MONTHLY AIR QUALITY REPORT FOR DECEMBER 2011

AQI COLOR SCALE

GOOD	MODERATE	UNHEALTHY FOR SENSITIVE GROUPS	UNHEALTHY
0-50	51-100	101-150	151-200

Calendar of maximum AQI values & their corresponding color for December 2011*

*Preliminary data

SAMPLE POLLUTANT REPORTING BOX

1 (day of month)	O3	CO
	PM10	PM2.5

SUN	MON	TUES	WED	THU	FRI	SAT
				1 O3 32 PM10 76 CO 20 PM2.5 28	2 O3 33 PM10 31 CO 11 PM2.5 25	3 O3 31 PM10 29 CO 06 PM2.5 24
4 O3 32 PM10 23 CO 06 PM2.5 34	5 O3 34 PM10 27 CO 09 PM2.5 40	6 O3 36 PM10 36 CO 14 PM2.5 46	7 O3 37 PM10 53 CO 18 PM2.5 67	8 O3 38 PM10 59 CO 26 PM2.5 77	9 O3 40 PM10 54 CO 34 PM2.5 88	10 O3 40 PM10 55 CO 34 PM2.5 84
11 O3 40 PM10 54 CO 25 PM2.5 78	12 O3 34 PM10 28 CO 20 PM2.5 43	13 O3 36 PM10 12 CO 06 PM2.5 15	14 O3 33 PM10 21 CO 10 PM2.5 23	15 O3 33 PM10 37 CO 17 PM2.5 55	16 O3 36 PM10 27 CO 17 PM2.5 26	17 O3 35 PM10 19 CO 06 PM2.5 25
18 O3 38 PM10 14 CO 06 PM2.5 23	19 O3 36 PM10 20 CO 06 PM2.5 36	20 O3 31 PM10 31 CO 09 PM2.5 64	21 O3 32 PM10 31 CO 10 PM2.5 51	22 O3 32 PM10 35 CO 19 PM2.5 54	23 O3 35 PM10 25 CO 11 PM2.5 40	24 O3 36 PM10 59 CO 22 PM2.5 141
25 O3 36 PM10 67 CO 32 PM2.5 157	26 O3 36 PM10 39 CO 16 PM2.5 54	27 O3 36 PM10 54 CO 20 PM2.5 70	28 O3 36 PM10 58 CO 25 PM2.5 77	29 O3 37 PM10 65 CO 25 PM2.5 85	30 O3 36 PM10 61 CO 27 PM2.5 80	31 O3 36 PM10 73 CO 30 PM2.5 155

Calendar of High Pollution Advisories and Health Watches issued during December 2011

SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10 E
11 E	12	13	14	15	16	17
18	19	20	21	22	23	24 B
25 B	26	27	28	29	30	31 B
					E	

LEGEND

HIGH POLLUTION ADVISORIES
A = PM-10 High Pollution Advisory
B = PM-2.5 High Pollution Advisory
C = Ozone High Pollution Advisory

HEALTH WATCHES
D = PM-10 Health Watch
E = PM-2.5 Health Watch
F = Ozone Health Watch

Calendar of Meteorological Conditions observed in Metro Phoenix during December 2011

SUN	MON	TUE	WED	THU	FRI	SAT
				1 D	2 B	3 B C
4 B C	5 B C E	6	7	8	9	10 E
11 E	12 B C	13 B C	14 B C	15 C E	16	17 B
18 B C	19 B C	20 B C E	21 C E	22 B C	23	24
25 E F	26	27 E	28 E	29 E	30	31 F

LEGEND

ELECTROMETEORS
A = Thunderstorm

HYDROMETEORS
B = Rain/Drizzle/Hail/Snow
C = Fog

LITHOMETEORS
D = Blowing Dust
E = Haze (vsby <10SM)
F = Smoke

Exceedance days during DEC 2011-

Total= 3

Date	Max AQI	Pollutant	Site/s
12/24	141	PM-2.5	South Phoenix
	125	PM-2.5	West Phoenix
12/25	157	PM-2.5	West Phoenix
	154	PM-2.5	South Phoenix
	135	PM-2.5	Durango
12/31	155	PM-2.5	West Phoenix
	151	PM-10	South Phoenix

Health Watches issued during DEC 2011-

Total= 3

Date	Max AQI	Pollutant	Site/s
12/10	84	PM-2.5	West Phoenix
12/11	78	PM-2.5	South Phoenix
12/30	80	PM-2.5	West Phoenix

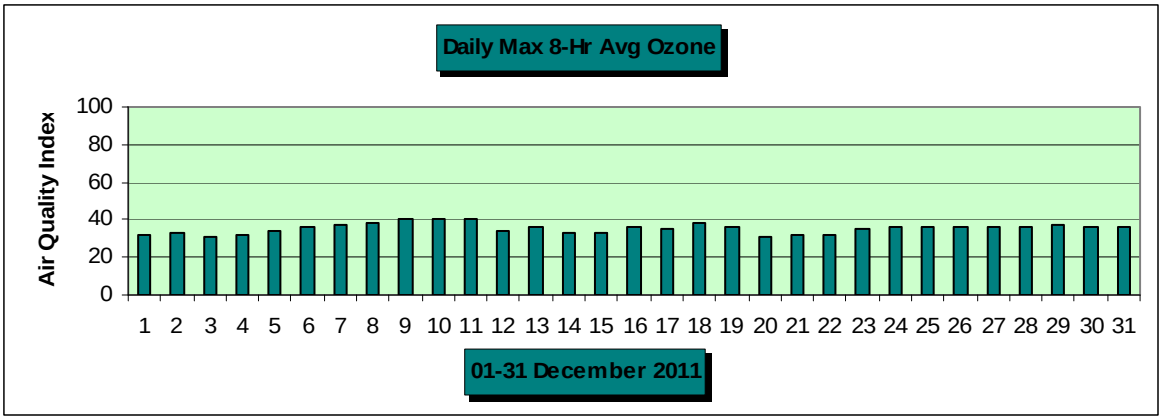
High Pollution Advisories issued during DEC 2011-

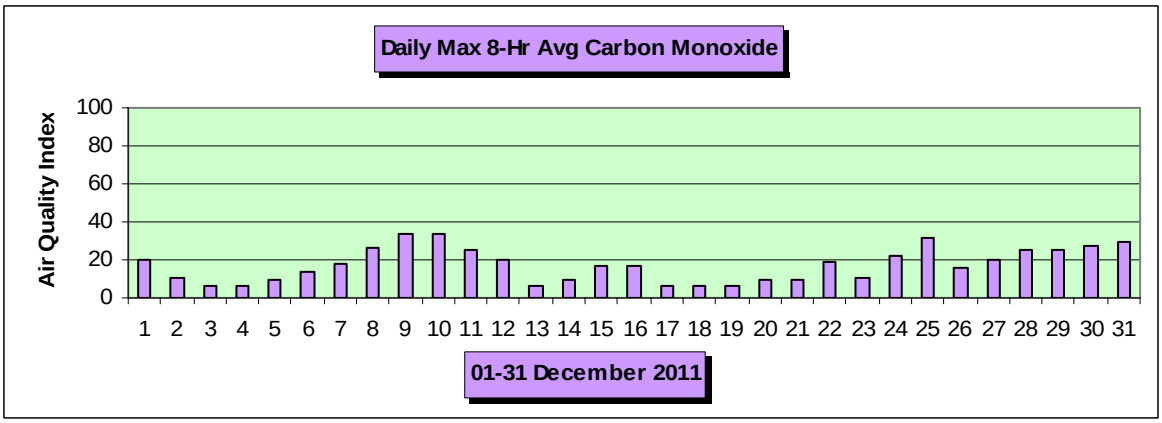
Total= 3

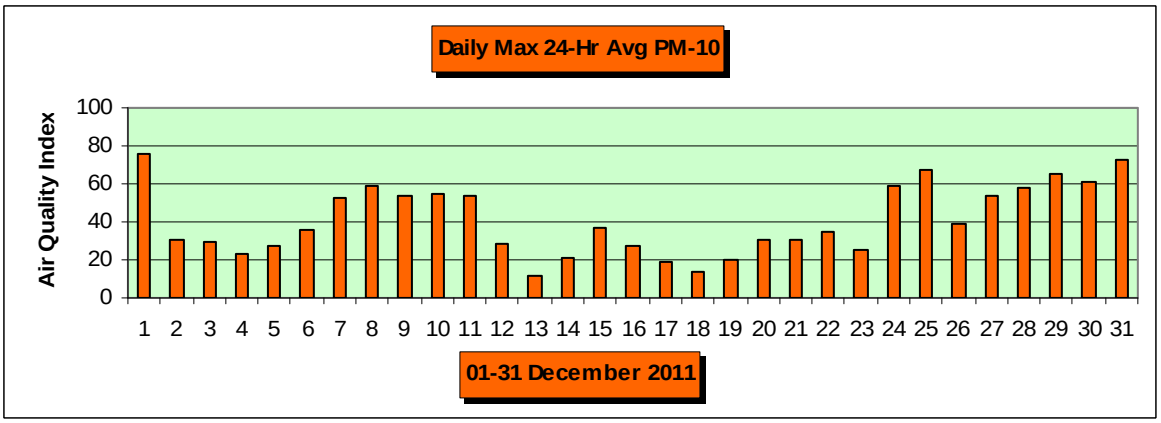
Date	Max AQI	Pollutant	Site/s
12/24	141	PM-2.5	South Phoenix
12/25	157	PM-2.5	West Phoenix
12/31	155	PM-2.5	West Phoenix

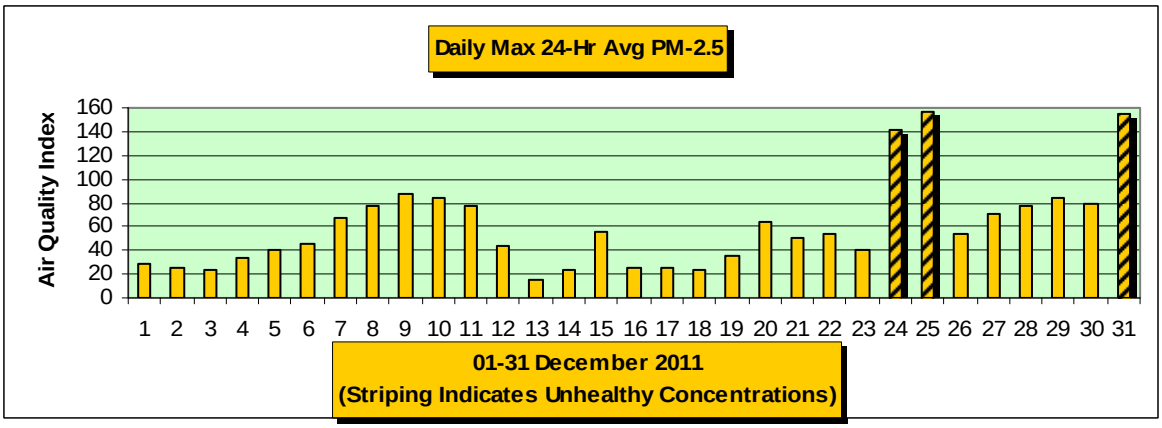
Concentration Recap:

Days in the **Good** category:	13
Days in the **Moderate** category:	15
Days in the **Unhealthy for Sensitive Groups** category:	1
Days in the **Unhealthy** category:	2
Days in the **Very Unhealthy** category:	0
Days in the **Hazardous** category:	0
Total Forecast Days:	31


Daily Max 8-Hr Avg Ozone
Air Quality Index
0
20
40
60
80
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
01-31 December 2011


Daily Max 8-Hr Avg Carbon Monoxide
Air Quality Index
0
20
40
60
80
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
01-31 December 2011


Daily Max 24-Hr Avg PM-10
Air Quality Index
0
20
40
60
80
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
01-31 December 2011


Daily Max 24-Hr Avg PM-2.5
Air Quality Index
0
20
40
60
80
100
120
140
160
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
01-31 December 2011
(Striping Indicates Unhealthy Concentrations)

Narrative: December 2011 began with yet another wind and blowing dust event. On the first of the month a deep upper level closed low and trough in the mid-latitude storm track was situated over southern California and was moving east. Low-level gradient winds over the Phoenix metro area combined with outflow winds from nearby showers and thunderstorms to produce wind gusts up to 28 mph during the a.m. period. This in turn generated areas of blowing dust between 7:00 a.m. and 1:00 p.m. that restricted local visibilities to as low as seven miles. Figures 1-2 are images from the local VISNET camera array and show the extent of the blowing dust between 9:00 an 10:00 a.m.

Figure 1

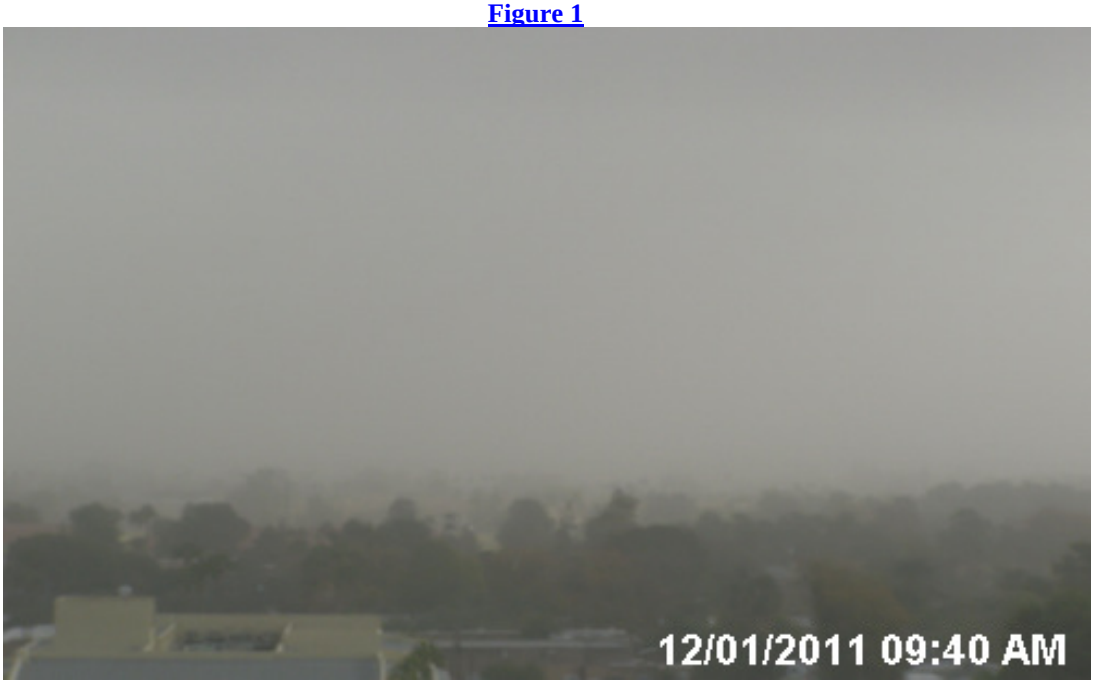


Figure 2

Fortunately, highest levels of coarse particles (PM-10) during this episode only reached the mid-moderate range of the Air Quality Index – probably due in large part to mostly light rain showers that occurred between 10:00 a.m. and 10:00 p.m. As this system approached and moved overhead, additional periods of precipitation occurred on the 2nd, 3rd, and 4th of the month. By the 6th the trough was located to the east of Arizona and a ridge approached from the west. Warming temperatures aloft as well as decreasing mixing depths and overnight inversion formation led to increased stagnation of the Valley air mass. Marginal or poor dispersion also occurred between the 6th and the 9th and this situation contributed to a rapid increase in particle pollution – particularly PM-2.5 (fine particle) concentrations. However, a major and increasingly chronic aggravating factor in this increase was due to smoke from the seasonal increase in residential wood burning. The steady rise in fine particle concentrations ultimately required the issuance of PM-2.5 Health Watches by ADEQ on December 10th and 11th as well as No Burn Day declarations by the Maricopa County Air Quality Department. Figures 3 and 4 show the atmospheric conditions within the boundary layer above the metro area on the 7th and 8th. As Figure 3 below illustrates, a strong subsidence inversion aloft existed on the 7th as well as a surface-based radiation inversion.

Figure 3

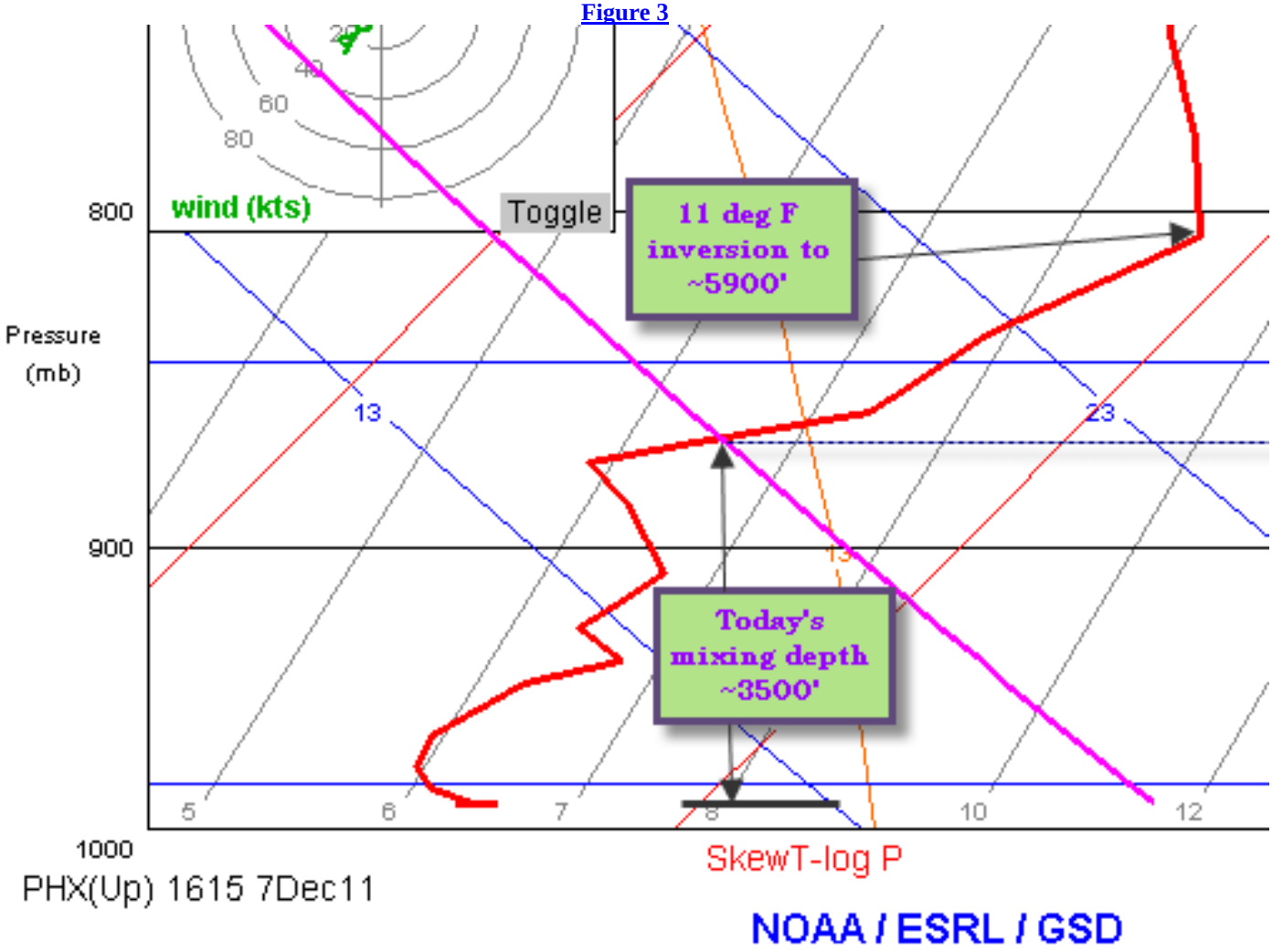


Figure 4

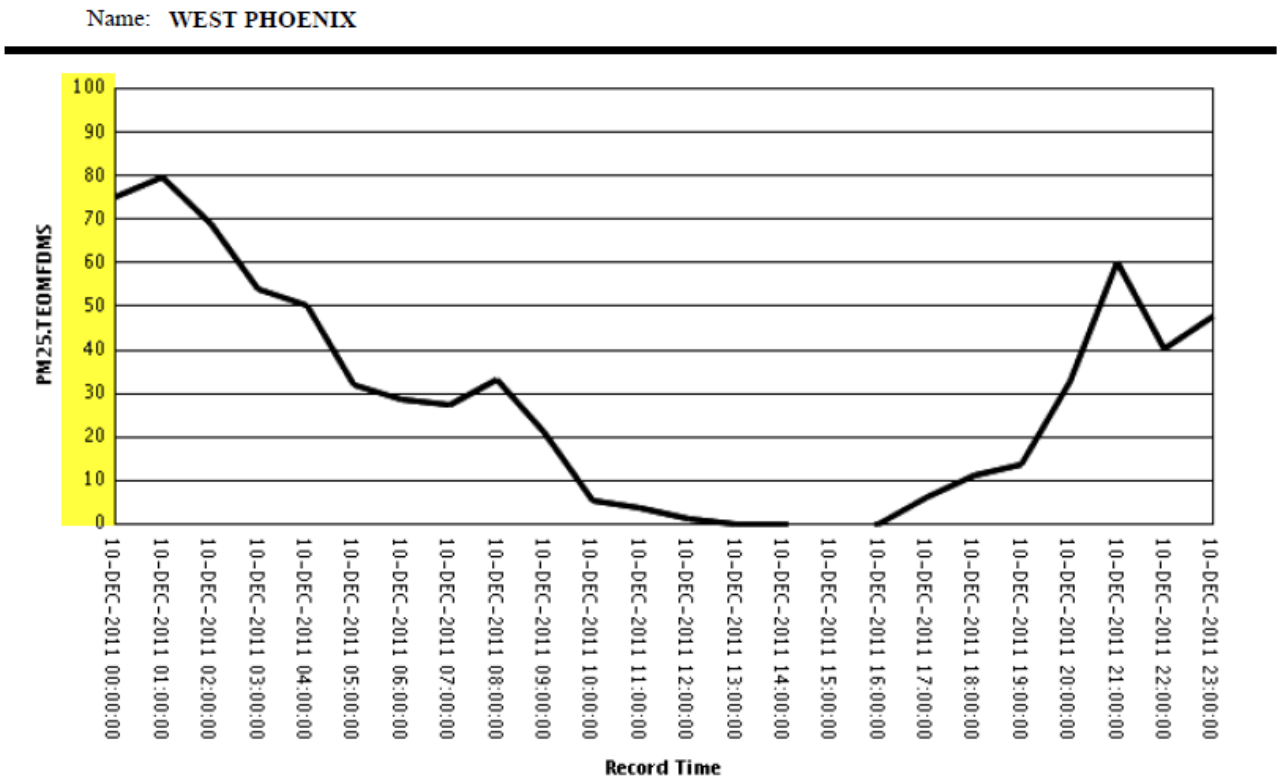
ACARS-BASED BOUNDARY LAYER PROFILE FOR PHOENIX METRO AREA

DATE	THURSDAY	DEC 08 2011
Inversion Strength	6.8/12.2	Degrees C/F
Inversion Height	1549	Feet AGL
Inversion Break Temp	58	Degrees F
Forecast High Temp	62	Degrees F
Best Mixing Depth	3058	Feet AGL
Mean Wind Speed	~5	Knots
Dispersion	MARGINAL	----------

Figure 5 is an image from the local VISNET camera array that shows the trapped layer of particle pollution over downtown Phoenix on December 7 and Figure 6 is the PM-2.5 time-series graph for the West Phoenix monitoring site on December 10.

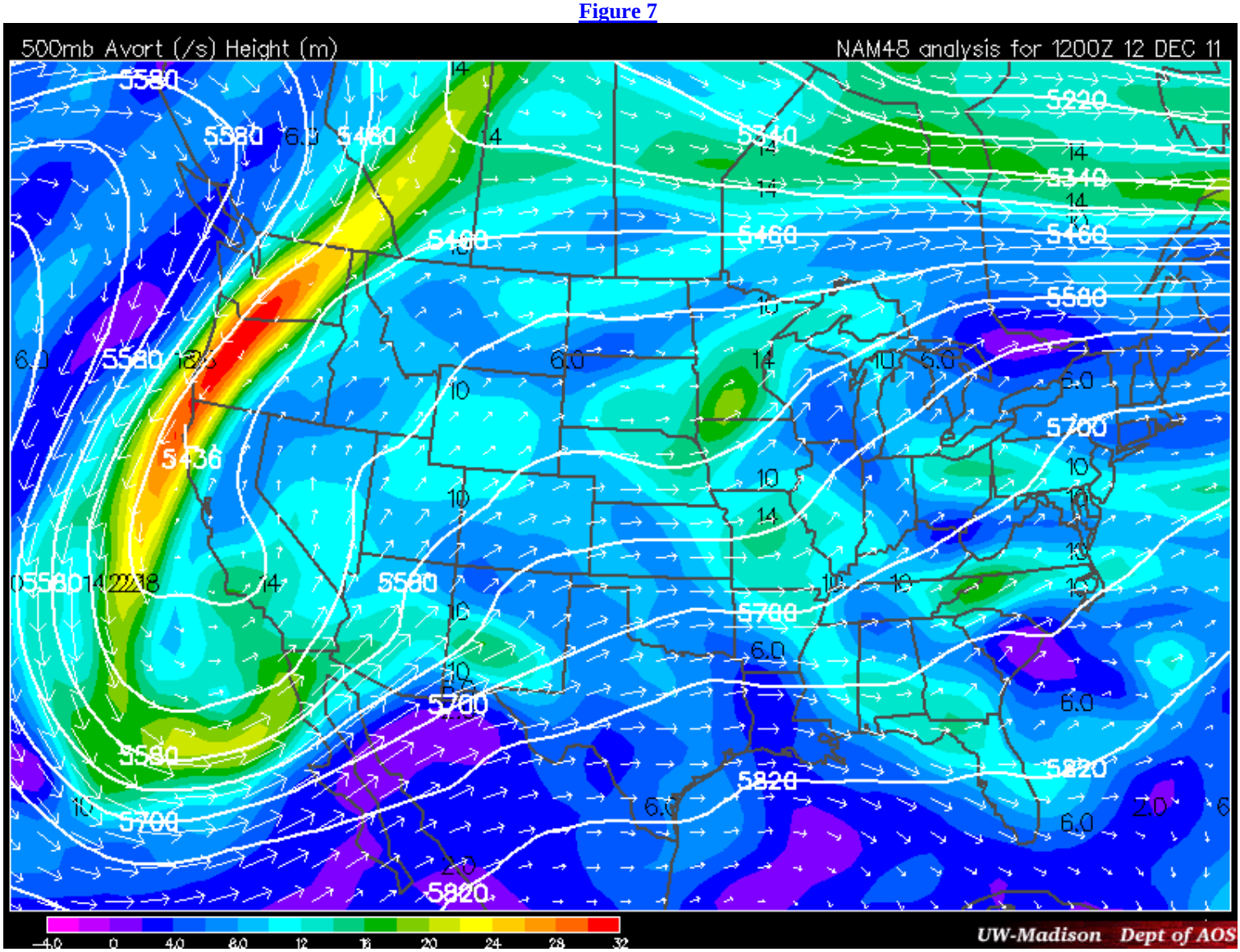
Figure 5

Figure 6



Fortunately, a change in the weather pattern occurred on the 12th with the approach and subsequent arrival of a large and strong upper level trough and surface cold front (Figure 7). This feature brought significant amounts of rainfall to the metro area on the 12th and 13th along with good to very good air quality and was followed by a series of weaker disturbances that produced additional periods of rain between the 17th and the 22nd.

Figure 7



The respite from elevated particle pollution levels was short-lived, however. An upper level ridge dominated the weather pattern during the remainder of the month. Because of the propensity for holiday and festive fireplace and appliance wood burning activities this time of year, the timing of the ensuing serious and lengthy stagnation of the air mass – punctuated by poor to marginal dispersion, strong surface-based radiation inversions, mostly light or calm winds, and low mixing depths – could not have been worse for the residents of the Valley. Figure 8 below shows a summary of the near-surface air mass characteristics over the metro area between December 24 and December 31. Mixing and inversion heights are in feet above ground level and the mean transport winds within the mixed layer are in knots.

Figure 8

DD/MM/YY	Day of Wk	Mixing Ht	Tran WS kts	Dispersion	Inversion C	Inversion Ht
24-Dec-11	Sat	2600	31806	marginal	5.4	1568
25-Dec-11	Sun	3200	12703	low marginal	7.5	1798
26-Dec-11	Mon	2700	20802	poor	6.2	1538
27-Dec-11	Tue	2300	variable 1	low poor	6.8	4189
28-Dec-11	Wed	1700	20002	poor	9.6	2431
29-Dec-11	Thu	1600	28403	poor	10.6	3215
30-Dec-11	Fri	2100	25904	poor	10.1	3806
31-Dec-11	Sat	1800	35302	low poor	8.8	2399

Between 2005 and 2010 unhealthy levels of fine particles (PM-2.5) had occurred in the Valley each year except one on December 24 and 25 due primarily to trapped smoke from wood fires. For 2011 PM-2.5 High Pollution Advisories and No Burn Days were again issued but the result was the same: unhealthy air quality on both days. Figure 9 shows the breakdown of maximum PM-2.5 AQI levels for late December from 2005 thru 2011 as well as the highest hourly PM-10 concentrations in ug/m3 for each day during that period. As can be seen, this situation tends to repeat itself again on December 31.

Figure 9

RECENT VALLEY PM-2.5 MAX AQI CLIMATOLOGY							
(**preliminary data**)							
Date	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
23-Dec	83	109	101	54	30	43	40
24-Dec	111	140	129	65	111	137	141
25-Dec	120	157	154	57	168	165	157
26-Dec	59	82	58	16	84	45	54
27-Dec	48	71	35	66	69	58	70
28-Dec	57	48	43	84	63	71	77
29-Dec	64	64	75	82	56	53	85
30-Dec	74	97	106	67	62	30	80
31-Dec	84	125	118	115	54	63	155
HIGHEST HOURLY PM-2.5 CONCENTRATIONS							
(ug/m3)/hour & 24-hour Average AQI color (**preliminary data**)							
Date	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
24-Dec	176.3/2300	180.1/2300	195.5/2100	76.0/2300	199.3/2300	238.4/2100	190.9/2000
25-Dec	179.7/2400	180.1/2400	273.8/0300	64.9/0200	232.8/0400	393.9/2400	237.4/2400
31-Dec	102.7/2300	171.4/2300	97.5/1500	201.6/2300	54.5/2300	136.8/2300	322.2/2200

Aside from the obvious adverse health impacts from such high levels of fine particle pollution, the visual impacts are also quite unappealing. Figures 10-16 are additional images from the local VISNET camera array showing the impacts of smoke on local visibilities during different times of day between December 24 and 31.

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

Figure 16 illustrates the effects of the air mass stagnation situation on the Valley boundary layer profile for December 27, Figure 17 for December 28, and Figure 18 for December 29.

Figure 16

ACARS-BASED BOUNDARY LAYER PROFILE FOR PHOENIX METRO AREA

DATE	TUESDAY	DEC 27 2011
Inversion Strength	6.8/12.2	Degrees C/F
Inversion Height	4189	Feet AGL
Inversion Break Temp	84	Degrees F
Forecast High Temp	66	Degrees F
Best Mixing Depth	2976	Feet AGL
Mean Wind Speed	<5	Knots
Dispersion	POOR	----------

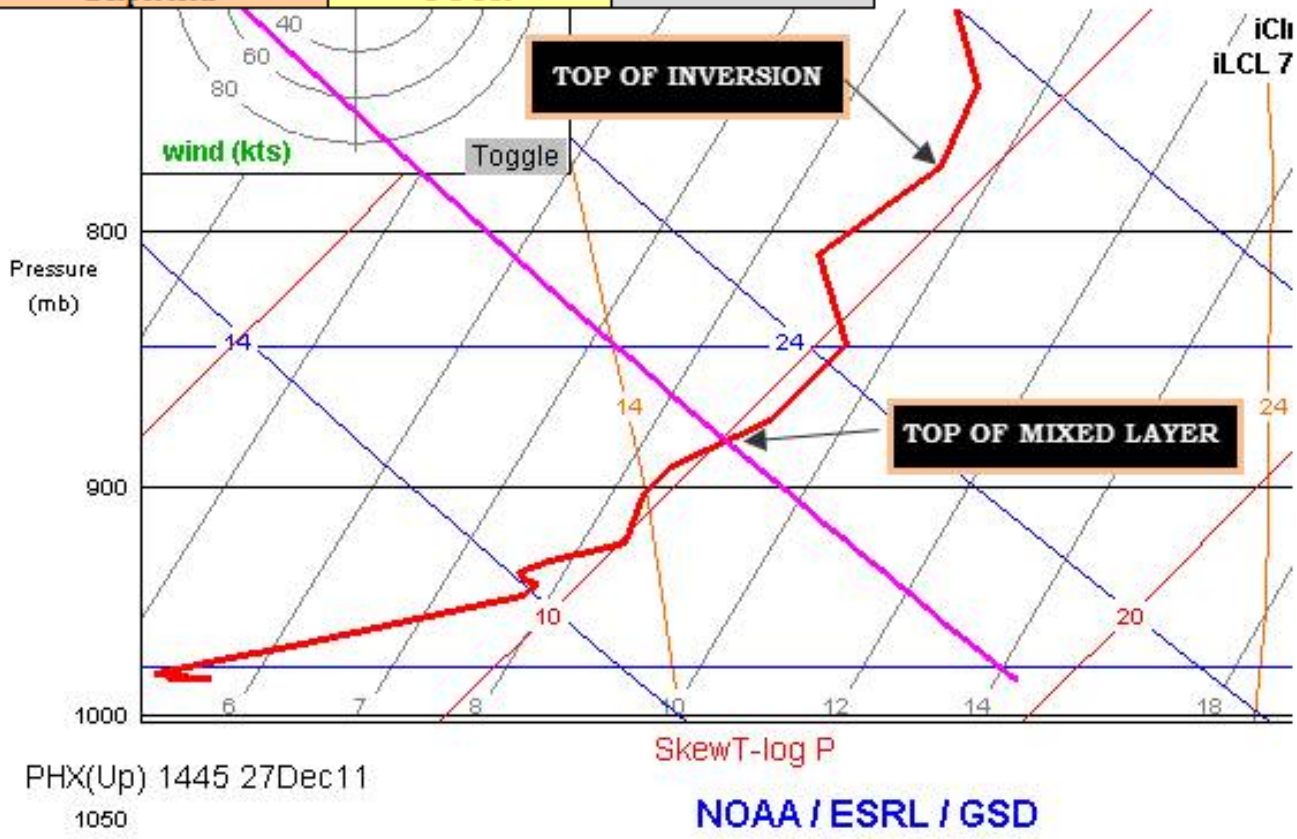


Figure 17

ACARS-BASED BOUNDARY LAYER PROFILE FOR PHOENIX METRO AREA

DATE	WEDNESDAY	DEC 28 2011
Inversion Strength	9.6/17.3	Degrees C/F
Inversion Height	2431	Feet AGL
Inversion Break Temp	71	Degrees F
Forecast High Temp	68	Degrees F
Best Mixing Depth	1856	Feet AGL
Mean Wind Speed	<5	Knots
Dispersion	POOR	----------

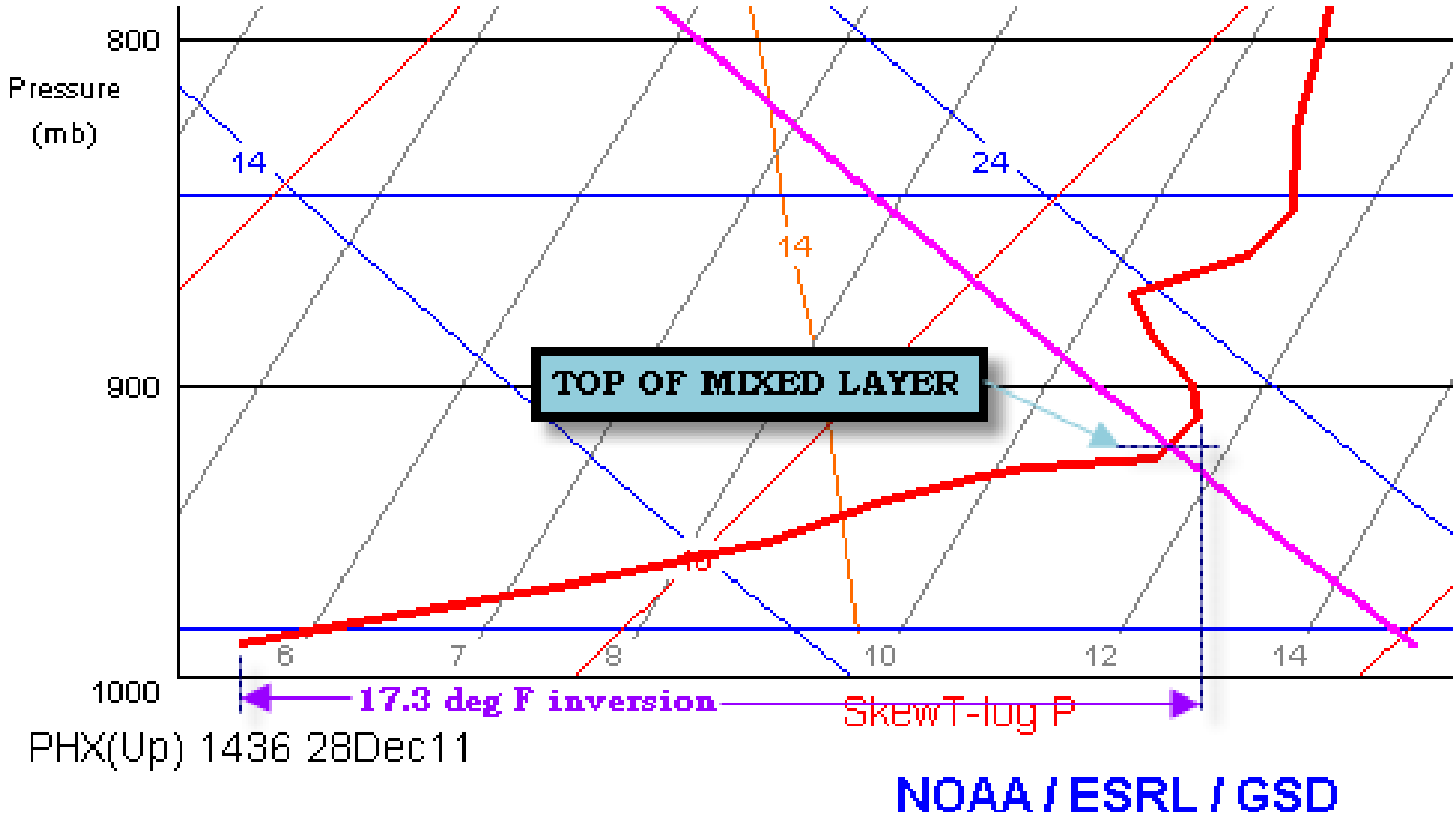
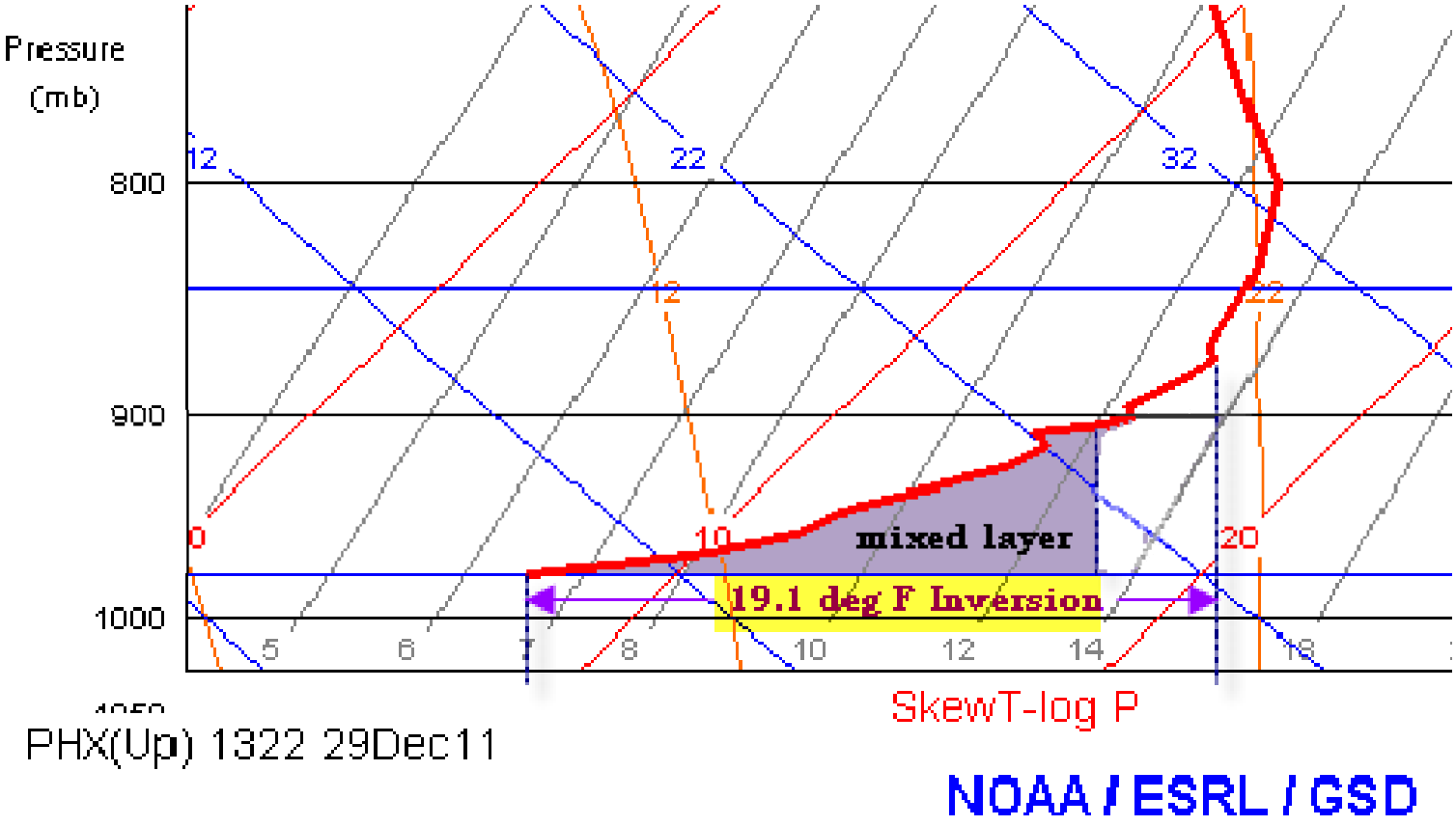


Figure 18

ACARS-BASED BOUNDARY LAYER PROFILE FOR PHOENIX METRO AREA

DATE	THURSDAY	DEC 29 2011
Inversion Strength	10.6/19.1	Degrees C/F
Inversion Height	3215	Feet AGL
Inversion Break Temp	78	Degrees F
Forecast High Temp	71	Degrees F
Best Mixing Depth	2167	Feet AGL
Mean Wind Speed	<5	Knots
Dispersion	POOR	----------



Thus, the year 2011ended on a sour note with a string of days in the Phoenix metro area having unfavorable to downright poor air quality. As Figure 19 shows, between ozone, coarse particulates, and fine particulates there was an undesirable number of days during the year for which unhealthy air quality was measured. -Reith

Figure 19