data in southern California showed that the prevailing hydroxyl radical concentrations of 2.6×10^6 molec. cm^{-3} in February are not significantly different from values computed for summer. This is in apparent contradiction to a commonly made assumption that winter hydroxyl levels are much lower.

On the whole, we conclude that typical urban atmospheres contain chemicals that are known to be toxic at much higher concentrations. Exposures to ambient levels of these species are highly variable. The task of characterizing the atmosphere with which this study is most concerned is itself, at best, highly incomplete. Much more atmospheric and toxicity data will be needed to determine the risks associated with long-term exposures to low levels of toxic species.

Table 1. *Field Sites and Measurement Schedule*

Experiment No.	City	Experiment Period	Site Address
1	Philadelphia, PA	4-22 April 1983	Lycoming and Castor St.
2	Staten Island, NY	25 April - 1 May 1984	Wild Ave. and Victory Blvd.
3	Downey, CA	18-27 February 1984	7601 East Imperial Rancho Los Amigos Hospital
4	Houston, TX	9-17 March 1984	Mae St. and I-10 Frontage Road
5	Denver, CO	24 March - 1 April 1984	Marion and E. 51 St.
6	San Jose, CA	4-16 April 1985	Alma and Senter Road (San Jose Historic Museum)
7	San Jose, CA	12-24 August 1985	Alma and Senter Road (San Jose Historic Museum)
8	San Jose, CA	13-21 December 1985	Alma and Senter Road (San Jose Historic Museum)

Table 2. *Atmospheric Concentrations of Measured Chemicals for Philadelphia and Staten Island*

	Philadelphia 4-22 April 1983					Staten Island 25 April - 1 May 1983				
	PPTV					PPTV				
Chemical Group and Species	Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]	Mean	S.D.	Maximum	Minimum	n/N
Chlorofluorocarbons:										
Trichlorofluoromethane (F-11)	369	182	1667	211	88/88	284	110	614	137	33/33
Dichlorodifluoromethane (F-12)	595	279	2474	340	88/88	566	269	1554	296	32/32
Trichlorotrifluoroethane (F-113)	—	—	—	—	—	—	—	—	—	—
Dichlorotetrafluoroethane (F-114)	41	88	616	10	76/76	24	13	80	10	31/31
Halomethanes:										
Methyl chloride	769	299	2883	348	91/91	654	280	1367	328	33/33
Methyl bromide	47	30	124	23	34/34	80	96	447	25	23/23
Methyl iodide	3	3	9	0.8	8/8	5	2	9	3	21/21
Methylene chloride (Dichloromethane)	622	559	3098	121	91/91	1109	1614	8868	243	34/34
Chloroform (Trichloromethane)	60	39	272	12	146/146	88	53	279	27	54/54
Carbon tetrachloride	280	220	2015	126	171/171	387	310	1475	131	66/66
Haloethanes and Halopropanes:										
Ethyl chloride	66	125	555	<10	19/19	47	28	107	21	11/11
1,2-Dichloroethane	—	—	—	—	—	—	—	—	—	—
1,2-Dibromoethane	21	49	436	<5	144/147	19	8	41	8	58/58
1,1,1-Trichloroethane	491	25	2679	164	172/172	403	257	1435	120	66/66

(Continued)

Table 2. *Atmospheric Concentrations of Measured Chemicals for Philadelphia and Staten Island*

Chemical Group and Species	Philadelphia 4-22 April 1983 PPTV Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]	Staten Island 25 April - 1 May 1983 PPTV Mean	S.D.	Maximum	Minimum	n/N
1,2-Dichloropropane	72	91	560	18	140/140	41	17	80	<10	54/54
Chloroalkenes:										
Trichloroethylene	149	173	1003	12	166/166	164	188	1021	12	63/63
Tetrachloroethylene	570	529	4337	76	284/284	792	901	4793	127	117/117
Aromatic Hydrocarbons:										
Benzene	1917	1721	11074	269	293/293	4367	6620	33960	117	99/99
Toluene	4260	4141	30576	382	287/297	7436	9340	44672	462	100/100
Ethyl Benzene	760	778	7256	85	264/297	2678	4186	16648	<50	76/100
m/p-Xylene	1598	1489	14050	194	283/297	2635	3286	15594	<50	83/100
o-Xylene	847	847	5852	<50	232/297	2596	3549	17353	<50	56/100
3/4-Ethyl toluene	714	636	3891	<50	192/297	1603	1597	6644	<50	46/100
1,3,5-Trimethyl benzene	526	333	1374	<50	31/297	1565	1814	7286	<50	24/100
1,2,4-Trimethyl benzene	943	757	5363	<50	222/297	2858	4841	29696	<50	54/100
Oxygenated Species:										
Peroxyacetylnitrate (PAN)	1068	678	3721	<50	281/309	1578	1111	5475	386	116/116
Peroxypropionylnitrate (PPN)	139	94	501	<50	280/309	213	150	902	<50	116/118
Formaldehyde	—	—	—	—	—	—	—	—	—	—
Acetaldehyde	—	—	—	—	—	—	—	—	—	—

[a] Arithmetic Mean.
[b] One standard deviation.
[c] n is the number of positive (non-zero) measurements; N is the total number of valid measurements.

Table 3. *Atmospheric Concentrations of Measured Chemicals for Downey, Houston, and Denver*

Chemical Group and Species	Downey 18-27 February 1984 PPTV Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]	Houston 9-17 March 1984 PPTV Mean	S.D.	Maximum	Minimum	n/N
Chlorofluorocarbons:										
Trichlorofluoromethane (F-11)	685	356	1718	168	45/47	488	142	1041	251	48/48
Dichlorodifluoromethane (F-12)	1183	779	3641	314	48/48	512	156	941	332	48/48
Trichlorotrifluoroethane (F-113)	118	53	313	48	47/47	58	16	114	36	48/48
Dichlorotetrafluoroethane (F-114)	34	20	89	12	47/47	18	3	30	12	47/47
Halomethanes:										
Methyl chloride	792	237	1655	470	48/48	961	361	2278	520	47/47
Methyl bromide	212	226	815	18	44/44	23	8	48	11	45/45
Methyl iodide	3	2	10	<1	45/45	12	10	51	2	47/47
Methylene chloride (Dichloromethane)	2399	1604	6641	443	47/47	324	300	1584	71	46/46
Chloroform (Trichloromethane)	135	81	385	26	64/64	249	243	1588	47	110/110
Carbon tetrachloride	199	71	331	103	48/48	291	175	1154	158	48/48
Haloethanes and Halopropanes:										
Ethyl chloride	28	17	106	11	43/43	448	871	2981	11	40/44
1,2-Dichloroethane	102	134	630	20	45/45	450	673	2456	<5	47/48
1,2-Dibromoethane	102	83	420	<5	52/61	293	550	3181	<5	104/106
1,1,1-Trichloroethane	1161	609	2727	161	64/64	375	208	1235	121	110/110
1,2-Dichloropropane	35	34	157	<2	43/64	158	108	724	<2	100/106
Chloroalkenes:										
Trichloroethylene	184	155	738	22	64/64	61	106	880	<2	104/110
Tetrachloroethylene	1471	694	3711	341	64/64	169	245	1604	20	109/109
Aromatic Hydrocarbons:										
Benzene	8720	5940	28790	970	107/107	6130	5838	40320	1030	102/102
Toluene	16890	12251	63970	1640	106/106	7270	9479	78160	270	100/102
Ethyl Benzene	4580	3712	16090	280	104/104	1540	1589	8200	<50	99/102
m/p-Xylene	10210	7785	37480	920	104/104	3340	3066	17910	<50	101/102
o-Xylene	4180	3219	15960	<50	103/103	1380	1389	7200	<50	89/102

(Continued)

Table 3. *(Continued)*

Chemical Group and Species	Downey 18-27 February 1984 PPTV Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]	Houston 9-17 March 1984 PPTV Mean	S.D.	Maximum	Minimum	n/N
3/4-Ethyl toluene	3220	2512	12270	<50	102/103	770	890	5920	<50	84/102
1,3,5-Trimethyl benzene	850	923	4040	<50	63/104	170	714	6760	<50	20/102
1,2,4-Trimethyl benzene	4020	3324	15590	<50	100/104	990	1005	7180	<50	76/102
Oxygenated Species:										
Peroxyacetylnitrate (PAN)	1231	1112	6671	67	207/207	751	787	7925	<50	188/193
Peroxypropionylnitrate (PPN)	60	67	403	<50	145/206	45	78	538	<50	89/189
Formaldehyde	15500	5900	41000	2000	48/48	3800	8300	22500	<400	11/11
Acetaldehyde	8500	6300	28400	1000	48/48	2200	1700	6700	<200	11/11

Table 3. *(Continued)*

Chemical Group and Species	Denver 24 March - 1 April 1984 PPTV Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]
Chlorofluorocarbons:					
Trichlorofluoromethane (F-11)	555	89	770	412	42/42
Dichlorodifluoromethane (F-12)	648	546	2811	334	42/42
Trichlorotrifluoroethane (F-113)	41	41	282	22	42/42
Dichlorotetrafluoroethane (F-114)	26	8	64	17	41/41
Halomethanes:					
Methyl chloride	780	227	1602	573	41/41
Methyl bromide	22	11	64	13	41/41
Methyl iodide	2	1	8	1	42/42
Methylene chloride (Dichloromethane)	569	456	2699	104	42/42
Chloroform (Trichloromethane)	123	40	259	38	98/98
Carbon tetrachloride	264	26	363	225	42/42
Haloethanes and Halopropanes:					
Ethyl chloride	23	21	123	9	41/41
1,2-Dichloroethane	23	29	124	<5	31/38
1,2-Dibromoethane	122	84	601	<5	98/99
1,1,1-Trichloroethane	647	320	1850	256	98/98
1,2-Dichloropropane	163	62	312	<2	96/97
Chloroalkenes:					
Trichloroethylene	53	49	241	5	99/99
Tetrachloroethylene	434	419	2499	51	99/99
Aromatic Hydrocarbons:					
Benzene	2230	2081	13480	380	85/85
Toluene	3340	3871	25780	390	85/85
Ethyl Benzene	1100	3454	31480	<50	70/85
m/p-Xylene	1900	2322	14770	<50	82/85
o-Xylene	630	1142	6630	<50	50/85
3/4-Ethyl toluene	440	707	4220	<50	48/85
1,3,5-Trimethyl benzene	80	221	1300	<50	14/85
1,2,4-Trimethyl benzene	650	972	5650	<50	53/85
Oxygenated Species:					
Peroxyacetylnitrate (PAN)	644	348	2039	191	209/209
Peroxypropionylnitrate (PPN)	22	29	85	<50	82/209
Formaldehyde	2300	1800	5500	<400	21/21
Acetaldehyde	1000	500	2100	<200	21/21

[a] Arithmetic Mean.
[b] One standard deviation.
[c] n is the number of positive (non-zero) measurements; N is the total number of valid measurements.

Table 4. *Atmospheric Concentrations of Measured Chemicals for San Jose*

Chemical Group and Species	4-16 April 1985 PPTV Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]	12-24 August 1985 PPTV Mean	S.D.	Maximum	Minimum	n/N
Chlorofluorocarbons:										
Trichlorofluoromethane (F-11)	529	217	1613	252	119/119	450	179	1330	244	127/127
Dichlorodifluoromethane (F-12)	1020	477	2751	458	117/117	881	345	2058	427	129/129
Trichlorotrifluoroethane (F-113)	1256	755	4605	395	117/117	616	407	2410	166	126/126
Dichlorotetrafluoroethane (F-114)	59	39	239	19	115/115	72	143	888	12	123/123
Halomethanes:										
Methyl chloride	1060	274	2508	673	116/116	–	–	–	–	–
Methyl bromide	400	549	4661	44	114/114	121	146	1067	<5	112/114
Methyl iodide	5	6	51	1	104/104	3	2	<10	1	128/128
Methylene chloride (Dichloromethane)	1534	906	4311	403	117/117	1119	1056	8257	142	128/128
Chloroform (Trichloromethane)	64	27	138	23	119/119	58	35	180	11	139/139
Carbon tetrachloride	193	51	398	55	119/119	144	20	213	85	142/142
Haloethanes and Halopropanes:										
Ethyl chloride	–	–	–	–	–	–	–	–	–	–
1,2-Dichloroethane	–	–	–	–	–	–	–	–	–	–
1,2-Dibromoethane	21	7	41	9	40/40	–	–	–	–	–
1,1,1-Trichloroethane	360	174	905	120	118/118	283	68	518	133	142/142
1,2-Dichloropropane	31	14	70	9	87/87	25	9	61	9	136/136
Chloroalkenes:										
Trichloroethylene	63	48	266	8	113/113	68	54	266	10	141/141
Tetrachloroethylene	427	259	1530	58	115/115	264	169	767	36	139/139
Aromatic Hydrocarbons:										
Benzene	3296	2239	11747	379	123/123	2060	1258	7816	441	145/145
Toluene	5667	4206	22155	637	122/122	3904	2742	19612	709	145/145
Ethyl Benzene	1213	1108	6355	131	122/122	859	736	4088	173	144/144
m/p-Xylene	3619	2701	14641	649	122/122	1981	1431	8380	515	140/140
o-Xylene	1361	950	5085	121	119/119	913	659	5125	216	141/141
3/4-Ethyl toluene	1023	756	4066	128	120/120	649	433	2927	147	142/142
1,3,5-Trimethyl benzene	224	208	1608	69	121/121	168	124	773	34	141/141
1,2,4-Trimethyl benzene	1272	832	4518	233	116/116	715	521	3591	112	135/135
Oxygenated Species:										
Peroxyacetylnitrate (PAN)	–	–	–	–	–	–	–	–	–	–
Peroxypropionylnitrate (PPN)	–	–	–	–	–	–	–	–	–	–
Formaldehyde	–	–	–	–	–	–	–	–	–	–
Acetaldehyde	–	–	–	–	–	–	–	–	–	–

Table 4. *(Continued)*

Chemical Group and Species	13-21 December 1985 PPTV Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]
Chlorofluorocarbons:					
Trichlorofluoromethane (F-11)	585	170	971	239	80/80
Dichlorodifluoromethane (F-12)	1435	376	2450	670	91/91
Trichlorotrifluoroethane (F-113)	1211	351	2321	476	92/92
Dichlorotetrafluoroethane (F-114)	227	245	967	34	94/94
Halomethanes:					
Methyl chloride	1118	581	4870	194	92/92
Methyl bromide	2869	3098	15424	239	92/92
Methyl iodide	9	4	23	3	80/80
Methylene chloride (Dichloromethane)	4181	1795	10310	1034	91/91
Chloroform (Trichloromethane)	102	38	203	38	93/93
Carbon tetrachloride	155	43	266	90	93/93
Haloethanes and Halopropanes:					
Ethyl chloride	–	–	–	–	–
1,2-Dichloroethane	–	–	–	–	–
1,2-Dibromoethane	7	3	18	2	61/61
1,1,1-Trichloroethane	1219	721	3174	345	93/93
1,2-Dichloropropane	24	5	35	9	85/85

Table 4. *(Continued)*

Chemical Group and Species	13-21 December 1985				
	PPTV				
	Mean[a]	S.D.[b]	Maximum	Minimum	n/N[c]
Chloroalkenes:					
Trichloroethylene	271	194	907	71	93/93
Tetrachloroethylene	1858	1202	6639	311	93/93
Aromatic Hydrocarbons:					
Benzene	12372	4501	23425	3921	95/95
Toluene	21155	8801	45947	6676	95/95
Ethyl Benzene	6176	3046	14453	1553	95/95
m/p-Xylene	13144	5809	25330	3672	95/95
o-Xylene	5714	2170	11001	2024	95/95
3/4-Ethyl toluene	4224	1574	8285	1476	95/95
1,3,5-Trimethyl benzene	1298	575	2662	254	95/95
1,2,4-Trimethyl benzene	5367	1903	10376	1838	95/95
Oxygenated Species:					
Peroxyacetylnitrate (PAN)	—	—	—	—	—
Peroxypropionylnitrate (PPN)	—	—	—	—	—
Formaldehyde	—	—	—	—	—
Acetaldehyde	—	—	—	—	—

[a] *Arithmetic Mean.*
[b] *One standard deviation.*
[c] *n is the number of positive (non-zero) measurements; N is the total number of valid measurements.*

H. B. Singh, R. J. Ferek, L. J. Salas, and K. C. Nitz are with SRI International, Menlo Park, CA 94025.
***L. T. Cupitt** is the EPA Project Officer (see below).*
The complete report, entitled "Toxic Chemicals in the Environment: A Program of Field Measurements," (Order No. PB 86-239 910/AS; Cost: $16.95, subject to change) will be available only from:
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