11.0 RESULTS

11.1 Introduction

As discussed previously, field samples were selected in a series of campaigns at each of the four (4) monitoring sites. Results are reported here for each of the four (4) categories of analyses: PAH, PCDDs/PCDFs, nitro-PAH/oxygenated-PAH, and mutagenicity. As is customary for ambient programs, all reported data have bee corrected using the appropriate field blank. Section 10.7 provides additional discussion regarding the significance of field blank results. Results within each of these analyte categories are further sorted according to location of the sampling program, as follows: Rice Straw, Fresno and Richmond.

11.2 Polynuclear Aromatic Hydrocarbons (PAHs)

11.2.1 Rice Straw Campaign

Results are provided for each of twenty (20) field samples selected for analyses via GC/MS SIM in Table 11-1. Results for eight (8) additional QA/QC samples (field blanks, method blanks, trip blanks, lab spike, solvent blank) are provided in Table 11-2. Results are provided in units of ng/m^3 for each of the PAH target parameters listed earlier in Table 4-2. All data shown represent field blank corrected values.

The customary sample-specific quality control data associated with these analyses are also provided. These include results of field applied surrogates (% recovery) and laboratory internal standard data (% recovery).

11.2.2 Fresno Campaign

Results are provided for each of eight (8) field samples selected for PAHs analyses in Table 11-3. Results for five (5) additional field blanks associated with the field samples are summarized in Table 11-4. All data are reported in units of ng/m^3 for each of the PAH target parameters listed earlier in Table 4-2. All data shown represent field blank corrected values. Sample-specific quality control data associated with these analyses are also provided. These include field applied surrogates (% recovery) and laboratory internal standard data (% recovery).

TABLE 11-1

Rice Straw Field Program
Ambient Monitoring Data For PAHs (field blank corrected)

Sampling Date	10-17-90	10-18-90	10-18-90	10-22-90	10-22-90	10-23-90	10-23-90
Field ID	CF-6	CF-9	CF-11	CF-17	CF-19	PG-11	CF-23
Lab ID	CF2D-S-515	CF3D-S-481	CF3N-S-499	493-PAHS	524-PAHS	514-PAHS	475-PAHS
Period	diurnal	diurnal	nocturnal	diurnal	nocturnal	diurnal	nocturnal
Spiking Status	spiked	spiked	spiked	spiked	spiked	spiked	spiked
Site	Colusa	Colusa	Colusa	Colusa	Colusa	Pl. Grove	Colusa
Sample Volume (m3)	212.8	173.7	160.9	142.0	185.0	328.3	182.0
Parameter	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)
Naphthalene	30	60	38	171	61	5.0	168
2-Methylnaphthalene	25	29	19	118	48	3.8	109
1-Methylnaphthalene	11	12	9.6	39	18	1.8	50
Biphenyl	85	191	128	240	114	33.8	86
Acenaphthylene	0.89	1.0	1.1	2.7	3.6	0.16	5.5
Acenaphthene	1.8	1.2	0.57	2.5	2.3	0.37	5.1
Fluorene	2.1	3.6	2.0	2.7	3.8	0.45	5.4
Phenanthrene	4.2	7.3	3.7	7.5	7.4	1.0	11
Anthracene	0.48	0.26	0.36	0.35	0.77	0.34	1.5
Fluoranthene	1.2	1.8	1.0	1.3	1.4	0.38	1.9
Pyrene	0.93	1.1	1.0	1.4	1.6	0.45	2.7
Retene	0.26	0.39	0.18	1.0	0.45	0.23	0.88
Benz(a)anthracene	0.29	0.28 B	0.26	0.04	0.09	0.19	0.26
Chrysene/Triphenylene	0.39	0.31	0.48	0.11	0.14	0.23	0.54
Benzo(b,j,k)fluoranthenes	0.83	0.33	0.68	0.58 B	0.36	0.45	0.47
Benz(e)pyrene	0.20	0.48	0.12 U	0.32	0.32	0.02	0.20
Benz(a)pyrene	0.26	0.18 B	0.28	0.23 B	0.14	0.19	0.18
Indeno(123,cd)pyrene	0.28	0.03	0.34	0.27 B	0.19	0.17	0.19
Dibenz(a,c/a,h)anthracene	0.24	0.12 U	0.45	0.49 B	0.37 B	0.22	0.20
Benzo(g,h,i)perylene	0.34	0.04	0.40	0.11	0.45	0.19	0.48
Coronene	0.29	0.45	0.31	0.55	0.59	0.06 U	0.60
Surrogate Recoveries (%)							
Flourene, D10 (field surrogate)	88	77	69	65	71	51	58
2-Fluorobiphenyl (lab surrogate)	69	57	NS	49	48	46	NS
Terphenyl, D14 (lab surrogate)	135	100	NS	101	105	63	NS

U = undetected at specified quantitation limit
B = blank value (shown) exceeds measured value NS = not spiked (to accomodate mutagenicity testing).

TABLE 11-1 (Cont'd)

Rice Straw Field Program
Ambient Monitoring Data For PAHs (field blank corrected)

Sampling Date	10-24-90	10-24-90	10-25-90	10-25-90	10-26-90	10-31-90	11-5-90
Field ID	PG-15	CF-26	PG-19	CF-28	CF-32	CF-38	PG-36
Lab ID	516-PAHS	484-PAHS	519-PAHS	82780	509-PAH	COL-28	591-PAHU
Period	diurnal	nocturnal	diurnal	diurnal	nocturnal	diurnal	nocturnal
Spiking Status	spiked	spiked	spiked	spiked	spiked	unspiked	unspiked
Site	Pl. Grove	Colusa	Pl. Grove	Colusa	Colusa	Colusa	Pl. Grove
Sample Volume (m3)	161.0	187.7	167.6	131.5	197.7	295.0	181.7
Parameter	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)
Naphthalene	4.0	217	109	29	11.9	67	5.2
2-Methylnaphthalene	2.7	148	529	17	6.5	33	2.6
1-Methylnaphthalene	1.3	64	26	7.2	3.0	16	1.3
Biphenyl	94	157	943	407	19	53	5.3
Acenaphthylene	0.07	5.3	0.53	0.20	0.13	2.4	0.11 U
Acenaphthene	0.68 T	5.2	2.6	1.1	0.27	1.4	0.17
Fluorene	1.0	6.3	3.9	2.0	0.55	3.1	0.81
Phenanthrene	1.3	12	6.3	2.9	1.3	7.4	0.91
Anthracene	0.17 B	1.5	0.02	0.11	0.11	1.2	0.11 U
Fluoranthene	0.12	2.0	0.87	0.91	0.44	2.6	0.28
Pyrene	0.16	3.0	0.64	0.71	0.31	2.2	0.23
Retene	0.35	2.0	0.66	0.39	0.51	0.17	1.10
Benz(a)anthracene	0.03 U	0.28 NC	0.29 B	NDI	0.12 NC	0.44	0.12
Chrysene/Triphenylene	0.29 B	0.39	0.27 B	NDI	0.24	0.75	0.22 U
Benzo(b,j,k)fluoranthenes	0.52 B	0.43	0.50 B	0.23 U	0.30 U	1.2	0.33 U
Benz(e)pyrene	0.06	0.35	0.23	0.08 U	0.10 U	0.51	0.11 U
Benz(a)pyrene	0.03 U	0.26	0.19 B	0.09	0.14	0.51	0.13 NC
Indeno(123,cd)pyrene	0.24 B	0.26	0.23 B	0.08 U	0.10 U	0.41	0.11 U
Dibenz(a,c/a,h)anthracene	0.06 U	0.91	0.06 U	0.15 U	0.20 U	0.14 U	0.22 U
Benzo(g,h,i)perylene	0.29 B	0.21 U	0.28 B	0.10	0.13	0.61	0.11 U
Coronene	0.06 U	1.1	0.40	0.21	0.20 U	0.54	0.22 U
Surrogate Recoveries (%)							
Flourene, D10 (field surrogate)	23	57	131	120	61	NS	NS
2-Fluorobiphenyl (lab surrogate)	23	NS	105	74	NS	NS	NS
Terphenyl, D14 (lab surrogate)	30	NS	100	110	NS	NS	NS

U = undetected at specified quantitation limit T = tentative identification NDI = not detected due to matrix interference

B = blank value (shown) exceeds measured value NS = not spiked (to accomodate mutagenicity testing) NC = not confirmed due to interference

TABLE 11-1 (Cont'd)

Rice Straw Field Program
Ambient Monitoring Data For PAHs (field blank corrected)

Sampling Date	11-5-90	11-7-90	11-7-90	11-7-90	11-7-90	11-8-90
Field ID	CF-46	PG-39	CF-50	PG-40	CF-49	CF-51
Lab ID	85-PAHU	596-PAHU	110-PAHU	181-PAHU	77-PAHU	598-PAHU
Period	nocturnal	diurnal	diurnal	diurnal	nocturnal	nocturnal
Spiking Status	spiked	unspiked	unspiked	spiked	unspiked	unspiked
Site	Colusa	Pl. Grove	Colusa	Pl. Grove	Colusa	Colusa
Sample Volume (m3)	200.0	264.5	196.0	383.4	174.6	194.4
Parameter	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)
Naphthalene	20	48	207	195	95	127
2-Methylnaphthalene	6.4	27	122	101	68	92
1-Methylnaphthalene	3.3	13	51	47	31	42
Biphenyl	19	157	207	155	129	173
Acenaphthylene	0.41	2.1	9.2	12	4.8	5.7
Acenaphthene	0.41	NDI	4.7	3.1	2.4	1.9
Fluorene	0.35	3.5	5.0	5.7	5.7	5.6
Phenanthrene	0.26	6.0	10	17	11	9.7
Anthracene	0.10 U	0.53	1.4	3.7	1.5	1.8
Fluoranthene	0.70	1.8	2.8	5.7	3.0	3.0
Pyrene	0.75	3.0	2.7	4.7	3.4	2.7
Retene	1.1	1.4	1.1	1.6	1.4	1.0
Benz(a)anthracene	0.39	0.21 NC	0.39 NC	1.4 NC	0.53 NC	0.57 NC
Chrysene/Triphenylene	0.65	0.42	0.56	1.7	0.86	0.67
Benzo(b,j,k)fluoranthenes	1.1	0.53	1.4	4.2	1.7	1.7
Benz(e)pyrene	0.39	0.18	0.66	1.6	0.80	0.82
Benz(a)pyrene	0.60	0.18	0.77	1.8	0.86	0.82
Indeno(123,cd)pyrene	0.33	0.27	0.56	0.76	0.52	0.77
Dibenz(a,c/a,h)anthracene	0.20 U	0.08 U	0.10 U	0.05 U	0.11	0.17
Benzo(g,h,i)perylene	0.34	0.42	1.2	0.91	1.0	1.3
Coronene	0.30	0.61	1.7	1.0	0.92	2.0
Surrogate Recoveries (%)						
Flourene, D10 (field surrogate)	50	NS	NS	NS	NS	NS
2-Fluorobiphenyl (lab surrogate)	NS	87	59	56	60	79
Terphenyl, D14 (lab surrogate)	NS	220	130	180	110	160

U = undetected at specified quantitation limit NC = not confirmed due to matrix interference

NS = not spiked (to accomodate mutagenicity testing) NDI = not detected due to matrix interference

TABLE 11-2

Rice Straw Field Program
Quality Control Analyses

Blank Type [A]	Field Blank		Field Blank		Field Blank		Method Blank		Method Blank		Trip Blank	Lab Spike	Solvent Blank
Field ID	CF4-PAH-520		FB3-PAH/513		FB1-PAH-496		ENSR XAD		Supelco XAD		NA	NA	NA
Lab ID	81934		81949		81942		MB900906		MB900910		82743	LCS910003	MB910003
Parameter	ng	ng/m^3	ng	ng/m^3	ng	ng/m^3	ng	ng/m^3	ng	ng/m^3	ng	% recovery	ng
Naphthalene	330	1.83	350	1.94	660	3.67	200	1.11	1100	6.11	74	190	33
2-Methylnaphthalene	120	0.67	120	0.67	260	1.44	54	0.30	180	1.00	27	120	24
1-Methylnaphthalene	47	0.26	52	0.29	93	0.52	19	0.11	70	0.39	11	80	10
Biphenyl	630	3.50 S	430	2.39	1900	10.56	170	0.94 S	77	0.43 S	79 S	120	90
Acenaphthylene	15	0.08	10	0.06 U	10	0.06	10	0.06 U	5	0.03 U	10 U	81	10 U
Acenaphthene	17	0.09	19	0.11	20	0.11	7	0.04 J	9	0.05	10 U	61	10 U
Fluorene	25	0.14	12	0.07	21	0.12	8	0.04 J	8	0.04	10 U	140	10 U
Phenanthrene	53	0.29	14	0.08	39	0.22	20	0.11	15	0.08	25	490	13
Anthracene	47	0.26	10	0.06 U	27	0.15	10	0.06 U	7	0.04	10 U	140	10 U
Fluoranthene	60	0.33	7	0.04 J	24	0.13	11	0.06	5	0.03	10 U	220	10 U
Pyrene	46	0.26	6	0.03 J	23	0.13	10	0.06	5	0.03	10 U	190	51
Retene	10	0.06 U	10	0.06 U	5	0.03 U	12	0.07	12	0.07	15	150	10 U
Benz(a)anthracene	52	0.29	NDI	0.00	48	0.27	18	0.10	4	0.02 J	10 U	56	6 J
Chrysene/Triphenylene	65	0.36	NDI	0.00	46	0.26	9	0.05 J	10	0.06 U	20 U	65	20 U
Benzo(b,j,k)fluoranthenes	140	0.78	30	0.17 U	83	0.46	16	0.09 J	15	0.08 U	30 U	61	30 U
Benz(e)pyrene	10	0.06 U	10	0.06 U	5	0.03 U	12	0.07	5	0.03 U	10 U	55	10 U
Benz(a)pyrene	55	0.31	7	0.04 J	32	0.18	8	0.04 J	5	0.03 U	10 U	74	6 J
Indeno(123,cd)pyrene	49	0.27	10	0.06 U	39	0.22	5	0.03 J	4	0.02 J	10 U	64	10 U
Dibenz(a,c/a,h)anthracene	120	0.67	20	0.11 U	69	0.38	20	0.11 U	10	0.06 U	20 U	75	20 U
Benzo(g,h,i)perylene	110	0.61	10	0.06 U	47	0.26	10	0.06	4	0.02 J	10 U	57	10 U
Coronene	20	0.11 U	20	0.11 U	10	0.06 U	20	0.11 U	10	0.06 U	20 U	75	20 U
Surrogate Recoveries (%)													
Flourene, D10 (field surrogate)	46		80		NS		50		NS		NS	69	NS
2-Fluorobiphenyl (lab surrogate)	36		46		86		32		79		27	44	NR
Terphenyl, D14 (lab surrogate)	69		140		119		49		92		81	60	78

U = undetected at specified quantitation limit T = tentative identification S = solvent effects J = estimated value

B = blank value (shown) exceeds measured value NS = not spiked NDI = not detected due to matrix interference NR - not recovered

A = typical sample volume of 180 m^3 used to calculate blank levels.

TABLE 11-3

Fresno Field Program
Ambient Monitoring Data For PAHs

Sampling Date	12-17-90	12-17-90	12-18-90	1-2-91	1-2-91	1-3-91	1-4-91	1-4-91
Field ID	F1PP 718	F1PA 720	F2PA 603	F3PAS 350	F3PPS 327	F4PAS 321	F5PAS 333	F5PPS 18
Lab ID	82935	82934	82940	82986	82984	82981	82973	82976
Period	nocturnal	diurnal	diurnal	diurnal	nocturnal	diurnal	diurnal	nocturnal
Spiking Status	spiked	unspiked	unspiked	spiked	spiked	spiked	spiked	spiked
Site	Fresno	Fresno	Fresno	Fresno	Fresno	Fresno	Fresno	Fresno
Sample Volume (m3)	181.2	151.6	183.2	184.4	186.7	179.0	196.7	184.2
Parameter	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)	(ng/m3)
Naphthalene	1301 E	1357	520	464	587	947	240	148
2-Methylnaphthalene	882	856	326	298	455	670	198	113
1-Methylnaphthalene	391	362	141	135	209	296	86	52
Biphenyl	240	327	344	756	586	1114	216	166
Acenaphthylene	160	99	32	34	70	52	18	5.9
Acenaphthene	15	10	4.5	4.9	8.0	7.3	3.0	2.1
Fluorene	45	26	11	18	28	26	11	5.4
Phenanthrene	110	61	27	43	64	61	29	12
Anthracene	23	11	5.0	5.4	10	7.3	3.7	1.1
Fluoranthene	32	21	7.6	13	18	18	10	5.9
Pyrene	31	20	7.1	11	15	15	8.6	5.1
Retene	72	21	6.6	8.1	21	11	6.0	4.2
Benz(a)anthracene	13	7.3	2.1	2.5	5.0	3.0	1.1	0.39
Chrysene/Triphenylene	17	10	2.7	3.8	8.6	4.3	1.6	0.76
Benzo(b,j,k)fluoranthenes	25	18	3.5	6.0	11	7.3	2.7	1.4
Benz(e)pyrene	9.3	5.4	1.5	2.2	4.0	2.9	1.0	0.46
Benz(a)pyrene	12	6.6	2.0	2.7	5.9	3.1	1.0	0.31
Indeno(123,cd)pyrene	5.2	6.6	1.9	2.4	4.6	3.5	1.2	0.44
Dibenz(a,c/a,h)anthracene	1.7	1.3	0.3	0.4	0.91	0.56	0.10	0.11 U
Benzo(g,h,i)perylene	5.2	7.2	2.0	2.7	4.4	4.1	1.2	0.47
Coronene	13 E	11	2.6	3.1	5.9	5.6	1.6	0.49
Surrogate Recoveries (%)								
Flourene, D10 (field surrogate)	75	NS	NS	70	84	84	91	68
2-Fluorobiphenyl (lab surrogate)	78	72	48	60	56	84	78	47
Terphenyl, D14 (lab surrogate)	256	132	101	105	179	131	94	73

U = undetected at specified quantitation limit E = exceeds calibration range

B = blank value (shown) exceeds measured value NS = not spiked (to accomodate mutagenicity testing).

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TABLE 11-4

Fresno Field Program
QA\QC Analytical Results

Sampling Date	12-17-90		12-18-90		1-2-91		1-3-91		1-4-91		4-2-91	
Field ID	F Blank		F Blank		F Blank		F Blank		F Blank		Method Bl	
Lab ID	82938		82942		82987		82982		82977		910168	
Period	---		---		---		---		---		---	
Spiking Status	unspiked		unspiked		unspiked		unspiked		spiked		unspiked	
Site	Fresno		Fresno		Fresno		Fresno		Fresno		Fresno	
Sample Volume (m3) [A]	180.0		180.0		180.0		180.0		180.0		180.0	
Parameter	ng	ng/m3	ng	ng/m3	ng	ng/m3	ng	ng/m3	ng	ng/m3	ng	ng/m3
Naphthalene	4300	24	4800	27	450	2.5	540	3.0	750	4.2	470	2.6
2-Methylnaphthalene	260	1.4	240	1.3	120	0.67	88	0.49	130	0.72	20	0.11
1-Methylnaphthalene	120	0.7	120	0.67	54	0.30	37	0.21	55	0.31	10	0.056 U
Biphenyl	440	2.4	960	5.3	550	3.1	530	2.9	480	2.7	200	1.1
Acenaphthylene	16	0.089	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Acenaphthene	15	0.083	19	0.11	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Fluorene	10	0.056 U	120	0.67	10	0.056	10	0.056 U	10	0.056 U	10	0.056 U
Phenanthrene	29	0.16	30	0.17	22	0.12	17	0.094	24	0.13	22	0.12
Anthracene	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Fluoranthene	21	0.12	10	0.056 U	14	0.078	10	0.056 U	10	0.056 U	10	0.056 U
Pyrene	21	0.12	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Retene	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Benz(a)anthracene	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Chrysene/Triphenylene	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U
Benzo(b,j,k)fluoranthenes	30	0.17 U	30	0.17 U	30	0.17 U	30	0.17 U	30	0.17 U	30	0.17 U
Benz(e)pyrene	11	0.061	10	0.056	10	0.056	10	0.056 U	11	0.061	10	0.056 U
Benz(a)pyrene	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	13	0.072
Indeno(123,cd)pyrene	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Dibenz(a,c/a,h)anthracene	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U
Benzo(g,h,i)perylene	15	0.083	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U	10	0.056 U
Coronene	24	0.13	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U	20	0.11 U
Surrogate Recoveries (%)												
Flourene, D10 (field surrogate)		NS		NS		NS		NS		80		NS
2-Fluorobiphenyl (lab surrogate)		44		53		49		61		57		65
Terphenyl, D14 (lab surrogate)		87		98		80		87		83		86

U = undetected at specified quantitation limit E = exceeds calibration range A = typical sample volume of 180 m3 used to calculate blank levels

B = blank value (shown) exceeds measured value NS = not spiked (to accomodate mutagenicity testing).

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11.2.3 Richmond Campaign

Results are provided for each of four (4) field samples selected for PAHs analyses in Table 11-5. Results for two (2) additional field blanks, one per each of two (2) sampling days are also summarized in Table 11-5. All data are reported in units of ng/m^3 and represent field blank corrected values. Sample specific quality control data associated with these analyses are also provided.

11.3 Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans (PCDDs/PCDFs)

As per the direction of CARB, only samples from the Fresno field program were selected to undergo PCDDs/PCDFs analyses. These analyses were conducted via HRGC/HRMS at Triangle Labs in Raleigh, North Carolina. A total of eight (8) samples were selected representing three (3) daily sampling sessions at the Fresno site. The days selected for examination, December 17/18 and 18/19 of 1990 and January 2/3 of 1991, were determined by the CARB to be days characterized by optimum meteorological conditions for Fresno in wintertime.

The eight (8) sample set includes results for five (5) ambient air samples and three (3) associated field blanks. The five (5) sample set includes two (2) collocated pairs. The results of these analyses are provided in Table 11-6. Results are provided for each of fifteen (15) 2,3,7,8-substituted PCDDs/PCDFs and congener class sums (Cl_4 - Cl_8) on a sample specific basis. All data are reported in units of pg/m^3 and represent blank corrected values.

11.4 Nitro-PAH and Oxygenated - PAH

Six (6) composite samples were selected to undergo analyses for nitro-PAH and oxygenated-PAH at Battelle Labs in Columbus, Ohio. Two (2) composite samples were prepared and analyzed from each of the three (3) field programs. As per joint agreement with the CARB and all of the Project Team, no field blanks were analyzed as part of this exercise. Each composite sample included both the vapor phase and particulate portions of all samples selected. The results of these analyses are provided in Table 11-7. Results are provided in units of ng/m^3 for each of the target parameters listed earlier in Table 4-3. The reported values, and associated detection limits where applicable, meet or exceed the detection limit goals established at the outset of the program (see Table 4-3).

TABLE 11-5

Richmond Field Program
Ambient Monitoring Data For PAHs (field blank corrected)

Sampling Date	1-24-91	1-24-91	1-24-91		1-25-91	1-25-91	1-25-91		1-25-91	
Field ID	508 R1PAS	357 R1PPU	501 R1PBS		315 R2PAS	412 R2PPU	430 R2PBS			
Lab ID	83271	83273	83274		83276	83278	83279		MB910192	
Period	diurnal	nocturnal	Field Blank		diurnal	nocturnal	Field Blank		Method Blank	
Spiking Status	unspiked	unspiked	spiked		spiked	spiked	spiked		spiked	
Site	Richmond	Richmond	Richmond		Richmond	Richmond	Richmond		Richmond	
Sample Volume (m^3)	183.2	168.0	180.0 [a]		201.7	175.9	180.0 [a]		180.0 [a]	
Parameter	(ng/m^3)	(ng/m^3)	(ng)	(ng/m^3)	(ng/m^3)	(ng/m^3)	(ng)	(ng/m^3)	(ng)	(ng/m^3)
Naphthalene	212	427	180	1.00	192	329	130	0.72	790	4.39
2-Methylnaphthalene	114	214	51	0.28	118	148	36	0.20	10	0.06 U
1-Methylnaphthalene	46.3	89.3	22	0.12	48.0	56.7	17	0.09	10	0.06 U
Biphenyl	331	242	370	2.06	246	134	200	1.11	320	1.78
Acenaphthylene	7.1	20.2	10	0.06 U	6.9	20.5	10	0.06 U	10	0.06 U
Acenaphthene	3.3	4.2	10	0.06 U	3.4	2.9	10	0.06 U	10	0.06 U
Fluorene	7.1	11.3	10	0.06 U	6.9	8.0	10	0.06 U	10	0.06 U
Phenanthrene	11.3	20.7	26	0.14	12.2	14.0	23	0.13	22	0.12
Anthracene	1.4	2.7	10	0.06 U	1.6	2.3	10	0.06 U	10	0.06 U
Fluoranthene	3.4	5.3	10	0.06	3.9	4.2	10	0.06	10	0.06
Pyrene	3.3	5.4	10	0.06 U	4.1	4.3	10	0.06 U	10	0.06 U
Retene	0.87	2.9	10	0.06 U	0.89	1.9	10	0.06 U	13	0.07
Benz(a)anthracene	0.43	0.95	10	0.06 U	0.31	0.80	10	0.06 U	10	0.06 U
Chrysene/Triphenylene	0.71	1.1	20	0.11 U	0.50	0.91	20	0.11 U	20	0.11 U
Benzo(b,j,k)fluoranthenes	1.0	2.0	30	0.17 U	0.74	1.6	30	0.17 U	30	0.17 U
Benz(e)pyrene	0.40	0.83	13	0.07	0.36	0.67	10	0.06 U	10	0.06 U
Benz(a)pyrene	0.37	0.95	10	0.06 U	0.23	0.91	10	0.06 U	10	0.06 U
Indeno(123,cd)pyrene	0.50	1.0	20	0.11 U	0.43	0.85	20	0.11 U	20	0.11 U
Dibenz(a,c/a,h)anthracene	0.22 U	0.24 U	40	0.22 U	0.20 U	0.23 U	40	0.22 U	40	0.22 U
Benzo(g,h,i)perylene	0.82	1.4	20	0.11 U	0.89	1.3	20	0.11 U	20	0.11 U
Coronene	0.60	0.95	20	0.11 U	0.64	1.1	20	0.11 U	20	0.11 U
Surrogate Recoveries (%)										
Flourene, D10 (field surrogate)	NS	NS	50		79	93	36		NS	
2-Fluorobiphenyl (lab surrogate)	51	50	38		52	48	24		42	
Terphenyl, D14 (lab surrogate)	68	70	63		65	62	56		71	

U = undetected at specified quantitation limit. NS = not spiked (to accomodate mutagenicity testing).

[a] - typical sample volume of 180 m^3 used to calculate blank concentrations (ng/m^3).

TABLE 11-6

Fresno Field Program
Ambient Monitoring Data For PCDDs/PCDFs

Sample Collection Period:
December 17 to 18, 1990

Sample ID Sample Volume	565 365.9 cubic meters		117 367.0 cubic meters		331 Field Blank
Parameter	pg/sample	pg/m3	pg/sample	pg/m3	pg/sample
2,3,7,8-TCDD	9.8	0.027	*< 9.6	*< 0.026	< 2.8
1,2,3,7,8-PeCDD	62.3	0.170	*< 78.9	*< 0.215	< 4.7
1,2,3,4,7,8-HxCDD	107	0.292	131	0.357	< 5.9
1,2,3,6,7,8-HxCDD	167	0.456	168	0.458	< 3.9
1,2,3,7,8,9-HxCDD	300	0.820	343	0.935	< 5.0
1,2,3,4,6,7,8-HpCDD	3500	9.57	3380	9.21	< 13.6
OCDD	12540	34.3	11010	30.0	*< 71.5
2,3,7,8-TCDF	49.0	0.134	32.9	0.090	< 1.8
1,2,3,7,8-PeCDF	30.8	0.084	32.6	0.089	< 3.4
2,3,4,7,8-PeCDF	55.2	0.151	*< 56.8	*< 0.155	< 3.2
1,2,3,4,7,8-HxCDF	116	0.317	131	0.357	< 4.9
1,2,3,6,7,8-HxCDF	32.4	0.089	33.1	0.090	< 3.7
2,3,4,6,7,8-HxCDF	44.3	0.121	62.7	0.171	< 4.8
1,2,3,7,8,9-HxCDF	< 14.6	< 0.0399	< 9.9	< 0.0270	< 5.4
1,2,3,4,6,7,8-HpCDF	*< 153	*< 0.418	*< 132	*< 0.360	< 5.9
1,2,3,4,7,8,9-HpCDF	25.3	0.0691	*< 27.7	*< 0.0755	< 9.5
OCDF	243	0.664	171	0.466	< 24.3
TOTAL/OTHER TCDD	224	0.612	217	0.591	< 2.8
TOTAL/OTHER PeCDD	281	0.768	574	1.56	*< 11.8
TOTAL/OTHER HxCDD	2090	5.71	2240	6.10	< 4.8
TOTAL/OTHER HpCDD	8040	22.0	7560	20.6	< 13.6
TOTAL/OTHER TCDF	844	2.31	819	2.23	< 1.8
TOTAL/OTHER PeCDF	703	1.92	617	1.68	< 3.3
TOTAL/OTHER HxCDF	412	1.13	454	1.24	< 4.6
TOTAL/OTHER HpCDF	18.0	0.049	164	0.447	< 7.3

< - Concentration below the indicated detection limit.
* - Estimated Maximum Pollutant Concentration.
Field blank 331 used to blank correct sample IDs 565 and 117.

TABLE 11-6 (cont'd)

Fresno Field Program
Ambient Monitoring Data For PCDDs/PCDFs

Sample Collection Period:
December 18 to 19, 1990

Sample ID Sample Volume	372 402.3 cubic meters		388 Field Blank	Method Blank
Parameter	pg/sample	pg/m3	pg/sample	pg/sample
2,3,7,8-TCDD	4.9	0.012	< 2.1	< 5.5
1,2,3,7,8-PeCDD	33.8	0.0840	9.0	< 6.4
1,2,3,4,7,8-HxCDD	35.0	0.0870	16.2	< 8.0
1,2,3,6,7,8-HxCDD	53.5	0.133	28.2	< 5.3
1,2,3,7,8,9-HxCDD	88.1	0.219	27.9	< 6.8
1,2,3,4,6,7,8-HpCDD	900	2.24	500	< 14.1
OCDD	3719	9.24	641	< 22.8
2,3,7,8-TCDF	16.4	0.0408	< 1.5	< 3.8
1,2,3,7,8-PeCDF	18.9	0.0470	< 3.4	< 6.7
2,3,4,7,8-PeCDF	*< 28.5	*< 0.0708	< 3.2	< 6.3
1,2,3,4,7,8-HxCDF	52.0	0.129	< 3.7	< 6.4
1,2,3,6,7,8-HxCDF	18.7	0.0465	< 2.8	< 4.9
2,3,4,6,7,8-HxCDF	*< 36.0	*< 0.0895	< 3.6	< 6.3
1,2,3,7,8,9-HxCDF	< 15.7	< 0.0390	< 4.1	< 7.1
1,2,3,4,6,7,8-HpCDF	*< 67.0	*< 0.167	< 4.5	< 6.1
1,2,3,4,7,8,9-HpCDF	< 20.9	< 0.0520	< 7.4	< 10.0
OCDF	165	0.410	< 17.8	< 18.0
TOTAL/OTHER TCDD	88.7	0.220	*< 3.1	< 5.5
TOTAL/OTHER PeCDD	149	0.370	9.0	< 6.4
TOTAL/OTHER HxCDD	671	1.67	236	< 6.5
TOTAL/OTHER HpCDD	2090	5.20	1010	< 14.1
TOTAL/OTHER TCDF	321	0.798	< 1.5	< 3.8
TOTAL/OTHER PeCDF	295	0.733	*< 2.3	< 6.5
TOTAL/OTHER HxCDF	214	0.532	< 3.5	< 6.1
TOTAL/OTHER HpCDF	76.8	0.191	< 5.6	< 7.6

< – Concentration below the indicated detection limit.
* – Estimated Maximum Pollutant Concentration.
Field blank 388 used to blank correct sample ID 372.
Method blank associated with sample IDs 565, 117, 331, 372 and 388.

TABLE 11-6 (cont'd)

Fresno Field Program
Ambient Monitoring Data For PCDDs/PCDFs

Sample Collection Period:
January 2 to 3, 1991

Sample ID Sample Volume	96 418.4 cubic meters		377 414.3 cubic meters		109 Field Blank	Method Blank
Parameter	pg/sample	pg/m3	pg/sample	pg/m3	pg/sample	pg/sample
2,3,7,8-TCDD	*< 11.4	*< 0.0272	*< 9.9	*< 0.024	< 5.2	< 8.7
1,2,3,7,8-PeCDD	80.4	0.192	83.4	0.201	< 10.0	< 19.3
1,2,3,4,7,8-HxCDD	120	0.287	159	0.384	< 23.2	< 13.4
1,2,3,6,7,8-HxCDD	243	0.581	207	0.500	< 15.4	*< 10.9
1,2,3,7,8,9-HxCDD	701	1.68	434	1.05	< 19.7	< 11.4
1,2,3,4,6,7,8-HpCDD	3320	7.93	3160	7.63	< 52.3	< 42.2
OCDD	7039	16.8	7429	17.9	181	*< 158
2,3,7,8-TCDF	20.0	0.0478	21.6	0.0521	< 4.6	< 6.1
1,2,3,7,8-PeCDF	*< 22.6	*< 0.0540	26.3	0.0635	< 7.1	< 13.2
2,3,4,7,8-PeCDF	47.1	0.113	41.7	0.101	< 6.7	< 12.4
1,2,3,4,7,8-HxCDF	136	0.325	146	0.352	< 11.8	< 14.8
1,2,3,6,7,8-HxCDF	*< 48.3	*< 0.115	*< 44.7	*< 0.108	< 9.0	< 11.4
2,3,4,6,7,8-HxCDF	85.3	0.204	69.1	0.167	< 11.6	< 14.6
1,2,3,7,8,9-HxCDF	< 21.3	< 0.0509	< 12.4	< 0.0299	< 13.0	< 16.4
1,2,3,4,6,7,8-HpCDF	< 14.2	< 0.0339	196	0.473	< 20.4	< 18.0
1,2,3,4,7,8,9-HpCDF	< 23.0	< 0.0550	25.2	0.0608	< 33.2	< 29.2
OCDF	88.5	0.212	216	0.521	< 128	< 60.0
TOTAL/OTHER TCDD	131	0.313	154	0.372	< 5.2	15.5
TOTAL/OTHER PeCDD	528	1.26	696	1.68	< 15.0	*< 149
TOTAL/OTHER HxCDD	3160	7.55	3250	7.84	< 18.9	*< 13.4
TOTAL/OTHER HpCDD	7640	18.3	7240	17.5	< 52.3	< 42.2
TOTAL/OTHER TCDF	581	1.39	699	1.69	< 4.6	*< 7.5
TOTAL/OTHER PeCDF	569	1.36	560	1.35	< 14.2	*< 10.4
TOTAL/OTHER HxCDF	592	1.41	579	1.40	< 11.2	*< 13.6
TOTAL/OTHER HpCDF	*< 187	*< 0.447	418	1.01	< 25.3	< 22.2

< - Concentration below the indicated detection limit.
* - Estimated Maximum Pollutant Concentration.
Field Blank 109 used to blank correct sample IDs 96 and 377.

TABLE 11-7

Ambient Monitoring Data for PAHs, Nitro-PAHs and Oxygenated PAHs in Composite Samples (Battelle)

Location	Fresno	Fresno	Richmond	Richmond	Rice Straw	Rice Straw
Period	Nocturnal	Diurual	Nocturnal	Diurual	Night/Day (Combined)	Night/Day (Combined)
Sample Code	82935/ 82984	82986/ 82981	83281/ 83286	83282/ 83287	82778/ 82491	82780/ 82494/ 82783
Sample Volume (M^3 Total)	367.9	363.4	406.5	442.4	469.6	523.6
Concentration	ng/m^3	ng/m^3	ng/m^3	ng/m^3	ng/m^3	ng/m^3
Fluoranthene	12.338	8.900	3.598	4.863	0.746	0.364
Benzo(a)pyrene	7.372	2.336	0.460	1.802	0.163	0.087
1-Nitronaphthalene	0.291	0.392	0.099	0.155	0.038	0.026
2-Nitronaphthalene	0.193	0.549	0.082	0.094	0.024	0.023
3-Nitrobiphenyl	0.094	0.257	0.024	0.017	<0.011	<0.010
9-Nitrophenanthrene	0.432	0.292	0.046	0.178	0.041	0.020
9-Nitroanthracene	0.045	0.037	0.012	0.023	<0.011	<0.010
2-Nitrofluoranthene	0.112	0.146	0.021	0.043	0.014	<0.010
8-Nitrofluoranthene	<0.014	<0.014	<0.012	<0.011	<0.011	<0.010
1-Nitropyrene	0.044	0.041	0.014	0.019	<0.011	0.013
2-Nitropyrene	<0.014	<0014	<0.012	<0.011	<0.011	<0.010
6-Nitrochrysene	0.022	<0.014	<0.012	<0.011	<0.011	<0.010
1,6-Dinitropyrene	<0.014	<0.014	<0.012	<0.011	<0.011	<0.010
9-Fluorenone	7.191	6.318	3.216	3.636	1.022	0.749
Naphthalene-1,8-dicarboxylic acid anhydride	4.786	4.792	1.254	2.681	0.314	0.182
Benzo(a)anthracene-7,12-dione	1.020	0.514	0.140	0.342	0.050	0.030
Pyrene-3,4-dicarboxylic acid anhydride	0.416	0.556	0.389	0.517	0.105	0.286

*Data presented here were excerpted from Table 3 of the Battelle report provided in Appendix C of this document.

11.5 Mutagenicity Testing

11.5.1 Rice Straw Field Program

Twenty (20) ambient particulate extracts from the two (2) "Rice Straw" burning sites and four associated field blanks were examined for mutagenic activity in the Ames/Salmonella bioassay. CH_2Cl_2 extracts of particulate filters only were tested. The corresponding sorbent traps from these samples were not selected for testing. The total sample activity (in revertants) was calculated by multiplying the mutagen density by the total sampling volume. The results of mutagenicity testing for the Rice Straw ambient particulate samples are provided in Table 11-8. Results are reported in units of revertants (total activity) as well as revertants /m^3 (mutagen density). The corresponding sample blanks were all reported to be non-mutagenic.

11.5.2 Fresno Field Program

Eight (8) ambient particulate extracts and a single field blank from the Fresno monitoring site were examined for mutagenic activity. CH_2Cl_2 extracts of particulate filters only were tested. The results of these analyses are provided in Table 11-9. Results are again reported in units of revertants (total activity) as well as revertants /m^3 (mutagen density). The corresponding field blank was found to be non-mutagenic.

11.5.3 Richmond Program

Four (4) ambient particulate extracts from the Richmond monitoring site were submitted for mutagenic activity testing. Neat filters (unextracted) and two clean unused filters were provided to the University of California at Riverside for testing. All six (6) filters were soxhlet extracted with CH_2Cl_2, concentrated and solvent exchanged into DMSO. Two (2) of the four (4) particulate sample extracts and one (1) of the two (2) blanks were included in the mutagenicity test. The results of these analyses are provided in Table 11-9. Results are again reported in units of revertants (total activity) as well as revertants /m^3 (mutagen density). The blank filter was found to be non-mutagenic.

TABLE 11-8

Rice Straw Field Program
Mutagenicity Testing of Ambient Particulate Extracts (UCAL Riverside)[a]

Field ID No.	Date	Period	Lab ID No.	Sample Volume (m^3)	Total Activity[b] (Revertants)	Mutagen Density[b] (Revertants/m^3)
CF-4 (Blank)	N/A	N/A	81934	N/A	0	N/A
CF-7	10-17-90	diurnal	81947	169.1	390	2.3
CF-10	10-18-90	diurnal	81941	179.7	1,800	10.0
CF-11	10-18-90	nocturnal	81940	160.9	450	2.8
CF-18	10-22-90	diurnal	82263	138.6	860	6.2
CF-20	10-22-90	nocturnal	82785	124.9	300	2.4
CF-23	10-23-90	nocturnal	82266	182.0	1,000	5.5
CF-26	10-24-90	nocturnal	82267	187.7	660	3.5
CF-29	10-25-90	diurnal	82787	131.8	510	3.9
CF-32	10-26-90	nocturnal	82783	197.7	120	0.61
CF-38	10-31-90	diurnal	82778	295.0	1,600	5.4
CF-46	11-05-90	nocturnal	82485	200.0	380	1.9
CF-49C	11-07-90	nocturnal	82492	183.9	1,600	8.9
CF-50C	11-08-90	diurnal	82501	217.5	1,800	8.1
CF-51C	11-08-90	nocturnal	82495	171.5	700	4.1
PG-12	10-23-90	diurnal	82264	372.2	1,500	3.9
PG-16	10-24-90	diurnal	82257	152.7	380	2.5
PG-20	10-25-90	diurnal	82260	172.9	690	4.0
PG-36	11-05-90	diurnal	82484	181.7	200	1.1
PG-39C	11-07-90	diurnal	82496	322.9	1,200	3.6
PG-40C	11-07-90	nocturnal	82490	347.6	4,200	12.0
N/A	N/A	N/A	Solvent Blank	N/A	0	N/A
N/A	N/A	N/A	MB900906	N/A	0	N/A
Trip Blank	N/A	N/A	N/A	N/A	0	N/A

a) Data presented here were excerpted from Table 1 of the UCAL Riverside report provided in Appendix B of this document.
b) Standard assay; TA98; -S9.

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TABLE 11-9

Fresno and Richmond Field Programs - Mutagenicity Testing of Ambient Particulate Extracts (UCAL Riverside)[a]

Lab ID No.	Field ID No.	Date	Period	Sampling Volume (m^3)	TA98; +S9[b] (rev m^{-3})	TA98; -S9 (rev m^{-3})
Fresno						
82936	F1PAC 713	12-17-90	Diurnal	120.6	6.1	8.1
82937	F1PPC 690	12-17-90	Nocturnal	181.7	11.0	19.0
82939	F1PPB 719	12-17-90	-	Blank	0.0[c]	0.0[c]
82941	F2PAC 699	12-18-90	Diurnal	163.1	13.0	7.6
82974	313 F5PAU	1-4-91	Diurnal	172.8	5.5	6.3
82975	314 F5PPU	1-4-91	Nocturnal	214.5	2.6	4.9
82979	678 F4PAU	1-3-91	Diurnal	183.9	27.0	27.0
82985	347 F3PPU	1-2-91	Nocturnal	174.3	19.0	36.0
82988	724 F3PAU	1-2-91	Diurnal	170.1	33.0	33.0
Richmond						
83272	337 R1PAU	1-24-91	Diurnal	181.0	11.0	7.7
83277	417 R2PAU	1-25-91	Diurnal	194.4	5.3	8.1
Clean Filter	N/A	-	-	Blank	0.0[c]	0.0[c]

a) Data presented here were excerpted from **Table 1** of the UCAL Riverside report provided in Appendix B of this document.
b) A 2% (v/v) mix was used.
c) Rev m^{-3} is undefined. No mutagenic activity detected up to the highest dose of 12.4% of sample per plate.

12.0 DISCUSSION OF RESULTS

12.1 Introduction

The discussion to follow will focus on the program objectives put forth in the Introduction. Our discussion will make use of the data summarized in Section 11, entitled "Results", as well as data provided in Appendices A-C of this document.

To further enhance a number of critical points in the discussion, we have made use of data available in the open literature. Complete citations for each of these literature references are provided in Section 13 of this report. A supplementary bibliography comprised of relevant articles not cited is also provided in Section 13.

The discussion to follow has been prepared on a field program location specific basis. Hence, Rice Straw data, Fresno data and Richmond data are addressed separately within each of these subsections. Data are presented and discussed on an analyte category specific basis, as follows: PAHs, mutagenicity testing, nitro-PAHs/oxygenated-PAHs, and PCDDs/PCDFs.

Particular attention was focused on a number of critical discussion points including, but not limited to, the following:

PCDDs/PCDFs (Fresno Only)

- Congener profiles will be examined and contrasted to atmospheric profiles at other locations.
- Diurnal variability of ambient concentrations will be examined to establish any site specific trends.
- Session specific and program average concentrations will be contrasted to other data in the open literature. This will be accomplished for Cl_4-Cl_8 congener class sums, as well as individual 2,3,7,8 substituted PCDDs/PCDFs isomers.

Polynuclear Aromatic Hydrocarbons (PAHs) (All Sites)

- PAH homologue profiles will be examined from each of the three types of sampling locations. Profiles will be contrasted with one another as well as compared to available data in the open literature.

- Ambient concentrations of target PAHs will be examined on a site specific basis to assess any apparent session to session trends.

- Ambient concentration data will be compared to preexisting data on PAH concentrations at other California locations, including data available at these same sites from other studies.

- PAH data from nocturnal samples collected at each site will be compared to data from the corresponding diurnal samples (if available).

Mutagenicity Testing (All sites)

- Mutagenic activity will be examined on a site specific basis.

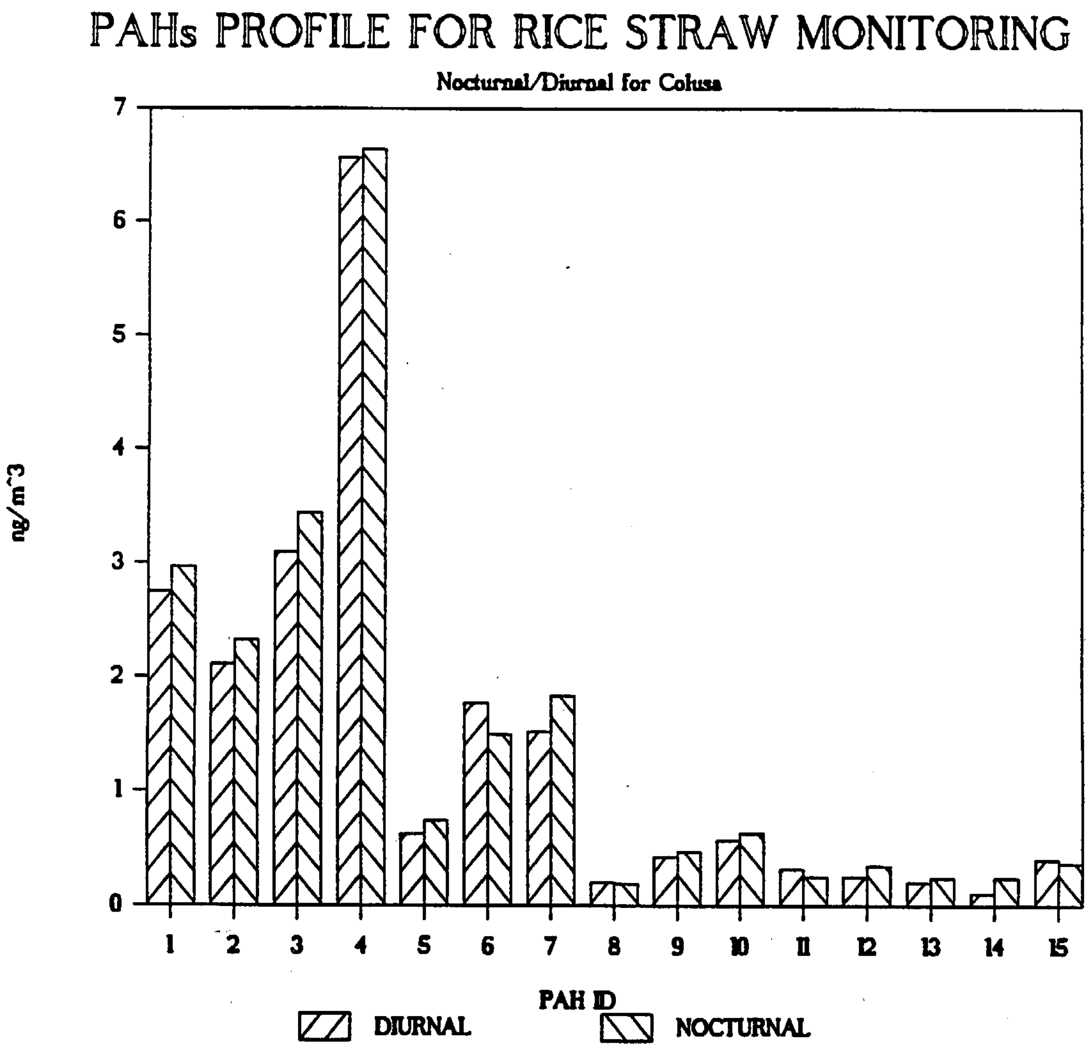
- Nocturnal and diurnal variability will be examined and the two (2) periods compared.

- Mutagenic activity will be examined in light of nitro-PAH and oxygenated-PAH data available at each site from composite sample analyses.

12.2 "Rice Straw" Field Program

12.2.1 Polynuclear Aromatic Hydrocarbons (PAHs)

The results of the PAH homologue analyses previously reported in Table 11-1 are graphically shown in Figure 12-1. Average concentrations are reported in units of ng/m^3 for each of fifteen (15) of the PAH target parameters. The nocturnal/diurnal values reported here are again considerably lower than data reported at other California locations, including the aforementioned Yuba City monitoring site [2]. In fact, the Yuba City site was designated in the previous study to be in an agricultural burning region and likely impacted by emissions from these activities. The relatively low PAH concentrations measured at each of the two (2) rice straw program sites in the present study more closely approximate ambient concentrations characteristic of rural settings such as Aiken, South Carolina [3] and Botrange, Belgium [4].



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123.cd)pyrene
14	Dibenz(a.c/a,h)anthracene
15	Benzo(g,h,i)perylene

FIGURE 12-1
PAH Concentrations (Selected Target Parameters) at Colusa Site
Comparison of Nocturnal vs. Diurnal
(Average of all Samples)

The concentration data in Figure 12-1, when examined on a nocturnal versus diurnal basis, does not suggest any measurable differences between the two types of sampling periods. In fact, considering the precision of the combined sampling and analysis scheme (±20%), the nocturnal vs. diurnal average concentrations for all of the fifteen (15) PAHs are nearly identical.

12.2.2 Mutagenicity Testing

The results of the mutagen assay analyses reported in Table 11-8 indicate relatively low activity and mutagen density. The highest samples only approached values in the range of 8-10 revertants/m^3. All of the values reported herein are considerably lower than activity data reported by Atkinson and Arey during a previous CARB sponsored program [2]. A summary of relevant mutagenicity data excerpted from this previous study is shown in Table 12-1.

Average mutagen density values of 26 (revertants/m^3) w/+ S9 and 32 (revertants/m^3) w/o -S9 for the Yuba City site, the site closest in geographical proximity to Pleasant Grove and the Colusa County Fairgrounds, are considerably higher than the values encountered during the present study. The mutagen density values reported in Table 11-8, in fact, more closely approach values reported for the Mammoth Lakes site during the previous investigation by Atkinson and Arey [2].

The mutagen density data for the Colusa County Fairgrounds and Pleasant Grove sites are in a similar manner much lower than values reported by the Bay Area Air Quality Management District (BAAQMD) at three (3) monitoring sites in the San Francisco Bay Area [1]. The latter study examined mutagenicity with and without S9 at three (3) monitoring stations in the Bay Area (Concord, Richmond, and Pittsburgh) during the calendar period of July 1984-June 1988.

A graphical plot of the mutagen density data for each site on a session specific basis, noting both nocturnal and diurnal concentrations, is provided in Figure 12-2. No apparent trends can be ascertained upon examination of these data. These finding corroborate the strong similarities (lack of differences) noted earlier in comparison of nocturnal and diurnal PAH data.

12.3 Fresno Field Program

12.3.1 PCDDs/PCDFs

12.3.1.1 Congener Sums (Cl_4-Cl_8) Profile Analyses

A composite profile of the Fresno ambient PCDDs/PCDFs data reported previously in Table 11-6 is graphically shown in Figure 12-3. Average concentrations for each of the Cl_4-Cl_8 PCDDs/PCDFs congener class sums are reported in units of pg/m^3.

TABLE 12-1

Summary of Mutagenicity Data[b] - Various California Locations [2]

			Mutagen Density (rev m^{-3}), TA98		
			+S9	-S9	
Location	Site Characterization	Date Sampled	Average	Average	Maximum
Glendora	Motor Vehicle	Aug. 1986	33	35	61
Yuba City	Agricultural Burning	Oct. 1986	26	32	95
Concord	Industrial	Dec. 1986/Jan. 1987	63	62	130
Mammoth	Wood Burning	Feb. 1987	17	7	17 (84, +S9)
Oildale	Oil Production	March-Apr. 1987	10	9	20
Reseda	Residential	June-July 1987	19	22	50
Pt. Arguello	Rural	July 1987	0.2	0.4	0.5[a]

[a]For a composite consisting of five 12-hr nighttime periods.

[b]Data taken from a report prepared by the University of California at Riverside [2] actual data table excerpted from Appendix A of this document.

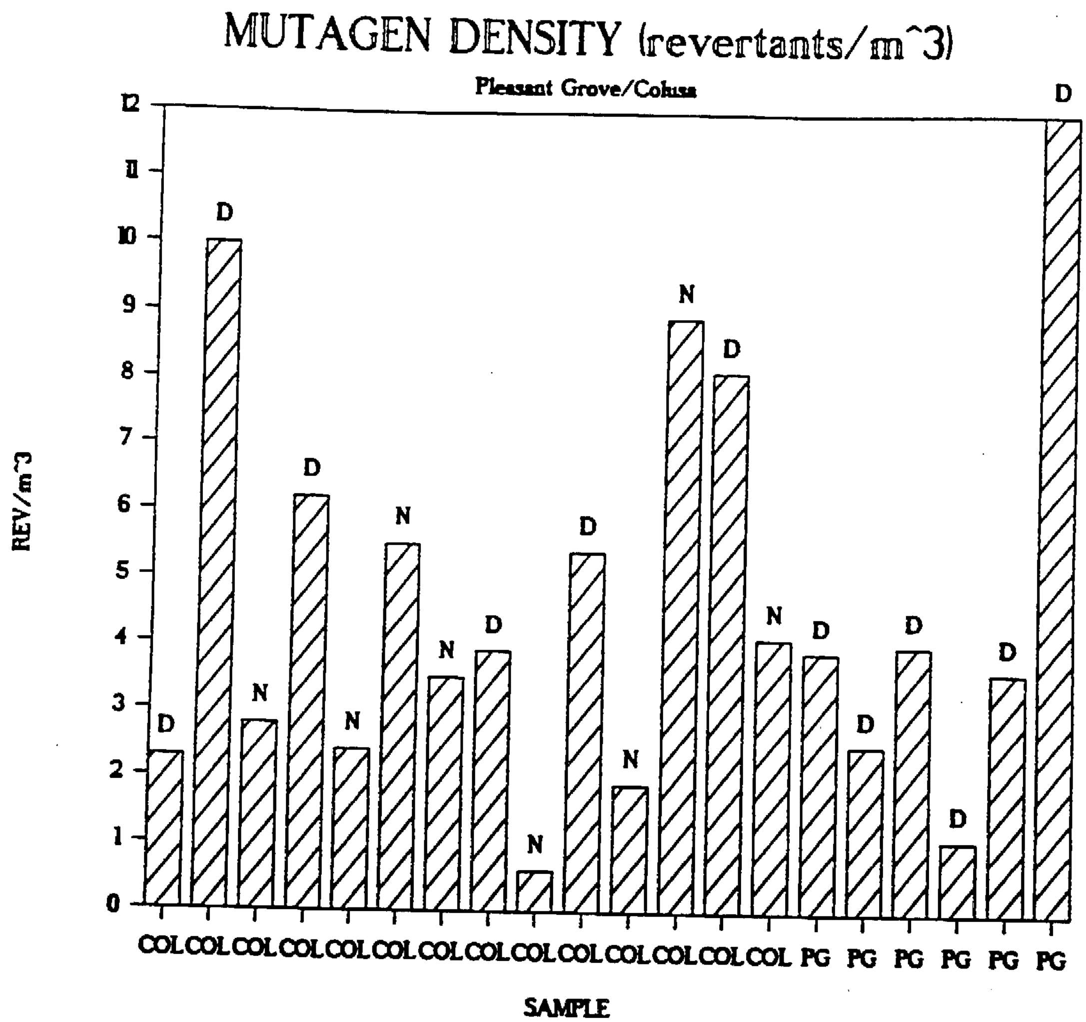


FIGURE 12-2
Mutagen Density (Revertants/m³) at Colusa /Pleasant Grove Sites
(Session Specific Data/Nocturnal and Diurnal)

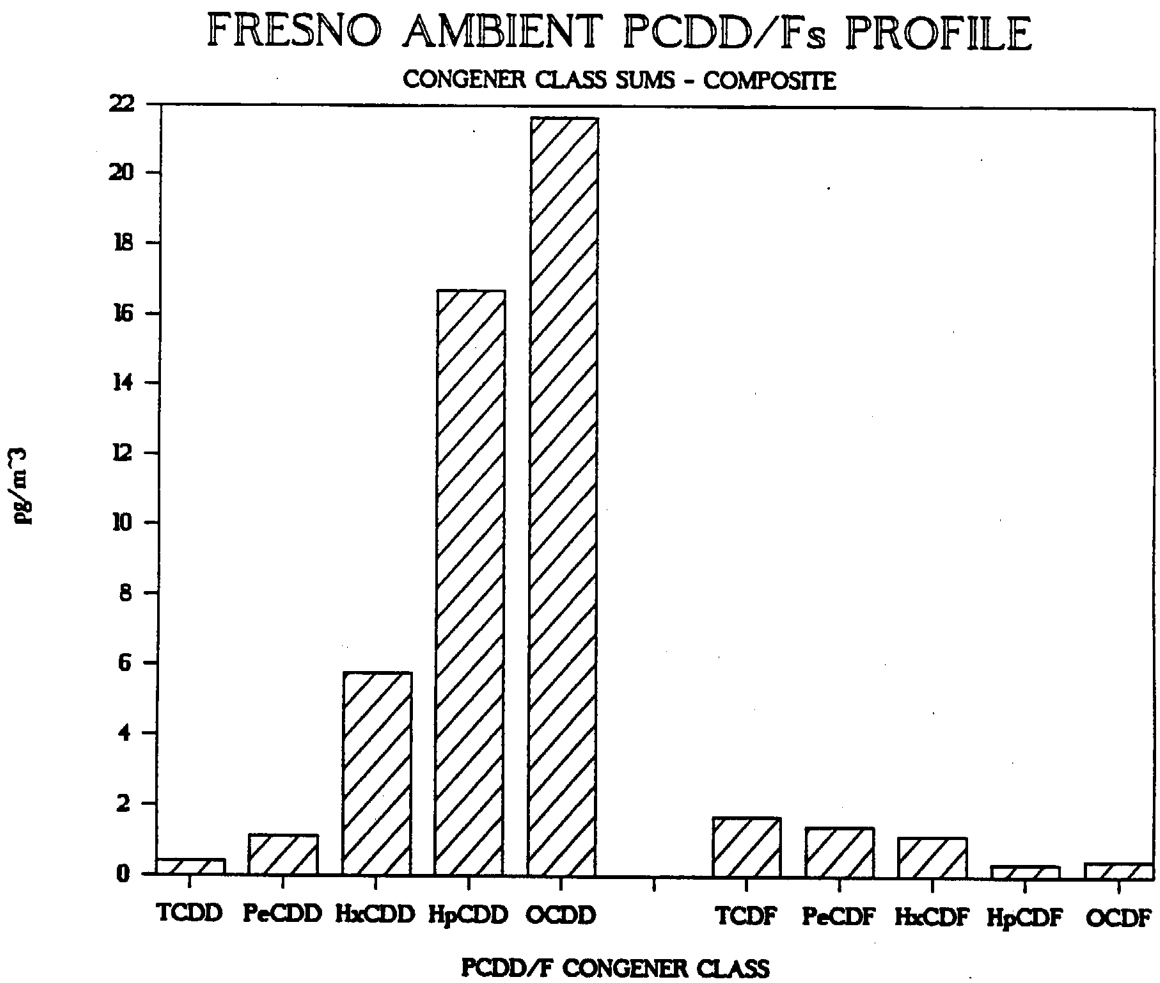


FIGURE 12-3
. Fresno Ambient Profile
Cl_4 -Cl_8 PCDDs/PCDFs Congener Class Sums
(Composite of all Samples/Sessions)

Note that these plots reflect the contribution of both measured and non-detected values. The latter values were assumed to be one-half the difference between zero and the corresponding sample specific detection limit.

An examination of the composite PCDDs/PCDFs congener (Cl_4-Cl_8) sum profiles in Figure 12-3 indicates a predominance of the hexa, hepta and octa PCDDs and the Cl_4-Cl_8 PCDFs. Within the PCDDs congener classes (Cl_4-Cl_8) we find increasing concentrations with corresponding increases in chlorine substitution ($Cl_4<Cl_5<Cl_6<Cl_7<Cl_8$). Conversely, the PCDFs profile within the Cl_4-Cl_8 congener classes indicates diminishing concentrations with corresponding increases in chlorine substitution ($Cl_4>Cl_5>Cl_6>Cl_7>Cl_8$).

The ambient PCDDs/PCDF profile reported for the Fresno campaign is consistent with those typically reported for ambient air in the open literature [7,5,6,19,17,20,21,9]. Further, this profile is consistent with that typically associated with combustion source emissions [15, 22, 23, 24, 25].

Previous PCDDs/PCDFs monitoring data collected by Hunt and Maisel in the South Coast Air Basin during the period of December 1987 through March 1989 indicated a nearly identical PCDDs/PCDFs profile to that observed here for the Fresno monitoring site [5,6]. In the former study it was concluded that atmospheric profiles of PCDDs/PCDFs congener sums suggest combustion source influences [5].

12.3.1.2 PCDDs/PCDFs Ambient Concentrations of Congener Class Sums (Cl_4-Cl_8)

The ambient PCDDs/PCDFs concentration data reported previously in Table 11-6 and plotted in Figure 12-3 and Figure 12-4 for the congener class sums (Cl_4-Cl_8) represent some of the highest atmospheric burdens of PCDDs/PCDFs reported to date in the open literature. The concentrations observed here are considerably higher than values reported previously for the South Coast Air Basin [5,6], as well as numerous urban settings throughout the United States and worldwide including Los Angeles [5,6], Bridgeport Conn. [7], Sydney, Australia [8], Bloomington, Indiana [9], Dayton, Ohio [10] and Detroit, Michigan [11].

It is likely that the elevated concentrations of PCDDs/PCDFs observed in the Fresno samples were directly influenced by the meteorological conditions that prevailed in the Fresno area during the field program. As evidenced by the meteorological data provided in Table 7-6, the Fresno region was characterized by unseasonably colder temperatures and low wind speeds during much of the sampling period.

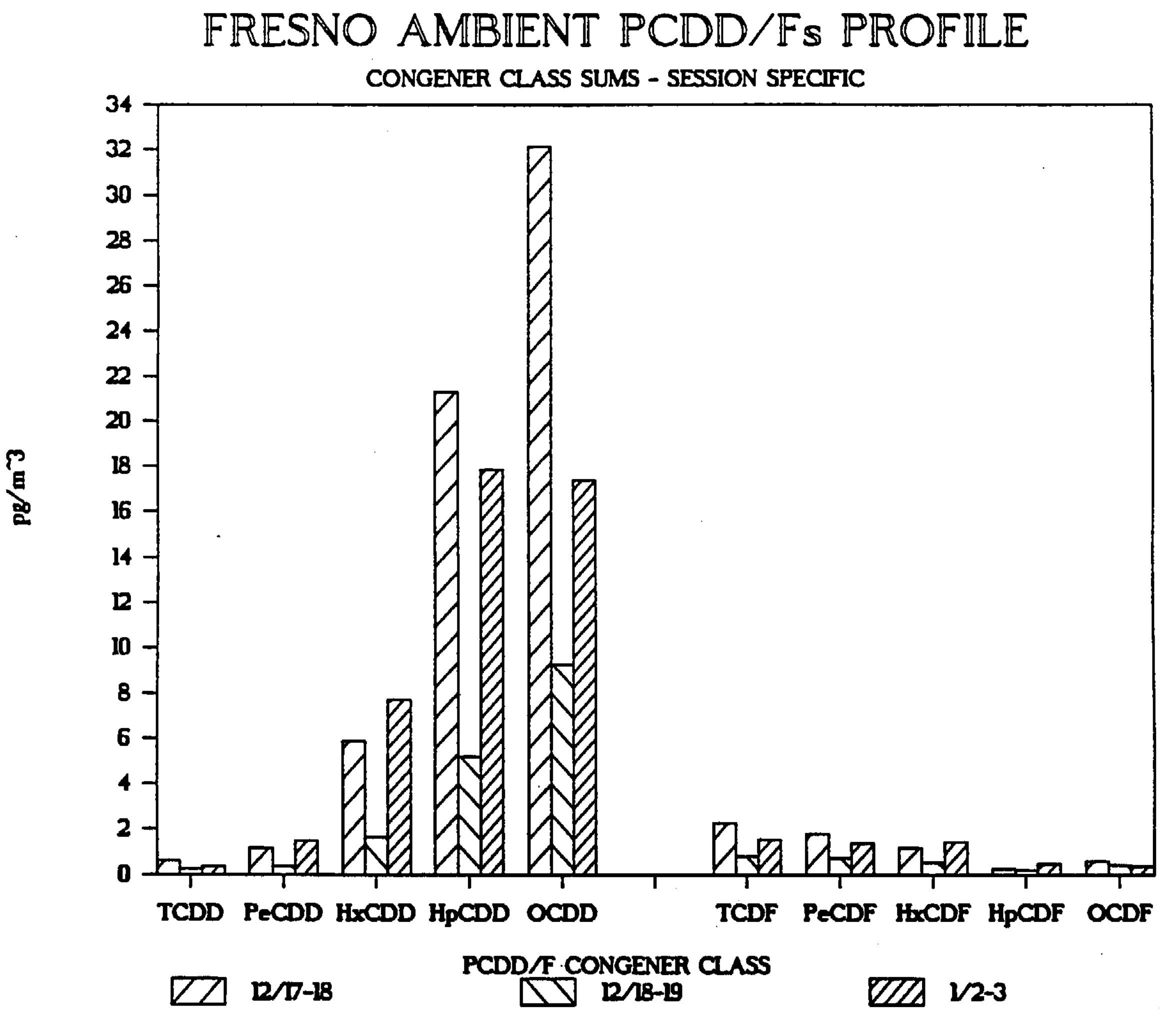


FIGURE 12-4
Fresno Ambient Profile
Cl_4 -Cl_8 PCDDs/PCDFs
Congener Class Sums (Session Specific)

The temperatures likely contributed to increased use of residential wood stoves while the low wind speeds contributed to the stagnant air mass that ARB staff indicated as being in place during the sampling period.

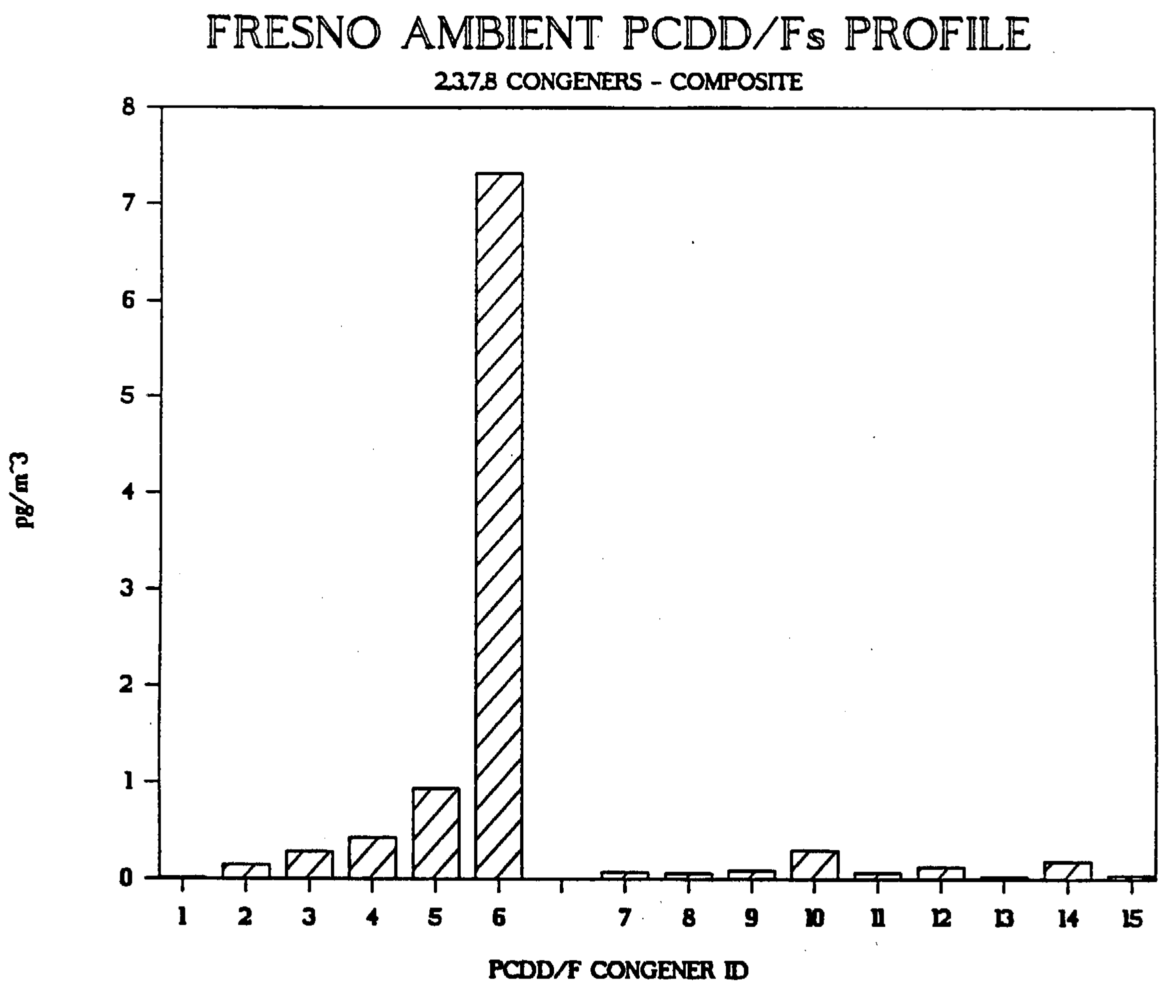
The highest concentrations are reported for the HxCDD, HpCDD and OCDD congener classes respectively. The HxCDD values range from 1.7 to 7.7 pg/m^3, the HpCDD values range from 5.2 to 21 pg/m^3, and the OCDD values range from 9.2 to 32 pg/m^3. In an examination of the three (3) sampling sessions the lowest values are reported consistently for the December 18/19 sampling period while the highest values are reported for the two (2) remaining sampling sessions collected on December 17/18 and January 2/3, 1991. A thorough and more detailed examination of localized Fresno meteorology on each of these days as well as other contributing factors is warranted to better understand these differences (e.g. wood burning practices).

12.3.1.3 2,3,7,8 Substituted PCDDs/PCDFs - Isomer Profile Analyses

All of the Fresno samples examined were characterized by measurable concentrations of the majority of the fifteen (15) 2,3,7,8-substituted PCDDs/PCDFs. The most predominant PCDD isomer as evidenced by the profile in Figure 12-3 is OCDD. The most predominant isomer of toxicological significance was 1,2,3,4,6,7,8-HpCDD as evidenced by the graphical profile shown in Figure 12-5. It has been ENSR's experience in other monitoring programs and in an examination of the open literature that this is the predominant isomer of toxicological significance in the ambient atmosphere. This particular trend is prevalent at sites known to be influenced by stationary or mobile combustion source emissions [7,12,13,14]. Czuczwa reports that this isomer constitutes approximately 55% of the HpCDD total in ambient particulate matter [15]. Hunt and Maisel report similar findings in monitoring conducted previously in Los Angeles and the South Coast Air Basin [5,6].

1,2,3,7,8,9-HxCDD was observed to be the most predominant of the three 2,3,7,8-substituted HxCDD isomers. This isomer is followed in significance by the 1,2,3,6,7,8-HxCDD and the 1,2,3,4,7,8-HxCDD. It has been ENSR's experience in other ambient monitoring programs conducted nationwide [5,6,7,16] as well as in an examination of the open literature [12,17,18] that the 1,2,3,7,8,9-HxCDD is the predominant HxCDD isomer of toxicological significance found in the atmosphere.

The HpCDD and HxCDD congener profiles that persisted in the ambient samples collected during this program strongly suggest the influences of stationary and/or mobile combustion source emissions [7,12,13,14].



PCDDs

Congener Class	Number	Isomer
Cl_4	1	2,3,7,8-TCDD
Cl_5	2	1,2,3,7,8-PeCDD
Cl_6	3	1,2,3,4,7,8-HxCDD
Cl_6	4	1,2,3,6,7,8-HxCDD
Cl_6	5	1,2,3,7,8,9-HxCDD
Cl_7	6	1,2,3,4,6,7,8-HpCDD

PCDFs

Congener Class	Number	Isomer
Cl_4	7	2,3,7,8-TCDF
Cl_5	8	1,2,3,7,8-PeCDF
Cl_5	9	2,3,4,7,8-PeCDF
Cl_6	10	1,2,3,4,7,8-HxCDF
Cl_6	11	1,2,3,6,7,8-HxCDF
Cl_6	12	2,3,4,6,7,8-HxCDF
Cl_6	13	1,2,3,7,8,9-HxCDF
Cl_7	14	1,2,3,4,6,7,8-HpCDF
Cl_7	15	1,2,3,4,7,8,9-HpCDF

FIGURE 12-5
Fresno Ambient Profile
2,3,7,8-PCDDs/PCDFs
(Composite of all Samples/Sessions)

All of the samples examined contained the majority of the 2,3,7,8-PCDF target parameters. Of the nine (9) PCDF isomers 1,2,3,4,6,7,8-HpCDF, 1,2,3,4,7,8-HxCDF and 2,3,4,6,7,8-HxCDF were the predominant species in the profile (See Figure 12-6).

The predominance of the 1,2,3,4,6,7,8-HpCDF is corroborated by ambient data gathered globally by many other investigators. Rappe and Kjeller in fact, report the 1,2,3,4,6,7,8-HpCDF to be the most predominant of the four possible positional isomers of HpCDF [12]. In numerous ambient measurements collected in Hamburg, FRG during the calendar period 1985-1986 the 1,2,3,4,6,7,8-HpCDF was observed to consistently represent 60-70% or more of the total concentration of Hepta CDFs. In this study the authors cited primarily combustion sources (mobile and stationary) as the major contributors to the atmospheric burden of PCDDs/PCDFs.

Similar conclusions may be drawn from data presented here in this program. The 2,3,7,8-substituted PCDDs/PCDFs profiles observed in Hamburg, FRG and here in this study suggest primarily combustion source influences [12].

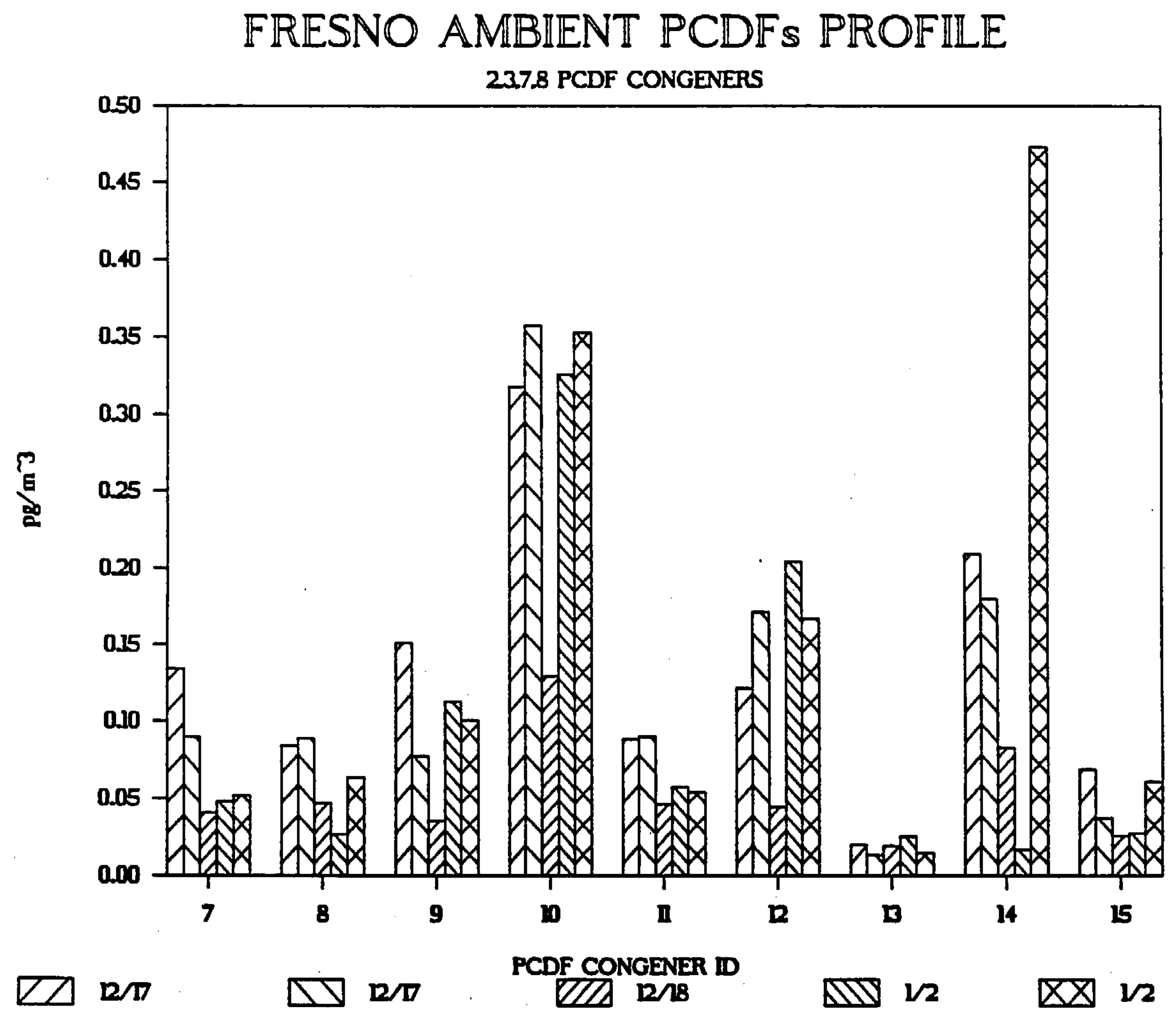
The predominant HxCDF isomers include the 1,2,3,4,7,8-HxCDF and the 2,3,4,6,7,8-HxCDF species. The 1,2,3,7,8,9-HxCDF isomer is virtually non-existent in the samples examined.

The relative contribution of each of the four 2,3,7,8-HxCDF isomers is comparable to profiles for these isomers observed by Hunt and Maisel in numerous ambient air samples collected across the State of Connecticut [7]. The principal isomer is the 1,2,3,4,7,8-HxCDF species while the 1,2,3,7,8,9-HxCDF is the isomer of least significance.

12.3.2 Polynuclear Aromatic Hydrocarbons (PAHs)

Results of the PAH analyses are summarized in Table 11-3. An examination at the eight (8) sample set (5 diurnal and 3 nocturnal) indicates significant concentrations of the majority of the PAH target parameters.

The highest ambient concentrations are observed in all samples for naphthalene, 1-methylnaphthalene, 2-methylnapthalene and biphenyl (see Table 11-3). These findings corroborate those of Atkinson and Arey in an examination of ambient PAH concentrations at seven (7) California locations [2]. Ambient concentrations for fifteen (15) of the PAH target parameters from the present study are plotted on a session or calendar day specific basis in Figure 12-7. A composite profile of these same data representing PAH concentrations as average values is provided in Figure 12-8. These values represent ambient PAH concentrations considerably higher than the majority of the ambient data for these same parameters gathered during previous California monitoring programs [1,2]. The values shown in Figure 12-7 and 12-8



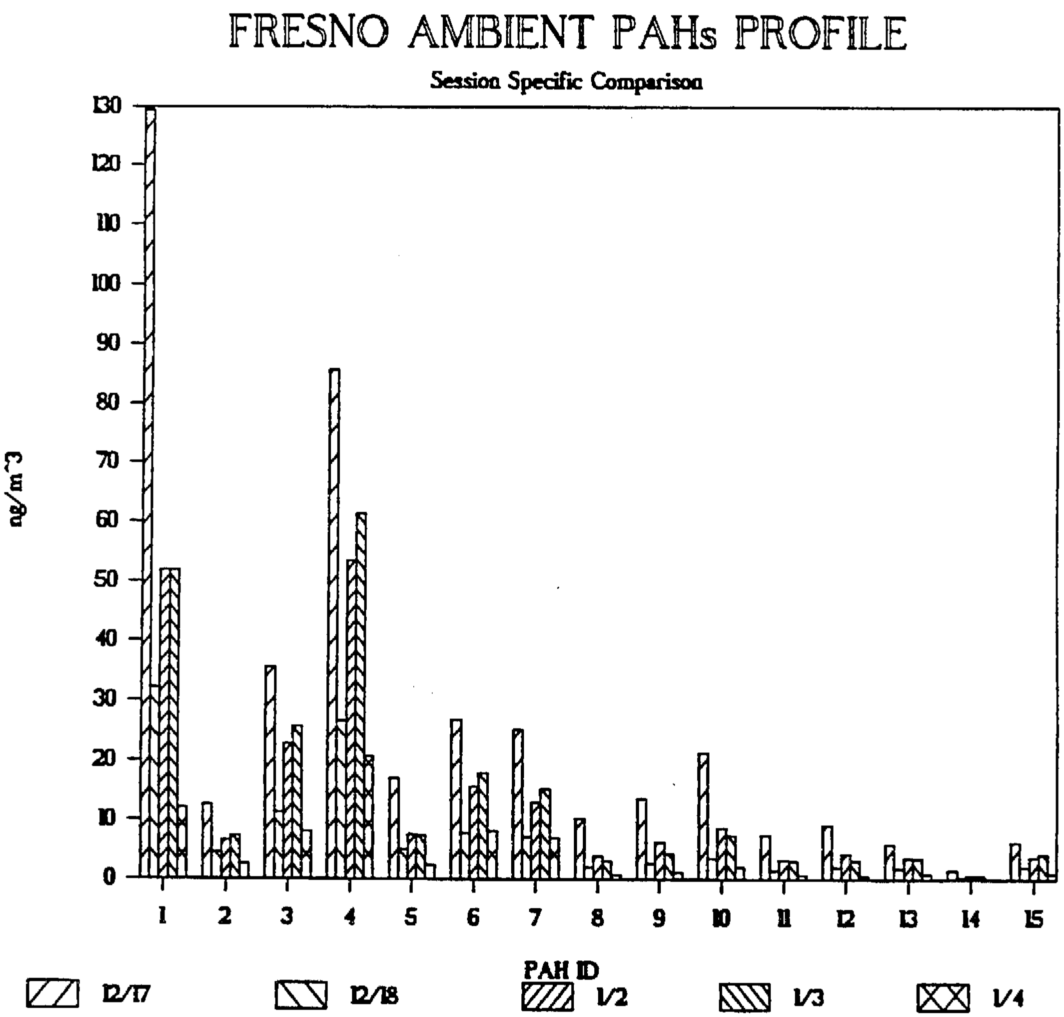
PCDDs

Congener Class	Number	Isomer
Cl_4	1	2,3,7,8-TCDD
Cl_5	2	1,2,3,7,8-PeCDD
Cl_6	3	1,2,3,4,7,8-HxCDD
Cl_6	4	1,2,3,6,7,8-HxCDD
Cl_6	5	1,2,3,7,8,9-HxCDD
Cl_7	6	1,2,3,4,6,7,8-HpCDD

PCDFs

Congener Class	Number	Isomer
Cl_4	7	2,3,7,8-TCDF
Cl_5	8	1,2,3,7,8-PeCDF
Cl_5	9	2,3,4,7,8-PeCDF
Cl_6	10	1,2,3,4,7,8-HxCDF
Cl_6	11	1,2,3,6,7,8-HxCDF
Cl_6	12	2,3,4,6,7,8-HxCDF
Cl_6	13	1,2,3,7,8,9-HxCDF
Cl_7	14	1,2,3,4,6,7,8-HpCDF
Cl_7	15	1,2,3,4,7,8,9-HpCDF

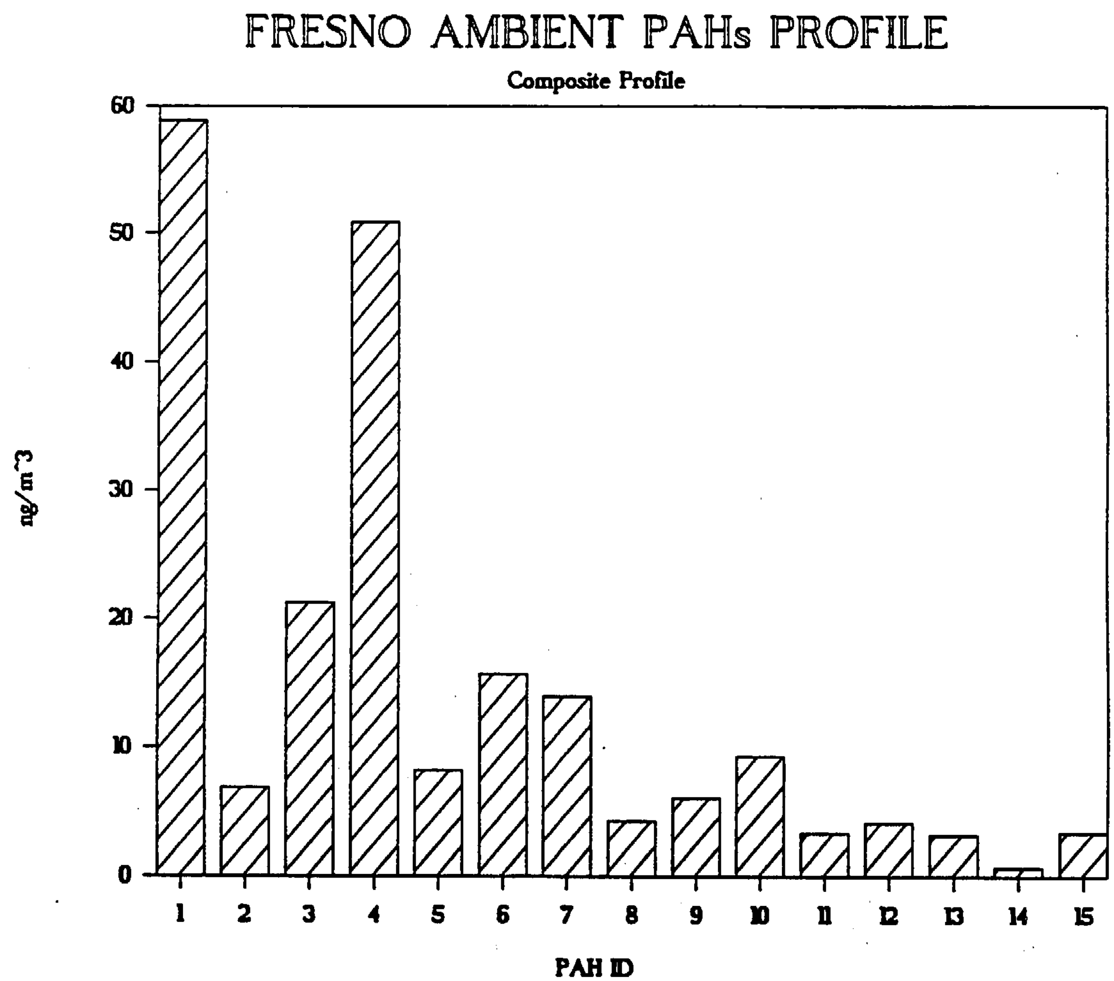
FIGURE 12-6
Fresno Ambient Profile
2,3,7,8-PCDFs Only
(Session Specific)



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123,cd)pyrene
14	Dibenz(a,c/a,h)anthracene
15	Benzo(g,h,i)perylene

FIGURE 12-7
Fresno Ambient PAH Concentrations - ng/m³
(Session Specific Comparisons)



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123,cd)pyrene
14	Dibenz(a,c/a,h)anthracene
15	Benzo(g,h,i)perylene

FIGURE 12-8
Fresno Ambient PAHs - ng/m³
(Campaign Composite Profile - All Samples)

more closely approximate values observed at the Concord, Calif and Mammoth Lakes, Calif sites as reported by Atkinson and Arey. The latter site was in fact characterized as impacted by wood-stove emissions during the sampling program [2].

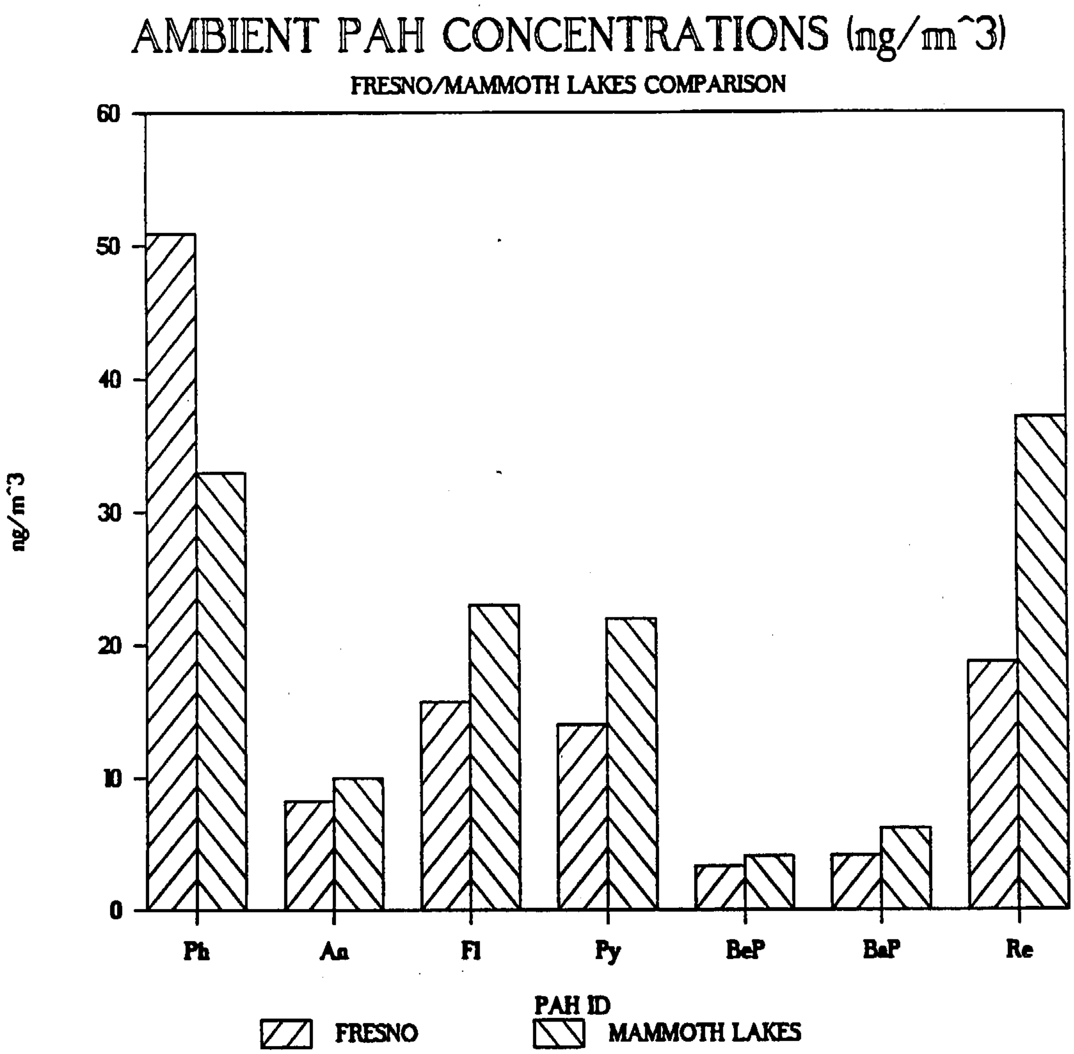
A comparison of ambient concentration data for selected PAHs measured at both Mammoth Lakes [2] and Fresno is illustrated in Figure 12-9. While the Mammoth Lake data are noticeably higher in most instances (the sole exception being phenanthrene) there is a marked similarity in the isometric profiles on a comparative basis. It is particularly significant to note the elevated concentrations of retene observed in both sample sets. Retene (1-methyl-7-isopropyl phenanthrene) is documented in the open literature and well known as a molecular marker associated with the combustion of wood. Atkinson and Arey report an average concentration of 37 ng/m^3 in ambient air samples collected at the Mammoth Lakes site during "active" wood combustion periods. Ramdahl reports further that retene is more closely associated with the combustion of soft resinous woods such as conifers as opposed to hard woods [26].

Retene concentrations observed at the Fresno site during the present study ranged from 4.2-72 ng/m^3 (Table 11-3) with an average concentration of 18.7 ng/m^3 (Figure 12-9). Higher concentrations were observed in nocturnal samples (in those instances when data from a nocturnal/diurnal pair are available). Note values reported for the nocturnal/diurnal pairs on 12/17/90 and 1/2/91. Average retene concentrations of 32.4 ng/m^3 and 10.5 ng/m^3 were measured for nocturnal and diurnal periods, respectively.

Conversely, retene concentrations at the "Rice Straw" and Richmond monitoring sites are considerably lower than those observed at the Fresno station. Values reported at the Colusa and Pleasant Grove sites ranged from 0.17-2.0 ng/m^3 while values at the Richmond site ranged from 0.87-2.9 ng/m^3.

The elevated retene concentrations observed in the Fresno sample set in concert with the higher nocturnal values provides strong evidence that the Fresno monitoring station was impacted by wood combustion emissions during the December 1990-January 1991 period in which this study was conducted.

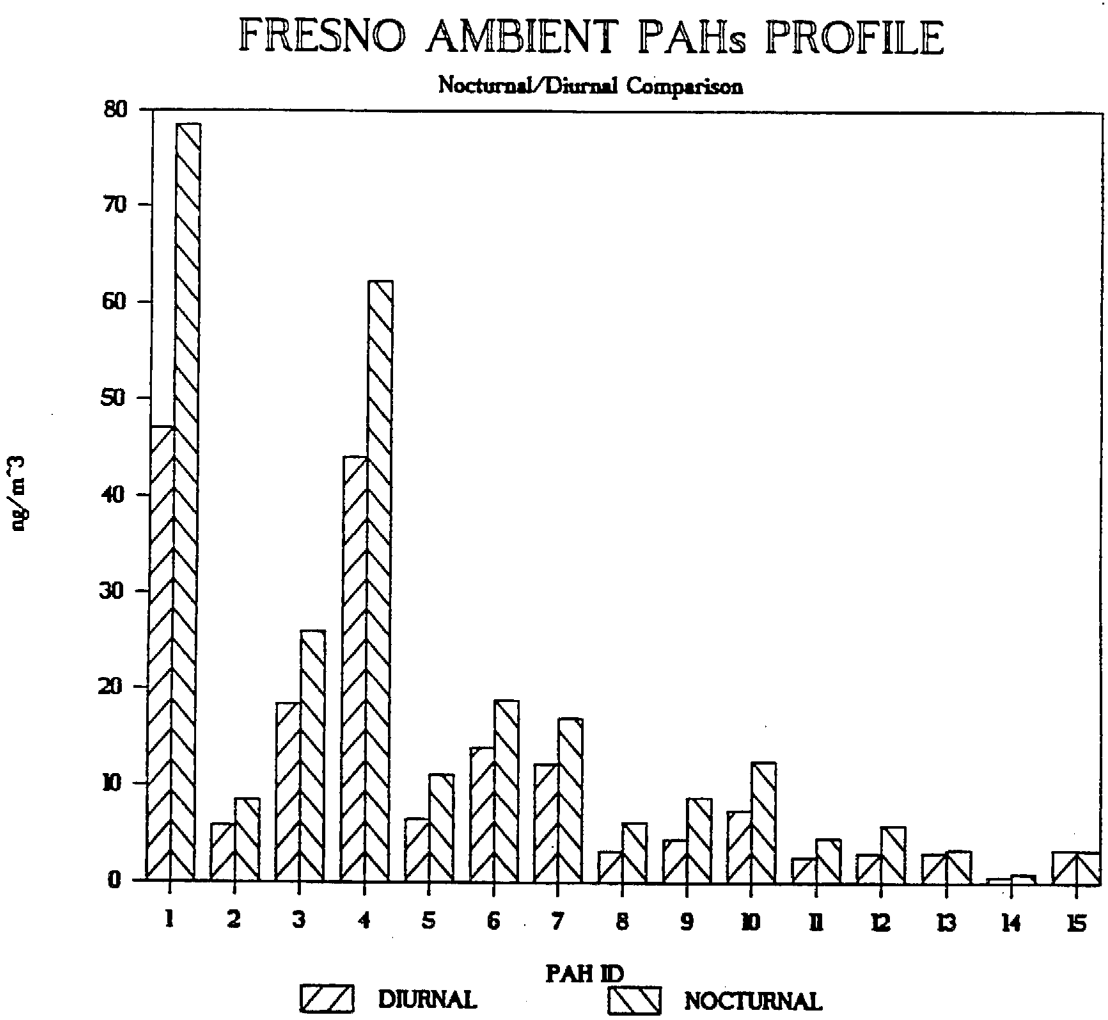
Comparisons of nocturnal and diurnal PAH concentration data for the Fresno sample set are shown in Figures 12-10 through Figures 12-12. The data plotted in Figure 12-10 represent campaign average nocturnal and diurnal concentrations for fifteen (15) PAH target parameters. In all instances the nocturnal average concentrations are noticeably higher than the corresponding diurnal average values. These findings are corroborated by our previous observations related to elevated nighttime values of retene. At the Fresno site more widespread wood combustion likely to occur during evening or nighttime hours (e.g., residential heating) contributes significantly to



(Key)

Ph =	Phenanthrene
An =	Anthracene
Fl =	Fluoranthene
Py =	Pyrene
BeP =	Benzo(e)pyrene
BaP =	Benzo(a)pyrene
Re =	Retene

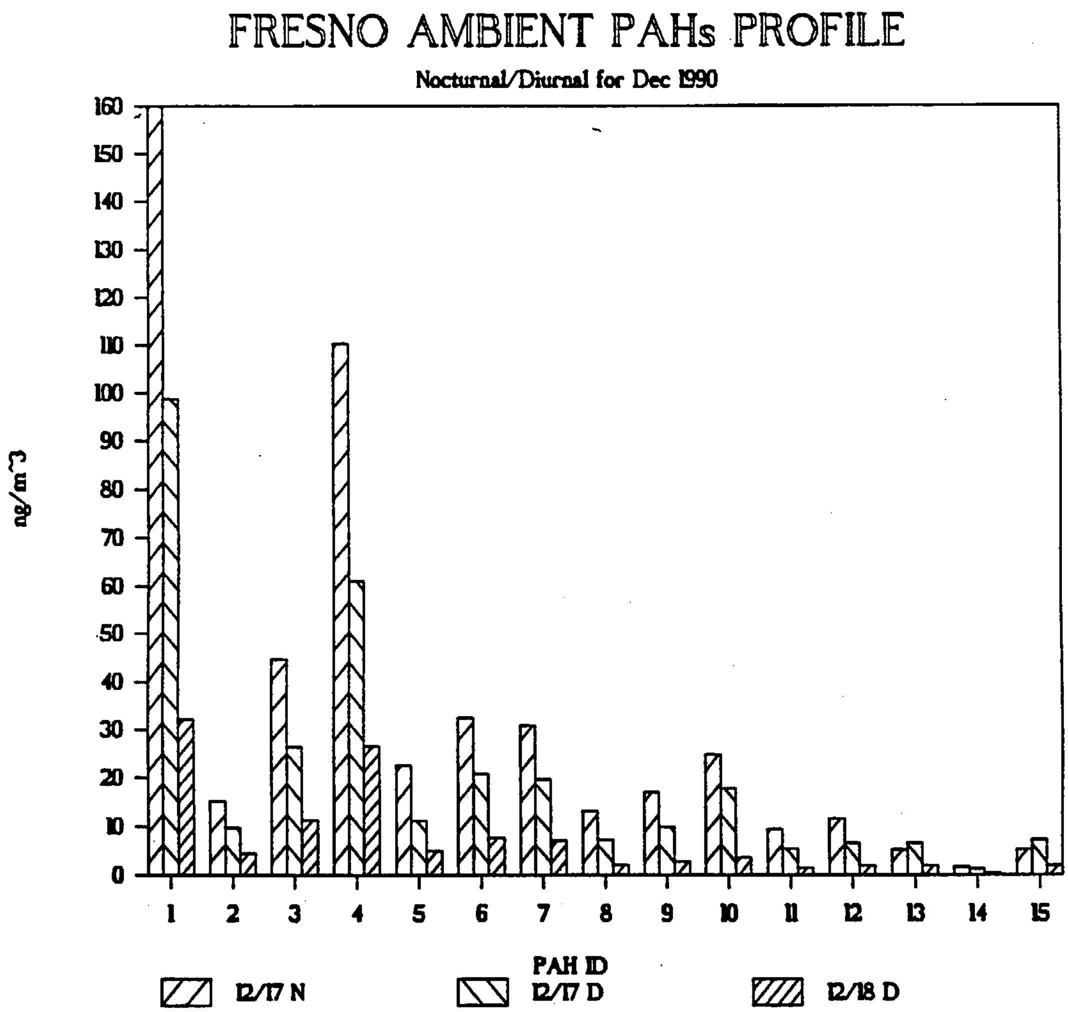
FIGURE 12-9
Comparison of Profiles for Selected PAHs
Fresno vs. Mammoth Lakes (2)



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123,cd)pyrene
14	Dibenz(a,c/a,h)anthracene
15	Benzo(g,h,i)perylene

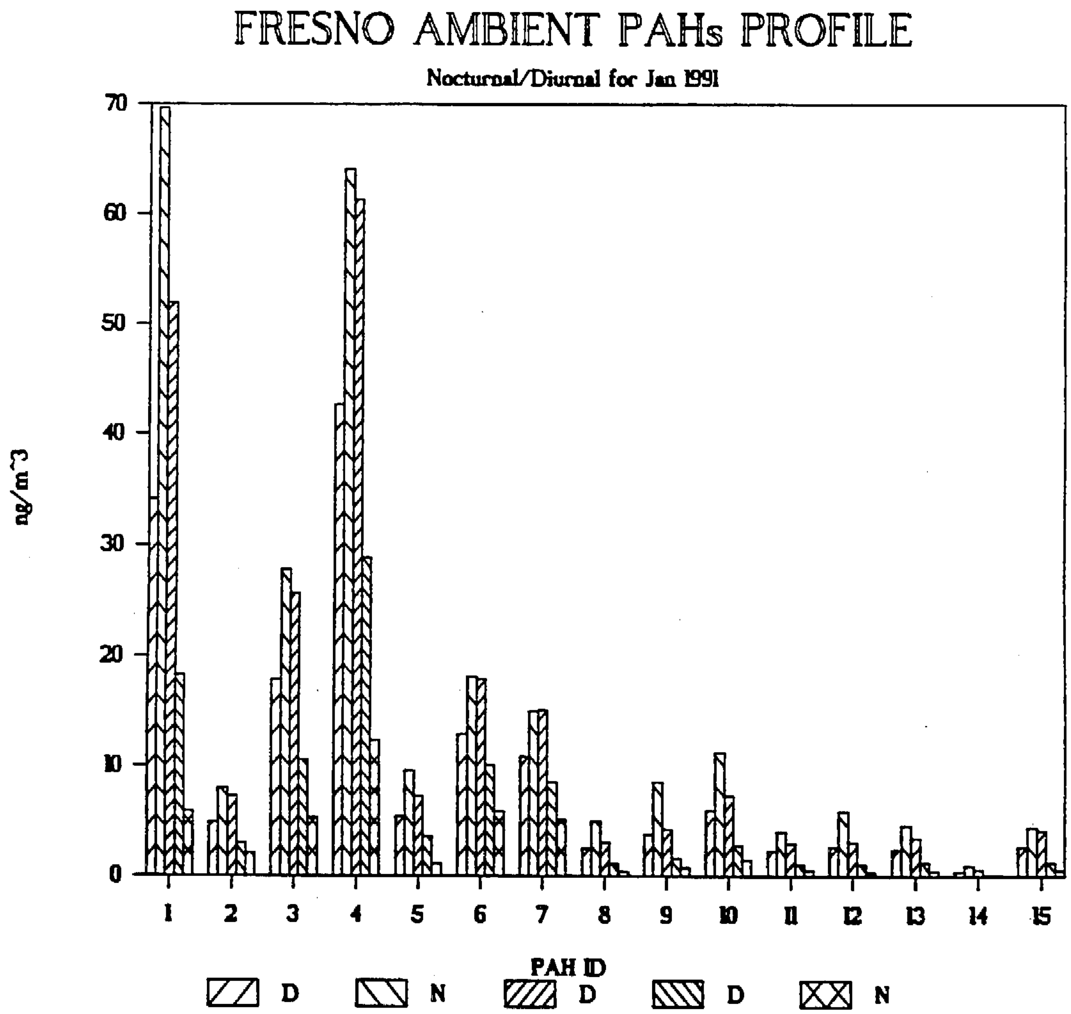
FIGURE 12-10
Fresno Ambient PAHs
A Comparison of Nocturnal vs. Diurnal Concentrations
(Composite Average of all Samples/Sessions)



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123,cd)pyrene
14	Dibenz(a,c/a,h)anthracene
15	Benzo(g,h,i)perylene

FIGURE 12-11
Fresno Ambient PAHs
A Comparison of Nocturnal vs. Diurnal Concentrations
(Session Specific, Dec. 1990)



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123,cd)pyrene
14	Dibenz(a,c/a,h)anthracene
15	Benzo(g,h,i)perylene

FIGURE 12-12
Fresno Ambient PAHs
A Comparison of Nocturnal vs. Diurnal Concentrations
(Session Specific, Jan. 1991)

air quality during this period. As evidenced by elevated levels of retene the attendant elevated PAH concentrations are most likely associated with wood combustion, as well.

12.3.3 Mutagenicity Testing

The results of the mutagenicity assay analyses reported in Table 11-9 for the Fresno Field Program indicate relatively high activity and mutagen density data in contrast to both the "Rice Straw" and Richmond ambient samples. The highest values are in fact reported for the January 2-3 sampling period. This finding is coincident with elevated PCDDs/PCDFs and PAH levels reported earlier for the same sampling period. The majority of the values reported are consistent with mutagenic activity data reported for the Mammoth Lakes site in Table 12-1. The higher values (27, 33, 36 rev m^{-3}) in fact approach activity data reported by Atkinson and Arey at the Yuba City and Glendora monitoring stations during a previous CARB sponsored program [2]. In an examination of the Fresno mutagenic activity there is no apparent trend in comparison of nocturnal and diurnal values. It is interesting to note, however, that mutagenic activity for the diurnal samples is quite comparable in comparison of +S9 activation data to -S9 activation data. These data suggest the presence of direct-acting mutagenicity with no enhancement from the addition of +S9.

Similar findings were reported by Atkinson and Arey in an examination of mutagenic activity at the majority of the seven (7) stations in the previous CARB sponsored program [2]. The only notable exception was the Mammoth Lakes site where a dominance of promutagenicity (with +S9) was observed over direct acting mutagenicity. This trend was not in evidence during the Fresno program, although it has been shown that both this site and the Mammoth Lakes site were directly influenced by air emissions from the combustion of wood.

In fact the mutagenic assay data for the Fresno nocturnal samples indicate a much greater activity for samples in the absence of S9 activation (-S9) than was observed with the addition of S9 (+S9). These data suggest a suppression of direct acting mutagenicity with the addition of S9.

12.3.4 Nitro-PAH/Oxygenated PAH

The highest ambient concentrations of the nitro-PAH and oxygenated PAH target parameters were measured in the Fresno composite samples. The predominant nitro-PAH measured in the sample was 9-nitrophenanthrene (0.43 ng/m^3) while 2-nitronaphthalene (0.55 ng/m^3) predominated in the diurnal Fresno sample. With the exception of 9-nitrophenanthrene higher concentrations of the nitro-PAH were observed in the diurnal composite sample than were observed in the composite nocturnal sample.

Elevated concentrations of 1-nitronaphthalene, 2-nitronaphthalene and 3-nitrobiphenyl in the Fresno diurnal sample (in contrast to the nocturnal composite) provide evidence for atmospheric photochemical reactions involving the respective parent PAH and OH radicals. Arey et. al. report this to be a predominant reaction mechanism during daylight hours. This is contrasted to reaction mechanisms involving N_2O_5 to form the same derivatives which are more prevalent at nighttime.

Chamber studies conducted by Atkinson, et. al. in which naphthalene and biphenyl were exposed to OH radicals in the presence of NO_x report the predominant derivatives to be 1-nitronaphthalene, 2-nitronaphthalene and 3-nitrobiphenyl [28]. Similar findings to those observed here for the Fresno field program were reported by Nishioka and Lewtas in Boise, Idaho, Arey and Atkinson in Glendora, California [30] and previously cited herein in the Torrance, California program [27]. The Idaho program was conducted in the Boise metropolitan area in wintertime during daylight hours. The Boise region is likely influenced by localized residential wood combustion emissions [29]. The Glendora study conversely was characterized by a photochemical air pollution episode but also during daylight hours [30]. For a comparison of the data collected during the present program at the Fresno and Richmond sites to data collected by Atkinson and Arey at seven (7) California monitoring stations, please refer to Table 12-2 [31].

Nearly equivalent concentrations of the four (4) oxygenated-PAHs reported in Table 11-7 were observed in both the nocturnal and diurnal composite samples. The highest concentrations were observed for 9-fluorenone (7.19 ng/m^3, 6.32 ng/m^3) while the lowest concentrations were observed for pyrene, 3-4-dicarboxylic acid anhydride (0.42 ng/m^3, 0.56 ng/m^3).

12.4 Richmond Field Program

12.4.1 Polynuclear Aromatic Hydrocarbons (PAHs)

Results of the PAH analyses are summarized in Table 11-5. An examination of the four (4) sample set (2 diurnal and 2 nocturnal) indicated measurable concentrations of nearly all of the PAH target parameters. The concentrations reported are in excess of those presented previously for the "Rice Straw" field program, yet markedly lower than the values observed during the Fresno field program.

The highest ambient concentrations are observed (see Table 11-5) in all samples for naphthalene, 1-methylnaphthalene, 2-methylnaphthalene and biphenyl. In a similar manner to the Fresno field program, the rank order of concentration for these four (4) isomers at Richmond were observed as follows:

Naphthalene (avg = 290 ng/m^3)
Biphenyl (avg = 238 ng/m^3)

TABLE 12-2

Ambient Concentrations of Naphthalene, Nitronaphthalenes and 3-Nitrobiphenyl - A Comparison of Fresno/Richmond Values with other California Locations

Site	ng m^{-3}			
	Naphthalene	1-Nitronaphthalene	2-Nitronaphthalene	3-Nitrobiphenyl
Glendora	3600	3.0	2.3	0.62
Yuba City	510	0.47	0.51	0.13
Concord	1500	0.36	0.29	0.07
Mammoth Lakes	780	0.09	0.08	<0.03
Oildale	290	0.09	0.14	0.02
Reseda	810	0.59	0.48	0.10
Pt. Arguello	87	0.02	<0.04	≈0.002
Fresno (nocturnal)	679 (n=3)	0.29	0.19	0.09
Fresno (diurnal)	706 (n=5)	0.39	0.55	0.26
Richmond (nocturnal)	378 (n=2)	0.099	0.082	0.024
Richmond (diurnal)	202 (n=2)	0.15	0.09	0.017

2-methylnaphthalene (avg = 148 ng/m^3)
1-methylnaphthalene (avg = 60 ng/m^3)

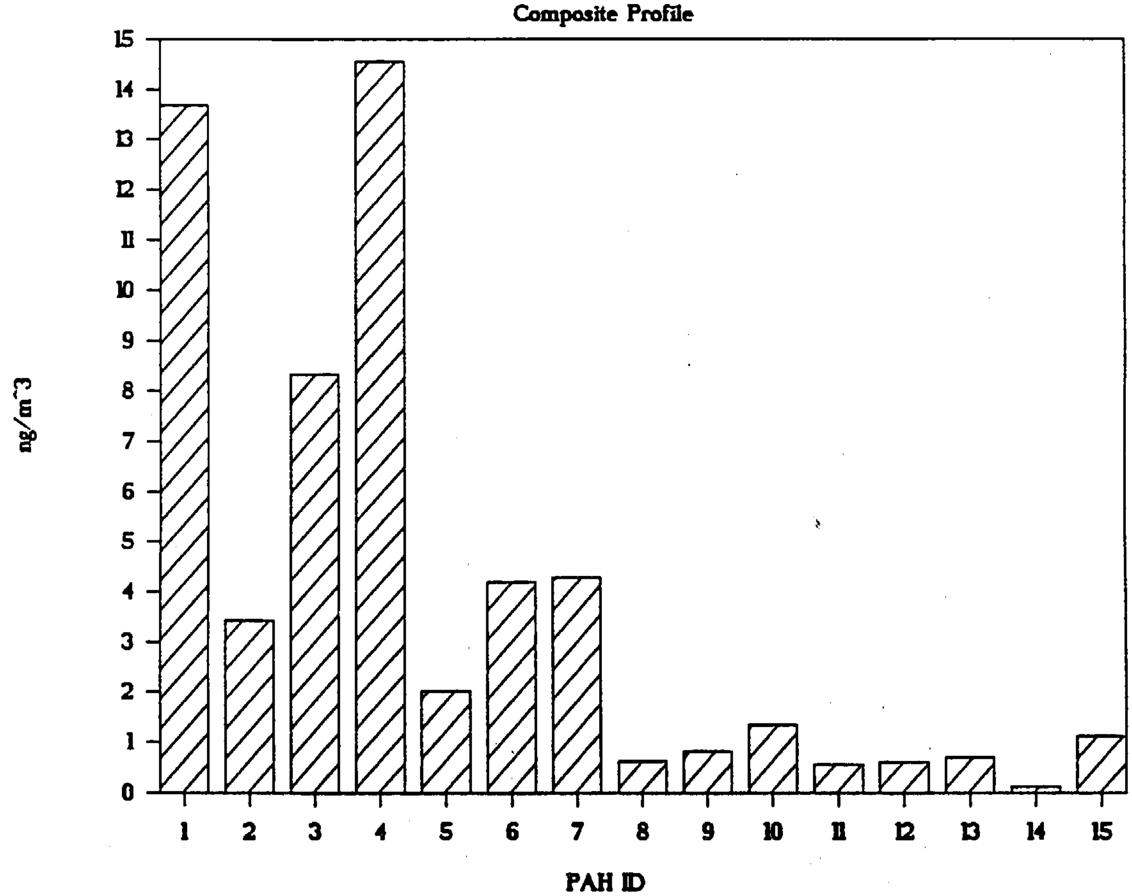
These findings corroborate those of Atkinson and Arey in an examination of ambient PAH concentrations at seven (7) California locations [2], as well as the findings reported herein for the Fresno field program. A composite profile of the Richmond PAH data noting average concentrations (all samples) for fifteen (15) of the PAH target parameters is provided in Figure 12-13. Upon examination of these data, we find the concentrations comparable to PAH levels in other urban locations in the United States and worldwide including Columbia, SC [3], New Bedford, MA [32], Thessaloniki, Greece [33,34] and Los Angeles, CA [35,36]. The levels are consistent with values reported by Atkinson and Arey as a result of the aforementioned California study [2]. The Richmond PAH levels are directly comparable to values reported for the Reseda and Glendora sites during the seven-station study [2]. While both the Reseda and Glendora sites can be regarded as urban settings the CARB sponsored study characterized them as being influenced by residential and motor vehicle activities, respectively [2]. The Richmond site was selected by CARB in the design of the present study as a site potentially influenced by petroleum refinery emissions. A comparison of ambient concentration data for selected PAHs measured at Richmond and Oildale is illustrated in Figure 12-14. The Oildale site examined previously was characterized by Atkinson and Arey as a site directly impacted by the oil production industry [2]. In all instances ambient concentrations for the Richmond site reported here were higher than those reported previously for the Oildale site. Note the relative similarities in the PAH isomeric profiles in comparison of data from Richmond and Oildale. It is interesting to note the near identical profiles in comparison of the Richmond composite profile (Figure 12-13) to that presented previously for the Fresno site (Figure 12-8).

Flessel et al. conversely characterize the Richmond site as situated so as to not be influenced by stationary source industrial emissions. They further report mobile sources to be the principal influence on air pollution at the Richmond BAAQMD monitoring station [1]. Values reported during the present study for benzo(a)pyrene (0.62 ng/m^3), and benzo(g,h,i)perylene (1.1 ng/m^3) are directly comparable to values of 0.3 ng/m^3 and 1.3 ng/m^3 reported respectively for these target parameters by BAAQMD at the same Richmond site during the calendar period November 1979 - October 1988 [1]. These authors concluded that mobile source emissions are significant influences on air quality at the site in contrast to industrial source emissions [1].

Comparison of nocturnal and diurnal concentration data for the Richmond sample set are shown in Figure 12-15. The data plotted represent campaign average data for fifteen (15) PAH target parameters. These data do not suggest any measurable differences in the two types of sampling periods. In fact, considering the precision of the combined sampling and analysis scheme

RICHMOND AMBIENT PAHs PROFILE

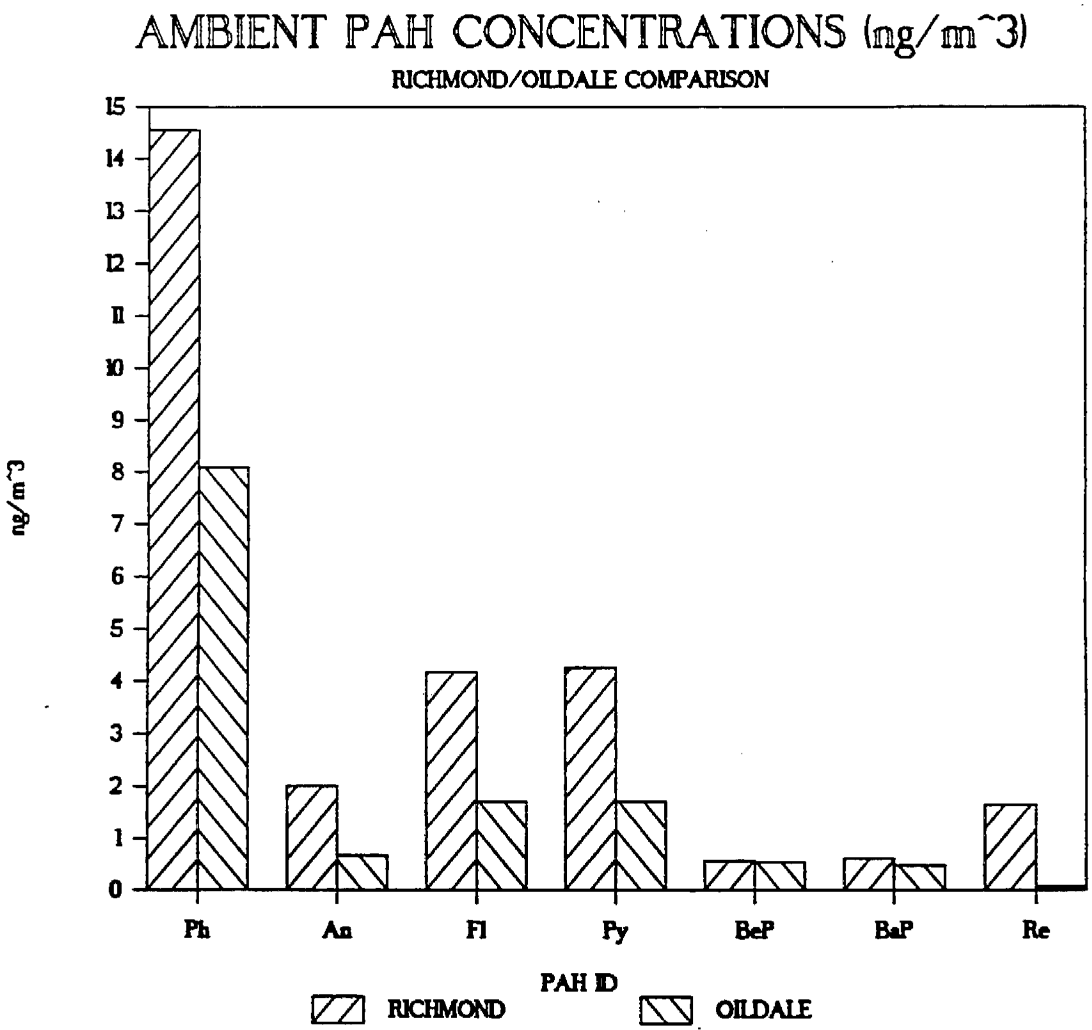
Composite Profile



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123,cd)pyrene
14	Dibenz(a,c/a,h)anthracene
15	Benzo(g,h,i)perylene

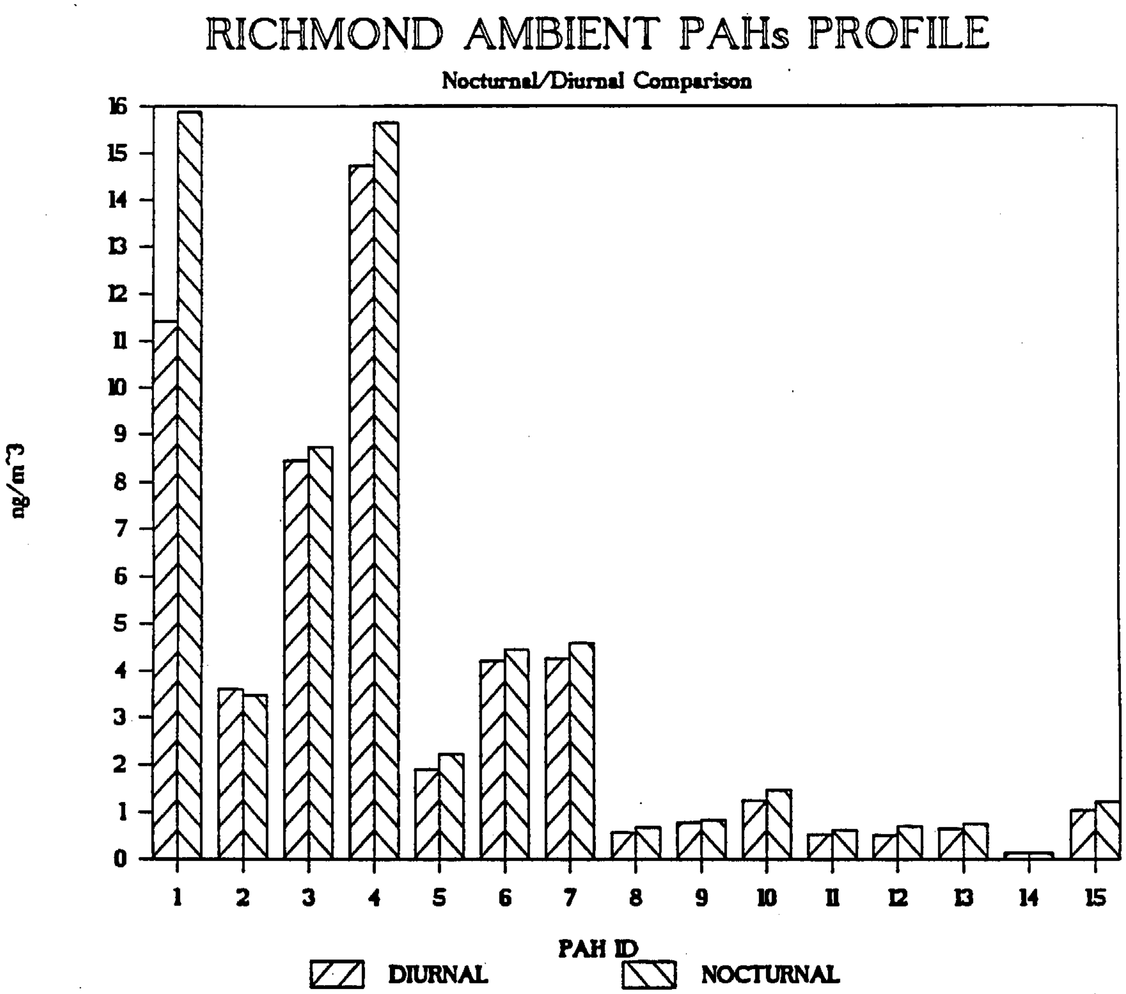
FIGURE 12-13
Richmond Ambient PAHs - ng/m^3
(Campaign Composite Profile - All Samples)



(Key)

Ph =	Phenanthrene
An =	Anthracene
Fl =	Fluoranthene
Py =	Pyrene
BeP =	Benzo(e)pyrene
BaP =	Benzo(a)pyrene
Re =	Retene

FIGURE 12-14
Comparison of Profiles for Selected PAHs
Richmond vs. Oildale (2)



PAH Target Parameters
Graph Coding System (Key)

No.	Parameter
1	Acenaphthylene
2	Acenaphthene
3	Fluorene
4	Phenanthrene
5	Anthracene
6	Fluoranthene
7	Pyrene
8	Benz(a)anthracene
9	Chrysene/Triphenylene
10	Benzo(b,j,k)fluoranthenes
11	Benzo(e)pyrene
12	Benzo(a)pyrene
13	Indeno(123,cd)pyrene
14	Dibenz(a,c/a,h)anthracene
15	Benzo(g,h,i)perylene

FIGURE 12-15
Richmond Ambient PAHs
A Comparison of Nocturnal vs. Diurnal Concentrations
(Composite Average of all Samples)

(±20%), the nocturnal vs. diurnal average concentrations for all of the fifteen (15) PAHs are nearly identical.

12.4.2 Mutagenicity Testing

The results of the mutagenicity assay analyses reported in Table 11-9 for the Richmond field program indicate relatively low mutagenic activity in contrast to the previous Fresno program data. The reported values which are noticeably higher than the "Rice Straw" activity data are considerably lower than activity data reported by Atkinson and Arey for five (5) of the seven (7) stations in the aforementioned California study [2]. Our Richmond values are consistent with mutagenic activity data reported for the Oildale site in Table 12-1. Since both of the Richmond samples examined represented diurnal sampling periods little can be said concerning nocturnal vs. diurnal mutagenic actvity. The mutagenic activity data reported herein are lower than the average values (revertants/m^3) reported for the same Richmond site during the July 1989-June 1988 by BAAQMD [1].

12.4.3 Nitro-PAH/Oxygenated PAH

The predominant nitro-PAHs measured in the Richmond diurnal composite sample were 9-nitrophenanthrene (0.178 $\mu g/m^3$) and 1-nitronaphthalene (0.155 $\mu g/m^3$). The predominant nitro-PAH species measured in the nocturnal composite sample were 1-nitronaphthalene (0.099 $\mu g/m^3$) and 2-nitro naphthalene (0.082 $\mu g/m^3$).

Equivalent concentrations of 9-Fluorenone were observed in both the nocturnal (3.22 $\mu g/m^3$) and diurnal (3.63 $\mu g/m^3$) composite samples. Duirnal concentrations for the remaining three (3) oxygenated - PAH were higher than the corresponding nocturnal values. The concentration rank order for both the nocturnal and diurnal composite samples was as follows: 9-fluorenone > naphthalene - 1,8-dicarboxylic acid anhydride > benzo(a)anthracene - 7,12-dione > pyrene - 3,4-dicarboxylic acid anhydride.

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14.0 GLOSSARY OF TERMS

2,3,7,8-substituted PCDDs/PCDFs	chlorines bonded in the 2,3,7 and 8 positions
ARB	Air Resources Board
BAAQMD	Bay Area Air Quality Management District
CH_2Cl_2	methylene chloride; dichloromethane
Collocate	Two or more samplers placed at the same site
Congener	member of particular PCDDs/PCDFs class (e.g., TCDD)
EPA	Environmental Protection Agency
fg	femtograms (10^{-15} grams)
Field blank	sample used to assess field/laboratory contamination
GC/MS	gas chromatography/mass spectrometry
HpCDD	heptachlorodibenzodioxin
HpCDF	heptachlorodibenzofuran
HRGC	high resolution gas chromatography
HRMS	high resolution mass spectrometry
HxCDD	hexachlorodibenzodioxin
HxCDF	hexachlorodibenzofuran
Isomers	compounds with same molecular weight but different chemical structure
lpm	liters per minute
m^3	cubic meters
Magnehelic	indicates sampler air flow
Method blank	sample used to assess laboratory contamination
Method 8290	EPA analytical method for PCDDs/PCDFs
µg	Microgram (10^{-6} gram)
µL	Microliter (10^{-6} liter)
Mutagen density	Atmospheric mutagenicity "concentration"; total activity divided by sampling volume (rev m^{-3})
M.W.	Molecular weight
NASN	National Air Sampling Network
NBS	National Bureau of Standards
NCI/GC/MS	Negative Chemical Ionization - Gas Chromatography/Mass Spectrometry
ng	nanograms (10^{-9} grams)
OCDD	octachlorodibenzodioxin

OCDF	octachlorodibenzofuran
PAHs	polycyclic aromatic hydrocarbons; polynuclear aromatic hydrocarbons
PCDDs	polychlorinated dibenzodioxins
PCDFs	polychlorinated dibenzofurans
PeCDD	pentachlorodibenzodioxin
PeCDF	pentachlorodibenzofuran
PFK	perfluorkerosene (MS tuning)
pg	picograms (10^{-12} grams)
ppb	part per billion
ppm	part per million
ppt	part per trillion
PS-1	General Metal Works air sampler
PSD	prevention of significant deterioration
PUF	polyurethane foam
QA/QC	Quality Assurance/Quality Control
rev	Revertants; net response above background in the Salmonella mutagenicity test
S9	Supernatant from a 9000 x g centrifugation of rat liver homogenate
SCAQMD	South Coast Air Quality Management District
SIM	Selected Ion Monitoring (Gas Chromatography/Mass Spectrometry
SOP	standard operating procedure
Sorbent	Material used to collect target analytes
TA98	Ames Salmonella typhimurium strain, detects frameshift mutations. Most sensitive strain for detecting ambient particulate mutagens
TCDD	tetrachlorodibenzodioxin
TCDF	tetrachlorodibenzofuran
XAD	polymeric sorbent for collection of target analytes; copolymer of styrene-divinyl benzene

APPENDIX A

MUTAGENICITY TESTING SCOPE OF WORK

UNIVERSITY OF CALIFORNIA AT RIVERSIDE

MUTAGENICITY TESTING OF EXTRACTS OF COLLECTED AMBIENT AIR PARTICLES

Janet Arey, Principal Investigator

Roger Atkinson, Co-Investigator

Solicited Proposal to the California Air Resources Board

for the period January 1, 1991 - December 31, 1991

December 1990

Statewide Air Pollution Research Center

University of California

Riverside, CA 92521

ARB-90(4):mutprop

INTRODUCTION

Extracts of collected ambient air particulate matter are direct acting in the Ames Salmonella typhimurium bioassay (see, for example, Atkinson et al., 1988 and references therein). During 1986-1987, under a contract to the California Air Resources Board (ARB), researchers at the Statewide Air Pollution Research Center (SAPRC), University of California, Riverside, collected ambient air samples at seven locations in California for subsequent extraction, chemical analysis for gas- and particle-phase polycyclic aromatic hydrocarbons (PAH) and nitro-PAH and and mutagenicity testing (Atkinson et al., 1988; Arey et al., 1989). The seven locations were chosen to be primarily impacted by differing combustion emissions, and were: Glendora, vehicle emissions; Yuba City, agricultural burning; Concord, industrial emissions; Mammoth Lakes, residential wood burning; Oildale, oil production emissions; Reseda, a residential area; and Pt. Arguello, a rural/background site (Atkinson et al., 1988).

One hundred and eighteen 12-hr daytime and nighttime ambient air samples were collected at these sites, and over forty PAH and PAH derivatives were identified and quantified. At all but the Pt. Arguello background/rural site for which the twenty 12-hr samples were composited into 2 daytime samples and two nighttime samples, mutagenicity testing of the individual 12-hr samples were carred out, using Ames strains TA98 (with and without added S9), TA98NR and TA98/1,8-DNP_6. Little useful information was obtained from the use of the strains TA98NR and TA98/1,8-DNP_6, (Atkinson et al., 1988), and the observed mutagen densities in revertants m^{-3} observed for strain TA98 (with and without S9) are summarized in Table 1. At all but the Mammoth Lakes site (impacted by residential wood smoke), there was no significant difference between the mutagen densities obtained with strain TA98 in the absence or presence of S9. At Mammoth Lakes, the TA98 mutagen densities in the presence of S9 were a factor of 1.2-6 higher than those in the absence of S9 and, combined with the chemical analysis data, this observation suggests the occurrence of predominantly fresh emissions at this particular site.

Currently, the ARB has contracted ENSR to collect ambient air samples for chemical analysis for PAH, PAH derivatives, PCDDs and PCDFs and for mutagenicity testing. This current ambient air study is complementary in certain aspects to the 1986-1988 SAPRC study (Atkinson et al., 1988) in that samples have been/will be collected from two sites in the Sacramento area (impacted by rice straw burning), Fresno (with some impact from residential wood burning in the wintertime), Richmond (which may be similar to the SAPRC Concord site), and three sites in the Los Angeles area. Clearly, it would be advantageous to have the mutagenicity testing conducted in such a manner that the presently ongoing study data can be directly compared to the existing data from the Atkinson et al. (1988) seven-sites study. At the request of the ARB staff, we are proposing to carry out mutagen testing of up to 70 samples collected during the present ENSR program.

Table 1. Summary of the Mutagenicity Data Obtained for ARB Contract No. A5-185-32

Location	Date Sampled	Mutagen Density (rev m^{-3}), TA98		
		+S9	-S9	
		Average	Average	Maximum
Glendora	Aug. 1986	33	35	61
Yuba City	Oct. 1986	26	32	95
Concord	Dec. '86/Jan. 1987	63	62	130
Mammoth	Feb. 1987	17	7	17 (84, +S9)
Oildale	March-Apr. 1987	10	9	20
Reseda	June-July 1987	19	22	50
Pt. Arguello	July 1987	0.2	0.4	0.5*

*For a composite consisting of five 12-hr nighttime periods.

METHODS OF PROCEDURE

Ambient air samples for mutagenicity testing will be collected on glass fiber filters by ENSR for 12-hr daytime and nighttime periods, at a flow rate of 240 liter min^{-1} (equivalent to ~9 CFM, versus 40 CFM for a standard high-volume sampler). These collected filter samples will be extracted by ENSR using dichloromethane, and the extracts to be tested for mutagenicity delivered to SAPRC. The mutagenicity testing will be carried out using Ames strain TA98 without added S9, except for the wintertime samples from Fresno, which will use strain TA98 with and without S9 (it should be noted that we will consult with the ARB staff on the advisability of adding S9 prior to conducting the tests). The general protocol for conducting the mutagenicity testing will be as carried out by Atkinson et al. (1988). Because of the lower volumes of ambient air sampled per 12-hr period [175 m^3 versus 815 m^3 for a standard high-volume sampler as used by Atkinson et al. (1988)], we will use 6 doses in duplicate instead of our previous 8 doses in triplicate. By this means, we will maintian sufficiently low detection limits that mutagen densities ≤ 10 rev m^{-3} can be accurately measured.

We will conduct tests with ~35 samples per test (an extract tested with and without added S9 being counted as two samples) and we will include the necessary standard mutagens for control purposes (Atkinson et al., 1988). The samples to be tested for mutagenicity will be decided upon by the ARB staff. Tests will be conducted in a timely fashion as soon as each of the two batches of 35 samples are available.

REFERENCES

Arey, J., R. Atkinson, B. Zielinska and P. A. McElroy (1989): Diurnal concentrations of volatile polycyclic aromatic hydrocarbons and nitroarenes during a photochemical air pollution episode in Glendora, California. Environ. Sci. Technol., 23, 321-327.

Atkinson, R., J. Arey, A. M. Winer, B. Zielinska, T. M. Dinoff, W. P. Harger and P. A. McElroy (1988): A Survey of Ambient Concentrations of Selected Polycyclic Aromatic Hydrocarbons (PAH) at Various Locations in California. Final Report to California Air Resources Board Contract No. A5-185-32, Sacramento, CA, May.

BUDGET

1/1/91 - 12/31/91

	Percent Time	Requested from Agency
SALARIES & WAGES		
Janet Arey, Principal Investigator Associate Research Chemist II	2%	
Roger Atkinson, Co-Investigator Research Chemist IV	1%	
Staff Research Associate III, Grade 2	10%	$4,133
Secretary II, Step 5	3%	622
TOTAL SALARIES & WAGES		$4,755
EMPLOYEE BENEFITS		
Staff: 22% of $4,755		$1,046
TOTAL EMPLOYEE BENEFITS		$1,046
SUPPLIES & EXPENSES		
Glassware & Chemicals		$2,000
Miscellaneous Supplies		585
TOTAL SUPPLIES & EXPENSES		$2,585
OTHER COSTS		
Xeroxing		$200
Equipment Maintenance		500
TOTAL OTHER COSTS		$700
TOTAL DIRECT COSTS		$9,086
INDIRECT COSTS: 10% of MTDC on $9,086		$ 909
TOTAL COSTS		$9,995

APPENDIX B

MUTAGENICITY TESTING OF AMBIENT AIR SAMPLES
QUARTERLY REPORT
July 1, 1991 - October 1, 1991

UNIVERSITY OF CALIFORNIA AT RIVERSIDE

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MUTAGENICITY TESTING OF EXTRACTS OF COLLECTED AMBIENT AIR PARTICLES

Quarterly Report

to the

California Air Resources Board

Contract No. A032-133

July 1, 1991 - October 1, 1991

Principal Investigator

Janet Arey

Co-Investigator

Roger Atkinson

Research Staff

William P. Harger

Statewide Air Pollution Research Center
University of California
Riverside, CA 92521

3-91:mutagen2

Twenty ambient air particulate extracts from "rice straw" burning sites and four sample blanks have been tested for mutagenic activity in the Ames/Salmonella bioassay. Salmonella typhimurium strain TA98 without microsomal activation (-S9) was used to test the twenty-four samples using the standard agar-overlay procedure. The results are given in Table I.

In order to test each sample at similar doses of air volume equivalents, air sampling volumes and portioning ratios for each sample were obtained from Laurie Ekes at ENSR. Sixteen of the particulate extracts were tested at doses of 0.52, 1.1, 2.5, 5.3, 12, 25 cubic meter equivalents with duplicate test plates at each dose. Because of the limited amount of sample available, the following samples were tested in duplicate at slightly lower doses: CF-11 (0.451, 0.953, 2.17, 4.59, 10.4, and 21.7 m^3), CF-23 (0.51, 1.08, 2.45, 5.19, 11.8, and 24.5 m^3), and PG-36 (0.509, 1.08, 2.45, 5.19, 11.7, and 24.5 m^3). Sample CF-26 was tested in duplicate at slightly higher doses (0.526, 1.11, 2.53, 5.36, 12.1, and 25.3 m^3). The laboratory blanks had no corresponding air volumes and were tested with a single test plate at six doses selected to be approximately equivalent to the percentages of the particulate extracts tested (1.1, 2.4, 5.4, 11.4, 25.8, and 53.9 percent).

Upon receipt from ENSR, the sample extracts were stored in the dark at -20 °C. Each extract was reduced in volume under a stream of dry nitrogen and solvent exchanged into dimethyl sulfoxide (DMSO) for mutagenicity testing. Six DMSO negative control plates were included in the test to determine the background or "spontaneous" revertants. The mutagen density for each particulate sample, in units of revertants per cubic meter (rev m^{-3}), was the slope of the dose-response curve as determined by a least-squares linear regression after subtraction of the spontaneous revertants. As a positive control, the standard mutagen 2-nitrofluorene was tested in triplicate at eight doses. For the air particulate extracts, the total activity (in revertants) was calculated by multiplying the mutagen density by the total sampling volume supplied by ENSR.

The results of the test are shown in Table I. The sample blanks were all non-mutagenic. For the particulate samples, mutagen densities ranged from 0.61 to 12 rev m^{-3}.

Table I. Mutagenicity of Extracts of Collected Ambient Air Particles (TA98; -S9; Standard Assay)

ARB Field ID	AK's Lab ID	Sampling Volume (m^3)	Total Activity (Revertants)	Mutagen Density (Rev m^{-3})
CF-4 (Blank)	81934	N/A	0	N/A
CF-7	81947	169.1	390	2.3
CF-10	81941	179.7	1,800	10
CF-11	81940	160.9	450	2.8
CF-18	82263	138.6	860	6.2
CF-20	82785	124.9	300	2.4
CF-23	82266	182.0	1,000	5.5
CF-26	82267	187.7	660	3.5
CF-29	82787	131.8	510	3.9
CF-32	82783	197.7	120	0.61
CF-38	82778	295.0	1,600	5.4
CF-46	82485	200.0	380	1.9
CF-49C	82492	183.9	1,600	8.9
CF-50C	82501	217.5	1,800	8.1
CF-51C	82495	171.5	700	4.1
PG-12	82264	372.2	1,500	3.9
PG-16	82257	152.7	380	2.5
PG-20	82260	172.9	690	4.0
PG-36	82484	181.7	200	1.1
PG-39C	82496	322.9	1,200	3.6
PG-40C	82490	347.6	4,200	12
N/A	Solvent Blank	N/A	0	N/A
N/A	MB900906	N/A	0	N/A
Trip Blank	N/A	N/A	0	N/A

2-Nitrofluorene positive control 500 (Rev ug^{-1})
DMSO negative control 36 (± 5.6) Revertants (± S.D.)

Ten ambient air particulate extracts and two sample blanks have been tested for mutagenic activity in the Ames/Salmonella bioassay. Salmonella typhimurium strain TA98 with and without microsomal activation (S9) was used to test the twelve samples using the standard agar-overlay procedure. The results are given in Table 1.

Eight dichloromethane extracts of particulate matter collected in Fresno (samples F1PAC 713, F1PPC 690, F2PAC 669, 313 F5PAU, 314 F5PPU, 678 F4PAU, 347 F3PPU, and 724 F3PAU) were each received from ENSR as aliquots of 10 ml and 90 ml. These particulate samples were collected in parallel with other samples which were previously analyzed for PAH. A sample blank, F1PPB 719, was also received and treated identically to the other extracts. Four filters containing particulate matter collected in Richmond (samples 337 R1PAU, 417 R2PAU, 494 R3PAU, and 433 R4PPU) were also received along with two clean unused filters. Upon receipt from ENSR, the sample extracts and unextracted filters were stored in the dark at -20 °C.

All six unextracted filters were Soxhlet extracted with 200 ml dichlormethane for 24 h and were reduced in volume by rotary evaporation. Because Richmond samples 337 R1PAU and 417 R2PAU were collected in parallel with samples which had been analyzed for PAH, they were included in the mutagenicity test along with one of the filter blanks. The other two Richmond samples had no corresponding PAH analyes and were archived along with the other filter blank. Each of the 12 extracts to be tested were further reduced in volume by evaporation under a stream of dry nitrogen and exchanged into dimethyl sulfoxide (DMSO) for the bioassay.

In order to test each sample at similar doses of air volume equivalents, air sampling volumes for each sample were provided by Laurie Ekes at ENSR. All of the particulate extracts were tested at doses of 0.55, 1.1, 2, 4, 7.5, and 15 cubic meter equivalents per plate, with duplicate test plates at each dose. The sample blanks had no corresponding air volumes and were tested with duplicate test plates at 0.46, 0.91, 1.7, 3.3, 6.2, and 12 percent of the sample per plate, six doses selected to be equivalent to the percentages used of the sample with the lowest sampled air volume. Each particulate extract was tested with and without microsomal activation provided by Arochlor-induced rat liver S9 (Litton Bionetics). A 2% (v/v) S9 mix was used (a concentration of S9 which we have previously found to optimal in the testing of ambient air particulate extracts). Six DMSO negative control plates were tested with and without S9 activation to determine the background or "spontaneous" revertants. The mutagen density for each particulate sample, in units of revertants per cubic meter (rev m^{-3}), was the slope of the dose-response curve as determined by a least-squares linear regression after subtraction of the spontaneous revertants. As positive controls, the standard mutagens 2-nitrofluorene (without S9) and benzo(a)pyrene (with S9) were tested in triplicate at eight doses.

The results of the test are shown in Table 1. The sample blanks were both non-mutagenic. For the particulate samples, mutagen densities ranged from 4.9 to 36 rev m^{-3} without S9 and from 2.6 to 33 rev m^{-3} with S9. S9 activation had a variable effect, in some cases increasing the activity modestly and in other cases decreasing activity modestly.

Table 1. Mutagenic Activity of ARB Particulate Extracts TA98, Standard Plate-Incorporation Assay

ENSR Lab ID	ARB Field ID	Sampling Volume (m^3)	TA98; +S9[a] (rev m^{-3})	TA98; -S9 (rev m^{-3})
82936	F1PAC 713	120.6	6.1	8.1
82937	F1PPC 690	181.7	11	19
82939	F1PPB 719	BLANK	0.0[b]	0.0[b]
82941	F2PAC 669	163.1	13	7.6
82974	313 F5PAU	172.8	5.5	6.3
82975	314 F5PPU	214.5	2.6	4.9
82979	678 F4PAU	183.9	27	27
82985	347 F3PPU	174.3	19	36
82988	724 F3PAU	170.1	33	33
83272	337 R1PAU	181.0	11	7.7
83277	417 R2PAU	194.4	5.3	8.1
CLEAN FILTER	N/A	BLANK	0.0[b]	0.0[b]

DMSO negative control (+S9) 35 (± 8) Revertants (± S.D.)
Benzo(a)pyrene positive control 770 (rev μg^{-1})

DMSO negative control (-S9) 27 (± 4) Revertants (± S.D.)
2-Nitrofluorene positive control 570 (rev μg^{-1})

[a] A 2% (v/v) mix was used.
[b] Rev m^{-3} is undefined. No mutagenic activity detected up to the highest dose of 12.4% of sample per plate.

APPENDIX C

ANALYSES OF PAHs, NITRO - PAH AND OXYGENATED - PAH

BATTELLE - COLUMBUS LABORATORIES

FINAL REPORT

on

ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH), NITRO-PAH, AND OXYGENATED-PAH IN AMBIENT AIR SAMPLES

to

ENSR CONSULTING AND ENGINEERING COMPANY

by

Jane C. Chuang

November 1992

BATTELLE
Columbus Operations
505 King Avenue
Columbus, Ohio 43201-2693

FINAL REPORT

on

ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH), NITRO-PAH, AND OXYGENATED-PAH IN AMBIENT AIR SAMPLES

to

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Jane C. Chuang

November 1992

INTRODUCTION

The objective of this study was to determine polycyclic aromatic hydrocarbons (PAH), nitro-PAH, and oxygenated-PAH in six composite ambient air sample extracts. A total of 13 sample extracts were provided by ENSR Consulting and Engineering Company. The sample extracts were composited according to the combination scheme provided by ENSR. The composite sample extracts were fractionated by silica gel column chromatography. The fractions containing the target analytes were analyzed by negative chemical ionization (NCI), gas chromatography/mass spectrometry (GC/MS) to determine target PAH, nitro-PAH, and oxygenated-PAH. The experimental procedures and analysis results are detailed in the following sections of this report.

EXPERIMENTAL PROCEDURE

The sample combination scheme, the designated sample code for the composite samples, and sample volumes are summarized in Table 1. The respective

TABLE 1. SAMPLE COMBINATION SCHEME AND THE DESIGNATED SAMPLE CODE FOR THE COMPOSITE SAMPLE

Original Sample Code	Composite Sample Code	Total[a] Sample Volume, m^3	Remarks
82935 82984	A	367.9	Fresno, nocturnal composite
82986 82981	B	363.4	Fresno, diurnal composite
83281 83286	C	406.5	Richmond, diurnal composite
83282 83287	D	442.4	Richmond, nocturnal composite
82778 82491	E	469.6	Rice straw composite
82780 82494 82783	F	523.6	Rice straw composite

(a) Data were provided by ENSR.

sample extracts were combined and concentrated to 1 mL by Kuderna-Danish (K-D) evaporation. The concentrated sample extract was applied to a pre-packed (1 g) silica gel column. Two elution solvents were applied to the column in the following sequence: 4 mL of dichloromethane (DCM), and 4 mL of methanol. The DCM fraction was concentrated to 1 mL by K-D evaporation for GC/MS analysis. The methanol fraction was saved in the dark at -20°C. A laboratory method blank was prepared by the same procedure. Another method blank was spiked with a known amount (100 ng each) of each target analyte and fractionated by a silica gel column using the same procedure described before. The spiked and non-spiked method blank samples were also analyzed by GC/MS. The internal standard, 1-nitropyrene-d_9 was added to each sample extract prior to GC/MS analysis.

Negative chemical ionization (NCI), GC/MS was used to determine target analytes. A Finnigan TSQ GC/MS/MS operated in GC/MS mode was used. Methane was used as the carrier gas and reagent gas. The GC column was a DB-5 fused silica capillary column (30 m x 0.25 mm; 0.25 μm film thickness, Supelco). Data acquisition and processing were controlled by a Finnigan INCOS Model 2300 data system. The MS was operated in the selected ion monitoring (SIM) mode. Peaks monitored were the molecular ion peaks (M), M-1, and M+1 ion peaks. Identification of the target compounds was based on their GC retention times relative to the internal standard (1-nitropyrene-d_9). Quantification of target compounds was based on comparisons of the respective integrated ion current responses of the target ion to the internal standard, with average response factors of each target compound generated from analyses of standard solutions. Because only trace amounts of 2-nitrofluoranthene and 8-nitrofluoranthene are available, the standard solutions of these compounds were analyzed to determine heir retention times relative to the internal standard. Quantification of these compounds was based on the average response factor of 1-nitropyrene. In addition, the pure standard of pyrene-3,4-dicarboxylic acid anhydride was not available. Quantification of this compound was based on the assumption that its response factor is one-half of the more volatile naphthalene-1,8-dicarboxylic acid anhydride.

RESULTS

The results of the recovery data for the spiked target compounds in the method blank are summarized in Table 2. As shown in these tables, the recoveries were greater than 90 percent for all the spiked compounds, indicating that the amounts of the target analytes lost through the fractionation step were negligible. Analysis of the laboratory method blank showed that none of the target analytes were detected in the method blank.

The concentrations of target compounds in the composite sample extracts are summarized in Table 3. The PAH concentrations ranged from 12.338 ng/m^3 of fluoranthene to 0.087 ng/m^3 of benzo(a)pyrene. Higher PAH concentrations were found in nocturnal composite samples as compared to the corresponding diurnal composite samples. This relative concentration trend was not observed for all the nitro-PAH and the oxygenated-PAH. The nitro-PAH and oxygenated PAH concentrations ranged from 0.013 ng/m^3 of 1-nitropyrene to 0.549 ng/m^3 of 2-nitronaphthalene, and from 0.030 ng/m^3 of benzo(a)anthracene-7,12-dione to 7.191 ng/m^3 of 9-fluorenone, respectively. In general, highest concentrations of all the target analytes were found in Fresno composite samples, followed by Richmond composite samples and rice straw composite samples.

TABLE 2. RECOVERY DATA OF SPIKED TARGET COMPOUNDS IN THE METHOD BLANK

Compound	Percent of Recovery
Fluoranthene	92
Benzo(a)pyrene	100
1-Nitronaphthalene	100
2-Nitronaphthalene	99
3-Nitrobiphenyl	97
9-Nitrophenanthrene	96
9-Nitroanthracene	98
2-Nitrofluoranthene	100
1-Nitropyrene	96
6-Nitrochrysene	100
1,6-Dinitropyrene	100
9-Fluorenone	92
Naphthalene-1,8-dicarboxylic acid anhydride	100
Benzo(a)anthracene-7,12-dione	97

TABLE 3. TARGET ANALYTE CONCENTRATIONS IN THE COMPOSITE SAMPLE EXTRACTS

Compound	Concentration,ng/m^3					
	A	B	C	D	E	F
Fluoranthene	12.338	8.900	3.598	4.863	0.746	0.364
Benzo(a)pyrene	7.372	2.336	0.460	1.802	0.163	0.087
1-Nitronaphthalene	0.291	0.392	0.099	0.155	0.038	0.026
2-Nitronaphthalene	0.193	0.549	0.082	0.094	0.024	0.023
3-Nitrobiphenyl	0.094	0.257	0.024	0.017	<0.011	<0.010
9-Nitrophenanthrene	0.432	0.292	0.046	0.178	0.041	0.020
9-Nitroanthracene	0.045	0.037	0.012	0.023	<0.011	<0.010
2-Nitrofluoranthene	0.112	0.146	0.021	0.043	0.014	<0.010
8-Nitrofluoranthene	<0.014	<0.014	<0.012	<0.011	<0.011	<0.010
1-Nitropyrene	0.044	0.041	0.014	0.019	<0.011	0.013
2-Nitropyrene	<0.014	<0.014	<0.012	<0.011	<0.011	<0.010
6-Nitrochrysene	0.022	<0.014	<0.012	<0.011	<0.011	<0.010
1,6-Dinitropyrene	<0.014	<0.014	<0.012	<0.011	<0.011	<0.010
9-Fluorenone	7.191	6.318	3.216	3.636	1.022	0.749
Naphthalene-1,8-dicarboxylic acid anhydride	4.786	4.792	1.254	2.681	0.314	0.182
Benzo(a)anthracene-7,12-dione	1.020	0.514	0.140	0.342	0.050	0.030
Pyrene-3,4-dicarboxylic acid anhydride	0.416	0.556	0.389	0.517	0.105	0.286

APPENDIX D

NWS LOCAL CLIMATOLOGICAL DATA

FOR SACRAMENTO, SAN FRANCISCO AND FRESNO

OCT 1990
SACRAMENTO, CA
FSS, FAA
EXECUTIVE AIRPORT

ISSN 0198-0807

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

EXECUTIVE AIRPORT

LATITUDE 38° 31' N LONGITUDE 121° 30' W ELEVATION (GROUND) 17 FEET TIME ZONE PACIFIC 23232

DATE 1	TEMPERATURE °F: MAXIMUM 2	MINIMUM 3	AVERAGE 4	DEPARTURE FROM NORMAL 5	AVERAGE DEW POINT 6	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL) 7A	COOLING (SEASON BEGINS WITH JAN) 7B	WEATHER TYPES 8	SNOW ICE PELLETS OR ICE ON GROUND AT 0400 INCHES 9	PRECIPITATION: WATER EQUIVALENT (INCHES) 10	SNOW, ICE PELLETS (INCHES) 11	AVERAGE STATION PRESSURE IN INCHES ELEV. 25 FEET ABOVE M.S.L. 12	WIND M.P.H.: RESULTANT DIR. 13	RESULTANT SPEED 14	AVERAGE SPEED 15	PEAK GUST: SPEED 16	PEAK GUST: DIRECTION 17	FASTEST MILE: SPEED 18	FASTEST MILE: DIRECTION 19	SUNSHINE: MINUTES 20	PERCENT OF TOTAL POSSIBLE 21	SKY COVER (TENTHS): SUNRISE TO SUNSET 22	MIDNIGHT TO MIDNIGHT 23
01	89	[illegible]	75	6	54	0	10		0	0.00	0.0	29.850	20	6.2	7.6			12	SW	681	96	3	2
02	88	[illegible]	72	4	44	0	7		0	0.00	0.0	29.800	33	5.8	8.3			17	NW	679	96	4	2
03	93	[illegible]	80*	12	43	0	15		0	0.00	0.0	29.880	35	7.9	8.7			23	NW	686	98	1	0
04	94*	[illegible]	77	9	51	0	12		0	0.00	0.0	29.935	20	5.3	6.4			15	SW	673	96	1	2
05	78	[illegible]	68	1	54	0	3		0	0.00	0.0	29.920	20	8.9	10.0			17	SW	660	95	7	6
06	80	53	67	0	37	0	2		0	0.00	0.0	29.900	33	10.0	11.6			17	NW	669	96	2	1
07	80	[illegible]	69	2	24	0	4		0	0.00	0.0	29.960	32	15.3	15.7			23	NW	693	100	0	0
08	83	46	65	-2	27	0	0		0	0.00	0.0	30.100	35	4.7	5.2			9	N	690	100	0	0
09	87	45	66	0	34	0	1		0	0.00	0.0	30.120	34	1.6	2.2			5	SW	688	100	0	0
10	88	46	67	1	38	0	2		0	0.00	0.0	29.930	23	0.7	1.7			4	SW	685	100	0	0
11	87	[illegible]	69	3	35	0	4		0	0.00	0.0	29.910	34	4.4	4.6			11	NW	683	100	0	0
12	86	45	66	1	37	0	1		0	0.00	0.0	29.960	35	1.1	1.8			7	N	681	100	0	0
13	86	51	69	4	42	0	4		0	0.00	0.0	29.855	32	3.3	4.7			10	NW	653	96	1	0
14	87	48	68	3	44	0	3		0	0.00	0.0	29.850	19	3.8	4.0			10	S	676	100	0	0
15	82	52	67	3	49	0	2		0	0.00	0.0	29.655	19	6.7	7.7			10	SW	654	97	1	1
16	83	54	69	5	40	0	4	8	0	0.00	0.0	29.670	32	6.2	9.2			20	NW	643	96	2	2
17	84	45	65	1	27	0	0		0	0.00	0.0	29.910	23	1.4	4.1			10	SW	625	94	1	3
18	71	54	63	0	46	2	0	1 6	0	0.04	0.0	29.940	24	5.6	10.4			17	SW	[illegible]	61	10	9
19	73	52	63	0	41	2	0		0	0.00	0.0	29.960	32	11.4	11.8			17	NW	639	96	0	2
20	75	44	60	-3	33	5	0		0	0.00	0.0	30.050	33	4.5	5.4			9	NW	644	97	1	1
21	80	44*	62	0	40	3	0		0	0.00	0.0	30.060	15	0.6	1.1			2	SW	635	96	1	0
22	81	49	65	3	44	0	0		0	0.00	0.0	29.960	32	2.0	3.4			8	NW	625	95	1	1
23	83	48	66	4	46	0	1		0	0.00	0.0	29.980	34	2.3	3.4			10	N	633	97	1	0
24	86	49	68	7	48	0	3		0	0.00	0.0	30.000	01	0.6	0.8				MSG	652	100	0	0
25	84	49	67	6	46	0	2		0	0.00	0.0	30.000	16	2.9	3.3			12	SW	619	95	5	4
26	84	48	66	5	47	0	1		0	0.00	0.0	29.990	33	2.7	3.6			11	NW	600	93	0	1
27	83	45	64	4	45	1	0		0	0.00	0.0	29.990	19	3.3	4.0			9	S	645	100	0	0
28	81	50	66	6	51	0	1		0	0.00	0.0	29.980	18	6.4	7.8			11	SW	549	85	4	3
29	74	52	63	4	48	2	0		0	0.00	0.0	29.980	18	5.9	7.2			12	SW	615	96	1	1
30	73	48	61	2	51	4	0	1	0	0.00	0.0	29.975	18	6.9	8.5			12	W	528	83	6	6
31	70	49	60*	1	48	5	0	1	0	0.05	0.0	29.960	19	4.0	7.5			11	SW	342	54	7	6
	SUM 2553	SUM 1572				TOTAL 24	TOTAL 82	NUMBER OF DAYS		TOTAL 0.09	TOTAL 0.0	FOR THE MONTH: 29.950	26	1.9	6.2			23	NW	TOTAL 19549	% FOR MONTH	SUM 60	SUM 53
	AVG 82.4	AVG 50.7	AVG. 66.6	DEP. 2.7	AVG. 42.2	DEP. -58	DEP. 34	PRECIPITATION ≥ .01 INCH 2		DEP. -0.77						DATE:		DATE: 7+		POSSIBLE 20810	94	AVG. 1.9	AVG. 1.7

NUMBER OF DAYS				SEASON TO DATE			
MAXIMUM TEMP. ≥ 90°	MAXIMUM TEMP. ≤ 32°	MINIMUM TEMP. ≤ 32°	MINIMUM TEMP. ≤ 0°	TOTAL 24	TOTAL 1468	SNOW, ICE PELLETS ≥ 1.0 INCH	0
2	0	0	0	DEP. -65	DEP. 270	THUNDERSTORMS	0
						HEAVY FOG	0
						CLEAR 24 PARTLY CLOUDY 6 CLOUDY 1	

GREATEST IN 24 HOURS AND DATES: PRECIPITATION		SNOW, ICE PELLETS		GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
0.05	31	0.0		0

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER.

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Kenneth D Hadeen
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

SACRAMENTO, CA

OBSERVATIONS AT 3-HOUR INTERVALS

Date	Hour LST	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Visibility Whole Miles	Visibility 16ths Mile	Weather	Temperature Air °F	Temperature Wet Bulb °F	Temperature Dew Point °F	Rel Humidity %	Wind Direction	Wind Speed (Knots)
OCT 1st	01	0	UNL	15			67	58	51	57	16	6
	04	0	UNL	15			66	58	52	61	20	12
	07	0	UNL	20			61	57	54	78	15	5
	10	0	UNL	20			73	62	55	53	23	3
	13	8	180	20			87	67	55	34	27	6
	16	2	UNL	20			85	66	53	33	20	7
	19	2	UNL	15			69	61	55	61	20	6
	22	1	UNL	15			64	58	54	70	16	5
OCT 2nd	01	0	UNL	15			62	57	53	73	12	5
	04	0	UNL	15			60	56	52	75	06	3
	07	0	UNL	20			58	55	53	84	00	0
	10	7	UNL	15			76	61	49	39	36	9
	13	10	UNL	8			84	61	42	23	33	11
	16	2	UNL	10			88	60	36	16	33	10
	19	0	UNL	15			71	54	37	29	00	0
	22	0	UNL	15			71	53	33	25	31	9
OCT 3rd	01	0	UNL	10			73	53	32	22	34	15
	04	0	UNL	15			68	52	34	29	35	14
	07	0	UNL	50			67	52	37	33	00	0
	10	0	UNL	15			79	59	42	27	32	9
	13	1	UNL	20			90	63	43	20	34	14
	16	1	UNL	20			92	64	44	19	02	5
	19	1	UNL	15			75	61	51	43	00	0
	22	0	UNL	10			68	60	54	61	00	0
OCT 4th	01	0	UNL	15			62	56	51	67	00	0
	04	0	UNL	15			62	56	50	65	00	0
	07	0	UNL	10			61	55	50	67	00	0
	10	0	UNL	8			83	63	48	30	20	5
	13	0	UNL	7			91	64	45	20	23	5
	16	1	UNL	10			92	66	47	21	23	12
	19	2	UNL	20			71	62	56	59	23	10
	22	0	UNL	15			66	60	56	70	16	6
OCT 5th	01	3	UNL	15			62	58	55	78	18	6
	04	2	UNL	10			60	56	53	78	20	7
	07	7	UNL	10			60	57	54	81	18	8
	10	7	UNL	10			70	61	54	57	24	12
	13	7	UNL	15			76	63	53	45	23	10
	16	8	200	15			75	63	54	48	20	9
	19	7	200	20			64	58	54	70	19	7
	22	5	UNL	15			59	56	53	81	17	7
OCT 6th	01	3	UNL	15			57	54	51	81	18	6
	04	0	UNL	15			54	52	50	86	35	5
	07	0	UNL	15			57	54	52	84	33	8
	10	2	UNL	10			68	52	35	30	32	12
	13	4	UNL	10			77	56	37	24	34	12
	16	5	UNL	15			78	55	33	20	33	12
	19	0	UNL	15			68	49	26	21	29	7
	22	0	UNL	20			66	48	24	20	34	12
OCT 7th	01	0	UNL	15			63	47	26	25	32	13
	04	0	UNL	15			62	46	24	23	32	12
	07	0	UNL	50			60	46	27	29	29	12
	10	0	UNL	10			70	51	28	21	34	17
	13	0	UNL	20			78	53	24	13	33	16
	16	1	UNL	20			79	53	22	12	34	15
	19	0	UNL	30			71	49	20	14	32	10
	22	0	UNL	20			65	46	21	19	34	15
OCT 8th	01	0	UNL	15			56	43	24	29	33	8
	04	0	UNL	15			56	43	23	28	33	10
	07	0	UNL	50			49	41	30	48	00	0
	10	0	UNL	25			67	48	25	20	01	7
	13	2	UNL	30			80	54	22	12	33	7
	16	0	UNL	30			82	54	18	9	02	4
	19	0	UNL	30			63	49	33	33	00	0
	22	0	UNL	10			55	48	41	60	00	0
OCT 9th	01	0	UNL	10			52	45	37	57	00	0
	04	0	UNL	10			47	42	36	66	24	3
	07	0	UNL	30			48	44	38	69	00	0
	10	0	UNL	10			73	52	28	19	33	5
	13	0	UNL	7			82	56	27	13	31	6
	16	0	UNL	15			85	56	22	10	35	5
	19	0	UNL	15			65	51	37	36	00	0
	22	0	UNL	15			58	50	41	53	00	0
OCT 10th	01	0	UNL	15			52	47	42	69	00	0
	04	0	UNL	15			49	44	38	66	00	0
	07	0	UNL	15			50	45	39	66	03	5
	10	0	UNL	10			73	54	36	26	19	4
	13	0	UNL	10			84	59	35	17	21	6
	16	0	UNL	15			87	58	30	13	21	5
	19	0	UNL	20			66	54	42	42	00	0
	22	0	UNL	15			58	51	44	60	00	0
OCT 11th	01	0	UNL	15			56	50	43	62	00	0
	04	0	UNL	15			51	47	42	72	00	0
	07	0	UNL	50			54	46	36	51	03	5
	10	0	UNL	30			69	52	34	28	34	9
	13	0	UNL	25			81	56	31	16	31	7
	16	0	UNL	20			86	56	22	9	35	10
	19	0	UNL	20			66	52	38	36	00	0
	22	0	UNL	20			57	49	40	53	00	0
OCT 12th	01	0	UNL	20			52	45	37	57	00	0
	04	0	UNL	20			50	43	35	57	00	0
	07	0	UNL	15			50	44	37	61	00	0
	10	0	UNL	15			71	54	38	30	36	5
	13	0	UNL	10			82	58	35	19	01	6
	16	0	UNL	15			86	57	27	12	00	0
	19	0	UNL	20			65	53	41	42	00	0
	22	0	UNL	10			60	51	43	54	00	0
OCT 13th	01	0	UNL	10			54	49	43	67	00	0
	04	0	UNL	10			53	47	40	62	00	0
	07	0	UNL	40			53	46	39	59	01	4
	10	0	UNL	30			72	56	42	34	01	3
	13	0	UNL	30			81	60	43	26	32	10
	16	1	UNL	20			85	58	33	15	33	7
	19	5	UNL	15			69	58	50	51	21	6
	22	0	UNL	20			61	54	48	63	24	4
OCT 14th	01	0	UNL	15			53	50	48	83	00	0
	04	0	UNL	15			51	49	47	86	00	0
	07	0	UNL	50			49	48	46	90	00	0
	10	0	UNL	30			70	55	41	35	00	0
	13	0	UNL	35			84	60	40	21	20	5
	16	0	UNL	40			86	60	38	18	21	5
	19	0	UNL	30			69	57	47	46	19	7
	22	0	UNL	20			60	52	45	58	18	6
OCT 15th	01	0	UNL	15			57	51	46	67	17	7
	04	0	UNL	15			54	50	45	72	16	6
	07	0	UNL	50			53	50	47	80	18	5
	10	5	UNL	20			67	56	47	49	24	7
	13	1	UNL	15			78	61	47	34	21	6
	16	0	UNL	15			81	61	46	29	22	7
	19	0	UNL	25			69	60	54	59	21	9
	22	0	UNL	15			65	59	55	70	18	6
OCT 16th	01	3	UNL	15			62	58	54	75	16	5
	04	2	UNL	15			57	54	52	84	13	5
	07	4	UNL	25			55	53	51	87	22	4
	10	0	UNL	20			68	60	54	61	32	8
	13	3	UNL	20			80	60	44	28	35	12
	16	0	UNL	7			81	54	24	12	33	14
	19	0	UNL	15			71	50	25	18	31	8
	22	0	UNL	20			63	47	26	25	33	8
OCT 17th	01	0	UNL	20			58	43	23	25	31	7
	04	0	UNL	30			52	42	27	38	00	0
	07	0	UNL	50			47	40	30	52	23	5
	10	0	UNL	30			69	50	26	20	00	0
	13	0	UNL	20			79	52	19	11	29	4
	16	3	UNL	20			83	55	22	10	00	0
	19	10	250	20			65	49	31	28	17	3
	22	10	250	20			64	49	31	29	21	6
OCT 18th	01	8	250	15			62	48	31	31	20	10
	04	9	200	15			60	50	40	48	18	6
	07	10	100	50			58	50	41	53	11	8
	10	10	100	50			63	52	42	46	21	10
	13	9	85	50			68	57	48	49	19	8
	16	10	32	5		H	62	56	50	65	30	15
	19	10	32	3		L	55	53	52	90	32	10
	22	10	9	7			54	53	52	93	32	9

WEATHER CODES

*	TORNADO	ZL	FREEZING DRIZZLE	IPW	ICE PELLET SHOWERS	BN	BLOWING SAND
T	THUNDERSTORM	S	SNOW	A	HAIL	BS	BLOWING SNOW
Q	SQUALL	SW	SNOW SHOWERS	F	FOG	BY	BLOWING SPRAY
R	RAIN	SG	SNOW GRAINS	IF	ICE FOG	K	SMOKE
RW	RAIN SHOWERS	SP	SNOW PELLETS	GF	GROUND FOG	H	HAZE
ZR	FREEZING RAIN	IC	ICE CRYSTALS	BD	BLOWING DUST	D	DUST
L	DRIZZLE	IP	ICE PELLETS				

CEILING: UNL INDICATES UNLIMITED

WIND DIRECTION: DIRECTIONS ARE THOSE FROM WHICH THE WIND BLOWS, INDICATED IN TENS OF DEGREES FROM TRUE NORTH: I.E., 09 FOR EAST, 18 FOR SOUTH, 27 FOR WEST. AN ENTRY OF 00 INDICATES CALM

SPEED: THE OBSERVED AVERAGE ONE-MINUTE VALUE, EXPRESSED IN KNOTS (MPH=KNOTS X 1.15).

OCT 1990 23232
SACRAMENTO, CA

OBSERVATIONS AT 3-HOUR INTERVALS

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
					OCT 19th						
01	10	20	7			55	55	54	97	32	8
04	7	40	10			54	51	49	83	34	8
07	0	UNL	50			52	50	47	83	35	7
10	0	UNL	50			60	52	45	58	33	14
13	0	UNL	40			70	55	41	35	33	12
16	0	UNL	50			72	53	34	25	33	14
19	0	UNL	30			63	49	32	31	30	8
22	0	UNL	20			57	46	32	39	30	10
					OCT 22nd						
01	0	UNL	15			54	48	41	62	14	4
04	0	UNL	15			52	47	42	69	00	0
07	0	UNL	30			49	46	43	80	00	0
10	0	UNL	20			68	55	43	41	31	8
13	0	UNL	20			78	59	42	28	29	8
16	3	UNL	20			79	58	38	23	34	5
19	3	UNL	20			63	54	46	54	24	4
22	0	UNL	10			59	53	48	67	00	0
					OCT 25th						
01	0	UNL	15			54	51	49	83	00	0
04	0	UNL	15			51	49	46	83	00	0
07	0	UNL	15			50	48	45	83	00	0
10	4	UNL	7			71	57	46	41	00	0
13	7	UNL	7			80	62	48	33	21	5
16	8	250	30			81	62	47	30	20	4
19	5	UNL	30			65	54	44	47	17	5
22	3	UNL	20			58	53	49	72	13	4
					OCT 28th						
01	5	UNL	20			56	51	46	69	13	5
04	1	UNL	20			53	50	47	80	13	3
07	3	UNL	50			51	50	49	93	14	6
10	5	UNL	50			66	59	53	63	16	7
13	4	UNL	50			77	62	50	39	18	6
16	6	85	50			79	64	53	41	22	11
19	2	UNL	30			66	59	54	65	22	10
22	2	UNL	20			60	55	51	72	18	7
					OCT 31st						
01	9	150	20			59	56	54	84	17	5
04	10	100	20			60	56	52	75	15	8
07	10	30	3		F	57	55	54	90	16	8
10	10	22	10			59	57	56	90	15	7
13	8	24	20		R	59	54	50	72	34	7
16	3	UNL	30			68	54	41	38	25	8
19	2	UNL	40			55	47	38	53	22	6
22	2	UNL	20			51	47	42	72	27	4

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
					OCT 20th						
01	0	UNL	20			50	43	33	52	30	8
04	0	UNL	20			48	42	33	56	30	6
07	0	UNL	75			46	40	33	61	00	0
10	0	UNL	50			59	47	32	36	33	7
13	5	UNL	40			71	51	29	21	03	6
16	1	UNL	40			75	52	24	15	34	8
19	0	UNL	30			59	48	35	41	02	3
22	0	UNL	20			52	46	39	61	00	0
					OCT 23rd						
01	0	UNL	10			55	51	47	75	16	4
04	0	UNL	10			51	49	47	86	10	3
07	0	UNL	25			49	48	46	90	29	3
10	0	UNL	10			68	56	49	51	32	6
13	3	UNL	15			79	59	43	28	34	5
16	0	UNL	15			83	60	41	23	30	5
19	0	UNL	15			65	56	49	56	00	0
22	0	UNL	15			[illegible]	54	47	60	00	0
					OCT 26th						
01	3	UNL	20			55	52	50	83	18	4
04	2	UNL	15			52	51	50	93	00	0
07	1	UNL	20			49	46	46	90	34	5
10	0	UNL	15			65	57	[illegible]	47	34	6
13	0	UNL	10			79	60	44	29	33	7
16	0	UNL	15			83	60	40	22	34	5
19	0	UNL	15			64	55	47	54	00	0
22	0	UNL	15			55	51	48	77	00	0
					OCT 29th						
01	0	UNL	15			55	52	50	83	12	5
04	0	UNL	15			53	51	49	86	18	6
07	0	UNL	40			52	51	49	90	14	5
10	0	UNL	35			66	58	51	59	22	5
13	1	UNL	40			72	58	47	41	16	4
16	1	UNL	40			73	57	44	36	22	9
19	0	UNL	40			59	53	47	65	19	6
22	0	UNL	20			54	51	49	83	12	7

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
					OCT 21st						
01	0	UNL	15			50	43	35	57	00	0
04	0	UNL	15			46	42	38	74	00	0
07	2	UNL	35			46	43	39	77	00	0
10	0	UNL	30			67	54	41	39	00	0
13	0	UNL	30			77	56	36	23	36	3
16	0	UNL	30			79	58	38	23	00	0
19	0	UNL	30			63	53	44	50	00	0
22	0	UNL	15			56	51	46	69	12	2
					OCT 24th						
01	0	UNL	15			57	51	46	67	00	0
04	0	UNL	15			52	49	45	77	00	0
07	0	UNL	20			50	48	45	83	00	0
10	0	UNL	15			72	59	48	43	00	0
13	0	UNL	10			82	62	47	29	30	4
16	0	UNL	10			85	62	45	25	02	4
19	0	UNL	10			66	59	53	63	00	0
22	0	UNL	15			59	55	52	78	00	0
					OCT 27th						
01	0	UNL	15			51	48	45	80	00	0
04	0	UNL	15			48	44	40	74	00	0
07	0	UNL	30			46	44	41	83	00	0
10	0	UNL	10			68	58	50	53	16	4
13	0	UNL	10			78	60	45	31	14	4
16	0	UNL	15			82	61	44	26	23	7
19	0	UNL	15			68	57	48	49	18	8
22	3	UNL	20			61	53	46	58	22	8
					OCT 30th						
01	2	UNL	20			51	49	47	86	13	7
04	1	UNL	20			50	49	47	90	12	7
07	0	UNL	20			49	48	47	93	13	6
10	6	UNL	30			63	57	53	70	18	6
13	7	200	30			72	60	50	46	17	10
16	9	180	30			69	58	50	51	22	11
19	10	150	20			63	57	53	70	22	7
22	10	150	20			61	57	53	75	21	6

SUMMARY BY HOURS

HOUR L.S.T.	AVERAGES: SKY COVER (TENTHS)	STATION PRESSURE (INCHES)	TEMPERATURE AIR TEMP °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND SPEED (MPH)	RESULTANT WIND DIRECTION	RESULTANT WIND SPEED (MPH)
01	1	29.945	57	50	43	65	5.1	21	0.9
04	1	29.940	54	49	43	68	4.6	24	0.4
07	1	29.980	53	48	43	73	4.0	17	0.4
10	2	30.000	69	56	43	42	7.2	31	3.4
13	3	29.960	79	59	41	28	8.6	31	4.3
16	2	29.910	81	58	37	24	8.6	29	4.5
19	2	29.920	66	54	43	48	5.2	23	3.2
22	1	29.940	60	52	44	60	5.2	25	1.5

HOURLY PRECIPITATION (WATER EQUIVALENT IN INCHES)

OCT 1990
SACRAMENTO, CA
23232

DATE	A.M. HOUR ENDING AT 1	2	3	4	5	6	7	8	9	10	11	12	P.M. HOUR ENDING AT 1	2	3	4	5	6	7	8	9	10	11	12	DATE
01																									01
02																									02
03																									03
04																									04
05																									05
06																									06
07																									07
08																									08
09																									09
10																									10
11																									11
12																									12
13																									13
14																									14
15																									15
16																									16
17																									17
18									T	T							0.01	T	0.03	T					18
19																									19
20																									20
21																									21
22																									22
23																									23
24																									24
25																									25
26																									26
27																									27
28																									28
29																									29
30																									30
31					T	T	0.01	0.01	0.01	T	0.01		T	T				0.01							31

MAXIMUM SHORT DURATION PRECIPITATION

TIME PERIOD (MINUTES)	5	10	15	20	30	45	60	80	100	120	150	180
PRECIPITATION (INCHES)	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04
ENDED: DATE	31	31	31	31	31	18	18	18	18	18	18	18
ENDED: TIME	0703	0703	0703	0703	0703	1849	1849	1849	1849	1849	1849	1849

THE PRECIPITATION AMOUNTS FOR THE INDICATED TIME INTERVALS MAY OCCUR AT ANY TIME DURING THE MONTH. THE TIME INDICATED IS THE ENDING TIME OF THE INTERVAL. DATE AND TIME ARE NOT ENTERED FOR TRACE AMOUNTS.

VALIDATED BY:
DON GRISINGER

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NOV 1990
SACRAMENTO, CA
FSS, FAA
EXECUTIVE AIRPORT

ISSN 0198-0807

LOCAL CLIMATOLOGICAL DATA
Monthly Summary

EXECUTIVE AIRPORT

SACRAMENTO, CA

LATITUDE 38° 31' N LONGITUDE 121° 30' W ELEVATION (GROUND) [illegible] 17 FEET TIME ZONE PACIFIC 23232

DATE 1	TEMPERATURE °F: MAXIMUM 2	MINIMUM 3	AVERAGE 4	DEPARTURE FROM NORMAL 5	AVERAGE DEW POINT 6	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL) 7A	COOLING (SEASON BEGINS WITH JAN) 7B	WEATHER TYPES 8	SNOW, ICE PELLETS OR ICE ON GROUND AT 0400 INCHES 9	PRECIPITATION: WATER EQUIVALENT (INCHES) 10	SNOW, ICE PELLETS (INCHES) 11	AVERAGE STATION PRESSURE IN INCHES ELEV. 25 FEET ABOVE M.S.L. 12	WIND (M.P.H.): RESULTANT DIR. 13	RESULTANT SPEED 14	AVERAGE SPEED 15	PEAK GUST SPEED 16	PEAK GUST DIRECTION 17	FASTEST MILE SPEED 18	FASTEST MILE DIRECTION 19	SUNSHINE MINUTES 20	PERCENT OF TOTAL POSSIBLE 21	SKY COVER (TENTHS) SUNRISE TO SUNSET 22	MIDNIGHT TO MIDNIGHT 23
01	67	40	54	-4	32	11	0		0	0.00	0.0	30.030	33	11.[illegible]	11.8			20	NW	634	100	0	0
02	67	47	57	-1	21	8	0		0	0.00	0.0	30.080	33	6.[illegible]	6.9			25	NW	631	100	0	0
03	71	40	56	-1	26	9	0		0	0.00	0.0	[illegible]	26	[illegible]	6.1			6	SW	629	100	0	0
04	73	40	57	0	30	8	0	8	0	0.00	[illegible]	[illegible]	[illegible]	[illegible]	6			5	SW	594	95	2	2
05	72	42	57	0	31	8	0	8	0	0.00	[illegible]	29.985	33	9.[illegible]	9.8			22	NW	590	94	1	1
06	70	51	61*	5	23	4	0		0	0.00	[illegible]	30.045	35	[illegible]	8.0			23	NW	623	100	0	0
07	69	41	55	-1	23	10	0		0	0.00	[illegible]	30.[illegible]50	[illegible]	5.[illegible]	5.5			14	NW	621	100	6	4
08	74	41	58	3	33	7	0		0	0.00	[illegible]	30.2[illegible]	[illegible]	0.[illegible]	1.3			8	NW	592	96	4	2
09	74	39	57	2	38	8	0	8	0	0.00	[illegible]	30.[illegible]60	[illegible]	0.[illegible]	1.1			4	SE	617	100	0	0
10	76	38	57	2	40	8	0	8	0	0.00	[illegible]	30.[illegible]20	35	2.4	3.1			6	NW	615	100	0	0
11	76	40	58	4	39	7	0		0	0.00	[illegible]	30.090	34	2.[illegible]	2.2			8	N	530	86	6	5
12	78*	42	60	6	37	5	0	1 8	0	0.00	[illegible]	30.070	30	0.6	2.1			6	N	571	93	1	3
13	75	44	60	6	30	5	0	8	0	0.00	[illegible]	[illegible]	[illegible]	[illegible]	6.7			10	SW	421	69	9	7
14	56	48	52	-1	48	13	0	1	0	0.06	[illegible]	30.000	32	[illegible]	6.8			9	NW	87	14	9	6
15	63	41	52	-1	41	13	0	1 8	0	0.0[illegible]	[illegible]	30.110	34	1.[illegible]	4.4			11	NW	605	100	0	0
16	59	43	51	-2	45	14	0	1 8	0	0.00	[illegible]	30.[illegible]	34	[illegible]	3.6			9	NW	325	54	10	8
17	70	43	57	5	42	8	0	6	0	0.00	[illegible]	30.070	[illegible]	[illegible]	2.1			5	SE	514	85	5	4
18	65	45	55	3	44	10	0	8	0	0.00	[illegible]	29.980	[illegible]	[illegible]	1.0			5	W	459	77	8	6
19	64	42	53	1	45	12	0	1 8	0	0.06	[illegible]	29.830	22	[illegible]	4.6			9	SW	353	59	10	9
20	58	36	47	-4	37	18	0	1 8	[illegible]	[illegible]	[illegible]	29.970	[illegible]	[illegible]	3.5			5	NW	535	90	6	5
21	59	39	49	-2	37	16	0	8	0	0.00	[illegible]	30.[illegible]70	[illegible]	[illegible]	4.9			9	NW	553	93	6	5
22	64	34	49	-2	38	16	0		0	0.00	[illegible]	30.290	33	[illegible]	1			6	NW	565	95	3	1
23	65	33	49	-1	37	16	0	1 8	0	0.00	[illegible]	[illegible]	33	[illegible]	1.7			6	NW	567	96	5	3
24	66	32	49	-1	36	16	0	1 8	0	0.00	[illegible]	30.020	24	0.[illegible]	1.4			5	SE	591	100	0	0
25	63	36	50	0	34	15	0	1 8	0	0.[illegible]	[illegible]	29.880	[illegible]	3.[illegible]	8.1			17	NW	348	59	9	6
26	56	39	48	-2	32	17	0		0	0.00	[illegible]	30.020	33	2.[illegible]	12.8			18	NW	587	100	0	0
27	55	30	43*	-6	30	22	0		0	0.00	[illegible]	30.2[illegible]	[illegible]	2.[illegible]	2.4			6	NW	585	100	0	0
28	60	30*	45	-4	34	20	0	1 8	0	0.00	[illegible]	30.[illegible]5	[illegible]	[illegible]	0.6			4	SE	513	88	7	4
29	59	33	46	-3	35	19	0	1 6	0	0.00	[illegible]	30.280	33	[illegible]	1.8			6	NW	428	73	10	8
30	65	38	52	3	34	13	0	1 8	0	0.00	0.0	30.170	33	5.[illegible]	5.7			14	NW	546	94	0	2

	MAXIMUM	MINIMUM	AVERAGE	DEPARTURE	DEW POINT	HEATING	COOLING
SUM / TOTAL	1989	1187				356	0
AVG / DEP	66.3	39.6	53.0	0.0	35.1	-4	0
SEASON TO DATE TOTAL						380	1468
SEASON TO DATE DEP						-69	270

NUMBER OF DAYS			
MAXIMUM TEMP. ≥ 90°	MAXIMUM TEMP. ≤ 32°	MINIMUM TEMP. ≤ 32°	MINIMUM TEMP. ≤ 0°
0	0	3	0

NUMBER OF DAYS	
PRECIPITATION ≥ .01 INCH	3
SNOW, ICE PELLETS ≥ 1.0 INCH	0
THUNDERSTORMS	0
HEAVY FOG	0
CLEAR 15	PARTLY CLOUDY [illegible] CLOUDY 8

FOR THE MONTH		
PRECIPITATION TOTAL	0.[illegible]	DEP -[illegible]
SNOW TOTAL	[illegible]	
STATION PRESSURE	30.[illegible]	
RESULTANT WIND	33	3.[illegible]
AVERAGE SPEED	5.1	
FASTEST MILE	25 NW	DATE: 2
SUNSHINE TOTAL	15829	% FOR MONTH 87
POSSIBLE	18167	
SKY COVER SUM	118	90
SKY COVER AVG	3.9	3.0

GREATEST IN 24 HOURS AND DATES			
PRECIPITATION	0.3[illegible]	25	
SNOW, ICE PELLETS	0.0		

GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
0	

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER

Kenneth D Hadeen
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

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NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

OBSERVATIONS AT 3-HOUR INTERVALS

NOV 1990
SACRAMENTO, CA

23232

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
	NOV 1st											NOV 2nd											NOV 3rd										
01	0	UNL	20			46	44	42	86	00	0	0	UNL	20			53	41	24	32	34	15	0	UNL	15			50	39	22	33	32	10
04	0	UNL	20			43	41	40	93	00	0	0	UNL	20			50	40	25	38	34	16	0	UNL	15			50	39	23	35	35	7
07	0	UNL	50			42	39	36	79	00	0	0	UNL	50			47	38	24	41	32	15	0	UNL	50			42	36	27	55	02	4
10	0	UNL	50			56	48	38	51	34	8	0	UNL	50			58	43	22	25	34	18	0	UNL	40			60	45	24	25	01	3
13	0	UNL	35			66	50	31	27	33	15	0	UNL	50			66	46	18	16	34	16	0	UNL	30			68	48	21	17	09	5
16	0	UNL	40			65	48	28	25	32	11	0	UNL	30			65	46	17	16	34	22	0	UNL	15			70	50	26	19	12	8
19	0	UNL	30			59	45	25	27	32	17	0	UNL	30			59	43	19	21	34	14	0	UNL	20			56	45	31	39	16	4
22	0	UNL	20			55	42	24	30	34	14	0	UNL	15			56	42	20	25	34	13	0	UNL	15			50	41	29	45	00	0
	NOV 4th											NOV 5th											NOV 6th										
01	0	UNL	15			46	38	27	48	00	0	1	UNL	7			50	45	39	66	00	0	0	UNL	15			55	43	27	34	32	18
04	0	UNL	15			43	38	31	63	00	0	7	UNL	7			45	43	40	83	00	0	0	UNL	15			53	42	28	36	34	18
07	0	UNL	10			41	37	31	68	31	4	0	UNL	6		H	44	39	32	63	05	5	0	UNL	90			52	42	27	38	34	19
10	0	UNL	7			60	47	30	32	26	3	1	UNL	6		H	60	49	37	43	29	9	0	UNL	40			62	46	24	23	35	22
13	7	UNL	6		H	70	52	31	24	24	3	6	UNL	15			71	54	36	28	33	12	0	UNL	40			68	48	20	16	36	20
16	5	UNL	15			72	52	30	21	00	0	0	UNL	40			71	49	18	13	33	14	0	UNL	50			66	47	22	19	34	16
19	7	UNL	10			56	45	31	39	00	0	0	UNL	25			59	45	25	27	30	10	0	UNL	50			61	45	22	22	34	16
22	2	UNL	7			52	43	31	45	00	0	0	UNL	20			57	43	24	28	33	15	0	UNL	20			53	40	19	26	35	10
	NOV 7th											NOV 8th											NOV 9th										
01	0	UNL	20			51	38	15	24	34	12	2	UNL	20			47	40	30	52	00	0	0	UNL	10			48	44	38	69	00	0
04	0	UNL	20			45	36	20	36	34	7	0	UNL	20			44	38	28	54	00	0	0	UNL	10			44	41	36	74	00	0
07	8	UNL	70			41	34	23	49	32	5	4	UNL	20			42	38	31	65	00	0	0	UNL	10			40	38	36	86	00	0
10	10	UNL	100+			55	42	23	29	30	6	3	UNL	10			62	47	27	27	00	0	0	UNL	7			61	48	34	37	16	4
13	4	UNL	35			66	47	20	17	35	8	8	UNL	7			70	50	26	19	00	0	0	UNL	6		HK	73	54	36	26	16	4
16	5	UNL	40			65	47	19	15	12	3	2	UNL	10			73	54	35	25	34	6	0	UNL	6		HK	73	56	40	30	32	4
19	4	UNL	40			54	44	30	40	00	0	0	UNL	10			56	49	41	57	00	0	1	UNL	4		HK	55	49	43	64	00	0
22	1	UNL	40			49	42	32	52	00	0	0	UNL	10			50	46	41	71	00	0	1	UNL	4		HK	48	46	43	83	00	0
	NOV 10th											NOV 11th											NOV 12th.										
01	0	UNL	4		HK	46	43	39	77	07	3	0	UNL	10			42	41	39	89	00	0	7	200	5		F	47	45	43	86	00	0
04	0	UNL	5		HK	43	40	37	80	02	3	0	UNL	7			41	39	37	86	00	0	3	UNL	5		H	42	38	32	69	24	5
07	0	UNL	5		HK	42	39	36	79	34	3	8	250	10			43	40	37	80	36	5	1	UNL	10			43	41	38	83	27	4
10	1	UNL	5		HK	60	49	36	41	35	7	7	UNL	30			59	49	37	44	35	5	3	UNL	10			63	51	38	40	35	4
13	0	UNL	7			71	55	40	33	34	5	3	UNL	30			74	55	35	24	31	5	0	UNL	15			75	54	33	22	26	4
16	0	UNL	15			75	56	39	27	33	3	8	UNL	30			74	55	37	26	30	4	0	UNL	15			77	55	32	19	00	0
19	0	UNL	15			55	50	45	69	00	0	8	200	35			57	51	44	62	00	0	3	UNL	15			57	48	38	49	00	0
22	0	UNL	10			49	46	43	80	00	0	7	UNL	15			50	46	42	74	00	0	4	UNL	10			51	46	40	66	00	0
	NOV 13th											NOV 14th											NOV 15th										
01	2	UNL	10			45	41	31	52	11	3	9	200	10			53	51	49	86	22	4	0	UNL	10			48	44	40	74	31	8
04	3	UNL	10			46	40	31	56	11	5	9	150	10			50	49	47	90	13	6	0	UNL	10			46	42	36	65	31	6
07	9	200	6		H	46	40	31	56	14	5	7	120	15			50	49	48	93	25	5	0	UNL	20			42	39	36	79	32	4
10	7	UNL	3		HK	62	46	31	31	16	5	10	120	7			56	51	47	72	35	10	0	UNL	30			53	45	36	53	00	0
13	10	200	3		HK	71	50	26	19	15	5	10	7	3		R	53	52	51	93	35	7	0	UNL	30			61	49	36	40	10	4
16	10	150	10			70	51	31	24	22	9	10	50	6		F	55	53	51	87	32	11	0	UNL	6		H	61	53	45	55	14	5
19	10	250	10			55	46	30	35	21	8	0	UNL	5		F	52	51	50	93	31	5	0	UNL	5		H	52	50	48	86	00	0
22	8	200	10			54	44	30	40	20	9	0	UNL	10			50	47	44	80	30	8	0	UNL	5		FH	48	47	46	93	00	0
	NOV 16th											NOV 17th											NOV 18th										
01	0	UNL	3		FH	44	44	43	96	00	0	10	100	7			54	49	44	69	00	0	4	UNL	15			45	45	44	96	00	0
04	1	UNL	3		FH	44	44	43	96	00	0	6	120	7			47	45	43	86	00	0	4	UNL	15			46	45	44	93	00	0
07	6	200	2	8	FH	44	44	43	96	00	0	0	UNL	7			44	42	40	86	00	0	10	200	7			47	46	45	93	00	0
10	10	200	3		H	53	50	46	77	34	6	2	UNL	7			61	51	42	50	21	3	7	200	10			54	50	45	72	26	5
13	10	200	4		H	59	53	47	65	33	5	7	UNL	10			67	53	38	35	12	4	10	120	7			61	52	44	54	00	0
16	10	100	4		H	58	52	47	67	35	3	9	250	10			67	53	39	36	00	0	4	UNL	7			62	52	42	48	30	7
19	10	100	5		H	56	50	43	62	24	3	10	160	15			55	49	42	62	23	5	4	UNL	5		H	50	47	43	77	00	0
22	10	100	5		H	55	51	47	75	12	4	0	UNL	15			50	48	45	83	00	0	6	200	4		H	48	46	44	86	00	0

WEATHER CODES

+	TORNADO	ZL	FREEZING DRIZZLE	IPW	ICE PELLET SHOWERS	BN	BLOWING SAND
T	THUNDERSTORM	S	SNOW	A	HAIL	BS	BLOWING SNOW
Q	SQUALL	SW	SNOW SHOWERS	F	FOG	BY	BLOWING SPRAY
R	RAIN	SG	SNOW GRAINS	IF	ICE FOG	K	SMOKE
RW	RAIN SHOWERS	SP	SNOW PELLETS	GF	GROUND FOG	H	HAZE
ZR	FREEZING RAIN	IC	ICE CRYSTALS	BD	BLOWING DUST	D	DUST
L	DRIZZLE	IP	ICE PELLETS				

CEILING: UNL INDICATES UNLIMITED
WIND DIRECTION: DIRECTIONS ARE THOSE FROM WHICH THE WIND BLOWS, INDICATED IN TENS OF DEGREES FROM TRUE NORTH: I.E., 09 FOR EAST, 18 FOR SOUTH, 27 FOR WEST. AN ENTRY OF 00 INDICATES CALM
SPEED: THE OBSERVED AVERAGE ONE-MINUTE VALUE, EXPRESSED IN KNOTS (MPH=KNOTS X 1.15).

OBSERVATIONS AT 3-HOUR INTERVALS

Columns: HOUR L.S.T. | SKY COVER (TENTHS) | CEILING IN HUNDREDS OF FEET | VISIBILITY: WHOLE MILES | VISIBILITY: 16THS MILE | WEATHER | TEMPERATURE: AIR °F | TEMPERATURE: WET BULB °F | TEMPERATURE: DEW POINT °F | REL HUMIDITY % | WIND: DIRECTION | WIND: SPEED (KNOTS)

NOV 19th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	9	120	5		H	47	46	44	89	00	0
04	8	UNL	7			46	44	42	86	00	0
07	10	160	3		FH	43	43	42	96	29	5
10	10	120	2	12	FK	51	48	44	77	15	3
13	10	160	5		HK	61	51	42	50	20	6
16	10	60	6		RWH	56	53	51	83	29	9
19	10	60	7			55	53	52	90	19	5
22	2	UNL	10			49	47	44	83	28	6

NOV 20th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	2	UNL	15			44	43	42	93	29	5
04	0	UNL	5		FH	39	39	38	96	00	0
07	7	UNL	50			39	37	34	82	30	5
10	6	UNL	50			50	43	35	57	30	4
13	7	200	50			55	45	33	44	35	5
16	8	UNL	50			57	46	34	42	00	0
19	3	UNL	40			45	42	37	74	00	0
22	8	200	15			44	41	38	80	00	0

NOV 21st

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	3	UNL	15			41	39	36	83	12	6
04	6	70	15			43	40	35	74	13	6
07	6	UNL	15			39	38	36	89	00	0
10	9	180	15			53	45	35	51	19	5
13	2	UNL	10			58	49	39	49	29	8
16	3	UNL	15			59	48	36	42	33	9
19	3	UNL	15			50	45	39	66	00	0
22	2	UNL	5		H	47	44	40	77	00	0

NOV 22nd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	3	UNL	7			43	41	39	86	00	0
04	0	UNL	7			40	39	37	89	00	0
07	2	UNL	7			34	34	33	96	00	0
10	1	UNL	7			51	45	39	64	00	0
13	2	UNL	15			60	49	38	44	34	7
16	4	UNL	40			64	51	38	38	34	6
19	0	UNL	20			48	44	40	74	00	0
22	0	UNL	15			43	42	40	89	00	0

NOV 23rd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	0	UNL	7			39	38	37	93	00	0
04	0	UNL	7			36	35	34	93	00	0
07	3	UNL	5		FH	34	34	33	96	00	0
10	7	UNL	4		H	50	45	40	69	32	4
13	5	UNL	10			61	50	39	44	31	5
16	6	UNL	40			65	51	37	36	35	7
19	3	UNL	20			48	44	40	74	00	0
22	0	UNL	5		K	41	40	38	89	00	0

NOV 24th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	0	UNL	5		H	37	35	31	79	00	0
04	0	UNL	3		FH	34	33	32	92	00	0
07	0	UNL	5		F	33	33	32	96	00	0
10	0	UNL	7			52	46	40	64	00	0
13	0	UNL	5		H	62	51	39	43	02	3
16	0	UNL	7			64	50	36	36	30	5
19	0	UNL	4		HK	46	43	39	77	00	0
22	2	UNL	3		FH	43	41	38	83	00	0

NOV 25th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	0	UNL	4		FH	40	37	32	73	11	4
04	0	UNL	3		FH	36	34	31	82	14	6
07	0	UNL	2	8	FH	38	35	31	76	12	4
10	9	200	5		H	54	44	31	42	14	12
13	10	21	15			61	47	30	31	14	12
16	10	20	2		RF	57	45	30	36	20	12
19	10	33	5		F	51	49	47	86	00	0
22	4	UNL	4		F	45	44	43	93	28	5

NOV 26th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	0	UNL	15			42	41	39	89	34	5
04	0	UNL	15			40	38	34	79	32	10
07	0	UNL	60			40	37	32	73	32	11
10	0	UNL	100+			49	44	39	69	33	14
13	0	UNL	100+			56	45	31	39	32	18
16	0	UNL	100+			55	43	26	33	31	15
19	0	UNL	40			47	40	30	52	31	7
22	0	UNL	20			43	38	30	60	31	9

NOV 27th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	0	UNL	15			36	34	30	79	00	0
04	0	UNL	15			37	34	28	70	06	4
07	0	UNL	50			31	30	28	89	00	0
10	0	UNL	40			43	38	30	60	00	0
13	0	UNL	10			52	43	30	43	[illegible]	5
16	0	UNL	10			54	42	25	33	35	5
19	0	UNL	10			42	38	32	68	00	0
22	0	UNL	10			39	36	32	76	00	[illegible]

NOV 28th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	0	UNL	10			35	33	31	85	00	0
04	0	UNL	5		F	33	32	30	89	00	0
07	1	UNL	3		F	31	30	29	92	00	0
10	4	UNL	2	12	F	46	41	35	66	00	0
13	10	UNL	6		H	60	48	33	36	20	4
16	7	UNL	6		H	56	46	33	42	00	0
19	4	UNL	3		H	45	41	36	71	00	0
22	2	UNL	3		F	41	39	36	83	00	0

NOV 29th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	3	UNL	3		F	36	35	34	93	00	0
04	3	UNL	2		F	34	34	33	96	00	0
07	7	UNL	2	8	FH	34	33	32	92	00	0
10	10	250	3		H	45	42	38	77	32	6
13	10	250	5		H	57	48	37	47	33	4
16	10	160	5		H	58	47	34	41	25	4
19	9	160	4		H	48	44	38	69	30	4
22	9	160	5		H	45	42	38	77	00	0

NOV 30th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	DIRECTION	SPEED (KNOTS)
01	7	UNL	5		H	43	38	31	63	00	[illegible]
04	8	UNL	5		H	43	38	32	65	00	[illegible]
07	0	UNL	4		FH	39	36	31	73	00	[illegible]
10	0	UNL	7			50	45	40	69	32	[illegible]
13	0	UNL	15			60	50	40	46	34	[illegible]
16	0	UNL	40			64	50	35	34	34	[illegible]
19	0	UNL	15			52	44	34	51	00	[illegible]
22	0	UNL	15			50	40	26	39	30	[illegible]

SUMMARY BY HOURS

HOUR L.S.T.	AVERAGES: SKY COVER (TENTHS)	STATION PRESSURE (INCHES)	TEMPERATURE: AIR TEMP °F	TEMPERATURE: WET BULB °F	TEMPERATURE: DEW POINT °F	REL HUMIDITY %	WIND SPEED (MPH)	RESULTANT WIND: DIRECTION	RESULTANT WIND: SPEED (MPH)
01	2	30.090	45	41	35	72	3.6	33	2.2
04	2	30.090	43	39	34	75	3.8	35	1.8
07	3	30.110	41	38	34	78	3.9	33	2.7
10	4	30.140	55	46	35	51	6.6	33	3.6
13	4	30.090	64	50	34	36	8.1	34	4.5
16	4	30.055	64	50	34	36	8.0	32	5.3
19	3	30.060	53	46	37	59	3.8	31	2.4
22	2	30.080	49	43	36	67	3.9	32	2.8

NOV 1990 SACRAMENTO, CA 23232

HOURLY PRECIPITATION (WATER EQUIVALENT IN INCHES)

DATE	A.M. HOUR ENDING AT												P.M. HOUR ENDING AT												DATE
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
01																									01
02																									02
03																									03
04																									04
05																									05
06																									06
07																									07
08																									08
09																									09
10																									10
11																									11
12																									12
13																									13
14											T	0.02	0.03	0.01											14
15																									15
16																									16
17																									17
18																									18
19																0.0[illegible]	0.04	T	0.01						19
20																									20
21																									21
22																									22
23																									23
24																									24
25															T	0.17	0.12	0.02							25
26																									26
27																									27
28																									28
29																									29
30																									30

MAXIMUM SHORT DURATION PRECIPITATION

TIME PERIOD (MINUTES)	5	10	15	20	30	45	60	80	100	120	150	180
PRECIPITATION (INCHES)	0.06	0.07	0.09	0.10	0.13	0.16	0.18	0.25	0.27	0.30	0.31	0.31
ENDED: DATE	25	25	25	25	25	25	25	25	25	25	25	25
ENDED: TIME	1524	1526	1524	1530	1546	1555	1606	1629	1640	1708	1733	1733

THE PRECIPITATION AMOUNTS FOR THE INDICATED TIME INTERVALS MAY OCCUR AT ANY TIME DURING THE MONTH. THE TIME INDICATED IS THE ENDING TIME OF THE INTERVAL. DATE AND TIME ARE NOT ENTERED FOR TRACE AMOUNTS.

VALIDATED BY:
DON GRISINGER

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JAN 1991
SAN FRANCISCO AP, CA
NAT'L WEA SER OFC
ROOM 607, INTERNATIONAL TERMINAL

ISSN 0198-0823

LOCAL CLIMATOLOGICAL DATA
Monthly Summary

INTERNATIONAL AIRPORT

SAN FRANCISCO AP, CA

LATITUDE 37° 37' N LONGITUDE 122° 23' W ELEVATION (GROUND) 8 FEET TIME ZONE PACIFIC 23234

DATE (1)	TEMPERATURE °F: MAXIMUM (2)	MINIMUM (3)	AVERAGE (4)	DEPARTURE FROM NORMAL (5)	AVERAGE DEW POINT (6)	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL) (7A)	COOLING (SEASON BEGINS WITH JAN) (7B)	WEATHER TYPES (8)	SNOW ICE PELLETS OR ICE ON GROUND AT 0400 INCHES (9)	PRECIPITATION: WATER EQUIVALENT (INCHES) (10)	SNOW, ICE PELLETS (INCHES) (11)	AVERAGE STATION PRESSURE IN INCHES ELEV. 18 FEET ABOVE M.S.L. (12)	WIND (M.P.H.): RESULTANT DIR. (13)	RESULTANT SPEED (14)	AVERAGE SPEED (15)	PEAK GUST SPEED (16)	PEAK GUST DIRECTION (17)	FASTEST 1-MIN SPEED (18)	FASTEST 1-MIN DIRECTION (19)	SUNSHINE MINUTES (20)	PERCENT OF TOTAL POSSIBLE (21)	SKY COVER (TENTHS) SUNRISE TO SUNSET (22)	MIDNIGHT TO MIDNIGHT (23)
01	54	34*	44*	-4	30	21	0	1 8	0	0.00	0.0	30.170	09	0.8	2.4	14	NE	8	03			9	8
02	53	36	45	-3	33	20	0	1 8	0	0.00	0.0	30.120	04	1.3	2.8	14	W	7	02			10	10
03	52	41	47	-1	35	18	0	8	0	0.00	0.0	30.000	06	1.0	3.0	18	N	12	04			10	9
04	53	36	45	-3	36	20	0	1 8	0	0.00	0.0	29.960	31	1.9	4.6	14	W	10	28			4	3
05	51	38	45	-3	38	20	0	2 8	0	0.00	0.0	30.090	10	1.5	3.8	15	W	9	07			8	6
06	51	39	45	-3	40	20	0	1 8	0	T	0.0	30.185	11	3.2	4.7	14	NE	12	11			9	9
07	59	47	53	5	48	12	0	1	0	0.01	0.0	30.190	12	3.7	7.4	21	S	13	19			10	9
08	53	46	50	2	44	15	0	1	0	0.00	0.0	30.070	06	4.3	6.0	18	NE	14	07			9	10
09	53	45	49	1	45	16	0	1 8	0	0.20	0.0	29.990	04	4.8	8.0	21	N	14	05			8	7
10	56	40	48	0	43	17	0	1 8	0	0.00	0.0	30.230	05	1.4	3.8	16	N	9	02			6	6
11	53	46	50	2	44	15	0	1 8	0	T	0.0	30.290	05	2.0	5.0	14	NE	9	07			10	10
12	57	49	53	5	49	12	0	1 8	0	0.0[illegible]	0.0	30.360	35	1.5	5.0	15	NW	12	30			10	10
13	60	50	55	7	51	10	0	1	0	0.00	0.0	30.360	28	6.3	9.8	22	W	18	28			9	9
14	57	50	54	6	49	11	0	1 8	0	0.0[illegible]	0.0	30.350	34	3.4	6.3	18	W	16	29			8	9
15	60	49	55	7	49	10	0	1 8	0	T	0.0	30.290	29	5.2	9.2	25	W	18	28			8	[illegible]
16	69	46	58	10	35	7	0		0	0.00	0.0	30.210	24	0.9	7.3	18	NW	14	34			4	3
17	70*	45	58*	10	37	7	0		0	0.00	0.0	30.200	33	[illegible].2	5.[illegible]			12	05			1	0
18	59	43	51	3	45	14	0	8	0	T	0.0	30.130	28	6.0	6.1	30	W	23	26			2	3
19	62	43	53	5	44	12	0		0	0.04	0.0	30.090	31	2.6	5.4	16	W	13	28			1	4
20	64	42	53	4	36	12	0	8	0	0.00	0.0	29.990	35	5.0	9.0	32	N	21	02			1	2
21	64	47	56	7	25	9	0		0	0.00	0.0	30.110	02	2.4	9.6	30	NE	23	03			1	1
22	61	39	50	1	31	15	0		0	0.00	0.0	30.140	29	5.1	7.8	21	W	18	29			2	2
23	63	40	52	3	40	13	0	1 8	0	0.00	0.0	30.120	28	3.2	7.1	18	W	16	27			1	3
24	58	41	50	1	41	15	0	8	0	0.00	0.0	30.130	24	1.2	6.9	14	W	12	28			1	0
25	55	39	47	-2	41	18	0	1 8	0	0.00	0.0	30.065	21	1.4	5.9	18	W	14	21			5	5
26	56	41	49	0	41	16	0	1 8	0	0.00	0.0	30.130	27	3.9	8.0	18	W	14	30			7	6
27	54	42	48	-1	42	17	0		0	0.00	0.0	30.090	25	4.2	8.9	22	NW	18	29			5	4
28	55	41	48	-1	41	17	0		0	0.00	0.0	30.010	26	3.0	7.9	20	W	16	29			1	3
29	61	39	50	0	39	15	0	8	0	0.00	0.0	30.105	23	1.5	7.6	17	SW	14	29			0	1
30	58	39	49	-1	40	16	0	1 8	0	0.00	0.0	30.220	10	0.6	6.1	18	S	14	20			8	7
31	59	42	51	1	43	14	0	1 8	0	0.00	0.0	30.190	24	0.5	6.3	15	NW	14	29			8	7
	SUM	SUM				TOTAL	TOTAL	NUMBER OF DAYS		TOTAL	TOTAL	FOR THE MONTH:								TOTAL	% FOR MONTH	SUM	SUM
	1790	1315				454	0			0.24	0.0	30.150	31	1.1	6.4	32	N	23	03			176	173
	AVG.	AVG.	AVG.	DEP.	AVG.	DEP.	DEP.	PRECIPITATION		DEP.						DATE: 20		DATE: 21+		POSSIBLE		AVG.	AVG.
	57.7	42.4	50.1	1.6	40.4	-58	0	≥ .01 INCH	5	-4.[illegible]												5.7	5.6

NUMBER OF DAYS				SEASON TO DATE		NUMBER OF DAYS		GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
MAXIMUM TEMP.		MINIMUM TEMP.		TOTAL	TOTAL	SNOW, ICE PELLETS ≥ 1.0 INCH	0	PRECIPITATION		SNOW, ICE PELLETS			
≥ 90°	≤ 32°	≤ 32°	≤ 0°	1417	0	THUNDERSTORMS	0	0.20	09	0.0		0	
0	0	0	0	DEP.	DEP.	HEAVY FOG	1						
				-320	0	CLEAR 10	PARTLY CLOUDY 6	CLOUDY 15					

WEATHER TYPES: 1 FOG; 2 HEAVY FOG; 3 THUNDERSTORM; 4 ICE PELLETS; 5 HAIL; 6 GLAZE; 7 DUSTSTORM; 8 SMOKE, HAZE; 9 BLOWING SNOW

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

OBSERVATIONS AT 3-HOUR INTERVALS

JAN 1991 — 23234
SAN FRANCISCO AP, CA

Columns: HOUR L.S.T. | SKY COVER (TENTHS) | CEILING IN HUNDREDS OF FEET | VISIBILITY: WHOLE MILES | VISIBILITY: 16THS MILE | WEATHER | TEMPERATURE: AIR °F | WET BULB °F | DEW POINT °F | REL HUMIDITY % | WIND: DIRECTION | SPEED (KNOTS)

JAN 1st

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	6	UNL	6		FHK	39	36	32	76	23	3
04	10	UNL	5		FHK	36	34	30	79	19	5
07	10	UNL	6		HK	36	34	31	82	00	0
10	10	UNL	5		H	45	39	29	54	11	5
13	10	200	5		H	52	42	27	38	04	6
16	9	200	4		H	53	42	26	35	16	4
19	7	200	5		H	46	40	31	56	19	3
22	3	UNL	4		H	42	37	29	60	00	0

JAN 2nd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	9	UNL	3		H	39	36	32	76	00	0
04	9	UNL	3		H	37	34	30	76	22	4
07	10	UNL	4		H	39	37	35	86	00	0
10	10	130	1	12	FH	46	42	36	68	03	3
13	10	160	3		H	50	42	32	50	01	4
16	10	150	2		H	53	43	30	42	03	5
19	10	140	5		H	49	42	34	56	13	4
22	10	140	5		H	50	42	31	48	36	4

JAN 3rd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	9	UNL	4		H	45	40	34	66	03	3
04	10	140	3		H	43	40	36	76	00	0
07	10	140	3		H	43	40	36	76	19	3
10	10	140	2		H	48	42	34	59	00	0
13	10	110	1	12	H	49	45	40	71	04	10
16	10	200	3		H	51	42	31	47	00	0
19	10	130	5		H	49	42	33	54	00	0
22	7	UNL	6		H	44	39	32	63	13	4

JAN 4th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	2	UNL	8			41	37	32	70	24	6
04	0	UNL	6		H	38	36	34	86	28	5
07	2	UNL	5		H	38	36	34	86	20	4
10	2	UNL	3		H	47	44	40	77	07	5
13	4	UNL	1	8	H	50	45	40	69	01	4
16	7	UNL	3		H	52	45	37	57	02	4
19	4	UNL	6		H	47	41	34	61	29	8
22	2	UNL	6		H	43	39	33	68	00	0

JAN 5th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	4	UNL	6		FH	39	37	35	86	00	0
04	6	2	0		F	41	41	41	100	00	0
07	10	0	0		F	40	40	39	96	17	4
10	7	10	1		FH	42	42	41	96	11	4
13	8	UNL	3		H	48	44	39	71	01	5
16	8	UNL	3		H	50	45	40	69	05	4
19	1	UNL	2	8	H	45	42	38	77	00	0
22	2	UNL	1	12	H	40	37	33	76	14	5

JAN 6th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	4	UNL	2	8	FH	39	37	34	82	15	4
04	10	5	2		F	40	40	39	96	00	0
07	10	11	1	8	F	41	40	39	93	00	0
10	10	20	3		F	44	42	40	86	12	8
13	9	200	4		H	49	45	40	71	06	6
16	10	65	4		H	49	45	41	74	15	3
19	10	21	3		RWH	48	45	41	77	05	6
22	10	40	3		H	51	49	46	83	13	6

JAN 7th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	15	2		LF	50	48	46	86	12	8
04	10	15	4		F	48	47	45	89	07	3
07	10	15	7		R	50	49	48	93	11	7
10	10	15	7			54	52	50	86	15	7
13	10	28	7			57	54	51	81	19	11
16	10	19	8			56	52	49	78	09	7
19	6	200	10			50	49	47	90	36	5
22	7	13	4		F	47	47	46	96	00	0

JAN 8th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	13	6		F	48	47	46	93	17	4
04	10	11	8			47	45	42	83	10	6
07	10	9	8			47	46	44	89	06	3
10	10	10	7			48	46	43	83	07	8
13	10	15	8			51	48	45	80	03	6
16	9	200	8			50	47	43	77	01	4
19	10	200	10			48	46	43	83	03	5
22	10	120	10			48	46	44	86	20	5

JAN 9th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	28	5		R	47	45	43	86	06	8
04	10	37	3		R	48	47	45	89	10	10
07	10	40	15			47	44	41	80	05	10
10	2	UNL	10			52	49	46	80	00	0
13	10	39	8			53	50	46	77	01	9
16	10	43	6		FH	52	49	45	77	35	8
19	9	37	6		FH	50	47	44	80	32	4
22	1	UNL	5		FH	48	47	46	93	20	4

JAN 10th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	1	UNL	4		FH	45	44	43	93	16	4
04	2	UNL	3		FH	42	41	40	93	23	3
07	9	35	2	8	FH	45	44	42	89	16	3
10	7	4	1	4	F	48	47	46	93	01	4
13	3	UNL	2		F	52	49	46	80	06	6
16	8	UNL	5		H	56	50	44	64	02	4
19	6	UNL	10			51	49	46	83	00	0
22	8	UNL	8			51	48	44	77	35	4

JAN 11th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	UNL	7			49	46	43	80	08	6
04	10	UNL	7			46	43	40	80	17	4
07	10	180	5		F	47	46	45	93	21	4
10	10	180	3		H	48	44	38	69	05	7
13	10	100	4		H	52	49	45	77	01	5
16	10	30	4		H	53	50	46	77	07	5
19	10	80	4		H	52	50	47	83	26	4
22	9	30	4		H	50	48	45	83	22	4

JAN 12th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	55	4		FH	50	49	47	90	00	0
04	10	33	3		RFH	49	48	47	93	07	4
07	10	14	1	12	RF	49	48	47	93	12	4
10	10	18	1	8	F	51	50	48	90	05	3
13	10	17	1	12	F	54	50	47	77	04	5
16	10	15	4		FH	56	53	51	83	06	5
19	10	19	8			55	53	51	87	29	6
22	10	15	0	6	F	53	53	53	100	27	9

JAN 13th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	2	0	6	F	53	53	52	96	29	5
04	10	4	7			53	52	51	93	30	7
07	10	3	5		F	53	52	51	93	20	4
10	7	220	4		F	55	54	53	93	13	4
13	8	10	8			59	55	52	78	07	5
16	9	5	10			56	54	52	87	28	16
19	2	UNL	8			51	51	50	96	29	12
22	8	13	5		F	51	51	50	96	29	8

JAN 14th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	2	0	12	F	52	51	50	93	30	7
04	10	4	1	4	F	52	52	51	96	26	3
07	10	2	2		F	51	51	50	96	03	5
10	10	7	4		F	51	50	49	93	01	7
13	10	3	4		F	53	51	49	86	04	5
16	2	UNL	6		H	57	53	50	78	11	4
19	10	1	1		F	50	47	43	77	29	14
22	10	5	6		F	52	51	50	93	35	5

JAN 15th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	10	0	0	6	F	50	50	50	100	04	5
04	10	2	1	12	F	51	51	50	96	20	4
07	10	4	3		F	50	50	50	100	16	4
10	10	7	4		F	53	52	51	93	07	5
13	8	15	10			58	54	50	75	34	5
16	6	UNL	10			57	53	49	75	28	15
19	4	UNL	10			52	49	45	77	28	16
22	0	UNL	12			50	48	46	86	29	9

JAN 16th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	0	UNL	12			48	46	43	83	28	4
04	0	UNL	12			53	47	40	62	34	12
07	1	UNL	15			52	45	36	55	02	8
10	1	UNL	25			57	47	35	44	11	10
13	2	UNL	40			63	48	31	30	20	10
16	9	220	40			67	50	29	24	15	4
19	5	UNL	20			57	45	30	36	28	10
22	4	UNL	20			50	44	37	61	16	4

JAN 17th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	0	UNL	20			47	42	35	63	00	0
04	0	UNL	20			50	45	38	64	00	0
07	1	UNL	20			49	44	38	66	16	4
10	1	UNL	20			61	49	36	40	10	7
13	0	UNL	20			66	51	34	31	16	5
16	0	UNL	30			67	52	36	32	12	5
19	0	UNL	15			58	48	37	46	27	5
22	0	UNL	12			54	46	36	51	29	7

JAN 18th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI-BILITY WHOLE MILES	16THS MILE	WEATHER	AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	SPEED (KNOTS)
01	0	UNL	12			48	44	40	74	00	0
04	0	UNL	8			48	46	44	86	00	0
07	0	UNL	7			44	42	39	83	00	0
10	1	UNL	4		H	52	49	46	80	04	5
13	1	UNL	4		H	58	53	49	72	29	17
16	6	UNL	10			57	51	45	64	29	19
19	10	9	12			53	51	49	86	26	10
22	8	16	12			51	49	46	83	25	5

WEATHER CODES

*	TORNADO	ZL	FREEZING DRIZZLE	IPW	ICE PELLET SHOWERS	BN	BLOWING SAND
T	THUNDERSTORM	S	SNOW	A	HAIL	BS	BLOWING SNOW
Q	SQUALL	SW	SNOW SHOWERS	F	FOG	BY	BLOWING SPRAY
R	RAIN	SG	SNOW GRAINS	IF	ICE FOG	K	SMOKE
RW	RAIN SHOWERS	SP	SNOW PELLETS	GF	GROUND FOG	H	HAZE
ZR	FREEZING RAIN	IC	ICE CRYSTALS	BD	BLOWING DUST	D	DUST
L	DRIZZLE	IP	ICE PELLETS				

CEILING: UNL INDICATES UNLIMITED
WIND DIRECTION: DIRECTIONS ARE THOSE FROM WHICH THE WIND BLOWS, INDICATED IN TENS OF DEGREES FROM TRUE NORTH: I.E., 09 FOR EAST, 18 FOR SOUTH, 27 FOR WEST. AN ENTRY OF 00 INDICATES CALM
SPEED: THE OBSERVED AVERAGE ONE-MINUTE VALUE, EXPRESSED IN KNOTS (MPH=KNOTS X 1.15).

OBSERVATIONS AT 3-HOUR INTERVALS

JAN 19th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	20	12			51	49	47	86	32	6
04	8	200	15			48	47	45	89	30	6
07	2	UNL	15			44	41	37	77	23	3
10	0	UNL	10			54	50	47	77	00	0
13	1	UNL	8			58	51	45	62	07	5
16	1	UNL	8			60	51	41	50	07	4
19	9	200	12			53	50	47	80	32	6
22	0	UNL	12			50	48	46	86	30	6

JAN 20th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	6	UNL	12			48	46	44	86	01	3
04	8	UNL	10			45	43	41	86	00	0
07	1	UNL	10			45	43	41	86	02	4
10	2	UNL	6		H	51	49	46	83	06	4
13	0	UNL	20			59	46	30	33	08	7
16	0	UNL	30			57	50	42	58	29	17
19	0	UNL	12			59	45	25	27	34	14
22	0	UNL	12			54	42	26	34	02	11

JAN 21st

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	2	UNL	20			53	43	30	42	06	19
04	1	UNL	20			51	42	29	43	06	11
07	2	UNL	50			49	39	24	38	11	8
10	1	UNL	50			56	43	25	30	08	6
13	0	UNL	50			60	43	18	20	18	6
16	0	UNL	50			64	45	17	16	34	3
19	0	UNL	20			54	41	21	28	29	5
22	0	UNL	20			54	43	27	35	29	10

JAN 22nd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	0	UNL	20			50	42	32	50	35	7
04	0	UNL	20			41	37	31	68	28	6
07	0	UNL	25			41	36	28	60	16	3
10	0	UNL	15			50	41	28	43	06	4
13	1	UNL	10			56	45	31	39	30	5
16	7	UNL	20			58	46	31	36	30	12
19	6	UNL	20			51	42	31	47	29	13
22	4	UNL	20			47	43	39	74	29	6

JAN 23rd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	2	UNL	12			44	42	39	83	00	0
04	2	UNL	12			43	40	36	76	23	3
07	8	5	8			44	43	42	93	17	3
10	0	UNL	4		H	49	47	44	83	01	5
13	0	UNL	7			53	48	43	69	01	10
16	2	UNL	7			63	49	32	31	00	0
19	3	UNL	15			53	46	37	55	29	13
22	3	UNL	15			50	46	41	71	25	9

JAN 24th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	1	UNL	12			46	45	43	89	27	7
04	1	UNL	12			44	43	41	89	00	0
07	1	UNL	10			44	43	42	93	12	8
10	0	UNL	4		H	50	47	44	80	12	8
13	0	UNL	7			54	48	42	64	08	4
16	0	UNL	6		H	56	48	39	53	35	5
19	0	UNL	12			49	46	42	77	28	10
22	0	UNL	12			46	42	38	74	26	7

JAN 25th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	0	UNL	12			44	42	40	86	20	4
04	0	UNL	8			41	39	35	79	23	4
07	1	UNL	5		F	42	41	39	89	00	0
10	5	UNL	3		F	47	45	43	86	15	8
13	5	UNL	8			53	48	43	69	05	6
16	8	UNL	8			53	48	42	66	21	12
19	10	33	10			51	47	42	72	29	6
22	8	31	10			50	46	42	74	00	0

JAN 26th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	130	10			43	41	38	83	27	6
04	9	31	7			44	42	40	86	25	3
07	9	35	5		FH	47	45	43	86	22	4
10	6	250	3		FH	50	47	43	77	09	8
13	8	250	4		H	53	48	43	69	35	7
16	7	UNL	12			54	48	41	62	26	12
19	1	UNL	12			48	44	40	74	25	8
22	0	UNL	12			47	43	39	74	25	7

JAN 27th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	4	UNL	12			47	45	43	86	30	4
04	8	15	12			43	42	40	89	19	6
07	5	UNL	10			44	43	42	93	16	3
10	10	15	7			49	46	43	80	12	5
13	4	UNL	8			53	49	44	72	25	4
16	0	UNL	10			51	47	42	72	29	16
19	0	UNL	12			47	45	42	83	28	10
22	2	UNL	12			44	41	36	74	19	6

JAN 28th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	5	UNL	12			44	41	36	74	15	6
04	10	16	12			44	42	40	86	17	6
07	6	16	12			44	43	41	89	26	5
10	2	UNL	8			50	46	41	71	02	4
13	0	UNL	7			52	47	42	69	02	6
16	0	UNL	7			53	48	42	66	29	14
19	0	UNL	12			48	45	41	77	26	9
22	0	UNL	12			45	42	38	77	24	4

JAN 29th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	0	UNL	12			42	40	37	83	18	4
04	10	8	12			43	41	39	86	17	5
07	0	UNL	7			40	39	38	93	13	6
10	0	UNL	6		H	48	46	43	83	13	7
13	0	UNL	10			59	48	35	41	03	7
16	0	UNL	10			57	48	37	47	28	12
19	0	UNL	10			51	46	41	69	24	6
22	0	UNL	10			45	42	38	77	16	5

JAN 30th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	0	UNL	10			42	40	38	86	21	4
04	6	13	10			41	40	39	93	17	4
07	0	UNL	7			44	43	41	89	36	7
10	7	UNL	6			48	44	38	69	12	5
13	10	UNL	6			52	44	34	51	36	8
16	10	UNL	8			[illegible]	50	42	58	31	10
19	10	200	8			52	49	45	77	36	5
22	10	UNL	8			[illegible]	47	43	74	00	0

JAN 31st

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	UNL	8			47	45	43	86	10	7
04	10	UNL	7			44	41	38	80	27	5
07	9	UNL	4		F	44	43	41	89	16	4
10	10	200	2		FH	49	47	45	86	34	5
13	10	200	2		H	52	48	44	74	07	5
16	1	UNL	6		H	58	51	45	62	28	8
19	1	UNL	7			51	48	44	77	26	5
22	0	UNL	8			47	44	40	77	18	7

SUMMARY BY HOURS

HOUR L.S.T.	AVERAGES: SKY COVER (TENTHS)	STATION PRESSURE (INCHES)	TEMPERATURE: AIR TEMP °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND SPEED (MPH)	RESULTANT WIND: DIRECTION	SPEED (MPH)
01	5	30.150	46	44	40	[illegible]	5.3	06	0.4
04	6	30.145	45	43	40	83	4.8	22	0.9
07	6	30.155	45	43	40	85	4.6	13	1.9
10	6	30.190	50	46	42	[illegible]	6.0	09	4.3
13	6	30.150	54	48	41	63	7.6	03	3.5
16	6	30.120	56	48	40	59	8.9	30	4.6
19	5	30.130	51	46	40	[illegible]	8.2	29	6.5
22	4	30.150	49	45	40	[illegible]	6.0	26	2.7

HOURLY PRECIPITATION (WATER EQUIVALENT IN INCHES)

JAN 1991 23234
SAN FRANCISCO AP, CA

DATE	A.M. HOUR ENDING AT												P.M. HOUR ENDING AT												DATE
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
01																									01
02																									02
03																									03
04																									04
05																									05
06																			T	T	T			T	06
07	T	T	T	T	T	0.01	T	T	T				T												07
08																									08
09	0.05	0.06	0.01	0.03	0.05	T	T																		09
10																									10
11																							T	T	11
12				T	T	0.01	T	T																	12
13																									13
14		T	T	0.01	T	T																			14
15		T	T	T																					15
16																									16
17																									17
18																				T					18
19	0.01																								19
20																									20
21																									21
22																									22
23																									23
24																									24
25																									25
26																									26
27																									27
28																									28
29																									29
30																									30
31																									31

MAXIMUM SHORT DURATION PRECIPITATION

TIME PERIOD (MINUTES)	5	10	15	20	30	45	60	80	100	120	150	180
PRECIPITATION (INCHES)												
ENDED: DATE												
ENDED: TIME												

THE PRECIPITATION AMOUNTS FOR THE INDICATED TIME INTERVALS MAY OCCUR AT ANY TIME DURING THE MONTH. THE TIME INDICATED IS THE ENDING TIME OF THE INTERVAL. DATE AND TIME ARE NOT ENTERED FOR TRACE AMOUNTS.

VALIDATED BY:
DON GRISINGER

SUBSCRIPTION PRICE AND ORDERING INFORMATION AVAILABLE FROM:
THE NATIONAL CLIMATIC DATA CENTER, FEDERAL BUILDING
ASHEVILLE, NORTH CAROLINA 28801
ATTN: PUBLICATIONS

U.S. DEPARTMENT OF COMMERCE
NATIONAL CLIMATIC DATA CENTER
FEDERAL BUILDING
ASHEVILLE, N.C. 28801

DEC 1990
FRESNO, CA
NAT'L WEA SER OFC
FRESNO AIR TERMINAL

ISSN 0198-0734

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

FRESNO AIR TERMINAL

LATITUDE 36° 46'N LONGITUDE 119° 43'W ELEVATION (GROUND) 328 FEET TIME ZONE PACIFIC 93193

DATE	TEMPERATURE °F: MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)	WEATHER TYPES (1 FOG, 2 HEAVY FOG, 3 THUNDERSTORM, 4 ICE PELLETS, 5 HAIL, 6 GLAZE, 7 DUSTSTORM, 8 SMOKE, HAZE, 9 BLOWING SNOW)	SNOW ICE PELLETS OR ICE ON GROUND AT 0400 INCHES	PRECIPITATION: WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE IN INCHES ELEV. 327 FEET ABOVE M.S.L.	WIND (M.P.H.): RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	PEAK GUST: SPEED	DIRECTION	FASTEST 1-MIN: SPEED	DIRECTION	SUNSHINE: MINUTES	PERCENT OF TOTAL POSSIBLE	SKY COVER (TENTHS): SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	59	33	46	-2	36	19	0	1 8	0	0.00	0.0	29.915	13	1.4	2.3	8	S	7	14	481	82	0	0
02	56	32	44	-4	32	21	0	1 8	0	0.00	0.0	30.020	12	2.2	2.8	9	S	9	13	237	40	4	4
03	59	31	45	-2	35	20	0	1 8	0	0.00	0.0	29.990	03	0.7	2.0	7	NW	6	09	351	60	7	7
04	61	32	47	0	37	18	0	1 8	0	0.00	0.0	29.960	36	0.7	2.5	10	S	8	15	310	53	6	6
05	56	32	44	-3	36	21	0	1 8	0	0.00	0.0	29.960	11	1.5	2.9	9	SW	7	32	387	66	6	5
06	63	32	48	1	35	17	0	1 8	0	0.00	0.0	29.930	06	1.2	1.8	7	W	6	08	382	65	3	3
07	66	32	49	2	36	16	0	1 8	0	0.00	0.0	29.865	01	0.5	2.1	7	W	5	31	324	55	7	4
08	67	31	49	3	34	16	0	1 8	0	0.00	0.0	29.830	11	0.8	2.0	7	SE	6	13	584	100	1	1
09	69	30	50	4	33	15	0	1 8	0	0.00	0.0	29.790	10	1.6	2.3	7	E	6	09	563	100	0	0
10	73*	34	54	8	33	11	0	8	0	0.00	0.0	29.700	31	2.5	5.1	15	NW	12	31	470	81	2	4
11	57	50	54*	8	46	11	0	1 8	0	0.01	0.0	29.705	32	4.9	6.3	16	N	10	36	0	0	10	10
12	54	47	51	5	47	14	0	1 8	0	0.02	0.0	29.710	31	2.8	3.5	12	NW	7	28	0	0	10	10
13	55	35	45	0	43	20	0	1 8	0	0.00	0.0	29.780	31	3.3	3.8	14	NW	10	30	46	8	8	6
14	49	32	41	-4	36	24	0	2 8	0	0.00	0.0	29.770	13	2.5	3.3	9	SE	8	12	107	18	7	6
15	51	33	42	-3	38	23	0	2 8	0	0.39	0.0	29.630	12	4.5	5.6	15	SE	12	12	55	9	9	5
16	50	31	41	-4	34	24	0	2	0	0.00	0.0	29.770	29	3.2	4.7	15	SW	10	30	337	58	3	3
17	50	33	42	-3	37	23	0	2 8	0	0.00	0.0	29.950	11	3.4	3.7	9	SE	8	13	257	44	6	5
18	55	30	43	-2	35	22	0	1	0	0.00	0.0	29.780	11	0.8	1.4	7	SE	6	13	579	100	3	4
19	46	31	39	-6	37	26	0	1 4	0	0.26	T	29.450	08	1.4	6.1	18	NW	14	36	0	0	10	8
20	43	28	36	-8	27	29	0	8	0	T	T	29.560	34	2.1	4.0	14	NW	12	32	374	65	5	3
21	36	24	30	-14	21	35	0		0	T	T	29.710	31	6.5	8.0	15	NW	13	31	316	55	2	1
22	35	19	27*	-17	18	38	0		0	0.00	0.0	29.910	17	1.0	3.1	13	S	7	17	577	100	0	0
23	42	18*	30	-14	20	35	0	1 8	0	0.00	0.0	30.040	34	1.1	2.0	7	NW	6	31	578	100	0	0
24	44	20	32	-12	21	33	0	1 8	0	0.00	0.0	30.010	32	2.3	2.7	7	NW	7	31	579	100	0	0
25	47	22	35	-9	22	30	0	1 8	0	0.00	0.0	29.885	14	0.5	2.8	7	NW	6	27	579	100	0	0
26	50	24	37	-7	25	28	0	1 8	0	0.00	0.0	29.840	08	0.8	1.2	7	N	5	15	579	100	0	0
27	54	26	40	-4	28	25	0	1 8	0	0.00	0.0	29.740	07	0.9	3.6	8	NW	7	12	579	100	0	0
28	51	26	39	-5	29	26	0	1 8	0	0.00	0.0	29.530	33	1.8	4.0	12	NW	8	31	580	100	0	0
29	47	24	36	-8	29	29	0	2 8	0	0.00	0.0	29.740	09	1.3	2.1	10	SE	8	13	258	44	2	2
30	51	25	38	-6	27	27	0	1 8	0	0.00	0.0	29.970	19	0.8	2.7	10	SE	7	14	481	83	1	1
31	53	24	39	-5	27	26	0	1 8	0	0.00	0.0	29.960	35	0.4	1.7	8	SW	7	20	581	100	1	2
	SUM 1649	SUM 921				TOTAL 722	TOTAL 0	NUMBER OF DAYS		TOTAL 0.68	TOTAL T	FOR THE MONTH: 29.820	01	0.5	3.3	18	NW	14	36	TOTAL 11551	% FOR MONTH	SUM 113	SUM 100
	AVG. 53.2	AVG. 29.7	AVG. 41.5	DEP. -3.8	AVG. 32.0	DEP. 111	DEP. 0	PRECIPITATION ≥ .01 INCH. 4		DEP. -0.93						DATE:19		DATE: 19		POSSIBLE 18029	64	AVG. 3.6	AVG. 3.2

NUMBER OF DAYS: MAXIMUM TEMP. ≥ 90°	MAXIMUM TEMP. ≤ 32°	MINIMUM TEMP. ≤ 32°	MINIMUM TEMP. ≤ 0°
0	0	24	0

SEASON TO DATE	TOTAL	TOTAL
TOTAL	1095	2071
DEP.	42	302

NUMBER OF DAYS	
SNOW, ICE PELLETS ≥ 1.0 INCH	0
THUNDERSTORMS	0
HEAVY FOG	5
CLEAR 18	PARTLY CLOUDY 8 CLOUDY 5

GREATEST IN 24 HOURS AND DATES: PRECIPITATION		SNOW, ICE PELLETS	
0.39	15	trace	21+

GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
T	20

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

FRESNO, CA

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER

Kenneth D Hadeen
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

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OBSERVATIONS AT 3-HOUR INTERVALS

DEC 1990
FRESNO, CA

93193

Column key: HOUR L.S.T. | SKY COVER (TENTHS) | CEILING IN HUNDREDS OF FEET | VISIBILITY: WHOLE MILES | VISIBILITY: 16THS MILE | WEATHER | TEMPERATURE: AIR °F | TEMPERATURE: WET BULB °F | TEMPERATURE: DEW POINT °F | REL HUMIDITY % | WIND: DIRECTION | WIND: SPEED (KNOTS)

DEC 1st

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	1	UNL	4		FH	38	36	34	86	10	4
04	0	UNL	3		F	36	35	33	89	00	0
07	0	UNL	1	12	F	33	33	32	96	00	0
10	0	UNL	1	12	H	47	43	38	71	15	5
13	0	UNL	2	8	H	57	48	39	51	14	3
16	0	UNL	3		H	57	48	38	49	00	0
19	1	UNL	2	8	H	47	43	39	74	00	0
22	1	UNL	2	8	H	40	39	38	93	00	0

DEC 2nd

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	2	UNL	1		F	37	37	36	96	00	0
04	3	UNL	1		F	32	31	30	92	00	0
07	3	UNL	0	8	F	34	33	32	92	13	8
10	2	UNL	0	14	FH	42	38	32	68	13	5
13	2	UNL	1	8	H	54	44	32	43	14	4
16	7	UNL	2		H	55	45	32	42	00	0
19	4	UNL	2		H	46	40	32	58	32	3
22	4	UNL	1	8	FH	39	36	32	76	09	4

DEC 3rd

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	7	UNL	1		F	36	34	32	85	06	3
04	2	UNL	1		F	34	33	31	89	00	0
07	3	UNL	0	12	F	32	32	31	96	07	3
10	5	UNL	1	4	H	45	40	32	61	00	0
13	10	UNL	2		H	56	48	40	55	30	3
16	10	UNL	2	8	H	58	48	38	48	00	0
19	7	UNL	1	12	H	50	45	40	69	26	3
22	6	UNL	1	4	F	41	40	38	89	04	4

DEC 4th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	5	UNL	0	12	F	37	36	35	93	09	3
04	4	UNL	0	12	F	35	35	34	96	00	0
07	7	UNL	0	8	F	34	34	33	96	00	0
10	0	UNL	0	14	H	47	43	38	71	00	0
13	10	UNL	1	8	H	58	49	39	49	00	0
16	10	250	2		H	59	49	39	48	00	0
19	3	UNL	1	12	H	49	45	41	74	24	3
22	6	UNL	0	12	F	41	40	38	89	05	3

DEC 5th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	4	UNL	0	12	F	39	38	37	93	00	0
04	5	UNL	0	12	F	36	35	34	93	00	0
07	10	UNL	0	8	F	34	33	32	92	13	3
10	8	UNL	0	12	F	43	40	37	80	12	5
13	4	UNL	1		H	53	46	38	57	24	3
16	3	UNL	1	8	H	55	47	37	51	00	0
19	2	UNL	1	8	H	44	41	37	77	06	5
22	2	UNL	1	4	FH	40	38	36	86	10	4

DEC 6th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	1	UNL	1	8	F	37	36	35	93	05	4
04	1	UNL	1	8	F	35	34	33	92	07	3
07	2	UNL	1		F	33	32	31	92	07	3
10	1	UNL	1	12	H	46	42	37	71	00	0
13	1	UNL	1	12	H	60	49	38	44	00	0
16	8	UNL	2		H	60	48	34	38	00	0
19	3	UNL	2		H	48	44	39	71	00	0
22	2	UNL	1	12	FH	41	40	38	89	03	3

DEC 7th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	4	UNL	1	12	FH	38	37	35	89	03	3
04	3	UNL	1	12	F	35	34	32	89	00	0
07	9	UNL	1	8	F	33	32	30	89	10	3
10	10	UNL	1	4	H	46	42	38	74	00	0
13	3	UNL	1	12	H	62	50	37	40	00	0
16	4	UNL	1	12	H	63	50	35	35	28	4
19	2	UNL	3		H	52	46	40	64	31	4
22	1	UNL	2		FH	42	40	37	83	11	3

DEC 8th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	2	UNL	1	8	F	38	37	36	93	00	0
04	1	UNL	1	8	F	34	33	31	89	05	3
07	0	UNL	3		F	32	31	28	85	09	4
10	1	UNL	2	8	H	48	43	38	69	14	3
13	1	UNL	2	8	H	63	50	35	35	00	0
16	1	UNL	2	8	H	65	50	33	30	28	4
19	0	UNL	2		H	48	43	38	69	35	4
22	0	UNL	2		F	39	37	34	82	00	0

DEC 9th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	0	UNL	2		FH	37	35	31	79	09	5
04	0	UNL	3		FH	34	33	31	89	00	0
07	0	UNL	3		FH	32	31	28	85	07	4
10	0	UNL	2	8	H	49	43	35	59	12	3
13	1	UNL	2		H	64	50	34	33	00	0
16	0	UNL	2	8	H	66	50	32	28	00	0
19	0	UNL	3		H	50	44	36	59	32	4
22	0	UNL	3		H	42	38	33	71	09	5

DEC 10th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	0	UNL	3		H	39	36	31	73	00	0
04	0	UNL	3		H	37	35	31	79	04	3
07	0	UNL	7			37	34	28	70	00	0
10	0	UNL	2	8	H	54	45	34	47	00	0
13	1	UNL	3		H	69	50	29	23	18	4
16	9	110	5		H	69	50	26	20	26	3
19	10	100	3		H	58	48	38	48	32	8
22	10	120	3		H	51	47	42	72	31	10

DEC 11th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	10	110	3		H	50	48	45	83	30	8
04	10	110	3		H	50	48	46	86	27	8
07	10	90	6		RW	51	48	45	80	36	9
10	10	75	3		H	53	50	46	77	01	7
13	10	75	3		RWH	56	51	47	72	31	4
16	10	70	7			56	51	47	72	33	5
19	10	70	7			53	50	47	80	32	5
22	10	95	6		F	50	49	47	90	00	0

DEC 12th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	10	80	5		F	50	49	47	90	00	0
04	10	75	4		F	49	48	47	93	30	5
07	10	65	2	8	RWF	47	46	45	93	01	3
10	10	8	1	8	F	47	47	46	96	01	4
13	10	50	4		FH	53	50	47	80	34	3
16	10	60	3		H	54	50	47	77	34	3
19	10	200	3		FH	51	49	47	86	00	0
22	10	24	3		F	50	49	47	90	00	0

DEC 13th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	10	200	2	8	F	48	47	46	93	00	0
04	8	200	2		F	45	44	43	93	00	0
07	10	19	1	4	F	48	48	47	96	00	0
10	10	19	1		H	51	49	47	86	00	0
13	10	22	1	8	H	52	49	45	77	31	8
16	2	UNL	5		H	53	48	42	66	29	5
19	0	UNL	4		H	46	44	41	83	33	8
22	0	UNL	3		F	39	39	38	96	35	3

DEC 14th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	10	1	0	2	F	38	38	38	100	34	3
04	10	3	0		F	33	33	33	100	00	0
07	10	3	0		F	33	33	33	100	15	6
10	10	0	0		F	38	38	38	100	13	6
13	10	7	0	12	F	42	42	41	96	18	4
16	0	UNL	2		H	49	45	40	71	00	0
19	1	UNL	1	8	F	40	39	38	93	00	0
22	2	UNL	0	12	F	33	33	32	96	12	3

DEC 15th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	1	UNL	1	8	F	36	36	35	96	12	7
04	0	UNL	2		F	33	33	32	96	12	6
07	8	120	7			38	36	33	82	14	4
10	10	28	1	8	RF	41	40	39	93	15	3
13	9	50	4		RWF	47	45	43	86	12	8
16	9	35	7		RW	48	46	44	86	30	3
19	5	UNL	10			42	42	41	96	04	4
22	1	UNL	2	8	F	36	36	36	100	00	0

DEC 16th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	7	2	0	1	F	33	33	33	100	00	0
04	5	UNL	0	3	F	33	33	32	96	00	0
07	0	UNL	15			32	32	32	100	00	0
10	0	UNL	20			43	38	31	63	30	6
13	6	25	20			48	41	32	54	31	7
16	4	UNL	20			47	41	32	56	31	8
19	0	UNL	10			43	41	39	86	24	4
22	0	UNL	3		F	36	36	35	96	05	3

DEC 17th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	0	UNL	2	8	F	34	34	33	96	11	4
04	10	3	0		F	34	34	34	100	11	4
07	10	3	0	14	F	37	37	37	100	13	5
10	10	27	2		F	42	41	40	93	13	7
13	4	UNL	3		H	48	44	40	74	00	0
16	2	UNL	10			50	44	37	61	00	0
19	0	UNL	10			41	39	37	86	00	0
22	0	UNL	5		F	37	36	35	93	07	4

DEC 18th

HOUR	SKY	CEIL	VIS MI	VIS 16THS	WEATHER	AIR	WET BULB	DEW PT	RH	DIR	SPEED
01	0	UNL	7			34	34	33	96	00	0
04	0	UNL	7			32	32	31	96	00	0
07	1	UNL	6		F	31	31	30	96	12	4
10	2	UNL	7			43	40	37	80	00	0
13	2	UNL	10			52	45	32	57	00	0
16	6	UNL	10			53	45	36	53	13	3
19	6	UNL	7			45	42	39	80	31	3
22	9	48	4		F	41	39	37	86	00	0

WEATHER CODES

*	TORNADO	ZL	FREEZING DRIZZLE	IPW	ICE PELLET SHOWERS	BN	BLOWING SAND
T	THUNDERSTORM	S	SNOW	A	HAIL	BS	BLOWING SNOW
Q	SQUALL	SW	SNOW SHOWERS	F	FOG	BY	BLOWING SPRAY
R	RAIN	SG	SNOW GRAINS	IF	ICE FOG	K	SMOKE
RW	RAIN SHOWERS	SP	SNOW PELLETS	GF	GROUND FOG	H	HAZE
ZR	FREEZING RAIN	IC	ICE CRYSTALS	BD	BLOWING DUST	D	DUST
L	DRIZZLE	IP	ICE PELLETS				

CEILING: UNL INDICATES UNLIMITED
WIND DIRECTION: DIRECTIONS ARE THOSE FROM WHICH THE WIND BLOWS, INDICATED IN TENS OF DEGREES FROM TRUE NORTH: I.E., 09 FOR EAST, 18 FOR SOUTH, 27 FOR WEST. AN ENTRY OF 00 INDICATES CALM
SPEED: THE OBSERVED AVERAGE ONE-MINUTE VALUE, EXPRESSED IN KNOTS (MPH=KNOTS X 1.15).

OBSERVATIONS AT 3-HOUR INTERVALS

DEC 1990 93193
FRESNO, CA

Date	Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Visibility: Whole Miles	Visibility: 16ths Mile	Weather	Temperature: Air °F	Temperature: Wet Bulb °F	Temperature: Dew Point °F	Rel Humidity %	Wind: Direction	Wind: Speed (Knots)
DEC 19th	01	8	55	5		F	42	40	38	86	00	0
	04	10	39	2	8	RWF	41	40	39	93	16	6
	07	10	27	1	8	F	41	40	39	93	16	3
	10	10	40	2		F	44	43	41	89	18	5
	13	10	25	4		RWF	42	41	39	89	36	12
	16	10	45	15			41	38	35	79	02	3
	19	6	95	15			39	37	35	86	16	5
	22	3	UNL	15			35	34	33	92	17	3
DEC 20th	01	0	UNL	15			30	30	29	96	00	0
	04	0	UNL	7			29	29	28	96	07	3
	07	10	100	10			31	31	30	96	00	0
	10	6	110	12			36	34	32	85	14	4
	13	5	UNL	20			43	37	27	53	31	9
	16	1	UNL	15			40	33	22	49	34	9
	19	0	UNL	15			34	30	23	64	02	3
	22	2	UNL	15			31	29	26	82	13	3
DEC 21st	01	3	UNL	10			29	28	25	85	13	6
	04	3	UNL	10			28	27	24	85	27	5
	07	1	UNL	10			26	24	19	75	30	8
	10	9	65	10			28	26	22	78	31	11
	13	0	UNL	15			33	30	24	70	31	7
	16	0	UNL	15			34	29	20	57	34	9
	19	0	UNL	15			29	25	18	64	30	6
	22	0	UNL	15			26	24	18	72	29	6
DEC 22nd	01	0	UNL	15			24	22	17	75	00	0
	04	5	UNL	15			22	21	18	85	00	0
	07	0	UNL	10			19	18	16	88	00	0
	10	0	UNL	10			27	25	20	75	17	3
	13	0	UNL	10			33	28	17	52	17	3
	16	0	UNL	10			34	28	17	50	16	5
	19	0	UNL	10			29	26	19	66	00	0
	22	0	UNL	10			25	23	20	81	06	3
DEC 23rd	01	0	UNL	7			23	22	20	88	00	0
	04	0	UNL	7			22	21	18	85	00	0
	07	0	UNL	3		F	18	17	16	92	11	3
	10	0	UNL	2	8	H	30	27	22	72	00	0
	13	0	UNL	4		H	39	32	20	47	36	3
	16	0	UNL	7			40	32	18	41	27	5
	19	0	UNL	7			31	28	22	69	36	3
	22	0	UNL	6		H	25	24	21	85	00	0
DEC 24th	01	0	UNL	5		F	26	24	21	81	00	0
	04	0	UNL	4		F	24	23	21	88	31	4
	07	0	UNL	4		F	20	19	18	92	03	3
	10	0	UNL	3		H	32	30	25	75	00	0
	13	0	UNL	7			42	34	20	41	31	5
	16	0	UNL	10			43	34	18	37	31	6
	19	0	UNL	7			33	30	23	67	00	0
	22	0	UNL	6		F	28	26	23	82	00	0
DEC 25th	01	0	UNL	5		F	25	24	22	88	02	3
	04	0	UNL	5		F	24	23	21	88	12	3
	07	0	UNL	2		F	22	21	20	92	00	0
	10	0	UNL	3		H	33	30	25	73	00	0
	13	0	UNL	5		H	44	36	23	44	30	4
	16	0	UNL	4		H	47	37	19	33	00	0
	19	0	UNL	5		H	37	31	21	52	00	0
	22	0	UNL	5		H	31	29	24	75	00	0
DEC 26th	01	0	UNL	5		FH	28	27	24	85	00	0
	04	0	UNL	4		F	25	24	23	92	10	4
	07	0	UNL	2		F	25	24	23	92	05	3
	10	0	UNL	3		H	39	34	27	62	00	0
	13	0	UNL	4		H	47	38	25	42	00	0
	16	0	UNL	5		H	49	39	24	38	00	0
	19	0	UNL	5		H	38	34	27	65	00	0
	22	0	UNL	5		F	31	30	27	85	00	0
DEC 27th	01	0	UNL	4		F	27	26	25	92	09	3
	04	0	UNL	4		F	28	27	25	89	07	5
	07	2	UNL	3		F	27	27	26	96	30	5
	10	0	UNL	2		FH	38	35	30	73	15	5
	13	0	UNL	3		H	50	41	28	43	00	0
	16	0	UNL	3		H	52	42	28	40	32	5
	19	0	UNL	3		H	37	34	28	70	00	0
	22	0	UNL	3		FH	33	31	28	82	12	4
DEC 28th	01	0	UNL	2	8	F	29	28	27	92	00	0
	04	0	UNL	3		F	28	27	26	92	09	4
	07	0	UNL	2		F	28	27	26	92	10	4
	10	0	UNL	3		FH	39	35	30	70	00	0
	13	0	UNL	2		H	50	41	30	46	29	6
	16	0	UNL	3		H	50	41	29	45	31	7
	19	0	UNL	4		H	41	37	32	70	32	5
	22	0	UNL	7			37	35	32	82	00	0
DEC 29th	01	0	UNL	7			30	30	29	96	00	0
	04	0	UNL	2		F	28	27	26	92	32	4
	07	0	UNL	1	8	F	25	25	24	96	10	3
	10	1	UNL	0	12	F	33	32	31	92	00	0
	13	1	UNL	1		H	44	39	32	63	00	0
	16	3	UNL	1	8	H	44	39	32	63	12	5
	19	3	UNL	1	8	FH	35	33	31	85	07	5
	22	3	UNL	1		F	33	32	31	92	00	0
DEC 30th	01	3	UNL	0	12	F	31	30	29	92	27	3
	04	2	UNL	0	12	F	29	28	27	92	00	0
	07	1	UNL	1	4	F	26	26	25	96	00	0
	10	2	UNL	1	4	H	36	34	31	82	15	3
	13	1	UNL	3		H	48	41	31	52	14	4
	16	0	UNL	5		H	50	40	24	36	24	5
	19	0	UNL	5		H	41	36	27	58	31	4
	22	0	UNL	4		H	29	28	25	85	07	4
DEC 31st	01	0	UNL	3		FH	28	27	25	89	00	0
	04	0	UNL	3		FH	26	25	24	92	00	0
	07	0	UNL	2		FH	25	24	23	92	08	4
	10	0	UNL	3		H	38	34	28	67	09	3
	13	1	UNL	1	12	H	49	40	28	44	00	0
	16	1	UNL	3		H	51	41	27	40	30	3
	19	5	UNL	3		H	40	35	28	62	21	3
	22	10	UNL	2	8	F	33	31	28	82	00	0

SUMMARY BY HOURS

Hour L.S.T.	Averages: Sky Cover (Tenths)	Station Pressure (Inches)	Temperature: Air Temp °F	Temperature: Wet Bulb °F	Temperature: Dew Point °F	Rel Humidity %	Wind Speed (MPH)	Resultant Wind: Direction	Resultant Wind: Speed (MPH)
01	3	29.820	35	33	32	90	2.2	08	1.0
04	3	29.820	33	32	30	91	2.6	07	0.5
07	4	29.830	32	31	29	91	3.5	09	1.7
10	4	29.860	41	38	34	76	3.3	13	1.2
13	4	29.810	50	43	33	55	3.9	31	1.5
16	4	29.790	51	43	32	50	3.7	31	2.3
19	3	29.800	42	39	34	72	3.4	32	1.9
22	3	29.825	37	35	33	86	2.7	06	1.2

HOURLY PRECIPITATION (WATER EQUIVALENT IN INCHES) DEC 1990 FRESNO, CA 93193

DATE	A.M. HOUR ENDING AT												P.M. HOUR ENDING AT												DATE
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
01																									01
02																									02
03																									03
04																									04
05																									05
06																									06
07																									07
08																									08
09																									09
10																									10
11							T	T	T		T	T	T	T	0.01		T								11
12							T	0.02	T																12
13																									13
14																									14
15									0.03	0.12	0.02		T	T		0.04	0.18	T							15
16																									16
17																									17
18																									18
19			T	0.02	0.05	0.02	T				T	0.02	0.05	0.08	0.02	T									19
20																								T	20
21											T														21
22																									22
23																									23
24																									24
25																									25
26																									26
27																									27
28																									28
29																									29
30																									30
31																									31

MAXIMUM SHORT DURATION PRECIPITATION

TIME PERIOD (MINUTES)	5	10	15	20	30	45	60	80	100	120	150	180
PRECIPITATION (INCHES)												
ENDED: DATE												
ENDED: TIME												

THE PRECIPITATION AMOUNTS FOR THE INDICATED TIME INTERVALS MAY OCCUR AT ANY TIME DURING THE MONTH. THE TIME INDICATED IS THE ENDING TIME OF THE INTERVAL. DATE AND TIME ARE NOT ENTERED FOR TRACE AMOUNTS.

VALIDATED BY:
DON GRISINGER

SUBSCRIPTION PRICE AND ORDERING INFORMATION AVAILABLE FROM:
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FIRST CLASS

JAN 1991
FRESNO, CA
NAT'L WEA SER OFC
FRESNO AIR TERMINAL

ISSN 0198-0734

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

FRESNO AIR TERMINAL

LATITUDE 36° 46' N LONGITUDE 119° 43' W ELEVATION (GROUND) 328 FEET TIME ZONE PACIFIC 93193

Weather types: 1 FOG; 2 HEAVY FOG; 3 THUNDERSTORM; 4 ICE PELLETS; 5 HAIL; 6 GLAZE; 7 DUSTSTORM; 8 SMOKE, HAZE; 9 BLOWING SNOW

DATE (1)	TEMPERATURE °F: MAXIMUM (2)	MINIMUM (3)	AVERAGE (4)	DEPARTURE FROM NORMAL (5)	AVERAGE DEW POINT (6)	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL) (7A)	COOLING (SEASON BEGINS WITH JAN) (7B)	WEATHER TYPES (8)	SNOW, ICE PELLETS OR ICE ON GROUND AT 0400 INCHES (9)	PRECIPITATION: WATER EQUIVALENT (INCHES) (10)	SNOW, ICE PELLETS (INCHES) (11)	AVERAGE STATION PRESSURE IN INCHES ELEV. 327 FEET ABOVE M.S.L. (12)	WIND (M.P.H.): RESULTANT DIR. (13)	RESULTANT SPEED (14)	AVERAGE SPEED (15)	PEAK GUST: SPEED (16)	DIRECTION (17)	FASTEST 1-MIN: SPEED (18)	DIRECTION (19)	SUNSHINE: MINUTES (20)	PERCENT OF TOTAL POSSIBLE (21)	SKY COVER (TENTHS): SUNRISE TO SUNSET (22)	MIDNIGHT TO MIDNIGHT (23)
01	53	27*	40*	-4	28	25	0	1 8	0	0.00	0.0	29.870	02	0.7	1.6	6	E	6	10	258	44	10	8
02	54	28	41	-3	30	24	0	1 8	0	0.00	0.0	29.810	30	1.4	1.8	10	NW	6	31	227	39	9	9
03	50	40	45	1	37	20	0	1 8	0	0.04	0.0	29.690	14	1.6	2.1	9	SE	7	11	0	0	10	10
04	49	44	47	3	44	18	0	1	0	0.07	0.0	29.650	11	0.8	1.1	6	E	6	06	0	0	10	10
05	49	45	47	3	43	18	0	1 8	0	0.00	0.0	29.780	07	1.1	3.2	9	E	6	11	0	0	10	10
06	54	38	46	2	42	19	0	1 8	0	0.00	0.0	29.880	11	2.1	3.1	9	S	6	07	133	23	7	7
07	60	39	50	6	43	15	0	1 8	0	0.02	0.0	29.880	11	1.2	2.0	9	E	6	11	227	39	7	7
08	50	45	48	4	46	17	0	2 8	0	0.00	0.0	29.770	18	0.6	2.8	9	SE	7	16	0	0	10	10
09	59	40	50	5	43	15	0	1 8	0	T	0.0	29.690	14	3.5	4.5	10	S	9	12	197	34	7	6
10	58	35	47	2	41	18	0	2 8	0	0.00	0.0	29.910	28	1.0	2.4	8	NW	6	29	369	63	6	4
11	55	38	47	2	44	19	0	2 8	0	0.00	0.0	29.980	15	0.4	2.8	8	E	8	09	28	5	10	10
12	49	45	47	2	45	18	0	2	0	0.00	0.0	30.040	15	2.3	3.0	8	SE	8	13	0	0	10	10
13	50	43	47	2	45	18	0	2	0	0.00	0.0	30.040	13	1.9	2.3	8	E	7	13	0	0	10	10
14	58	48	53*	8	46	12	0	1 8	0	0.00	0.0	30.030	31	0.3	1.0	10	W	6	28	119	20	9	10
15	53	42	48	3	46	17	0	1 8	0	T	0.0	29.930	31	4.1	4.6	12	W	8	32	0	0	10	10
16	54	40	47	2	44	18	0	1 8	0	0.00	0.0	29.890	13	1.1	3.5	9	S	7	16	34	6	10	8
17	59	34	47	2	40	18	0	2 8	0	0.00	0.0	29.910	12	2.2	3.6	9	S	7	09	491	82	5	2
18	68*	34	51	5	36	14	0	1 8	0	0.00	0.0	29.810	12	2.3	3.1	10	SE	7	13	598	100	0	0
19	63	38	51	5	39	14	0	1 8	0	0.00	0.0	29.750	34	1.3	4.9	15	NW	12	34	600	100	0	0
20	60	35	48	2	37	17	0	1 8	0	0.00	0.0	29.650	35	1.0	3.4	13	W	10	29	601	100	0	[illegible]
21	61	35	48	2	32	17	0	8	0	0.00	0.0	29.760	31	3.5	4.8	12	NW	9	31	604	100	0	0
22	62	31	47	1	28	18	0		0	0.00	0.0	29.820	04	1.6	2.7	8	NW	7	09	605	100	0	0
23	64	31	48	2	31	17	0		0	0.00	0.0	29.800	08	0.8	2.3	7	E	6	09	607	100	3	2
24	63	32	48	2	30	17	0	8	0	0.00	0.0	29.790	35	0.9	1.2	12	NW	5	33	609	100	0	0
25	65	32	49	2	30	16	0	8	0	0.00	0.0	29.720	35	0.6	2.5	10	N	6	08	610	100	0	0
26	58	31	45	-2	33	20	0	1 8	0	0.00	0.0	29.780	31	1.5	2.3	9	NW	7	30	612	100	2	2
27	59	30	45	-2	34	20	0	1 8	0	0.00	0.0	29.750	10	1.1	2.6	10	S	7	16	613	100	0	0
28	57	32	45	-2	35	20	0	1 8	0	0.00	0.0	29.660	35	0.8	2.6	9	S	7	32	615	100	0	0
29	58	30	44	-3	35	21	0	1 8	0	0.00	0.0	29.795	11	2.0	2.6	8	SE	6	07	480	78	1	0
30	66	31	49	1	31	16	0	1 8	0	0.00	0.0	29.900	08	1.7	2.0	9	SE	7	10	618	100	3	3
31	66	36	51	3	30	14	0	8	0	0.00	0.0	29.870	07	0.8	2.1	8	NW	7	34	209	34	10	9
	SUM 1784	SUM 1129				TOTAL 549	TOTAL 0	NUMBER OF DAYS		TOTAL 0.13	TOTAL 0.0	FOR THE MONTH: 29.830	09	0.4	2.7	15	NW	12	34	TOTAL 10064	% FOR MONTH	SUM 169	SUM 158
	AVG. 57.5	AVG. 36.4	AVG. 47.0	DEP. 1.5	AVG. 37.7	DEP. -56	DEP. 0	PRECIPITATION ≥ .01 INCH 3		DEP. -1.92						DATE: 19		DATE: 19		POSSIBLE 18548	54	AVG. 5.5	AVG. 5.1

NUMBER OF DAYS				SEASON TO DATE						
MAXIMUM TEMP.		MINIMUM TEMP.		TOTAL	TOTAL	SNOW, ICE PELLETS ≥ 1.0 INCH	0			
≥ 90°	≤ 32°	≤ 32°	≤ 0°	1644	0	THUNDERSTORMS	0			
0	0	11	0	DEP.	DEP.	HEAVY FOG	6			
				-14	0	CLEAR 13	PARTLY CLOUDY 5	CLOUDY 13		

GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
PRECIPITATION		SNOW, ICE PELLETS			
0.11	03-04	0.0		0	

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER

Kenneth D Hadeen
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

FRESNO, CA

OBSERVATIONS AT 3-HOUR INTERVALS

JAN 1991
FRESNO, CA

93193

JAN 1st

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	7	UNL	2		F	30	29	26	85	00	0
04	5	UNL	2		FH	29	28	26	89	00	0
07	5	UNL	2		FH	27	26	25	92	10	3
10	10	UNL	2	8	H	37	34	30	76	00	0
13	10	250	2	8	H	48	40	30	50	30	3
16	10	UNL	1	8	H	51	42	30	45	35	3
19	10	UNL	2		H	42	37	30	63	30	5
22	8	140	2		H	33	32	29	85	10	5

JAN 2nd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	8	250	1	8	FH	33	32	29	85	00	0
04	7	UNL	1	8	FH	28	28	27	96	00	0
07	9	140	3		H	31	30	29	89	00	0
10	8	UNL	2		H	43	38	32	65	00	0
13	10	180	2		H	53	44	32	45	30	4
16	10	250	2		H	53	44	32	45	28	5
19	10	250	2		H	45	40	32	61	00	0
22	10	250	3		H	44	38	30	58	00	0

JAN 3rd

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	95	2	8	H	41	37	32	70	10	4
04	10	95	2	8	H	42	38	32	68	00	0
07	10	250	2		H	42	38	32	68	11	6
10	10	80	1	4	H	44	40	35	71	11	4
13	10	55	1	4	RH	48	43	37	66	00	0
16	10	48	1		RH	49	44	38	66	17	4
19	10	40	1	8	RFH	46	45	43	89	16	3
22	10	44	1	8	RF	45	44	43	93	00	0

JAN 4th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	7	0	8	RF	44	44	44	100	00	0
04	10	50	0	6	RF	44	44	43	96	00	0
07	10	3	0	5	F	44	44	44	100	00	0
10	10	6	1		F	45	45	44	96	00	0
13	10	7	1	8	F	47	46	45	93	18	3
16	10	12	1	8	F	49	47	45	86	00	0
19	10	11	3		F	48	47	45	89	00	0
22	10	11	3		F	47	46	44	89	15	3

JAN 5th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	9	3		F	47	46	44	89	13	3
04	10	8	3		F	47	46	44	89	34	3
07	10	11	3		F	47	45	43	86	34	4
10	10	12	3		F	47	45	43	86	25	3
13	10	16	3		H	48	46	43	83	34	4
16	10	13	3		H	48	46	43	83	00	0
19	10	13	3		H	48	46	43	83	00	0
22	10	13	4		H	48	46	44	86	10	5

JAN 6th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	16	7			48	45	42	80	13	5
04	10	16	7			48	45	41	77	11	3
07	10	16	7			46	44	42	86	14	5
10	10	15	7			48	46	43	83	09	5
13	10	18	7			50	47	43	77	19	5
16	4	UNL	10			52	48	44	74	00	0
19	3	UNL	7			47	45	43	86	33	4
22	4	UNL	5		F	42	41	40	93	00	0

JAN 7th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	3	UNL	7			40	40	39	96	00	0
04	8	UNL	7			40	40	39	96	00	0
07	10	90	4		F	41	40	39	93	00	0
10	10	80	3		H	47	45	43	86	00	0
13	4	UNL	10			56	51	46	69	00	0
16	2	UNL	10			60	52	44	56	00	0
19	9	200	5		H	51	49	46	83	00	0
22	6	UNL	5		F	44	43	42	93	09	3

JAN 8th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	5	2		F	46	46	45	96	13	3
04	10	5	0	8	F	46	46	45	96	00	0
07	10	0	-0	2	F	45	45	45	100	35	3
10	10	0	0	2	F	46	46	46	100	00	0
13	10	6	1		F	49	48	47	93	33	3
16	10	9	3		H	50	48	46	86	33	3
19	10	11	3		F	49	47	45	86	20	5
22	10	15	4		F	49	48	46	90	13	5

JAN 9th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	10	4		F	47	46	44	89	14	8
04	10	13	2		F	46	45	44	93	12	8
07	10	80	3		F	46	45	44	93	-12	4-
10	8	75	1	8	FH	50	47	44	80	16	5
13	6	75	5		H	55	50	44	67	15	6
16	3	UNL	7			57	50	43	60	20	5
19	1	UNL	7			49	47	44	83	00	0
22	0	UNL	5		FH	44	43	42	93	00	0

JAN 10th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	1	UNL	3		F	38	38	37	96	00	0
04	0	UNL	4		F	36	36	35	96	08	3
07	5	UNL	5		F	38	37	36	93	00	0
10	8	UNL	7			47	44	40	77	00	0
13	4	UNL	6		H	56	50	45	67	30	3
16	1	UNL	5		H	57	51	45	64	30	4
19	3	UNL	5		H	50	48	45	83	23	4
22	7	UNL	2	4	F	44	44	43	96	13	4

JAN 11th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	8	250	0	8	F	44	44	43	96	00	0
04	10	250	0	2	F	42	42	42	100	00	0
07	10	UNL	0	10	F	38	38	38	100	09	3
10	10	0	0	1	F	43	43	43	100	19	3
13	10	200	1	8	F	50	48	46	86	00	0
16	10	200	2		H	54	50	47	77	34	3
19	7	UNL	1	8	FH	50	48	46	86	28	3
22	10	200	2		F	48	47	46	93	00	0

JAN 12th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	0	0		F	45	45	45	100	20	5
04	10	0	0		F	45	45	45	100	00	0
07	10	0	0		F	45	45	45	100	00	0
10	10	1	0	2	F	45	45	45	100	15	3
13	10	3	0	8	F	46	46	46	100	13	6
16	10	8	0	14	F	49	48	46	90	12	5
19	10	7	1		F	48	47	45	89	13	5
22	10	2	0	12	F	46	46	45	96	13	7

JAN 13th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	1	0	2	F	44	44	44	100	09	4
04	10	0	0		F	44	44	44	100	05	3
07	10	0	0		F	44	44	44	100	00	0
10	10	2	0	4	F	44	44	44	100	12	4
13	10	5	1		F	47	46	45	93	19	4
16	10	10	1	4	F	49	48	46	90	00	0
19	10	5	1		F	48	47	46	93	16	4
22	10	17	2		F	48	47	46	93	00	0

JAN 14th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	28	2	8	F	49	47	45	86	00	0
04	10	28	2	8	F	49	48	46	90	00	0
07	10	21	2		F	49	48	46	90	00	0
10	4	UNL	3		H	54	50	46	75	00	0
13	10	33	5		F	57	51	46	67	00	0
16	9	32	7			57	51	44	62	00	0
19	10	32	7			54	50	45	75	16	5
22	10	32	7			52	50	47	83	00	0

JAN 15th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	8	28	7			45	44	43	93	00	0
04	9	27	7			45	44	43	93	00	0
07	10	27	7			47	46	45	93	29	4
10	10	27	8			51	48	45	80	31	4
13	10	25	4		H	53	50	47	80	30	7
16	10	21	3		FH	52	49	46	80	32	7
19	10	11	1	8	LF	49	49	48	96	32	4
22	10	13	3		F	49	48	47	93	29	6

JAN 16th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	10	21	5		F	49	47	45	86	05	4
04	10	28	4		F	47	47	46	96	00	0
07	10	7	2		F	48	47	46	93	10	3
10	10	11	2	8	F	49	48	46	90	32	4
13	9	23	4		H	53	49	44	72	13	4
16	10	UNL	4		H	54	49	44	69	16	6
19	4	UNL	3		FH	45	44	42	89	00	0
22	2	UNL	3		F	42	42	41	96	07	5

JAN 17th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	0	UNL	1	8	F	40	40	39	96	05	3
04	0	UNL	1	8	F	37	37	37	100	00	0
07	3	UNL	0	2	F	35	35	34	96	13	3
10	3	UNL	1	8	F	44	42	40	86	12	4
13	5	UNL	3		H	55	49	43	64	21	5
16	6	UNL	4		H	58	50	42	56	00	0
19	0	UNL	4		H	48	45	41	77	17	3
22	0	UNL	2	8	F	42	41	40	93	08	6

JAN 18th

HOUR L.S.T.	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISIBILITY WHOLE MILES	VISIBILITY 16THS MILE	WEATHER	TEMPERATURE AIR °F	WET BULB °F	DEW POINT °F	REL HUMIDITY %	WIND DIRECTION	WIND SPEED (KNOTS)
01	0	UNL	2		F	39	38	37	93	00	0
04	0	UNL	1	8	F	37	37	36	96	00	0
07	0	UNL	1	8	F	34	34	33	96	00	0
10	0	UNL	3		H	49	46	42	77	16	3
13	0	UNL	7			64	51	37	37	18	3
16	0	UNL	15			68	51	33	27	20	3
19	0	UNL	10			53	45	35	51	00	0
22	0	UNL	7			44	41	36	74	05	3

WEATHER CODES

*	TORNADO	ZL	FREEZING DRIZZLE	IPW	ICE PELLET SHOWERS	BN	BLOWING SAND
T	THUNDERSTORM	S	SNOW	A	HAIL	BS	BLOWING SNOW
Q	SQUALL	SW	SNOW SHOWERS	F	FOG	BY	BLOWING SPRAY
R	RAIN	SG	SNOW GRAINS	IF	ICE FOG	K	SMOKE
RW	RAIN SHOWERS	SP	SNOW PELLETS	GF	GROUND FOG	H	HAZE
ZR	FREEZING RAIN	IC	ICE CRYSTALS	BD	BLOWING DUST	D	DUST
L	DRIZZLE	IP	ICE PELLETS				

CEILING: UNL INDICATES UNLIMITED

WIND DIRECTION: DIRECTIONS ARE THOSE FROM WHICH THE WIND BLOWS, INDICATED IN TENS OF DEGREES FROM TRUE NORTH: I.E., 09 FOR EAST, 18 FOR SOUTH, 27 FOR WEST. AN ENTRY OF 00 INDICATES CALM

SPEED: THE OBSERVED AVERAGE ONE-MINUTE VALUE, EXPRESSED IN KNOTS (MPH=KNOTS X 1.15).

OBSERVATIONS AT 3-HOUR INTERVALS

Column key: Hour L.S.T. | Sky Cover (Tenths) | Ceiling in Hundreds of Feet | Visibility: Whole Miles | Visibility: 16ths Mile | Weather | Temperature: Air °F | Temperature: Wet Bulb °F | Temperature: Dew Point °F | Rel Humidity % | Wind: Direction | Wind: Speed (Knots)

JAN 19th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	7			42	39	35	76	33	4
04	0	UNL	7			40	40	39	96	31	6
07	0	UNL	10			40	40	39	96	00	0
10	0	UNL	5		H	49	46	42	77	32	3
13	0	UNL	6		H	59	50	41	52	00	0
16	0	UNL	6		H	62	50	38	41	07	3
19	0	UNL	6		H	51	45	39	64	16	3
22	0	UNL	5		H	43	40	37	80	00	0

JAN 20th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	5		F	41	40	38	89	08	5
04	0	UNL	5		F	39	38	36	89	00	0
07	0	UNL	3		F	36	35	34	93	09	5
10	0	UNL	3		F	50	45	39	66	00	0
13	0	UNL	3		H	58	50	43	58	33	4
16	0	UNL	7			59	47	32	36	29	9
19	0	UNL	7			50	43	35	57	00	0
22	2	UNL	7			43	40	35	74	00	0

JAN 21st

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	2	UNL	7			42	39	35	76	34	3
04	0	UNL	7			41	38	35	79	30	4
07	0	UNL	7			37	36	34	89	27	5
10	0	UNL	6		H	46	41	35	66	27	5
13	0	UNL	8			59	48	35	41	26	6
16	0	UNL	15			60	45	25	26	32	5
19	0	UNL	10			48	39	27	44	00	0
22	0	UNL	10			39	35	28	65	00	0

JAN 22nd

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	10			34	32	28	79	00	0
04	0	UNL	10			33	32	29	85	08	4
07	0	UNL	15			32	31	28	85	03	3
10	0	UNL	12			52	43	32	47	00	0
13	0	UNL	10			61	47	31	32	00	0
16	0	UNL	12			61	45	23	23	32	5
19	0	UNL	10			49	39	24	38	35	3
22	0	UNL	10			40	35	26	62	07	5

JAN 23rd

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	10			37	34	29	73	00	0
04	0	UNL	10			34	33	30	85	00	0
07	0	UNL	10			33	32	30	89	05	3
10	0	UNL	10			50	43	33	52	14	3
13	5	UNL	8			61	47	29	30	00	0
16	6	UNL	7			63	48	29	28	27	3
19	3	UNL	7			49	41	31	50	00	0
22	3	UNL	7			43	38	32	65	13	4

JAN 24th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	1	UNL	7			36	34	31	82	09	3
04	0	UNL	7			35	33	30	82	00	0
07	0	UNL	7			33	32	29	85	00	0
10	0	UNL	5		H	50	43	34	54	00	0
13	0	UNL	5		H	60	47	30	32	35	3
16	0	UNL	5		H	62	47	29	29	33	3
19	0	UNL	7			52	43	32	47	00	0
22	0	UNL	7			43	38	31	63	00	0

JAN 25th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	7			36	34	31	82	00	0
04	0	UNL	7			32	30	27	82	09	4
07	0	UNL	7			34	32	28	79	24	3
10	0	UNL	7			49	41	31	50	09	4
13	0	UNL	7			62	47	30	30	31	4
16	0	UNL	7			63	48	29	28	31	3
19	1	UNL	6		H	51	42	31	47	00	0
22	0	UNL	4		H	44	39	33	65	00	0

JAN 26th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	6	UNL	4		H	38	36	32	79	00	0
04	3	UNL	4		FH	36	34	31	82	35	3
07	4	~~UNL~~	2		FH	32	31	30	92	00	0
10	3	UNL	2		H	43	39	33	68	00	0
13	2	UNL	5		H	54	45	34	47	27	4
16	0	UNL	7			58	47	35	42	30	6
19	0	UNL	7			50	44	37	61	28	3
22	0	UNL	5		H	40	37	33	76	10	3

JAN 27th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	3		F	37	35	32	82	00	0
04	0	UNL	2		F	33	32	30	89	00	0
07	0	UNL	1	8	F	31	30	29	92	00	0
10	0	UNL	1	8	H	44	41	36	74	16	4
13	0	UNL	2		H	55	47	37	51	18	3
16	0	UNL	4		H	58	45	36	44	31	4
19	0	UNL	4		H	47	43	36	66	00	0
22	0	UNL	4		H	40	38	35	82	00	0

JAN 28th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	3		F	37	35	32	82	09	3
04	0	UNL	3		F	34	33	31	89	00	0
07	0	UNL	2		F	33	32	31	92	00	0
10	0	UNL	2		H	46	41	35	66	00	0
13	0	UNL	2		H	56	47	37	49	18	4
16	0	UNL	2		H	56	47	37	49	33	5
19	0	UNL	4		H	47	43	37	68	00	0
22	0	UNL	4		H	42	39	35	76	35	4

JAN 29th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	3		F	36	35	33	89	09	3
04	0	UNL	2		F	33	33	33	100	00	0
07	1	UNL	0	12	F	32	31	30	92	13	5
10	0	UNL	1		F	43	40	37	80	15	3
13	0	UNL	2		FH	55	47	38	53	00	0
16	0	UNL	3		H	57	47	35	44	00	0
19	0	UNL	3		H	47	42	36	66	00	0
22	0	UNL	3		FH	39	37	34	82	07	5

JAN 30th

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	0	UNL	3		F	36	35	33	89	08	[illegible]
04	0	UNL	3		F	36	34	31	82	00	[illegible]
07	0	UNL	2		F	31	30	29	92	07	[illegible]
10	0	UNL	3		H	50	43	34	54	00	[illegible]
13	0	UNL	5		H	61	45	32	34	00	[illegible]
16	10	UNL	7			65	49	29	26	00	[illegible]
19	6	UNL	7			51	42	29	43	00	[illegible]
22	10	UNL	5		H	43	39	32	65	06	[illegible]

JAN 31st

Hour L.S.T.	Sky Cover (Tenths)	Ceiling in Hundreds of Feet	Whole Miles	16ths Mile	Weather	Air °F	Wet Bulb °F	Dew Point °F	Rel Humidity %	Direction	Speed (Knots)
01	10	UNL	5		H	39	35	29	67	09	3
04	10	UNL	6		H	38	35	30	73	36	3
07	10	UNL	7			37	34	30	76	00	0
10	10	200	6		H	48	42	33	56	00	0
13	10	200	6		H	62	47	27	27	11	4
16	10	250	7			63	48	29	28	00	0
19	10	UNL	7			52	43	30	43	07	4
22	6	UNL	7			44	38	30	56	00	0

SUMMARY BY HOURS

Hour L.S.T.	Averages: Sky Cover (Tenths)	Station Pressure (Inches)	Temperature: Air Temp °F	Temperature: Wet Bulb °F	Temperature: Dew Point °F	Rel Humidity %	Wind Speed (MPH)	Resultant Wind: Direction	Resultant Wind: Speed (MPH)
01	5	29.830	41	39	37	87	2.5	10	1.6
04	5	29.820	39	38	36	90	.6	05	0.7
07	5	29.840	38	37	36	91	2.4	09	1.0
10	5	29.875	47	43	39	75	2.4	15	0.9
13	5	29.820	55	47	39	59	3.5	24	1.1
16	5	29.795	57	48	38	54	3.5	30	1.8
19	5	29.810	49	44	38	69	2.2	21	0.5
22	5	29.825	44	41	38	81	2.8	09	1.9

HOURLY PRECIPITATION (WATER EQUIVALENT IN INCHES) JAN 1991 FRESNO, CA 93193

DATE	A.M. HOUR ENDING AT 1	2	3	4	5	6	7	8	9	10	11	12	P.M. HOUR ENDING AT 1	2	3	4	5	6	7	8	9	10	11	12	DATE
01																									01
02																									02
03											T	T	T	T		T	T	T	T	0.01	T	T	0.01	0.02	03
04	0.02	0.01	T	0.04	T																				04
05																									05
06																									06
07									T	0.01	0.01														07
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30																									30
31																									31

MAXIMUM SHORT DURATION PRECIPITATION

TIME PERIOD (MINUTES)	5	10	15	20	30	45	60	80	100	120	150	180
PRECIPITATION (INCHES)												
ENDED: DATE												
ENDED: TIME												

THE PRECIPITATION AMOUNTS FOR THE INDICATED TIME INTERVALS MAY OCCUR AT ANY TIME DURING THE MONTH. THE TIME INDICATED IS THE ENDING TIME OF THE INTERVAL. DATE AND TIME ARE NOT ENTERED FOR TRACE AMOUNTS.

VALIDATED BY:
MATTHEW BODOSKY

FRESNO, CA
USCOMM - NOAA - ASHEVILLE, NC 175

U.S. DEPARTMENT OF COMMERCE
NATIONAL CLIMATIC DATA CENTER
FEDERAL BUILDING
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